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Internet of Things(IoT)Based Smart Healthcare System

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Abstract —*The proposed system is a health care app in collaboration with an IOT based medicine box for people suffering from neurological defects such as Alzheimer's, Dementia, Parkinson's as well as other age related problems. It is an initiative made to target the most common symptom that is forgetfulness. The medicine box is an integration of sensing hardware system and an android application that generates notifications based on various patients activities. This app also incorporates patient's details and medicine schedule. In the modern healthcare system, this medicine box can act as a great tool to help the patients organize their medicine schedule and adhere to it as prescribed by their physician thus improving their quality of lives.*

Keywords- *Alzheimer; Android; Internet of Things IoT; Notifications; Application; medicine box; Caretaker; patient*

I. INTRODUCTION

The neurological disorders such as Alzheimer's, Dementia Parkinson's are diseases that keep on getting worse with time.Such diseases do not have cure.These diseases mainly affect the daily lives of sufferers as they are related to the brain.Symptoms mainly include confusion; altered levels of consciousness, inability to communicate, forgetfulness, etc.Patients with such diseases are prescribed with medicines that slow down the progress of such diseases.Hence it can be difficult for people with such diseases to lead an independent life.They normally require a caretaker by their side to guide them throughout the day.

At a certain point of time constant dependence on the caretaker can turn out to be irritating for the patient.The caretaker as well cannot be present 24*7 to monitor the patient.A medicine on the other hand plays a crucial role in the lives of patients suffering from these diseases as some of these medicines can be life dependent medicines too.As forgetfulness is a major symptom it is necessary that the patient must be monitored periodically for medicines.
The smart healthcare system thus overcomes these problems by providing assistance to the caretaker by keeping a timely track on the medicines being consumed by the patients as well as the doses missed by them.It also monitors the wrong medicine being taken by the patient.It also notifies the caretaker once the medicine box is empty to timely refill it
.

II. EXISTING SYSTEM

The medicine boxes currently present in the markets mainly consists of the traditional ones which are simple to use and cost efficient.These are used by a huge number of people because of its simplicity as well as those whose main concern is just storage of medicines.Then there are several mobile applications available that are specifically used to save reminders for medicines along with their names as per the timings entered by the user.These apps help the patients to take medicine on time.Also medicine boxes with associated alarms are available.These medicines boxes buzz or ring at a specified time notifying the patient to take medicines.
Although these present systems in the market have their own benefits, they cannot be used by patients with acute problem of forgetfulness nor can they track activity of the patients.Also patients who depend on caretakers can't use such systems.

III. PROPOSED SYSTEM

To minimize and ease the work of the caretaker as well as to make the patient suffering from neurological disorders independent to some extent we are presenting a solution for this problem by developing an "IoT based Smart Health Care system" which is basically an assistive application for caretaker as well as for patient.This application will reduce the burden on care taker, and provides useful features to keep patient alert.
The goal for Smart Healthcare System is to progress the patients capabilities and improve their overall quality of life. The patient may not be in the active state always and capabilities are not always good because the memory deteriorates as time passes. Also, caretakers have to keep track on patient 24/7.This app helps the caretaker to keep track of the patients medicine schedule by using an IoT based medicine box which generates notifications in case the patient has missed his dose and also keeps a track of over dosage/under dosage of medicines. This application generates notification about the

medicine getting empty and also ensure caretaker about the right pill consumed by patient.Hence, caretaker monitors medication activities of patient and tracks patient progress.The smart healthcare application provides facility to store personal details of patient, caretaker as well as family members like name, relation etc,which can help patient to recognize his family members.
Our app aims to provide following functionalities:

- Gives reminder to have medicine as well as ensures that the patient has consumed it.
- Notifies caretaker about the under dosage/over dosage of pill.
- Ensure the consumption of right pill by patient.
- Notifies to restock medicines once empty.

IV. DESIGN

The medicine box has dimensions 4*1 inches.An entire box is divided into 4 slots.Each of the slot will consists of a single type of medicines.The name of the slot can be renamed through application according to the type of medicine that it will contain. For ex, if slot A is supposed to contain Crocin then slot A will be renamed as Crocin and will only contain Crocin in it.The medicine box will have a microcontroller embedded in it (in our system we are using Arduino Uno). The microcontroller will receive information through the application and will function according to the data provided by the user.The box will have a buzzer connected to it which will buzz the specified time.Each slot will also have an LED attached to it.Glowing LEDs will indicate the slot from which the medicine has to be taken.

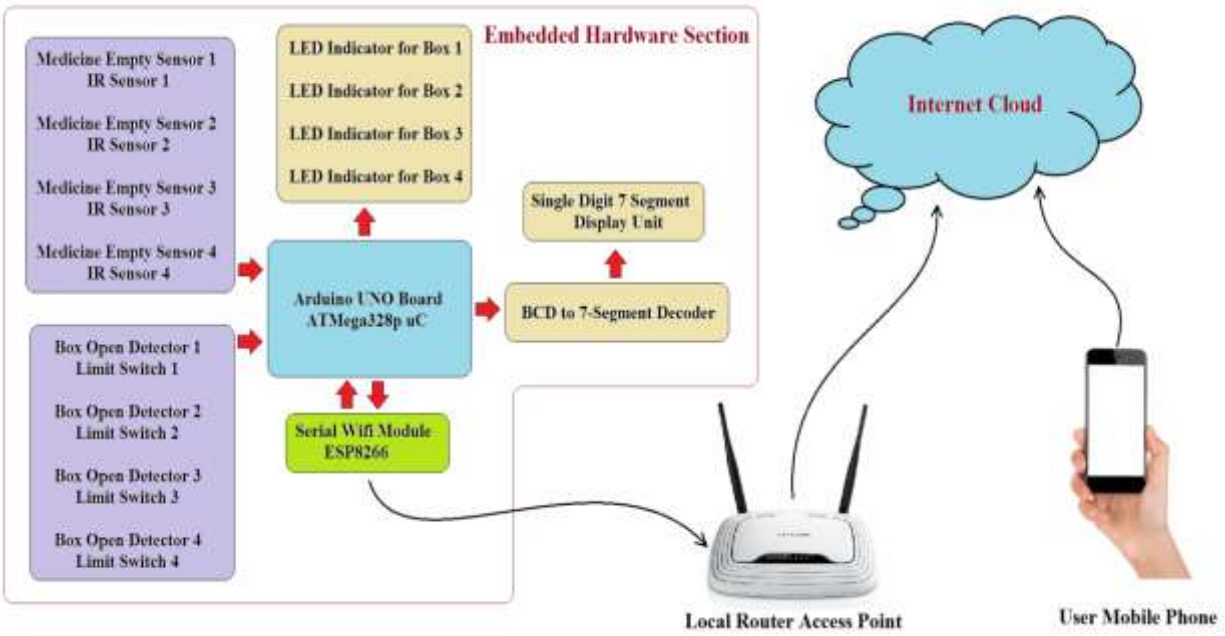

Figure 1: Block Diagram of System

Each slot will contain IR sensors which will detect the presence of medicines in the slot also a limit switch will be attached which will track the opening activity of the box.Also there will be a single digit common seven segment display which will display the number of tablets required to be taken from each slot.

V. WORKING

The entire system is connected using ESP8266 Wi-Fi module. The details regarding the medicines should be entered through the application.The working of the medicine box starts once the details have been entered by the user including the timing and the slot from which the medicine has to be consumed.The microcontroller will receive information through the application and will function according to the data provided by the user. According to the activity of the patient the medicine box will then generate data and this data will be sent to the application through internet. This information will be displayed on the app in the form of notifications.The notifications that will be received are as follows:

3.1. Slot not opened

The box has to be opened by the patient according to the time entered in the app.If there is no activity detected by the medicine box on the specified time then after a delay of 30 seconds a notification will be sent on the app specifying that the patient has not taken medicines.

3.2. Slot opened

When the patient opens a particular slot from which the medicine has to be taken the caretaker will be notified that the patient has taken the medicines along with the name of the slot.In case the patient has to take multiple medicines from different slots at a time then the corresponding LEDs of different slots glows at an interval of 2 minutes.The seven segment will also display the number of tablets to be taken for each slot at an interval of 2 minutes.

3.3. Wrong Slot opened

If the patient opens a slot in contradiction to the name of the slot entered in the app then a notification will appear stating that the patient has opened the wrong slot.This will help the caretaker to take an action accordingly at that instance of time.

3.4. Slot empty

Once the slot becomes empty, it will be detected by the IR sensors and accordingly a notification will be generated stating that the medicines needs to be restocked along with the name of the slot.This will help the caretaker to timely restock the empty slots.

Figure 2: Flowchart of operation

The entire application can be reset**.**Any new patient detail can be added after resetting the application**.**All the previous patient data will be erased making it reusable by other patients**.**

VI. HARDWARE COMPONENTS:

We used the following hardware to make the Medical box to work as a system in synchronization.

4.1. IR Sensors

An Infrared Sensor is an electronic device, which works in pair to detect the motion of the surrounding.The pair consists of an Emitter and a Detector.We are using IR sensors to detect the presence of medicine in the box and based on the last retreival of the tablet by the patient the careteaker will be notified to restock the box timely.

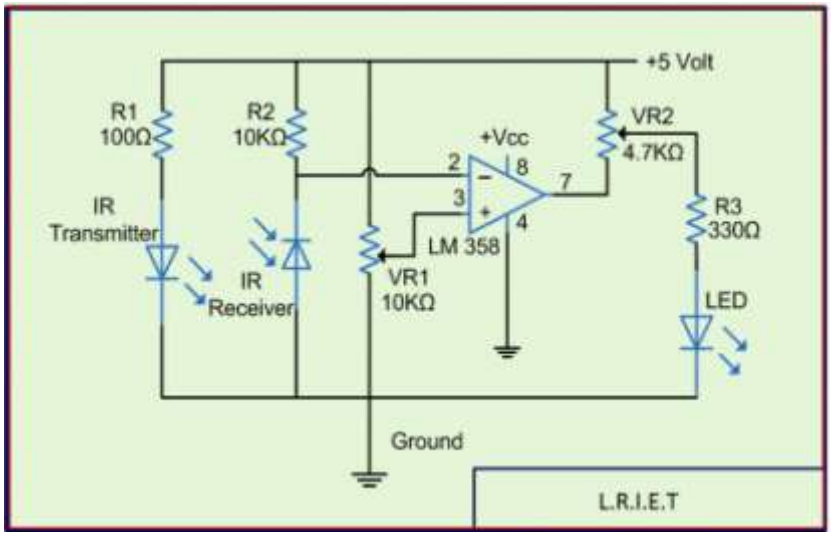

Figure 3: IR Sensor Circuit Diagram

4.2. ESP8266 Wi-Fi Module

The entire system is wirelessly connected through a WiFi ESP8266 Module. All the data from the Arduino Board is carried away by the Wi-Fi to reach to the end-user via Application Gateway.

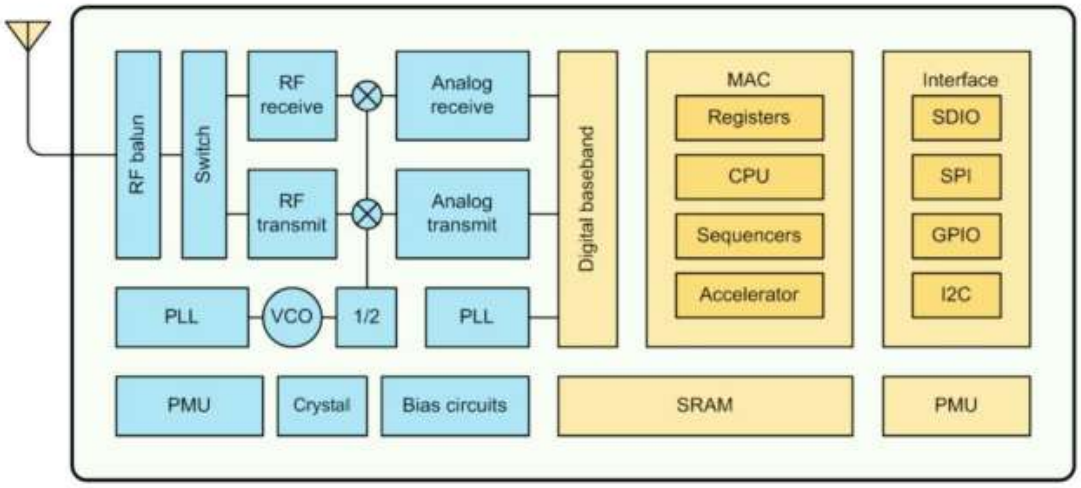

Figure 4: Esp8266 Block Diagram

4.3. Buzzer

For the patient to be alarmed on a daily basis on time, we are using a buzzer for sound which helps the patient to understand that he needs to take his pills and operate the medicine box according to it.

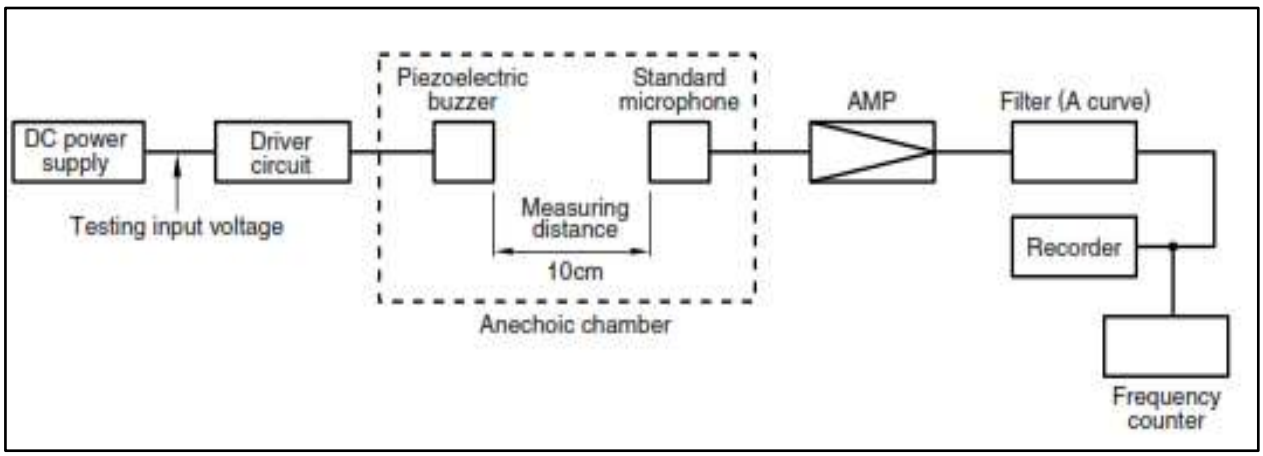

Figure 5: Sound Measuring Method

4.4. Seven Segment Display

The seven segment display is used to display the count of the pills that are to be consumed by the patient. It is in connection with the binary module which in turn is in connection with the Arduino.The binary decoder will simply be converting the binary data from the Arduino Board in a seven segment displaying format.

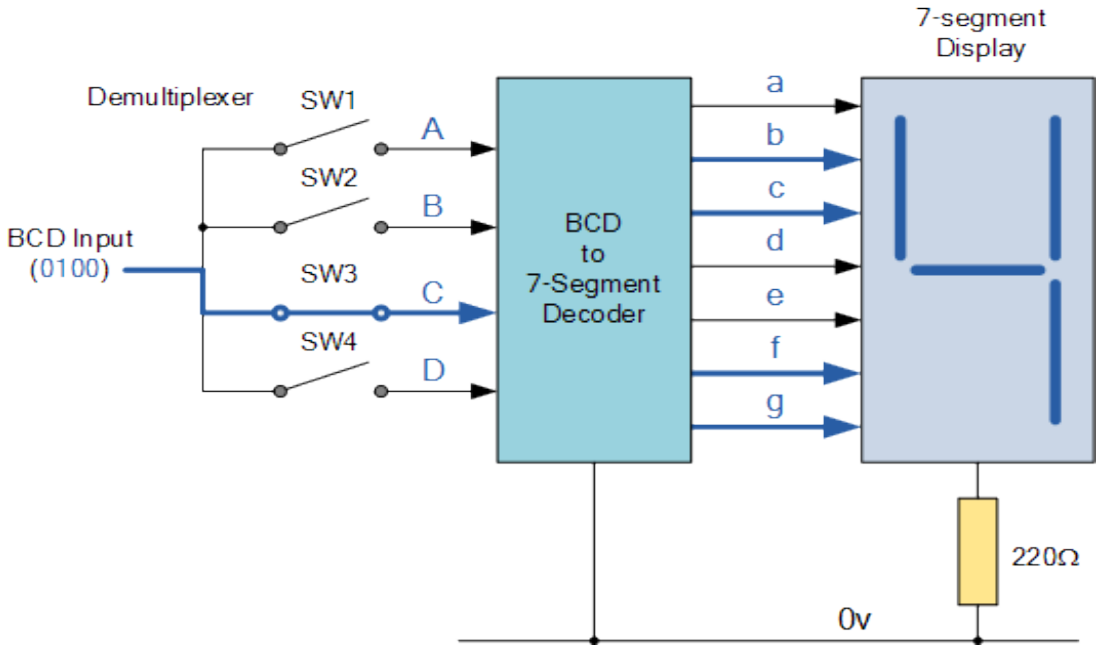

Figure 6: BCD to 7-Segment Decoder

4.5. LED's

The LED's are placed at each and every slot to indicate the slot from which the medicine has to be taken.In our model we are using four LED's for four slots respectively.

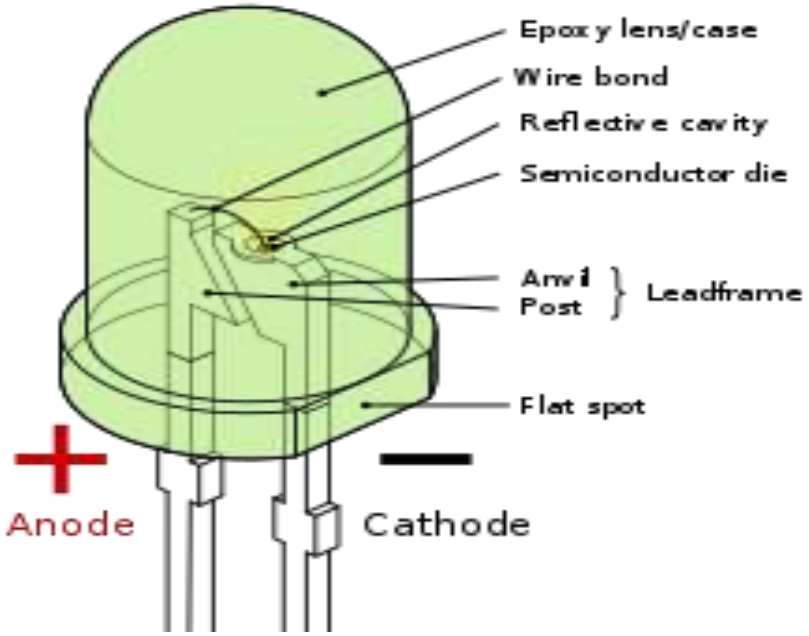

Figure 7: LED

4.6. Arduino UNO

The Arduino UNO is the microcontroller we will be using in our model. It will be embedded at the bottom of the box to which various sensors will be attached. The sensors will generate data that will be processed by the Arduino and this data will be forwarded to the application via Wi-Fi module. It consists of 14 input output pins out of which 4 pins will be occupied by sensors placed for detecting the emptiness of the box, 4 pins for tracking the box activity, one pin each will be occupied by buzzer, seven segment display and ESP8266 module respectively.

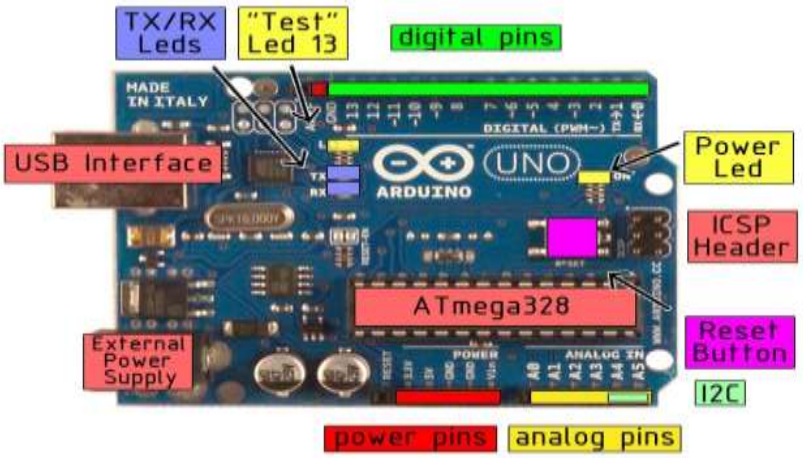

Figure 8: Arduino UNO

VII. EXPERIMENTAL RESULT

We tested our medicine box using four different types of tablets namely Crocin, Digene, Asprin and Dispirin in the quantities one, one, two, five respectively.In our scenario, the patient is supposed to take one Digene, one Aspirin and two Dispirins. We have performed activities to test all the functionalities of the medicine box and also keeping in mind how an elderly person or a patient with neurological disorder may behave in real time environment.

Slot name	Number of tablets present in slots	Activity performed	Notifications displayed
Crocin	1	Slot opened	Wrong slot opened
Digene	1	Slot opened	1.Slot opened 2.Restock medicines
Aspirin	2	Slot opened	Medicine taken
Dispirin	5	No Activity	Slot not Opened

Table 1: Result

We tested our model with various medicines varying in shapes and sizes.It gave expected results.Keeping in mind various parameters, the medicine box was successfully tried and tested.Notifications were generated as expected.The application worked well in synchronization with the medicine box.The number of slots can be expanded if we use Arduino Mega.Also, the accuracy of the medical box can be improved by adding additional sensors IR sensors.

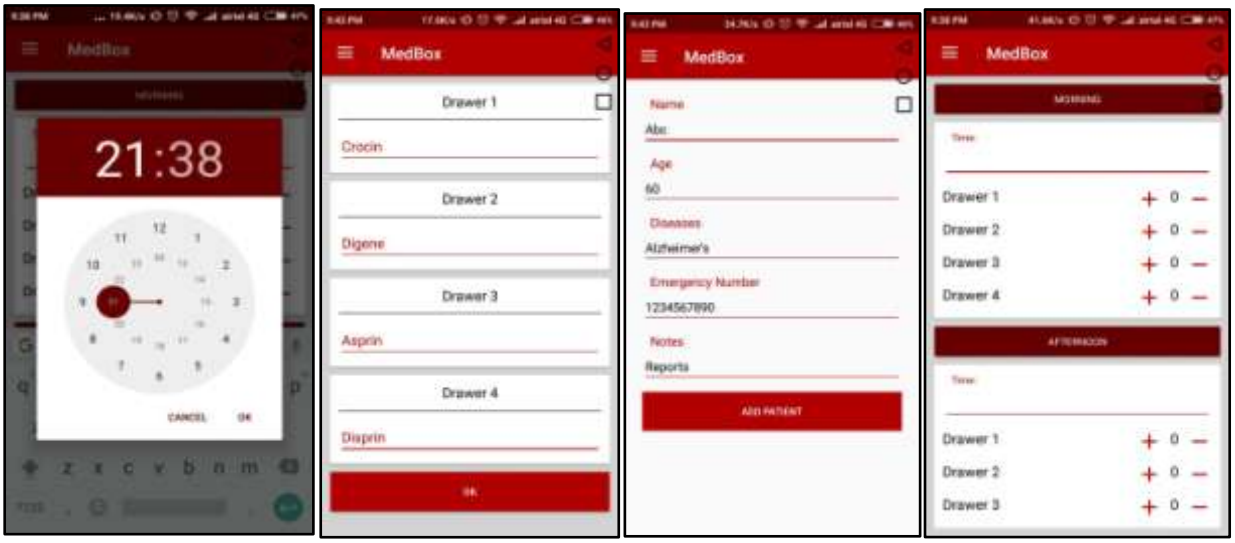

Figure 8: Snapshots of the app

VIII. CONCLUSION

With "IoT based smart Healthcare System" we tried to reduce the burden on the caretaker by providing a smart solution by using IoT and integrating the medicine box with android application.This will also make the patient independent to

some extent.This box cannot only used be used by patients but also a number of people who suffer from memory loss or forgetfulness.Using this system patient will be able to take medicines on time thus improving their quality of lives.

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BIOGRAPHY

Dr. Ashfaq Amir Shaikh received his bachelor of Engineering (B.E.) degree in Computer Science and Engineering from Dr. B.A.M.U. Aurangabad Maharashtra India and M.E degree in Computer Science and Engineering from University of Pune Maharashtra India in 1999 and 2010 respectively. He has received his PhD degree in the department of Computer Engineering from JJT University, Jhunjhunu, Rajashtan, India. His current research interests include Big Data, Computer Networks, Mobile Computing, E-commerce, cloud computing. Presently, he is working as an Assistant Professor in the department of Information Technology department at M.H.Saboo Siddik College of Engineering, Mumbai, India.

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