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Pattern System Design and Analysis for HBR Based GSM Network

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Abstract

The main function of this design is to monitor the health of a patient. The purpose of this project is to study different solution alternatives to remotely control the heartbeat rate situation so that these solutions take into account the usability and availability of services. The low-cost device concept has been developed to control heartbeat rate for patient globally based on the data records from the sensor forwarded to the Microcontroller, and then transmits the condition to the caretaker or the expert or a doctor which have been given as the recipient in the form of SMS via GSM modem. Furthermore, the result also displays the readings on LCD as a digital value. The decision made by sensing this value and then alarm the people nearby if the condition reaches the abnormal value (less than 60 or more than 100) for over 10 years and also send an urgency SMS. It concludes that in such case this design is useful to measure the heart rate so that patient can be under control, prevented from the serious situation. The future development is to add the module of the voice alarm system to indicate parameters crossing the threshold value.

Keywords: Patient Monitoring System (PMS), Human Heartbeat Rate, ECG Signal, GSM Network

I. INTRODUCTION

Healthcare in the hospital can be time expending additionally due to traditional equipment, particularly in heartbeat issues and monitoring. Modern innovations and progress monitoring arrangements can control the patient's situation and their circumstance in real-time care within the full checking at the proper time. For that reason remotely handles the circumstance of heartbeat rate situation by self-system checking integrated by warning system. The functioning of the Heart Beat rate system design is based on the fact that the blood circulates for every heartbeat that can be sensed by using a circuit formed by the combination of a sensor and a circuit equipped with a light-emitting diode (LED) and The Global System for Mobile Communications (GSM) based system. Depending upon the rate of blood circulation of the heartbeat rate is calculated. This calculated value is communicated to a remote person through a GSM modem interfaced with it. The primary function of this research is to monitor the heartbeat rate health parameters of a patient during a substance situation. This research has monitored the Heart Beat of the Patient and the Data collected by these sensors are sent to the Microcontroller. The Microcontroller interpreting the record and analyze the incident and then transmits the data to the manager in the form of messages (SMS) using a GSM modem. If the conditions go abnormal then the sensor senses those digital values and alarm the people around as well as sending urgent SMS.

II. RELATED WORK

The auto health care monitoring systems for possible responses are playing a vital role in hospitals [1],[2]. This part described the background theory and previous research related to this study. Adequate theory and a literature review have been stated as the basis to support the investigation of the results and the expansion of the most current methodology to respond to the research output targeted. The current reaches investigation have concentrated on these issues notified that quiet checking the actual situation on a solid potential to progress heartbeat rate control [3],[4]. However, the passage of the issue of action to screen the understanding amid the insecurity heartbeat appraisal through coordinated debate within the hospital must be succeeded within the execution due to the basic circumstance [5]. It stretches a better approach to convey wellbeing care administrations when the distance between the specialist and Patient is essentially far. Patients in rural areas and the critical situation will get full advantages from this monitoring system. Understanding and observing patient situations is one of the telemedicine technologies, which continuously needs change to create it superior and advance monitoring system, especially for serious disease infections.

Heart attack is one of the most serious disease cases immediate deaths due to heart strength. This death of the heart strength will end with a strike of blood flow to the heart tissue [6]. The main function of the hearts is to push blood into the cardiovascular structure in human beings; if one of its parts fails to work the heart acquires to attack, and in the due passage, indicates to death if not give artificial respiration to on time [7].

In 2017 Dual created a model for heartbeat rate application utilizing the nonstop checking of parameters to distinguish and anticipate the heart assault and produce an alert. The integrated buzzer will work when body temperature and heart rate indicated the edge level. The research concept is measuring the heart rate and body temperature at the same time [8],[9]. However, these projects stated the basic condition, where the

supportive observation is mainly required the advance sensor characterization. In expansion it is exceptionally great effort done by the researcher by using gadget due to its transportability which implies the patients can carry it subsequently.

In 2019 Sani presents a design of an internet of things-based (IoT) for human heartbeat rate monitoring and control system. His results determine that the case of heartbeat rate of children under age of 17 and above 17 is between 65 to 115 and 60 is 100 beats per minute (bpm) respectively [10]. A mutual practice in the medical area of study is to measure the heart rate is using Electrocardiography (ECG) device to measures heart beat rate [11],[12], where function heart is counted due to the voltage changes in electrical activity, which is detected via electrodes located on the skin. Generally, Electrocardiography device provides more consistent heart rate evaluation compared to Photoplethysmography (PPG) method [13],[14]. However PPG introduced for different physiological measurements including heart rate (HR), breathing rate, heart rate variability (HRV), oxyhemoglobin saturation, and blood pressure [15],[16].

There are now a number of researches on human health monitoring systems based on the Internet of Things (IOT) being conducted throughout the world. Foreign countries were ahead of China in developing human health monitoring systems application based via Internet of Things [17]. Remote consoling and specialist care of blood pressure, blood glucose stages, and particular medical data have complete significant advances system [18]. Some precise design and application developments were offered by the researcher in various designs for probable fatal disease responses, with an indeed application that they were efficient. At least the design based technology can manage to save a certain life of people via an accurate model. In addition to the standard requirements of unstable heart beat rate as consistent for the patient compared to other offensive techniques.

III. PATIENT MONITORING SYSTEM USING GSM

The primary function of this research is to monitor the heart beat rate health condition of a patient through hardware device and update the situation via short messaging (SMS). The device has monitored the Heart beat rate of the patient through the data collected by these sensors are sent to the Microcontroller to make decision according the threshold value either the minimum or maximum target set it as standard value. The Microcontroller then response to the value by sending message to the respected people via GSM modem connected with the Arduino. The purpose of using GSM modem is to transmit the abnormal information to the doctor or targeted people set it by the admin. The transmitter keeps recording the data from the patient through heart sensor via real-time condition and compares them with the target parameters. Not only the data send the information through GSM module as SMS, it is also display the readings on LCD. The functioning of Heart Beat rate system design is based on the fact that the blood circulates for every heartbeat that can be sensed by using a circuit formed by the combination of a sensor and a circuit equipped by LED and GSM based system. Depending upon the rate of the blood circulation of the heart beat rate is calculated. This calculated value is communicated to remote person through a GSM modem interfaced to it.

IV. REAL-TIME DATA MONITORING

Real-time data monitoring (RTDM) is a process through which an administrator can review, evaluate and modify the monitoring condition. Based on the superior technology, patient monitoring systems have recently become one of the most significant advancements. This research comprises connecting the heartbeat sensor to the Arduino so that the patient's condition can be monitored simultaneously, obviating the need for the sensor and other devices to check the patient's status. RTDM primarily helps in monitoring and managing the investigation and use of data across a complex sensing system.

V. SYSTEM DESIGN AND INSTRUCTION

The system design concept is integrated software & Hardware following the instructions by the microcontroller using Arduino programming language. Typically the system takes the reading data from the patient through the sensor and compares the input value with the data stored in the microcontroller, the system will act depending on the input data then it decides if it is a normal situation or not. In the critical situation, it will use a GSM module to send an SMS message alert. Each part connected to the microcontroller has it is owned instructions to operate with the GSM module by AT command to send and receive data which is instructions used to control a modem. AT is the abbreviation of Attention. Every command line starts with "AT" or "at". That's why modem commands are called AT commands. Figure 1 shows the actual prototype for a real-time patient monitoring system via ECG signal using GSM network via integrating the hardware with the software.

Fig. 1. Prototype design and implementation

VI. DESIGN METHOD AND OPERATION FLOW

The patient's heart rate will be continuously measured by the device. The device talks with a mobile device, which has been programmed through the microcontroller with a customized application that will enable the alarm mechanism according to the verified data from the sensor. GSM Module is used to communicate between the device and the mobile phone. Heart Beat Sensor, Arduino kit, LCD, and GSM Module are the main components of this prototype. When a finger is placed on the sensor, it produces a digital output of a heartbeat. The beat rate obtained through LED flashes in unison with each input heartbeat while the heartbeat detector is operational. This digital output can be used to measure the rate of Beats per Minute (BPM) with an Arduino device. At each pulse, it works on the similar concept of light modulation by blood flow via the finger attached to the sensor. Figure 2 shows the flowchart of the system operation and decision making according to the input value from the sensor. Consecutively for these index values have index factors in measuring BPM level. Figure 2 represents the operation carried out on the element of data collection. It contains a series of processes in brief descriptive labels describing the process being carried out on the data to generate the design.

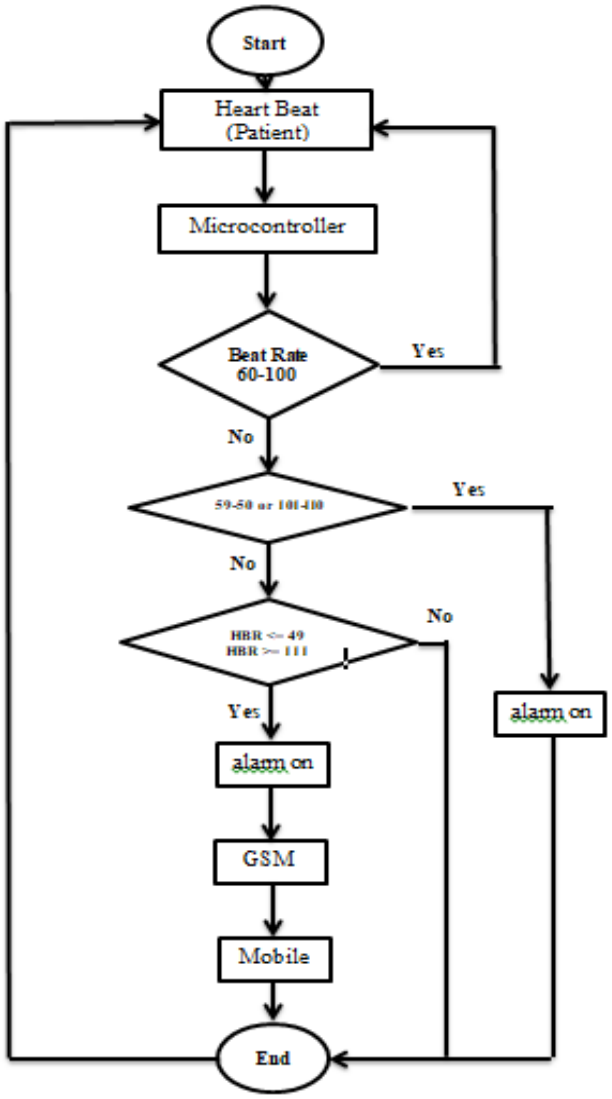

Fig. 2. Schematic flow chart diagrams representing the proposed solution

VII. DETECTED HEART BEAT RATE LEVEL DECISION

Heart Beat Rate Level is only a profligate for vitality that produces out from sensor measuring digital output via patient finger. At the point when the microprocessor attempting to decide whether a trigger value is upper or lower the target value of Heart Beat Rate Level. Figure 3 shows the ideal case of the normal reading extracted by com 4 (Arduino/Genuino Uno).

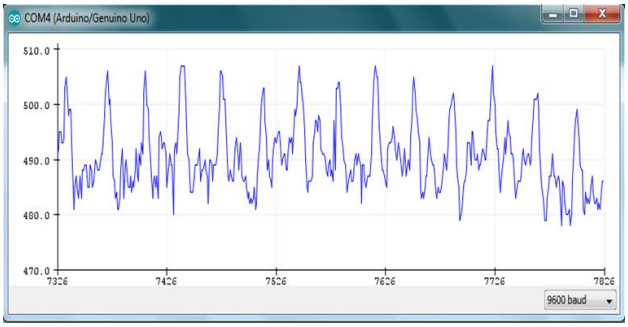

Fig. 3. The ideal case signal from Com4 Genuino Uno

VIII. RESULTS AND DISCUSSION

The proposed prototype designed to detect the heartbeat rate levels of the human, by sending a warning message to indicate the risk incidence after the signal input from the sensor and processed by the microcontroller. The devices trigger the level of the heartbeat rate and compare it with the standard level defined as a rating factor ($100 \geqslant P \geqslant 60$). Therefore, the device needs to measures the continuous activated signal from the finger through the specific sensor and displays the real-time value through the LCD integrated with the Arduino device to decide the worth situation if any. Based on the research design idea, if the detected level of signal exceeded the optimal level, then a warning message will appear to alert the user to rescue the patient. Figure 4 shows the real data from King Fahad Hospital taken from one of the patients after hidden his information, this signal taken by normal ECG in the hospital. Figure 5 shown the data extracted from the prototype and displayed in the oscilloscope, which shows the level of the signal below 100, as well as more than 60, therefore the display shows warning 97 as stated in the LED on the device.

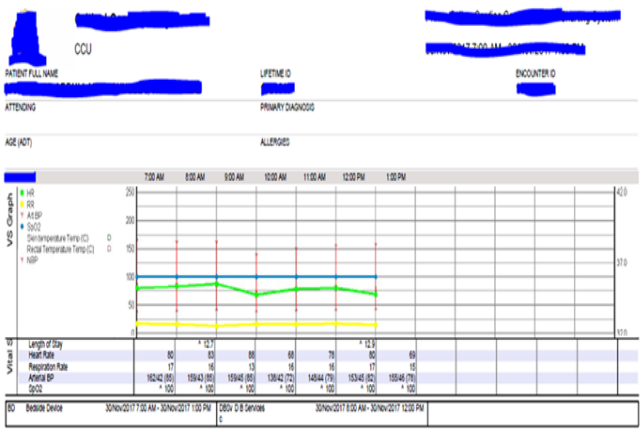

Fig. 4. The ideal case signal from Com4 Genuino Uno

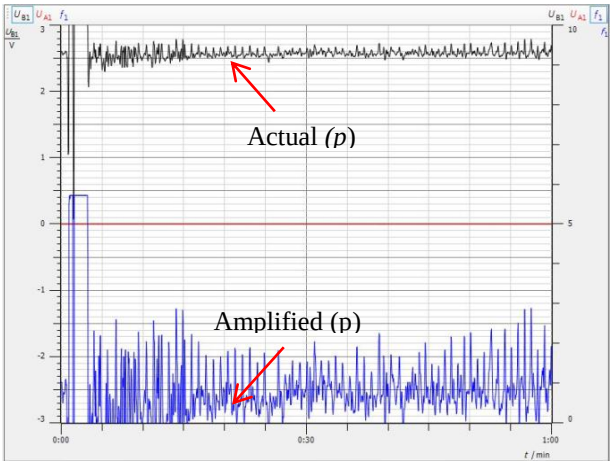

Fig. 5. Normal case reading from the prototype

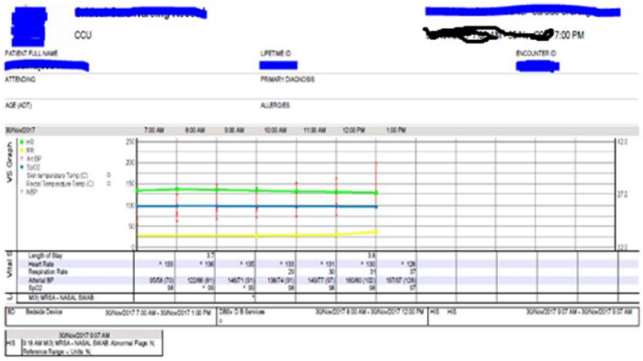

Fig. 6. A real reading by ECG device from PSCC Hospital for death case

The signal shows in Figure 6, no detect signal is obtained; only a steady-state line (default/ideal case) was displayed. The device as well shows no signal, but the reading of HBR shows the value of 2 as an error reading, due to the sensor accuracy problem in some cases.

The success rate of the prototype device shown in figure 7 characterized the rate as the number of 19 times succeed out of a trail of 25 times completed the accurate trigger. This is a truly coarse measurement; using the simplest explanation to configure the results in a short time or how well it can confirm the accuracy and probability of using the device.

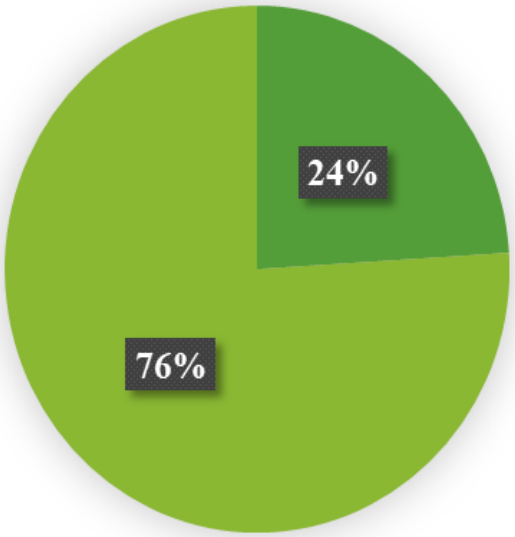

Fig. 7: Rate of successful test

To determine the accuracy of the research design, the normal pulse sensor was used to acquire the heart rate. A power bank is used for circuit operation. The finger of the patient should be attached to the sensor expressively as for the most accurate reading. The Serial oscilloscope device result attached to the prototype for the actual signal was agreed upon by a certified doctor to confirm its accuracy.

IX. CONCLUSION

This paper summarized the adopted methodology for the research stated in the flow chart, which symbolized the proposed solution to measure the heartbeat rate of a human. The design provided the details of data collection according to the schematic flow chart diagrams representing the proposed solution to trigger the HBR of the human for a long or short time. Furthermore, this paper discussed the level of HBR that can harm the life the human which detailed in the figs to be lower than 100 and above 60 as a trigger point. Finally, it described the hardware design and the required component to obtain a reasonable result with high accuracy. However the device did not get 100% accurate, due to the type of sensor, but somehow the performance of the device significantly performs more than 76% as successful rate. To provide a more accurate result, the sensor should be changed to a more accurate design to trigger the actual result including high sensitivity. It's suggested that the prototype still can be used to trigger the HBR of the patient, but due to the sensor problem, it is recommended to change the sensor recurrence.

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