Abstract — This paper presents a new system for adverse drug reaction (ADR) monitoring for the elderly. By sorting the medication for the user and dispensing the dosages at the prescribed times ADRs can be prevented before they can occur. The device, named MediMaidTM, may also be used to log symptom information, which may be useful for diagnosis and emergency situations. The various components of the design function as a whole in order to safely deliver medication to the user in a timely manner. User analysis results indicate that MediMaidTM is a simple, effective and efficient way of delivering medication as well as preventing and monitoring ADRs.

Index Terms — Adverse drug reactions, elderly, medication, tracking

I. INTRODUCTION

EVERY year, with over 22,000 human pharmaceutical products available, an increasing number of elderly Canadians experience adverse reactions to drug therapy. There is a need for a system that will assist the senior population, aged 65 and above, in order to prevent mild or potentially fatal effects of adverse drug reactions (ADRs). Such a system should be inexpensive, user-friendly, and have a relatively large capacity for medication since many senior citizens are prescribed up to 5 pills at any one time [1]. The device must also be able to dispense medication at appropriate times and alert the user appropriately. Many members of elderly community also have limited technical ability; therefore an interface that is easy to use should be implemented.

Current approaches to medication organization include blister packs and the generic pill box, as well as some electronic units that may be capable of holding and dispensing more than one pill at once. However in these cases, issues such as an incorrect dosage being dispensed, symptom logging, and providing medication schedule and ADR history to emergency personnel are not addressed. These issues are addressed in this system.

Initially, a survey to concerning ADRs and system characteristics would be useful in their prevention was conducted at various pharmacies. This information considered when designing critical hardware characteristics of the device. A software user interface was created and tested on the target population as a method of evaluating its efficacy. The deliverables consist of the software interface and a 3D printout of the portable unit, which will be discussed in Section D.

II. CONCEPTUAL DESIGN

A. Overall design

A schematic of the overall design is shown in Figure 1. The user retrieves the appropriate medication from the pharmacy with a detachable pill storage unit (not shown in figure) and subsequently fills the system. This cartridge may be stored elsewhere if desired. A conveyor belt carries the medication/supplements towards the dispensary area, determining if the correct dosage was put forth according to a scale. This medication is held within the holding compartment until the user retrieves the dose at the appropriate time. This time is determined using a previously inputted schedule, and the user is alerted through audio and visual means.

Figure 1: Conceptual design for MediMaidTM system

B. Major components

Major components of the device include the polyethylene cartridge, waste bin, holding compartment and dispensary area. Additional components include conveyor belts were made of silicone, in order to reduce the risk of pill contamination, an analytical scale was implemented and a LCD screen. A portable component of the system, the DayPodTM, was also designed.

III. DETAILED DESIGN

A. Conveyor

The design has ten individual conveyor belts, thus allowing the patient to store a maximum of ten different types of medication. In order to minimize the likelihood of a surplus number of pills traveling beyond the conveyor belt and onto the scale, the exit of the belt may be adjusted according to pill size through the use of a hinged flap on either side of the conveyor belt. These flaps may be adjusted in order to decrease or increase the width of the end of the belt. The length and height
of the conveyor belt compartments were determined according to the average size of typical medication that elderly take [2]. An average of 60 pills may be stored in each slot. The elongated design minimizes the occurrence of pills stacking upon each other.

B. Scale

The scale has accuracy of up to one milligram, and a servo motor is responsible for tilting the weighed pills towards either the holding compartment or waste bin. The shaft of the servo is able to travel in an angular motion between 0 to 180 degrees. Using a pulse coded modulation, the duration of the pulse dictates the magnitude of the angle of the output shaft. Thus the length of the pulse will determine how far the motor turns, and the distance traveled will be proportional to the amount of power supplied to the motor. If the scale reads a weight 70% higher than expected, it will rotate to the rejection bin, and the contents can be later removed.

C. Interface

The interface consists of an LCD screen and ten, four main buttons and six smaller buttons. Three of the main buttons are located to the right of the LCD screen and are labeled "Symptom Log", "Print", and "DayPod". The "Symptom Log" button takes the user to the symptom selection interface, as shown in Figure 2. Each option represents a different symptom that may occur from drug interactions. These include chest pain, chills, vomiting, irregular bowel movement, headache, and stomach aches. Upon completion, a time stamp based on log time will be recorded along with the entered data.

![Figure 2: Initial screen viewed by users when logging symptoms](image)

This information may be obtained at a later date by using the "Print" option located directly below "Symptom Log". This option allows the user to get a printout of the last 12 hours, 24 hours, 2 days, 3 days, and/or 4 days of logged information, as well as a dosage schedule.

The third button provides an option for receiving an advanced dosage which can be loaded into the DayPodTM. The DayPodTM button will lead to a menu where the user may choose what future dosage times they wish to obtain.

The "Dispense" button is positioned at the bottom of the interface panel below the LCD screen. When pressed, the it will activate the door which separates the holding compartment from the dispensary, allowing the pills to reach the dispensary section, thus making them available to the user.

D. DayPodTM

The DayPodTM is a portable device that incorporates a four-dose compartmental system that many elderly users are familiar with from typical blister packs. Through the use of the "DayPod" option, described in Section C, the user will be able to obtain dosages ahead of time and load the DayPodTM with each amount received from the dispensary. Similar to the stationary dispensing unit, the DayPodTM has monochrome LCD screen that provides information including the compartment from which the user should obtain their pills, the current date and time, as well as the time until the next dosage, as seen below in Figure 3.

![Figure 3: Front view of DayPodTM turned on.](image)

IV. DISCUSSION

Various aspects of the design were analyzed, including the graphical user interface (GUI) and the cost of the system. The GUI analysis required evaluation of a sample user interface and questions concerning its ease of use, user acceptability, and other elements including the appropriate age and price. The manufacturing cost was determined to be $667.

It was determined that the design is not only feasible from a monetary perspective, but it is also a practical and effective method of preventing adverse drug reactions in the elderly population. In future models, changes may be made such as the addition of menus in the user interface to give the user more control over the device.

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REFERENCES