

# Advanced Real-Time Cargo Vehicle Tracking and Control System Using Wireless Technology

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**Abstract** – A vehicle tracking and control system is the complete solution for vehicle management and monitoring. The tracking and control device can be installed in the vehicle and with the help of monitoring software we can track the information about the cargo vehicle and can be controlled during the abnormal condition. A smart monitoring and control system for cargo vehicle in real time has been reported in this paper. The system principally monitors various parameters of cargo vehicle such as speed, container weight, location, fuel level etc which are crucial data for controlling the cargo vehicle. The novelty of this system is the implementation of the tracking and controlling of cargo vehicle is done by measuring essential parameters. The developed system is a low-cost and flexible in operation and thus ensures the robust tracking and control system for cargo vehicle. Additionally the system will be integrated with monitoring station to determine the safe journey of the cargo vehicle. In this proposed system, various sensor devices sense different parameters for tracking the cargo vehicle. These values are transferred to PIC microcontroller and later it is transferred to GSM/GPRS for sending it to central monitoring station and can be controlled by the monitoring station.

**Index Terms** – PIC, GSM/GPRS, GPS, Load cell.

## 1. INTRODUCTION

Transport is one of the important infrastructures of any country. The main problem about the transportation is the uncertainty of vehicle route, unfortunate reduction in cargo material due to pilferages, delay in transportation and any other issues invoke abnormal conditioning. The safety of private and public vehicles is a major concern to ensure their safety while travelling. To avoid this problem many designs and techniques have been designed and implemented in the vehicles. However designing a vehicle security system and interfacing the monitoring by the owners will be absolute solution for the current situation and need. A vehicle tracking system is the complete solution for vehicle management and monitoring. The tracking device can be installed in the vehicle and with the help of monitoring software we can track the information about the cargo vehicle. Tracking devices automatically record details about the vehicle at all the times, whether the engine is on or off. There are various types of monitors, including tachographs and electronic boxes, also known as trip

computers. They record lengths of time the vehicle is moving and stationary during a journey, speed at which the vehicle is driven, distance the vehicle travels between the stops and the date, time and place of starting and finishing a journey, driver's details and vehicle identification. Modern vehicle control system combines use of automatic vehicle location in individual vehicles with software that collects these data for comprehensive picture of vehicle locations. Vehicle tracking system commonly uses GPS or GLONASS technology for locating the vehicle. Vehicle tracking devices can be expensive to install. A system that uses cellular based technology, which transmits information about vehicle movements to a landline every minute, can be costlier. A satellite system, which is capable of tracking a vehicle all over the world also results in high cost.

Considering performance and cost factors related to design and development of tracking systems and also predicting the usage of the power consumption have been demonstrated. However, low-cost, flexible and robust systems for continuously monitoring and control of the cargo vehicle are at early stages of development. In this paper, a low-cost, flexible and real-time tracking system by tracking various essential parameters for safe journey of cargo vehicles which can easily tracked and controlled by the central monitoring station has been propose.

## 2. EXISTING SYSTEM

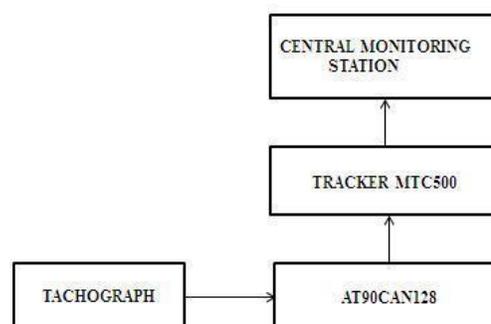


Figure 1: Functional block diagram

## B. SYSTEM DESCRIPTION

The tracking system was proposed the creation of a CAN network for monitoring parameters route of cargo vehicles. By decree of law, all cargo vehicles must contain tachograph device that collects and records all information practiced during the trip, such as speed, distance, RPM (rotations per minute), among other parameters. The data provided by the tachograph are sent to the CAN network, collected and interpreted by AT90CAN128 microcontroller and sent to the monitoring station by serial communication by a tracker (MTC 500). Thus, the central monitoring company will quickly follow the route of its drivers, and the characteristics of travel practiced by them.

In order to control the journey of drivers cargo carriers have invested in systems event monitoring facility via embedded devices. The installation of devices called tachograph became mandatory for all cargo and passenger transport vehicles. The tachograph functions as a kind of "black box" of vehicle, recording driving time, distance travelled, speed applied by the vehicle driver, among other information. Thus, this article aims to implementation of a CAN network load vehicles for monitoring, control of recorded information and sending these through a tracker module, throughout the route of travel. The management of these data will be AT90CAN128 the microcontroller.

## C. CARGO VEHICLE MONITORING

### 1. NETWORK CAN

The CAN bus is a serial bus consisting of two yarn, developed for monitoring sensors and actuators in an automotive system. Furthermore, it can provide a data transmission rate of up to 1Mbit / s with security. The CAN\_H and CAN\_L signals are sent simultaneously the bus. Thus, for the conversion of the signals CAN network is compatible with logic levels, each drive must contain a decoder that converts the signal CAN binary numbers "0" and "1". The decoder AT90CAN128 is used by the ATA6660. This circuit Integrated has been specially designed by Atmel® to in applications involving high speed bus CAN

### 2. MICROCONTROLLER AT90CAN128

The microcontroller was chosen AT90CAN128. This one component is the AVR line, manufactured by Atmel®, has 8bit RISC technology with 64 pins. Moreover, it has 128Kbytes of flash memory, 4Kbytes EEPROM memory.

### 3. TACHOGRAPH

The tachograph is an electronic device used for driving time registration, distance, speed practiced by the driver, among other information. The old models used in its configuration a roll carbon paper to record this information for a few days, and the roll to be replaced at the end of the paper. The equipment

used in the project is digital and allows insertion / output driver, the speed record every second, driver activities and co-driver, RPM, maximum permitted speed, total distance travelled, crashes and other events. This device model L1000 / B manufactured by ACTIA and has communication interfaces serial and CAN. From the documentation provided by the manufacturer tachograph, it was possible to connect it to the CAN network developed.

### 4. TRACKER

The device used for tracking vehicle of load is the MTC 500. The product has serial port for integration with terminals Data, in this case with the microcontroller AT90CAN128. Moreover, this device allows the user to define the business rules of its operation. With this information can generate all occurrences of vehicle, without interference from the central control or signal availability. MTC 500 tracker will receive for its serial port the data sent by AT90CAN128 collected from monitoring by the CAN network, and will direct them to the central network control via GPS / GSM. The tachograph will send to the CAN bus messages status during the course of the trip, the microcontroller AT90CAN128 will be responsible for receiving and interpreting these messages and send them via the serial communication for tracker. Thereafter the device sends, depending on the GSM signal, the received data to the central vehicle monitoring. Thus, the center can monitor quickly and easily the events in each cargo transportation route.

## 3. PROPOSED SYSTEM

In order to control the journey of cargo carriers, embedded systems have been invested in event monitoring facilities. Various parameters for monitoring are collected and sent through wireless technology to monitoring station.

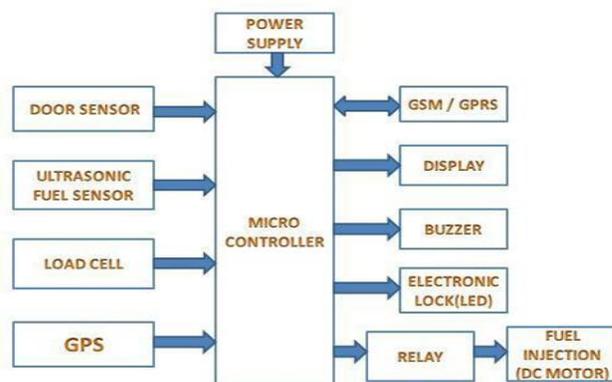


Figure 2: Functional block diagram

The figure 2 shows the functional block diagram of proposed method. In this, various sensor devices sense different parameters for tracking the cargo vehicle. These values are transferred to PIC microcontroller and later it is transferred to GSM/GPRS for sending it to central monitoring station to make

necessary control action.

#### A. PIC MICROCONTROLLER

PIC18F8722 microcontroller is used for transferring the information from the sensor placed on the vehicle to wireless network. The outputs of the sensors are given to the microcontroller and this microcontroller will analyze the signal and send it to GSM/GPRS. The controller has peripheral features like inbuilt ADC, required to get the signals from the various sensors. Besides this, the microcontroller that is used in this project has some additional advantages. It has Maximum clock frequency is 32MHz and hence it is faster than 8051. It is Based on RISC and Harvard architecture and hence even faster. Embedded C is used for programming the microcontroller.

PIC18 microcontrollers implement a 21-bit program counter, which is capable of addressing a 2-Mbyte program memory space. Accessing a location between the upper boundary of the physically implemented memory and the 2-Mbyte address will return all '0's (a NOP instruction). The

PIC18F6527 and PIC18F8527 each have 48 Kbytes of Flash memory and can store up to 24,576 single-word instructions.

The PIC18F6622 and PIC18F8622 each have 64 Kbytes of Flash memory and can store up to 32,768 single-word instructions. The PIC18F6627 and PIC18F8627 each have 96 Kbytes of Flash memory and can store up to 49,152 single-word instructions.

#### B. GPS AND GSM

A complete GPS tracking solution is the combination of the GPS device, monitoring software and server. The device can be installed in the vehicle and various parameters can be monitored such as location and path tracking, fuel and mileage monitoring, speed detection, accident detection, geo fencing and auto fencing.

GPS based tracking solution is an innovative technology which enables to remotely track or monitor the location and various parameters at any given point of time. The location information can then be accessed from a central location through a website or a mobile phone.

GSM is a plug and play GSM Modem with a simple to interface serial interface. It is used to send SMS from vehicle to monitoring station by controlling it through simple commands from micro controllers and computers. It uses the highly popular SIM300 module for all its operations. It comes with a standard RS232 interface which can be used to easily interface the modem to micro controllers and computers. The modem consists of all the required external circuitry required to start experimenting with the SIM300 module like the power regulation, external antenna, SIM Holder, etc. GSM is used when GPRS signal is not available.

#### C. SENSOR UNITS

##### 1. DOOR SENSOR

###### LIMIT SWITCH

Limit switch is used as door sensor. The switch detects the act of door open and close. When the door is opened without authentication then wireless network will send indication to the monitoring station.

###### OPERATION

A limit switch is an electromechanical device that consists of an actuator mechanically linked to set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection. Here object is the door, when door is opened the switch makes electrical connection which is intimated to the microcontroller and thus detects the pilferages.

##### 2. ULTRASONIC FUEL SENSOR(HC-SR04)

Ultrasonic fuel sensor is used to detect whether there is sudden decrement in fuel level due to pilferages during the trip. Liquid level in a container is measured by coupling the transducer to the bottom of the container using couplant. The transducer generates a short ultrasonic sound pulse which is transmitted through the container wall and into the liquid. The pulse travels up through the liquid until it reaches the surface where it is reflected and returns back through the liquid to be received by the transducer. The liquid level then could be calculated by the round-trip transit time and the sound velocity in the liquid.

##### 3. LOAD CELL

Load cell is used to monitor the weight of the container. They are used to sense force or a weight under a wide range of adverse conditions. A load cell is transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. The sensing o spring element is the main structural component of the load cell. The elements designed in such a way that it develops a strain directly proportional to the load of the cargo vehicle.

##### 4. SPEED CONTROL

Relay circuit is used to control the speed of vehicle. The speed is decreased during abnormal condition. A transistor is to drive the relay, we can use considerably less power to get the relay driven.

Because a transistor is an amplifier, we just have to make sure that the base lead gets enough current to cause a larger current to flow from the emitter of the transistor to the collector. Once the base receives sufficient power, the transistor will conduct from emitter to collector and power the relay. With no voltage or input current applied to the transistor's base lead, the transistor's emitter-to-collector channel is open, hence blocking

current flow through the relay's coil. However, if sufficient voltage and input current are applied to the base lead, the transistor's emitter-to-collector channel will be closed, allowing current to flow through the relay's coil. The benefit of this circuit is a smaller and arbitrary (DC or AC) current can be used to power the circuit and the relay.

5. GEO-FENCING

Geo-fencing is used to detect deviation from authorized route. Geo-fencing application operates and interacts with different location-based services using GNSS and communication technologies. The concept is based on an in-vehicle embedded device, which allows determining, and sending regularly its location to the management center. More precisely, each vehicle is equipped with an embedded computer, a GPS receiver, and a 3G communication module for data transmission. The in-vehicle embedded application receives data from the GPS receiver and sends it through the communication module to the server for processing. The Geo-fencing application runs on a server. Once the vehicle characteristics are registered in a database, its current position is known (using GPS/3G module embedded into the vehicle) and sent to server via internet relying on a network based on 3G. The management center is regularly informed about current positions of the registered vehicles. When, for example, a vehicle deviates from its allowed itinerary, the management center takes decisions and suggests appropriate solutions.

6. BUZZER AND DISPLAY

A buzzer takes some sort of input and emits a sound in response to it. Here buzzer is used to alert the driver about abnormal condition of cargo vehicle. Here small 12mm round speaker that operates around the audible 2kHz range is used.

LED on the electronic lock is used to indicate the driver about the abnormal condition such as during sudden reduction in fuel ,when door is opened during the trip etc.

7. POWER SUPPLY 12V AND 5V POWER SUPPLY

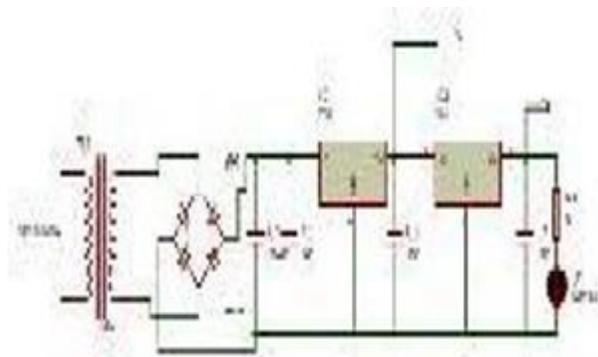


Figure 3: Block diagram of the 5v, 12v regulated power supply

This is a circuit of 12V 5V power supply. We can also say it combine or dual power supply circuit. The circuit is using two different fixed voltage regulator ICs. The first IC is LM7812 which will convert the voltage coming from the transformer and provides a 12V regulated output on the pin 1 of LM7805 IC.

The voltage will then converted to 5V DC by the LM7805 IC, due to which you will receive two different voltages at the same time. Use suitable heat sinks with the ICs. The transformer can be a 230V to 12v 500mA ratings.

4. RESULTS

The figure 4 shows the hardware module of the proposed system. In this, the door sensor, ultrasonic fuel sensor, load cell, display, buzzer, relay and GPS are connected to microcontroller and at abnormal condition, GSM/GPRS is used by the microcontroller to transmit the data collected from the sensor devices to the monitoring station and vehicle is controlled.



Figure 4: Hardware module of proposed system

5. CONCLUSION

Automobile thefts in the transportation systems have caused significant loss of productivity. To improve the safety, security and efficiency of the transportation systems of the traveling cargo vehicle, the project have been developed. In this system the sensor devices measures the required data which is essential for safe journey of the cargo vehicle and hence the in-vehicle system composed of a microcontroller, sensors and GPS/GSM/GPRS to acquire the vehicle's status information and transmit it to a server through GSM/GPRS network. Also the PIC microcontroller used here is advanced and very efficient which provides timely action. The system can able to track and control the vehicle anytime and at any location and can be controlled at abnormal condition. The proposed system

is robust and advanced due to the presence of PIC microcontroller and data collected for tracking and controlling is provides ultimate security for cargo vehicle. The practical model of this paper proved to be very efficient, cheaper, and reliable system for the security of the cargo vehicle.

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