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An Automated Car with Distance Sensor Using Raspberry Pi

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ABSTRACT: an autonomous car is a modern day technology which has lot of benefits and scope for development. It is a simple and efficient way of detecting collisions using a simple distance sensor [HC-SR04]. This can also be integrated with a camera module and hence can be used as a drone. This drone can be used in hostile situation where human interventions are arduous. We have the latest micro-controllers and system integrated chips to achieve automaticity. This SoC consumes less power. This is a socio-beneficial project since this can be implemented on every vehicle to avoid collision and also can be implemented on the line of defense.

KEYWORDS: HC-SR04, Camera module, Drone, Micro-controllers, SoC.

I. INTRODUCTION

1.1 Motivation

There are 17 deaths occurring for every hour on Indian streets as per a survey conducted by Indianexpress[1].Accident facilities have been increasing. Taking into account the recent accident caused in Delhi due to smog, where the drivers weren't able to see due to toxic present in the air. Nearly 24 cars were involved in the accident on the Yamuna express Highway and several people were injured due to this. In these situations Distance sensors that detects the obstacles present comes in handy. This is one scenario- A case in florida where the accident scene ran for 1 mile. Drivers were blinded by a combination of fog and smoke caused by a nearby brushfire - and that fire may have been set intentionally.

1.2 Our Work

Distance sensor uses Sonar technology to detect the obstacles present in front. Here, Sonar uses sound propagation technique where we send a sound wave and based on speed of sound and time taken for the wave to reflect back to the sensor we compute distance of the object lying in front of it. It can be implemented in all the directions using multiple distance sensors.

The main problem we're facing is there are lot of circumstances when humans make errors while driving, machines once programmed won't deviate from the course of action .So making a car autonomous will definitely avoid the cause of accidents .it is defiantly a tedious task to completely make a car autonomous and humans won't rely on it completely but once 100% efficiency is achieved it'll sail smoothly. Why we feel many naive approaches fail is lack of enough test trials to make it live. What we need is a traffic system that can completely rely on automation to make loves better and easy. What is the most interesting aspect we focus in our paper is automation. Live relay feed from the camera module we're using distance sensor that is an economic way to detect and set the collision distance to avoid accidents. What we're proposing is a completely autonomous car that can sense the distance and not only warn but stop the car and move away which has never been implemented before its just distance sensor will sense and give a beep sound.

There are many automatic or self driven cars nowadays but none of them are operating as expected there'll be some drawbacks .in our scenario what is the drawback is the distance sensor sensing angle should not increase a particular angle if it exceeds it'll be a problem so the solution for this is deploying multiple distance sensors.

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II. PROBLEM STATEMENT

2.1 What is the problem?

As we have told earlier there are a lot of accidents happening around due to driver's carelessness or due to situations where driver can't actually see and there are many hostile situations where human intervention can't actually happen. So, here are trying to build an automated to address the issues mentioned above. This car not only helps us to find obstacles and avoid collisions but also uses a camera module to provide us with a live relay of what actually is happening in a hostile situation. And just think of a situation where area is too less for human to actually work and find out what actually is going on. In those places we can actually deploy this automated car.

2.2 Why is it interesting and important?

This has a lot of applications and is very beneficial to society to prevent accidents. This can also be used in hostile situation as mentioned and hence accounts for the safety of human life as well. This is prototype of how it can actually be achieved. This automated car project implementation done with a very low budget and can be implemented with other heavy duty vehicles as well. And another important factor about this automated car is this that it runs on very low voltage, however it requires little more power supply than the one provided raspberry pi which is the very less to drive the motors of the car. Isn't it fascinating that how a small system on chip can help us build such a project, this SoC acts an integral and intermediate component to achieve this. Just with few pins help us send input and get us output. Output here is the movement.

2.3 Why is it hard?

This is hard to implement with respect to sensing of objects. Of course it is possible to use multiple sensors and still it will be difficult to sense diagonal objects. Not that it is impossible to sense diagonal objects, but it is very hard to implement and the code will as increase as the number of sensors increase and we must make sure it these code doesn't overlap. It is not easy to implement live relay using VLC let's say as we actually need a higher pixel camera and the bandwidth needed to supply the data must be more or else we must get a lag. If a higher pixel camera is not used then analyzing the data we just lived relayed is not possible.

It is hard to implement both the features since the complications increase with respect to working, however it is manageable since the camera module implementation doesn't include much code.

2.4 Why hasn't it been solved before?

There are a lot of Projects or Prototypes that actually implements the features such mentioned above. But they are implemented separately, that is only one of the features is implemented and not both of them in a single project. Few of them completely concentrate on automation more like self-driven cars and collision detection. And there are few other projects and sole purpose those projects are to stream data and they are usually implemented as controllers and there isn't any automation involved in it. And this project implements both automation as well as drone facility in a single project.

That's the advantage of our project since it implements both under a single system. There are few more examples where additional features are implemented along with one of them mentioned above. Line we implement self-driven cars using lane detection. Or say high quality video relaying with drone. Drones that can fly as well are also implemented.

Good thing about our project is along with distance and live streaming of video which can implement the above mentioned features like lane detection, self-driving and much more. However here we have just implemented automation using distance sensor and drone facility by providing live streaming of data using raspberry pi camera module.

2.5 What are the key components of my approach and results?

Here, to implement we usually need a SoC that is a system on chip, here we are using raspberry pi as mentioned. Raspberry pi is different from many other controllers that are available. It's just a controller, but it is a mini computer. In this, we make use of GPIO pins that is general purpose Input and Output pins to provide input and obtain output. As specified the power supplied by raspberry pi is not actually enough to drive 4 motors and hence we use an additional battery pack bridged with L298N H Bridge. So by using this additional power is supplied to run these motors for

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enough time. Along with this we distance sensor to sense obstacles using sonar technology and camera module which can directly plugged into raspberry pi. Raspberry pi has a separate slot for to plug in camera module. We use a mid-ranged RPM motors for our project soldered onto a chasey. And we use a bread board to place distance sensor and then connect it to GPIO of raspberry pi. Here, for automation we actually use a loop mechanism to actually avoid collision.

Finally this project will be an automated car that senses obstacles and avoid it and relays the data which it actually captured. This usually can be added new features like making it a self-driven car with lane detection or it can also be implemented as a controlled car that is more like a remote controller. However remote controlling is not implemented here. This can be achieved using Tkinter module or using many other ways. Limitations are that we are using only 1 distance sensor that is on the front and obstacles are not detected while going reverse or while turning left or right. And this car doesn't go to a particular location, like self-driven cars, here we have just implemented automation will relaying of live data.

III. SYSTEM ARCHITECTURE

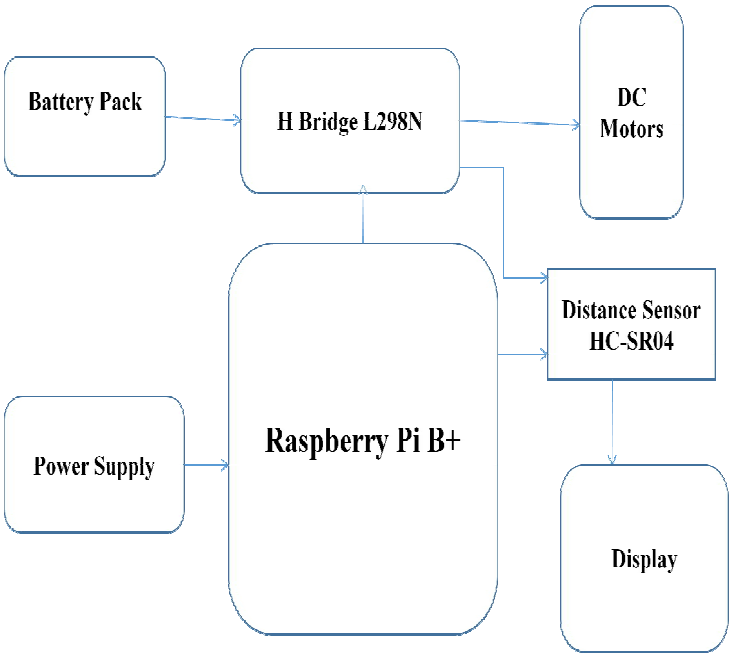

Figure 3.1: System Architecture

3.1. Raspberry Pi and Edimax Adapter

Raspberry Pi is a system on chip unlike Arduino. It's not just a controller it is a mini computer integrated on a chip. It is powerful due to a lot of thing that can be implemented with it. There are a lot of Raspberry Pi models available. Earlier we had Raspberry Pi with 26 pins now Raspberry Pi usually comes with 40 pins. For this project we use Raspberry pi B+ model with 512MB of RAM. GPIO pins are used to give input and get output. There are only two variations with GPIO pins that are HIGH and LOW. GPIO pins are connected to H-Bridge through jumper wires and motors are connected to output slots of H-Bridge. We even have ground and voltage pins in Raspberry pi. Raspberry pi provides us facility to connect monitor through HDMI and various USB devices like keyboard, mouse etc. by providing USB slots. We mount Raspbian OS which is one of Linux'sdistributions on SD card.

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Figure 3.2: Raspberry Pi

We use one of the USB slots to connect Edimax wireless adapter which provides us to connect to Wi-Fi or hotspot connection. Recent Raspberry pi chips come with inbuilt Wi-Fi facility. For the older versions we must use wireless adapters that are supported by Raspberry Pi. We recommend Edimax because it comes with inbuilt drivers.

3.2. Motors and Its Working

It is a device that can't convert electrical energy into mechanical energy. It works on the basis of induction that is when we supply direct current to it the 2 magnetic plates or coil windings are going to produce a magnetic field that will rotate the shaft and the motor starts spinning. There speed varies and is usually measured in terms of **rpm** this can be controlled by the power input we provide .The heart of the motor working are the coils which produces field which is directionally proportional to the current flowing through it. The current is carried along the armature it resides between the poles. The direction of force relies on **Fleming's left hand rule i.e.**

"If we keep our thumb, index and middle finger perpendicular to each other then middle finger indicates the direction of current in the conductor, index finger the magnetic field (north or south poles) then the thumb will point in the direction of the mechanical force that is generated."

3.3. H-bridge[L 298N]

It is a circuit that will let you apply load across the device .it is mainly a regulating device that controls the operation of motors basically an H-bridge will see to it whether the motor rotates forward backward or just one of them rotates etc. It basically gets the name H-bridge from the representation of the circuit.

Figure 3.3: H-bridge [L 298N]

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These operate on the principal of switches say p1 and p4 are closed then we see that a positive voltage will be applied if p2 and p3 are closed then a negative voltage will be applied across the bridge. This H-bridge houses slots for us to connect the motors to control their speed and direction and there by moving our vehicle.

3.4. Distance sensor (HC-SR04)

It is a device used to calculate the distance of objects lying in front of the sensor by using sound waves. It is based on sonar technology.

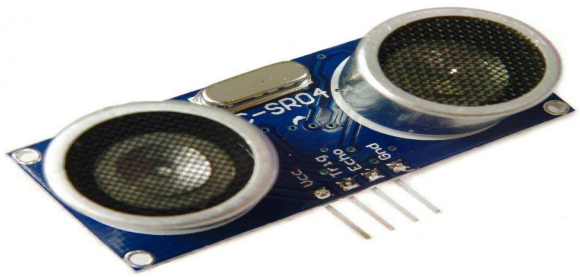

Figure 3.4: Distance sensor (HC-SR04)

A. How does it work?

This device works by sending out a sound wave from the transmitter (trig pin) and when this wave finds an object, it is reflected back and received at echo pin. The time between the transmission and reception of the sound wave allows us to know the distance of the object.

In our project we use a resistor (1k) for the sensor on a bread board so as to limit the power supply which may damage the device.

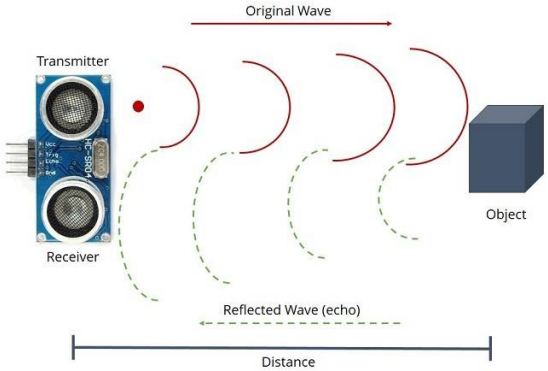

Figure 3.5: Working of distance sensor

3.5. Battery pack

Power supplied Raspberry Pi isn't enough to run the Motors so we use additional battery pack to give enough power for motors to run. We can use the portable power supply to provide power to Raspberry Pi.

3.6. Camera Module

Since this concentrates project on being the drone we actually need to live stream the data as the car moves. So for that we use camera module which can be directly plugged into Raspberry pi. Just like plug and play and we use it using python's camera module. There is a particular slot for camera module on raspberry pi.

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IV. RELATED WORKS

Autonomous car is a vehicle that is capable of sensing its environment and navigating without human input. Here Raspberry Pi used as a central processing unit and Raspberry Pi camera module mounted on top. The Camera module would provide the images of the real world [1]. Camera module is used for monitoring the traffic issues [2].In air, sound travel at a speed of 343meters per second .An ultrasonic distance sensor (HC-SR04) sends out the pulses of ultrasound which are inaudible to human and detect the echo that is sent back when the sound bounces off a nearby object. It than uses the speed of sound to calculate the distance from object [3]. The driver activity can also be monitor through the internet [4]. Automatic parking is an autonomous car-maneuvering system moves vehicle from traffic lane into parking spot. While taking reverse and forward in parking lane the chances of getting collision is more .To overcome this the sensor will react to the object range and stop car when it is close to the object [5].Using wireless network communication (VANET) the vehicles can communicate with each other on a road with both driverless car and human driven car [6].

V. CONCLUSION AND FUTURE USE

Automation of the car is achieved and this system can be used as drone by using camera module plugged into pi and relaying it using VLC in our case. This car is run on batteries and there is a need for change of these batteries quiet often and there is no way of providing back up. Here, the automation is achieved in such a way that it just moves on itself and avoids collision by moving in other direction when an obstacle is detected. This distance can actually be configured according to our needs.

Thus, depending where we are actually deploying our car that is in what environment we can actually configure the distance and then deploy it. Here the car runs for a period of time on its own without actually colliding anywhere and streaming the live data of situation which we want to study.

This model of car can actually be used a base of implementing a lot of things. This car provides fundamental automation which can be enhanced much more like when we add multiple distance sensors. There are a lot of algorithms which uses many video detection and other techniques and then process it to detect lane. So lane detection can be implemented. This can be implemented on other heavy duty or much bigger vehicles. We can live stream the data and to this we can night vision as well so we will able to get the data where is no light situation. This can be made to self-driven car which goes to the destination based on the location and using other algorithms as we mentioned above like lane detection. This car can also be used to process the data which it streams by capturing screenshots using raspberry pi camera module. This is more like image processing linked with automated car and thus can help us study the hostile environment as well.

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