ArduMed - Smart Medicine Reminder for Old People

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Abstract— It is a frequent observation that people give more preference to their work and other material things than taking care of their health. If smart, working adults can forget taking proper medications, the situation can only be worse for our parents and grandparents. Often they forget to take their medications or take overdose of it, resulting in further health deterioration. Our system aims to reduce this problem by reminding patients about their medications and showing them the correct amount of medication to take. It is a combination of physical and digital reminder that will be helpful for people of any age, but is specially helpful to old people who forget taking their medications.

Index Terms— medicines, medicine reminder, smart system, old people, elderly people, smart pill box, smart medicine reminder

1 INTRODUCTION

Our smart medicine reminder system is designed for, but not restricted to, helping old people in taking care of themselves in taking their medications at the correct time and in the correct amount. It has been observed that people in general neglect their health and give preference to other things than taking their medicines. This is also the reason they forget to take their prescriptions on time. Many health maintainance organizations, health practitioners and medical researchers have realized that increased use of patient reminders can significantly increase the treatment of chronic illness and delivery of medical services to the patients who need it. Several organizations have themselves started implementing the patient medicine reminder system in the health care field and it is currently being implemented in several hospitals in the western countries to see if the method reaps any benefits. It is known throughout that *Over The Counter (OTC)* medication taking patients should take prescriptions in a limited or prescribed quantity at the respective times they are supposed to take their medications. However, many patients and specially old people, do not take their medicines in the correct quantity. They either take overdose of medicines thinking it will help them heal faster, or they fear the doctor has prescribed a larger quantity than required and take under dosage of medicines. The former leads to several disastrous health implications while the latter delays the treatment of the patient and in wome cases, allows the illness to spread further requiring further treatment.

Furthermore, some patients are so occupied with their day-to-day activities that they just forget to take their medications. This is particularly true for old patients who have to take more than one medicine at more than one time in a day. Setting alarm clocks is a tedious task which patients are too lazy to set again and again. If asked about what time people have to take their medicines, many forget to answer the correct times or remember whether they have already taken the medicine in the day already. Elderly people specially face this problem because of their degrading memory and in severe cases, forget that they have already taken their prescription and retake the same medicine 2 or 3 times in the same duration. This may not be harmful for lighter medicines, but for some strong and concentrated medicines, it can have further harmful effects to the body. This is exactly where our medicine reminder system can help. Our system takes up the prescription details from the user such as the duration of the prescription, the names of the medicines, the times they are to be taken and the amount of each medicine which is to be taken. After all this data has been entered, our system will remind the user at the prescribed time of which medicine is to be taken in form of a mobile notification and a physical reminder. The patients can leave taking medicines to just our app. Whenever the time for the medicine is up, they will be notified and they only have to take their prescriptions during that time, and no other time. If implemented properly, this will drastically decrease overdose of medicines due to forgetfulness and the patients will also be reminded to take their medicines.

2 RELATED WORK

Several medication reminder systems have been built upon different concepts and on different platforms. Many people have started using healthcare related apps and their popularity has been growing but there are still several issues that have to be answered by them. My MediHealth [1] is a medicine reminder system built specifically for children. It runs on smart phones and provides user interface for managing prescription schedules and alerts for reminding patients about the type and time of the medication according to the prescribed medicine schedule. Several systems use RFIDs (radio-frequency identification) or motion detection technologies to make sure that patients are really taking their medications [2][3]. It was proposed by Park et al, a medication reminder sync system based upon synchronization of data. The system transmits open mobile alliance (OMA) data

synchronization (DS) based messages which contain the patient's prescription data and the device data to a remote medical staff. It further synchronizes data modified by these personnel in the medication server [4].

Prasad B has created an app by the name of Medicine reminder pro. It is an android application which can serve upto 15 reminders. User can order these reminders in either non-repeating or repeating patterns. Hourly time intervals between the alarms can also be selected, with the minimum range being 1 hour. At the specified time, the app will send out a notification with a LED indication, an alarm and vibration [5].

Zao et al created Wedjat – a Smart Phone Application which tries to avoid medicine administration errors. Wedjat can perform three primary functions:

- Send out prescription in-take reminders
- Support identification of medicine and in-take directions
- Maintain records of medicine in-take [6]

3 Analysis

After studying and analyzing all the above existing popular applications based on Android mobiles, some major findings noticed which reduce their popularity.

A. Findings in existing systems:

1. Users have to enter the name of the tablet/capsule manually everytime. It cannot be added automatically.
2. Users have to enter the quantity/dose of the tablet/capsule manually everytime. It cannot be added automatically.
3. Users have to enter the reminder about the times of dosage manually i.e. 2 or 3 times in a day.
4. Users have to manually select the duration of the reminder.
5. They are not facilitating anything regarding the original prescription.

Everything needs to be done manually. We need an app which can reduce a lot of the manual work and automate stuff. Also the existing systems have some major drawbacks. Those drawbacks are as follows:

B. Drawbacks of existing systems:

1. Reminders cannot be set automatically. There is a need for manual work in setting the reminder.
2. A lot of time is consumed in manually setting the reminders.
3. They don't facilitate storing the original prescription.
4. The possibility exists for the existing systems to hang down due to the manual work involved.

4 Proposed System

The medicine reminder system will have one duty and that would be to remind the user that he is due for taking the medicine. We are trying to make sure that the user never forgets to take the medicine and hence we do the reminder in three ways. One is that we have visual indicator which would be the light. We also felt that if a person is not sitting close to pill box he may not notice the lights hence we have also added a buzzer which will give a auditory indication that the medicine needs to be taken. In the case that patient is outside, we have a mobile reminder app which will remind using mobile notifications for that time. The mobile application can be installed in the android devices. It will add recurring events to the mobile's calendar and will alert the user when he has to take the medicine with the list of medicines and it's prescribed dosage.

5 System Overview

The system can be said to be divided into two categories: hardware and software. The software portion will do the reminder part of the task, which is to remind patients to take their medicines along with how many spoons or pills they are supposed to take. The reminder can be set in two ways: using the web application, or by using the mobile app. Both the applications require users to login, so that their medications can be synced with their calendar. To improve this process further, we will assign a color to each medicine (since it has been proved that visual cues such as colors are easier to remember than names [7]) and when it's time for the reminder, an LED of that color will be switched on signifying that it's time to take that medicine.

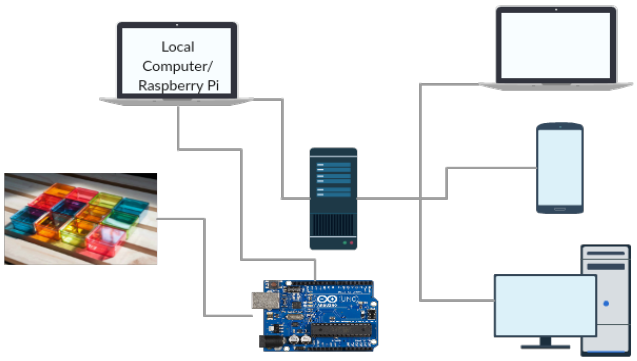

Fig 1. Architecture of the Medicine Reminder System

Furthermore, The medicine reminder system will can be accessed

in two ways: using the webapp and using the mobile application. The webapp will take medicine prescription as the input then this data is used to add the event in the user's Google calendar after google authentication using OAuth2. The data is also stored in MongoDB which is used by arduino to switch on the corresponding LEDs in the particular time according to the doctor's prescription.

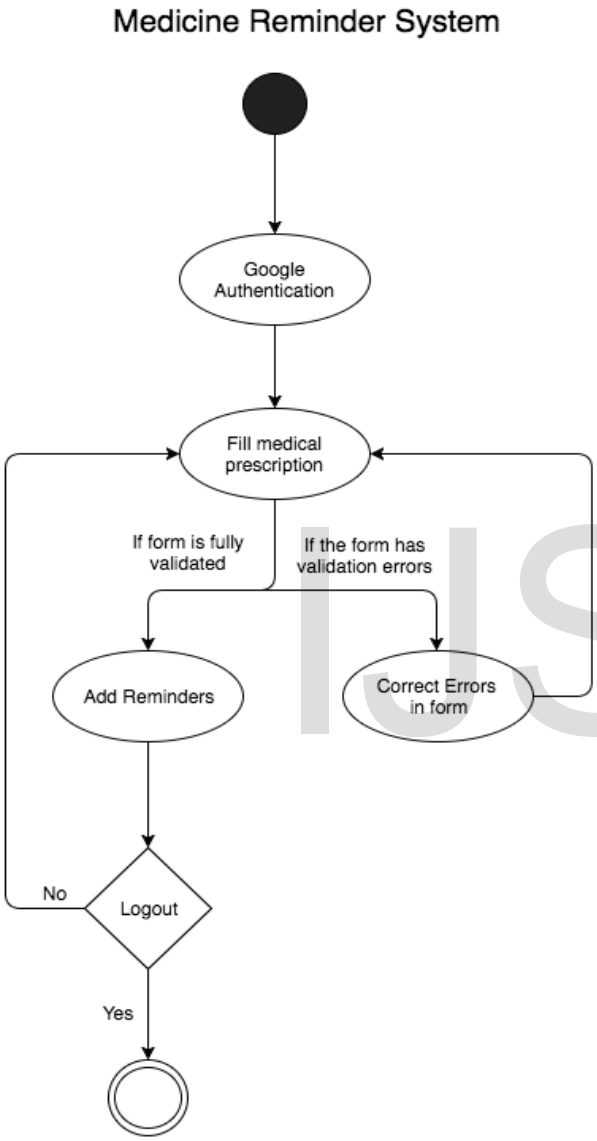

Fig 2. Activity Diagram of the Medicine Reminder System

5.1 Assumptions and Dependencies

The assumptions to be made before using the system:

- The user must be able to read, write and understand the basic english language
- The user should have an android phone which is switched on for using apps
- Icons and features must be identifiable and distinguishable
- The person should be able to hold the Walking Stick firmly for using it
- The user must have a Google ID

Some of the main dependencies of this system are :

- Hardware Dependencies: The web hosting server should be up and available to host the webapp. For the android app the mobile device should have a working internet connection for authentication and adding the events to calendar.
- Google API Dependencies: The system uses Google's OAuth 2.0 API for user authentication. It has also integrated the ability to interact with the user's google calendar. Hence for expected functionality of the system the APIs should be available for all time and locations by google.

6 Implementation of the Proposed System

Some of the main features of our system are:

1. Storing the doctor's prescription - The user has to fill the details of doctor's prescription in the form and then that data will be stored in the MongoDB
2. Adding Reminders for taking medicine - The user is verified firstly by using Google authentication, then user fills the form which is then used to add the reminders in the user's calendar according to the time slot and recurrence specified in the form
3. Showing the list of medicines with their dosage at prescribed time - The user gets a notification in his device at the time of taking a medicine, and that notification contains the list of medicines to be taken along with their respective dosage
4. Showing LEDs to identify which medicine has to be taken currently

To configure the app, the user has to enter the following details:

A. Name of the Patient (helpful for future prescriptions)
B. Age of the Patient (helpful for future prescriptions)
C. Prescription Duration - the duration for which the patient has to take the medicine
D. Number of Medicines - field is mandatory to generate further options
E. Names of the Medicines - to keep track of what medicines are taken by the user and to remind the user

later of the medicine to take

F. Dosage Time - the time at which to remind the user, whether in morning, evening, night or a combination of the three
G. Dosage Quantity - the quantity of dosage to be taken for each medicine

For the Web app:

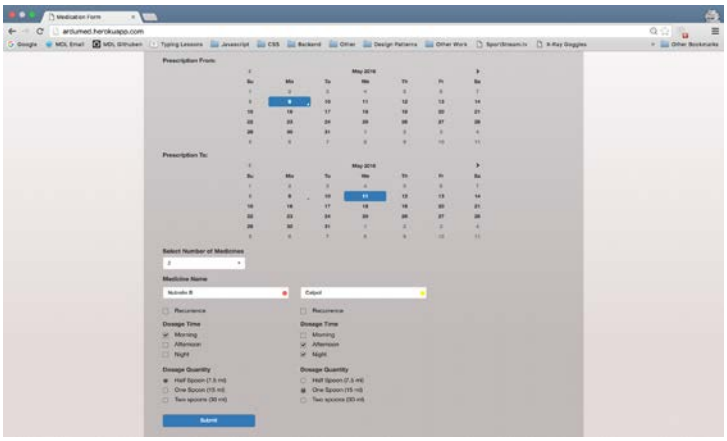

Fig 3. Prescription details to be entered - Web app

For the mobile app:

Fig 4. Login screen for mobile application

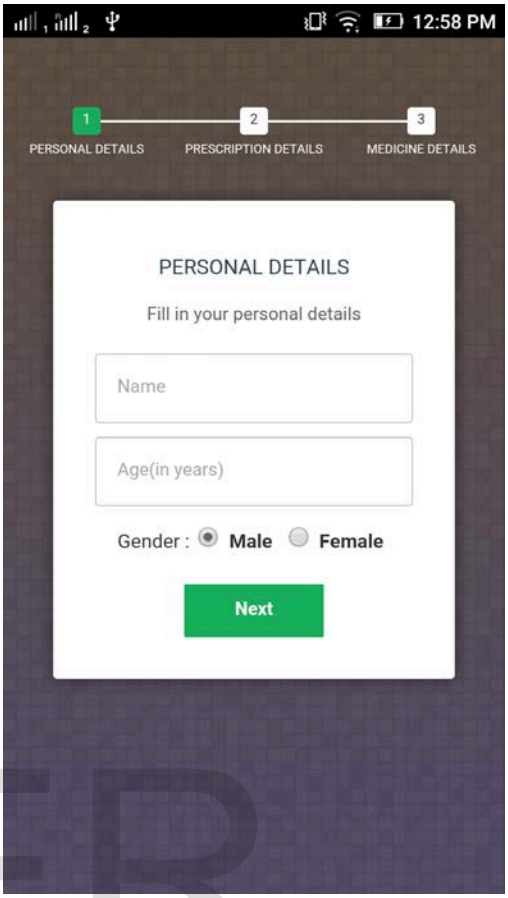

Fig 5. Prescription details on mobile app

7 RESULTS

The ArduMed medicine reminder system serves reliable reminders, has a good and easy to use user interface and supports a lot of features adhering to medicines. The details are not at all confusing and can be easily understood by the user. The best part of the application is that the details only have to be entered one time. On submitting the details once, the data is synced on all the user's devices on which he/she is logged in. This allows for easy reminders no matter what device the user is using. The reviews on the system are overall positive and it addresses most of the flaws in the current reminder systems. However, there are a few issues which we intend to address further:

- we can only remind the person but not make him take the medicine forcefully
- we are not following up on alarms so if the user skips the alarm, we don't bug him continuously

We did a survey on 40 people and asked them to download and use the app for their medicinal needs and see if it helps them. According to the gathered report, 78% of the users said that the

app actually was helpful in reminding them about their medications and would love to use the app. 14% said that they would like further improvements in the app which would be very helpful to them. Thus we intend to improve the app and support as many devices as we can.

8 Conclusion And Future Work

The Ardumed medicine reminder system is a useful resource for those who need technological help in completing or need help in working through day-to-day tasks and taking care of their health. It is a smart and organized system that is designed with helping the elderly people in our homes, but we have not put any restrictions that stop an everyday user from using the system. Anyone can need medical attention and normal people forget taking their prescriptions as well. The Ardumed feature will help them out in regulating their medications. It can also help a working person with a busy schedule by sending him a notification on the device he uses full day, his laptop. Thus there is no restriction on the user base for our system.

For the future work we have decided to add a confirmation from the user whether they have taken the medicine or not. If they haven't taken the medicine the information will be send to the doctor and he can they reschedule the further medicine reminders according to the new schedule. Overall, ArduMed is a much needed system by the elderly people in our homes. It helps them in taking their medications in the prescribed quantity and at the prescribed time.

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