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# Simulation of Obstacle Avoidance Robots

**Mukhtar Ibrahim Bello[1], Muhammad Ahmad Baballe[2*]**
[1]Department of Computer Science, School of Technology, Kano State Polytechnic, Kano, Nigeria
[2]Department of Computer Engineering Technology, School of Technology, Kano State Polytechnic, Kano, Nigeria

**Abstract:** The first function of the system is to detect the presence of obstacles. When the user activates the system using the power ON/OFF switch, the Arduino microcontroller will read the data. When the ultrasonic sensor detects the presence of an obstacle in the process of moving forward, the robot will move backward. If the robot does not sense any obstacle, that is, if the distance between an obstacle and it is wide, it will then move forward again until it senses an obstacle before it stops. C programming is used for Arduino board applications to develop the program for the whole system's operation. There are three light-emitting diodes; the first one shows the amount of charge in the batteries, while the remaining two show that if the robot is moving forward, one of the two LEDs will be on, and if it is moving backward, one of the LEDs will also be on. There is also a power source unit that is used to charge the batteries used in the system.

**Keywords:** Simulation, Arduino Uno, Ultrasonic sensor, Robots.

**Research Paper**

***Corresponding Author:**
*Muhammad Ahmad Baballe*
Department of Computer Engineering Technology, School of Technology, Kano State Polytechnic, Kano, Nigeria

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## I. INTRODUCTION

Research on robotic navigation is starting to take off on its own. Experts in robotics began to develop a variety of free routes finding algorithms. Because the robot must be able to be securely controlled from the starting point to the objective (destination), the navigation system is seen to be of utmost importance. The robot must be able to avoid obstacles or, to put it another way, not run into them. This is the first of two aspects that function as a guide. Second, the robot must constantly ensure that it reaches its objective (target). The difficult part is deciding one of the various travel options to choose. In reality, a driver is frequently still plagued by uncertainty when making decisions, like in the example above. If this is implemented in a mobile robot (autonomous robot), it will be quite intriguing. If these issues are applied to autonomous mobile robots with obstacles that the robot must avoid, new issues can be created from simple ones like these. A mobile robot's need to be able to recognize obstacles and decide how to avoid them would lead to complicated issues, not to mention the fact that the main target (goal) can vanish from the camera's field of vision. All of that necessitates an extremely challenging computing procedure. Since the sensor that will be used is a camera sensor, the light intensity is a factor that must also be taken into consideration. The aforementioned elements will make it challenging for the robot to reach its destination. Many studies have been conducted on obstacle avoidance, beginning with the presentation of fuzzy algorithms for reactive navigation for mobile robots in complex situations [1- 61]. According to this study, fuzzy logic is fairly effective and responds quickly to challenges. Only static impediments in the robot's workspace are addressed in this study; moving obstacles brought on by moving objects are not taken into account. This study only focused on static obstacles that unexpectedly appeared, but model-based predictive controller (MBPC) using neural networks and ultrasonic sensors is also used to navigate mobile robots around static obstacles that unexpectedly appear in their workspace [62- 77]. Motion planning and mobile robot pathways using the Dynamic Artificial Neural Network (DANN) method [78- 80]. A mobile robot can be guided by this research around both static and moving obstacles on a level surface. Generalized Dynamic Fuzzy Neural Networks (GDFNN), a combination of the neural network and fuzzy methods, were used to design real-time control autonomous mobile robots in order to further improve the robot's ability to overcome obstacle avoidance [81]. The experimental results demonstrate that GDFNN performs better than traditional fuzzy logic control. Additionally, some people use Reinforcement Learning with Neural Networks (RLNN) to solve the obstacle avoidance issue for mobile autonomous robots [82]. The outcomes of the simulation demonstrate that the robot may enhance its capacity for learning and can carry out the tasks set forth in a complicated environment [89- 92].

Researchers are beginning to innovate by fusing camera sensors with lasers to detect impediments in real-time. This kind of sensor can accurately identify two- and three-dimensional objects [83]. Stereovision systems were created based on a combination of omnidirectional cameras and perspective cameras, even in more recent research [84]. This method uses a long field of view from a perspective camera and a 360°C field of view from an omnidirectional camera to estimate the positions of obstacles in three dimensions. In earlier investigations, a number of vision system implementations based on color sensors [85], camera sensor Pixy 2 CMUcam5 [86], and thermal cameras [87], were examined. The experiments mentioned above produce excellent results, specifically real-time obstacle detection. However, no movable barriers were employed in the earlier studies. The objective of this study is to create a moving obstacle avoidance technique. This project will create an autonomous mobile robot based on previous research that can navigate on its own to avoid moving impediments brought on by environmental changes in the robot's working environment. Two webcams are utilized as stereo vision sensors to identify the environment. Pedestrians are employed as obstacles because their upper bodies can be detected. This object was chosen since the actual environment is where the robot is working. In order to send the robot to the target (destination), the intelligence technique as a control system must be able to deal with the issue of moving impediments in the work area. Neuro-Fuzzy is the control system that is utilized to avoid obstacles. With this investigation, a three-wheeled omnidirectional robot was used with the anticipation that it would be able to navigate obstacles with ease and flexibility. In order for the mobile robot to arrive at a predetermined target (goal), it is necessary to design a robot behavior that has the ability to identify the target object, the ability to detect moving obstacles and make decisions to avoid them flexibly. The robot will use these actions to navigate. The robot is guided from its starting position to its destination using stereo vision and the Neuro-Fuzzy algorithm. Omnidirectional robotics and the Neuro-Fuzzy algorithm are used to help the robot recognize impediments and make decisions that the robot will avoid in order to improve its capacity to deal with changing surroundings. This research focuses on robot navigation systems, which include locating the target (destination), which is considered to always be in the robot's line of sight, identifying obstacles and dodging them, and generating flexible and fluid movements. Pedestrians, who are detected using upper body detection, are the obstacle items used. The robot uses a corridor and an indoor chamber that are each 4 meters long and 4 meters wide as its workspace. Since the robot does not follow a path when walking, this study is not concerned with covering the smallest distance. The goal of this project is to create a stereo vision-based navigation system to assist omnidirectional mobile robots in avoiding obstacles. The suggested approach makes use of the Neuro-Fuzzy algorithm to generate a barrier-free path in real-time and direct the robot's movement so that it is adaptable and fluid. Designing a robot behavior that can recognize the target object, detect moving impediments, and make flexible judgments to avoid them is important in order to direct the mobile robot to reach a predefined location. Examining the robot's navigational behaviors is the aim of this study. As demonstrated, this study increases the state- of the-art in obstacle avoidance based on the visual sensor for robot navigation systems by using a stereo camera to detect a target and obstacles as input to ANFIS. There are two main parts to the research methodology for this paper. The first stage is to develop a method for controlling the linear and angular velocity of autonomous mobile robots [88].

### II. HOW TO CREATE A ROBOT THAT AVOIDS OBSTACLES USING ULTRASONIC SENSORS

Before building the robot, it is essential to understand how the ultrasonic sensor works because it will be essential in spotting obstructions. Keeping track of how long it takes to broadcast ultrasonic beams and how long it takes to receive them after they have impacted a surface is the basic principle underlying how an ultrasonic sensor works. The formula is then used to calculate the distance. The trig pin of the HC-SR04 is therefore set high for at least 10 us. To transmit a sound beam, eight pulses at a frequency of 40 kHz are used. The signal hits the surface and bounces back, landing on the HC- SR04's receiver echo pin, where it is subsequently picked up. The Echo pin was already very high when the message was sent [94- 95].

## III. MATERIALS AND METHOD

***3.1. The materials used in this research are shown in Table I below.***

**Table I: materials used in this research**

| S/N | Name of components | Number used |
|---|---|---|
| 1 | Arduino Uno | 1 |
| 2 | Ultrasonic sensor | 1 |
| 3 | 5 volt DC motor | 2 |
| 4 | LM298N Motor Driver Module | 1 |

***3.2. METHOD***

This section of research handles the operation of the whole system. The first function of the system is to detect the presence of obstacles. When the user activates the system using the power ON/OFF switch, the Arduino microcontroller will read the data. When the ultrasonic sensor detects the presence of an obstacle in the process of moving forward, the robot will move backward. If the robot does not sense any obstacle, that is, if the distance between an obstacle and it is wide, it will then move forward again until it senses an obstacle before it stops. C programming is used for Arduino board applications to develop the program for the whole system's operation. There are three light-emitting diodes; the first one shows the amount of charge in the batteries, while the remaining two show that if the robot is moving forward, one of the two LEDs will be on, and if it is moving backward, one of the LEDs will also be on. There is also a power source unit that is used to charge the batteries used in the system.

### 3.2.1. Arduino Uno with Driver Motor

This is the pin configuration of how the Arduino Uno is connected with the motor driver, which is used to turn on the motor.

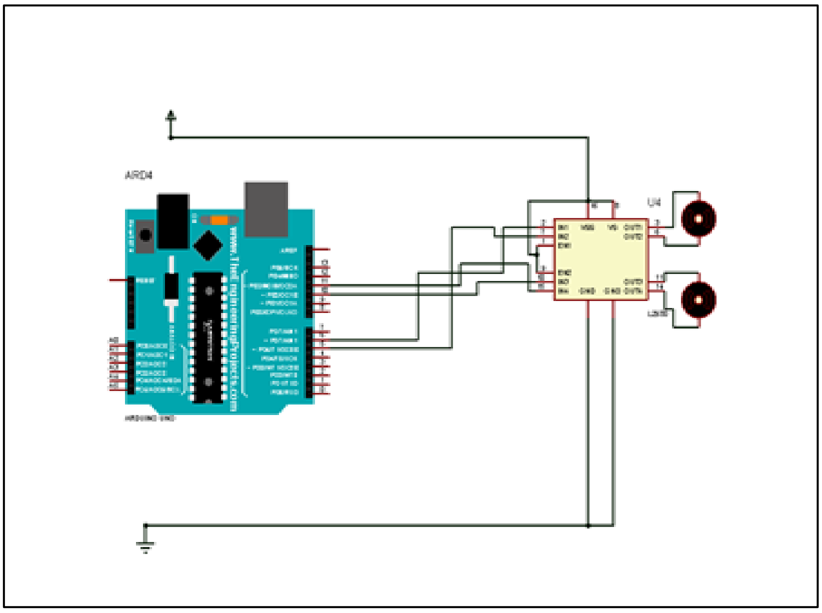


**Figure 1: Pin configuration of the Arduino and driver motor**

### 3.2.2. Pin Configuration of the Arduino with Servo Motor

The below diagram shows how the Arduino Uno is connected to the 5-volt servo motor. The ultrasonic sensor is mounted on the servo motor. This motor helps rotate the sensor to detect obstacles.

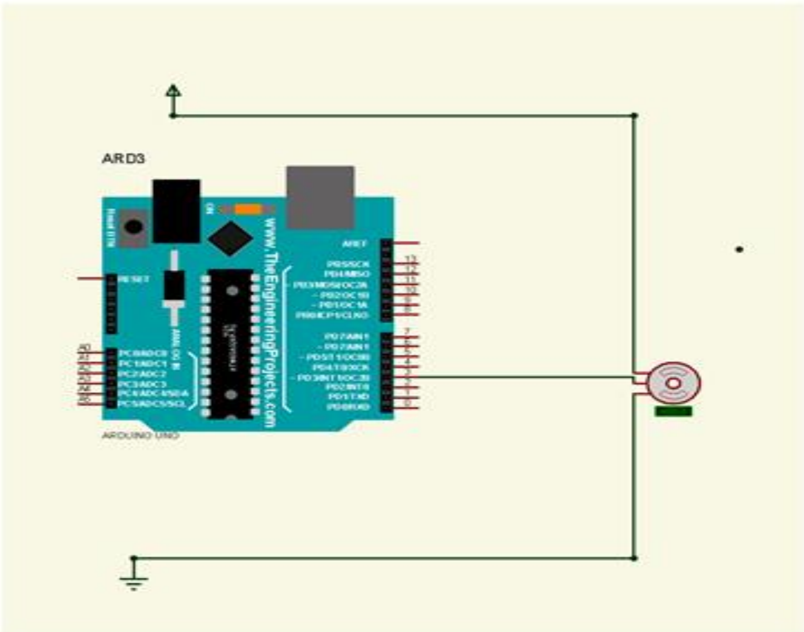


**Figure 2: Pin configuration of the Arduino to 5v dc motor**

**3.2.3. Pin Configuration of the Arduino to Ultra Sonic Sensor**

The image below shows how the pin of the Arduino Uno is connected to the ultrasonic sensor. This ultrasonic sensor is used to detect an obstacle that is in front of the robot.

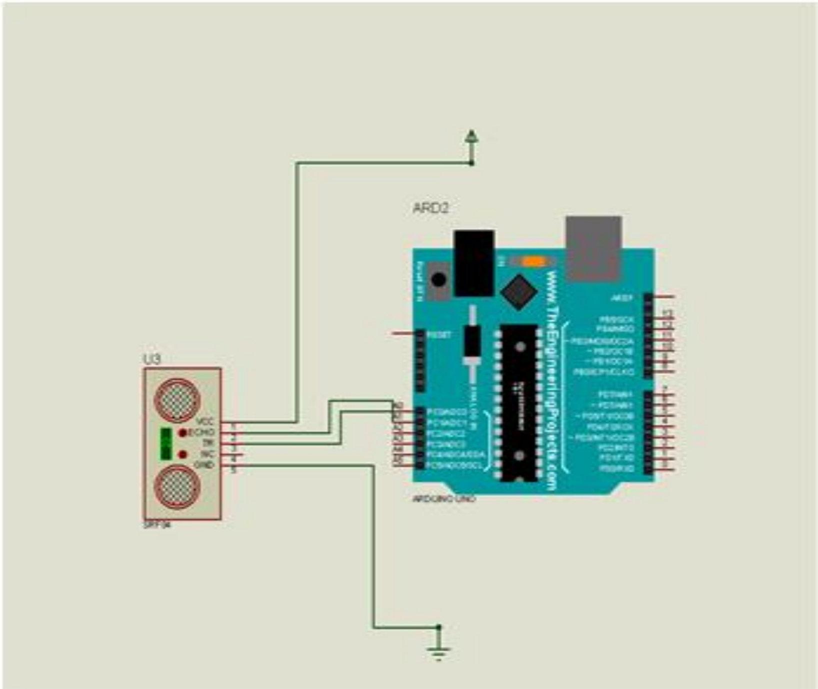


**Figure 3: Pin configuration of the Arduino to the ultra-sonic sensor**

## IV. RESULT

The simulation result is obtained and also shows the whole circuit implementation of the obstacle avoidance robot. The program was written in the Arduino IDE integrated development environment and debugged from the C language into machine code (a hex file). It is then simulated on the PROTEUS ISIS professional and tested. The program was found to be working successfully with some minor errors, which were corrected before the completion of the project. The casing was made using plastic rubber, based on a dimension, and joined using gum rubber.

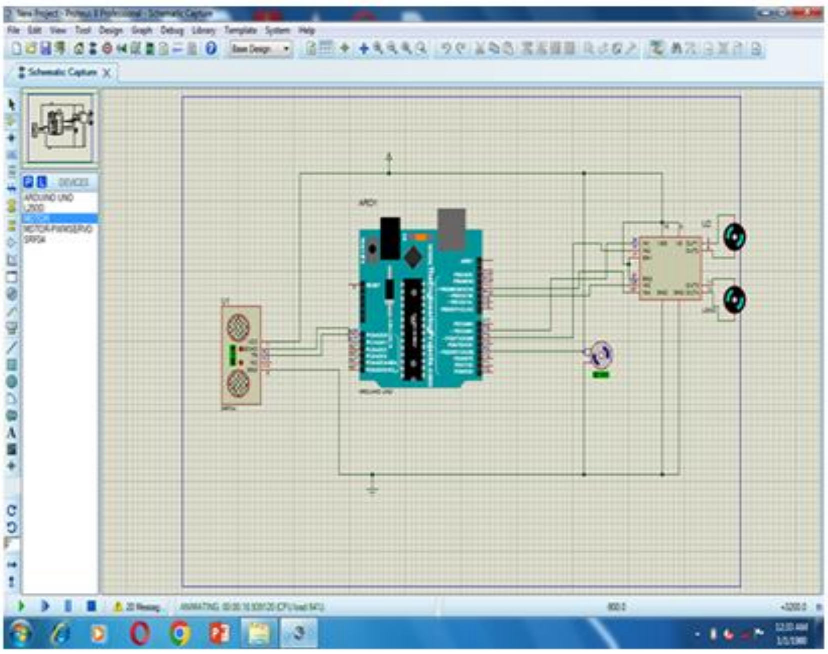

**Figure 4: Simulation result of the whole system**

## V. CONCLUSION

This research has been successfully completed and tested. The obstacle avoidance robot was tested to sense the presence of an obstacle. Whenever this robot senses the presence of an obstacle, it will move backward until it is far away from the object it senses, then it will move forward again towards this object. This device is useful, and it finds application in diverse areas of life.

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