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A Conceptual Framework for IoT-Based Health Care System

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Abstract: Patient monitoring systems are gaining their importance as the fast-growing global elderly population increases demands for caretaking. These systems use wireless technologies to transmit vital signs for medical evaluation. The aim of the project is to provide a better health care to people from house in more economic and pertinent friendly manner. The need of home based health monitoring system is increased now days because health care cost is increasing exponentially in last few decades. In the proposed home based health monitoring system using android smart phone includes the aspects of acquisition of medical parameters like Body temperature, Pulse rate and ECG. Processing of a collected data using ARM11 (Raspberry Pi) processer and processed data is then displayed on doctors or relatives android mobile phones. Also the data can be displayed on personal computer. The system is utilizing a low cost component to transmit data like ECG to physician for monitoring; diagnosis and patients care at significantly low cost, regardless of patient's location.

Keywords: Raspberry Pi, RFID, Data Acquisition (DAQ).

I. INTRODUCTION

In intensive care units, there are provisions for continuously monitoring patients. Their heart rates, temperatures, ECG etc. are continuously monitored. But in many cases, patients get well and come back to home from hospital. But the disease may return, he may get infected with a new Disease, there may be a sudden attack that may cause his death. So in many cases, patients are released from hospital but still they are strongly advised to be under rest and observation for some period of time (from several days to several months). In these cases, our system can be quite handy. Patient's data (temperature, heart rate, ECG etc.) will be frequently measured and sent to server. Period of sending (say every 3 min) can be set. Heat rates can be sent every minute and temperatures can be sent after half an hour etc. But these can be parameterized to ensure that when a patient is normal, not many readings will be sent so that sensors have a longer life-time. But when the patient is ill, readings will be taken frequently and sent to server. Monitoring person learns patient specific threshold. Say the regular body temperature of a patient is 37□c whereas one person feels feverish if his body temperature is 37.0□c. By employing an averaging technique over a relatively long time, Observer can learn these thresholds for patients. Using android application, one can view his medical history date wise, event wise etc.

Android application can perform data mining on a particular patient data to discover important facts. Suppose a person has medium high temperature that starts at evening and lasts till midnight. If this phenomenon continues for several days, observer can detect this fact and inform to doctors saying "You frequently have short-period fever that may be a symptom of a bad disease. Consult patient immediately". This system can transmit continuously data. Suppose a patient has come back home after cardiac surgery. If the patient as cardiac problems likes arrhythmia, then there will be irregular variation of heart signal. This may occur only once or twice a day. But if system transmits continuous data, such variations will be immediately detected and alerts will be issued. Early detection and diagnosis of potentially fatal physiological conditions such as heart attack require continuous monitoring of patients health following transfer from hospital to home. Studies have shown that 30% of patients with a discharge diagnosis of heart failure are readmitted at least once within 90 days with readmission rates ranging from 25 to 54% within 3 – 6 months. In response to these types of needs, home based health monitoring systems are being proposed as a low cost solution. Such a system consists of physiological data that stores, process and communicate through a local manner such as smart phones, personal computers. Such systems should satisfy strict safety, security, reliability, and long term real-time operation requirements.

The IOT can bring multiple benefits to healthcare through the use of RFID tags, sensors, intelligent equipments, etc. it enables the online interaction of patients identification by using RFID tag. In advancement of technologies like IoT and Cloud, the sharing of data and collaboration among services will have transformative impact on personal healthcare. Based on the same concept a comprehensive Cloud – IoT health care system to empower depressed patients over their treatment process. In this proposed

framework we create a network consisting of all the health actors for sharing and collaboration of data and service on single platform.

II. LITERATURE SURVEY

In the previous existing method PC devices used as data acquisition (DAQ) systems we are able to collect vital information about the elderly patients remotely. Existed system which monitors temperature & pulse rate of different patients and immediate action is taken using Bluetooth technology. The Mobile Hub has many attractive features cheaper price, portable, location awareness, inbuilt touch screen , however on the other side it has also significant limitations compared to a full PC hardware like limited CPU power, memory, storage size and external interface connection support, The Mobile Hub is targeting different functionalities compared to the Home Hub solution due to the smaller screen size and fewer hardware interfaces, and it can extend the usability with additional special features, such as mobility, location awareness and small size. Mobile Hub software is capable to run almost all Bluetooth enabled and Android based Smartphone. In a sudden panic situation an alarm can be activated manually (by the patient) or automatically (by e.g. the accelerometer) with the mobile device. When an alarm signal initiated the central dispatcher is able to acquire location information (based on GSM/GPRS cell information) immediately.

The AT&T Medical imaging and information Management Solution (MiiM), enables health professionals, to expedite patient care by means of web enabled virtual collaboration and mutual interpretation of patient images, such as X-rays, compared tomography (CT) or Magnetic Resonance Imaging (MRI) scans. The system allows users access to review patient images almost instantly, from anywhere, giving attending physicians critical point-of-care updates and time to see more patients. This significantly reduces long-term technology costs and speeds patient care management. The solution can also enable national hospital networks to manage referral patient image when transferring to and from other institutions, anywhere in the world. Accenture cloud migration services help these advances in clinical workflow gain faster adoption in the healthcare.

III. PROPOSED SCHEME

Block Diagram of this paper is as shown in bellow Fig.1.

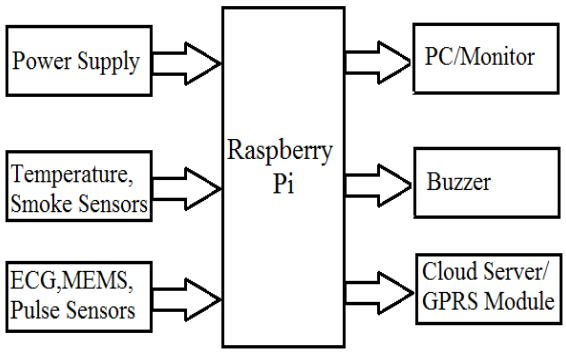

Fig.1. Block diagram.

III. METHODOLOGY

Micro Controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

Raspberry Pi 2: The Raspberry Pi 2 delivers 6 times the processing capacity of previous models. This second generation Raspberry Pi has an upgraded Broadcom BCM2836 processor, which is a powerful ARM Cortex-A11 based quad-core processor that runs at 900MHz. The board also features an increase in memory capacity to 1Gbyte.

Temperature Sensor: A thermistor is a type of resistor whose resistance is dependent on temperature. Thermistors are widely used as inrush current limiter, temperature sensors (NTC type typically), self-resetting over current protectors, and self-regulating heating elements. The TMP103 is a digital output temperature sensor in a four-ball wafer chip-scale package (WCSP). The TMP103 is capable of reading temperatures to a resolution of 1°C.

Fig. 2. Temperature sensor.

Thermistors are manufactured in the form of beads, probes, disc, washers and rods as shown in Fig.2. The beads are made in diameter ranging from 0.15mm to 2.5mm. These are useful where temperature sensing must be done in very limited spaces. Sealing thermistor beads in glass rods upto 25mm in diameter forms the probes. These are more rugged than beads and work well in liquids.

Pulse Sensor: Attach to finger and get Analog out from the sensor based on heart beat pulse. You can read the analog output with microcontroller ADC and then plot it or calculate readings like heart beat per minute. It is simple to use and accurate results as shown in Fig.3. The sensor consists of a super bright red LED and light detector. The LED needs to be super bright as the light must pass through finger and detected at other end. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal.

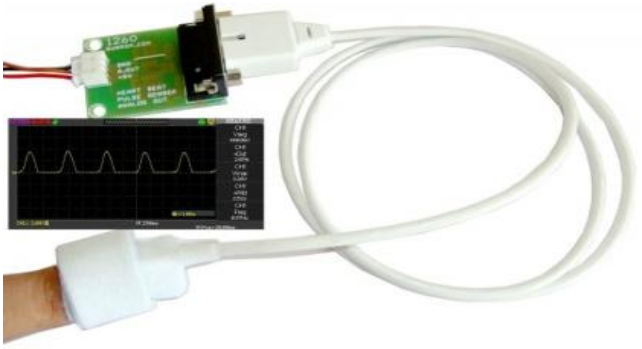

Fig.3. pulse sensor.

Buzzer: A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave ovens, & game shows. The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep. The "Piezoelectric sound components" introduced herein operate on an innovative principle utilizing natural oscillation of piezoelectric ceramics as shown in Fig.4. These buzzers are offered in lightweight compact sizes from the smallest diameter of 12mm to large Piezo electric sounders. Today, piezoelectric sound components are used in many ways such as home appliances, OA equipment, audio equipment telephones, etc. And they are applied widely, for example, in alarms, speakers, telephone ringers, receivers, transmitters, beep sounds, etc.

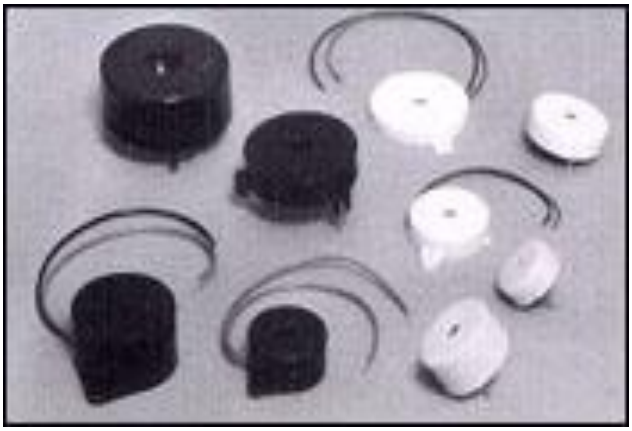

Fig.4. Types of Buzzers.

ECG Sensor: The electrocardiogram (ECG or EKG) is a diagnostic tool that is routinely used to assess the electrical and muscular functions of the heart as shown in Fig.5. The electrocardiogram (ECG) has grown to be one of the most commonly used medical tests in modern medicine. Its utility in the diagnosis of a myriad of cardiac pathologies ranging from myocardial ischemia and infarction to syncope and palpitations has been invaluable to clinicians for decades.

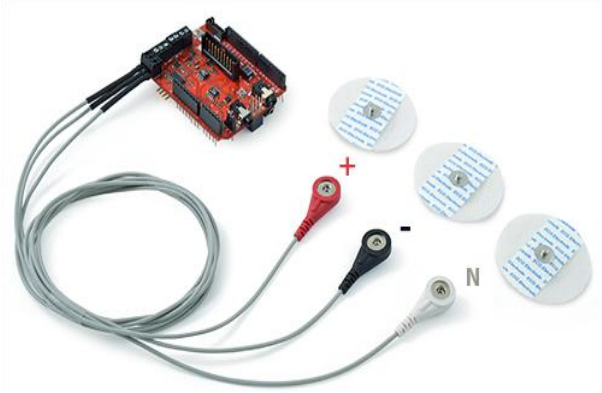

Fig.5.ECG Sensor.

An ECG is used to measure the heart's electrical conduction system. It picks up electrical impulses generated by the polarization and depolarization of cardiac tissue and translates into a waveform. The waveform is then used to measure the rate and regularity of heartbeats, as well as the size and position of the chambers, the presence of any damage to the heart, and the effects of drugs or devices used to regulate the heart, such as a pacemaker.

GPRS: GPRS (general packet radio service) is a packet-based data bearer service for wireless communication services that is delivered as a network overlay for GSM, CDMA and TDMA (ANSI-I36) networks as shown in Fig.6. GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packet switching is where data is split into packets that are transmitted separately and then reassembled at the receiving end. GPRS supports the world's leading packet-based Internet communication protocols, Internet protocol (IP) and X.25, a protocol that is used mainly in Europe. GPRS enables any existing IP or X.25 application to operate over a GSM cellular connection. Cellular networks with GPRS capabilities are wireless extensions of the Internet and X.25 networks.

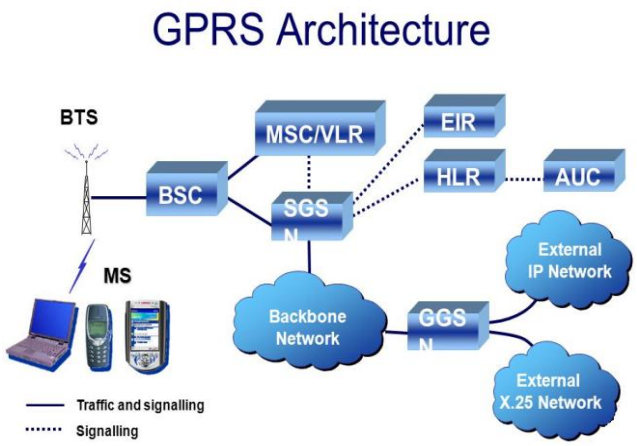

Fig.6. GPRS Architecture.

a. To Dial a Number

To dial a number you will have to send the command -> ATD NUM;

Where NUM is the number you want to dial.
For instance to dial 9008620582, send the command ATD 9008620852;
To disconnect the number use the command – ATH
To redial a number use the command – ATDL

b. To Send a SMS

To send SMS send the command -> AT+CMGF=1
Modem will then send the text -> OK
Then send -> AT+CMGS="NUM"
Where NUM is the number you want to send the SMS to.
Modem will then send the text - TYPE THE MESSAGE>
Enter the message and then press ctrl+z to send SMS
Here are a few useful AT commands for changing the settings –
To change the baudrate – AT+IPR=BAUDRATE(Ex 9600)
For more details refer AT commands Document page 33
To save the settings – AT&W
To restore factory defaults type AT&F then save it by sending AT&W

MEMS: Accelerometers are acceleration sensors. An inertial mass suspended by springs is acted upon by acceleration forces that cause the mass to be deflected from its initial position. This deflection is converted to an electrical signal, which appears at the sensor output. The application of MEMS technology to accelerometers is a relatively new development. A MEMS-based magnetic field sensor is small in size, and so it can be placed close to the measurement location and thereby achieves higher spatial resolution. Additionally, constructing a MEMS magnetic field sensor does not involve the micro fabrication of magnetic material. Therefore, the cost of the sensor can be greatly reduced. Integration of MEMS sensor and microelectronics can further reduce the size of the entire magnetic field sensing system. This device is used to measure strain in an object, which is detected by a foil strain element. If the object, to which the gauge is attached is somehow deformed that creates electrical charges and is known as the gauge factor.

IV. RESULTS & ANALYSIS

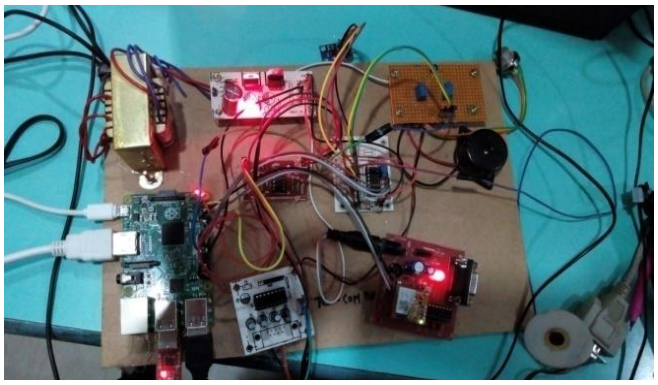

Fig.7.

Whenever the Power Supply has been given to the kit and all sensors has to be connected to the patient's body then sensors will monitor the patient's condition.

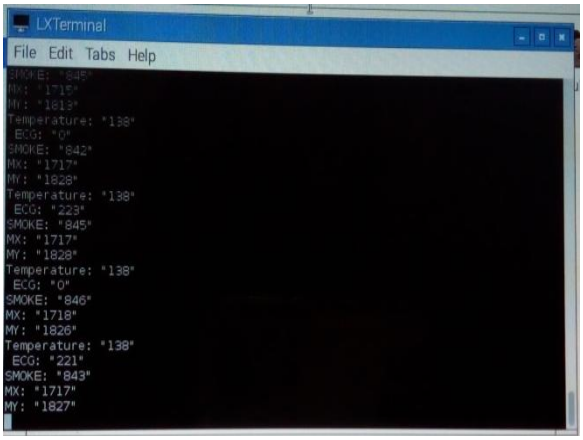

Fig.8.

Sensors will continuously read the data from patient's body and will display on the monitor to which we have connected HDMA cable.

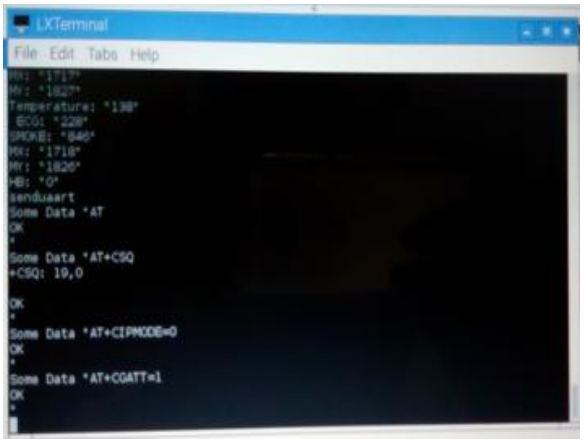

Fig.9.

Though we are capturing data very second but we will send the data to the cloud for every one minute, when we are sending the data we can see the GPRS commands. Once the data has been sent to cloud again sensing will be started and the same process will be repeated

Fig.10.

In the absence of Internet we can also view the patient's information on the flash magic with UART.

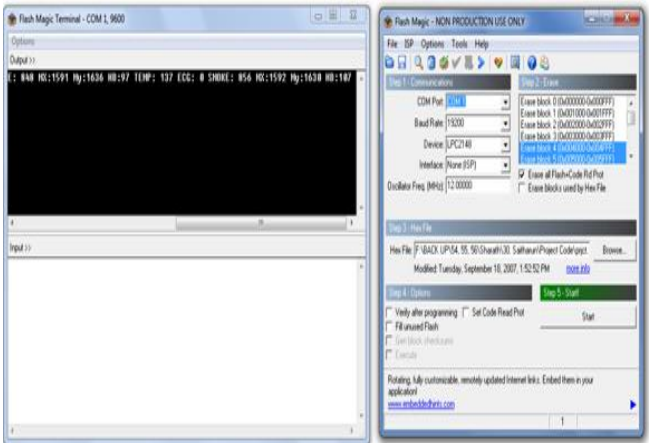

Fig.11.

V. CONCLUSION

This system reduce costs by enabling in home monitoring of patients, eliminating the need for utilization of expensive facilities, and reducing the need for transportation of patients to physicians and Medical centers. In the near future, the number of Internet connected devices would increase exponentially, from parking spaces to houses to refrigerators; the IoT is bringing more and more things into the digital mode everyday, which would at some day in the future make IOT a multi-trillion dollar industry. With such a fast pace growth, the day is not too far that we can even reconfigure our dinner even before reaching home on the way. Offer a viable mobile healthcare service permitting health professionals to remotely assess, diagnose and treat patients whilst the patients are free to continue with daily life activities and stay fully mobile. Demonstrate and validate the precise conditions to be fulfilled for subsequent commercial deployment. IOT in the near future would bring the following changes in the lifestyle of the people.

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