ABSTRACT

Child safety is a major concern in any society due to the vulnerability of a child and consequently, higher rates of crimes against children. With this issue on our hands, a smart wearable Internet of Things sensor network for monitoring the environment of a child can be developed to help parents ensure the safety of their children. It must also necessarily include amechanism for tracking the child. An advantage of this wearable device is that, according to its design, it can be accessed from any mobile device and does not mandate a lot of technical knowledge from the user to operate. The purpose of this device is to facilitatethe guardian or parents in locating their child with ease and ensuring its well-being. The basic mechanism of this system involves monitoring the environment through sensor nodes, acquiring real-time data and transmitting this data to a cloud server. The data can be accessed by users through a web-based interface present on this cloud server. The wearable also functions to send alerts tothe user through a mobile application in case an emergency condition is detected by it. The design of this model involves developing a medium for communication between the parent/guardian and the child's wearable device. The child's location is tracked using GSM mobile communication to specify the location of the child inreal-time.

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1. INTRODUCTION

Child safety is a major concern in any society due to the vulnerability of a child and consequently, higher rates of crimes against children. With this issue on our hands, a smartwearable Internet of Things sensor network for monitoring the environment of a child can be developed to help parents ensure the safety of their children. It must also necessarily include a mechanism for tracking the child. An advantage of this wearable device is that, according to its design, it can be accessed from any mobile device and does not mandate a lot of technical knowledge from the user to operate. The purpose of this device is to facilitatethe guardian or parents in locating their child with ease and ensuring its well-being. The basic mechanism of this system involves monitoring the environment through sensor nodes, acquiring real-time data and transmitting this data to a cloud server. The data can be accessed by users through a web-based interface present on this cloud server. The wearablealso functions to send alerts to the user through a mobile application in case an emergency condition is detected by it. The design of this model involves developing a medium for communication between the parent/guardian and the child's wearable device. The child's location is tracked using GSM mobile communication to specify the location of the child inreal-time.

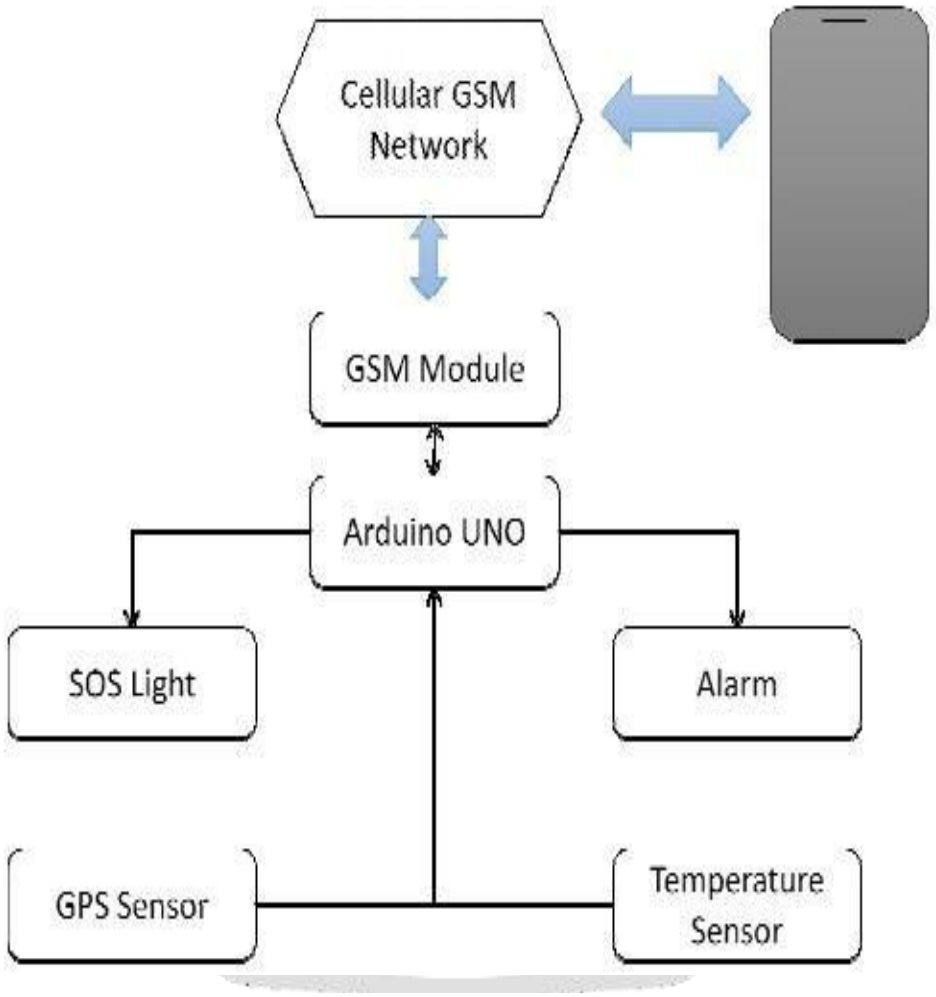
Safety is the most wanted power for everyone in today's world. Rape is the one of the major crime in India practiced against Child and Women. The crime rate is growing steadily sincelast few decades. According to latest National Crime Records Bureau (NCRB) 2013 annual report, 33,707 rape cases are reported across only India. The number of reported rape caseshas been steadily increasing over the past decade. This technology is the best way to solve this problem. That's the reason to develop this device that can act as a rescue device and protect at the time of danger. The motivation behind this project is an attempt to focus on a security system that is designed merely to serve the purpose of providing security to children and women also so that they never feel helpless while facing such social challenges.

The motivation for this wearable comes from the increasing need for safety for children in present times as there can be scenarios of the child getting lost in the major crowded areas. This paper focuses on the key aspect that lost children 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. Therefore, it is intended to use the SMS as the communication type between the parent and child's wearable device, as this has fewer chances of failing when compared to Wi-Fi and Bluetooth. The platform on which this project will be running on is the Arduino Uno micro controller board based on the ATmega328P, and the functions of sending and receiving SMS, which is provided by the Arduino GSM Module using the GSM network. 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 whenever the parent wants. In the scenario, a lost child can be located by the parent could send a predefined keyword as an SMS to the wearable device which would reply by sending location to the parent mobile.

Additionally, the wearable equipped with a distress alarm buzzer which sets to active by sending an SMS keyword "BUZZ" to the wearable. Hence the buzzer is louder and can be heard by the parent from very considerable distance. Also, the parents via SMS can receive coordinates of the child, which can help them locate the child with maximum 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. It is based on a multi-sensor Arduino micro system and a low power Bluetooth 4.1 module. The major drawback for the Vital band is that it uses Bluetooth as the mode of communication between child and the parent. Therefore, the wearable device proposed will be communicating with the parent via SMS through GSM which would ensure that there is a secure communication link. Also, customization of the wearable can be possible as per our needs by reprogramming the Arduino system.

2. ARCHITECTURE

An ATmega328p micro controller controls the system architecture of the wearable device with anArduino Unobootloader.



System overview of the wearable device.

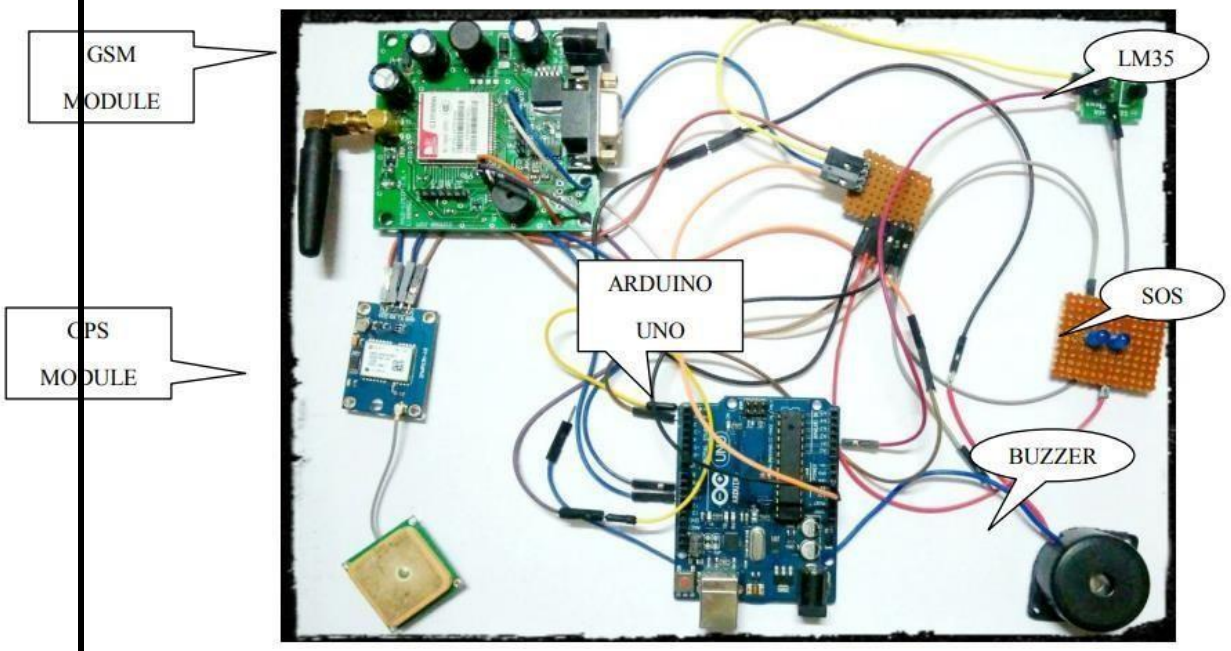
The figure illustrates the architecture of the child safety wearable device, which depicts the various technologies and technological standards that are used. The Arduino Uno collects the data from the different modules interfaced to it, such as the GPS module upon being triggered by the Arduino Unoby receiving SMS from GSM module. The GSM module is used as an interface to send the data received by the Arduino Uno via SMS to a mobile. The GSM module functions as a trigger for the Arduino Uno to request data from its various modules connected to it. If an SMS text with specified keyword is sent to request the current location or GPS coordinates is sent to the GSM module via the user's phone, then the GSM module triggers the Arduino Uno to request the current GPS coordinates.

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 Unothrough short message service to a mobile. 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 getthe present latitude or longitude (GPS coordinates) to the GSM module via the user's phone.

3. WEARABLE DEVICE

The wearable device, for now, is not built on a system on chip model, rather has been proposed using larger components andcan later build on the SOC platform once put into manufacture.



The wearable device tasked with acquiring various data from the all the different modules connectedto it. It comprises of Arduino Uno based on the ATmega328P micro controller. The Arduino Uno receives data from different modules and analysis the data and customizes the data in a user understandable format. For the moment the design is not made compact, since the focus now has been to show that this concept of smart wearables would be highly impactful for the safety of the children. The wearable system runs on a battery or any external source. In order to minimize power consumption, the wearable device has been programmed to provide GPS and other information onlyupon request by SMS text via GSM.

4. COMPONENTS

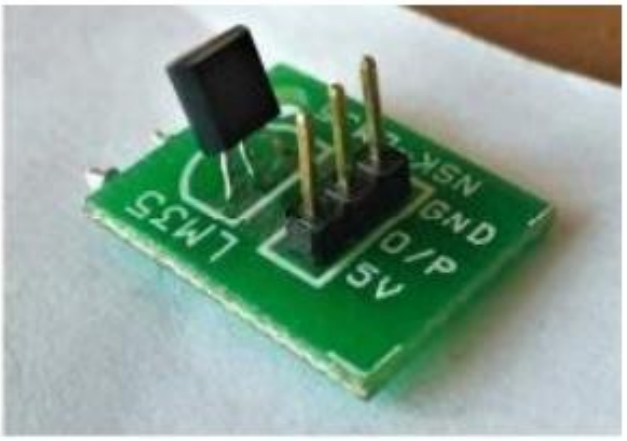
➢ GPS Location Sensor

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 established like the connections with GSM module. It has a low power consumption and small size, which is very compact. The GPS module output comprises of standard string information which is governed by the National Marine Electronics Association (NMEA) protocol. Once the SMS trigger text "LOCATION" is sent from the cell phone of the user, thistext is received by the GSM which in turn triggers the Arduino Uno to execute the GPS code to fetch thecurrent, accurate location of the GPS module. The location output received from the GPS module is in the following format.

The output received by GPS Location Sen

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 withthe keyword "LOCATION". Once the SMS trigger text "LOCATION" is sent from the smartphone 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 string received from the GPS module is in the following format:

- **Temperature Sensor**



In order to measure the temperature of the surroundings of the child, a LM35 sensor is used. The sensormodule is equipped with a thermistor for measuring the ambient temperature and the fluctuation with maximum efficiency. The observable temperature detectability for this sensor ranges from to and the precise accuracy for this device range from to. The temperature is connected to the Arduino Uno. The temperature value is stored in a variable whichmay be integer or string type. Hence the temperature is called by the Arduino upon receiving the proper SMS keyword “TEMPERATURE” by the user’s smartphone.

The output received from temperature sensor:

- **SOS Light:**

The another theory that this paper focuses on is that bystanders are the first mode of help for a missingchild. 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 may 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 long dashes. Since a very long time the SOS signal has been universally known for being the signof 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 of the Arduino.

- **Alarm Buzzer:**

In the scenario, if a child is separated from his/her parents. The parent can locate the child by soundin a very loud alarm on the wearable. To achieve this, a piezoelectric buzzer is used, which is responsible for emitting a strong tone upon the output being set to HIGH. The buzzer module is activated upon sending an SMS text with the keyword "BUZZ" from a cell phone. Also, this buzzerworks like the SOS led by alerting the people nearby with the distressed tone that the child might belost and needs assistance. The buzzer is the child might be lost and needs assistance. The buzzer is connected to the digital pin of the Arduino.

- **GSM Module:**

GSM is a standard developed by ETSI to describe protocols for Second Generation digital cellularnetwork used by phone.GSM can accept any GSM network operator SIM Card and act just like a mobile phone with its unique phone Number.

GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine- SIM900A, works on frequencies 900/1800 MHz The Modem is coming with RS232 interface, which allows you connect PCas well as microcontroller with RS232 Chip (MAX232). The baud rate is

configurable from 9600- 115200 through AT command. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet etc. through simple AT commands.

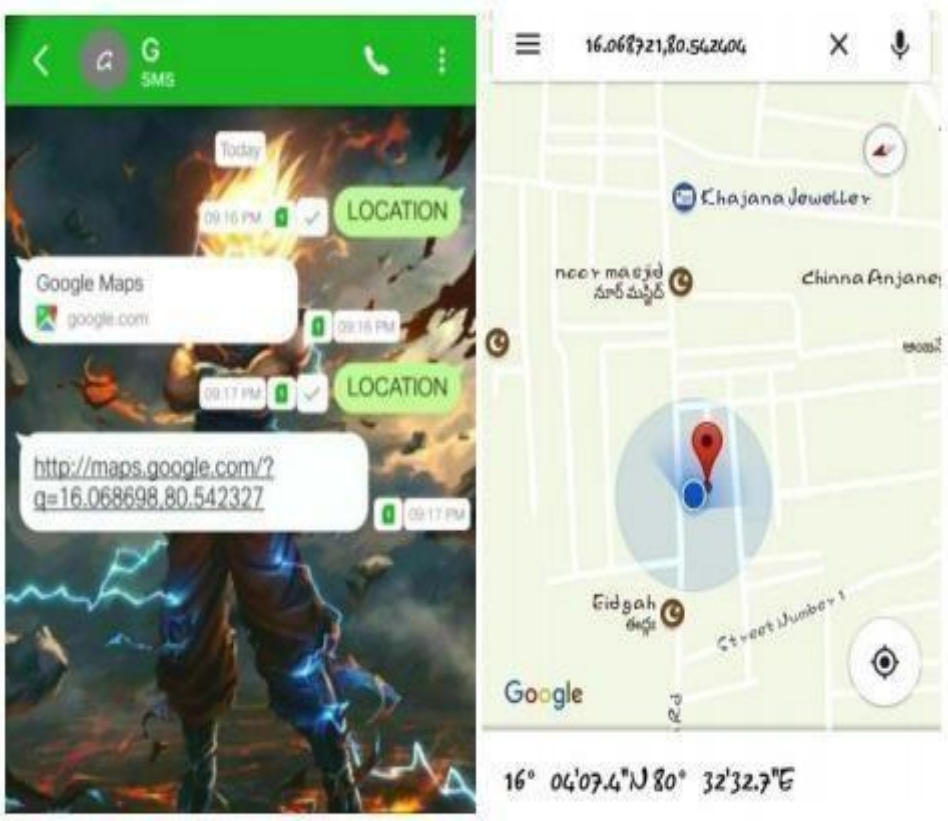
It transfers the information over to the user via SMS. Arduino provides GSM libraries for GSM moduleas well which allows the GSM module to make/receive a call, send/receive SMS and act as a client/server. The GSM module receives 5V power supply directly from the 5V pin connection at the Arduino Uno 5V. The serial communication between the Arduino Uno and GSM module is performed between the serial pins 0,1. The Arduino has been programmed to receive SMS text messages from the parent's cellphone via GSM module. The GSM module will constantly be scanning the received text messages for the specific keywords such as "LOCATION", "TEMPERATURE", "SOS" and "BUZZ".

5. RESULTS

In this section, the experimental tests were performed to detinning the various components of theproposed wearable device.

➢ 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 tum, open the gmaps app or any default browser and display location.



In all the scenarios the GPS module was tested, it would respond back to the user's cellphone less than a minute. 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 show exactly at which side of the building it is present. Whereas for blue dot is showing the wearable to be present on the street, which is marginallyoff from the exact location. This marginal miss match inthe pin-point location of the wearable can tum out to be fatal in a real-life scenario, where the parent may be miss lead to the wrong location of the child. Therefore, NEO6MV2 GPS module proves to be successful in providing the precise locationwith 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 string sent: “LOCATION”, “TEMPERATURE”, “UV”, “BUZZ” AND “SOS” it would not send a reply back to the GSM module.

➢ Temperature Sensor:

Similar to the GPS location sensor, the Temperature sensor were tested multiple times under differenttemperatures. The sensor performed exceptionally well to the test performed. The response time to receive a response back to the keyword "TEMPERATURE" was under a minute. Also, the temperature sensor was subjected to higher temperatures and compared with a thermostat reading present in the room which would differ with the sensorreading by +O.5°C to -O.5°C.

➢ SOS Light and Alarm Buzzer:

Upon sending 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. Upon receiving the proper keywords, the SOS light and Alarm Buzzer would first perform the particular task of flashing the SOS light and sounding a alarm which can take a little longerthan their sensor counterparts.

After completion of their respective functions, the response is sent back to the user cell phone stating:"SOS Signal Sent" and "Playing Buzzer".

6. APPLICATIONS

Some applications of the proposed wearable device:

- It can be used for the safety of women in society
- It can be used for the safety of the children.
- It can be used for the safety of elderly aged people
- It can be used as a legal evidence of crime with exact location information forprosecution
- It can be used for the safety of physically challenged people

7. ADVANTAGES:

- Easy Availability& Affordability

Gone are the days when buying a GPS enabled Wearable Device for kids was considered a luxury.

Today, however, the scenario is different. There are plenty of options readily available. It is easy to buy a smart watch for kids of your choice online. What's more, these magnificent tech gadgets don't burn a big hole in your pockets and make up for an affordable buy.

Now a smart watch is just a click away! Besides ,these smart-watches lend a style statement to yourfashion conscious kids.

- Tracking Made Easy

Fueled by IOT, the GPS enabled Wearable Device act as a saviour for parents who are always

clouded with worries about their kids. Tracking a child was never this easy. These Wearable Device

allow parents to track their children in crowded/public places or when they are out of sight say at school, picnic or an outing. Parents can use these smart-watches to track the location of their lost kids

- Smart watch is Technology in Disguise

No matter how tech advanced the smart watches are, they hardly look like one. Most manufacturershave worked hard to mold their tech wonders in a time piece that looks everything but a tech piece! Their childish designs and bright colour combination is perfect to disguise them. This is precisely why most people can hardly spot the difference between a smart watch and an ordinary watch. Goodfor kids who use them, as their adorable designs keep these watches safe from the prying eyes.

- Watches Over Your Kids

GPS tracker watches are a boon for parents as they help in watching over your kids when either theyare away or you are away from them. These devices:

1. Tracks kids when they reach school or arrive home from school.
2. Track kids when they are untraceable in a crowded space.
3. Track kids when they are away from home and out of your sight.

- Guarantees Peace of Mind to Parents

Parents, whether at home or office, are always worried about the safety of their kids. The fearof losing your child to avoidable circumstances is the concern area

for all mommies and daddies. On the other hand, a smart watch equipped kid is always traceable and reachable in case of contingencies and emergencies. This in fact, offers great solace for parents, who are relieved at the thought of maintaining an uninterrupted connectivity with their children, anytime, anywhere. Enough to of course, guarantee the much-needed peace of mind.

8. 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 alongwith 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.

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 pre-programmed to present the user with a set of predefined keyword options such as "LOCATION," "SNAPSHOT," "SOS," etc. Whereas for the future aspect of this wearable device based on what type sensor is added to it, additional specific keywords could be added such as, "HUMIDITY," "ALTITUDE," etc. This android app provides mote interface to the user which help to understand easily. The main idea in this android app is to provide keyword button i.e. that for getting location we have a specific button, by pressing this button we get the location instead of typing the keyword which ease our work.

9. CONCLUSION:

This safety device for children that can be used in online transportation is perfect for children today. In addition to the low cost of manufacture, the speed of sending locations accompanied by images of the perpetrator via the telegram application is also relatively fast, 0.91 seconds and 11.57seconds respectively using the same network between the device and the receiving cellphone. While using a different network between the device and the receiving cellphone, the speed of sending the location is 0.96 seconds, and the speed of sending images is 12.09 seconds. It also uses the latest technology, IoT, the GPS module and camera for development. This tool has a high accuracy of 97.5% for location delivery, and has an accuracy of 100% for sending images. This tool provides a very high contribution because currently online transportation is widely used by children due to the busyness of parents. Thus, besides being able to monitor children on online transportation, it will also be able to easily detect if something is dangerous. The situation of the child and the offender will be easily identified. In addition, if this tool is mass-produced, it will not be confused with one another because there is a telegram ID database that is entered into each device, therefore making a high contribution tosociety. The further research can use A IoT technology with the hope of getting shorter time and improving the camera application so that the image results are always accurate, the image quality is better, and the delivery of the location point is accurate up to 100%. Also other more sophisticated technologies in the future can be used for the perfection of this tool, if it is mass-produced.

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