Review on IoT-aware, smart Healthcare automatic monitoring system of patients and biomedical devices within hospitals

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ABSTRACT

Technology plays the vital role in healthcare not only for sensory devices but also in communication, recording and display device. It is very important to monitor various medical parameter and post operational days. Hence latest trend in Healthcare communication method using IOT is adapted. The IoT has a variety of application domains, including health care system. The IoT revolution is redesigning modern health care with promising technological, economic, and social prospects Among others, mainly radio frequency identification(RFID), wireless sensor network (WSN), and smart mobile technologies are leading this evolutionary trend. In the wake of this tendency, this paper proposes a survey on novel, IoT-aware, smart system for automatic monitoring and tracking of patients, personnel, and biomedical devices within hospitals and nursing institutes. Staying true to the IoT vision, a smart health care and management system (SHS), which relies on different, yet complementary, technologies, specifically RFID, WSN, and smart mobile, Internet of things serves as a catalyst for the healthcare and plays important role in wide range of healthcare applications.

Keywords— IOT, Internet Protocol, SHS, RFID, Microcontroller, Embedded system, ECG, ICU, Monitoring.

I. INTRODUCTION

Today Internet has become one of the important part of our daily life. It has changed how individuals live, work, play and learn. The Internet of Things (IoT) is an idea responding an associated set of anybody, anything, whenever, wherever, any administration, and any system. The IoT is a megatrend in cutting edge advances that can affect the entire business range and can be thought of as the interconnection of exceptionally indistinguishable shrewd items and gadgets inside the present web foundation with broadened benefits.

Imagining an existence where a few articles can detect, impart and share data over a Private Internet Protocol (IP) or Public Networks. The interconnected articles gather the information at standard interims, examine and used to start required activity, giving an insightful system to breaking down, arranging and basic leadership. IoT-based medicinal services administrations are relied upon to lessen costs, increment the personal satisfaction, and advance the client's understanding.

From the point of view of medicinal services suppliers, the IoT can possibly lessen gadget personal time through remote arrangement. As a platitude goes Health is riches it is outstandingly essential to make usage of the development for better prosperity. Thusly it is obliged to add to an IOT system which gives secure wellbeing mindfulness checking.

Exceptional human services systems driven by remote advancements are relied upon to help endless maladies, early analysis, continuous observing, and medicinal crises. Passages, therapeutic servers, and wellbeing databases assume crucial jobs in making wellbeing records and conveying on-request wellbeing administrations to approved partners. Research slants in IoT-based social insurance incorporate system structures and stages, new administrations and applications, interoperability, and security, among others. What's more, arrangements and rules have been produced for conveying the IoT innovation in the medicinal Field in numerous nations and associations over the world.

Improving the proficiency of human services frameworks and biomedical frameworks is a standout amongst the most testing objectives of cutting edge society. The whole idea of IOT remains on sensors, entryway and remote system which empower clients to impart and get to the application/data. Nevertheless, among every one of the districts no spot does the IOT offer more unmistakable assurance than in the field of wellbeing mindfulness.

II. LITERATURE SURVEY

A review of previous work carried out in the IoT(internet of things) and the methodology adopted to reduce their limitation is summarized as follows:

In the existing system of hospital, the patients are being monitored with the help of Arduino boards and GSM technology where in Arduino boards acts as a microcontroller but not as a server. Hence in order to overcome all these features Arduino Nano boards or renesas microcontrollers are being included with the NodeMCU which a latest version is and also acts both as a microcontroller as well as server. Main feature of this methodology is its cheap cost for installation and multiple advantages. Here one can access the patient data like heart beat and body temperature in laptop, cell phone or a computer.

Prabha Sundaravadivel [1] (2019 IEEE International Symposium on Smart Electronic Systems (iSES) (Formerly iNiS) *Most of the health monitoring applications for response plans are used to alert or notify the users in case of emergency situations. Response plans help in overcoming an emergency scenario in case of a disaster. On several occasions, the person of interest receives medical attention, once there is an on-set of the medical condition. With current smart healthcare facilities, where there are advantages of monitoring one's health on a daily basis, a person does not need to wait to be critically ill or meet with a disaster in order to receive necessary medical services. Leveraging the advantages of smart healthcare architectures in this research, we propose a smart rapid medical response plan, which monitors the physiological signs of people in a community and gives regular feedback or alerts the hospitals accordingly. The proposed framework provides feedback on different scales by ensuring the well-being of the individuals and alerting them to be cautious towards potential health issues. The routing of these sensor networks based on the emergency level is demonstrated using an opensource tool, CupCarbon. The proposed framework was simulated using the ZigBee radio standard and the overall simulation time for 40 nodes was 95 seconds.*

Ashvini Kamble [2],(2018 4th International Conference on Computing Communication and Automation (ICCCA)) ,*In their paper, the technical revolution in the field of Internet of Things makes all object interconnected. The concept of IoT has been used in so many sectors from Smart Home to Smart City. But the main contribution of IoT in healthcare is just remarkable. This paper proposes an idea of Health Monitoring System which monitors the physiological parameters of the patient which includes Temperature, heartbeat, ECG, with the use of these sensors which can be connected to Raspberry Pi Board that transmits the data to a local server. In case of any odd behavior or any critical signs and symptoms are recognized, the caretaker in addition to medical doctors are notified by right way through the message or E-mail. To design an efficient Remote Monitoring System, Security is of paramount importance. subsequently to provide security to the patient's data Shamir's Secret key Sharing Algorithm is used in which data and keys will get split, saved at different location and to retrieve them threshold cryptography is used. For Heart Disease diagnosis the prediction algorithm support vector machine(SVM) is used. Therefore the system presents quality healthcare to all.*

Rama Reddy Rajanna [3](2018, IEEE Third International Conference on Circuits, Control, Communication and Computing), *In this paper Heart rate variability (HRV) measurement is very much essential to determine the heart's health and it's functioning. The real-time HRV measurement helps physicians to assess the physiological state of a person or a patient. Several personal HRV monitoring devices have been developed and put to use in different ways. However, less has been explored, when it comes to leveraging the benefits of internet-of-things (IoT) and cloud technology for real-time HRV monitoring using wireless sensor networks. This work describes an implementation of an IoT cloud-based HRV monitoring application using a low-power embedded microcontroller interfaced to a Wi-Fi embedded network*

processor. An ECG analog frontend AD8232 was wired to a low-power microcontroller MSP430, and the micro-controller was interfaced to CC3100 Wi-Fi booster pack through a serial peripheral interface (SPI) for acquiring the wireless transmission capability. The microcontroller was programmed to acquire the data from the analog frontend by enabling the timer interrupt control. The ECG peak detection algorithm was implemented on the microcontroller to derive heart rate and inter-beat-interval (IBI) values. The real-time heart rate values were streamed to PubNub IoT web interface using TCP/IP stack on Wi-Fi booster. The data from PubNub channel was visualized using freeboard.io dashboard. The experimental results confirm the suitability of implemented wireless sensor node for real-time HRV monitoring and to implement multi-parameter healthcare monitoring IoT applications.

Saikat Mukherjee[4] (2019 INTERNATIONAL CONFERENCE ON VISION TOWARDS EMERGING TRENDS IN COMMUNICATION AND NETWORKING, *This paper represents a design and implementation of a Wireless Heart rate monitor system using ARDUINO Lilypad which is enabled with the feature of sending SOS messages or calls through GSM module. Upon monitoring if abnormal conditions arise, a call-ring (for 5 sec) or message (customized message) will be sent to a predefined mobile number depending upon how bad the situation is. There are two parts of the whole process, a transmitting circuit and a receiving circuit. The most important part (the transmitter section) for any medical assistance system is the part which will be associated with the patient .So it has to be easy to use and most importantly easy to carry. In this work ARDUINO Lilypad has been used as the main governing microcontroller board which makes the transmitting circuit wearable. The patient only needs to wear the transmitting circuit in his/her hand with the Pulse sensor attached to the finger. A RF module has been used to make the data transmission wireless and the programming has been done in ARDUINO IDE.Keywords— ARDUINO Lilypad, Pulse Sensor, RF Module, ARDUINO UNO, SIM900A GSM Module.*

Ashish Birajdar [5] (2019 Fifth International Conference on Science Technology Engineering and Mathematics (ICONSTEM)), *Measuring the Electrocardiogram (ECG) signal is an important method for the identification of Heart diseases.The ECG signal has the knowledge of the degree of how much heart perform its function. The existing devices cannot store the ECG information, which results in loss of ECG information. In this*

paper, using Internet-of-things (IoT) we propose a new methodology for ECG recording and monitoring. A wearable monitoring node gathers the ECG information and using Wi-Fi technology is transmitted directly to IoT cloud and is stored on SD Card for offline storage. The ECG wave is displayed through the local LCD and developed Web Interface/Mobile-Application. The ECG information can be conveniently acquired using smart devices with a web browser, which has diminished the cross plat form issue.

III. PROBLEM DEFINITION

In hospitals, where patient's status needs to be regularly monitored, is usually done by a doctor or other paramedical staff by constantly observing some important parameters, such as body temperature, and heartbeat, thus, this task becomes tedious after sometime. Hence it can cause problems. However, there are many researchers have attempted before to solve it in many different ways, but the earlier methods in several cases either SMS will be sent using GSM or RF module will be used to send patient's data from sender device to receiver device. Moreover, in the earlier cases the history of the patient cannot be displayed, only current data is displayed

IV. REQUIREMENT OF THE SYSTEM

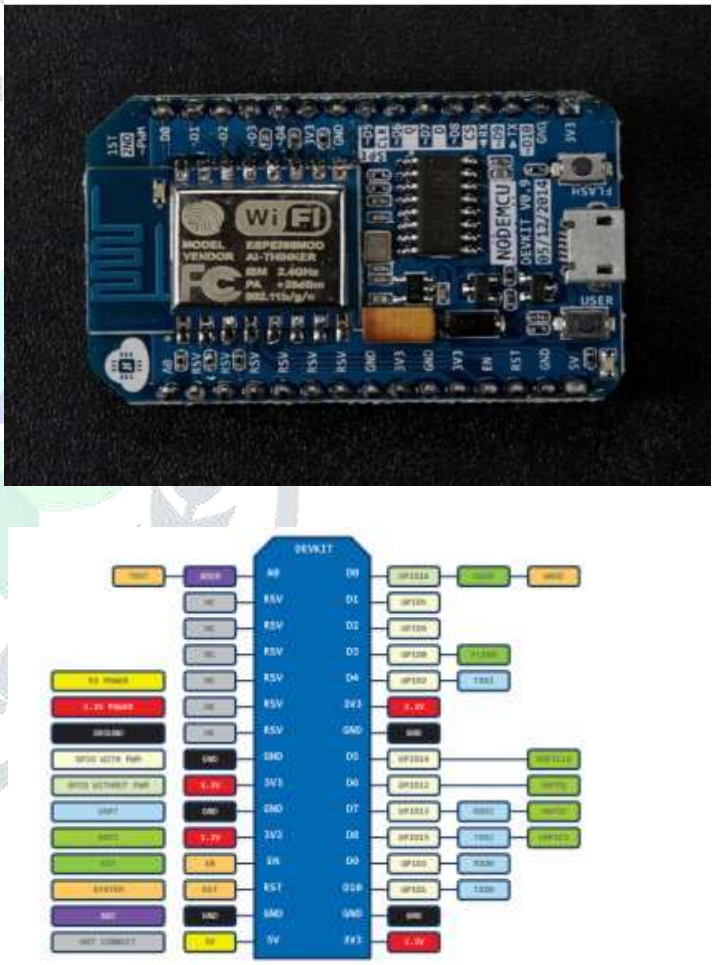
We require the following electronic components to make the proposed device as per the block diagram shown above the system consists of:-

- *NODE MCU*
- *Temperature Sensor (LM35)*
- *Heart Beat Sensor*
- *16x4 LCD*

- *TRANSFORMER*
- *CAPCITOR*
- *RESISTOR*

V. INTRODUCTION TO NODEMCU

- *NodeMCU is an open source LUA based firmware made for ESP8266 wifi chip. By researching value with ESP8266 chip, NodeMCU firmware goes with ESP8266 Development board/unit for instance NodeMCU Development board[39].*
- *The NodeMCU (Node MicroController Unit) is an open source programming and contraption development condition that is worked around a particularly moderate System-on-a-Chip (SoC) called the ESP8266. The ESP8266, formed and made by Espressif Systems, contains each central bit of the incited PC: CPU, RAM, coordinating (Wi-Fi), and even a forefront working structure and SDK. Unequivocally when gotten at mass, the ESP8266 chip costs just $2 USD a piece. That settles on it an uncommon choice for IoT exercises of various sorts.*
- *In any case, as a chip, the ESP8266 is in like manner hard to get to and use. You have to tie wires, with the best fundamental voltage, to its PINs for the most clear endeavors, for instance, controlling it on or sending a keystroke to the PC on the chip. In like manner, you have to program it in low-level machine concludes that can be deciphered by the chip gear. While this fragment of coordination isn't an issue when the ESP8266 is used as an exhibited controller contribute mass-passed on equipment, it is a massive weight for prodigies, programming fashioners, or understudies who need to look at changed avenues concerning it in their own exceptional IoT endeavors. Getting a page from the viable playbooks of Arduino or a Raspberry Pi, the NodeMCU undertaking intends to streamline ESP8266 improvement. It has two key parts. 1. An open source ESP8266 firmware that is based over the chip maker's particular SDK. The firmware gives a prompt programming condition subject to eLua (displayed Lua), which is an essential and exuberant scripting language with a set up originator plan. For new comers, the Lua scripting language is surely not hard to learn. 2. A DEVKIT board that wires the ESP8266 chip on a standard circuit board. The board has a worked in USB port that is starting at now wired up with the chip, gear reset get, Wi-Fi gathering contraption, LED lights, and standard-sized GPIO (General Purpose Input Output) pursues that can associate with a bread board. Figure 1.2 exhibits the DEVKIT board, and Figure 1.3 demonstrates the mapping of its pins.*
- ***THE NODEMCU DEVKIT BOARD***



The NodeMCU DEVKIT board.

VII. PROPOSED METHODOLOGY

The proposed system defeats by persistent observing of patients, helpful for different patients, database report upkeep and sign to concerned restorative authorities.

In this strategy we utilized the arrangement of methods accessible for the ICU patient's wellbeing observing framework with wired correspondence innovation. In the novel framework the patient wellbeing is ceaselessly observed and the obtained information is transmitted to an utilizing Wi-Fi remote systems. In future we can extend this framework by utilizing RFID innovation through this innovation we can screen the numerous quantities of patients.

The patients in the ICU room can be consistently observed by detecting the parameters like temperature, heart beat rate, gas level with wired The sign detected from the patients is millivolt however the sensors volt will be 5v sensors will have the speakers the detected sign is enhanced and it won't make hurt human wellbeing .at that point the sign are send to the Arduino .Using WI-FI module the outcomes will be ceaselessly transmit to web of thing and the information will be put away straightforwardly to the database and if any irregularity the sign will be send to restorative authorities. Wellbeing checking is a casual, non-statutory strategy for reviewing your workforce for indications of sick wellbeing, including lower back agony. This sort of word related wellbeing the board framework can empower you, as a business, to know about medical issues and mediate to anticipate issues being caused or aggravated by work exercises.

Temperature sensor is utilized to gauge temperature with an electrical yield corresponding to the temperature (in oC). Temperature Sensor module depends on the semiconductor LM35 temperature sensor. The LM35 Linear Temperature Sensor module can be utilized to identify surrounding air temperature. This sensor is created by National Semiconductor Corporation and offers a practical range between - 40 degree Celsius to 150 degree Celsius.

A heart beat rate screen is an individual observing gadget that enables one to quantify one's pulse continuously or record the pulse for later examination. It is to a great extent utilized by entertainers of different sorts of physical exercise. The ordinary testing grown-up human pulse ranges from 60–100 bpm.

PROPOSED METHODOLOGY FLOW CHART

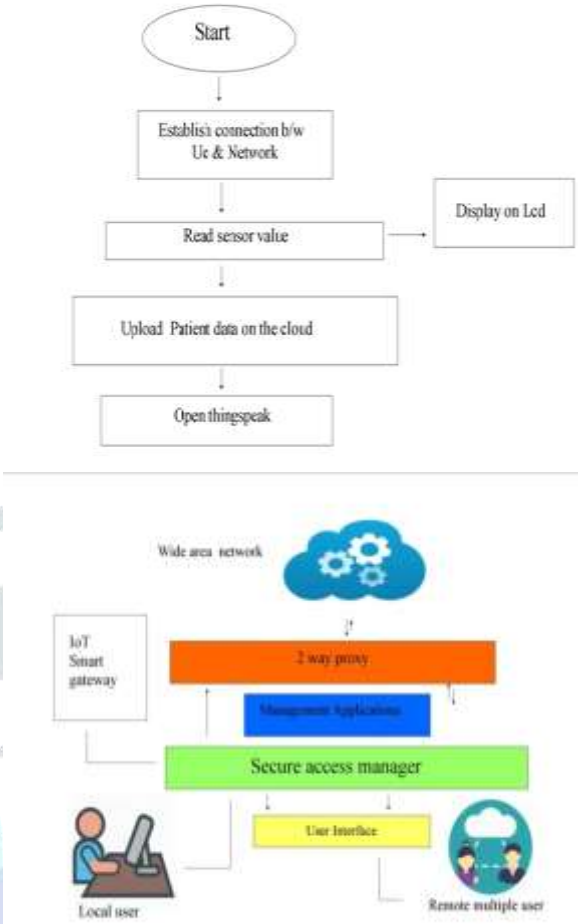


Figure 7.1: Flow chart of Proposed Methodology

Software Implementation: (SYSTEM SOFTWARE DESIGN)

This proposed system deals with the configuration of the software, program procedures and framework approaches used in programming the Arduino in our proposed system. The software program roles are receiving information and orders, performing distinctive orders, controlling operational stations and supporting information input/output gates. We have attempted to offer general thoughts on program stream and usage (see flow charts). We divided our design into various parts, contingent upon the useful connection between these parts, to be dealt with easily and when a section or a piece is not working appropriately, it can be detected and treated. The application created for this work (Arduino IDE 1.8.1) is responsible for the participation, communication and collaboration between the hardware and the portable PC or smart phone. It has been written in C language to follow the guidelines of coding for the project. WiFi MCU Node ESP8266-12E needs a software introduced inside Arduino IDE [26]. First we install the Arduino Software/IDE, then we open

the Arduino program IDE, then select (File), where one can find the (Preferences) Dialog. Choose (Preferences), a (Settings) list will be Computer Science & Information Technology (CS & IT) 63 opened, in "Additional Boards Manager URLs" add this line and click on "OK":" http://arduino.esp8266.com/stable/package_esp8266com_index.json "then go to (tools again), from the list choose (board), select (boards manager) at the top. Select "ESP8266" and install it [27]. To determine the type of the board, connect the Board to the PC, then select Device Manager in (my computer). One will see the serial ports in (other devices). Again, select (tools) and choose the COM number (=serial port). In the same list (i.e. tools), choose type of the board (e.g. Node MCU ESP8266-12E or Arduino Mega 2560) [28]. The technique used to outline this product is an upper to lower down organised programming plan. The ports must be defined and determined in the start of the program along with the installing of required libraries then entering the code then uploading, and after that saving the code by a name inside the Arduino`s memory. After the port locations and definitions, the program initially calls various libraries, e.g. Serial Peripheral Interface (SPI) Library, Ethernet Library, Temperature and Humidity Library and RFID Library. Our smart home system software involves programming the Arduino by C and C++ languages (utilising IDE accompanies the microcontroller itself), and Applications such as Arduino IDE 1.8.1 for windows10, ESP8266 WIFI control, Arduino WIFI control and Arduino Bluetooth control device for Android smartphones. The application program is a NET based application. Entering an IP in the URL of the browser connects the devices to the ESP. The application programs are mindful of setup and arrangement, and keep up the entire smart home system utilising a database to keep log of smart home system parts, we utilise XML files to spare system log. The Arduino programming is through utilising C and C++ languages. Utilising IDE accompanies the microcontroller itself. Arduino software collects information about events from associated sensors, then applies activity to devices and what is pre-programmed in the server. The communication inside the proposed system is through the following:

TP-Link Router that boosts wireless network throughout the home, broadcasting the WIFI that connects MCU Node, ESP8266-12E, ESP8266-01 to smartphone and PC. The Router is also connected to the Ethernet shield via a cable (RJ-45), connecting it to an Arduino.

3.2.1 Thingspeak

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics[40].

Internet of Things (IoT) describes an emerging trend where a large number of embedded devices (things) are connected to the Internet. These connected devices communicate with people and other things and often provide sensor data to cloud storage and cloud computing resources where the data is processed and analyzed to gain important insights. Cheap cloud computing power and increased device connectivity is enabling this trend.

IoT solutions are built for many vertical applications such as environmental monitoring and control, health monitoring, vehicle fleet monitoring, industrial monitoring and control, and home automation.

At a high level, many IoT systems can be described using the diagram below:

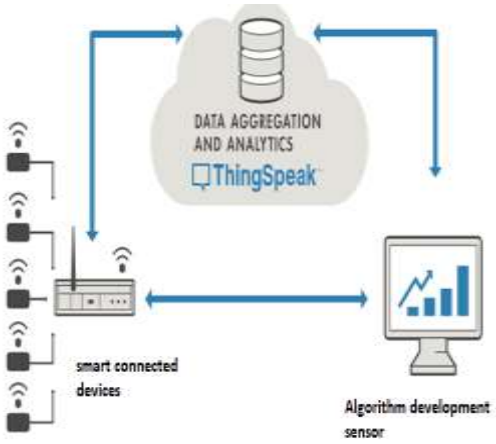


Figure 3.15: data upload in thingspeak(open IoT cloud platform).

On the left side, we have the smart devices (the "things" in IoT) that live at the edge of the network. These devices collect data and include things like wearable devices, wireless temperatures sensors, heart rate monitors, and hydraulic pressure sensors, and machines on the factory floor.

In the middle, we have the cloud where data from many sources is aggregated and analyzed in real time, often by an IoT analytics platform designed for this purpose.

The right side of the diagram depicts the algorithm development associated with the IoT application. Here an engineer or data scientist tries to gain insight into the collected data by performing historical analysis on the data. In this case, the data is pulled from the IoT platform into a desktop software environment to enable the engineer or scientist to prototype algorithms that may eventually execute in the cloud or on the smart device itself.

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