



RESEARCH ARTICLE

A MOBILE BASED DRUG DOSAGE CHECKER ON INTERNET OF THINGS PLATFORM

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Abstract---Running effective and appropriate healthcare is one of the most important objectives of any nation for its economic and social development. It has been perceived that there has been severe incidence that takes place in drug administration due to clinical errors and or negligence on the path of the patient which has led to several adverse drug reaction cases.

In this paper, a Drug Dosage Checker application was developed to double check the drug dosage being prescribed or given by the physician via the nurse or pharmacy to the patient. The application also enables the user to set a reminder to know when next to take another dosage.

The system is based on the Internet of Things (IoT) paradigm on a mobile platform which allows for dosage checking from anywhere and at any place.

The system design was carried out using a standard feasibility study. The user interface was designed using the Eclipse IDE (Integrated Development Environment), Extensible Markup Language (XML), Java and Android Emulator ADT (Android Developer Tool). The SQLite was used to implement a self-contained, transactional SQL database engine.

Keywords---- Dosage checker, Mobile, IoT, Health Care

I. INTRODUCTION

Human health and well-being is the ultimate goal of any economic, technology and social development. The rapid rising and aging of population is one of the macro powers that will transform the world dramatically, it has caused great pressure to food supply and healthcare systems all over the globe[1]. It has been observed that there has been a severe incidence that takes place in drug administration worldwide due to clinical errors and or negligence on the path of the patient which has led to several adverse drug reaction cases. This kind of negligence prolongs hospital stay and about one third of the adverse drug reactions occur during drug administration. In addition, Adverse Drug Reaction (ADR) and harmful effects of pharmaceutical excipients are important clinical issues due to the ADR rate appearance in hospitals[2]. In a situation whereby a patient visits an hospital, after complaining to the doctor and the doctor prescribed drugs to be used but then the nurse made an error by giving the wrong drug or dosage to the patient probably due to medication labels or packaging were of poor quality or damaged[3] and it could even be illegible handwriting of the physician. This kind of situation could lead to a severe drug reaction which could lead to mortality in some cases. To tackle this problem, a drug dosage checker would bridge the gap where the patient could double check the drug and dosage being prescribed by the physician and also check the correctness of the dose to be taken. The Internet of Things technology can be used to effectively curb Adverse Drug Reaction as a result of wrong drug usage. The phrase "Internet of Things" (IoT) was coined at the beginning of the 21st century by the MIT Auto-ID Center with special mention to

Kevin Ashton[4]. As a complex cyber-physical system, the IoT integrates all kinds of sensing, identification, communication, networking and informatics devices and systems and seamlessly connects all the people and things upon interests, so that anybody at any time and any place, through any device and media, can more efficiently access the information of any object and any service[5]. “Ubiquitous” is the distinct feature of IoT technologies, so the IoT is sometimes called ubiquitous identification[6].

This paper presents an enhanced approach assisting both the patients and all affected stakeholders of drug users. The solution presented is an application, which could be installed or downloaded in common devices such as smart-phones, PDAs and PCs.

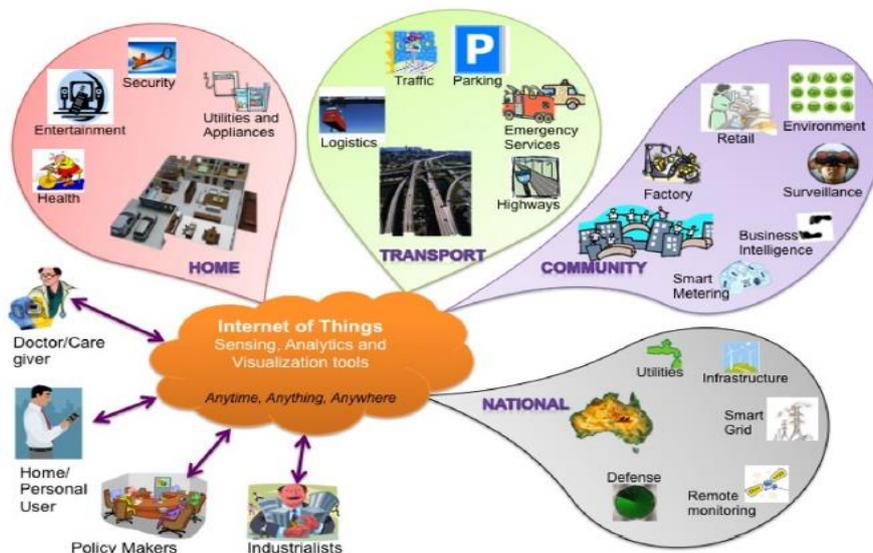


Fig 1: Internet of Things schematic showing the end users and application areas based on data (source: J. Gubbi et al. / Future Generation Computer Systems 29 (2013) 1645–1660)

II. DRUG DOSAGE CHECKER

The combination and dosing of the drugs is determined by clinical trials undertaken on different disease types, using single drug or combination drug regimens with varying doses to ascertain a sensitivity of the disease to the trial combination being undertaken. The majority of patients receive standard dose therapy worked out from these large and extensive clinical trials which are undertaken.

In determining the dose for any regimen the person’s current height, weight, blood test results and age are considered[7].

A.. Drug Calculation

Prior to administration it is necessary that you confirm the drug, dose schedule and rate of administration. Chemotherapy drugs are usually dosed according to the patient’s body surface area (BSA).

The BSA can be calculated in two ways; using a formula as below or a nomogram. Nursing staff should always use the formula;

$$BSA (m^2) = \frac{\text{Height} \times \text{Weight}}{3600}$$

B. Role of a Second Checker

To ensure an incident-free procedure, the role of the second checker is as important as the role of the person actually preparing and administering the fluids and medications. The second checker acts as the final checking point for checking the *right dose*, *right route*, and *right time*, and *right rate*.

C. The Metric System

- i. Every weight and measure in the metric system bears a simple relation to the initial unit, the meter.
- ii. Every unit is multiplied or divided by the same number (that is, 10) to obtain the next higher or lower denomination, and an increase or decrease is expressed by moving the decimal point either to the right or to the left.
- iii. It's almost universal adoption makes it an international system.

D. Administration of drug dosage in children.

The doses in the monographs drawn below are either stated on a specific dose per weight/surface area basis or by an age/weight range. In some circumstances other methods may be required for calculating the appropriate dose in children. The following method of calculating doses should only be used if a specific dose cannot be found since it assumes the child is 'average'[8].

AGE	MEAN WEIGHT FOR AGE		Mean Surface Area of Age	% of Adult Dose
	KG	LB.		
New-born (full term)	3.5	7.7	0.23	12.5
2 months	4.5	10	0.27	15
4 months	6.5	14	0.34	20
1 year	10	22	0.47	25
3year	15	33	0.62	33.3
7 year	23	50	0.88	50
10 year	30	66	1.05	60
12year	39	86	1.25	75
14 year	50	110	1.50	80
16 year	38	128	1.65	90
Adult	58	150	1.73	100

Table 1: (Percentage Method of Calculating Doses)

E. Some Common Drug and there Prescription

- i. **Amoxicillin / Amoxycillin**

Dosage:

1-2gm IV Q6hrly

INDICATIONS:

1. Treatment of infections caused by susceptible organisms
2. Empirical treatment to cover enterococcus.

Presentation and Administration:

Compatible for 6 hours with normal saline, 3 hours with Hartmann's, 1 hour with D5W and glucose and sodium. (Note that amoxicillin is less stable in solutions that contain glucose so it is preferable to avoid these solutions). Store at room temperature

Clinical Pharmacology:

Amoxicillin is bactericidal against susceptible organisms during the stage of active multiplication. It acts through the inhibition of biosynthesis of cell wall mucopeptide. Amoxicillin has been shown to be active against most strains of the following microorganisms:

PRECAUTION

General

Prescribing Amoxicillin in the absence of a proven or strongly suspected bacterial infection or a prophylactic indication is unlikely to provide benefit to the patient and increases the risk of the development of drug resistant bacteria.

ii. **Ciprofloxacin**

Presentation and Administration:

200mg / 100ml (solution in normal saline)

Store at room temperature

Administer required dose over not less than 60 minutes. Solution is usually infused undiluted but can be mixed with other compatible IV fluids. Compatible with the following IV fluids; Normal saline 5% Dextrose 10% Dextrose Hartmann's Glucose and sodium chloride Do not mix with any infusion solution or medicines.

Dosage:

400mg 8-12hrly

PRECAUTIONS

General

Prescribing ciprofloxacin tablets and oral suspension in the absence of a proven or strongly suspected bacterial infection or a prophylactic indication is unlikely to provide benefit to the patient and increases the risk of the development of drug-resistant bacteria.

iii. **Paracetamol**

ICU INDICATIONS:

1. Analgesia
2. Antipyretic

Available in 500mg capsules, tablets, soluble tablets and suppositories.

Dosage:

1gm 4 hourly (maximum 4gm/24 hours)

PO/PR:

1gm 4 hourly (maximum 4gm/24 hours)

Note: In patients with chronic or active hepatic disease, especially those with hepatocellular insufficiency, chronic alcoholism, chronic malnutrition (low reserves of hepatic glutathione), and dehydration the dose should not exceed 3g/day.

ADVERSE REACTIONS

- Dizziness, headache, dystonia
- Gastrointestinal
- Vomiting, dry mouth, diarrhoea, constipation, nausea, dyspepsia, enlarged abdomen,
- Anaemia

III. TERMINOLOGIES

- A. Dose:** is the amount of drug taken at any one time. This can be expressed as the weight of drug.
- B. Dosage Regimen:** is the frequency at which the drug doses are given. Examples include 2.5 mL twice a day, one tablet three times a day, one injection every four weeks.
- C. Dosage Strength:** is the amount of drug in the dosage form or a unit of the dosage form (e.g. 500 mg capsule, 250 mg/5 mL suspension).
- D. Route of Administration:** is the way the dosage form is given. Common routes of administration include oral, rectal, inhalation, nasal and topical.

IV. SECURITY FEATURES OF THE PROPOSED SYSTEM

- A. Registration: users of the system would have to register with their Identification (ID) and a password before the usage of the system is possible.
- B. A user can only view its own database but does not have access to other users information even if they both registered on the same device
- C. Users information is stored in a secure SQL lite database.

V. ANALYSIS AND DESIGN OF THE PROPOSED SYSTEM

Drug Dosage Checker is a system (application) designed to assist the user (patient) to double check the drug prescribed to them by the physician in an offline mode with or without the internet. The app would be able to give the user prescription of drugs dosage, side effects etc. measures is available all together in the app. Also, the user could set a time alarm that serves as a reminder to the user about when next the user is supposed to use his/her drug.

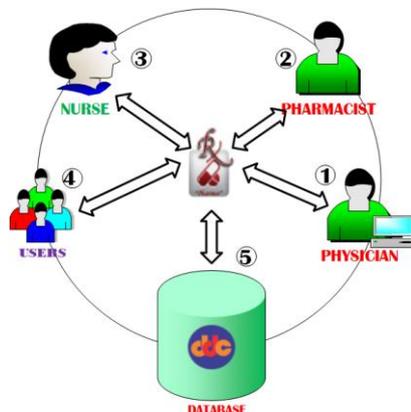


Fig 2. The Proposed System Architecture

VI. CONTEXT FLOW DIAGRAM

Context flow diagram, showing the data flow of the system.

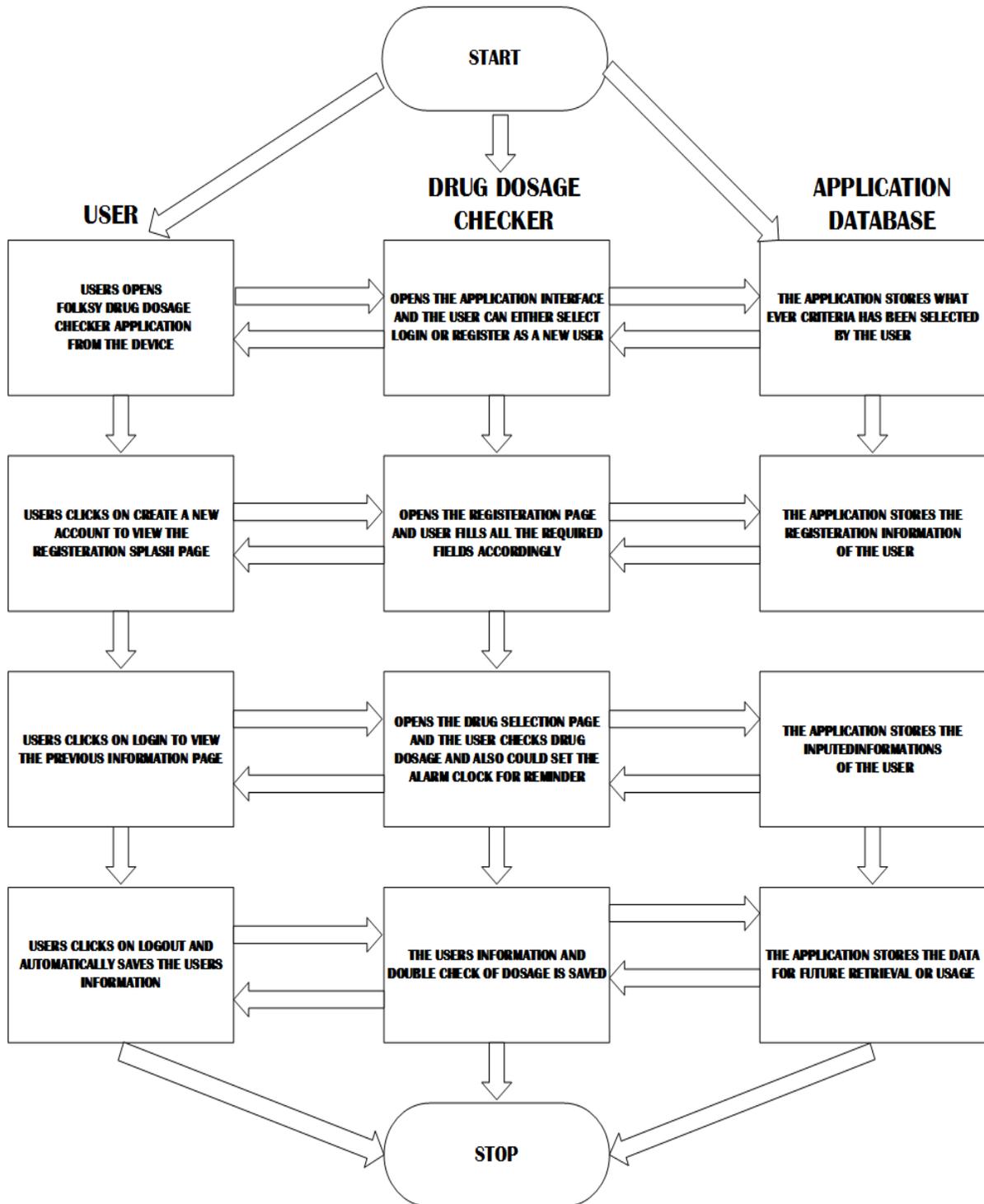


Fig 3. Representation context flow diagram of Drug Dosage Checker.

VII. FLOW CHART OF THE SYSTEM

Flow chart shows the steps and direction of which the flow of data moves and they are connected with an arrow

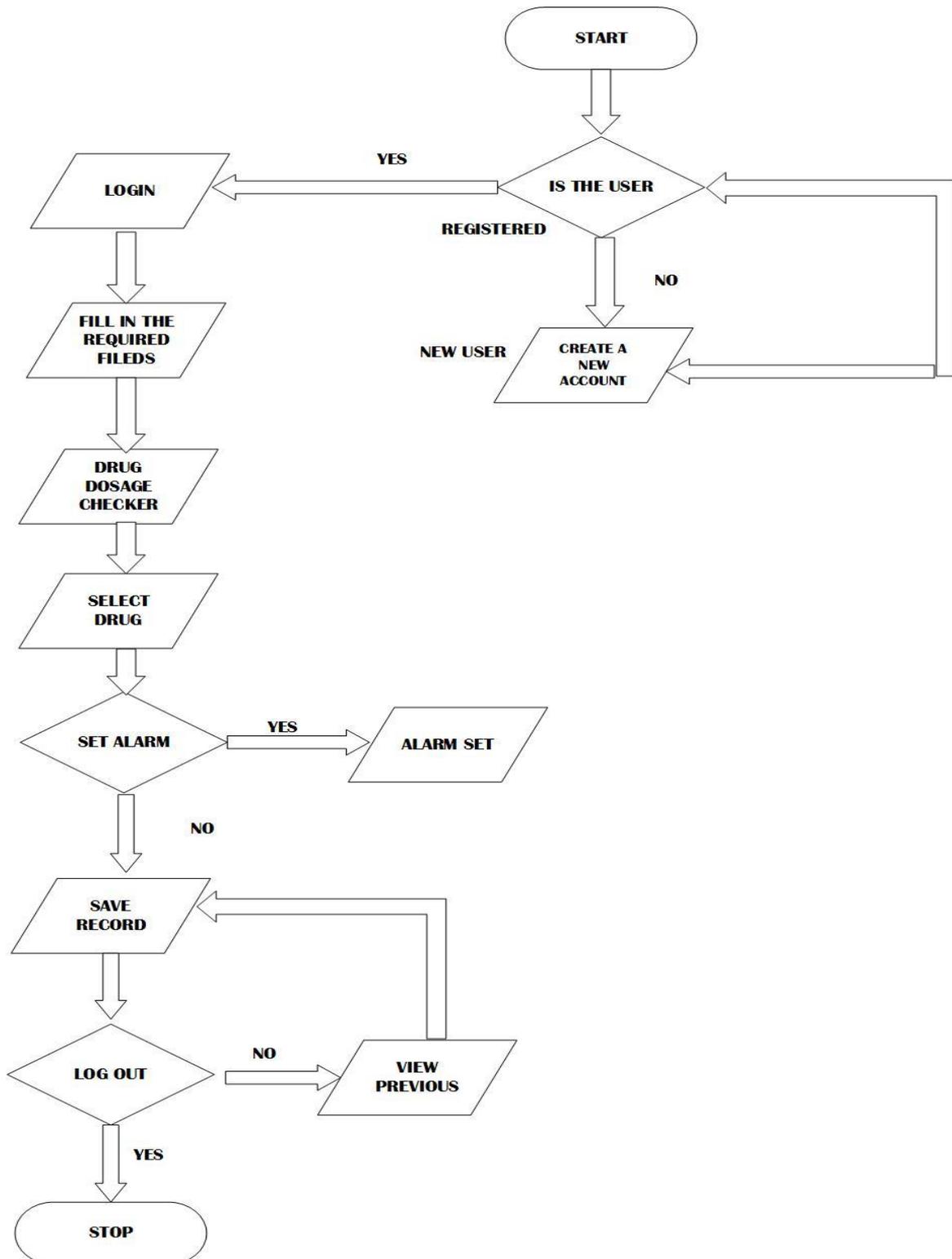


Fig 4. Flowchart of the System

VIII. USE CASE DIAGRAM OF THE SYSTEM

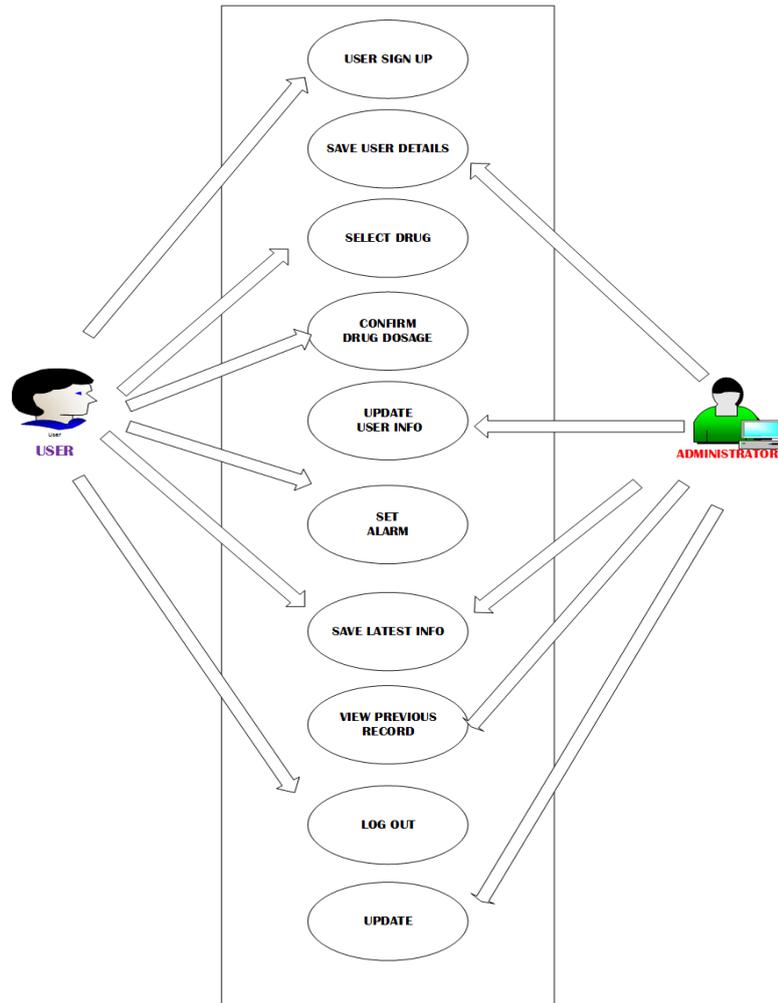


Fig 5. Use case Diagram for the system

IX. IMPLEMENTATION

Access of the drug dosage application using the Android device. The front end of the program is the visual and interactive user interface which is seen by the user and which user can manipulate or interact with it within the process of registering, user account. The user interface was designed using the Eclipse IDE (**Integrated Development Environment**) for development, Extensible Markup Language (**XML**) for designing the interface, Java programming, Android Emulator ADT (**Android Developer Tool**).

A. Hardware Requirements

Hardware that was used include:

- i. A mobile application processor system on chip (SoC)
- ii. Minimum Processor Speed Required 1.2GHz CPU.
- iii. Minimum Random Access Memory (RAM) 512MB or above.
- iv. Minimum of 32GB for storage or above.

B. Software Requirement

Android Operating System Jelly Bean 4.2 and above, JAVA library, JDK 1.7 (Java Developmental Kit version 1.7) techniques, An Android V1.6 Emulator ADT (Android Developer Tool) and Extensible Markup Language (XML).

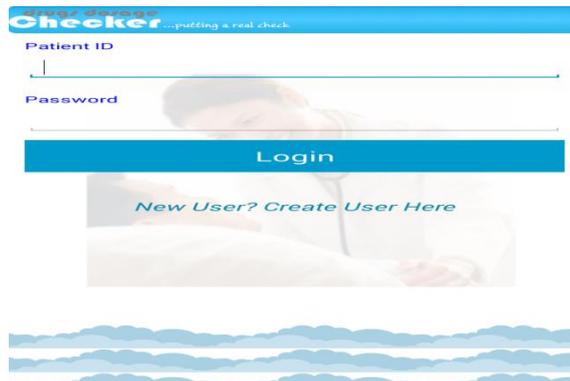


Fig 6. User Login page

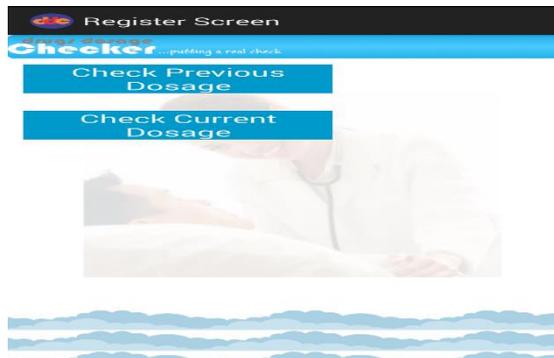


Fig 7. Registration page

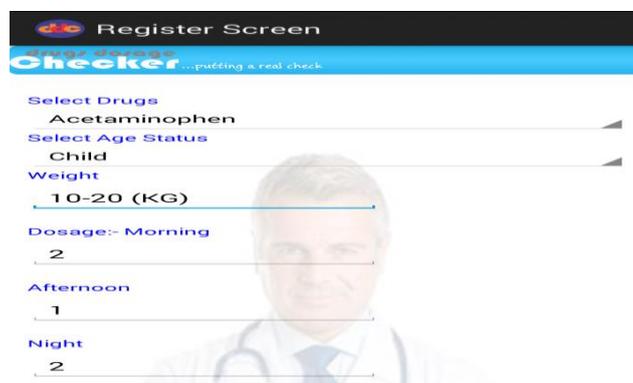


Fig 8. Drug Description Page

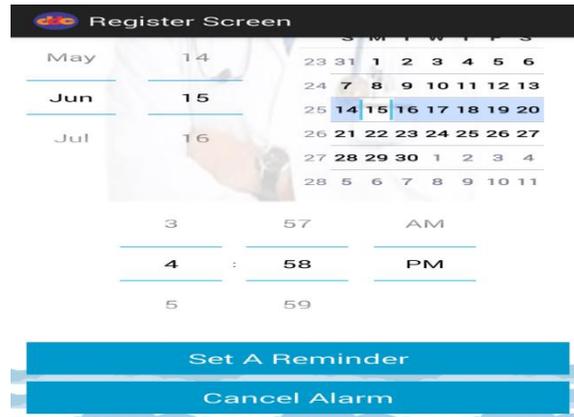


Fig 9. Alarm Setting Page

X. TESTING AND RESULT

After the design of the Application has been concluded, the application was tested. Not just technically to correct the use of Java codes, also functionally to see to what extent its aim and objectives were achieved. Ultimately three methods of testing were adopted in this study, and they are;

- a. The integrity testing
- b. The usability testing
- c. System Result Analysis

A. Operating System Testing

When coding was completed, it was necessary to test the application to see which android operating system is the minimum requirement to work with the application. Android 4.2 jelly bean was observed to be the minimum operating system requirement when tested on the Eclipse android emulator of the software.

B. Usability Testing

This is to ensure that the documents are useable, even after they have been confirmed technically correct. To do this the application was installed on different android phones like Samsung, Tecno, HTC, and it ran very well on their different devices of Android operating system 4.2 jelly bean and above.

XI. SYSTEM RESULT ANALYSIS

The activities of the system developed was analyzed to see whether the set goals have been successfully achieved, from the users satisfaction end, the information gotten was able to provide the correct prescription of drug dosage to the user.

XII. CONCLUSION AND FUTURE WORK

Providing a consistent connection between patients, physicians, pharmacists, pharmaceutical researchers and drug companies is a crucial step towards enhancing the quality of knowledge management and thereby e-health services in the pharmaceutical domain.

The application designed will assist the user(s) (patient) to double check the drug being prescribed to them by the physician and when it is confirm by the user, the user(s) could set up an alarm which would be a reminder about when the user(s) should use the next dosage being prescribed thereby reducing severe Drug Adverse Effect as a result of overdose or under dose. With this application the user is confident that the drugs taken are accurate and timely as recommended by the physician.

XIII. RECOMMENDATION

This work is scalable and it is very open to upgrades and knowledge expansion. In order to make the system more effective, resourceful and secure, the following aspects can be worked on:

1. More security in securing the data of the user(s).
2. Reading drugs using Barcodes Scanner
3. Creating links where by user(s) could have a live chat with doctor at any place in time.
4. The system could be upgraded to other operating systems like the windows, iOS, Blackberry OS etc.

XIV. REFERENCES

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