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Sensor Based Healthcare Model

Sri Shanthi Meesala[1]*, G.V. Ramesh Babu[2]

[1]Department of CSE, S.V. University, Tirupati
[2]Dept of Comp. Science, S.V. University, Tirupati

Corresponding Author: shanthimeesala.03@gmail.com

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Abstract - The theme of the work done is to have an SMS text-enabled communication medium between the outsider and the guardian (through GSM communication). At the moment there are many wearables in the market which help track the daily activity of people and also help find the person using Wi-Fi and Bluetooth services present on the device. However, Wi-Fi and Bluetooth appear to be an unreliable medium of communication between the guardian and the person. The guardian can send text with specific keywords like “LOCATION”, “TEMPERATURE”, “HEARTBEAT”, “SOS”, “BUZZER”, and the wearable device will reply you back with a text containing the health conditions and also accurate real-time location of the person which upon tapping will provide directions to the person’s position on Google Maps App and will also give the surroundings temperature. So our project mainly focuses on the basic design and implementation of such devices.The secondary measure taken is the implementation of the bright SOS light and the distress alarm buzzer present on such devices which when activated by the guardian via SMS text displays SOS light brightly and sound an alarm which a bystander can easily spot as a sign of distress.

Keywords - IOT, Safety, Wearable, GSM, GPS, Sensors

I. INTRODUCTION

The Internet of Things System (IOT) refers to the set of devices and systems that stay interconnected with real-world sensors and actuators to the Internet. IOT includes many different methods like smart cars, wearable devices and even personal implanted devices, home automation systems, and lighting controls; smartphones which are increasingly being used to measure the world around them.

Similarly, wirelesses or networks that measure weather and flood defenses, tides and more. There are two important aspects to the IOT: the devices themselves and the server-side architecture that supports them. The motivation for this wearable comes from the increasing need for the people to alert themselves or the guardian of the situation regarding the person’s health statistics.

Our project focuses on an essential aspect that the people around can help the person and can play a significant role in the safety. Most of the wearable available today are focused on providing the location, activity of the person to the guardian via Wi-Fi and Bluetooth. However, Wi-Fi and Bluetooth seem to be an unreliable source to communicate. Therefore it is intended to use SMS as the mode of communication between the guardian and the person’s wearable device, as this has fewer chances of failing compared to Wi-Fi and Bluetooth. The platform on which this project will be running on is the Arduino Uno microcontroller board based on the ATmega328P, and the functions of sending and receiving SMS, calls and connecting to the internet. The Arduino GSM shield provides it with the help of a GSM network. Also, additional modules employed which will give the current location of the person to the guardian via SMS.

The secondary measure implemented is the SOS Light indicator that will be programmed with Arduino UNO board to display the SOS signal by using the morse code. The different modules stay enclosed in a custom-designed 3D printed case. In the scenario, the guardian can locate the person and could send an SMS to the wearable device which would activate the SOS light feature on the wearable. Therefore alerting the people around the person that he/she is in some distress and needs assistance as the SOS signal is universally known as the signal for help. Additionally, the wearable has a buzzer which sets to active by sending the SMS keyword "BUZZ" to the wearable. Hence the buzzing sound is loud and can be heard by the guardian from a very considerable distance. Also, the guardian via SMS can receive accurate coordinates of the person, which can help them locate the person with accuracy.

Some of the existing work done on these similar lines are for example the low-cost, lightweight Wristband Vital which senses and reports hazardous surroundings for people who need immediate assistance such as children and seniors. The basis is on a multi-sensor Arduino micro-system and a low-power Bluetooth 4.1 module. The Vital band samples data from multiple sensors and reports to a base station, such as the guardian's phone or the emergency services. It has an estimated battery life of 100 hours. The major drawback for the vital band is that it uses Bluetooth as the mode of communication between child and the parent. Since the distance between the two in some cases could be substantial and the Bluetooth won't be able to establish a close link between the two. Some more of the similar wearable devices are the Memo, Sprouting, and Swing band having their several drawbacks. Therefore, the wearable device proposed will be communicating with the parent via SMS which would ensure that there is a secure communication link. Also, customization of the wearable is possible as per our needs by reprogramming the Arduino system.

II. SYSTEM OVERVIEW

An ATmega328p microcontroller controls the system architecture of the wearable with an Arduino Uno boot-loader.

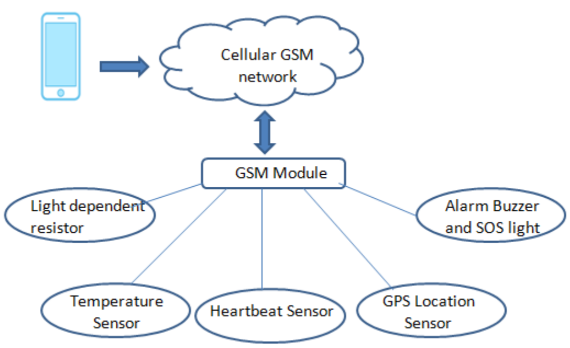

Fig 2.4: System Overview

The system architecture of the wearable is based and controlled by an ATmega328p microcontroller with an Arduino Uno bootloader. The Arduino Uno collects different types of data from the various modules interfaced to it, such as the GPS module upon being triggered by the Arduino GSM shield. The GSM shield is used as an interface to send the data received by the Arduino Uno via SMS or MMS to a smartphone over GSM/GPRS. The GSM shield functions as a trigger for the Arduino Uno to request data from its multiple modules. If an SMS text with distinct characters is sent to seek the current location or GPS coordinates is sent to the Arduino GSM shield via the user's smartphone, then the GSM shield triggers the Arduino Uno for the current GPS coordinates. Once the Arduino Uno has received at the coordinate information, it will process this information and transfer it over to the GSM shield, which then via SMS sends the coordinates to the user's smartphone. The user can tap on the coordinates which will open up the default GPS application installed on the phone and will show the user the distance between the person and the user.

III. WEARABLE DEVICE AND ITS COMPONENTS

The block diagram of the design consists of a power supply unit, atmega328p controller, a fingerprint sensor module, dc motor.

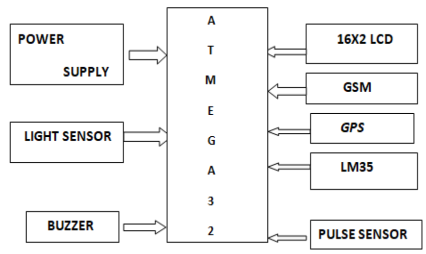

Fig 3.1: Block diagram of the proposed system

A. Power Supply

The source of input to the circuit is from the regulated power supply. The input(a.c) of 230V from the mains supply is the stepdown by the transformer to 12V. The rectifier then is fed by it. The output acquired from the rectifier is a pulsating d.c voltage. So to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is supplied to a voltage regulator to get a pure constant dc voltage.

B. Arduino

The Arduino UNO is an open-source microcontroller board. The Microchip ATmega328P microcontroller is the base. The UNO board has 14 Digital pins, 6 Analog pins, and is programmable with the Arduino IDE (Integrated Development Environment) by a type-B USB cable. This board can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

C. Liquid Crystal Display

The model considered is for its low price and great possibilities most frequently used in practice. The basis is the HD44780 microcontroller (Hitachi), and it can display the messages in two lines with 16 characters each. It shows all the alphabets, Greek letters, punctuation marks, mathematical symbols. Also, it is possible to display symbols that the user makes up on its own. Automatic shifting message on display (shift left and right), the appearance of the pointer, backlight are considered to be useful characteristics. The pins present along one side of the small printed board used for connection to the microcontroller. There is a total of 14 pins marked with numbers (16 in case the background light is built-in).

D. GPS Technology

The Global Positioning System (GPS) is a satellite-based navigation system that sends and receives radio signals. A GPS receiver collects these signals and presents the user with information. Using GPS technology, one can determine the position, velocity and time, 24 hours a day, in any climate conditions anywhere in the world for free.

The goal of the Global Positioning System (GPS) is to determine the position of a person or an object on Earth in three dimensions: east-west, north-south and vertical (longitude, latitude, and altitude). Signals from three overhead satellites provide this information. Each satellite sends a message that codes where it is and the time of emission of signals. The receiver clock times the response of each signal and then subtracts the emission time to determine the time lapse and hence how far the signal has traveled (at the speed of light).

It is the distance the satellite was from the object when it emitted the signal. Thus, the object's location is at a single point at which the three spheres intersect.

```
void gps_enable()
{ pinMode(gsm_pin, OUTPUT);
pinMode(GPS_pin,OUTPUT);
digitalWrite(gsm_pin, LOW);
digitalWrite(GPS_pin, HIGH); //Serial.begin(9600);
delay(100); //wifi
}
```

E. Light Dependent Resistor

LDRs (Light Dependent Resistors) are very helpful, especially in light/dark sensor circuits. Usually, the resistance of an LDR is very high, sometimes as high as 1,000,000 ohms, but when the illumination is with light, the strength drops dramatically. Thus in this project, LDR plays a vital role in switching on the lights based on the intensity of light, i.e., if the intensity of light is more (during daytime), the lights will be in off condition. Moreover, if the intensity of light is less (during nights), the lights will be switched on.

The output of the LDR is given to ADC which then converts the analog intensity value into the corresponding digital data and provides this data as the input to the microcontroller. The pseudo code for light sensor can be written as follows

```
if ((light < 100) && (l3 == 0))
{ l3 = 1; buzz_on();
delay(500);
clear_gsm();
irq_gsm = 0;
buzz_off(); gsm_send_num_mesg3(mobilenum,"T:",s1, "l:", s3, "HB:", s2,"http://google.co.in/maps/place/" ); }
if ((light > 800) && (l3 == 0))
{ l3 = 1; buzz_on(); delay(500); clear_gsm(); irq_gsm = 0; buzz_off(); gsm_send_num_mesg3(mobilenum,"T:",s1, "l:", s3, "HB:", s2,"http://google.co.in/maps/place/" );
}
 if ((light > 100) && (light < 800)) { l3 = 0;
}
```

F. Temperature Sensor (LM35)

LM35 converts temperature value into electrical signals. These sensors are precision integrated-circuit temperature sensors. This output voltage is linearly proportional to the temperature in Celsius. It needs no external calibration since it is internally calibrated and does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. It's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy and can be used with the single power supplies, or with the plus and minus supplies. Since it draws only 60 µA from its supply, it has very low self-heating, which is less than 0.1°C in still air.

The main feature of this sensor is: For each degree of centigrade temperature it outputs 10milli volts. The pseudo code is as follows

```
if ((temperature > 50) && (l1 == 0))
{ l1 = 1;
buzz_on(); delay(500); clear_gsm(); irq_gsm = 0; buzz_off(); gsm_send_num_mesg3(mobilenum,"T:",s1, "l:", s3, "HB:", s2,"http://google.co.in/maps/place/" );
 }
 if (temperature < 40) { l1 = 0; }
```

G. Heartbeat Sensor

Heartbeat sensor is designed to give the digital output of the heartbeat when a finger touches it. When it is working, the beat LED flashes in unison with each heartbeat. This digital output can be linked to microcontroller directly to measure the Beats Per Minute (BPM) rate. Heartbeat sensor is designed to give the digital output of the heartbeat when a finger touches it. While this heartbeat detector is working, the LED flashes in unison with each heartbeat. This digital output can be linked to microcontroller directly to estimate the Beats per Minute (BPM) rate. The working is based on the modulation of light by blood flow within finger at each pulse.

The pseudo code is as follows

```
if ((hb > 85) && (l2 == 0))
{ l2 = 1; buzz_on(); delay(500); clear_gsm(); irq_gsm = 0; buzz_off(); gsm_send_num_mesg3(mobilenum,"T:",s1, "l:", s3, "HB:", s2,"http://google.co.in/maps/place/" );
 }
if (hb < 85) { l2 = 0; }
```

H. Buzzer Circuit

Digital systems and the microcontroller pins lack enough current to drive the circuits like relays, buzzer circuits, etc.

While these circuits require around 10milli amps to perform the operation, the microcontroller's pin can give a maximum current of 1-2milli amps.

For this reason, a driver such as a power transistor is set in between the microcontroller and the buzzer circuit. The operation of this circuit is as follows: The input to the base of the transistor is from the microcontroller port pin P1.0. The transistor switches on when the base to emitter voltage is higher than 0.7V (cut-in voltage). So when the voltage applied to the pin P1.0 is high, i.e., P1.0=1 (>0.7V), the transistor will be switched on, and thus the buzzer will be ON. When the voltage at the pin P1.0 is low, i.e., P1.0=0 (<0.7V) the transistor will be in off state, and the buzzer will be OFF. Thus the transistor acts as a current driver to operate the alarm buzzer accordingly.

The pseudo code is as follows

```
void buzz_on()
{ pinMode(buzz, OUTPUT);
digitalWrite(buzz, LOW); }
void buzz_off()
{ pinMode(buzz, OUTPUT); digitalWrite(buzz, HIGH); }
```

IV. FUTURE ENHANCEMENTS

1. Camera Module

For surveillance of the child's surroundings, to get a clearer picture of the location, this wearable can also contain a camera module incorporated into it. The hardware used would be an adafruit TTL serial camera. The significant focus of this wearable project is the GSM module which is a better choice than Bluetooth, Wi-Fi or ZigBee due to the short range and connectivity problems of these technologies. Arduino GSM shield possesses the added advantage of using GPRS which enables the board to use the internet if required. Whereas for the camera module which supports video streaming but due to the constraint of trying to use the only SMS, therefore only four wire connections will be taking place. To communicate with the camera, the Arduino UNO will be using two digital pins and a software serial port. Because the camera or the Arduino Uno does not have enough onboard memory to save snapshots clicked and stored it temporarily, an external storage source microSD breakout board will be used to store the images temporarily. The camera runs on a usual baud rate of 38400 baud. The camera receives information in the same manner as the GPS module. It is on standby conserving power and waiting for the particular keyword "SNAPSHOT" is sent from the user's smartphone to the GSM shield will activate the camera to begin clicking a snapshot of the surroundings and save the file temporarily on the external microSD card. After which Arduino Uno will access the saved image from the microSD storage and transfer it to the GSM module which sends it to the user via SMS/MMS text.

2. Android App

The idea behind the Android app is by having an automated bot to respond to text message responses from the user. It will provide the user with predefined response options at just the click of a button. The user doesn't need to memorize the specific keywords to send. Also, the bot will be preprogrammed to present the user with a set of predefined keyword options such as "LOCATION," "SNAPSHOT," "SOS". Whereas for the future aspect of this wearable device based on the type of sensor attached, additional specific keywords could be added such as, "HUMIDITY," "ALTITUDE".

V. CONCLUSION

The prototype of monitoring health care systems wearable devices is capable of acting as a smart loT device. It provides guardian with the real-time location, surrounding temperature, and SOS light along with Distress alarm buzzer for their person's surroundings and the ability to locate their person or alert bystanders in acting to rescue or comfort the person. The smart person safety wearable can be enhanced much more in the future by using highly compact Arduino modules such as the LilyPad Arduino which can be sewed into fabrics. Also, a more power efficient model will have to be created which will be capable of holding the battery for a longer time in any type of situations.

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