

A Medicare System for Personal Healthcare Management

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Abstract-

In today's fast moving busy world, forgetfulness has become a grave concern especially the elderly and people suffering from chronic disease fail to take their medicines regularly. As per WHO (World Health Organization) it is found that nearly half of the total population do not adhere to the prescribed medication. With the advanced technology, people can be assisted for managing proper medication. This paper proposes a novel solution that uses IOT based sensor(RFID) application for Medication adherence to provide personal health care assistance. Quick counter measures are given with real time tracking of events. The developed instrumented pillbox called Medicare provides healthcare assistance on regular basis. Unlike the existing system, our device improves by providing timely reminders using load cell based on the change in weight. Also, the proposed system connects all the three healthcare players (Doctor, Patient and Pharmacy) on the same line through IoT. Our pillbox is not only restricted to seven day pill adherence but also for extended duration. This approach is easily adaptable and can impact millions of people that benefits healthcare industry.

Keywords—IoT, Load cell, Medication adherence, RFID, Healthcare players.

1. Introduction

In this fast-moving world, development of technology is inevitable. We are at an inflection point where new or developed technologies and its benefits are going to get applied to our lives in each possible way. Personal health care management has not seen focus yet at independent level and is currently focusing on higher percentage of given mass. A common people situation is, visiting their healthcare provider multiple times for their ongoing follow-up of a chronic problem or disease. With each visit, major challenges accounting for senior citizens and specially abled people will be to adhere the medication prescribed. People whose age is 65 years or older, fail to take the medicines that leads to complex health issues. With none to less human assistance in guiding the senior citizens in terms of medication, there comes a need to guide them through connected devices.

2. System Design

This paper explores solution for critical problems in the field of personal health care that could be potentially sketched through "Internet of Things". The objective of the proposed system is helping the aged and specially-skilled to intake the right medicine on time as forgetfulness is a grave concern for them resulting in delayed cure or aggravation of the diseases. The solution begins with digital prescription handshakes with few other drivers for adherence and quality healthcare by connecting all healthcare players and to maintain a real-time track of events with data scenarios through IOT. Firstly drugs are manufactured in the drug factory and stored in the pill bottle. Medicine pill bottle is punched in medicine data to RFID tags. Pill bottle is send to the pharmacy. Patients visit doctor and will get e-prescription through mobile. They receive pill bottle in person or through mail order. RFID reader in the Medifit senses the medicinal data from the RFID tag in the pill bottle and gets updated.

A. PILL CACHE- MEDICARE

We explain the working of the Medicare as shown in Fig1 which contains Medical Pill Information about the pill, expiry, weight for each pill, temperature to be maintained. The medication keyed into pill bottle, smart phones, fit bits when pharmacy delivers and doctor prescribes to patient. Monitoring medication intake through weight sensor monitor patients intake of pills each moment and temperature sensor monitors the required temperature. Doctor, pharmacy, and patients are kept in the same line on patient's intake and medication availability.



Fig 1: Structural view of MEDICARE.

B. MEDIFIT

An automatic flash message from the cloud is sent to Medifit which is shown in Fig2. This helps to take medicines in the correct time which gives an alert depending on the availability of the medicine for the course to be completed. If a shortage of the medicine occurs then there will be an automatic message that connects the nearest pharmacy hub for the order.



Fig 2: Structural view of MEDIFIT.

C. Functional Role of Players

Each of the players, play a specific role in healthcare along with solution elements to make them accountable. This helps in self-monitoring.

1) User’s Perspective- Patients

After the first medical check of the patient, the prescription which contains the details such as patient name, patient id, Medicines, dosage, and time of intake data are fed to the cloud which in turn is joined together as a sequence to the pharmacy. The patient will receive prescription as such through mobile. The pill bottles contain medicine with RFID tag for each. The wearable device senses this tag and automatically gets them updated, and then an alert flash message pops. This operational procedure is shown in Fig3. If not, the alarm rings as a remainder for the intake of the medicine. Solution introduces weight sensor in each pill bottle to monitor weight of pill bottle by the number of medicines available. If we do not see decrease in weight (intake of medicine) after alarm period (like 20 minutes) informs close relative of the patient.

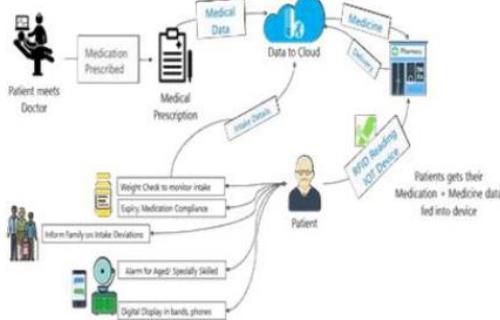


Fig 3: Patients Work Flow.

2) Doctor’s Perspective

Medication storage is also concern that majority of world population do not practically keep track of temperature of medicine to counter them the pill bottle with temperature sensors is available to inform us on storage temperature. If this is not satisfied then an automatic response from the device is given to the doctor which is depicted below(Fig 4).

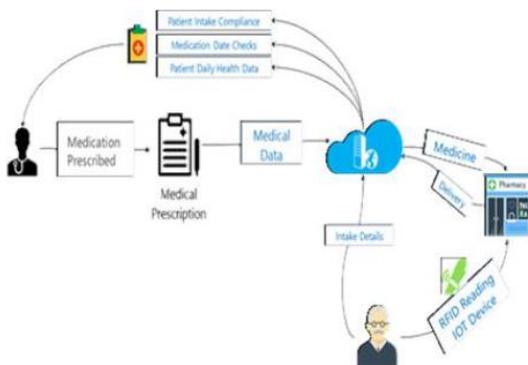


Fig 4: Doctor Work Flow

3) Drug Manufacture Cycle

The RFID tag is procured and punched with the RFID data such as drug name, dosage, weight, temperature, expiry, and price and manufactured date. The medicine Medicare is filled with pills and latched with RFID tag. Pill bottle with pills gets dispense to the pharmacy as shown in Fig5.

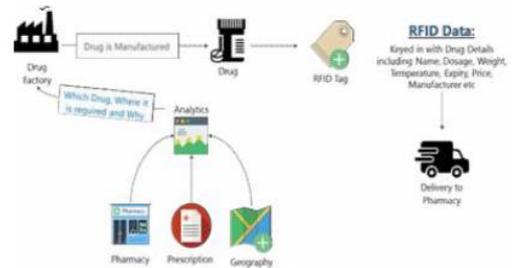


Fig 5: Drug Manufacturer Work Flow

3. Edge Over the Others

Table 1 portrays "our edge over the others" by comparing with the various startups. An end to end bottle containing RFID tagged medicines along with weight monitoring and temperature sensors to help monitor intake and temperature. Reminders through fit bit style wristbands and through mobile to provide analytical inferences, reminders for intake and display fallouts to self and to family information share. The heart of the solution is data cloud engine that supports large data collection and computation to facilitate frequency based monitoring and connected environments.

Table 1 – Edge over Others

	Our Solution	Current World	Few Start Ups
Medical RFID Pill Bottle	✔	✘	✔
Digital Medication Reminders	✔	✘	✔
Alarm Medication Reminders	✔	✘	✔
Medication Intake Check -Weight Monitoring-	✔	✘	✘
Medicine Compliance -Medicine & Medication Expiry -	✔	✘	✘
Analytical Inferences	✔	✘	✔
Family Information Share	✔	✘	✘
Connected Environment	✔	✘	✔

4. Testing and Implementation

The initial prototype of our solution was done for the basic understanding of IOT with the sensor’s worked on Thingspeak platform. The next stage implementation was carried out by integrating all the features of Medicare system which is described.

A. RFID Tagged Pill Bottle with Reader

Foremost activity in the solution should be the RFID information and their data. Solution uses Passive RFID tags shown in Fig 6 available below to carry unique identifier for each of the medicinal bottles.



a) Passive RFID Tag b) RFID Tag read through Wearable
Fig 6: RFID Module

The RFID Tagged Unique identifier will be read through our wearable device and detect the ID. The ID is then moved on to the Cloud using the Wi- Fi IOT Chip. The WI-FI brings in the tag information to its cloud database and relates the medicine, its summary set of data. The required tagging is performed to have the wearable perfecting the reminder information as in Fig 6b.

B. Thermal Reading of Pills

With the LM35 temperature sensor, the Arduino based pill bottle bottom and cap monitors the temperature at a constant interval if the temperature moves outside the boundary of required number an indication is depicted to patient to store the medicine at required place and light. Arduino Uno creates an innovative environment for each of the solution makers to dive in and perfect the connecting environment. The 5V capacity Arduino along with LM35 monitors the temperature at right levels as in Fig 7.



Fig 7: Temperature module

The Temperature through the WIFI chip is transmitted to the cloud database. Based on the continuous monitoring, at right point of time the patient is informed on Temperature adherence.

C. Observe Weight of Pills

The weight sensor is a creative way to monitor the medicine intake every place patients are moving to. The weight sensor available as HX711 in the market along with the right load cell scale helps in monitoring the intake by validating the weight of the pill bottle carrying medicine. Fig 8a and Fig 8b shows few snapshots of the results. Each of the medicinal pills has its weight and each proportionate weight decrease equates to medicine taken by patients.



a) Weight of Pill Bottle Monitored b) Pill Bottle Weight Indicator
Fig 8: Weight module

As an initial phase, use case scenarios were analyzed and the implementation starts with the digital prescription as front end using html and php as shown in Fig 9.



Fig 9: The E-Prescription

The pharmacy has pill bottles with RFID tag and the Medifit containing the RFID reader that automatically gets synced. Timely reminders are sent to the patient as alerts in the Medifit watch for the medication adherence as in Fig 10.



(a)Pill bottle with punched RFID tags. (b) Medifit

Fig 10: Pharmacy module

Initially we tested the Medicare system by taking 3 different pills for the medication adherence reminders. The LED turns on indicating the tablet to be taken. The LED turns off only when the pill is taken. It works in reference to the load cell that detects the decrease in the pill after it has been taken as in Fig 11.



(a)Design of Medicare System (b) LED turned on indicating that the 1st pill to be taken.

Fig 11: Medication Adherence

When pills are not taken, an alert message will be sent to the kith and kin. Also, the Medicare system is attached with temperature sensor that checks if the pills are kept in the correct place (required temperature). Temperature sensor monitors the increase and decrease in temperature as shown in Medifit.

5. Conclusion & Future Scope

Our contemporary idea presents a novel solution improving medication adherence. The proposed solution “Medifit” will transition the current word of mouth, paper-based system to an automatic, real- time and improved quality-based system. The Medifit also generates a good Medication Adherence and pervasive connectivity. This idea would be enhanced in way that it ensures a quality healthcare by monitoring the patient based on the continuous feedback that is being received. Many wellness programs can be conducted to make people know the importance of healthcare. It can also be made easier by providing a payment transparency such as online transactions. We can also maintain all in one record which contains the patient details. These

additions pave a way for our solution to be even more acceptable by the users.

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