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IoT based Advanced Wearable Safety Device using Arduino

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Abstract – *In today's world, none of us whether a man or a woman is safe. We essentially need a device or something that can provide us safety. Nowadays, internet is the key to control almost everything. This paper describes an advanced device which will safeguard people by monitoring their health. The device is based on the internet of things i.e. IoT. It senses various parameters of body and based on their combined value, it sends an alert to the saved contacts. The device is advanced due to its precision. Besides using GPS and GSM, it uses a number of sensors connected to Arduino which give a more précised result than any of the common device. There are also two manual switches that can be pressed anytime by the user according to his/her requirement. It uses an IoT platform 'Google Cloud' which stores and monitors the health data.*

Keywords*: IoT, GPS, GSM, Google Cloud, Arduino.*

Introduction

Safety is the priority to every human being. In the present time it has become quite difficult to be safe and secure. Whether we talk about a kid, a woman or a man, all of us need safety and security. Internet has opened a number of ways to do the needful in this direction. We know the common symptoms of a person in danger. If a person fears, his/her heart beat increases, blood pressure becomes high, hands and body shake due to fear, blood flow increases, we breath rapidly, rate of respiration becomes high, sweat comes out, body temperature increases, muscles become active etc. We can measure the extent of fear in a person by sensing the level of these symptoms. When these symptoms are above a specific threshold, we can say that a person is in danger. There are specific sensors for measuring the above described symptoms. Here, we connect all these sensors to an Arduino board which is programmed according to our needs like saving contacts in order to send an alert and setting of threshold for sensors, above which an alert will be sent to the saved contacts. We have to connect GPS to track the location of the person and GSM to send messages to the saved contacts. The device consists of various sensors like temperature sensor, heart rate and respiration sensor ADS1292R ECG/Respiration Breakout Kit, muscle sensor SEN-13723 EMG sensor, sweat sensor EDA/Galvanic Skin Response sensor, Vibration sensor SW-420 Module, blood pressure sensor and two manual switches. If we want to give an alert manually, we can press the switch according to our convenience.

Literature Review

Dhruvil Parikh[1] (2020) Alert messages are sent to the concerned authorities in any emergency proved by the device due to variations in its input. The physiological signs that are investigated are galvanic skin reaction, body heartbeat, and body vibrations.

Mehmet Tastan[2] (2018) The device continuously measures body temperature and heart rate of the person. Health monitoring can be done in an easy way.

P. Nandhini[3] (2018) Existing applications are advanced in the manner that leads to an innovative idea for child and women safety.

Pawade and Gaikwad[4] (2015) An android terminal child tracking system was proposed by them. The device has two controls, one is parental control and the other is child control.

Niti Shree[5] (2016) In order to track children, their parents will get an aid by using android based child safety system. The real time location of the child is sent to the parents.

Bhanupriya and Sundarajan[6] (2017) An activity tracker wrist band was proposed which was integrated with multiple devices based on the behaviour of human reactions.

M. Sathya[7] (2018) Health monitoring system is based on IoT using compact sensors which aids the patient to be aware about his/her health.

Objective

The main objective of this work is to provide safety to people by the means of an automatic and portable device based on IoT. The device provides safety by monitoring the health of the user. Therefore, it can also be used as a health monitoring device. The design of the device is such that it will give out the most précised output. Besides being automatic, the device can also be controlled manually.

System Overview

In my work, a number of sensors are connected to the microcontroller of Arduino. It can be clearly presented through a schematic diagram given below:

Fig - 1: Schematic diagram of the device

Electrocardiogram sensor is used to measure the heart rate of a person. Electrocardiography (ECG) is used to get information of cardiovascular system of the person. The device consists of MAX86150 Integrated ECG and PPG Bio-Sensor. It operates at 1.8 volts. It monitors heart rate and also acts as pulse oximeter.

Fig – 2: Electrocardiogram/Heart rate Sensor

Generally, if a person is in trouble, his/her hands shake. The device consists of SW-420 Module of vibration sensor. It operates at 3.3 volts to 5 volts DC voltage.

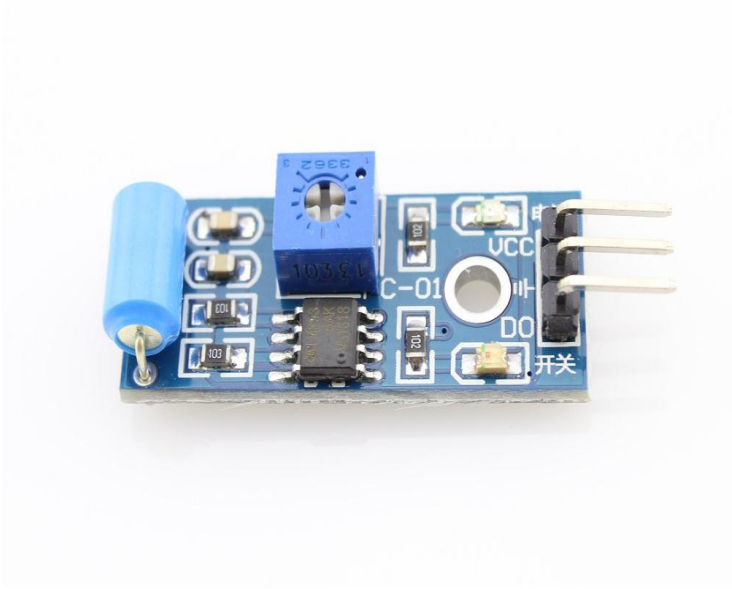

Fig – 3: Vibration Sensor

Respiration rate of a person increases when he/she is in trouble. Therefore the device consists of ADS1292R Respiration/ECG break out kit. It can also measure heart rate of any person. We may also use basic belt respiration sensor.

Fig – 4: Respiration Sensor

Blood pressure sensor is used to sense the blood pressure of the user's body. We can check the blood pressure of a person by using PPG. Generally, whenever a person fears, his blood pressure increases. Therefore,

MAX86150 sensor will measure the blood pressure of a person.

EMG Sensor or Electromyogram sensor is used to sense the muscle activity of a person. The device contains SEN-13723 EMG sensor to measure the muscle activity of a person.

Fig – 5: Electromyogram Sensor

EDA Sensor or Electrodermal activity sensor or galvanic skin response sensor is used to measure the conductive changes of skin due to variation/increase in activity of sweat gland.

Our device consists of temperature sensor in order to measure the body temperature of a person as we know that generally a person's body temperature increases whenever he/she is in danger.

Manual Switch-1 can be pressed manually by the user during any kind of emergency according to his/her requirement.

Manual switch-2 can be pressed by the user when he/she wishes to give an alert to the saved contacts telling them that the previous message was incorrect, they must ignore it.

There is a GPS Module in our device. Global Positioning System is a satellite based radio navigation system. In our project, GPS will give the exact geographical location of the person in danger to the saved contacts.

The Global System for Mobile Communication (GSM) module is interconnected to arduino in order to send and receive messages. The device consists of Simcom SIM900 and Arduino UNO module.

MAX86150 is a two in one sensor for measuring heart rate as well as blood pressure of a body. It is an Integrated Electrocardiogram (ECG) and Photoplethysmogram(PPG) Bio-Sensor. Here ECG measures the heart rate where PPG measures the blood pressure.

All these sensors are connected to the Arduino Uno. Arduino Uno is basically an open source microcontroller. It is based on the Microchip ATmega328P microcontroller.

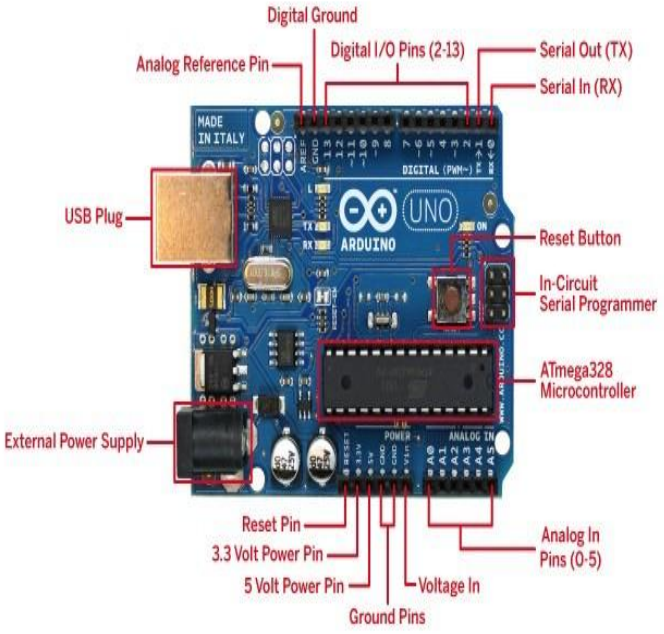

Fig – 6: Arduino UNO

Working

In this project, basically the output produced by the readings of various sensors is responsible for giving an alert to the saved contacts.

First of all we upload our code in the system. In order to give an alert to some specific people, we need to save their contact numbers in our code along with the message to be sent according to different situations.

After uploading code to the system, we need to connect the sensors to the arduino. Whenever the output is greater than the set threshold, an alert will be sent to the saved contacts along with the location of the user.

GPS or Global Position System detects the latitude and longitude of any region on earth with exact universal time co-ordinates. GPS sends the position coordinates with great accuracy.

GSM or Global System for Mobile Communication is now the default global standard for mobile communication. Here, GSM is used to share the location detected by the GPS and also sends an alert message to the saved contacts.

Other than this automatic action, one can also send an alert using the manual switch during any kind of emergency. There is an extra switch that can be pressed by the user if any incorrect message/alert is sent to the

respective contacts. Pressing the second switch indicates the receiver to ignore the previous message.

Here, we use Google Cloud as an IOT platform to store the data in the cloud. It will help in monitoring the health of user time to time. We can get an instantaneous health check status using Google Cloud.

The working of device will be clearer by the following flowchart:

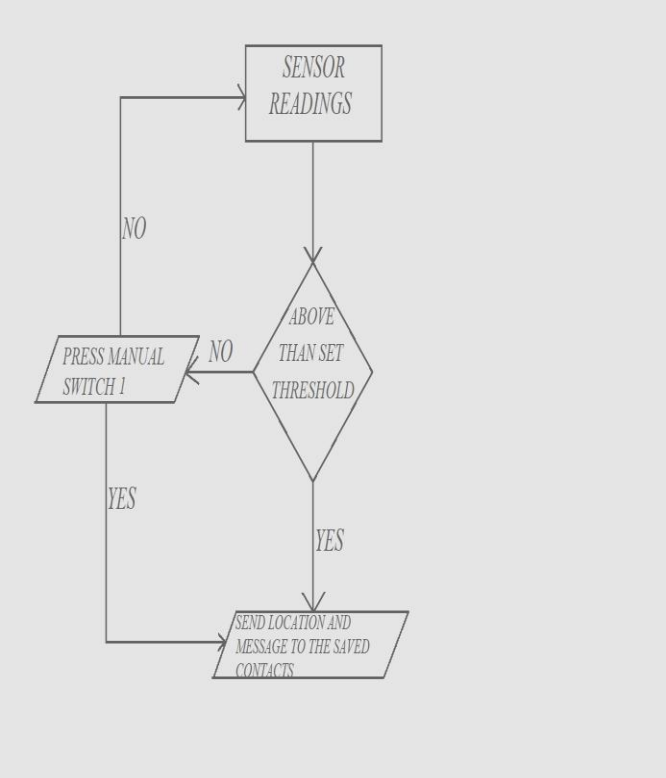

Fig 7: Flowchart of the system

Results and discussion

If the device is used under any of the above discussed critical situations then it will give an alert to the respective contacts/authorities along with location of the user. The same will happen if the user presses the manual switch to send an alert. The message will be sent in the format given below:

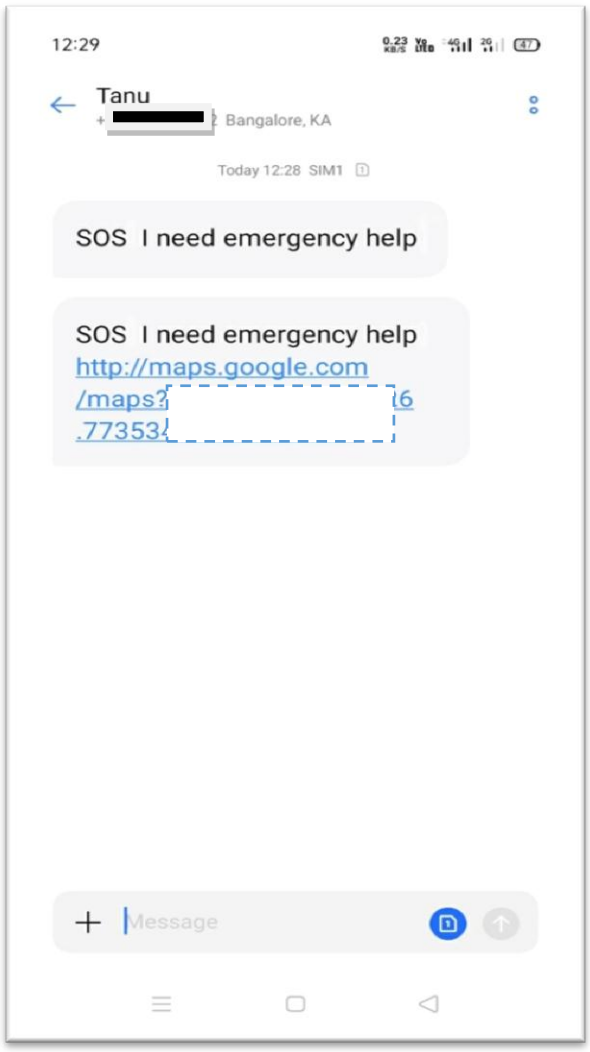

Fig – 8: Message format

Future Scope

With the advancement of technology, the device can be made to work under high precision. Some new sensors can be incorporated to increase its accuracy. We can also use cameras and voice recording system to make it more efficient for the future use. Various extra modules can be added to the device which can make it easier to use. In order to increase the functionality of device we may introduce several new technologies to the system.

Conclusion

The device can not only be used for safety purpose but also for monitoring health. It is an automatic wireless device and therefore it is easy to use. The device is compact in size, hence it is portable. The device works with high precision and the manual switches facilitates better use of the device whenever required.

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