SMART WEARABLE DEVICE FOR CHILD PROTECTION

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ABSTRACT:
This paper discusses the concept of a smart wearable device for small children. The purpose of this device is to help the parents to locate their children with ease. To make communication medium between the child's wearable and the parent easy, GSM mobile communication is used. parent can send a text with keywords such as "LOCATION", "TEMPERATURE ","UV", "SOS", "BUZZ". The wearable device will reply back with a text containing the real time accurate location of the child which upon tapping will provide directions to the child's location on Google maps app and will also provide the surrounding temperature, UV radiation index so that the parents can keep track if the temperature or UV radiation is not suitable for the child. The secondary measure also used in this project is people present in the surrounding of the child react for the child's safety till the parents arrive and locate them. This secondary measure performed by using a bright SOS Light and alarm buzzer present on the wearable device which activated by the parents via SMS text should display the SOS signal brightly and sound an alarm. Hence this paper aims at providing parents with a sense of security for their child.

Keywords-loT, Children, Arduino, Safety, UV,SOS.

I. INTRODUCTION

The Internet of Things System (loT) [1] refers to the set of devices and systems that stay interconnected with real-world sensors. The motivation for this wearable comes from the increasing need for safety for children in current times as there could be scenarios of the child getting lost in the major crowded areas. This paper focuses on the key aspect of; the lost child can be helped by the people around the child and can play a significant role in the child's safety until reunited with the parents. The platform of this project will be running on Arduino Uno microcontroller board based on the ATmega328P, and the functions of sending and receiving SMS, calls and connecting to the internet which is provided by the Arduino GSM shield. Also, additional modules employed which will provide the current location of the child to the parents via SMS. The second measure added is SOS Light indicator that will be programmed with Arduino UNO board to display the SOS signal using Morse code. Therefore alerting the people around the child that the child is in some distress and needs assistance as the SOS signal is universally known as the signal for help needed. Additionally, the wearable comes equipped with a distress alarm buzzer which sets to active by sending the SMS keyword "BUZZ" to the wearable. Hence the buzzer is loud and can be heard by the parent from very considerable distance. Also the parents via SMS can receive accurate coordinates of the child, which can help them locate the child with pinpoint accuracy. Therefore, the proposed wearable device will communicate with parent via SMS which would ensure that there is a secure communication link.

II. SYSTEM DESIGN AND ARCHITECTURE

This section discusses the architecture and the design methodologies chosen for the development of the Child Safety wearable device.

A. System Overview

An ATmega328p microcontroller controls the system architecture of the wearable with an Arduino Uno boot- loader. A 5 pin header allows for power (+3V) and ground connections as well as providing access to TX, RX, and reset pins of the ATMega328p. The Arduino Uno collects various types of data from GPS module The GSM shield is used as an interface to send the data received by the Arduino Uno via SMS or MMS to a smart phone over GSM GPRS. The GSM shield functions as a trigger for the Arduino Uno to request data from its various modules.

If an SMS text with distinct characters is sent to request the current location or GPS coordinates is sent to the Arduino GSM shield via the user's smart phone, then the GSM shield triggers the Arduino Uno to request the current GPS coordinates.

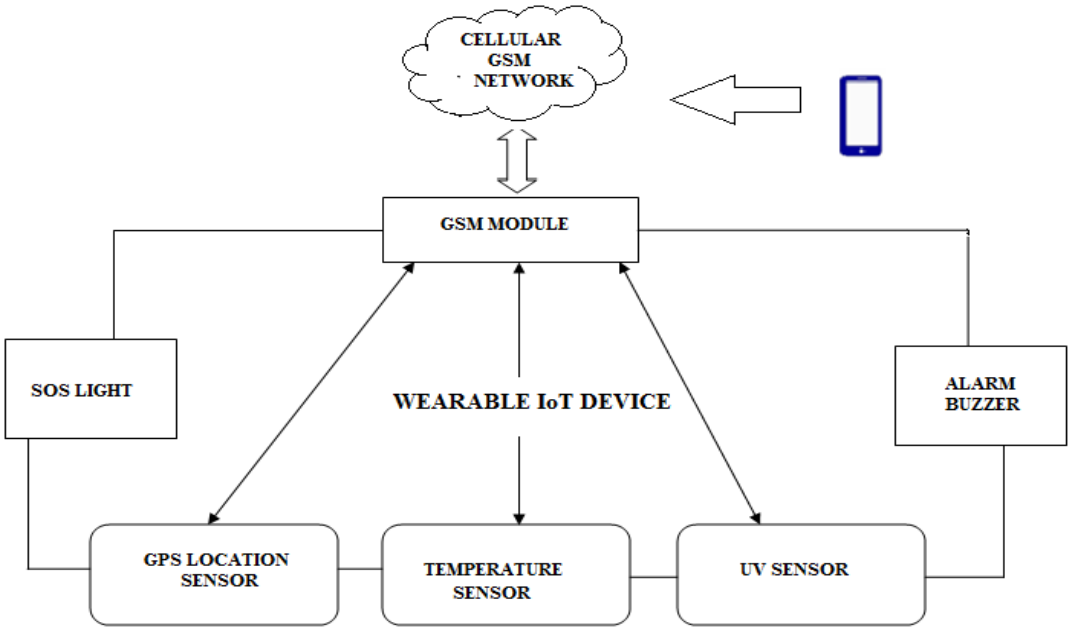

Fig 1. System overview of wearable device for child protection.

The GSM shield uses digital pins 2 and 3 for the software serial communication with the MIO. Pin2 is connected to the MlO's TX pin and pin 3 to its RX pin. The Ml0 is a Quad- band GSM/GPRS modem that works at GSM850Mhz, GSM900Mhz, DCS1800Mhz, and PCS1900Mhz. Once the Arduino Uno has received at the coordinate information, it will process this and transfer it over to the GSM shield SMS sends the coordinates to the user's smart phone. The coordinates which will open up the default GPS application installed on the phone and will show the user the distance between child and user.

B. Wearable loT Device

The wearable device comprises of Arduino Uno based on the ATmega328P microcontroller. It receives the data from its various physically connected modules. The physical characteristics of the wearable device are proposed to be a wrist watch which remains placed around the wrist of the child during times when the child is not being accompanied by an adult/parent. The wearable system runs on a battery with an output voltage of 5V. For determining the real time location of the child Parallax PMB-648 GPS module has been used which communicates with the Arduino Uno through a 4800 bps TTL-level interface. The connections between the Arduino Uno and the GPS module established with three wired connections which enable the Arduino to read the GPS data. The GPS module receives location information from the various satellites present in the NAVSTAR (American Satellites Timing and Ranging Global Positioning System) GPS system [1.To interface the PMB-648 GPS module with the Arduino to provide precise latitude and longitude GPS coordinates, the Tiny GPS library was added into the Arduino IDE. The Yin (red wire) on the PMB-648 GPS module is connected to the 5V pin on the Arduino Uno via jumper cables. Similarly, the GND (black wire) pin on the GPS module is connected to the GND pin on the Arduino Uno via jumper cables. The TXD (yellow wire) is connected to pin 6 of the Arduino Uno via jumper cables on the breadboard. The pin six on the Arduino Uno is a digital pin which can also be used for PWM (Pulse Width Modulation) applications.

1. GPS Location Sensor

Once the SMS trigger text "LOCATION" is sent from the cell phone of the user, this text is received by the Arduino GSM Shield which in turn triggers the Arduino Uno to execute the GPS code to fetch the current, accurate location of the GPS module. The location output received from the GPS module is in the following format. Once the SMS trigger text "LOCATION" is sent from the smart phone of the user, this text is received by the Arduino GSM Shield

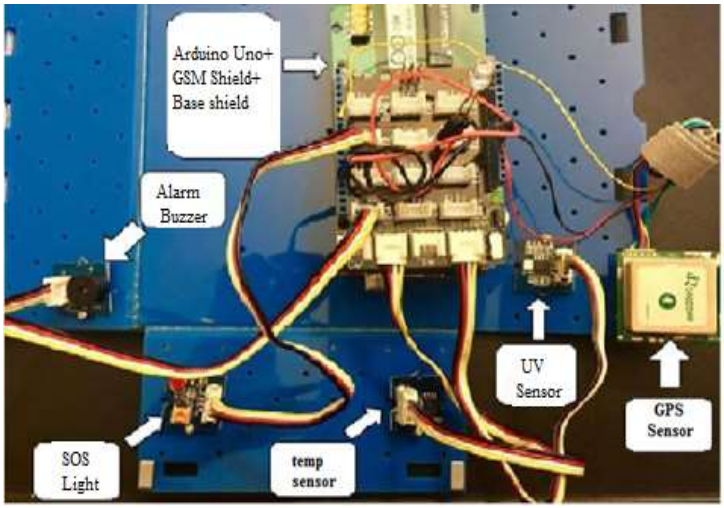

Fig 2: proposed system of wearable device

which in turn triggers the Arduino Uno to execute the GPS code to fetch the current, accurate location of the GPS module. The location output string received from the GPS module is in the following format:
Then the final results for latitude and longitude are inserted into the following URL format:
http://maps. google. coml?q=<lat>, <lng>

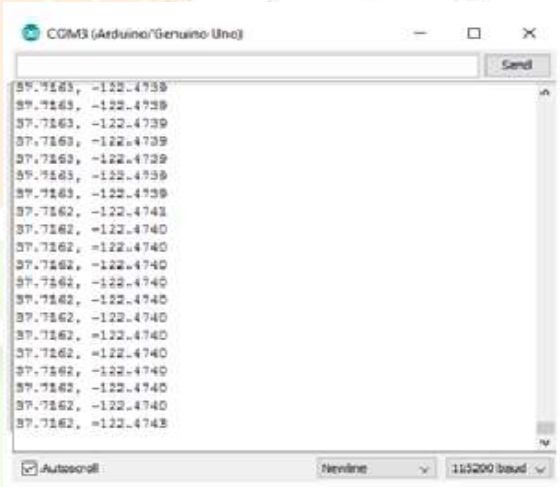

Fig 3. Output received from GPS location sensor.

Hence the user can just directly click on this received Google maps hyperlink which will automatically redirect the user to the Google Maps app on the smart phone and show the pinpoint location of the child. This SMS can be received directly on the default SMS app or via Android app on the user's smart phone.

2. Temperature Sensor

In order to measure the temperature of the surroundings of the child, a seed studio grove temperature sensor was used. The sensor module is equipped with a thermistor for measuring the ambient temperature and the fluctuations with high accuracy. The observable temperature detectability for this sensor ranges from -40°C to -125°C and the precise accuracy for this device range from +1.5°C to -1.5°C. The temperature is connected to the Arduino Uno and GSM shield using a Grove base shield which contains eight digital ports ranging from D1 to D8, four analog ports ranging from AO to A3 and 4 I2C ports. Therefore, the temperature sensor is connected to the A2 analog port of the base shield. The temperature value is stored in a string getTemp(a), where "a" is the integer type. Hence the getTemp(a) is called by the GSM module upon receiving the proper SMS keyword "TEMPERATURE" by the user's smart phone.

3. UV *Sensor*

In order to measure the ultraviolet radiation intensity present around the surroundings of the child, UV sensor was used. The UV sensor is built on the GUVA-SI2D sensor (spectral range of 200nm-400nm). The purpose of a UV sensor in a child wearable device can be to protect the child from harmful radiations of the sun. The UV sensor is connected to the AO port of the base shield

4. SOS Light

The purpose of the SOS light is to be able to alert the people nearby that the child might be in distress since the light will be flashing the universal SOS light symbol which many people nowadays know for to be a sign for help. This can be activated by the parent itself by sending an SMS text with the keyword "SOS" to the child's wearable which will activate the SOS light flashing. The SOS light works on the principal of Morse code in which "S" stands for three short dots and the "0" stands for three long dashes.

5. Buzzer

The parent can locate their child by sounding a very loud alarm on the wearable. To achieve this, grove seed studio buzzer was used, which has a piezoelectric module which is responsible for emitting a strong tone upon the output being set to HIGH. The grove buzzer module is activated upon sending an SMS text with the keyword "BUZZ" from a cell phone. The buzzer is connected to the D4 digital port of the base shield.

Fig 4: Arduino GSM Shied

III Results

In this section, the experimental tests were performed to determine the various components of the proposed wearable device Fig5 by testing the wearable device multiple times with repeated SMS texts. The GPS location sensor was able to respond back with the precise latitude and longitude coordinates of the wearable device to the user's cell phone, which then the user would click on the received Google maps URL which would, in turn, open the google maps app and display the pinpoint location in the cell phone.

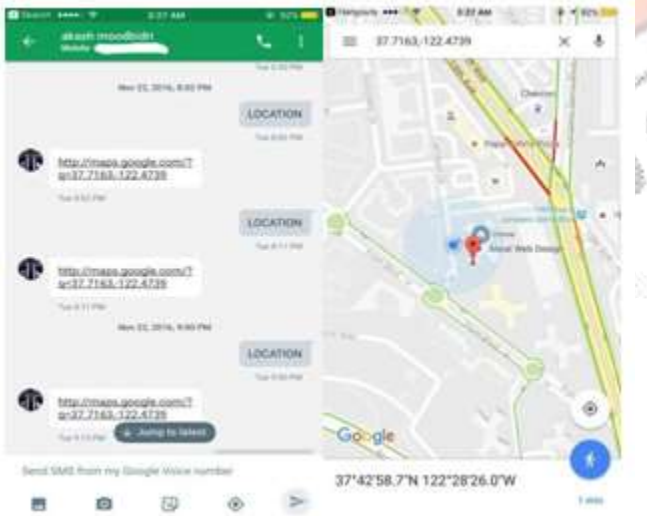

Fig 5. Left: Cell phone SMS app for LOCATION sensor and Right: Google maps with latitude and longitude coordinates.

The UV sensor was measured under different intensities of sunlight around the child. The UV sensor was quick in response to the changes in the intensity of sunlight. The response time to receive a response back to the keywords "UV" was with in a minute as well.

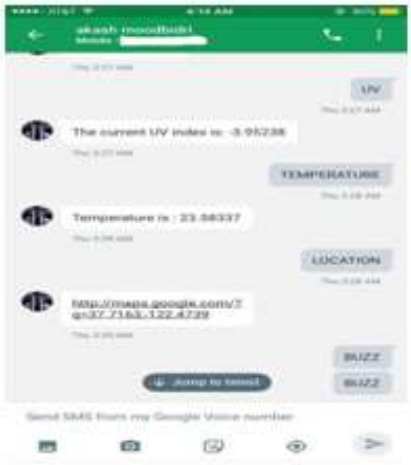

Fig 6. SMS app screen for UV & Temperature sensor

Upon receiving the correct keywords, the SOS light and Alarm Buzzer would first performs the particular task such as flashing the SOS light and sounding a distress alarm which can take a little longer than their sensor counterparts. After completion of their respective functions, the response is sent back to the user's cell phone as: "SOS Signal Sent" and "Playing Buzzer."

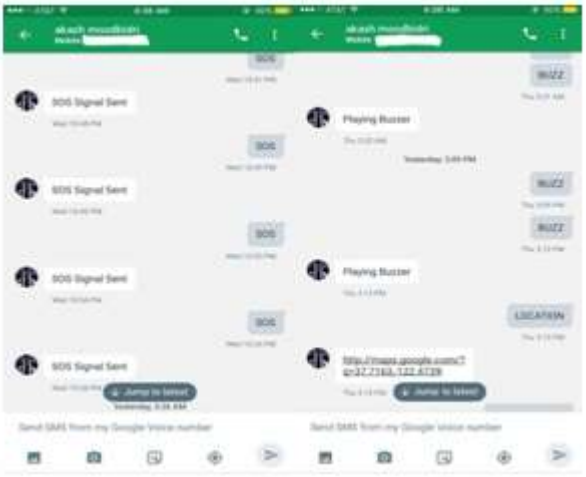

Fig 7. SMS app screen for Left: SOS Light & Right: Distress alarm buzzer.

IV FUTURE SCOPE

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 in it. The hardware that could be used would be a TTL serial camera. To talk to the camera, the Arduino uno will be using two digital pins and a software serial port to talk to the camera. Since the camera or the Arduino Uno do not have enough onboard memory to save snapshots clicked and store it temporarily, therefore an external storage source micro SD breakout board will be used to save the images temporarily.
2. Android App:
The idea behind the Android app has been derived from 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," etc.

V CONCLUSIONS

The child safety wearable device is capable of acting as a smart loT device. It provides parents with the real-time location, surrounding temperature, UV radiation index and SOS light along with Distress alarm buzzer for their child's surroundings and the

ability to locate their child or alert bystanders in acting to rescue or comfort the child. The smart child 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.

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