Mobile Robotic Arm Controlled Via Web Server

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ELEC 5530 Project Type 3

I. Overview

The goal of this project is to design and create a miniature mobile robotic arm. Initially, user control was going to be enabled through the usage of a Playstation 4 controller connected wirelessly via Bluetooth to a Raspberry Pi or equivalent microcomputer. However, upon further research, the ESP32 SoC could easily make use of WiFi communication standards by hosting its own web server. Using a computer or smartphone, the user can control the robot by writing data to the server. A popular phone app called RoboWifi provides the user a graphical interface that takes the inputs and communicates with the server. The arm itself has four degrees of freedom and is based off the EEZYbotARM by daGHIZmo and is designed to be driven by MG90S servos. A mobile platform that has two continuous servos acting as wheels has been retrofitted for the arm assembly. The robot is controlled completely wirelessly and is powered by an onboard regulated 7.2V battery.

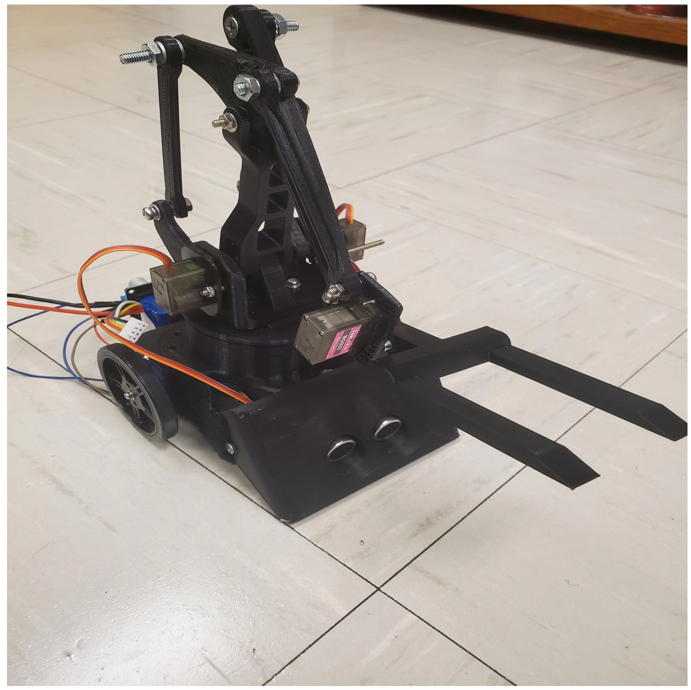

Fig. 1. Final Mobile Robot Assembly

II. Robotic Arm

Mentioned previously, the arm design is borrowed from the EEZYbotARM project by daGHIZmo. Instead of using the already designed claw grabber, a fork was modeled and 3D printed. The fork is attached to a servo so that it can rotate and angle payloads for better handling. Due to the limited access to Metric screw sizes, various random screws and nuts were used to construct the robot. This, along with too small of tolerances lead to some mechanical issues to overcome. The biggest issue being linkage screws impacting other linkages and limiting rotation. To fix this, the parts had to be drilled or cut out so that the over reaching bolts can pass through without resistance. The other big issue at hand was that, due to the 3D printing process, the areas where the servo armatures contact the prints were not big enough and had to be filed down.

III. Mobile Platform

In 2018, SPaRC(Student Project and Research Committee) held a sumo-bot competition. The base of one of these robots has been retrofitted for usage of stabilizing a robotic arm. Two continuous servos are configured in differential drive format to move the platform. Additionally, the platform is fitted with line sensors and an ultrasonic range finder which can be implemented in further improvements. Due to its small size, the battery and regulator are situated on the back of the platform. This grants ease of access and quick battery disconnect when needed.

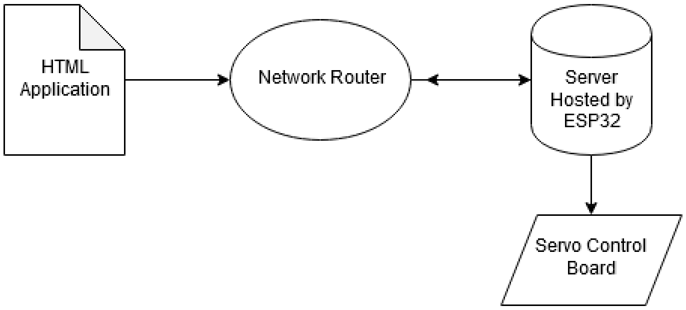

Fig. 2. Control Diagram

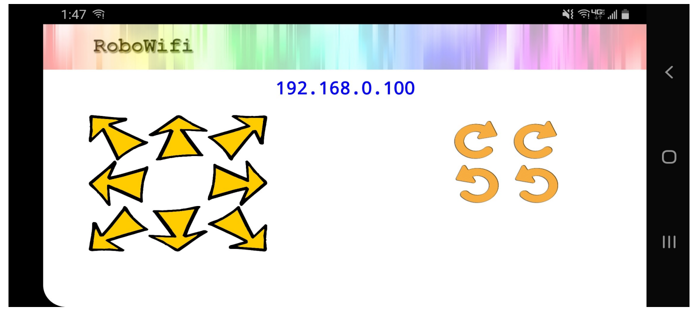

Fig. 3. RoboWifi Interface

IV. Power

To drive the servos and power the microcontroller, a 7.2V Nickel Metal Hydride battery is regulated by a Drok step down buck converter. The battery was a random spare but it is labeled with 80C and 450mAh ratings. During maximum load the servos can pull as much as 1.5 Amps: this typically happens in very short bursts. The battery was loaned by the RC Hobbyist club which explains the high C rating since drones use short bursts quite frequently during flight. The battery is large enough that no issues with longevity have occurred during use.

V. Control

Conducting research into hobbyist wireless communication hardware, the ESP32 SoC proved to be the cheapest, and most powerful chip that would allow for anyone connected to the same network to control the robot. The ESP32 can host its own web server on chip and can connect wirelessly to a network access point such as a router. Using standard HTTP requests, an app or web page can be used to send commands to the server which then get interpreted as servo commands. Figure 2 shows an overview of the control logic. An app called RoboWifi is used for this particular implementation. Figure 4 shows this interface. Each of the buttons correspond to the movement of a particular servo or a combination of movements for the differential drive.

VI. Challenges

After all the mechanical issues were filed or drilled away, the remaining problems lie with the servos. Jitter, or rapid small movements, occurs in the servo responsible for rotating the base. Velcro was applied at the joints to act as a mechanical dampener. This seems to have reduced the jitter intensity but it is sometimes still present. There are several components that could be responsible. The servos themselves are cheap knockoffs and the quality is questionable. The software libraries used have been reported to not be the best solution for reliable servo control as well. Lastly, the regulated supply might be noisy but this is unlikely.

Fig. 4. Noah Niedzwiecki

VII. Bibliography

I'm Noah Niedzwiecki and I am a senior in Computer Engineering at Auburn University. During my time at Auburn I worked for Dr. Hamilton as a Undergraduate Research Assistant as well as held several officer positions in SPaRC. After graduation I will work for Ciena in Atlanta developing network hardware and software solutions.