



OR



PHARMACY



Pharmacist: "and which medication reminder device would you like to use with this prescription?" [1]

DGMasters Inc.



PillMaster

Jasmine Liu

Jose Mendoza

Chris Xiao

Tony Lu

Ritchie Kieu

Daniel Lan

Main Organizer: Jasmine Liu

Road Map

- * Introduction
- * Our Design
- * Our Team Responsibilities
- * High Level System Overview
- * Hardware Design
- * Software Design
- * Electrical Design
- * Scheduling
- * Materials
- * Financial Status
- * Business Case
- * What We Learned
- * Future Works
- * Conclusions
- * Acknowledgement
- * References
- * Questions

Introduction

* Research

- 7.9% of the frail elderly of 65 or over are put into nursing homes in Canada[2]
- Elderly who are exposed to medication system errors have an increase up to 80% in their chance of death in a period of 3 months [3]

* Company Goal: Tackling problems in the dispensing stage

* Project Scope:

- Reduce medication system error through an automatic and programmable pill dispenser

Our Design

* Automated Medicine Dispensing System

- Flexible scheduling/personalization
- Expandable
- Programmable

User Input



[4]



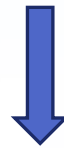
PillMaster Output



[5]

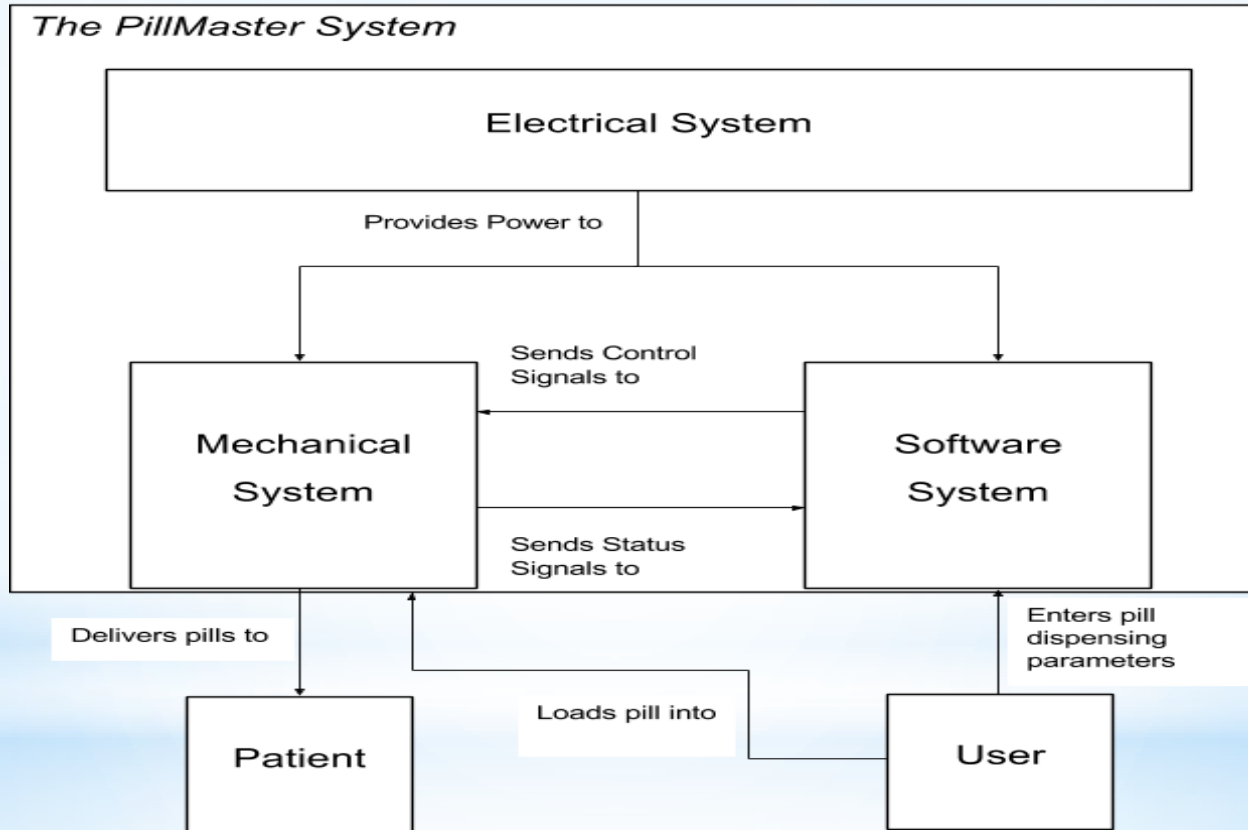
Our Team Responsibilities

Software Team	Mechanical/Electrical Team
Designed the software flow	Designed the pill path
Programmed Arduino	Cutting Mechanism
Timer	Dispensing Mechanism
Motor Control	Built the case
LCD	Power routing



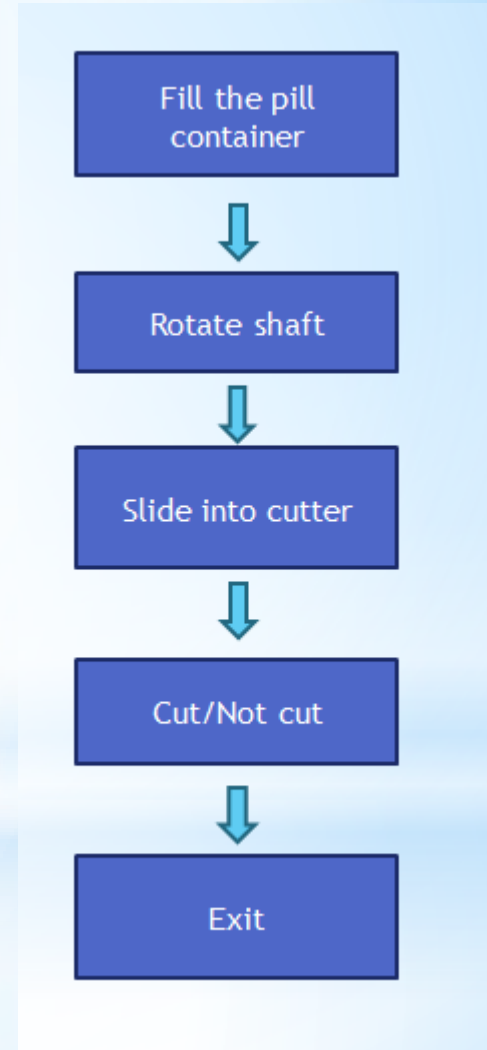
Integration
Testing
Debugging

High Level System Overview

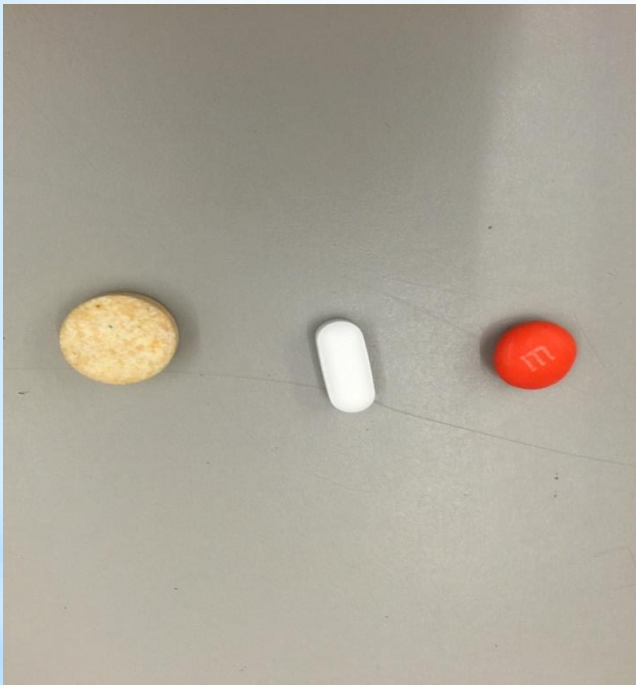


Hardware Design

- *The hardware consist of the pill path which can be see conceptually on the right
- *The mechanical parts:
 - Container/shafts/dispenser
 - Slider
 - Cutter



Hardware Design



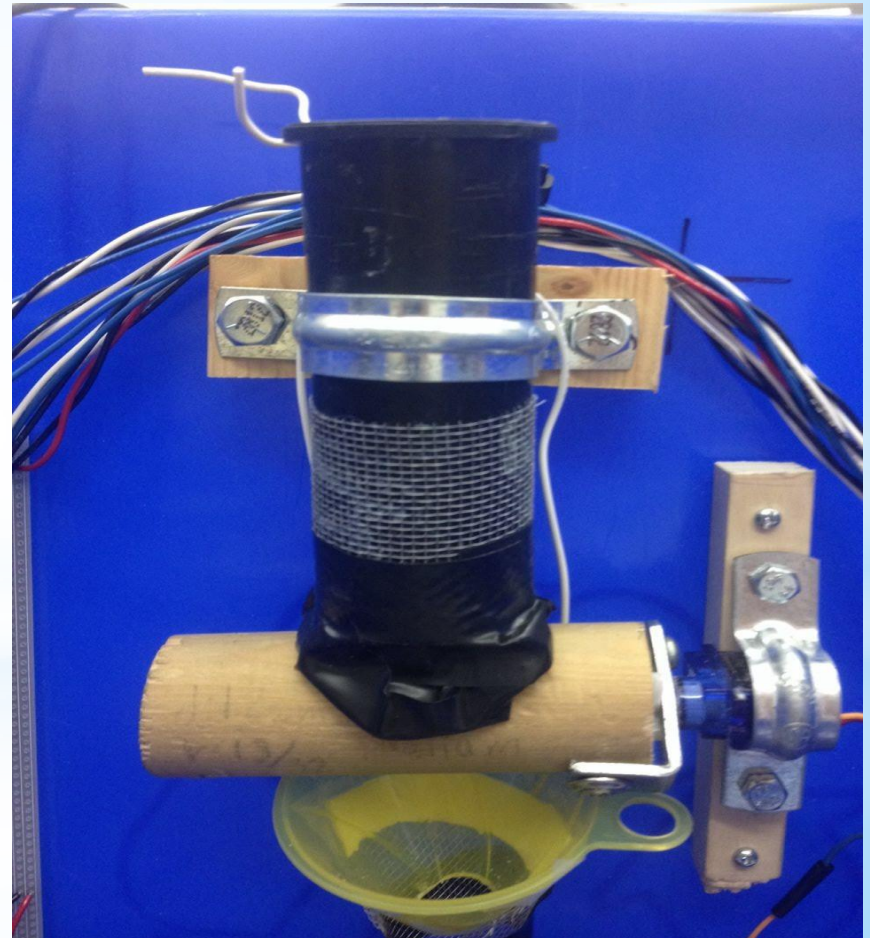
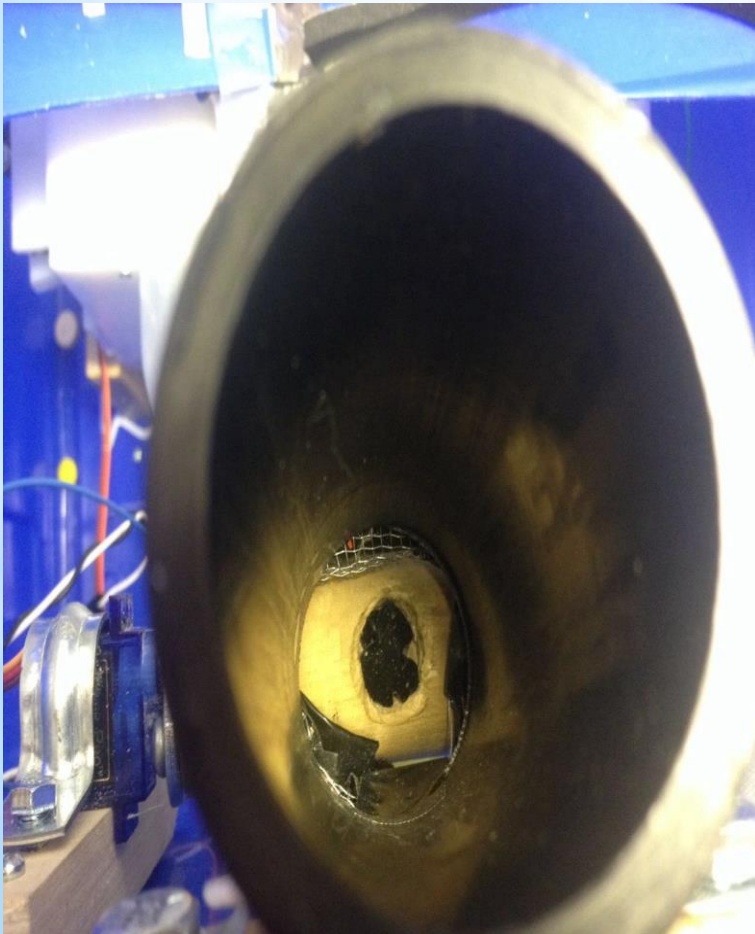
Pill Types (Left to Right):

- Vitamin (D1.5cm W0.5cm)
- Tylenol (L1.75cm W0.3cm)
- M&M (D1.4cm W0.4cm)

We only choose these for testing purposes because their shapes and sizes are commonly found in daily life

Hardware Design Cont'd

* Container/Shaft Connection



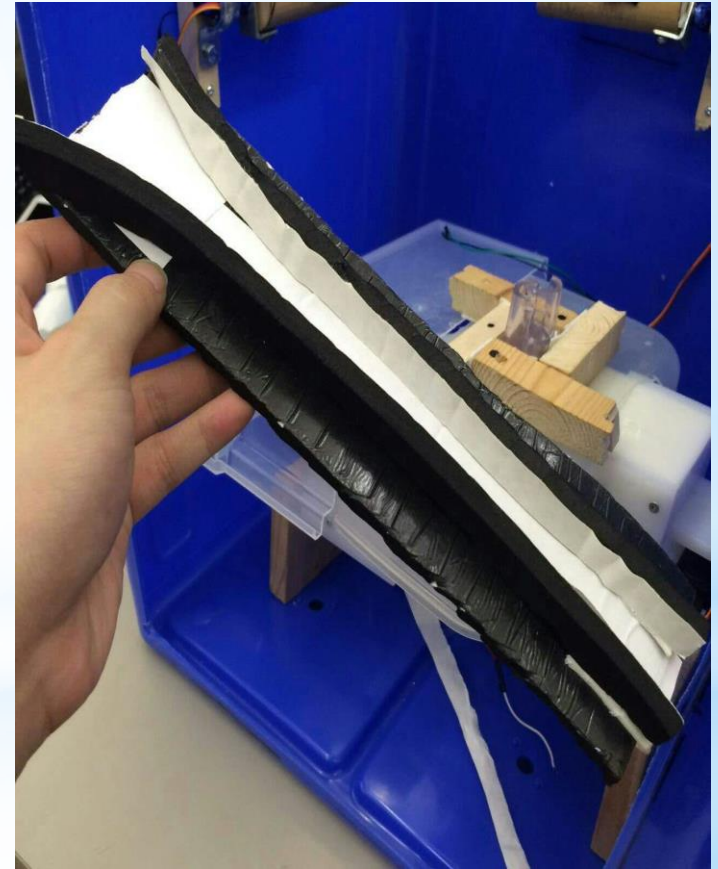
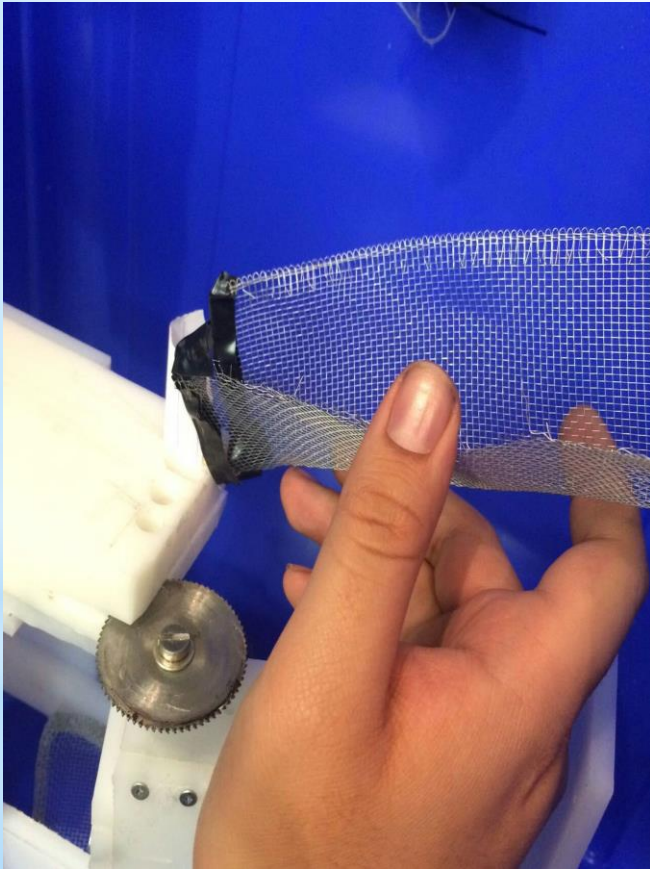
Hardware Design Cont'd

*Dispensing Mechanism Video



Hardware Design Cont'd

*Slider Mechanism Developing Progress



Hardware Design Cont'd

*Slider Mechanism Final Solution



Hardware Design Cont'd

*Cutting Mechanism Developing Progress



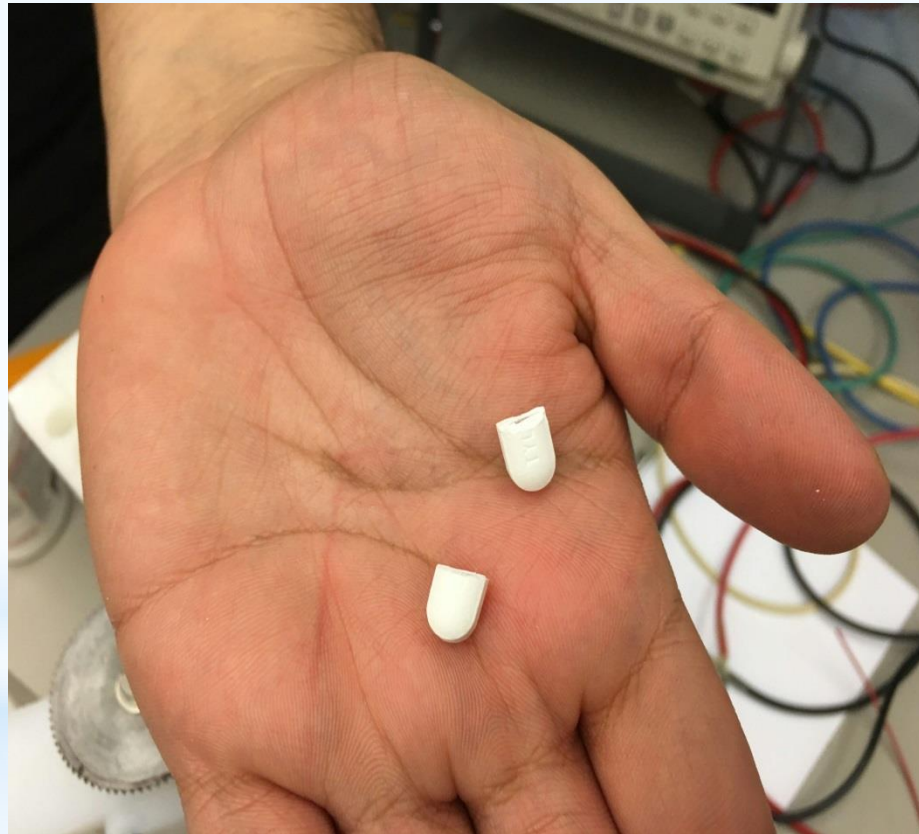
Hardware Design Cont'd

*Cutting Mechanism Video

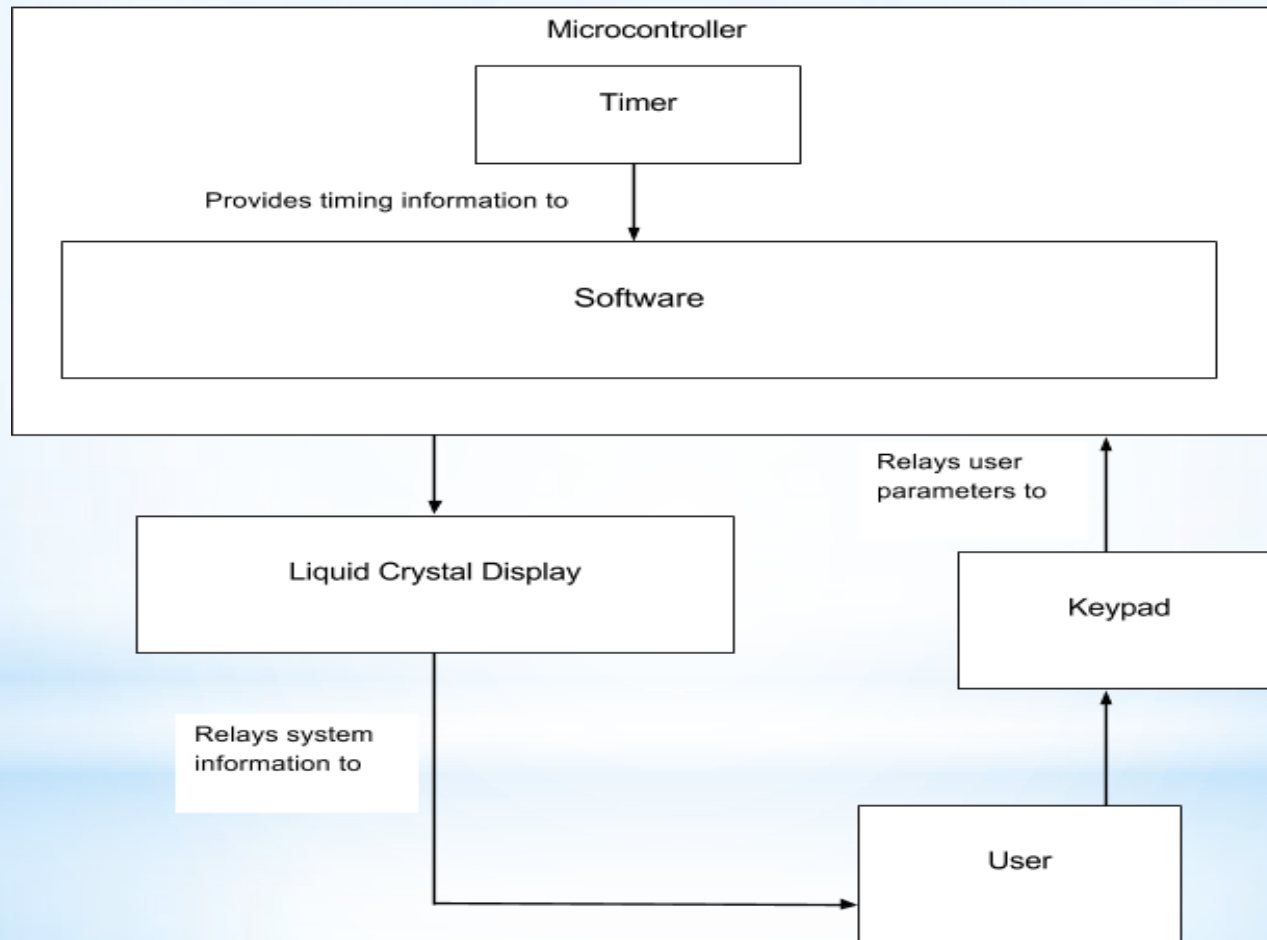


Hardware Design Cont'd

*The cut pill



Software Design



Software Design Cont'd

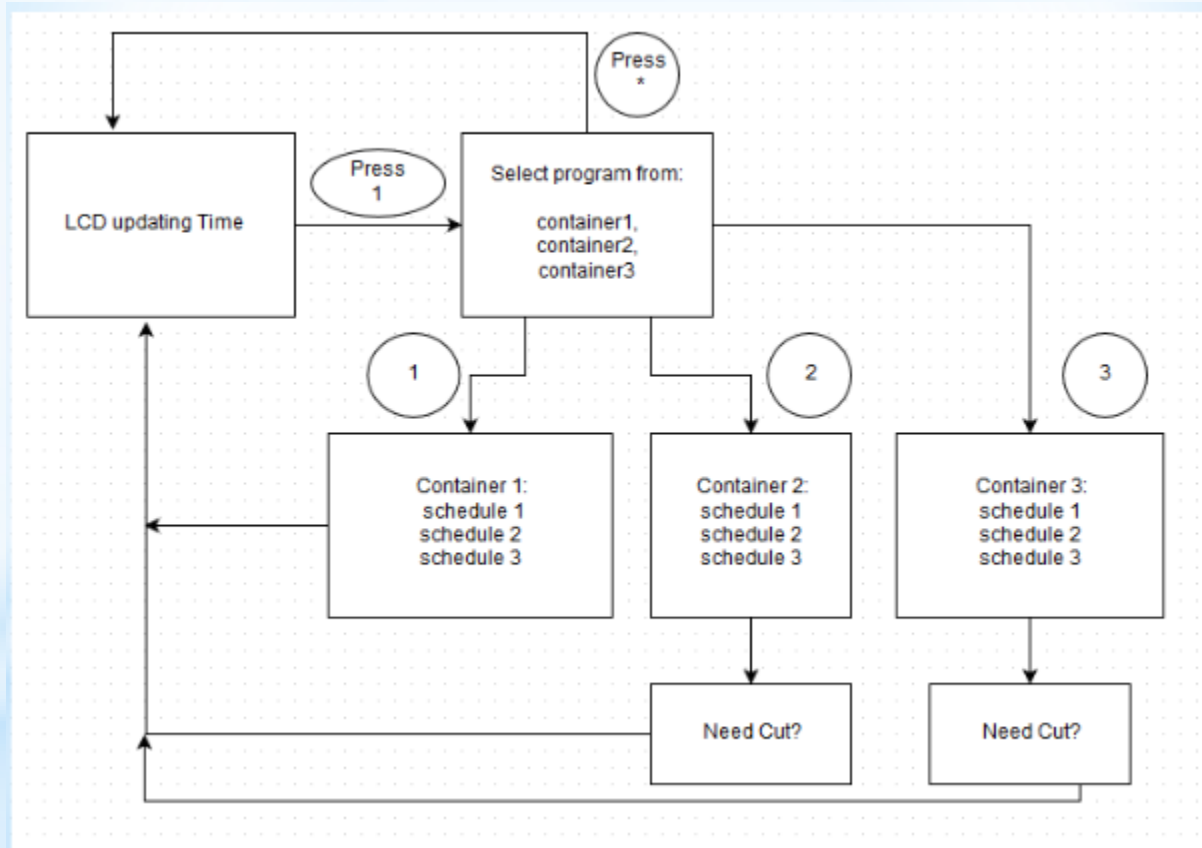
- * Microcontroller: Arduino Mega 2560 R3 Plus

- * Programming Language: Arduino

- * The main functions of the software:
 - Scheduling time
 - Motor control
 - Message display

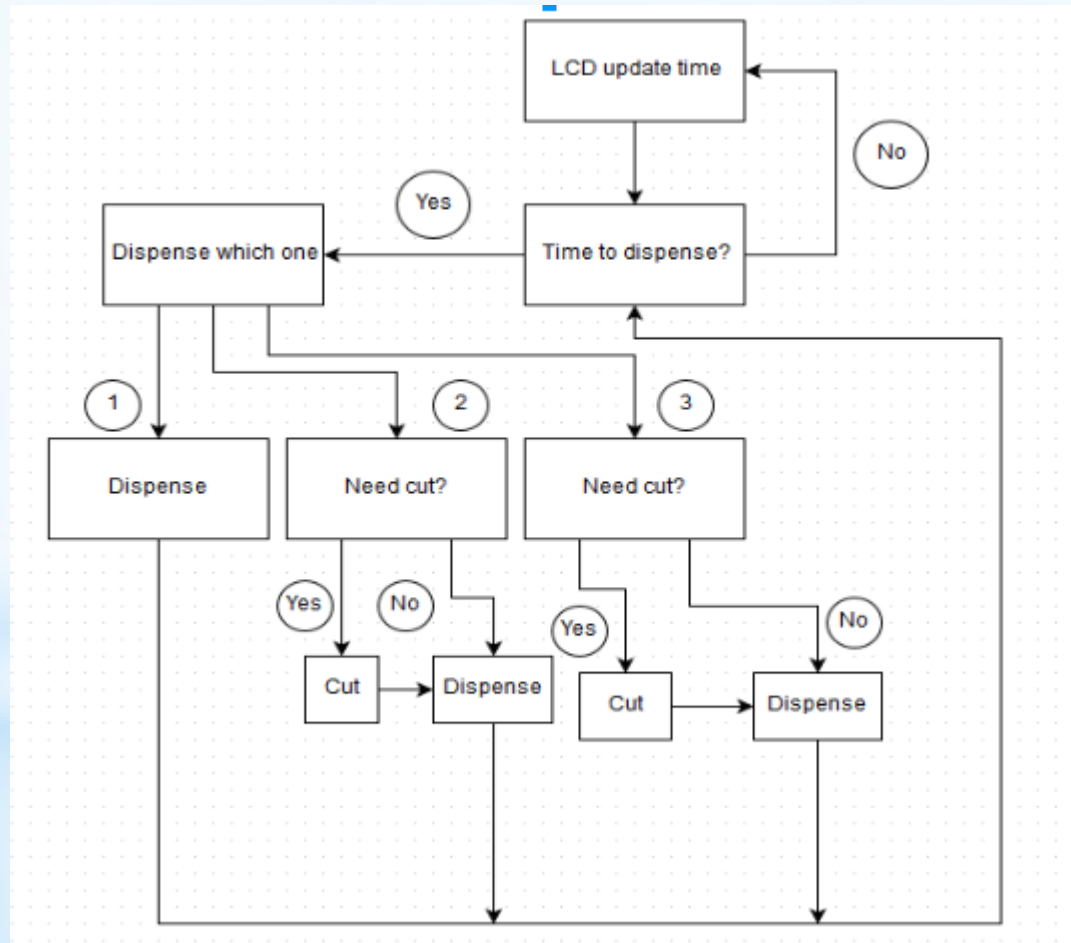
Software Design Cont'd

* Software Schedule Design Flow

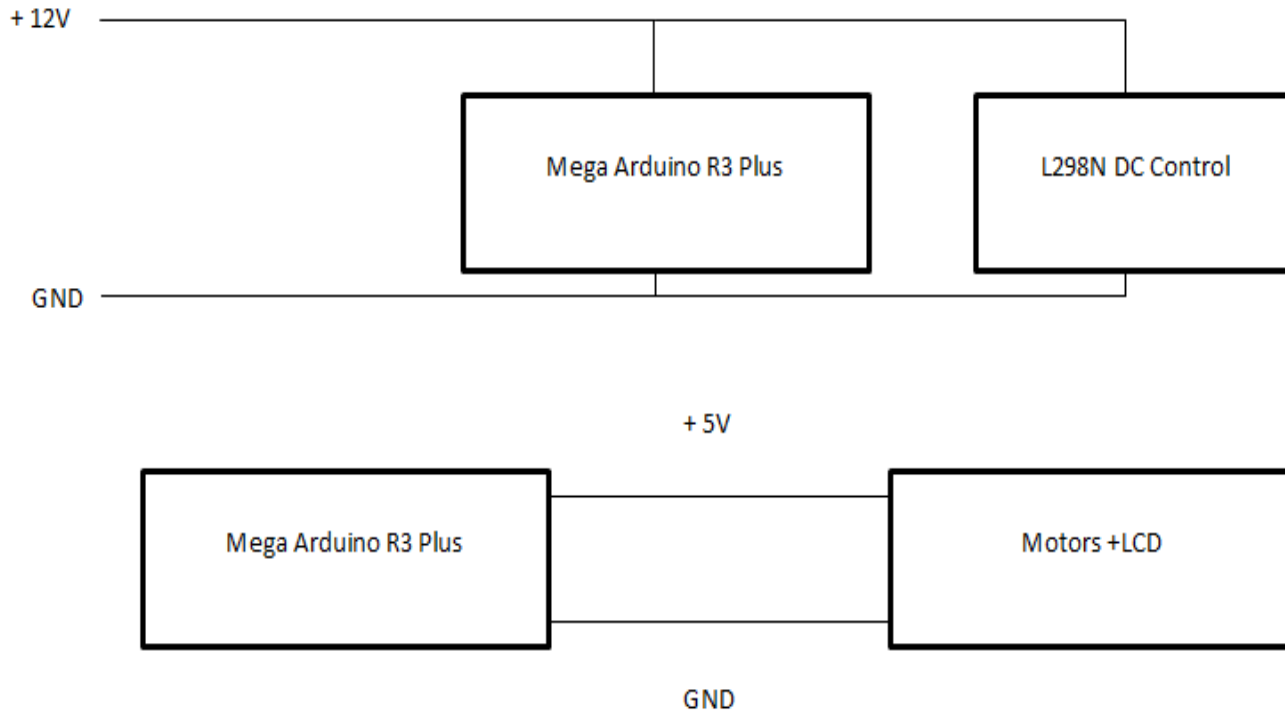


Software Design Cont'd

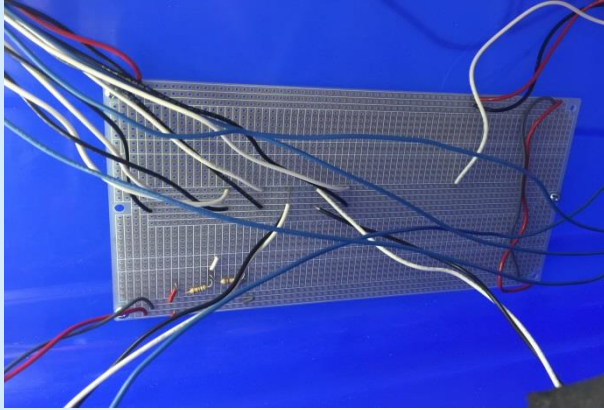
*Software Motor Control Design Flow



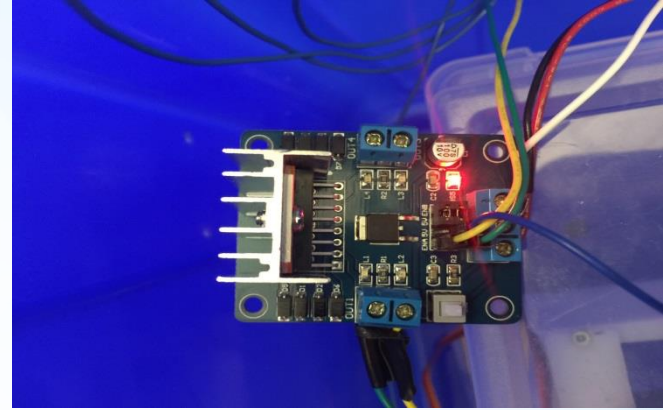
Electrical Design



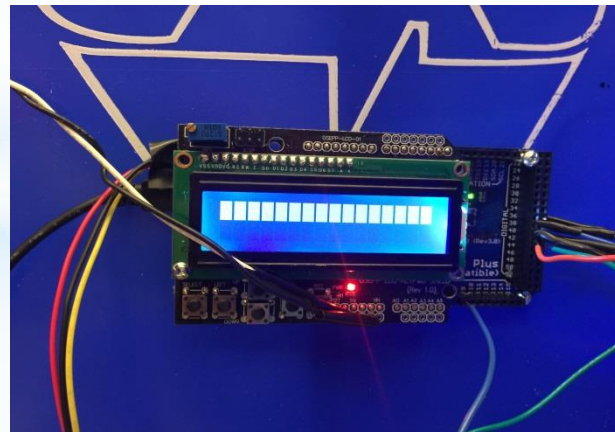
Electrical Design Cont'd



Perf-Board

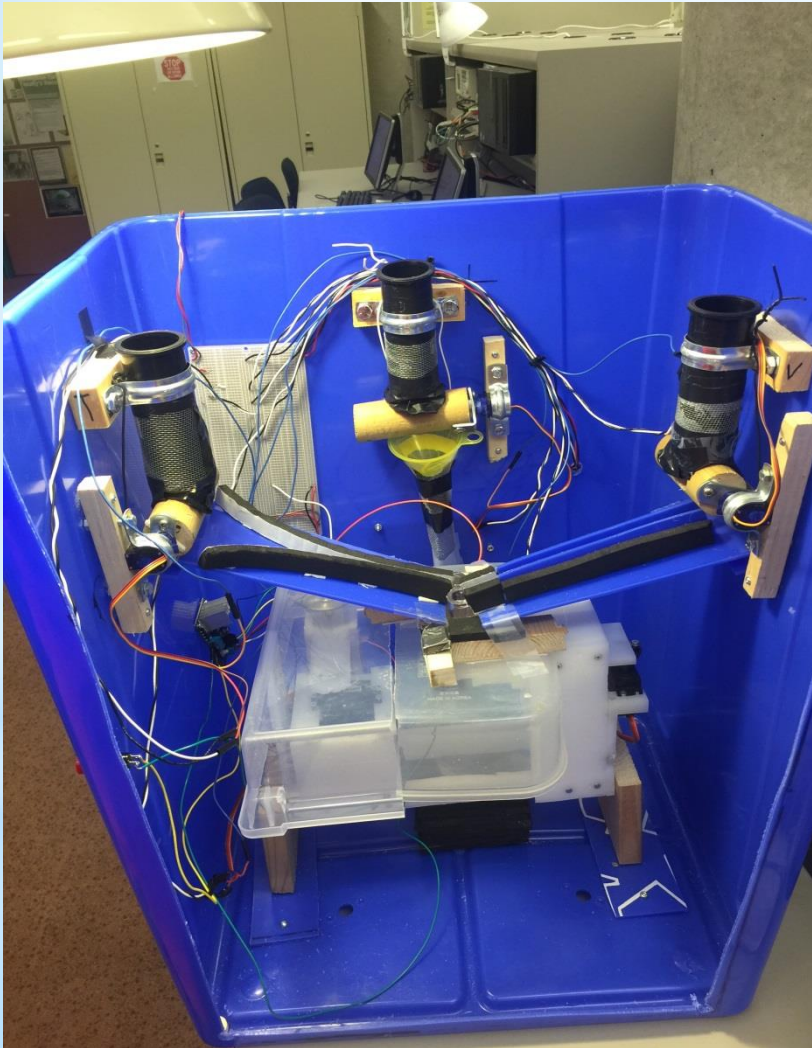


L298N Module



Mega R2560 R3 Plus & LCD

Proof of Concept



Fill the pill
container



Rotate shaft



Slide into cutter



Cut/Not cut

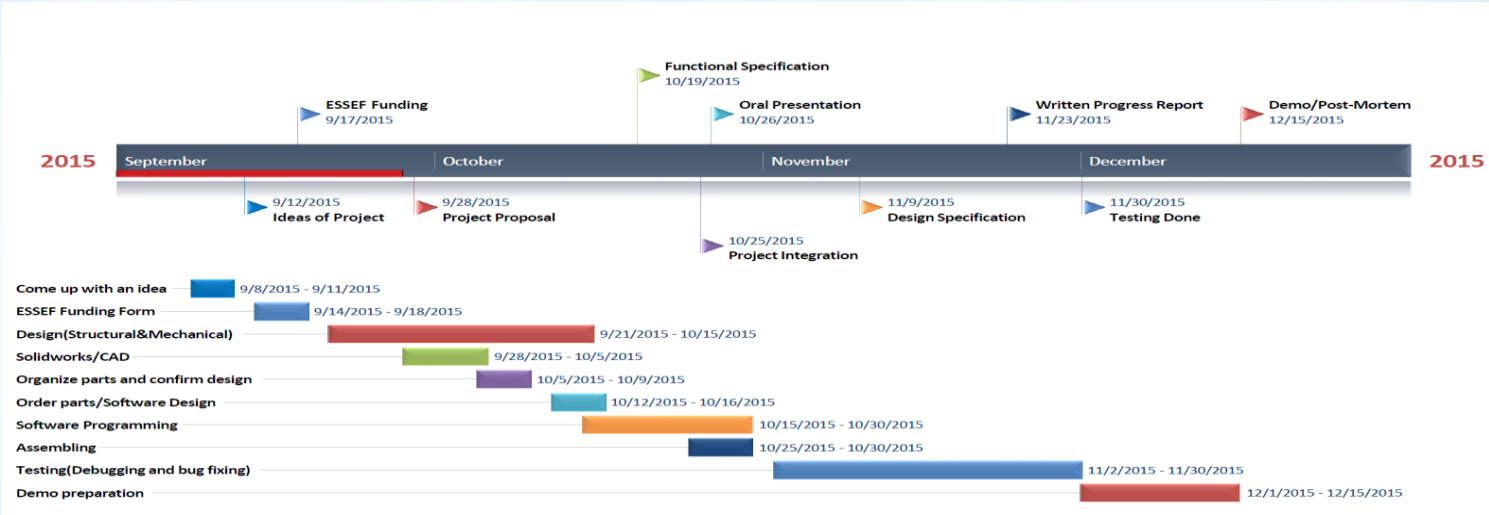


Exit

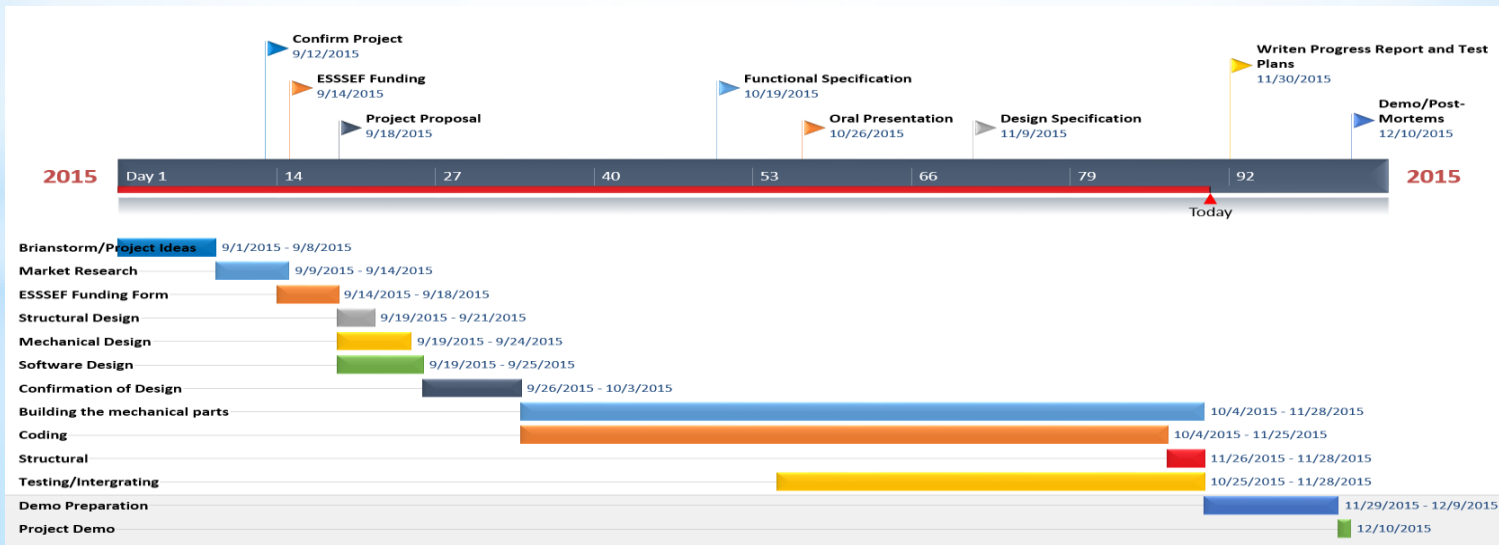
Proof of Concept

Scheduling

Intended



Actual



Materials

Main Components	Materials
Rotating shaft	Wood
Casing	Recycle bin
Pill Container	Plastic
Arduino Board/Motors/LCD	Electronics
Cutter	Polypropylene copolymer Saw Blade
Pill Slider	Recycle bin

Financial

Estimated Expenditure

Estimated Expenditures	\$1000
Motors x6	\$150
Cutter	\$25
Support Material	\$200
LCD and Keypad	\$190
Arduino Board x2	\$200
Sensors x4	\$120
Power adapter	\$40

Actual Expenditure

Total Expenditures	\$485.5		
Servo motors for the shaft x 3	\$36	12 keys keypad x 2	\$10
DC motor	\$17	LCD screen and keypad panel	\$26
High torque servo x 2	\$70	Cables	\$18
Saw blade	\$11	Infrared sensors x 3	\$30
Black tube containers x 3	\$8	Timer x 2	\$19
Plastic tubes	\$12	Breadboard	\$14
Nuts and bolts	\$30	L298N Module of Arduino	\$23
Protoboard	\$10	Aluminum Screen	\$16.5
Connectors for coaxial plugs	\$2	Plastic boxes x 2	\$9
Recycling bin for frame	\$12	Wood rod and screws	\$12
Microcontroller Mega 2560 R3 Plus	\$70	shaft connectors	\$30
ESSEF Funding	\$450		
Total Remaining	-\$35.5		

Business Case/Market

Potential Market :

- There are approximately 5,780,900 Canadians over the age of 65 on July 1, 2015 [6]
- The amount of elderly care institutions in Canada is approximately 1400 [7]

Cost:

- If we mass produce the product, we can reduce the cost to \$200/unit, which is more than half saving from the original costs.

Profit:

- Our expected selling price for each unit is \$300
- Profit = \$100/unit

Business Case/Competition

Direction Competitor

- * Philips Lifeline Medication dispensing service
- * Takes up to 6 types of pills
- * Cost: \$588/year



[8]

PillMaster

- * Cost: \$300
- * Personalization/Customization
- * Can cut the pill
- * Can be portable or fixed in position

What We Learned

*Technical Skills

- Prototyping
- Mechanical design
- Programming Arduino
- Project Documentation
- Project Planning
- Machine shop work

*Soft Skills

- Teamwork
- Communication

Future Works

*The flaws in our design and improvements

- Size
- Choose of materials
- Functionality
- Less components
- Mobile Phone App

*Potential market

- Nursing home
- Hospital
- Household

Conclusions

* Project Achievement

- We are able to built the pill dispenser as we designed
- Hardware and Software are compatible

* Project Failure

- We are not able to install the infrared/pressure sensors due to time and workspace constraints
- Pill dispenser size



Acknowledgement

- ❖ Steve Whitmore- Documentation and presentation skills
- ❖ Andrew Rawicz - Initial project idea approval
- ❖ Lukas-Karim Merhi-Progress check
- ❖ Anh Kieu - Cutter Mechanism advice
- ❖ ESSEF - Funding the project

References

- [1] <https://healthrecordresources.files.wordpress.com/2013/01/medtime-cartoon.png>
- [2] Statistics Canada, "Living arrangements of seniors," Statistics Canada, 2011.
- [3] J. Dimant, "Medication Errors and Adverse Drug Events in Nursing Homes: Problems, Causes, Regulations, and Proposed Solutions," *Quality Improvement*, vol. 3, no. 2, pp. 81-90, 2002.
- [4] <http://atomicoasters.com/2013/01/user-input-generational-advancement>
- [5] <http://lifehacker.com/swallow-pills-easier-with-the-pop-bottle-and-lean-fo-1657584939>
- [6] <http://www.cbc.ca/news/business/statistics-canada-seniors-1.3248295>
- [7] Longterm Care Canada, "Longterm Care Canada," 2011. [Online].
http://www.longtermcarecanada.com/long_term_care_resources/care_years_pg_9.html.
- [8] <https://www.lifeline.philips.com/health-solutions/health-mdp>

***Questions?**