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IoT based Patient Fetal Heart Rate Monitoring

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***Abstract*—Technology plays the foremost role in healthcare not only for sensory devices but also in communication and recording. It is vital to observe varied medical parameters under post operational days. So the most recent development in healthcare communication methodology is customized to serve even in remote areas by the term IoT, which plays a catalyst for the healthcare and plays distinguished role in many applications. In this paper, microcontroller is used as a gateway for communication. This system puts forward a wise patient fetal health monitoring system that uses sensors to trace patient health and uses internet to intimate their relatives or concerned doctors in case of any emergency. The controller is additionally connected with a buzzer to alert the caretaker regarding variation in detector output. In addition, to trace the status of the heart rate the controller is interfaced with LCD display furthermore as wireless local area network association so as to transmit alerts. If the system detects any changes in patient pulse rate or BP, the system automatically sends an alert to the doctor regarding the patient status over IoT and additionally shows the details of temperature of patient, live over the cloud. So IoT based patient health monitoring system effectively uses internet to watch patient health status and save lives on time. For this reason fast conditional medication may be simply done by this technique. This system is easy to setup and is capable of high performance and time to time response.**

Keywords*— *healthcare communication, IoT, Patient Fetal Heart Rate monitoring system

I.INTRODUCTION

In developing countries, there are more growing range of individuals with persistent diseases because of totally different risk factors like nutrient imbalance and physical inactivity. According to WHO report, 4.9 million individuals die from carcinoma from the consumption of snuff, overweight a pair of 2.6 million, 4.4 million for increased cholesterol and 7.1 million for high pressure. Due to the technological development, there is a great variety of running sensors giving important signs such as blood pressure cuff, glucometer and pulse monitor together with electrocardiogram, which permits the patient to take their vital signs daily. The readings taken daily are sent to doctors and enable them to suggest the medicine and physical exercise routine that enable them to improve the quality of life and overcome such disease.

Congenital heart defects may occur due to genetic syndrome, inherited disorder or environmental factors which are to be clinically monitored by Fetal ECG (FECG) signals before a baby is born. Hence, it is very crucial for the doctors to detect the heart defects before it causes any damage to the fetus or the mother. From the ECG signal, peaks of the QRS complex give the precise information about the heart rate of the abdominal ECG (AECG) signal. The detection can be done by placing electrodes on the maternal abdomen in either of two methods such as (i) Ausculation - periodically listening to fetal heart rate using stethoscope or Doppler transducer and (ii) Electronic Fetal Monitoring Instruments which involves external and internal methods of recording heart beat of fetus and contractions of uterus.

Internal Fetal Monitor

Internal fetal heart rate monitoring uses an electronic transducer connected directly to the fetal skin. A wire electrode is attached to the fetal scalp or other body part through the cervical opening and is connected to the monitor.

This type of electrode is sometimes called a spiral or scalp electrode. Internal monitoring provides a more accurate and consistent transmission of the fetal heart rate than external monitoring because factors such as movement do not affect it. Internal monitoring may be used when external monitoring of the fetal heart rate is inadequate, or closer surveillance is needed.

External Fetal Monitor

External fetal heart rate monitoring uses a device to listen to or record the fetal heartbeat through the mother's abdomen. A fetoscope (a type of stethoscope) is the most basic type of external monitor. Another type of monitor is a hand-held electronic Doppler ultrasound device. These methods are often used during prenatal visits to count the fetal heart rate. A fetoscope or Doppler device may also be used to check the fetal heart rate at regular intervals during labor. Continuous electronic fetal heart monitoring may be used during labor and birth. An ultrasound transducer placed on the mother's abdomen conducts the sounds of the fetal heart to a computer. The rate and pattern of the fetal heart are displayed on the computer screen and printed onto special graph paper.

The most commonly used FECG monitoring technique is the non- invasive or the External Fetal Monitoring until or otherwise an emergency is awaited during labor.

II. BACKGROUND OVERVIEW

The system used for health monitoring is the fixed monitoring system, which can be detected only when the patient is in hospital or in bed. Recently accessible systems are huge in size and available only in the hospitals in Intensive Care Unit. Nowadays, Zig Bee can be used to transmit the patient information to their relatives or to their concerned doctors.

Fig.1. Existing System

Telemonitoring system via WBAN is evolving for the need for home primarily based mobile health and personalized medicine. WBAN will able to collect the information no heritable from sensor and record the output. This output results sent to controller wirelessly to health watching system. In this paper, Zig Bee is employed to in WBAN technology because of its guaranteed delay demand for health Telemonitoring system. Zig Bee is employed in the communication.

In the aforementioned existing system, patient needs to get hospitalized for regular monitoring of the patient. It is not possible once they get discharged from the hospital. Also the health parameters measured using existing systems sent through Zig Bee, Bluetooth protocol are normally used for only short range communication to transfer the data. Not all the time the doctor can fetch these details. Hence IoT based monitoring gains an upper hand over a wide range of applications.

Lingui Atzori addresses the main advantage of IoT as an enabling factor and a promising paradigm in communication of wireless and wired sensors as well as actuators networks. The results of IoT are synergetic activities gathered in various fields of knowledge, like telecommunication, informatics, social science and electronics.

Vandana Milind Rohokale developed their approach for monitoring and managing good health parameters like heart attack, blood pressure, hemoglobin, blood sugar, abnormal cellular growth for rural and poor human being's health from any part of the world connected when through IoT. It is crucial since in many developing countries the death rate due to lack of timely medical treatments are more compared to other developed countries. The wireless communication and the wireless node entities can increase their effective quality of service through co- operation.

III. EXISTING METHODOLOGY

The system which we prefer to develop would not only help in monitoring the health of the patient when he is in bed but also when he is out of bed. The main idea of the system is to transmit the information through the webpage to continuous monitoring of the patient over internet. Such a system would continually detect the important body parameters like temperature, pulse rate and would compare it against predetermined range set and if these values cross the specific limit, it would immediately alert the doctor. In this system microcontroller is used to transmit the data. It is connected to IOT which provides information to doctor or caretaker. The data of the patient's health is stored in the cloud. The doctor can easily access the patient's health anytime from anywhere. An LCD and buzzer is also connected to the microcontroller for the patients to view their health status live. In case of emergency it would automatically alert the doctor and relative of the patient via SMS. In such case the patient will get rapid medical help and also would save time and energy of the relatives, who cannot be near the patient all the time.

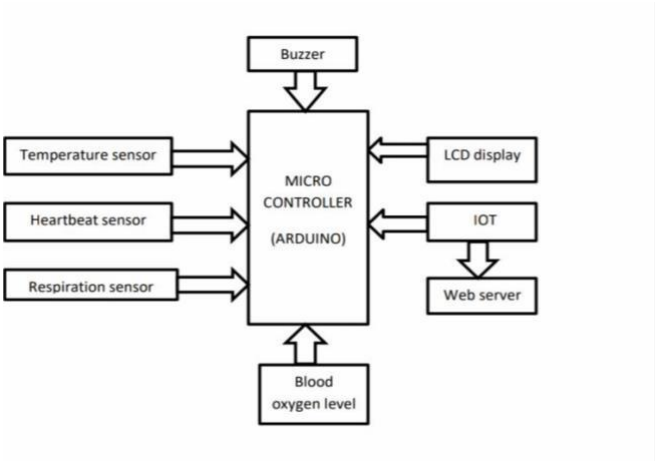

Fig.2. System Overview

A. MICROCONTROLLER

Microcontroller is the most important unit of the entire system. It is actually responsible for all the process being preceded. It will access and control all the peripheral devices

or components, connected in the system. Arduino UNO is a free source microcontroller based on the microchip At Mega 328p. This has some valuable facilities like they can easily convey the required information with a computer or with other microcontroller. In short, the complete success of the project depends on the software code in the microcontroller.

Fig.5. Heart Beat Sensor

Fig.3. Arduino UNO

B. TEMPERATURE SENSOR

The LM35 series are integrated circuit temperature sensors, whose output voltage is linearly proportional to the Centigrade temperature. Temperature sensor hence is a preferable one over linear temperature. Sensors calibrated in Kelvin like the user is not needed to less the large constant conductivity from its output to convert centigrade scaling. Temperature sensor is a device which senses variation in temperature across it. LM35 need not any external source to provide typical accuracies. This is the 3leg IC that directly gives the analogue output. This requires +5v dc for its operation. Reading given by their sensor is in centigrade.

Fig.4. Temperature Sensor

C. HEART BEAT SENSOR

Heart beat sensor is used to give digital output of pulse rate when a finger is placed on it. Here we will be making a cavity having a bright Light Emitting Diode and one LDR just opposite it. By locating the finger in between the Light Emitting Diode and LDR, the pulse of the heart is detected. When the heart beat detector is working, LED flashes in unison with each heartbeat. The digital output can be connected to the microcontroller directly to detect the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

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D. IOT

Internet of Things is usually considered as connecting things to the internet and using that connection to access anindividual objects.

Fig.6. Sensors interfaced with IoT

Otherwise remote devices and objects with built in sensors are connected to an Internet of Things platform, which collects the information from different devices and stores it in the cloud. And then transfers the data to that particular website.

E. RESPIRATION SENSOR

For several medical purposes the respiration of a patient needs to be monitored. Respiration sensor calculates the breathing rate and relative depth of abdominal or thoracic breathing. It is easy to measure and can be worn over clothing because it is an elastic band type.It is placed over the abdomen.

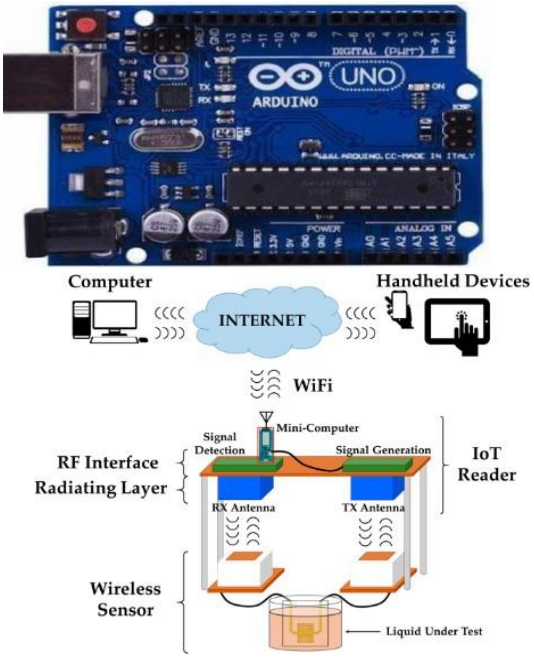
IV. SIMULATION RESULTS AND ANALYSIS

In this project, detecting the various parameters of the patient using Internet of Things is done. In health monitoring system based on IoT projects, the real time factors of the patient are sent to the cloud by using internet connection. These data can be sent to anywhere in the world, so that the user will view the details anytime. This is the major advantage over SMS based health monitoring system. In IoT based patient health monitoring system, data of the patient health are often seen by doctors or their loved ones. The reason behind is that, the data has to be accessed by visiting an internet site or computer address, whereas in Global System for Mobile communication based patient monitoring system, the health parameters are sent using GSM via SMS.

Fig.7. Pulse and temperature rate

IoT based health monitoring system has 3 senses. Initial one is a temperature sensor, second one is heartbeat device, and the third one is respiratory sensor. This is extremely useful since the doctor will detect the patient's health parameters simply by visiting internet website or IP address. And today several IoT apps are also being developed. So the doctor and relatives will monitor or track the patient health through Android apps. To operate an IOT based health tracking system, you will need a Wi-Fi connection. The microcontroller or the Arduino board connects to the Wi-Fi network using Wi-Fi module. This system will not work when there is no Wi-Fi network, Arduino UNO board continually reads the input from 3 senses. Then it sends the information to the cloud by sending this information to specific URL/IP address. Then this action of accelerating data to the cloud is repeated for a specific period of time.

IoT healthcare is the most emerging field in the medical area. This project is mainly for elderly person who is alone at home. It is also helpful for senior citizens living alone or with 1 or 2 members. This is really helpful when relatives or members of the family have to go out for some unavoidable reasons. Multi challenged person can use this project. IoT tracking proves really useful when we need to record, monitor and keep track of changes in the



health parameters of the patient. In Internet of Things based patient monitoring system, we can have the database of the health parameters. This helps the doctor to easily find the changes in the health parameters or history of the patient while suggesting the treatment or medicine for patient. Hospital stays are reduced due to remote patient monitoring. Hospital visits for regular check-ups are also minimized.

Patient health parameters are stored in the cloud. So it is more beneficial than maintaining the records in printed paper in separated files or in digital computer, laptops, pen drives or specific memory location. In such cases there may be a chance of losing the data. Whereas in case of IoT, the data stored in the cloud has only minimal chance of data loss. Cure can be provided at starting stage. Notification to doctor is sent in case of critical conditions even though the patient is unable to provide any details.

The GPS module will find out the location or position of the patient using longitude or latitude received. Then it will sent the location to the cloud using Internet Of Things and then doctors can find out the position of the patient in case they have to take some preventive action or nearest hospital will be informed automatically using GPS and ambulance will be sent to the patient.

V. CONCLUSION

With the wide use of internet, this work is concentrated to execute the internet technology to establish a system which would communicate through internet for better health. Internet of Things rules the whole world in various fields, mainly in health care sectors. Hence the present work is done to design an Internet of Things based smart patient health tracking system using an Arduino microcontroller. In this, pulse rate sensor is used to detect the heart beat and temperature sensor to read the temperature and sends the data to the cloud using internet. This information is also sent to the LCD display, so patient can easily know their health status. During critical situations to alert the doctor, the warning message is sent to the doctor's phone and at the same time buzzer turns to alert the care taker. The doctor can view the sent data by logging the specific website or IP address. Hence continuous patient monitoring system is designed.

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