ENGINEERING DESIGN PROCESS

Prepared By

Habilou Sanwidi
hss67466@uga.edu

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Prototype delivery Plan

From our previous document, Engineering Design Process, the following components were required for the success of this project–

- *Arduino Uno Rev 3*
- *Reversible 12V Motor*
- *Push Pull 12V Solenoid*
- *HC-05 Bluetooth module*
- *24 V DC Power Supply (Solenoid + Motor)*
- *24V to 12V – 5V step down converter*
- *Dual and Single Relay Modules (One of Each)*
- *USB 2.0 Cable (to program Arduino)*
- *Door Closer*
- *Holding Pieces (to be Built)*
- *Jumper Wires*

However, during the implementation stage, some problems have been encountered and in order to overcome them, certain changes must be made. The first one is regarding the controller. Instead of an Arduino, we'll be using a Raspberry Pi. The reason is because Arduinos do not support multithreading, which is an ability identified during implementation. Using a Raspberry Pi will offer more functionalities and computing power. Another change is the use of a key. This change must be made to compensate for the fact that certain phones do not allow automatic detection or connection via Bluetooth. This key will be a Raspberry Pi Zero.

After changes, we plan to have the following components in our prototype–

- *1 – Raspberry Pi Zero*
- *1 – Raspberry Pi 3*
- *1– Reversible 12V Motor*
- *1 – Push Pull 12V Solenoid*
- *1 – JuiceBox*
- *1 – Li-on Battery*
- *1– 24 V DC Power Supply (Solenoid + Motor)*

- *1 – 24V to 12V – 5V step down converter*
- *1 – Single Relay Module (Relay 2)*
- *1 – Double Relay Module (Relay 1)*
- *1 – Door Closer*
- *1 – Holding Pieces (to be Built)*
- *Jumper Wires*

Raspberry Pi 3

Raspberry Pi Zero W

JuiceBox Zero

Relay Module

Solenoid

Door Closer

Power Supply

Gear Motor

Step-Down Converter

SD Card

Li-on Battery

Connections

Relay 1 (Single Channel Module)

Supply 5V to Relay 1. Connect one wire from the solenoid to the NC pin (Normally Close) of Relay 1 and the other to the a GND pin of the power supply. The COM pin will be connected to the power supply (12V output). The IN pin connects to GPIO 17 (Raspberry Pi 3).
At normal state, the plunger is pushed out by a spring into the frame piece which means that the door is locked. To unlock it, the Raspberry Pi 3 will output some voltage through GPIO 2, which will alter the position of the switch inside the relay to allow current to flow through the NC pin which will retract the plunger.

Relay 2 (Dual Channel Module)

In order to be able to reverse the direction of the motor, a dual channel relay is necessary. Supply 5V to Relay 2. Connect Both wires of the motor to the COM pins (Common) of Relay 2. Supply 12V to both NO pins (Normally Open) of Relay 2. IN1 and IN2 will respectively connect to GPIO 27 and GPIO 22 of the Raspberry Pi 3. The same logic is applied here. When there is no voltage at IN1 (pin 10) and IN2 (pin 11), the motor is not moving. When IN1 is HIGH (Voltage) and IN2 LOW (No Voltage), the motor will spend in one direction and the other direction when IN1 and IN2 interchange values. The rotation of the motor causes the door to either open or close.
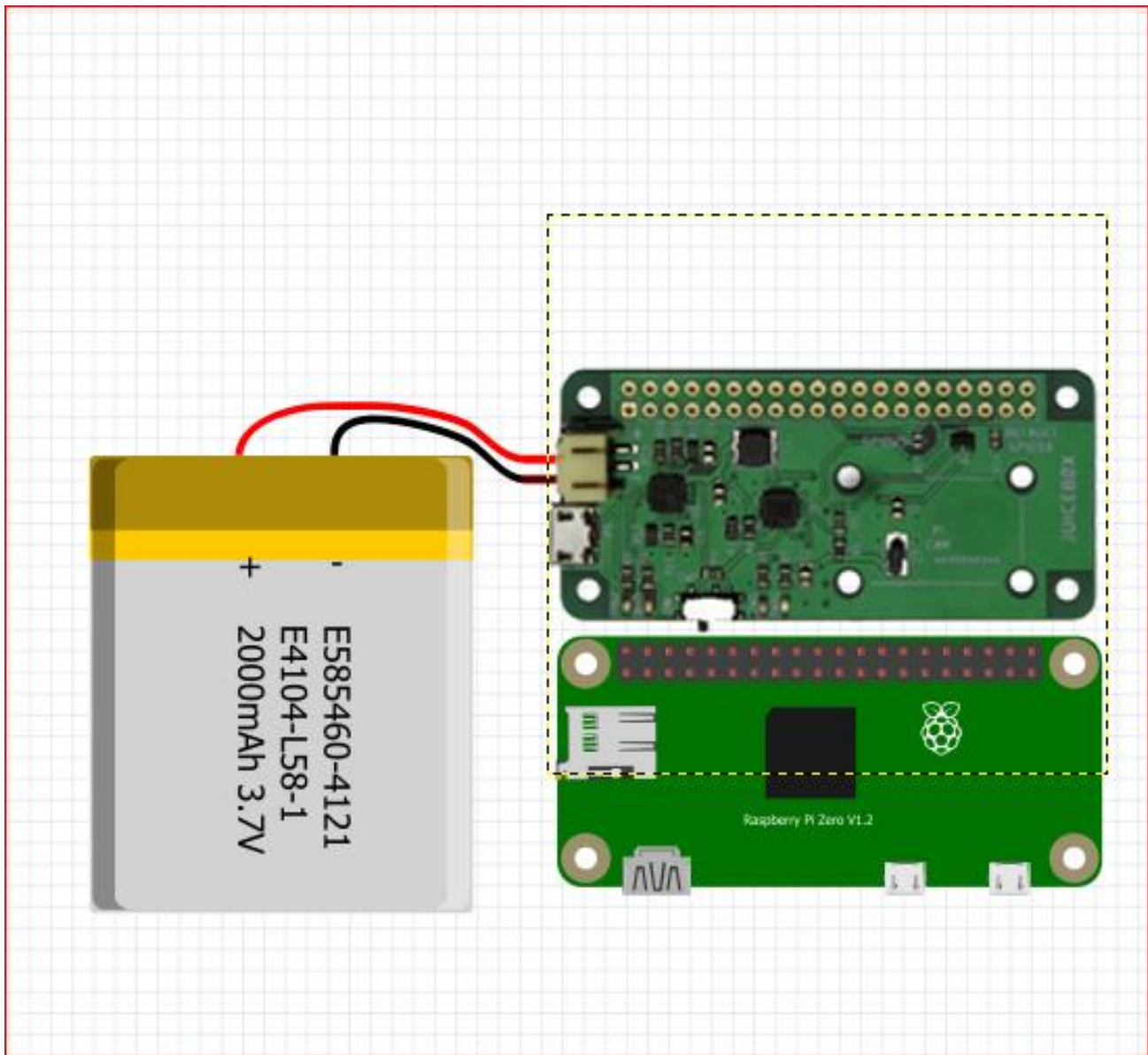
Raspberry Pis (RPI)

Both RPIs will be supplied with 5V. For the RPI Zero, we'll use the JuiceBox Zero, a battery management board that renders our key mobile. Another advantage of this board is that it can charge the battery that will be used to power the RPI Zero.
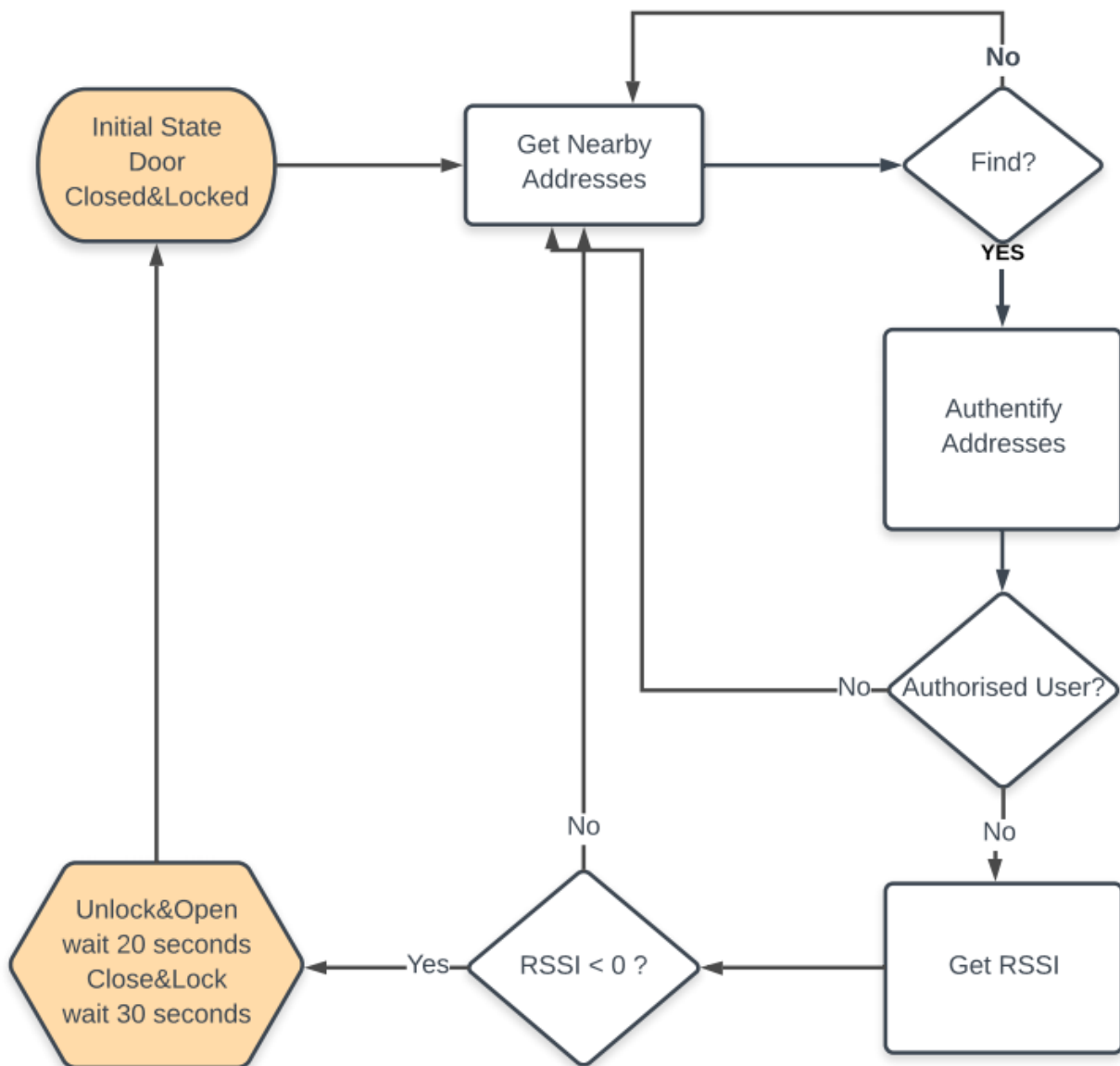
Breadboard

Raspberry Pi 3
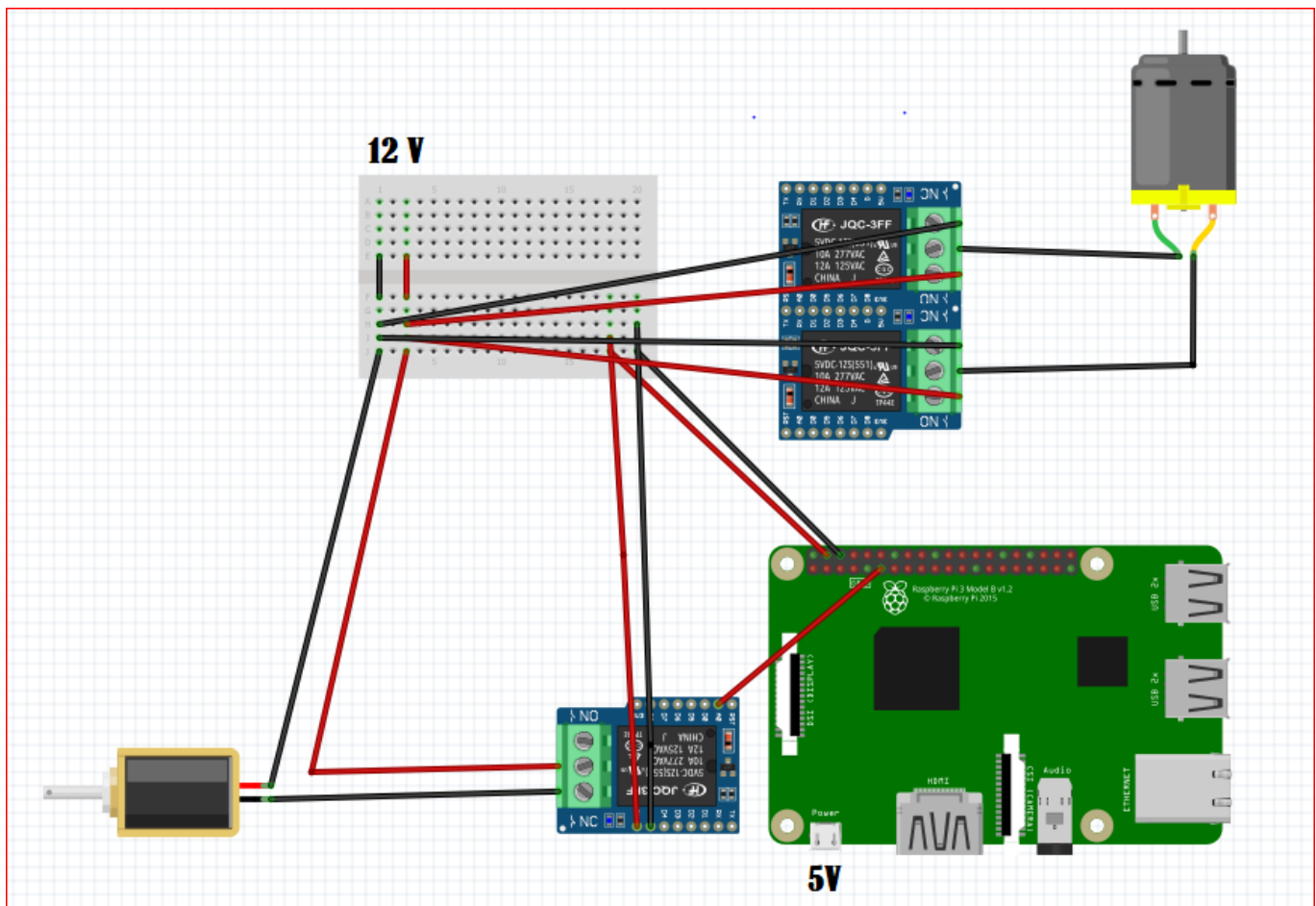
Raspberry Pi Zero (Key)

State Diagram

Mounting

The Gear motor will be attached to the door about a third of the length of the door from the hinges. One end of the door closer will be attached to the door frame slightly above where the motor is attached, but not directly above. Of the constructed pieces, the small one will be attached to the door frame and the other to the door, with the solenoid in between.