Real Time Vehicle Fleet Management and Security System

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Abstract- Nowadays most of the public and commercial transportation organizations are using the vehicle tracking system to track the vehicles in real time. But, in many organizations like cab service providing companies, public vehicles and school busses do not have the security system. The purpose of this project is to provide the effective vehicle tracking, real time online monitoring, dedicated remote server for fleet data storage and security features in a single system.

This Real Time Vehicle Fleet Management and Security System project is built on a Linux Based embedded microprocessor. GPS Receiver is interfaced for vehicle location tracking, GSM-GPRS modem is used for communication and for Security purpose a physical panic button, Biometric sensor, Camera, and speakers are used. A dedicated server used for data acquisition and a GUI renderer is created for user interface. This GUI-renderer will plots and displays the real time data dynamically.

Keywords—GPS; GSM; GPRS; HTTP; FTP; PHP; UART.

I. INTRODUCTION

The vehicle fleet management involves the administration of motor vehicles such as cars, vans and trucks etc. Fleet management allows companies which rely on transportation in business to minimize the risks associated with improving transportation efficiency, safety, productivity and reducing the overall transportation and staff costs.

Cab companies need to monitor all the cabs in real time so that they can route the vehicle to nearest customer. The Cab companies should ensure the safety/security of its customers.

Nowadays the need of security/safety in taxicabs is increasing. The primary goal of this project is to provide the security/safety to the people by using the technologies like, Driver authentication, In-car surveillance camera, Physical panic button, Remote controlled voice alarm system etc.

The transportation firms like cargo carrying companies need to track their vehicles all the time to deliver the cargo on time and manage their warehouse [1] [2].

II. SYSTEM OVERVIEW

The Real Time Vehicle Fleet Management and Security System have In-vehicle system, in which all the hardware is interfaced to CubieTruck board. This In-vehicle system is placed in the vehicle.

A remote server used for data acquisition in real-time and GUI is created for user interface and dynamic plotting.

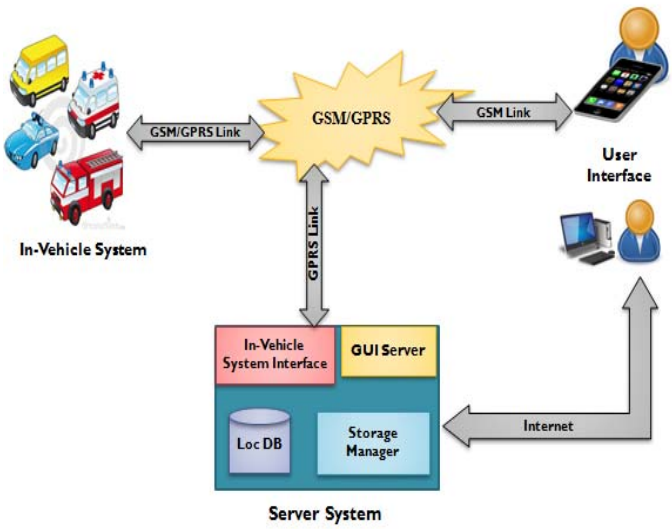

Figure1. System overview

The main function of the In-vehicle system is to acquire the vehicle location, speed, time using GPS Receiver, Driver information using Fingerprint sensor then transmitting this data to the remote server at a fixed interval of time using GPRS HTTP protocol. Here a physical panic button is interfaced for emergency situations; this panic situation is informed through SMS, CALL, and Server update along with this Camera will take the pictures from the vehicle and uploads to the server using FTP protocol. The speaker is interfaced as voice alarm for security, from base station this voice help alarm can be activated and deactivated.

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At the base station a remote host server is maintained. In this remote host server a PHP script is running to accept the In-vehicle system data and stores the incoming data to database. HTML script is used for user interface, in which Google maps API is embedded and it takes data from database and plot the vehicle location path in real time. A FTP database is maintained to accept the pictures and data files from In-Vehicle system.

This system will proved vehicle tracking, real time online monitoring, security features. This system is useful for Cab service companies, public transport, School organisation etc.

III. System Design

There are two main parts in this project, i.e building Real Time Vehicle Fleet Management and Security System.

1. In-Vehicle System
2. Server System

A. *In-Vehicle System*

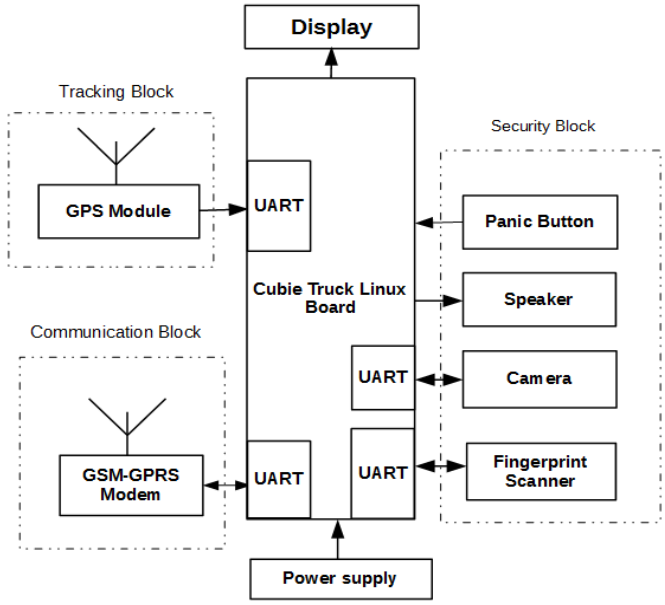

Figure 2. In-Vehicle System block diagram

Embedded Linux board Cubietruck is used for building In-Vehicle system. The main purpose of In-vehicle system is to get the vehicle location details, monitor and control the Security system devices and use the communication device to communicate between In-Vehicle system and base station server.

In-vehicle System collects the location details using the GPS receiver. It will monitor and control the Security devices such as Biometric Fingerprint sensor for driver authentication, panic button to indicate panic situation, Camera for taking picture in the vehicle and remote controllable voice alarm system.

A GSM/GPRS modem is used to establish the communication between the In-Vehicle system and central server(base station). This GSM/GPRS modem establishes the communication by using SMS, HTTP, FTP protocols. HTTP protocol used to upload the location data and fingerprint driver ID to the server, SMS to user phone. FTP protocol used to upload the captured pictures and data files to the remote server.

B. *Server System*

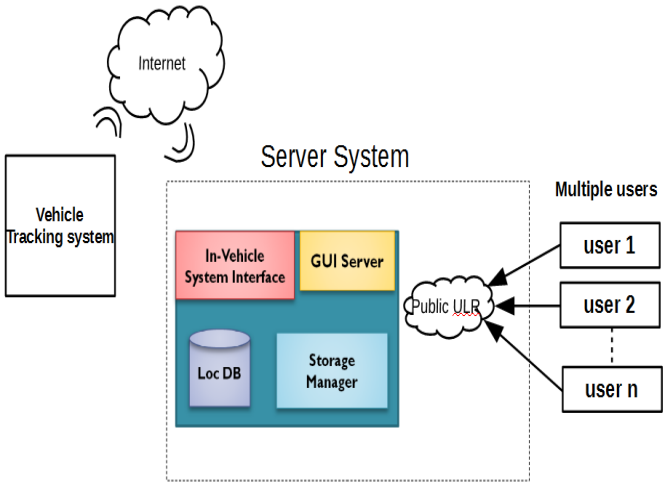

Figure 3. Server System block diagram

Main purpose of server system is to accept the data from the In-Vehicle system and maintain a database to store the accepted data and the GUI server for user interface.

In-Vehicle system server interface have the PHP script, which will accept the data from the vehicle module through GPRS HTTP protocol. This acquired data then transferred to the database. Database accepts the data from PHP script and appends the data to the existing data.

A storage manager is used to accept the data files i.e. image and data files from the In-Vehicle system through FTP communication. GUI server will take the real time location details from the location database and plots in the Google maps.

IV. System Implementation

A. *Cubie Truck Microprocessor*

Cubietruck is the core processing unit in this project. All the hardware components are interfaced to this board.

Cubie truck is an embedded microprocessor board, which supports embedded Linux based operating systems like Ubuntu, Fedora and Android etc. The Cubietruck board has the Allwiner A20 SoC. Allwinner A20 SoC features a Mali400 MP2 GPU from ARM and it features Dual-Core Cortex-A7 ARM CPU.

B. GPS Receiver Device [GPS-634R]

The Global Positioning System (GPS) is used in navigation systems. Satellites send the precise information of their position, GPS use these details to calculate the location, time and speed information in all weather conditions. GPS need clear line of sight to three or more GPS satellites.

In this project GPS-634R GPS receiver module is used to get the location details. This module also gives the details such as date, time, and ground level speed along with the location details. GPS receiver output is in terms of NEMA standard. This modem working standard baud rate is 9600.

$GPRMC NEMA string is extracted to obtain Latitude, Longitude, Date, Time and ground level Speed.

C. SIM 900 GSM/GPRS Interface

GSM/GPRS modem is interfaced to establish the communication between the In-Vehicle system and Base station server. The SIM900 controlled by using AT commands.

Used Communication types:

- Through SMS send and receive
- Through CALL
- Through HTTP protocol data transmission
- Through FTP protocol for picture/data transmission

Programmed to identify the new incoming SMS and if SMS conations the vehicle location request it will reply a SMS containing the Latitude, Longitude, date, time, speed, driver ID and a Google web-link in which latitude and longitude are embedded.

In this project *GPRS HTTP protocol* used and programmed to transmit the vehicle data to the remote server continuously (typically every 2-6 seconds once). Here In-vehicle data is, Driver ID, Latitude, Longitude, Time, Date and Speed.

If the GPRS connection is lost, program will detect and it will re-enable the GPRS network connection.

In case of fading GSM Channels i.e. if GSM network coverage is lost, program is written to detect and to store the data in internal database and once GSM network coverage available then it will transmit the data by using the File transfer protocol (FTP).

File transfer protocol (FTP) is used to transfer the camera image/data file from In-vehicle system to the remote server.

D. Fingerprint Sensor [SYNO CHIP AS601, R305]

In this project fingerprint sensor is used for the driver authentication. This scanner can store up to 1000 finger temples in the module.

Fingerprint scanner will continuously monitor the input finger scan. If the scan found then it will match scanned template with existing temples in the database for match. If match found then it gives template ID number.

Here GPIO pin PI15 is connected to the push button for adding new entry to the Fingerprint module database. When the push button pressed it will scan two times, creates a template and stores it in a database with template ID number.

E. Camera interface

In this project, an iBall camera is interfaced to the Cubietruck board. The camera module is used for the security purpose. It will take the pictures depending on the events or on request. If a panic button is pressed in vehicle, then camera will take the pictures and it will send it to the base station. Base station person can also request for the picture any time.

F. Panic Button and Alarm system interface

Panic button is interfaced for panic alert from the vehicle to the base station through SMS and GPRS services. When the panic button pressed the processor detects the interrupt and sends an SMS to base station and it will takes the picture and sends it to the base station server.

For voice alarm, system is using the Audio jack of the Cubietruck Board. This alarm system can be activated /deactivated from base station by sending the SMS to GSM modem in the In-Vehicle system.

G. POSIX Multithreading

Since several hardware components are interfaced to Cubietruck board, to achieve the real-time monitoring/response POSIX multithreading is used.

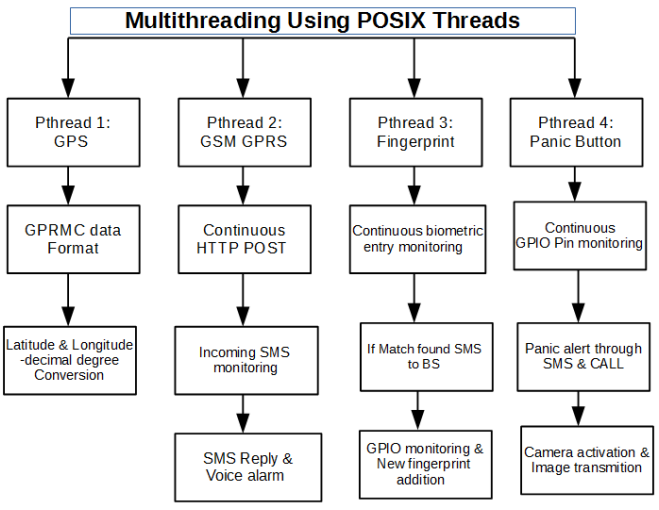

Figure 4. POSIX multithreads and major code blocks

Above figure shows the four threads and the major code blocks associated with the each pthread. All four threads run parallel and threads will hold/switch depending on the priority.

H. Server System implementation

Server system mainly contains the four blocks.

1. In-Vehicle System to Remote Server Interface
2. Location database
3. Storage manager
4. GUI Server

1. In-Vehicle System to Remote Server Interface

For In-Vehicle system to Remote Server Interface at server side, a PHP script is running to get/accept the data in specific format from the HTTP web link.

2. Location Database

The In-Vehicle system will send the GPS data and Driver fingerprint ID to the server using HTTP POST method. At the server, a location database is used to store the incoming data.

3. GUI Renderer

GUI renderer is designed for user interface. A HTML code is included in PHP script. In this HTML code a Google maps API is embedded with Google maps security code. This code reads the data from location database and plots this data in the Google maps dynamically.

4. Storage Manager

A FTP storage manager is created in the remote host server to accept the date files and Images.

I. In-Vehicle interfaced system hardware interface picture

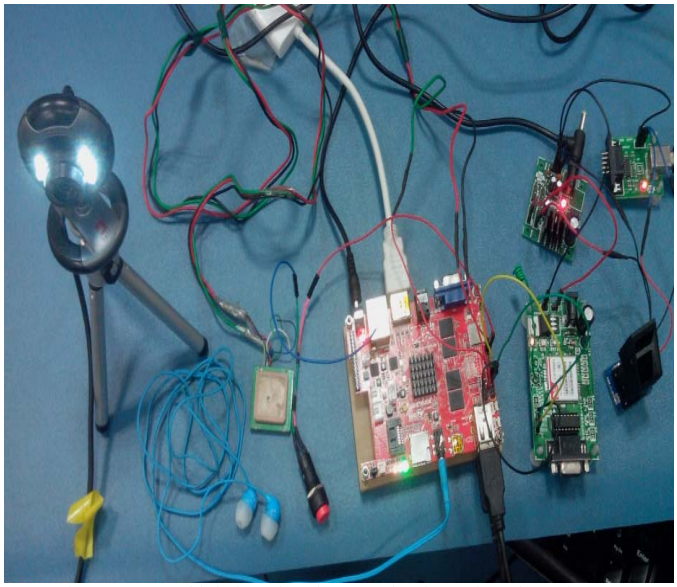

Figure 5. In-Vehicle interfaced system hardware interface pictures

V. Salient Features

A. Dedicated Server Implementation in Enterprise

In this project a dedicated server is implemented for the In-Vehicle system. All the data from the In-Vehicle system is sent to this dedicated server.

This dedicated server has the PHP script to accept the data from the HTTP web-link and a database will store this data. A GUI renderer is implemented to process this stored data and display in Google maps. A FTP database manager is used for accepting the pictures and data files from In-Vehicle system.

B. Self diagnostic of the GPRS connection

For self diagnostic of the GPRS connection an algorithm is implemented, it will monitor the each time HTTP POST upload status from the server. If it fails to upload due to GPRS disconnection, then the code will automatically enables the GPRS and uploads. This way it keeps check the GPRS connection status.

C. Reliable Communication in fading GSM Channels

Main problem in using GSM modem is that, there will be a situation where there is no GSM/GPRS network coverage available. In this situation system cannot send the data to the server and location data will be lost.

To avoid the above problem, system keeps count the failure events while uploading data using HTTP post method. If the continuous failure events count reaches 5 then system start storing data to the data file in the Cubietruck. When GSM/GPRS network connection available then it uploads this data file to remote server using the file transfer protocol (FTP).

VI. Applications

A. For Cab Services

Cab Service providing companies need to monitor their cabs in real time to provide the better service to the customers. This system provides the online monitoring and the security features like driver authentication, Physical panic button, Camera pictures transmission to base station and voice alarm system which can be controlled remotely.

B. For School Bus monitoring

This system will help the school managements for online monitoring of the school busses and they can check the vehicles over speed etc. Parents can know the vehicle location through SMS or using the web link which will have the current location of the school-bus to pick up their children.

C. For cargo carrying trucks

Cargo carrying companies need to monitor their vehicle through online, which allows to better usage of the warehouse. By analyzing the fleet data they will know the time taken to deliver the cargo in different timing of the day. They can plan the less traffic routes and timings to minimize the transportation cost.

VII. Results

The proposed Real Time Vehicle Fleet Management and Security System is implemented and obtained the results.

TABLE I. GPS/GSM-GPRS transmit/receive timings

GPS receive data time interval	Every 1 second
Average time taken for HTTP POST	3-5 seconds
Average time taken to upload a 20480kb image/data file using FTP protocol	20-25 seconds

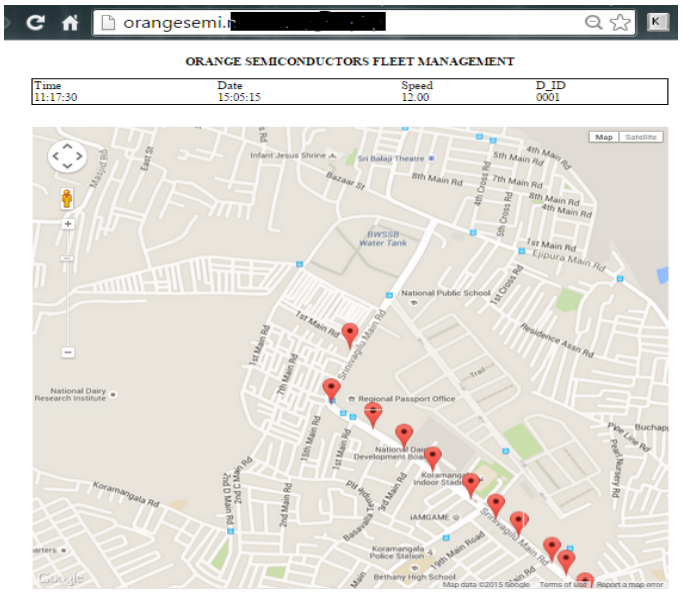

Figure 6. HTML GUI for user

VIII. Conclusion And Scope For Future Work

Real Time Vehicle Fleet Management and Security System will provide the tracking, security and online monitoring in a single system. This system is very useful to taxicabs companies due to its security features and it also useful for firms like School Bus monitoring, cargo carrying trucks etc.

This system can be upgraded for live video streaming in public busses by using 3G/4G enabled modem. Antenna tempering alerts can be added in case someone tempers or damages the system or GPS. GSM jamming Protection mechanism can be implemented, i.e. anti-gsm network jammers, so that Jammers fail to work properly.

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