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Abstracts

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Feasibility of Robotic Identification of Extraterrestrial Minerals

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I. Introduction

The continued growth of the human population will require an ever expanding utilization of resources. At some point we will either need to stop population growth or harvest these resources somewhere other than Earth. The mining could occur on anything from another planet to small asteroids or the moon. In order to avoid the difficulties that arise when humans live in low gravity environments for extended periods of time, much of this mining could be done by robots. During the mining process the robots would need to identify the minerals that could be utilized. If the identification is visual, the robot would need to target a certain area based on various characteristics of the light reflected from the minerals.

A visual target system could be used as a preliminary test to identify likely areas and it could be confirmed with a chemical analysis. The visual system would be a faster and cheaper way to identify promising areas than a large number of chemical analyses. The effectiveness of the system depends on the ability of the robot to differentiate between light reflected by different minerals. The ability to detect these slight differences in light needs to have high reliability and accuracy if the system is going to be practical.

A. Research Question

How can robotic targeting research help identify minerals to mine on the moon and other planets?

B. Significance

This research will help lead to humans' ability to utilize resources more effectively. Minerals from other planets could be more effective for reasons including cost, availability, and environmental impact. The technology being researched could also aid in human migration to other planets by identifying the materials needed to enact such migration. Many people will benefit from this research including: companies who stand to make a profit off of mineral sales, consumers who buy products that contain minerals, and countries which have a poor source of mineral wealth in their regions.

II. Literature Review

The rate of mineral consumption is great and increases year by year. Innovative techniques to find new sources on Earth are sought out by many engineering firms. One of these firms attempted to use an optical sensing method to find mineral deposits in glaciers found in Nepal. Their experiment resulted in the discovery of layered silicates, hydroxyl-bearing and calcite minerals within these glaciers (Casey; 2012). Other intuitive methods include the use of magnetic imaging to find rocks that contain minerals. This was conducted in Finland after numerous studies were found evidence of mineral deposits in the mountainous regions of the country. The study concluded that gold was found in many areas of the mountain, proving that magnetic imaging is a viable method of finding minerals (Mertanen; 2012). These techniques and others are all practical uses of imaging systems that find minerals in desolate areas.

In Raman spectroscopy as a method for mineral identification on lunar robotic exploration missions Alian Wang, Bradley Jolliff, and Larry Haskin state that a robot using a Raman spectrometer would be useful in analysis of lunar minerals (Wang; 1995). Simulations were run using a modern spectrometer to identify minerals expected on the moon. The simulations proved to be very effective and gave hope for future improvements in this field.

III. Research Design

A. Data

We will use an NXT robot equipped with a webcam and light sensor controlled through a MATLAB interface. The webcam will be used for image capture and the light sensor to identify location on the ground. The MATLAB program will analyze the images and light sensor data and use them to direct the robot to center itself in front of the target.

B. Procedures

The robot will be placed in a circular arena containing a target hung on white walls. The floor will be white with a black ring several inches inside the wall. A MATLAB script will be executed which will cause it to continuously take pictures in order to find an object. The robot will be tested on its ability to locate itself on the black ring in front of the target. Once the robot has acquired its target, it will center in on the object and shoot a laser pointer. Both speed and accuracy will be measured by how fast the robot can find the object and how accurate the laser is to the center of the bull's-eye. Using data from multiple trials, we will compare them to standards set before the experiment is carried out. If the speed and accuracy meet the criterion set, then the efficiency of the MATLAB code will be known.

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IV. Outline of the Study

Chapter 1 will introduce the current technologies and innovations in target acquisition systems. Chapter 2 discusses the practical use of these innovations in finding extraterrestrial minerals. Chapter 3 will discuss planets known to have minerals available for human use. Chapter 4 talks about the feasibility of sending mining equipment, humans, and other necessary tools. Chapter 5 analyzes the business aspects of such ventures and the profit potential for business willing to partake in projects such as these.

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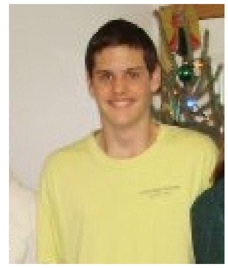

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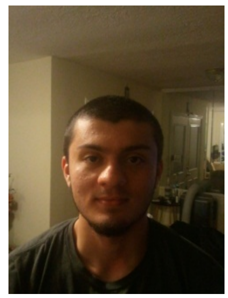

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Collaborated Identification: Storage and Accuracy in Facial Recognition

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I. Introduction

Facial recognition software has come a long way since its beginnings, but it has not yet been perfected. Our technologically advanced society has implemented facial recognition software into everyday use in computers, cameras, smart-phones, etc. For those applications, the software works well enough for the user to be satisfied. However, the software is not as technologically advanced as required when it is to be used for both local and national safety. Current facial recognition systems can be easily tricked into not finding to correct suspect of a crime. For example, the presence of facial hair, or differing hair styles cause the system to believe that the criminal is just an innocent citizen. Local police and military need a quick, efficient, and accurate system for the use of catching persons of interest, i.e. criminals, domestic and international terrorist, etc.

By focusing on not just facial recognition but it's accuracy and sharing capabilities, there is a possibility of creating a system with massive collections of photos easily shared (very similar to present social networks but of course confidential and with a more useful purpose) with systems all throughout the world to A. identify a criminal in time and B. broadcast his position to give context to other systems all over the world on who to identify and seek.

A. Research Question

Our research project is centralized around the research question, "How can a robotic target acquisition system improve identification of persons of interest?" For the purposes of this experiment, criminals will be the main persons of interest.

B. Significance

In this day and age of technology, both the military and local police need a more accurate process for finding persons of interest. Facial recognition is key to a quick end to searches for either criminals or missing people, and the current technology of facial recognition software is not as accurate as is required. With our study, we hope to be able to improve the identification of persons of interests. Also the data found through facial recognition technology can be added into a database that could be used for future uses of finding persons of interest. Therefore over time analysis and patterns could be found in this shared database and moreover the database would feed back into the facial recognition with these patterns to make theoretically continuously more accurate systems.

II. Literature Review

Over the last decade or so, facial recognition and identification of individuals has become more sophisticated; a system that had a high margin of error years ago is now a feasible option for governments to detect persons of interest in a native environment, with many running variables. Although there are several ways to approach this concept; the two basic components are first locking in on the target and then identification of the individual. A new way to approach the long history of facial identification is to make use of current advanced technology as well as long standing technology to incorporate multiple ways of facial detection (many of which are recent and boast higher accuracy rates) and utilize them in current areas of interest such as government buildings, airplanes, or any other place with a high degree of people passing. One of the methods that we advocate is that instead of solely depending on 2D images that have a high rate of failure, facial detection utilize newer computer processing backed up methods that have cropped up in recent years. For example in the 'Manipulate image into front image' study (FR-1, 2003, pgs. 10-11) where cameras were incapable of capturing front pictures, they computer generated the side photos to be able to scan and detect. Besides this, a facial recognition system should utilize other more mathematically sound methods like distance between the difference facial features ("Facial recog", 1998, p. 10) which are impossible to fool unlike simple evasion methods like growing a beard, wearing glasses, or even the normal aging process. Moreover we claim that to add to the additional and usual scanning features used currently, a system needs to double check false positives by first scanning them through social media catalogs such as Flickr, Facebook, and Twitter (FR-2, 2004, pgs. 9-10). Obviously people evading the government would not place their pictures online therefore any false positives that might fall through the cracks could be double checked within three to four seconds (FR-2, 2004, pgs. 9-10), similar to prior study in which researchers used social media to identify students rather than using it as a discriminating factor. This could save valuable man power as a system with obviously higher accuracy than a human. The great upside to utilizing facial recognition compared to other technology is that the infrastructure for it is already placed in most buildings. Surveillance cameras have nearly blanketed the government landscape and can be used to feed into a database for 2D facial detection (Angwin, 2011). Therefore this technology, already in place simply needs to be implemented into a larger database and improved on the acquisition of targets. A unified system based on all surveillance devices or even multiple building that can scope on a potential suspect and follow him through several cameras has potential uses; more time is given for the system to get data to double check the individual based on multiple face shot and the aforementioned social media method. Also it saves man hours by only notifying a human if something is a highly accurate match.

Besides traditional 2D methods, 3D modeling and texturing is more expensive, yet has a much higher accuracy rate than traditional 2D and could be seldomly used to either verify individuals or in high suspect situations, for additional insurance. Once such a 3D model is created (for example in a prison system) it can be utilized with side shots and poor lighting unlike 2D models so such types of systems could first be massively used in prison and then uploaded to high suspect areas in case of a release of a prisoner or even mandatory in high surveillance buildings to insure additional safety alongside traditional 2D models (Hsieh, 2010)

III. Research Design

A. Data

The data that we are planning to study for the experiment will be JPEG photos captured by a webcam on top of the NXT Robot. This will be effective since it will provide sufficient data and detail for collection for analysis. Moreover the pictures are readily available and there is enough to provide sufficient data for analysis.

B. Procedures

Data collection. NXT Robot will have a webcam attached to it which will be taking pictures and transmitting them to MATLAB for analysis. In the experiment we will be measuring the RGB pixel array created when a picture is taken of the target. We will then use the array to find the center of the target.

Figure 1. Example of the NXT Robot that will be used in this experiment (*NXT robot*, 2011)

Data analysis. MATLAB will take the pictures being fed from the robot's webcam and determine shape to lock in on the object (dartboard) and then utilize either various algorithms or color detection RBG system arrays to figure out the precise coordinates of the target. To determine accuracy, we will enable the robot to have a window of error, small enough that the center of the target can be precisely located.

IV. Outline of the Study

Through this experiment we hope to help the advancement of technologies in facial detections, specifically in military and police issues of catching suspects. In the experiment we will program an NXT Robot to detect a specific image on a white background. The robot will conduct this by reading the RBG array created by a picture of the image taken by a webcam attached to the robot. Once the robot detects the image, it will attempt to center the image and take a final picture of the complete image.

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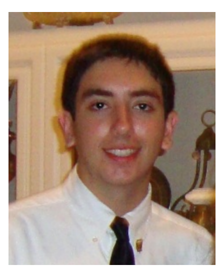

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Target Decay or You Will Pay

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I. Introduction

The wearing off of enamel and other layers of the tooth causes tooth decay, commonly known as cavities. This occurs when food and drink are left on the surface of the tooth for extended periods of time. When combined with plaque, the food debris causes dissolution of enamel, which can even lead to the dentin, the inner layers of teeth, to be directly attacked and weakened by the acids created by the combination of debris and plaque. Dentists most commonly use dental instruments such as the explorer, an instrument with a sharp tip, to locate decay. Dentists use the instrument to probe the tooth for physical weakness, such as feeling for a sticky layer and looseness in the gums.

With today's advancements in technology, robots, machines, and cameras are assisting in all areas of society. To apply this medically to one of the professions that still mostly uses 20th century technology, a new approach using a target acquisition system is required. "Probing", is no longer efficient since it may further aggravate areas of decay on teeth. X-rays reveal tooth decay long before human eyes can visually confirm that there is decay. While the use of X-rays may be an option for dentists, there come many health hazards. For complete dental X-rays, the human body is exposed to rays, which contain harmful radiation. This leads to people wearing lead to protect themselves from the harmful exposure. The film captured by the rays also takes many minutes to develop, which is a problem in our fast-paced culture, where instant gratification and efficiency take part. Ideally, everything is quick, simple, and cost-effective, yet the dental industry continues to lag behind. By using a target acquisition system, our future dental society will be able to detect decay quickly and effectively on the surface of the tooth, with no invasive procedures. Since the human eye and the use of dental instruments are inaccurate, this new technological technique of locating decay prevents missed cavities, which only worsen as time progresses.

A. Research Question

The guiding research question for this study is the following: How can a target acquisition system improve the mapping of decayed enamel on human teeth?

B. Significance

Dentists have several methods to keep teeth healthy but many of them use the dentists' eyes to locate problems, leading to inaccuracies. By allowing technology to assist locating potential problems in teeth, many problems can be more accurately resolved. Target acquisition systems have the potential to locate decay in teeth that could be missed by dentists, helping prevent the need for crowns or replacement teeth. These dental procedures tend to be very costly, which puts a strain on the consumer and limits the expected amount of patients receiving this treatment type. By suggesting another type of dental testing, it is possible to lower costs while using a less invasive, 21^{st} century procedure.

II. Literature Review

Cavities are holes that are caused by the decay of tooth enamel over time. Enamel is the protective layer covering the tooth, and when the remains of food and drink dissolve it, the exposed tooth is easily damaged, leading to fillings and the possible procedure of a root canal and implants. Many people in our society are in constant fear of the dentist. They postpone dental check-ups, so they don't have to hear the dreaded word, "cavity". Although delaying a dental visit only creates time for the decay to eat through the enamel, causing it to grow bigger and deeper over time. What was just a minute piece of decay that could have been easily treated has now reached the nerves inside your tooth, causing that sensitive feeling to hot or cold food and drinks. Once a cavity has been untreated for an extended period of time, the tooth underneath becomes sensitive and can be very painful. A cavity may contribute to the development of chronic pain behavior amongst children and can even lead to atherosclerotic diseases such as myocardial infarction or stroke ("Tooth Decay"*)*.

Teeth are very essential for living. They play a vital role in speech and are necessary for chewing the food you eat. A healthy adult mouth has a total of 32 teeth, including the wisdom teeth. Each tooth is made up of four parts, the enamel, dentin, pulp, and cementum tissues. The enamel is the white outer most part of the tooth. It is considered the hardest substance in the human body. Made up of calcium phosphate, its rock-like structure can undergo the pressure of mastication, cutting, and ripping apart food. The next layer under the enamel is called the dentin. It is made up of living cells that make up most of the tooth. The dentin secretes a yellow tinted hard mineral substance hydroxylapatite that supplements bone building. Underneath the dentin lies the pulp, the inner edifice of the tooth that comprises of blood vessels and nerves. Cementum, a physically hard layer of tissue that holds the teeth and gums together in place relative to the jawbone, is essential for structure of the mouth ("The Teeth (Human Anatomy): Diagram, Names, Number, and Conditions"). It is said that human teeth are part of the skeletal and digestive system. While teeth are not considered bone because they are made up of enamel and dentin, they build up the framework of a human skeleton, which would classify them as part of the skeletal system. Teeth are also considered part of the digestive system because they are needed to masticate food in the process of mechanical digestion.

III. Research Design

A. Data

The instruments that will be used to perform our test include the LEGO Mindstorms NXT. The LEGO Mindstorm NXT will be built into a robot that provides mobility toward and around our target. Attached to the NXT will be a clip-on webcam that provides a resolution of approximately 640 pixels by 480 pixels. This webcam will enable us to take a picture of our target. A USB device will connect to the webcam and will be hooked to a desktop that will run a program called MatLab, version 2012a. With both the NXT and the webcam connected to the computer by a USB cable, the robot is able to execute commands programmed through the MatLab interface. The robot's target is a dartboard made of foam, about two feet in diameter. The dartboard contains stripes of red and black with a bright yellow bull's-eye. A couple of false targets will be present to distract the webcam from finding its target. Those false targets will be made of different patterns and colors. During whole process of finding the target, the robot will be restricted to a certain amount of space on the floor. This space will be enclosed with a circle of forty-two inches in diameter. We will analyze the success rate of whether the NXT robot can identify the center of the target within the threshold of 55 pixels.

B. Procedures

We will collect data by having the NXT run through a program we designed and coded to locate a target. The NXT will move forward and backward as well as being able to spin until it is directly centered to the target. The NXT will repeat the process set by the program until it has located the specific target. The process begins by first checking the NXT and the webcam for functionality, after which the NXT will spin in place slowly while searching for the target. When the robot has "located the target" it will stop spinning, and advance forward to the end of the area that the NXT is restricted to. Next, the NXT will fine-tune the spinning by rotating in place in smaller increments in order to center the target in the webcam. At this point the NXT will pause while success or failure is recorded. MatLab allows the picture of the target to be broken up into three color components: red, green, and blue. The numerical values range from 0-225 with zero being black (complete absence of that color) and 255 being white (complete inclusion of that color). Once the mostly black target has been captured by the webcam, the color components will show whether the target is the goal target or a fake one. The target is located once the colors the webcam captures matches up with the value range that we have established in our program.

The figure above is an image of the NXT robot.

Data analysis. We will take the trials and calculate success based on how often the NXT found the correct target within a certain distance (TBD) and whether it was diverted by a fake target. The trial run will be considered successful if the target is correctly located within the distance, but not if the distance is greater than the specified or if the NXT incorrectly identifies a false target. The experiment will be considered successful if the percent success is greater than 80%.

IV. Outline of the Study

The first chapter of our study lays background information regarding our study. It introduces our research question and the significance of why we chose our topic. The second chapter discusses the anatomy of a tooth and the essential role they play in life. Chapter 2 also describes the health hazards that tooth decay causes. The third chapter of our study describes how we will obtain our data. It also explains the procedures that will be used to obtain or data along with an analysis of our data.

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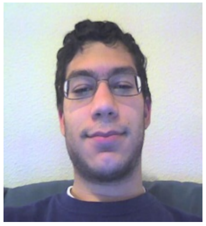

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Helicopter Defense: the Implementation of Target Acquisition Systems

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I. Introduction

Throughout the years, war has always been present in some form. As technology improved and innovation spurred us forward, war evolved from its primitive roots to become a very technological battle. Many of the weapons that are relied on, such as machine guns and grenades, are the product of innovation in the fields of technology. However, some of the technology that is still in use is severely lacking. Many soldiers have fallen victim to this technology void. One of the more prominent issues in the field of war is the survival rate of helicopters. The vehicles themselves are relatively slow moving, noisy, and vulnerable in comparison to other forms of transportation. While the issue itself has been a prominent one since the 1940s, there still is no definite solution. Several possible solutions have been brought forward, but so far, none have been put into practice.

A. Research Question

Everyday around the world America's soldiers put their lives at risk in order to defend the nation and her interests. In many areas where the military is present such as Iraq and Afghanistan, military helicopters are left vulnerable to attacks from ground forces, especially in urban areas. This study attempts to address this issue by providing a defense system that will improve the survival rate of military helicopters and save American lives. How effective would a target acquisition system be in improving the automated defense systems of military helicopters from incoming missiles and explosives in urban war zones?

B. Significance

As this study begins, it is important to understand the weight of this issue. The success of the study would prove the effectiveness of laser-guided target acquisition systems. The study's findings could be used to improve existing target acquisition systems and provide a jumping-off point for future studies. If successful, the proposed target acquisition system, when implemented, would protect military helicopters against ground-based assault. This, in turn, would save hundreds of soldiers who man said aircrafts. In addition, the technology could be modified to outfit other military vehicles or weapons. The modification and implementation of the proposed target acquisition system would improve the survival rate even further, saving lives and keeping soldiers safe on the battlefield.

II. Literature Review

Since the initial use of the helicopter in the Vietnam War, the survival rate of helicopters and their crew has been an issue. Because the crafts themselves are loud, slow moving, and easily damaged, they are frequently targeted during missions, generally by small arms such as Rocket Propelled Grenades and the 7.62mm AK-47/AKM. (Kopp, 2005) As helicopter armor is generally light, smaller weapons are all that is needed to severely damage a helicopter and gravely injure or kill an unsuspecting crew. The biggest concern for the helicopters is dealing with the RPG, as "Tolerance to RPG damage is problematic given the killing power of such weapons. While additional armour may help, no helicopter can ever carry enough armour to defeat an anti-tank weapon built to kill or cripple heavy armoured vehicles" (Kopp, 2005). For example, a CH-47 Chinook helicopter was recently shot down by an RPG in Afghanistan, which resulted in the death of 30 Americans. The helicopters are equipped with electro-optic missile sensors that can detect a missile and alert the pilot as to which direction the missile is coming from. (Weinberg, 2011) However, such systems do not help to protect the helicopter, and only serve as a warning for the pilot to possibly evade the missile. The only systems that actually serve to destroy or intercept are for heat-guided missiles. One example of these systems is ITT's Common Infrared Countermeasures system, which uses lasers to scramble the seekers in the missiles, causing them to veer off their original path. (Pappalardo, 2011) On the opposite end of the spectrum, BAE Systems is developing the Advanced Precision Kill Weapon System, a laser-guided missile system that is being tested on helicopters. The missile is fired from the helicopter and guided to the target with a laser, lessening the risk of collateral damage. (Hughes, 2008) However, none of the existing systems completely protect helicopters.

III. Research Design

A. Data

To discover if laser-guided target acquisition systems are indeed a suitable and reliable option for defending helicopters, the study will be testing a simplified target acquisition system to determine the effectiveness of such technology. The target acquisition system will consist of a Lego NXT robot that will be programmed to search for a specific target and direct a laser point at the center of said target. To determine the effectiveness of a target acquisition system, three sets of data will be measured: if the system can discover the correct target, how fast the system can discover the correct target, and how far from the center the laser guide is on the target. As access to actual helicopters is unavailable in this study, the use of the smaller scale target acquisition system programmed into the NXT robot will provide with theoretical data with which logical conclusions can be made about the implementation of such systems on a larger scale. In addition, the construction of the robot and the arena in which it will function is relatively easy to replicate, and is easily accessible and available to others in a similar situation.

B. Procedures

Data collection. Using the Lego NXT robot as our model target acquisition system, three sets of data will be measured: if the system can discover the correct target, how fast the system can discover the correct target, and how far from the center the laser guide is on the target. A series of tests will be run to measure if the system can discover the correct target. During the tests, the robot will be placed in a ring with various targets along the edge, and the robot will have to successfully find and direct a laser point at the appropriate target. During these tests, a stopwatch will be used to measure the time elapsed between when the program begins and when it pinpoints the target. Once the robot has discovered the correct target, the distance between the laser point and the center of the target will be measured to determine how closely the system can target the center of the bull's-eye.

Figure 1. The Lego NXT Robot that will be used to collect the data will have a similar design to the robot depicted above. However, a webcam will be positioned on top of the robot to both allow the robot to locate the target, but also to allow those completing the study to see what the robot sees.

Data analysis. Once the tests are completed, the data determining if the robot found the correct target will be compiled and averaged to determine the percentage of success. The data from the other two test will also be compiled and averaged together. The average time, distance from center, and percentage of success will then be compared to the results of similar tests to find how effective the robot design is in comparison to other designs and technologies.

IV. Outline of the Study

The results of this study will be divided into 5 chapters. Chapter 1 will introduce the study, bringing forth the issue of helicopter survival rates and its significance on the war front. Chapter 2 will outline the issues that contribute to the poor survival rate of helicopters, along with previous attempts to remedy the problem. This chapter will outline the problems with the prior attempts, and offer a solution throught the findings of this study. Chapter 3 will outline the robot's requirements and tasks that it must perform to test the target acquisition system, along with the procedures that will be used to collect data with the robot. Chapter 4 will present a compilation of the data collected by the robot. The data will then be compared to other, similar tests performed to address the survival rate of helicopters to determine the effectiveness and reliability of a target acquisition system in protecting helicopters. Chapter 5 will summarize the study and draw a conclusion about the effectiveness of a target acquisition system in protecting helicopters, highlighting both the benefits and liabilities in implementing such a system.

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Effectiveness of Target Acquisition System in the Early Detection of Cancer

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Kendahl Phagan, *Mechanical Engineering, HEP, University of Houston*

I. Introduction

When someone walks into a hospital in order to receive medical attention, he or she is immediately bombarded with a list of scans and imaging tests to complete. These scans may include MRIs, Ultrasounds, CTs, etc., all of which use some type of image processing technology to help doctors determine the state of health of a patient. The various imaging technologies give information on the structure and function of major organs, the strength of skeletal structures, as well as, development of certain diseases. As a result, it is very important to make sure these devices and technologies are working in the most effective way to produce accurate images of the human body.

Medical imaging technologies play an important diagnostic role when concerning cancer. They often serve as the final step or test in determining whether a person has developed cancerous cells. Such technologies also help in determining the source of cancer and the extent to which it has spread through the body. The information received from such images is necessary to proposing a specific course of treatment and care to the patient. Since tumor cells grow and divide rapidly as time passes, the sooner the cancer is found, the sooner and more effectively it can be treated. Consequently, researchers are constantly looking for ways to improve the technology used for imaging tumor cells so as to find tumor cells at the earliest stage possible.

A. Research Question

The guiding research question for this study is the following: How can a target acquisition system improve the early detection of tumor cells? In order for an imaging device to show the presence of cancerous cells, it must be able to show a significant difference between a normal cell and a tumor cell. Research in this field is focused towards finding ways to produce in depth images of the body which will make it easier for doctors to diagnose cancer towards the beginning of its development. The purpose of this study is to determine how a target acquisition system can improve the early detection of tumor cells. The study will look into the effectiveness of a system designed to recognize specific targets in the context of finding tumor cells in the human body.

B. Significance

This study will present an alternative technology for cancer imaging. The study aims to provide more insight into improving the techniques used to image tumor cells according to the surface texture and structure of the cells. In addition, the study will also contribute to the discussion of how to improve rates of early detection of cancer in patients, and advance the research conducted in the area of improving imaging technologies in the medical field.

II. Literature Review

Many cancers can be treated effectively by common treatments if they are detected early. As a result, a primary goal of cancer research is to study how to improve imaging technologies so that they can detect cancer at its earliest stage.

Since the surfaces of cancer cells differ from those of normal cells, cancer cells behave differently than normal cells. Cancer cells do not adhere to each other as firmly as normal cells do, and as a result, they act as single units when they invade tissues. Cancer cells, unlike normal cells, also aggregate in the presence of concanavalin A (con A). In light of these facts, there is a new hypothesis that ties together the effects of cyclic AMP and microvilli on cell aggregation (Kolata, 1975). Cells that have high concentrations of cyclic AMP behave normally, while cells with low concentrations of cyclic AMP resemble cancer cells in their growth rates, shapes, and abilities to bind in presence of con A. It was also found that cancer cells have more microvilli on their surfaces than normal cells that were not dividing. While a cell that lacks microvilli has a smaller surface area and is smoother, a cell covered with microvilli has a greater surface area. This increased surface area might be related to an increased ability of the cell to bind in the presence of con A (Kolata, 1975). Determining the presence of microvilli on the surface of the cells by imaging devices or an image acquisition system may lead to a possible diagnosis of the presence of cancer cells in a patient.

Certain molecular alterations also help distinguish between cancer cells and normal cells. Such alterations include the presence of specific biomarkers. There have been recent discoveries of the role of biomarkers in aiding the early detection of cancer. By detecting the presence of certain biomarkers, doctors can make a certain conclusion about the presence of tumor cells. Studies which focus on the estimation of minimal detectable tumor sizes based on blood tumor biomarker assays provide further information about the condition of the body during the early stages of cancer (Lutz, Willmann, Cochran, Ray, Gambhir, 2008). This type of information contributes to specifying the targets, such as biomarkers, for cancer imaging devices and advancing the technology used to detect the early signs of cancer.

Recent research focuses on developing optical imaging probes that target the activity and expression of specific proteases, enzymes which are involved in tumor progression. For example, the overexpression of proteases, such as matrix metalloproteinase (MMPs) and cathepsin B, are key to the biological functions and structure of tumor cells (Yhee, Kim, Koo, Son, Ryu, Youn, Choi, Kwon, Kim, 2012). MMPs participate in tissue remodeling and contribute to the survival of cancer cells. Cathepsin B plays an important part in the growth, migration, invasion, and metastasis of cancer cells. By observing and understanding the interaction of certain protease specific probes in the tumor region, these studies provide more information on accurately diagnosing cancer.

The majority of cancer-related deaths are as a result of metastatic disease, which has been correlated with the presence of circulating tumor cells (CTCs) in the bloodstream. Therefore the ability to reliably enumerate and characterize these cells could provide useful information about the biology of the metastatic cascade, facilitate patient prognosis, act as a marker of therapeutic response, and aid in novel anticancer drug development. Several different techniques have been utilized for the enrichment and detection of these rare CTCs, each having their own unique advantages and disadvantage. In particular, there is a study that provides a comprehensive examination of two image cytometry approaches for CTC analysis that are in routine use in laboratories, the iCys Laser Scanning Cytometer (Compucyte, Cambridge, MA) and the CellSearch (R) system (Veridex, North Raritan, NJ). The ability to detect, enumerate, and characterize CTCs is an important tool for the study of the metastatic cascade and the improved clinical management of cancer patients. These rare cells could shed light on the basic biology behind this highly lethal process and ultimately change current patient treatment guidelines (Darzynkiewicz, Holden, Orfao, Telford, Wlodkowic, 2011).

Cell image analysis in microscopy is the core activity of cytology and cytopathology for assessing cell physiological (cellular structure and function) and pathological properties. Biologists usually make evaluations by visually and qualitatively inspecting microscopic images, and thereby recognize deviations from normality. Nevertheless, automated analysis is strongly preferable for obtaining objective, quantitative, detailed, and reproducible measurements, i.e., features, of cells. Yet, the organization and standardization of the wide domain of features used in cytometry is still a matter of challenging research. The Cell Image Analysis Ontology (CIAO) is being developed for structuring the cell image features domain. CIAO is a structured ontology that relates different cell parts or whole cells, microscopic images, and cytometric features. Such an ontology has incalculable value since it could be used for standardizing cell image analysis terminology and features definition. It could also be suitably integrated into the development of tools for supporting biologists and clinicians in their analysis processes and for implementing automated diagnostic systems (Colantonio, Martinelli, Salvetti, Gurevich, Trusova, 2008).

III. Research Design

A. Data

The data to be collected will be the number of successful trials, how close to the center of the target the robot pointed its laser, and how long it took the robot to find the target. These data will give the accuracy, precision, and speed with which the robot locates the target. Such data will allow us to assess the effectiveness and efficiency of this target acquisition system in the context of finding the presence of tumor cells in the body.

B. Procedures

A robot will be programmed to identify a specific target from a collection of assorted targets while staying inside a specified area. We will use the NXT Lego robot and a webcam to conduct the tests (Figure 1). The robot will be attached with a camera with which it will guide itself to the target. It will also be equipped with a laser point with which it will shoot a laser at the center of the target.

Figure 1. Robot used in study.

Before the program that tells the robot what to do begins, the robot will be facing away from the targets. We will conduct multiple trials in order to determine accuracy, precision, and speed of the robot in finding the specified target. For each trial, we will record whether the robot successfully located the target, how close the target’s laser point is to the center of the target, and the time it takes for the robot to find the target. A stopwatch will be used to record how long it takes for the robot to locate the target.

The data will be analyzed to find the averages and standard deviations of accuracy, precision, and speed, as well as the percentage of successful trials. A successive trial consists of the robot correctly identifying the specified target. By calculating the percentage of successful trials, we will be quantifying the effectiveness and accuracy of the system in finding the correct target. We will calculate the average distance between where the laser point landed on the target and the center of the target. We will also calculate the average time it took for the robot to find the target. The standard deviations for each average will be calculated in order to determine how efficient the target acquisition system is overall. We will project the effectiveness of this system in recognizing tumor cells from normal cells, and then compare this system to the effectiveness of other imaging systems and devices.

IV. Outline of the Study

Provide an outline of your proposed study. See the examples in your textbook. Chapter 1 introduces the purpose of the study, explains the context of the research question, and provides the significance of the study. Chapter 2 discusses and cites literature relevant to the study. Chapter 3 describes the data to be collected and how the data will be collected and analyzed. Chapter 4 will state the results of the analysis of the data. Chapter 5 will discuss the significance of the results and their contribution to the ongoing discussion of the theoretical construct.

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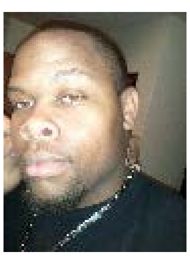

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Evaluation of a Target Acquisition System for the Improvement of Landing Efficiency of High Speed Jets

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I. Introduction

Landing a jet is no easy task. Amongst the other things required, high speed jets need a lot of room to be able to land. The jet has to fly at the right altitude and be approaching at a reasonable speed in order for it to land safely on a strip. Each runway strip is different, it can be narrow or shorter than another, and so the approach of each, individual landing is different depending on where the jet is intended to land. Landing on a strip that is wide and long for the jet to safely stop is quite different than landing a jet in an island or air craft carrier that has extremely limited space. In cases like this, utmost precision and caution would be the topmost priority of any pilot and crew.

Depending on the circumstance, it takes different amounts of personnel to be able to land the jet. For example, sometimes only one pilot is needed to guide a jet and other times, two. Emergency personnel are always on hand in case something goes wrong, and it sometimes does. In situations like these, it requires a lot of time and effort to develop the most up to date techniques and technology to aid the pilot in efficiently landing the jet with ease. They work, but there is always room for improvements. Especially when dealing with accuracy and precision. What happens when things go wrong and the jet is not flying at the right height or coming in at the right speed? What happens when the pilot loses control or is unable to maneuver the air craft in order to land properly? These are the types of questions that perked our interest and caused us to investigate possible improvements in aiding the landing of high speed jets.

A. Research Question

Our research question is the following: How can a target acquisition system improve the landing efficiency of high speed jets?

B. Significance

The purpose of this study is to determine if a target acquisition system can improve the present landing efficiency of high speed jets in order to make it less dangerous. If yes, then these enhancements would help save more lives in the case of a malfunction or an error. Additionally, by allowing technology to do the work, money could be saved because it would reduce the number of people required to perform the landing. In another aspect, if proved to be more effective, target acquisition systems, such as these, could lead to the manipulation and implementation for other purposes. For example, driving in a very dense area where speed could be a major hazard. In a situation like this, using a target acquisition system would decrease the chances of the car colliding with an unpredictable obstacle, thereby saving many lives.

II. Literature Review

Landing any airborne body is the hardest task any pilot will encounter. Not only is he responsible for the safety of all the passengers aboard, but also for the physical jet itself. A jet can land in two possible places: open land or an aircraft carrier, also known as a flight deck. Because the military makes the most known use of jets, the landing is usually executed on the later in the open sea. Having extremely limited runway space (only 500 feet), a precise landing is of utmost importance. To aid the pilot in landing, each jet has a tailhook, an extended piece of wire that is connected to the plane’s tail. It is up to the pilot’s job to try to successfully hitch the hook with an arresting wire that is present. There are four arresting wires on the landing deck and these, when caught by the tailhook, help slow down the jet and allow it to slow down in the restricted space. Regardless of where the jet is scheduled to land, all landings share the idea of a stabilized approach. This means that a steady speed is required along with the full pre-plan and knowledge of how and where to land the jet precisely. Timing, precision, and full control of the steering are the most important components of a successful land.

Even the smallest mistake can cause things to go terribly wrong. Granted that they are rare but they do happen, especially in an area where there is limited space. Pilots often perform a rejected landing, as they are called, if they don’t feel comfortable performing a landing in the position they are in. This means that the pilot rejects the first attempt at landing, goes around in a circle, and tries landing again. Sometimes, rejected landings can do more harm than good. A severe loss of control and visual references and confusion amongst the crew are just some of the problems that may arise because of these types of landings. They can also cause the pilot to get more tensed as pressure starts to mount after multiple failures, especially when it comes to something like landing an aerial body. The best way to avoid situations like these is to get the precise landing correct the first time itself. Although difficulties and glitches will always be present, doing the best to avoid them can have positive consequences, the most important being the safety of the pilot and all aboard.

III. Research Design

A. Data

To gather our data we will use the NXT robot and test its ability to detect a specific target, in this case a bulls-eye, and then move towards it. We will use a timer to determine how long it takes the robot to detect the target. To keep from falling off the elevated surface, the robot will have to distinguish between the white area inside the ring and the black line that lines the ring. This will be done by examining the consecutive pictures that the robots capture. Based on these, the threshold values can be calculated, allowing for a better precision and accuracy in locating the bulls-eye.

B. Procedures

In the beginning, we will set the robot off course and not facing the bulls-eye after which we will measure the time it takes for it to find the target, move towards it, and then readjust its position relative to the target. Meanwhile, we will be observing whether or not the robot follows a direct path to the bulls-eye with some sort of precision. We will record our observations of the trial runs. Finally, we will tally how many times the robot managed to successfully find the intended target. We will use the method of standard deviation to approximate how accurate the procedure is. This will allow us to determine if it would be helpful for a jet.

Figure 1. This is the NXT robot that will be used to perform the tests. The ability of this robot to detect a specific target will aid in the landing of a jet

Data analysis. All the data that is acquire will be scrutinized thoroughly to produce every single bit of information needed. For example, a tally chart will be kept, displaying how many times the NXT robot actually managed to find the target successfully. This will be the first step in determining if this acquisition system is effective even if on a small scale. We will also be keeping track of the extent to which the machine failed to meet its goal. In other words, what caused it to veer off path? An analysis of these interferences and their solutions would help strengthen the robot's goal.

The total time taken by the robot will be another necessary bit of information. Too much time needed would imply that something has gone wrong in the program which requires attention otherwise the system is ineffective. In the aviation world, the longer a jet spends in air, the more money it costs. Therefore, time would be a major source of concern. An average of the times will be taken, giving us an idea of what to expect from the robot on a random trial.

The pictures taken by the NXT robot will also be inspected. We will need to find a reasonable threshold value which will allow it to locate the specific target and not another distraction. This will be done by looking at certain chunks of pixels and determining from them the vital threshold values for each of the primary colors. Failure to input the correct numbers could result in severe problems for the jet because that may lead to the aircraft landing in an unexpected place. Finally, we will calculate the standard deviation in order to determine the accuracy of the process as a whole.

IV. Outline of the Study

Chapter 1 presents the reason and motivation behind the study. It lays out the idea and places it in terms of the aviation industry. This chapter also includes the significance of the study, making it relevant to the real world. Chapter 2 provides all the necessary background of a jet to allow for an easier understanding and application of the research question. Chapter 3 includes the entire research design and the process that will be implemented to acquire the needed data. At the same time, it will describe all of the methods in which the data will be analyzed and extracted for the required information.

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Eradicating Structural Failure

Nabiha Hossain, *Civil Engineering, HEP, University of Houston*

I. Introduction

Structural soundness is an important issue that is taken for granted. “Galloping Gertie,” the bridge that became ductile and collapsed in 1940 is one of many examples of structural failure found in bridges, radio towers, turbines, and buildings all across the world and the time span of civilization. An engineer’s underlying duty is to ensure the working condition of any product or structure he designs. A manufacturing warranty or a repair service can supplement designs of smaller scale, but when it comes to a large structure, thorough research is needed to guarantee success during initial construction. While much research has already been completed and events of structural failure have exponentially decreased during an age of technological surge, just this year several buildings in Rio de Janeiro, Brazil collapsed and killed thousands.

As much as technology has advanced in construction and the synthesis of building materials, the inevitability of human error and environmental conditions still wreaks. To lessen these risks, rather than estimating by mere calculations, which is currently the status quo, something must be done during the actual construction process to target structural weakness before it affects its operators and inhabitants.

A. Research Question

The question then posed is, how can a target acquisition system help eliminate structural failure during the construction process? This research addresses a method of finding the weaknesses in structures to help engineers amend problems in building plans and load conditions that otherwise would not have been noticed during construction.

B. Significance

Safety is always first when it comes to construction, and pinpointing areas in a structure that could jeopardize such an imperative is significant. Besides the humanitarian impacts, tackling structural failure is economical. The effort to maximize safety could perpetuate through revised building code as result of thorough research and further lessen the risk of structural failure.

II. Literature Review

A. Risks

The engineering of structures is very risk-based, and an article by Taylor & Francis Ltd, in *Structure and Infrastructure Engineering Journal,* performed research to categorize risks and methods to minimize these risks. They assert that, there are “two broad types of uncertainty; the aleatory type which is part of the randomness of natural phenomena… expressed in terms of the probability of occurrence, and the epistemic type which is associated with imperfections in modeling and estimation of reality… because of these epistemic uncertainties the calculated results, such as failure probability, safety index, risk, and expected life-cycle cost, [also] become random variables with respective distributions.” Their research found the risks of building structures, though manageable, are bound to a margin of error. They advised the most conservative building plans to minimize risk, even then without structural certainty.

However, for the sake of efficiency, the design treatment needed to facilitate the groups of people, vehicles, and/or objects using the structure being built must not yield to conservatism. The newest structures must keep up with the latest needs. A method to move beyond theoretical calculations and evaluate the finished structure before it is in use would best diminish building risks as much as possible

B. Calculation

A journal article by the United States Nuclear Regulatory Commission explored the scope of calculating structural failure probability in piping and found that “calculations show… gross errors in flaw sizing or significant departures from current flaw standards could negate the expected benefits of flaw detection.” (2) The article proposes that current flaw detection models, while substantially accurate, leave many factors unaccounted for, and are only applicable for a small range of piping sizes and thicknesses. On matters of uncertainty in the construction process, the research provides that, “initial flaw-size distributions [is] the greatest source of uncertainty in calculated failure probabilities because of the unavoidable difficulty in estimating the very low probabilities for the large fabrication flaws, which (if present) have a major impact on piping integrity.” (2) Mathematic models alone simply do not have far enough reach to encompass the needs of structural safety.

C. Simulation

Researchers at Cornell University have taken the challenge of anticipating structural failure and developed computer simulations as a result. They “assert that their calculations provide a much more specific and accurate way to predict structural failure. Their models are based on how different sizes and shapes of cracks, even microscopic ones, form and grow… which allowed them to predict how structural elements -- such as the bridge beams -- would hold up under different stresses and loads.” (3)Their research also points to the prevalence of foreseeable structural problems and aims to eliminate error in the design process.

The research within this article centers on targeting structural risk during the building process to ensure the sustainability of any given structure that has had such precautionary methods applied on it. A combination of the simulation programs developed by the Cornell researchers and a target acquisition system that scans the actual load in comparison to the simulated theoretical load would almost completely eliminate structural failure.

III. Research Design

A. Data

An NXT Toolkit for the MATLAB environment was used to prototype the target acquisition system within a robot. Image data was processed by MATLAB to detect desired objects. The ability to dynamically detect images can be used with certain criteria to analyze the stresses and loads of infrastructure.

B. Procedures

The robot was designed to identify the target’s location, move towards the target, center on the objective figure, and capture the image based on RGB arrays.

The program used to control the robot was made to process target images. For this prototype the target were based on color schemes. With program manipulation it will be possible to adjoin certain colors to certain loads, just as certain colors are associated with thermal sensor imaging accordingly. The program possesses the algorithms and functions necessary to manipulate an image array and command the robot to act accordingly in order to secure the target. The robot is in charge of the mechanics, that is, it acts upon a loop system of the program to find the target in scope of its camera, move towards the target on a platform, and precisely centers on the given target with a laser, and subsequently exit out of the loop.

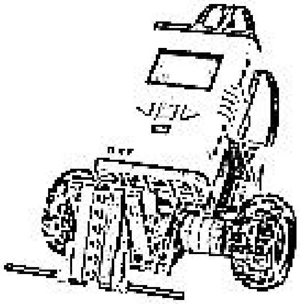

Figure 1. Sketch of NXT robot used to extract data

C. Data Analysis

In order for the NXT robot to identify the target, the arrays of images taken will be given a mass which serves as a sum of the image in binary form specific to a certain color. Note that a desired color within the target has a certain “mass.” When the image taken by the robot reaches a certain mass, it will have found the general area of the target. At this point, having the “mass” of the target is convenient to find the center of mass, i.e. the target’s exact center, and since the array of the image is two dimensional, it is necessary to find the center of the x-component and the y-component of the array.

$$x_{cm} = \frac{m_1x_1 + m_2x_2 + \cdots + m_nx_n}{M}$$

$$y_{cm} = \frac{m_1y_1 + m_2y_2 + \cdots + m_ny_n}{M}$$

Figure 2. Equations for the center of mass.

IV. Outline of the Study

Chapter 1 introduces the subject and establishes its pertinence in science, while Chapter contains a literature review of past applications and research on the subject. Chapter 3 entails the research design of the project. The final two chapters will present the findings and summary of the study.

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Target Acquisition in Deep Space

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I. Introduction

As mankind continues to explore the world outside of the atmosphere, it becomes more important to be able to detect and identify objects in space. The research focuses on the possibilities in which target acquisition systems can achieve this by simulating the situations in which such a system can prove useful. Ultimately the data found will provide safer working conditions and continue to build on the legacy of space exploration that started the U.S.S.R.'s Sputnik and lives on today with the International Space Station.

A. Research Question

How can a target acquisition system help in the detection and identification of objects in space? The answer to this question is hoped to be found through research into the viability of target acquisition systems. The experiments will be relatively small in scope as a webcam attached to a robot will be used to recognize different targets by their shapes, sizes, and colors. The data provided through this experiment should translate into evidence that such a target acquisition system can provide reliable and accurate results that will be applied to protect satellites from space debris, project trajectories for objects in space, and provide real time recognition of unidentified objects.

B. Significance

While this experiment will involve stationary targets that pose no threat to observers or the robot used to detect and identify them, the real world applications will deal with objects moving at incredible speeds across the vastness of space. Target acquisition systems are of great use in outer space conditions as they serve several roles that increase the safety of humans and human made objects. This research will translate into showing how accurate a target acquisition system is when it comes to warning a satellite of a possible collision, providing real time information on the path of a comet or asteroid so that scientists on Earth can better observe it, and detecting unusual behavior in heavenly bodies that can expand mankind's understanding of how the cosmos works.

II. Literature Review

The research question for the study will give a better understanding of the need for target acquisition systems to detect and identify objects in space. There are numerous articles and studies on systems that use target acquisition, and tell why it is important. According to an article called *Detecting, Tracking and Imaging Space Debris,* the US Space Command tracks "man-made debris" and "space-debris" in orbit. The tracking of space-debris and meteoroids is a major concern due to the hazard they pose to satellites and other operational spacecraft (Leushake et al., 2002). Along with this, the *United States Strategic Command* and the *Joint Functional Component Command for Space* program are crucial in this area. Their duty is to detect new man-made objects in space, produce orbital data, inform if objects will cause interference, and predict when and where a space object will enter the Earth's atmosphere (United States Strategic Command [USSSTRATCOM], 2011).

Current systems in place for the detection of objects in space include radars and optical sensors (Lewis & Wright, 2010). According to an article in *All Things Nuclear* titled *SBSS: Revolutionary?*, the United States uses these two types of target acquisition systems. However, the efficiency of the radars decreases rapidly once distance between target and radar increase (Lewis & Wright, 2010). For this reason the usage of optical sensors is more beneficial. These sensors detect reflected sunlight to track objects in space. There are two types of optical sensors in place: ground-based electro-optical sensors and the Space Based Space Surveillance (SBSS). Ground based systems can detect objects much farther in space and consist of telescopes linked to cameras and computers, but are very limited (USSSTRATCOM, 2011). The SBSS is thus intended to be capable of observing objects in space at any point. Despite this, The SBSS is much smaller than ground based sensors, and cannot detect objects that these ground-based sensors cannot already detect (Lewis & Wright, 2010).

III. Research Design

A. Data

This experiment will provide data that demonstrates the efficiency and accuracy of a target acquisition system. Such data includes the amount of time necessary to locate the target, the time needed to move to the target, and the accuracy with which the robot can identify a target that matches the given parameters. In order to collect our data we will be relying on MATLAB in conjunction with the NXT robot. Using MATLAB, the NXT robot will be programmed to locate a target, and analyze the target in order to identify the ratio of the three primary colors: green, red, and blue. This will demonstrate the accuracy and speed of the target acquisition system to see how effective it can be in real world applications.

B. Procedures

The tests will be performed by guiding the NXT robot by using MATLAB to find a pre-determined target. MATLAB will be used to locate the target, move towards it, and center the target. In order to do this scripts will be written to detect targets that match a certain threshold of light intensity, and instruct the robot on how to behave if such a target is not immediately found. This will provide data on the accuracy and precision with which the NXT robot can identify a target. To carry out this experiment the NXT robot will first initialized through MATLAB. Once a connection has been properly established, a webcam attached to the robot will be instructed to analyze the objects within its current field of vision. If the target is found the robot will then move towards the target, and stop when it reaches a marker identifying its position. The robot will then center the target, and analyze the light intensity to identify the target.

IV. Outline of the Study

Chapter 1 introduces the project, and provides a background in which it is founded on. It gives the main points to our research question, and how the experiment is designed to resolve such question. Along with this, Chapter 1 describes the importance of such research, and how data retrieved will prove useful for mankind. Chapter 2 gives information about current target acquisition systems currently in place. It describes how these systems currently operate, and to what extent they are limited. Chapter 2 gives insight as to why more research needs to be done in the field of target acquisition systems. Chapter 3 is an analysis of the experiment that is intended to resolve the research question. It describes the type of data that is to be extracted, and how it relates and is significant to the research question. Chapter 3 explains how the NXT robot and camera, the instruments in use for the experiment, will acquire the data needed.

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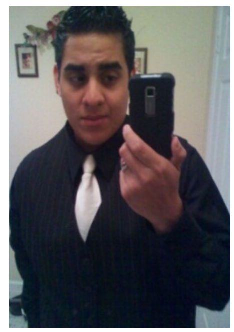

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Finding Weakness in Offshore Pipelines With a Target Acquisition System(TAS)

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Paul Soni, *Mechanical Engineering, HEP, University of Houston*

I. Introduction

On April 20, 2010 an explosion of Deepwater Horizon resulted in a seafloor oil gusher. The BP oil spill went on for three months in the Gulf of Mexico and released about 4.9 million barrels of crude oil. This was the largest accidental oceanic oil spill in the history of the petroleum industry. The spill caused extensive damage to marine and wildlife habitats and to the Gulf's fishing and tourism industries. One of the problems that caused the oil spill was the lack of a system to ensure well safety. With the current president agreeing to offshore drilling in moderation and the republican candidate of the upcoming election most likely to increase offshore drilling if he gets elected, offshore drilling will expand and the maintenance has to keep up with the expansion.

A. Research Question

The purpose of this study is to see if a target acquisition system can be used to find weaknesses in underwater pipelines in an offshore oil platform. Although not enough funding and time restricts the researchers to use NXT robots and a webcam to create a similar target acquisition system to be used in offshore platforms. This study will be to see if the target acquisition system can be reliable enough to use in environments where the human eye would be inefficient.

B. Significance

This study is crucial because identifying weak areas in underwater pipelines can help prevent horrific environmental disasters, such as the BP oil spill, caused by busted underwater pipes. A target acquisition system that identifies areas of weakness in a pipe can find weaknesses that human eyes could possibly miss. So a target acquisition system can alert someone to solidify a pipeline before it is too late, and thus prevent future environmental hazards.

II. Literature Review

A. Pipelines weaknesses

It is difficult to ever narrow down the cause of a major leakage of oil through a pipeline to one prominent factor; normally several factors play a role. However, physical defects such as welding, corrosion, and cracks are typical symptoms of possible weak areas of a pipeline. In oil and gas industries large pipe lines are needed to transport vast amounts of material over long distances. “These long pipe lines are constructed by joining one end of the pipe to the other end by established welding techniques in girth weld con figuration. During welding there is a chance for involving various defects such as slag inclusions, porosity, and imperfect fusion in the joint”(Yi Dake) Another way that pipelines weaken is by creep, the continuous permanent deformation of a body as a result of stress or heat. An example of how creep is a significant factor is “steam pipelines, which operated at high pressure and high temperature, are widely used in power plants and chemical plants. Under these conditions, creep is a significant factor, which causes failure of the pipelines” (Xiao-Chi). Although the conditions are not as severe for an oil pipeline the pressure and stress can produce significant creep to cause a failure in the pipelines.

B. Non-destructive testing

Over the years, people have come up with ways to test material for cracks or abnormalities. “Non-destructive testing (NDT) techniques have been widespread in many engineering domains, and radiographic testing is one of the most important methods for welding inspection to verify the structural integrity of the parts and the reliability of components in the petroleum, chemical, nuclear, naval, aeronautics and civil construction industries” (Yingjie). There are at least four main types of NDT however due to the nature of the inspection there are only two that can be used in the environment of the deep sea. “Ultrasonic Inspection is a method of detecting discontinuities by directing a high-frequency sound beam through the base plate and weld on a predictable path. When the sound beam's path strikes an interruption in the material continuity, some of the sound is reflected back. The sound is collected by the instrument, amplified and displayed as a vertical trace on a video screen. Both surface and subsurface defects in metals can be detected, located and measured by ultrasonic inspection, including flaws too small to be detected by other methods”(Hayes). Another method, the one most likely to be used if funding would allow is “radiography is based on the ability of X-rays and gamma rays to pass through metal and other materials opaque to ordinary light, and produce photographic records of the transmitted radiant energy. All materials will absorb known amounts of this radiant energy and, therefore, X-rays and gamma rays can be used to show discontinuities and inclusions within the opaque material. The permanent film record of the internal conditions will show the basic information by which weld soundness can be determined” (Hayes). This method uses a film which would be time consuming and ineffective to use with large amounts of data because a film has to be interpreted manually, but a digital radiography is possible. “In order to overcome the limitation of the traditional RT method, we developed a digital gamma-imaging system based upon a commercially available CdTe/CMOS pixel array detector (AJAT, SCAN1000 [5]) and a 75 Se gamma source” (Cho).With these available tools, a program can be written to go through the data and find possible targets the only thing missing is finding a way to get the inspection tools down into the deep sea.

C. Underwater Robotics

Inspections at these depths are considered inaccessible or unsafe for human beings. “In the marine sciences, gliders, autonomous underwater vehicles (AUVs), and remotely operated vehicles (ROVs) are some interesting machines that are deployed with sensors to perform measurements in hazardous places (e.g., deep sea or cold waters), for extensive period of times (e.g., beyond those safe for divers) and at relatively low cost” (Breen). With the digital data provided by the NDT, the AUV can locate and pinpoint areas that are weakening or defective.

III. Methods

A. Data

The data will consist of the number of times the target acquisition system’s webcam tries to identify the target. With that a percentage can be made of times the NXT robot correctly identifies the target to analyze the efficiency of the system.

B. Procedures

Construct a robot with a webcam attached to it that can identify the target. Then, we will run trials to determine how accurate the webcam is in identifying the weak areas. The NXT robot will be in an arena to locate the target and move in line to the center of target. With everything in place we will record the total numbers of trials attempted and determine whether or not the center of the target was correctly identified. The webcam’s resolution is detailed enough to pick up the image of the bull’s-eye and should be able to correctly identify the center of the target. If the TAS identifies the center within the margin of error then that will be considered a successful trial. We will have two different margins of errors, one being large the other small. The data from the large margin of error will be used to find the accuracy of the system. The small margin of error will be for precision in the TAS.

By analyzing the success or failure of the NXT robot to do so gives one an idea if the same theory could be applied to identifying pipeline weaknesses. The percentage of times the TAS identifies the target show the effectiveness of the system and in the field the better chance of detecting the target means that money can be used more efficiently at repairs.

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Computer Vision for Automated Weaponry Systems

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I. Introduction

The field of military technology is constantly expanding and the threats faced by our troops are constantly creating new tactics to counter that technology. In the past, science fiction has depicted technologies in the media well before they are possible in reality. Autonomous sentry turrets have been depicted in a number of movies such as 1979's Alien by Ridley Scott, where the protagonists used a series of automated turrets to fend off a dangerous foe without the risk of personal harm. Advancements in computer technology have recently reduced the cost and size of processors to the point that that the sort of image processing required for this technology is now available and cheap. Testing systems for their effectiveness is an important first step in developing this technology.

A. Research Question

How effectively can computer vision be used in a robotic weaponry system to allow that system to track and fire upon targets without direct human assistance?

B. Significance

Autonomous military robots would prove extremely useful to military and security institutions, by enabling personnel to avoid more dangerous situations in the field by allowing for an unmanned first line of defense, thus reducing the risk of bodily harm to personnel in case of attack. They could also allow tacticians to engage in new tactics involving unmanned defensive position in extremely dangerous areas, and they could increase the area that a smaller number of forces can defend or increase the security of critical areas.

II. Literature Review

In order to understand the effectiveness of a sentry turret as described, it is important to know what similar technologies already exist and how they are being used.

According to Noah Shactman, DARPA has been funding closed circuit television project conjoined with computers to process the data gathered by the cameras for potential threats and or problems (Shactman). This technology is an important step in developing a sentry turret as it gives a large sample for identification issues that could be experienced by such technologies.

In the article by Blain Loz, he describes an image-processing turret system similar to this project, which provides a terrific look at target acquisition and stationary weapon platforms working in unison that have already been developed (Loz). This system was created by DoDAAM, a South Korean military technology company for the purposes of protecting the Korean DMZ and is a wonderful example of these systems in action.

In an article by Aaron Saenz, he offers insight into the fact that the US military has quickly taken up usage of unmanned aerial vehicles, and some of the moral issues discussed concerning them (Saenz). These issues should be addressed fully before technologies that allow live ammunition to be controlled by a computer are deployed in most combat zones.

III. Research Design

A. Data

We will built a robot and program it to acquire a target using the image processing capabilities inherent in Matlab. We will be testing this robot for both its speed and accuracy as it acquires the target.

B. Procedures

We will run the robot in a series of ten tests. Each test requiring the robot to spin in order to locate the target, and then move towards the target to the edge of the circle before adjusting so a mounted laser is centered on the target. We will time the robot from edge detection until the time it is within 12 inches of the center of the target, then using a ruler we will determine the offset from the center of the target.

C. Data analysis

Using the timing data we will compare accuracy to time and determine if there are any results that do not achieve an accuracy of at least 12 inches within three seconds.

Each test which resulted in an accuracy of at least 12 inches within three seconds will be considered a successful test as that is an appropriate accuracy for a walking human target. We will use the number of successes to calculate the percentage of successful tests.

IV. Outline of the Study

Section one will include our introduction and research question. Section two will be our literature review. Section three will discuss the data we will gather and how we will gather and analyze this data. Section four will be the results of our procedure. Section five is where we will state our conclusions based off of our findings.

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This summer he will be working as a cook at Philmont scout ranch in New Mexico. He enjoys cooking, focusing particularly on the methods of cooking and the chemistry behind certain reactions in the kitchen. His current research interests are robotics and automation.

Targeting Polyps in Coral Reef Waters

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Rachel Roberts, *Chemical Engineering, HEP, University of Houston*

I. Introduction

The health of coral reefs is largely dependent upon sunlight, temperature, and the presence of pollution. Not only do coral reefs serve as a breeding ground for a plethora of exotic species, they act as a sponge for excess carbon dioxide in ocean waters. Removing carbon dioxide, a notorious greenhouse gas, inhibits global warming.

Adequate sunlight is essential for the survival of certain species of algae that contribute to polyp health, and the larvae are stimulated by sunlight as well. An excess of heat causes coral "bleaching," which inhibits larvae production. Coral reefs can be smothered by sediments leftover from pollution, and overgrown seaweed crowds the coral waters when agricultural wastes cause a surplus of nutrients in the water.

The dispersal and settlement of coral larvae determines the survival of coral ecosystems. The polyps perform a mass annual dispersal, during which hundreds of thousands of larvae are released from their mother polyp into the open water. Within a few months the larvae settle, budding new polyps to form coral colonies. The abundance of the undeveloped polyps directly correlates to the health of the coral reefs. We aim to monitor this process by developing a target acquisition system that can be used to quantify the larvae population in a given sample of water.

A. Research Question

How can a target acquisition system be used to accurately detect the presence of polyp larvae in coral reef waters?

B. Significance

This study is significant due to its direct correlation with the health of coral reefs, and in turn the health of the earth's environment as a whole. Without this natural carbon dioxide filter, global temperatures will continue to increase. In addition, coral reefs are essential to aquatic biodiversity, and vastly contribute to tourism-based economies.

Our research findings can be used by scientists working towards preserving and rehabilitating coral reefs. Our analysis of coral larvae populations can be used to assess the current state of health in coral reefs, because understanding the population density of polyp larvae will help scientists know which reefs are suffering. This assessment can be used to determine the level of urgency for scientists to enact preservative procedures. This data can also be used as a starting point for further studies, in which our results can be used to observe and analyze trends in the larvae population in relation to other environmental factors.

II. Literature Review

The preservation of coral larvae is directly related to the continued existence of coral reefs, which are a huge contributor to the filtration of carbon dioxide (CO_2) out of ocean waters. An ocean void of coral reefs will suffer the consequences of excess CO_2, including increased temperatures and higher acidity. These changes will prove detrimental to the marine ecosystem as a whole.

Beginning in the Industrial Revolution era, the release of CO_2 caused by human activity has resulted in an increase of atmospheric CO_2 concentrations in the atmosphere from roughly 280 to 385 parts per million (CRA). This dangerous increase in atmospheric CO_2 concentrations is counteracted in part by the ocean's absorption of the gas. The oceans have absorbed approximately one-third of the anthropogenic carbon emissions released, or about 525 billion tons. This absorption has significantly reduced the greenhouse gas levels in the atmosphere, minimizing a decent fraction of global warming impacts (CRA). However, this absorption results in a lower ocean pH, destroying marine life. It is estimates the nearly 25% of coral reefs have already been destroyed, and up to two-thirds of all coral reefs are classified as currently at risk (PCRF).

The coral reefs maintain a symbiotic relationship with a certain type of algae, Symbiodinium, that actively absorb CO_2 during photosynthesis. Symbiodinium converts CO_2 into carbohydrates using sunlight, and this provides food for the corals. At the same time there's evidence that suggests that the coral are actually farming their captive plants, meaning the corals actually control the output of the algae (ARC). This removal of CO_2 gas from the ocean by the coral helps restore healthy pH levels in the water, proving the importance of coral reef preservation.

Our study will focus on observing and analyzing the effectiveness of a target acquisition system formed using NXT robotics and MATLAB programming. We will study this data with relation to the effectiveness of its ability to monitor the population density of coral larvae in reef waters. We will attempt to assess the specificity of our acquisition system in order to gain information on how effective this software can be for the field of study pertaining to coral reef preservation. This assessment will give rise to methods of gaining more information on the state of coral reefs. By observing the health of the larvae, scientists can be proactive in preserving the most able reefs, and observing possible unknown causes for the reefs' deterioration. These findings can then be used in future studies to work towards a healthier marine environment.

III. Research Design

A. Data

Our data consists of images of the polyps taken by a webcam that will be fixed to the front of our NXT robot. In our experiment, the robot will autonomously perform a sequence of tasks leading to target acquisition. The images will be automatically taken and processed periodically until the target is flagged as “found.” We will program the robot using MATLAB, and MATLAB will use our codes to communicate with the NXT Toolkit and, in turn, the robot.

Our webcam will the attached to the robot, and will also be programmed using MATLAB to take the picture after a certain amount of time and after each time the robot turns. We will identify whether the target has been acquired by separating the colors on each picture into arrays, and coding MATLAB to interpret which color patches are indicative of our target. This method of data collection can be used to identify the frequency of polyps in samples of water, and this data can be used to compare the observed frequency of polyps targeted to an ideal population density per sample of water.

B. Procedures

Using MATLAB, we will program the NXT robot (see Fig. 1) to rotate clockwise in specific increments and subsequently take a picture with the webcam. We will use MATLAB to make the robot automatically measure the light intensities in each picture taken by the webcam and quantify these intensities into separate color arrays. Then, using MATLAB scripts, we will code these arrays to identify a desired threshold of intensity based on the color of the target we are trying to detect. MATLAB will separate the data that meets the threshold from the data that falls short into extremes, so our image can be analyzed as white and black. The number of pixels that meets the threshold will each be counted as one “mass,” and the total mass will determine whether the target is fully in view of the webcam. When the right mass of target is processed, the robot will stop turning.

It will then move forward until it reaches a black strip (the edges of the arena), and then stop. It will do this by the use of an attached light sensor directed at the ground which observes the intensity of light rebounded. Once the observed intensity reaches a certain value, the robot will halt.

At this time, the robot will take another picture of the now much closer target. It will analyze this picture and identify the “center of mass,” since our target will be symmetrical and evenly spaced. The center of mass will be indicative of the center of the target, and the robot will point a small laser (also attached to the front of the bot) at this location.

Figure 1. Robot used in study.

C. Data Analysis

The analysis of our data will comprise of observing the accuracy of our robot’s ability to locate the target effectively and find the center based on our MATLAB programming. We will analyze what threshold intensities are required in order to target certain colors. These observations can be used to increase the precision of our robots’ targeting capabilities. We will use our data to observe what factors are most effective for target acquisition, such as the amount of time needed for the robot to be stationary before a clear picture can be taken, and the degree by which the robot must turn in order to collect data in a time-efficient manner without losing the ability to process minute changes in the “mass” of target in view. These analyses can be used to deduce whether our device will be successful when applied to the study of polyp populations in coral reefs.

The data collected by our device if it were to applied to samples of coral waters after or during the reef dispersal could be analyzed in a number of ways. Our robot will be set to take a picture in different locations in even time increments, and the robot will be able to quantify the presence of the polyps in each photo based on our set threshold frequencies. We can use these calculated “masses” to take the average mass density over a given time in a given area of the reef to assess the general state of the population. We could also set further thresholds, so that the robot can be set to categorize certain ranges of target mass into levels of population density. This analysis can be used to observe specific trends in the presence of larvae. By taking many data trials with different environmental variables, we can use our data categorization to compare population densities with respect to time of day, depth of water, and the rate of disappearance of the larvae after dispersal, and other experimental factors.

IV. Outline of the Study

Chapter 1 of our study contains an introduction to the field of coral reef study and some information about the reef ecosystem itself. It also includes our research question and the significance of this study, in order to give context for why we are conducting our research. Chapter 2 serves as our literature review, in which we gather information pertaining to our research question from prior studies done on the coral reefs and its current situation in the oceans. We have communicated information about the reefs from different reputable institutions that will help the reader understand the way reefs contribute to the environment, and how our study can be used to further these observations. Chapter 3 is our research design, in which we elaborated on the specific data we are collecting, the instruments we are using, and the methods by which we carry out our trials. We also explain our proposed method of data analysis. Chapter 4 is this current section, and acts as an expanded table of contents for the sections of our research study.

Chapter 5 will consist of our actual results, quantified after we have conducted our trials. We will display the data collected from the images our robot acquired, and then discuss the trends and observation we made based on our data. Our final chapter will be Chapter 6, the conclusion of our study. We will here made deductions about the accuracy of our device and its ability to be applied to the study of coral reefs.

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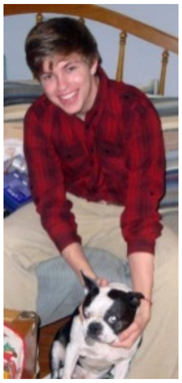

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Object Acquisition System to Help the Blind

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I. INTRODUCTION

Blind and severely visually impaired people encounter significant challenges while trying to get around on a daily basis. For the most part, the aids available to the blind today are the same as those available to the blind decades ago. Walking canes are used by repeatedly tapping the ground in front of the user's feet while walking; it alerts the user about obstructions in his or direct path, such as curbs, potholes, staircases, etc. Seeing Eye dogs are another form of aid to the blind and visually impaired. A Seeing Eye dog is harnessed so that it is kept close to the blind person, and it is trained to lead the owner away from dangers that are harder to locate and detect, like incoming cars or bicycles. Though walking canes and Seeing Eye dogs do prove quite helpful in making up for a person's visual deficiency, there is still plenty of room for advancement. There is currently research and development being done regarding methods of transmitting visual input from an external device to the person using the device. Compared to the more basic awareness that there is some obstacle or some danger, finding ways to specify what exists in one's surroundings is a good next step in helping improve the mobility of the visually impaired.

A. Research Question

How can a target acquisition system assist blind people with recognizing obstacles?

B. Significance

This study will assess how providing blind or severely visually impaired people with more information about the different type of objects in their surroundings compares to simply identification through use of a walking stick. The results of this study will show that target acquisition systems have the capacity to be used to give blind people the aid a walking companion would give. In addition our research will be able to provide major cooperation with proof that target acquisition is a viable upgrade to a walking stick, which in turn will lead to the further development of this technology and eventually reach consumers.

II. LITERATURE REVIEW

To begin, this study is meant to provide a means of obstacle identification and avoidance using target acquisition on webcam data. This study must touch upon the problems that blind people currently face without any aids as well as the problem that remain or arise when aids are used. In addition this study must touch on what environment will blind people be using an aid system and also how will information be relayed to a blind person using an aid system. Due to the copious amounts of literature on these subjects what follows is a synopsis of literature that contributes the most profoundly to this study.

On its own the United States is home to one hundred million people who suffer from blindness or another visual impairment. These men and women have much trouble navigating on their own on a daily basis. Although there exist aids for navigation such as guide dogs, there exists room for improvement. Guide dogs are very effective in providing blind people with assistance however they are very expensive as well as to most people a burden to maintain reports Shoval, Ulrich, and Borenstein. According to their publication most blind people rely on using "the white cane – the most successful and widely used travel aid for the blind." The walking stick is the accepted tool in the blind community. The cane's lightweight, usually portable design is able to detect obstacles on the ground, such as holes bumps, steps, and walls. However Shoval, Ulrich, and Borenstein argue that the cane is flawed because beyond the effective range of the cane, about 3 to 6 feet, the user is unable to probe and therefore the traveler perceives only limited information about the environment. The writers of *Navigation System for the Blind: Auditory Display Modes and Guidance* argue that even with canes "the blind traveler has lacked the freedom to travel without assistance, for efficient navigation through unfamiliar environments relies on information that goes beyond the sensing range of these devices." In addition, the obstacles are only discovered with contact. In other words a cane would be useless in a crowded area because of constant contact. Also, in detecting objects further away the cane would not work which would make travelling difficult outdoors where obstacles are usually far away compare to the indoors.

This leads into another very important distinction that is made by the writers of *BlindAid: An Electronic Travel Aid for the Blind* who say that outdoor mobility can present more potential dangers to blind travelers because obstacles and hazards such as motor vehicles and dangerous terrain can be life-threatening. Furthermore, since indoor hazards tend to be far more benign, the safety issues addressed by typical travel aids are less useful indoors. This implies that the method for aiding blind travelers in the outdoors requires different techniques which may possibly be very different from those used indoors (Mau). For example in a building a target acquisition system would want to target walls and doorways to navigate the halls. However in an outdoor environment, a sidewalk would need to be targeted. Curbs, potholes, elevation changes, cars and sign poles would need to be targeted in order to keep a blind person from hitting anything.

Throughout the literature acquired and summarized above, there exists a lack of information or consensus on the way visual data (or the data of where obstacles are) should be relayed or conveyed to the blind traveler. Creators of *BrainPort Vision Device* came up with a solution to transmit data as electrical pulses on the tongue (Layton). Whereas others have used an auditory system that play certain sounds to signal where obstacles may be. Other methods include vibration feedback. All in all many different ways to transfer data to the user are being created and experimented with each with unique advantages and disadvantages. The lack of information regarding the best way to transfer data is something that attention must be given to in order to conclude this study with an effective solution.

III. Research Design

A. Data

The data we are collecting will be measured in terms of the target acquisition robot's ability to find and identify the target image. We will run 15 trials to assess the effectiveness of the robot. Attention will be focused on measuring the accuracy of pointing to the target and the consistency in being able to identify the target object.

B. Procedures

Data collection. We will run multiple trials with the target acquisition system to see how it detects and identifies various target objects. The robot will travel within a set area, showing capability to move and spin, detect a specific target among other potential objects or images, and then center in on that specified target. We will calculate average accuracy of the acquisition system by the ability of the robot to point a laser point in the direction of the center of the object. Trials will be conducted and the distance of the center of the object and the point on which the laser is pointing will be measured. We will measure consistency in terms of number of successful identifications of the target object over the number of number of total trials. A successful identification will mean that the robot was able to point the laser on any area to the desired target, and a unsuccessful identification is when the robot's laser is not on the desired target. In addition to test the advantage of using a target acquisition system to assist blind people we will run a test with a blind person using no aid, a walking stick, and the target acquisition system. The test would place various obstacles and would involve the blind person to walk across the room. We will measure how many object the person was able to successfully identify, how many obstacles were consciously avoided, and how long it took to cross the room. This data will provide us with convincing evidence of which aid method for the blind is the best in providing them with mobility.

Data analysis. We will use the distance data between the laser point and the center of the target to calculate accuracy. Taking the average of the distances will give us the average distance that we can expect our system to be "off." This average distance is the margin of error we can expect from our system. Using the identification data that say the system successfully or unsuccessfully identified the target, we can get the success rate. The number of successful over the number of unsuccessful identifications, taken as a percentage, will give the percent success rate. Taking the data from the test conducted by a blind person, we can get a number that can scale how useful each system is. Using the following equation we can get this number:

$$\text{Usefulness} = A(\text{\# of objects identified}) + B(\text{\# of objects avoided}) + (\text{Longest trial time} - \text{trial time})$$

Where A and B are decimals between 0 and 1 defining the importance of identifying objects and avoiding objects respectively.

IV. Outline of the Study

Chapter 1 introduces the project by presenting the research question and presents all relevant context that is needed to understand the question and project goals. It will also include the discussion of data collection and analysis. Chapter 2 will introduce the various written resources that relate and contribute to our research. A discussion of each piece of literature will be included. Chapter 3 will present the result of our research. The results of our test will be reveled as well as the conclusion made by analyzing the data acquired. Chapter 4 will conclude our research by addressing the research question, asking whether our solution is successful, and plotting the next step in solving our problem.

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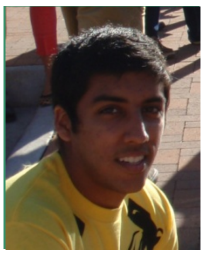

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Biotechnology for the Visually Impaired

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Kathleen Menezes, *Biomedical Engineering, HEP, University of Houston*

I. Introduction

"It's just remarkable that we've gone from having no cure to blindness to a situation where we can restore sight to some extent" –Palanker

The use of biotechnology and target acquisition systems could be a major factor in the solution to curing human blindness. Biotechnology has been used in the visual field in ways like photoreceptor transplantation or retinal implants, but it has yet to be perfected through neuroprosthetics [1]. So while there has been some progress in this field in aiding the blind to see color, read large fonts and the like, it has yet to be refined to the point to where it could even be compared to typical human vision.

Further research upon the pathways from the brain to the human eye could, however, help to perfect any currently existing biotechnology or could help to create a basis for any future biomedical creations. Using biotechnology, not only could those with permanent blindness observe colors or shapes, but they would be able to receive signals from their eyes to the brain – even if these pathways were previously damaged. Essentially, the biotechnology would have to be connected directly to the brain, and maybe even fully bypass the visual networks from the eye. Therefore, not only those who were blinded by genetic predispositions or by an illness would be able utilize the biotechnology, but also anyone with permanent damage to a part of the eye from external causes. These implants would replace an impaired part of the eye, introducing a new way to help aid those who are currently visually impaired.

A. Research Question

How could a target acquisition system be implemented to help treat and reverse blindness in humans in relation to recognizing sources of activity and three-dimensional recognition?

B. Significance

This research into target acquisition and biotechnology is important for four reasons. First, it has the potential to help those with difficulty seeing or visual incapability, and could help to more or less erase long-lasting effects of human blindness. Second, this research could be implemented into further research of reverse engineering of the human brain. Third, our proposed prototype could be effective in serving as a replacement of specific parts of the human eye that become damaged. Lastly, this research could be implemented in the various ways biotechnology could create a robotic system in which sight is aided by reactions to other senses.

II. Literature Review

To help us to answer this research question, we will include literature on various eye diseases, the human visual pathways, recently engineered biotechnology in the optic field, effects of robotic implants in humans, how webcams or robotic eyes work, and various ways that animals use their other senses in lieu of vision.

In humans, the optic nerve is used to send signals from your retina to your brain, where these signals are interpreted as images that you see [11]. Information travels from the retina to the nerve, and then to the optic chiasm. Once in the optic chiasm, the nerve fibers pass through the optic tract until they reach the visual cortex, which is located at the back of the brain [9]. Optic nerve atrophy (ONA) occurs when the optic nerve becomes damaged. This type of damage causes vision to dim, and the ability to see fine detail will often be lost, and the pupil's reaction to light will diminish [4]. Any damage to the optic nerve cannot be reversed and any vision lost cannot be recovered [4].

Some causes of ONA include tumors, inadequate blood or oxygen supply before birth, heredity [4] or various eye diseases, most commonly glaucoma. [4]. Glaucoma is caused by the liquid aqueous humor not flowing out of the eye properly, causing fluid pressure in the eye to build up. [11]. There are multiple types of glaucoma, but each of them can cause blindness if left untreated [11].

A few recently engineered solutions to similar optic problems could be applied to helping reduce or eliminate the visual disability caused by glaucoma. A few of these include recent developments in non-invasive techniques to predict intracranial pressure [7] and recent advances of cell therapy for retinal diseases [8]. Also, some recent research suggests that the complete elimination of mutant myocilin expression in trabecular meshwork cells gives the possibility of avoiding the primary open-angle glaucoma phenotype, practically eliminating the chance of any optic nerve atrophy caused by glaucoma [3]. This could be made possible through a recent breakthrough in achieved specific ablation of certain parts of the eye. [13]. Although these examples could help to further identify or protect against optic nerve atrophy, they are not being used to combat the effects of atrophy in already visually impaired individuals.

Some animals are already biologically equipped with additional senses that help them to register an object's location, without the use of sight. Whales, whose sight is disrupted by deep dark water and a lack of sunlight, can use two different techniques to navigate. One is through the use of sound, because they have developed a remarkable sensory ability used for locating food and for navigation underwater called echolocation. [10]. Echolocation is the location of objects by reflecting sound. Another technique whales have, as well as birds, is the sense of magnetism. When the intensity of the earth's magnetic field fluctuates across the globe, these animals are able to sense these changes and use them like a map [6]. These are just two ways that animals are able to use other senses in addition to poor sight.

Robotic implants do have their share of complications when compared to a non-robotic implant because the time involved in surgery can be increased, due to the need to adjust the robot properly to the patient. This increase in time can lead to a potentially increased risk of infection [12]. Also, some implant systems may require extra resources in fastening the robot to the patient, which also can raise the chances of infection and even blood loss [12]. While extremely rare, malfunction can occur, in which cases an implant may require a system reboot, or a surgeon may often abandon of the robotic portion of the surgery in favor of traditional techniques. [12]. It is possible that local injuries around the surgical site may occur due to the exposure of sensitive tissue to the robotic implant, which might otherwise not occur using traditional tools or techniques [12].

The use and understanding of how a camera views its images is crucial to the rebuilding and programming one like it. A camera's function is to receive visual information and interpret it as an electronic video signal [2]. The VCR on a camcorder receives an electronic video signal and records the images on video tape as magnetic patterns; however, a digital camera translates the information into bytes of data as 1s and 0s instead of marking it as magnetic patterns. The 1s and 0s are easier to record, give a more accurate image than the magnetic strips, and do not lose any data. These different cameras and their respective way of viewing could help us to implement a camera in our research.

III. Research Design

A. Data

We will be using a robot prototype in order to test and design the target acquisition system. This robot will be built by our team, and will be programmed using the MATLAB language. It will be designed to search for and locate the center of a dartboard on an otherwise blank white wall, using a webcam as its "eye". Once this robot system is initialized, it will be able to reach our goal in three broad steps. The first of these will include locating the desired target and then moving toward it until it reaches a line placed on the floor in front of the wall. The robot will then center a laser attached to it, in order to detect the specific location of the bulls-eye.

B. Procedures

Data Collection. We will run a series of tests with the robot and target acquisition system in order to measure its effectiveness. Because a Webcam will be connected the robot during the testing, we will be able to see what the system views on its camera. We will test and record the accuracy of the system's ability to search, move at an appropriate time and distance, and the precision of its detecting abilities. These tests will undoubtedly vary, depending on how the robot and system reacts to various programs.

Data Analysis. Essentially, we will be analyzing the accuracy, precision, and time efficiency of the target acquisition system's capabilities. We will average the values of the robot's time efficiency and performance, and judge the success of the prototype by the standard deviation of its results. In this way, we will be able to find the robot's ability through the averages values calculated, and the precision of the robot between trials by analyzing the standard deviation calculated.

FIGURE 1. Robot prototype used in collecting data

IV. Outline of the Study

In the first chapter, we will introduce our research, identify our research question, and tell the significance of the study. Chapter two will present literature that is relevant to our research. The third chapter will present our research design and introduce the robot that will be used as our source of data collection. Chapter four will analyze the data collected through test trials and calculation, and the fifth chapter will serve as a conclusion to our study.

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Preventing Potential Pipeline Problems

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***Abstract*—As the demand for oil continues to increase, oil pipelines remain the most prominent means of transportation of oil, as well as the most efficient. These pipelines, if not maintained properly, can lead to extreme economic distress and environmental disasters. A target acquisition system could improve the industry's ability to maintain these pipelines. Being able to monitor and scan the pipelines to find weaknesses, cracks, or any other flaws or hazards that could damage the transportation of oil, would be highly beneficial and a great advantage to the workers who are responsible for maintaining these pipelines.**

I. Introduction

Despite the fact that oil and gas pipelines are the most efficient means of transporting these resources, they are far from perfect. Pipeline leaks, spills, and even explosions, such as BP's Deepwater Horizon incident in 2010, happen more often than the general public would like. Although the complex systems of oil rigs, drills, and transportation pipelines will never be flawless, there are definitely steps to be taken to improve their sustainability, safety, and quality. A large problem posed by oil pipelines is that, when there are weaknesses or small leaks in the pipes, it is difficult to identify them. These small strains and weaknesses have the potential to cause some serious problems if left unattended. A target acquisition system that could scan these pipelines, detect any potential trouble areas, and relay their locations to the workers, would provide a cost efficient way of ensuring the integrity of the pipelines. If oil rig workers and petroleum engineers knew where the trouble areas were, how severe a threat they pose, and the appropriate steps to take in order to fix the problem, they could collaborate and take preventative measures. This system would preserve and ensure that there will not be unnecessary losses of the sources of nearly 60% of the world's energy.

A. Research Question

How could a robotic target acquisition system aid the oil and gas industries by recognizing and reporting structural weaknesses in oil and natural gas pipelines?

B. Significance

This study will answer the question of how a robotic target acquisition system could aid the oil industry in effectively maintaining oil pipelines. A target acquisition system would be able to find problems before they become too hazardous. A target acquisition system will be able to find small flaws such as cracks, strains or weaknesses in the pipelines before they become breaks, holes or gaps. Such a system will make oil pipelines safer for the environment and more beneficial to the companies that use them. Less oil will be wasted because cracks and weaknesses will be detected, flagged and repaired early.

II. Literature Review

In order to better understand the topic, we break down the literature review into four different sections; Benefits of Robotic Divers, Qualities and Efficiency, Current Advancements in Pipeline Technology, and British Petroleum spill.

A. *Benefits of Robotic Divers*

According to Marine Technologies, Inc., their staff consists of "highly trained and proficient divers" that must be professionally trained and certified by the OQSG (Operator Qualification Solutions Group). These divers are responsible for a variety of tasks, including corrosion prevention on underwater pipelines, measuring the thickness of the pipe walls, movement of pipes that are in use, as well as installing, maintaining, and repairing underwater valves and pipes [2]. Through our research, we hope that these tasks can be done safely and more efficiently with the aid of an autonomous robotic diver. These robotic divers would implement our target acquisition system and, by scanning the pipelines and identifying problem areas, would reduce the time human divers would spend in the water and ultimately keep the pipelines operating in optimal condition.

B. *Qualities and Efficiency*

In an article by the National Environment & Planning Agency (NEPA), coated steel is the best fit material for constructing oil and gas pipelines. It is very noncorrosive (with cathodic protection), resists impact and abrasion, can withstand high pressures, and has a reasonable cost. Also, it has a high flexural ability and, when welded, possesses great joint strength and tightness. [5]

C. *Current Advancements in Pipeline Technology*

In 2011, Save The World Air, Inc. proposed a new technology that would revolutionize the world's ability to transport oil. This new Applied Oil Technology (AOT), when added as an interrupter to current pipelines, would drastically reduce the amount of friction applied by the crude oil onto the surface of the pipes. By installing multiple AOT units, the excess fluid particles mixed with crude oil is aggregated by electroplating and compacting, allowing the oil to flow faster and use less energy, which would greatly reduce the operational costs. In the Trans-Alaska Pipeline, this new technology reduced CO_2 emissions by 59 million pounds per pumping station [4]. Overall, this technology will undoubtedly improve the efficiency of the pipeline transportation of oil and improve both environmental impact and energy efficiency. This makes the pipeline industry grow in popularity and, with the aid of a robotic pipeline scanner, managing both existing and future pipelines safe, cost efficient, and environmentally friendly.

D. *British Petroleum Spill*

According to Harry R. Weber and Michael Kunzelman from the Associated Press, British Petroleum settled lawsuits brought forth by more than 100,000 fishermen who lost their jobs, cleanup workers who became sick and other people who have been hurt by the 2010 oil disaster in the Gulf of Mexico. This oil spill was the worst offshore spill in the United States' history. The oil spilled into the Gulf of Mexico for more than 85 days until engineers were successful in capping the well [1]. The British Petroleum disaster in the Gulf of Mexico shows what the consequences are for oil spills. According to the *The Guardian* news company, British Petroleum has spent fourteen billion U.S. dollars in the Gulf of Mexico as of January, 2012, and has set aside another twenty billion dollars for economic claims and restoration work [3]. All of this money was spent fixing something that could've been prevented.

E. *What Does All this Information Mean?*

With our target acquisition system implemented by either an autonomous robotic diver, or a robot that will scan pipelines that lie above ground, potential hazards will be identified and taken care of to prevent future accidents and disasters. With the growing popularity of the Applied Oil Technology, a system such as ours will definitely be in high demand. With the oil flowing at record speeds through the pipelines after going through AOT interrupters, even the slightest crack could lead to a torrential outpouring of oil. Oil spills will be much larger and spread much faster than ever before. In the case of the underwater pipelines, this means more oil pouring out at a much faster rate, posing great danger to all marine life, as well as the human divers responsible for repairs. Similarly, with above ground pipelines, the more oil that pours from a weakness, hole, or crack leads to a higher area of contamination in the environment. Lastly, given the characteristics of the metal used to construct the pipelines, it is possible to have a general idea of the average "wear and tear" that will be applied to the pipes while in use, and the robots would monitor this "wear and tear" process.

III. Research Design

A. Data

The instruments used to perform our tests include MATLAB, a webcam, a NXT Lego robot, a target, and a laser pointer. The robot we will use is built out of NXT Lego parts. This robot has both a webcam and a laser attached to it. We have given the robot the ability to move forward, backwards, turn left, and turn right. We also have made it so the laser pointer can be aimed up or down. Using MATLAB, we program the robot to be able to take pictures using the webcam and then proceed to move the robot and to point the laser at the desired location, which in this case is a bulls-eye on a dartboard. The data we will collect is whether the system can acquire the target or if it passes over the target without recognizing it. Our data will also include the speed in which it will find the target. By gaining speed, we recognize the fact that accuracy may be compromised, so finding the perfect mixture of speed and accuracy would provide for the best system. If the robot is remarkably slow but accurate, it may not be able to scan the pipelines efficiently; however, if it is too fast, the robot may begin to overlook the desired trouble areas. Refining the program to be accurate and precise as well as quick in targeting the bulls-eye will help us to provide an answer to our research question.

B. Procedures

Data Collection. In this study, the data will be collected through the tasks executed by the robot. The main objective for the robot will be to acquire a target designated by the programmer. This target acquisition project will occur through the robot's ability to execute three commands. The first task the robot must complete is to capture a picture of the area immediately in front of it using the webcam mounted to the top of it. This picture will then be analyzed by the program to determine if the desired target is currently in the field of view. If the desired target is currently in the field of view, then the robot will immediately proceed to the next step. However, if the target is not yet present, the robot must rotate a user-specified amount and repeat the image-analysis process. This process will continue until the desired target is successfully captured in the webcam's field of view. The second of the three tasks is for the robot to move forward until it detects the presence of a black line. This black line will be the border of the wooden platform on which it is sitting. The robot will possess the capability to detect the intensity of light using the light sensor attached to the front of the robot. Upon detecting the line, the robot will stop forward movement and begin the third step. The final task that the robot will execute is to center the beam of a laser pointer onto the center of the target (in this case, the bull's eye). In order to be able to do this, we have attached a small platform with which to hold the laser. This platform is attached to a third motor, which we will use to rotate the platform vertically, in order to align the laser beam with the center of the target. Upon the successful completion of the third task, the robot has achieved the desired objective.

Data Analysis. After all the desired data has been collected, we will analyze it by comparing the speed it took for the robot to find the target compared to the speed that the robot is programmed to move. We will also investigate the robot's ability to analyze the images captured by the webcam and whether or not it succeeds in perceiving the different colors and/or shapes that are present within the images. The speed it takes for the robot to execute the command and its accuracy in deciding if the target is present or not will both prove to be beneficial when addressing our research question. In use within the oil and natural gas industries, speed and accuracy in detecting hazards or potential hazards is crucial to both the reliability of the pipelines, the safety of the workers, and ultimately the economic stability of the company to deliver its resources. Our vision of the pipeline robot would need to be able to scan the surface of the pipeline and find areas that are different than those which surround them, just as the NXT robot must scan the area for a designated target shape or target color amid the white space surrounding it. In being able to identify these "trouble spots", the pipeline robot would then be able to relay the position of the threat (in this study, the laser represents this ability) so that the workers would be able to take the appropriate steps in preventing the problem or provide damage control. This, in turn, will help to keep pipeline damages to a minimum and keep pipelines operating at their fullest potential for as long as possible.

IV. Outline of the Study

The primary goal of the study is to research and test the available use of target acquisition systems in the petroleum pipeline industry. Through research, we found current target acquisition systems, as well as how necessary it is to prevent oil pipeline disasters. Through building and testing our own system, we found out how effective our target acquisition system can be in detecting a desired target and how effective one could be in finding weaknesses in pipelines.

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Traffic Management through Integrated Traffic Signals

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I. Introduction

Most of the traffic is controlled through the use of automated traffic lights. Idling vehicles have been shown to waste large amounts of unnecessary fuel and also emit unnecessary amounts of carbon dioxide into the atmosphere. This in turn causes excess fuel spending and pollution in the environment. This also leads individuals to have to account for congestion and plan their trips around these causing earlier departures which take time out of their lives. To reorganize the entire infrastructure to ensure better travel from the new suburban areas would cost the city millions of dollars. Therefore, we propose to develop a system of integrated traffic light cameras across the transportation grid of a city. The camera would reflect infrared light across an area and be able to interpret a vehicle's speed by the speed in which the light reflected from the car returned to the camera with image processing software. The traffic light would take this data, transmit it to other traffic signals and utilize algorithms to create the most efficient light timings across the traffic infrastructure to ensure minimized delays and maximum travel times. Another issue that causes congestion on highway infrastructure are accidents. Accidents often block a lane of two, and long response times cause traffic to build up for hours at a time until the issue is resolved. With the integrated traffic system, the traffic signal would be able to identify and accident and link into police and fire departments to notify them of an accident.. The use of integrated traffic signals would reduce transportation times, cost less fuel for drivers, reduce accidents, increase response times, and ultimately ensure a much more optimal commute.

A. Research Question

How could robotic target acquisition be used to maximize the efficiency of traffic lights?

B. Significance

One of the main goals engineers set out with is to maximize efficiency in others' lives. By making sure traffic lights are at their peak efficiency, we can provide a subtle but significant bonus to every person who uses said roads. Furthermore, if a more effective system could be implemented, it would spread, making the subtle effect much more pronounced.

II. Literature Review

In one study, An Analysis of the Fixed-Cycle Traffic-Light Problem by Richard Cowan, Cowan analyzes the issue of the current traffic light scenario. Through data collection he notes that "fuel consumption is greatest during acceleration, and road authorities are considering signal settings which attempt to minimize vehicles that incur delay." (Cowan). Since acceleration occurs more often from a red light to a green this uses excess fuel increasing fuel consumption, increasing fuel costs. This in turn hikes prices of gas, and causes inefficient transportation movement across the infrastructure. The National Transportation Operations Council reported that "The impact isn't trivial. Even changing the delay of lights by a few seconds could reduce road congestion by as much as 10%. It would reduce air pollution from vehicles by as much as one-fifth, cut accidents at intersections and save about five tanks of gasoline per household each year"(Jerome) Right now, the traffic lights operate based on the largest queue of people waiting. It allows for a high departure rate compared to the saturation rate, and puts cars in a waiting queue to receive a green light. However, it does not always correctly identify the best solution because the algorithm is based on moving the largest number of people rather than the most efficient amount of people. This ruins efficiency because a driver might lose the opportunity to continue a green light if they are late to the traffic stops. P Wackrill in his study on traffic congestion developed an algorithm that "finds a minimum cost assignment of flows to a network…it takes the sum over all the arcs of the products, cost x flow is linear". It tries to fix the problems that occur at bottlenecks and crossovers where accidents are highly likely to occur. In combination with integrated traffic lights the algorithm would be set to find the most dynamic arcs of movement with the most movement with the minimum cost and fuel consumption by the vehicles involved. This would involve image detection utilizing image processing in which the photo can be analyzed such as "edge detection procedure both reference and real time images are matched and traffic lights can be controlled based on percentage of matching"(Choudekar) which compares the image received to the standard image which sets the light timings.

III. Methods

A. Data

Using an NXT Robot, we will observe the ability of a targeting system to successfully acquire a target, observing the amount of time a targeting system will take to find its goal as well as what difficulties it encounters in searching for it. Once acquired, we will use that data, coupled with our own observations, to determine the potential strengths and weaknesses of our possible traffic control system.

B. Procedures

We will begin each test with an NXT Robot with a webcam mounted on it. We will then place it on the center of a flat, round surface lined with a two inch black ring, and upon starting the program; the NXT Robot will travel to the black ring and upload an image to be processed by MATLAB. MATLAB, using image editing, will determine if the robot is facing the target it intends to acquire by analyzing the distribution and presence of different colors. If the image is not detected or not detected in full, the robot is programmed to spin a set number of degrees and repeat the search again, repeating until it has found the target. After the target has been located, using image editing, MATLAB will break down the image uploaded from the webcam into its component colors. We will set MATLAB to detect the bull's-eye by setting a range in which the color of the bull's-eye as well as its shape is defined. When the bull's-eye has been located, the robot will then proceed to center the webcam and fire the laser, which will be mounted adjacent to the webcam. Each test will be timed using a stopwatch and monitored for errors.

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Target Acquisition System in Combat

Chris Huerta, *Mechanical Engineering, HEP, University of Houston*

Jabari Budd, *Mechanical Engineering, HEP, University of Houston*

I. Introduction

The development of technology throughout the years has grown exponentially and can easily be noticed no matter where you go. The antiquated, brick like cell phone from the 90's transformed into a computer like system that can handle extraordinary tasks. Robots that were only seen in Sci-Fi films are now becoming reality and being used in many countries for military purposes. Instead of risking the life of a human in order to maintain surveillance over an enemy threat, a human can control a robot and use a Target Acquisition System (TAS) to identify potential threats. Technology has gotten far enough to where the need for a human is not necessary 24/7 to maintain surveillance. With the Improved Target Acquisition System(ITAS), there is no need for humans to risk their lives to protect their country. Machines such as the TOW (Raytheon), use such technologies that allow it to detect and engage in combat in order to defeat enemy armored vehicles.

Though technology has come far we still have a long way to go. The constant advancements we gain daily not only bring us closer to extending life but it also allows us to preserve life. Over 1,400 United States soldiers die yearly during times when we are at "peace." Even more of these soldiers are injured and wounded both physically and mentally. The crippling affect that war has on our soldiers is one that should be avoided. With the advancing technologies relating to TAS we should so be able to limit the dangers our soldiers will be facing. By taking out the danger our soldiers face we will be able to use better tactics that will not put soldiers in harm's way. We will be better suited to prevent attacks like 9/11 from happening again. Thus allowing us to be a safer and more secure country.

A. Research Question

The guiding research question for this study is the following: How can the implementation of a target acquisition system in military tactics benefit the use of unmanned vehicles when referring to national defense?

B. Significance

The significance of success in this experiment can help greatly in the saving of the lives of Americans and their allies. It can allow for the removal of troops from the danger of warfare. It will allow for our country to better protected from the threat of an attack. This research would be targeted towards the United States Government, the military, and the companies that manufacture weapons for the military. With this research, fewer families will have to deal with losing their love ones due to war.

II. Literature Review

The technology behind the target acquisition system has come a long way throughout the years. During its infancy stage, it was considered a breakthrough when Rockwell unveiled its target acquisitioning system in September 1992 that weighed less than 45 lbs(Design News 1992). This TAS was used in the Stabilized Payload Infrared Reconnaissance Image Intensifier Turret (SPIRI2T), a technology that would provide a "jitter-free image under rigorous tactical environments"(Design News 1992). At this time, TAS was only able to provide images and not what would come to be the era of unmanned combat. At this point in time, SPIRI2T was intended to be present in scientific platforms, communications relays, TV news filming and branches of law enforcement. Less than 20 years later, TAS has made a leap that made its functions in SPIRI2T look like a mere recording device. The Long-Range Advanced Scout Surveillance System (LRAS3), produced by Raytheon and used by the U.S. Army contains a multi-sensor target acquisition system that detects, recognizes, identifies and geo-locates targets at long distances (Defense Update, 2010). A year later, target acquisition systems have made their way into military weapons. The XM25, dubbed the "punisher" is a 25mm, 13 pound semi-automatic weapon that enables small units and individual soldiers to engage targets with a 25mm air-bursting capability for all operational environments (Army Times, 2011). This weapon has been tested in Afghanistan and Iraq and is said to have a range up to 1,000 meters. The efficiency and capabilities of the weapon makes soldiers forget about the weight and focus more on the task at hand. The development of target acquisition system has been incredibly revolutionary in the last two decades. Now, there is less risk of an American soldier getting hurt from enemy infantry since machines with TAS can now detect them more efficiently, and now actually counter attack.

In 2003 a helicopter that included radar and a targeting system was designed for the army (New York Times, 2003). It would cost 22 million dollars and would be able to track as many as 128 targets and decide the top 16 most dangerous. Then it was able to transmit this info to other helicopters and ground forces in the area. This would've allowed for safer travel and easier detection of enemy moments. The Lightweight Counter Mortar Radar was used in Afghanistan in 2010 (Fires, 2011). This implementation of a targeting system allowed for us to be able to see how to improve it. The LCMR has to be in pristine conditions and doesn't work very well in mountainous areas. They found that it was most successful in areas with flat land and properly trained teams. Also there weren't spare parts at bases so if one of the LCMR's messed up the process to fixing them was too long. So understandably you must create a targeting system that work in many environments and can come with cheap maintainable parts. TAS allow for easier and faster analyzing of data (NSWC Crane News). It allows for war fighters to be used faster and more effectively. If TAS allows for more efficiency in war efforts the less amount of time we have to spend at war and the faster we can bring our soldiers home. Allowing for a greater chance of survival.

III. Research Design

A. Data

In order to receive the data necessary one must first check to make sure everything is running properly. The robot must be properly built and the camera must be secured onto it. The laser must be pointing straight from the center of the camera. The robot and camera must be able to be controlled through the use of MATLab. All functions must be running in order for the attempts to be successful.

B. Procedures

The goal of the activity is for the camera on the robot to get the target centered so that the laser pointer can accurately target it. In order to get this accomplished there is a certain procedure that must be followed. First the MATLab workspace must be completely cleared so that there is no interference from previous uses. All devices must be turn on and set up. Then any variables that you have must be set up so that your process can be made simpler. After the basics of setting up, the robot must locate the target by focusing on it with the camera or spinning until it is found. The robot must then move forward to the line so that use can use your laser on the target. After accurately getting the target with the laser the "clean up" phase should begin. All programs must be closed and then the process would be complete.

Figure 1. Named "Megatron" the robot has a warlike look. It is an NXT robot with a camera attached to its head. Above the camera directly centered is a laser pointer. The laser pointer is tightly attached so it cannot move and has a switch attached so that it can be kept on or off.

Data analysis. We will be using a webcam to take pictures of the target and then filter out the colors that are unnecessary in finding the target. We will first let the robot know that the total amount of pixels in the image will be 320x240 pixels. We will then have the robot scan the area with the webcam to see if the target is within full view. If so, the robot will take a picture of the target, convert it into a black and white image and if the percentage of white pixels are within the designated range, the robot will move forward and then center the image. If target is not within full view, the robot will then turn and scan again. This process will repeat until the target is within full view.

We are using the process of converting the image to black and white in order to differentiate the color yellow from the rest of the target. By converting the image to black and white, we are left with a black image with white representing the yellow rings and the bulls-eye. Since our goal is to aim a laser as close to the bulls-eye as possible, this is the most efficient way of getting rid of any excess colors.

IV. Outline of the Study

Part 1 introduces the project and gives background and significance. Part 2 gives examples that pertain to Target Acquisition Systems in today's society. Part 3 discusses what we will gather data with, how we will gather the data, and how it will be analyzed.

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Currently he is a member of the fraternity Delta Upsilon. He likes to run and participate in sports. He is interested finding the positive effects of technology on society. He would like to one day move to Hollywood and became a famous actor.

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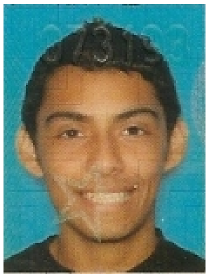

Chris Huerta (HEP ‘11) will be receiving the B.S. degree in Mechanical engineering from the University of Houston in 2015.

In his spare time he likes to run, play soccer, or play his violin. He is interested in the effects technology will have on the environment. Besides majoring in Mechanical Engineering, he is intending to minor in Mathematics and Finance.

Virtual Reality in Military Applications

Chi-lun Chu, *Electrical Engineering, HEP, University of Houston*

Christopher O' Hara, *Mechanical Engineering, HEP, University of Houston*

I. Introduction

Communication has been crucial to an effective military since Caesar. Caesar relied upon messengers relaying messages from one person to the next to connect his broad empire. At the time, this relay system proved to be fastest means of conveying information across vast distances. In the nineteenth century, a giant leap in communication was made with the invention of the telegraph and Morse code. Innovation continued with the radio which allowed transmission of messages through air. Without the need for wires, transmission of messages could be directed anywhere that a receiver could accept a signal. The military application of the new technology proved to be crucial in World War I and World War II. Efficiency of transmitting strategy and intelligence drives the military to continue to develop technologies in the field of communication.

In the modern era, the military is on the frontier of communication. Portable phones project signals into space and are redirected by satellites. Words are no longer the only forms of information that are sent through air waves. Video is transmitted, and different layers of the electromagnetic spectrum can be used to add new dimensions to the battlefield. The information that is gathered by cameras and other devices can be shared through a network. Soldiers can access this network through handheld computers and earphones. The problem comes when the soldier is in a fire fight. Soldiers must be able to communicate while maintaining an awareness of their surroundings. Soldiers are trained to talk to each other through hand gestures and over their radios. Having to glance down at a handheld computer or map can be deadly in a high tension situation. Conveying position information and strategy through verbal methods can be time consuming and may be misinterpreted in a high pressure situation, and hand gestures are limited in the type of information they may convey. A new leap in communication technology is needed to convey information without requiring a soldier to shift his attention from the battle.

A. Research Question

How can a targeting acquisition system be used in conjunction with virtual reality to allow military commanders to seamlessly convey information about the battlefield?

B. Significance

The study of target acquisition systems and virtual reality will create a faster and deadlier strike force. The project will allow soldiers to receive the location of objects and soldiers through a visual overlay. (1) First, with the objective in view at all times, the force can assess their approach in real time and always maintain visual contact. (2) Second, with constant visual contact of the enemy, soldiers can naturally adjust tactics without the enemy's knowledge. (3) Finally, visual alerts will allow soldiers to avoid friendly fire. With these promises, this study researches technologies that will improve the performance of soldiers on the battlefield.

II. Literature Review

Target acquisition systems and virtual reality are not new and have already been implemented in several areas. Target acquisition systems have been used in a variety of military systems. The Rockwell International Corp. created a system that could find enemy combatants in any weather condition. This system uses a forward-looking infrared sensor with a 256 x 256 focal plane array to produce infrared imagery. Television imagery is also produced from a high-resolution camera. These sensors are mounted on a stabilizer and attached to an unmanned aerial vehicle. While on reconnaissance, the system can identify enemy combatants and transmit their location to strategists and military leaders. ("Rockwell Unveils…", 1992)

Virtual reality has been used by the military to train their soldiers to use expensive vehicles. The cockpit is set up to be one to one in scale, but everything that is exterior is recreated in a virtual world to simulate real life situations. This method has allowed the military to save money because setting up such scenarios in real life would cost much more, and the soldiers still receive the experience that they need. ("Virtual Reality Training…", 1998) Virtual reality is also being used in real life situations of medicine. Doctors can perform surgery using robots and a live video feed from a tiny camera. This minimizes the size of the incision that needs to be made to reach the desired location. If used in conjunction with an MRI machine or other medical scanners, the live video feed can be augmented with a virtual reality representation of information being collected by the scanners. This exciting use of virtual reality and imagery can allow the doctor to seamlessly perform surgery as if he were touching the organ. (Satava, 1993)

When these technologies are combined, virtual reality can be used to overlay real objects which creates an augmented reality. Augmented reality has been used for maintenance of military vehicles, but some of the most exciting uses have been implemented in military jets. The F35 fighter jet, crown jewel of the United States armed forces, uses an advanced heads-up display to relay visual information to its pilots in a full 360-degree "world". The main goal of military AR systems today is to give ground soldiers the same level of situational awareness that these pilots have, offering them complete control over the battlefield. (Lockheed-Martin, 2010) Tanagram, a U.S. digital development firm, is already prototyping a technology they call HMD-AR, or head-mounted display-augmented reality. The basic dismounted soldiers are able to use the system's audio, video, and processing capabilities to create and utilize a virtual reality in the field as they carry out dangerous missions. Squad members, call signs, rendezvous points, targets, and enemy combatants are all highlighted in the AR created by a team, and all information is shared amongst personnel both on the ground and back at command. (Tanagram, 2012)

III. Research Design

A. Data

The instruments that will be used in the test are a web camera, a NXT platform, a MATLAB script, a dart board, white cardboard, sticky notes, a timer, a tape measure, and a protractor. The camera is mounted on the NXT platform. The NXT platform is a small robot with two electric motors that power two plastic tires. Refer to Figure 1 for an image of the platform. By changing the power to each tire, the platform can move forwards, backwards, and turn right or left. The platform will use a script written in MATLAB as its instructions for movement. The MATLAB script will be run on a desktop computer. In addition to coordinating the robot, the script will also create a three layer matrix to capture color images from the camera. Each layer will use a shading scale from 0 to 255 to display an image that is composed of the basic colors red, blue, and green. It will use the matrix to create a grayscale image for each color to isolate the dart board from its surroundings and to determine the center. The dart board has yellow rings and a yellow dot at its center, and it will be mounted on a white piece of cardboard, as seen in Figure 2. A laser will be taped to the camera and calibrated to focus on the center of the image that the camera captures. Sticky notes will be used to mark the last point for each attempt that the laser stops. A timer will be used to keep track of how long the system requires to find the center. A measuring tape will be used to determine the distance from the real center of the dart board to the marked points, and a protractor will be used to determine the angle from the horizontal across the center of the circle.

B. Procedures

<u>Data collection.</u> The process begins with the setup. The NXT platform with the webcam mounted on it will be placed in the center of a circle. The dart board will be placed on a white board, as seen in Figure 2. The camera will be facing away from the dart board to force the platform to turn the camera towards the dart board. A timer will be set to record the time it takes for the camera to find the center of the dart board. The script will turn the platform a number of degrees and will use the camera to capture an image to determine if the dart board is within view. It will look for the unique combination of red, green, and blue that creates the red of the board. It will repeat this process for the yellow of the board. A certain number of pixels in the image must contain the unique colors to verify that the board is in view. If the board is not in view, the script will spin again and repeat the process. When the script determines that the dart board is in sufficient view, the script will command the platform to move forward until it touches the edge of the circle. The light sensor that is mounted on the front of the platform will detect when the color of the circle changes from white to black. Once at the edge of the circle, the script will command the camera to capture an image. It will calculate the center of mass of the red color and the yellow color and turn the platform the amount necessary to reach the center. The process will be repeated until the center of mass is within a certain distance of the center of the image. Since the laser will be attached to the camera and will point to the center of the image, the laser will be trained on a spot close to the center of the dart board. The position will be marked with a sticky note to record the position of the laser. This process will be repeated four times. For each attempt, the time, the distance, and the angle will be recorded, and a mark will be placed on the laser spot.

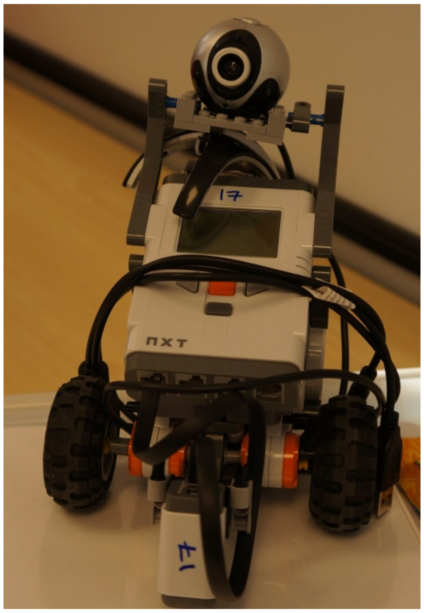

Figure 1. This is the NXT platform with a webcam mounted on top. Two motors power the wheels, and a light sensor is mounted on the front.

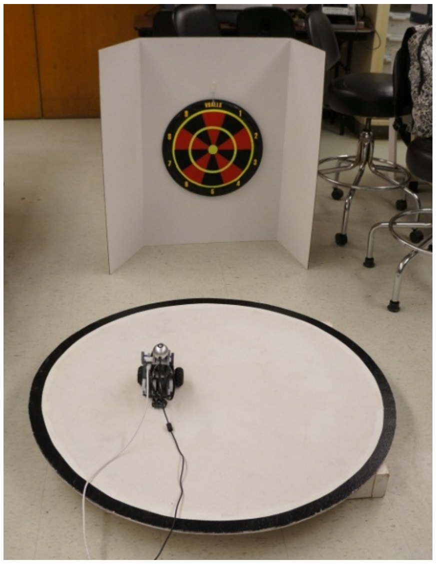

Figure 2. This is the setup for the target acquisition experiment. The robot will spin to find the target, move to the black line, and center the laser on the bull's eye.

<u>Data analysis.</u> After the four attempts are completed, the data will be collected and used to calculate the results. Each attempt's time will be used to calculate the average time that the system requires to find its target. The time reflects on the efficiency of

the MATLAB script in recognizing colors and objects. The accuracy will be determined by calculating the mean of the distances from the center of the dart board. This shows the average amount of error that the system has in locating the center of the object. The precision will be calculated by finding the mean distance and angle of the marks and marking this point. This shows the consistency of the system in finding the same point each time it runs the program.

IV. Outline of the Study

Chapter 1 will introduce the context of the project, targeting acquisition systems, and augmented reality. Chapter 2 will show the literature review of articles that relate to targeting acquisition and augmented reality. Chapter 3 will give a description of the research design, which includes the instruments and processes used to collect the data. Chapter 4 will reveal the findings of the project. Chapter 5 will discuss what the findings mean to military communications and the technology behind the project.

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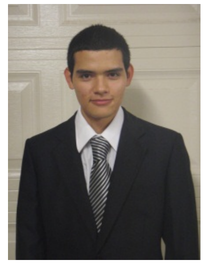

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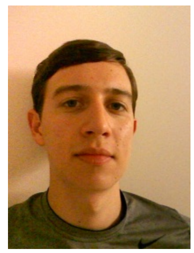

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Benefits of Robot Assisted Surgery

Kyle Dixon, *Mechanical Engineering, HEP, University of Houston*

Trent Gray, *Chemical Engineering, HEP, University of Houston*

***Abstract*—Although many of us may not have experienced surgery first hand, we can all understand the importance of its precision and quality. This study is designed to discover how a target acquisitioning system can contribute and make surgeries more efficient and improve the quality. Improvements in the area could help prevent many health problems for us in the future.**

I. Introduction

The medical industry is perhaps the most important industry in the world. However, a large problem with the medical industry as well as every industry is the quality and amount of potential errors. As we strive to perfect everything we do, errors are unfortunately still a common occurrence with humans. Which is why, throughout history, we implement machines into our daily lives to do tasks for us, such as robots assembling vehicles to robots performing surgery.

Traditionally, surgery is performed completely by hand and the risk of mistakes and slip ups are high. With advancements in robotic design, these machines can be used to aid in tasks throughout a surgical procedure. With the steady, predictability of robotics the percentage of errors made in surgery would decrease greatly.

In addition to the literal assistance in surgery from robotics, target acquisitioning systems could be used to find potential threats to health and point surgeons in the right direction. For example, weak or thin spots in veins those surgeons cannot see themselves.

A. Research Question

Although many of us may not have experienced surgery first hand, we can all understand the importance of its precision and quality. This study is designed to discover how a target acquisitioning system can contribute and make surgeries more efficient and improve the quality.

B. Significance

By delving deeper into the use of robotics we can improve the quality of the robotics which would in turn result in an even better quality surgery or action performed by the robot. We can improve they're stability, reaction speed, and strength.

Research on robot assisted surgery enables surgeons to be more precise with their tools and actions. The robot will virtually eliminate the "human" errors we all consistently make, such as shaky hands, and slips.

Upon improving the robot, we can improve the doctor's ability to operate the robot. Making the robot user friendly is essential to the effectiveness of it, so we must ensure that the doctors have the ability and training to operate such a design.

II. Literature Review

Not only has the quality of surgical procedure been increasing, but also the methods to use new technology become more complicated. Which is why new surgical devices, medical informatics systems, and diagnostic tools can only be as effective as accessible they are to surgeons. Therefore medical equipment must truly be more innovative than complex in fear of this being considered disruptive technology. However the enormous amounts of knowledge found in the medical research fields warrants surgical technology to progress at a similar standard. However with the development of new technology come very high investment from the private sector, and therefore raise the cost of healthcare and make it less affordable to the public. The debate rises of how we can lower the costs of robotic surgery while improving its quality. New medical technology can ring up a large bill the overall value needs to be worth that cost.

From around 150 years ago when antiseptic techniques broke new ground the possibilities of surgery increased greatly. And so the invasive methods of surgery have grown into their own fields. Invasive can be defined as keeping surgeons able to accomplish goals in surgery with as little necessary risk as possible. Surgical procedures differ in complexity and so a large part of invasive surgery is the concept of minimalism. The fewer steps in a procedure the less time a patient is on the table so complications are at a lower rate. Through these facts we can determine an idea for robotic technology to be more simple than complex.

III. Research Design

A. Data

Using a NXT robot, a webcam, and a laser, we will determine how effective the robot is in distinguishing color and shape difference to find a bulls-eye in the center of a target among other decoys. Endoscopy has often been used to examine patient cavities for presence of tumors, polyps, and other disease states. The endoscope can be easier passed through cavities such as the trachea or colon. Three-dimensional images of body cavities, similar to those our NXT robot processes, are obtained and analyzed to dictate the path that to be taken to pass the endoscope. Often time's sedation and heavy analgesia can be avoided. Our robot's target acquisition is similar to that of Endoscopic procedure, cameras are used in surgery to help the surgeons identify the tumors, however if the robot could distinguish different types of malicious tumors and save surgeons time. In laparoscopic surgeries, two, three, or four incisions are made in the abdominal or thoracic cavity to insert the instruments and video equipment. The surgeon will use a remote control to monitor images and then decide where to take action.

B. Procedures

We will equip a robot with the webcam and laser, appropriately program the robot to take in light reflection readings and distinguish different shapes. The robot is programmed to break down the colors of a dart board, and keep adjusting its position until the desired shape and color is in the camera view. This way the desired target does not need to be sent through the surgeon to be collected, the robot can formulate the image on its own. We will examine the length of time the robot takes to perform the target acquisition due to the fact in surgery, latency (the time it take for the robot to perform its action) can be critical toward the patients outcome. We will then analyze the overall accuracy of the robot with respect towards its programmed target and what its sensors actually pick up.

Figure 1. NXT Robot used to collect data.

IV. Outline of the Study

In the surgeries already performed with the use of robotic assistance surgeons were polled on the overall effectiveness of the robot and the results are shown graphically in Figure 1.

Robotic assistance effect on error

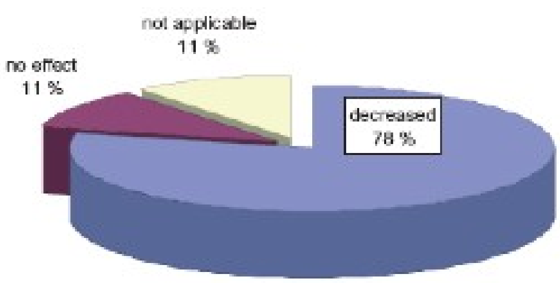

Figure 2. Robotic assistance error.

As shown in Figure 2, the majority of surgeons agree that robotic surgery decrease the amount of errors made during a surgical procedure.

IV. Outline

A. Summary

Overall, our study shows that robot assisted surgery drastically improves the quality of the surgical procedure. At minimum the robot does not hinder the operation.

B. Interpretation

Our data proves our statements of improved surgery. Our actual experiment proves that robots can be used to visualize and distinguish different objects in an area. Future testing should be done to bring robotic surgery to its full potential.

C. Limitations

Limitations of our study are the limits of our own robot. With the type of robot and webcam we are only able to be so accurate. Better equipment as well as more experience with programming would enable us to improve our robots and see what other things they are capable of.

D. Suggestions for Future Research

More work should be done in the area of finding weak or these areas in veins. Discovering were these spots are before they become fatal would save many lives and help extend their years much longer.

E. Conclusions

Without concern for our own health, our average life spans dramatically decrease. Improvements in the medical field are relevant to the entire world. While assistance in the operating room may not lengthen the average life span, it will prevent future problems to ensure that the majority of people get the chance to experience the average life span. Preventing minor errors made by humans as well as helps see things the human eye cannot will drastically improve the quality of surgery as well as the diagnosis. Robotic surgery is a must if we continue to strive for improvement.

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Obstacle Detection System for the Visually Impaired

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I. Introduction

In today's increasingly complex world, the ability to see is useful in order to fully interact with one's surroundings. Even though the Americans with Disabilities Act has required that businesses and other establishments implement methods for the visually impaired to live and work freely, there are several situations that one encounters every day which do not have suitable workarounds for the visually impaired. For instance, consider the act of navigating a busy sidewalk. In order to successfully move along the sidewalk, humans constantly evaluate their surroundings in order to calculate whether they have a chance of injuring themselves on an object or another person. In order to accurately judge the distance and velocity of any potential hazards, humans require the use of their eyes to provide the necessary location information. However, those who are visually impaired are required to gather this data through the use of seeing-eye dogs, which require upkeep and care, or they must resign themselves to the lower quality information provided by the use of a white cane.

In the twenty-first century, with the advent of image recognition and targeting technology, such as the Optical Character Recognition used in scanners, or techniques used to determine the existence of patterns in photographs, it has become increasingly simple to use computers to understand the world around us. Image recognition technology has recently come to the forefront of the digital world due to the increasing popularity of augmented reality applications, which interpret data from the camera of a mobile device and provide the user with extra information about what they are "seeing".

A. Research Question

How can an object detection system be used to help the visually impaired avoid obstacles? In order to help the visually impaired reduce the risk of injury while navigating the outside world we will attempt to create an efficient obstacle detection system that uses image recognition technology to detect potentially hazardous obstructions in the path of a person. Our robotic system will be used as a test bed for interpretation of the image recognition data.

B. Significance

As we move into an era where we have the ability to pocket large amounts of processing power, the visually impaired will be able to harness image recognition technology in order to detect obstacles in their path. The use of an obstacle detection system by the visually impaired will have a marked impact upon the individual and community. An efficient and accurate detection system will be able to reduce the risk of injury due to movement by alerting the user to the location and velocity of any potential hazards.

II. Literature Review

Obstacle detection is by no means a brand new thing in the world of science and technology. There have been many attempts and many implementations of these systems can be found in the modern world closer to everyday life than you think. One such system was invented by Hideaki Tanaka that uses "a primary radar device and a secondary radar device which irradiate different types of transmission waves to each other" to detect what obstacles the waves are hitting and help the vehicle the system is attached to avoid said obstacles, which is used in crash several crash avoidance and assisted parking systems (Tanaka).

Another system used for detecting and avoiding obstacles is one created by inventor Sanjay Nichani. Nichani's system is much closer to our own system in that it uses visuals of its surroundings. The system uses multiple visual inputs to "detect an obstacle in a viewed scene … developing a 3-D reference model." (Nichani) Included in the reference model is the object with the visual detection system and any obstacles detected. The system then analyses the models for distances between all objects and plans a safe route for the object with the system.

Finally, Joseph L Jones of the IRobot Corporation developed another, similar system that he and the company applied to robots. This system uses sound waves to determine the location of any surfaces near the robot in order to keep the robot safe and the robot's surroundings safe preventing damage in places where such robots are used such as factories with important and expensive machines and workers that need to be kept safe from moving parts and robots' swinging arms.

III. Methods

A. Data

The data for this study will be gathered from the outcomes of the tests that we run with the target acquisition device. The target acquisition device is made to find the bull's eye of a dartboard that is placed on a white background. The target acquisition device is a Lego Mindstorms NXT Robot that has been modified with a webcam and a laser that places a point at the center of the webcam's image. The NXT Robot has been programmed using a combination of LabView and Matlab, using the NXT Toolkit as well as the Image Acquisition and Image Processing toolboxes. The target acquisition device must then use fine movements in order to place the bull's eye at the center of the webcam's image area. This device was used in an attempt to simulate the abilities of the human eye and to determine the position of an object based on the principles of edge and color detection.

B. Procedures

In order to determine the accuracy of our target acquisition system, we will record the number of successful identifications of the bull's eye of the dartboard. The dartboard will be mounted on a white background at a fixed height. The robot will only be required to move the camera in a horizontal direction.

The test of the target acquisition device will consist of three stages. First, the target acquisition device will be placed facing away from the bull's eye and then activated. The robot will then turn around the staging platform until it has identified the dartboard through edge detection. Once the device detects that the dartboard is fully in the frame, it will move forward to a line that has been placed at the edge of the staging platform. Once the targeting device has reached the line, it will attempt to find the bull's eye of the dartboard by making adjustments to the laser's position. The test will be considered over whenever the laser is shown to be on the bull's eye of the target, or the supervisor determines that the robot is unable to identify the target.

The robot will be completely autonomous once it is placed on the staging platform and can only be touched once the test has been completed. We have made the assumption that there will only be one bull's eye for the robot to identify, and there will be no decoy stimuli for the robot to stumble upon. We believe that this testing protocol will be effective because it involves the identification of a target that is against a background of extraneous stimuli, but not multiple targets. `

Figure 1. The mobile portion of the target acquisition system

<u>Data Analysis.</u> The data that we collect will be simply based on whether the target acquisition system was able to identify the target without human intervention in the allotted time. As each test of the system is completed, we will note whether the laser was on the bull's eye of the dartboard. If the bull's eye is correctly identified, the system will receive a positive denotation. Since we will run multiple trials of the system, we will be able to manipulate the data using several different methods. We can sort the data by the starting location of the mobile portion of the system, or by a simple comparison of the number of successes to the number of failures. This method of analysis will scale well when used in conjunction with future experiments and will allow us to compare the success rates of each iteration of the target acquisition system. For example, if we were to update the dartboard detection algorithms and perform a number of trials, we would be able to determine which version of the system was able to perform better in field testing. Although the type of data that we will be collecting is extremely limited, it will prove itself extremely versatile when conducting further experiments using this target acquisition system.

IV. Outline of the Study

In the first section, we identify the purpose of the study through an analysis of the need of the ability of sight to navigate our everyday world and introduce the possibility of an artificial device to augment or replace those abilities. We then distilled the above analysis into a research question and identified the significance of this study. Section II consists of a concise review of several United States patents that are related to target acquisition systems and obstacle detection algorithms.

Section III focuses on the design of our study, and consists of individual subsections that discuss the data, equipment, procedures, and data analysis. The first subsection of Section III covers the design of the physical environment of the study, from the arrangement of the testing arena to the programming languages used in the development of the algorithms. The "Procedures" section clearly defines a testing protocol that we feel most closely matches real-world conditions and the assumptions that we made about the physical environment. The "Data Analysis" section constructs an extensible framework that we will utilize in order to transform our simple data collection process into a series of observations that will adapt to future experiments in this study.

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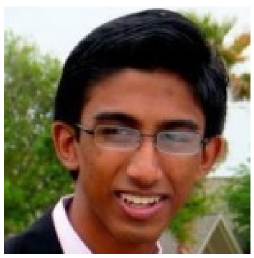

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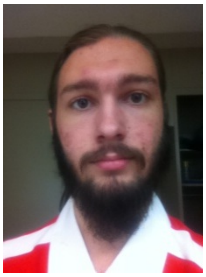

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Can a Target Acquisition System Aid Nanorobots in Curing Cancer?

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Joshua Seitz, *Mechanical Engineering, HEP, University of Houston*

I. Introduction

In the mid-eighteenth century, scientists had developed a greater understanding of the causes of death through the development of autopsies. Scientists had identified cancer as a disease, a newfound illness that ultimately leads to death. Breakthroughs in microscopic studies in the nineteenth century made clear the damage cancer brings, and cancer diagnosis became possible. Since then, people had been fighting to better comprehend this fatal disease and develop treatments for it. However, the nature of different cancer cells dependent on its location has been a stumbling block to scientists even to this day.

Perhaps the most common treatment of the lethal illness is radiation therapy. It is typically perceived as using a huge machine to concentrate the radiation on the cancer cells and kill them without affecting the surrounding organs. Such treatments are not entirely foolproof, some even as severe as causing a second cancer. The alternative to radiation therapy is chemotherapy. This type of cancer treatment involves the usage of drugs to destroy DNAs of cancer cells in order to inhibit the creation of new cancer cells. However, the side effects of chemotherapy are many. They range from pain, diarrhea, and constipation to hair loss, vomiting and even memory loss. Developments of new, safer treatment methods are vital so that patients can feel more at ease and have better chances of survival.

A. Research Question

"How can a target acquisition system aid in efficiently delivering personalized treatment to cancer cells?"

The treatment we envision comprises the usage of nanorobots programmed with target acquisition systems to locate cancer cells and administer proper and focused treatment. This method rules out many of the side effects that may happen with currently available treatment methods because it is more specific and personalized.

B. Significance

The outcome of the study will ultimately be a breakthrough in the oncological field. The new treatment will be safer and more effective. It will prove to be a whole new solution to the treatment of cancer, and might be able to treat even the worst of cancer cases. End-stage cancer will no longer be terminal because of the ability of the nanorobots to go wherever the cancer cells are, despite how widespread it may be. With further development, it could, perhaps, even facilitate the treatment of other illnesses.

II. Literature Review

The results of the research will be obtained on a scale much larger than that of microrobotics and nanorobotics. However, the literature review section will encompass the concepts involved in nanorobotics. In-depth analysis of our research question revealed three main areas worthy of discussion. These include ongoing and future research, issues with the miniaturization of robotic components, and providing the nanorobots with the ability to resist destruction by the human body's immune system. At present, a miniature target acquisition design is mostly theoretical due to multiple issues that are discussed below.

In one of the articles that we reviewed, the author discovered that "the number of nanodevices used to integrate a nanorobot should consider carefully the hardware size with regard to its applicability for operation inside the body." (Cavalcanti, 2008) The integrated circuit chips we see nowadays show the best efforts to miniaturize a very complex integrated circuit. However, to shrink a complex circuit down to nano scale requires completely different technology. As a possible solution, these complex computational circuits may be simplified so that they can be small enough for practical use in a nanorobot. As previously stated, the survivability of the nanorobots is another major issue as the human body tends to attack foreign objects. Since nanorobots are synthetically produced, they are prone to attack by the immune system. Therefore, future research can be done on the materials used to construct the nanorobots and its relevant designs to give immunity to the nanorobots.

Possible solutions for the issue above have also been found addressed in the theoretical design put forth in the article on diabetes control. The nanorobot can have "an artificial glycocalyx surface, and which minimizes adsorption and bioactivity in relation to fibrinogen as well as other blood proteins, ensuring sufficient biocompatibility to avoid immune system attack" (Cavalcanti, 2008). Additionally, there is an article detailing the advancements of a research project involving micromotors that, perhaps in the future, could power microrobots driven by a flagellum (Kleiner, 2009). Theoretical designs include capsule shaped robots with cameras at the front and the motor inside. They can possibly float through the blood stream and perform simple tasks such as emitting a chemical agent, attacking something based on their shape or chemical components and have all the potential to attack cancer in new ways (Kleiner, 2009).

Unfortunately, these robots have to be driven by an external power source, which required the development of a power pack small enough to fit into the robot. However, a battery of this size is still a long way from development, thus rendering the micromotor useless by itself. Another possible means of movement is by the use of external magnetic forces to direct the robot to the desired location (Sharma R., 2010). This method enables exterior control over the nanorobots inside of the body, thus allowing more precise motions and eliminating the need for an internal power source.

III. Research Design

A. Data

The specific components used for this research include an NXT robot, a webcam, a target with a bullseye, a laser pointing device and MATLAB. The robot was built out of the Lego Mindstorms NXT toolkit. It consisted of two drive wheels and one support wheel, which are all controlled by motors connected to an onboard computer module that holds a program written by the user. A light sensor mounted to the front of the robot gives feedback about color changes on the platform the robot moves around on. The webcam functions as to capture an image and send it to the computer for processing. It was attached onto the robot as an optical sensor. The main purpose of the webcam is to find the target, which has a yellow circle as its bullseye. After finding the target, a laser is used to point at the center of the bullseye. A program written in MATLAB uses information from the webcam and the light sensor and gives instructions to the robot. It also helps to process the image taken by the webcam.

Figure 1. This is the NXT robot that will be used to collect our data.

The data we will record include: “Did it find target?”, “Did it stop at black line?” and “Was the laser point in the bullseye?” If these three tasks can be completed smoothly, then the amount of time the robot takes to perform the entire process will be recorded. The time taken will prove the efficiency of the robot in completing the process. If the laser point does not hit the bullseye, then we will record the distance of it from the center of the bullseye. The results of this allow us to analyze the accuracy of the positioning and correct for possible misalignment.

B. Procedures

Data collection. We will run tests on this robot repeatedly in order to gain a sufficient data set. By observation, we will determine whether or not it performs the three tasks it is supposed to perform. A stopwatch will be used to time the speed at which the robot performs all three tasks. If it does not hit the bullseye, a ruler will be used to measure the distance between the laser point and the center of the bullseye. We will record the data in a table with headings that represent each task it has to perform. There will also be a final column of the table labeled “Notes” which will contain comments or anomalies that happened during the tests.

Data analysis. This section describes how you will analyze your data. Are you taking averages? Are you calculating standard deviations? Are you calculating the percentage of success? You may be doing many things. Describe them and justify your choices. We will take an average of all the times that we have recorded for each trial. The average will give us an idea of the overall efficiency of this system in practical application. We will also take an average of the distances measured to get a physical value that we can use to further enhance the accuracy of the robot. Finally, we will calculate the percentage of success of all the trials to determine whether or not the system is dependable. A trial will be considered a success if the laser point is within the bullseye. The system will be deemed dependable if the rate of success is 90%.

IV. Outline of the Study

The first chapter of the proposal will be the introduction. It includes the research question and the significance of the study. The second chapter covers the literature review. The third chapter is the research design. Within this chapter, the data, the method of data collection and the method of data analysis will be discussed.

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Laser Defense Systems: The Catalyst in Modern Defense Warfare

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I. Introduction

In this study, we are taking statistical measurements from a laser fired at a stationary target in order to measure the accuracy of a laser targeting robot. Through these measurements, we'll attempt to improve laser guided missile defense systems. Since technology is advancing in warfare, we have decided study how accurate a laser targeting robot is.

A. Research Question

How can target acquisition systems be used by laser targeting robotics to help improve laser guided missile defense systems?

B. Significance

This study will attempt to convince the U.S. military to use laser targeting robots as target acquisition in missile defense systems. Right now, there are very few missile defense systems that use target acquisition system in the military. Our research will promote laser technology in the missile defense sector by showing data that reflects the accuracy of these systems. This technology has been introduced but we aim to emphasize its practical use with the help of quantitative data and research that explains particular aspects of this technology. Hence our research can help strengthen US missile defense capabilities. The defense in this country is heavily relied on projectile missiles. If we have the missile defense system use target acquisition system, it will not only industrialize modern warfare, but it will improve the defense of the United States.

II. Literature Review

The main question we are asking comes from the increase of laser technology over the past century. Many science fiction movies have relied heavily on the idea of a laser being used for the betterment of mankind or to destroy planets. We'll provide our take of the reality of lasers in defense

A. Star Wars Meets Reality

Lasers for a long time have been a part of science fiction, but now they are a precursor to science fact. We're mainly focusing on the development and implementation of lasers in the military. These lasers have been harnessed by "using physics" (Vergano) and "the advances of technology". "Lasers are faster and more precise than bullets" and they may cost much more than a bullet, but as Tony Stark said in Iron Man, we prefer the weapon that you only have to fire once.

B. Boeing Defense Plans

High powered lasers have a practical use in missile defense systems and the following article is a concrete example of how lasers can detect and destroy missiles. This field of laser acquisition systems is very relevant to our project because we will be programming a robot to detect and shoot a laser at a generic target. The same concept is being used in the missile defense sector by Boeing, Lockheed Martin and Northrop Grumman. These companies have made the world's first laser defense system that has "engaged and destroyed an in-flight ballistic missile, and … accomplished it in the missile's boost phase of flight." The high powered chemical oxygen iodine laser system was installed on a Boeing 747-400F aircraft and it managed to successfully detect and destroy an incoming ballistic missile in less than two minutes. Thus laser acquisition systems have a big role to play in missile defense systems and this article presents a present day application of this concept. This article will help us understand and strengthen the procedure and scope of our project.

C. Northrop Grumman

Northrop Grumman has developed a laser that operates automatically and in any condition of weather. There are presently "1,300 LLDR" in Afghanistan and Iraq to this day, which means they have been under development for some time. They have also developed "many of the world's most sophisticated manned and unmanned aircraft".

D. Conclusion of Literature Review

From these articles, we can conclude that the United States has already been interested in the advancement of laser targeting defense systems. In a couple of years, we shall see grounded or in orbit satellites that will use this laser technology to improve the defense qualities of the United States from its present day structure.

III. Research Design

A. Data

The instruments we will use to perform the test of target acquisitioning systems and the improvement to laser guided missile defense systems is a LEGO: NXT Robot that will have a webcam attached to it. The LEGO: NXT Robot is what we will use to apply the laser pointer to. A dartboard will be used to test the laser accuracy. We will also be using a webcam to take pictures of the target and to help guide the NXT Robot. Matlab is another instrument that we shall use to program the robot.

B. Procedures

First, we will build a LEGO: NXT Robot using the proper procedural manual that came with the kit. Then we will attach a laser pointer to the NXT Robot. Next, we will build a structure on the robot to support a webcam that fits perfectly on top of the robot. Then, we will set up a dartboard that is color coded in order to do the next portion of our project in Matlab. We will use the colors and write a code in Matlab to determine the parameters for our code. Next we will write a code in Matlab utilizing the color codes and parameters of the entire dartboard. Next we will run the Matlab code for the robot to find and center the webcam and itself so a laser could be fired. Then, we will fire the laser at the dartboard. The Webcam will take a picture and upload it on to the screen. Then we will write a code in Matlab to determine how far from the bulls eye point the laser is. We will write down the data and record it in a journal. Next we will use Matlab to enter our data, and we will also use Matlab calculator functions and user defined functions to calculate, mean, standard deviation, and other results to determine the accuracy of targeting acquisitioning systems. We will determine if our quantitative data is sufficient so that target acquisitioning systems can be improved by laser guided missile defense systems.

Figure 1. This is the robot we will use for our project.

In our study, we will take measurements of the distance between the laser area of impact and the bull's-eye. We will conduct multiple trials and will use the sample data calculate the average distance of the laser beam from the bulls-eye. Standard deviations will also be calculated. We will also use a histogram to show the statistical measurements that were taken and then explain the results. These statistics will help portray the accuracy of target acquisition systems.

IV. Outline of the Study

The Introduction is explaining what our study is based on. The Literature Review is our research behind the actual study, and what we have found. The Research Design is how we will conduct our study and explain the itinerary of each step.

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Currently he is a full time student and the University of Houston. He is studying Biomedical Engineering. His current research interests are in prosthesis implementation and design and improving prosthesis for those returning home from war and amputees. He aspires to further his education by going to a medical school in Texas or graduate school at the University of Houston and receive a doctorate in Biomedical Engineering.

Medical Applications for Target Acquisition

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I. Introduction

Our world today has made many advances in many different fields in the past several decades; among the most important of these fields is the medical field. Within the medical field, cancer has become increasingly clearer and better understood among scientists. However, the problem remains on how to cure cancer. Since this advancement has not been reached, this project will attempt to find a way to detect abnormal cells before they have the opportunity to turn into malignant tumors or metastasize. Normally, this would be done by an MRI that takes a picture then, a doctor would have to go in and look at and interpret these images. This procedure that was described includes many possibility for human error, misinterpretation of the images or that a doctor may just not be able see that there is mass of abnormal cells. Another problem with this is that people do not usually go through with this process unless it is thought that they already have cancer or tumors or they are showing signs of having cancer.

Instead of waiting for these situations, this project is interested in finding a way to easily scan the whole body without high amounts of radiation and for the program to point out the abnormal, eliminating human error completely. This robotic procedure could be done on a regular basis to a person who has a family history of cancer or just if a doctor suspects something is not right within the body, such as a person showing signs of cancer. This issue will be accomplished by using a robot that uses visual images to locate a specific target and then uses a laser to very accurately point of the spot that was being searched for; whether a target or a mass of abnormal cells. We will build a prototype robot that uses this processing system to locate a bull's eye on a wall with other inaccurate targets included to make sure that it can locate the specific target that is being searched for.

A. Research Question

How can an image recognition system help surgeons differentiate between abnormal, possibly cancerous cells and regular cells?

B. Significance

A robot will be made and programmed to locate a target, and then pinpoint a laser at the very center of this target. This question was made with the idea that this robot could be turned into a machine that can find and locate any sort of abnormal cells masses within the human body and then pinpoint them so that human error is no longer a problem.

This study is very important and useful for the continuance of the study of cancer as it moves forward. Since the cure to cancer has not been found a way to help prevent cancer at least seems very necessary. This machine will be much more cost effect than other x-ray machines. As well as saving time since the machine will be able to locate the mass instead of a doctor having to interpret the images. The effects of radiation will also be significantly lowered so a person could undergo many more treatments without the harmful effects of radiation. Another part is that it will greatly reduce the area of human error since a machine will be reading over the images instead of human eyes.

II. Literature Review

There are numerous methods that physicians use to image cancer cells in the human body. Some methods are more useful than others are at different stages in the cancer treatment or prevention process. For example, MR and nuclear techniques, including PET, are preferred across the board in cancer assessment; however, MR techniques excel in phase screening and primary diagnosis of the tumor while nuclear techniques excel in staging, monitoring the tumor, and follow-up after treatment. Despite their differences, we can agree that all imaging techniques attempt to provide a clear, comprehensible look at the abnormal masses present in the human body in effort to provide the oncologist with the opportunity to make an accurate assessment of the mass.

"Imaging is used to assess tumour size, wall thickness, internal architecture, including septations, calcifications, cystic and solid components and papillary nodules" (Cutari 156). From these images, oncologists will identify trends in the cell masses and determine if a tumor is benign or malignant among other properties. In "Simultaneous in vivo Positron Emission Tomography and Magnetic Resonance Imaging", the researchers discovered that "the combination of PET and fMRI measurements would allow different phases of a complex pharmacological response to be interrogated" and that this "combined multimodality system produces consistent information in a real-world setting" (Catana). In a different study, a new imaging technology, "MR spectroscopic imaging (MRSI, SI) can present information in the form of metabolite maps, which represent not only simply anatomy but also local metabolic states or local tissue abnormalities" (Yang).

These two studies introduce new technologies and improvements to existing technologies to provide a better look at determining cancerous masses as well as their virility. Likewise, our robot technology will not only provide an image of the scanned area, but it will take on the job of the oncologist and interpret and identify the image for any abnormal masses. This can prove to be very useful and will eliminate human error and will make it safer for the person.

III. Research Design

A. Data

We are using a program system called MATLAB to design a program for our robot to run. MATLAB stores data from flags and image processing and sends the code to the robot. We built our robot so that it is equipped with a light sensor on the top that will tell it when to stop at the black line on the ground. Once it has done this then it will locate the target, still running the MATLAB program. Once it is ready, it will shine its laser and it will also use its webcam to take a picture of what is in front of it. This is where we will begin to collect our data. We will measure the accuracy of our laser based on how close it is to the center of the bull's eye. We will use a ruler as well as some basic geometry to find this data that we are recording.

B. Procedures

Finding the center of the bull's eye on a target is a process that the robot completes through a series of simple steps. First, the robot's work environment, all variables, and auxiliary devices are reset so that any existing values or memories do not conflict with the code to act upon old data. The camera is initialized and a test shot is taken. Then, the NXT brick is initialized. The robot will find the target by rotating in useful increments and taking a photo of whatever is in front of it and comparing it to what it knows the target is supposed to look like. Once the image meets the criteria and is in full view, the robot will cease to spin and move forward. This then calls another part that allows the light sensor to be used to detect a black line. Once the black line on the ground is in front of the target it will begin to center its camera on the target once again. Once the target is found the laser will be switched on. Since the laser is centered directly above the camera, we can assume that it will shine somewhat in the center of the camera feed. Adjustments will be made so that the laser matches with the center of the picture that the camera sees. Assuming this, the laser will be illuminated and will hopefully have a high degree of accuracy, hitting the center of the bull's eye. However, taking in account the crudeness of the robot build we will have to build in a margin of error. This will slightly alter the results and create a larger standard deviation.

Data analysis: After we have finished building and programming our robot we will proceed to testing the accuracy of our programming and robotic device. We will run our robot based on the MATLAB program that we have created, then we will measure the accuracy of our laser centered on the target. We will measure this by finding the center of the circle then comparing to wear the laser actually hit. We realized with the ruff design we had to allow for a margin or error. Once we measure the accuracy in centimeters we will repeat the experiment several times. After repeating the experiment multiple times we will then take the mean and standard deviation of our data. We are doing this because we want to see first how accurate our robot is then, we want to see what the average overall is. Then since we allowed for this margin of error we will calculate the standard deviation so we have a good idea about how much our data differs.

The measuring of our data is a very important and difficult aspect to this project. Not only does the laser have to be accurate, our measurements also have to be accurate. This was taken into consideration so, using geometry and our knowledge of finding circles we were able to accurately pinpoint the very center of our target. Then, we measured how far away from the center the laser hit. Since our robot was very crude we did not think it necessary to take in account as to what direction the laser was off so, this information will not be measured. However, if this were to be done on a larger scale we would cut down the margin of error and measure the direction and millimeters of how far the laser was off. From this information we would use standard deviation as well as direction so improvements could be made to further the project.

IV. Outline of the Study

In section I, I introduced research that had been done previously on the topic then I stated my research question and explained the significance behind the project. In section II research was done on previous experiments to gain a better background knowledge of our project that we were about to start. The articles we found we used to explain more about our project then were cited. In section III we focused on the actual design of our project and what exactly it is we would be doing, measuring and testing. Then, what it was we were actually doing with this information. In the section we first explained what our data was going to be and how we were going to obtain this data. After this was our procedure in how we were going to go about programming and running our robot on the track that was built. Then finally we explained how we were going to read and interpret this data and how this could be useful on a larger scale. Then in section IV we included a data outline of our paper as well as the references used previously in the literature review.

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The Function of Target Acquisition Systems in High Precision Surgery

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I. Introduction

Though surgery is often the best available means to treat disease, it is prone to human error. Technology is taking over several aspects of medicine. Particularly, in the field of surgery, people have just begun to see the potential benefits of the development of robotic devices and extremely complex imaging systems. Robotic devices and imaging systems can help eliminate this human error. One such type of surgery that uses technology is the field of minimally invasive surgery. Minimally invasive surgery involves procedures that avoid making large incisions. Instead, surgeons use long, complex instruments outside the body that allow them to operate on tissue within the body. In situations like these, imaging systems are needed to guide the surgeon into making the right hand movements. In other words, the surgeon that holds the laparoscopic instrument is guided through the use of cameras and a monitor. In this case, the idea of a target acquisition system to more effectively pinpoint the direction of motion would potentially allow for more successful surgeries that reduce the rate of operation deaths, ultimately eliminating them all together.

Our project aims to develop a system that can potentially recognize patters, shapes, and color at a higher precision within a reasonable time limit for when the surgeon is in the operating room.

A. Research Question

Our proposed question is: "How can a target acquisition system be applied to surgery that requires a high precision?" The study aims to explore more about the possible fusion between advancement in robotics technology and medical field. Particularly, we will study how a developed target acquisition system can be applied to surgeries that require high-precision.

B. Significance

Statistics collected from the American Cancer Society show that more than a third of the total operations on cancer patients will result in the death of the patient (Siegel, Ward, Brawley, & Jemal, 2011). Our research aims to improve this limit of surgery. Our developed system can potentially operate at a higher precision and at places where the human hand cannot reach. Combining with the recent breakthrough in color-coded tumor cells made by assistant professor Quyen Nguyen, this study can possibly eliminate the dangers of high-risk surgery and increase the success rate of previously non-operable disease (TED Talks 2011).

II. Literature Review

For a competent understanding of the application and usefulness of the research question for this study, a brief review of three areas of research is necessary. First, research pertaining to use of technology in high precision surgery is discussed, then research on target acquisition systems is considered, and finally research on the potential benefits and disadvantages of robotic surgery is examined.

The human body involves complex metabolism and close interconnected processes in which the disruption of one process can alter or damage the whole cycle of a healthy human. For many diseases, the only solution is surgery, which is the process of treating diseases from the organ level. For example, cancer is still an incurable disease in which abnormal cells divide without control and invade other tissues. Eventually, cancer cells can spread to other parts of the body through the blood and lymph systems. Most surgeries require some form of precision, which can be measured by its success rate. In our project, we plan to focus on high-precision surgeries in a particularly new form of procedures, namely, minimally invasive surgeries. Minimally invasive surgery (MIS) or laparoscopic surgery is an advanced surgical technique "that is performed with the assistance of a video (endoscopic) camera and several thin tools that resemble children's scissors attached to a long thin shaft. In laparoscopic surgery, it is important to *perform operations as quickly and accurately as possible* to alleviate injuries and increase the chance of a successful surgery" (Herring, Trejo, & Hallbeck, 2009). Thus, the short duration combined with high accuracy requirements of this procedure fits our definition as high-precision surgery. Furthermore, it is still a very new field of study, which has many potential applications. Recent studies show that minimally-invasive surgery is a procedure that is important in high precision surgery of "the temporal bone"- if heavily damaged could result in complete hearing losses (Klenzner, et al., 2008), and even cancer, particularly "malignant pleural effusions" – "common and debilitating complications of wide array of malignancies that maybe primary to the pleura or to other intra- or extra- thoracic sites" (Ciuche, Nistor, & Pantile, 2011).

Target acquisition systems, are a field of robotic imaging studies in which the developed system has the ability to recognize patterns or "to effectively detect the camouflaged target in the complex background" (Pan, Chen, Fu, Zhang, & Xu, 2011). In the process of building such a robotic system, it involves heavy coding and trials in many different cases that most resemble real life situations, and the end-application of the system. Normally, such a system is built upon the detection of colors, shape/pattern, and edges to filter out the noise from the surroundings. “Classical methods of edge detection involve convolving the image with an operator (a 2-D filter), which is constructed to be sensitive to large gradients in the image while returning values of zero in uniform regions” (Narendra & Hareesh, 2011). Not to limit its options, in a recent study by PLA University of Science and Technology, they proposed the use of 3D convexity as a detection method. “This method has shown better results than the classical edge detection method”. However, there are some limitations in their study as to how to formularize the selection of the threshold of D^2_{arg} (Pan, Chen, Fu, Zhang, & Xu, 2011). Thus, this is also a very new field of study that is under development and has many potential uses in medicine, military, and normal consumer markets.

A. Fusion of Surgery and Target Acquisition Systems-

Robotic-assisted surgery has been available for quite a few years. Minimally invasive surgeries is one of the many examples: it is a highly precise process and it requires “the use of a video (endoscopic) camera and several thin tools” to make a small incision (Herring, Trejo, & Hallbeck, 2009). In a 2009 study, an imaging robot had been introduced into the procedure of minimally invasive surgeries. “Combined fluorescence and white light imaging is desirable as the latter can offer navigational cues, while the former can provide additional functional information through auto-fluorescence” (Noonan, Elson, Mylonas, Darzi, & Yang, 2009). In other words, the use of colors will guide the robot through the maze of organs and make a successful surgery on small area of operation. This is not the only study on fluorescence and robotic surgery. In a recent Ted talk, assistant professor Quyen Nguyen introduced her research on neural tumor imaging using probes that can bind to and make the nerve tumor cell fluoresced (Nguyen, 2011). Cancer surgery involves removing all of the tumor cells from your body and spares as many healthy cells as possible (Mayo Clinic, 2011). Thus, only robotic imaging system can have a near perfect precision for minimally invasive surgeries in treating cancer. Thus, from these studies, the use of fluorescence would be a way to eliminate the “noise” from the surrounding and make the target-acquisition system more accurate in handling these cases.

As robotic surgery has grown in the medical field, there have been some highlighted benefits and disadvantages to the process. The use of surgery has been praised for its advantages in “reduced operative complications, reduced postoperative pain, and better cosmetic results compared to conventional laparoscopy” (Jung, Kim S., Kim Y., 2009). This type of surgery allows for the patient to have less post-surgery complications than the conventional route of surgery. Several studies agree with the assertion and claim that this provides even more benefits such as “less pain [and] faster dismissal” for the patient (Diego, 2011). Suregeons also believe that this provides “improved dexterity, better visualization, and high level of precision” (Hyung, 2007). However, many have also discussed the advantage with robotic surgery, with the main argument being its heavy costs. Robotic surgery is a field that results in “extremely high costs” (Hyung, 2007) in order for it to be preformed efficiently and effectively. Although the costs may be high, the benefits that be reaped from this could “partially offset” them (Diego, 2011).

III. Research Design

A. Data

The data that we will be analyzing to answer our research question will be gathered from a mobile robot with a webcam attached to it in order to acquire a target with a laser. The robot itself will be built from Lego NXT parts that will then be programmed using MATLAB. The robot will be able to move so that it can get to a set distance in front of the target. The use of MATLAB will allow us to program the robot to not only move but to also use the webcam that will be placed on it in order to acquire the target that its is seeking. Specifically, our goal is to use MATLAB to program the robot to project a beam in the red center of the bull’s eye target. Using the attached camera will allow for it to find this very target. Finally, there will be a laser placed on the robot which the robot will use to center its beam on its desired target in order to determine if it is has indeed found it. These are the instruments we plan to use to answer our research question.

B. Procedures

Data collection. The data for our study will be obtained through our robot that will seek to acquire its target. In order for us to obtain the results needed, we will be searching for three things. First, the robot must locate its target, second the robot must move towards a predetermined distance set by a line, and finally, the robot must center its laser on the target. In order for it to locate its target, we will be programming the robot to be able to spin omnidirectionally to find the target. Then, it will take a photo using the webcam and display the photo on the computer to calculate if it has reached its destination. If it has reached, it will flag that the target is there and continue. If it does not locate the target, the MATLAB code will order it to loop and search for the location again. After the robot acquires its target, it will move forward until it reads a black line that borders a board that it will be placed on. It will find the line through its light sensor that is placed on it, allowing it to distinguish the dark shade of the line from the light shade of the board. After reaching the line, it will stop in front of the target and move to the final step. The final step will be for the robot to center its laser on the target. To do so, we will program the robot to be able to move backwards from the line if needed in order to position itself and then move forward again to center the laser on the target. The robot will repeat this process until the laser is centered on the target. This will then conclude the robot’s objective.

Data Analysis. After collecting our data, we plan to analyze it through finding the optimal time for the robot to locate the target and the accuracy of the robot differentiating the correct shapes and colors. Before we discuss our analysis, we must first explain that we chose this method to obtain data because it best resembled what our research question was seeking to answer. We chose this method because incorporated both the idea of acquiring a target and processing the image in order to determine if it is in fact the correct target. Just as in high precision surgery, it demonstrates the movement of the robot and differentiates between what its desired target is. Now we will discuss how we analyze our data. We will first examine how long the robot takes to find the target, then measure each time the robot attempts to find the target. We will then see of the attempts, which will be the optimal time, which will provide a prime example of what would be beneficial to our study. Next we will analyze how accurate the robot is when differentiating between different colors and shapes. The robot will be searching for the target, which has different colors and shapes around it. We will program it to do so through two different ways, one of colors and one of shapes, and see which one provides more accurate results. This in turn will contribute to our study by seeing whether colors or shapes have an effect when trying to find an optimal target during surgery.

IV. Outline of the Study

In the first chapter, we provide the backbone to the essence of surgery and how technology and the development of nations are increasing the demand for surgery. We then proceed to introduce our specific question, its significance, and its ultimate goal. Chapter II provides a brief overview of 3 areas of surgery research. They introduce a few types of surgery that use robotic imaging systems. Chapter III outlines the data we will be analyzing and the specific components used in developing the physical project. It outlines the specific data our robot will gather and what we will do with it. In this final chapter, we will also explain how we plan to analyze it.

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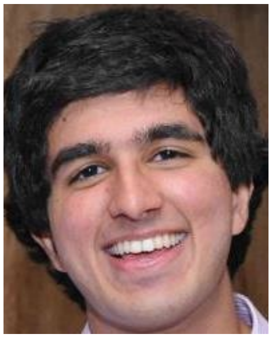

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