October 24th, 2015

Dr. Bijan Karimi

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Professor Karimi,

Attached is the proposal for our senior design project. The project will consist of a motion tracking controlled robot arm mounted on a mobile platform. The user will be able to move the platform and control the movement of the arm by moving their own arm, all while monitoring the arm through an attached camera.

This project is intended to serve as a prototype to a future device that could be used in dangerous situations, such as bomb disposal, rescue or scouting operations, or handling potentially dangerous materials. We believe that our work on this project could be beneficial to the safety of people in these situations.

Jeffery Ruocco, Jeffrey Falberg, Getro Jean-Bapiste

**Mobile Motion Tracking Robot Arm**

**Senior Design Project Proposal**

From: Jeffrey Falberg, Getro Jean-Baptiste, Jeffery Ruocco

To: Professor Bijan Karimi

October 24th, 2015

**Project Summary**

Our proposed project is a mobile motion tracking controlled robot arm. Motion tracking will be done with a Microsoft Kinect and the arm will be built from a kit and modified as needed. The user will be able to control movement of the arm in five degrees of freedom: up and down, left and right, forwards and backwards, rotating the wrist, and opening and closing of the gripper. The arm will be attached to a remote controlled platform. The platform will include a camera streaming to a remote monitor. This allows the user to control the platform while monitoring and using the arm through the camera, even if the arm is in a different room. The user can then drive to distant objects and interact with them using the robotic arm.

**Project Description**

There are many situations in which it may be necessary for a person to interact with an object, but it is not safe to do so. An example of these situations include work in bomb disposal, unsafe conditions such as extreme heat or cold, low oxygen or high pollutant environments, working with potentially dangerous materials.

Our plan to help solve this problem is a motion tracking controlled robotic arm. Our proposed project will allow a person to stand in front of a Microsoft Kinect and accurately control the robotic arm simply by moving their own arm. By using motion tracking, the user will be able to respond quickly, accurately, and appropriately. This removes a person from harm, but still allows them to use quick thinking and their expertise that may not be possible with other solutions.

Ideally, the arm would be attached to a robust platform and be capable of heavy objects at a great distance from the user. Due to cost constraints, our design will be a smaller scale model. The platform will most likely not be able to traverse rough terrain and will only be able to lift small, lightweight objects.

**Project Goals**

* Create a mobile motion tracking controlled robot arm with gripper
* Allow the user to control the arm and platform from a distance
* Create an arm that a user can control to travel to a distant location, pick up an object, and bring it back

**Literature Search**

There are several examples of a Microsoft Kinect being used to move a robot arm. The Kinect is capable of accurate skeletal tracking, and ample documentation is provided by Microsoft [4]. There are also demonstrations and source code provided for motion tracking with the Kinect and its use with robotic arms that we can reference [6]. There is further guidance and more examples provided in the references section.

**Project Design**

Motion tracking will be done with a Microsoft Kinect; it will track the user’s arm up down, left and right, forward and backwards, rotation of the wrist, and opening and closing of the hand. The Kinect will be communicate to a PC running our program made using the Microsoft Kinect SDK. The program will interpret the data from the Kinect and communicate wirelessly through an Xbee radio frequency module. The Xbee module operates on a 2.4GHz frequency to transmit data to a receiver. The Xbee receiver will communicate with a microcontroller mounted on the robot. In turn, the microcontroller will operate the required motors to move the arm in the appropriate direction, as well as move the mobile platform that the arm will be mounted to. The mobile platform will be controllable with one hand, most likely through a keyboard or controller, allowing the user to move the platform and control the arm simultaneously. A camera will be attached to the platform and will stream video to a remote monitor. The user will be able to monitor the video from the camera to operate the arm and move the platform.

Below you can see the process of communication and interfaces for the project:

**Work Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Motion tracking with Kinect | Jeff R. |  |  |  |  |  |
| Using microcontroller to control arm | Jeff F. + | Getro |  |  |  |  |
| Using Kinect to control arm |  | All |  |  |  |  |
| Wireless communication between PC and microcontroller |  |  | Jeff F. |  |  |  |
| Making the arm mobile |  |  | Getro |  |  |  |
| Fine tuning |  |  |  |  | All |  |
| Unexpected Issues |  |  |  |  | All |  |
|  | November | December | February | March | April | May |

As shown in our work plan, we intend to have a rough motion tracking controlled arm by February. By the Spring 2016 semester, our focus will be on wireless communication and making the arm mobile, as well as refining the movement and accuracy of the arm. Although specific names are assigned to each task, all members will be available to work on a task if needed.

**Cost**

Our planned design includes a Lynxmotion AL5D Robotic Arm, Lynxmotion Tri-Track Chassis kit, Xbee RF wireless communication modules and USB interface, a Microsoft Kinect, and a wireless camera kit. We estimate the cost of the project to be around $1000. Depending on our available budget, we may opt to replace the Lynxmotion Tri-Track Chassis kit with a cheaper alternative.

**Team Qualifications**

Jeff Ruocco has experience programming in C/C++, C#, and Python. He has also worked with microcontrollers and has experience soldering. He will be the primary programmer for the Kinect motion tracking, and will assist with work on the microcontrollers.

Jeff Falberg has coded in C/C++ and Python, and has also working with microcontrollers. He will work on programming the microcontroller and the communication between the Xbee wireless communication modules.

Getro Jean-Baptiste has a background in electrical engineering and a strong interest in the electrical components and hardware needed for the project. He will be responsible for building and wiring the hardware, including the arm and mobile platform, as well as power management.

**References**

[1] "Senior Design: Robotic Arm with Kinect Interface - Detailed Report (long Post)." *Ben Beignet Yeh*. 7 Dec. 2013. Web. 24 Oct. 2015.

[2] "Kinect Controls Arduino Wired Servos Using Visual Basic 2010." *Instructables.com*. Web. 24 Oct. 2015.

[3] "RobotGeek Snapper Arm Getting Started Guide." *RobotGeek Snapper Arm Getting Started Guide*. Web. 24 Oct. 2015.

[4] "Tracking Users with Kinect Skeletal Tracking." *Tracking Users with Kinect Skeletal Tracking*. Web. 24 Oct. 2015.

[5] Eisen, Jon. "Kinect Controlled Robotic Arm, A Natural Interface." *YouTube*. YouTube, 14 May 2012. Web. 24 Oct. 2015.

[6] Waldron, Rick. "JavaScript: Arduino, Kinect Controlled Robot Arm - JavaScript Robotics, Johnny-Five, Microprocessor, NodeBots, Tutorial, Web Connected Devices - Bocoup." *Bocoup*. 10 Mar. 2104. Web. 24 Oct. 2015.