Personnel Tracking Using GPS And ZigBee

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Abstract— **This paper outlines the background, concept, methodology, domains, precedents, user testing, and reflection of Personnel Tracking. This work is aimed towards a safer walk of life. The innovative design of this work will help creating a new, safer and modern place to live and survive. This work mainly discusses the development of an electronic device which is a transceiver. It receives and transmits GPS signal from the satellite. The key aspect of this device is the mode of communication. This device does not use cellular networks or internet. It uses ZigBee Wireless Technology which is Low-cost, Low-power, wireless networking for device monitoring and control. Another highlight in the work is the use of Arduino. It is a open-source physical computing platform based on a single Micro-controller board and a development environment for writing software for the board.**

Keywords—Global Positioning System(GPS), Personnel Tracking Device(PTD), ZigBee

I.   INTRODUCTION

Confirming the existence of a large-scale human trafficking network, state police have found that at least an average of 22 girls have per day have gone missing in the Indian state of Andra Pradesh, only this year, while the total number of women and girls that have gone missing in the last four years stands at a staggering 23,760 out of the 47,181 people who have gone missing since 2009.

Out of the number of children who were kidnapped, 66% (10,938) are girls. As the number of missing girls seems to be only increasing as, till July 2012, another 2,786 children have gone missing with over 70% of them (1,955) girls. That means that about 10 girls go missing each day. Similarly, 2,519

receiving the GPS coordinates which includes latitude and longitude coordinates and also the speed of motion of the person carrying the PTD.

Thus when the person carrying this PTD experiences a panic situation in which the victim is being abducted or being attacked forcibly then the victim can start the PTD which will start sending the GPS coordinates along with a message like SOS which would say "I am in danger."

It can be seen in all the above mentioned methods that cell phone is quite common in most of the methods and also SMS which also uses cellular networks. Our main concern here is to save a person who is in danger mainly who is being abducted. The kidnapper confiscates and destroys the cell phone hence connection is lost totally and also our hope of saving the person. This is the main drawback that the PTD overcomes.

II.   COMPARITIVE STUDY

In Al-Suwaidi and Zemerl's work [1], the problem was solved by proposing an application "Locating Friends and Family Using Mobile Phones with Global Positioning System (GPS)". The architecture of the system is based on client

women were missing till July this year, which means every day 12 women go missing.

In Al-Suwaidi and Zemerl work [1], the problem was solved by proposing an application "Locating Friends and Family Using Mobile Phones with Global Positioning System (GPS)".

Chandra, Jain and Quadeer [3], used a simple web server approach along with SMS to solve their problem.

Anderson, Lustig, Brunette, Boriello and Kolko [4], proposed solution for "transportation information system" using only GPS and SMS.

Al-Mazloum, Omer and Abdullah[5], proposed a solution that takes advantage of the location services provided by mobile phone since most of kids carry mobile phones.

The solution to the problem proposed in this paper is the use of PTD. The key point that makes PTD different from the rest of the tracking devices is the communication protocol it uses. Unlike most other devices which use Cellular network or Internet to communicate or socialize a PTD uses Wireless Technology for communication. This makes it very cost effective and reliable and has a wide coverage range. The PTD uses ZigBee communication protocol thus when the user is in dire situation and has lost all means of communication to the world (his cellular phone) it is then that the PTD's ZigBee Mesh Networking comes in handy.

The PTD is a small, wearable device which is capable of receiving its GPS coordinates and sending the same to people of concern like police control room, parents and other important   persons   who   will   be server approach. The client phone registers and login into the server. Then, the client periodically sends his coordinate location updates to the server which stores it in a database. Thus, any client wishes to learn the location of another client will have to register and login to the server to request the location. This application was developed to helps locate family member and friends. The mobile application was implemented using J2ME. As for the server, it uses MySQL Database along with PHP to guarantees that the server would not be overloaded. This proposed solution makes each client has same control and command privileges as the other which is not convenient for use in child tracking application where only the parent should have the control and command privileges. A limitation of this solution is that in order for the system to work there must be internet connectivity in both client and server sides.

Chandra, Jain and Quadeer [3], used a simple web server approach along with SMS to solve their problem. It was implemented for JAVA enabled mobile devices equipped with GPS receptor. A client can either send his location to other

clients directly by SMS or by sending it to the web server's database via internet. Clients can view the location on the Google maps. The aim of this application is to enable the user to share his location with his friends.

Anderson, Lustig, Brunette, Boriello and Kolko [4], proposed solution for "transportation information system" using only GPS and SMS. On the client side, a device(a box) containing a GSM modem and GPS unit. On the back end side the database server stores the details and locations connected to a basic GSM phone for SMS capability. When a user wants to request the location of the client, it sends an SMS request to the server's GSM phone. The server then replies to the client with the last location. A unique feature of this is that it does not require internet connectivity on both sides.

A. Al-Mazloum, E. Omer and M. F. A. Abdullah[5], proposed a solution that takes advantage of the location services provided by mobile phone since most of kids carry mobile phones. The mobile application use the GPS and SMS services found in Android mobile phones. It allows the parent to get their child's location on a real time map. The system consists of two sides, child side and parent side. A parent's device main duty is to send a request location SMS to the child's device to get the location of the child. On the other hand, the child's device main responsibility is to reply the GPS position to the parent's device upon request.

It can be inferred from the literature review that there are many solutions to locate a missing person or child. Some of the methods proposed above require internet connectivity on both ends and most of the solutions are GSM based and require cellular phones and make use of cellular networks and smart phones and mostly the devices are controlled by the parent side. Hence keeping all the drawbacks of the previous methods in mind I have come up with this solution of designing a PTD which works based on ZigBee protocol unlike the above methods and also is not a smart phone but rather is a wearable device which can be worn secretly on self so that it can be used in time of emergency and also that it is actuated by the user of the device.

III. PTD INNOVATIVENESS

The PTD is a small, wearable device which is capable of receiving its GPS coordinates and sending the same to people of concern like police control room, parents and other important persons who will be receiving the GPS coordinates which includes latitude and longitude coordinates and also the speed of motion of the person carrying the PTD.

Thus when the person carrying this PTD experiences a panic situation in which the person is being abducted or being attacked forcibly then the person can start the PTD which will start sending the GPS coordinates along with a message like SOS which would say "I am in danger."

With the help of this PTD and its signal we can reach out to the people in danger and help save them from their mishap. In case of doubts like if this is going to work cent percent, one thing we can be sure of is that we are a step closer in saving one's life rather than waiting for that person to be lost for over 24 hours and then infinitely.

We will have various details like when and where the person was in danger and where that person is and we will surely have the 1000 meter diameter range of where the person is which narrows down the search considerably.

A. *Concept*

The Personnel Tracking Device is a Wearable, self powered, data contextualization system which allows the users to acquire their immediate GPS location from the GEO Satellites and keep sending those coordinates to all the people concerned. Users choose when to switch on the PTD that is in times of trouble when the person feels endangered or some panic situation where the person is being abducted or forcibly transported or trafficked to some unknown location.

The interaction with the device is passive, as it is meant to be worn on the body or attached to a personal item such as a wrist band which stays in the user's personal space at all times.

The work consists of two parts, the first being the transmitter end which consists of a modular GPS transceiver which acquires GPS location and date, time and speed etcetera interfaced with an XBee and Arduino stack. The software used to run this module stack is Arduino 1.0.6
The laptop is used for programming the Arduino shield and the acquired GPS coordinates are displayed on the Serial Monitor of the Arduino 1.0.6 application.

The second component of this work is a receiver end. It's a portal or a pathway of how the acquired data is transmitted to the various destinations. The means by which the data is being transmitted is wireless technology using ZigBee protocol. This is the highlight of the work as it uses ZigBee which is very cost effective, low power consuming and can cover a wide range. The receiver end is achieved by interfacing an XBee module with a display screen which is laptop in our case, thus in this way the GPS signal and the panic alert message is displayed.

B. *Design Questions*

The foremost design question that the Personnel Tracking Device addresses is how to create a device which is of an appropriate size, easy to use, easy to veil and that works with a software system which provides a trustable experience for users, so much as they continue to use the PTD and maintain a desire to keep it with them always. All of these design goals must be met or users must decide using the PTD is not worth the effort.

C. *Hardware Ease of Use*

The PTD needs to be easy enough for an average person or a child to use as well as maintain the device in working order. The maintenance of the PTD system culminates in battery replacement. An advantage in using this is that an average person is familiar with these objects and how they function within the given system. For implementation purpose the GPS receiver is connected to the Arduino Mega by means of Jumper wires which makes the connection very simple. The Arduino Mega module is interfaced to the system by means of USB cable which are time tested and user friendly. Thus the connection of the receiver module is very simple.

D. Hardware Size

The PTD must be small enough to wear on clothing and yet allow the user to behave in a natural way. The purpose of this module is to acquire GPS signal dynamically as the user is moving or being taken away that is in motion.

E. Software Look and Ease of Use

The programming of the Arduino is done on the application software Arduino 1.0.6. The code in Arduino is referred to as a Sketch. There are various sketches for GPS system which prints out Date, Longitude, Latitude, speed over ground in mph and kmph, course over ground in degrees and the Satellites being used and the number of satellites and the satellites in view.

F. Hardware Prototype

For implementation purpose we use an XBee module which is configured by an XBee protoshield.
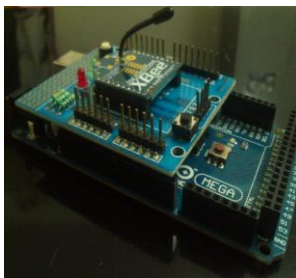

Fig.1 XBee Stack

In the figure1 the PTD has been implemented by stacking an XBee on a XBee shield and stacking these two on an Arduino mega board. The reset button of the Arduino board has been programmed to be the panic button. The XBee protoshiled is used to configure an XBee into either a router or a coordinator and this is done with the help of XCTU software. Now this stack is interfaced with the GPS receiver.

The other receiving end of the PTD is implemented by connecting another XBee to the laptop which is used for display purpose. The GPS signal along with the panic alert message is viewed over hyperterminal. This was a brief about the hardware implementation.

IV.   APPLICATION REQUIREMENT

A. Requirements

This work is designed for persons especially girls and kids who are at a high rate of risk and danger. The users of PTD must carry the PTD with them whenever they are outside. The destination addresses of the various end points will be fed into the PTD beforehand. Thus in this way when a person is in danger the PTD is secretly actuated by the user and it starts a continuous sequence of transmission of its current location and also an alert message along with the user name. The implementation of the PTD has been done using ZigBee nodes which are light weight radio transceivers with long battery life and a wide range of transmission.

B. Application Architecture

I propose to solve the problem based on mainly GPS and ZigBee technologies. Combining these two together eliminates the use of tracking via a cell phone which is vulnerable during times of danger. The location is provided by the GPS and the location and the alert message is communicated via the efficient communication protocol ZigBee. The design concentrates to somehow transmit the position and alert message secretly without using any cell phones thus avoiding cellular networks. The transmission is only done in times of danger and it is only actuated by the user thus resulting in a system that is secretive, wearable, and user friendly and a life saver.
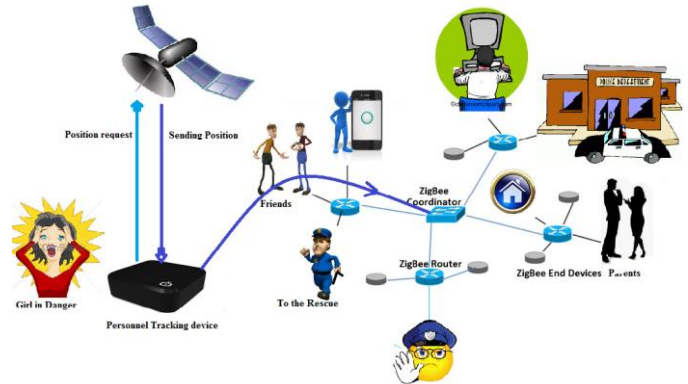

Fig.2 Architecture of the Proposed System

The architecture of the proposed system as shown in figure consists of firstly the PTD which is carried by the user which in our case is the girl in danger. This PTD is responsible for acquiring the GPS location of the user from the satellite and process it and then transmit it to various other end users which will be the people concerned and the police station. Thus for achieving this we make use of a ZigBee module which consists of a transceiver, a GPS receiver and a microcontroller. These three units combined together form the PTD. The communication part is the second phase of the architecture. Various ZigBee nodes are used to form a personal area network which comprises of a coordinator and various routers and end devices. The PTD can be actuated only by the user and once actuated it keeps transmitting the position along with an alert message. The third phase of the architecture is made of the end users who require a device like a system or a phone for displaying the message and also internet connectivity for the map to show the exact location of the received coordinates. Thus end users cannot actuate or request from the PTD. So when a person is being abducted, the person is supposed to secretly actuate the PTD which will request for its current location and keep sending the position information along with the alert message to the various destination addresses that are already assigned to the PTD. The various end users on receiving the message spot the location coordinates on the map and quickly go for the rescue aid, thus providing a greater chance to save somebody. The proposed system has many advantages. Firstly it eliminates the use of cellular networks thus eliminating the use of cell phones as when a person is being kidnapped cell phones are discarded. Secondly the PTD is wearable so it can be worn secretly inside lapels, wrist bands or ankle bands. Thirdly it has long life and is cheap. Fourthly it has a very good and wide coverage range. And finally it ensures a safer walk of life.

V.   COMARISON AND RESULT

The various mentioned related works and compared and the result is obtained in the table below.

Table1. Comparison of Previous Works

Author Name	Principle	Technologies	Limitation
Zemerl	Client-Server approach	GPS&Mobile phones	Discoverable, Size is big
Quadeer	Web-Server approach	Internet& SMS	Discoverable Size is big
Anderson	Client-Server	GSM&SMS	Discoverable Size is big
E.Omar	Parent-Child approach	Android Mobiles& SMS	Discoverable Size is big
Proposed work	One User-various end users	PTD&ZigBee	Hidden Size is small

In the above table we can see that all of them are using cellular networks and have to make use of a SIM for using SMS and some of the methods make use of internet. Thus as mentioned earlier when a person is being abducted the kidnappers prime intension is to eliminate the victims mode of communication hence he targets the mobile phone thus once the mobile has been eliminated there can be no more tracking. Hence this is where the proposed PTD stands different from others. It is meant to be hidden and it does not use GSM, SMS or internet. Instead it uses ZigBee protocol which is very useful to cover a wide area by forming a WPAN using mesh networking. Thus unknown about the presence of this PTD the kidnapper is deceived and the victim is successfully transmitting his GPS location along with an alert message and thus is a step closer to being rescued.

VI.   CONCLUSION AND FUTURE WORK

In conclusion the main motivation for this work is to create a safer tomorrow for the people especially the vulnerable girls. The main theme of this work is being secretive and calling out for help. It avoids the use of internet or cellular networks and cell phones. It makes use of GPS and ZigBee technologies. Regarding future work the device can be made to auto transmit the location and alert message based on certain conditions such as change in route taken etc. A very wide area can be covered by using multiple routers and greater range ZigBee modules thus ensuring that no matter at what end the user it the message is transmitted successfully to the end users.

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