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Long Term Monitoring of Sleep Disordered Breathing Using IOT Enabled Polymer Sensor Embedded Fabrics

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Abstract--- *This paper presents the design and implementation of health monitoring fabrics incorporated with wireless biomedical parameters monitoring system supported by different biomedical sensors and microcontroller unit Arduino UNO with Wi-Fi. The devices can be able to measure physiological parameters like vital sign, Heart Beat, Temperature of a patient those who wear the fabrics. The patient is continuously monitored both in the transmitter side and receiver side by doctor. There are number of techniques available for the ICU patient's health monitoring system with wired communication technology. Within the novel system the patient health is continuously monitored using wireless sensor networks and therefore the acquired data is transmitted to a microcontroller unit Arduino UNO then to Wi-Fi. At the receiver side the information is collected with Wi-Fi and Arduino and displayed on relevant displays.*

Keywords--- *Fabrics, Heart Beat, Temperature, Biomedical Sensors.*

I. INTRODUCTION

Health insurance access, quality and affordability are issues all around the globe. There are settled in varieties in light of pay and geography, and the high costs of restorative administrations present moderateness challenges for countless people. Significant amounts of individuals don't get the quality care that they require. Convenient advancement offers ways to deal with help with these challenges. Cardiovascular sickness has demonstrated that heart beat rate assumes a key part within the danger of heart assault.

Coronary illness, for example, heart assault, coronary illness, congestive heart disappointment, and intrinsic coronary illness is the main source of death for men and ladies in numerous nations. More often than not, coronary illness issues hurt the elderly individual. Frequently, they live with their own and nobody is willing to screen them for 24 hours a day.

In this proposed system, the pulse rates of patients are continuously monitored and take care by utilizing sensors as simple method.

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II. LITERATURE REVIEW

S. J. Jung and W. Y. Chung presented the Flexible and scalable patient's health monitoring system. The most benefit of this enabling factor is that the mixture of some technologies and communication solution. The results of Internet of Things are synergetic activities gathered in various fields of data like telecommunications, informatics and electronics[1]. K.S.Shin and M.J.Mao Kaiver proposed health monitoring system using telephone with self analysis which includes IoT a alternate paradigm that uses smart objects that not only capable of collecting the information from the surroundings and interacting the physical world [2].

Cristina Elena Turcua presented Health care applications supported the web of Things survey aims to present an in thorough information about how frequency to develop and improve people's access to quality and health care services and to optimize the health care in the system [3]. Gennarotartarisco and Tabilo Paniclo proposed maintaining sensing coverage and connectivity in large sensor networks mainly includes the knowledge about the way to build or develop a replacement wireless healthcare system technology supported clinical decision support systems, information science, wireless communication and also data processing kept in new premises within the field of private health care[4].

Gubbi Jayavardhana et al developed the web of Things (IoT): A vision, architectural elements, and future direction which propose on demand positioning and tracking system. It's supported IOT based smart heath care enabled devices and suitable for giant environments[5]. J.L. Kalju proposed a system, and is capable of measuring different physiological parameters and are used to propose a system for pulse reconstruction for rate adaptive pacing in the world [6]. Loren Schwiebert et al presented the power of smart sensors which are developed from the mixture of sensing materials in conjugation with combined circuitry for other biomedical applications in it [7].

Gentili G.B proposed an easy microwave technique to watch the cardiac activity. It explained the utilization of wireless micro sensors networks for medical monitoring and environmental sensing within the remote areas [8]. Reza S.Dilmaghani and Goutam Motika presented the planning of Wi-Fi sensor network that is capable of monitoring patient's chronic diseases at their home itself via a foreign monitoring system in the environment[9]. Kadish developed a system, which includes several thing to manage complex situations, the pump will need several MEMS based sensors to monitor more parameters like glucose, heart rate, temperature and ECG etc… [10]. In 1992, L.G.linberg proposed a replacement method, which frequently uses fiber optic probe to watch pulse and respiration rate simultaneously [11].

J.L. Kalju developed a system, used for measuring different physiological parameters and are want to design a system for pulse reconstruction and develop people's access to quality and health care services and to optimize the health care process[12]. M. Nakagawara and K. Yamakoshi proposed a transportable instrument to watch vital sign, flow and other cardiovascular variables, and also data processing kept in new premises within the field of private health care[13]. Eugene Ingshawshih presented the utilization of wireless micro sensors networks for medical monitoring and environmental sensing within the world activities gathered in various fields of data like telecommunications, informatics and electronics [14]. Yuan-Hsiang Lin

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proposed a system which is a combination of PDA (Personal Digital Assistant) and WLAN (Wireless Local Area Network) for mobile patient monitoring [15].

In this paper continuous monitoring of the patient's different parameters such as body temperature, Heart Beat monitoring is obtained and transmitting this data to the doctor's cabin continuously as well as displaying data at transmitter side so that patient also observed the relevant outputs and then at the receiver side or in doctors cabin the data is collected with Wi-Fi and Arduino and displayed on relevant display.

III. PROPOSED METHOD

The design of fabrics which embedded a monitoring system capable of reading an ECG signal and temperature of a patient and is then transmitted via WIFI to a display module that can be a WEB application. The captured information is sent via a IOT using local network to a database implemented on a web page. A Web application allows access to data from any WIFI-connected device. Non-contact electrode procedures for obtaining physiological signals become increasingly necessary and mark the current trend in medical. In this system we are continuously monitoring the patient's different parameters such as body temperature, ECG and pulse rate.

A. Working of the System

This automatic wireless IOT based health monitoring system is used in hospitals for patients works on the principle of temperature sensing. This whole system consists of two units one is transmitting unit and other is receiving unit. Both have separate power supply and LCD display. The transmitting unit is fixed in the fabrics wear by the patient and its leads are connected to the patient's body. The figure 1 shows the position of the sensor pad inputs.

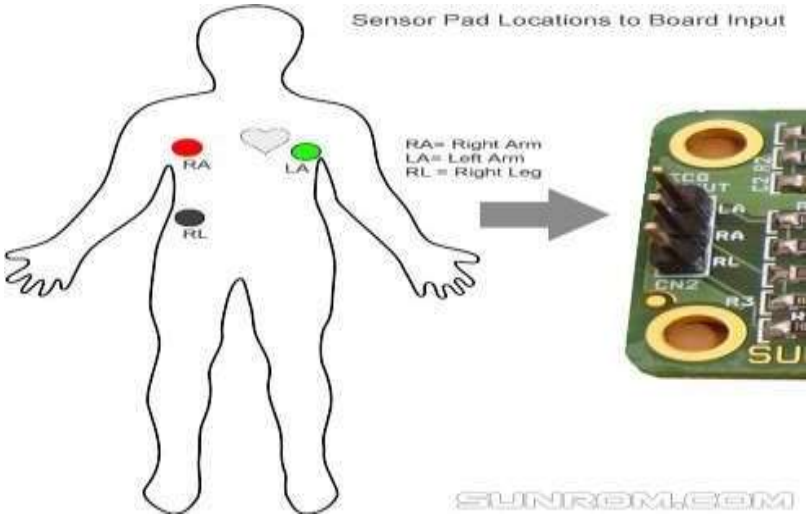

Fig. 1: Position of Sensor Pad Input

Similarly, the receiving unit receives this aliteration value through RF receiver and sends this value to microcontroller, then microcontroller displays this aliteration value at receiving unit LCD display. Because the receiving unit is placed near to the doctor or any other related person then they can easily know the temperature of any patient body without going towards him. Then the patient must be easily treat consistent with his blood heat.

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B. Block Diagram

The main challenge is to form elders equipped with for growing new technologies and to become familiarity towards Smartphone, computer, etc… IoT based Smart healthcare with the assistance of smart devices and objects improves the healthcare monitoring system effectively, thus by reducing the inefficiencies of existing healthcare system. Smart devices with new and upgraded technologies enhances the information accuracy to be collected, real-time accessibility of patient's condition, intelligent integration of knowledge collected, maintaining the integrated data smartly through cloud service, etc. IoT along-side smart devices reduce complexity and complications within the healthcare system.

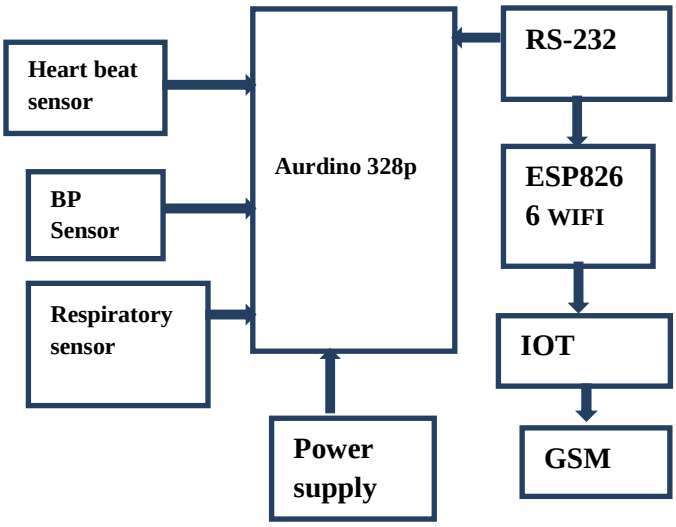

Fig. 2: Block Diagram of Proposed System

The figure 2 shows the block diagram of patient monitoring system and its components are Arduino 328p, Heart beat sensor and Respiratory sensor. The whole system's based on voltage regulation. The ESP8266 is a highly integrated chip designed for the needs of new connected world. Many modern personal computers haven't any RS-232 ports and must use an external converter to attach to older peripherals. Some RS-232 devices are still found especially in industrial machines or scientific instruments.

C. Fabrics

Fig. 3: Fabrics Embedded with Medical Unit

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Figure 3 shows the fabrics embedded with medical unit. The ECG channels are not intended to be used in the home environment as cardiac activity will be captured using the non-contact ERB, thus negating the need for any electrodes. However, it is useful in validating the device and potentially will be used in future application to gain additional information about cardiac activity. The connections to the disposable ECG electrodes can be routed via either jumper wires or shielded low resistive EMI fabric**.**

D. System Description

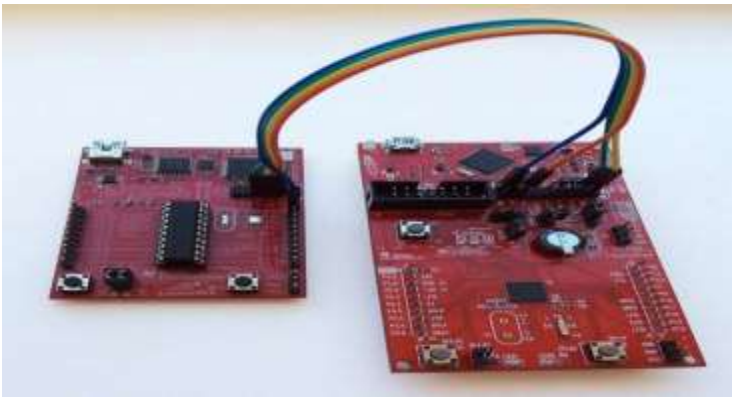

Fig. 4: Design of Hardware Setup with Sensors

Figure 4 shows the hardware set up of many sensors and the circuit is maintained in the device. It includes a power supply, an aurdino 328p, a temperature sensor, RF Transmitter, receiver module and LCD display. To monitor the temperature of the patient's body, the aurdino 328 p are mostly used. All the measured parameters like temperature, heart beat are displayed in the LCD display in the transmitter side and transmitted as encoded serial data through RF module and received in the receiver end.

The main parts of the system are described as follows.

a. Heart Beat Sensor

The device was tested to determine if it is capable of capturing both cardiac and respiratory activity over the course of a night's sleep. Additional proof-of-concept experiments are performed to determine if the prototype device is capable of accurately capturing respiration and cardiac activity.

Fig. 5: Heartbeat Sensor

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Figure 5 shows the Heart beat sensor. The Heart Beat Sensor provides an easy thanks to study the heart's function. This sensor monitors the flow of blood within the finger. As the heart forces blood through the blood vessels in the finger. The quantity of blood within the Finger changes with time. The sensor shines a light-weight lobe (small High Bright LED) through the ear and measures the sunshine that's transmitted to LDR.

b. BP Sensor

A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to prevent a fluid from expanding, and is typically stated in terms of force per unit area. A pressure sensor usually acts as a transducer. It generates a sign as a function of the pressure imposed. For the needs of this text, such a sign is electrical.

c. Respiratory Sensor

Abnormal rate of respiration s and changes in respiratory rate are a broad indicator of major physiological instability, and in many cases, rate of respiration is one among the earliest indicators of this instability. Therefore, it's critical to watch rate of respiration as an indicator of patient status. Air Flow sensor can provide an early warning of hypoxemia and approximate.

d. RS 232

In telecommunications, **232** (Recommended Standard 232)is the normal name for a series of standards for serial binary single-ended data and control signals connecting between a DTE (Data Terminal Equipment) and a DCE (Data Circuit Equipment). It is commonly used in computer serial ports. The standard defines the electrical characteristics and timing of signals, the meaning of signals, and therefore the physical size and pin out of connectors.

e. ESP8266 WIFI Shield

ESP8266 has powerful on-board processing and storage capabilities that allow it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, and therefore the entire solution, including front-end module, is meant to occupy minimal PCB area.

IV. RESULTS AND DISCUSSIONS

Fig. 6: Output in LCD

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Figure 6 Shows the Output in LCD display. The screen shows the output which is exhibited within the particular time interval. The appliance is straight forward because it just exhibits the analog values followed by a handout describing the sort useful displayed. A Mobile device based wireless healthcare monitoring system was developed which may provide real time online information about physiological conditions of a patient mainly consists of sensors. Thus the real time monitoring system is maintained and developed in this device.

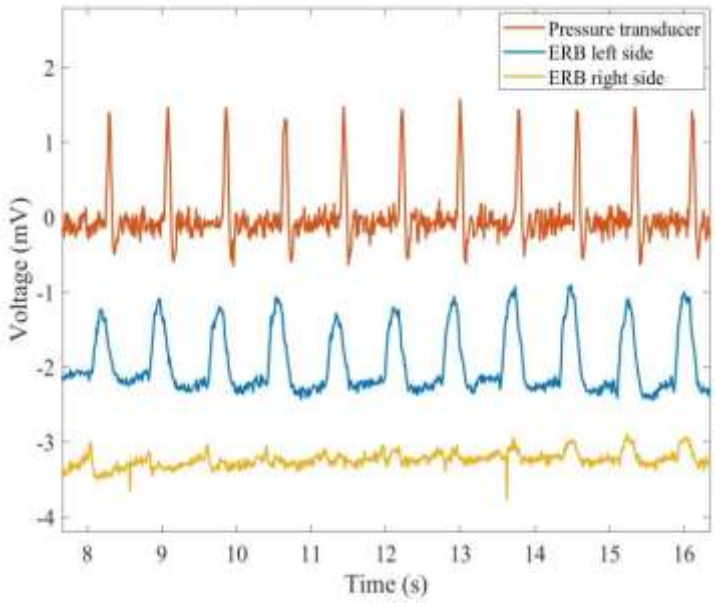

Fig. 7: Output in Mobile Application

Figure 7 Shows the output in mobile application. The output in the mobile application is connected in the Blink server using IOT. Since the embedded system is decided to specific tasks, design engineers can optimize it, reducing the size and price of the merchandise, or increasing the reliability and performance. Some embedded systems are mass-produced, taking advantage of economies of scale. The ECG signals are recorded and saved within the system. Any deviations within the system may occur may automatically send aware of doctor. Through adaptable wellbeing applications, sensors, remedial gadgets, and remote patient checking things, there are boulevards through which human services conveyance are often moved forward. These developments can encouraging so as to chop down costs the transport of thought, and interfacing people to their human administration suppliers.

Observations

Table 1: Observations Made for Different Samples

TESTINGS	TEMPERATURE(C)	PULSEBEAT(bpm) (60-100)	QRS INTERVAL (0.04-1.2)
Sample 1	37.4	74	0.06
Sample 2	38.6	88	0.04
Sample 3	38.9	100	0.08
Sample 4	39.0	68	0.05

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The above tables provides the details furnished for samples which was observed in the device. The device will send the report to the doctor by SMS. The details are reported and observed for day to day progress. The normal resting heart rate for adults over 10 years is between 60 to100 (bpm). The deviations in the range may be due to some problem in heart. The range above 100 is to be dangerous and the patient is yet to be under surveillance by the device. But a heart rate lower than 60 doesn't necessary mean the person have a medical problem. A number of conditions can affect our heart rate. An arrhythmia causes the guts to beat the heart too fast, too slow or with an irregular rhythm.

The advantages of the proposed system includes system is cost efficient and reliable, patient's data are stored with unique ID, the devices are time efficient with highly portable device, the patient's history are quickly analysed by the data, a web application allows access to data from any WIFI connected device.

V. CONCLUSION

Wearable sensors, particularly those equipped with non-contact IoT intelligence, offer attractive options for enabling observation and recording of data in home and work environments, over much longer durations than are currently done at office and laboratory visits.. The doctors can view the sent data by logging to the html webpage using unique IP and page refreshing option given so continuously data reception achieved. Hence continuous Heartbeat monitoring system is designed.Applications grant both patients and suppliers to have passage to reference materials, lab tests, and therapeutic records utilizing cell phones. Complex versatile wellbeing applications help in regions, for example, preparing for human services labours, the administration of perpetual sickness, and observing of basic wellbeing markers. These developments can encouraging in order to cut down costs the transport of thought, and interfacing people to their human administration suppliers.

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