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A Smart Stretcher and Integrated Medical Intelligence System Model for Unconscious Person

M.Aiswarya[1]*, Dr.Ramkumar Prabhu[2]

[1]UG Scholars, Department of ECE, Apollo Engineering College, Chennai.
[2] Professor, Department of ECE, Apollo Engineering College, Chennai.

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Abstract

The integration of health information technology into primary care includes a variety of electronic methods. This can improve the quality of care which makes the process quicker. The purpose of this project is to highlight the main features of an intelligent stretcher and a system of monitoring crucial signs of unconscious person. Arduino is the selected device for information processing which collectively obtains the heart rate and respiratory rate of the patient, updating directly to the intensive care unit via IoT. This further updates the biometric details to the police station informing about the accident. This system is developed by using affordable technology and merging different function to offer an expedient solution. Additionally, the stretcher is provided with automatic moving mechanism under the guidance of one person which reduces manpower requirement.

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1. Introduction

In current cases, health care institute is very important for the community and needs for emergency services of needs from different types of issues. As a technology improvement, it plays vital role for good and effective treatment of the patient also. Recent technologies are looking so important for the complete efficiency for medical equipment. Information technology has the significant role to improve the value, care, and effectiveness of healthcare. The use of technology becomes more widespread and necessary in the field of health care. It is necessary to monitor the health condition of unconscious patients, especially when the person has met with an accident

* Corresponding Author: Dr.Ramkumar Prabhu
Department of ECE, Apollo Engineering College, Chennai
Email: ramkumarprabhu@gmail.com

The health care professional should be aware so that they can diagnose beforehand. Here, several sensors are implemented in a stretcher to monitor the human health condition and the information is updated to the hospital server through IoT so that doctors can know. It is necessary that the police officials are informed about the incident and the location, which is done in the proposed system using IoT. In case of any emergency of patient health conditions
the health status of the person presciently. IoT is an exceptional and intelligent technique that reduces human effort and easy access to physical devices. This technique also has an independent control feature which allows the stretcher not just update information, but also automatically move the stretcher under the guidance of a human.

2. Related Works

Different research promotes the use of technology, which intends to assist people with disabilities or mobility impairments. Previous work has been done by means of health devices like sensor devices. By the support of these instruments progressively modifications happening in a patient health condition will be known. These sensor devices will be fixed to the human and monitor the health issues and conditions hour by hour. The progressively fluctuating health condition is observed by a healthcare expert who is closer to the patient and who is reserved from the patient also. Another project proposes a prototype of an intelligent stretcher controlled by voice command and a system of monitoring vital signs for people with disabilities or reduced mobility. Raspberry Pi and Arduino are selected devices for processing information and software is integrated into data collection in order to develop a global system. The main contribution of this prototype is to provide medical treatment to patients [1].

3. Proposed System Overview

The project is a prototype that integrates electronic devices, microcontrollers, and health monitoring sensors to a simple stretcher. Additionally, the stretcher is provided with a driving mechanism which makes the stretcher semi-automatic.

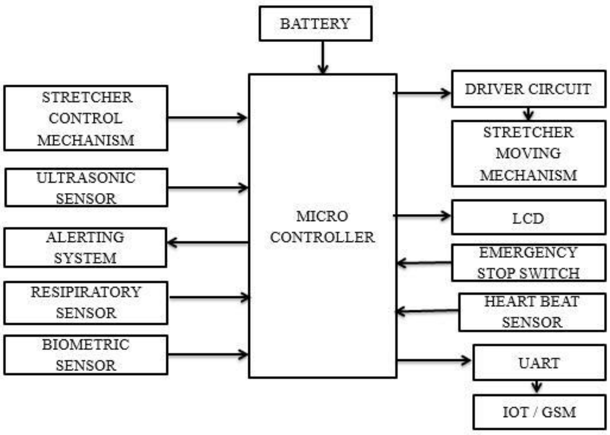

Figure 1. Block Diagram of Smart Stretcher

To understand the prototype, it is essential to split into 3 major sections.

- Updating biometric to police station
- Updating health information to hospital
- Driver circuit.

The block diagram of the stretcher implantation is given in Fig.1. The microcontroller is heart of the system which coordinates the entire process of updating and driving mechanism.

The Biometric sensor, Respiratory sensor, and Heartbeat sensors connected to the Arduino mega – which consist of ATMega2560. All these sensors provide an analog input to the microcontroller. The biometric detail from the sensor is updated to the police station via IoT. Similarly, the pulse rate and respiratory rate are updated to the hospital server. Further, the stretcher is provided with a driving circuit that works with the help of a force sensor. Based on the pressure applied to the sensor, the stretcher moves. The ultrasonic sensor is placed to check if any obstacle is present in front of the stretcher. In case obstacle is found, the buzzer alarms and alerts the person guiding the stretcher.

3.1. Updating Biometric details to the police station

As soon as the patient is laid on the stretcher, the biometric details is obtained by the fingerprint/biometric sensor. This information is unique for every individual and should be pre-collected by the officials.

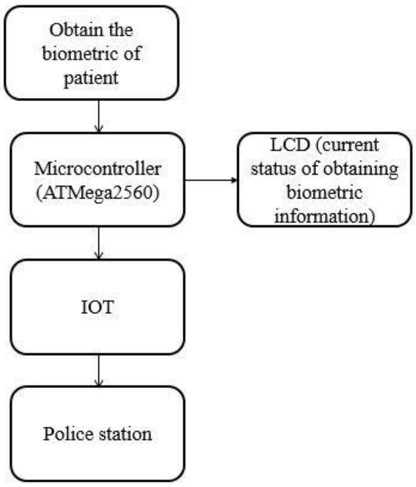

Figure 2. Flowchart- updating biometric details to the police station

Once the patient is laid on the stretcher, the fingerprint is scanned by placing the patient's finger on the biometric sensor. The biometric sensor captures the image of the fingerprint. The biometric information obtained is stored in the microcontroller and updated to the police station using IoT via UART. The information received will be matched with the previous data which is already available. This way, the individual who underwent an accident will be identified to proceed on with the legal activities. Also, using GSM the location of the accident can be accurately known.

3.2. Updating Health information to the hospital

The Heartbeat Sensor and the Respiratory Sensor implemented in the stretcher will be used to gather the pulse rate and respiratory rate which are the essential parameters to be monitored continuously.

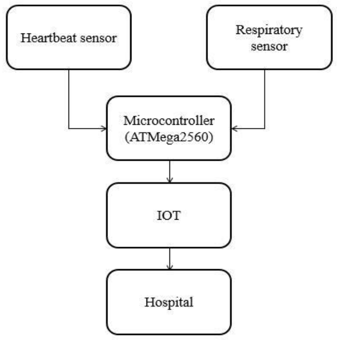

Figure 3. Flowchart- Updating Health Information to the Hospital

The heartbeat sensor is clipped to the finger which detects the beats per minute (BPM) by observing the light reflected from the finger which is depends on the blood flow vibration of the patient. Likewise, the frequency of the breath is determined by the respiratory sensor. Now this detail is updated to the microcontroller AT Mega 2560, which in turn updates to the hospital server via IoT through UART. In this Prototype, We update to the hospital server, which is open-source.

3.3. Stretcher driving mechanism

This prototype aims to provide a semi-automatic stretcher moving mechanism. Driver circuit (L293D) acts as an interface between the microcontroller and the stretcher

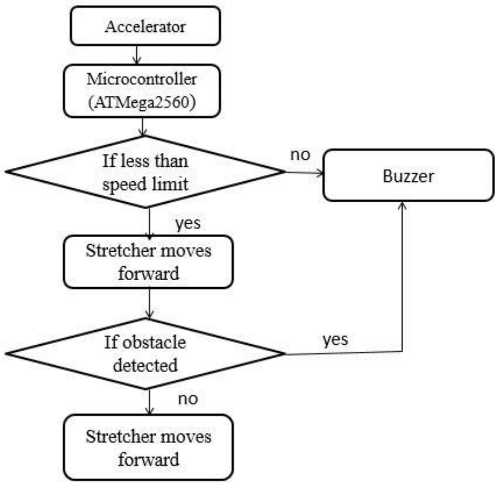

Figure 4. Flowchart- Stretcher Driving Mechanism

With the help of the force sensor, depending on the pressure applied by the person guiding the stretcher, the stretcher moves automatically. A speed limit is set in the microcontroller. In case, the stretcher crosses the speed limit, the buzzer alarms, intimating the person to press the emergency stop button. Also, the stretcher is provided with an ultrasonic sensor that checks for any obstacle in the front of the stretcher. If any obstacle detected, the buzzer is again activated.

4. Overview of System specifications

4.1. Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board based on the ATMega 2560. It has 54 digital input/output pins. 16 analog inputs, 4 UARTs (hardware serial ports). AT Mega 2560 acts as the heart of the smart stretcher. Each sensor will provide the necessary input to the ATMega 2560. The microcontroller will update this data via UART to the respective servers. Also, it directs the stretcher to move accordingly.

4.2. Biometric Sensor

Biometric sensors used in this prototype collect the fingerprint of the patient. A biometric sensor is a transducer that changes over a biometric treat of an individual into an electrical signal. This framework has two fundamental occupations - it needs to get a picture of your finger, and it needs to decide whether the example of edges and valleys in this picture coordinates the example of edges and valleys in pre-filtered pictures that are put away as of now. Every human has unique finger print and strained and protected as an encrypted biometric key or scientific demonstration.

4.3. Respiration Sensor

The Respiration sensor used in this prototype monitors and gives you an indication of the relative depth of breathing. It is to be worn as a nasal mask. The sensor placed in the mask uses short term data of breathing sounds and lower computation complexity to perform real-time breathe detection. The sensor consists of a microphone that detects the frequency range of the breath of the patient. The sensor is connected to the microcontroller which processes human breath and the corresponding frequency value is determined. Research suggests that the frequency range of single breath of a healthy human being is 60Hz-1000Hz. If the frequency is less than 60Hz it is noted as abnormal low and if the range is greater than 1000Hz it is noted as abnormal high.

4.4. Heartbeat Sensor

The heartbeat sensor is designed to give the digital output of heart beat when a finger is placed on it. When the heartbeat detector is working the beat LED flashes in unison with each heartbeat. It works away at the rule of light regulation by blood flow through finger for each heartbeat. The sensor comprises of a splendid red LED and light indicator. The LED should be brilliant as the most extreme light should go in finger and identified by the indicator (photodiode). Presently, when the heart siphons blood through the veins, the finger turns out to be somewhat increasingly hazy thus less light reached the detector. With each heart pulse, the detector signal varies. This variation is converted to an electrical pulse. This signal is amplified a nd triggered through an amplifier which outputs +5V logic level signal. The pulse signal is applied to the microcontroller which is monitored by the program. Whenever this input goes high the counter which is present internally will counts how many 1ms intervals present between two high going heartbeat pulses. This number is then divided by 60,000 and the result is the pulse rate.

4.5. Driver Circuit (L293d)

DC motors generally need current above 250mA to function when used with integrated circuits like ATMega 2560, IC 74 series cannot supply this amount of current. Hence, a motor control circuit is used, which acts as a bridge between the motor and microcontroller. The L293D has 4 Half H Bridges. An H-bridge is fabricated with four switches S1, S2, S3 and S4. When the S1 and S4 switches are closed, then a +Ve voltage will be applied across the motor. By opening the switches S1 and S4 and closing the switches S2 and S3, this voltage is inverted allowing invert operation of the motor controlling the direction of the motor.

4.6. Force Sensor

A force sensor is electronic equipment whose underlying material is a force-sensing resistor. The resistance of an FSR depends on the pressure that is applied to the sensing area. The more you apply, the lower the resistance. The resistance range is actually quite large: > 10 MΩ (no pressure) to ~ 200 Ω (max pressure). Strain gauges are attached to a material with known mechanical properties, like steel. The strain gauges is used to measure how much the material has deformed by detecting its change in resistance. This allows the stretcher to move automatically depending on the pressure applied by the person guiding the stretcher.

4.7. Buzzer

A buzzer or beeper is an audio signaling device. It generates consistent single tone sound just by applying DC voltage. The buzzer consists of an outside case with two pins to attach it to power and ground. When the current is applied to the buzzer it causes the ceramic disk to contract or expand. Changing in this then causes the surrounding disc to vibrate which produces sound. Buzzer act as an alarm. When the stretcher moves faster than the speed limit, the buzzer produces a sound, alerting the person guiding to press the emergency switch to stop the stretcher. Additionally, if an obstacle is detected, the buzzer indicates by producing a sound.

4.8. Liquid Crystal Display

Liquid crystal display technology works by blocking light. LCD is made of two pieces of polarized glass (substrate) that contain a liquid crystal material between them. LCD used in this prototype is a 16 character, 2-line alphanumeric which connected to a single 9-way D-type connector. This allows the device to be connected to most E-block I/O ports. In this LCD, each character is displayed in a 5×7 pixel matrix. LCD is used to display the current status of the information being updated to and from the microcontroller.

4.9. Ultrasonic Sensor

The ultrasonic sensor is a type of an acoustic sensor divided into three broad categories: Transmitters, Receivers, and Transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signal, and transceivers can do both Ultrasonic sensors work by producing sound waves at a recurrence unreasonably high for people to hear and trust that the sound will be reflected back. The microcontroller is utilized for correspondence with a ultrasonic sensor. The microcontroller imparts a trigger sign to the ultrasonic sensor. When set off, the ultrasonic sensor produces ultrasonic wave burst and starts a period counter. When deterrent is identified, it mirrors the ultrasonic sign. The reflected (reverberation) signal is gotten back and the clock stops. The yield of the ultrasonic sensor is a high heartbeat with a similar term as the time contrast between transmitted ultrasonic blasts and the got reverberation signal which is additionally prepared and checked with the restriction of some separation. On the off chance that the obstruction is identified inside the limits, the ringer cautions the individual directing the stretcher.

4.10. System Software Overview Arduino Ide

The Arduino Program contains two main parts, setup () and loop (). The setup () sets up the Arduino hardware such as specifying the sensor inputs and output lines. The loop consists of the code for initializing the sensors and obtaining the input, and updating to the respective servers. The loop () function is repeated endlessly as long as the Arduino board is turned on. A biometric sensor and respiratory sensor is placed in a mask.

Figure 5. Proposed Smart Stretcher

Figure 6. Side View of The Stretcher

The second comprises of force sensor and a drive circuit which helps the stretcher to move in forward or reverse direction.

Figure 7. Liquid Crystal Display

Arduino IDE (Integrated Development Environment) is used to write the program and dump into the arduino board. The programming language used is C/C++.

5. Experimental Results

It depicts the setup of proposed smart stretcher. It involves Arduino mega board with two sections. The stretcher section comprises of heart beat sensor. Figure 8 describes the patient's personal information obtained by matching with the fingerprint (obtained using biometric sensor) which is updated to the police server via IoT.

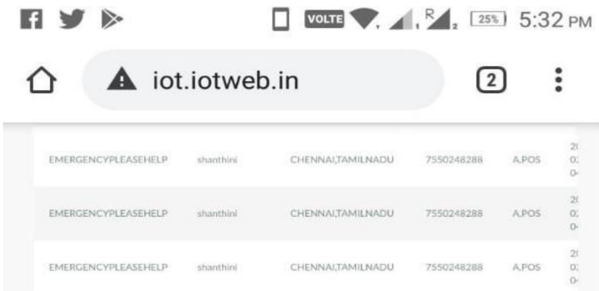

Figure 8. Updating Patient's Personal information

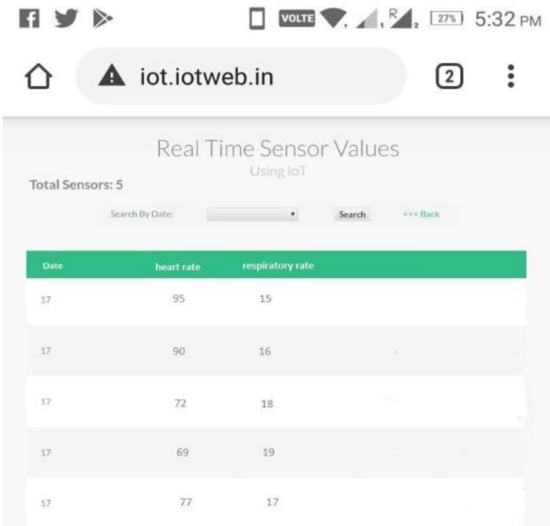

Figure 9. Updating Patient's Medical Information

It describes the patient's medical information (heart beat rate and respiratory rate) which is updated to the hospital server through IoT

6. Conclusion

Through the technological feasibility experiment and evaluation of Smart Stretcher, we demonstrated that Smart Stretcher has incredible attainable in improving patient security at some stage in switch and stimulating collaboration amongst medical staff. Through our new approach, integrating all sensors and networks, we may want to enhance a new system which should solve the patient safety problem. Moreover, we concluded that, this system can help to become aware of affected person emergency status and be used to screen affected person conditions without increasing workforce workload. Also, the stretcher sends the biometric important points to the police station to proceed with legal activities in case of accidents. Though, it was once an exploratory test and evaluation; we have to behavior a large-scale scrutiny in the close to future.

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