A Novel technique for patient health monitoring system

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ABSTRACT

Among the creating advancements in medical field remote checking is the one that applies both data processing and communication advances to observe the patient which can ready to screen continuously and sending the gathered live information to the doctor's facility incorporated database server. This setup permits the individual wholeheartedly in their step by step presence without taking excursions to the specialist and also checking their wellbeing endlessly. Remote health monitoring system presents advantage both to the Health Care Professionals (HCP) additionally to the patients. As an aftereffect of this remote checking structure, HCP can observe the patient's physiological condition in the remote range at whatever point. Right when the framework is tweaked to a particular patient then the system itself actually screen for atypical and fundamental physiological condition without the relationship of the HCP. This framework is really helping them in not contributing much vitality with each of the patients for monitoring. Patients can be benefitted through this system by method for abiding and recuperating at their home instead of staying in the clinic surroundings likewise they can swear off passing by focus routinely. Patient's end time can be thwarted by lighting up and giving the restorative administrations in the opportune time to the patient who is in need.

KEY WORDS: Patient monitoring, Health care Professionals, Remote Monitoring.

1. INTRODUCTION

Remote health monitoring system are by and large in view of utilizing wearable sensor gadgets for gathering information from patients dwelling outside doctor's facility and exchanging the deliberate parameters to a focal stockpiling with the assistance of developing data processing and systems administration technologies. Mobile monitoring systems have advanced recently with the advent of Short Message Service (SMS) provided by mobile communication service providers. Monitoring devices can be interconnected to PCs and with the help of GSM gateway devices, messages can be sent to programme mobile numbers if there is an abnormal activity recorded by the monitoring device.

Various methodologies have been proposed in the literature as of late to take care of the issue for the patients from living in the healing facilities. In each method, researchers have been proposed and demonstrated propelled remote health checking framework for better patient observing. The literature reliably demonstrates this was difficult to accomplish and just a few authors succeeded in completely actualizing the monitoring system. The authors concentrated to the point of interest in different techniques, but this work was mostly theoretical and accompanied by experimental results. Bor-Rong Chen, 2011, proposed, a stage to empower home checking of patients with Parkinson's disease (PD) utilizing wearable sensors. Reza S. Dilmaghani, 2011, presented the outline of a novel remote sensor system structure to screen patients with perpetual infections in their own particular homes through a remote observing arrangement of physiological signals. Ahmed N Abdullal, 2011, proposed an enhanced multipatient monitoring system. Chengcheng Ding, 2009, proposed a human health remote observing framework taking into account Zigbee remote communication .These frameworks sets up a remote restorative consideration system environment at home or doctor's facility, the system gathers the data through the Communication interface HCI interface encourages the patient's health additionally to destitution stricken zones of the debilitated can get the vital therapeutic services B Priya, 2009, developed a model of a remote health checking framework equipped for sending SMS identified with the status of the patient. Since just a model was planned in this work, sensor exactness and other information securing components were traded off by picking or reenacting the accessible sensor as opposed to utilizing biomedical sensors because of expense and accessibility factors. Ying Zhang, 2009, built up a Bluetooth-based remote sensor system for constantly checking the physiological signs of a patient. This new innovation has potential for offering an extensive variety of advantages to patients, medical workforce, and society through the nonstop observing element, early identification of variations from the norm with high dependability and security, and potential learning revelation through data mining of all gathered therapeutic data. Arun Kumar and Fazlur Rahman, 2006, has created and executed a remote health recording and ready framework for use by the elderly, athletes in training and fire fighters. The system has preference when contrasted with the smart shirt or vest based remote health recording system, since it is simpler to wear it on the arm and will be less restraining and uncomfortable in hot climate environment. Urs Anliker, 2004 explains an advanced care and compact telemedical screen (AMON), a wearable restorative observing and ready system focusing on high-hazard heart/respiratory patients. The framework incorporates constant accumulation and assessment of multiple vital signs, Intelligent Multiparameter therapeutic crisis identification, and a cellular connection to a medical center. Jovanov E, 2001, proposed a patient monitoring

system with intelligent sensor network. Brengelmann GL, 2000 describes the necessaties of various kinds of diseases to be monitored.

In all the above literary works the diverse systems for home patient observing was concentrated on and numerous remote sensor strategy has been finished. The literature survey additionally gives thought regarding the execution of remote sensor systems. Among these procedures Bluetooth based remote sensor system is presented in this work. This strategy has numerous points of great accuracy with different methods.

The objective of the work attempted is to build up a prototype model of the remote wireless healthcare monitoring system and stretch out it to actualize a complete health monitoring system with sensors for measuring parameters like body temperature, heart rate and pressure with minimal effort utilizing routine gadgets and keep up great accuracy. The storage of patient records, including programme handling and examination can be done. In the local computer after processing and analysis, decisions are made by sending an SMS to a specific doctor if readings go above a certain limit.
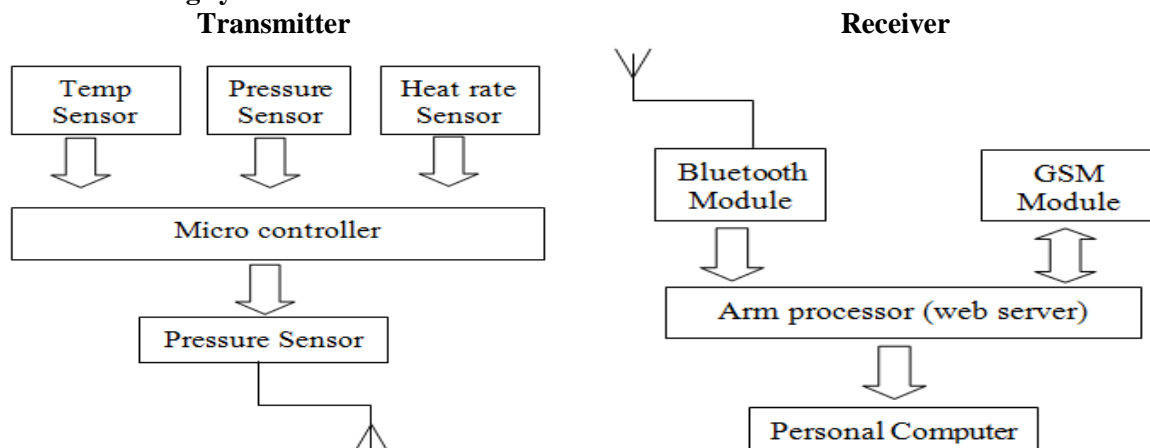
Patient monitoring system:

Figure.1. Block diagram of patient monitoring system

Figure 1 demonstrates the flow diagram of patient observing system. The measured data has been transmitted through serial port communication by means of RS232 from the remote patient versatile unit to the remote access point unit for the data of patient records, including automatic processing and investigation. In the computer after processing and analysis, decisions are made by sending an SMS to a specific doctor if the readings go beyond a certain set value. This system mostly comprises of two units; remote patient compact unit and remote access point unit. The remote patient convenient unit will be with the patient so that the patient medicinal information will be caught utilizing the sensors connected to it. The subtle elements will be shown in the LCD show so that the patient will likewise have the capacity to know their data. The information will be handled by the PIC microcontroller and will be further sent to the Bluetooth module so that the information can be sent to the remote access point unit Segura-Juarez, 2004. This unit will be put inside a base Bluetooth run so that the information will be caught subsequently. The information can be gotten to by the specialist from wherever utilizing an IP address. Moreover, the set limit esteem for every patient so that when the information goes above or beneath the set esteem a SMS will be sent to the specialist's telephone so that a caution can be given

Wireless patient portable unit: Figure.2 shows the hardware unit of wireless patient portable unit. It consists of temperature sensor, heart rate sensor, pic microcontroller and Bluetooth module and LCD display. The Bluetooth module is used to transfer the data that are being captured by the sensors.

Figure.2. Wireless patient portable unit

Figure.3. Heart beat sensor

Temperature sensor: The LM35 arrangement is an integrated-circuit temperature sensor, whose output voltage is calibrated to a Celsius (Centigrade) temperature. The LM35 along these lines has a favorable position over direct temperature sensors adjusted in ° Kelvin, as the client is not required to subtract an extensive, consistent voltage from its output to acquire advantageous Centigrade scaling which has been considered by Silventoinen (1996). As it draws just 60 µA from its supply, it has a low self - warming, under 0.1°C in the as yet air (Ying Zhang, 2009). The

LM35 is appraised to work over a −55° to +150°C temperature range, while the LM35C is evaluated for a −40° to +110°C territory (−10° with enhanced exactness). The LM35 arrangement is accessible bundled in hermetic TO-46 transistor bundles, while the LM35C, LM35CA, and LM35D are additionally accessible in the plastic TO-92 transistor bundle. The LM35D is likewise accessible in an 8-lead surface mount little diagram bundle and a plastic TO-220 bundle.

Heart beat sensor: Heart beat sensor is intended to give a binary output of heart beat when a finger is set on it. At the point when the heart beat sensor is working, the beat LED flashes as one with every heartbeat. This digital output can be associated with microcontroller specifically to measure the Beats Per Minute (BPM) rate proposed by Alexandros P, 2010 and B.Priya, 2009. It deals with the rule of light regulation by blood course through finger at each pulse.Figure 2.3 demonstrates the heart beat sensor.

Table.1. Specification of heartbeat sensor

Parameter	Value
Operating Voltage	+5V DC regulated
Operating Current	100 mA
Output Data Level	5V TTL level
Heart Beat detection	Indicated by LED and Output High Pulse
Light source	660nm Super Red LED

Microcontroller: The PIC18F452 microcontroller has 16K of code space, 10-bit A/D converters, 34 I/O pins and many other features in a 40-pin DIP package.

Bluetooth module: WCS-232 believers RS232 signal to remote Bluetooth signal. In the event that both ends of the communication use WCS-232, remote 1:1 data will be accessible. Compactness is expanded with the goal that it can be connected to a PC, portable PC, PDA, and so on. It is completely good with the serial COM port of a PC, the item should be utilized as a part of sets. Bluetooth remote innovation is a short-range information innovation proposed to supplant the links associating convenient and/or settled gadgets while keeping up elevated amounts of security. The key elements of Bluetooth innovation are vigor, low power, and ease. The Bluetooth detail characterizes a uniform structure for an extensive variety of gadgets to interface and speak with each other (Eliasson, 2008). A major Bluetooth remote innovation quality is the capacity to at the same time handle both information and voice transmissions. This empowers clients to appreciate assortment of creative arrangements, for example, a without hands headset for voice calls printing and fax abilities, and synchronizing PDA, portable workstation, and cell telephone applications to name a few. Figure 4 demonstrates the WCS 232 Bluetooth module which is utilized.
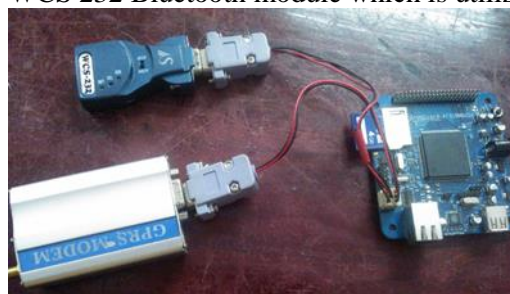

Figure.4. Bluetooth module   **Figure.5. Wireless Access Point Unit**

Wireless access point unit: Figure.5 shows the hardware unit of wireless access point unit. It consists of ARM processor, Bluetooth module and GPRS module.

GPRS modem: The word modem is gotten from the words modulator demodulator. This gadget capacities by empowering most PCs to transmit information to various systems, for example, cellular telephones or different PCs (Rasid, 2005). A general package radio service (GPRS) modem is another global system for mobile communications (GSM) modem that additionally bolsters remote information transmission utilizing GPRS technology (Reza, 2011). A GSM modem for the most part uses a circuit-switched kind of innovation in transmitting information, while the GPRS modem uses packet-switched technology to do the same. This as often as possible results in quicker transmission of information over a GPRS association when utilizing the GPRS modem. A GRPS cellphone may go about as a GPRS modem in a manner that it can associate a portable PC or a desktop PC to a system or the Internet. To utilize the portable workstation or desktop PC to send or get short message service (SMS) or multimedia messaging service (MMS) messages by means of a GPRS system, a GPRS modem is generally required (Jun, 2004). This is by and large a superior approach to interface with the Internet utilizing versatile and remote associations than the GSM modem concentrated (Featherstone, 2002). It is basically quicker and more proficient as far as transfer speed and association time.

The essential elements of a GPRS modem incorporate remote information correspondence and coordination with a few applications that require widespread serial transport (USB) associations. Between a GPRS wireless and a

standalone GPRS modem, it is much of the time better to utilize a GPRS modem in data transmission. As far as sending and accepting SMS or MMS, there is irrelevant contrast between the two devices. They both utilize the same rates and the same pace in transmitting messages. Figure 6 demonstrates the GPRS modem which is used. GPRS modems as a rule come as an outer USB gadget, some of which incorporate portable outside radio wires. These outer USB devices can be compared in shapes and sizes as the PC mouse or most outside USB drives. They likewise come as cards, typically utilized for tablets. These sorts of GPRS modems likewise generally wear an outside antenna, which can be moved to get the most extreme remote sign quality and respectability connection. Using a GPRS modem gives clients a chance to get to a few sorts of online administrations in light of its capacity to bolster a few protocols. These protocols incorporate Internet protocol and X.25 associations, among numerous others. Internet protocol (IP) are techniques used in the Internet in sending information starting with one PC then onto the next.

Figure.6.GPRS modem

Communication with modem: Each GPRS modem imparts by means of AT commands utilizing UART. AT commands are guidelines used to control a modem. AT is the contraction of AT tention. Each command line begins with "AT" or "at". That is the reason modem commands are called AT commands. Large portions of the commands that are utilized to control wired dial-up modems, for example, ATD (Dial), ATA (Answer), ATH (Hook control) and ATO (Return to online information state), are likewise bolstered by GSM/GPRS modems and cellular telephones (Pavlopoulos S, 1998). Other than this regular AT order set, GSM/GPRS modems and cellular telephones bolster an AT command set that is particular to the GSM technology, which incorporates SMS-related orders like AT+CMGS (Send SMS message), AT+CMSS (Send SMS message from storage), AT+CMGL (List SMS messages) and AT+CMGR (Read SMS messages).

Implementation: The system mostly comprises of two units; remote patient convenient unit and remote access point unit. The remote patient compact unit will be with the patient so that the patient restorative information will be caught utilizing the sensors joined to it. The details will be shown on the LCD screen so that the patient will likewise have the capacity to know their data. The information will be prepared by the PIC microcontroller and will be further sent to the Bluetooth module so that the information can be sent to the remote access point unit. This unit will be put inside a base Bluetooth run so that the information will be caught subsequently. The information can be gotten to by the doctor from wherever utilizing an IP address. The limit for every patient is set, so that when the information goes above or underneath the set esteem a SMS will be sent to the specialist's telephone so that a caution can be given.

Patient information management system: As the work is for observing the heart rate, body temperature and weight of the patient, the yield of the patient data administration system will be three parameters (Heart rate, Temperature, pressure). The information that has been getting from the serial port is then analyzed and configured to the desired format to show in the GUI. The incoming information is in the Temperature-pressure-pulse rate format, the Hyper Terminal gives the approaching information effectively as the examples specified which appears in the figure 7.
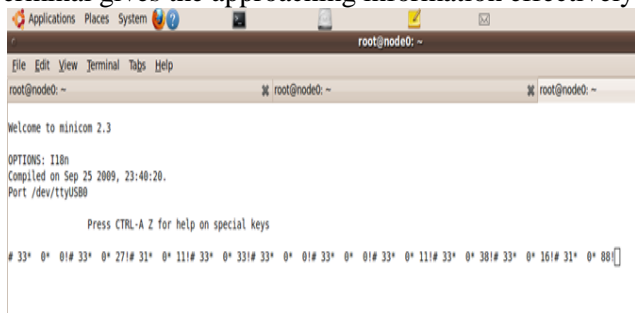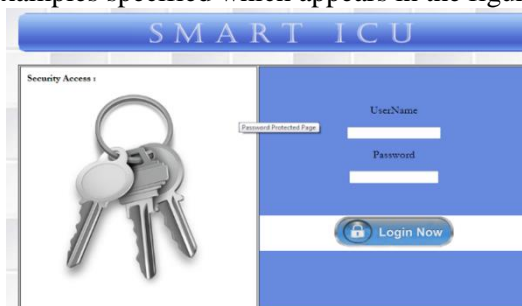

Figure.7. Incoming data   **Figure.8. Active server page**

The doctor can check the patient details from any area with the assistance of a PC or laptop. As the specialist tries to get to the server page it will request a username and secret key.

In the event that any information isn't right the page won't be opened just if the entered information is correct the page will be redirected .This is to guarantee a safe level to the patient data. The screen demonstrating the server page is appeared in the fig.8. When the "login now" button is pressed the page will be diverted to the following page.

If the points of interest isn't right the page will show an error message. The benefit of this page is that it gives adequate security level of the patient personality.

Figure.9. Navigation panel

Figure.10. Control panel

In the wake of signing in, the page will be diverted to the route board where one can see the control panel and a screen panel. When clicking any of the panel it will open up the following page so that the pieces of information can be gotten to. The route panel appears in the figure 9.

At the point when the control panel is clicked it will go to the following page where it is needed to enter numerous information, for example, patient id, patient name, then the three parameters must be set, for example, temperature, pressure and heart rate. Its upper and lower range must be set. Then an alert interim must be set so that in this period the SMS will be sent to the doctors mobile regardless of the possibility that there is no abnormality occur in the patient. It is needed to likewise set the mobile number of the doctor so that the information will be sent to the doctor's phone. The separate set values for every patient relying upon the patient's condition is required. This is on the grounds that every patient's condition will be distinctive taking into account their disease. If one set the same limit it won't give better result as in some cases the patient's condition won't be basic, relying upon his decease. Figure 10, demonstrates the control panel screen and as the submit button is clicked the information will be saved in the database.

From the navigation page if one look to the monitor panel the patient's information can be obtained. The page will contain three blocks, they are patient details, normal health readings and current health readings. In the patient subtle elements piece it will contain patient id and patient name. Also there are two blocks one start alert and another stop alert. If the start alert is clicked the patient condition will be sent to the doctor's phone inside the predefined interval. If stop alert is clicked the message will never be sent unless a critical condition is reached. The next block is that of ordinary health readings, these qualities are those which are set at the control panel so by looking at these qualities the basic condition is being distinguished and as there is any irregularity it will give an alarm message. The next block is the present health readings where the temperature, heart rate and weight readings can be seen. The current health readings and the typical health readings will be thought about as each new information shows up and in view of this data the message will be sent to the doctor. The fundamental preferred standpoint is that the doctor need not need to check the patient information every single time, only when the message comes the information must be checked. Figure 11 demonstrates the screen board.
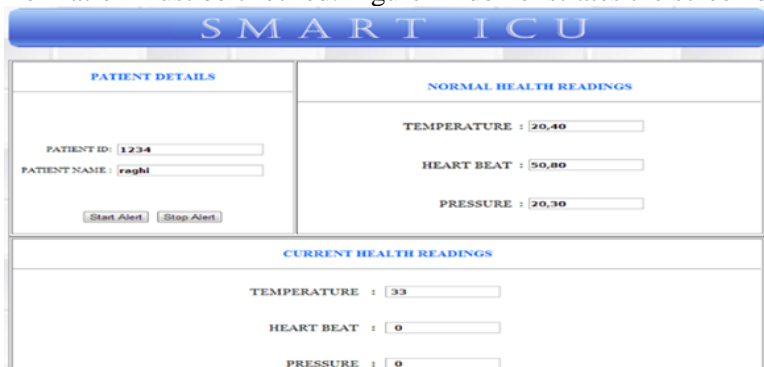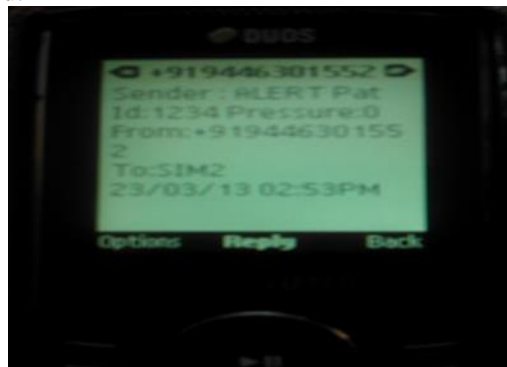

Figure.11. Monitor panel

Figure.12. Alert message

Connect a portable PC or a desktop PC to a network or the Internet. To utilize the portable PC or desktop PC to send or get SMS or MMS messages through a GPRS system, a GPRS modem is generally required. This is generally a better way to connect to the Internet using mobile and wireless connections than the GSM modem. It is just speedier and more productive as far as data transfer capacity and association time. GPRS modems usually come in the form of an external USB device, some of which include movable external antennas. These outer USB devices can be compared in shapes and sizes as the PC mouse or most external USB drives. They likewise come as cards, normally utilized for tablets.

These sorts of GPRS modems additionally as an external antenna, which can be moved to get the most extreme remote signal quality and integrity connection. Using a GPRS modem gives clients a chance to get to a few sorts of online administrations on account of its capacity to bolster a few protocols. These protocols incorporate Internet protocols and X.25 associations, among many others. Internet protocols (IP) are strategies used in the Internet in sending information from one PC to another. Figure 12 demonstrates the alert message being shown.

Comparison table: Table 2 shows the readings for temperature, heart rate and pressure taken for three different patients. For each patient the readings will be different based on their health conditions.

Table.2. Comparison Table

Parameters	Temperature (^{0}c)	Heartrate (BPM)	Pressure (mmHg)
Patient 1	37	60	0
Patient 2	38	72	0
Patient 3	34	68	0

All the readings appeared above demonstrates a typical health state monitoring of the patients. Since no pressure sensor executes the output dependably indicates zero perusing. Subsequently the doctor will get a ready message, taking into account the reading.

2. CONCLUSION

Observing gadgets can be interfaced with PCs and with the assistance of GSM device, messages can be sent to the mobile numbers if there is an unusual action recorded by the diagnosing sensor. In the neighborhood PC subsequent to handle and analysis, decisions are made on sending a SMS to a particular doctor if readings go over a specific set threshold. In this work temperature sensor and heart rate sensor was actualized effectively. Since there was absence of accessibility of pressure sensor, it was not included in the implementation part but rather in the software segment the pressure table is given. So as a future work the pressure sensor can be connected to get the reading. Also it can be included more sensors with the goal that it gives more advantages to the patients.

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