

Smart Phone Controlled Robot

Griffin Beck

Mentor: Dr. Kim Pierson | Department of Physics & Astronomy, UW-Eau Claire



University of Wisconsin
Eau Claire

INTRODUCTION

Robots with advanced capabilities are currently controlled almost exclusively by specialized expensive hardware and sophisticated programs. Smaller simpler system can use inexpensive “instances” of this hardware such as the widely used open-source Arduino or Raspberry Pi, but these systems offer limited capabilities and no long range communication. This project explored using the computational power and long-range communication capabilities of widely available smart phones

PURPOSE

The purpose of this project is to use a smart phone to remotely control a robot. A set of specialized communication and control programs called “Apps” can be developed and downloaded to a smart phone that is connected to the robot. Using a smart phone as the control system of the robot, allows for access to powerful and flexible hardware at a lower cost. The flexibility of the phone’s hardware allows it to be used for remote control over the internet using built in Wi-Fi and Cellular antennas. A smart phone also offers access to a variety of sensors such as gyroscopes and cameras. These sensors can be utilized not only to monitor the robot remotely, but with the powerful processing power of the smart phone, they could be utilized for autonomous control. The combination of the size of a smart phone and its flexibility, could be used to develop a modular system to connect to robots and allow different robots to be controlled simply by plugging the phone in.

HARDWARE SYSTEM DESIGN

The hardware used for testing the developed Apps, includes an Arduino, and a Galaxy S7 smart phone. The Arduino uses serial over USB to communicate with the Smart phone. This serial connection is used for transmitting commands to the Arduino. The Arduino’s purpose is to determine what hardware needs to be controlled, based on the commands sent over the serial connection. The Arduino in the test robot communicates using the I2C bus to control the motors based on the commands received from the phone.

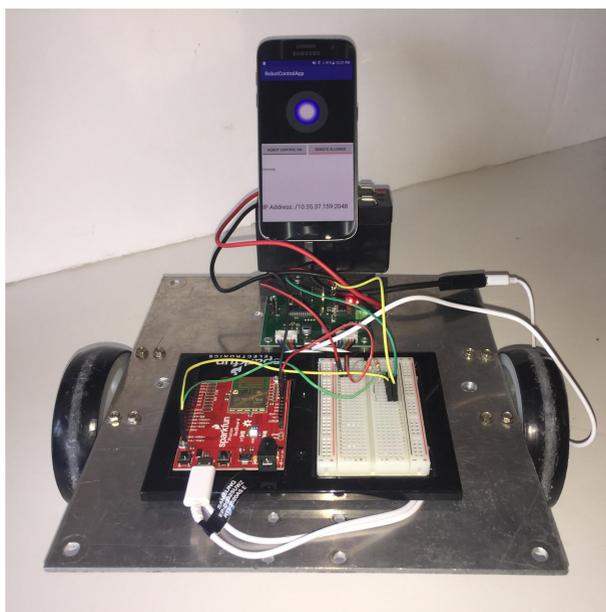


Figure 1: Smart Phone Controlled Robot

SOFTWARE SYSTEM DESIGN

The App is currently split into three parts and “threads”. The three threads are, the Remote Control thread that handles the remote connection and control, the User Interface (UI) thread that handles local control and robot control data, and the Serial thread that handles connection and transferring data to Arduino.

The UI thread handles the updating and changing of the App’s UI. It also handles the enabling and disabling of the other two threads. The final purpose of the thread is to handle the transfer and holding of data for other threads to use. It does this by having a “class” which accepts and sends data to other threads using “handlers” which are designed for sending data across threads. This data includes accepting new commands and data, and sending that information or holding it for the thread that needs it.

The Serial Thread uses a “handler” to accept new commands from the UI thread. It then converts the command and data into values that are within the limits expected for a given command. This conversion is usually converting percentage values for drive control from doubles to integers and then converted to bytes and written to serial using the USBSerial library.

The final thread is the Remote Control thread which uses TCP sockets to allow other applications to connect directly to the app. Once the connection is established the remote application uses a stream of bytes to constantly update aspects of the robot based on the controls of the remote application.

CONCLUSION

With this app, robots can now be controlled from far greater distances by using any available internet connection. Furthermore, This app also allows for different robots to be easily controlled and switched between, since the app’s communication to the robot is not restricted to specific hardware.

FUTURE IMPROVEMENTS

- Adjust remote control to be over internet for control at much greater ranges.
- Modularity to allow easy and quick switching between robot types.
- Autonomous Control using AR (Augmented Reality) technology.

ACKNOWLEDGEMENTS

- UW-Eau Claire Blugold Fellowship Program
- Department of Physics & Astronomy

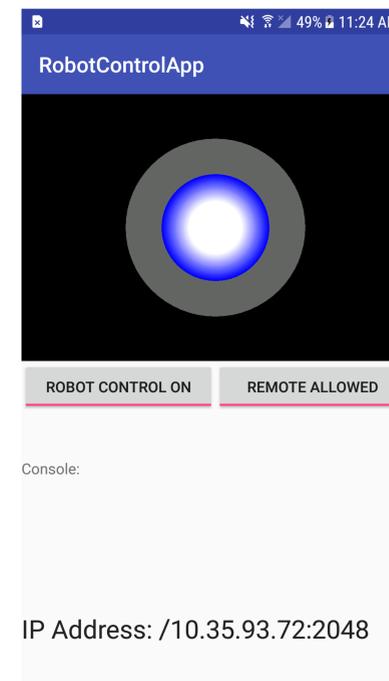


Figure 2: App used to Control Robot
The App UI has several components, the first is the joystick which can be moved to drive the robot. The second part is the control buttons. These buttons allow serial communication as well as remote control to be toggled on and off. The last piece is the information section which has console that displays debug info from the Arduino. There is also the IP address section which displays the IP address to use for connecting from a remote application