

A Survey on Remote Patient Monitoring System

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Abstract: In recent years, waiting time in hospitals, emergency admissions, etc extremely costlier. It also increases the work load of doctors and medical professionals. Managing the quality, cost of the treatment and caring for elderly patients are important issue in healthcare. These issues have a demand for remote patient health monitoring system. Here the human body parameters are monitored by different ways through wearable medical devices, biosensor and smart textiles. Then the collected data transferred to the remote server through internet. Security, accuracy, wearable sensors, outdoor monitoring and ease of use are some of the aspects in remote patient health monitoring system. This paper reviews the current development and research on remote patient health monitoring system. A variety of system implementation were evaluated and compared to identify the technical shortcomings in the present health monitoring system. The aim of this survey is to provide the direction of future improvements.

Keywords: Remote patient health monitoring system, biosensors, wearable medical devices, smart textile and outdoor devices.

I. INTRODUCTION

The remote patient health monitoring system is an effective and useful research area in recent years. Constant monitoring of health and vital parameters of patients is essential to provide adequate healthcare. As vital parameters and health of patient can fluctuate over time, there should be mechanism to constantly report them to the doctors, nurses or care taker so that immediate care should be given to the patient if required. The effective remote patient monitoring system should also support security and privacy concern that is because patient's health record has sensitive data and they should be securely stored and transmitted to the remote server. Outdoor monitoring is also important aspect of patient monitoring. That is when the patient moves away from the home environment, it should not affect the monitoring process. Current trends in telemedicine, Tele-care, e-health and e medicine are aimed towards enhancing the present healthcare system to continuously monitor the health of the patient through almost real time updates of their medical records.

The paper proposes an approach where status of various physiological health parameters such as heart rate, humidity, temperature, body movement is continuously monitored and sends to the personal home server via Zigbee or Bluetooth transceiver.

II. LITERATURE SURVEY

A. Patient Health Monitoring Using Bluetooth Enabled Device

Bluetooth enabled device also used for remote patient health monitoring. A Bluetooth enable patient health monitoring system was proposed in [1] to detect Alzheimer disease. Patient carries the Bluetooth enabled monitoring device and access point is placed in each room. All are connected to local database of patient monitoring system. The monitoring device selects any one of the access point with strongest signal strength when patient moves from one room to another. The local data base will store be stored once the location and movement of patient are traced. The collected location information is forwarded to the decision engine which is placed in the hospital.

This decision engine has movement recognition software. So the medical practitioner can perform remote diagnosis to determine whether the patient has Alzheimer disease or not.

B. Patient Health Monitoring Using WSN

Wireless Sensor Network (WSN) is also used for patient health monitoring system the distributed telemonitoring system was proposed in [3]. It uses services layers over light physical devices (SYLPH) model. It service oriented architecture model. The objective of this model was that resources to be distributed among multiple WSN. We can execute this model over different wireless devices independently. Various networks from different wireless

technologies can also be connected using this model.

C. Patient Health Monitoring With the Help of Mobile Phones

Mobile phones plays important role in patient monitoring to transmit, receive and process patients details. HealthNet mobile monitoring was proposed in [2]. BSN (Body Sensor Network) embedded in cloths and collect body parameter. Then it communicates with patient’s mobile phone. Patient’s shirts were embedded with sensors and central hub. The vital Signals were collected by sensors and transmitted to central node. Central node then communicates with mobile phone through Bluetooth link.

III. OUTDOOR MONITORING AND ENABLING SECURITY IN WSN FOR PATIENT HEALTH MONITORING

A. Patient Health Monitoring Using Body Sensors

Body sensors are used in patient health monitoring for acquiring body parameters continuously. The biosensors acquire the physiological signals and transmit them to the central node. Wearable sensors based on health monitoring system was reviewed in [4]. vital signs are converted from analog to digital before sending to the central node. Analog to digital converter have filtering circuits and amplifiers. Central node and biosensors are connected by any one of the wireless transmission like Zigbee, Bluetooth.

The central node consists of wireless transmission module, logical signal database, communication and control signal module, CPU. Communication and control signal module receive the amplified signal .signals are processed by the CPU and given to the wireless transmission node. This wireless transmission module transmit the signals to medical centre for analysing and give alarm in case of emergency.

B. Patient Health Monitoring Using Smart Phones

The security architecture of health net [2] is based on sensor network based on cloths. It collects all the vital parameters of the patient and transmits to the mobile phone which is carried by the patient. Patient’s mobile phone will securely receive, store and forward the data to the trusted medical professionals. All processes are done using smart phones. The unwanted data sequence is filtered and only necessary data is transferred to handheld devise using data mining technique. Doctor to patient communication done with WLAN 802.11 or Bluetooth. Emergency calls are generated in case of emergency condition.

C. Patient Health Monitoring With Security

Various privacy and security mechanisms were used in patient health monitoring. In [2] the vital parameters were transmitted, received and stored by smart phones. AES 128 encryption is used between sensors to the central node and patient’s phone. The encryption secured data is achieved by AES-128 encryption. For secured data communication AES-128 encryption and message authentication code were used. Some of the existing system was reviewed to know the different methodologies used and issues identified by those systems. They are summarized in Table I

IV. DISCUSSION AND EVALUATION

TABLE I: SUMMARY OF EXISTING SYSTEM

Paper Title	Methodology Used and Advantages	Issues
Secure and Cost- effective Remote Monitoring Health- Guard System[5]	The front end of the app interact with zephyrs HxM BT and other Bluetooth sensors to record patients heart rate, BP, temperature. The app is designed mainly to eliminate the need to type in the medicine information term by term by the patient and provides the Automated notification services.	Real time monitoring will not be seen.

Performance Analysis of Zigbee based Wireless sensor Network for Remote Patient Monitoring[6]	Simulations are carried out using ns2.34. Performance is analysed in comparison with various physiological signals used for patient health monitoring. Provide direction to choose appropriate node density, data transmission rate and communication duration for required performance.	It is observed that PDR and through put get drastically affected with increase in node density and data transmission rate, when compared to average network delay.
Wireless Remote Patient Monitoring System: Effects of Interference[7]	When dash7 or Zigbee integrated with a mobile phone accompanied by the patient can overcome range limitation problem. We have demonstrated that ZigBee is highly susceptible to signal interference from Wi-Fi and Bluetooth and that Dash7 does not suffer from this problem.	The nature of this technology the network communicates wirelessly without notifying any parties that they or their equipment is being monitored and tracked.
Design Of Low Cost, Wearable Remote Health Monitoring And Alert System For Elderly Heart Patient[8]	Robust sensors capable of sensing and monitoring these symptoms with microcontroller to alert during emergencies. It is a portable and economic system which was aimed at the elderly population who are mostly pensioner and dependent on other sources.	It is difficult to create ideal system which is 100% efficient when it concerned with the measurement of body parameters.
An IoT Based Remote HRV Monitoring System For Hypersensitive Patients [9]	HRV parameters are derived using wireless ZigBee pulse sensor using MQTT protocol. Application server collects HRV data and plot graphs. This system solved the issue occurred in power consumption, security in wireless networks. This system is more reliable, low cost, and easy to use for hypersensitive patients.	There is no HRV analysis system for hypersensitive patients available to help doctors track the progression of patient's condition.
Designing Low-Cost Adaptable And Personalized Remote Patient Monitoring System[10]	The user interface with the RMS through an application installed on a mobile device using return of investment (ROI) cost benefit analysis. Interaction between doctors and patients can be facilitated at lower cost.	There is high initial one time purchase cost and subsequent maintenance cost as well as the cost for training hospital staff.
A Wireless Health Monitoring System Using Mobile Phone Accessories. [11]	Using smart case we are measuring real time ECG and heart rate monitoring. Collected data on ECG are stored and analysed in real time through application. System is light weight, cost effective and user friendly.	Quality of ECS is significantly affected by the pressure of the fingertip.
Design On Mobile Health Service System Based On Android Platform[12]	Android mobile data collection terminals and server connect with Wi-Fi network and data services through implementation based on HTTP web server. The is a high flexibility and scalability.	In order to make accurate diagnosis system needs to be expanded further.
Real Time Patient Monitoring System Based On Internet Of Things.[13]	the system is more intelligent that can able to detect the critical conditions of patient by processing sensor data Doctors or nurses are allowed to monitor the patient ICU unit in real time which improves efficiency and service quality.	Other sensors like humidity and ECG are not tested since there is not enough medical device support

To evaluate the existing system some of the features are considered.

Table II: Evaluating features

Wearability	The size and weight of the system should be low
Accuracy	The system should provide accurate results
Security	Secure transmission of patient's should be supported
Outdoor Monitoring	It should not disturb the monitoring when patient moves out of home environment
Ease Of Use	The system should be user friendly and easy to use.

V. CONCLUSION

Remote patient health monitoring with body sensors network is an effective solution for patient health monitoring. It reduces the health cost and waiting for long time to get treated in hospitals .multiple patients can be monitored at time. Body parameters are collected continuously and forwarded to the hospitals. So it reduces the chance of false treatment and quality of treatment improved.

The remote patient health monitoring can be effective. For outdoor monitoring includes security scheme.

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