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RealTime Implementation of RTOS based Vehicle Tracking System

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A vehicle or fleet management system is implemented for tracking the movement of the vehicle at any time from any location. This proposed system helps in real time tracking of the vehicle using a smart phone application. This method is easy and efficient when compared to other implementations. In emerging technology of developing IOT (Internet of Things) the generic 8 bit/16 bit micro controllers are replaced by 32bit micro controllers in the embedded systems. This has many advantages like use of 32bit micro controller's scalability, reusability and faster execution speed. Implementation of RTOS is very much necessary for having a real time system. RTOS features are application portability, reusability, more efficient use of system resources. The proposed system uses a 32bit ARM7 based microcontroller with an embedded Real Time Operating System (RTOS).The vehicle unit application is written on FreeRTOS. The peripheral drivers like UART, External interrupt are developed for RTOS aware environment. The vehicle unit consists of a GPS/GPRS module where the position of the vehicle is got from the Global Positioning System (GPS) and the General Packet Radio Service (GPRS) is used to update the timely information of the vehicle position. The vehicle unit updates the location to the Fleet management application on the web server. The vehicle management is a java based web application integrated with MySQL Database. The web application in the proposed system is based on OpenGTS open source vehicle tracking application. A GoTrack Android application is configured to work with web application. The smart phone application also provides a separate login for administrator to add, edit and remove the vehicles on the fleet management system. The users and administrators can continuously monitor the vehicle using a smart phone application.

Key words: Vehicle tracking;32 bit Microcontroller; RTOS; FreeRTOS;IOT; Google Maps; Smartphone application; GPS/GSM/GPRS technology; OpenGTS;

The new generation embedded systems are currently moving from 8 bit/16 bit microcontrollers to 32 bit micro controllers. Below are few of the major reasons to choose 32 bit micro controllers over the conventional 8 bit/16 bit controllers.

- Programming is easy.
- Better Performance in terms of speed.
- Preferred for Real Time Embedded Systems.
- Less Power Consumption.
- Ease of porting application code.

The emerging technologies like touch screen, internet connectivity for micro controllers makes a Real Time Operating System (RTOS) mandatory for an embedded system. The main purpose of using an RTOS is the growing application complexity. Nowadays even a simple embedded application requires lot of error checking mechanisms and sometimes small algorithms to process the data. This makes the application code more complex, also the integration of many input and output devices forces the need for timely process of data. Normally RTOS have a

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disadvantage of requiring more memory and are also expensive. Now there are many open source Real Time Kernels been developed with lower memory foot print and less interrupt latency to work on small scale micro controllers. One of them is FreeRTOS which are designed for micro controllers with low memory foot print.

The Global Positioning System has been predominantly used in many applications. The GPS mostly fits in application like navigation and tracking of persons or objects. The tracking of vehicles and persons are nowadays essential and increasing. Shipping industry was the first to implement vehicle tracking systems to know where the ships is at any given time. Nowadays automated tracking systems are widely been used in many places to track the vehicle location. Since the development of vehicle tracking systems had started before long time. Now there is need for cost effective and reusable solution for tracking systems. Most of the Vehicle tracking systems is builton 8 bit /16 bit microcontrollers. The additions of new features are tedious and require lot of rework. Many cases may also lead to complete modification of existing architecture both on hardware and software. This can be overcome by having a 32bit micro controller with an RTOS.

Fig. 2. Architectural overview of proposed system

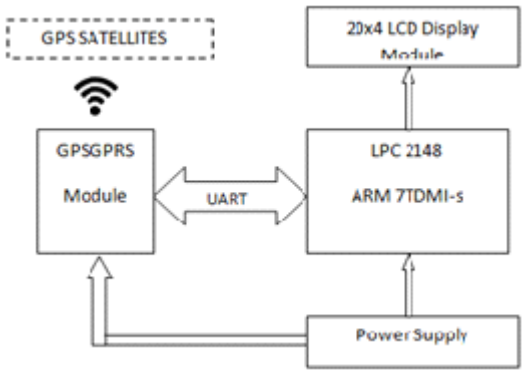

Fig. 3. Vehicle Unit

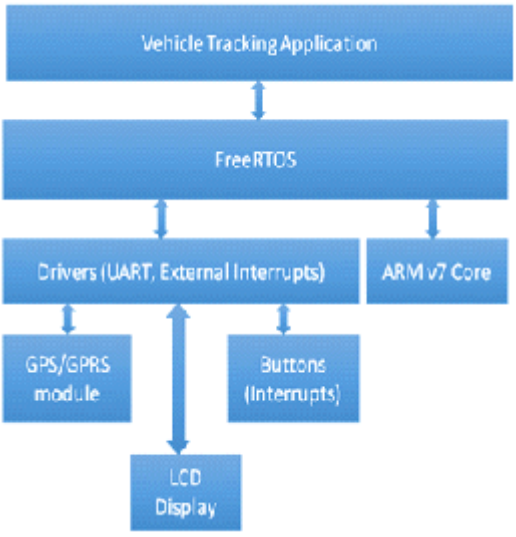

Fig. 4. Vehicle Unit Software Architecture.

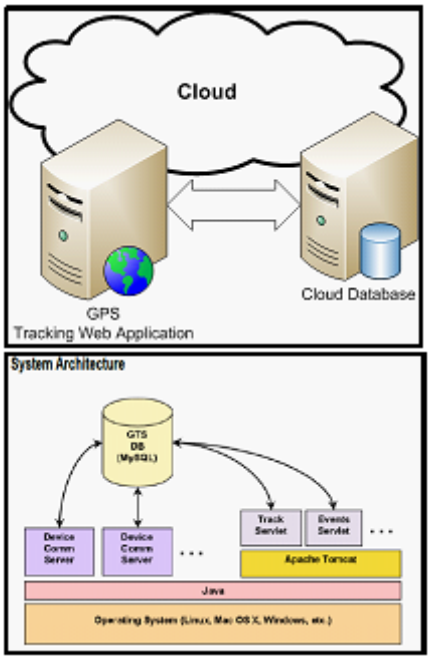

Fig. 5. Web Tracking Application Architecture

The proposed paper is a design and implementation of a vehicle tracking unit based on 32bit micro controller embedded with a Real Time Operating System (RTOS). The vehicle unit system application is written over FreeRTOS environment. This system also consists of a smart phone application for tracking and administrating the Vehicle management System using any android based smart phone.

Requirements of rtos based embedded system:

The needof having Real time operating systems is multitasking. The deadlines must be met with the time specified. The main purpose of real time vehicle tracking system is to have a timely update of tracking a vehicle. The current location co-ordinates, the speed and the direction of the vehicle must be updated from time to time. The proposed system is soft real time based system where the time deadlines will not lead to any harm or disaster.

The basics features of the FreeRTOS are explained below:

1. FreeRTOS provides a Real Time Kernel which can be customised based on the foot print of the micro controller.
2. RTOS kernel Codes are written mostly in C and its portable.
3. Supports Message queues, Semaphore and Mutexs.

Implementation of the system:

The overall implementation of the system is as shown in the figure. It consists of three parts first vehicle unit, server module and android based real time monitoring application. The design and implementation of hardware and software architecture for each module is explained in detail in the below sections.

Vehicle unit:

The vehicle unit comprises of three important hardware modules. The LPC2148 ARM7v-TDMI-s micro controller is used as the main unit which is used to fetch the GPS data, process the GPRMC message string, display and update the information to the server. The second most important module which is used both as GPS and GPRS is a SIM908A module. The major advantage of this module is that is has a POWER Down mode which can be used to save power. Both the GPRS data and GPS data can be accessed via single UART connection. The third is the 20x4 character LCD display which is used as output in the vehicle unit

Fig. 6. Web Application 1

Fig. 7. Web Application 2

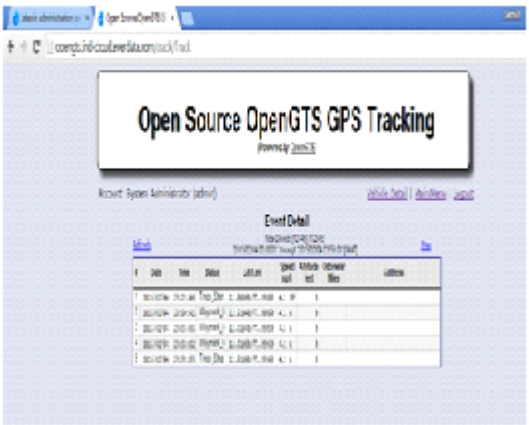

Fig. 8. Database

Fig. 9. Android Application.(a) New device (b) Vehicle list (c) Event detail report

The block diagram in figure 3 shows the hardware blocks used in the vehicle unit. The software built on this hardware is based on C programming language. As mentioned earlier the application is built over RTOS environment. The software building blocks are as shown in figure 4.

Server unit:

The server unit consists of a cloud server which is purchased from cloud vendors. The system is a scalable in hardware like CPU speed and RAM. The web server application, unique URL is provided on purchase with the cloud server. The database MySQL is also provided with the server. The tracking application is based on the open source OpenGTS tracking java based web application. It is installed on the tomcat apache web server on the cloud and interfaced with MySQL. The tracking application accessed via the provided URL and information from the vehicle unit is also pushed to the same URL. The web tracking application architecture is as shown in figure 5.

Androidmonitoring application:

The android application is configured to hosted URL to fetch and display the information from the web application. The smart phone must be activated with data connection like GPRS, or EDGE (3G). Go Track free is the android application used for monitoring.

RESULTS

The below shown screen shots are taken from the proposed system implementation. The figure 6 to 8 shows the OpenGTS web tracking application which shows the details of tracking , secure login and a detailed event tracking table. The figure 9 shows the snapshot of the same details on the android application.

CONCLUSION:

We have designed and developed a vehicle tracking unit with a 32bit ARMv7 based micro controller with an embedded RTOS. We have built the complete tracking system which consists of the vehicle tracking unit, the Web server application and the android based smart phone application. The design and implementation is tested in real time to track a vehicle. The test results have also been updated in the proposed paper. The hardware system architecture which consists of the ARM architecture, RTOS and the device drivers were implement for future reusability and expandability. The overall hardware is designed keeping in mind to incorporate any addition in the forthcoming implementations on the same system.

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