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Research paper

IOT based Advanced Medicine Dispenser Integrated with an Interactive Web Application

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Abstract

Internet of Things (IOT) is a development of the internet which plays a major role in integrating human-machine interaction by allowing everyday objects to send and receive data in a variety of applications. Using IOT in healthcare monitoring provides an avenue for doctors and patients to interact and to track the dosage of medication administered. The paper presents an interactive, user friendly network integrated with an automated medicine dispenser which uses IOT, cloud computing and machine learning. The network was built on a python tornado framework with a front end developed using materialise CSS. The feasibility of this approach was validated by building a prototype and conducting a survey.

Keywords: *Automation; Cloud platform; e-health; health informatics; Internet of Thing; IOT; Online database; web application*.

1. Introduction

The field of medicine has seen a revolution with a multitude of new technologies at its disposal. But the doctor-patient relationship has remained the same through these long years of advancement. There is a lack of regular monitoring of the patient and improper dosage of medication being administered to the patient.
A digital solution has a great scope in changing the present scenario. With existing technologies to monitor heartbeat, moment-to-moment blood pressure, rate and depth of breathing, body temperature, oxygen concentration and many more. An online database by way of cloud computing integrated with a medicine dispenser allows the doctor to monitor the patient and administer the proper dosage.
Existing research in the field of health informatics or has been limited to either the software or the hardware, and has been unable to integrate the hardware unit to a network. A few examples are the papers on IOT enabled pill bottle where the authors propose an alarm system for the elderly to take their medicine [1] , IOT modeling for e-health systems by considering a few scenarios are considered and analyzed [2] among others. [3] [4] [5].
A prototype of the medicine dispenser was built and connected to the health network. The setup was tested and its effectiveness was evaluated.

2. Proposed Solution

2.1. Design Of Medicine Dispenser

like slots arranged in a circular pattern. Each slot will be of varying diameter based on different generic medicine size. This compartment will be fitted on a stepper motor to rotate it through 360 degrees.

The design of the dispenser is simple and compact. It consists of a main storage compartment which will be cylindrical with barrel
Each slot will be having a hole on the bottom. All except one of these holes will be covered by a disc connected to a servo motor. There will be an LED display and an alarm system in the dispenser and each one will be individually identified by a machine ID.

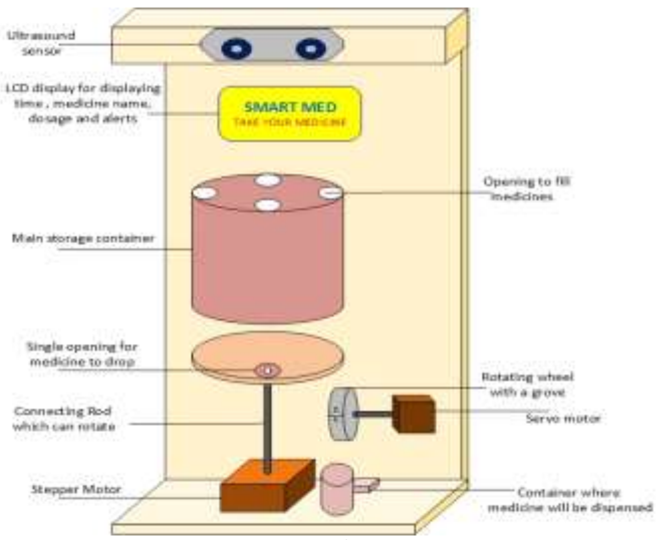

Figure 1: Breakdown Structure of the Medicine Dispenser

The working of the dispenser is being controlled by a Raspberry-Pi. It acts as the local server and downloads or updates the patient's dosage information from the main cloud server whenever it comes online. This feature enables the dispenser to work without an active internet connection throughout its usage. The Raspberry-Pi needs to be periodically connected to the internet to update the progress.

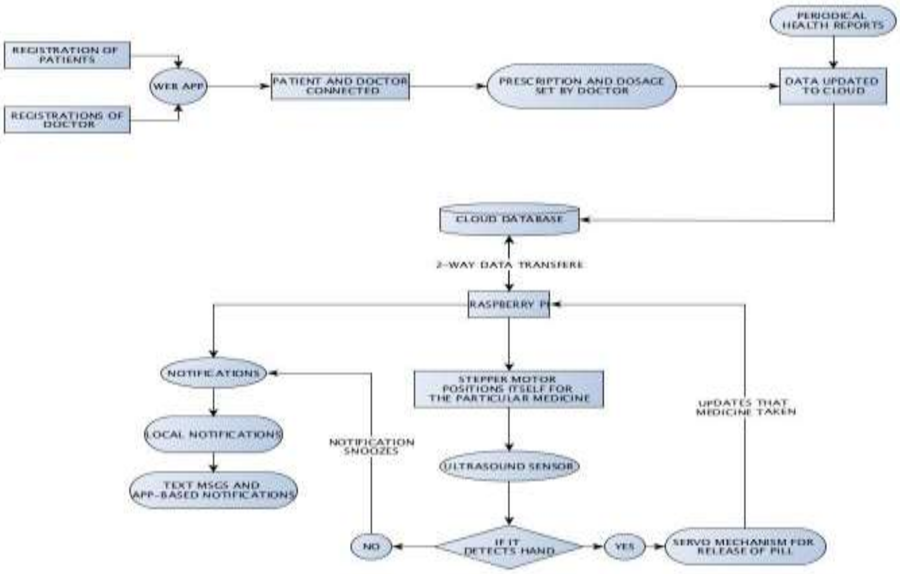

Figure 2: Control Flow Diagram

The Raspberry-Pi does all the on-board processing as well as records the analytics which are updated to the main server when it comes online. The medicine count is measured using the ultrasound sensor as it makes the pill to drop in the dispensing container (as in Figure 1) after issuing a notification. The medicine will be dispensed only when the patient reaches a threshold limit of 40-60cm near the dispenser.

2.2. Health Network

The network is hosted on the Tornado web server and is built on bootstrap using materialise CSS. This is linked to the database where each client's information is stored. A replica of this is present in the local database. The network compares the data of the patient, which is updated by the machine at regular intervals, to the ideal requirements and estimates recovery time. The network is in the form of a web-app which can be accessed by the both-doctors and patients.

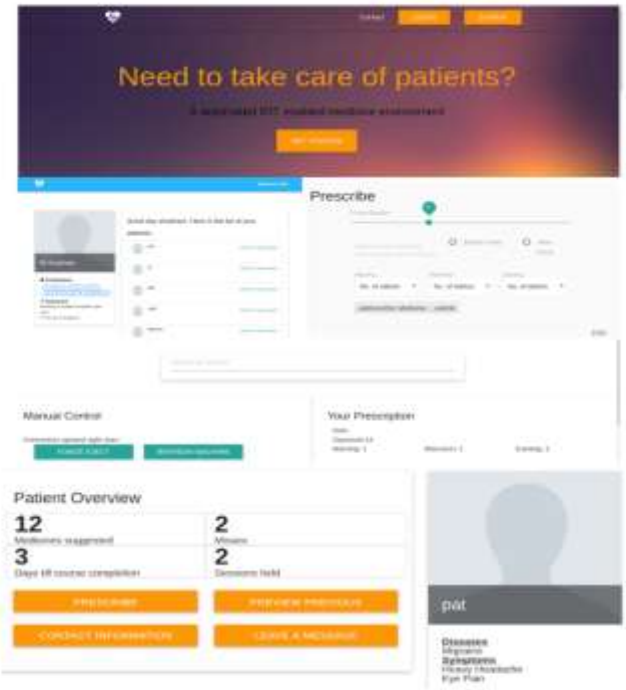

Figure 3: Web application sample

The network and the dispenser are integrated to work together (as shown in Figure 3). The functionality can be expressed as follows,

1. Patients can sign in to the web application and search for doctors based on filters such as locality, specialization, experience etc.
2. The doctor and the patient are linked together in the web-app when the patient applies for an appointment.
3. Then the patient can undergo a physical check-up at the allotted time, the results of which along with the required medication will be uploaded by the doctor in the web-app.
4. The patient needs to buy the required medicines and fill it in the dispenser as per markings in the medicine dispenser.
5. The dispenser keeps a track of the number of tablets and their usage which is uploaded

The pills can be manually taken out in case of machine errors.

3. Experimental Results

The health network along with a prototype model was tested with a person diagnosed with chronic hypertension and diabetes. Three medicines were taken for our analysis and comparison purpose. The patient was prescribed for the duration of two months in December and January. For the purpose of this experiment she was advised to take the medicine in the month of December without an aid and approximately note the time at which the medicines were taken. The web app with the medicine dispenser was interfaced with her mobile phone as an additional aid during the month of January.

From the recordings (as shown in Figure 4) the following conclusions can be drawn,

She totally skipped six dosages in the month of December.

The maximum skipped dosage was of medicine B.

Upon reflection the reasons were identified as,

Medicine A was skipped on the last date as the tablets were finished.

Medicine B was skipped as the patient forgot to take them.

Medicine C was skipped due to her unavailability at home

The application consists of a few limitations as outlined below,

Application isn't capable of giving notifications for medicines which are action depended and not time depended.

The dispenser cannot deliver liquid medicines.

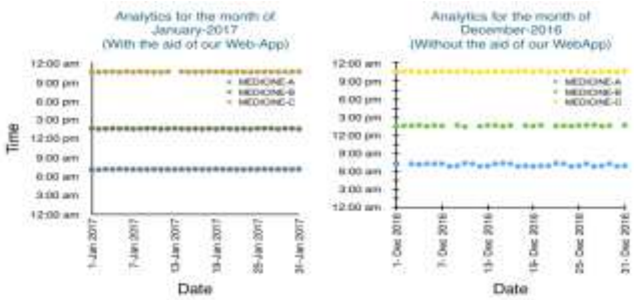

Figure 4: Data Obtained

4. Conclusion

The automatic medicine dispenser is an effort to make treatment of patients a personal experience and provides a very efficient way to track the medicines taken even without being physically present. This project has shown the effectiveness and the possible application of IOT devices in tackling the problems faced by patients in taking medications. There is a lot of scope for development in this field. Neural networks can be integrated into the application to predict hereditary diseases using a database of family medical history. In case of conflicting symptoms in patients, machine learning can assist doctors in diagnosis of the ailment and the possible medications for it. The application can be linked to local ambulance services, blood banks and medical shops for patients to have access to all medical services in a single application.

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