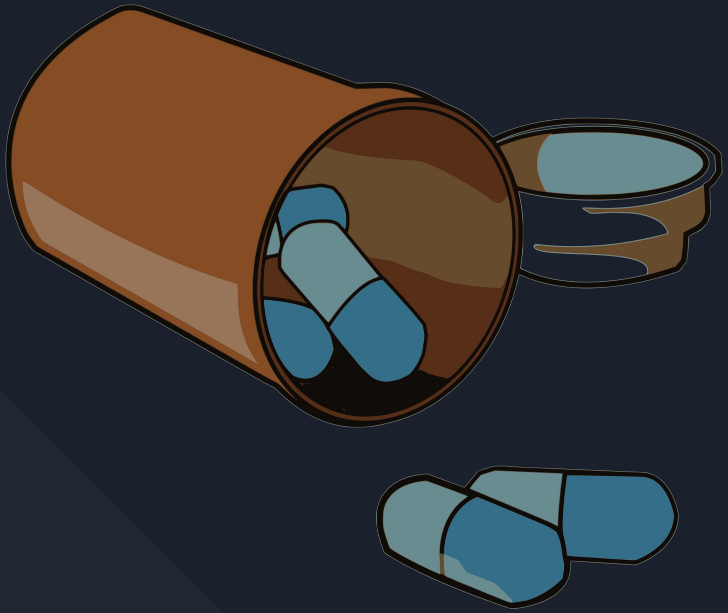
Sched-Med



Group 12

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Problem

- The tedious management of prescription pills, vitamins, and or supplements.
- Maintaining the mental capacity in order to remember to take pills, and what pills to take.
- The inconvenience of having to organize, store, and deal with a number of pill bottles/containers.
- Some people can forget taking certain medications that can be life threatening if not taken.

Proposed solution

- Relieving the user of any nuisance stemming from any of the previously described issues or other issues involving the need to intake any type of pill frequently.
- An approach that will simplify this need, as well as provide convenience to the user.

Project Overview

- The Sched-Med will be a user initiated pill-dispensing mechanism. The device itself is stand-alone portable structure. Also, a relatively small scale unit that can store and house a number of different pills, or prescriptions.
- This design includes a smart-phone application that will ultimately be tethered to the pill-dispensing mechanism, and serve as the main user interface. Allowing for the user to schedule, and control when their pills need to be dispensed. The app will provide a prompt, or notification based on the timeline set prior by the user, and when it is time for dispensing the user can either accept or decline.

Motivation

- To provide a relatively inexpensive alternative to the existing pill dispensing products currently on the market.
- A product that is personal, and suitable for a home and/or living area. Rather than large scale products typically located in medical facilities.
- Relieve any further burden of already having to deal with prescribed pills, and/or medication.
- Gain Experience in Application Programming, and device tethering

Goals & Objectives

- To facilitate the pill managing, and intake process
- Keep patient/user medication pills safe, and readily available
- Minimize Dosage & Prescription Scheduling errors
- Prevent any potentially harmful misuse of pills and/or medicine
- Relatively small in size, compact
- Intuitive User interface
- Affordable

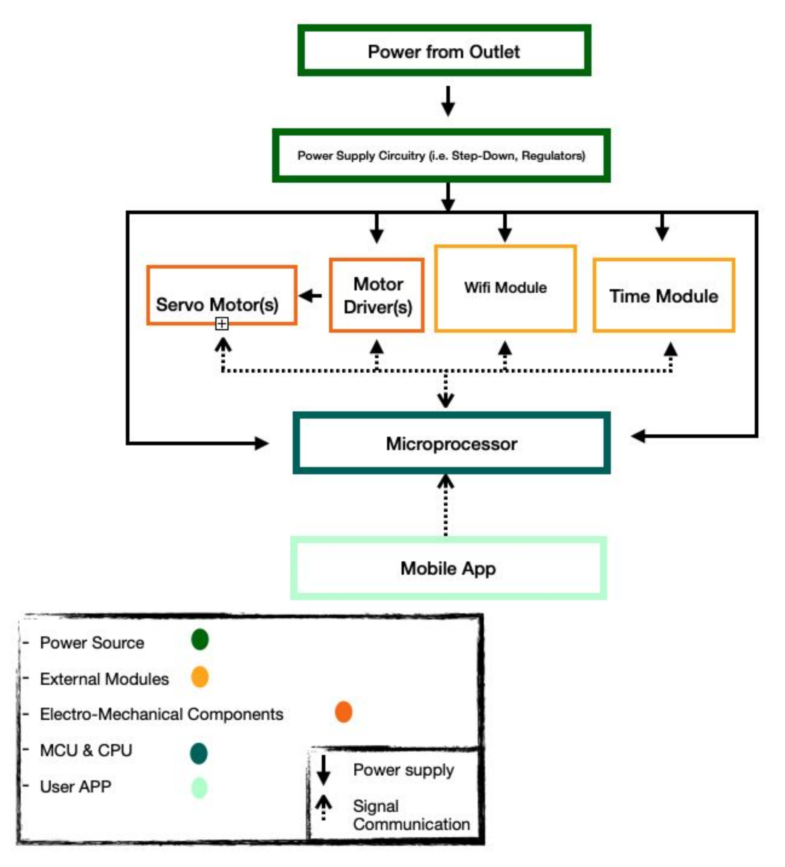
Specifications

Component	Parameter	Specification
Pill Holster(Pill storage Capacity)	Diameter	1.5"
Pill Holster(Pill storage Capacity)	Height	1.4"
Pill Holster	Quantity	8
Application Tethering	Distance	3-5 Meters
Power Supply	Input	12 V
Max Dimensions	L x W x H	6 x 6 x 7

Requirements

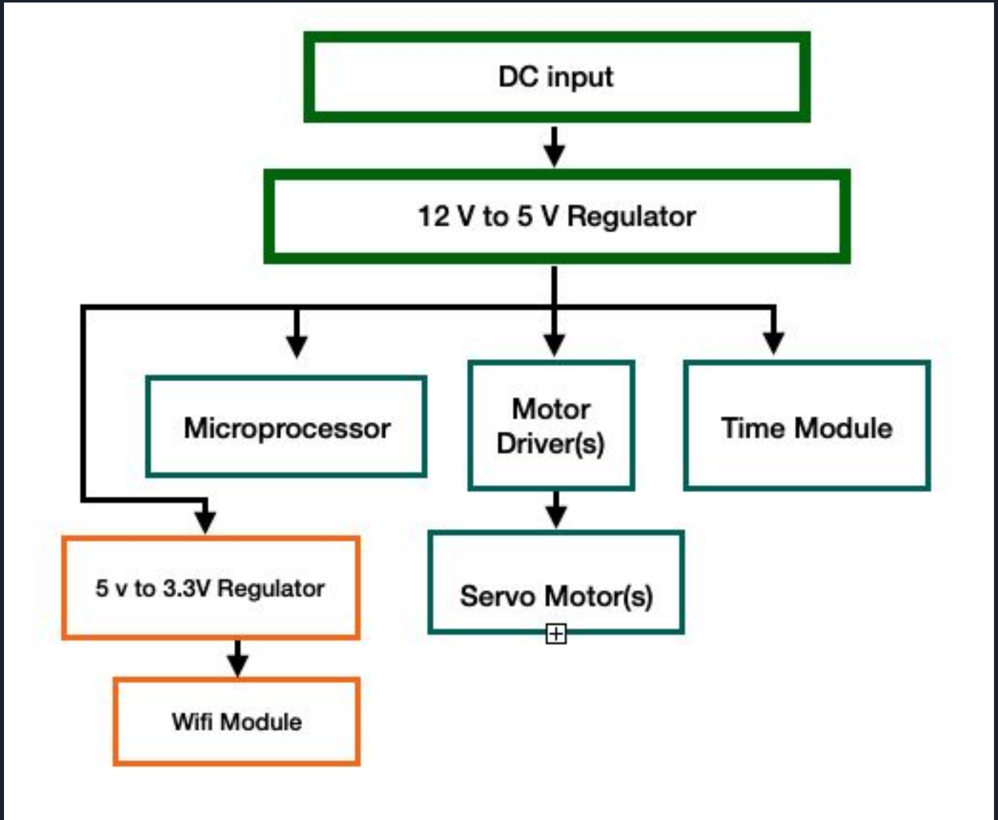
Requirement	
Pill Holster Capacity	6 (MIN)
Production Cost	$200 (MAX)
Weight	4 lb (MAX)
Dispensing Speed	3.5 sec (MAX)
Application Response	2.5 sec (MAX)

Power Supply & Signal Communication



- 12 V DC Power Supply stepped down to suitable input voltage
- Mobile App will be main UI
- Micro-Controller serves as hub for signal communication between all design components

Power Supply Hierarchy

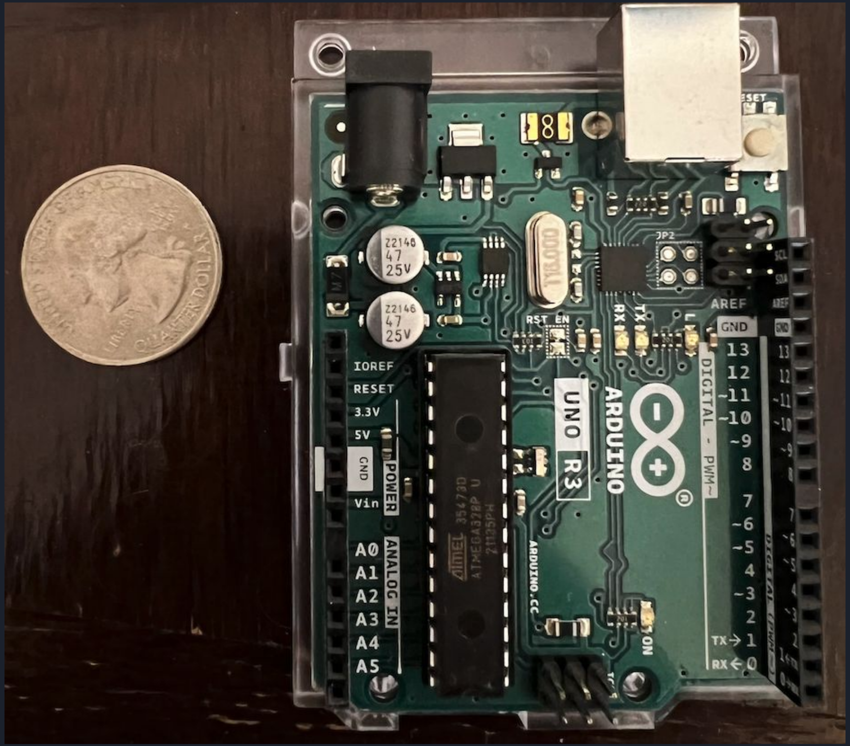


MicroController

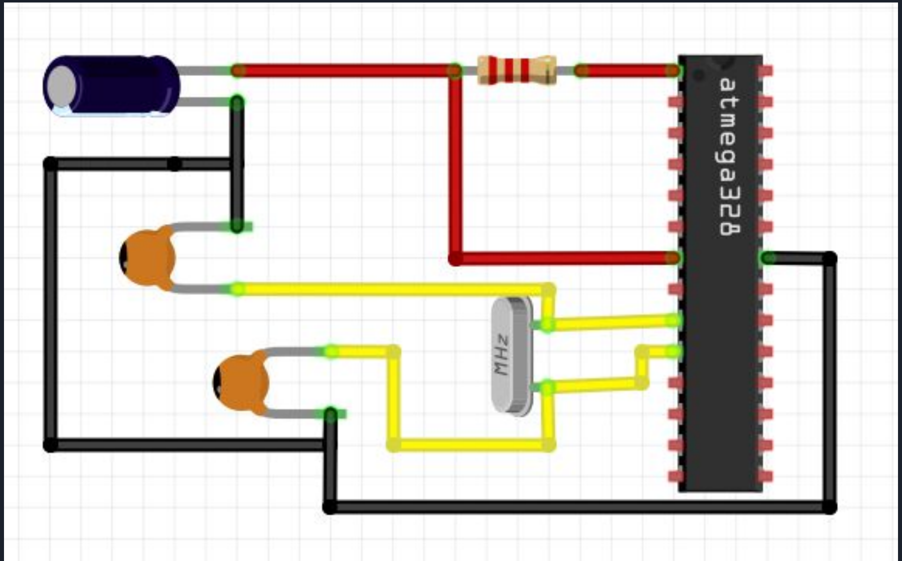
- Arduino Uno R3
- Used mainly for testing & programming

<u>Important Features:</u>

- C++ w/ Additional Arduino Libraries
- ATMEGA32P Micro Controller Chip (Main MCU)
- 14 Digital I/O pins
- 6 Analog Pins
- Operating Voltage = 5 V



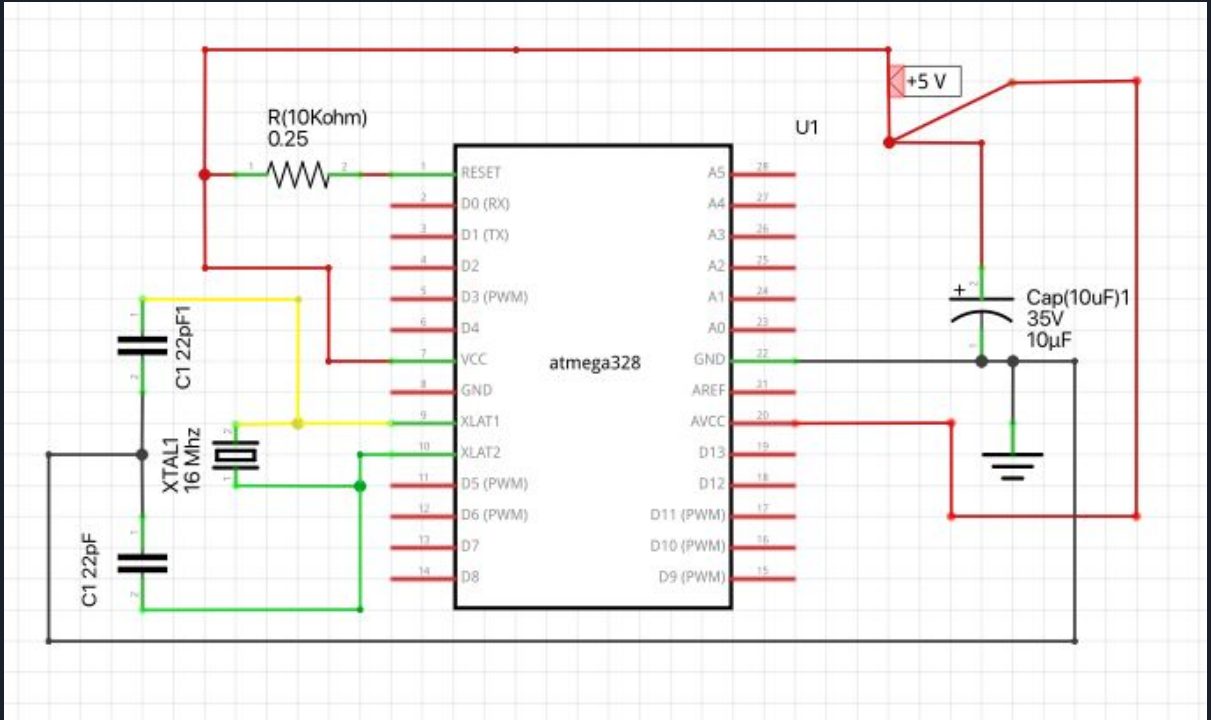
ATMEGA328PU Microchip



5V input = Red wire
Ground = Black Wire

- Our Main MCU
- By implementing a few extra components such a 16 MHz Crystal we can emulate the functionality of the Arduino UNO
- Bootloader Code pre-installed to facilitate the management of our sketches

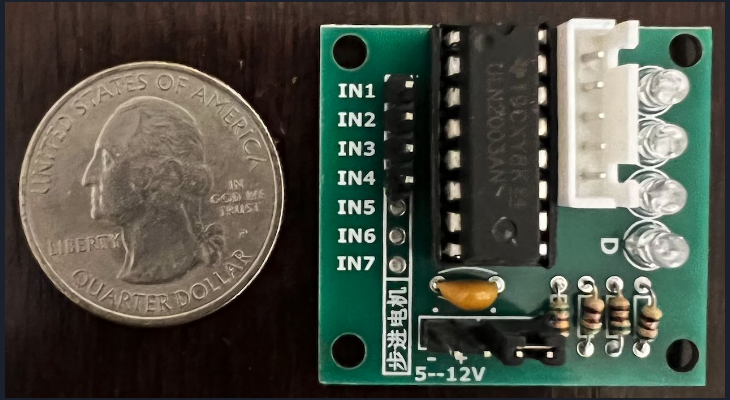
ATMEGA328PU Schematic



- ATMega328 offers a number of digital input & output pins that are useful in our case of motor control.
- Cost-effective and relatively easy to program

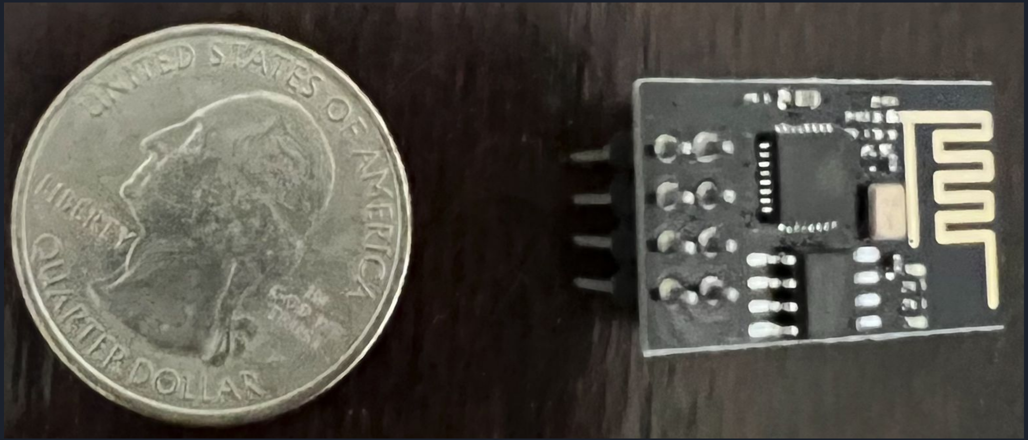
Stepper Motor/Motor Driver

- ULN2003 Driver Module & 28BYJ-48 Stepper Motor
- 5 V Input
- Consume around 240 mA, thus this power will be drawn from external source rather than Arduino
- Step Angle: 5.625°/64 (360° rotation)
- Cost effective



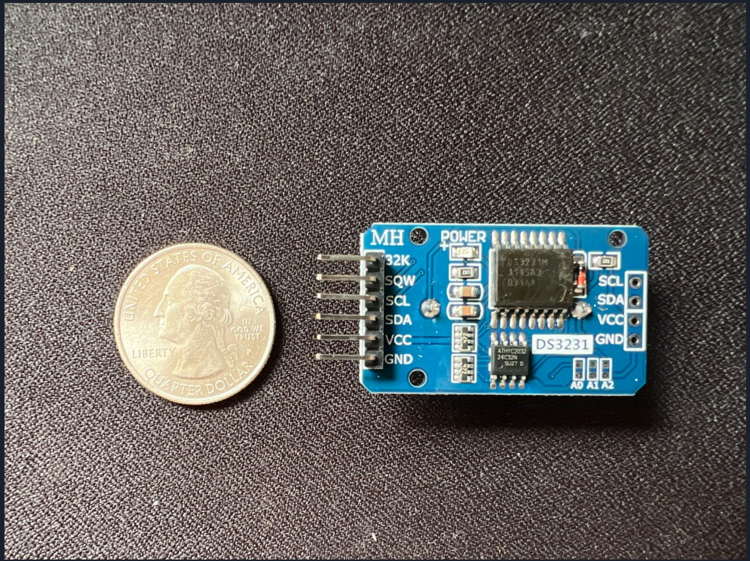
Wifi Module

- ESP8266 Wifi Module
- 3.3 V input
- 4 MB Flash Memory
- Application hosting capability
- Cost effective

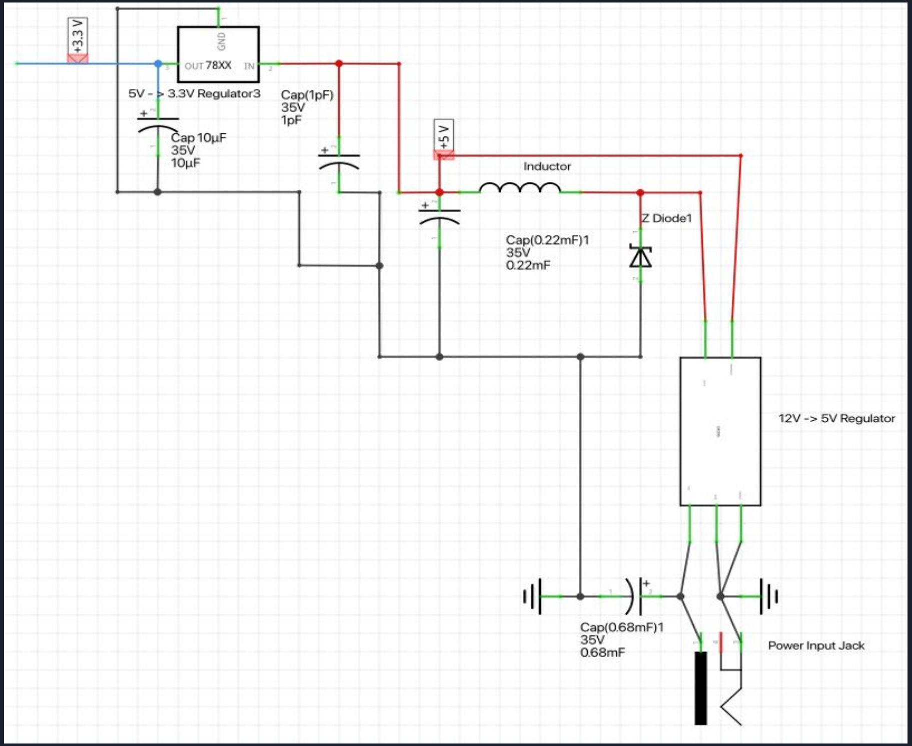


Time Module

- DS3231 Real Time Clock Module
- Backup battery, in case main power is disconnected
- Accurate 32kHz oscillator
- Communication through I2C interface
- 5 V input

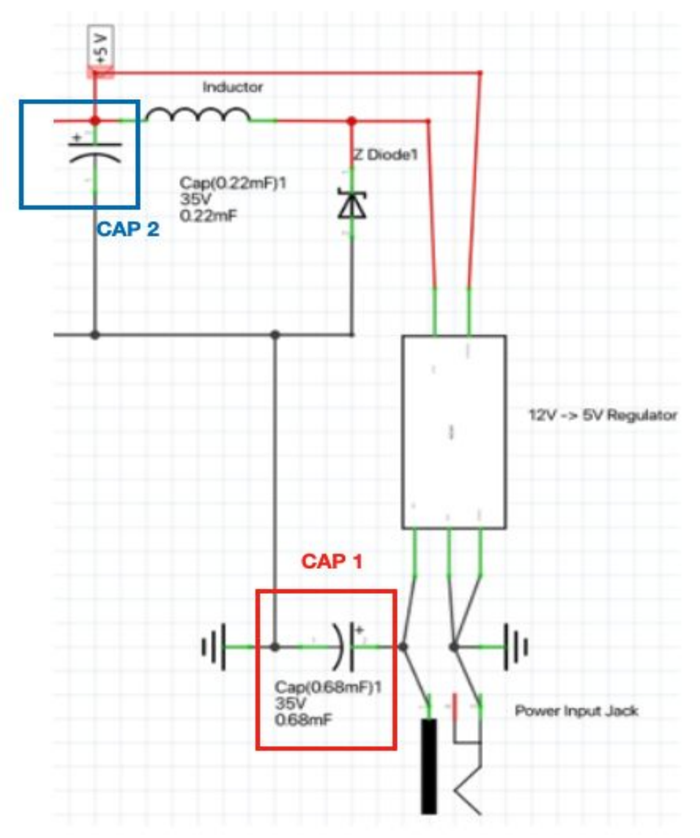


Power Supply Schematic



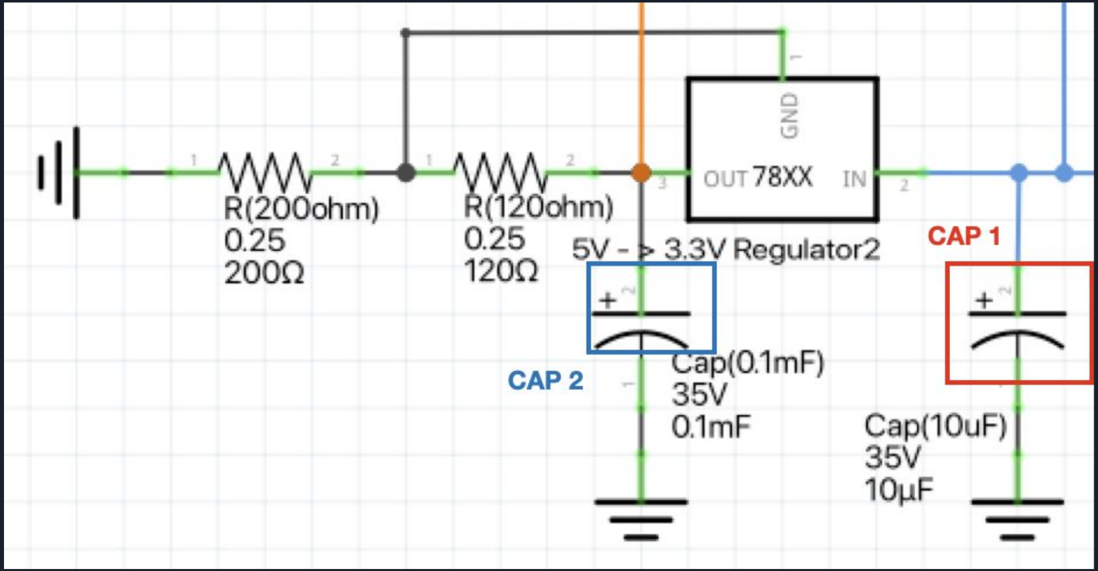
- 12V input using Male to Female Standard 2.1 x 5.5 mm Power Jack
- 12V will be stepped down to 5V
- Then once more to 3.3V
- This is done by using two separate Voltage regulators

Voltage Regulator 12V -> 5V



- LM2596 series by Texas Instruments
- 5 pin surface mountable layout
- Highly efficient switching regulator capable of driving a 3 Amp load
- Capacitor 1 is an input bypass capacitor, preventing any harmful voltage transients
- The Zener diode is a catch diode also preventing any voltage spikes, as well as providing a return path for the inductor current when the power is switched off.
- Zener diode’s have low forward voltages, and quick recovery time between bias switching.
- Capacitor 2 is an output capacitor that filters the output and ensures regulator loop stability

Voltage Regulator 5V -> 3.3V



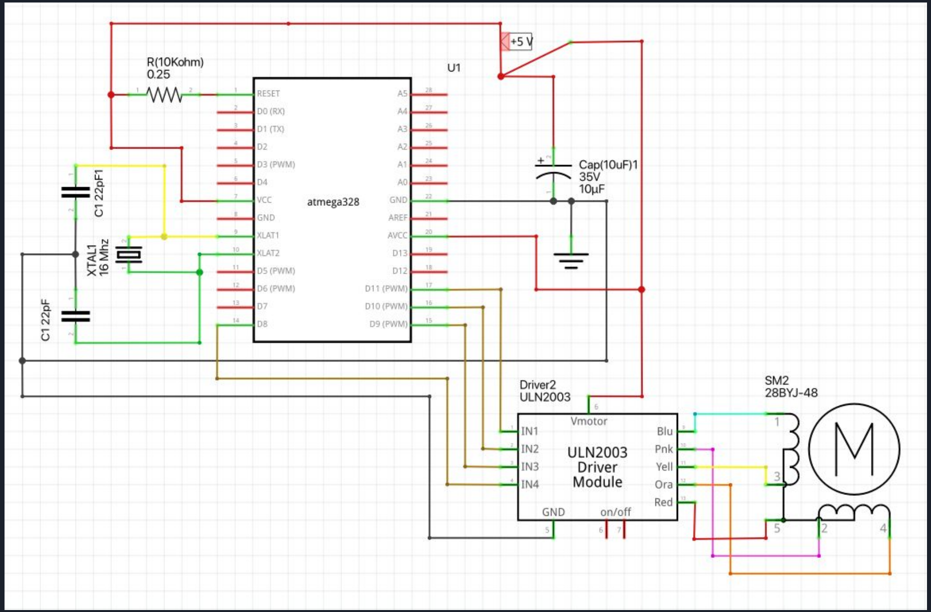
- LM1117 series by Texas Instruments (Same Package & Footprint as 78XX editions)
- Capable of driving 800 mA load
- Capacitor 1 is an input bypass capacitor.
- Capacitor 2 is an output capacitor that is critical for regulator stability, and improving transient response
- The resistor values are specifically chosen to give an output of 3.3V

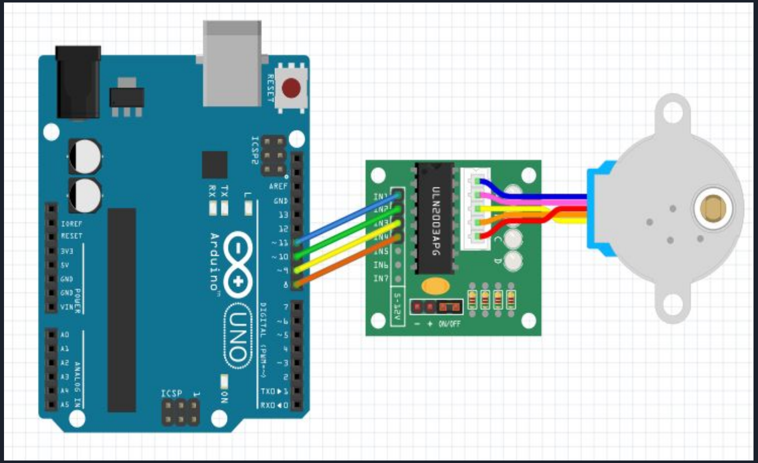
Vout = 1.25(1 + R2/R1)

R1 = 120 ohms

R2 = 200 ohms

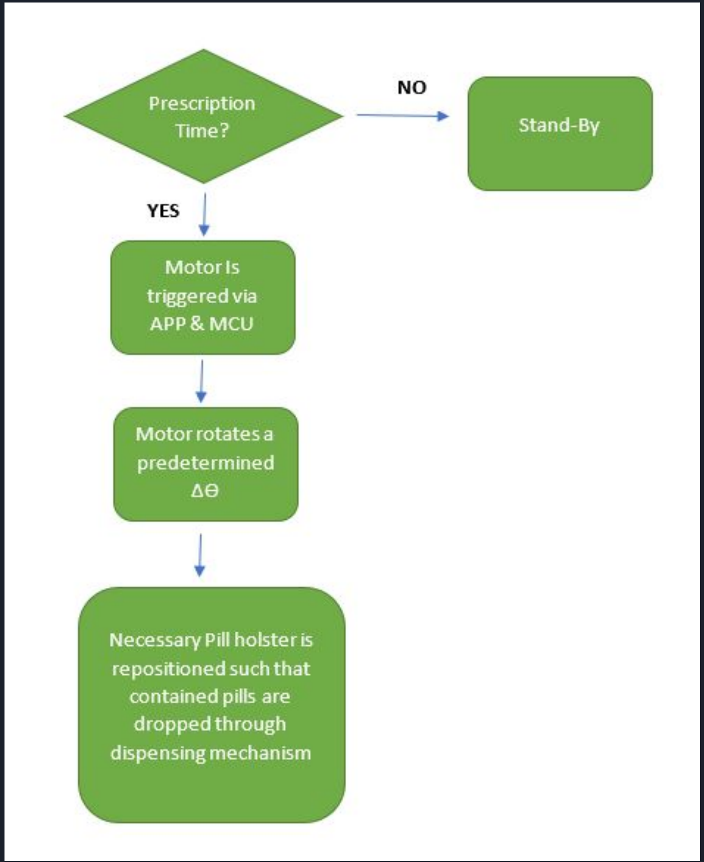
Stepper Motor Schematic & Microcontroller Connection

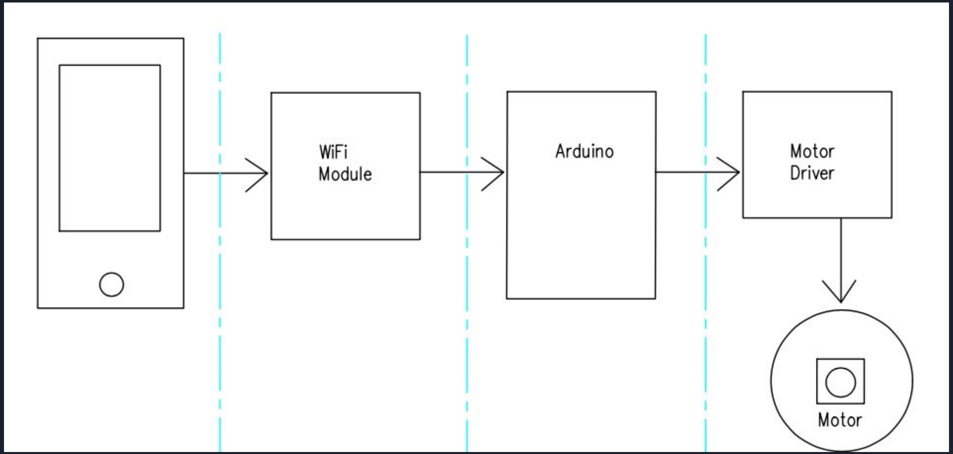




Note: The above image displays how we initially plan to use the Arduino to help in developing and testing the motor programming. ULN2003 breakout board will be recreated on PCB.

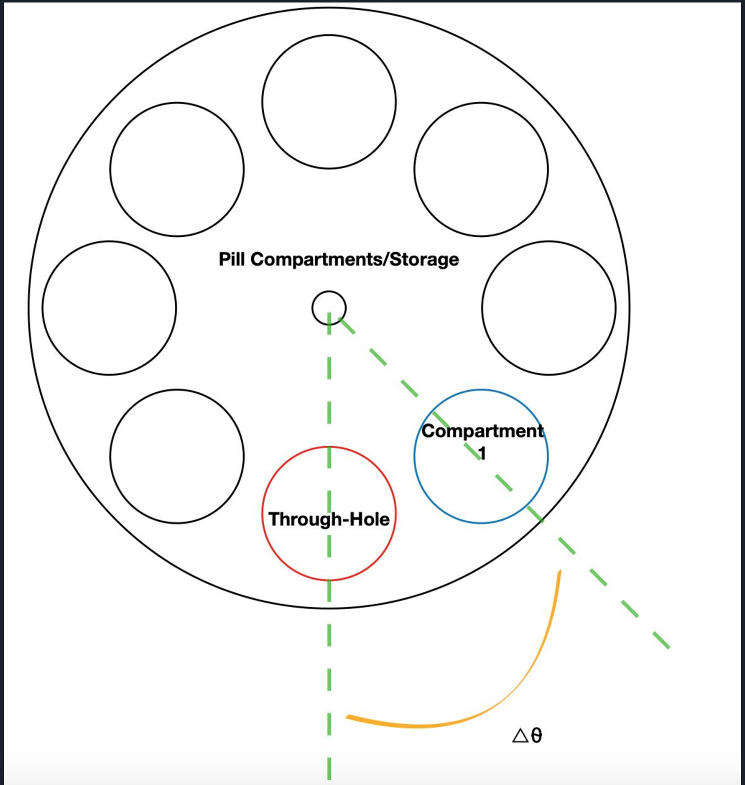
Stepper Motor Flowchart





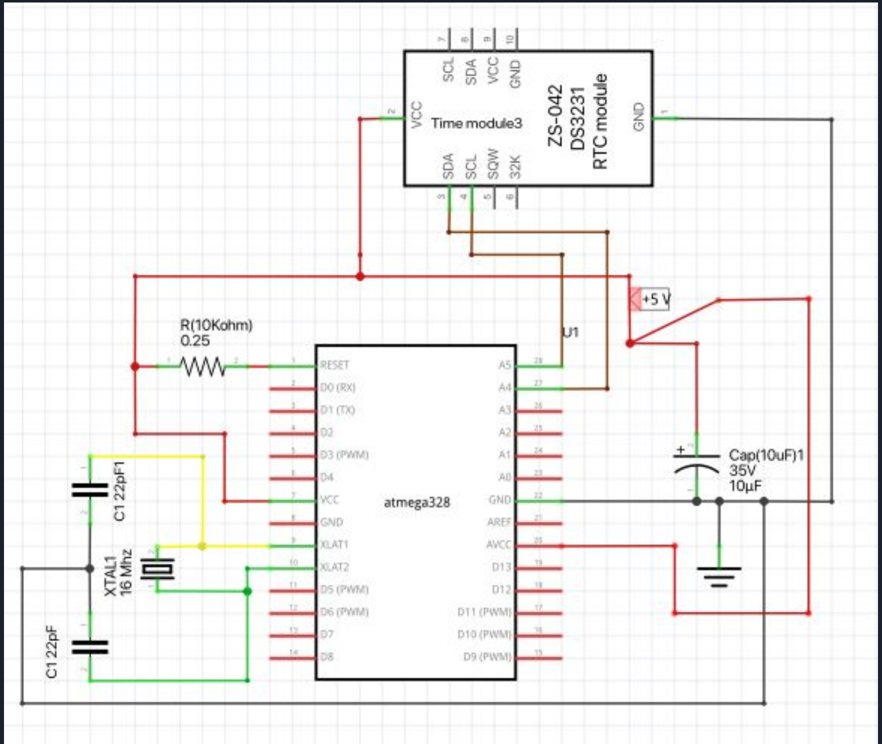
- User will be notified when it is time to dispense pills.
- Ultimately, triggering the system to become active and start the dispensing process

Motor Logic & Dispensing Mechanism

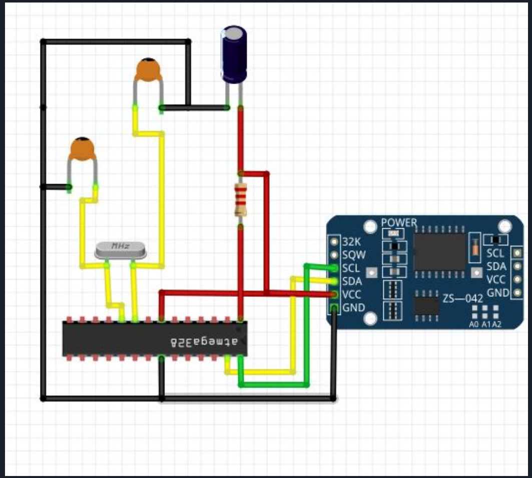


- Pills will be stored in 7 of the 8 compartments shown.
- As the user initiates or accepts their next set of pills to be dispensed(i.e. Compartment 1) this wheel will rotate via stepper motor positioning Compartment 1 directly over through-hole and ultimately dispensed.

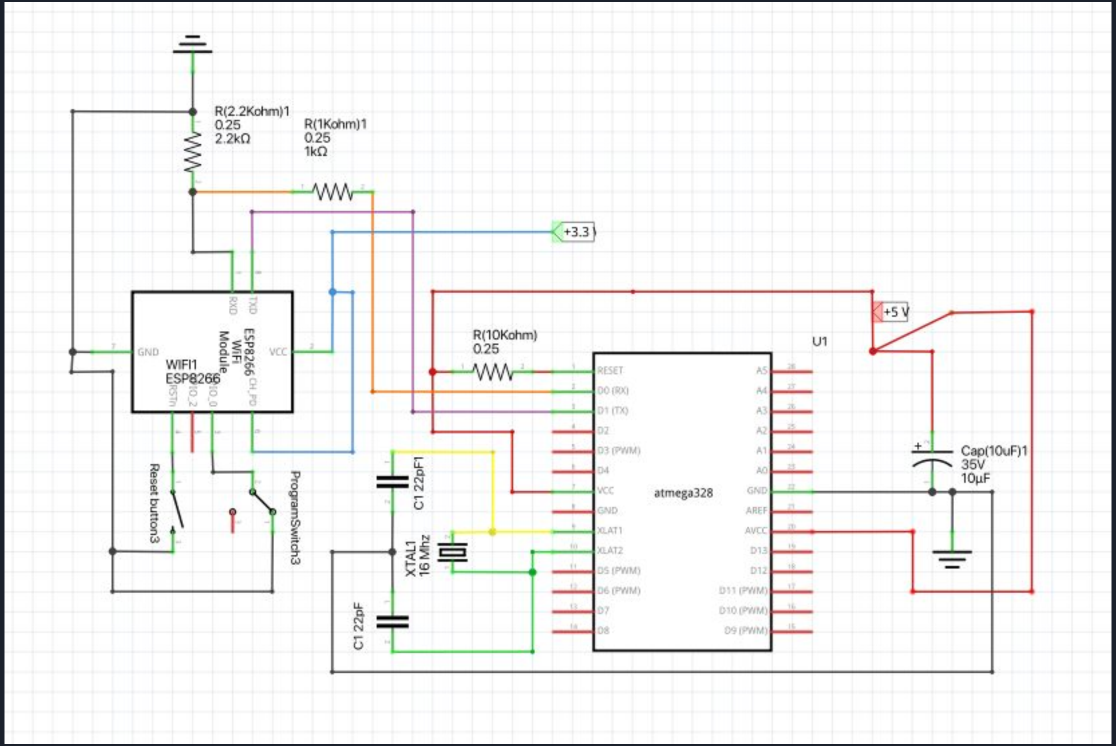
Time Module Schematic



- DS3231 Real Time Clock module
- Connected to ATMEGA328 at Serial Clock and Data pins
- Will Receive a 5 V input
- Necessary to keep accurate, real time for user scheduling

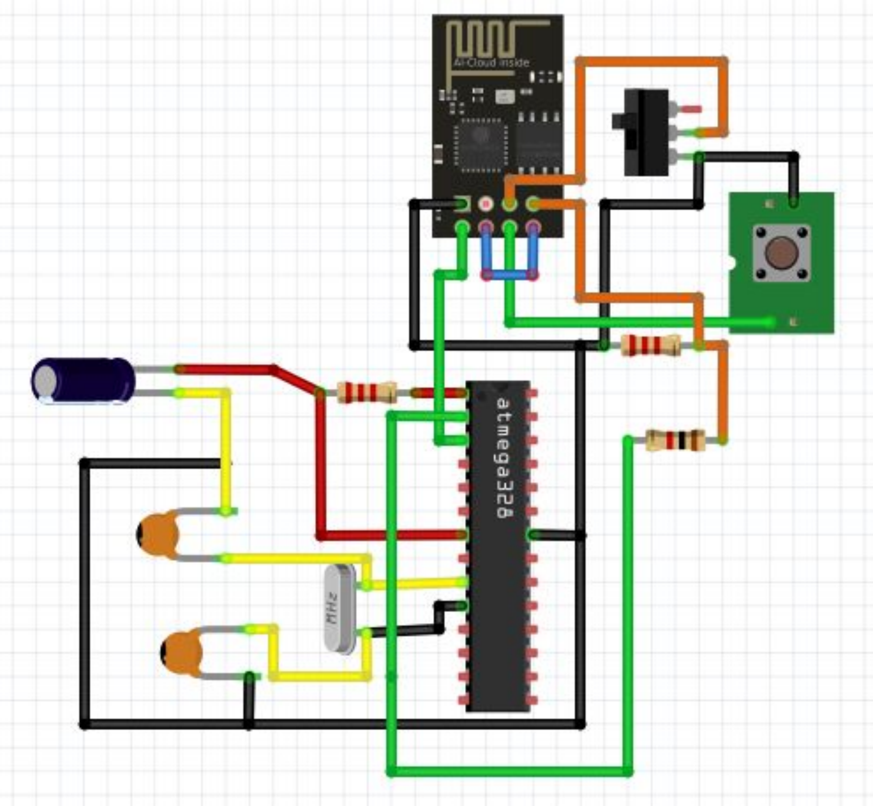


WIFI Module to Microcontroller Connection



- Featured is a Reset button, that will be used when, and if we need to reset the module programming.
- Also, a 3 pin programming switch is used to initiate, and allow for the module to be programmed.

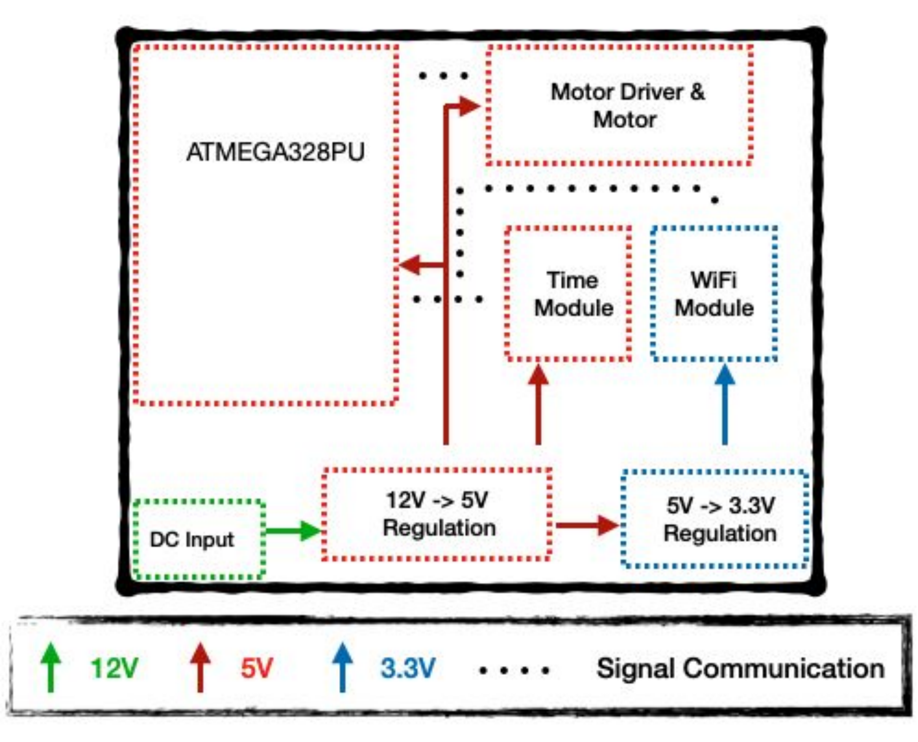
WiFi Module Continued



- Enables the user to communicate with the ATMEGA328, by serving as the “link” between the Application and Microcontroller.
- All parts shown will be mounted on PCB, which be located in the main control unit.

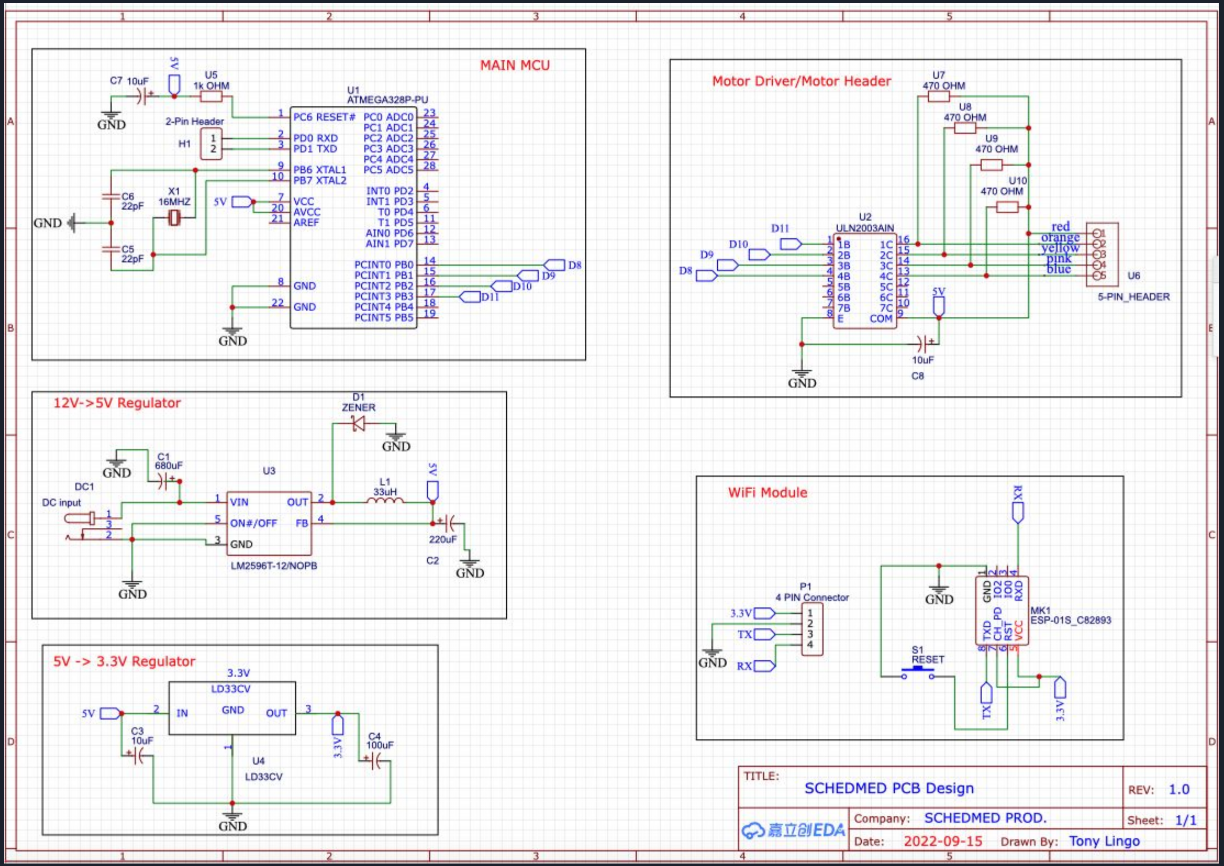
5V input = Red wire
3.3V input = Blue wire
Ground = Black Wire

PCB Concept



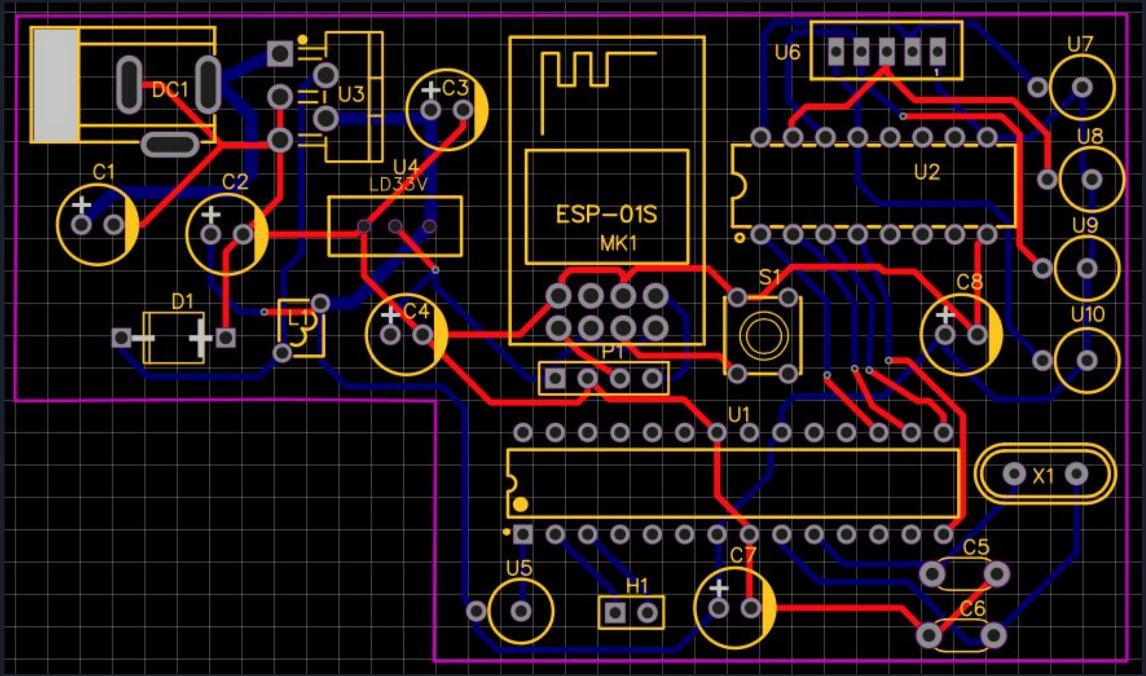
- Power supply positioned reasonable distance from receiving components in order to prevent issues EMI interference.
- Headers/ Breakouts will be used where necessary.

Current Operating Circuit



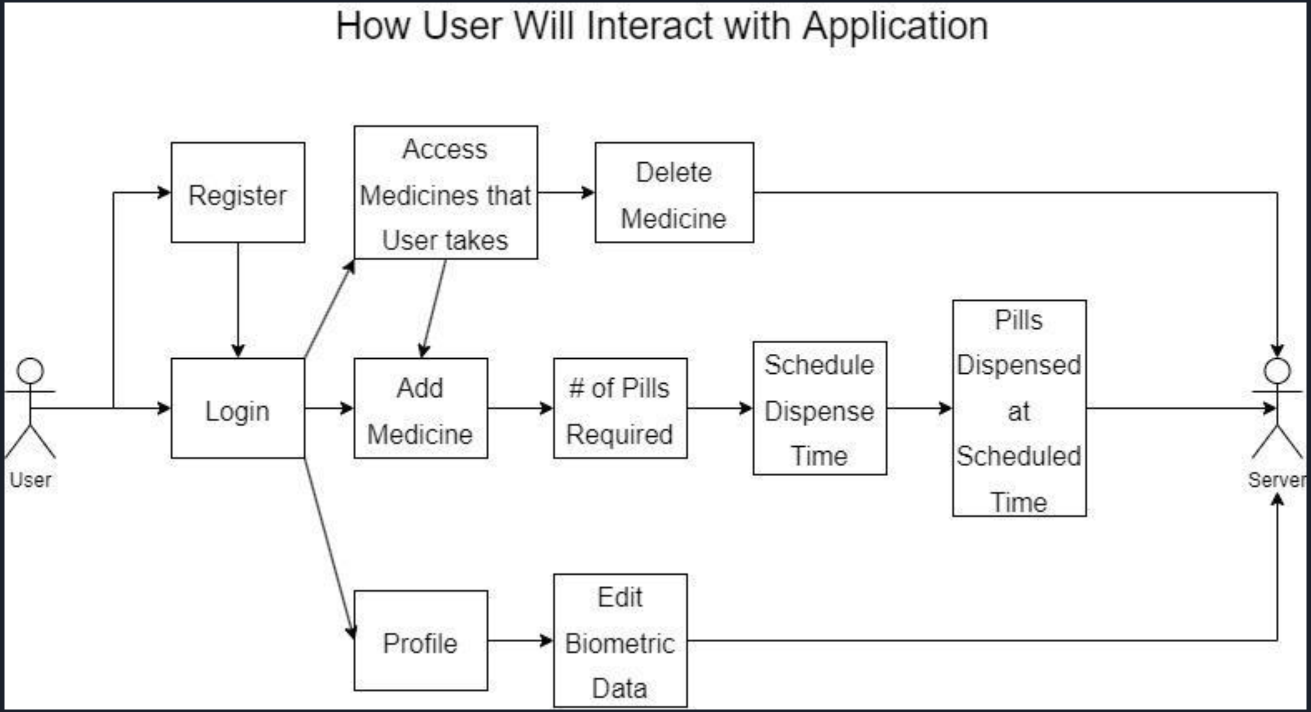
- As the circuit of our design will change from a “programming state” to an “operating state”, is important to make the proper adjustments for final PCB. Below is a display of SchedMed final schematic as it stands now.

PCB Design/Layout

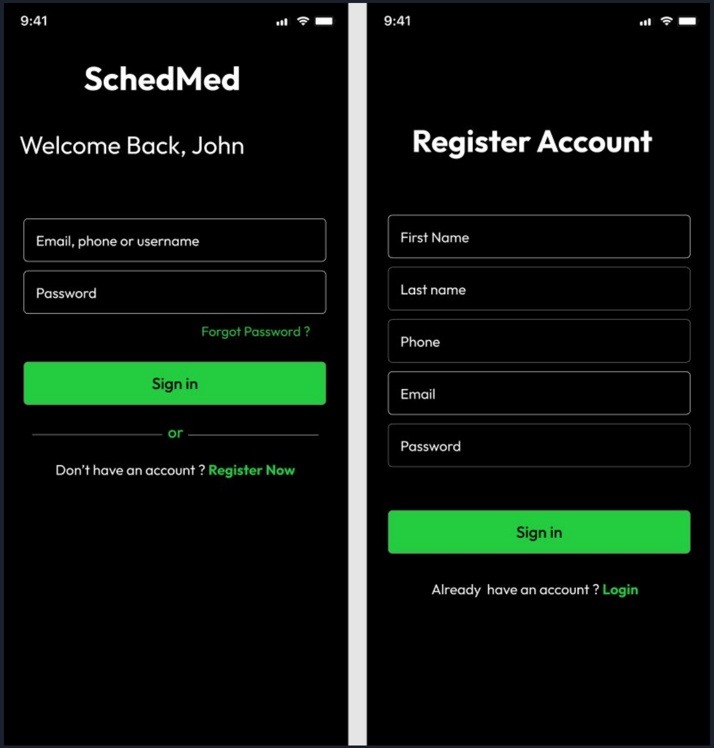


- Microcontroller will be mounted directly to PCB
- All components are through hole packages
- Power supply is located on the left portion of PCB
- All other IC units will be located on the right portion of PCB
- 2 Layer board

App Flowchart

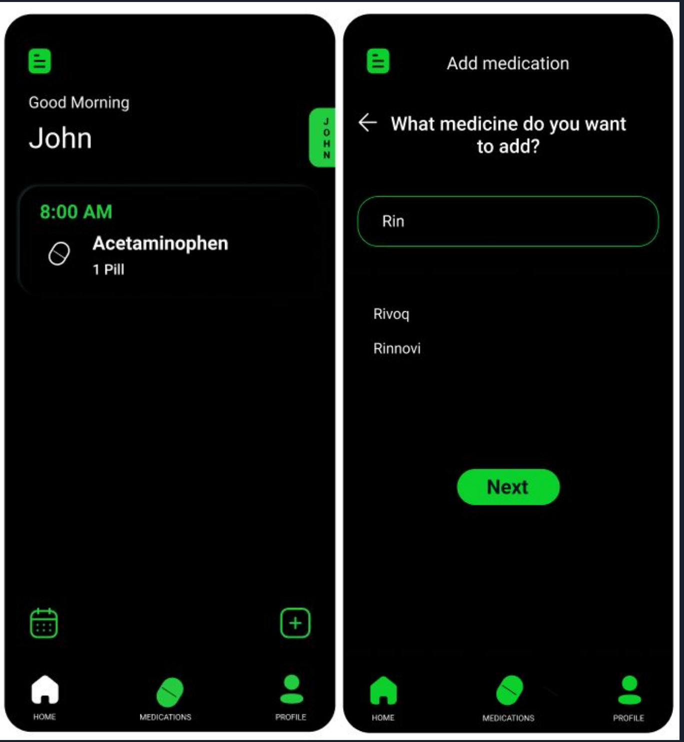


App Screenshots



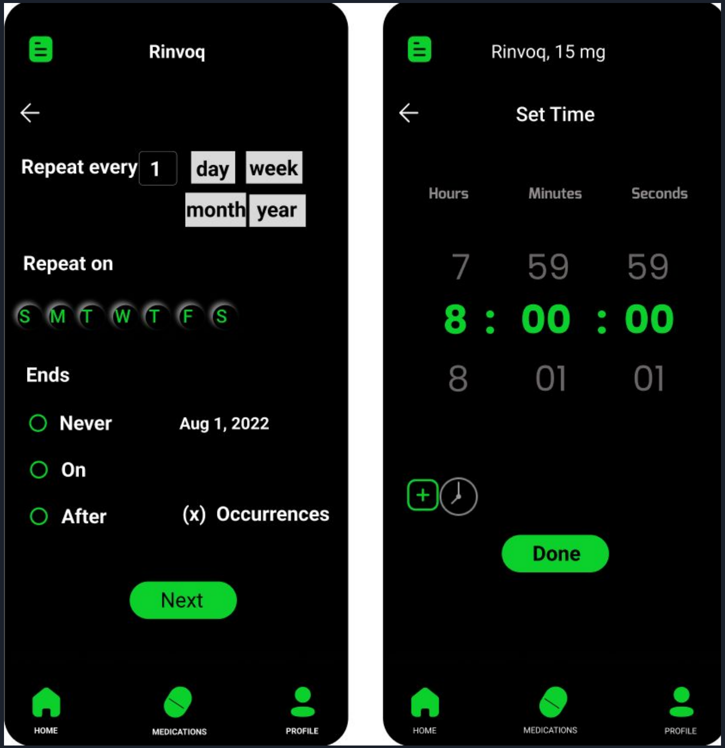
- Login screen and register screen for the user to retain the medicine data that's stored in the database and fetched by the API.

App Screenshots



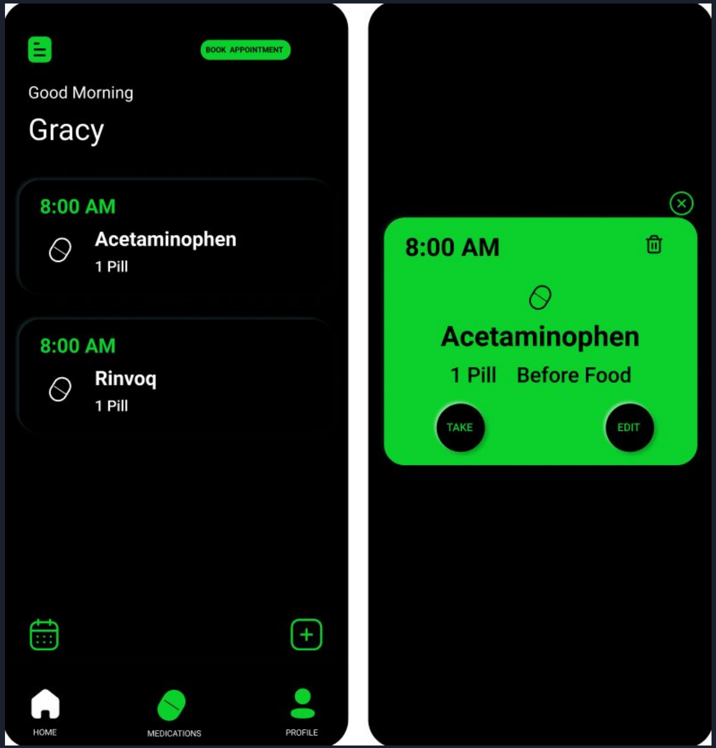
- User can add a reminder on the bottom right denoted by the ‘+’ symbol.
- App will ask the name of the medicine.

App Screenshots



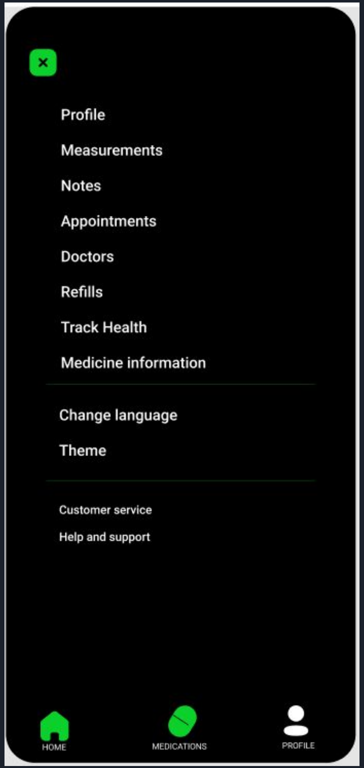
- App asks how often the medicine will need to be taken by the user.
- User can put in how many days of the week the medicine needs to be taken.
- User will set the time the medicine will be dispensed on those given days.

App Screenshots



- This screen denotes when new medicine is added like a list.
- User can tap on any medicine and displays what time the medicine needs to be taken and the date.

App Screenshots

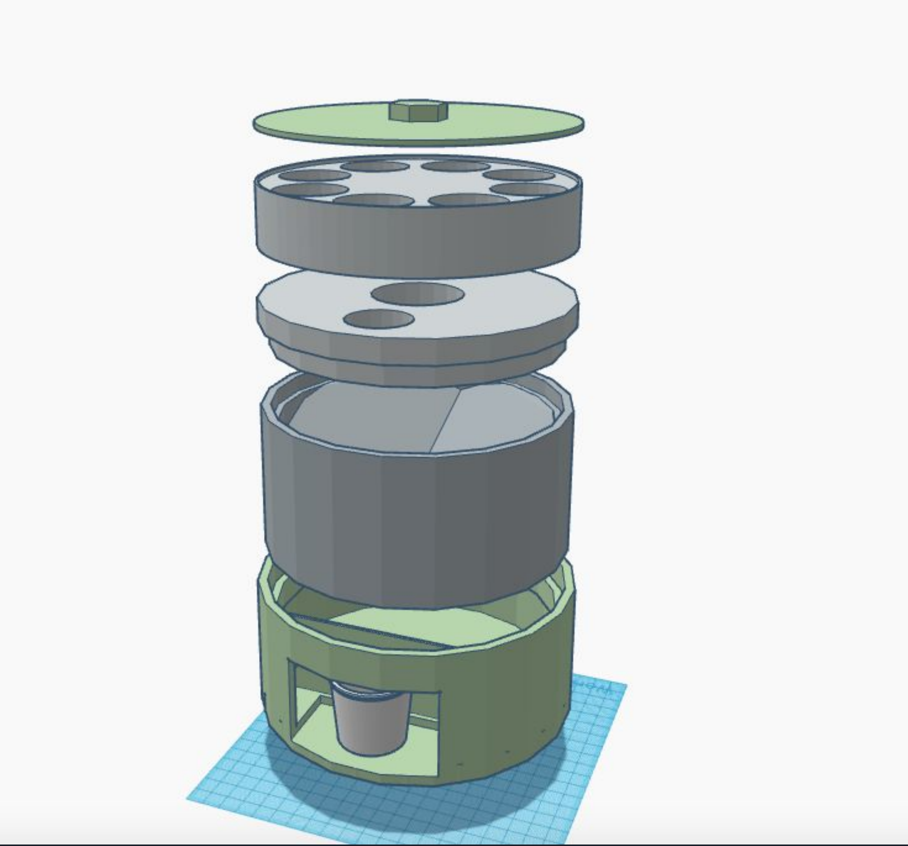


- This is the settings screen where the user would go to logout, edit profile and change app appearance to dark mode if needed.

3D Printing

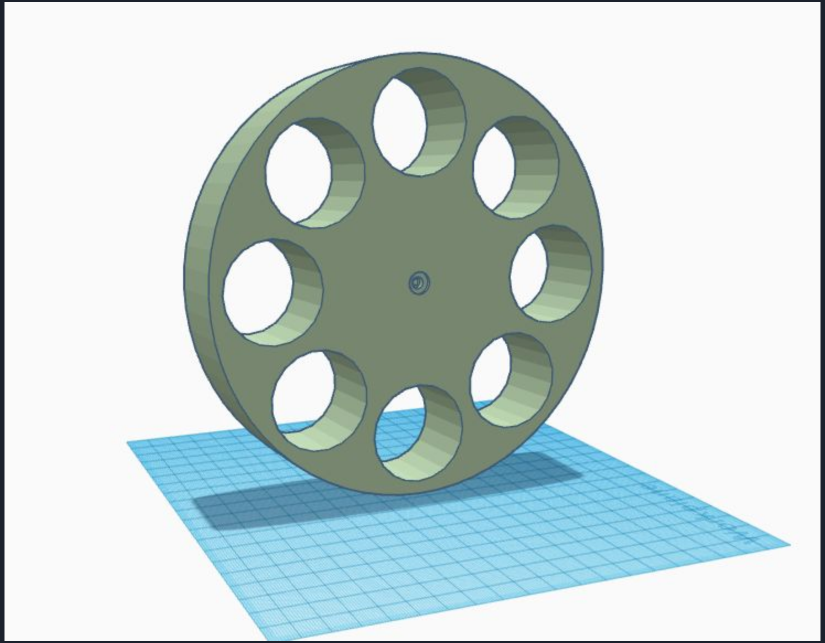
- Almost every major component of the physical structuring will be 3D printed.
- This approach allowed for us to develop a unique design, that will compliment the functionality of the Electro-mechanical components involved in our design(i.e. Stepper Motor(s), etc.)
- Plan to use ABS filament material.
- Rigid, & Light weight
- Rapid turn-around, and prototyping

3D Modeling Concept



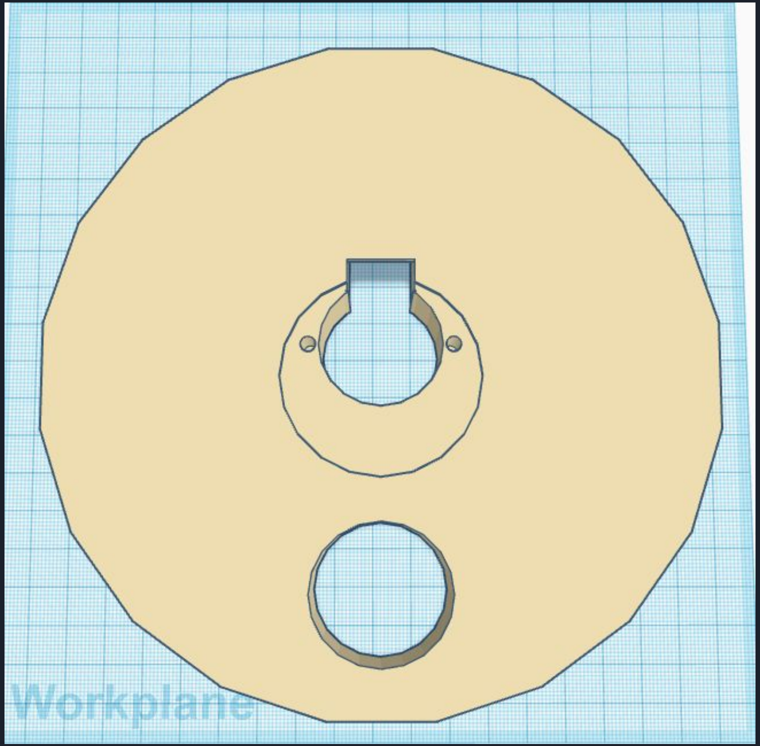
- 6 part system
- Ease of access for user to replenish pill compartment(s)
- ABS filament Material
- Light weight
- Main Control unit housed in bottom piece

Dispensing Mechanism



- Pills will be stored in each compartment
- Will rotate by means of attached stepper motor
- Located directly above motor housing/pill filtering system
- Pills will be dispensed into easily retrievable cup as seen in previous slide

Stepper Motor Housing/Placement

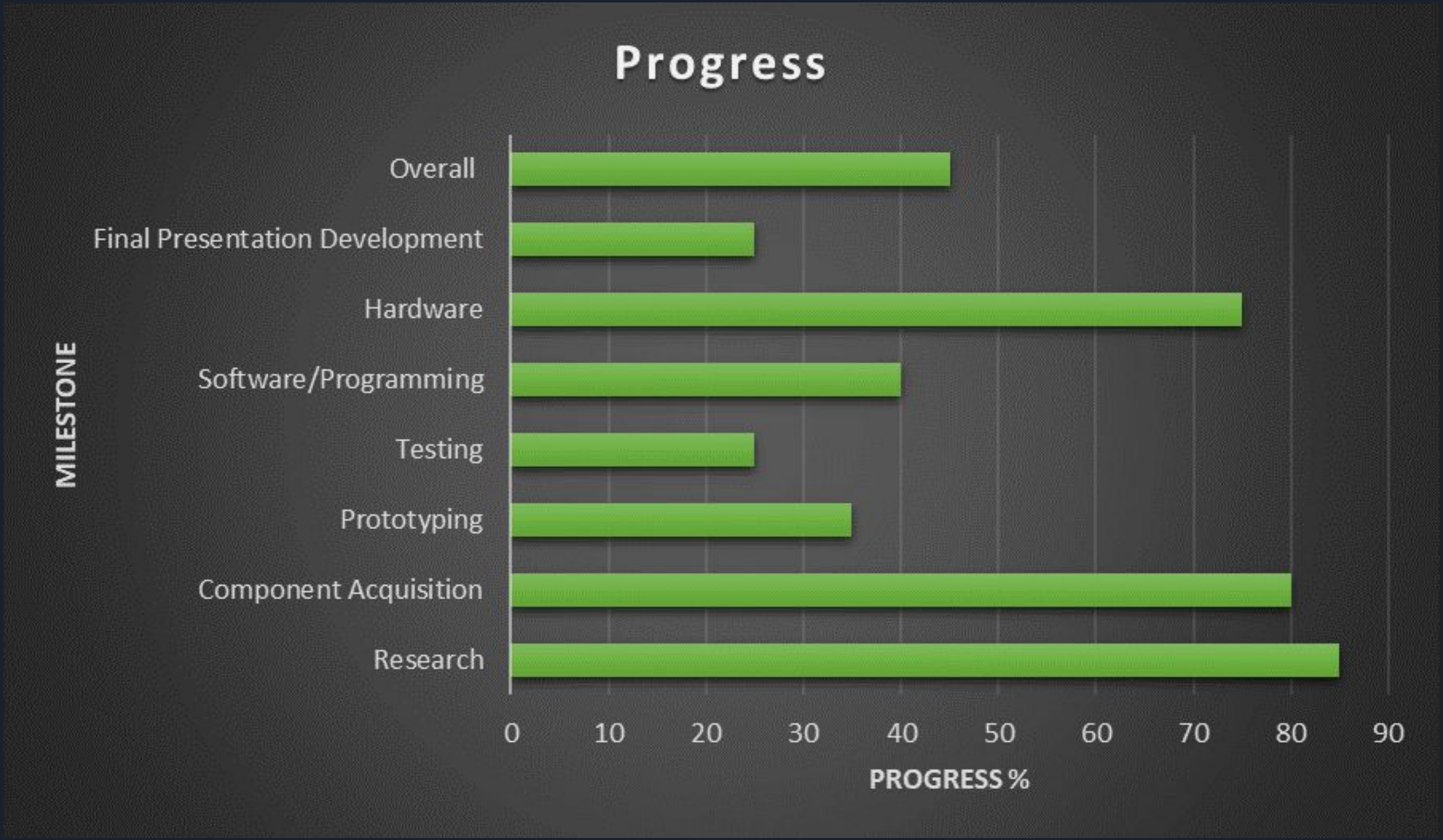


- Stepper Motor will mount in the middle of platform
- Centerpiece/ reference point for angular rotation of wheel
- Throughhole for pills to drop through rest of dispensing system

Budget and Finance

Component	Price	Supplier
MicroController Arduino UNO	$26.35	Amazon
DS3231 RTC Time Module	$9.99	Amazon
ESP8266 ESP 01 WiFi Module	$8.99	Amazon
12V DC power supply	$8.95	Adafruit
DC Power Jack/input for PCB	$5.99	Amazon
5V DC Step Motor	$4.95	Adafruit
LM2596T-5.0 5V Regulator	$6.95	Mouser or Adafruit
LM1117 3.3V Regulator	$1.25 per pc	Adafruit
1N5824 Zener Diode	$8.77	Amazon
33 µH Inductor	$5.99	Amazon
Resistor & Capacitor Kit	$9.99	Amazon
Jumper Wires	$6.89	Amazon
ABS 3D printing Filament material	$22.30	Amazon
Total	$121.37	

- Not including PCB thus far


Progress
Overall
Final Presentation Development
Hardware
Software/Programming
Testing
Prototyping
Component Acquisition
Research
MILESTONE
0
10
20
30
40
50
60
70
80
90
PROGRESS %

Workload Distribution

Constraints

- Economic
- Environmental
- Social
- Health
- Manufacturability

Constraints: Economic

- Due to COVID-19, it has been challenging to gather parts as demand for them have risen
- Production of goods and services decreased heavily

Constraints: Environmental

- Most of our mechanical structuring and housing for pill storage will be 3D printed
- All load requirements will be properly assessed in order to minimize any heat loss amongst electrical components

Constraints: Social

- User interface will be designed to suit users of all ages
- We want our product to be financially accessible to people of different socioeconomic backgrounds

Constraints: Health & Safety

- We must make sure that our pill dispenser dispenses pills at the time users set on the app
- If not, it could throw off the schedule that doctors prescribed to the consumer
- We have to keep in mind that people with dementia may try out our product

Constraints: Manufacturability

- Our biggest will be manufacturing the mechanical structuring of our pill dispenser
- We must design efficient design mechanisms
- A solution to this is 3D printing

Standards

- C Programming Language Standard ISO/IEC 9899:2018
    - Interpretation of programs/expectations written in C

- C++ Programming Language Standard ISO/IEC 14882:2017
    - Interpretations/expectations of programs written in C++

Questions?