MODERN IoT BASED TECHNIQUES FOR PATIENT HEALTH MONITORING

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Abstract: In recent years, the aging of the population has led to a change in the health field with special attention to the issue of health care sector, in which the patient health parameters can be monitored. Internet of things can make the medical equipment more efficient by permitting the continues observing of the patient. This paper reviews the current researches and development on this patient monitoring including ECG measurement, patient movement detection and other parameters. A variety of system implementation were compared and evaluated to identify the technical shortcoming in the patient monitoring system. The objective of this paper addresses the survey on IoT based patient monitoring system to provide a better healthcare to people in more economic and patient friendly manner. The quality data obtained from the application helps in improving diagnostic and treatment related decision making.

IndexTerms **- Health care, Sensors, FIR Filter, real-time data acquisition**.

I. INTRODUCTION

Over the last few years, with the significant advances in the internet of things (IoT) have started to develop new technological achievements that greatly impact society, science and especially medicine. The recent healthcare system should provide better healthcare reviews to people at any time anywhere in the world. Population is increasing day by day and the aging population has become one of the major issue. As a result, the need of long term care are increasing. The Internet of things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and network connectivity which enables these objects to connect and exchange data. IoT devices can be widely used to enable remote health monitoring and emergency notification systems. These health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fitbit electronic wristbands, or advanced hearing aids. Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well.

Researchers also have developed new medical functions of such technologies for systems of remote health monitoring[13]. Internet of Things (IoT) technologies like wireless sensor networks, radio frequency identification (RFID), Bluetooth, ZigBee can be used to facilitate better health care. Electronic consultations are possible through interactive services which provide real-time interactions between patient and provider. Videoconferencing has been used in a wide range of clinical disciplines and settings for various purposes including management, diagnosis, counselling and monitoring of patients. Specifically, by generating the most of this network of devices, healthcare professionals could use data to create a system of aggressive management [14].

II. RELATED WORK

There are various technologies that can be used in the field of healthcare monitoring. Wearable devices, WSN technology, RFID, Zigbee are different methods used here. In the medical field, sensors are used to measure healthcare parameters such as heartbeat, body pressure and temperature, ECG, motion, etc. thus enabling the design of innovative services able to substantially improve citizens healthcare. Related work includes various techniques and work done related to healthcare monitoring systems.

A. Health parameter monitoring

Luca Catarinucci et al.[1] proposes a system for automatic monitoring and tracking of patients for developing a smart environment. The smart hospital system is designed to gather real time data of patients using an ultra-low-power Hybrid Sensing Network (HSN) which is based on 6LoWPAN nodes integrating UHF RFID specifications. The developed smart hospital system believe that many 6LR nodes are arranged in the environment to gather data from the patients, including temperature, pressure, and ambient light conditions. A control centre is used to store the collected information. These information are switch on automatically to the database. The medical parameters are analysed using a monitoring application. The collected information are forwarded to a CE, both local and remote users are able to gather the data using a web application.

Jubi Rana et al [4] describes that, in the modern era, most of the healthcare managements developing new technologies for remotely monitoring the patients. In recent years an electronic medical record (EMR) system is used for storing the medical details of patients. Many insurance companies and healthcare organizations can make use of this data stored on the cloud. In this paper a wireless body-area network is used to recover and forward the patient health status in a non-interruptive fashion. By making use of a smart phone the healthcare system is incorporate with the wireless sensor network. This paper implements a technique called key search algorithm. Which helps to detect the appropriate medical professionals for different health abnormalities and ensures that the patient's abnormal health data is sent only to the appropriate medical professionals. This algorithm works only when the filter has a single abnormal input. A survey is carried out in the rural area for collecting the health status of patients where there is no improved technologies for health monitoring and no access to healthcare professionals. The communications between the wireless smart boards (ALIX boards) and the data store/database will also be encrypted. Access to the database of medical data should also be by only authorized medical personnel and the ALIX boards. Dissemination would occur at multiple entry points. This could be done by public IP access with internet connectivity. This can be equipped with the environment to giving the real time updates.

Sandesh Warbhe et al [6] presents a Wearable Healthcare monitoring system is very relevant and fundamental especially in remote areas. This system will implement a sensor interface with ultra-low power MSP430 microcontroller, physiological sensors such as Heart rate sensor, Temperature sensor, Humidity sensor, Acceleration sensor, Zigbee transceiver for wireless transmission integrated in jacket. The personal server have some memory where some results are arranged which it gives to the patient at the time of emergency it acts like a feedback. MSP430 is the ultra-low power microcontroller of Texas instruments designed especially for low power applications which has several low power modes which can be used to minimize the overall power consumption, instant wake up time about 1us which allows the MSP430 based system to remain in low power modes for longest interval of time extending battery life. The processing power needed by the system and the maximum allowed power consumption lead to a trade-off between systems requirements. Thus, this trade-off can be optimized and the needed performance can be achieved by a minimum power consumption. The heart rate sensor or PPG sensor consists of IR-diode and photodiode. Since the change in blood volume is synchronous with the heart rate. The variation in blood volume in tissues can be measure using a light source and a detector. This technique can be used to calculate the heart rate. The information is send directly to a wireless gateway that may be plugged into home server via Zigbee transceiver or it can be send to Smartphone via Bluetooth. The wireless gateway provides time synchronization services and forwards messages to a physician server and/or a medical server.

Ambika.S et al [7] proposes a system, describes a framework deal with SPOC. That is secure and privacy-preserving opportunistic computing. With SPOC, smart phone assets including computing power together with energy can be opportunistically gathered to process the computing-intensive personal health information (PHI) during m-Healthcare emergency with insignificant security revelation. An economical user-centric privacy management and conjointly a new privacy preserving real number computation (PPSPC) technique is introduced to makes a medical user (patient) to participate in opportunist computing in sending his PHI data. This schema confess a medical user to decide who can participate in the opportunistic computing to assist in processing his overwhelming PHI data. The attributed-based access control can help a medical user in emergency to identify other medical users.

Nidhi Mutha et al [8] proposes that, the system make use of many sensors used to capturing the patient's data including heart rate, respiration rate, temperature etc. A real time intelligent Content Management System (CMS), installed at particular hospital. And which is capable of taking important decisions on the basis of patient's medical status and information collected from patient side. This system is beneficial for specialists to monitor their patient remotely via mobile application. The system consist of two modules. The former is wearable device, which contain Arduino micro controller, sensors and Bluetooth module. The Arduino consists of ATMega128 microcontroller. The temperature sensor is LM35 temperature sensor. And pulse sensor is used to sense the pulse. The Android application is the second module. Two profiles are made for the doctor and the nurse and they are directed for the registration process. After successful registering, the nurse will click on connect button for communication between an Android application and Arduino .After connecting, the sensors that are mounted on device will start sensing the patients data such as temperature and pulse rate. This data will be stored on nurse Android phone. Then these collected data is forwarded to the central database. Central database stores the patient health record. A threshold value is already set for the health parameters. If the sensed health parameter is higher than the threshold value, an immediate message is send to the doctor and necessary action is taken for the situation.

Swapnila Shinde et al [9] proposes a telemedicine related healthcare system. Telemedicine is two-way, real-time interactive communication between a patient and healthcare provider at a distant site, supported by audio and video equipment and integrated medical devices. Advances in IT infrastructure, communication and connected medical devices are enabling clinicians to evaluate, diagnose and treat patients remotely. As the healthcare industry is being driven towards value based care, the use of telehealth technologies results in many positive outcomes including: fewer hospital re-admissions, more faithful following of prescribed courses of treatment, and faster recovery than that of patients not receiving remote intervention. There are two modes in this system. Former is patient data and later is store-end-forward mode. Patient mode are given at the remote terminal immediately after acquisition, and the later includes forwarding data to the health care centre. The collected data is send to the hospital by using a GSM module. In this system the hospital is act as the server side and the remote area is the client side. If there is no network availability in the remote area, then a GSM module can be used. So by this telemedicine system, people can take health test from their area and send the data to the hospitals. They need nod go for the hospitals. At the server side the data is automatically monitored. Specialized heart rate monitoring sensors are used to measure the ECG. Temperature sensor is used for collecting temperature reading. The measured data can be forwarded to the control centre for further observations.

Soumya S. Kengana et al [10] proposed a system which encounters the patients' health status to avoid the dangerous condition. The Zigbee protocol is used to send the sensed information to the central storage. The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi. And here a personal area networks is created with small, low-power digital radios for medical device data collection. The collected data through Zigbee is automatically updated to the dB and which can be seen on the web application. This system include less amount of hardware and software. The basic hardware requirements are sensors, power supply, LPC2148 microcontroller, LCD, buzzer, Zigbee modules and software as follows Keil IDE, Flash Magic, Visual Studio IDE, Eclipse IDE. Temperature sensor, ECG sensor and heartbeat sensor are interfaced with the microcontroller. The output of this sensors are analog signals which are converted to digital signals using an ADC. Any serious change is occurred, a message will be send to the care givers and immediate decisions will be taken according to the information.

Thirumalasetty Sivakanth et al. [11] came with a different system for continues health monitoring. This health monitoring system contains many sensors connected to an individual. Here they propose two units, namely aggregator and processing units. The sensors communicate with these units. A specialized device or PC can be used as a data aggregator or processing unit. The aggregator unit collect each sensor data from the body. In the design part they utilized an ARM7LPC2148 microcontroller, which act as an aggregation. And the Hospital computer can be used as a processing unit for our system. A wired USB connection can be used for the communication between the aggregator and processing unit. The processing unit has the responsibility to process the data collected from the aggregator. For monitoring the ECG, graphs can be drawn using this data and it is also possible to produce different services to the users based on this data. This health monitoring model can obtain important medical opinion from the doctors and care givers for the patients. Alarms or reminders can be used in case of any emergency.

M. Ryan Fajar Nurdin et al [12] introduces one application of IOT as media data transmission for the electrocardiogram (ECG) signal. The proposed model includes ECG sensor module, data transmission module. Which are based on Zigbee communication protocol and a server for data storage and application. The ECG signals are retrieved by the ECG hardware module. The ECG hardware contains disposable electrodes, which can be fix to the human body. Then the ion current in the body is converted to electron current. Each user is associated with an ECG device after measuring the signals. The entire ECG signals are gathered on a server and then are delivered to the network. The data can be accessed from the web page. Authorized person such as doctors, nurse, and care givers can retrieve this information and provide necessary advice for the patients. Doctors can monitor ECG graph of all patient.

B. Video monitoring

Andreas P. Plageras et al. [2] proposes a healthcare system which make use of sensors, actuators, camera etc. This system is helpful for the people who have problem with movement, chronic diseases and especially for elderly people. In this system video monitoring is also possible. By utilizing this technique, the coma patients, people who are in dangerous situation can be continuously monitored. In the home environment there is a home 6LoWPAN mesh network which consists of sensors, actuators, cameras, an edge router and a local server, the gateway which contains router and a local dB and the remote environment or cloud platform as its called which consists of a remote cloud server and a cloud database where data and video are stored and analysed. The real time data is stored in a cloud. In the developed model data and video transferring is possible because all the nodes are connected each other. The error detection and correction is done in the data link layer. The data link layer is separated into two, MAC layer and the adaptation layer of 6LoWPAN. The MAC layer in this system is the IEEE 802. 15. 4 standard. This standard provides access to the media but does not determine the routing performance. The adaptation layer is where the adjustment from IPv6 to IEEE 802. 15. 4 is done. The routing of the video and data are done in the network layer.

Abhishek Bansal et al [3] introduces an approach for patient movement monitoring system. This system is mainly helpful for those patients they are taking medical treatment in both local and foreign hospitals. And this system is based on frames comparison approach. Using this approach a very small changes caused by movement in real time can be monitored. These changes made by the patients may be normal or abnormal movements in the absence of nurse or doctor. In this approach an HD camera is attached with system. The attached camera will automatically take frames. Then compare the new frame with the previous frame during the whole monitoring. If there is any change occur in the patient then the graph will draw for the changed movement. Using this study, it will be easy to monitor a critical patient such as coma or dialysis patients or the patients who were on bed for a long time. Detecting this small changes due to movement can improve their treatment.

Alberto Fernandez et al [5] presents a system, which is based on a non-contact health monitoring system embedded in a mirror-like device and a non-invasive and automatic activity monitoring system embedded in a watch like device. There are three distinct face detectors are used and which are based on the viola and jones algorithm. The face normalization algorithm compromises the pose, rotation, scale of the selected part of the face. Using this mirror-like device the patient's vital signs can be distillate from the face. Using a watch like device the patient's physical activity can also be monitored. Patient's movements can be usually detected using the accelerometer. The physiological monitoring subsystem collects physiological data (HR, RR and HRV) using computer vision techniques through a mirror-like device. After gathering all the details, which are forwarded to the integration subsystem. By using this data alarms and instructions can be given to the patients and caretakers. A web page is used to display all the collected data.

TABLE 1: Comparison Table

Author	Topic name	Advantages	Disadvantages
Abhishek Bansal, et al.[3],2014	Monitoring and Movement Detection of Patient Using Consecutive Frame Comparison Method	Identify the various changes made by the patient body. Helpful for critical patients like coma and dialysis patients.	Monitor only a part of the patients body.
Swapnila Shinde et al.[9], 2016	A Survey on Telemedicine Application in an Embedded System	Provide better performance and accuracy.	Higher cost.
Ms. Soumya S , et al.[10] 2016	Real time wireless patient monitoring system based on IoT	Reduced communication costs and minimized service delay	Complicated case where users have random medical request and diverse privacy preservation requirements
Thirumalshetty Sivakanth, et al[11],2016	Design of IoT based smart health monitoring and alert system	The systems provide low complexity, highly portable for health care monitoring of patient	Big database is required for storing data of multiple Patients.
Mr. Sandesh Warbhe, et al.[6],2015	Wearable Healthcare Monitoring System	Potential to treat a medical problem at the location it was measured.	Increased challenges in designing and fabricating wireless medical device.
Jubi Rana , Et al.[4],2015	HealthCare Monitoring and Alerting System Using Cloud Computing	Emergency alert SMS send only to the authorized person	No accurate measurements of environmental parameters
Ambika.S , Et al.[7] , 2015	Secure and Privacy Approach in Mobile Healthcare	Continuously take patients health parameters in each 5 minutes	Monitoring the emergency, no any indications and internal attacker provided.
Nidhi Mutha,et al.[8]2015	Patients vital signs monitoring via android application	Provide security and safety	Time delay occurred between reading signs and uploading to the server.

III. CONCLUSION

There are many distinctive approaches discussed in several papers. Each of these papers bring improved accuracy and mention different technologies used in the healthcare system. Wearable sensors, RFID, Zigbee, wireless sensor network are different technologies to monitor the patient's healthcare. Here we discussed different research and advancement of sensor and video based systems for health monitoring system. The above discussed approaches make use of different healthcare methods that are widely used in recent years. Which make an easy way to detect and analyse patient health condition especially helpful for the chronic patients. It enable early detection of different health conditions and also provide easy disease prevention methods.

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