

Design and Development of Low Cost Automotive Vehicular Communication System Based on ARM

Kale Sanket B, Satyajit A. Pangaonkar

Abstract— Several European research projects in the vehicular area address the enhancement of vehicular safety. In the frame of the Caring Cars project, an on-board car-gateway embedded architecture for safety and wellness applications has been designed. This paper puts forward the essentials of this modular, dynamic and robust architecture and defines in detail the advanced navigation, Data acquisition and Safety features built in a single board computer. By mean of this device, the emergency services will always be able to track the affected vehicle and monitor the state of the vehicle. Thus the system can help the vehicle occupants and inform the status to the emergency services to save the occupants in critical situations also it gives real time traffic information Security and accident prevention on single To improve the level of supervision and management for cargo transport vehicles, especially trucks carrying coal it is important to develop transport vehicles remote monitoring module.

Index Terms— Embedded Linux ,C++, Qtopia ,Qt Creator ,Linux Drivers for USB CAM ,ADC Device Drivers, UART Protocol for Data transmission & Receive for GPS and GSM Module, ARM Mini2440 Board, S3c2440 ARM 9 Processor, GPS , GSM , Temperature sensor ,USB Camera, DC Motor.

I. INTRODUCTION

In this modern, fast moving and insecure world, it is become a basic necessity to be aware of one's safety. The number of vehicles also increases on roads and highways. This result in more accident that interns leads to the traffic jams and public get help instantaneously Maximum risks occur in situations. It's the intelligent vehicle control for critical remote location application. This system can deal with both pace and security. The Vehicle Monitoring and Security System is a GPS based vehicle tracking system that is used for security applications as well. The project uses two main underlying concepts. These are GPS (Global Positioning System) and GSM (Global System for Mobile Communication). The main application of this system in this context is tracking the vehicle to which the GPS is connected, giving the information about its position whenever required. This is done with the help of the GPS satellite and the GSM module attached to the vehicle which needs to be tracked. The GPS antenna present in the GPS module receives the information from the GPS satellite in NMEA (National Marine Electronics Association) format and thus it reveals the position information. This information got from the GPS antenna has to be sent to the Base station wherein it is decoded. For this we use GSM module which has an antenna too. Thus we have at the Base station; the complete data about the vehicle.

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For real time monitoring an automatic monitoring system can be established with GSM, in this vehicle automatically identify and upload critical data about the vehicle and operating conditions. The monitoring device can send modified control parameters and guidelines to the vehicle driver. These parameters are temperature, ultrasonic distance, IR.

II. RELATED WORK

Many researchers have proposed the use of cutting edge technologies to serve the target of vehicle tracking. These technologies include Communication, GPS, GIS, Remote Control, server systems and others. The proposed tracking system in this paper is designed to track and monitor automobiles' status that is used by certain party for particular purposes, this system is an integration of several modern embedded and communication technologies. To provide location and time information anywhere on earth, Global Positioning System (GPS) is commonly used as a space-based global navigation satellite system [2]. The location information provided by GPS systems can be visualized using Google Earth [3]. In wireless data transporting, Global System of Mobile (GSM) and Short Message Service (SMS) technology is a common feature with all mobile network service providers [4]. Utilization of SMS technology has become popular because it is an inexpensive, convenient and accessible way of transferring and receiving data with high reliability [6]. In current system there is different module for security and car monitoring tracking, and traffic information accident prevention system. Here this system explains new Design and implementation of complete package for vehicle on single ARM -9 boards. In current system it is sensory to provide tracking and monitoring system which is connected to base station and through base station require vehicle continuously tack and monitor for safety of goods in logistic, cargo vehicle transportation. For this system developed to security, tracking, monitoring and traffic information with accident prevention. The implemented tracking system can be used to monitor various parameters related to safety; emergency services and engine stall [1]. The paper shows an implementation of several modern technologies to achieve a desirable goal of fleet monitoring and management.

III. HARDWARE DESIGN

Figure1.show Vehicular system block diagram. ARM board with different components mounted on it. It is the heart of system receiving information from different module and sends it to GSM module for server.

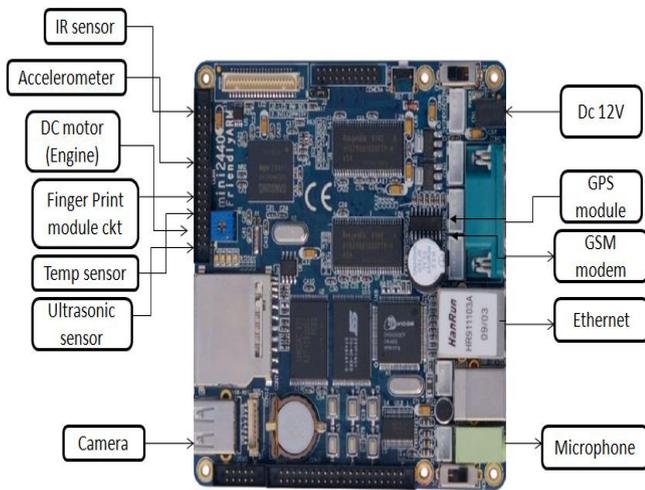


Figure 1: Vehicular System Block Diagram

A. GSM Module

Global System for Mobile communications (GSM) is the wireless standard for wireless communication used to send information to the control station. It Support instructions of AT commands. SIM300 can be integrated with a wide range of applications. SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz SIM300 provides GPRS multi-slot class 10 capabilities and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.



Figure 2: GSM Modem

B. ARM Mini 2440

Friendly ARM Mini2440 Board is equipped with SAMSUNG's S3C2440A 16/32-bit RISC microprocessor, it is is designed to provide hand-held devices and general applications with low-power, and high-performance micro-controller solution in small die size. The S3C2440A is developed with ARM920T core, 0.13um CMOS standard cells and a memory complier. Its low- power, simple, elegant and fully static design is particularly suitable for cost- and power-sensitive applications. It adopts a new bus architecture known as Advanced Micro controller Bus Architecture

C. (AMBA) C. GPS Receiver

Global Position System (GPS) is satellite navigation that provides location, and time information in all weather conditions, anywhere on or near the Earth GPS Receiver MT3318 Module is used to receive data in in standard National marine electronics association (NMEA) format. The PS module has -157dBm tracking sensitivity with 9600 baud GPS modules are popularly used for navigation, positioning,

time and other purposes. GPS antenna receives the location values from the satellites. GPS gives information about Message transmission time Position at that time and send to the server for GUI (Graphical User Interface) and store into server. GPS is interface with ARM processor. ARM processor using UART1 protocol interface with GPS receiver. Which contains information about Vehicle position (longitude, latitude) and speed GPS Sentences beginning with the following specifications: \$GPGGA, \$GPGSA, \$GPGSV, \$GPRMC, and \$GPVTG. And sentences also begins with \$GPMSS, \$GPZDA as shown in [table 1]. The detail NMEA protocol:

TABLE- 1 Formats of NMEA Messages

Sentence ID	Description
\$GPGGA	GPS Fix Date
\$ GPGSA	GPS Dilution of Precision and active satellites
\$GPGSV	GPS Satellite in view
\$GPRMC	Recommended minimum specific GPS/Transit data
\$GPVTG	Track made good and ground speed
\$GPMSS	Beacon Receiver status
\$GPZDA	UTC Date/Time and Local time Zone Offset

D. Accelerometer

Accelerometer sensor is used to measure static (earth Gravity) or dynamic acceleration in all three axes; forward/backward, left/right .It gives output in voltage 1.65V to 3.3V in positive direction and in negative direction the voltage drop from 1.65V to 0V.

E. On Board Data Storage

The SD card is interface with ARM by using SPI protocol in board. All vehicle related data which is transmitted to system is store into SD card.

F. Microphone

The driver can record his voice over the microphone in any case of emergency the same data will be stored over the SD card to retrieve. This system acts as Black box for vehicle to store emergency voice.

G. Accident Detection

To detect the accident will use the IR sensor, if in this case, the system acquire the information, will alert surrounding through buzzer and send the GPS data to the sever indicating the accident also send emergency massage for help to emergency services.

H. Accident Privation

Will calculate the distance of the adjacent vehicles and updates the microcontroller on same, if any any vehicle is neared then the predefined value then the system will alert the driver using the buzzer. Driver can take action according to situation.

I. Emergency Button

Here we are using switches to detect any accident. As soon as any of the switches are pressed the latitude and the longitude of that place are recorded (with the help of GPS),also we are recording various vehicle parameters such as engine temperature, fuel level ,speed etc. These parameters are then sent to the base unit and emergency services via the GSM modem.

J. Temperature Sensor

It continuously monitors the temperature of engine as well as cabin & sends its value to microcontroller. If temperature of engine or cabin exceeds desire value then system alerts to driver.

K. Fingerprint Detection System

We will implement a Fingerprint Detection System. This system tries to find the identity of a given Fingerprint according to their memory (Training Set). We are designing our own vehicle unit which consists of 2 DC motor based wheels. These wheels are operated using 12v DC motor. The system works at 5v and the DC motors operate at 12V, so to match the voltages we are interfacing a DC motor driver circuit L293D which will in turn drive the DC motors. Finger Print Scanner cans the finger print of driver and authentication it if the identity of driver is matched he can start vehicle and GSM module massage to base station with his identify. Here, we want to find the identity of a person where an image of fingerprint of that person (test image) is given to the system.

L. Camera

In order to view the scenario over the vehicle we use the USB camera which will driven through Video for Linux drivers of the board, for demonstration scenario we will shown it over the intranet network over the web .

M. Base unit

Base Unit Contain all the peripheral to be monitored in our Project connected to the ARM 9 Board, as the user starts his vehicle, the system will collect all the information from the sensors and the information is transmitted to Tracking server using GSM/GPRS modem on GSM network by using SMS. Tracking server also has GSM/GPRS modem that receives vehicle location information via GSM network and stores this information in database. This information is available to authorized users of the system. The base station is continuously communicated with the vehicle.

N. Traffic information

On Server Side we will equip a GSM Modem to communicate to the Vehicle data received by the server modem will be shown the Visual Studio Widow to know the exact location and status of the Vehicle .After gating data traffic density neared by vehicle module send information to server.

IV. SOFTWARE DESIGN

A. ARM Linux Operating System

In this project, we are using Linux2.6.3 kernel cross compiled for ARM architecture, RM Linux is a port of the successful Linux Kernel to ARM processor based machines.

B. GUI: QTOPIA GUI Library

Qt is a cross-platform application framework that is widely used for developing application software with a graphical user interface (GUI), and also used for developing non-GUI programs such as command-line tools and consoles for servers. Qt uses standard C++ but makes extensive use of a special code generator together with several macros to enrich the language. To develop the Programs, we use Qt Creator IDE (Interface Development Environment) to write and debug the source codes.

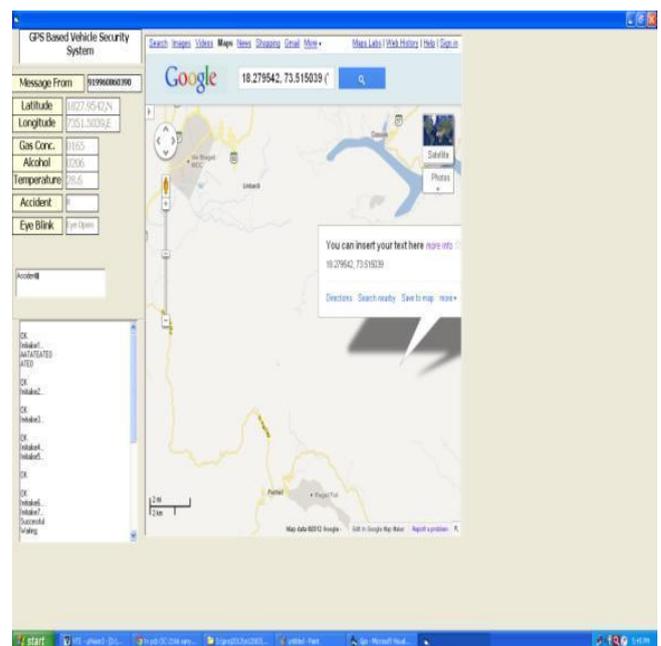
C. Server

Server is base station in this system which is monitoring and tracking vehicle using GUI application. The Visual studio is used to develop GUI application. Server receive require information through GSM module display and store. Base station continuously monitoring vehicle and it can send required information to vehicle. Figure shows vehicle poison on Google map.

Figure 3: GUI of Server

V. WORK FLOW OF THE SYSTEM

Figure 4 shows the working flow of system ARM is the heart of system where all data from different module is received processed and send to Base station through GSM module. As



system start driver has to authenticate his finger on finger print detection module if authentication fail driver can not start vehicle .If authentication success engine will start vehicle identity number and driver identity number will send to the server this information with time will store in server. The GPS module continuously receiving data from satellite in formats of NMEA Messages calculate position, speed of vehicle send to GSM module with temperature of vehicle server receive this data. The transmitted GPS data is processed by a Visual Basic program using a Kalman filter to correct the current position.



The resulted data of corrected position and automobile parameters is sorted in an Excel sheet. The Excel file is exported to a KML file that is compatible with Google Earth program. Hence, Google Earth will view the location and status of the automobile on the map by reading the KML file.

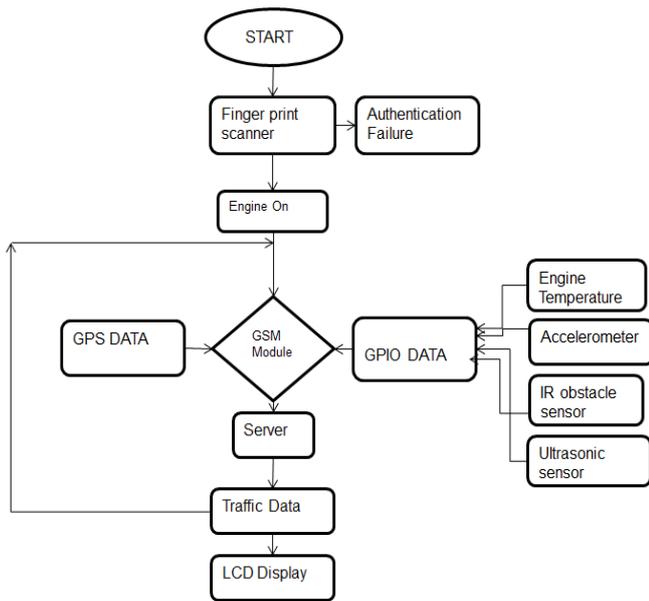


Figure 4: Flow Diagram of System

The KML file, developed for Google Earth, is used to save geographic data that includes navigation maps and other driving instructions. After starting engine on IR obstacle sensors and ultrasonic sensor continuously sensing obstacle if obstacle coming near to the vehicle i.e crosses the predefined distance buzzer will on and driver should take action. Accelerometer is used to detect accident if detected the emergency message transmitted to the server and emergency services such as police or hospital. Server store all required data.

VI. CONCLUSION

Design and implementation of low cost automotive vehicular communication module based on ARM which is complete package of vehicular tracking, monitoring by using GPS and GSM on GUI in base station also provide security, identity by using Fingerprint Detection System. This system also provides accident prevention mechanism with traffic information. This system continuously communicates with base station over GSM module and store requires data into server. The system is useful in much application such as surveillance, security, tracking, which may be installed in cargo trucks, cars, motorcycle, and boat. The system can be used in many applications.

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