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"An Arduino Based Indoor & Outdoor Positioning System (IOPS)"

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1.Abstract

The purpose of this project is to design and construct a hand-held wireless GPS tracking device that can be tracked from the Internet. The project consists of three parts. The first part is a mobile device with an embedded GPS and wireless Internet connection to transmit its current location. The second part is a web server that will receive the data, parse it, and store it for access over the Internet. The third component is the user interface that will allow others to visually see where the hand-held GPS device is and has been. To view its location, one could use any device that can connect to the Internet such as a desktop computer, laptop, PDA, or cell phone. The data available through a browser includes a scalable map of the surrounding area, latitude, longitude, speed, and altitude of the hand-held device. The system is intended to be a general purpose tracking device; however, the user interface will be tailored to the university shuttle system.

Keywords: Arduino Mega 2560, GPS, GSM

2.Introduction

This can be used to provide timely assistance to the person in panic. Determining accurate geo-location of a person or object is of great importance in everyday life. This applies to small children who must attend school and have to take the journey alone. It also applies to aged people who are physically unfit for proper self care. Again it applies to the physically disabled like people with impaired vision, mobility disabled and so on. A cost effective and accurate system is in demand for the said purposes.

The GPS based asset or person tracking system is one that makes use of the Global Positioning System (GPS) to determine the precise location of an asset/person to which it is attached. Such a system with cost effective design enables owners to view the present and past positions recorded of the target on Google Map through a purposely designed website or android application.

The aim of current project is to develop such a system. The system components consist of a GPS sensor, GSP modem and Arduino Mega2560 processor platform. A button is interfaced with Arduino which is used to trigger the alert system. The system is intended to be carried by the user whose geo-location is of interest to the far away guardian. When the button is pressed Arduino sends the current geo-location of the user to the predefined mobile number. The guardian can then use that latitude/longitude data to map the person in panic on the goggle map or some other tool.

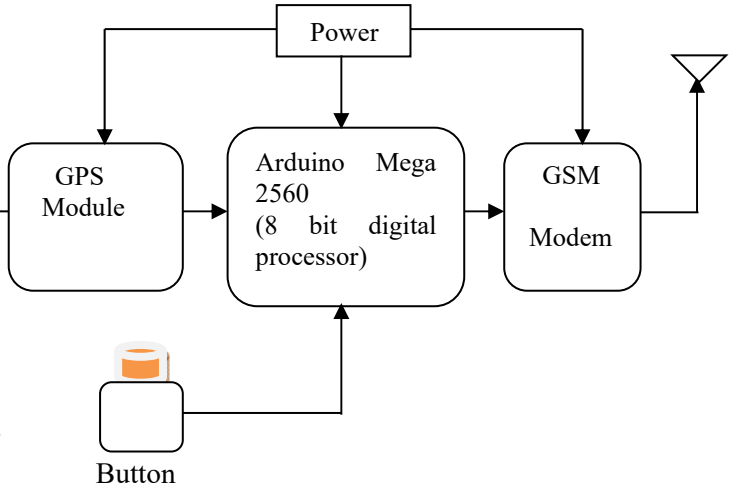
With slight modification the system can be operated completely from a battery and can be made truly mobile. Right now for the purpose of demonstration it is made to operate from a regulated power supply derived from 230V AC power system.

3.Related Work

[1] Design and Prototyping of Visible Light Indoor Positioning System (1) This report describes the design and prototyping of an indoor positioning system (IPS) using visible light. Current IPS are using RF and/or ultrasound technologies. Devices transmit unique identification (ID) codes, which are received by passive detectors in known fixed locations of a building. The basic system requirements are tracking of static and moving

objects with room accuracy and reliability in terms of detection error rate 104.

[2] "RADAR: An In-building RF-based User Location and Tracking System. (2) The proliferation of mobile computing device and local area wireless networks has fostered a growing interest in location-aware system and services. In this paper present RADAR, a radio-frequency (RF) based system for locating and tracking users inside building. RADAR operates by recording and processing signal strength information at multiple base stations positioned to provide overlapping coverage in the area of interest. It combines empirical measurements with signal propagation modeling to determine user location-aware services and applications. We present experimental results that demonstrate the ability of RADAR to estimate user location with a high degree of accuracy[3]



Fig(1):Block diagram

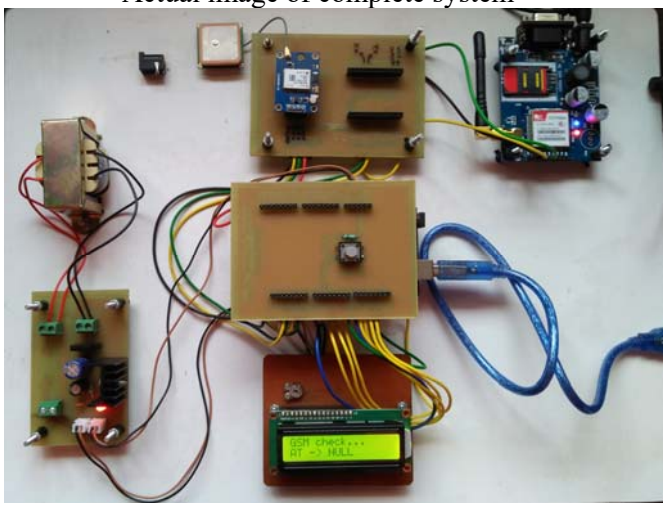
4. Proposed methodology

Figures show the methodology used to implement the system. GPS continuously keeps track of current geo position of user in terms of latitude and longitude. Arduino maintains the geo position values obtained from GPS module in memory. Arduino awaits button press event from the user. If button press found then Arduino formats the values of latitude and longitude as text SMS and Arduino sends SMS by activating the GSM modem.

5. Experimental results :

Figure shows the picture of complete system.

----------Actual image of complete system----------

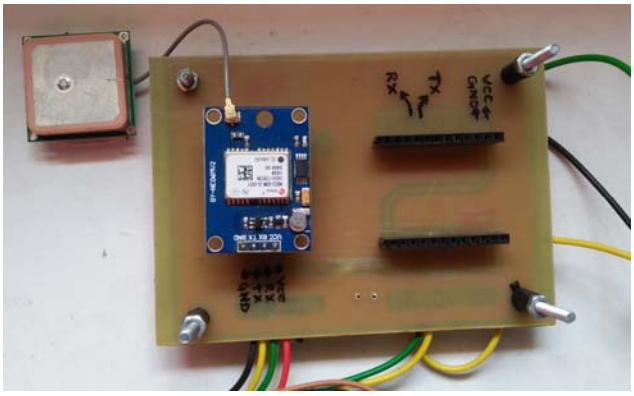


Fig(2): Actual image of complete system

Initially we thought of using Arduino Uno in place of Arduino mega2560. But Arduino Uno has only 1 serial port and that too is most often used for serial communication with computer that is for programming and debugging purposes. In our system we have GPS module and GSM module that require

serial interface. Now we can create software serial port on non-serial pins of Arduino Uno using Software serial library. However such an approach is not as reliable and efficient as a dedicated hardware based serial port.

------Actual image of GPS interface with Arduino----



Fig(3):GPS interface with Arduino

The GPS module outputs data in NMEA format every second and that is huge. Hence we thought using dedicated serial for this purpose would be good even from future modification and development perspective. For this purpose we choose Arduino mega2560 as processor platform for the system. Arduino mega has total of 4 serial ports. Thus we used serial 1 for GPS, serial 2 for GSM and serial port 0 for debugging using computer.
Again the GPS module operation is critical as there are aspects like cold start, warm start and hot start. If the system remains off for long time and has changed position during this period then it takes a cold start which requires considerable amount of time for successful GPS fix. After this however it outputs data with just 1 second delay.
Again all of data output by GPS was not useful for our purpose. Hence it was required to sort out data to get just the latitude, longitude and altitude information. Figure below shows the screen shot of Arduino serial monitor which shows GPS data received by Arduino.

The information is contained in line that begins with $GPGGA. Again this data exists in ASCII text format and may be required to be converted to floating point number format if required. However that was not necessary for us.
To send SMS using Arduino we have GSM800 module. Using GSM module with Arduino was not an issue as it uses standard AT commands for various operations. Figure shows the screen shot of sequence of commands used to send SMS.

--------Actual image showing GSM interface with Arduino---------

Fig(4): GSM interface with Arduino

AT Commands :

```
//-------------------------------------------------
 AT
 OK
//-------------------------------------------------
 AT+CMGF=1
 OK
//-------------------------------------------------
 AT+CMGS=”mobile number”
> actual message
   Ctrl+z
```

Again 16x2 LCD is used in the system to display process flow information. For interfacing this LCD with Arduino we have ready library available in Arduino IDE. This library uses the standard 6 pin interface.
For having all these interfaces physically done with Arduino without damaging the board we built an Arduino shield using standard FR4 PCB board. The layout for the same was prepared in eagle CAD pcb design software. Figure shows the image of Arduino

shield. This made soldered wiring connection possible with Arduino pins.

--------Actual image showing LCD interface with Arduino---------

Fig(5): LCD interface with Arduino

It was observed that for successful operation of GPS and GSM module a good sky view for GPS and good network signal range for GSM were necessary. For this purpose we had to arrange the demo setup near to the laboratory window.
The system was tested by various members of project group and also by others members of the Electronics laboratory at different times of day and week. Every time it gave 100% success rate. And now we are quite assured that the system works as per initial design plan.
Figure shows the actual image of GPS module being active and position information being displayed on LCD screen.

--------Actual image of GPS + LCD showing lat and long information---------

Fig(6):GPS + LCD showing lat & long information

Figures below show the various steps taken by system when panic button is pressed by user.

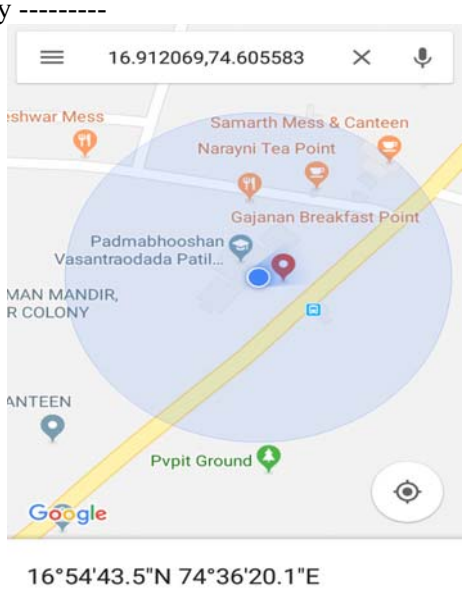
--------Actual image showing LCD display after button is pressed---------

Fig(7): LCD display after button is pressed

--------Actual image showing Text message recived on mobile display ---------

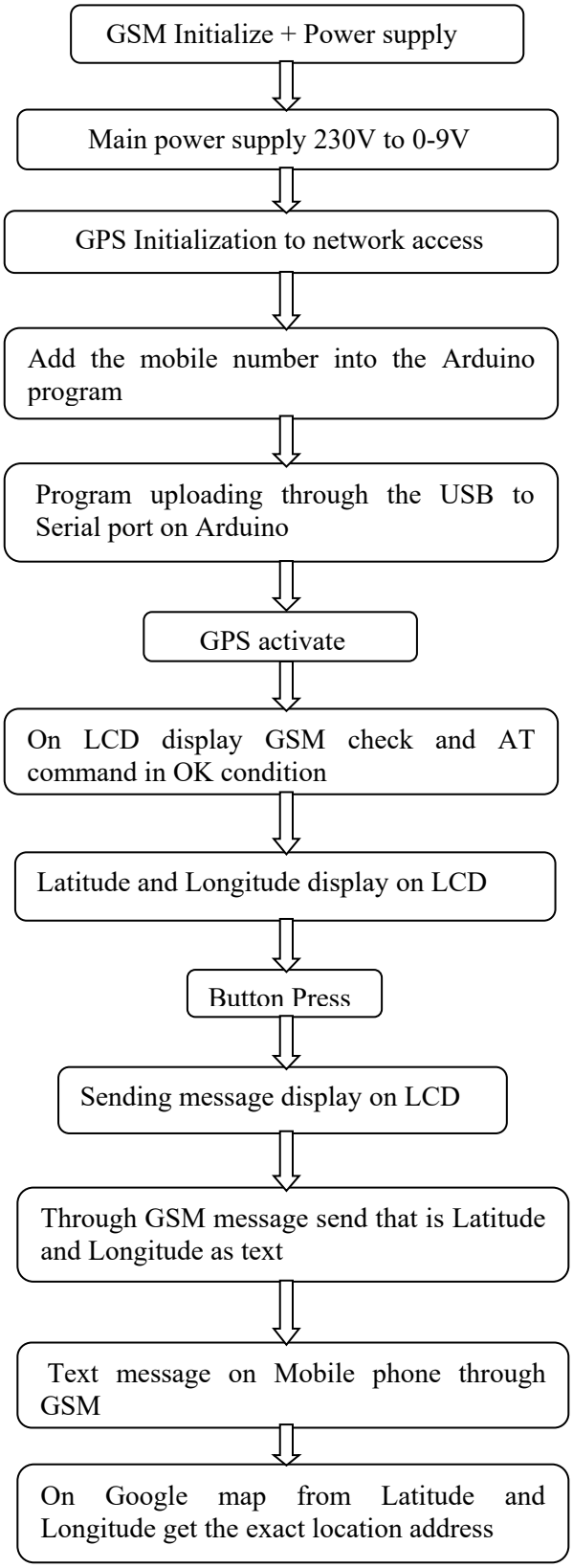
Fig(8): Text message recived on mobile display

--------Actual image showing Output on Google map display ---------



Fig(9): Output on Google map display

Process flow of system



-------From the above process flow results we can perform the demo as shown in below table-------

Fig(10):Demo Experiment Chart

6.Conclusion

This system would facilitate automatic monitoring of geo location of person using the device. It would facilitate in providing timely assistance to the same person. It would be very useful for aged, disabled and children tracking as well women's security purpose.

7.Future Work

1. Use of High quality GPS modem for more precise location detection
2. Use single board system to minimize system size
3. Furnished and compact design for commercial implementation

8. References

[1] K. Dividis, "Design and prototyping of a visible Light indoor positioning osystem", Philips research Eindhoven 2007

[2] P. Bhal and V. N. Padmanabhan, "RADAR: An in-building Rf-based of user location and tracking system", The 19th Annual joint conference of the IEEE computer and communications societies (INFOCOM '00) Vol. 2, pp. 775-784, March 2000.

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Sr. No.	Mobile number	Latitude & longitude	Location Address
1.	9975328204	LAT=16.911947 LON=74.605728	P.V.P.I.T.,Budhgaon college bus stop.
2.	9763278932	LAT=16.825052 LON=74.651412	Near vidyamandir Brahmanpuri road,Miraj.
3.	9607042374	LAT=16.8813152 LON=74.5959026	Ahilyanagar bus stop Kupwad road,Sangli
4.	8605593713	LAT=16.8561362 LON=74.5668852	Hirabaug Ganapati mandir Panchmukhi Maruti road ,Sangli
5.	7775061381	LAT=16.9120622 LON=74.5958279	Laxminagar Budhgaon Near Aadarsh school,sangli

Fourth Author
Mr.D.O.Shirsath Presently working as Assistant Professor in department of E&TC Engineering Padmabhooshan Vasantraodada Patil Institute Of

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