Body Controlled EOD Robot

Cody Varner, Zening Wen, Yazhou Li, Sixian Zhang and Huiwen Chu

Project Mentor: Abolfazl Razi

School of Informatics, Computing and Cyber Security, Northern Arizona University

Abstract

Purpose: Recent advancements in technology has revolutionized the way we view and operate robots. For instance, robots are becoming more efficient and have replaced humans in performing dangerous activities. This development has led to a decrease of injuries and has sparked a new age of robotics.

Description: This project deals with creating a new solution to how Explosive Ordnance Disposal (EOD) operate. Specifically we want to give the user a more efficient way of operating the robot. To do this, we have come up with a solution to control the robot using the motions of the users arm.

Design

Our solution design contains three parts:

- EOD robot
- Control System
- Visualization system

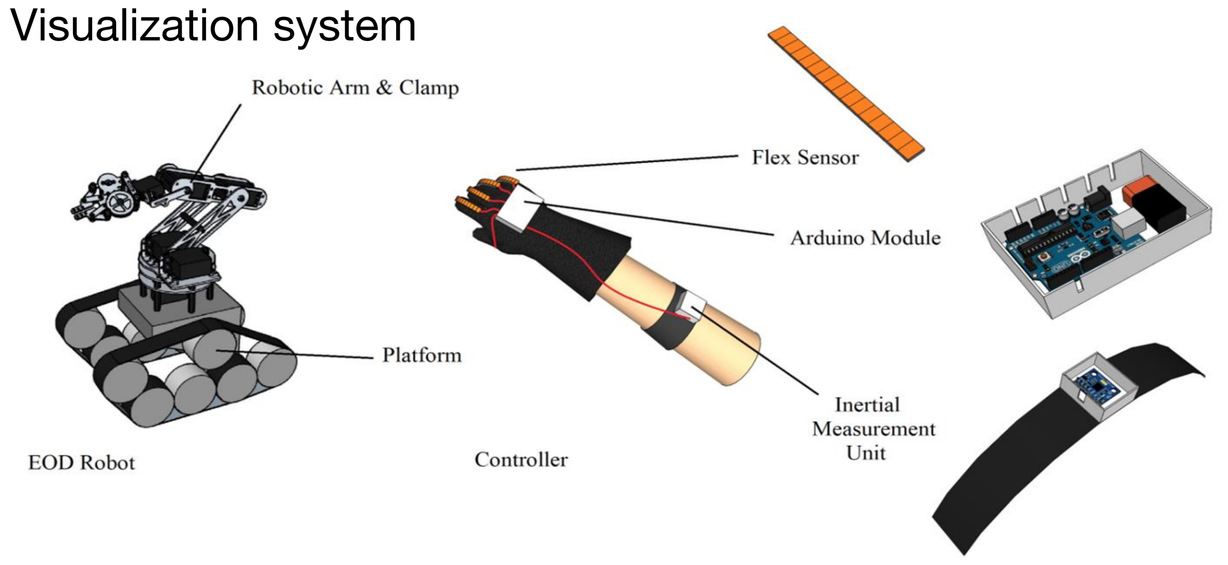

Figure 1: Design drawing of the solution

The EOD robot is equipped with a robotic arm and a mobile platform, which are controlled by the control system. The control system has a clamp controller and a arm controller.

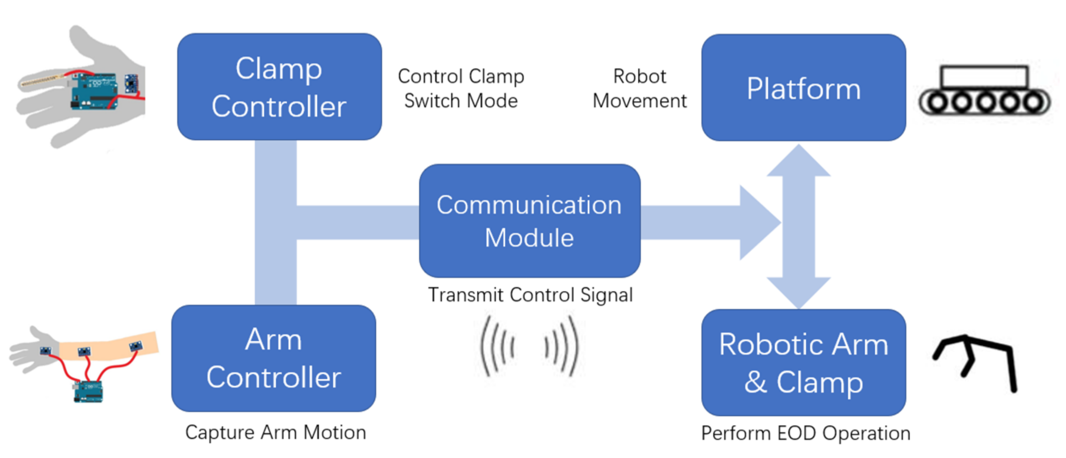

Figure 2: Communication Workflow

The control system gathers motion information of the user's arm through the motion sensors. The motion information is analyzed to recognize the user's command and is processed to control signals.

The control signal is transmitted through wireless communication module to the robot and is used to control the platform and the robotic arm separately.

EOD Robot

What is an EOD Robot?

- EOD = Explosive Ordnance Disposal
- Designed specifically to perform hazardous tasks like bomb disposal, disarming booby traps, observation of a region of space unsafe for human interaction, etc.

In this project the Explosive Ordnance Disposal Robot can be separated to platform and robot arm.

Platform: Using the climbing track, which can make the robot fit more types of landform. The two GM25-370 motors can provide stable torque (1.0kg.cm/80rpm/1.7W/0.5A) with a stable 12V power supply.

Robotic Arm: In order for our robots arm to resemble a human-like arm, our team found it best to use a 6 degree of freedom arm with a two fingered clamp as its end effector.

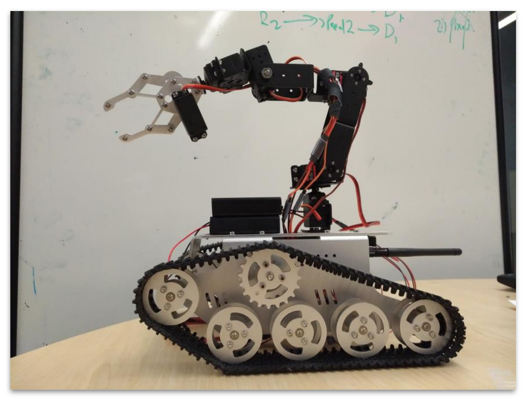

Figure 3: EOD Robot

Control System

The control system contains a glove, a wristband, and an arm band with two flex sensors, three MPU6050 motion sensors, one NRF24l01 wireless module, and an Arduino Uno attached to it.

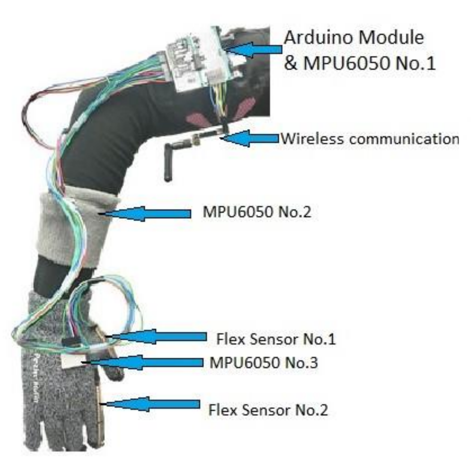

Figure 4: Control system design

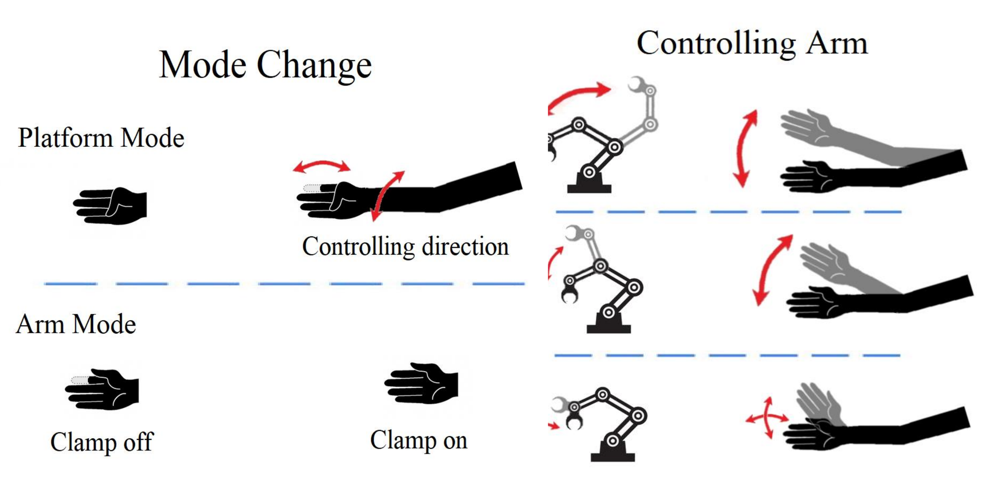

Figure 5: Controlling method

The controlling method of the system is based on mode switch. Two flex sensors attached to the thumb and the index finger are used to control the opening/closing of the clamp as well as switching modes between platform control mode and robotic arm control mode.

Three MPU6050 motion sensors are attached to the hand back, forearm, and upper arm to control the motion of the robotic arm as well as the moving direction of the platform.

Switching between modes: When the thumb is bended, the controller can only control the platform, with index finger controlling its speed and forearm turning control its direction. When the thumb is released, the controller can only control the robotic arm, with each part of the arm controlling correspondent joint on the robotic arm.

Visualization System

Visualization System is built to provide visual motions. It can be used to predict the actual motion of the robot or familiarize users with the control system.

We use Unity game engine to build our visualization system and import the 3D model built in 3ds Max. The control signal is sending through the serial port wirely. The control method used by visualization system is the same as controlling the robot.

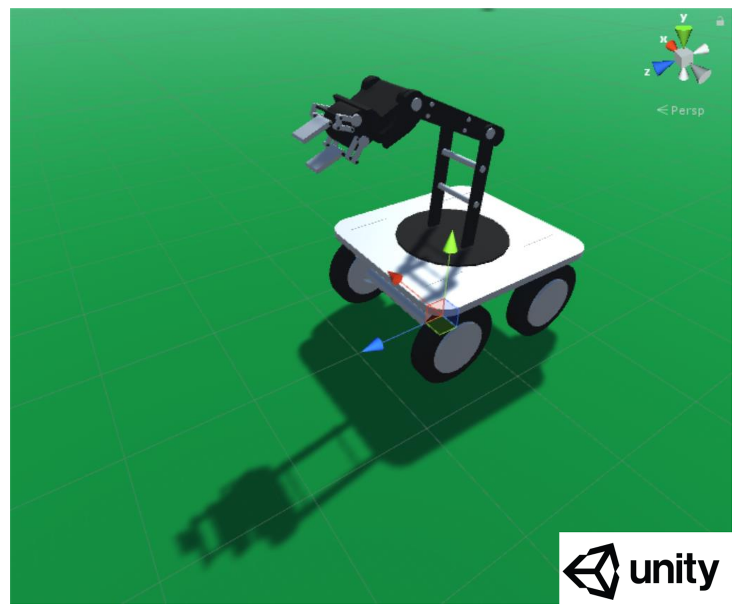

Figure 6: 3D model of robot

Application

Our design can be used as a user interface that provide intuitive control method to the robot where dangerous and accurate tasks are performed. Such as:

- Exposal Ordinance Disposal
- Dealing with dangerous chemical in laboratories
- Geological detection in dangerous area

Table of Parts

The table below shows all the parts used in this project.

Parts (EOD Robot)	Number of the parts	Parts (Controller)	Number of the parts
Clamming track platform	1	MPU6050 motion sensor	3
Motor drive controller board (L298N)	1	CD4051BE Multiplexer	1
DC motor (GM25-370)	2	Arduino Uno	1
6 DOF mechanical robotic arm kit	1	NRF24l01	2
Servo motors	6	Flex sensor	2
Arduino Mega	1	Battery box (9V)	2
Arduino Mega shield	1	Battery box (12V)	3

Table 1.Parts used in the project

References

[1]. Grimmett, R., & Caggiani, M. (2014). *Arduino robotic projects : Build awesome and complex robots with the power of Arduino (Community experience distilled).*

[2]. Langbridge, J. (2015). *Arduino sketches : Tools and techniques for programming wizardry.*

[3]. Huang, Q., Yu, Z., Zhang, W., Xu, W., & Chen, X. (2010). *Design and similarity evaluation on humanoid motion based on human motion capture. Robotica, 28(5), 737-745.*

Link to our teams website: https://www.cefns.nau.edu/capstone/projects/EE/2018/OrdnanceDisposal2/home.html

Acknowledgments

We would like to thank Dr. Razi, Dr. Winfree and the SICCS Department at Northern Arizona University for helping fund this project.