

Autonomous navigation and obstacle avoidance with pick and place application

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Abstract : The project is designed to develop a system in which robot is used for pick and place application with the help of line following algorithm. This system includes three main parts which are electric circuit, mechanical design and programming. In this highly developing society, time and man power are critical constructions for completion of task in large scales. Autonomous navigation is to save human efforts in regular and frequently carried work. Essentially this robot uses multiple sensors to control the direction that has been lined with black taped on white surface. This system deals with implementing a pick and place robot using Arduino microcontroller. This robot have an ability to locate itself to the location where the object to be lifted is available with the help of chassis and dc motors which not only perform the movement of robot but also movement of robotic arm with the help of gripper it can hold the object from specified location and place it to desired location.

KeyTerms - Arduino microcontroller, IR sensor array, Motor driver IC, Robotic Arm gripper, Chassis, Ultrasonic sensor.

I. INTRODUCTION

In highly developing society time and man power are critical constrains for completion of tasks in large scales. The main benefits of using robots instead of human are they never get tired, they can work in physical conditions that are uncomfortable or dangerous. This system uses line following technology for mobility with control from microcontroller. In the industrial manufacturing sector pick and place robots have been used in variety of material handling application. The project is design to built an autonomous navigation of vehicle with pick and place application. For this system microcontroller Arduino uno is used to achieved the desired operation as a main control system. It is one of simplest and most easy to use. Detecting object with the ultrasonic sensor and then soft catching arm gripper is used to lift and place the object from specified location to desired location. Line following algorithm used to follow path. The path consist of a black line on white surface or vice versa. The sensor array senses the line drawn on floor. In pick and place line following robot hardware part as well as software programming are concurrently both improved. So the objective is to make a system which can carried load by following line to reduced physical effort in industry & to consume production time.

II. LITRATURE SURVEY

The project “line follower robot using a sophisticated sensor approach”, Ebieuwao, Adekunle perform in depth analysis on the adoption of color sensors to enable the robot to be able to detect the path in shortest possible time. The project “Design and construction of line following robot using Arduino ”Khin khin saw, Lae yin mon perform analysis on detecting black line to move over the white surface using Arduino. The research on robotics has been done to implementing this system. The study goes on mechanical working of Dc motor referred from K.S fu & R.C Gonzalez. To control robotics ,sensing, vision & intelligence details taken from C.S.G Lee. The study of working with DC motor include the selection of motor based on the required about the speed of the robot movement & weight to be carried and also power consumption. In this robotics system the motors used are having high torque & low speed because of it needs to carry some more weight of pick and place arm with it.

III. SYSTEM DEVELOPMENT

This project investigates the obstacle detection with pick and place application. This system is designed to develop a system in which robot eliminate error to get more precise work and also for cost effectiveness as well as reducing harm to the object. If any obstacle presets on the path the ultrasonic sensor detect the obstacle & robot will pick the object place it to the desired location. Here gripper consider as robotic arm is main part of the system. Which perform pick and place operation. Robot moves towards destination by using robot chassis.

LINE FOLLWER ROBOT

Line following robot is an automated guided vehicle, which follows a line drawn on the floor. Specifically the line is the path in which line follower robot goes and it will be a black line on a white surface.



Fig: Block diagram of line follower robot

IV. BLOCK DIAGRAM

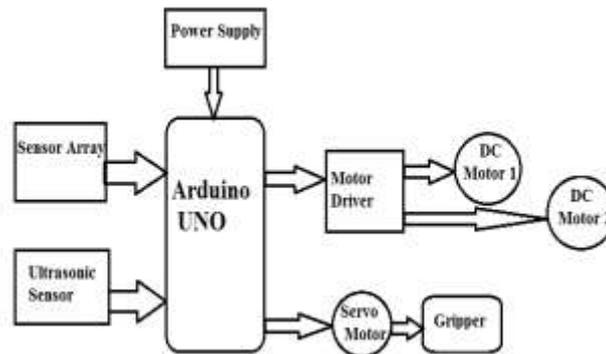
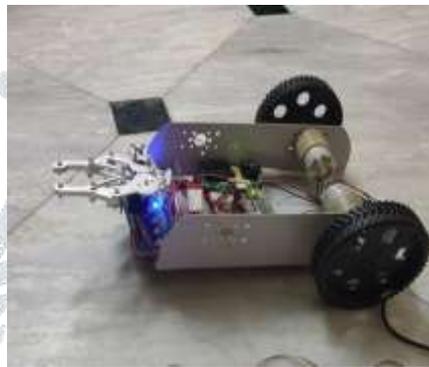


Fig: Architecture Diagram

V. WORKING

For implementing this system we have an infrared sensor array beneath the front of our robot. This IR sensor array senses the line & send voltage signal to analog to digital converter. The ADC send binary signal which comes from sensor array to microcontroller Arduino. For detecting obstacle we have used ultrasonic sensor. A ultrasonic sensor is placed in front of robot chassis. It senses the object which comes in front of it. Then after sensing object kept in front of it, ultrasonic sensor sends a signal to microcontroller & then microcontroller commands the wheel motor to stop. At the same time microcontroller send signal to servo motor to wake up and pick the object up by gripper.



Robot Body

VI. HARDWARE SPECIFICATIONS

For Autonomous navigation of vehicle communication with sensor, controller, motors should be established.

1. Arduino Uno

It is the most control unit of the robot. Arduino uno board designs use a variety of microprocessor and controllers. Arduino microcontroller processes all data and provides the particular command to the parts as it is ordered. Microcontroller boards are having sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. Universal Serial Bus (USB) is used for loading programs from personal computers to the board by using serial communication. The microcontrollers are typically programmed using features from the programming language C and C++. Program can easily be uploaded from computer through USB cable. It can be powered by both USB connection or external power supply.



Fig: Arduino Microcontroller

2. L293D Motor driver

Specifically Motor drivers are used to control the motor. This motor driver IC is required to power the motor. L293D is a simple 16 pin motor driver dual H-bridge integrated circuit (IC). This L293D motor driver IC acts as a current amplifier, because it takes a low current signal and provides a higher current signal. To drive the motors, higher current signals are used. Motor drivers are available in IC form and are implemented in the form of an "H-Bridge". From the microcontroller's output, the motor driver IC allows to switch the motor On/Off. An important feature is that they can allow the motor to rotate both in forward as well as in reverse direction. This means each motor has two dedicated inputs from a microcontroller, one for direction control and one as an ON-OFF switch. L293D contains two inbuilt H-bridge driver circuits. Two DC motors can be driven simultaneously, in common mode operation in forward or reverse direction.

3. Ultrasonic Sensor

Ultrasonic sensor helps our robot to react with the world. By using sound waves an ultrasonic sensor can measure the distance to an object. To calculate distance between obstacle and system first calculate time between sound wave generated and sound wave bounce back. Here, we have calculated the possible distance in between ultrasonic sensor and obstacle. Whenever the robot will follow the path one time will come at which the calculated distance will matched with obstacle and that result will be sent to arduino for further operation.



Fig: Ultrasonic sensor

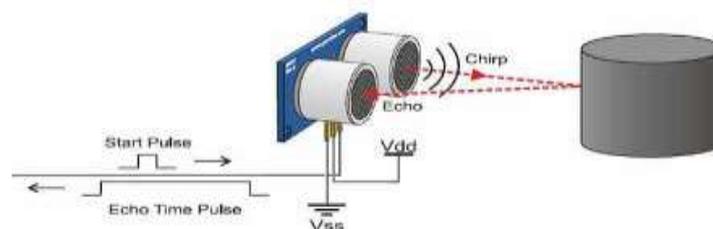


Fig: Working of ultrasonic sensor

4. IR Sensor Array

IR Sensor array contain 8 IR LED and 8 IR sensor also it has two mode of output

- 1) Analog output(direct analog data from IR sensor)
- 2) Digital output(using linear voltage comparator with potentiometer)

Line following robot senses black line by using sensor and then sends the signal to Arduino. According to sensors output the arduino drives the motor. If the left sensor comes on a black line then the robot turn on left side. If the right sensor sense black line then robot turn towards right side.



Fig : IR Sensor array

5. Robotic Arm Gripper

A Gripper can hold objects, handle and release the object as like human hand. A gripper is the component of an automated system. A gripper can attach to a robot or it can be a part of a fixed automation system.



Fig : Robotic Arm Gripper

VII. ADVANTAGES

1. To reduce human effort in industries.
2. It increases consistency in its work.
3. To increase productivity with time management.
4. They are able to work without taking breaks or making mistakes.
5. Reducing damages for object.

VIII.APPLICATIONS

1. Industrial automated equipment carriers.
2. Automated cars
3. Deliver medication in a hospital
4. Shopping malls
5. Material Handling
6. Hazardous Environment
7. Industries
8. Placing of books in library
9. Agriculture

CONCLUSION

The autonomous robot will help in factories, industries to reduce labor and cost of carrying objects. Hence, the aim of this project is to design a system which can perform task of carrying object, from source to destination with line following application. The robot will carry certain amount of load it will be useful in industry, library, home application, super market and health care system. Most importantly autonomous robot will save time is the main factors for rapid production. Now a days time and man power are main constrains for completion of a task. By using this system industrial activity and hazardous operation can be done easily and safely in short time. It is capable of lifting weight by using high torque motor.

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