Mini Project Report on

OBSTACLE AVOIDANCE CAR USING ARDUINO

Submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE & ENGINEERING

Submitted by:

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CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the project report entitled **"OBSTACLE AVOIDANCE CAR USING ARDUINO"** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering of the Graphic Era (Deemed to be University), Dehradun shall be carried out by the under the mentorship of **Dr. Upma Jain, Assistant Professor**, Department of Computer Science and Engineering, Graphic Era (Deemed to be University), Dehradun.

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Chapter 1

Introduction

1.1 Introduction: An autonomous car is a vehicle that can guide itself without human command and control. It is also known as a driverless car, self-driving car, unmanned vehicle, or a robot car. Autonomous vehicles can perceive their surroundings (obstacles and track) and commute to destination with the help of a combination of sensors, cameras, and radars. Advanced control systems can interpret the information provided by sensors to detect obstacles and choose the most suitable navigation path for the vehicle [1]. Enormous research has been carried out to bring the idea of autonomous car to life. Now a days, such vehicles have become a concrete reality and they have been created and extensively tested on roads, although they are not yet commercially available on a large scale.

Robotics is part of today's communication. In today's world Robotics is fast growing and interesting field. It is simplest way for latest technology modification. Now a days communication is part of advancement of technology, so we decided to work on Robotics field, and design something which will make human life simpler in day today aspect. Thus, we are supporting this cause.

In autonomous vehicles, one of the most important features is the correct and accurate detection of obstacles as well as the track of the vehicle. The vehicle or car should be able to detect the presence of an obstacle precisely and well in time so that it can stop itself at a safe distance to avoid the collision. Track detection [2] is also a very important factor as the vehicle must be able to keep itself within the limits of track and follow the lines on the road to remain rightly on the track and to follow the lane as well.

An obstacle avoidance robot is an intelligent device, which can automatically sense and overcome obstacles on its path. Obstacles avoidance is a robotic discipline [3] with the objective of moving vehicles based on the sensorial information. The use of these methods front to classic methods is a natural alternative when the scenario is dynamic with an unpredictable behavior. In these cases, the surroundings do not remain invariable, and Tus the sensory information is used to detect the changes consequently adapting moving. It will automatically scan the surrounding for further path.

This project deals with the study of various approaches for obstacle detection and track detection that have been studied/implemented in the literature by different researchers. Vehicle safety systems are generally classified into types:

- Active
- Passive

Active systems include collision avoidance system, automatic braking, adaptive cruise control and lane departure warning system, whereas passive systems generally comprise features such as seat belts, air bags, crumple zones and laminated windshields. Therefore, obstacle detection and track detection fall into the category of active vehicle safety systems.

This project is basic stage of any automatic robot. This ROBOT has sufficient intelligence to cover the maximum area of provided space. It has an ultrasonic sensor which are used to sense the obstacles coming in between the path of ROBOT. It will move in a particular direction and avoid the obstacle which is coming in its path. We have used two D.C motors to give motion to the ROBOT. The construction of the ROBOT circuit is easy and small the electronics parts used in the ROBOT circuits are easily available and cheap too.

Development being a critical characteristic of adaptable robots in obstacle avoiding and way affirmation significantly influences how people react and see an independent structure. PC vision [4] and range sensors are basic article recognizable proof systems used in versatile robots ID.

PC distinguishing proof method is more intensive and exorbitant procedure than the range sensors strategy. The use of radar, infrared (IR) and ultrasonic sensors [5] to operate an obstacle recognition system began as precisely on time as the barrier recognition system. 1980's. Regardless of the way that, in the wake of testing these advances it was contemplated that the radar development was the most suitable for use as the other two advancement choices were slanted to environmental restrictions, for instance, storm, vacation day, and earth.

The measuring device approach was furthermore a monetarily sensible development each for this and what is to come back. The sensors don't seem to be restricted to recognizable evidence of an obstacle.

1.2 Identification of Need: Obstacle avoidance was chosen as a test for conditioning in the robot. We do not focus on any special task but rather want to verify whether conditioning models can be used for adaptively solving tasks of a physical robot at all.

The sensorium is very simple (six photoreceptors), [6] and a world of very reduced complexity was created. One type of obstacles was presented: a black box (for 3.5 in. computer disks) at different positions. All experiments were conducted on a cream-colored desk.

The naive robot starts with default behavior, i.e., it drives straight ahead. When an obstacle is put in its way, the robot hits it and the reflex triggers a backward movement. The exact direction of this retreat depends on which tactile sensors have been touched.

When hitting obstacles, the robot learns coincidences of short-term memory representations and unconditioned stimuli. After about 700-time steps (about 80 s of robot action), the robot was generally able to avoid obstacles of high contrast relative to the background. However, the robot could not detect the obstacle if the contrast edge was presented exactly in the middle of the visual field and the robot steered straight toward the obstacle so that the edge was kept always in the middle.

The use of unmanned underwater vehicles [7] is steadily increasing for a variety of applications such as mapping, monitoring, inspection and intervention within several research fields and industries, e.g., oceanography, marine biology, military, and oil and gas. Particularly interesting types of unmanned underwater vehicles are bio-inspired robots such as underwater snake robots (USRs).

USRs may also propel themselves using energy-efficient motion patterns inspired by their biological counterparts. They can thereby increase the propulsion efficiency during transit and maneuvering, which is among the great challenges for autonomous underwater vehicles. In this paper, a control system for path following, and algorithms for obstacle detection and avoidance, are presented for a USR [8] with thrusters attached at the tail module.

The position of the obstacles is detected using a single camera in the head module of the USR and a developed computer vision algorithm. For the proposed control concept, the robot joints are used for directional control while the thrusters are used for forward propulsion. The USR circumvents obstacles by following a circular path around them before converging back to the main straight-line path when this is safe. Experimental results that validate the proposed methods are also presented.

In this case there is no optical flow to be measured and no CS signal can be used to anticipate the reflex movements. Using two cameras can avoid this problem. Most runs showed that middle EMD representations are suppressed up to less than 40% of their initial weight (“hippocampal synapses”), which is due to a rare occurrence of these stimuli representations in coincidence with collisions. Thus, the network correctly learned to pay less attention to irrelevant stimuli.

Information about self-motion is necessary estimate the distance of objects by visual flow. This signal was not provided in the experiments described above. To enhance our system's performance, we added further inputs of proprioception. Copies of motor signals were low pass filtered and connected to the network by modifiable C synapses. With this additional information the robot showed a more stable obstacle avoidance behavior because the network could distinguish between visual flow occurring when the robot moved ahead and when it turned. To achieve this result, it was made sure that the obstacle's contrast edge was never in the middle of the robot's visual field.

Chapter 2

Literature Survey

[9] Presented a single-beam mechanically-scanning profiling sonar to detect obstacles under water. The profiling sonar can produce a cone-shaped beam which is ideal for detecting near surface obstacles. One of the objectives of their work was to investigate the suitability of using sonar near the water-air boundary for which the study found promising results. There were other works using multiple sensors to make the robot more accustomed to its surroundings by employing both range and appearance-based obstacle detection [10, 11]. Their obstacle detection also includes a combination of global and local avoidance. They fused the strengths of an image and an ultrasonic sensor to detect objects and measure its size. Detection of the object was carried out by the ultrasonic sensor and its measurement required the help of a camera. The code was designed to receive the distance to object, its height and width. Surveillance robots are specially designed for mining accidents, earthquake disasters, and hostage situations etc. Many groups of researchers have developed surveillance robots with the ability to conduct emergency search and rescue work. [12] presented 'Robot-Assisted Emergency Search and Rescue System with a Wireless Sensor Network. [13] presented 'Mobile Rescue Robot for Human Body Detection in Rescue Operation of Disaster'. [14] presented 'Rescue Robotics Using Artificial Intelligence', [15] presented 'Design and Implementation of e-Surveillance Robot for Video Monitoring and Living Body Detection' and [16] presented 'Surveillance Robot Using Arduino Microcontroller, Android APIs and the Internet'. All those researchers are based on gas sensor, LDR & metal detector to detect a bomb, PIR to sense human movement and to detect human alive or dead, LM35 to detect temperature, Distance sensors, Compass & communicating over Zig-Bee, RF & internet. By detecting human body temperature wirelessly, the system can identify whether the human is alive or dead. The robot also has a long-range First-person view (FPV) video monitoring system.

2.1 **Artificial Intelligence:** Artificial intelligence is the branch of computer science that develops machines and software with human-like intelligence. It is the intelligence exhibited by software or machines. The central goals of artificial intelligence research include knowledge, reasoning, learning, planning, perception, the ability to manipulate and move objects and natural language processing. The field was founded on the claim that a central property of humans is intelligence, and that it can be sufficiently well described to the extent that a machine can simulate it.

2.2 **Robotics and Robots**: It is a branch of technology and deals with designing, construction, operation, and application of robots. It also deals with the computer systems for their sensory, control, information processing and feedback. These technologies deal with automated machines that can replace humans in manufacturing processes or dangerous environments. These robots resemble humans in behavior, appearance, and/or cognition. Robotics requires a working knowledge of mechanics, electronics, and software [15].

Robots are machines and are of a wide range. The common feature of robots is their capability to move. They perform physical tasks. Robots have many different forms. They range from industrial robots, whose appearance is dictated by the function they are to perform. Or they can be humanoid robots, which mimic the human movement and our form.

Robots can be grouped generally as:

- Manipulator robots (for e.g., industrial robots)
- Mobile robots (for e.g., autonomous vehicles),
- Self-reconfigurable robots, the robots that can conform themselves to the task at hand.

Robots may act according to their own decision-making ability, provided by artificial intelligence, or may be controlled directly by a human, such as remotely controlled bomb disposal robots and robotic arms; or. However, most robots fall in between these extremes, being controlled by pre-programmed computers [2].

2.3 **Robot Working:** Human beings on a basic level are made of five major components:

- A muscle system that can move the body structure
- A body structure itself
- A power source that can activate the muscles and sensors
- A sensory system which can receive information about the body and the surrounding environment
- A brain system which can process sensory information and tell the muscles what to do.

Robots are made up of the same components as above. A typical autonomous robot has a sensor system, a movable physical structure, a power supply, and a computer brain that controls all these elements. Basically, robots are man-made versions of the animal life. They are machines that can replicate human and animal behavior.

2.4 **Actuator:** All robots have a movable body (almost all). Some have motorized wheels only, while others may have a dozen of movable parts (that are typically made of plastic or metal). Like bones in a human body, the individual segments relate to the help of joints. Robots use actuators to spin wheels and jointed pivot. Some robots use solenoids and electric motors as actuators; others some use a pneumatic system (a system driven by compressed gases); yet others use a hydraulic system. A robot may even use all these actuator types together.

Robots need a power source to be able to drive the actuators. Most robots have a battery, or they plug into an electricity source. Pneumatic robots need air compressors or compressed air tanks, and hydraulic robots need a pump that pressurizes the hydraulic fluid. The actuators are wired to an electrical circuit. The circuit powers these electrical motors and solenoids directly. It also activates the hydraulic system by manipulating electrical valves. The valves determine the pressurized fluid's path through the machine.

2.5 **Robot Learning:** Robot learning is an intersecting research field between robotics and machine learning. It studies techniques that allow robots to acquire skills and adapt to its environment by learning various algorithms. Learning can take place either by self-exploration or through guidance (from a human teacher), like in robot learning that learns by imitation.

2.6 **Autonomous Robot:** Autonomous robots are independent of any controller and can act on their own. The robot is programmed to respond in a particular way to an outside stimulus. The bump-and-go robot is a good example. This robot uses bumper sensors to detect obstacle. When the robot is turned on, it moves in a straight direction and when it hits an obstacle, the crash triggers its bumper sensor. The robot gives a programming instruction that asks the robot to back up, turn to the right direction and move forward. This is its response to every bump. In this way, the robot can change direction every time, it encounters an obstacle. A more elaborate version of the same idea is used by more advanced robots. Roboticists create new sensor systems and algorithms to make robots more perceptive and smarter. Today, robots can effectively navigate a variety of environments. Obstacle avoidance can be implemented as a reactive control law whereas path planning involves the precomputation of an obstacle-free path which a controller will then guide a robot along. Some mobile robots also use various ultrasound sensors to see obstacles or infrared. These sensors work in a similar fashion to animal echolocation. The robot sends out a beam of infrared light or a sound signal. It then detects the reflection of the signal. The robot locates this distance to the obstacles depending on how long it takes the signal to bounce back. Some advanced robots also use stereo vision. Two cameras provide robots with depth perception. Image recognition software then gives them the ability to locate, classify various objects. Robots also use smell and sound sensors to gain knowledge about its surroundings.

Chapter 3

Methodology

The obstacle avoidance robotic vehicle uses ultrasonic sensors for its movements. Arduino is used to achieve the desired operation. The motors are connected through motor driver IC to Arduino. The ultrasonic sensor is attached in front of the robot.

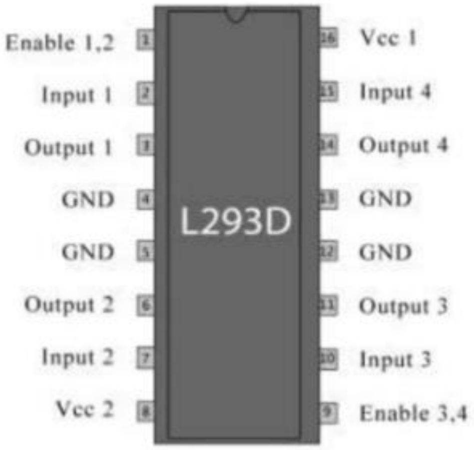
Whenever the robot is going on the desired path the ultrasonic sensor transmits the ultrasonic waves continuously from its sensor head. Whenever an obstacle comes ahead of it the ultrasonic waves are reflected from an object and that information is passed to the Arduino. The Arduino controls the motors left, right, back, front, based on ultrasonic signal. To control the speed of each motor pulse width modulation is used (PWM).

When ultrasonic sensor detects the object which is kept inside the path it will send the signal toward the Arduino uno and according to that it will rotate the motor M3 & M4 in forward direction and rotate the motor MI & M2 in reverse direction such way that the car gets moving in left direction.

3.1 **Arduino UNO:** Arduino/Genuine Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform for an extensive list of current, past, or outdated boards see the Arduino index of boards.

3.2 **Motor Driver L293D:** Motor drivers take a low current control signal but provide a higher current signal thus acting as a current amplifier. The higher current signal drives the motors. L293D is a motor driver that allows direct current (DC) motor to drive on either direction. It contains two inbuilt H-bridge driver circuits to rotate the motor in clockwise or anticlockwise direction, voltage need to change its direction. H-bridge is a circuit that allows voltage to be flown in either direction. Hence H-bridge IC are ideal for driving a DC motor.

Here are 4 input pins for L293d, pin 2.7 on the left and pin 15 10 on the right as shown on the pin diagram Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right-hand side. The motors are rotated based on the inputs provided across the input pins as LOGIC 0 or LOGIC 1. For rotating the motor in clockwise direction, the input pins must be provided with Logic 1 and Logic 0. Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.



3.3 **Motor (50 RPM/ 9V):** The obstacle detection and avoiding robot uses two 200rpm and 12V DC geared motors. The motor used has a 6mm shaft diameter with internal holes. The internal holes are for easy mounting of the wheels by using screws. It is an easy to use low- cost motor for robotics application.

An Electric DC motor is a machine which converts electric energy into mechanical energy. The working of DC motor is based on the principle that when a current- carrying conductor is placed in a magnetic field, it experiences a mechanical force.

The direction of mechanical force is given by Fleming's Left-hand Rule and its magnitude is given by F = BIL Newton. DC motors are seldom used in ordinary applications because all electric supply companies furnish alternating current.

3.4 **Ultrasonic Sensor:** An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sorer sensor and the object.

It emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance.

The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board,

To generate the ultrasound, you need to set the Trig on a High State for 10 PS That will send out an 8-cycle sonic burst which will travel at the speed sound, and it will be received in the Echo pin. The Echo pin will output the time in microseconds the sound wave travelled.

Chapter 4

Result and Working

The Ultrasonic Sensor emits an ultrasound of 40000 hz which travels through the air, and it will bounce back after strike from an obstacle. Arduino consider the travel time and speed of the sound and calculate the distance.

If the distance is less than stopping distance that is already declared in code by the developer, the car will stop. The ultrasonic sensor emits the sound wave in both direction one by one and receive the waves. Arduino take as input from the sensor and calculate the distance of both directions. Arduino compare both distances and which distances will greater than other one, in that direction car will turn. And would run in straight direction.

Table 1. Avoidance accuracy of Static Obstacle

Environment	Type Of Obstacle	Detected	Avoided	Accuracy
Well-Lit	Single Solid Obstacle	Yes	Yes	100%
Dimly Lit	Single Solid Obstacle	Yes	Yes	100%
Well-Lit	Uniform Shaped Surface	Yes	Yes	100%
Dimly Lit	Uniform Shaped Surface	Yes	No	40%
Well-Lit	Double solid obstacles	Yes	Yes	75%
Dimly Lit	Double solid obstacles	Yes	Yes	70%
			Average	80.83%

Accuracy = (number of successful avoidances)/ (number of test cases)

Accuracy Range

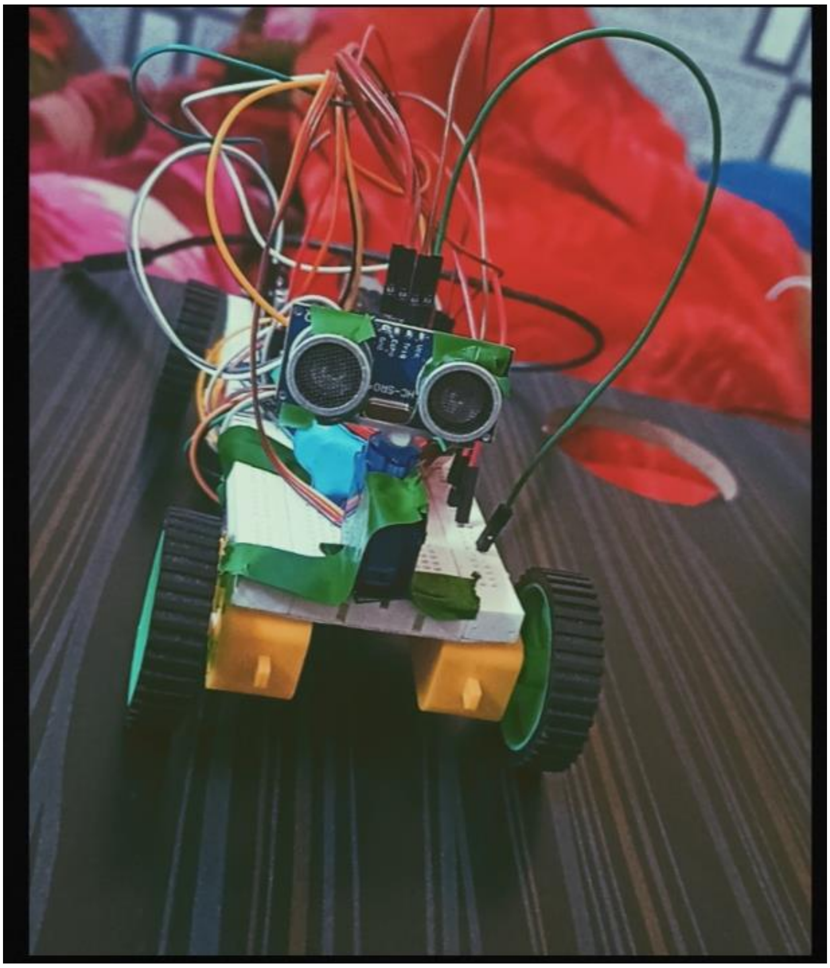
Extremely Sharp 80-100%

Slightly sharp 60-79%

Sharp 50-59%

Not sharp 0-49%

Table 1 shows the precision of the system when tested against the fluctuated environment, variety of obstacle, and in this way the things once the object is recognized it stayed away from it. Experimental results with varied positions of obstacle show the flexibility of the robot to avoid it and have shown a decent performance in our laboratory. The robot is additionally ready to acknowledge victims before it, the sensing element system is extremely low-cost, as a result, it solely uses one distance sensing element.



Chapter 5

Conclusion and Future Work

5.1 Conclusion: Today we are in the world of robotics. Knowingly or unknowingly, we have been using different types of robots in our daily life. The project is “obstacle detection and the avoidance robot” is practically proved by using the Ultrasonic sensor for sensing the robot, Motor Shield Driver for the driving the dc motors, dc motor is used for the movement of the robot with the help of the Arduino Microcontroller. A lot of factors determined the accuracy of the robot we designed. These factors were the environmental phenomenon in which the robot was tested, the number of obstacles present making the test space crowded or relatively less crowded the type and shape of the obstacle (the robot is designed for a uniform shaped obstacle). These factors majorly affected the sensors. The accuracy of the robot is dependent on the sensors used. Thus, the nature of the sensor and its accuracy defined the accuracy of my robot.

5.2 Future Recommendations:

- Adding a Camera: If the current project is interfaced with a camera (e.g., a Webcam) robot can be driven beyond line-of-sight & range becomes practically unlimited as networks have a very large range.
- Use as a firefighting robot: By adding temperature sensor, water tank and making some changes in programming we can use this robot as firefighting robot.
- We can extend this project with wireless technology by IR (or) RF (or) ZIGBEE.
- We can use the DTMF receiver by using the mobile phone.
- This robot can be used for pick and place the required object by giving directions to the robot, but ultrasonic sensor should be replaced depending upon the application

5.3 Future works: To enable robots to be able to adapt to its environment is an important domain of robotics research. Whether this environment be underwater, on land, underground, in the air or in space.

A fully autonomous robot can

- Work for an extended period without intervention f power supply.
- Avoid situations that are harmful.
- Move either all or part of itself throughout its operating environment.

The most effective method to increase the accuracy of my robot is the inclusion of better sensors, although the project cost might increase but the accuracy will increase as well as the problem space where the robot can be used. Better actuators and more efficient robot.

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