

Aiding Defense with Autonomous Vehicle Control using IOT

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Abstract

Autonomous vehicles gaining importance these days, various research works are under process, to improve the system. Internet of Things gaining more importance in real world application, it provides control through remote server. Our aim is exploit the autonomous vehicle advantages using Internet of Things. Though autonomous vehicles are designed aimed to reduce manual drives through remote operations, there is need for defense application to reduce manpower and save lives. We aim to design an Internet of Things (IOT) controlled autonomous vehicle. The idea behind it to develop an autonomous/self-driven car, which can be controlled remote by given information over webpage or an IOT page of cloud server. Proposed self-driven remote controlled car will have sensors, camera to automate features like traffic detection, obstacle detection, vision tracking and visualizing the environment etc. This vehicle is aimed for defense application, wherein our military can have control over the self-driven car, monitor the environment and make laser gun point movements etc. Our proposed remote control / autonomous car will work for two conditions, one is through manual control and one is through auto control. Thus the vehicles can be reached safely by avoiding human error. Internet of Things module is used to provide control over the automated vehicle. This paper further investigates the existing methodology and its drawbacks while bringing an efficient autonomous vehicle of partial automated and full automated functionalities.

Keywords: Self-driven car, autonomous car, RF Camera, Ultrasonic sensor, laser gun, Internet of Things

I. INTRODUCTION

In the vehicular network, exploiting use of IOT and automization to bring an efficient self driven car to reduce traffic flow in roads and highways is mandatory. With the growing technology advancement, customers are looking for automation in every sector. Growing number of accidents due to manual error is abundant these days, thus it is mandatory day to avoid these threats. While driving drivers get distracted due to mobile phone, sound systems, and other entertains available in car, thus driver will eventually hit objects ahead of them. Autonomous cars bring the maximum security and comfort during travelling. Vision tracking controls the vehicles with remote control will be better than manual driven cars allowing to handle more traffic with lower delays. Apart from the road and highways travelling control, it is necessary to bring a permanent solution to defense losses. Autonomous car with vision tracking and visualizing environment along with laser gun movement will be better solution for dense applications. By controlling the car movement by semi- automation or full automation with the help of vision tracking and efficient sensor handling makes human mistakes reduced. In defense applications, it is mandatory to access the car from a remote location to give safety to our military man's lives. In such cases, remote controlled car using IOT module would be better solution.

Nowadays, use of public transport is reduced and individual vehicles usage is growing multifold in every year. In urban areas, traffic becomes a problem due to increase of individual's vehicle. To avoid the accidents due to traffic and to handle traffic effectively, there is a need for Smart Transportation System. Vehicular networks undergoing is becoming strong research area considering its various application and working conditions. Yet another revolution of vehicular networks is autonomous vehicles must be developed to support heavy traffic conditions in roads. Vision control system of automated vehicle handles traffic much efficiently with minimum delay and with less pollution, creating a good comfort level for passengers.

Similarly, when we consider defense application, the autonomous vehicle is even more important to save our officers lives. Unmanned air, naval and land vehicles still in research area. Artificial intelligence transforming this research area as a possible one. Our proposed autonomous vehicle is aimed at unmanned, less expensive and more advanced system. It is necessary to develop a battlefield vehicle to save millions of lives in the border. The unmanned vehicle is a potential hazard, as it may consider our friendly forces also an enemy.

II. BACKGROUND

Autonomous vehicles are generally classified as five types namely Level 0- No automation, Level 1- Driver assistance, Level 2- Partial automation, Level 3- conditional automation, Level 4- High automation, Level 5- Full automation. In our proposed system Level 3 and Level 4 are demonstrated. In proposed level 3, the conditions are controlled from IOT module from remote server. This level brings more secure driving. In proposed level 4, obstacle detection is done and updated to IOT module if any found, this is under research stage as fully autonomous vehicle

cost is very high. During traffic jam, driving become too hard to handle, in such traffic and obstacle detection is vital. Existing techniques handled in traffic light detection using color segmentation. In our proposed technique, Ultrasonic sensor is used to identify obstacle on roadside. Existing technique on autonomous ground vehicle research is focused on obstacle detection, however it lags under remote control from internet. Similarly works were proposed on obstacle detection using ultrasonic sensors, whereas this work not used any remote server control like internet module. In these system consists of RF camera with single position monitoring, ultrasonic sensor used to detect obstacles. The current position of vehicle can be check by using GSM. Here user checks the position periodically through SMS. But the information does not updated in Internet server.

III. LITERATURE REVIEW AND SURVEY

Existing research on autonomous vehicles have started from early 1980's Carnegie Mellon university Navlab and ALV. This work is considered to be first work, in which high effort has take to bring it in real time. In 2013, Vision Lab's Braive is the next level of autonomous car, which is demonstrated under traffic. Google's self driven cars are the perfect modeled one, which implements obstacle detection on roadside, the demonstration of these vehicles are found be safe on the streets of America. These vehicles are successful in demonstration and going to be marketed by 2020. Telsa motors are also working on driverless cars and these models are going to hit road in another two years. These two research is bringing revolutions to the vehicular networks. Many countries over the world are bringing the autonomous vehicle into real world. Developing Countries like India is struggling to bring autonomous cars into real world due to complications available in our road side systems. Thus it is meaningful to propose our work for military applications as defense vehicles.

Takeo Kanade proposed Autonomous Land Vehicle [1] at Carnegie-Mellon University in 1986, their goal is to develop an intelligent mobile robot with visionaries and named it Terregator. Takeo Kanade of civil engineering department of Carnegie-Mellon University developed this work. The design of Terregator is 6 wheeled vehicle, 64 inch of long, all wheels are controlled motors. One motor controlled right 3 wheels and one motor controlled left 3 wheels. He developed a prototype vehicle consisting path planning, obstacle avoidance. He provided terrain map and path information to system to control over the vehicle. He used sonar to measure the distance and laser scanner for measuring distance and capturing reflection information. This prototype model is limited in roadside, as it has given prior path /road map information. It was intended primarily for indoor work.

First results in robot road [2] is discussed by Richard Wallace from department of Robotics Institute of Carnegie-Mellon University in 1986, he developed vision navigation program to keep the vehicle centered on road. It captures the roadside image continuously to represent two horizontal and two vertical bounding line segments. This process takes time to identify the edges on road, which limits the

speed of the vehicle. Texture segmentation was identified on captured images, for identifying edges of road by comparing smooth and the surrounding region is not. He detected road edges is one which counts the number of edges per unit area and classifies all those areas where the edge count is high as a single region. Limitations of this work is driving off the road is not considered. Similarly, driving between trees, walls and driving around circles are not considered. The limitation in this working model was mainly due to availability of hardware and high-end cameras. This studied was carried out by focusing mainly on edge detection and image segmentation. Whereas this study completely avoided obstacle detection and avoidance.

Jesse Levinson in 2011, proposed a Fully Autonomous Driving system [3] is an expensive real working model. He proposed object recognition system using Kalman tracker, which identifies the shape of the object and motion of the object. This identification objects and segmentation found limitation on objects recognition system, consider a situation when a pedestrian presses a crosswalk button, he is identified as pole it is mounted on and the person is not recognized. He also developed traffic light detection purely as vision-based approaches. He fed temporal information, and he calculated and pre-mapped traffic light locations. There are certain limitations found in traffic light detection as well, this system assumed that a prior on the global location of traffic lights is available during detection, there is no dynamic detection done. He also proposed direction and stop sign board detection, he used SVM classification to identify the direction and sign board. There are certain limitation exists in direction and sign classification is there is no algorithmic way of detection, it taken manual efforts to annotate.

In [4], Jianwei Gong of University of California, proposed recognition and tracking of traffic lights. He used color segmentation for recognition. He evaluated various methods on color segmentation and arrived that threshold method is better on results and performance. He collected image sequences periodically to monitor the size of the target. He used Continuously Adaptive Mean Shift, which has taken color histogram as input. However, this method faced limitations as it only considered color segmentation. When a sky background is considered color based segmentation works fine and gives more accuracy, whereas, in urban roads, color based techniques will leads to false detection, thus reduces accuracy of detection. Shape consideration along with color segmentation can be considered for better accuracy, but he limited the proposal to color segmentation only. Also no real time working model of hardware is considered, only considers the traffic light detection using C++.

Early research on obstacle detection [5] using ultrasonic sensor is proposed by Johann Borenstein in late 1980's. He developed a mobile robot to help physically disabled. However, ultrasonic sensor cannot be used in environments where high accuracy is required.

In [6], Xiaodong Miao proposed lane detection system for autonomous vehicles. He applied canny edge detector on road images, then matching process done to categorize road line, he then proposed k-means clustering to localize lane. However, this techniques can be adopted and used in any smart vehicles, whereas the application

towards road side is not tested.

In [7], Gurjashan Singh Pannu proposed autonomous car using raspberry pi. He used raspberry pi as controller with camera, ultrasonic sensors to detect obstacles. He implemented this with Raspbian OS, which he finds more compatible with raspberry pi controller. He used python and openCV for image processing of identified visionaries. He proposed lane detection, obstacle detection and navigation. For lane detection, he used a combination of feature and model base, as it works fine for all types of roads. Ultrasonic sensors used in this model to identify objects. However, this model is developed as an autonomous car for road side travel, we aim at defense application vehicle to target and point enemies. Also this proposed system lags under remote operations through Internet of Things module, which is much essential for defense applications to control on vehicles.

IV. OBJECTIVES

Our objective of proposed work is defined based on application and working modules. The main objective is to develop an autonomous vehicle for defense application and evaluates its usage on road without a laser gun module. A prototype of autonomous vehicle is proposed, which supports Obstacle detection, Environment monitoring, Laser gun for target and Unmanned Vehicle movement. The proposed vehicle can be aimed at reduction of manual drives through remote operation controlled over Internet of Thing module and introduce as defense vehicle for land battlefield. To exploit the advantage of IOT is our main objective to handle the unmanned vehicle effective through remote commands. Automization of defense application needs huge fund, thus it is our objective to aim at less expensive and economically affordable autonomous vehicles with low maintenance costs.

V. WORKING PROCESS

Our proposed work handles the autonomous vehicles in two ways, one is manual control through remove commands and another is fully automated. The function of the two working model is defined below.

A. Manual control

In manual control, the movement of vehicle is controlled through the IOT commands, such as command like LEFT, RIGHT, FORWARD will be give to control the movement.

LASER Gun's Upper and Lower movement is used to point at the target is controlled by IOT module.

RF camera tracking control is used for visualizing the environment.

Ultrasonic sensor is used for obstacle detection. If there are any obstacles detected by Ultrasonic sensor then the vehicle stop immediately.

RF camera provides vision tracking of the vehicle and LASER gun is used for defense purpose.

B. Auto control

In auto mode, the vehicle searches for any human presence and updates the information on server.

All information is Updated top IOT server of webpage interface through PIC microcontroller.

VI. IMPLEMENTATION

The proposed work is implemented for two categories of autonomous vehicle level such as level 3 and 4. One is manual control with conditions provided from IOT module and another one is auto control, which controls automatically and updates to IOT module. The proposed system consists of ultrasonic sensor for obstacles detection, RF camera for viewing the location and surrounding environment and laser gun for pointing the enemies and destroy them. The vehicle acts as a search and rescue robot or defense robot for eliminating the threats based on the command given over the internet. It can also be enhanced in such a way to operate in manual or auto mode based on the circumstances in future. There are many advantages available in proposed system over existing one, here the commands can be updated from web server, and this is economically affordable for common people, low maintenance cost.

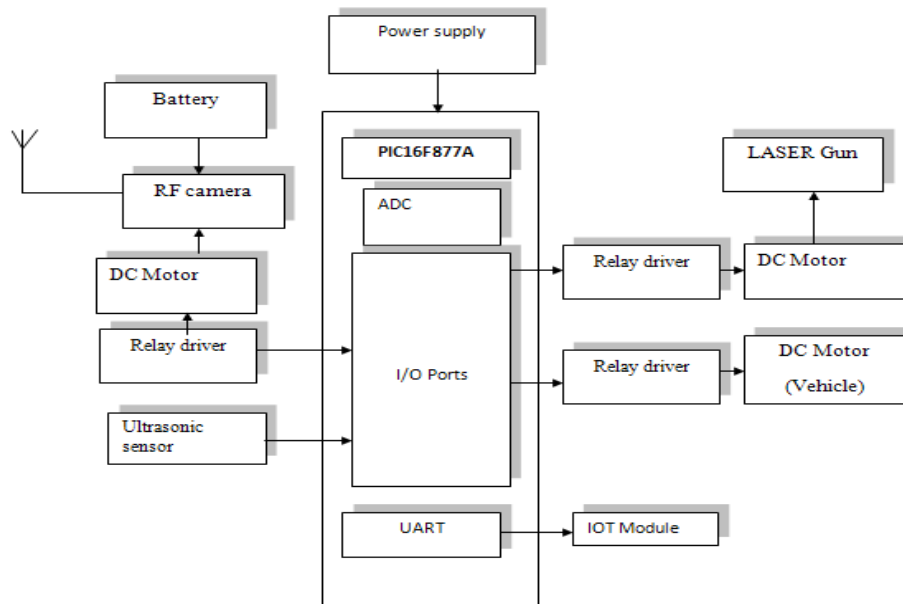


Fig 1. Block diagram

A. RF Camera Tracking

RF camera tracking control is used for visualizing the environment. RF camera provides vision tracking of the vehicle. RF camera is provided clockwise and anti clockwise rotation from remote control. IOT module supply the information to PIC controller, PIC controller rely the information to relay driver, which in turn controls the RF camera movement.

B. Laser Gun Model

As the application is designed for defense application, the proposed driverless vehicle has laser gun as another module to control. LASER Gun's Upper and Lower movement is used to point at the target. From IOT module, remote control on laser gun can be given as upward and downward movement for laser gun to point the target.

C. Obstacle detection

Ultrasonic sensor is used for obstacle detection. The ultrasonic sensor emit frequency signal periodically. If ultrasonic sensor detects any object, echo signal are emitted, which is taken as input to the sensor through Echo pin. If any obstacle is identified it is updated to the IOT module. If there are any obstacles detected by Ultrasonic sensor then the vehicle stop immediately.

D. Vehicle movement control

As we process two type level, under condition control level, manual control are given through the IOT module, the movement of vehicle is controlled. Controlling commands such as left, right, forward s given via IOT module, such that our designed vehicle moves according to the given command. Under level 4, that is full automatic, auto control is used, in this category if vehicle find any obstacle it stops and updated to IOT module. All information is updated in IOT web server through PIC microcontroller.

The following figure shows the working model of developed autonomous vehicle.

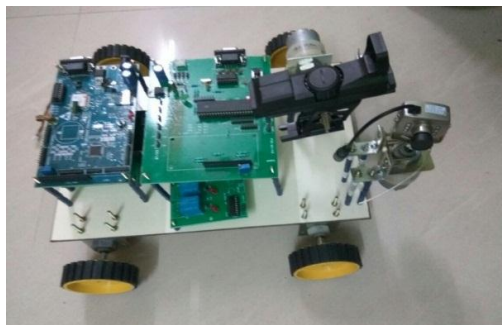


Fig.2. Developed Autonomous Vehicle

The above figure depicts the assembled and working model of autonomous vehicle designed for defense application. It is modeled with PIC controller, IOT module, RF camera and laser gun. This prototype is handled by user from remote server.

VII. RESULTS AND DISCUSSIONS

Existing research on autonomous vehicles have started from early 1980's Carnegie Mellon university Navlab and ALV. This work is considered to be first work, in which high effort has take to bring it in real time. In 2013, Vision Lab's Braive is the next level of autonomous car, which is demonstrated under traffic. Google's self driven cars are the perfect modeled one, which implements obstacle detection on roadside, the demonstration of these vehicles are found be safe on the streets of America. These vehicles are successful in demonstration and going to be marketed by 2020. Telsa motors are also working on driverless cars and these models are going to hit road in another two years. These two research is bringing revolutions to the vehicular networks. Many countries over the world are bringing the autonomous vehicle into real world. Developing Countries like India is struggling to bring autonomous cars into real world due to complications available in our road side systems. Thus it is meaningful to propose our work for military applications as defense vehicles.

VIII. CONCLUSIONS

Few automation features are implemented to create an autonomous vehicle. Autonomous vehicle is implemented to support level 3 and level 4 of automization category. Manual control with conditions provided from IOT module and another one is auto control, which controls automatically and updates to IOT module. The proposed model consists of ultrasonic sensor for obstacles detection, RF camera for viewing the location and laser gun for pointing the enemies and destroy them. The proposed is designed aimed to reduce manual drives through remote operations, there is need for defense application to reduce manpower and save lives. The vehicle acts as a search and rescue robot or defense robot for eliminating the threats based on the command given over the internet. It can also be enhanced in such a way to operate in manual or auto mode based on the circumstances in future. The experiments conducted based on manual control from IOT module of remote server and auto control of vehicle movement. The results shows that our model works fine with the vehicle control on movement and laser gun target on manual control, similarly with obstacle detection and vehicle movement control on auto mode.

IX. FUTURE ENHANCEMENTS

The proposed working model is limited to some features considering the costs on hardware. There are many features can be included in this work to enhance it and bring it as a complete model. Image processing techniques such as edge detection and

lane detection can be added, as it will improve the feature of self-parking. Machine learning algorithm can be implemented to identify the friendly forces nearby the autonomous vehicle and also the two node's distance can be calculated to avoid collisions. Whereas obstacle detection is done in our work, it can be extended to identify the object detection and recognition, while it will be useful to identify the type of the object.

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