July 25, 2020

Dr. Andrew H. Rawicz and Dr. Craig Scratchley
School of Engineering Science
Simon Fraser University
Burnaby. BC, V5A 1S6

Auto-Pharm Tech.

Re: ENSC 405W/440 Proposal for Auto-Pharm

Dear Dr. Andrew H. Rawicz and Dr. Craig Scratchley,

The enclosed document attached with this letter is our proposal document for our product: Auto-Pharm, the automatic medicine supplier. The main goal of Auto-Pharm Technology is to provide an effective way to help each family, especially the elderly, reduce the daily burden of medication, and take care of the elderly's medication safety in place of other family members. This product can provide multiple kinds of medicine and set the time to alarm the elder to take them through the website. It doesn't require the elderly to remember the operations, it can prevent the medicine accident from taking the wrong drugs or overeating when no caregiver supervises the elderly.

The following proposal document will provide a high-level overview of the product. The proposal will first start with the Auto-Pharm's background and the scope of the product, and then analyze the benefits, potential risks, the market of this product, and the cost consideration. Also included an illustration of the project schedule, the relevant detail about the company will also be provided in this proposal.

Auto-Pharm consists of five creative senior engineering students, Yu Yang, Yixuan Wang, Yuyan Dong, Yimin Long, Tao You, coming from three different engineering majors. Our team has extensive Co-op working experience in software and hardware to aid us in realizing this proposition.

Thank you for taking the time to review our proposal. If you have any questions, advice, or comments regarding the document, please contact our Chief Communications Officer Yu Yang at yya168@sfu.ca.

Sincerely,

Yuyan Dong
Chief Executive Office

Proposal for Auto-Pharm

Automatic Medicine Supplier

Team 6

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Executive Summary

In today's society, health is a matter of great concern to everyone. For the elderly population, the daily use of medicines is an increasingly common phenomenon due to deterioration of bodily functions and various diseases, In the U.S, the ambulatory elderly need to fill between 9-13 prescriptions a year, and the average elderly patient is taking more than five prescription medications [1]. It also means that preventing or reducing medical errors, such as drug errors and overdoses, is a worthy subject of study, and that there is a broad market for it: it is hard for anyone to avoid drugs throughout their life.

Auto-Pharm technology is an emerging, rapidly developing medicine company that has developed an impressive product, Auto-Pharm, to prevent the seniors from taking the wrong medicine or overeating drugs. The team consists of five creative Simon Fraser University engineering students. Each member provides their own working experiences, skills, and knowledge to improve this Auto-Pharm technology.

Auto-Pharm's mission is to provide multiple kinds of pills with a predefined dosage at a specific time to the elderly. The caregivers can set the alarm to remind the elderly to take medicine when the caregivers can not take care of the elderly. Auto-Pharm is intended for all the people who need to take medicine, but their guardians cannot always supervise them, especially for the elderly with the memory issue. Meanwhile, Auto-Pharm eliminates the guardians' worries about unable to remember the instrument's operation, the device will be automated, and provide interactions with the caregivers.

This proposal document will contain a brief introduction of the background about the elderly taking their medication, followed by an outline of the product's system overview, the analysis of risk and benefits, the market, the schedule of the project developing, and the funding. There are similar products on the market to ensure that the elderly take the correct medicine at a specific time. Considering the factor about memory impenitent of the elderly, Auto-Pharm decided to decrease the numbers of buttons as much as possible to be perspective to the elderly. We estimated that the total cost of Auto-Pharm's primary components would be $145, and the customers will purchase $150 for the final product.

In the week of August 16th, Auto-Pharm Technology will demonstrate Auto-Pharm's proof-of-concept. And then following the scheduled plan to complete the engineering prototype by the middle of December 2020. Auto-Pharm Technology will work on the product step by step and aim to achieve all the functions in the end. With the skills and knowledge of each member, Auto-Pharm Tech. wishes the product can be extended to all over the world.

Table of Contents

List of Figures

List of Tables

1. Introduction

Aging population refers to the number of people over the age of 65 (the seniors) is increasing in virtually every country in the world [1]. And most of the seniors require multiple medications to maintain their health, the average elderly patient is taking more than five prescription medications in the U.S [2].

Nowadays, there are many medicine dispensers on the market to prevent the elderly from forgetting to take their medicine and overeating. They contain various functions, such as setting the alarm to remind the elderly, providing the specific pieces of pills to the seniors, or sending emergency messages to the caregivers. However, these products do not take into account that the elderly suffer from memory impairment and vision issues. The new solution: Auto-Pharm has deleted the buttons, which will not require the seniors to press for getting their drugs. Auto-Pharm utilizes the Auto-Pharm technology's website to do the interfaces with the caregivers. To be more specific, the caregivers will need to set the alarm time and the dosage of the pills for the elderly, and the instrument (Auto-Pharm) will get this information from the website, dropping the drugs before the set time. Meanwhile, Auto-Pharm will contain a series of double-checking systems to allow the guardians of the elderly to correct the number of medicines and the time setting. The product prevents medicine errors in less communication with the seniors, helping the guardians to supervise the elderly.

2. Project Overview

For the second section of this proposal, it will introduce the Auto-Pharm project overview from two parts: Hardware, and software. It also will include the scope of the project to describe the stages needed during the project development.

2.1 Hardware & Software System Overview

Auto-Pharm aims to help the seniors to take their medications safely and promptly when the caregivers are out at work and cannot supervise them. The most attractive feature of Auto-Pharm will be its design about the double-checking function. The development team added a complete self-checking system in the device and built a schedule section on the website to serve as a better medicine dispenser. The instrument itself contains motors which are controlled by a microcomputer to provide the pills automatically. A high-level behavioral hardware diagram description of functionalities is shown in Figure 2.1.
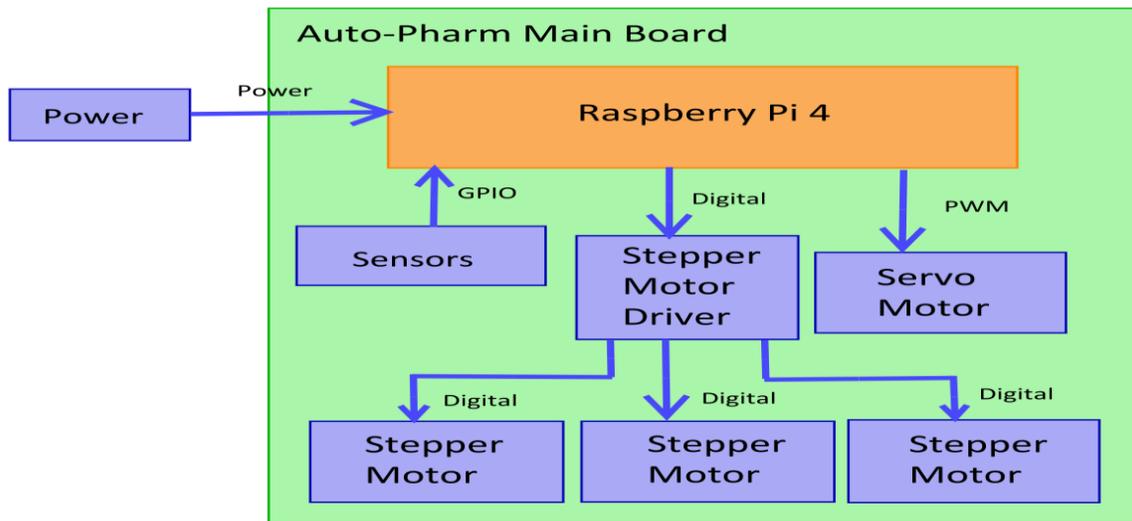
Figure 2.1: Auto-Pharm Hardware System Overview

Figure 2.1 illustrates Auto-Pharm's hardware system overview, where the Raspberry Pi 4 (the microcomputer) gets the information about the alarm time and dosage from the website. Then it will control these components to achieve their tasks. The drugs will be provided by the turntables, which are connected with the stepper motors. Sensors are the part that Auto-Pharm technology members add to check whether the pills are taken away by the elderly or not. Auto-Pharm will also remind that the amount of medicine is not enough, then the guardians of the elderly need to fill it manually.

The software of Auto-Pharm is a website which the caregivers can access anytime, the main function of the website is to help the caregivers make the setups, such as dosage, time of taking medicine. It also provided the email notification to the caregivers if the medicine had not been taken from the device after 30 minutes of predefined time.

2.2 Scope

As mentioned in the introduction part, Auto-Pharm's objective is to provide an instrument that helps the guardians to supervise the elderly about taking medicine on time, and the seniors are not required to remember Auto-Pharm's operation. During the development of this product, Auto-Pharm technology members would like to separate the stages as Proof-of-Concept, Engineering Prototype, and Final Product. Ultimately, the device will be placed on the table, providing the number of pills automatically at the setting time. Additionally, the checking function on Auto-Pharm reduced the probability of getting false alarms as possible. For the

Proof-of-Concept stage, the main body of the device will not be assembled, but in the Engineering Prototype stage, both soft and hardware will be formed as the final appearance.

3. Risks

As the development of Auto-Pharm will last for eight months, Auto-Pharm technology members investigated and discussed the potential risks that may be involved in the project. Risks such as safety considerations are the most important as the instrument's audience is planned for seniors. Auto-Pharm should ensure that each component has a safe performance, and it will not harm the elderly during operation. Especially, several electronic components need to be connected to the power supply. The following sections highlight some of the problems that Auto-Pharm technology members might face during the prototyping and final product manufacturing and the plan to minimize such risks.

3.1 The Instrument

The instrument is placed on a table, providing the elderly with the presence of medicines every day, which means that the instrument's overall shape will have a physical level of the potential risk to the elderly. In other words, Auto-Pharm should protect seniors from accidental bumps while taking medicine. The members of Auto-Pharm have considered the situation of the elderly being injured by the instrument. Therefore, the Auto-Pharm will be designed with flat and rounded edges.

3.2 Safety from Components

Besides considering the safety of the overall shape of the Auto-Pharm, the safety of power sources and rotating components like motors is also an important aspect. Auto-Pharm's power will come from the electricity source of the house or apartment, so the instrument will utilize the power adapter to convert any high voltages at the first beginning. To explain that, the highest working voltage of components will only be 5V to avoid injuring the elderly because of leakage. The selected electronic components can also work properly in this power-environment. Meanwhile, the power sour and wires will contain short current protection as the final product of Auto-Pharm to protect the elderly. Auto-Pharm will intend to enclose the motors and other components in a durable enclosure to prevent the seniors from getting confused about the motor and other objects, reducing the chances of misuse by seniors.

4. Benefits

The first and most important potential benefit of Auto-Pharm as a product is to ensure whether the elderly take medicine on time or not when the guardian cannot supervise seniors, protecting the life of the seniors indirectly. Moreover, Auto-Pharm is designed to be a simplistic instrument

that the seniors will not need to know operation. In this section, more details about benefits will be elaborated for the elderly and caregiver.

4.1 Reassure the Caregivers

Auto-Pharm aims to reduce part of the guardian's burden about supervising the elderly to take medicine when the caregivers are working. The information about the alarm and dosage of pills is set remotely through the website by the caregivers. And Auto-Pharm will send the emergency message as E-mail to the guardians of the elderly after 30 minutes if the instrument detects that the elderly do not take their medicine. To explain more, Auto-Pharm contains a weight sensor at the medicine outlet where the elderly will take their pills, the weight detected indicates that seniors have not taken the pill. Therefore, the alarm will remind the senior people, and then the emergency message will be sent to the caregivers after ringing 30 minutes of the alarm. Furthermore, the website will also provide the information about the remaining number of drugs, sending a message about drug shortage to the guardians, so that the caregivers can fill the medicine in time.

4.2 Friendly User Interface

The instrument will need to be bound to the web page that the caregivers will register with their email account. The design of Auto-Pharm is very straightforward to understand to reduce the pressure of operation for the caregivers. For the instrument, each turntable (three in total) will clearly label the medicine type name ("A, "B", "C"). And then the website of Auto-Pharm is also very clear as the below figure 4.2 shows:
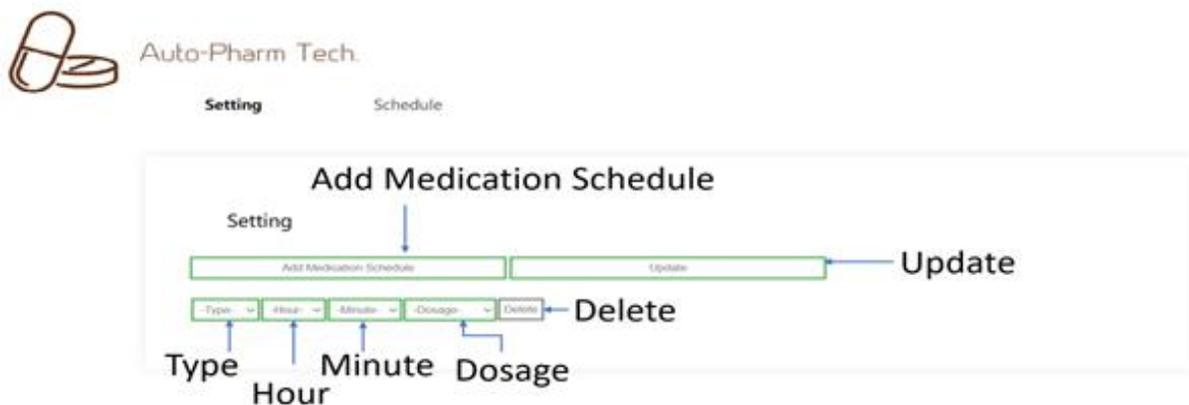
Figure 4.2: Website for Setting Alarm

Figure 4.2 shows the web page after the caregivers register their account, this page allows the guardians to set up the alarm reminder, and the "type" corresponds to the turntables with name "A", "B" and "C" to be more convenient while the caregivers are working on the website. Meanwhile, the website contains a "schedule" section to allow caregivers to double-check the defined information, protecting the safety of the elderly.

5. Market Analysis

According to the study published in the British Journal of Clinical Pharmacology, medication underuse – not taking enough of prescribed drugs, is a big problem. The study indicated that two-thirds of the patients did not take the full amount of the medications they need, 56% of the patients took a drug longer than recommended, or at the wrong time of day, and 40% not only misused but also underused various medications [3].

For these problems, the general solution is the family of the elderly assists the patients while they need to take medicine to avoid accidents. However, many elderly patients are living alone, which means it is hard to guarantee that the elderly's family can take care of them for 24 hours. Considering the vast potential of this market and its large population, the company product: Auto-Pharm will provide an efficient and advanced solution to reduce the possibility of medication errors in the elderly by reminding the elderly users to take their medicine on time and interact with their caregiver in real-time.

5.1 Target Customers

The target customers are seniors who need to take medicine and live alone. According to Carl Salzman's report, "Medication compliance in the elderly" (1995), drug non-compliance severe for older patients. Estimates of the extent of drug non-compliance in the elderly vary from 40% to a high of 75% [4]. In this report, Carl Salzman also stated that there are three common forms of drug treatment non-compliance are found in the elderly, which are overuse and abuse, forgetting, and alteration of schedules and doses [4]. Some older patients who are acutely ill may take more than the prescribed dose of a medication in the mistaken belief that more of the drug will speed their recovery.

Furthermore, the research of Salzman found that there is around 25 percent of the elderly need to take at least three medications, the average drug use among elderly hospitalized patients suggests that taking eight medications simultaneously may be typical [4]. The existence of drug non-compliance and the data from Salzman's research imply that the elderly need external assistance to avoid the risk of taking medication. However, as mentioned before, most seniors are living alone. In the US, nearly 29% of the 46 million community-dwelling older adults live alone, about

half of the community-dwelling oldest old ($\geq$ 85 years) live alone [5]. Older Americans comprise 13 percent of the population, but they consume 30 percent of all prescription drugs [5]. The trend of population ages over 65 is shown in Figure 5.1:

Population ages 65 and above (% of total population)

World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision.

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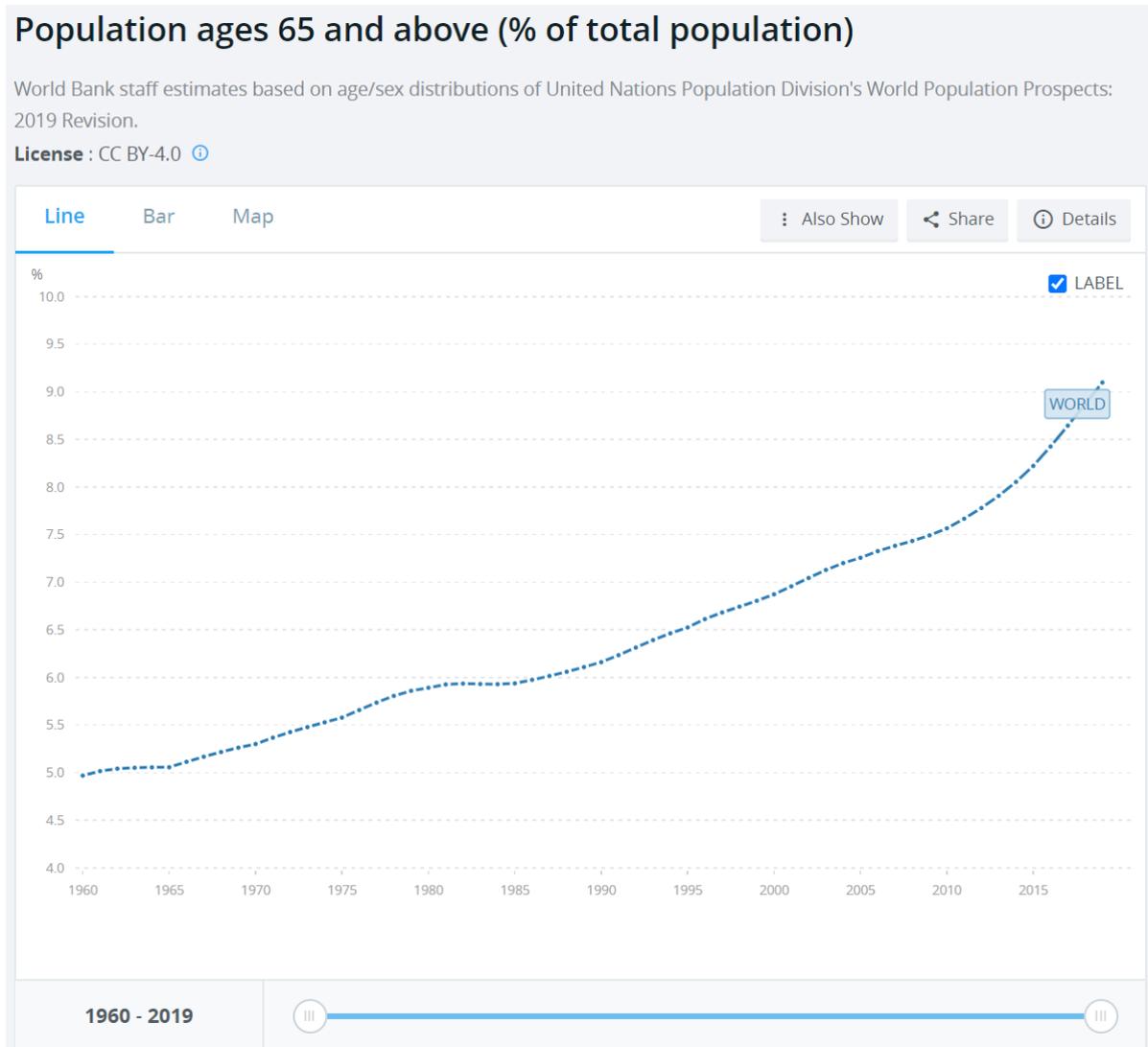
Figure 5.1: Population ages 65 and above [6]

Auto-Pharm is dedicated to helping the above groups to avoid medication risks. Showing in Figure 5.1 [6], the trend of population ages over 65 all over the world is increasing. Therefore, the potential customers for Auto-Pharm also grow, which means that the market of Auto-Pharm will also expand.

5.2 Market Size

According to the "Automatic Pill Dispenser Machine Market Overview", in 2016, the global market size of automatic pill dispensers was $1.755 billion [7]. And it was expected to reach the US $3.023 billion by 2023, with a compound annual growth rate of 8% during the analysis period (2017-2023) [7]. The growth of the elderly population drives the market growth. Meanwhile, the high installation costs for large automatic pill dispenser machines are expected to limit the market's growth. In these cases, Auto-Pharm occupies advantages in the market as it is low-cost, easy to install and suitable for the family because of the compact size. Figure 5.2 shows the segmentation sample graph:

Automatic Pill Dispenser Machine Market Segmentation

BY TYPE

- Centralized Automated Dispensing Systems
  - Robots/Robotic Automated Dispensing Systems
  - Carousels
- Decentralized Automated Dispensing Systems
  - Pharmacy-Based Automated Dispensing Systems
  - Ward-Based Automated Dispensing Systems
  - Automated Unit Dose Dispensing Systems

BY APPLICATION

- Hospital Pharmacy
- Retail Pharmacy
- Home Healthcare
  - By Indication
    - Dementia
    - Old age
    - Visual Impairment
    - Physical Disability
    - Parkinson's Disease
    - Mental Health excluding dementia
    - Learning difficulties
    - Others
  - By Age-group
    - 18-64 Years
    - 65-74 Years
    - 75-84 Years
    - 85 Years and Above

BY REGION

- North America
  - U.S.
  - Canada
  - Mexico
- Europe
  - Germany
  - France
  - UK
  - Italy
  - Spain
  - Rest of Europe
- Asia Pacific
  - Japan
  - China
  - India
  - Rest of Asia-Pacific
- LAMEA
  - Latin America
  - The Middle East
  - Africa

Figure 5.2 Automatic Pill Dispenser Machine Market Segmentation [7]

From the market Segmentation shown in Figure 5.2, based on the type, the global automatic pill dispenser market can be divided into a centralized automatic dispenser system and distributed automatic dispenser system. Centralized automatic dispensing systems have the highest market share and are expected to grow at the highest growth rates during the forecast period. The growing use of automated pill dispensers in older people who need medication drives the growth of the market for centralized, automated distribution systems. On the end-user base, home care accounts for the largest share of the market due to the rising elderly population, this also indicates that Auto-Pharm will have a broad market with the increasing of the elderly population and needs of home care.

6.Finances

The finances section will list the estimated costs of each component that will or may be used during the development of Auto-Pharm, this section will also include the available funding resources, these resources can help the Auto-Pharm Technology to reduce the total cost and related fees during development.

6.1 Device/Components Costs

The instrument of Auto-Pharm contains multiple electronic components, such as motors, LEDs, and load cells. Most components will be purchased from a supplier in large quantities, and the cost for each component are shown in Table 6.1, including the estimated cost of the final product. To be specific, the table's cost is estimated based on the components seller's price, and the cost will be reduced when buying wholesale of components.

Table 6.1: Auto-Pharm Components Cost Breakdown

Items	Quantity	Cost per unit ($CAD)	Total Cost ($CAD)	Adjust Total Cost ($CAD)
Raspberry Pi 4 Model B 2GB	1	76	76	49
5V Stepper Motor + ULN2003 Driver Board	4	7.99	31.96	16
TX711 Loadcell Amplifier + 100g Mini Load Cells	2	18.9	37.8	30
Plastic Gear, Pulley, Bracket, Belt Kit	1	13	13	10
MG90S Metal Servo Motor	2	15	30	6
GT2 Timing Belt	2 (meters)	4.5	9	8.1
Total Price (without tax)			197.76	119.1

The adjusted cost in Table 6.1 refers to the discount, which is expected to get from the retailer for large quantities of components. These expenses are subject to change because of the development of Auto-Pharm and the quantities of components. During the design improvements, there might be additional costs.

6.2 Funding

Various funding resources are provided to assist new companies to promote and research. The investigations are not limited to academic organization and government. These sources can strongly support our ideas and the implementation of the project. A variety of associations of Simon Fraser University (SFU) provide flexible chances on supporting students' projects. The funding will efficiently reduce the cost of projects.

Engineering Science Student Endowment (ESSEF): The category C among these 5 subcategories is a reasonable option to apply. The C type funding is for a Class Project from an Engineering Science class which covers 25% of the total fee of the project [8].

IEEE Student Branch Funding: The IEEE Student Branch provides this funding for inventions of engineering students and guides them through the design competitions [9].

Wighton Development Fund: The information of this funding is provided by Dr. Andrew Rawicz. Because this funding is directly relevant to the course and our project meets the requirements, it will be reasonable to apply for the funding [10].

7. Competition

Currently, the market already has multiple competitors about medicine dispensers to senior adults. For instance, the locked pill dispenser is named MedMinder from MedMinder System Inc, and the Philips Medication Dispenser. They provide drugs to the elderly in different ways to prevent seniors from taking the wrong medicine or overeating. Auto-Pharm has its advantage over the existing products in the market.

7.1 MedMinder Locked Pill Dispenser

The MedMinder Locked Pill Dispenser is designed as similar to a calendar that labeled "Monday" to "Sunday" on the device, and there are four columns, which means the MedMinder has 28 compartments to store the seniors' pills. Figure 8.1 shows the outward appearance of this instrument.

Figure 7.1: MedMinder Locked Pill Dispenser [11]

This instrument's working principle is to divide the day into four stages, such as morning, noon, afternoon, and evening. The device will utilize the lights in the specific compartment to remind the elderly to take the pills in this compartment. For example, only the compartment of the first column and the first row, which responses to the morning stage of Monday, will light up on Monday morning. Seniors will not be able to open the cover of other compartments if the time does not match. Meanwhile, the elderly will get a phone call if they did not take medicine for the first time, and then the caregiver gets an emergency notification if the phone call does not respond by senior. The disadvantage of this product is that the caregivers need to pay $49.99 per month, and the guardians should contact the company to set the time stages [11][12]. Besides these issues, the phased administration is not enough and specific for seniors is also a limitation of this device.

7.2 Philips Medication Dispenser

Philips Medication Dispenser optimizes the design of the compartment which compares with MedMinder Locked Pill Dispenser, and it chooses to put the pills in a small size cup, and one small cup represents the amount of medicine that the elderly need to take at one time. The outward appearance is shown in Figure 7.2:

10

Figure 7.2: Philips Medication Dispenser [13]

The caregivers can organize the drugs cups by utilizing the loading tray and then manually putting them into the instrument. The dividing line of time is more precise, such as the 1:00 in the afternoon and 5:00 in the afternoon. The instrument will send out a voice reminder at the predefined moment, and the medicine will be given after the seniors come and press the red button in the middle of the device. After 90 minutes of the defined time, if the medicine has still stayed at the pick-up area, the instrument will send the emergency message to the caregivers to prevent medical errors. Philips provides a better solution than the MedMinder. However, they sell their product at $59.59 per month. Furthermore, the products are not friendly for seniors with memory impairment because they may leave once they pressed the button and forget to take their pills [14]. Auto-Pharm learned the advantages of them and made improvements to their shortcomings to have a place in the market.

7.3 The Advantages of Auto-Pharm Compared with Competitors

By comparing Auto-Pharm with two competitors, Auto-Pharm has two main advantages: Firstly, the price of the device. For Auto-Pharm, it will only cost $150 one time payment, the customers will be able to save their money and get a similar service. Secondly, the time setting of medicine will be more flexible in Auto-Pharm, for the competitor: Philips Medication Dispenser, it only allows the service department to set the time of medicine, the customers will not have access to the time setting. For Auto-Pharm, the device comes with a user-website that will allow the customers to set and change the schedule anytime.

8. Project Plan

Figure 8.1 shows the beginning project plan from April to August. Before the second progress meeting on July 8th, the plan was perfectly followed by the team's expectations. The user-website linked to the device is almost finished to meet the prototype standard the team made on the design specifications. Through July, the team is preparing to assemble the hardware part and write software scripts to drive the hardware parts. The software not only needs to control the hardware parts but also links to the webpage.
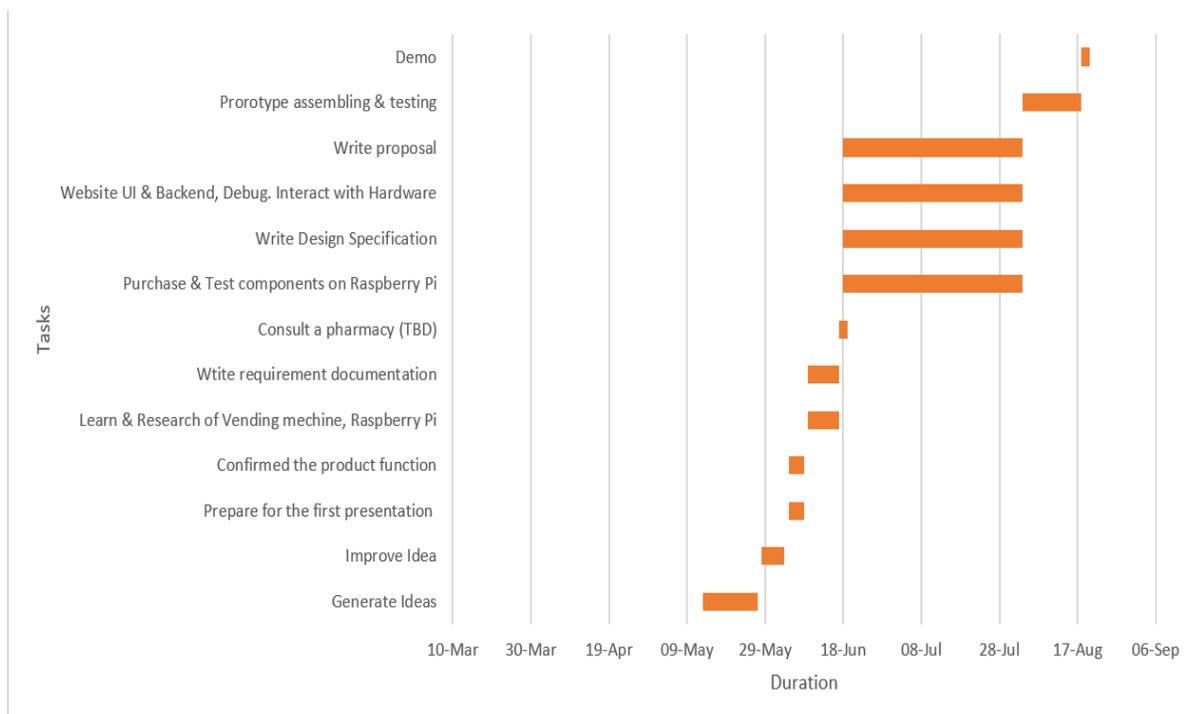
Figure 8.1: Project Plan Through 2020 Summer Semester

As Figure 8.1 indicated, Auto-Pharm's plan proceeds to completion of the project proposal before July 29th as the requirement and design specifications are finished. As for the progress of Auto-Pharm's development, the members had achieved the main functionality of the website

before July 8th: the time reminder setting. Meanwhile, the electronic components have shipped into Canada, which are expected to get the shipment on July 29th. Then members will proceed with the assembly of components and operate them with the microcomputer. From the start of August, the plan will be completed, and the testing part will be processed. The demonstration date is around August 18th to August 20th.

9. Company Overview -Meet the Team

Auto-Pharm Technology formed in June 2020, which consists of five young and skillful engineering students from the Faculty of Applied Science Simon Fraser University (SFU). Auto-Pharm tech. members wish to bring a solution to prevent seniors from medical errors caused by taking wrong pills and overeating. Auto-Pharm, to be expected to release in December 2020, will be the product, and after that, the members will improve and manufacture the design of Auto-Pharm.

Yu Yang - Chief Communication Officer

Yu is a 5th-year student pursuing a System Engineering degree. She completed her 8 months of Co-op at Lee's Electronic Component, learning much knowledge about how to utilize the components and the microcomputer. Moreover, Yu had used this knowledge to design an attendance device. She also improved her communication skills with different customers when she was doing her Co-op as the technical sales and analyst in Lee's, so that she will be able to keep the team members' communications efficient.

Yixuan Wang - Chief Operation Officer

Yixuan is a 5th-year System Engineering student at SFU. During his Co-op career, he gained lots of experience in mechanical design and project management. Meanwhile, Yixuan also has experience in researching and improving technical documents during his previous Co-op term. He will apply his knowledge about system qualification testing and his organization skills to develop Auto-Pharm better. At the same time, he believes that he can organize the progress of Auto-Pharm's development and keep the quality of our technical documents to improve the product.

Yuyan Dong - Chief Executive Officer

As a 5th-year System Engineering student, Yuyan has industrial experience in validating Mechanical and Software for the instrument. His Co-op experience improved his abilities in website development, including database design. He will use his software skills and mechanical knowledge to the company. Meanwhile, he is an imaginative person, and he proposed the initial

design idea of Auto-Pharm. Yuyan's vision for Auto-Pharm Technology is to protect the seniors' lives when their caregivers could not supervise the elderly about taking medicine.

Yimin Long - Chief Technology Officer

Yimin is a 5th-year Computer Engineering student with a variety of project experience in codings, such as python, C++, and JavaScript. Yimin's previous Co-ops involved developing testing scripts for automation and software programs. Her knowledge about firebase helps Auto-Pharm build the front-end and back-end of the website, providing ways to develop the database to store the information. She is passionate about coding and website design, looking for opportunities to explore more coding experience in various fields.

Tao You – Chief Financial Officer

Tao is a 6th-year Electronic Engineering student with experience in automation and robotic. His previous Co-ops involved electrical components, technological explanations, and market understanding at Lee's Electronic Components. He will ensure that the cost of Auto-Pharm will not increase to a large amount by utilizing his market research, and Tao will keep analyzing the market size of our products. Meanwhile, Tao also hopes to apply the knowledge that he has gained about the microcontrollers and electrical components to build it.

10. Conclusion

An increasingly busy life is the main reason that caregivers worry about the safety of taking medicine for the elderly. Auto-Pharm aims to help the guardians prevent seniors from taking wrong pills and overeating, especially, the seniors suffering from memory impairment and vision issues. Although the market is saturated with numerous medicine dispensers, Auto-Pharm will still have a place in the market by reducing the interaction with the elderly to prevent misusing and the accurate alarm setting through the website. The competitors in the market provide either a press button or locked compartments on the instrument. However, the products on the market do not provide a solution to serve the elderly when seniors get confused about how to operate the instrument because of poor memory. Meanwhile, the competitors do not give drugs to the seniors at a specific time, and the guardians will need to contact the officers of the company to set the reminder up. Auto-Pharm technology considered to reduce the cumbersome steps for operating the instrument and the given shortcomings of the products on the market, the instrument can be bound to the website, and the caregivers can utilize the website to set the specific time alarm on their own.

For the future of Auto-Pharm, the development of the mobile applications will be put on the schedule and the amounts of drug carry will also be enhanced. We would like to thank Dr. William Craig Scratchley, Dr. Andrew Rawicz, and the teaching assistants for organizing and supporting the development of Auto-Pharm. We are planning to release the final product by the end of 2020.

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