

Research Article

Design and Implementation of Unmanned Ground Vehicle using GSM Network

Mandakini H. Pimple^{†*} and R.C. Thool[†]

[†]Information Technology, SGGSIET & T, Nanded (MH), India

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Abstract

Now a days, there are huge variety of application are designed by scientist and engineers which need to use of robots as opposed to humans. One of the reasons is, robots can perform such task which is dangers to human or inaccessible to them. By designing an unmanned vehicle are helping to increase human safety by enabling the human to control the vehicle from remote location. This paper describes the design and implementation of unmanned vehicle which is controlled or handled by SMS or call with the help of GSM network.

Keywords: GSM Module SIM 900A, ATmega328 Microcontroller, L293D, Web camera.

1. Introduction

We are very much well versed about the general concept of remote controller system, which is used to control electronic gadgets from a certain distance. It is not that far, that we have started using remote controller systems to control Television sort of things. At that stage, only single device could be controlled within a very short range, may be bound the control ability within a small room area only. However, with respect to time and progress in technology-predominantly telecom network and electronics prejudiced our requirement to our necessity to be able to control residential and commercial appliances, industry or mining equipment's from a maximum possible distance. Reason behind such requirements may be to reduce cost by reducing manpower, comfort and to increase efficiency on daily operational activities (Md. Shahinoor Mannan *et al*, 2014).

Wi-Fi enabled device not only transmit data and receive data but also it control device remotely. Wi-Fi controlled device make use of radio frequency as a medium for communication.

However Wi-Fi network has limited range and the range further fetter when there are obstacles like walls, tree etc. we can use Bluetooth technology as medium for sending and receiving of data. But as we know Bluetooth was designed for a very short distance, even with the new 4.0 version.

The IR systems which employ the infrared technology work only on the principle of line of sight. An IR transmitter device, generally a remote control,

which is directed to the device being controlled. Furthermore, the communication is restricted if there are obstacles and other hindrances (Amey Kelkar, 2014).

It may be more than twenty years or so that Scientists, Engineers are working on long distance controller systems towards management of home or office appliances remotely. A study on early development shows an approach to develop long distance controllers based on Software running on a Computer, Dual Tone Multi Frequency (DTMF), and Public Switched Telephone Network (PSTN) to ensure long distance signal transportation (B. Koyuncu, 1995).

Some of the developments consist of DTMF based circuitry to receive and execute control signals over traditional telephone networks and suggests future development using microprocessor or microcontroller based systems (Coskun *et al* 1998).

The rest of the paper is organized as: In section 2, literature survey is made on different existing technique that make use of unmanned vehicle. Section 3 introduces the proposed methodology. In section 4 actual implementations and we discuss the results and lastly in section 5 and 6 contains the conclusion of research work & future work respectively.

2. Literature Survey

This section gives an overview of the related research that has been done regarding different techniques for unmanned ground vehicles. Some of these are as following:-

In paper (Sourangsu Banerji, 2013) proposed a vehicle with help of phones using GSM network interfaced with a microcontroller which is used to

*Corresponding author: Mandakini H. Pimple

remotely control an unmanned robotic vehicle thus overcoming distance barrier problem and communication over obstacles with very minimal or no interference but is solely network dependent.

(Sourangsu Banerji, 2014) in this it proposed the same result and give the same benefits associated with the designs described with microcontroller by Sourangsu Banerji in 2013. But without using a microcontroller the advantage of this system can be summarized as reduced circuit complexity, reduced cost of manufacturing and ease of deployment and it reduces the manpower which require to build a software as the proposed model does not require any form of programming. But the big disadvantage of the proposed model is that as microcontroller is not used extra function cannot be added. The basic aim of this model is to overcome the drawback of conventionally used RF circuits with current design or provide an alternative to the existing one. As microcontroller is not used extra function cannot be added.

(Amey Kalkar, 2014) presented a paper in which a simple mobile with GSM network to control unmanned vehicle. In this it uses Arduino Uno controller board is programmed to make decision based on input from DTMF decoder and accordingly output the signals to the motor attached. Arduino Uno provides many features prototype shield, Wi - Fi shield, Bluetooth shield etc. and it is specially designed for experiment and research purpose.

In paper (Jen-Hao Teng, et al, 2010) it designs and implements a RFID (Radio Frequency Identification) based autonomous mobile car. The microcontroller of microchip is used to control the autonomous mobile car and communicate with RFID reader. The command which helps to move the vehicle are written onto the RFID tag and tags are then stuck on the track. The job of RFID reader used to communicate with RFID tag and transmit the moving commands to micro controllable unit and accomplish the proper action like to turn the vehicle appropriately or to speed up or speed down the vehicle as per requirement. This RFID based mobile car can be used for industrial automation, goods transportation, data transmission, and unmanned medical nursing etc.

(Binoy B. Nair, et al, 2010), this paper based on GSM technology along with IR sensor and Camera. Basically this paper is design and implemented for many operation like waste handling, bomb disposal, and search and rescue etc. where to avoid great risk for humans. Here the IR sensor and camera are used to detect and avoid the obstacle and send the live images to the destination for further action. The vehicle can be capable of travelling over rough surface and of performing basic pick-and -place type actions.

In the paper (Bishwajit Banik Pathik. et al, 2015), proposed a method which uses same technology described by the author in [9] i.e. GSM instead of IR, the vehicle which is used in this it is solar powered standalone vehicle which could be controlled by mobile phone which is GSM enabled from anywhere.

(Shiv Kumar Verma, et al, 2014), proposed a technique for unmanned ground vehicle which uses a Trajectory Planning i.e. path planning Algorithm (TPA) to identify different obstacles like human, tree, care which comes in the path of unmanned vehicle.

3. Proposed model

In this proposed model we comes with the technique in which we are not only using the calling function but also messaging to handle the unmanned vehicle from remote place. The basic architecture for this system is as follows with brief working about the architecture.

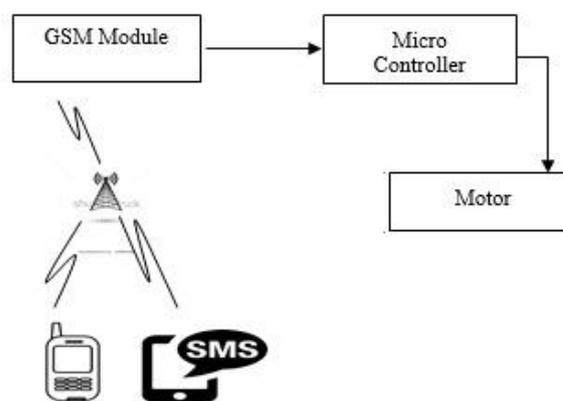


Fig. 1 System Model

Fig. 1 shows the hardware architecture of the proposed unmanned vehicle. In this proposed model we designed a vehicle which can be control from any remote places through call and text from any mobile phone even with a low cost black and white mobile phones.

When we want to move the vehicle from remote place, firstly we have to make a call to the destination number which we insert the SIM in the GSM module. Whenever the call is made from the remote place through a GSM network that call is received firstly by GSM module i.e. SIM 900A which had a single SIM port where we can insert any service provider SIM. The job of GSM module is to receive the call and transferred this call to the microcontroller to take further action, after transferring the call to microcontroller, the microcontroller is preprogrammed and according to the code it performs the action i.e. the vehicle can be move forward and reverse, similarly this result also can be achieved through the text message also, to do we need to send message which containing the simple alphabet "a" so the vehicle can move forward from its current position similarly to move the vehicle backward we have to send the alphabet "b", to turn the vehicle left and right we need to send the simple alphabet "c" and "d" respectively.

During this operation a web camera is also mounted on vehicle which is used to detect the obstacle during the path or it also used to see the live images or video from anywhere.

For building any system, the most essential part is what kind of hardware and software is required. The unmanned ground vehicle consist GSM module i.e. SIM 900A for providing GSM network to SIM, microcontroller ATmega 328 used to perform all operation DC motor for rotating the vehicle and a web camera for capturing images i.e. the system consist of high range megapixel camera for capturing more clear images of vehicle.

GSM module: Here we are using GSM module i.e. SIM 900A manufactured by SIMCom. SIM900A is a dual-band GSM/GPRS module. Using SIM 900A we can implement any application which can be used in India only and which uses only SMS, call and GPRS functionality. GSM module has single SIM port which allow to insert any service providers SIM and which use to send SMS, make and receive calls, and do other GSM operations by using simple AT commands which can be easily interface with computer and any microcontroller. It only requires 12v power supply to work.

ATmega 328 Microcontroller: Here we are using arduino uno pro as microcontroller called ATmega328 Microcontroller. It requires 5 v power supply. It can be powered by USB port as well as DC adapter or using battery source and the power source is selected automatically. It provides 32 KB of flash memory for storing your code. The nice thing about the Arduino board is that it is relatively cheap, plugs straight into a computer's USB port, and it is dead-simple to setup and use.

L293D: This motor driver IC can simultaneously control two small motors in either direction; forward and reverse with just 4 microcontroller pins. DC motors requires 5v DC supply to rotate the vehicle as per instructions. Its inexpensive compare to other motor like servo motor. It used in experimental purpose.

Web camera: The unmanned ground vehicle consist of a digital camera which is mounted on the vehicle for capturing the image which has 5 mega pixel camera for capturing more clear images of environment to take further action.

4. Implementation

Below flowchart describes the procedure or steps to describe even the message can going to control the unmanned ground vehicle. For this we burn the code onto the microcontroller using C language for this we use the arduino uno pro as controller. The sample code is as shown below to control the ground vehicle through message which is used to turn the vehicle forward, reverse and left.

For this a sample code is shown below , where the remote user is need to send a simple text message which contains a simple letter "a" for moving the vehicle forward and b for reverse etc.

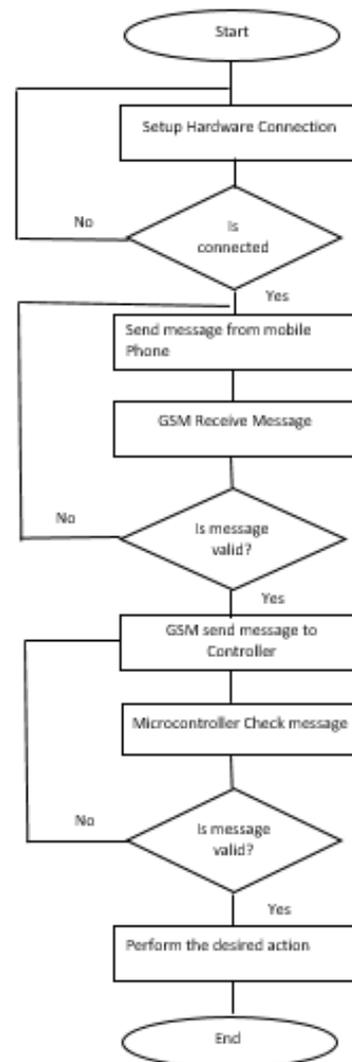


Fig. 2 Flowchart

```

if(incoming_char=='a')
{
  //Forward
  digitalWrite(2, HIGH);
  digitalWrite(4, HIGH);
  delay(3000);
  digitalWrite(2, LOW);
  digitalWrite(4, LOW);
}
if(incoming_char=='b')
{
  digitalWrite(3, HIGH);
  digitalWrite(5, HIGH);
  delay(3000); |
  digitalWrite(3, LOW);
  digitalWrite(5, LOW);
}

if(incoming_char=='c')
{
  //Left Turn
  digitalWrite(2, HIGH);
  digitalWrite(5, HIGH);
  delay(3000);
  digitalWrite(2, LOW);
  digitalWrite(5, LOW);
}
  
```



Fig.3 Unmanned Ground vehicle

Above fig.3 shows the unmanned vehicle which we are implemented. In that we clearly observed that web camera is placed above the vehicle which can send live images or videos anywhere when GSM network is exists. It's slowly network dependent. We implemented the unmanned vehicle which can be control by call as well as through text message.

Conclusions

The purpose was to develop a unmanned ground vehicle are

- 1) We can control vehicle from any remote location and drive the vehicle in any direction using GSM module which will reduces the risk of humans as the vehicle can be handle from any remote places.
- 2) By developing such unmanned vehicle, we overcome the drawbacks of the conventional system which uses Wi-Fi, Bluetooth technology so we can send and receive data from anywhere without worrying about the distance.
- 3) As camera mounted on vehicle we can easily avoid the obstacles and we can send live images or videos anywhere as we using the GSM technology.
- 4) Its light weight because we uses a GSM module so no need to stack the mobile on vehicle and no worry about to charge it.

Future work

The designed used for unmanned vehicle in this paper can further be improved and enhanced to meet suitable needs according to its application. A wireless camera can be mounted on top of it which can send videos and images to the remote phone. We can also give predefined path to drive the vehicle as per need which is can be used in industrial application.

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