Zigbee Based Home Patient Monitoring: Early Detection of Alzheimer Disease

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Abstract- **Diagnosis of Alzheimer disease increases in senior citizen. Nowadays Medical Treatment becomes costly which increases demand of an e-healthcare system (electronic healthcare). In this article we propose a Zigbee based home patient monitoring system which helps in early detection of Alzheimer disease. The location and movement pattern of a patient can be tracked and recorded with the help of short-range Zigbee communications. Thus a medical practitioner can perform remote diagnosis. This system can be enhanced for long range outdoor environments with location tracking technology like GPS (Global Positioning System). The e-healthcare system is expected to facilitate medical treatments, improve the quality of life of senior people, and reduce healthcare costs.**

Keywords - **Zigbee, Alzheimer's disease, home patient monitoring, e-healthcare system**
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I. INTRODUCTION

Nowadays healthcare cost is becoming more expensive and increase in population creates many problems like long waiting time in hospitals, cost and also increases the workload of doctors and hospital staffs.

The system which providing cost effective patient care and improving the quality of treatment are very important for all countries. For home patient monitoring in electronic healthcare (e healthcare) technology is used. This new technology supports continuous real time monitoring of patient and analyzed by medical practitioners, so it is better to have early healthcare.

Alzheimer's disease (AD) is a dementia which gradually destroys the ability to reason, remember, imagine and learn. It affects around 30 million people in the world. It will be very common and expected to triple in the next 50 years. Early stage, middle stage and late stage are the three main stages of Alzheimer's disease. In the late stage, it affects the brain very seriously and more obvious.

Today AD is detected at a late stage and the treatment is given slowly. Hence the early detection is essential for better medical treatments. Here a zigbee based monitoring system is used for detecting the symptoms of Alzheimer's disease. The location and the movement of a patient are captured by short range zigbee technology and stored in a database. The stored data is transmitted to a decision engine through Industrial Scientific Medical (ISM) band having 2.4 gigahertz bandwidth.
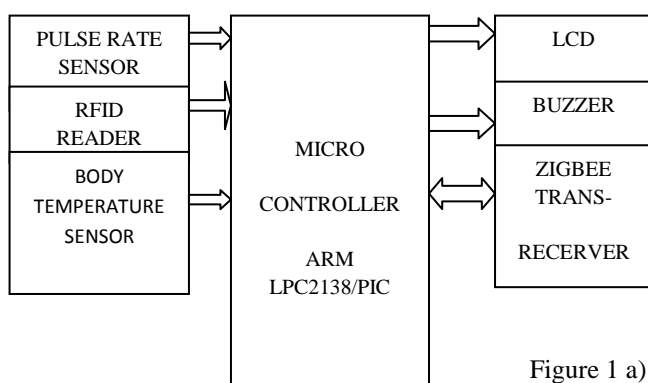
II. ZIGBEE IN-HOME PATIENT MONITORING

ZIGBEE based-home patient monitoring system, facilitating early detection of Alzheimer's disease. This e-healthcare solution consists of two main components, in-home patient monitoring and TELEDIAGNOSIS. With the virtue of short-range ZIGBEE communications, Radio Frequency Identification (RFID) the location and the movement of a patient can be tracked and reported to medical practitioners. The collected data is then transmitted via ISM band to a decision engine (on a remote site). A corresponding medical practitioner makes use of this intelligent decision engine to analyze and determine whether the patient of interest is developing Alzheimer's disease.

This novel e-healthcare solution is expected to facilitate medical treatments, reduce overall healthcare costs, and plausibly improve the quality of life of seniors.

A. **Block diagram**
a. **Transmitter**   b. **Receiver**
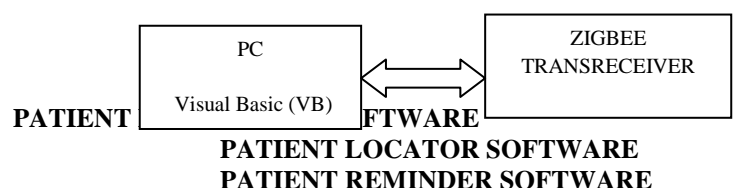

Figure 1 a) Transmitter b) Receiver

B. Description

This system is basically consisting of pulse rate sensor, body temperature sensor, RFID reader, Zigbee Transreceiver and the buzzer as hardware parts and visual basic as software part.
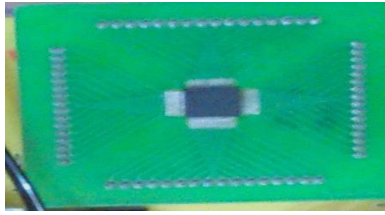
MICROCONTROLLER ARM LPC2138/PIC

Figure 2 microcontroller LPC2138

We are using LPC2138 microcontrollers in our project as shown in fig.2 which is based on a 16/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with 512 kilobytes of embedded high-speed flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 percentages with minimal performance penalty.

Liquid Crystal Display:

LCD is used in our project to visualize the pulse rate, patient information, body temperature of patient, patient condition at any instinct. We have used 16x2 LCD as shown in fig.3 which indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can display on 16x2 LCD.

Figure 3 LCD showing title of the project

LCD can also used to check the output of different RFID modules interfaced with the microcontroller. Thus LCD plays a vital role in a project to see the output and to debug the system module wise in case of system failure in order to rectify the problem.

Buzzer:

Buzzer has used in our system to indicate or to grab the attention regarding an emergency situation occurred. Buzzer act as a panic horn which indicates the need of instant attention as the condition of patient goes haywire.

RFID READER:

RFID reader is interfaced with the microcontroller. RFID reader works on weigand protocol and transmits the wireless signal at 125 kilohertz. RFID Reader has two data line i.e. DATA0 and DATA1. Both the lines are active low and are connected at the external interrupt pins (INT0, INT1) of the microcontroller. Logic 1 is transmitted on DATA1 line and logic 0 is transmitted on DATA0 line.

Figure 4 RFID modules with cards

Interfaced RFID Reader continuously transmits the electromagnetic field across it. The range is max of 10cm. when the RFID tag/card comes within this range; the RFID card gets powered up and provides their 26 bit ID data to the RFID reader.

We are using RFID Reader Module for saving patient data to whom we monitors and for tracking the location of patient. RFID cards are fixes at every location entry to track the location of patient.

Temperature Sensor:

Temperature sensors are used to sense the temperature of patient. We have used a Temperature sensor called LM35. This temperature sensor can sense the temperature of the patient body. So, irrespective of the application to which it is used, it gives the reading of the temperature. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

Temperature sensor is an analog sensor and gives the output into form of analog signal. This signal is feed to ADC which will convert it into digital form. Once converted into analog form, the microcontroller can process the digital temperature signal as per the application.

Pulse Rate Sensor:

The pulse rate Sensor provides a simple way to study the heart's function. This sensor monitors the flow of blood through Finger as shown in fig.5. As the heart forces blood through the blood vessels in the Finger, the amount of blood in the Finger changes with time. The sensor shines a light lobe (small High Bright LED) through the ear & measures the light that is transmitted to LDR. The signal is amplified, inverted and filtered, in the Circuit.

Figure 5 pulse rate sensor

The pulse rate sensor is basically used to keep track on the pulse rate of the person. In programming the maximum and the minimum st point are provided for the pulse rate. If the pulse rate goes below or above the set point then the alert will be immediately issued by the microcontroller.

ZIGBEE TRANSRECEIVER:

Zigbee is a communication standard for use in the wireless sensor network defined by the Zigbee Alliance that adopting the IEEE 802.15.4 standard for its reliable communication.
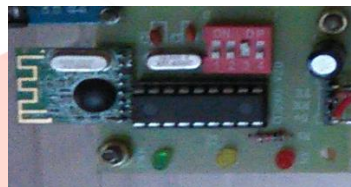

Figure 6 zigbee transreceiver module

Zigbee has been chosen due to its features that fulfill the requirement for a low cost, easy to use, minimal power consumption and reliable data communication between sensor nodes.
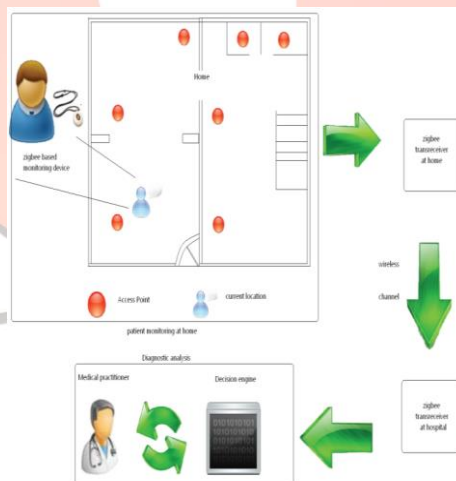
III. WORKING

Figure 7 home patients monitoring

The whole system works as shown in fig.7. ZIGBEE based monitoring device is carried by patient. It helps to track location of patient. This device is continuously sending signals to another ZIGBEE TRANSRECEIVER which is synchronized to pc with visual basic software.

Pulse rate sensors sensing pulse of patient and sends it to processor. LCD shows status signals like current pulse rate, body temperature and information of patient like his name age, location etc.

RFID reader used to save data regarding particular patient. Buzzer is using for emergency, when patient under monitoring in critical condition it beeps and also inform to surrounding peoples. Here two ZIGBEE TRANSRECEIVER modules are using one at patient site and another one at medical practitioner site.

PC having patient monitoring software, Patient locator software, Patient reminder software helps to track location of patient and also take decision on the basis of information. Decision making perform is by medical practitioner. This proposed module helps to early detection of symptoms of Alzheimer's patient.
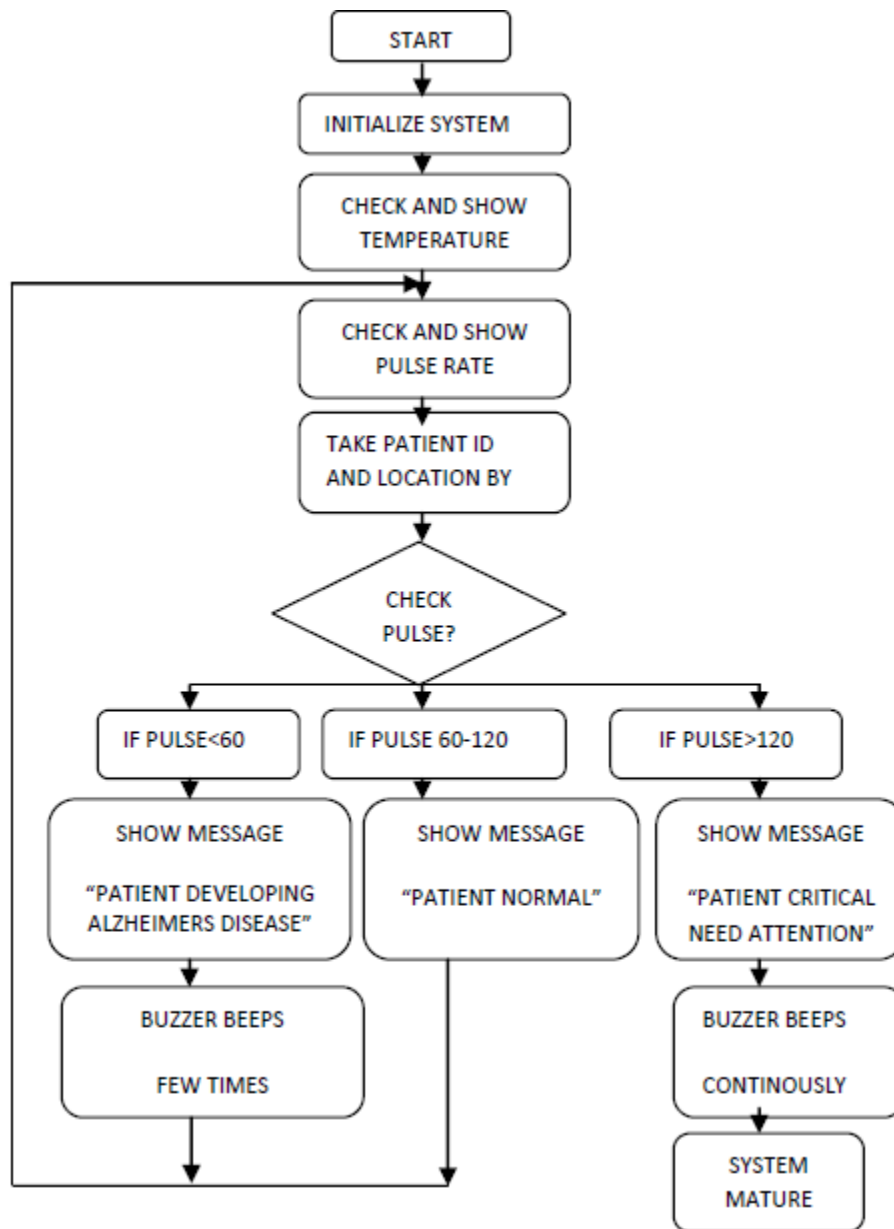
IV. FLOW OF SYSTEM

Figure 8 flow diagram

The system has been flow as shown in fig.8. At first it initialises the system then check for body temperature of patient, which shows on LCD display. Afterwards pulse rate has been check and display on LCD. In next step we get patient information i.e. name, age, and location of patient.

We are design our system for three condition of patient normal, critical and developing stage of Alzheimers disease. In normal condition if patient having pulse rate between 60 to 120 LCD shows message of "patient normal". For critical condition like heart attack pulse rate is above 120 and LCD shows message "patient critical need attention" also buzzer beeps continuously until patient get immediate attention which mature system at that instant. The Alzheimers patient have low pulse rate probably below 60 for which our system design in third condition. For the patient detected pulse rate below 60 LCD shows message "patient developing Alzheimers disease" and buzzers beeps four to five times.
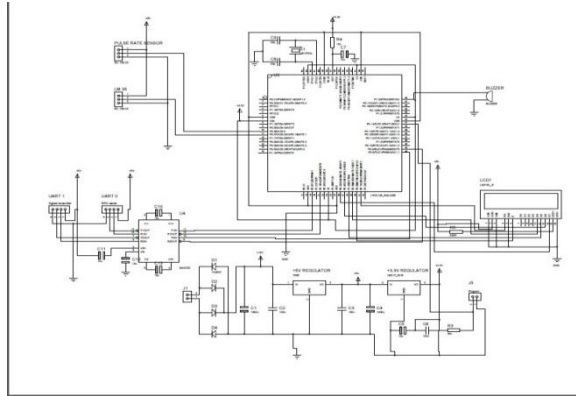
V. THE COMPLETE CIRCUIT

Figure 9 circuit diagram

The complete circuit diagram show in fig.9 how we interfaced and connect different sensors as well as modules to microcontroller and pc. Our system is divided into three parts i.e. transmitters, receiver and receiver with patient monitoring software explained as below.

Transmitter

Figure 10 actual transmitter

Transmitter consist two sensors and two modules as shown in fig.10. Sensor which used in our project is pulse rate sensor and body temperature sensor. Pulse rate sensor connected to pin 10 and Body temperature sensor to pin 11 of LPC 2138 controller. Both the modules i.e. RFID module and ZIGBEE connected via max 232 to controller. Pin 48 of controller reserved for buzzer which used in critical condition.

Receiver

Figure 11 actual receiver

Receiver of system consist only three unit power supply as shown in fig.11. ZIGBEE module and one DB9 port for pc connection in which patient monitoring software is installed.

Receiver with Patient Monitoring Software

Figure 12 receivers with pc (VB)

We are used visual basic for making Patient monitoring software which is installed in PC. PC is connected to ZIGBEE receiver by DB9 connector as shown in fig.12. Patient monitoring software basically used for saving patient data and get pulse rate information of patient.

VI. RESULT AND ANALYSIS

Results of patient monitoring system is divided into three different condition i.e. normal, critical and developing Alzheimers disease condition which are shown in figure as per condition of patient.

Normal condition

Normal person or healthy person have pulse rate 60 to 100 but here we set it 60 to 120. At first RFID card swaps we get patient information like patient name, age as shown in LCD figure below. Then pulse rate and location is detected show on LCD. The detected pulse is in normal range so LCD showing message "Patient Normal". Patient monitoring software display patient ID and pulse rate of patient as shown in fig.13.
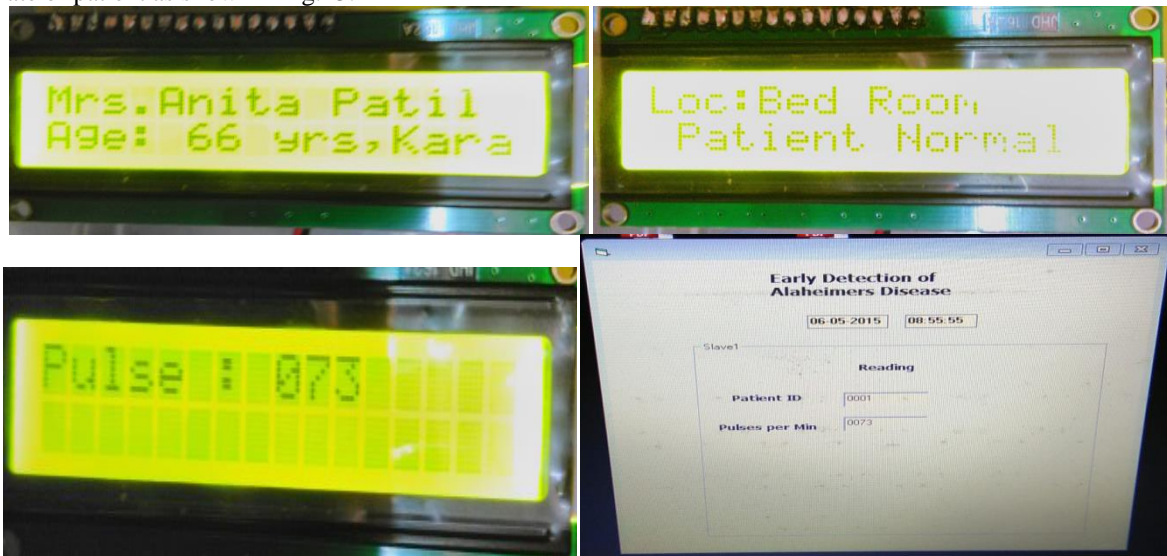

Figure 13 response of normal patient

Critical condition

Sometimes patient may suffer from cardiac arrest or heart attack so there is immediate attention is needed so we are adding critical condition as an extra feature. For critical condition we set max pulse rate to 120 as detected goes beyond 120 LCD shows message "Patient critical Need Attention" as shown in fig.14. In critical condition buzzer beeps continuously and system become mature until patient get attention.
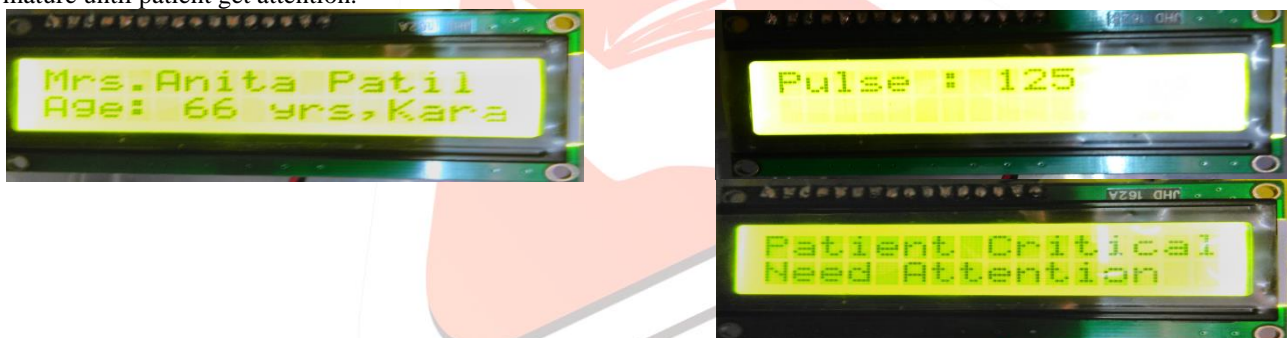

Figure 14 response of critical patient
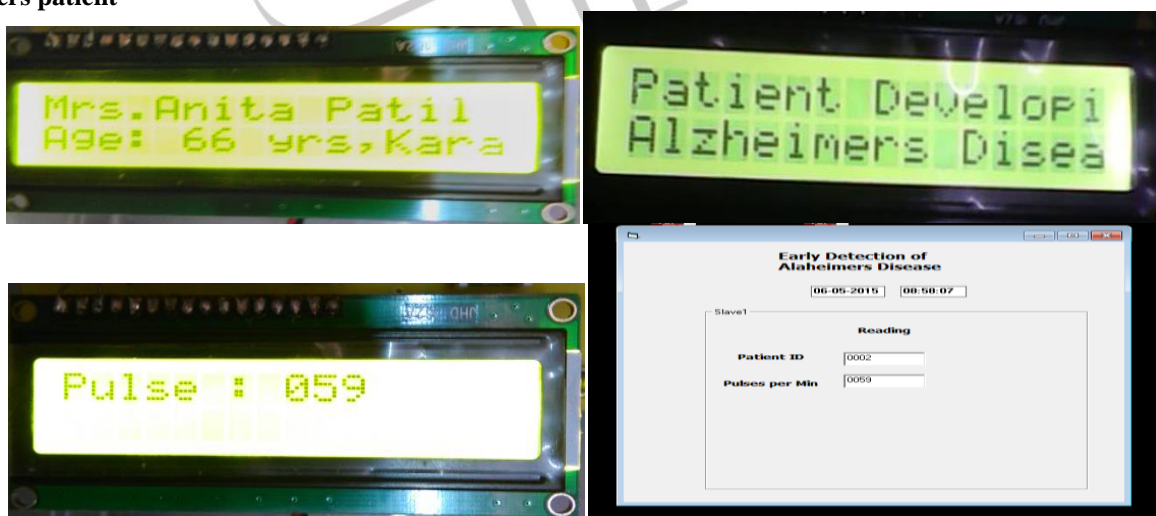
Alzheimers patient

Figure 15 response of Alzheimers patient

Basically Alzheimers patient having low pulse below 60 , so we set it to 60. As detected pulse rate fall below 60 LCD show message "Patient Developing Alzheimers Disease" as shown in fig 15 and buzzer beeps for four to five times.

VII. CONCLUSION

With technological advances, e-healthcare solutions are expected to be prevalent in the near future, providing affordable, high-quality, and accessible healthcare to every person. The proposed ZIGBEE based-home patient monitoring system to facilitate early detection of Alzheimer Disease.

The proposed e-healthcare solution, a doctor will plausibly be able to offer better treatments to the patient, thereby prolonging his life expectancy and enabling him to gain independence with dignity in his own home.

VIII. REFERENCE

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