

Pill-Matic

An Automatic Pill Dispenser
by Health-Assist

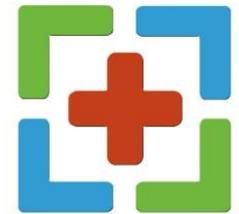
Apr 20, 2016

Connor Dueck
Devon Louie
Jerry Yao
Adam Gabriel
Peter Hsu



Road Map

- The Problem
- The Solution
- Who we are
- Design Process
- System Overview
 - Hardware
 - Firmware
 - Software
- The Business Model
 - Pricing Scheme
 - Competition
 - Financing
- Costs and Expenditures
- Scheduling
- Learning Outcomes
- Future Development
- Questions



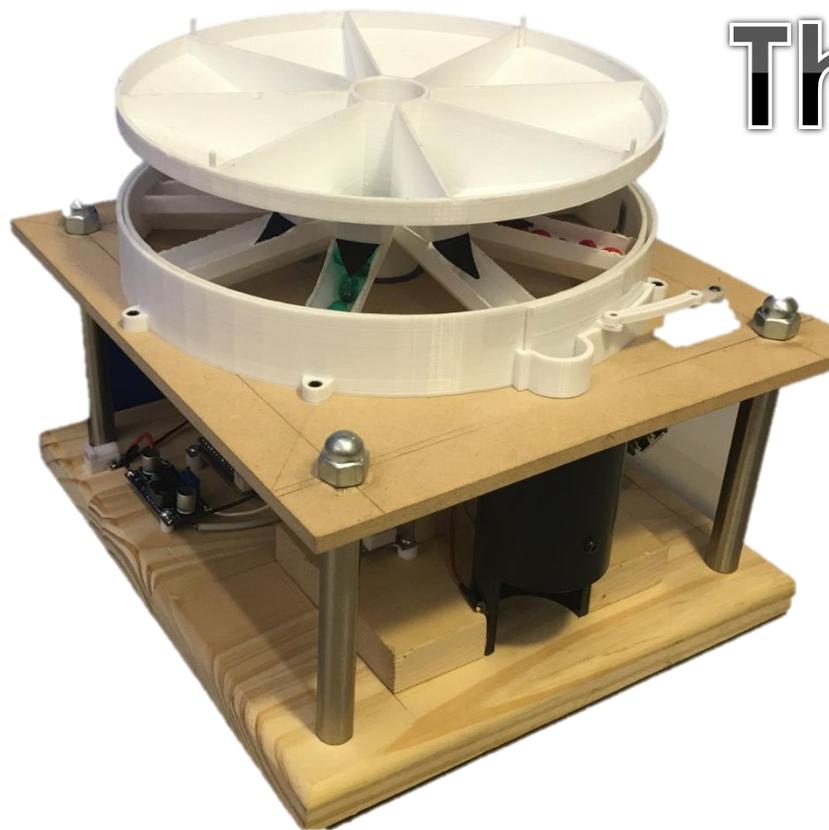
The Problem

“Medication has become an integral part of modern life, 40.5% of people from age 6 to 79 take prescription medication” [1]

“Administration errors account for 26% to 32% of total medication errors—and nurses administer most medications. Unfortunately, most administration errors aren’t intercepted “ [2]



The Solution



The Pill-Matic



Health-Assist

The Solution

- Tackle the problem at the medication administration level
- Simple and effective one-stop remedy for all prescription needs
- Offer convenience and ease for elderly Individual
- Provides security and efficiency within medical and nursing organizations



Who we are

- Connor Dueck – 4th Year System Engineer - CEO
- Devon Louie– 4th Year Computer Engineer - CFO
- Jerry Yao– 4th Year Electronics Engineer - COO
- Adam Gabriel– 4th Year Computer Engineer - CTO
- Peter Hsu– 4th Year Computer Engineer - CIO

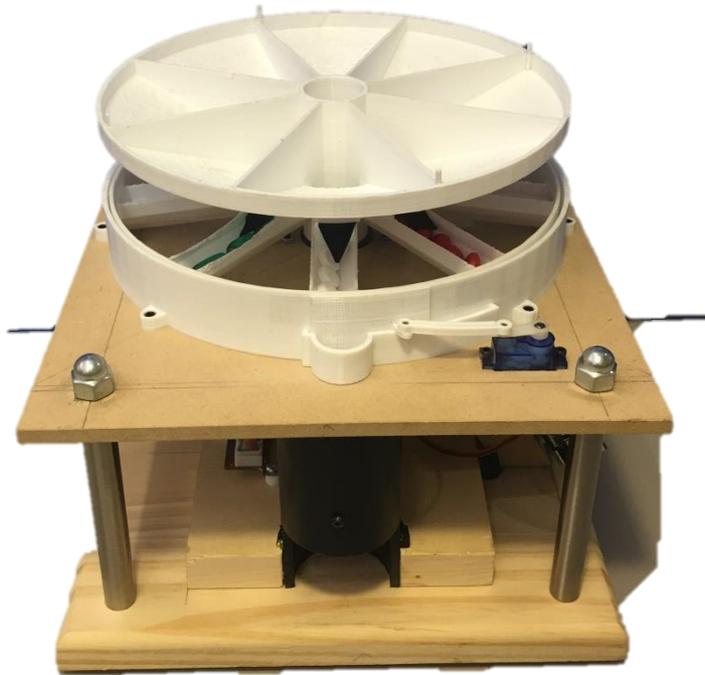


Design Process

- Iterative process – reevaluating design throughout prototype development
- Aggressive scheduling to ensure delays do not affect our end product
- Modular implementation with team integration
- Plan for many initial functionalities
 - Cut down complex ones as we approach deadline
 - Keep mandatory hard features



System Overview



- Automatic Dispensing System
- Schedules time via touchscreen or through mobile app
- Notes pill number and type and dispenses at correct time



Hardware Overview Raspberry Pi 2

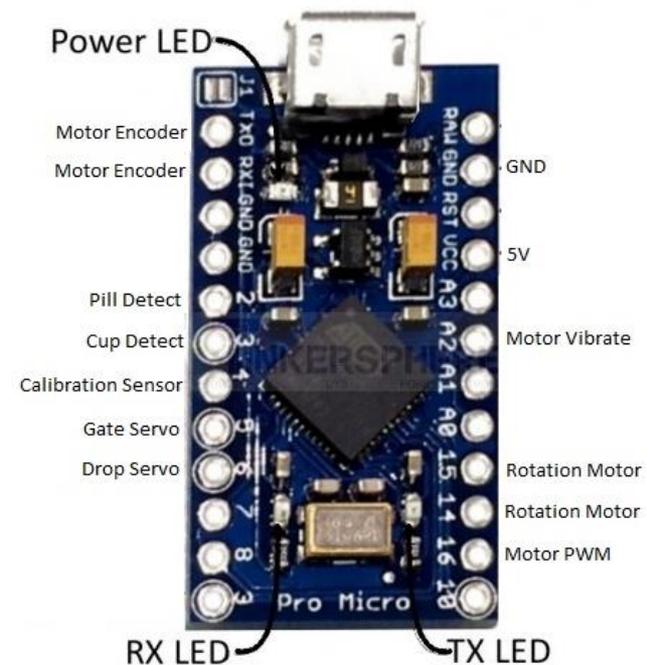
- Brains of the Pill-Matic
 - Scheduling
 - Dispensing
 - Touch Screen Control
 - Communication with smart phone



Hardware Overview

Arduino Pro Micro

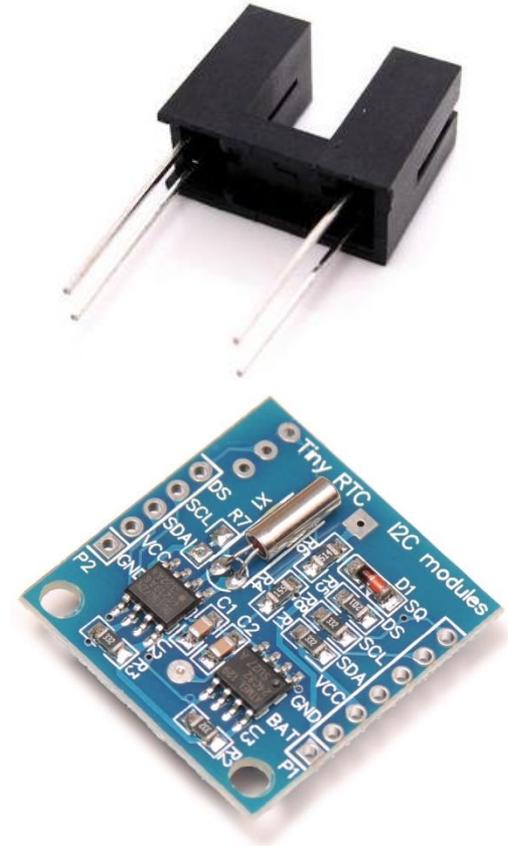
- Motor and servo control
- Reads calibration sensor and break beam sensors



Hardware Overview

Sensors

- DS1307 Real Time Clock
 - Accurate Time Keeping
- 600PPR Quadrature Encoder
 - Storage disk rotation tracking
- Photo interrupter
 - Detects calibration position
- IR Break Beam Sensor
 - Pill and Cup detection



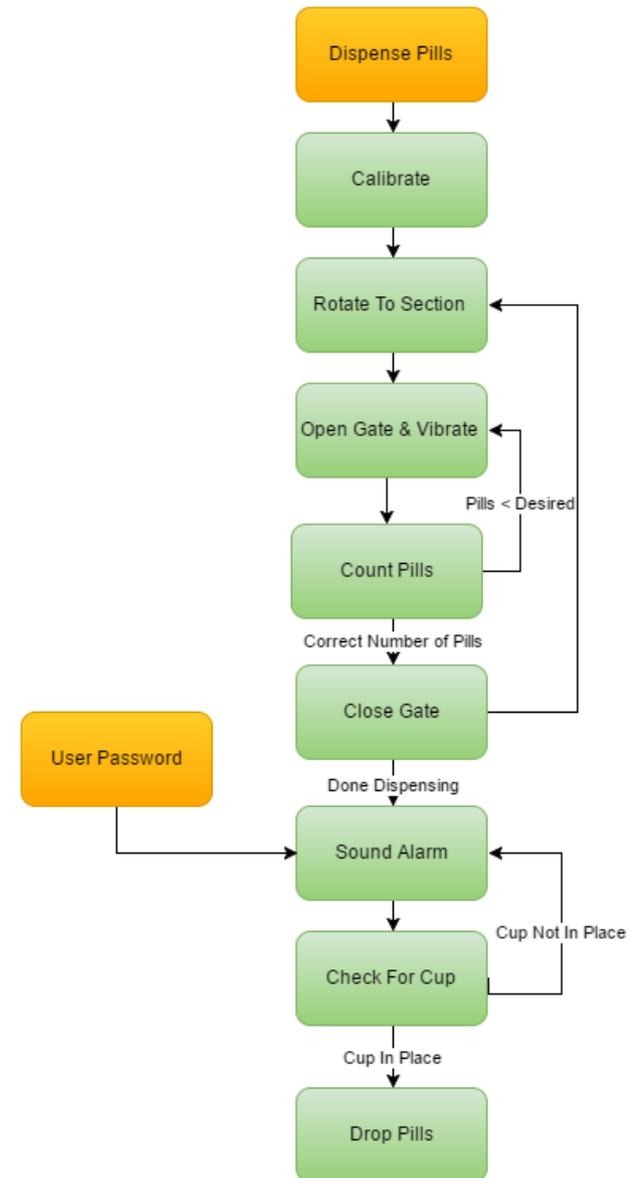
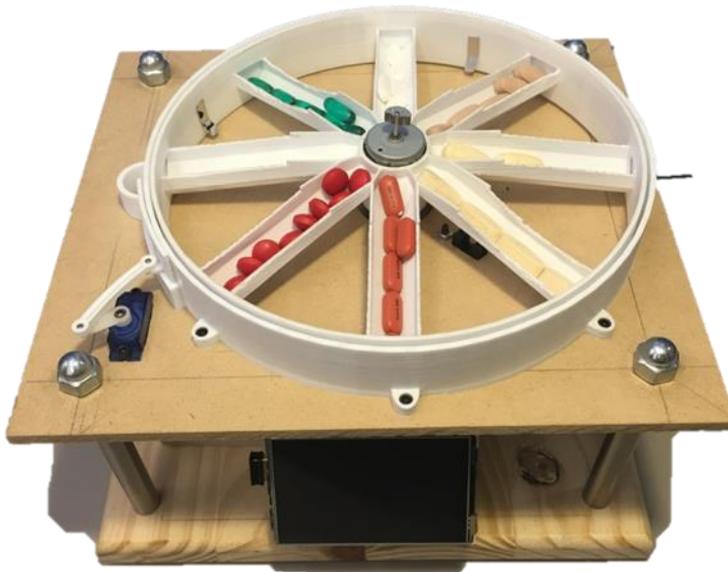
Hardware Overview

Motors and Servos

- 12V – 200:1 – 17RPM DC motor
 - Storage Disk Rotation
- TB6612FNG Motor Driver Module
- Micro Servos
 - Gate operations and dropping pills



Hardware Overview

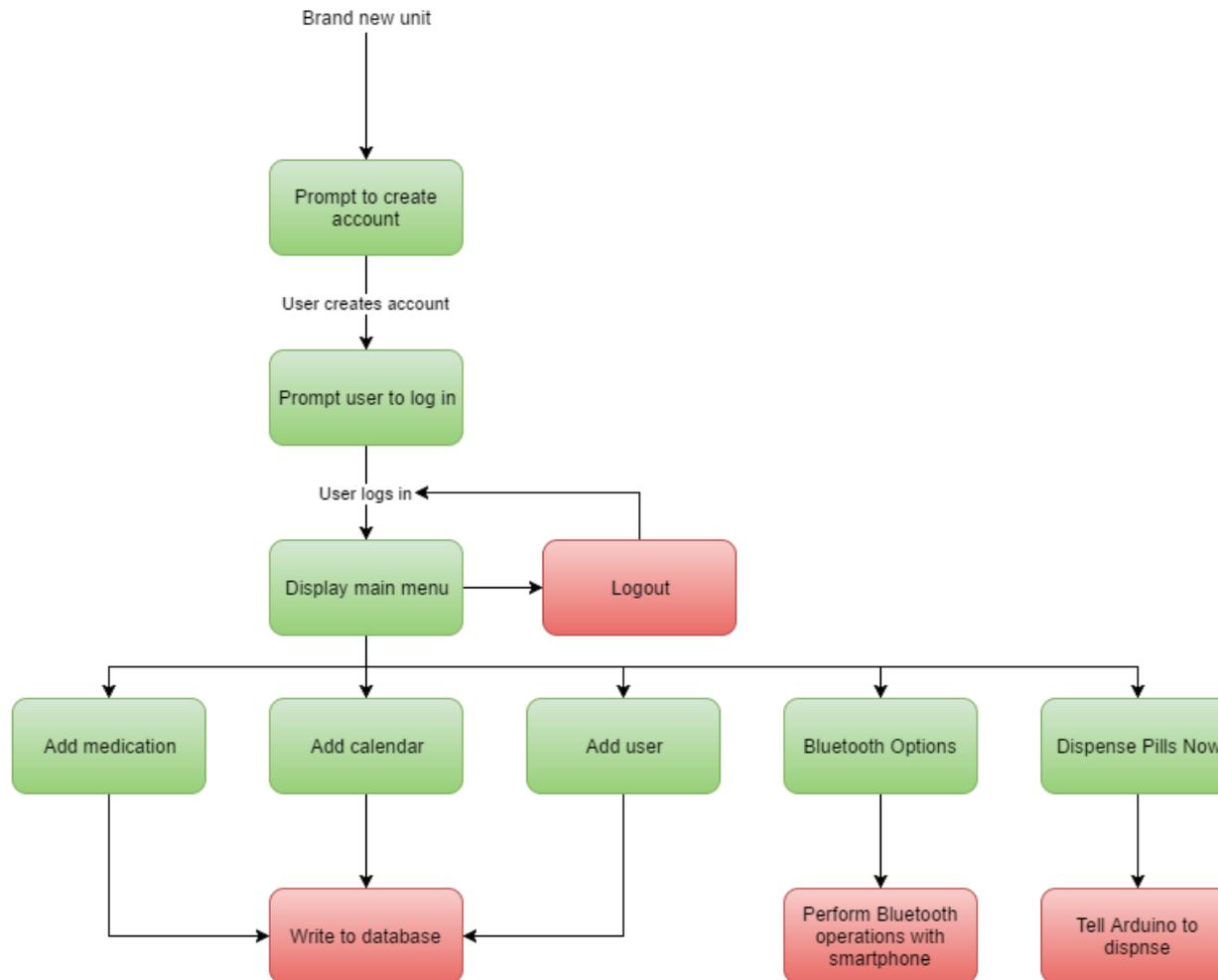


Firmware Features

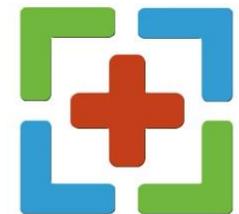
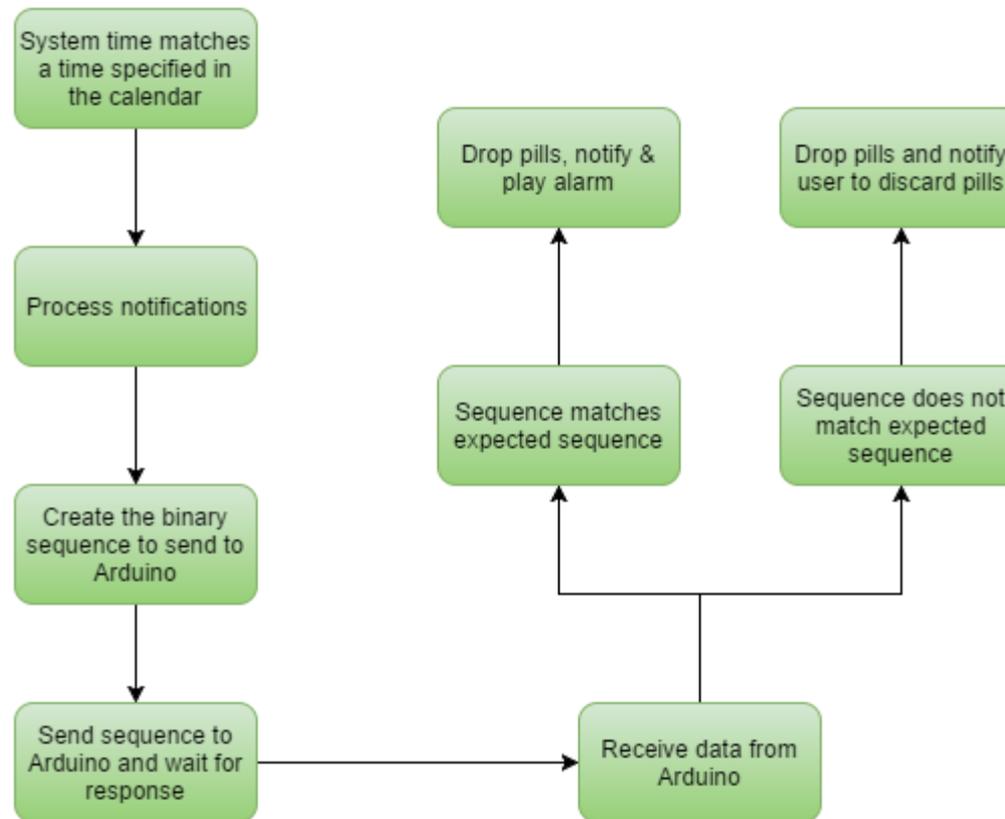
- Add medications
- Add and edit medication schedules
- Add users
- Lock screen and profiles based on users
- Notify user when scheduled time is reached
- View levels and schedules
- Bluetooth sync with smartphone app
- Dispense pills now

Firmware

User interface overview



Firmware Notification System Overview



Software Implementation

- Python with Kivy and Python on Android
- Pyjnius, Java / Android native functions
- File transfer via Bluetooth
- Algorithm to display data



Software Features

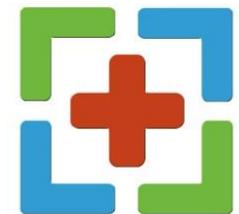
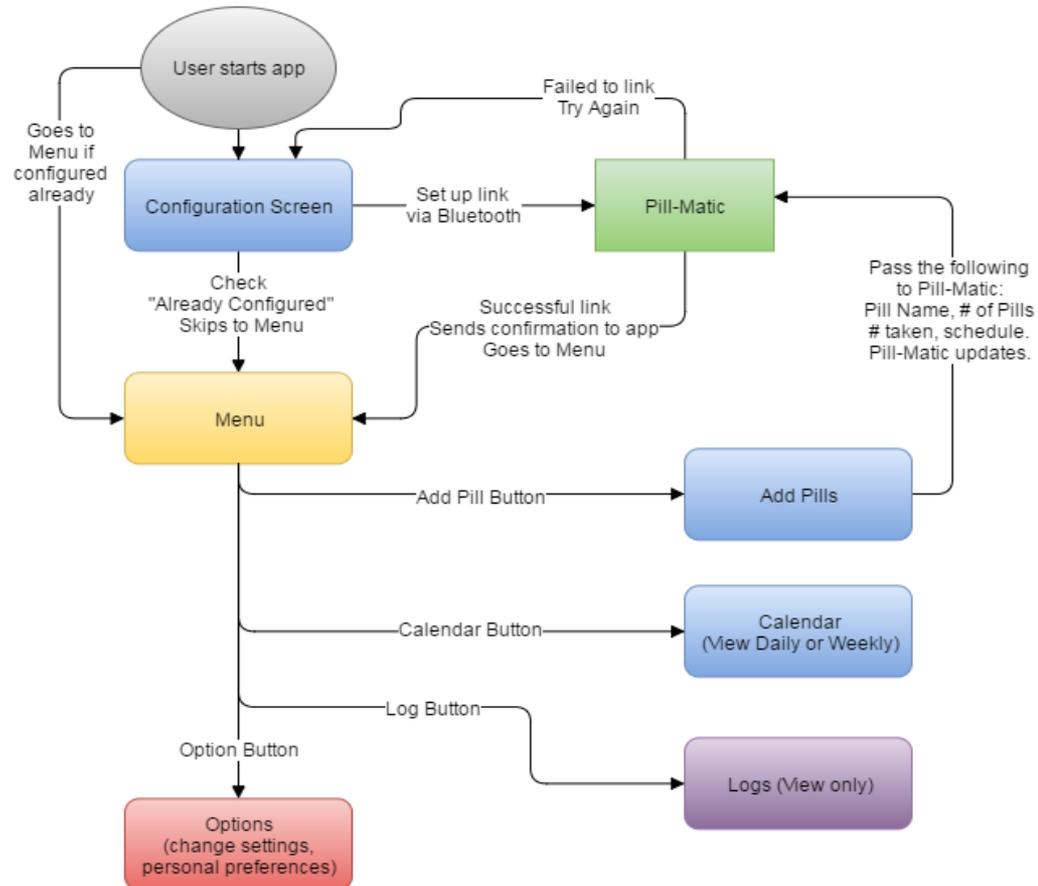
- File transfer with Pill-Matic
- Schedule display for Day and week
- User and app logs / log view
- Add / Remove schedule of existing pills

Event	Result
viewed log page	Successful view
Added medications	Advil on Tue 1200 #01
viewed log page	Successful view
Removed medications	Centrum on Tue 1200 #01
Removed medications	Centrum on Sun 1200 #10
Removed medications	Centrum on Sun 1500 #12
Added medications	Centrum on Mon 1100 #01
Added medications	Centrum on Tue 1100 #01
Added medications	Centrum on Wed 1100 #01
Added medications	Centrum on Thu 1100 #01
Added medications	Centrum on Fri 1100 #01
Added medications	Centrum on Sat 1100 #01
Added medications	Centrum on Sun 1100 #01
Added medications	Centrum on Sun 2300 #01
Added medications	Centrum on Sat 2300 #01

Back



Software Overview



The Business

- Individual unit sales in retail stores
 - Primary target market are for seniors or family members of seniors
- Subscription model for hospitals and nursing homes
 - Secondary target market aimed at caretakers that have multiple seniors to care for
- Part of a “Internet-of-Things” ecosystem that can be developed



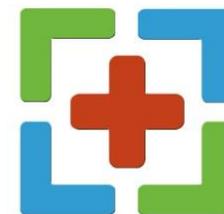
Pricing Scheme

- Total costs per unit are expected to be around \$500 as well
 - Extra pay of salary for engineers, and logistics and administrative fees
 - Reduced materials cost due to bulk purchasing
- Plan on selling for \$700 or 25% margin per unit sale
- Subscription model will depend on number of units ordered



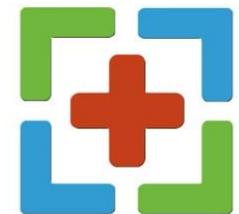
Competition

	Ivation	E-Pill	Phillips	Pill-Matic
Retail Price (CAD)	\$150.00	\$995.00	\$49.00 Monthly	\$700.00
Pill Capacity	336	700	1000	100 per hopper * 8 hoppers = 800
Reminder System	✓	✓	✓	✓
Max # of Alarms	4			2 Billion (Expandable with SD card)
Custom Scheduling		✓	✓	✓
Tamper Proof	✓	✓	✓	✓
Smartphone Notifications				✓
LCD Touch Screen				✓
Alarm Duration	Until it is turned off	Until it is turned off		Until it is turned off
Usage Record				✓



Costs and Expenditures

Item	Description	Total Price \$ (CAD)
Pololu Dual DC Motor Driver	1A, 4.5V-13.5V	6.78
Pololu 6mm Mounting Hub		10.89
12V, Gear Motor with Encoder	12V, 58RPM, 60:1 Gear	29.21
12V, Gear Motor with Encoder	12V, 17RPM, 200:1 Gear	29.21
DFRobot Micro Server		9.58
3.5" TFT Resistive Touch Screen	For Raspberry Pi	39.56
12vDC 5A power supply		33.80
Socket Head Screws -3/4" x 4-40		8.70
HS-311 Servo Motor		10.45
Raspberri Pi 2		59.99
Bluetooth Module		15.99
3D Printing	Outer Printing, Hoppers, Test Pieces	126.21
Hardware Purchases	MDF, Small Nuts, Bolts, PVC Pipe, LockTite	33.99
2 X Arduino Pro Micro	Previously Owned	10.53
Main Board Components	Previously Owned	10.00
Taxes		56.54
Total		491.43
ESSEF Funding		415.00
Remaining		76.43

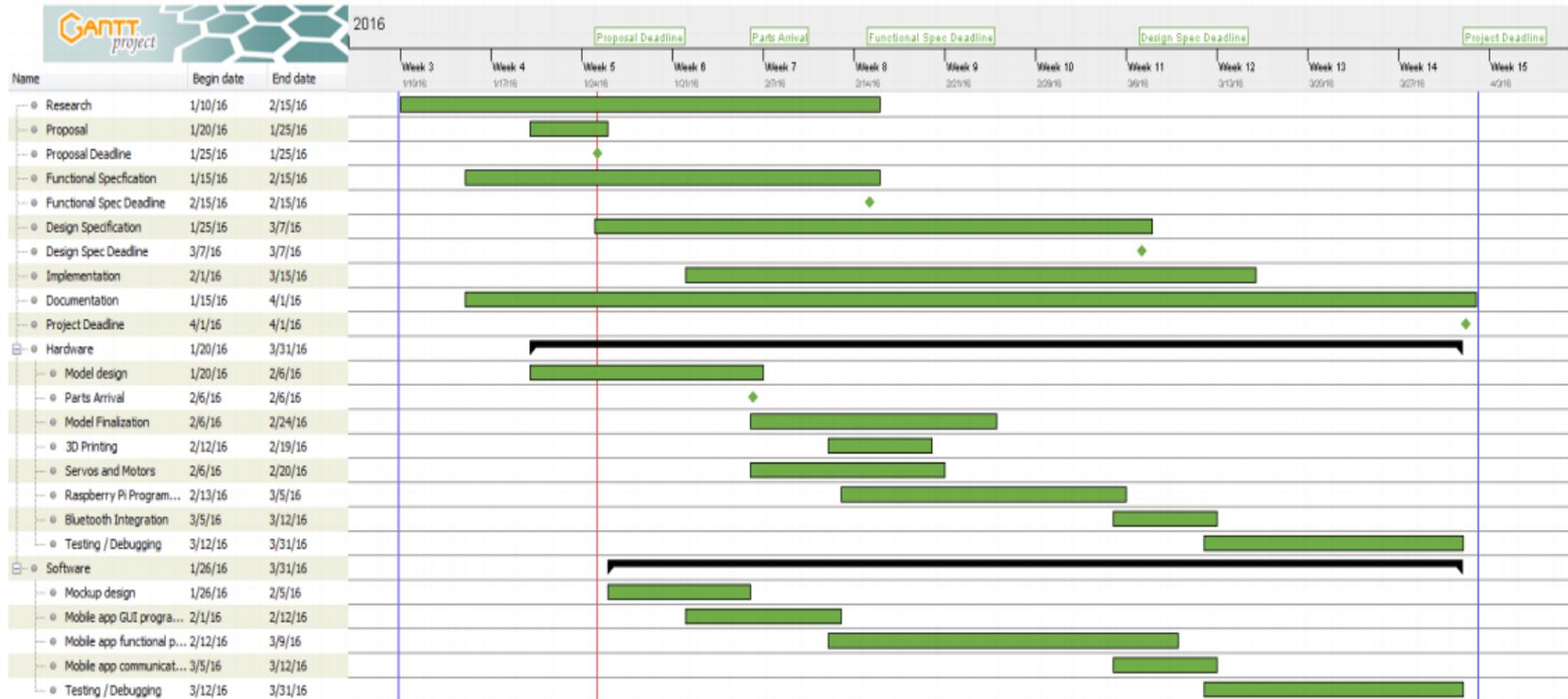


Financing

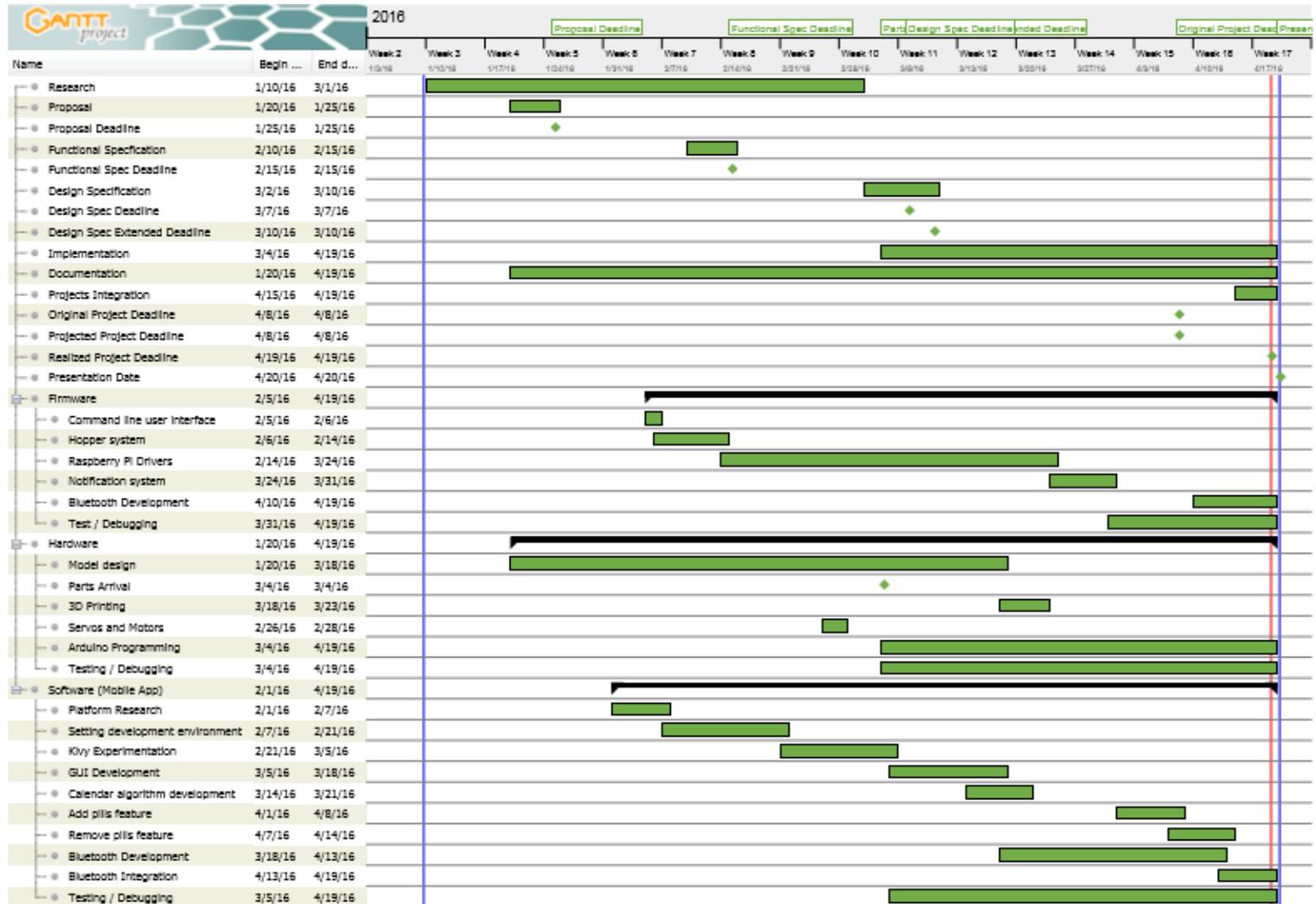
- ESSEF Funding – Asked for \$525, received \$415
- Planning on applying for Wighton Fund
- Otherwise, split remaining \$76.43 five ways between group members



Planned Schedule



Actual Schedule



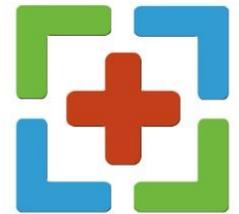
Learning Outcomes

- Work takes longer than we think
- Unexpected issues and debugging can take a large chunk of time
- Prototyping from design to finished product
- Teamwork and communication



Future Development

- Notification system on the mobile app
- Larger screen
- A case for entire system
- Compatible with more pills
- Increase speed and efficiency in the dispensing process
- Refine the GUI on the Pi and the dispenser
- Option to empty all hoppers
- Factory reset ability



Acknowledgements

- Gary Shum – ProtoMAT access
- Gary Houghton – Drill access
- Isaac Guld (3D Printing) – Great quality and a good deal

Questions



References

- [1] <http://www.statcan.gc.ca/pub/82-003-x/2014006/article/14032/tbl/tbl1-eng.htm>
- [2] <https://americannursetoday.com/medication-errors-dont-let-them-happen-to-you/>

