A Survey on Implementation for the Autonomous Pill Dispenser to Remind Medication with Alarm and Mobile Notifications

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Abstract: *Population aging is a global issue and medication adherence is a major problem in health care sector. This paper proposes an autonomous medicine dispenser box that alleviates irregularities in taking prescribed medication at appropriate time. The main purpose of this system is to help patients primarily seniors, other vulnerable group that may need assisted care, and to switch from approaches dependent on human memory to automation with negligible supervision ,hence reducing human efforts and preventing error prone tasks of giving wrong medicines at the wrong time in wrong amount. The system contains a programmable alarm system with an interactive UI and sends notifications about the medicine taken and supply of medicines.*
Keywords: Internet of Things, Assistive Technology, Pill Dispenser.

1. INTRODUCTION

As people grow older, they depend more heavily upon outside support for health assessment and medical care. The current healthcare infrastructure in recent society is widely considered to be inadequate to meet the needs of an increasingly older population. Most patients have diseases which need to take medications over a long period of time in order to stabilize their conditions. Ensuring that the patients consume the right medication at the appropriate time becomes crucial. To overcome this problem proposed system work to ensure that the elderly can live safely and independently in their own homes for as long as possible.

Assistive Technology (AT) maintains and improves the individuals functioning and independence, thereby promoting their well-being[1]. But today only 1 from each 10 people in need have access to AT due to high costs and a lack of awareness, availability, personal training, policy and financing [1]. IOT is making strong inroads in the medical industry with the introduction of relevant sensors and devices. Internet of Medical Things (IOMT) is a collection of medical devices connected to health care IT systems for different application [2].

The proposed system deals with the pill time taken for particular patients. Initially, the medication schedule is framed as per the patient's requirement and if necessary can be changed. The system will alert with an alarm at that particular time. To make the system user friendly, the LCD screen shows the timing. After having pills, the system will update the pill no. also check the pill count, when the pills remaining are few, the order for particular pill is sent by the system automatically to medical shop via SMS system.

2. RELATED WORK

The Internet of Things plays a vital role in in-home healthcare services. In [1] is presented two medicine trays having compartments. Each of them is capable of holding more than one pill. To set the schedule of medicines for the patient an android application is built through which notifications are sent to the entities involved accordingly [2]. The system has LCD display that reads "take medicine" at the specific time [3]. The audio buzzer signal helps to alert the patient about the dosage timing [4]. The [5] smart drawer uses an RFID reader and pill boxes equipped with RFID tag to record the type and time of the pill box being removed by the patient.

Table 1: Literature Survey

Title of Paper	Author	Year	Summary of Paper
Intelligent Pillbox: Automatic and Programmable Assistive Technology Device	Juan Marcelo Parra	2017	A circular medicine box which will rotate itself at each dosage time.
Smart Medicine Dispenser (SMD).	Wissam Antoun	2018	An android Application sends notifications to the entities involved accordingly.
MEDIBOX IoT Enabled Patient Assisting Device.	Achsah Mary Marks	2016	The LCD displays the details of the medicine and buzzer for alarm notification.

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Automated Medication Dispensing System	Mrs. Bhagya Shree S R	2014	Uses the LCD display and audio buzzer signals.
Medication Adherence Monitoring Using Modern Technology.	Murtadha Aldeer	2017	The system uses RFID tag to keep the record of pills taken.
Automatic Pill Reminder For Easy Supervision	Animesh Kumar Sahu	2017	It uses the LCD display and GSM module to send the notifications

3. SYSTEM ARCHITECTURE

The setup consists of a small circular box divided into multiple compartments, having a lid to open and an IR sensor attached to it. The box is connected to a real time clock, a microcontroller device Arduino Wemos which processes the activities and accordingly displays the pill details and time od intake on the LCD attached to the box and a GSM module which sends message to the family physician or members in case the pill is not taken. The box consists of several compartments each having a pill for a definite time of the day.
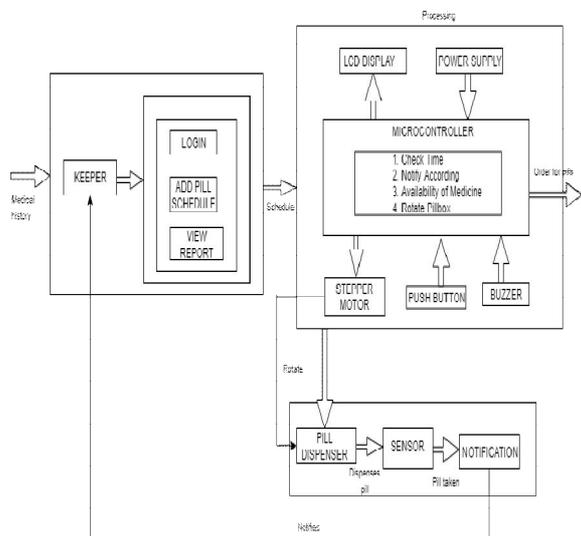

Figure 1: Overview of System Architecture

The figure-1 represents the interaction between keeper and doctor with the pillbox through an interface and a microcontroller. The device alerts the patient using a buzzer at the time of dosage and sends notification to the keeper if the pill is taken by the patient. When the patient takes medicine there is an interaction between the pill box and

the patient. The system is composed by different modules that are controlled by Arduino. There are different types of communication of each module. It could be one way or two way. Therefore the Arduino sends commands to the modules but also receives data from them. The controller obtains the hour from the RTC, the alarm is set at the correct time. The arduino sends the command that activates the motor, the led system and activates the buzzer. The LCD displays the name or the time of the medicine. If the patient take the pills from the pill box, the infrared system notify to the arduino and sends a notification that the pill was taken by the patient to the keeper.

4. METHODOLOGY
The Iterative Dichotomizer 3 (ID3) algorithm is used in the proposed system. The ID3 builds a decision tree from a set of examples and is used to classify future set of samples. The algorithm here is basically used to predict if the patient will take the pill based on previous record.
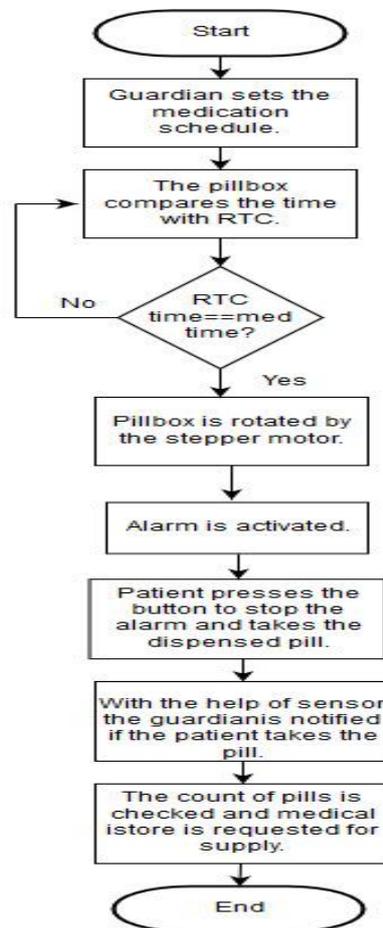

Fig -1: System Flow.

Equations

Entropy:

$$H(X) = -\sum_{i=1}^{n} p(x_i) \log_b p(x_i)$$

Equation (1).

Information gain:

$$For\ Set\ S\ ,\ Attribute\ A$$
$$Where\ S\ is\ split\ into\ subsets\ based\ on\ values\ of\ A$$
$$\subset_S^A = Subset\ A\ of\ S$$
$$I_E = Entropy\ ,\ \mathrm{p}(\subset_S^A) = \frac{size(\subset_S^A)}{size(S)}$$

$$I_G(S,A) = I_E(S) - \sum_{}^{n} (\mathrm{p}(\subset_S^{A_i}) * I_E(\subset_S^{A_i}))$$

Equation (2).

5. CONCLUSION

The autonomous pill box designed aims at assisting a patient completely with a user friendly manner and reduces human efforts. The circular shape of the box will help in rotating the box and the dispenses the only pill required; the alarm and notification features will help in keeping the record of the medication and will greatly increase the medicine effectiveness.

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