

Senior Design Medication Dispenser Proposal

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1 Introduction

As people live longer, people have the opportunity to know their grandparents and even great grandparents longer than they have before. Many have the experience of caring for their aging relatives which can be challenging due to the effects that age has on the body. One such experience is with the medication that is often prescribed to better help individuals combat the effects of age. A family member or caretaker may be able to sort the medication for the parent, grandparent, or great grandparent, but they cannot be with them at all times of the day to ensure they are taking the medication that helps them. In fact, in many cases, older parents, grandparents, or great grandparents want to continue their independent lives without feeling that they are being monitored. In this design project we are seeking to support continued independence of individuals as well as increased adherence to medication prescriptions. In such a fast-paced world, the simple task of complying to a medication schedule can become difficult with numerous responsibilities and tasks. This design project would tackle this problem by developing an innovative medication dispensing system with personalized reminders.

2 Problem Description

Today's world is becoming increasingly medicated. This is not unexpected as research finds new ways to treat and cure disease and the expected lifespan continues to increase. People are also more willing to use medication to treat an increasing number of illnesses both physical and mental. In an increasingly medicated world, where the population continues to age, there are many who need to consistently take those medications for them to be effective. It is important that medication is taken regularly and on time. This is so important because the primary factor of medicine effectiveness is consistency. If the medication is not taken correctly in the correct

dosage it will not perform the function it was intended. Medication is prescribed to be taken repeatedly at intervals when the effectiveness begins to wane. Many of these medications are lifelong prescriptions for chronic conditions.

While many individuals may be able to get into a habit of taking their medication on time, there will be cases where they will forget. This is a particular concern with aging populations which have a stronger propensity to develop memory related illnesses. This population also is more likely to have a larger quantity of medications to take to address the effects of age on the body. With these two factors playing a role in the likelihood that an individual will take their medication each day at the right time, there is a space for a system which can remind them to take the medicine. This is the primary problem that our product will solve. It will increase the consistency with which an individual takes their prescribed medication each day to increase the effectiveness of the medication.

3 Proposed Solution

Our solution is to create a system which reminds the patient when to take which medications. We are assuming that a capable caretaker will be incharge of the initial sorting of the medications into the appropriate days and times within the pill container. The caretaker will also be able to input the prescription information so that the system will then know when and how to dispense the medications as well as any additional relevant information regarding the medication. It will have two main types of reminders which can be customized for the patient: in-home environment reminders and phone reminders.

The container which will hold the medication will be 3D printed. The container will be 3 rows of 7 columns corresponding to taking medications in the morning, midday, and evening for a 7 day week. There will be three conveyor belts, one for each time of day with 7 cubbies attached to it. The cubbies will be 3D printed as independent objects with loose lids hinged on one side. Each lid will have the day of the week and time printed on the lid for ease of sorting by the caretaker. When it is time for medications to be taken, the appropriate conveyor belt will move, sending the cubby off the end and opening the lid to pour the medication into a funnel and onto a tray.

The system will have a section for the caretaker to input information necessary for the medications. Some examples of information include what medications, the dosage, and whether the patient needs to eat, drink water, or anything else with the medication. These reminders will be displayed on a screen next to the medication when the patient is reminded to take them.

The first type of reminder for the patient is an in-home system. This will be either a visual or auditory reminder. The visual reminder will be a screen saying “Time to take your medications!!” with a bright blinking light to get the attention of the patient. The auditory reminder will be “Time to take your medications!!” at a volume loud enough to get the patients attention but not an uncomfortable volume. Depending on the patient's needs, which could be deteriorating hearing or sight, either or both of these reminder methods can be chosen. These parts of the system will connect to the main portion of the system via bluetooth and we suggest that they go in the living room, kitchen, and bedroom. The second type of reminder for the patient is a reminder on their smartphone or tablet. The system will have a bluetooth connection for the phone which will prompt a reminder on the phone. The reminder will be similar to the room reminders but will also vibrate the phone to get the patients attention.

The system will also connect to wifi so that it will have a real time clock which adjusts with timezones and daylight savings time. There will be a sensor in the tray which will send out additional reminders if the medications have not been taken within a set amount of time. Some patients may need another reminder after 5 or 10 minutes, others may want it after 30 minutes, it depends on the time sensitivity of the medications being taken and how quickly the patient is capable of getting to the medications.

4 Demonstrated Features

- Dispense on Time
- Multiple Repetitive Reminder Functions
- User Drug Information available when Taking Pills
- Input of information by caretaker
- Knows if medicine has been taken

In the upcoming May demonstration, we will highlight five key features showcasing our solution's ability to effectively address medication management challenges:

Firstly, the "Dispense on Time" feature ensures timely medication distribution, reducing the risk of missed doses.

Secondly, our system offers "Multiple Repetitive Reminder Functions," allowing users to customize reminders for various medications or dosing schedules. This reminder could be set as audio and/or visual.

Thirdly, the "User Drug Information" feature provides comprehensive details during pill intake.

Additionally, our solution allows caretakers to contribute through the "Input of Information by Caretaker" feature, ensuring that the correct medication is being ingested.

Lastly, our system incorporates a "Knows If Medicine Has Been Taken" feature, utilizing sensors to track and verify medication adherence in real-time.

5 Available Technologies

Part	Quantity	Price	Purpose	Link
Motor	2	\$6.89	movement of pin container in x and y directions	Link
3D print Pill storage and tray	1	NA	for organization of medicines and dispensing	NA
OLED Screen	1	\$5-\$20	Medicine Information	Link

Bluetooth	4	NA	For room and phone indicators built in from ESP32	NA
LEDs	4	<\$10	Additional indicator of medicine status	Link
Speakers	3	~\$20	Additional indicator of medicine status	Link
Microcontroller board	1	\$50	Control of system and real time clock	

6 Engineering Content

Our team will need to use engineering to create a physical dispenser subsystem, satellite reminder subsystems, PCB layout, software integration, bluetooth interface, and phone interface. The physical dispenser subsystem will include a design for the pill organizer which will use CAD skills. It will also include a way to house the OLED, main PCB, motors, and speaker. This subsystem will include creating the mechanism for the dispenser as well and determining which design for the dispenser is most effective to output the correct pills when necessary and have a sensor to determine when the pills have been taken.

The satellite reminder subsystems will include 2-3 bluetooth integrated satellite systems which can interface with the main dispenser a few rooms away. The primary engineering for this subsystem will be integrating bluetooth and real time communication with the primary dispenser. Each satellite will include an LED for visual reminders and speakers for audio reminders.

The PCB layout subsystem will design for a PCB which allows the microcontroller to interface with the OLED, bluetooth, LED, speakers, phones, and motors. The engineering in this subsystem will include adding the following interfaces: OLED will be an SPI interface, the LEDs are through GPIO, the bluetooth will be able to do SPI, UART, or I2C, the speakers will be GPIO or another interface, and the motor will be GPIO.

The bluetooth and phone interfaces will be part of a greater software subsystem that will work on a real time clock which is responsive to time zones and daylight savings time. The engineering in this subsystem will include getting all functions of the reminders, medicine information, and feedback on if the medication has been taken integrated into one working system that can function at the right time each day. There will also be a component where not only do reminders have to be able to be sent to a phone, but the system also needs to be engineered to take in information about the prescriptions to show the medicine being given at each time and any additional information about taking the medication such as if the patient is required to eat when taking the medicine.

7 Conclusions

In conclusion, our medication dispensing system provides a unique solution to a large healthcare issue. Through the integration of technology and user-friendly interfaces we can provide a reliable tool that would not only improve the consistency of medication adherence but also provide a lasting positive impact on a patient's well being. Our system ensures a more efficient and accurate dispensation of medication that would reduce the amount of missed doses. The design also caters to a diverse audience enhancing accessibility. Demonstrated features include timely distributed prescriptions, customizable reminder notifications, drug information, caretaker input, and real time tracking of medical adherence would highlight the adaptability and effectiveness in our innovative approach. As this develops, we envision an ongoing trend of transformation in healthcare practices that would become patient-centered care.