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Path Optimization Robot

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Abstract: ***Path optimization robots are the obstacle avoider robot which can perform preferred task in an unknown environment by finding and overcoming obstacles in their path without continuous human interferences. In Robotics, obstacle avoidance is a task of satisfying some control objective subjected to non-intersection or non-collision position constraints. The obstacle avoidance robot is considered to be distinct from other path deciding robots.***

In this paper, Robot senses any obstacle automatically and diverts its position to right and follows a suitable path. Ultrasonic sensor is used to sense the obstacle. The two basic parts for working with the Ultrasonic are the echo and trigger. It consists of two motors, which controls the side pair wheels of each and help in moving forward and backward direction. Once the obstacle is sensed in its path through ultrasonic sensor, then the robot diverts its path depending upon the obstacle size and distance between the robot and obstacle. When the obstacle size is small robot takes deviation coming close to obstacle whereas when the obstacle size is big it takes deviation far from the obstacle and reverts to its main path. Such that if a destination is fed to the robot then it can map the whole terrain and can reach its destination by deciding a suitable path and avoiding obstacle.

Keywords: Autonomous Robot, ARM 7 microcontroller, Ultrasonic Sensor, Camera, Obstacle avoidance.

I. INTRODUCTION

Today, the use of self-governing robot vehicles is growing rapidly in various applications such as manufacturing, hazardous materials handling surveillance, etc. An autonomous Robot (driverless, self-driving, robotic vehicle) is a vehicle that can sense its environment and navigating without human input. Autonomous Robot are tackles that can reach the target with set of instructions. An autonomous Robot allows to reach the desired destination using obstacle detection. One of the major problem in robotics is the Robotic Path Planning. It's difficult is to optimize the path and avoid the obstacle in its desired path. So, here we have implemented a Path Optimization Robotic Vehicle which can be used to sense the obstacle and take deviation from the actual path based on object size and distance and reach its target without any disturbance. Ultrasonic sensor is used for sensing and finding the distance between the obstacle and the Robot. Such that d destination is fed to the robot and the robot can map the whole terrain and can reach its destination by deciding a suitable path and avoiding the obstacle.

II. EXISTING SYSTEM

Today, there have been a number of successful attempts in designing obstacle avoiding robots. These works differ by selection of sensors, path mapping process and the algorithms applied to set the operational parameters. There have been numerous projects in this arena using laser scanner, infrared sensor, GPS and multiple sensors to accomplish obstacle detection and avoidance. Researchers are persistently trying to

find more precise ways to develop autonomous robot or vehicle movement technology. In obstacle detection, the selection of sensor is vital for the required application of the robot, otherwise it might fail to operate even though all hardware and software are working properly. For example, a robot with optical sensors in a room with glass walls might create more collisions than avoidance. Hence sensors should be selected in accordance with the characteristics of the obstacles [1]. The robot generates a collision free path from a grid map using wave front algorithm. The robot developed uses ultrasonic sensors to detect obstacles in real time and requires no path planning. Its processing unit is based on the Arduino platform. The Autonomous Surface Vehicle (ASV) [5] is employed a single-beam mechanically-scanning profiling sonar to detect obstacles under water. The profiling sonar can produce cone-shaped beam which is ideal for detecting near surface obstacles. One of the objectives of the work was to investigate the suitability of using sonar near the water air boundary for which the study found promising results. Although similar detection technology is used, our robot is designed to work on the ground and detect obstacles above the surface.

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 [2] [4]. Their obstacle detection also includes a combination of global and local avoidance. The strengths of an image and an ultrasonic sensor to detect objects and measure its size. Detection of 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 [2]. The obstacles are detected using depth map image and morphological operations are used to remove the noise present in sensor data. This algorithm is used for obstacle detection and distance measurement using stereovision [6]. The Particle Swarm Optimization (PSO) based obstacle detection algorithm is proposed to determine the path for cleaning robot. A grid-based scenario with both static and mobile obstacles are considered to determine the path. The proposed work is simulated in MATLAB 2013b. From the results obtained it is inferred that the algorithm is validated for both cluttered and uncertainty environment, which enable to bypass the obstacles. It also ensures that the destination is attained by selecting the path without the obstacles [7].

III. PROPOSED SYSTEM

The optimization robot is a autonomous machine that can perform task automatically or without any external guidance. Robotics is generally a combination of computational intelligence and physical machines (motors). Computational intelligence involves the programmed instructions. This paper proposes a robotic vehicle called as “Path Optimization Robot” has an intelligence built in architecture, such that it guides itself whenever an obstacle comes ahead of it. The robot is built using an ARM 7 microcontroller. Ultrasonic sensor(HC-SR04) is used to detect any obstacle ahead of it also measures the distance between obstacle and the robot and sends a command to the microcontroller. Camera is used to capture the obstacle image in its path. After capturing the image, information is send to the ARM 7 microcontroller. Depending on the input signal received, the microcontroller redirects the robot to move in an alternate direction by actuating the motors interfaced to it through a motor driver IC (L293d H-Bridge) depending upon the size of the obstacle and distance between obstacle and the robot. The robot takes the deviation based on size of obstacle such that when the obstacle size is small robot takes deviation coming close to obstacle whereas when the obstacle size is big, it takes deviation far from the obstacle and reverts to its main path.

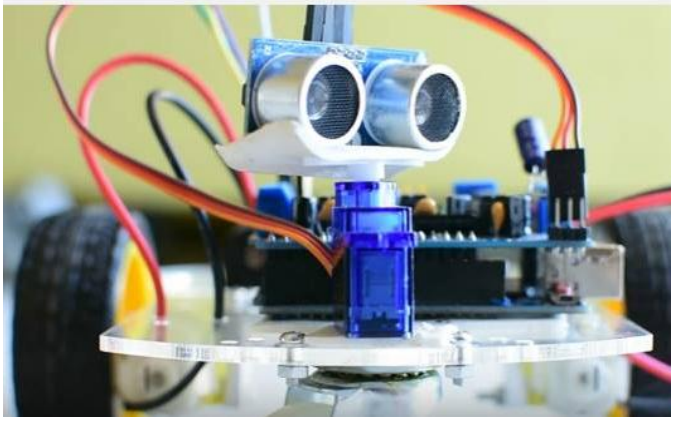

Figure 1: Proposed obstacle avoidance robot

OBJECTIVE

The robot developed in this project is expected to fulfil the following objectives:

- ✓ The robot would have the capacity to detect obstacles in its path based on distance and the size of obstacle.
- ✓ After obstacle detection the robot would change its relative open path by making Autonomous decision.
- ✓ It doesn’t require any external control during its operation.
- ✓ It can measure the distance between itself and surrounding objects in real-time.
- ✓ It would be able to operate effectively in unknown environment.

TECHNICAL APPORACH

- ✓ Ultrasonic sensor detects the obstacle and measures the distance.
- ✓ Camera captures the image of the obstacle.
- ✓ Setting up wireless communication between the computer workstation and the robot to transmit and receive information using Zigbee.
- ✓ The robot is programmed to receives the wireless transmitted motion commands from MATLAB for its motion.
- ✓ Information from ultrasonic sensor and MATLAB are given to ARM 7 microcontroller.
- ✓ ARM 7 controller redirects the robot depending upon the received input signal such as the obstacle size and distance between object and the robot.

BLOCK DIAGRAM

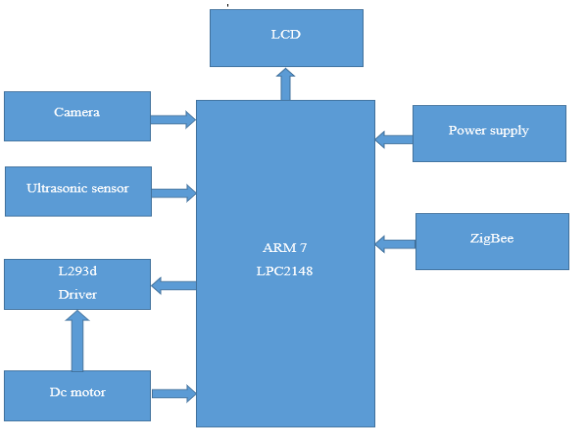

Figure 2: Block diagram of the obstacle avoidance robot

IV. WORKING

The obstacle avoidance robot which detects obstacles and correspondingly changes its direction to avoid collisions. The Arm 7 microcontroller are used, and it is interfaced with an 16x2 LCD display and an Ultrasonic sensor. The 16x2 LCD display indicates the distance of the robot from the obstacle when the robot is in the range of 2 cm to 400 cm and it also displays the direction in which the robot will turn when it sees an obstacle. The Ultrasonic sensor (HC-SR04) are used to detect obstacles in the path. The ultrasonic sensor is used with Arduino, ARM, PIC, Raspberry Pie etc. Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence it is powered by 7805 voltage regulator. The Trigger and the Echo pins are both I/O pins and hence they can be connected to UARTs pins of the Arm 7 microcontroller.

To start the measurement, the trigger pin must be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it is getting reflected by any object the Echo pin goes high for a amount of time which will be equal to the time taken for the wave to return back to the sensor. The duration of time for which echo pin stays high, is measured by the MCU/MPU. It gives the information about the time period of the wave to return back to the Sensor. Using this information, the distance is measured between the obstacle and the robot.

The camera captures the obstacle image. All captured images are converted to grayscale images, because the information quantity can be reduced to one third of colour images, and the colour information is unlikely to be vital in global environment. The edge of the image represents the outline of obstacles, and the surface and the shadow of obstacles have brighter or darker pixels. After calculating the distance and capturing the image of the obstacle, the information will be given to the Arm 7 microcontroller. The Arm 7 controller operates at 3.3v. The controller will decide the movement of the robot. Depending upon the area of the obstacles, the controller decides whether it's a small object or a big object. If the object sensed is small then the robot must take a nearer deviation or if it's a big object, farther deviation has to be taken and it come backs to its actual path and reach its destination.

The above figure represents the working of an obstacle detector robot such that it will be moving in an unstructured environment. If there is any obstacle in the path, then the robot stops and change its direction depending upon the obstacle size and the distance between the robot and the obstacle.

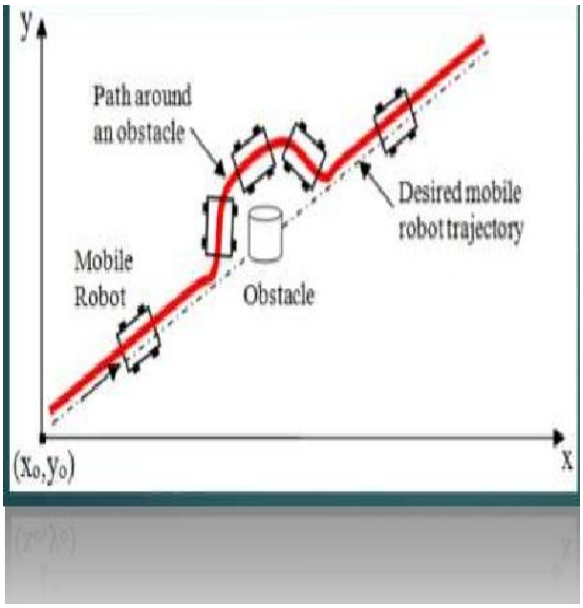

Figure 3: Working of Path Optimization Robot

STRUCTURAL OUTLINE

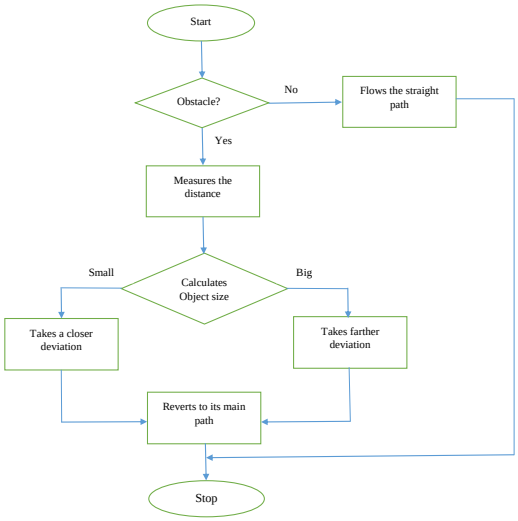

Figure 4: Sequential flow of obstacle detection robot

V. ADVANTAGES

- ✓ Robots movement is automatic so, they can move without any human interferences.
- ✓ Robots can perform the task faster than the humans and much more consistently and accurately.

- ✓ It is used for long distance applications and simplicity of building.
- ✓ The system in the robot is like once install and forget.
- ✓ They can be used in industries as automated equipment carriers.

VI. FUTURE SCOPE

- ✓ By adding temperature sensor, water tank and making few changes in algorithm we can use this type of robot as Fire Fighting Robot.
- ✓ Ultrasonic sensor can be designed even by using touch pads for obstacle detection, where the robot can start with a touch or voice detector.

VII. CONCLUSION

Path Optimization Robot is creation of an autonomous robotic arm that will choose a clear path by avoiding obstacles. It can be used in areas where human interference is not probable. Robots grabs information about their surroundings objects. With the help of the ultrasonic sensor the robot sense the obstacle in its path and depending upon the obstacle size the optimization robot will take the deviation. Such that obstacle avoidance plays an important role in an unknown environment to reach its destination.

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