International Journal of Scientific Engineering and Technology Research

ISSN 2319-8885
Vol.03,Issue.31
October-2014,
Pages:6251-6256

www.ijsetr.com

ARM Hardware Platform for Vehicular Monitoring and Tracking

KOMMU RENUKA[1], CH.SREEDHAR[2]

[1]PG Scholar, Global Institute of Engineering and Technology, Moinabad, Hyderabad, India, E-mail: renuka9676@gmail.com.
[2]Assistant Professor, Global Institute of Engineering and Technology, Moinabad, Hyderabad, India.

Abstract: Design of Vehicular monitoring and tracking system based on ARM using GSM and GPM is proposed. The vehicular module is used to track, monitor, and surveillance and finds the accident spot and intimate to the monitoring station. The proposed design provides information regarding vehicle Identity, speed, and position on real time basis. This information are collected by the ARM7 TDMI-S core processor LPC2148 by using different module and dispatch it to the monitoring station where it stores the information in database and display it on graphical user interface (GUI) that is user friendly. GUI is built on Microsoft Visual Studio 2010. This design provides information in real time using µc/OS-II.

Keywords: ARM7 TMI-S, MEMS Accelerometer, GPS, GSM, LPC2148, Wireless Monitoring Station, µc/OS-II.

I. INTRODUCTION

In today's world as the population increases day by day the numbers of vehicles also increases on the roads and highways. This result in more accident that interns leads to the traffic jams and public get help instantaneously. This module provides information about the accident to the hospital and police station. As a result sudden help public life may save and the traffic jams are reduced. 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 [3].A server computer at the (remote) monitoring station that is continuously waiting for data from the system, should record the actions of the vehicle into a database. This contains the information regarding Vehicle velocity, position, identity and temperature in two fashions. The information given to monitoring station is in continuous manner and when the accident occurs. The development of vehicular design brings public many convenience in life but also brings many problems at the same time, for example, traffic congestion, difficulty in monitoring dispersive vehicle, theft and other series of problems[5]. We are intended to made this monitoring wireless using ARM7 hardware platform ported with real time operating system µc/OS-II.

A. Key feature of this design include:

1. Vehicle real-time monitoring by sending "its" information regarding velocity, Position (longitude, latitude) to the monitoring station and to the user/owners mobile that should help them to get medical help if accident or the theft.
2. Display that information on GUI and also at the same time these information are stored in the database.
3. User/owner has an access to get real-time position of a vehicle in real time.
4. Also in case of theft vehicle should be stop at the same time where this system is ported on the mobile vehicle.
5. It includes a temperature sensor that gives temperature in degree Celsius for monitoring the environmental conditions around the goods or other stuff in the transport vehicle.

A. Hardware of Vehicular System

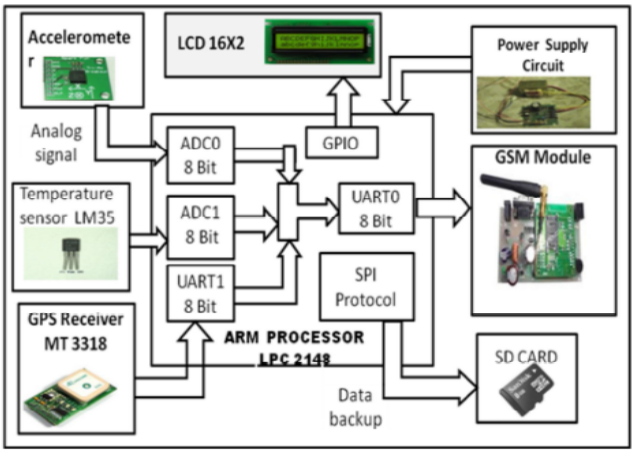

Fig.1. vehicular system block diagram.

The complete block diagram is as shows in fig.1.The vehicular system [VS] includes hardware that consists of an ARM 7 TDMI core processor, Accelerometer, GPS module, GSM module, SD memory card, l6x2 LCD, and temperature sensor. The whole VS works on a 5V or 9V dc regulated power supply. The GPS receiver module interfaced with UART1 of ARM processor provides speed and location information. The identity of a vehicle is fixed that is saved in a flash memory of a processor. The temperature sensor provides temperature per degree Celsius to an ARM

processor. The temperature sensor is interfaced to an ADC1 of ARM processor. Vehicular speed, position and temperature are stored in a SD card. The SD card is interfaced to an ARM processor using SPI (Serial Peripheral Interface). All this information are shown on LCD that is interfaced with a GPIO0 and send it to a monitoring station (receiver side) by GSM module wirelessly that is interfaced with UART0 of ARM processor. Also the same information is given to a concern person to get that information anywhere anytime. The module requires GSM SIM (Subscriber Identity Module). As per the definite event stored in a program and when collision/accident occurs that is sense by an Accelerometer which is interfaced to ADC0 of ARM processor. The detail descriptions of all modules are as follows.

A. GSM Module:

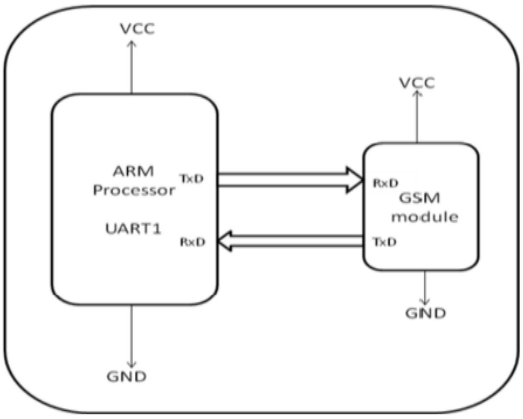

Fig.2.Interfacing of GSM module with ARM Processor on UART1.

Global System for Mobile communications (GSM) is the almost popular wireless standard for mobile phones in the world. GSM module allows transmission of Short message service (SMS) in TEXT mode and PDU mode. The proposed design uses SIM 300 GSM module in text mode. This design uses SIM300 GSM module that provide 900/1800/1900MHz Tri-band for VOICE, SMS, DATA, and FAX. This module operates on AT command over TTL interface. AT command is an abbreviation for Attention command that is recognized by GSM Module. This abbreviation is always used to start a command line to be send from TE (Terminal Equipment) to TA (Terminal Adaptor). The information contains information speed, position (longitude, latitude), identity and temperature of a vehicle that is transmitted to the monitoring station by the SMS through the GSM network.. SIM 300 Module works on 12V, 2A power supply. The module is configured at 9600 baud rate. Fig.2 shows interfacing of GSM module with ARM Processor on UART1where TxD pin of ARM processor is connected to RxD pin of GSM module and vice versa. The transmitted data from ARM processor using UART1 module contains information about Vehicle Identity that may be checked and displayed on Hyper-Terminal and as per the connection shown in fig 2 the same data is send to a specified mobile number and monitoring station as shown in fig.3.

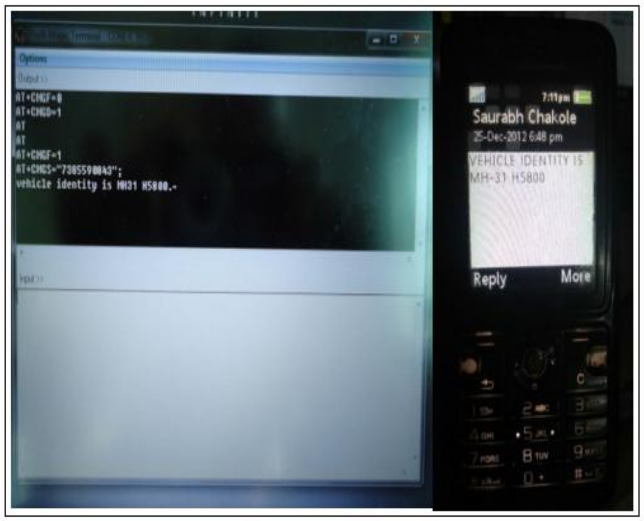

Fig.3. Identity of a vehicle on mobile and on hyper terminal.

B. GPS Module

Global Position System (GPS) is a space-based satellite navigation that provides location and time information in all weather conditions, anywhere on or near the Earth.GPS Receiver MT3318 Module is used that have a active patch antenna from Cirocomm. The GPS receiver tracks 51 satellites simultaneously. The module is mounted on the PCB along with the 3.3V low drop voltage regulator, transmit, receive and power indication LEDs, Schmitt trigger based buffer for 5V to 3.3V logic level conversion. This GPS receiver gives data output in standard National marine electronics association (NMEA) format. The GPS receiver gives -157dBm tracking sensitivity. The module is configured at 9600 baud rate. Module requires a 5V supply and can be interfaced with the 5V TTL / CMOS logic. The detail NMEA protocol:

1. GPGGA - Global Positioning System Fix Data
2. GPGSA - GPS DOP and active satellites
3. GPGSV - GPS Satellites in view
4. GPRMC: Recommended minimum specific GPS/Transit data Speed.
5. GPVTG: Track Made Good and Ground

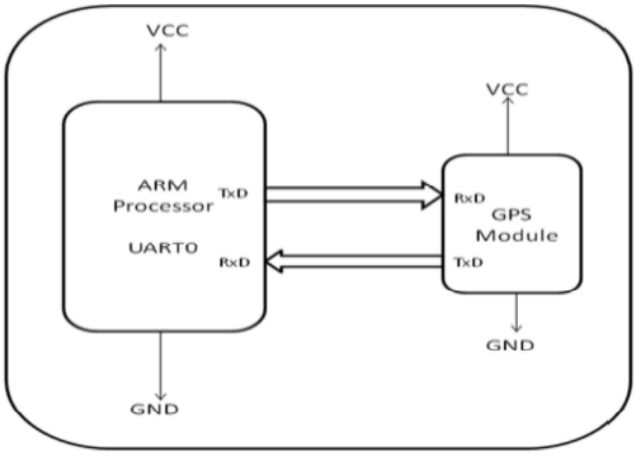

Fig.4.Interfacing of GPS module with ARM Processor on UART1.

Fig.4 shows interfacing of GPS module with ARM Processor on UART1where TxD pin of ARM processor is connected to RxD pin of GPS module and vice versa. The data from GPS receiver in NMEA format is received on ARM processor using UART1 protocol which contains information about Vehicle position (longitude, latitude) and speed. This information can be check on HyperTerminal of a computer using USB to serial convertor. Per the connection shown in figure 4, the same data is send to a specified mobile number and monitoring station as shown in fig.5.

Fig.5. Position and speed of a vehicle on HyperTerminal and Mobile

C. Accelerometer

An accelerometer measures acceleration. Acceleration is a measure of how quickly speed changes. Accelerometer sensor is used to measure static (earth Gravity) or dynamic acceleration in all three axes, forward/backward, left/right and up/down. The output of accelerometer provides 1.65V to 3.3V in positive direction and in negative direction the voltage drop from 1.65V to 0V. The output of accelerometer is in analogue form with three different output voltages each representing X, Y and Z direction of motion. These three voltage signal are processed through ADC0 on three different Channels available on ARM. ADC0 is configured at 4.5MHz clock from system peripheral clock. The 8 bit digital output from ADC0 is fed to UART1 of ARM. Accelerometer is used in this design for the collision detection. The maximum output voltage of accelerator module is 3.3V that is a CMOS voltage of the processor.

D. ARM7 processor

The conventional 8 and 16bit Microcontrollers has its deficiencies when compared with 32bit microcontroller. This proposed system design uses the ARM processor. ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers. This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. The Philips LPC2148 which is based on 32 bitARM7 TDMI core supporting real time simulation. When ARM processor combined with RTOS with timing constraint can be realized for the data acquisition and transmission of data with high precision.

E. Data Storage

The system includes memory card which is used to store data. The data contains vehicle ‘ID’, ‘Position’ (Longitude’, 'Latitude)', date, time and velocity of a vehicle. The memory card can be expanded depending upon the purpose. The data storage provision is implemented using Serial Peripheral Interface (SPI) protocol supported by the LPC2148 ARM7 processor. This stored data can be access any time for monitoring (speed of a vehicle, correct path, collision etc.), comparison, and traffic analysis purpose.

II. LITERATURE REVIEW

In this chapter, we will discuss about the information found by study and research that is critical and have an important value in the contribution of the whole project. It also gives some basic knowledge or theoretical base and is used as a foundation to successfully achieve the main objectives. Most of the literatures are from the related articles, journals, books and previous works of the same fields. These literatures are then compiled and use as a guidance to the work of this project. GSM and GPS based vehicle location and tracking system will provide effective, real time vehicle location, mapping and reporting this information value and ads by improving the level of service provided. A GPS-based vehicle tracking system will inform where your vehicle is and where it has been, how long it has been. The system uses geographic position and time information from the Global Positioning Satellites. The system has an “on board module which resides in the vehicle to be tracked and a "Base Station" that monitors data from the various vehicles. The On-Board module consists of GPS receiver, a GSM modem. The number of hardware I have gathered from previous journals and other sites are given below. All these are used together and worked according to our requirement.

A. GSM Modem

Communication among vehicle, Owner, police and emergency is established accordingly as per requirement through GSM (Global Service for Mobile communication). AGSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection or it may be a mobile phone that provides GSM modem capabilities. A GSM modem could also be a standard GSM mobile phone the appropriate cable and software driver to connect to a serial port or USB port on our computer.

B. GPS Modem

Exact location on earth can be known GPS latitude, longitude information. Global Positioning System (GPS) is space based radio navigation System consisting of a constellation of Satellites and a network of stations used for monitoring and controlling. The GPS is operated and maintained by the Department of defense (DOD).The GPS is a constellation of satellites in orbit around the Earth which transmit their positions in space as well as the precise period. It is receiver that collects data from the satellites and computes its location anywhere in the world based on information it gets from the satellites. Develop new microprocessor-based products and applications. The ARM is one of the major options available for embedded system developer.

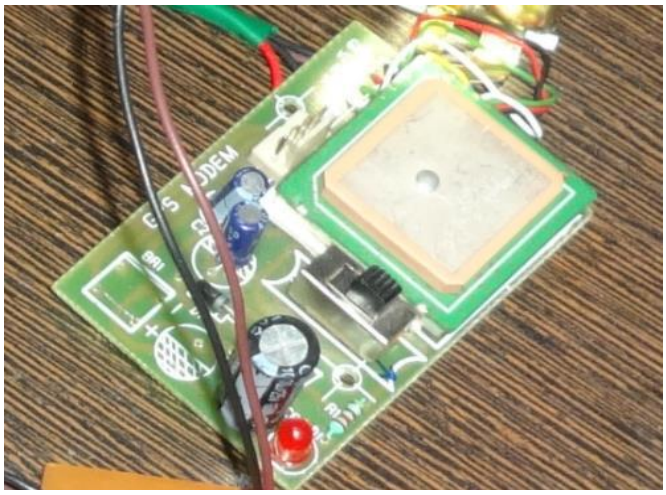

Fig.6. GPS module.

C. ARM7 LPC2148 TDMI

Over the last few years, the ARM architecture has become the most pervasive 32-bitarchitecture in the world through wide range of ICs available from various IC manufacturers. The ARM processors are embedded in products ranging from cell/mobile phones to automotive braking systems. Worldwide community of ARM partners and third-party vendors has developed among semiconductor and product design companies including hardware engineers, software developers, and system designers. ARM7 is one of the widely used micro-controller family in embedded system application. This section is humble effort for explaining basic features of ARM-7. The ARM is a family of instruction set architectures for computer processors based on a reduced (RISC) architecture developed by British company ARM Holdings. A RISC-based computer design approach means ARM processors require significantly fewer transistors than typical processors in average computers. Here this approach reduces costs, heat and power use. These are desirable traits for portable, light, battery-powered devices—including smart laptops, phones, and tablet.

A simpler design facilitates more efficient multi-core CPUs and higher core counts at lower cost providing higher processing power and improved energy efficiency for servers and supercomputers. It Provides 8kB of on-chip RAM accessible to USB by DMA. One or two (LPC2141/2 vs. LPC2144/6/8) 10-bit A/D converters provide a total of 6/14analog inputs with conversion times as low as 2.44 us per channel.

- Single 10-bit D/A converter provide variable analog output.
- Two 32-bit timers/external events counter PWM unit and watchdog.
- Low power real-time clock with independent power and dedicated 32 kHz clock input.
- Multiple serial interfaces including two UARTs (16C550) two Fast I2C-bus, SPI and SSP with buffering and variable data length capabilities.
- Vectored interrupt controller with configurable priorities and vector addresses.
- 45 of 5 V tolerant fast general purpose I/O pins in a tiny LQFP64.
- Nine edge or level sensitive external interrupt pins available.

On-chip integrated oscillator operates with an external crystal in range from 1 MHz to30 MHz and with an external oscillator up to 50 MHz.

D. Sensors

1. Temperature Sensor (LM35): The Temperature- LM35 sensor continuously monitors the temperature of surface at which it is mounted, generally vehicle engine and body. If the Temperature exceeds predefined value, the microcontroller will send alert to the driver by means of buzzer usually fixed near to Dash board.

2. MEMS Accelerometers (ADXL335): The ADXL335 is a low power, thin, small, complete 3-axis accelerometer with signal conditioned voltage outputs. Product processes acceleration with a minimum full-scale range of ±3 g. They can measure the static acceleration of gravity in tilt-sensing device, as well as dynamic acceleration resulting from vibration, shock, or motion. X-axis is connected with controller and continuously checks that ‘g’ value change.

E. Similar Projects

Accident detection and trace of vehicle is the one of the useful project to the human beings in today’s life. This project is mainly used to accident detection and trace the vehicle location by using GSM and GPS modules. To implement this project we are using AT89S52 microcontroller. The GPS and GSM modules are attached to the vehicle. The GPS receiver continuously receives the Latitude and Longitude coordinates from the satellites revolves around the earth. These coordinates’ values are displayed on the LCD. One of the main requirements of any intelligent transportation system is to be able to identify vehicles in the traffic. This project presents an intelligent vehicle identification system used within a complete solution for a traffic monitoring system that uses novel wireless sensor network architecture to monitor traffic. Novel wireless sensor network architecture to monitor traffic is proposed

where a visual sensor node captures images of the traffic and sends them to the traffic control center for processing. Also, this paper compares between three main localization and recognition algorithms. To locate the vehicle logo in the traffic image a symmetry detection algorithm is used to detect the inherent symmetry in vehicle frontal images. A fine location of the logo is identified using three different methods in the region marked by the symmetry line. After locating the logo three feature sets are extracted and presented to the classifier to correctly identify the type of the vehicle. The results of the localization and recognition algorithms show the efficiency of the presented system in identifying vehicle types with a recognition rate over 90%.

III. HARDWARE IMPLEMENTATION

This chapter briefly explains about the Hardware Implementation of the project. It discusses the design and working of the design with the help of block diagram and circuit diagram and explanation of circuit diagram in detail. It explains the features, timer programming, serial communication, interrupts of LPC2148 microcontroller. It also explains the various modules used in this project.

A. Project Design

The implementation of the project design can be divided in two parts.

1. Hardware implementation
2. Firmware implementation

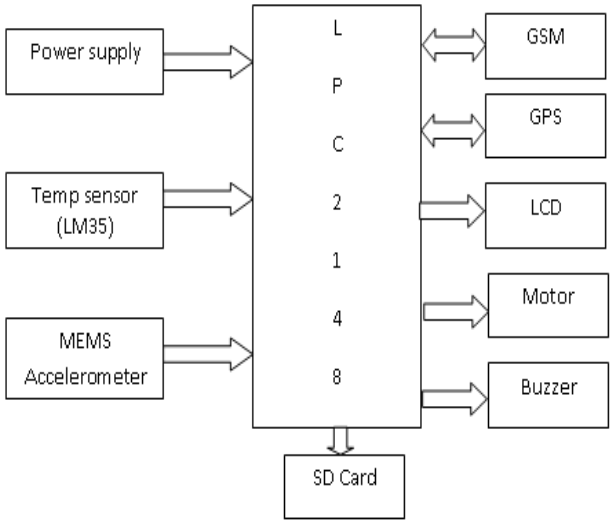

Fig.7. Block diagram of vehicle monitoring and tracking system

Hardware implementation deals in drawing the schematic on the plane paper according to the application, testing the schematic design over the breadboard using the various IC's to find if the design meets the objective, carrying out the PCB layout of the schematic tested on breadboard, finally preparing the board and testing the designed hardware. The firmware part deals in programming the microcontroller so that it can control the operation of the IC's used in the implementation. In the present work, we have used the Orcad design software for PCB circuit design, the Keil µv3 software development tool to write and compile the source code, which has been written in the C language. The Pre-load programmer has been used to write this compile code into the microcontroller. The project design and principle are explained in this chapter using the block diagram and circuit diagram. The block diagram discusses about the required components of the design and working condition is explained using circuit diagram and system wiring diagram.

1. Block Diagram of the Project and its Description

The block diagram of the design is as shown in Fig.7. It consists of power supply unit, microcontroller, MEMS, LM35, GSM, GPS, Ultrasonic Sensor, Touch screen, LCD and the voice playback circuit. The brief description of each unit is explained as follows.

B. Working Procedure

The main aim of this project is that traces the vehicle and provides the security from the engine overheating. And every time the SD card in the vehicle stores the information about the engine temperature and GPS values along with the time. This information will be used for future reference to know the time and the cause of the accident of the vehicle occurred. In this project the MEMS sensor is used to monitor the moment of the vehicle. If this sensor value goes beyond some particular value, it means the vehicle met with an accident, the information was received by the owner of the vehicle and his friends about the accident and the GPS values. Three numbers are stored by default by using the code. By using a message we can change those numbers in future. If the temperature goes beyond particular value, then the engine of the vehicle stops immediately and alerts the user by SMS along with the GPS values. Every time the sensor activates, the system gives the buzzer. The LCD display was used to display the GPS values and the sensor values. For every 10 seconds the sensors data and GPS values are gets stored in the SD card in .xls format. You can read the SD card by using the card reader. The coding was written in embedded C language and compile using keil compiler. The relevant hex file was dumped into the microcontroller using FLASH MAGIC software.

IV. FIRMWARE IMPLEMENTATION OF THE PROJECT DESIGN

A. Firmware Implementation

Firmware implementation deals in programming the microcontroller so that it can control the operation of the IC's used in the implementation. In the present work, we have used the Orcad design software for PCB circuit design, the Keil µv4 software development tool to write and compile the source code, which has been written in the C language. The Flash magic programmer has been used to write this compile code into the microcontroller.

B. Software Tools Required

- Orcad
- Keil µVision4
- Flash Magic

Orcad is used for drawing the schematic diagram, it is mentioned above. Keilµv4, Flash magic are the two software tools used to program microcontroller. The working of each software tool is explained below in detail.

1. Programming code description

A compiler for a high level language helps to reduce production time. To program the LPC2148 microcontroller the Keil µv4 is used. The programming is done in the embedded C language or Assembly language. Keil µv4 is a suite of executable, open source software development tools for the microcontrollers hosted on the Windows platform. One of the difficulties of programming microcontrollers is the limited amount of resources the programmer has to deal with. In personal computers resources such as RAM and processing speed are basically limitless when compared to microcontrollers. In contrast, the code on microcontrollers should be as low on resources as possible.

2. Keil Compiler

Keil compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code. The compilation of the C program converts it into machine language file (.hex). This is the only language the microcontroller will understand, because it contains the original program code converted into a hexadecimal format. During this step there are some warnings about eventual errors in the program. If there are no errors and warnings then run the program, the system performs all the required tasks and behaves as expected the software developed. If not, the whole procedure will have to be repeated again. Below figures show the compilation of the program.

Fig.8. Compilation of source Code.

V. CONCLUSION

The Vehicular System provides information of a vehicle like velocity, position, through a GPS module and identity of a vehicle to a monitoring station and to a mobile phone according to a definite event stored in a program or a query from a monitoring station. Accelerometer senses the collision of the vehicle and sends this information in real time to a hospital/police station. The monitoring station display these information on GUI also stored these information in database for further process according to a program. 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.

VI. REFERENCES

[1] Saurabh S. Chakole, Asstt. Prof. Vivek R. Kapur, Asst. Prof. Y. A. Suryawanshi, "ARM Hardware Platform for Vehicular Monitoring and Tracking", 2013 International Conference on Communication Systems and Network Technologies.

[2] Zhang Wen, Jiang Meng" Design of Vehicle positioning System Based on ARM", Business Management and Electronic Information (BMEI), International Conference 2011 IEEE.

[3] Lu Xutao1, Cui DongSen2" Design of Transport Vehicles Remote Monitoring System", 2nd International Conference on Education Technology and Computer (ICETC). 2010.

[4] Peng Chen, "ShuangLiu, Intelligent Vehicle Monitoring System Based on GPS, GSM and GIS", WASE International Conference on Information Engineering. 2010.

[5] Hui Hu, Lian Fang, published a paper title "Design and Implementation of Vehicle Monitoring System Based on GPS/GSM/GIS", Third International Symposium on Intelligent Information technology Application. 2009.

[6] M.AL-Rousan, A. R. AI-Ali and K. Darwish, published a paper title" GSM-Based Mobile Tele Monitoring and Management System for Inter-Cities Public Transportations", International Conference on Industrial Technology (ICIT).This paper presents a Tele-monitoring. 2004 IEEE

[7] http://micrium.com/rtos/ucosii/overview.