IoT based ECG Monitoring in Versatile Ambulance System

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***Abstract*:- It is seen that the latency in arrival time of ambulance in the hospital eventually leads to the conversion of patient health to critical condition. The sudden cardiac arrests and arrhythmias are some of the major situations faced in the emergency ambulance. IoT rises as a powerful domain where embedded devices and sensors can connect and exchange information over the internet. This project aims to exploit the technique of IoT for the transmission of acquired ECG and other vital parameters from emergency ambulance to the appropriate hospital by preserving the confidentiality of the data. In this work, an ECG monitoring system is designed with using ECG sensors and temperature sensor. The architecture embedded with an automatic sensor which shows the noise free uninterrupted numerical ECG values in real time manner. The streaming of vital data from the emergency ambulance is achieved by using IoT. The graphical representation of the data is acquired in the required hospital web server by the transmission of the same using IoT. A traffic signal module is also implemented into the proposed model to notify when the ambulance is present at the programmed vicinity of the signal.**

Keywords : IoT, Wi-Fi module, ECG sensor, Microcontroller, ZigBee

INTRODUCTION

The Indian scenario of CVD (cardiovascular diseases) had been shown a death rate of 273 per 100000 population. The global survey also demonstrates a death rate of 235 per 100000 and this develops to a tussling situation to the cardiac patient in emergency ambulance. This crisis need an intelligent technology to resolve the existing challenges such as reliable data transmission, remote monitoring of healthcare data and latency of ambulance. IoT is a dynamic global network infrastructure raised for a smart healthcare era.

Today it is increasingly about value instead of potential, about the combination of IoT, AI and other related technologies to derive insights, decisions and revenues from sensor data and about IoT monetization, as scalable, IoT enabled projects become part of less limited business objectives and digital transformation projects with a focus on services and applications.

High blood pressure (BP) is one of the most important risk factor for cardiovascular diseases (CVD) which is the leading cause of mortality. The systolic and diastolic blood pressure has been analyzed by doctor, in the examination period. Another parameter which defines the heart functioning is the heart rate.

The penetration of internet and wireless communication technology in the industry has been augmented by the regulations set by the governing agencies to adopt the electronic health record (EHRs) to pass the accurate patient information and streamline the communication between the patient and the hospitals. The establishment of the connection and communication between the remote locations and the ease of analyzing the collected data to provide a sensible conduction without any human interference has become a reality in the healthcare industry through a combination of wearable sensors and connecting it to a private network to relay the data to the concerned authorities. For the wireless communication ZigBee emerge as a low cost, low power mesh networking standard. It is designed for wireless automation and remote monitoring.

In this proposed system a ECG monitoring application using Internet of Things along with traffic control using ZigBee protocol is explained. The graphical interface data are acquired in the necessary hospital web server. This paper also deals with the architecture of the system and the results obtained along with the conclusion we arrived about this area of study.

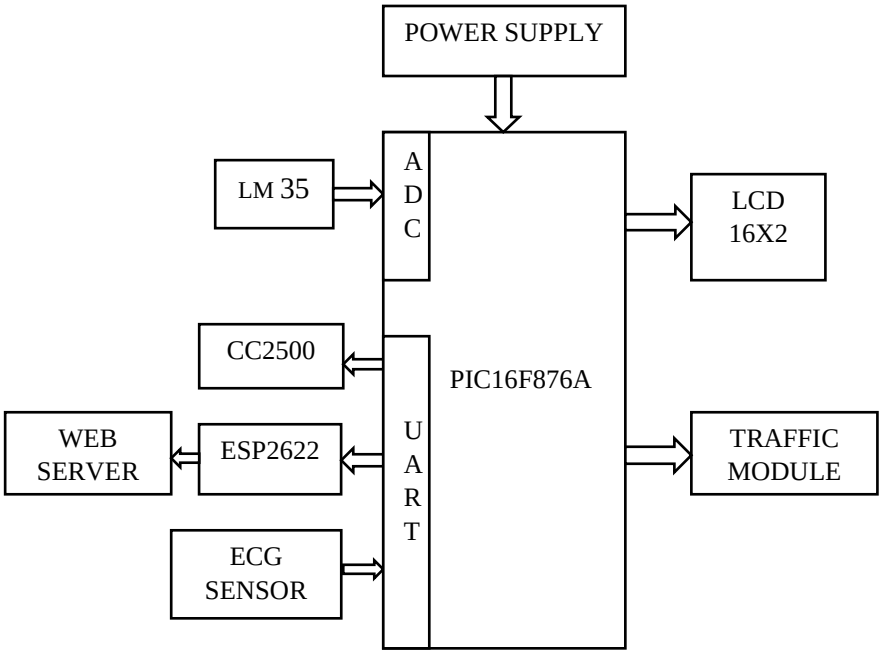
EXISTING SYSTEM

In the existing system a Bluetooth based WSN is used to design a heart rate monitoring system. Wireless sensor networks were the basic technology of this model of system. HC-05 Bluetooth processed on PC is used to transfer the pulse-oximeter (SPO2) data obtained using the sensor wirelessly through arduino to a personnel computer. MATLAB programming is used to design the Graphical user Interface (GUI) so that the model can be accessed without any prior programming knowledge.

SYSTEM ARCHITECTURE

The architecture of the system consists 5 parts simply, wireless communication standard, wireless module, sensor module, microcontroller and traffic module. The data acquired by the sensor is processed by the PIC microcontroller which is then sent to the required web server using wireless module using the Internet of things. Also the traffic signals are controlled whenever the ambulance is about 30-100 m around the sign.

BLOCK DIAGRAM



I Wireless Communication Standard

The Internet of Things (IoT) is a novel paradigm that is rapidly gaining ground in the scenario of modern wireless telecommunications. The basic idea of this concept is the pervasive presence around us of a variety of things or objects – such as Radio-Frequency Identification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbors to reach common goals. IoT based architecture of smart hospital is implemented to improve efficacy of present hospital information system, such as: fixed information point, inflexible networking mode, and related parameters.

II Wireless module (802.11/ESP8266)

ESP8266 is a complete and self-contained Wi-Fi network solutions that can carry software applications, or through another application processor uninstall all Wi-Fi networking capabilities. When the device is mounded and as the only application of processor the flash memory can be started directly from an external move .it can also be integrated with GPIO port sensors.

III Microcontroller (PIC16F876A)

The PIC15F876A CMOS FLASH-based 8-bit microcontroller packs PI C architecture into an 28-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. This PIC microcontroller belongs to the mid-range family with 14 bit wide data memory. The PIC16F876A features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 5 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART).

IV Sensors

a. ECG Sensor

This type of sensor helps in the acquisition of data as numerical values with high accuracy. It Shows Systolic, Diastolic and Pulse Readings and also the compact design fits over your wrist like watch. Each reading consist of 15 bytes at 9600 baud rate. The output reading is 8bit value in ASCII format fixed digits, from 000 to 255.

b. Temperature Sensor

The LM35 series are integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy.

V Traffic Module (CC2500)

A traffic control module is also included in the system so as to provide indications when the ambulance reach the vicinity of the traffic signal. The continuous blinking of the signal of this system is demonstrated using another Wi-Fi module

CC2500. ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used for wireless networking. ZigBee (CC2500) is a low cost true single chip 2.4 GHz transceiver designed for very low power wireless applications. The RF transceiver is integrated with a highly configurable baseband modem. ZigBee devices are required to conform to the IEEE 802.15.4-2003 Low-Rate Wireless Personal Area Network (LR-WPAN) standard. ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones.

RESULT AND DISCUSSION

The acquisition and transmission of vital health parameters from the emergency ambulance to the hospital system and provision of a negotiable path for ambulance at the traffic controllers are the main objective of the system. Systolic pressure, Diastolic pressure, Heart rate and Temperature are the parameters that can judge the health status of the patient. The ECG sensor act as a mainstream sensor module which acquires the Systolic pressure, Diastolic pressure and Heart rate as numerical values rather than the graphical values irrespective of noise and motion artifacts. It has also an LCD display for conveniently representing the numerical values from the sensor modules. ThingSpeak is an authorized free server which will provide the judging parameter of the patient by means of graphical representation. Hence the data's are in the form of graphs in the server. In the traffic module, when the ambulance reach the vicinity the traffic controller gives a continuous yellow LED blink to infer the presence of the ambulance. So the ambulance get an unobstructive path to travel and reach its destination in early.

CONCLUSION

The latency in the ambulance services may make the major cardiac arrest patient vulnerable to death. This system tends to resolve most of this issue. The signal acquisition and data transmission from a moving ambulance is extremely difficult. This proposed system tends to resolve and minimize the issue of occurrence of motion and sound artifacts to a maximum level. The new ECG system breaks the traditional medical care mode and make full use of this advancing IoT technology and rich resources in PIC16F876a.This system maintains it's flexibility by preserving all the data in a reliable IoT cloud. The data transferred through an IoT cloud is promised to be highly confidential and secured. The graphical representation obtained in the authorized web server that communicates with the IoT cloud is an accurate and precise result. In future, the proposed system can be modified to a portable device that can monitor the health and cardiac issues of a person around the world and transmit it to any part of the world.

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