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LoRa intelligent troop tracking and location monitoring system

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ABSTRACT
Tracking based applications have been quite Popular in recent times. Most of them have been limited to Commercial applications such as vehicular tracking (e.g Tracking of a train etc). However, not much work has been Done towards design of a personal tracking system. Our Research work is an attempt to design such personal Tracking system. In this paper, we have shared glimpses of Our research work. The objective of our research project is to design & Develop a system which is capable of tracking and Monitoring a person, object or any other asset of importance (called as target). The system uses GPS to determine the Exact position of the target. The target is aided with a Compact handheld device which consists of a GPS receiver And GSM modem. GPS receiver obtains location coordinates (viz. Latitude & Longitude) from GPS satellites. The location Information in NMEA format is decoded, formatted and sent To control station, through a GSM modem. Due to use of Open CPU development platform, no
external Microcontroller is required, with additional advantage of Compact size product, reduced design & development time And reduced cost. Thus, the proposed system is able to track the accurate Location of target. This system finds applications in tracking Old-age people, tracking animals in forest, tracking delivery Of goods etc. Our final designed system is a small-size
Compact l.S"X3.7S" Tracker system with position accuracy Error <30m (100 feet).

KEYWORDS:

GPS; GSM; Tracking; Navigation; NME; AT Commands

I. INTRODUCTION

In recent times, tracking has become an important Issue. Failure to keep track of assets is being related to Loss of money and time. Tracking, in our sense, is to Determine the pin-point location of the parcels & goods, Animal or person of interest, at all times. With this broad Definition in mind, we shall establish both ethical and Economic importance of tracking in next few lines. In the current scenario, tracking of goods and parcels Is done exclusively through bar-code system.[1] When the Item is packed, a barcode sticker is pasted along with the Packaging of the item. As the parcel is carried away along Its trajectory to the destination, at every check point in the System, the bar-code is scanned manually and the position 978-1 -4673-8587-9/16/$31 .00 ©2016 IEEE [1] Of the parcel is entered in the system.[2] However, this Approach has two severe concerns. First one being, due to Human intervention in the system, the system immensely Depends on the enthusiasm of the human operator to make An entry in the online database. Secondly, all the stake Holders know only about the position of the parcel at the Checkpoint, but nowhere in between. [3]Similarly, in case of endangered wild life animals, the Tracking currently depends on their vision captured in High-resolution cameras. However, the exact and accurate Position is known pnly at unpredictable instants.[4] In case of Causalities of the animal, the same may not be known for a Long time. Tracking of human beings has been a matter of Interest too. Especially for the old age people who need Special attention, tracking becomes important.

[5]Our Personal Tracker is customized for this particular Application, although it can be used in other Tracking Applications as well. [6]GPS based trackers have been integrated into public Transport systems and they are popular in use. However, Tracking of individual person or assets, as discussed has not Been made possible yet. We firmly believe, this is because None of the systems has been robust and diverse enough to Serve as a solution to each of the issue discussed above. [7] Our approach based on OpenCPU platform is a

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Radical solution for personal tracking applications. Based On OpenCPU platform, we have implemented a compact Personal tracker 1.5" X 3.75 " inches in dimensions, Which is capable of determining the exact position of the Target with an accuracy< 30m(CEP).
Understanding that our system will be used in critical Application accuracy
size, both, matter a lot, We have objectives as:

1. To design a highly accurate position tracking System
2. To keep the size of device as small & compact as Possible and keep weight low. [9]

Low size and weight objectives ensure that the system Doesn 't
Interfere with the daily activities of the person Using it.

DETAILED EXPLANATION

The Navigation systems, GPS project was the first launched by Department of defence in 1973, initially with 24 Satellite aim. Currently, there are 31 satellites used by GPS.[10] With Russian Glonass, Chinese

BeiDou, Indian IRNSS and EU's Galileo, there are multiple such satellite Based systems.[12] More details about development of GPS System can be referred [13] . In E. Hammerle, P. Winton and S. Fett, propose An indoor position tracking system. This system tracks the Position using estimation technique known as Partial Pulse Positioning, which makes use of a radio-frequency (RF) Transmitter.[14] Based on the reflections obtained from Different reflectors placed in the indoor-environment, the Position of the RF transmitter is determined. [15], F. Evennou and F. Marx present an aided dead-reckoning

Navigation system based on WiFi signal strength Measurements. The position and attitude are determined Using low cost sensors. The errors are then fixed using WiFi signal strength measurements. Signal processing Algorithms are used to correct the drift.[16] Inertial navigation Systems interact with the WiFi positioning system to Provide highlyaccurate real-time navigation. A common issue with GNSS/GPS based navigation System is multipath propagation. The issue is especially Serious in urban areas with tall buildings.[17] It is fairly Possible that the direct line of sight to a satellite may be Blocked by a building or skyscraper and its signal might Reach the receiver on the ground, only after one or more Reflections. Since the signal path is longer for the reflected Signal, ranging errors occur, which result in false Prediction of position. The issue of reflection by buildings Is also possible even when there is direct line of sight.[18] Meguro et at. propose a precision positioning Technique which can be applied to track vehicles in urban Areas. The proposed technique mitigates multipath Propagation with help of an omni-directional infrared (IR) Camera. Positioning is performed only considering the Visible satellites that have lesser multipath errors. Invisible Satellites (satellites which are hidden behind buildings)are Not considered, although signals are received from all Satellites. The IR camera aids in judging which signals are To be considered for positioning. Kouji Murakami et at. [19], have proposed a system For tracking of everyday objects for a service robot. The System consists of an intelligent cabinet, floor sensing [20]System and a data management system. Using a RFID Reader, the intelligent cabinet can measure the position of An object on itsel£ The floor sensing system uses a laser Range finder. Using laser range, it is capable of measuring The position of an object on the floor and the position of a Human walking in a room. The captured data is logged in By data management system for providing inputs to Service robot. In case of multipath propagation, removing the Reflected signals might lead to a shortage of satellites in Fixing the position. STang et at. [21], propose cooperative Relative positioning (CoReIPos) scheme. In this scheme, Correlated information, including that of reflected signals, Is used to compute relative position. M Fuzi et at. [22], propose a method to estimate the Location of pedestrians by locating their moving mobile Devices. GPS is used in order to determine the absolute Position of the mobile device & dead-reckoning methods Using built-in sensors in the mobile are used to obtain the

Relative movement of the mobile.[23]Open CPU RlL Layer: Open CPU RlL Layer, is a open Source layer which is embedded into user API layer. Using RlL layer, developer can simply call API to send AT Commands and immediately get the response when API Returns. Some of the basic API such as telephony, SMS etc Are provided along with Open CPU package. However, the Developer can write his/her own custom API or new APIs For different functionalities. Application Layer:[24] In Application Layer, the desired Functionality is realized by calling suitable API from RlL Layer. The firmware is developed for Application layer. Detailed description of Open CPU is available in Open CPU Documentation.[25]

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PERFORMANCE VALIDATION

The entire firmware is written in Embedded C Language in Eclipse CDT. Arm Sourcery CodeBench Lite Tool chain is required for OpenCPU platform. Details About Eclipse CDT & Sourcery CodeBench can be Referred at Eclipse Website [26] and MentorGraphics Website respectively [27]. In our Research work, we have used Quectel L80 GPS module and Quectel M66 GSM/GPRS module. The GPS L80 module is interfaced to GSM/GPRS Module Through UART pins.

FEATURES OF PERSONAL TRACKER

Battery operated system: To keep the Tracker portable, The entire system has been powered using 3.3V output, l100mAh battery.[28]

There are features to indicate low battery condition, to notify the user to charge the battery. The battery can be charged by using USB charging cable.

Emergency SOS switch: In case the user is in Emergency (sayan elderly person using the tracker

Has sudden health ailment), he/she can press the SOS switch and an alert call will be initiated. There Are up to 2 telephone/mobile numbers to which Telephonic call will be dialed, so that user can Convey his message. [29] Update Emergency number through SMS: The Telephone number to which alert call has to be sent In case of emergency can be updated using SMS. In our Tracker, sending SMS 'UPDATE *123# <number>" to the SIM inserted in the tracker will Cause update of Emergency number. We have used String parsing for the module to understand the Correct SMS. Tracker Locator: In order to locate the Tracker (in Case it is misplaced), a buzzer has been provided. Dialing the SIM card inserted in the Tracker, the Buzzer will ring and Tracker can be locate

PROPOSED METHOD

When the Tracker is turned ON using the power Switch, it waits till the SIM is registered to the GSM & GPRS network. LED blink pattern I(Blink 5 times, 500ms Each) in di cates success ful regi strati on. At same time GPS L80 module is also turned on and It starts sending GPS information in NMEA format[30]. The GPS information consists of 7 strings. Of our Importance is, $GPGGA string as it contains timestamp And location information in terms of Latitude and Longitude information. $GPGGA string has been Explained in next subsection. GPS information is read through UART protocol and Necessary string parsing is done to get the information in An format easy to interpret by human operator. At fixed intervals oftime(At every 30 minutes in our Code), this GPS information is sent to a Email Id Registered by the user using SMTP protocol. Details of SMTP protocol are mentioned in [30]. The battery voltage is monitored by ADC peripheral Of the module. If it goes below decided threshold (1.9V in Our code), LED blink pattern 2(Blinks 7times, 250ms Each) indicates Low battery condition. At any instant of time, if user presses SOS button (switch), a telephone call is initiated to the number set by the User. If the first call is failed, immediately another telephone Call is initiated to second number registered by user. Microphone is included so that target can pass his message. The process of updating number to which emergency call Should be dialed is explained in previous subsection At any moment, if a call is made to the SIM inserted In the module, the buzzer rings and is used to locate the Tracker.[31]

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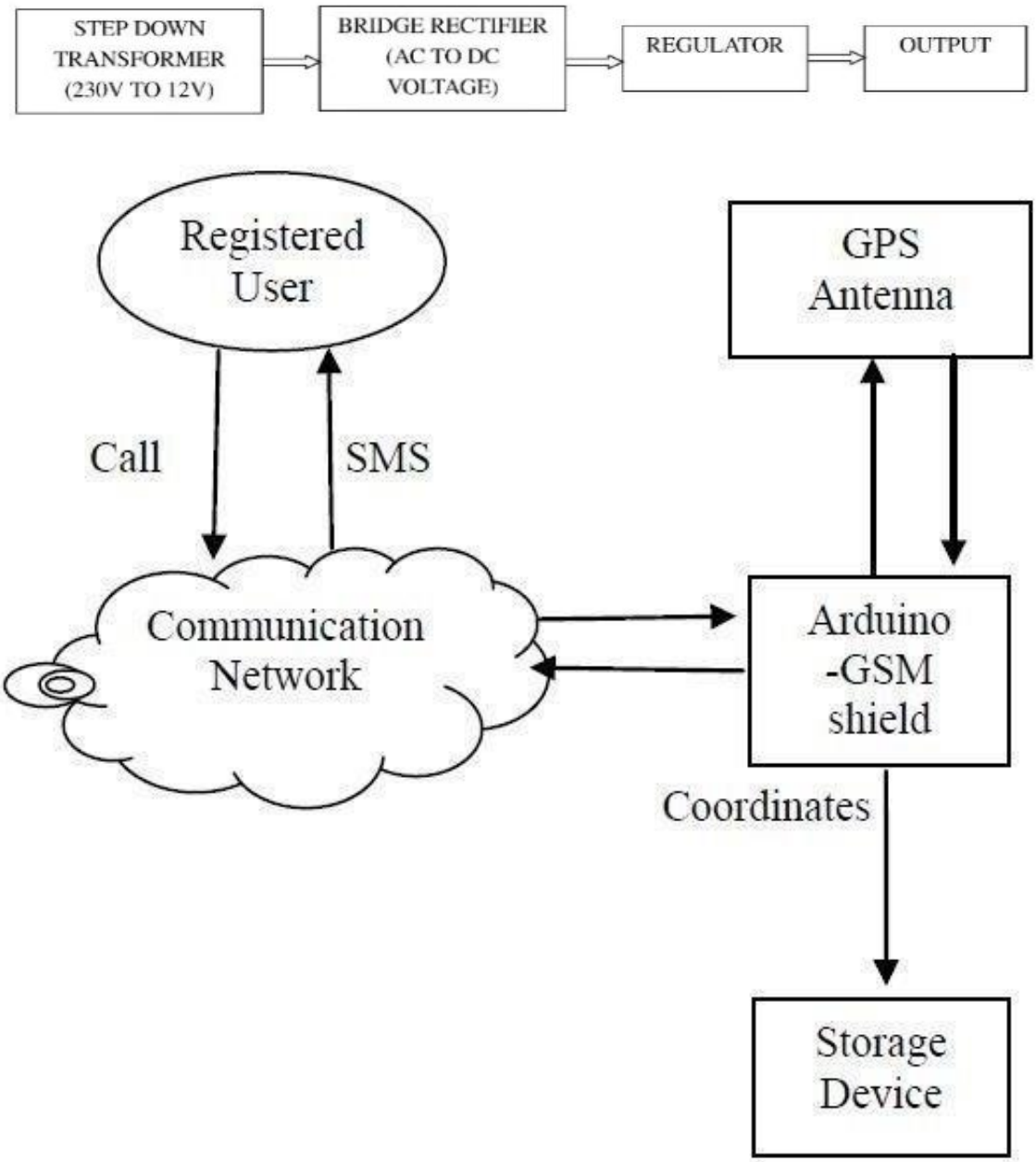
BLOCK DIAGRAM



II. CONCLUSION

We have tested our module in indoor environment Which is top floor of a building, where most GPS satellites Should be in direct line of sight. The GPS location Obtained was compared with that obtained using PowerGPS software and also Google Maps. We were Successful in determining the precise location with error of Unit second of longitude/latitude at worst. This roughly Approximates to 100 feet or 30m, i.e. maximwn position Error was less than 30m. Also, we observed that depending On strength of GPS/GPRS network, there was a delay of 6-30s in initiating the telephone call, sending mail etc. This [5] Delay can be

minimized by choosing Network operator With good coverage. Our designed tracker is compact in Size and with position accuracy error <30m, our objectives Are successfully attained.

SCOPE FOR FUTURE WORK

A -based application for Android or iOS can be Developed and provided along the Tracker. Instead of Getting location longitude and latitude coordinates, which Are difficult to understand by common user, the location Can easily be viewed on a Map. Work needs to be done to improve accuracy of Position fix and improving performance in indoor Environment

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