



## BLUETOOTH GPS APPLICATION BASED ON LATITUDE AND LONGITUDE FOR CHILD TRACKING MODEL

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### ABSTRACT

GPS is a device that is capable of receiving information from GPS satellites and then to accurately calculate its geographical location. This paper presents child tracking system based on modelling of latitude and longitude coordinate and speed changing tracker. The system consists of a Bluetooth GPS receiver and an android smartphone. Communication between GPS and a smartphone is via Bluetooth protocol which requires the Bluetooth GPS to be paired with a smartphone. The smartphone will extract the coordinate and speed from GPS signal which send using National Marine Electronic Association (NMEA) format. This information is analysed to measure the distance and speed. The smartphone and the speed is more than 2.8km/h after receive an alarm the location of the child can be track using Google map or parent can be share the information via media social such Facebook or Whatsapp. The child tracking model based on latitude and longitude coordinate and speed parameter system has been successfully designed and implemented. It is able to protect the child safety by monitoring the location of the child.

**Keywords:** GPS, NMEA, bluetooth, google map, tracking.

### INTRODUCTION

Global Positioning System (GPS) is a well-known wireless tracking system, which has found its way into consumer electronic devices such as smart phones and cameras [1]. GPS is the only system today that can show the exact position of an object on earth anytime, in any weather, no matter where it is located. GPS was designed by the U. S. military. The concept started in the late '60s, but the first satellite was not launched until February 1978. In 1989, Magellan Corp. introduced the first hand-held GPS receiver. In 1992, GPS was used in Operation Desert Storm and on March 1996, the President of the United States of America decided to make GPS available for free to civilian users.

TGPS receivers come in a variety of formats, from devices integrated into cars, phones and watches [2]. GPS receivers are composed of an antenna which is tuned to the frequencies transmitted by the satellites, a receiver-processors and a highly stable clock (often a crystal oscillator). They may also include a display for providing location and speed information to the user. Many GPS receivers can relay position data to a PC or other device using NMEA 0183 protocol, although this protocol is officially defined by the National Marine Electronics Association (NMEA) [3].

Bluetooth is a standard wire-replacement communications protocol primarily designed for low-power consumption, with a short range based on low-cost transceiver microchips in each device [4]. Because the devices use a radio (broadcast) communications system, they do not have to be in visual line of sight of each other. However, a quasi-optical wireless path must be viable [5]. Range is power-class-dependent, but effective ranges vary in practice.

Android OS is an open source and the source code is released by Google under the Apache license. The operating system is based on Linux and the application software runs on an application framework which includes

Java-compatible [6] libraries based on Apache Harmony. This android is designed primarily for touch screen mobile devices and the user interface is based on direct manipulation using the touch screen [7]. The first Android phone was sold in October 2008 and the latest version is Kit Kat Android 4.4. In this paper, the development of a system to track a child is proposed. This system can help parents to locate and find their missing child by using an Android smartphone, which can communicate with a GPS device that is attached to their child. The device attached to the child is a GPS receiver module. The GPS receiver has the capability to calculate the position of the child using data received from GPS satellites. These data are collected by the microcontroller and transmitted out to the android device using wireless Bluetooth transceiver. The GPS receiver has the capability to transmit out data at a radius range of ten meters. Parents can monitor and track the location of their child by using 'Child Tracker App' installed in the parents' android smartphone. By using the 'Child Tracker App', parents can monitor the location and distance of their children. The application will give an alert if the child is five meters away from them. If the child is more than 10m away and the parents cannot see their child, they can send data profile of their child to their families and friends through current social media applications such as Whatsapp, Twitter, Facebook and etc. Entering the child's data profile is the first step which has been completed once the 'Child Tracker App' has been installed.

### METHODOLOGY

The main approach in designing the complete Child Tracking Model can be divided by two categories: Bluetooth GPS Selection. The Universal Bluetooth GPS Receiver XGPS150A is very simple to use (please refer to Figure-1). There is a quick set up process that includes pairing your device with the receiver. Once this is done, the Receiver will automatically connect to the device it



was last paired with and ready to communicate with android software developed.



**Figure-1.** Bluetooth GPS (XGPS150A).

The GPS Module will be attached to the child and carry along, where they go and it will send signal continuously to smart phone via Bluetooth connection. The advantages of using this GPS module are:

- a. Determine your location at anywhere which represent by latitude and longitude, unlike AGPS that only shows in urban area.

- b. Show how many satellites the device sees and the signal strength of each satellite.
- c. Display the battery level of the module and give alarm when battery almost drains out.
- d. GPS Receiver is successfully connected to your iPad/iPod touch/iPhone.

The GPS will send many types of data follow the National Marine Electronics Association (NMEA) as tabulated in the Table-1. However, only two types of data will be used for child tracking modelling:

- a. Global Positioning System Fix Data (GPGGA).
- b. Track made good and ground speed (GPVTG).

GPGGA will provide the coordinate latitude and longitude in degree and minute format, while GPVTG will provide speed in km/h as shown in Table-1.

**Table-1.** Information send by XGPS150A GPS.

<b>\$GPBOD</b>	<b>Bearing, origin to destination</b>
\$GPBWC	Bearing and distance to waypoint, great circle
\$GPGGA	Global Positioning System Fix Data
\$GPGLL	Geographic position, latitude/longitude
\$GPGSA	GPS DOP and active satellites
\$GPGSV	GPS Satellites in view
\$GPHDT	Heading, True
\$GPR00	List of waypoints in currently active route
\$GPRMA	Recommended minimum specific Loran-C data
\$GPRMB	Recommended minimum navigation info
\$GPRMC	Recommended minimum specific GPS/Transit data
\$GPRTE	Routes
\$GPTRF	Transit Fix Data
\$GPSTN	Multiple Data ID
\$GPVBW	Dual Ground/Water Speed
\$GPVTG	Track made good and ground speed
\$GPWPL	Waypoint location
\$GPXTE	Cross-track error, Measured

### Android software development

App Inventor for Android which is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT) is used to develop user interface and program. The logic flowchart as shown in Figure-2 gives information on the how the program is developed. Once signal is received from Bluetooth GPS, the \$GPGGA and \$GPVTG data will be extracted from bundle of information for further action. The Child Tracker App requires users to setup the child's profile such as name, age, height, weight, race and add a picture. Then, the

Bluetooth GPS and the parents' Android smartphone must be paired to start the Bluetooth GPS operation. The program designed in the App will retrieve the data from the Bluetooth GPS. The data from Bluetooth GPS in degree, minutes and second format will be converted to degree only. The data will present the location based on the latitude and longitude. Next, the program will calculate the distance between the Bluetooth GPS and the parents' android smartphone.

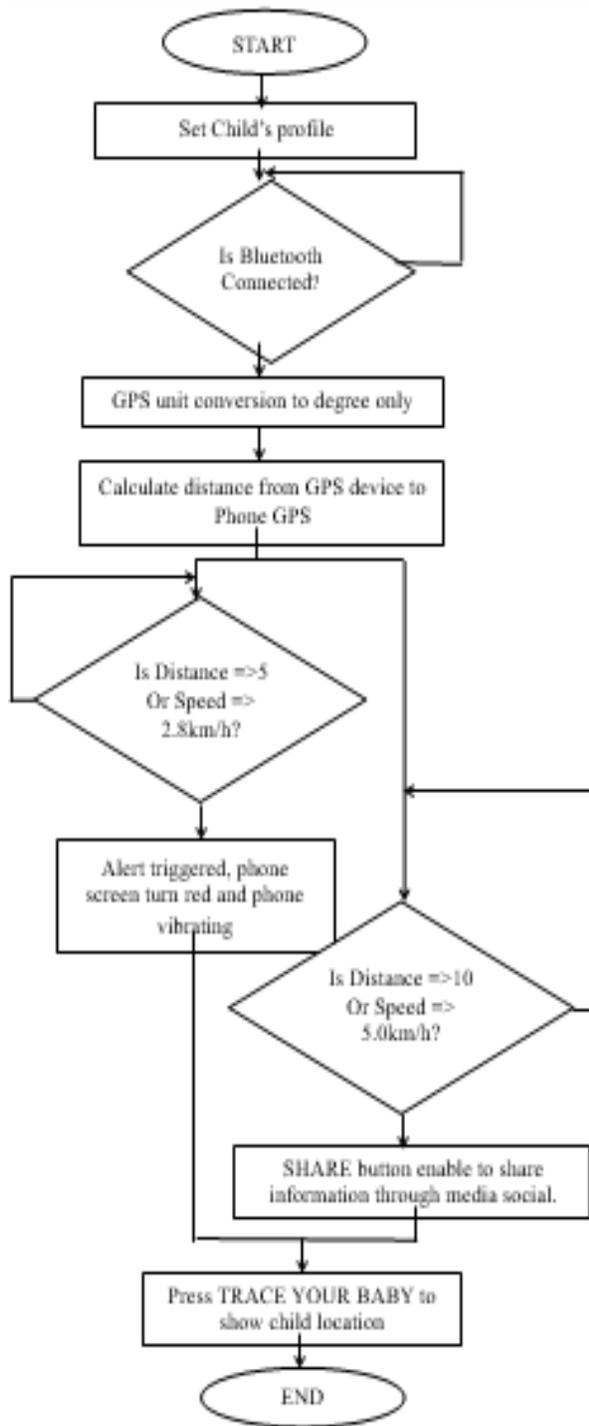


Figure-2. Research framework.

There are two conditions regarding this application. The first condition is when distance is equal to or more than 5m or speed equals to or more than 2.8km/h. When this condition is fulfilled, alert will be triggered causing the phone screen to turn into red colour and parents' phone to vibrate. The second condition is when distance is equal to or more than 10m or speed equals to or more than 5.0km/h. When the second condition is fulfilled, 'SHARE' button is enabled to share information through media social such as Whatsapp, Twitter and etc. If one of these two condition triggers, then parents shall press the TRACE YOUR BABY button to locate their child's location at that time.

more than 5km/h. When the second condition is fulfilled, 'SHARE' button is enabled to share information through media social such as Whatsapp, Twitter and etc. If one of these two condition triggers, then parents shall press the TRACE YOUR BABY button to locate their child's location at that time.

**Unit conversion**

The actual \$GPGGA data extracted are as illustrated in Figure-3:

Description	Description Detail
GGA	Global Positioning System Fix Data
082653.981	Fix taken at 08:26:53.981 UTC
0302.4671,N	0302.4671,N
10130.9374E	Longitude 11 degree 30.9374' E
0	Fix quality:
	0 = invalid
	1 = GPS fix (SPS)
	2 = DGPS fix
	3 = PPS fix
	4 = Real Time Kinematic
	5 = Float RTK
	6 = estimated (dead reckoning)
	(2.3 feature)
	7 = Manual input mode
	8 = Simulation mode
00	Number of satellites being tracked
3.9	Horizontal dilution of position

Figure-3. Data extracted.

The latitude and longitude is provided in degree and minute such as 0302.1234, where 03° or degree and 02.1234' or minute [8]. However, the calculation and location search by Google map uses unit degree thus the unit conversion will be used demonstrated by this formula [9]:

$$\begin{aligned} \text{Latitude or longitude} &= \text{degree} + \text{minute}/60 \\ &= 0.3 + 2.4671/60 \\ &= 3.04111^\circ \end{aligned}$$

**Distance calculation**

The distance measured between Bluetooth GPS module and smart phone will be determined using this 'Haversine' formula [10].

$$\text{Distance, } d = \text{acos}(\sin(\text{lat1}) \cdot \sin(\text{lat2}) + \cos(\text{lat1}) \cdot \cos(\text{lat2}) \cdot \cos(\text{long2}-\text{long1})). R$$

where Lat1 = latitude point 1, Lat2 = latitude point 2, Long2 = longitude point 2 and R = earth radius.

**Speed**

The \$GPVTG provides speed information as illustrated in Figure-4:



\$GPVTG	,293.6,T	0302.4671,N
005.5,N	010.2,K	*48

Description	Description Detail
VTG	Track made good and ground speed
054.7,T	True track made good (degrees)
M	Magnetic track made good
022.1,N	Ground speed, knots
040.9,K	Ground speed, kilometers per hour
*48	Checksum

Figure-4. Speed information.

The speed is taken directly from the information and used in the alarming programming. In above example, the ground speed kilometer per hour is 40.9km/h tested using car.

### Alarming and map

The alarm system will be triggered after the distance, and speed is change exceed setting during this modelling

### Method

The system consists of Bluetooth GPS receiver and android smart phone. Communication between GPS and smart phone is using Bluetooth protocol, which Bluetooth GPS needs to be paired with smart phone. After that, it will connect automatically based on last paired with. The smart phone will extract the coordinate and speed from GPS signal is sent using National Marine Electronics Association (NMEA) format. This information is analysed to measure the distance and speed. The smart phone will give an alarm when the GPS is 5 meters away from the smart phone and the speed is more than 2.8km/h. After receiving an alarm, the location of the child can be tracked using Google map or parents can share the information via social media such as Facebook, Twitter, Whatsapp, Facebook messenger, email and others.

### RESULTS AND DISCUSSIONS

In this section, the performance of the application and device is tested. The GPS receiver is paired to the android device and used a selected App from the Google Play to ensure the Bluetooth connection is established successfully to avoid loss of data packet and also signal intermittent that caused by the other end of Bluetooth device. Then, the GPS receiver is tested using the designed application which is named the Child Tracker App.

When users or parents activate the child tracking apps, the detail on the setup page is shown as in Figure-5. Users need to insert their child's detail such as name, age, race, height and weight. A picture of children is also required. If the user's phone is not connected to Bluetooth GPS device, the background screen is in white colour. To use the tracking device, user's phone has to be paired with the GPS device.

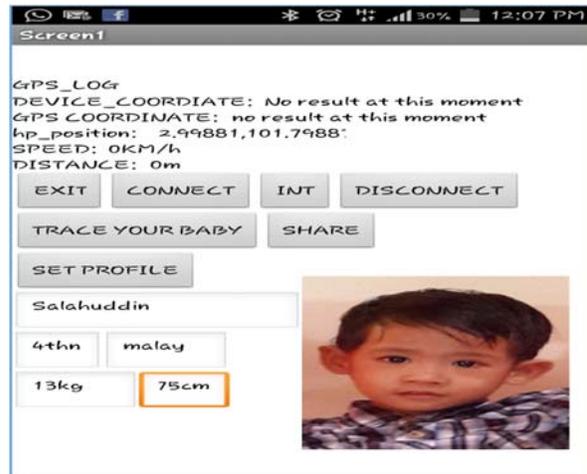


Figure-5. Child data profile and picture.

If both devices are successfully connected and paired, the background screen turns red in colour as shown in Figure-6. Latitude, longitude as well as distance are displayed on the user's app. The device shall monitor children's distance and location when both devices are turned on.

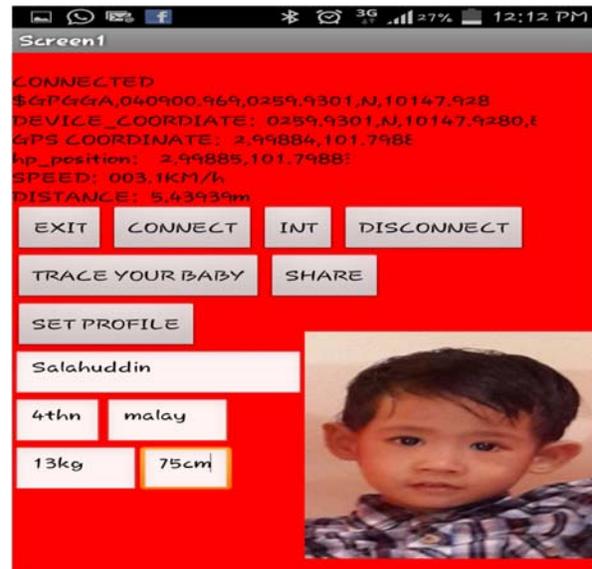


Figure-6. List GPS start connected and give the value of the latitude, longitude and distance.

Then, if one of two condition that were set in the apps is met, an alert shall be triggered and sent to user's phone as a warning to indicate that the children are away from the parents. Then, the SHARE button is enabled at the same time, as shown in Figure-6. If the SHARE button is pressed, the list of media social list shall appear and users can select which apps they would like the alert message to be sent to as illustrated in Figure-7. For example, if the users select Whatsapp as their option, then the alert message will be sent to Whatsapp recipients



containing the children profile as shown in Figure-8. If users want to know the location of their children, they needed to press TRACE YOUR BABY button to see the location, which is based on latitude and longitude.



Figure-7. List of App available will appear for selection.



Figure-8. Example on Whatsapp.

From the performance of both software and hardware, the system is working according to the designed program. Bluetooth on both GPS device and android are turn ON. When the GPS receiver at child is paired to a parent's android smartphone, the GPS starts to give the latitude, longitude, distance and speed of the child. When the program detects the distance between the child and the parent to be more than 5 meters, the android phone vibrates to give an alert signal to the parent. The Bluetooth signal coverage is up to 10 meters. When the program detects the distance between child and parent exceeds 10 meters, the SHARE button is enabled and parent is able to share the child's data profile with family, friend and social media such as Facebook.

## CONCLUSIONS

The child tracking model based on latitude and longitude coordinate and speed parameter system has been successfully designed and implemented. The suitable Bluetooth GPS is used to represent the child tracker and has good connectivity with the Child Tracker App in parents' android smartphone. In conclusion, the system is able to protect the child safety by monitoring the location of the child. Overall, the basic prototype has been developed and tested with successful workability.

However, the current proposed system could only cover 10 meters in radius. Therefore, it is recommended to use a combination of GPS and RFID to cover a wider range.

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