



# Intelligent Vehicle Follower System

Shiju Gangadharan<sup>1</sup>

*M.E Embedded System Technologies Dept. Of ECE  
PSN College of Engineering and Technology,  
Tirunelveli, TN*

P Naga Rajesh Kumar<sup>2</sup>

*M.E, Associate Professor Dept. Of ECE  
PSN College of Engineering and Technology,  
Tirunelveli, TN*

**Abstract:** Robotics is the branch of mechanical engineering, electrical engineering, electronic engineering and computer science that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics.

The concept of creating machines that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century. Throughout history, it has been frequently assumed that robots will one day be able to mimic human behaviour and manage tasks in a human-like fashion. Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes,

The main aim of the project is to provide security to transport vehicle automatically by the control system. This project includes pilot vehicle which control transport vehicle by keeping the distance detected by IR sensor. If there is a fire on the way to the pilot vehicle, pilot vehicle will sense the smoke using smoke sensor, immediately the transport vehicle will stop and it sends the information as message to control room via GSM and alarm starts ring at the control room. By using wireless camera, Pilot vehicle will observe the transport vehicle and the security from the control room can observe each and every movement.

## Keywords

Intelligent vehicle highway systems, traffic management, intelligent vehicles, intelligent speed adaptation.

## I. INTRODUCTION

Due to the growing traffic demand and the growing need for mobility and transportation, traffic jams are still increasing in frequency, duration, and impact all around the world. Often traffic congestion problems can to some extent be solved by building new roads; however, this option is often not feasible due to lack of space, financial costs, or environmental constraints. An alternative, usually more feasible option is to use the existing infrastructure in a more efficient way through traffic management and traffic control. This approach combines advanced control methods with various control measures (such as traffic signals, ramp metering installations, dynamic speed limits, etc.) to reduce the impact of traffic jams.

As a next step in this direction, advanced technologies from the field of control theory, communication, and

information technology are currently being combined with the existing transportation infrastructure and equipment. This will result in integrated traffic management and control systems, called Intelligent Vehicle Follower Systems (IVFS), that incorporate intelligence in both the roadside infrastructure and in the vehicles. Though this step is considered to be a long-term solution, this approach is capable of offering increased performance of the traffic system (Sussman, 1993; Jurgen, 1991; Fenton, 1994). *Advanced Railway Safety Monitoring System.*

In this paper we will combine the intelligence of both roadside infrastructure and automated vehicles. More specifically, in the proposed approach, the roadside infrastructure will use traffic control and management methods that support platoons of intelligent vehicles. The control approach will also be embedded in the hierarchical traffic management and control framework for IVFS. This project is a demo version of automatic controlled industrial vehicle security system.

This project consists of two vehicles namely Pilot vehicle and highly protected Industrial transport vehicle. The pilot vehicle movement is controlled by RF module. The transport vehicle will follow only the pilot vehicle by keeping the distance detected by IR sensor. If there is fire on the way, pilot vehicle will sense the fire using fire sensor, immediately stop the pilot vehicle as well as transport vehicle and it send the information as message to control room via GMS and alarm start ring at control room. By using wireless camera connected to the pilot vehicle, it can observe the transport vehicle and its path from the control room and can observe the each and every movement of the transport vehicle. The vehicles uses microcontroller Atmel 89C51 as its brain.

An automated vehicle follower or automatic guided vehicle (AGV) is a mobile robot that follows markers or wires in the floor, or uses vision, magnets, or lasers for navigation. They are most often used in industrial applications to move materials around a manufacturing facility or warehouse. Application of the automatic guided vehicle has broadened during the late 20th century.

## II. TARGET OF INTELLIGENT VEHICLE FOLLOWER SYSTEMS (IVFS).

- To make RF controlled Intelligent Vehicle Follower System (IVFS) to control the transportation in industries.
- To detect and trace the pilot vehicle movement controlled by RF module and follow up by the transport vehicle.

- To detect the fire presence on the transport path and send alarm message to control room from pilot vehicle using GSM.
- To understand the working of GSM system interface with Microcontroller system.
- To make an IR based object tracking and following system.
- To trace the transport vehicle using wireless camera connected to the pilot vehicle.
- To reduce time and energy for transportation.
- To use as multipurpose vehicle in industries to convey the load.

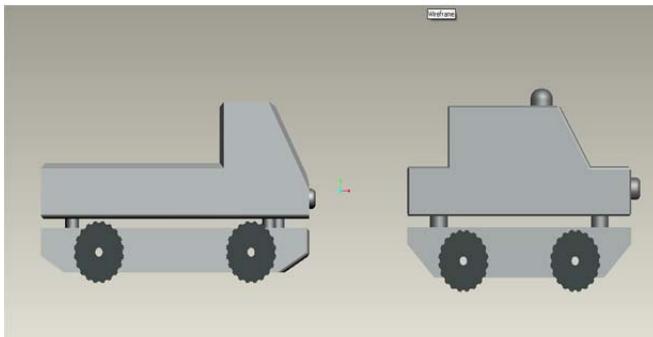


Figure 1 Front view of the Intelligent Vehicle Follower Systems (IVFS).

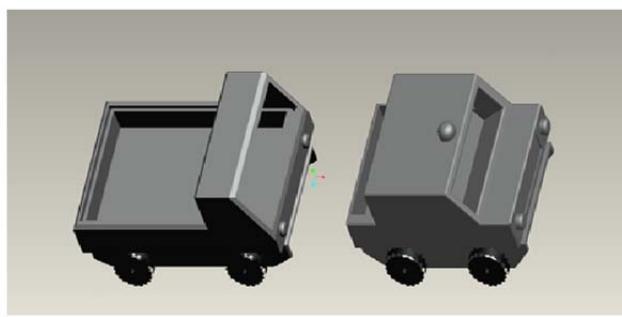


Figure 2 Top view of the Intelligent Vehicle Follower Systems (IVFS).

### III. WORKING OF INTELLIGENT VEHICLE FOLLOWER SYSTEM

The project is designed to develop a robotic vehicle that follows a specific path. This project uses a microcontroller of 8051 family for its operation. A pair of IR sensors comprising IR transmitter and IR receiver is interfaced to the microcontroller to detect the pilot vehicle for its direction movement.

Intelligent Vehicle follower robot is a useful robot that is used in ware houses, industries, and highly secured areas etc, where it follows pilot vehicle in a defined path. This proposed system fulfils the desired functionality and demonstrates the working of it. It uses a pair of IR sensors, comprising of one IR transmitter and a photo diode in each. It guides the robot to follow a specified path by giving appropriate signal to the microcontroller. Two DC motors are used interfaced to the microcontroller through a motor driver IC. Input signals given to the microcontroller from the sensors and then the controller takes the appropriate

action according to the program written in it and drives motors as desired.

Further the project has been enhanced by adding more advanced sensors to it. This will add more features to the existing project. For example, we can use IR sensors for detect any obstacle in front of the transport vehicle to maintain the distance between two vehicle without collision and to take appropriate action. Thus the combination of three IR sensor connected in front of transport vehicle gives entire direction to the microcontroller that how to follow the pilot vehicle as per the movement and stop even the absence of pilot vehicle movement.

The Pilot vehicle is controlled remotely by the RF module. Here we used four channel RF modules to control the pilot vehicle movement. The 4 channel RF module gives different signals to controller such as forward, backward, left, right movement direction. Thus the pilot vehicle can be remotely operated by the operator and show the movement of the vehicle for demo purpose. Thus the transport vehicle will follow exactly the pilot vehicle movement. Here to observe the transport vehicle movement using a wireless camera inside the pilot vehicle. Thus we can observe any attack or any undesirable disturbance is occurring in front of transport vehicle. In this system, we added a fire sensor to detect any fire presence in front of pilot vehicle. If it detects any fire presence, then immediately sends alarm message to control room via GSM module attached to the pilot vehicle. Thus it can provide additional security to the proposed system to ensure the maximum security.

### IV. HISTORY

The IVFS can tow objects behind them in trailers to which they can autonomously attach. The trailers can be used to move raw materials or finished product. The IVFS can also store objects on a bed. The objects can be placed on a set of motorized rollers (conveyor) and then pushed off by reversing them. IVFS are employed in nearly every industry, including, pulp, paper, metals, newspaper, and general manufacturing. Transporting materials such as food, linen or medicine in hospitals is also done.

An IVFS can also be called a laser guided vehicle (LGV). In Germany the technology is also called *Fahrerlose Transport System* (FTS) and in Sweden *förlösa truckar*. Lower cost versions of AGVs are often called Automated Guided System (AGSs) and are usually guided by magnetic tape. IVFS are available in a variety of models and can be used to move products on an assembly line, transport goods throughout a plant or warehouse, and deliver loads.

The first AGV was brought to market in the 1950s, by Barrett Electronics of Northbrook, Illinois, and at the time it was simply a tow truck that followed a wire in the floor instead of a rail. In 1976, Egeman Automation (Holland, MI) started working on the development of an automatic driverless control system for use in several industrial and commercial applications. Out of this technology came a new type of AGV, which follows invisible UV markers on the floor instead of being towed by a chain. The first such system was deployed at the Willis Tower (formerly Sears

Tower) in Chicago, Illinois to deliver mail throughout its offices.

Over the years the technology has become more sophisticated and today automated vehicles are mainly Laser navigated e.g. LGV (Laser Guided Vehicle). In an automated process, LGVs are programmed to communicate with other robots to ensure product is moved smoothly through the warehouse, whether it is being stored for future use or sent directly to shipping areas. Today, the AGV plays an important role in the design of new factories and warehouses, safely moving goods to their rightful destination.

## V. NAVIGATION

A slot is cut in to the floor and a wire is placed approximately 1 inch below the surface. This slot is cut along the path the AGV is to follow. This wire is used to transmit a radio signal. A sensor is installed on the bottom of the AGV close to the ground. The sensor detects the relative position of the radio signal being transmitted from the wire. This information is used to regulate the steering circuit, making the AGV follow the wire.

## VI. BLOCK DIAGRAM

This project consists of 89C51 Microcontroller, IR sensors, Fire sensor, GSM modem. The project provides security to transport vehicle automatically by control system. If there is a fire on way to the pilot Vehicle, it will sense and send information to control room and observe each Movement by using wireless camera.

This project includes pilot vehicle which control transport vehicle by keeping the distance detected by IR sensor. The pilot vehicle is controlled by RF module. If there is a fire on the way to the pilot vehicle, pilot vehicle will sense the fire using fire sensor, immediately the transport vehicle will stop and it sends the information as message to control room via GSM and alarm starts ring at the control room. By using wireless camera, Pilot vehicle will observe the transport vehicle and the security from the control room can observe each and every movement. In the present world these kinds of technologies surely keep us safe while travelling.

## BLOCK DIAGRAM OF PILOT VEHICLE CONTROL SYSTEM

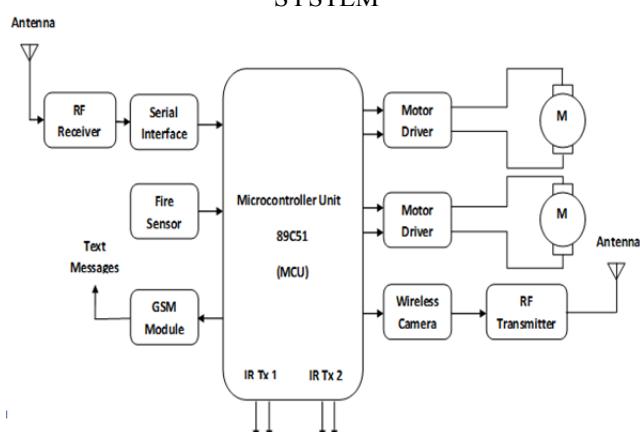


Figure 3 Block diagram of Pilot Vehicle Control System

## BLOCK DIAGRAM OF TRANSPORT VEHICLE SYSTEM

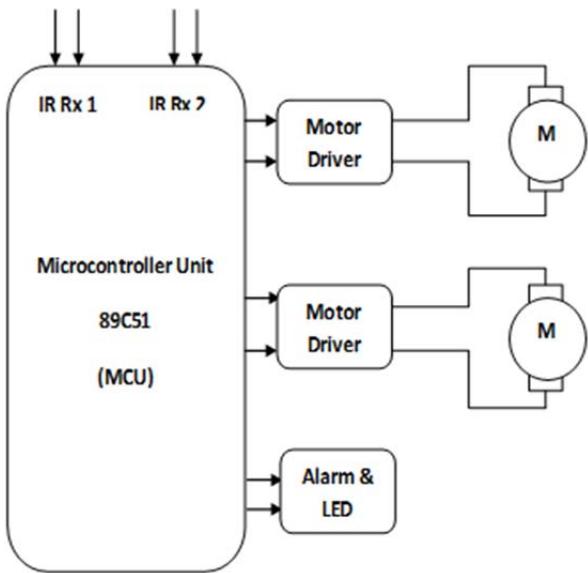


Figure 4 Block diagram of Transport Vehicle System.

## VII. VEHICLE MOVEMENT TRACKING USING SENSORS

### 7.1 Automatic Vehicle Tracking System

For high speed error detection and correction IR sensor modules used. Sensor circuit consists of 4 numbers of Infrared LEDs, which provide high radiant intensity, narrow emission. The IR transmitter and receiver circuit is shown in Figure 5. Switching transistor with op-amp acts as a constant current source for IR LEDs.

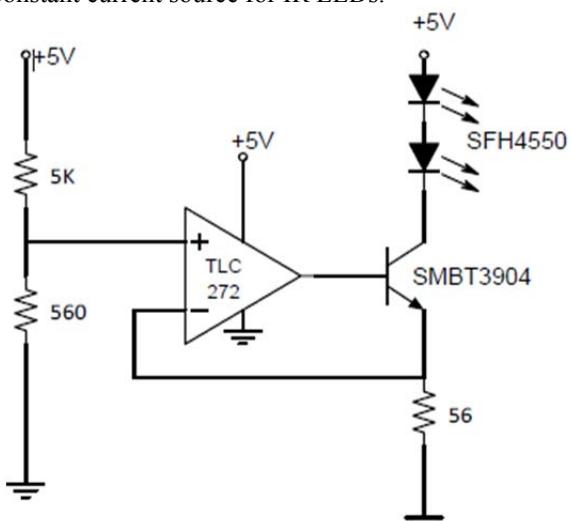


Figure 5 Circuit diagram of IR Transmitter

This project is used to transport the materials from one place to another place in industries. This robot vehicle has the facility to find out its path. The path is tracking by IR sensor.

First, RF card number (Location) has to be loaded into the memory, this is done by using switch1 and switch2 is used for storing corresponding number. After pressing the Start switch (switch3), according to sensor output signal the

microcontroller controls the vehicle by using (forward/reverse/stop) the left and right side of the DC motor which are placed in vehicle. IR transmitter and receiver are used to find the obstacles in the path. The IR led will be switched on/off at a frequency and is received by the IR receiver. If any obstacle is placed in the path The IR sensor fails to receive the light rays, this time it gives a signal to the microcontroller that an obstacle is present in the path. The microcontroller will stop the vehicle immediately and siren will ON.

After 1 minute the robot will check the path status. If obstacle is removed the robot will move forward. Else robot will send message to control room. After 5 minutes the robot will check the path status. Still obstacle is not cleared the robot will turn in the opposite direction and it will travel to starting place. From the control office we can control the robots by sending commands from PC, this commands is encoded and sent through RF medium, the RF receiver in the vehicle will receive the commands and send to the microcontroller. The microcontroller will convert the decoded data and do the corresponding action. the RF encoder (12 E)and RF decoder (12 D), which consists of 12 address bits and 4 data bits, so software written inside both the microcontroller will convert the user data into 4 bit encoding form. The transmission is done under the frequency of 433 MHz.

Application of the proposed system is for industries. The robot movement depends on the track. Use of this robot is to transport the materials from one place to another place in the industry. IR transmitter and receiver are used to find the obstacles in the path. RF transmitter and receiver are used to send/receive the command from/to robot/control unit. The IR and RF technology is one of the most widely used wireless communication technique in most of the embedded applications. For RF communication we are using the transmitter and receiver in the range of 433 MHz. for IR transmissions the IR led is used in the frequency of 38 kHz.

## Components

Power Supply :5V/12V DC  
 Micro controller :Atmel AT89S52  
 LCD :16x2 characters  
 Proximity metal sensor.  
 DC motors(12V DC)  
 DC motor driver (L293D)  
 IR transmitter and IR receiver.  
 RF transmitter and RF receiver  
 Switches  
 Siren

## Software used:

Embedded C keil Microverson  
 TopView Simulator

Vital role of 7805 voltage regulator in ‘Intelligent Vehicle Follower System’ The adapter output voltage will be 12V DC non regulated. The 7805/7812 voltage regulators are used to convert 12 V to 5V/12V DC.

Micro controller-AT89S52,The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel’s high density non volatile memory technology and is compatible with the industry- standard 80C51 instruction set and pin out.

The robot is controlled by microcontroller. It performs change the motor direction by giving signal to driver IC, getting command from switches, sending command to RF transmitter and transmit and receive the IR signal from IR remote. Buzzer is controlled by the microcontroller using single pins, Ie giving high means device will switch on and vice versa. Sometimes it may be interchange according to the transistor used to drive the device.

## 7.2 RF Encoder (HT 12E)

The 212 encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12\_N data bits. Each address/ data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a TE trigger on the HT12E or a DATA trigger on the HT12A further enhances the application flexibility of the 212 series of encoders. The HT12A additionally provides a 38 kHz carrier for infrared systems.

### Features

Operating voltage 2.4V~12V for the HT12E  
 Low power and high noise immunity CMOS technology  
 Low standby current: 0.1\_A (typ.) at VDD=5V  
 HT12A with a 38 kHz carrier for infrared transmission medium  
 Minimum transmission word \_ four words for the HT12E  
 Data code has positive polarity  
 Minimal external components  
 HT12E: 18-pin DIP/20-pin SOP package.

RF encoder used is 12 E which has an automatic tuning facility to the receiver, it consist of 12 address bits and 4 data bits. In this project it is used to send the commands from vehicle to the control unit and vice versa

## 7.3 RF Decoder (HT 12D)

The 212 decoders are a series of CMOS LSIs for remote control system applications. They are paired with Holtek 212 series of encoders (refer to the encoder/decoder cross reference table). For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen. The decoders receive serial addresses and data from a programmed 2 12 series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times continuously with their local addresses. If no error or unmatched codes are found, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission.

## Features

- Operating voltage: 2.4V~12V
  - Low standby current
  - Capable of decoding 12 bits of information
  - Pair with Holtek H212 series of encoders
  - Binary address setting
  - HT12D: 8 address bits and 4 data

In this project if vehicle had find a obstacles in his path it will send data to the control unit, and sometimes the control unit will send command to the vehicle to change the path, this commands are send and received through RF frequency, the commands is converted into 4 bit encoded data format using encoder chip. The encoded data is transmitted by using this device. The transmission frequency range is 300MHz in the data rate of 20Kbps.

## Applications

- Remote Keyless Entry Systems
  - Remote Fan/Light Control
  - Garage Door Opener Transmitters
  - Remote Sensor Data Links

## 7.4 RF receiver

The MICRF002, an enhanced version of the MICRF001 and MICRF011, is a single chip OOK (ON-OFF Keyed) Receiver IC for remote wireless applications, employing Micrel's latest

QwikRadiotm technology. This device is a true “antenna-in, data-out” monolithic device. All RF and IF tuning is accomplished automatically within the IC, which eliminates manual tuning and reduces production costs. Receiver functions are completely integrated. The result is a highly reliable yet extremely low cost solution for high volume wireless applications. Because the MICRF002 is a true single-chip radio receiver, it is extremely easy to apply, minimizing.

## Features

## Complete UHF receiver on a monolithic chip

Frequency range 300 to 440 MHz

Typical range over 200 meters with monopole antenna

Data rates to 2.5kbps (SWP), 10kbps (FIXED)

In this project the communication between vehicle and control unit is through RF frequency the RF encoder will encode the data sent by the microcontroller into 4 bit mode then it is transmitted using the RF transmitter with frequency 433 MHz. The transmitted data transmitting from RF transmitter is received by RF receiver. The output of this unit is encoded data format. For decoding purpose this data is send to the input of decoder.

### Applications

Automotive Remote Keyless Entry

Long Range RFID

## Remote Fan/Light Control

#### Garage Door/Gate Openers

Siren.

## VIII. CIRCUIT DIAGRAM

### 8.1 Circuit diagram of Pilot Vehicle System.

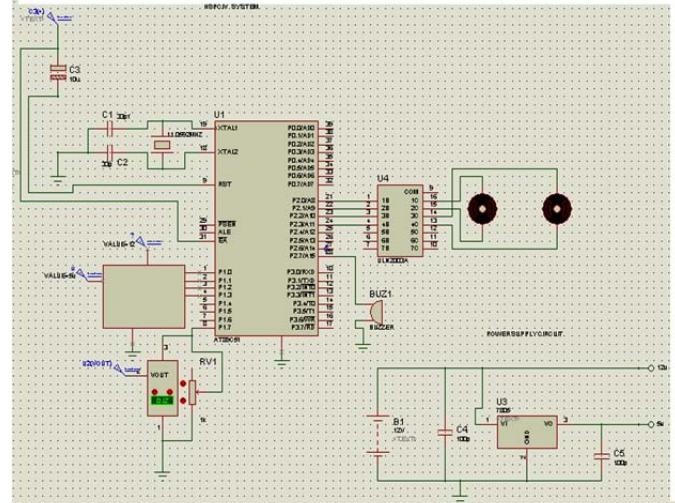


Figure 6 Circuit diagram of Pilot Vehicle System.

## 8.2 Circuit diagram of Transport Vehicle System.

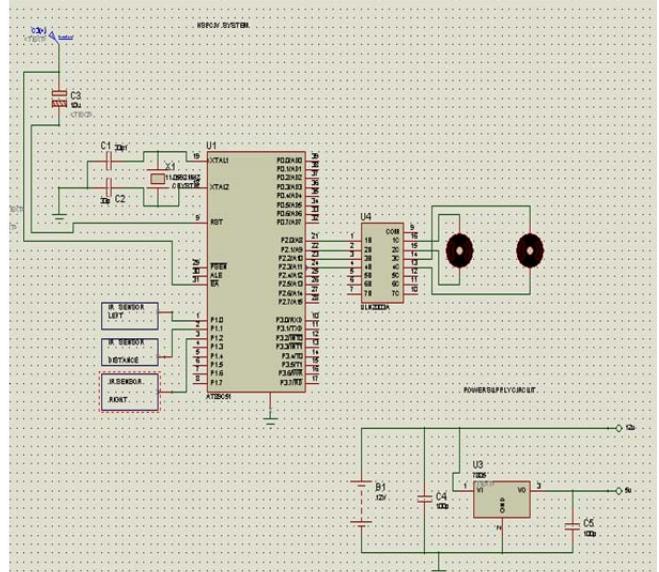


Figure 7 Circuit diagram of Transport Vehicle System.

## IX. IMPLEMENTATION

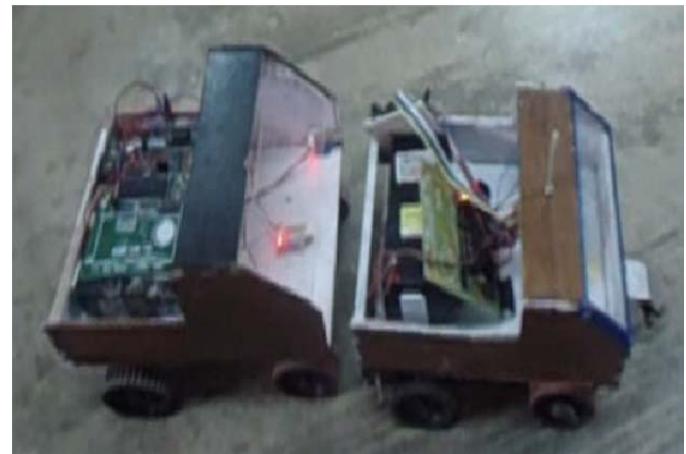


Figure 8 Image of Pilot Vehicle followed by Transport Vehicle



Figure 8 Image Intelligent Vehicle Follower System (IVFS)

## X. CONCLUSION

It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Thus the data to be sent is encoded within the transmitted signal so that a well designed receiver can separate the data from the signal upon reception of this signal. The decoded data can then be used to perform specified tasks. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

A low-cost and simple system to ensure the safety of passengers and pedestrians. It certainly provides a hope for bringing down the alarming rate of road accidents. The proposed system is capable of simply displaying the traffic signals in an LCD screen inside the vehicle. In future, provisions may be included to cut out the fuel supply to the engine to provide a smooth deceleration if the speed of the vehicle exceeds a threshold value. This is a very useful technique to control the vehicle speed automatically. It is mainly useful in the areas where high rate of accidents are recorded.

## XI. FUTURE ENHANCEMENT

It is believed that autonomous navigating cars will be the next big thing of the future. There will be a need where the car would be required to park in the allotted space autonomously by sensing the parking lane. Also in most of the countries where lane driving is prevalent, the speed has to be adaptively changed on detection of a lane change. So this smart car with its robust line following and detection capability will come in handy. It is planned to incorporate wireless protocol for communication between the cars which will serve greatly to avoid collision and also to share the relative information about one another thereby helping in traffic management.

Vehicle following robot based materials supply system can play a vital role in the field of hospitality. Vehicle following robot's application over electronics engineering can't be underestimated. A GSM module can be placed

with the line following robot so that if any untoward incident occurs then that system can make a call to the doctor, it also helps the doctors for remote diagnosis of patients even when he is away from hospital by remote presence. The line follower robots can also be improvised by using RFID tags so that accuracy of the system increases. Robotics is very big field for the new innovation and research. By using the robot in real time applications, a health care system can be managed in an effectively way.

## REFERENCES

- [1] Mehran Pakdaman, M. Mehdi Sanaatiyan, "Design and implementation of Line following robot", Second International Conference on Computer and Electrical Engineering, 2009.
- [2] M.Zafri Baharuddin, "Analyst of Line Sensor Configuration for Advanced Line Follower Robot", University Tenaga National.
- [4] P.Heyrati, A.Aghagani, "Science of Robot Design and Build Robot", Azarakhsh Publication, 2008.
- [5] Freescale MC9S12XDP512RMV2 Datasheet, Rev. 2.21, October 2009.
- [6] Rajesh Kannan Megalingam, Vineeth Mohan, Paul Leons, Rizwin Shooja, Ajay M, "Smart Traffic Controller using Wireless Sensor Network for Dynamic Traffic Routing and Over Speed Detection", IEEE Global Humanitarian Technology Conference (GHTC), pp: 528 - 533, 2011.
- [7] Turgay Celik and Huseyin Kusetogullari, "Solar-Powered Automated Road Surveillance System for Speed Violation Detection", IEEE Transactions on Industrial Electronics, pp: 3216 - 3227, 2010.
- [8] Vladimir Glavtchev, Pinar Muyan-Ozcelik, Jeffrey M. Ota, and John D. Owens, "Feature-Based Speed Limit Sign Detection Using a Graphics Processing Unit", IEEE Intelligent Vehicles Symposium, pp: 195 - 200, 2011.
- [9] Wang Hongjian, Tang Yuelin, Li Zhi, "RFID Technology applied in highway Traffic Management", International Conference on Optoelectronics and Image Processing (ICOIP), pp: 348 – 351, 2010.
- [10] Telaprolu,m.k,sarma,V.V.;,ratankanth,E.K.;Rao,S.N.;Banda,v.,vehicularElectronics and safety (ICVES), IEEE international conference pune (2009). Gangadhar, S.; R N shetty Inst. Of Technol, An intelligent road traffic control system, IEEE conference publication kahargpur (2010).
- [11] Bajestani, S.E.M., Vosoughinia, A., "Technical Report of Building a Line Follower Robot" International Conference on Electronics and Information Engineering (ICEIE 2010), vol 1, pp v1-1 v1-5, 2010.
- [12] Bong. D.M.K, "Automatic Guided Vehicle System" in Department of Electrical Engineering, University Tenaga Nasional, Malaysia, P.41, 2004.



**Shiju Gangadharan** was born in North Kerala, India, on July 5, 1983. He had completed Diploma in Electronics in Kerala under Kerala Technical Education Board in 2004. He received his B.E. degree in Electronic and Communication Engineering from Anna University of PGP College of engineering & Technology, Tamilnadu, in 2007. He worked in different companies in Bangalore. He studied M.E. degree in embedded system technologies from PSN college of engineering and technology in south Tamilnadu. His research interests include Embedded System Programming, Project Implementation, satellite communication, and Mechatronics System Design.