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IoT based Health control & Emergency Detection System with First Aid actions

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***Abstract*— In the recent years, some of the major challenges of our human society is diagnosing of chronic diseases and increases of other infectious diseases. Thus, it is becoming necessary for patients to follow regular medication to fight against the diseases. In response to these challenges an IoT based automatic health monitoring (HM) system is proposed which is capable of taking care of patient's health condition such as drug's medication and vital signs monitoring. The proposed system consists of bio sensors for monitoring the temperature and blood pressure of the patients and the medicine box indicates the time of drugs to be consumed and also setting an alarm to intimate the patient if the medicine taken incorrectly. This shall greatly reduce the frequency of visit to hospital and facilities of hospitals can be made available in our home environment.**

Keywords*—Bio-Sensors, Health-IoT, Intelligent Medicine Box, Internet-of-Things (IoT)

I. INTRODUCTION

Currently, health care is a great burden factor for elderly population and regularity of persistent diseases. Many health organizations are focusing on quality of life in social, medical and psychological point of view. Many countries are undergoing hospital restructuring by reducing the number of hospital beds and increasing the proportion of home healthcare [2]. Promising trend in healthcare is to move routine medical checks and other healthcare services from hospital (Hospital-Centric) to the home environment (Home-Centric) [2]. By doing so, first, the patients can get seamless healthcare at any time in a comfortable home environment; next, society's financial load could be greatly reduced by remote treatment; third, limited hospital resources can be released for people in call for of emergency care. In-home healthcare and services can considerably reduce the total spending on medical care or treatment [1]. Figure 1 depicts the approximate medical expenditure for patient in hospital care and home care. In order to track the physical status of the elderly and, in the meanwhile, to keep them healthy, the proposed idea will be helpful.

IoT expands the internet that connects various objects wirelessly. IoT is a network where many objects that surround us will be networked in one form or another. In drug management system designing the devices and equipment to increase the patient independency is important. Thus, this system is to deliver the drugs to the disabled to take the right medicine at right time, without the presence of the nurse.

In order to track the physical status of the elderly and, in the meanwhile, to keep them healthy, the following two daily tasks are essential [1]: Real-time monitoring and analyzing critical signs to early detect or predict life-threatening difficult events; Checking whether they are following their prescribed treatment, with taking their prescribed medicine on time.

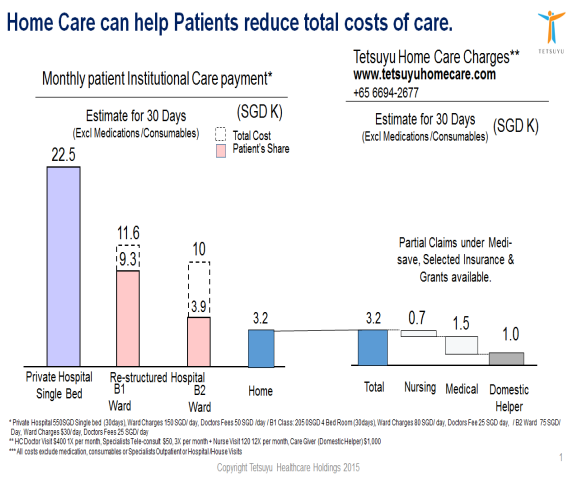

Fig.1 Patient medical expenses at hospital & at home

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With rapidly aging populations brought immense pressure and challenges to global healthcare systems. The major problem for the both the individual and healthcare providers is the poor medication adherence. Psychological measurement devices are getting smaller, lighter, cheaper and more comfortable to wear. These devices together with wireless connectivity provide the real time information and facilitate timely remote intervention to predict the events such as heart attack, epilepsy and stroke especially in remote or rural areas where expert treatment is unavailable [3].

The proposed idea in this paper provides the valuable solution to the medical non-compliance problem.

The invention of iMedbox helps the patients to keep track of their medicine consumption through a series of LED alarm indicates signals.

II. Backround And Frame Work

A. Architecture of IoT Health Control System

The architecture of IoT health control system is shown in Fig. 2. It consists of two network modules: 1) Hospital Management; and 2) iMedBox and sensor data

The hospital management module is directly linked to hospitals and other professional medical facilities such as medicine supply chain. For example, doctors can efficiently manage a large group of patients. They can inspect the medication history as well as the physiological status history of a specific patient; make further analysis of a suspicious portion of patient's bio-signals.

The iMedBox and sensor data is the basis of the entire network. It consists of data sensing and acquisition devices, local computing and processing units, data storage devices, and wired/ wireless transmitting modules.

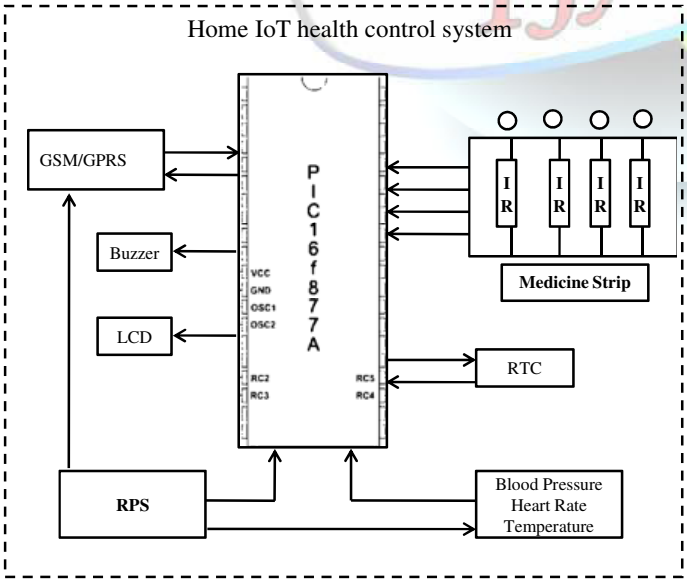
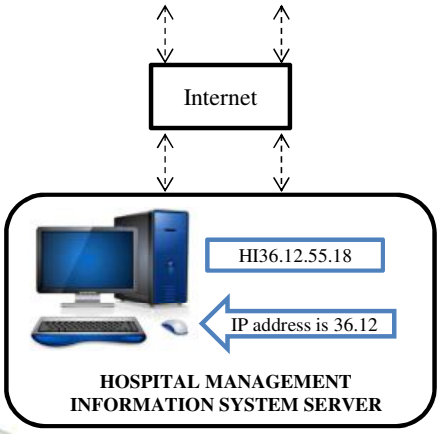


Fig.2. Architecture of proposed health control system



B. IoT system

Through IoT technology, the doctor can inspect the physiological status history of a specific patient, which is very useful in making further analysis of patient bio signal and in case of emergency a new medicine can be prescribed.

Moreover, the doctor can monitor the overall examination of the patient physical condition over a period of time (e.g. one week or one month). As the result of this, the doctor can easily identify the patient health condition have improved and make them aware of the progress. Both patient and their family may feel reassured, that helps to build the positive loops into the rehabilitation and self-care.

C. iMed Box

An intelligent medicine box serves as home health care gateway; IoT devices such as wearable sensors are seamlessly connected to iMed box. The iMed box consists of PIC, IR sensors, micro controller and drugs, Medication section. The body worn sensors will detect and transmit the users bio signals to the iMed box in real time. The iMed box is connected to GPRS through which the data are transmitted over the network to the hospital environment/care taker. All the collected information is interpreted, stored and displayed locally on iMed box. The Processed information can also be forwarded to the health-IoT network for future clinical diagnosis.

D. Wireless sensors

Heartbeat, Temperature sensors are used to collect the parameters of the patient and these data fed to the controller for processing. These sensors continuously monitor the health condition of patient by providing alarms and trigger a message when there is any abnormal variation in pulse rate.

1) IR sensor

Infrared radiation is the portion of electromagnetic spectrum having wavelengths longer than visible light wavelengths, but smaller than microwaves. Infrared waves are invisible to human eyes. An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object

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as well as detects the motion. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold.

2) Blood Pressure Sensor

Blood pressure monitor operation is based on the oscillometric method. This method takes advantage of the pressure pulsations taken during measurements. An occluding cuff is placed on the left arm and is connected to an air pump and a pressure sensor. Cuff is inflated until a pressure greater than the typical systolic value is reached, and then the cuff is slowly deflated. As the cuff deflates, when systolic pressure value approaches, pulsations start to appear. These pulsations represent the pressure changes due to heart ventricle contraction and can be used to calculate the heartbeat rate.

Pulsations grow in amplitude until mean arterial pressure (MAP) is reached, then decrease until they disappear.

- Working Voltage: +5V, 200mA regulated
- Output Format: Serial Data at 9600 baud rate (8 bits data, No parity, and 1 stop bits). Outputs three parameters in ASCII.
- Sensing unit wire length is 2 meters.
- TX-OUT = Transmit output. Output serial data of 3V logic level, Usually connected to RXD pin of microcontrollers/RS232/USB-UART.
- +5V = Regulated 5V supply input.
- GND = Board Common Ground

3) Temperature Sensor

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ºC). The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. The sensor self-heating causes less than 0.1 ° C temperature rise in still air.

The IC has just 3 pins, 2 for the power supply and one for the analog output. The output pin provides an analog voltage output that is linearly proportional to the Celsius temperature. Pin 2 gives an output of 1millivolt per 0.1°C (10mV per degree).

VOUT = 10 mv/°F × T

Where,

- VOUT is the LM35 output voltage
- T is the temperature in °C

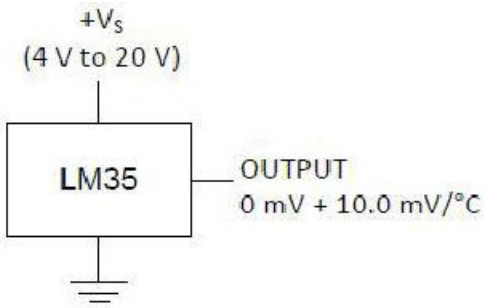

Fig.3 Basic Centigrade Temperature Sensor (+2°C to +150°C)

4) LCD Display

LCD display is used here to indicate the parameters such as BP, temperature and also flash the message during the medication time. More microcontroller devices are using 'smart LCD' displays to output visual information. The following discussion covers the connection of a Hitachi LCD display to a PIC microcontroller. LCD displays designed around Hitachi's LCD HD44780 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 8 x 80 pixels of the display. Hitachi LCD displays have a standard ASCII set of characters plus Japanese, Greek and mathematical symbols.

For a 8-bit data bus, the display requires a +5V supply plus 11 I/O lines. For a 4-bit data bus it only requires the supply lines plus seven extra lines. When the LCD display is not enabled, data lines are tri-state which means they are in a state of high impedance (as though they are disconnected) and this means they do not interfere with the operation of the microcontroller when the display is not being addressed.

5) Proteus & CCS software

A compiler is a computer program (or set of programs) that transforms source code written in a programming language (the source language) into another computer language (the target language, often having a binary form known as object code). The most common reason for wanting to transform source code is to create an executable program. Christo Ananth et al. [4] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day."Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for. The main design of this project is to track the heart attack of patients who are suffering from any attacks during driving and send them a medical need & thereby to stop the vehicle to ensure that the persons along them are safe from accident. Here, an eye blinking sensor is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller.If eye blinking gets stopped then the signal is sent to the controller to make an alarm through the buffer. If spO2 sensor senses a variation in pulse or low oxygen content in blood, it may results in heart failure and therefore the controller stops the motor of the

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vehicle. Then Tarang F4 transmitter is used to send the vehicle number & the mobile number of the patient to a nearest medical station within 25 km for medical aid. The pulse rate monitored via LCD .The Tarang F4 receiver receives the signal and passes through controller and the number gets displayed in the LCD screen and an alarm is produced through a buzzer as soon the signal is received.

The Proteus software is Virtual System Modeling and circuit simulation application. The suite combines mixed mode SPICE circuit simulation, animated components and microprocessor models to facilitate co-simulation of complete microcontroller based designs.

III. IMPLEMENTATION

A. *Medicine Box*

The medicine box keeps track the number and time of pills the patients have taken. This device is capable of improving patient's health significantly. The functions of the Medicine Box are based on IR sensors and a microcontroller keeping track of time and amount of pills left in the Medicine Box. The pill is placed between two IR sensors which interrupt IR light falls on the light sensor. Each pill will have dedicated IR sensors, i.e., number of pills is equal to the number of IR sensors.

Patient's schedule for taking his medication is also stored in the medicine box which uses this information to deduce whether the patient is complying with his treatment.

1) *Dispensing System:*

The medicine box consists of two different colors LEDs namely, Green and Red. Green LED indicates that the medicine box is ON. At the prescribed time of medication the respective LED indicator will give red flashing signal with a beep sound to intimate the patient that the tablet/pill to be consumed. As the pill is filled between IR sensors, the output from the dedicated sensor will be 0V; this indicates the particular pill is not consumed. When the patient opens the medicine box to take the pill, the light falls on the light sensor and it gives the output of 5V to the microcontroller. If the output is 5V then the microcontroller will account that the tablet is consumed. Therefore, the Medicine Box records that pill has been consumed and sends the data to output system (personal computer). The total count of the tablets in each slot will be stored in the system and each time when the patient consumes a medicine the number will be decreased from the total count. Once it is recorded that the pill has been taken the LED indication in front of the pill vial will glow continuously green till the next pill taken time as per schedule program. If the person tries to take the wrong medicine within scheduled program time then medicine Box will give on the alert to the patient that this medicine/pill is not to be taken through the LCD. Lastly when the next programmed time has been reached, the corresponding LED automatically flash the green signal with an audible alarm.

The 16 MHz crystal is used as the clock in PIC microcontroller, it is essential for applications relating to timing, alarm etc. This will be used to make sure that the device gives alert sound to the user to take patient's medication at the appropriate time, and that the medication is dispensed in a well-timed approach. The time will be set upon system power up. The device has both sound and visual indications because the patient may have either a hearing or sight impairment. When it is time to take the medicine, a single LED will blink and the buzzer of the device will give an alarm, and the LED will flash. The figure 4 depicts the working of bio sensors.

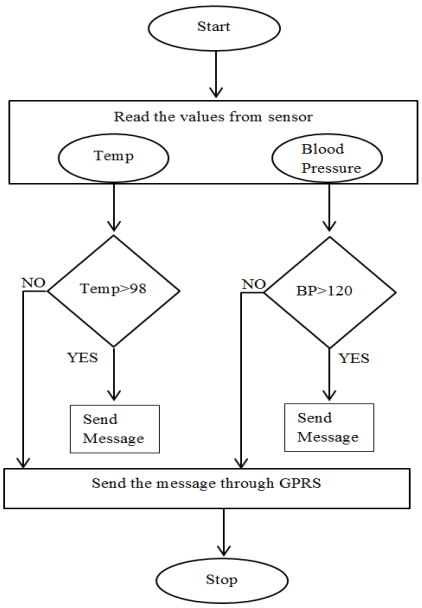

Fig.4 Bio sensor flow chart

The Temperature and blood pressure sensor reads the parameters of the patient. The normal temperature of human body is 98 deg F, when the temperature increase above this value the controller sends the message to hospital management and the care taker indicating the patient is in need of medication through GPRS. Similarly, when the blood pressure varies (above or below the prescribed value) the controller sends the message.

IV. CONCLUSION AND FUTURE SCOPE

In this paper, a low cost embedded system is designed for monitoring and diagnosing the patient health through Internet of Things. It helps the people who are physically and mentally disabled, where the installed bio sensor in a home environment can send message to their relatives or care taker in case of any emergency. The proposed iHome Health IoT system expands the scope and coverage of traditional health

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care information system extending from a confined hospital environment and emergency center to user's home, body and medicine. The medicine box serves as a home healthcare station providing strong interoperability and network connectivity. This system can deliver various services, such as monitoring of real-time bio-signals, alarms and medication noncompliance control and also it combines the health network, telemedicine, and emergency detection with first aid actions. The designing of this embedded system requires low cost where all the hardware's are reliable to buy. Even an alms person can buy this medicine kit that can be installed and maintained easily.

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