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Review Article

The Several uses for Obstacle-Avoidance Robots

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Abstract

The intelligent device known as the Obstacle Avoiding Robot can detect impediments in its path automatically and steer clear of them by turning in a different direction. The essential necessity for any autonomous mobile robot is the ability to avoid collisions, which is made possible by this design. The obstacle-avoiding robot has a wide range of uses and is currently employed by the majority of military organizations, helping to complete numerous dangerous tasks that no soldier could perform. The issue of obstacle avoidance in mobile robot navigation systems is discussed in this work. The robot needs to be controlled from its starting place to its destination without colliding with anything; hence the navigation system is seen to be of utmost importance. The robot must be able to navigate hazards and get where it is going. This study aims to examine the robot's navigational behaviors in order to avoid obstacles.

Keywords: Artificial Intelligence; Stereo Vision; Navigation; Obstacle Avoidance; Omnidirectional Robot.

INTRODUCTION

Robotic navigation research is beginning to take on a life of its own. Robotics experts started to create a number of free paths finding algorithms. The robot's navigation system is regarded as being extremely crucial since it must be able to be securely controlled from the starting point to the target (destination). There are two elements that serve as a guide: the first is safety, where the robot must be able to avoid obstacles or, to put it another way, not run into them. Second, the robot must always make sure to reach its goal (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]. Stereo-vision 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. This study's goal is to examine the robot's navigational behaviors. By using a stereo camera to detect a target and obstacles as input to ANFIS, as shown, this study advances the state-of-the-art in obstacle avoidance based on the visual sensor for robot navigation systems. The research technique for this work is divided into two primary sections. Building a technique to control the linear and angular velocity of autonomous mobile robots is the initial step [88].

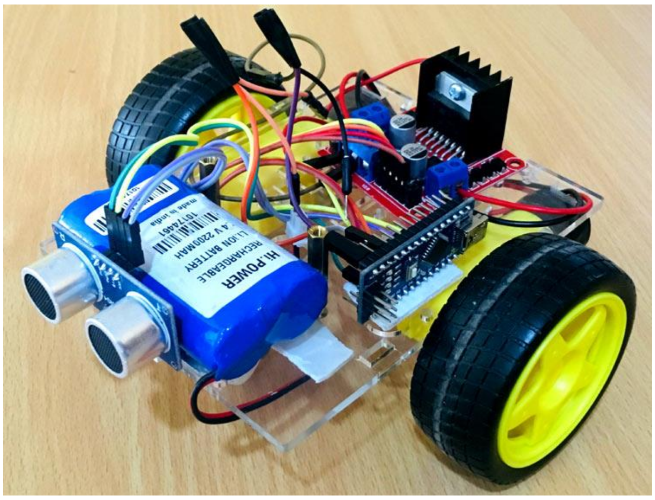

Fig._1: Obstacle avoidance robot

HOW TO CREATE A ROBOT THAT AVOIDS OBSTACLES Using Ultrasonic Sensors

It is crucial to comprehend how the ultrasonic sensor functions before beginning the robot's construction because it will play a crucial part in identifying impediments. The fundamental idea behind how an ultrasonic sensor operates is to keep track of how long it takes the sensor to broadcast ultrasonic beams and how long it takes to receive them after they have struck a surface. The distance is then determined using the formula. As a result, the HC-SR04's trig pin is set high for at least 10 us. Eight pulses at a frequency of 40 kHz each are used to transmit a sound beam. The receiver echo pin of the HC-SR04 then picks up the signal after it hits the surface and bounces back. When the message was sent, the Echo pin had already risen high [94].

The several uses for obstacle-avoidance robots

1. Almost all mobile robot navigation systems can make use of obstacle-avoiding robots.
2. They can be employed for domestic chores like automatic vacuuming.
3. Additionally, they can be employed in hazardous conditions where human penetration might be lethal.

CONCLUSION

According to the research, the distance measurement method is accomplished by dividing the baseline and focal length by the distance between the midpoints of the two frames. It's crucial to increase the precision of distance measurements to obstacles and targets in order to support the capacity for obstacle avoidance. The maximum measurement error for an obstacle is 3.40 percent when the obstacle distance is 250 cm, whereas the largest measurement error for a target is 1.39 percent when the target distance is 180 cm. When the target distance is 80 cm or 240 cm, the measurement error is 0.00%, whereas the measurement error for the obstacle distance is 0.00% when the obstacle distance is 190 cm. When the robot recognizes a target item based on the target angle and angle delta data, where these values are processed by ANFIS to generate angular velocity, the robot's trajectory will change. Throughout multiple testing, the robot's heading toward the target's least value was 0.03 degrees. When the robot senses an obstacle, it moves to the right or left, depending on the speed of Vy, which is determined by processing the object's distance and angle. The advantages of robots that avoid obstacles are highlighted.

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