

AUTONOMOUS REAL TIME OBSTACLE AVOIDANCE ROBOT USING RASPBERRY PI

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ABSTRACT – *In this research work, we present formal approach to real time obstacle avoidance by using multiple ultrasonic sensor which are collaborate with the raspberry pi. The purposed robot is capable to work in under unstructured environment. Designed robot is independent and not necessity of human interaction to drive the robot when obstacle is occurred in the path. Multiple ultrasonic sensor is useful to detect obstacle precisely with minimum time complexity. Raspberry pi is a single board computer which is used to develop robot using multiple ultrasonic sensors which having fast processing speed as compared to Micro-controller. If obstacle occurred in path of robot ultrasonic sensor provides distance of obstacle from robot to take the self-decision and avoid the obstacle. Purposed robot is capable to take self-decision to avoid obstacle and move to forward direction. Raspberry pi provides fast processing speed to controlled robot in unstructured environment.*

Key Words: Robot, Ultrasonic sensor, Obstacle, Raspberrypi, Micro-controller.

1. INTRODUCTION

Robotics is the most interesting research field to develop various types of robots such as semi-autonomous and autonomous. Autonomous robot does not need to any human interaction and it will work by using self-decision mechanism. Capability to avoid the obstacles in path it is the primary constraint to design autonomous robot which capable to work in under unfamiliar environment and precisely detect and avoid the obstacles. This robot is develop by using raspberry pi and it will provide fastest processing speed as compared to available micro-controllers. The purposed robot is designed by using multiple ultrasonic sensor to detect the obstacle and avoid the collision. Ultrasonic sensors are mounted over the robot. Ultrasonic sensor transfer ultrasonic wave continuously from the sensor head. If obstacle is occurred in the path of

robot then ultrasonic waves are reflect back from obstacle to robot and input signal is pass to raspberry pi to take actions according to input signals. Raspberry pi control the motor with the help of motor-controller with respect to left, right, forward and backward.

2. LITERATURE SURVEY

Robotics is a fast growing research field and autonomous robot having capability to work in unfamiliar environments without remote control or without any human interaction. [1] Ultrasonic sensor is most useful and low cost sensor to develop obstacle avoidance robot and it will work with the transmitter and receiver mechanism. [2] Ultrasonic sensor can give signal to micro-controller to take the decision such as left, right, forward and backward according to obstacles occurred in path of robot. [3] To development of obstacle avoidance robot is required collaboration of many sensors according to task of robot. [4] Raspberry pi is a single board credit card size computer which is used to design the robot and ultrasonic sensors are familiar with it to design obstacle avoidance robot. [5] Ultrasonic sensor is able to measures the distance from the ground to robot. Reflected pulses can be easily obtained by using constrained optimization. [6] In the robotics collision avoidance is the fundamental problem and it arrived at the context of autonomous robot navigation in unstructured environment which occupied with obstacles and need to continuous cycle of sensing the obstacles. [7] Reciprocal collision avoidance method is very useful to avoid the collision of robot with the obstacles. [8] Machine learning is applied to path planning of robot. Time variable grid method is used to avoid the obstacles. Based on grid method the new method is developed to detect obstacles in unfamiliar environment. This path planning method can be applied on computer games. [9] Design and development of low cost mobile robot to avoid the obstacles with the steering algorithm. Using steering algorithm there is no need to stop the robot in front of any obstacles. It will continuously avoid the obstacles and move towards the destination. [10] Successful navigation required accurate localization of robot in large unstructured environment. Robot Position parameters such as coordinate and orientation makes the state variable vector. Kinematic model is used to implementation of kalman filter which is useful to estimate the position of robot. [11] Obstacle detection and collision avoidance is very challenging task in unfamiliar

environment and to overcome this challenge use the sensor fusion technology to fuse the data of ultrasonic sensor and Kinect sensor. [12]

3. EXISTING SYSTEM

Many simple robots are developed in past decade and human can be controlled to robot by using remote controller. Human interaction is needed to navigate the robot in unfamiliar environment. In autonomous robot there is no need to human interaction and the robot working on self-driving mechanism to avoid the obstacles and move towards the destination.

4. PROPOSED SYSTEM

This research work proposed an autonomous real time obstacle avoiding robot in which no need of human interaction to control and drive it. This robot is capable to detect and avoid the obstacles in unstructured environment.

4.1 Basic Design of Robot

Raspberry pi board is use to develop the robot and the General Propose input output pin are connected with the DC motor through motor driver kit which supply power to actuators. Actuators are used to move the robot in different directions such as forward, backward, left and right with respect to given commands.



Fig -1: Raspberry pi Board

Raspberry pi is a single board computer having 40 pins. Raspberry pi work with 1 GB ram and 1.2 GHz quad-core processor which provide the fast processing speed. Brief description of pin connectivity to movement of robot is given in following table 1.

Table-1: GPIO Pin Description

| Movement | Pin23 | Pin24 | Pin4 | Pin17 |
|----------|-------|-------|------|-------|
| Left | 1 | 0 | 0 | 1 |

| | | | | |
|----------|---|---|---|---|
| Right | 0 | 1 | 0 | 1 |
| Forward | 1 | 0 | 0 | 1 |
| Backward | 0 | 1 | 1 | 0 |

4.2 Ultrasonic Sensor

Ultrasonic sensor is used to design of real time obstacle avoidance robot. This sensor working with frequency and it will continuously emit the frequency in front of robot to detect the obstacles. When obstacle occurred in the path of robot the frequency signal reflected back to receiver which consider as the input signal to raspberry pi for processing.



Fig -2: Ultrasonic Sensor

Vcc pin of Ultrasonic sensor are connect to 5v power pin of raspberry pi, Trig pin is connect to input pin of raspberry pi, Echo pin is connect to output pin and Gnd pin is connect to Ground pin of raspberry pi. Range of Ultrasonic sensor signal is 2 cm to 200cm and trigger pulse with is 10us.

4.3 Algorithm-Working Principle

Ultrasonic sensor work with transmission and receiver, transmitter transmit the ultra-sonic wave in front of robot and when obstacle occurred in the path of robot ultra-sonic wave reflected back and received by the receiver which is input to raspberry pi to take decision as per the received signals.

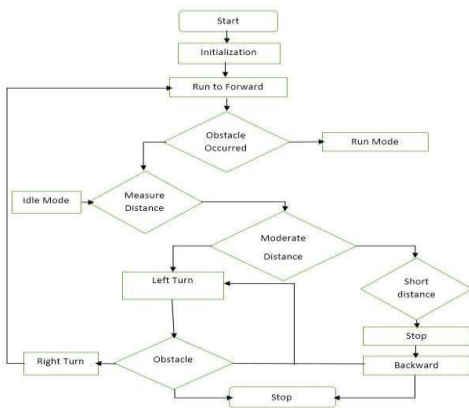


Fig -3: Flowchart of Obstacle Avoidance Robot

5. EXPERIMENTAL WORK

Proposed robot is implemented by using the raspberry pi with multiple Ultrasonic sensor. Raspberry pi having its own operating system which is Raspbian and it will give the fast processing speed as compared to micro-controller. In raspberry pi there is no limit of memory as like micro-controller and we run large programs using raspberry pi. Raspberry pi having 40 pin to attachment of motor driver kit and various sensors.

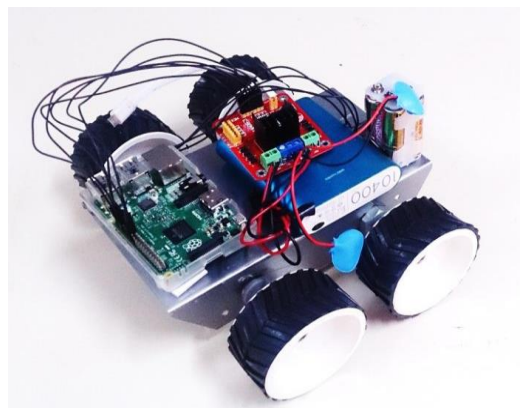


Fig -4: Raspberry pi Based Robot

Ultrasonic sensor are mounted over the robot to sense the environment. If there is obstacle ahead of robot this sensor gives signal to raspberry pi to take action according the signal such as left turn, right turn, forward and backward.

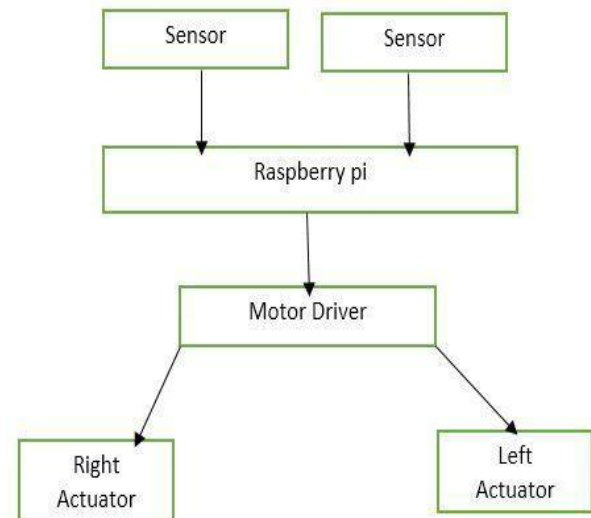


Fig -5: Block Diagram of Robot

Raspberry pi is an open source hardware platform to develop different systems and robots which support to python programming language. We use python programming language to design real time obstacle avoidance robot. We can easily write and run python program using raspberry pi which is single board computer.

6. CONCLUSION

We build a robot that capable to take self-decision and move in unfamiliar environment without any human interaction. Multiple ultrasonic sensors can detect the obstacles more accurately as compared to one sensor. Autonomous real time obstacle avoidance robot can detect obstacles accurately and take decision such as left, right, forward and backward to move the destination.

The work can be extended into design of multiple colored object detection robot and may be design of surveillance robot to monetization of environment.

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