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A Review on Dispenser Mechanisms of Medicine Dispenser

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***Abstract*— In the modern age it is difficult for family members to be available all the time to support the aged and in our society most families are nuclear. Caring for the aged is of serious concern in the developing countries. Sometimes despite their best effort, the aged fail to remember to take their medication on time. There are issues concerning seniors' ability to remember to take and handle their medicine on their own. Automatic medicine dispenser is one approach as a solution to this problem. It dispenses medicines on prescribed time with notifying the caretaker. There are various medicine dispensers with same functionality and IOT but different dispenser mechanism and design. The design and mechanism vary with the type and size of medicine. The main concern is dispenser design as the medicines are in various shapes and sizes. Hence a optimal dispensing mechanism for storing and dispensing all types of medicines is required. In this paper, a detailed review of dispensing mechanism of the Automatic Medicine Dispensers and its design is presented.**

Keywords*— *Medication management, Dispenser mechanism, Older Adults.

I. INTRODUCTION

The success of advances in public health and modern medicine have resulted in unprecedented levels of life expectancy and population segments of older adults that introduce challenges of how to efficiently care for older adults worldwide. Population aging has accelerated in recent years, with estimates that the annual net global gain of adults aged 65 and older will exceed 10 million every year until 2015 and over 60 countries will have at least 2 million people in this cohort by the year 2030[1]. Medication adherence is a growing concern throughout the healthcare industry with doctors, healthcare systems, and other stakeholders (insurance companies) since the elderly or senior patients' medication has a big issue of drugs misuse [2]. It is very likely for them to forget to take their pills on time. Especially, those who take multiple medications at the same time. Also, they might take wrong dosage accidentally which may lead to unfortunate consequences such as death [3]. In addition, a study has been done by group of professors (Grey, Mahoney, and Blough) at University of Washington about medication adherence in three home healthcare agencies on one hundred forty-seven older participants taking three or more medications, which resulted in 30.6% participants were under adherent and 18.4% participants were over adherent with at least one medication [4]. Adherence to medication is one of the most intriguing and complex behaviours demonstrated by patients. Non-adherence to a therapeutic regimen may result in negative outcomes for patients and may be compounded in populations with multiple morbidities which require multiple drug therapy. Such a population is exemplified by the elderly. However, non-adherence may not be more prevalent in older patients and there is no consensus in the literature that age is a predictor of poor adherence. Indeed, older patients may deliberately choose not to adhere to medication (intentional non-adherence) to avoid adverse effects [5]. Older adults with multiple chronic conditions face the complex task of medication management involving multiple medications of varying doses at different times [6]. Several studies found the prevalence of multiple chronic conditions in older adults exceeds 60% [7]. A systematic review of studies from seven different countries suggests that more than half of preventable drug related (PDRAs) admissions are the result of medication errors with estimated prevalence of PDRAs in older patients more than twice that of younger patients [8]. A recent study of older adult medication self-management found that most errors occurred in the activities of administering the right medications at the proper dose and time (31.8%); following clinical advice regarding medication use (21.7%); and modifying medication use based on clinical advice and self-monitoring (41.9%) [9]. Telehealth technologies are used in home and community settings to enable monitoring of older adults' well-being (for example, by capturing vital signs) [10] and communication with health care providers (using video or other synchronous communication platforms) [11]. Advances in such technologies have also enabled the development of devices that can be used in residential settings to assist with medication management and monitoring of elderly adults using cost effective methods. Medication e-management applications are electronic tools for patient empowerment, enhancing accuracy of medication administration through reminder services and promise to lower costs and involve patients in the care delivery process. These tools include medication dispensers, wristwatch alarms and smartphone applications [12]. In addition, integrated environmental sensing applications have been developed for prompting of patients in different contexts to improve medication adherence [13]. A medication dispensing device as a medication management intervention to older adults discharged from a home health care program. Medication management is a complex task and older adults have different usability concerns than younger counterparts regarding vision, cognitive ability and physical function. The medication dispensing device was designed to simplify the complex task of medication management with the aim of

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reducing medication errors and improving communication with providers. Medication error reduction and better communication are important to reach the larger goals of improved outcomes in older adult health status, rates of hospitalization, rates of nursing home admission, total costs of care and costs per quality adjusted life year. Older adults in this study accepted the medication dispensing device as reliable, easy to use and useful in coordinating personal medication management. These results indicate that technology-enhanced medication dispensers can be acceptable tools for older adults to help manage their care.

II. AUTOMATIC MEDICINE DISPENSER

A pill dispenser is a device which gives medicine to be taken at time. These devices are very useful to take proper medication at ease. Automatic dispenser has separate compartments for each pill which can be dispensed at required time with required number of each pill. IOT is used to for the build of the device. Microcontroller is the heart of the device which controls various operations of the device. The stepper motor and the servos are controlled by the microcontroller through motor controller. The microcontroller is connected to the cloud through a WI-FI module, by which all the data is upload to and downloaded from cloud. GSM module is used to send alert messages to the caretaker about the pills taken or not so that they can manually remind the patient in case they didn't take the pill. The remote access via cloud is being made secure with secure login and encrypted data storage. The user must provide username and key to access data in the cloud. The device then decrypts the encrypted data and utilizes it.

III. DIFFERENT MEDICINE DISPENSER AND ITS MECHANISM

There are various automatic medicine dispenser and each with different dispensing mechanism. Certain mechanisms are designed specifically for one type of medicine i.e., one shape and size. Here, we are discussing such dispenser mechanism and mainly focusing on dispenser that can hold and dispense various types of medicines.

A. Midlands and east the automated pill dispenser

It holds up to 28 days' worth of medication securely in its integral medication tray. It reminds the user with an alarm and flashing light when it is time to take their medication and makes the pills available at the right time in an opening in the lid. It can be programmed to alarm from once up to 28 times daily. Typical users are those taking time sensitive medication (for example those with Parkinson's disease), who have some confusion (e.g., early dementia) or those with learning difficulties. It can be simply programmed to alarm and present the pills in the lid opening when they are due. Only the medication that is due at that time can be taken. It is programmed using the three programming buttons which are used to set all the functions including the time, number of doses per day and the alarm times. When it is time to take medication the internal tray rotates, the alarm sounds and the light flashes. The user then simply picks up the dispenser and tilts it to take the medication in the hand or suitable container. This cancels the alarm and flashing light. The dispenser will then wait until the next alarm time and repeat the process [14].

Fig. 1

B. Smart Pill Box for Medicine Reminder and Monitoring System

Pill storage will consist on a Zippers where all the different compartments will be contained in the form of hollow pillars, which will be the ones holding the pills in them. For the pills to access each pill compartment a servo installed below the lid which will be holding the Zippers will align via a command sent by the computer each one of the compartments with the entry hole, making the pills fall directly to the selected compartment. Once the compartment in use is filled the servo will rotate the tube as to align the next compartment with the entry hole. The mechanism for the pill dispensing module will use two Arduino-controlled servos, one of them located under the lid and attached to the pill storage cylinder (same servo as the one used in the pill refilling mechanism) and another one which will control an intermediate piece Mechanism consists in three different stages: default stage, pill load stage and pill release stage. After the pill release stage, the system will reset to the default stage [15].

Fig. 2

C. Automated Pill Dispenser

The purpose of the unit is to house the medication, house the sorting mechanism for the medication, and protect the medication from the environment. The dispensing unit is also the place from where the patient will retrieve their medication after its dispensed. This means that the unit also includes an

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external slot to which the medication will be dispensed to and retrieved. The first was that the dispending unit was originally going to be three parts with a contact fit. However, the design was too fragile when printed and easily broke. Secondly a three-part design only allowed us minimal space to design a way for the pills to be brought to the outside. Thirdly the dimensions of the shafts were too tiny and were subject to breaking at an original diameter of 3mm. The diameter was increased to 3mm on the shaft with a 5mm centre because the plate was now two pieces and as such more room was allowed which kept the same spacing between the rollers which was 11mm to allow the pills to pass through. Additionally, the sponge rollers diameter was increased to 9.5mm as we found that more surface area allowed the pills to pass between the rollers easier [16].

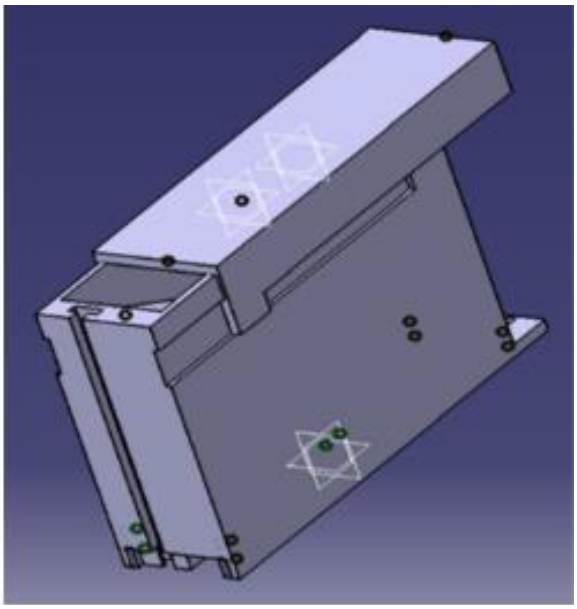

Fig. 3

D. Low-cost automatic pill dispensing unit

The pill chamber consists of the pill storage unit, and the pathway. The pill storage unit is made up of simple plastic canisters, sitting on a flipper that is powered by a motor. The flipper lets pills out of the canisters in singles onto the pathway, which is covered by a magnetic lid, which only opens when the flipper opens. There is an overt intention to control the frequency and speed of release of pills from the dispensing unit. When the motors turn, a circular course is prevented by a stopper; the tablets fall down into the troughs from the canisters by gravity. On reaching the trough, they are further accelerated to the magnetic lid, which has an embedded switch that when opened the sound goes off, resetting the machine and bringing it to a stop [17].

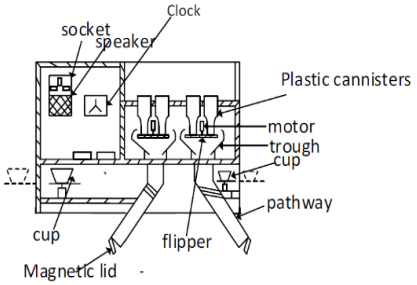

Fig. 4

E. Automated medication dispensing system

When RTC time is equal to the pre-set time, it implies that it is time to take medication. Thus, at this time, the Stepper motor rotates by 90 degrees and the slot 1 viz. for 8.00 am is exposed at the dispenser cap opening. Along with the stepper motor, a LED and a buzzer start off. This is useful for Deaf and Blind people respectively. The patient is given a time of 5 minutes to take the medications. The audio alarm will run and the LED will be glowing for these 5 minutes. After 5 minutes, IR sensor is activated [18].

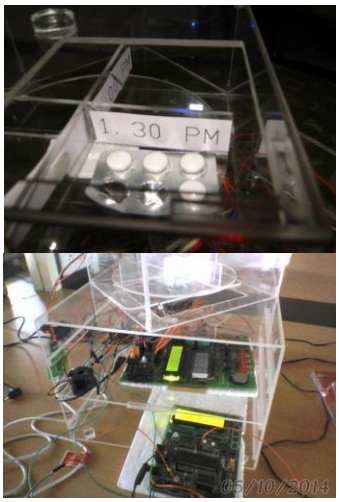

Fig. 5

F. Smart Medicine Dispenser (SMD)

In this paper, we built an Android application that is responsible of controlling the whole system. It's the primary way of interacting with the system, the application stores its data on the cloud and performs synchronization upon login. To dispense the pills, the phone will automatically connect to the Arduino via Bluetooth and starts sending commands indicating which container and Stepper Motor should be rotated. Each container is controlled separately with its own LED and can keep up to 7 servings (a serving can consist of multiple pills of the same type). Servo motors are used to rotate the cylinders; the motors are controlled by an Arduino Uno R3, using PWM signals that make the servo rotate for a bit then stop, and are connected as shown in figure [19].

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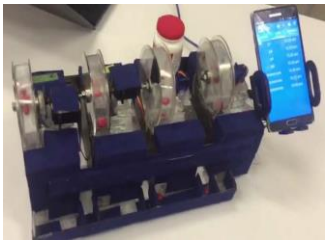

Fig. 6

G. Pill dispenser with alarm via smart phone notification

The pill dispenser is installed with three compartments specially designed for three different types of pill. Once the button is pressed, vibration motor and IR sensor will be turned on. The vibration motor vibrates the compartment where the pills were placed earlier until the pills fall-out from the compartment to the drawer through a pipeline. IR-sensor will start to count the amount of the pills fall-out based on the pills amount that have been set at the beginning. The process will stop once the number of pills that fall-out meet the requirement of the medication needed [20].

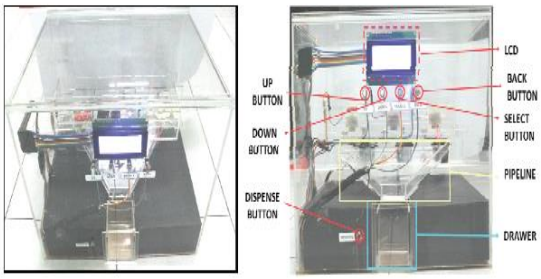

Fig. 7

IV. CONCLUSION

This study introduced a medication dispensing device as a medication management intervention to older adults discharged from a home health care program. Medication management is a complex task and older adults have different usability concerns than younger counterparts regarding vision, cognitive ability, and physical function. The medication dispensing device was designed to simplify the complex task of medication management with the aim of reducing medication errors and improving communication with providers. Medication error reduction and better communication are important to reach the larger goals of improved outcomes in older adult health status, rates of hospitalization, rates of nursing home admission, total costs of care and costs per quality adjusted life year. Older adults in this study accepted the medication dispensing device as reliable, easy to use and useful in coordinating personal medication management. These results indicate that technology-enhanced medication dispensers can be acceptable tools for older adults to help manage their care in collaboration with home care nurses. These results are encouraging because acceptance of technology-enhanced medication management is a requirement toward improved monitoring of unpredictable responses to drug therapy in older adults. Design and cost were indicated as areas for improvement. Design is an iterative process and implementations in a real-world context often reveal opportunities for better design. A method was needed to ensure that the aged and the patients would take medicines on time as prescribed by the doctor, so that the working class can be relieved of the patient's medicating schedules. Also, it was necessary to ensure that correct dosage was given at the correct time in their absence. The system must be absolutely user friendly and flexible to change the timings at which the medications have to be dispensed. These features have to be incorporated in a system at a very cheap price so that it is affordable by every common man. Considering all these key points an automatic medicine dispenser for older adults has to be designed with optimal dispenser design. In this paper some of the dispensing mechanisms are considered, studies and discussed. Out of these mechanisms an optimal mechanism is to be chosen and upgrade for further improvisation or new mechanism must be designed taking inspiration from all the mentioned mechanisms such that it can store any medicine or pill.

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REFERENCES

[1] Kinsella KG, Phillips DR, Bureau PR. Global Aging: The Challenge of Success. Population Reference Bureau; 2005.

[2] [2] A. V. Dhukaram and C. Baber, "Elderly Cardiac Patients' Medication Management: Patient Day-to-Day Needs and Review of Medication Management System," *2013 IEEE International Conference on Healthcare Informatics*, pp. 107-114, 2013.

[3] [3] World Health Organiztion, http://www.who.int/medicines/en/ , accessed on Juy 21, 2017.

[4] [4] S. L. Gray, J. E.Mahoney, and D. K.Blough, "Medication Adherence in Elderly Patients Receiving Home Health Services following Hospital Discharge." Annals of Pharmacotherapy, 35(5), pp. 539-545, 2001.

[5] [5] Hughes CM. "Medication Non-Adherence in the Elderly: How Big Is the Problem? Drugs & Aging" 2004;21(12):793–811.

[6] [6] Gellad WF, Grenard JL, Marcum ZA. "A Systematic Review of Barriers to Medication Adherence in the Elderly: Looking Beyond Cost and Regimen Complexity." Am J Geriatr Pharmacother. 2011; 9(1):11–23.

[7] [7] Wolff JL, Starfield B, Anderson G. "Prevalence, *Expenditures, and Complications of Multiple Chronic Conditions in the Elderly*." Archives of internal medicine. 2002;162(20):2269–76.

[8] [8]. Winterstein AG, Sauer BC, Hepler CD, Poole C. Preventable Drug-Related Hospital Admissions. The Annals of pharmacotherapy. 2002;36.

[9] [9]. Field TS, Mazor KM, Briesacher B, DeBellis KR, Gurwitz JH. Adverse Drug Events Resulting from Patient Errors in Older Adults. Journal of the American Geriatrics Society. 2007;55(2):271–276.

[10] [10]. Rantz MJ, Alexander G, Aud MA, Wakefield BJ, Miller SJ, Galambos C, Koopman RJ, Skubic M.Improving Nurse Care Coordination with Technology. CIN Comput Informatics Nurs CIN - ComputersInformatics Nursing. 2010;28(6):325–332.

[11] [11]. Demiris G, Speedie SM, Finkelstein S. Change of Patients' Perceptions of Telehomecare. Telemed JE Health. 2001;7(3):241–8.

[12] [12]. Naditz A. Medication Compliance - Helping Patients through Technology: Modern Smart PillboxesKeep Memory-Short Patients on Their Medical Regimen. Telemedicine and e-Health Telemedicine ande-Health. 2008;14(9):875–880.

[13] [13]. Hayes TL, Cobbinah K, Dishongh T, Kaye JA, Kimel J, Labhard M, Leen T, Lundell J, Ozertem U,Pavel M, et al. A Study of Medication-

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 03, March-2021

Taking and Unobtrusive, Intelligent Reminding. TelemedicineJournal and e-Health. 2009;15(8):770–776.

[14] [14] Midlands and east the automated pill dispenser project report.

[15] [15]*Smart drugs:Improving healthcare using Smart Pill Box for Medicine Reminder and Monitoring System*, Diaa Salama Abdul Minaam, Mohamed Abd-ELfattah, Information Systems Department, Faculty of Computers and Informatics, Benha University, Egypt, Received 23 February 2018; revised 9 September 2018; accepted 20 November 2018.

[16] [16] *Automated Pill Dispenser*, Mr. Christopher Chariah, Vaughn College of Aeronautics and Technology, ASEE's 123rd annual, conference and exposition, New Orleans, LA, JUNE 26-29 2016

[17] [17] G. A. Mugisha, F. Uzoka and C. Nwafor-Okoli, "*A framework for low cost automatic pill dispensing unit for medication management*," 2017 IST-Africa Week Conference (IST-Africa), Windhoek, 2017, pp. 1-10, doi: 10.23919/ISTAFRICA.2017.8102411.

[18] [18] S. R. Bhagya Shree, P. Chandra Shekar, A. Arjun, G. R. Manoj, A. Nithin and R. S. Raj, "*Automated medication dispensing system*," 2014 Eleventh International Conference on Wireless and Optical Communications Networks (WOCN), Vijayawada, 2014, pp. 1-6, doi: 10.1109/WOCN.2014.6923079.

[19] [19] W. Antoun, A. Abdo, S. Al-Yaman, A. Kassem, M. Hamad and C. El-Moucary, "*Smart Medicine Dispenser (SMD)*," 2018 IEEE 4th Middle East Conference on Biomedical Engineering (MECBME), Tunis, 2018, pp. 20-23, doi: 10.1109/MECBME.2018.8402399.

[20] [20] N. B. Othman and O. P. Ek, "*Pill dispenser with alarm via smart phone notification*," 2016 IEEE 5th Global Conference on Consumer Electronics, Kyoto, 2016, pp. 1-2, doi: 10.1109/GCCE.2016.7800399.