



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 6, June 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512



9940 572 462



6381 907 438



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Design of an IOT Based Autonomous Vehicle with the Aid of Artificial Intelligence Computerised Vision

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ABSTRACT: A partially autonomous vehicle system is presented here. It highlights the idea to develop a remote controlled car which can be driven from anywhere using internet over a secured server. This car will also have limited automation features like traffic light detection, obstacle avoidance system and lane detection system so that it can drive itself safely in case of connectivity failure. The main goal here is to minimize the risk of human life and ensure highest safety during driving. At the same time the car will assure comfort and convenience to the controller. A miniature car including the above features has been developed which showed optimum performance in a simulated environment. The system mainly consists of a Raspberry Pi, an Arduino, a Picamera, a sonar module, a web interface and internet modem. The Raspberry Pi was mainly used for the Computer Vision algorithms and for streaming video through internet. The proposed system is very cheap and very efficient in terms of automation.

I. INTRODUCTION

PRESENTSCENARIO:

Although we have automated cars like Google car and Tesla cars, people are not showing interest on them as they are of high cost and they are not having any trust on fully automated vehicles. And many other vehicle manufacturers are including different kinds of technologies in their vehicles like lane detection, traffic light detection, parking space detection, etc. But there are several limitations in these models such as

- For traffic light detection, heuristic models and color segmentation are in use. These techniques are not giving efficient results.
- For lane detection, various edge detection techniques are in used. But they are not producing accurate solutions.

II. PROPOSED SYSTEM

The overall work can be divided into two major categories. They are:

1. The car can be remotely controlled through Internet using a web browser. In case of connectivity failure it can act autonomously in a good weather conditions.
2. The proposal consists of computer vision algorithms and video transmission with internet.
3. There are four main features in this proposed system. They are:
 - Streaming video and remote access
 - Obstacle avoidance
 - Traffic light detection
 - Lane detection

III. OBJECTIVE

With the rising power of technology, we are able to accomplish things at a much quicker rate and we can even automate them. To reduce road accidents, autonomous cars came into existence. There are many companies working on automated vehicles such as Google, Tesla motors, etc. But, people are not confident on these fully automated vehicles and also these are of high cost. So, to overcome these situations, a secured automated vehicle must be developed.

The main aim of this project is to automate a car by using conditional automation. It can detect and avoid the obstacles around it, it can detect traffic lights and lanes and it can be controlled from a remote location. In this proposed system

we used IOT and Computer Vision algorithms for getting an efficient output.

MOTIVATION OF WORK:

As the technology is evolving day-by-day, it is solving many problems in an easy and efficient manner. And now-a-days due to over population and heavy traffic conditions road accidents became common in daily life. Many people are losing their lives and many people lost their livelihood. If we can use the technology to solve this problem, we can avoid many accidents and can save many lives. With these thoughts in mind, we came up with this project.

ADVANTAGES:

➤ COLLECTSMORE FRAMES FROM ENVIRONMENT

A Haar Cascade Classifier is developed with respect to the working environment which can be easily be extended to work in real life environment and by collecting a lot more frames from the environment and by using power computer.

➤ PREVENTS ROAD ACCIDENTS

An ultra-sonic sensor is embedded within the system to detect and avoid the obstacles there by preventing road accidents.

➤ CLEAR VISION OF LANE MARKER

For the lane detection technique the popular canny edge detection and Hough line transform was used. This algorithm is highly efficient for a road with clearly visible lane marker.

➤ REMOTE ACCESS

Sometimes, it gets necessary to access the car from a remote location in order to reduce hassles. In this case, it would be a lot more convenient if the car could be viewed from a remote computer and driven by interaction through the computer keyboard.

DISADVANTAGE:

➤ AFFECT OF CLIMATIC CONDITIONS

When there is rain or fog around our vehicle, it cannot detect the lanes and traffic lights correctly. Because, the pi-camera might get covered with rain drops or fog.

➤ ONLY APPLICABLE IN FAMILIAR AREAS

As this is a conditional automation system, it does not support in all the environments. It is applicable only in the familiar places for the driver.

➤ FAST INTERNET CONNECTION IS REQUIRED

As we are using IOT and Computer Vision technologies which works under high speed internet, our vehicle must travel in high speed internet zones in order to fulfill the automation purpose. But as of now, not every place have a high speed internet which became a major limitation.

APPLICATIONS:

➤ Used to detect obstacles and avoids them in heavy traffic areas.

➤ Used to detect traffic lights and act accordingly.

➤ Lane detection algorithm is highly efficient for a road with clear visible marker and hence it can change the lane automatically.

➤ Remote access through web browser.

➤ Used for an accident free driving.

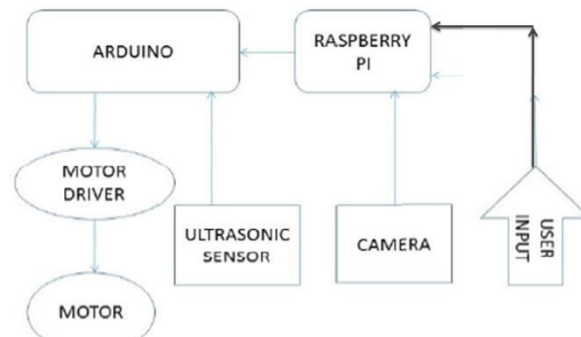
INDIVIDUAL BLOCKDESCRIPTION:

➤ Ultra sonic sensor transmits an ultrasonic wave through its transmitter and when the wave gets objected by any material it gets reflected back towards the sensor and the sensor detects it.

➤ Arduino takes the input from the sensor and controls the motor through the motor driver block.

➤ Camera is mounted to the raspberry pi board in order to capture the frames and videos for video detection and streaming purposes.

➤ The web server is connected to the raspberry pi's wifi module in order to host the web pages for remote access.



ULTRASONIC SENSORS:

Ultrasonic sensors are used to detect the presence of targets and to measure the distance to targets in many robotized processing plants and process plants. Sensors with an ON or OFF digital output are available for detecting the presence of objects and sensors with an analog output which changes relatively to the sensor to target separation distance are commercially available. Ultrasonic obstacle sensor consists of a set of ultrasonic receiver and transmitter which operate at the same frequency. The point when the something moves in the zone secured the circuit's fine offset is aggravated and the buzzer/alarm is triggered.

RASPBERRY PI 2 MODEL B

The Raspberry Pi device looks like a motherboard, with the mounted chips and ports exposed (something you'd expect to see only if you opened up your computer and looked at its internal boards), but it has all the components you need to connect input, output, and storage devices and start computing. You'll encounter two models of the device: Model A and Model B. The only real differences are the addition of Ethernet and an extra USB port on the more expensive b.



FLOWCHART-1 DESCRIPTION

- The image frames captured from the video were converted into gray scale images.
 - Using Haar feature based cascade classifier and python openCV modules the system has been trained.
 - To reduce the image noises Gaussian blur filter was used.
- For detecting the color of traffic lights image detection process has been done.

FLOWCHART-2 DESCRIPTION

- Suitable masking was done to filter out the noise from the original image using Gaussian filter.
- Enhancing the intensity of the image by finding the intensity gradient.
- Pixels that were not part of an edge were removed. Thus an image with thin edge is observed.
- Implementing canny edge detection by using hysteresis.
- For efficiently detecting any shape Hough line transformation is used.

FLOWCHART-1

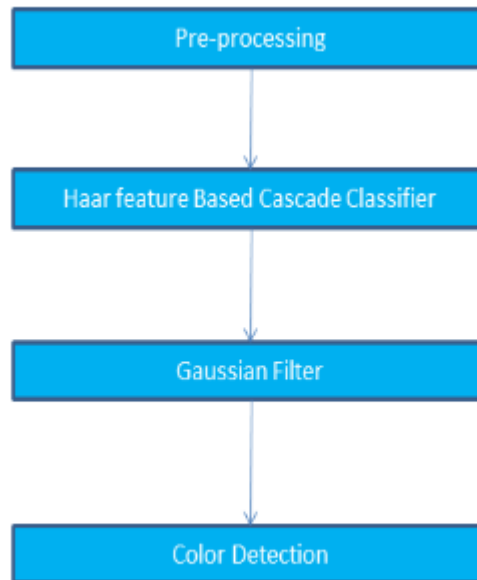


Fig 2.2 Traffic light detection process

FLOW CHART-2

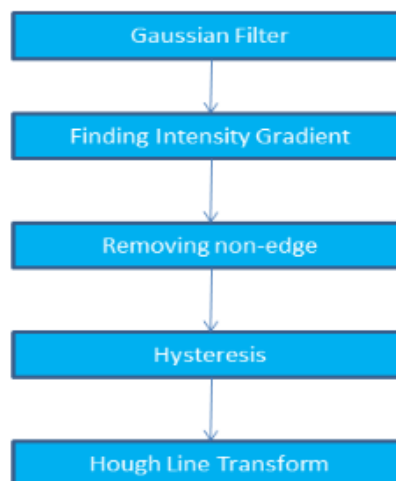


Fig 2.3 Lane detection

DC MOTOR:

A **DC motor** is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of themotor.

MOTOR DRIVERS:

A motor driver IC is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver ICs act as an interface between microprocessors in robots and the motors in the robot. The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC

motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. For this tutorial we will be referring the motor driver IC as L293D only. L293D has 16pins.

IV. TESTING AND RESULTS

TESTING

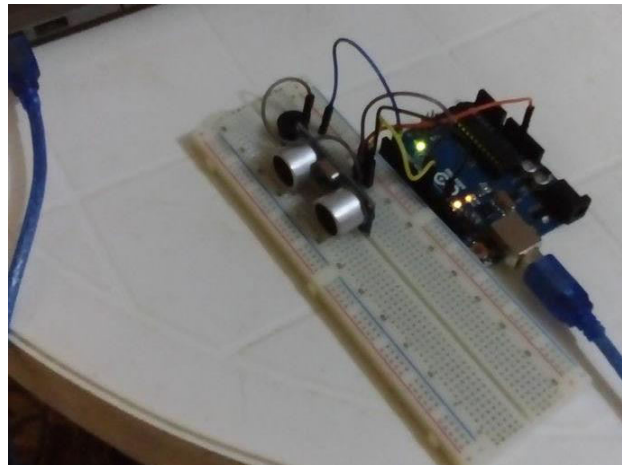
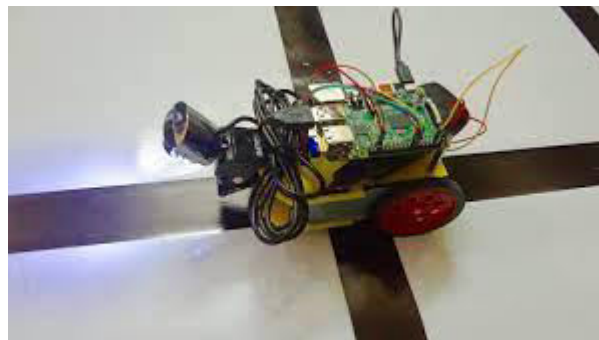


Fig 6.1 Obstacle detection using ultrasonic sensor

- During the construction of project, we tested the obstacle detection feature of our project. Whenever an object is placed in front of the ultrasonic sensor, the sensor detected the obstacle and we got the result in serial monitor of Arduino IDE.



Lane detection using a pi camera and image processing

- For testing the lane detection feature of our project, we made a small road using tapes and kept our prototype. It detected the lanes and its edges.
- For testing the video streaming and remote access feature, we used a web browser to view the video.

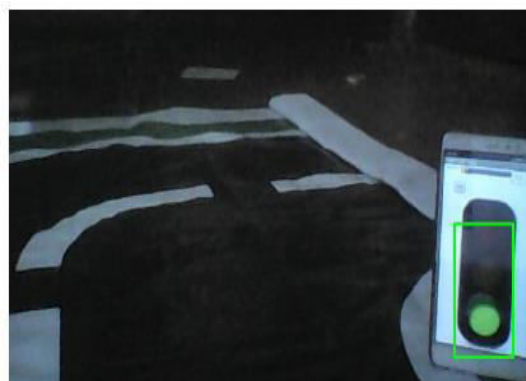


Fig 6.3 Traffic light detection



- For testing traffic light detection, we kept a sample image of traffic lights in front of the pi camera and it recognized the green light and the prototype followed the commands.

V. RESULT

A miniature car including the above features has been developed which showed optimum performance in simulated environment. The sonar sensor is set up in front of the car. The camera is fixed on the window of the car and the processing units are set within.

VI. CONCLUSION

Here we implemented some automation in a regular car. This prototype successfully achieved the goals. However Raspberry Pi maybe powerful but yet we need a much powerful computing machine if we need to implement it on a real car. Or multiple Raspberry Pi could be cascaded to perform different tasks.

FUTURE SCOPE

- If we can predict the climatic conditions and alert the automation system then we can reduce the effects.
- If we use Level-5 automation, a lot more work is to be done.
- We can build a navigation system on top of it.
- A much better classifier for traffic light detection can be designed to get better performance in a real life scenario.
- Using advanced machine learning algorithms in this technology might reduce the limitations.

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