Motion-based Control System: Proof-of-Concept Implementation on Robotics via Internet-of-Things (IoT) Technologies

Déjà Tyla Jackson, Zoë Cesar, Jacob Martinez, Meng Han, and Selena He
Department of Computer Science, Kennesaw State University

Extended Abstract

The Internet of Things (IoT) is the new networking paradigm where objects can be connected to the Internet and communicate to each other. Applications of the IoT have surfaced in many aspects of our lives in items such as wearables devices, smart city, and no-cashier grocery store. The education system can take advantage of this advancing technology and integrate it into a Smart Campus and Classroom environment. In the classroom, smart devices can take over tasks such as attendance check and PowerPoint slide control. Hence, we propose to take advantage of motion sensors to implement a gesture recognition system that could command a robot to perform an action. If the proof-of-concept implementation is successful, we can apply the motion-based control system to the Smart Classroom project, having the robot control items such as slides, computer systems, projectors, and lights in the classroom.

Gesture recognition is the mathematical interpretation of motions performed by a human and interpret by a computing device. Many previous projects use cameras to view the subject's gestures and be able to recognize that gesture, these projects are known as image-based systems. For non-imaged based systems, there are three main implementations methods for implementing a gesture recognition system. These methods include a glove-based, band-based, or non-wearable systems. While most existing projects have implemented gesture recognition through the use of camera systems, this project combines accelerometer, gyroscope, flex sensor data and machine learning algorithms to recognize gestures. Figure 1 illustrates the major components in our project, how those components send and receive data, and where those components are located within the communication chain. In our implementation, the Intel cruise motion sensors will provide raw movement data to the connected Arduino board (shown in Figure 2). This Arduino system will then process this data into a recognized gesture represented as an enumerated value. Once the Arduino has identified a valid gesture, it will send the corresponding value to the cloud server. The cloud server will log the incoming value with a timestamp and forward the data to the Raspberry Pi. The Raspberry Pi will, upon receiving the enumerated value, execute the corresponding action by controlling the output of the motors. We have created an Arduino Sketch that captures the X, Y and Z coordinates data from the sensing system and sends the collected data to an excel spreadsheet using PLX-DAQ and have begun to train the data. Figure 4 illustrates the data analysis for a Circle Gesture. The gesture unique ID will be stored in the cloud server with correspond timestamp. Python scripts are implemented to control the Raspberry Pi built robot (Shown in Figure 3) according to the retrieved gestures.

Figure 1: System Architecture

Figure 2: Sensing System

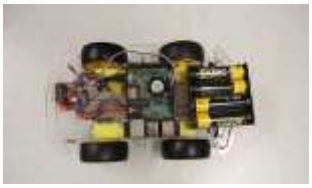

Figure 3: Robot

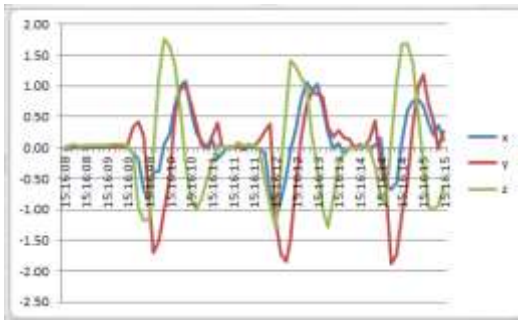

Figure 4: Circle Gesture Data