

## **Child Safty and Health monitoring system**

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### **ABSTRACT**

*This paper discusses the concept of a smart wearable device for little children. The major advantage of this wearable over another wearable is that it can be used in any cellphone and doesn't necessarily require an expensive smartphone. The purpose of this device is to help parents locate their children with ease and also give the information about child health like child temperature; heart beat rate blood pressure, dehydration. At the moment there are many wearable's in the market which help track the daily activity of children and also help find the child using Wi-Fi and Bluetooth services present on the device. But Wi-Fi and Bluetooth appear to be an unreliable medium of communication between the parent and child. Therefore, the focus of this paper is to have an SMS text enabled communication medium between the child's wearable and the parent as the environment for GSM mobile communication is almost present everywhere. The parent can send a text with specific keywords such as "LOCATION" "TEMPERATURE" "SOS" "BUZZ", "SWT", "HBT" etc., the wearable device will reply back with a text containing the real time accurate location of the child and send location image by using the camera which is capturing the image, which upon tapping will provide directions to the child's location on Google maps app and will also provide the surrounding temperature so that the parents can keep track if the temperature is not suitable for the child. and we always need to have a secondary measure at hand. The secondary measure used in this project is the people present in the surrounding of the child who could instantly react for the child's safety till the parents arrive or they could contact the parents and help locate them. The secondary measure implemented was using a bright SOS Light and distress alarm buzzer present on the wearable device which when activated by the parents via SMS text should display the SOS signal brightly and sound an alarm which a bystander can easily spot as a sign of distress. Hence this paper aims at providing parents with a sense of security for their child in today's time and also alerting about child health when they are out of station by using sensors*

**Keywords-*IoT, Children, Safety, Wearable***

### **I. INTRODUCTION**

The Internet of Things System (IoT) [1] refers to the set of devices and systems that stay interconnected with real-world sensors and actuators to the Internet. IoT includes many different systems like smart cars, wearable devices [2] and even human implanted devices, home automation systems [3] and lighting controls; smartphones which are increasingly being used to measure the world around them. Similarly, wireless sensor networks [4]

that measure weather, flood defenses, tides and more. There are two key aspects to the IoT: the devices themselves and the server-side architecture that supports them [5]. The motivation for this wearable comes from the increasing need for safety and health monitoring for little children in current times as there could be scenarios of the child getting lost in the major crowded areas as well as there is need for any health problem take place when they are out of stations. This paper focuses on the key aspect that lost child can be helped by the people around the child and can play a significant

Role in the child's safety and health monitoring until reunited with the parents. Most of the wearable's available today are focused on providing the location, activity, etc. of the child to the parents via Wi-Fi [8] and Bluetooth [9]. But Wi-Fi and Bluetooth seem a very unreliable source to transfer information. Therefore, it is intended to use SMS as the mode of communication between the parent and child'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 Raspberry pi [10] single board computer based with wireless LAN and Bluetooth connectivity, and the functions of sending and receiving SMS, calls and connecting to the internet which is provided by the GSM shield using the GSM network [11]. Also, additional modules employed which will provide the current location and image of the child to the parents via SMS. The second measure added is SOS Light indicator that will be programmed with Raspberry pi board to display the SOS signal using Morse code. The different modules stay enclosed in a custom designed 3D printed case [12]. In the scenario, a lost child can be located by the parent could send an SMS to the wearable device which would activate the SOS light feature on the wearable. 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 then locate the child with pinpoint accuracy and camera capture the image of exact location of child and send to the parent via SMS when parent sending the SMS "SNAPSHOT" to the wearable for location image. Additionally, the wearable comes equipped with a health monitoring unit which gives the information about child body temperature, dehydration level, heart beat rate of child and blood pressure. Some of the existing work done on these similar lines are for example the low-cost, lightweight Wristband Vital [2] which senses and reports hazardous surroundings for people who need immediate assistance such as children and seniors. It is based on a multi-sensor Raspberry pi 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 just won't be able to establish a close link between the two. Some more of these similar wearable devices are the Mimo, Sprouting, and the OIN iSwingband 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 Raspberry pi system.

## II. SYSTEM DESIGN AND ARCHITECTURE

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

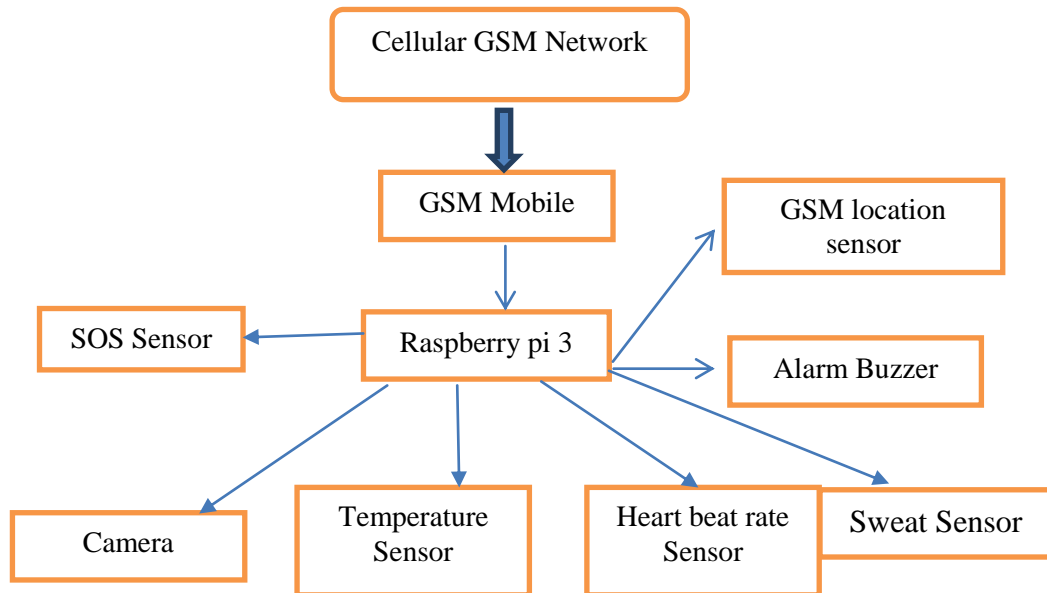


Fig 1. System overview of the wearable device.

### 2.1. System Overview

A raspberry Pi controls the system architecture of the wearable with an allows for power (+3 V) and ground connections as well as providing access to TX, RX, and reset pins of the AT Mega328p. The Fig illustrates the architecture of the child safety and health monitoring wearable device, which depicts the various technologies and technological standards used. The system architecture of the wearable is based and controlled by an AT - mega328p microcontroller with an Raspberry Pi Board. The Raspberry pi-3 collects various types of data from the different modules interfaced to it, such as the GPS module upon being triggered by the Raspberry pi GSM shield. The GSM shield is used as an interface to send the data received by the Raspberry pi via SMS or MMS to a smartphone over GSM/GPRS. The GSM shield functions as a trigger for the Raspberry pi 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 Raspberry pi GSM shield via the user's smartphone, then the GSM shield triggers the Raspberry pi to request the current GPS coordinates. It also supports TCP/UDP and HTTP protocols through a GPRS connection. Once the Raspberry pi has received at the coordinate intonation, it will process this intonation and transfer it over to the GSM shield, which then via SMS sends the coordinates to the user's smartphone. The user can just 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 child and the user.

## 2.2. Wearable IoT Device

The wearable device, for now, is not built on a SoC model, rather has been proposed using larger components and can later build on the SoC platform once put into manufacture. The wearable IoT device tasked with acquiring various data from all the different modules connected. It comprises of Raspberry pi based on the ATmega328P microcontroller. It receives the data from its various physically connected modules, anatomizes this data and refines the data in a more user understandable format to the different available user interfaces. The user, therefore, can conveniently view the information on their cellphone. The physical characteristics of the wearable device are proposed to be as 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. For the moment the design is not made compact, since the main focus now has been to show that this concept of smart wearables would be highly impactful for the safety of children. The wearable system runs on a battery with an output voltage of 5V. In order to maximize power consumption, the wearable device has been programmed to provide GPS and image information only upon request by SMS text via GSM shield. Fig 2. Proposed wearable IoT Device.

1) GPS Location Sensor For determining the real-time location of the child Parallax PMB-648 GPS module has been used which communicates with the Raspberry pi through a 4800 bps TTL-level interface. Once the SMS trigger text "LOCATION" is sent from the cell phone of the user, this text is received by the Raspberry pi board GSM Shield which in turn triggers the Raspberry pi 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 SMS text is received which contains none of the pre-programmed keywords, then the Raspberry pi GSM shield automatically deletes the text message and does not reply back the user with any location details. Once the SMS trigger text "LOCATION" is sent from the smartphone of the user, this text is received by the Raspberry pi GSM Shield which in turn triggers Raspberry pi to execute the GPS code to fetch the current, accurate location of the GPS module.

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 smartphone 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 smartphone.

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  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  and the precise accuracy for this device range from  $+1.5^{\circ}\text{C}$  to  $-1.5^{\circ}\text{C}$ . The temperature is connected to the Raspberry pi and GSM shield using a Grove base shield upon receiving the proper SMS keyword "TEMPERATURE" by the user's smartphone.

3) Heartbeat rate Sensor In order to measure the heart beat rate of child, a highly sensitive sensor.

4) Sweat Sensor in order to detect the sweat of child body for detection of dehydration level

5) SOS Light Another theory that this paper focusses on is that bystanders are the fast mode of help for a missing child. 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 "O" stands for three longdashes. Since a very long time, the SOS signal has been universally known for being the sign of distress and help. The SOS signal is referred to by all security personals, who if find the child to be missing can act and help locate the parents with surplus resources present at their disposal. The SOS Light is connected to the pin 13 of the base shield. 6) Distress Alarm Buzzer In the scenario, if a child is separated from his/her parents. 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 cellphone. Also, this buzzer works similar to the SOS led by alerting the people nearby with the distressed tone that the child might be lost and is in need of assistance. 7) A camera is used for capturing cleared image of location

### **2.3 GPS Location Sensor**

Upon testing the wearable device multiple times with repeated SMS texts. The GPS location sensor was able to respond back with precise latitude and longitude coordinates of the wearable device to the user's cellphone, 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 all these scenarios the GPS module was tested, it would respond back to the user's cellphone within a minute. The GPS turned out to be so precise with the location that it performed even better than

the GPS on an expensive smartphone. As shown in the image below, the GPS module (red bubble) was able to show the current location of the wearable with pinpoint accuracy and also show exactly at which side of the building it is present. Whereas for the smartphone (blue dot) is showing the wearable to be present on the street, which is marginally off from the exact location. This marginal miss match in the pin-point location of the wearable can turn out to be fatal in a real-life scenario, where the parent may be misled to the wrong location of the child. Therefore, the Parallax PMB-648 GPS module proves to be successful in providing the precise location with high accuracy and with a good response time. The only drawback that could be stated was, the GSM module could not interpret multiple valid keywords sent in a single message. For example, SMS strings sent: LOCATION, TEMPERATURE, BUZZ SOS; it would not send a reply back to the GSM module. Fig 6. Left: Cellphone SMS app for LOCATION sensor and Right: Google maps with latitude and longitude coordinates displayed.

### **2.4. Temperature, Heart beat rate sensor:**

Similar to the GPS location sensor, the Temperature, and Heart beat rate sensors were tested multiple times under different temperatures and higher intensities of sunlight. Both the sensors performed exceptionally well to the test performed. The response time to receive a response back to the keywords "TEMPERATURE" and "HBT" was under a minute. Also, measured under different intensities of sunlight.

### **2.5SOS Light and Distress Alarm Buzzer:**

The light and buzzer differ from the above sensors in the SMS trigger mechanism. Upon sending an SMS with either "SOS" or "BUZZ," this would trigger the light and buzzer to perform output function instead of providing measurements back to the user's cellphone such as in the scenario of the other sensors. Upon receiving the correct keywords, the SOS light and Alarm Buzzer would first perform the particular task of 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 stating: "SOS Signal Sent" and "Playing Buzzer"

### **III. CONCLUSION**

The child safety wearable device is capable of acting as a smart IoT device. It provides parents with the real-time location, surrounding temperature, Heartbeat, dehydration level 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 and health monitoring wearable can be enhanced much more in the future by using highly compact A Raspberry pi module. 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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