ECE 435: Introduction to Smart Devices

Midterm Project Proposal

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Honor Code:

I have neither given nor received unauthorized assistance on this graded report.

X____Michael Bowyer_____________

1. Statement of the Problem

The problem which will attempted to be solved is the inconvenience of controlling an remote control(RC) devices such as RC cars and quad-copters. There are already solutions on the market which allow users to interface with RC cars or devices, but the interfaces which are available fail in either 1 of 2 ways.

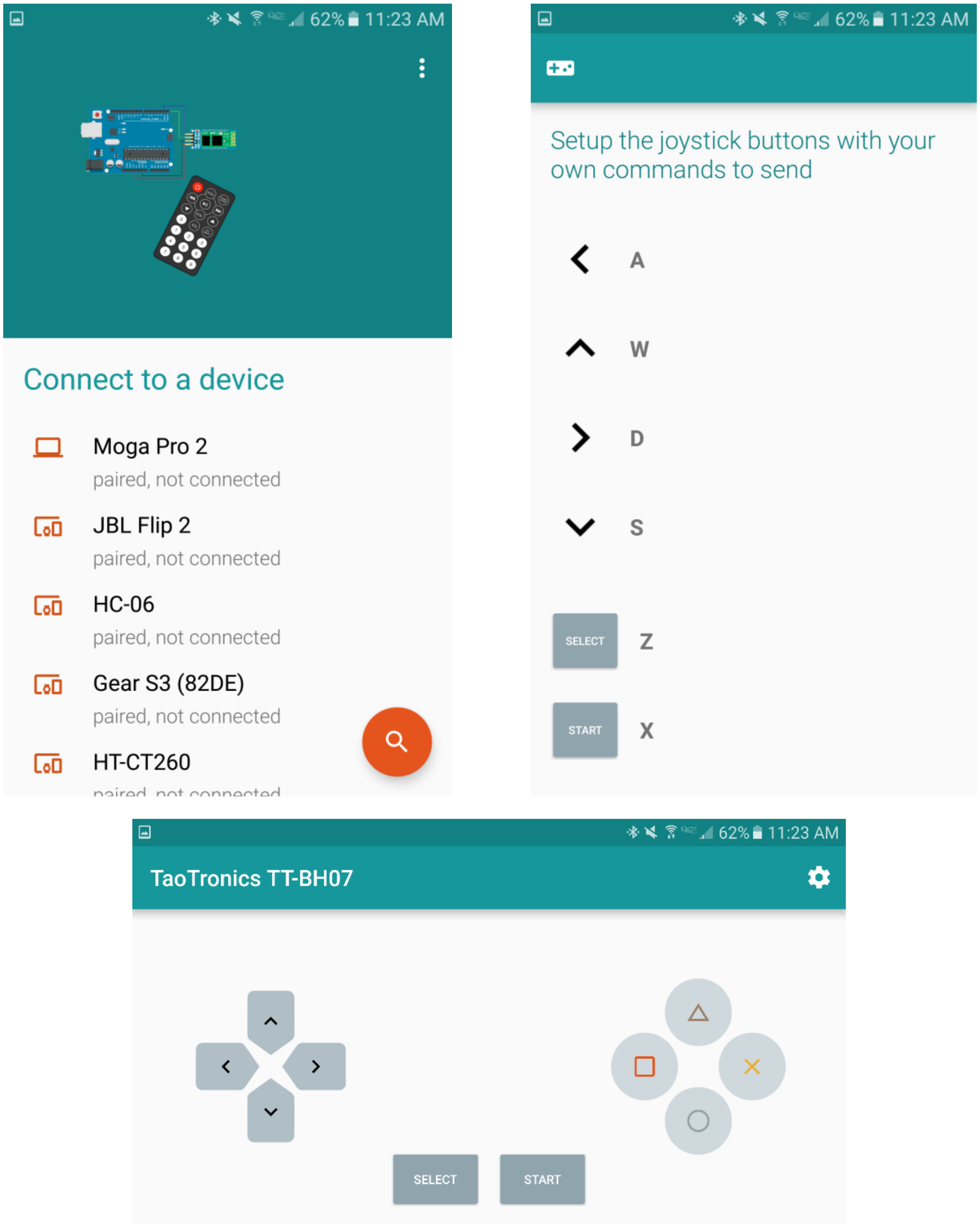
The first way the current solutions fail is cost, complexity, and inflexible. These solutions offer complicated and expensive methods of control making it difficult to learn the controls, and different to afford them, and therefore making prototyping difficult. These solutions also use non-popular communication methods which requires specific hardware and communication techniques. These solutions typically come with proprietary software interfaces which make changing controls difficult if not impossible for users.

The second way current solutions fail is simplicity. These solutions are typically cheap and easy to use for users. They typically use popular communication methods such as Bluetooth. But these solutions lack the ability to offer complexity to users. These solutions are composed of basic features which allow users to interface with, but only in a basic manner and because of this simplicity it makes them relatively flexible. Meaning users can flexible change the communication interface between the solution and the users device. But this also means more complicated concepts such as roll, pitch, and yaw are not available for these solutions.

The problem is concretely put as the lack of a solution which users can interface with easily, flexibly, which also provides solutions for complicated ideas such as roll, pitch, and yaw.

2. Market Research

There are plenty of apps on the google play store which represent the simple Bluetooth control. The most downloaded, best rated, and most useful which can be found is the Arduino Bluetooth controller app. This app is shown in figure 1. The app is very easy to use, as it allows users to select the Bluetooth device which they would like to communicate with, and then use the controller to interact with their remote device. The controller interface consists of numerous buttons, all of which can be flexibly customized to send strings of data over Bluetooth when pressed. This give users flexibility when developing their remote control device. But it also limits the user in the fact that their device can only be controlled view buttons, not joysticks or sensors.



Connect to a device

Moga Pro 2
paired, not connected

JBL Flip 2
paired, not connected

HC-06
paired, not connected

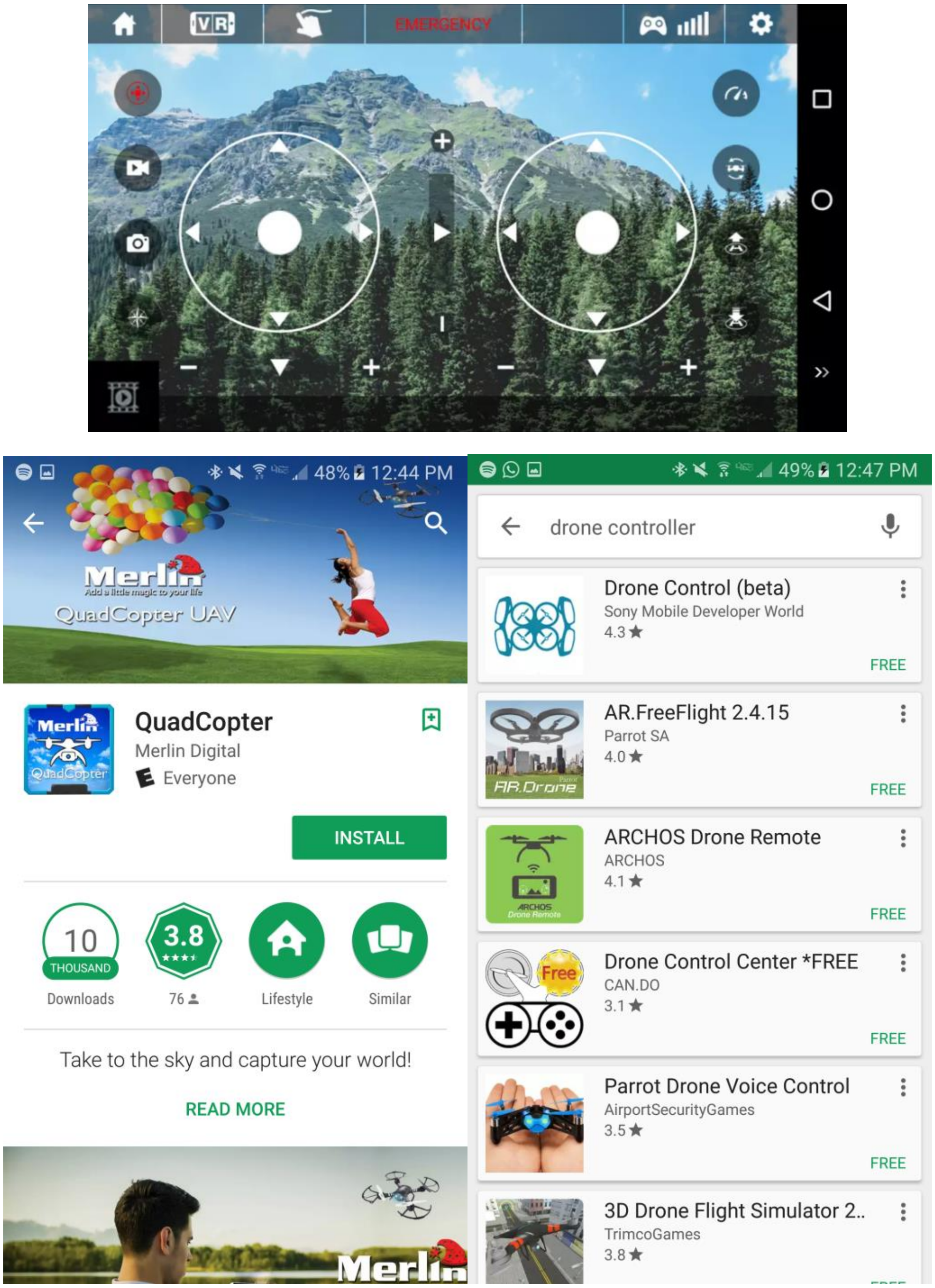
Gear S3 (82DE)
paired, not connected

HT-CT260
paired, not connected

Setup the joystick buttons with your own commands to send

Figure 1: Arduino Bluetooth Controller Screen Shots

The more advanced apps which can control remote devices using things like joysticks, Gyroscope, and Inertial Measurement units typically require a specific hardware device. Some examples of this can be seen in figure 2. The first image of the figure shows a screen shot from an app called Quadcopter, which allows a user to control a Merlin quad copter using an on screen joystick or a mobile devices gyroscope. Meaning it is possible to control only Merlin Manufactured Quad copters, and no other quad copters. There are many apps just like this one, which relate the app to a specific quadcopter or remote controller car. This makes it impossible for users to control a device they have made using these apps.



48% 12:44 PM

Merlin
Add a little magic to your life
QuadCopter UAV

QuadCopter
Merlin Digital
Everyone

10 THOUSAND	3.8		
Downloads	76	Lifestyle	Similar

Take to the sky and capture your world!

49% 12:47 PM

drone controller

Drone Control (beta)
Sony Mobile Developer World
4.3 ★
FREE

AR.FreeFlight 2.4.15
Parrot SA
4.0 ★
FREE

ARCHOS Drone Remote
ARCHOS
4.1 ★
FREE

Drone Control Center *FREE
CAN.DO
3.1 ★
FREE

Parrot Drone Voice Control
AirportSecurityGames
3.5 ★
FREE

3D Drone Flight Simulator 2..
TrimcoGames
3.8 ★

Figure 2: Advanced Remote Control Device Apps

3. Proposed Solution and Requirements

The proposed solution to this problem is an app which has flexibility of sending information from sensor data over Bluetooth. This means that users can access various sensors from their device, such as a gyroscope, or a joystick on the device, and communicate the sensor data to their device over the popular communication method of Bluetooth.

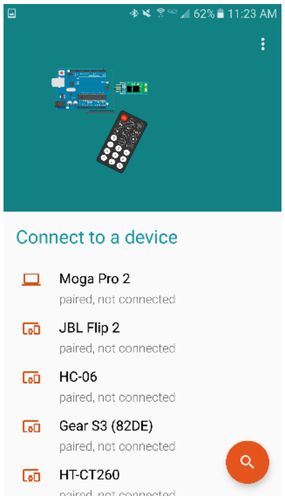
The proposed solution will allow users to connect to their remote controllable device with any smart phone or tablet via Bluetooth, and flexibly control the device via customizable communication strings. The app will allow users to customize what strings of data are sent via Bluetooth to their remote controllable device. This means that sensor data such as gyroscope data, accelerometer data, joystick data all can be sent to the remote control device in any format which the user would like!

This solution overcomes both downfalls of the current solutions on the market. It overcomes the downfalls of the more advanced solutions due to the fact that it will be capable of flexible communication with a large range of hardware. While still at the same time providing the advanced features which these apps provide. It will also overcome the downfalls of the simpler solutions available by adding in the more complicated features which the advanced solutions due offer. While at the same time still offering what the simpler apps have down such as flexibility and user interface with a large range of hardware devices.

The app also allows anyone to easily interface with a mobile device. Instead of needing a specific controller to control the remote device, they can use any mobile device. This makes replacement easy, it makes deplorability of devices easier, and allows users to get more advanced features which basic controllers do not have built in such as customization.

4. User Interface

The app interface will be similar to the app presented earlier, the Arduino Bluetooth Controller. The home screen of the app will have a list of Bluetooth devices which are available to communicate with. An example of this is shown in figure 3.



Connect to a device

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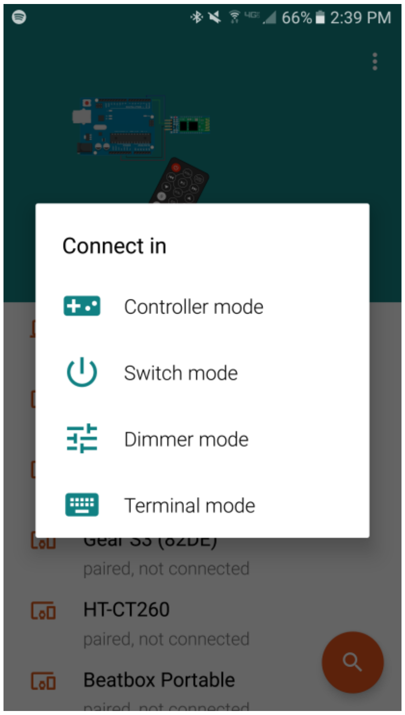
HT-CT260
paired, not connected

Figure 3: Example Homescreen of the proposed solution

Once a user selects which device they want to connect to and communicate with they will then select which mode they would like to control the device with. An example of this selection menu will look like the one in Figure 4, which is a screen shot from the Arduino Bluetooth Controller App. Except with the main difference being that the modes will be Joystick Mode, Gyroscope/Accelerometer Mode, and mode Tank/Tread Mode



Gear S3 (82DE)
paired, not connected

HT-CT260
paired, not connected

Beatbox Portable
paired, not connected

Figure 4: Example Mode Control Selection of propose solution

Once a mode is selected, the app will take the user to the mode control screen which they have selected. The Joystick Mode will have an onscreen joystick which allows users to control the device based on the position of the joystick on the screen. An example of the Joystick user interface is shown in figure 5. The Gyroscope/Accelerometer Mode will allow a user to control their device based off of the special orientation of the mobile device in space, much like how mobile racing games work. A representation of this action can be seen in figure 6. The Tank mode control will allow users to use two separate seek bars to control the device as if there are two tank treads moving at different speeds. A representation of the user interface of the tank drive can be seen in figure 7.

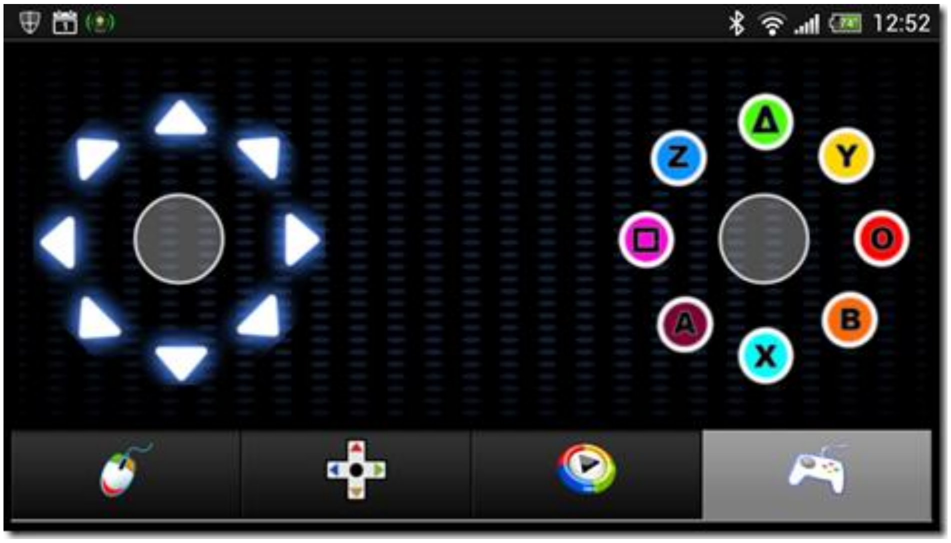


Figure 5: Example of Joystick Mode Control user Interface

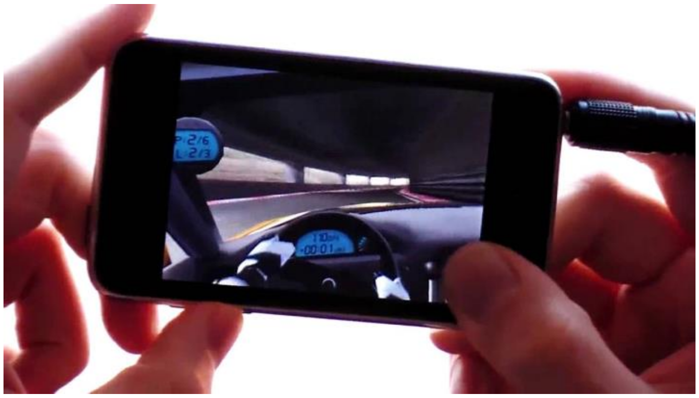


Figure 6: Example of Joystick Mode Control user Interface

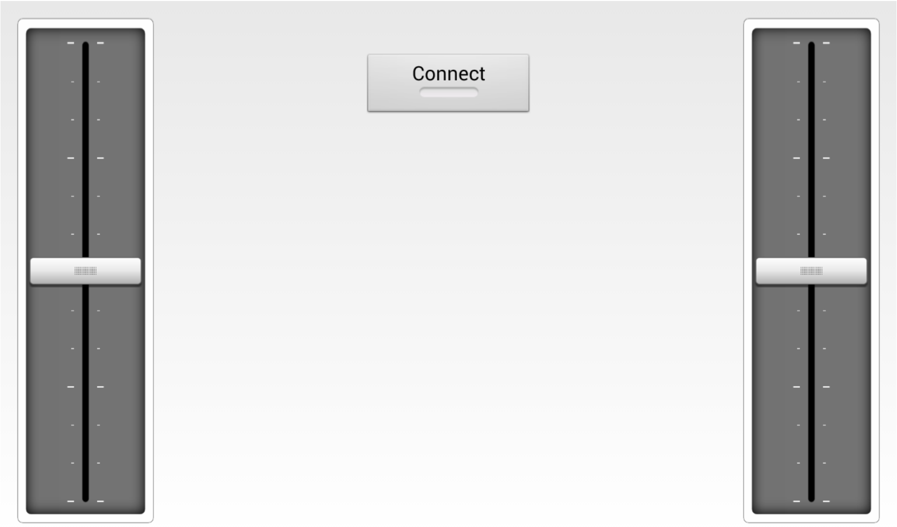


Figure 7: Example of Joystick Mode Control user Interface

Once the user is in the mode control screen which they have selected there will be a settings option on each mode control. When selected the user will be taken to a new screen which allows the user to customize the data sent in this mode. An example of the type of user interface will see can be seen in figure 8. This figure shows what value to send when the button is pressed. The proposed app will have a customizable way to send headers along with the data returned by the control mode. For example, the joystick control mode will return a position of the joystick. This app will allow the user to customize the data being sent to their device by including things such as headers.

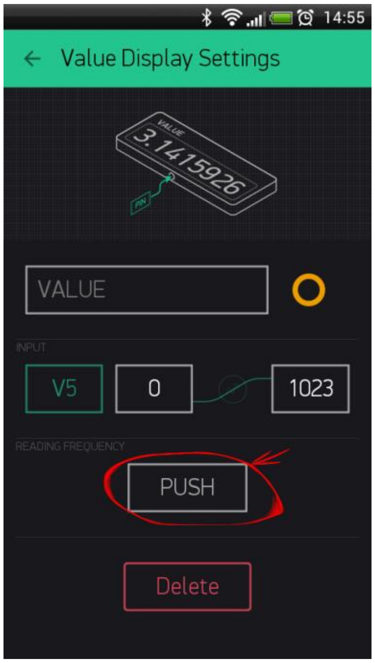


Figure 8: Example of Joystick Mode Control user Interface

5. Technical Specifications

The following classes will need to be used in order for this app to communicate with a remote control device via Bluetooth.

- **Bluetooth Manager** – to manage the Bluetooth communication.
- **Bluetooth Device** – to manage and communicate with the device which the user would like to communicate with and control.
- **Bluetooth Socket** – handle to communicate with the Bluetooth device

The following classes will be needed to manage and interpret sensor data such as touch screen, Accelerometer, and Gyroscope.

- **SensorManager -** allows the app to gain access and use the various sensors within the device.
- **SensorEventListener -** Used for receiving notifications from the SensorManager when there is new sensor data.
- **SensorEvent -** This class represents a Sensor event and holds information such as the sensor's type, the time-stamp, accuracy and of course the sensor's data.

6. Testing

Benchmark	Testable Item
List of Bluetooth Devices	The app should be able to display a list of all of the available Bluetooth devices connected to the device.
Pop-up window of Mode Control	Once a list from the Bluetooth device is selected then a pop-up which allows the user to select which mode control they want to use.
Selection & Transition of Mode control	Ensure that when the mode control selected takes the user to the proper mode control intent.
Bluetooth Communication	Communicate with and send arbitrary strings to an external bluetooth device.
Tank Mode Control	Collect and print data from both seek bars in the tank mode control.
Joystick Mode Control	Collect and print data from joystick mode control.
Gyroscopic/Accelerometer Control	Collect and print data from accelerometer and gyroscope.
Tank Mode Control Communication	Collect and send data from joystick control to an external Bluetooth device.
Joystick Mode Control Communication	
Gyroscopic/Accelerometer Control Communication	Collect and send data Gyroscopic/Accelerometer to an external Bluetooth device.

7. Tutorial

I plan to create a tutorial which will allow students to access sensor data from their devices, and then transmit that data via Bluetooth communication.

8. Link to Prezi

http://prezi.com/kczpz8kzv0gi/?utm_campaign=share&utm_medium=copy