IoT based Health Monitoring System

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Abstract: IoT based health monitoring system demonstrate collection and interoperation of data, the data provided to the doctor can support the emergency medical service for a patient for the improvement of healthcare. The sensors and Raspberry Pi 3 Model B are the physical objects equipped for communicating with the doctor though internet. This proposal will help the doctor to control the overall state of monitored patients independently and easily monitor the patient information from anywhere in the world. The system comprises of web server part: The sensors gather the medical information of the patient that include patient's heart rate, blood pressure, and pulse rate and the physical examine of the patient is also monitored through the Pi camera, and this information is sent to the Internet through Raspberry Pi which acts as a server. The doctor and patient can monitor the patient data from any place of the world through the provided IP server address anytime. The emergency alert is sent to the patient if the sensor value is exceeded the threshold data. Thus, the quality of care with regular monitoring and reduce the cost of care and actively employ in data collection and analysis of the same is empowered and enhanced in IoT devices.

Keywords: IoT, Healthcare, Health Monitoring, Medical Services.

Introduction

The Internet of Things is a rising topic of social, economic and technical significance. Internet of Thing interact with sensors, controllers and transceivers for providing communication through the internet and becoming the constitutive part of the Internet, it is built with a suitable protocol which helps the interacting and communicating with each other and with the users respectively. This communication through internet helps to build several applications which are developed based on IoT in which every physical object like sensor devices are connected to the internet [1]. Healthcare plays a major role in the Internet of things which reduces the difficulty faced patients and doctors. The homecare is provided instead of the expensive clinical care and prevention is provided by the efficient healthcare service. This service will help every individual by following the basic healthcare, which leads to more advantageous results [2]. The importance of healthcare on IoT is increasing to support the quality of care, improve the access to care and finally to decrease the cost of care. IoT ensures the healthcare services by maintaining digital identity for each patient due to which many health problems have been getting undetected in conventional healthcare systems are reduced. The communication between the health sensors device with the computer or smartphone which has the default ability to communicate with the server which makes the whole system cost reduce and the complexity of the system is also reduced. Hence the system can also be made IoT enabled and Machine TO Machine compatible [3].Here the proposed paper show a reliable continuous monitoring by the doctor, solution of patients anywhere in the world based on a healthcare monitoring system can be checked. The patients carry a set of body sensors to collect their body parameters.
Rest of the paper is organized as follows. In Section II, Related Work is discussed. Section III proposed system. Section IV, implementation and results. Finally, Section V concludes the paper along with the further research and references.

Related Works

In [1] Ravi Kishore Kodali et.al proposed the healthcare monitoring which is implemented to check the temperature of the patient. The Zig Bee mesh protocol is used where the patient 24-hour care records is being monitored. In-hospital records are maintained in the cloud. IoT empowered devices at the same time enrich the quality of care with regular monitoring and actively engage in data collection and moderate the cost of care and analysis of the same.
In [2] Jasmeet Chhabra et.al proposes the plan and implementation for emergency medical services based on IoT health monitoring system. In this project the patient health related problems and healthcare cost is reduced. The collection, recording, analyzing and sharing data streams though the internet which reduce the patient problem of visiting the doctor every time to check the health parameter like heart beat rate, temperature and blood pressure.
In [3] Thirumalasetty Sivakanth et.al presents a reconfigurable sensor network for essential health checking. The possibility of patients collapse and the life-threatening consequences is reduced in content and real-time health monitoring system. The

complete information of patient is be mechanically obtained by the doctor by NFC technology. Biosensors interfaced with the microcontroller will screen patient's imperative health. If any of the sensor's preset threshold value is overdone above, a sensor's value will be sent to doctors and the patient's caretaker through message.

In [4] Y. T. Zhan et.al presents the implementation for the increasing elderly population and the wide prevalence of various chronic diseases led to the development of telehealth systems. It gives the comprehensive understanding of wearable technology for the remote healthcare system. The basic idea of this system is to implement a tele-home patient monitoring by making use of wearable devices, wireless communication, and multiple sensors.

In [5] A. Murray et.al presents the planning of modern medicine, effective and safe use of healthcare technology as essential for any healthcare system. Concerns about medical equipment care have been raised up. This paper discusses the efforts that have been made to progress the healthcare system. It also provides the lack of medical equipment safety measures and the protective steps that need to be taken care to improve the quality of healthcare.

In [6] Saed Tarapiah et.al presents the paper which grantees to improve the quality of health care services and reduce the total cost of health care, to avoid over-hospitalization and assurance that those who require emergency care to make it faster. It is a system that can measure heart rate and body temperature and communicate with them in case of accidental behavior to manage medical personnel using GSM, GPS and web technologies to achieve immediate action to save the patient's life.

In [7] Dr. K N Muralidhara and Bhoomika.B.K, presents the design for IoT smart healthcare system using the microcontrollers. In this, the pulse oximeter, the temperature sensor and the heart rate are designed for the patient and the microcontroller to send data through the wireless network protocol and the data also shows the patient displayed on the LCD screen who knows his health status. Under extreme conditions, the reminder of the doctor's warning message will be sent to the doctor's phone via the GSM modem connection and at the same time the buzzer will alert the guard. The experts can see the information that logs the log to the HTML site of the page using IP address and page recovery methods that are so persisted by the information collection. So the continuous patients check framework is composed.

In [8] D. Mahesh Kumar, presents health systems based on wireless sensor networks. The wide range of benefits of wireless technology for the medical staff, patients and the continuous monitoring of the community, early detection of abnormal situations and potential knowledge found in the past data inserted all the information collected. The system helps the health care staff to control the complete state of the patient in a separate, real-time and great way. Through the network can reach every node of the patient at any time as long as the network terminal is available. The patient sends a set of sensors to collect their body parameters. The medical staff evaluates the overall condition of each patient and checks the collected values of the nodes.

Luciano Tarricone et al [9], paper suggests, IoT-aware, architecture for tracking of patients, automatic checking, and biomedical devices within nursing institutes and hospitals. The IoT vision are kept true, a smart hospital system (SHS), depending on the specific RFID, WSN, technology, but complement each other, the smartphone, with each other. The SHS is able to collect, both physiological parameters of patients and environmental conditions through an ultra-low-power hybrid sensing network (HSN) poised of 6LoWPAN nodes integrating UHF RFID functionalities. The detected data will be sent to the Control Center's Advanced Monitoring Application (MA) so that they can access the local and remote users through the Web service.

Sampada Sathe and Alok Kulkarni [10], paper attempts to evaluate and understand the application of IoT in personalized care for the realization of excellence in health care costs within reasonable limits. Here it describes how IoT's functions and how to use it in the use of remote sensing technology and wireless technology to achieve health care requirements.

Proposed System

A health monitoring system consists of several sensors connected to a patient and they communicate the data through the processing unit. In the project, Raspberry Pi is used as a data aggregator as well as a processor. The patient and doctor smartphone/computer are used as a monitoring system.

As in figure 1, the sensors system is used to obtain the information or readings from the patient and the reading which is read are converted into signals. These signals are provided for processing to Raspberry Pi, which is the IoT module. The Pi then displays the information on a Monitor and also stores the information over the cloud. This information can be accessed by the doctor on his phone/computer and get the information. If any emergencies, the patient is sent an alert automatically through the mail for medical medication.

The flow diagram of the project is shown in figure 2, the sensors value are read and displayed on the monitor and stored in the cloud for future use. If blood pressure sensor output is above 120 an alert mail is sent to the patient automatically to consult the doctor.
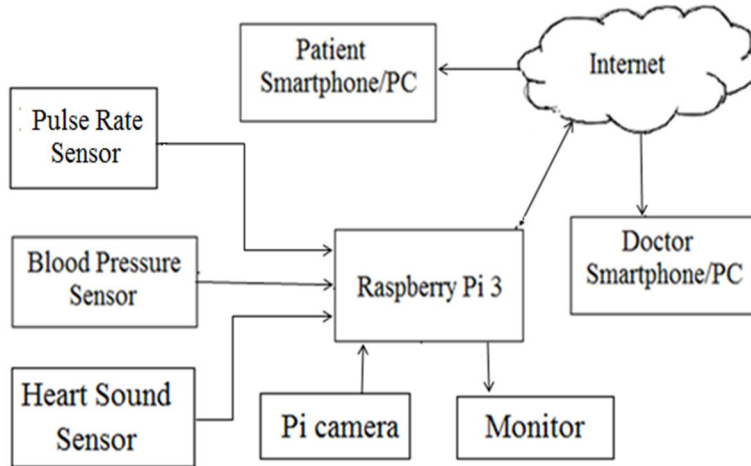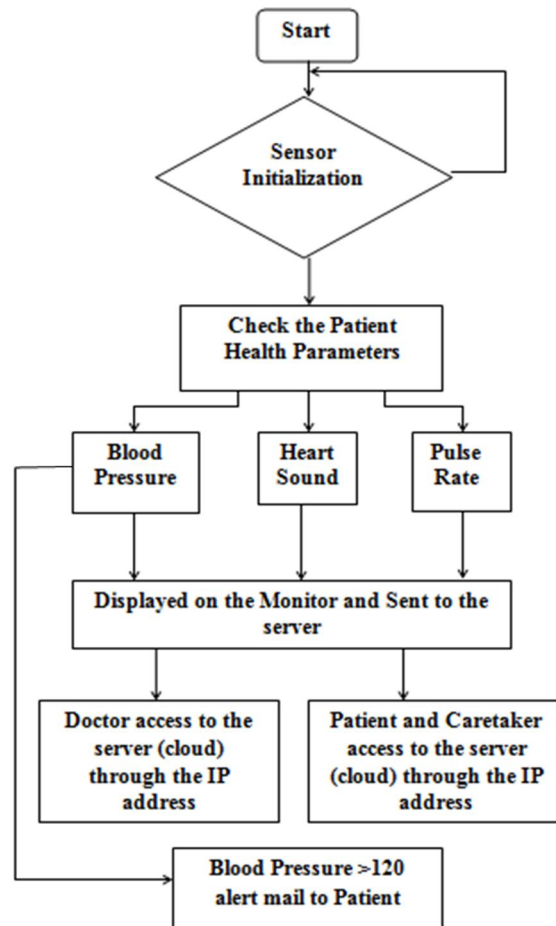
Fig 1: Block Diagram

Fig 2: Flow Diagram

Implementation and Result

The kit implementation for Health Monitoring System is shown in the figure 3.The Mouse and Keyboard connected to the USB port of Pi and the Monitor connected to the HDMI video port. The sensors connected to the GPIO pin through which the data from the Pi is transferred to the server and the patient can monitor the data on the monitor.
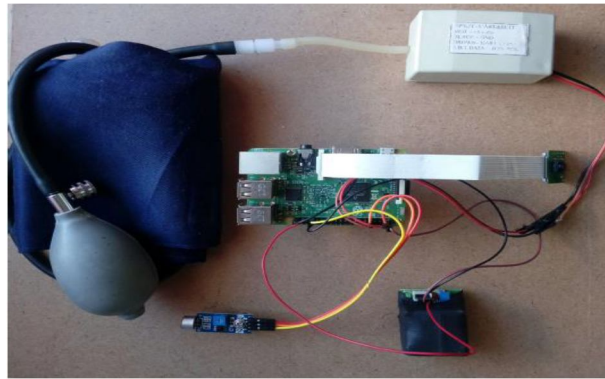
Fig 3: Kit Implementation for an IoT based Health Monitoring

Figure 4 shows the display of the health monitoring system on the patient's monitor. After the use of the pulse rate, blood pressure and heart sound sensor, the digital output from the sensor through the Pi is displayed on the Monitor.
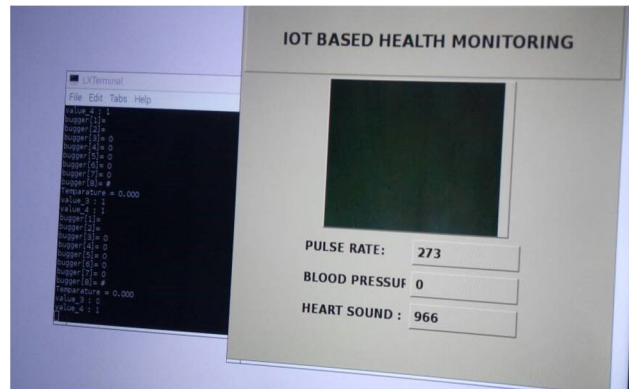

Fig 4: Display on Monitor after Execution

The Pi camera output is displayed on the server, the IP address of the server is same as the IP address of the raspberry pi. The camera output is shown in figure 5.
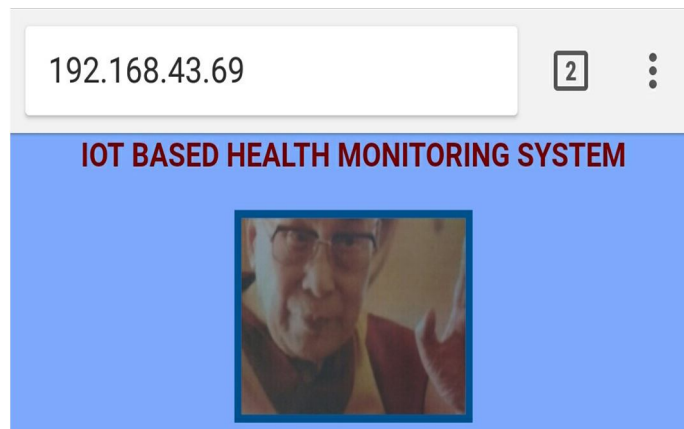

Fig 5: Pi Camera output

The Sensors output is displayed on the server, the IP address of the server is same as the IP address of the raspberry pi which is shown in figure 6. This is data base where the patient's health report is stored for future requirement by the doctor and the patient. If the patients' blood pressure >120 an alert mail is sent to the patient by the doctor for the medial medication.
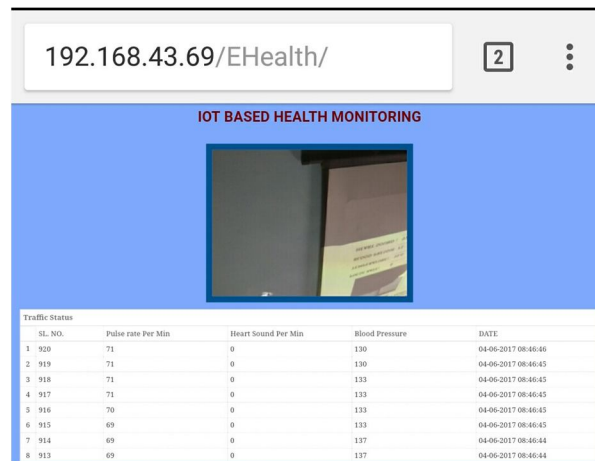
192.168.43.69/EHealth/

IOT BASED HEALTH MONITORING

Traffic Status

SL. NO.	Pulse rate Per Min	Heart Sound Per Min	Blood Pressure	DATE
1 920	71	0	130	04-06-2017 08:46:46
2 919	71	0	130	04-06-2017 08:46:45
3 918	71	0	133	04-06-2017 08:46:45
4 917	71	0	133	04-06-2017 08:46:45
5 916	70	0	133	04-06-2017 08:46:45
6 915	69	0	133	04-06-2017 08:46:45
7 914	69	0	137	04-06-2017 08:46:44
8 913	69	0	137	04-06-2017 08:46:44

Figure 6: Server output on Monitor

Conclusion

IoT is a combination of various technologies that enable different devices and objects to interact with each other and use different network technologies. The main idea of the proposed system is to provide better and more effective health care services to patients with networked Internet information such as cloud experts and doctors can use this data and provide a quick and effective solution. The final model will be equipped with a function where the doctor can check his patient anywhere, anytime. Emergency alert e-mail is sent to the patients if the threshold value is reached that to consult the doctor. This system is helpful for patients who are advised for the complete bed rest and the paralyzed patients, where the doctor can physical monitored the patient from the home with the help of the Pi camera which is used in the system. The goal of the proposed framework is to adopt a new production of medical systems that can provide health care services for high quality and low-cost patients using this combination of large data analysis, cloud computing, and computing technologies.

The enhancement for the designed system will connect more sensors and connect all the objects to the Internet for quick and easy access. The proposed model can also be deployed as a mobile application in order to become easy to access the model around the world. The mobile application can be enhanced with the ambulance services, doctor's list, nearby hospitals. The patients who are advised for the complete bed rest and the paralyzed patients can also be monitored and given precautions by the doctors by visual and audio by using the pi camera. The system is implemented for one-to-one access, which can be implemented for many by giving unique id for each member/patient in the home or the hospital.

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