Wearable Child safety System

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Abstract. The paper focuses on a smart wearable device used for children. The main benefit of this wearable compared to other wearable is that it can be used in any of smart mobile phones and does not need a very costly mobile phone and not a highly technical human. The main idea of this wearable safety system is to aid the parents in finding their child very easily. In the current scenario, there are lot of wearable that monitors the routine behavior and activities of children and also help to find the child using Wireless Fidelity (Wi-Fi) and Bluetooth services that are available on the device. But both of them seems to be an unsecured communication in between the parent and the child. Therefore, the objective of this paper is SMS (Short message service) text enabled link in between the child's wearable and the respective parent. The main idea for achieving this is Global System of Mobile Communication (GSM). The parent has to send a text message in the form of SMS using words like “Temperature”, “SOS”, “Location”, “Buzz” etc., to the wearable system. The wearable device sends an acknowledgement in the form of a text showing the location of the child and will provide the atmospheric temperature, so that the parents can have a track if the temperature does not suit the child. The next measure that can be taken is by using a SOS Light that is bright. Distress alarm buzzer present on the wearable device can also be activated by the parents through SMS text to display the SOS signal very clearly and rings an alarm which the nearby public can immediately react to the safety of the child till the parents come or they can try to reach he parents and assist in locating the child.

1. Introduction

The main idea of this wearable arrangement arises from the challenging need for child safety as there can be circumstances where child gets missing in most of the crowded areas. This work mainly focuses on the vital aspect that lost children can be helped by the public. This system plays an important role in the protection of the kid until brought together with their parents. Therefore it is required to make use of the short message service as the link between the child's wearable and the
parent and, as this way of doing has less probability of failure in comparison to Bluetooth and Wi-Fi. Arduino Uno microcontroller board based on the ATmega328P is the platform used for running. The process of communication with SMS is provided by the Arduino GSM Module by the use of the GSM network. And it will make available the current location of the kid to the concerned parents via short message service. The second measure added is SOS Light indicator that will be coded with Arduino UNO board to show the SOS signal whenever the parents need [1]. In this situation, a missing kid can be found by the parent who could send a specially defined keyword as a short message service to the wearable that acknowledges with the current location to the parent’s phone. Additionally, the wearable equipped with a distress alarm buzzer which sets to active by sending a short message service keyword "BUZZ" to the wearable. Hence the buzzer is with high volume and can be heard by the parent from very considerable distance. Also the parents via short message service can receive location of the child, which can help them locate the child with maximum accuracy. Some of the existing works are the lightweight, low-cost, Wristband Vital that senses and reports hazardous surroundings for people who requires immediate assistance such as children and seniors. This utilizes a Arduino system along with a Sensor system and Bluetooth 4.1 module. This Bluetooth module is a low power module. The major disadvantage for this important band is that it employs Bluetooth as the way of communication in between parent and the child. Therefore, the wearable device implemented in this paper will be effectively communicating the parent via SMS through GSM .This ensures that there is a secure communication link [2]. Also, customization of the wearable can be possible as per the needs by reprogramming the Arduino system.

2. System design and architecture

This section also shows the proposed architecture and the design procedures preferred for the development of the Child Safety wearable system. System Overview consists of an ATmega328p microcontroller that decides the architecture of the wearable system with an Arduino set up as in Fig 1.

2.1 The ARDUINO UNO

It gathers the statistics and information from the various modules connected to it, such as the Global positioning system module .This system is activated by the Arduino Uno by receiving short message service from GSM module. This module is used as a link to send the data received by the Arduino Uno through short message service to a mobile [3]. The GSM module functions as a trigger for the Arduino Uno to request data from its various modules connected to it. A text with special keyword is sent to get the present latitude or longitude (GPS coordinates) to the GSM module via the user's phone.

2.2 Wearable device

The wearable device is not constructed on a system on chip SOC model. But it has been anticipated to use bigger components and in future, it can be built on the SOC platform. The wearable device acquires collection of data from the various modules that are connected to it. It comprises of Arduino Uno based on the ATmega328P microcontroller. The arduino Uno receives data from different modules and analyse the data and customizes the data in a user understandable format. For the moment the design is not made compact, since the main focus now has been to show that this concept of smart wearable’s would be highly impactful for the safety of the children. This wearable child safety system works on a battery or any external source [4]. In order to minimize power consumption, the wearable device has been programmed to provide GPS and other information only upon request by SMS text via GSM.
3. Block Diagram of the Proposed System

System Overview consists of an ATmega328p microcontroller that decides the architecture of the wearable system with an Arduino set up as in Figure 1.

![Block Diagram of Child safety System](image)

3.1 GPS Location sensor

For determining the real-time location of the child, NEO6MV2 GPS module has been used which communicates with the Arduino Uno through a 9600 bps software serial interface. The connections between the Arduino Uno and the GPS module are made. This system exhibits a very low power consumption and very compact in size. The GPS module output comprises of standard string information which is governed by the National Marine Electronics Association (NMEA) protocol. Short Message service (SMS) triggers text "LOCATION" and is transmitted from the mobile phone of the user. Upon transmission, this text is acknowledged by the GSM. This text in addition prompts the Arduino Uno for execution and hence Arduino Uno runs the GPS code and gathers the present, current, and accurate location of the GPS module. The following formats are the location output received from the GPS module [5]. The latitude and longitude coordinates received are stored in variables called "latitude" and "longitude," which are then called upon when the SMS text received on the GSM module matches with the keyword "LOCATION". The location output string received from the GPS module is in the following format: 1 330516 Time Stamp 7 183.7 Speed in knots 4 A validity - A- ok, V-invalid 8 231.8 True course 3 4785.23 current Latitude 8 123456 Date Stamp 3 S North/South 10 004.2 Variation 5 00042.24 current Longitude 9 E East/West 6 W East/West 12 *70 checksum D.

3.2 Temperature Sensor

The temperature of the surroundings of the child can be monitored using a LM35 sensor. This element is equipped with a thermistor (with a particular temperature coefficient of resistance) for measuring the surrounding temperature and the variation with efficiency. The temperature sensor is coupled to the Arduino Uno board. The value of the temperature is stored in a variable which may be integer or string.
type. Hence the temperature is invoked by the Arduino Uno upon getting the appropriate short message service keyword “TEMPERATURE” from the user’s mobile phone.

3.3 Alarm

In the scenario, if a child is separated from his/her parents. The parent can find out the location of the child by alarm sound in a very loud alarm using this wearable device. In order to achieve this, a piezoelectric buzzer is utilized, and this is responsible for emitting a strong tone upon the output being HIGH.

3.4 The Buzzer Module

It is activated upon sending an SMS text with the keyword “BUZZ” from a cell phone. Also, this buzzer module works by alerting the people who are in the nearby surroundings with the distressed tone that the child might be lost and requires assistance. The buzzer is connected to the digital pin of the Arduino.

3.5 GSM Module

Dual Band GSM/GPRS engine named SIM900A is built with the GSM/GPRS Modem–RS232, it works with frequencies of about 900/1800 MHz. The Modem is available with RS232 interface. This interfaces PC and microcontroller with RS232 Chip (MAX232). The baud rate can be configured between 9600-115200 bps through AT (Attention) command. And also it is appropriate for short message service, voice as well as data communication application for machine to machine interface. Onboard Regulated Power supply allows connecting wide range of unregulated power supply. Using this modem, it is likely to make calls, send short message service, read short message service, attend the arriving calls and use internet etc. through simple AT commands. Also it transfers the information to the user via SMS. Arduino offers libraries for GSM module .This allows the GSM module to make and receive a call, send and receive SMS and act as a client and a server. The GSM module accepts 5Volts power supply directly from Arduino Uno 5V. The serial communication between the Arduino Uno and GSM module is achieved through the serial pins 0, 1. The Arduino has been planned to obtain text messages from the parent’s smart phone through the GSM module. The GSM module constantly scans the received text messages for the specific keywords like “Location”, “Temperature”, “SOS” and “Buzz”. GPS Location Sensor tests the wearable device multiple times with repeated SMS texts. The GPS location sensor will be able to respond with accurate latitude and longitude coordinates of the wearable system to the user's smart mobile phone [6]. The user would connect to the received Google maps Uniform Resource Locator (URL). This in addition opens the google map app or any default browser. This in turn displays the location. Child safety system set up is as shown in Figure 2.
4. Result

This paper using the GSM technologies is beneficial as the cellular range is vast and since all the communication between the wearable and the user is taking place via SMS and therefore no internet connectivity is required. But, still, the GSM module possesses the added advantage of using GPRS which enables the board to use the internet if required.

In all the situations, testing of the GPS module will be done. This would respond back to the user's smart phone very quickly. The current location of the wearable system can be seen from the GPS module with exact accuracy and also shows exactly where it is present. Sometimes it can be seen that the wearable is marginally off from the exact location [7]. This mismatch in the exact location of the wearable can turn out to be serious in a real life situation, where the parent may be misled to the incorrect location of the child. Therefore, it is found that NEO6MV2 GPS module is effective in providing the accurate location with worthy response time and in great accuracy [8]. The single disadvantage is that the GSM module could not interpret numerous valid keywords directed as a single message. For example, SMS string sent: ‘Location’, ‘Temperature’, ‘Buzz’ and ‘SOS’.

SOS Light and Distress Alarm Buzzer will send an SMS either "SOS" or "BUZZ," .This would trigger the light or buzzer to perform an output function instead of providing measurements back to the user's mobile such as in the scenario of the other sensors [9]. Upon receiving the proper keywords, the SOS light and Alarm Buzzer would first perform the particular task of flashing the SOS light and sounding an alarm which can take a little longer than their sensor counterparts [10]. After completion of their respective functions, the response is sent back to the user cell phone stating: "SOS Signal Sent" and "Playing Buzzer".

5. Conclusion

Camera Module can be used for surveillance of the child surroundings. This gets a clearer picture of the location or place this wearable can also be incorporated on a camera module . The hardware that can be used would be a adafruit TTL serial camera or any other camera module. Since the major focus

![Figure 2 Child safety System set up](image-url)
of this wearable is the GSM module which is a better alternative than Bluetooth, Wi-Fi or ZigBee due to the short range and connectivity issues. Some camera module supports video streaming. Due to the constraint of trying to use only SMS, only four wire connections are used. The red and black wires will be connected directly to +5V and GND respectively to the Arduino Uno board. The RX pin is used for sending data via arduino Uno and GSM board. The TX pin is utilized for receiving incoming data from the modules. The 10 K resistor divider is used. The camera's serial data pins utilizes a 3.3V logic, and it would be a good idea to divide the 5V down so that it reaches 2.5V. Normally the output from the digital 0 pin is 5V high. Resistors are connected such that camera input never reaches beyond 3.3V. Two digital pins and a software serial port will be used by Arduino Uno while communicating with the camera. An external storage micro board can be used to save the images provisionally as the camera or the Arduino Uno do not have sufficient onboard storage space to save snapshots. Camera operates on a typical baud rate of 38400 baud. The camera collects information in the same method as the GPS module does. It will be on standby power saving mode and waits for the keyword 'snapshot' or any other word well-defined in the program. This keyword is sent from the user's mobile phone to the GSM kit. This in turn activates the camera by the Arduino Uno. Then a snapshot of the surroundings can be taken and the file can be saved temporarily on the external SD (Secure Digital) memory card. After this process, Arduino Uno will access the stored images from the SD storage and relocate it to the GSM module. This in turn is send to the user through SMS text.

Android App: An automated bot is required to respond to text message responses from the user. This is the main idea behind the use of Android App. Response options are predefined and provided to the user at a single click of a button. Specific keywords that are to be sent must be memorized by the user. In addition to it, the automated bot can be pre-programmed to present the user with a set of predefined and specified keyword such as "Location," "Snapshot," "SOS," etc. As a future scope, additional specific keywords could be added. For eg, "Humidity," "Altitude," etc could be added. Android app offers extra edge to the user for understanding easily. Provision of a predefined keyword button for getting Location is the main notion in Android App. This eases the work.

6. Future Scope

The child safety wearable system acts as a smart device. Child’s surroundings can be located with the help of accurate and precise real-time location. Surrounding environment temperature, SOS light along with Distress buzzers are provided in this system. This helps in locating their child. This also aids the bystanders to rescue the child. The smart child safety wearable can be boosted considerably in the future by using extremely squeezed Arduino modules like Lily Pad Arduino which can be embroidered into fabrics. Also as a future scope, more power efficient model can be created that holds the battery for a longer time.

7. References

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