



Modelling of Obstacle Avoidance robot using LABVIEW

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Abstract: The increased demand of current industry for efficiencies and safety has led to a greater need for people with an added expertise in the field of 'Robotics & Automation'. Robotics & Automation is nothing, but design, construction, operation, and application of robots added with computer-based control systems, sensory feedback, and information processing. The design of a robotic system is combination of principles of electronics, mechanical and computer knowledge. The aim of robotics is to design intelligent system that can help and assist humans in their day-to-day lives and stay everyone safe. Robot will do tasks where human cannot work efficiently, in order to achieve this kinematic model of moving wheeled robot with consideration of obstacles using visual programming language LabView has been used.

Keywords: LabView, Python, Sensor, ADXL,

I. INTRODUCTION

Robotics and automation is one of fastest growing technology in past few decades. mobile robots is the possibility to use them in extreme conditions where the residence of people is dangerous or impossible such as inspection of radioactive materials, bomb detection and deactivation, mining processes, or where humans cannot survive in environment like in space, underwater, in high heat area, and clean up and residual of hazardous materials and radiation. The purpose of development of mobile robot involves research aimed at expanding technological capabilities of mobile robots in an uncertain environment by increasing their intellectual abilities. For the effective functioning of mobile robots, it is necessary to design accurate model of a motion control system that performs assigned work and allow making proper decisions in uncertain situations

II. SYSTEM DESIGN

Software Used

- A. LabView
- B. Python

Hardware Used

- A. Power Supply
- B. Arduino
- C. motor driver
- D. Ultrasonic Sensor
- E. ADXL
- F. RF module

Software Used:

A. LabView

LabVIEW is software provided by National instruments which offers graphical programming approach to visualize every aspect of system. which includes programming and hardware components used in system, this also helps in debugging and testing of application. Here we have used LabVIEW for tracking path of robot and analysed it with predefined path using graphs.

B. Python

Python is fastest growing language with wide variety of applications. It is General-Purpose high-level programming language. It is basically Object-oriented language. It supports wide variety of libraries and applications .it is used in wide variety of platforms such as AI, machine learning and robotics. In this paper programming is done using python

HARDWARE USED:**A. Power Supply:**

We have used 9V batteries for Robot. Here we have used 5V/1A switch mode power supply with output regulation of 5v. It has standard USB connector to power Arduino

B. Arduino:

We have used 32 GB microSD card which will be able to write at 20 mbps. where we can store data, which will work for operating system.

C. Motor Driver-

We have used L298N motor driver module. This L298N Motor Driver Module is a high power motor driver module for driving DC Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator.

D. Ultrasonic sensor-

Here we have used ultrasonic sensor to detect obstacles coming on the way. For that we have used HC-SR04 ultrasonic sensor which has two eye like structure in the front which forms ultrasonic transmitter and receiver. this module gives 2cm-400 cm contactless measurement action with ranging accuracy of 3 mm. It has 4 pins such as VCC, trigger Echo and Ground respectively. Ultrasonic sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, raspberry pie etc. Function of this module is, ultrasonic transmitter transmit ultrasonic wave continuously in environment when this waves gets stuck by any object then it get reflected back towards the sensor this reflected wave is observed by receiver. distance between two signals is calculated by following formula

$$\text{distance} = (\text{time} \times \text{velocity of sound (340M/S)}) / 2,$$

E. ADXL:

Here we have used ADXL345 accelerometer sensor which gives us change in angle and direction with respect to x y z direction.

ADXL345 is 3-axis MEMS accelerometer module which can be interfaced with both I2C and SPI. it is also low power device having voltage regulation of 3.3v and level shifting which makes it easy to interface with devices such as 5v microcontrollers or Arduino. ADXL345 has 4 sensitivity levels which are ranging from +/- 2G to +/- 16G. ADXL345 supports output data rates between 10Hz to 3200Hz. it is well suited for mobile device applications. It also calculate static acceleration due to gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion or shock. It has high resolution up to 3.9 mg/LSB which enables measurement of inclination changes less than 1.0°.

F. RF module:

Here we have used RF modules which contains 433MHz transmitter and receiver modules. The transmitter consumes significantly low power in battery operation.

III. DEVELOPMENT OF CONTROL SYSTEM**Mathematical model of robot**

A differential drive robot is a two wheeled robot with two controllable wheels rotating about the single shaft. To start any differential drive robot in a plane, the robot needs a linear velocity V and angle θ for orientation.

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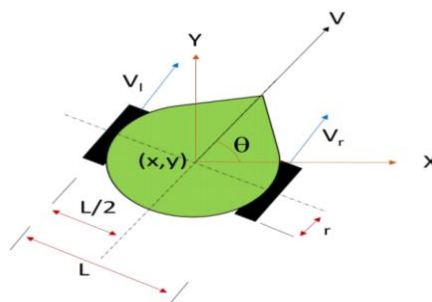


Figure 1.0.1: Differential Drive Mobile robot parameters.

the right wheel, V_l is the velocity of left wheel, L is the distance between the centre of the wheels, θ is the directional angle of the robot with respect to the reference coordinate system and r is the radius of the wheel.

The velocity of the robot is given by average of both velocities

$$V = V_r + V_l / 2 \quad (1.0)$$

As shown in figure, to move the robot in certain direction it needs velocity V and orientation θ .

With help of these parameters, velocity of left and right wheel is given to kinematic equation to find out linear and angular velocities of robot. with help of angular velocity, orientation is calculated, and these are fed back to make system close loop to increase stability

Kinematic equations of a mobile robot-

To find out rate of change of position of mobile robot in x -direction i.e X' is given by

$$X' = V \cos(\theta) \quad (1.1)$$

similarly, in Y direction with orientation angle θ is given by Y'

$$Y' = V \sin(\theta) \quad (1.2)$$

Thus, angular velocity is

$$\theta' = \omega = \frac{(V_r - V_l)}{L}$$

Substituting the linear velocity V from equation (1.0), in equations (1.1) and (1.2), modifies x' and y' as,

$$X' = \frac{(V_l + V_r)}{2} \cos(\theta) \quad (1.3)$$

$$Y' = \frac{(V_l + V_r)}{2} \sin(\theta) \quad (1.4)$$

The velocity V of the robot given by

$$V = \sqrt{x'^2 + y'^2}$$

From equations (1.3) and (1.4)

$$V = \sqrt{\frac{(V_l + V_r)}{2} \cos(\theta) + \frac{(V_l + V_r)}{2} \sin(\theta)} = \frac{(V_l + V_r)}{2}$$

The velocities, V_r and V_l can now be calculated using the equations

$$V_r = (V + \frac{L}{2} \omega)$$

$$V_l = (V - \frac{L}{2} \omega)$$

The outputs,

V_r and V_l can used to generate the output x' , y' and ω using equations.

By integrating the values, we get actual values for x , y and θ .

Controller gain is given by,

$$s.\Theta(s) = \Omega(s)$$

$$\therefore G(s) = \frac{\omega(s)}{\theta(s)} = \frac{1}{s}$$

Where transfer function $G(s)$ having zero steady-state error with proportional gain.

IV. PROPOSED SYSTEM

Flow Chart

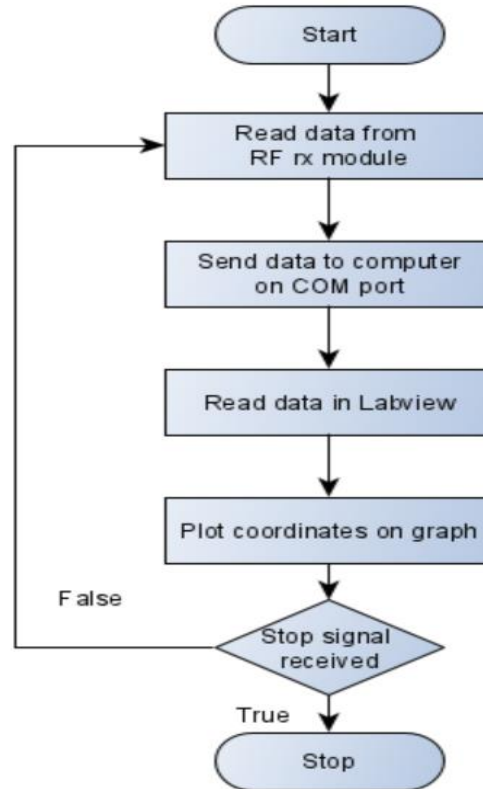


Fig. LabView side Flow chart

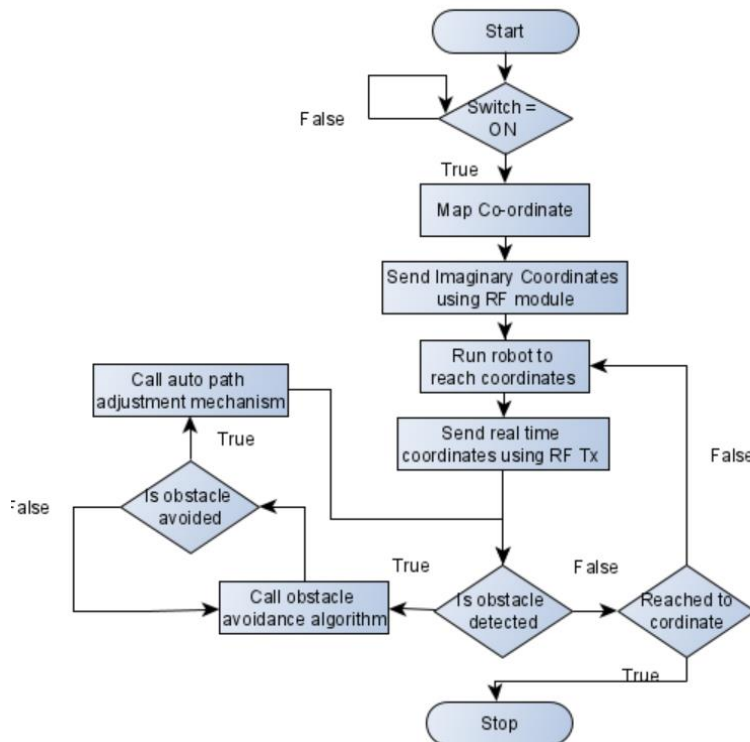


Fig. Robot side flow chart

This model allows investigating the movement of the robot in the task of achieving the specified coordinates, with the ability to set the start and end coordinates, the control coefficients of the linear and angular velocities even if it stuck to obstacles, In order to drive robot from one location to another with specified co-ordinates we have used Arduino and software called LabVIEW to get location of co-ordinates in form of graphs. when robot starts from one location towards destination it finds nearest co-ordinates in this process if robot faces any obstacle in between, with help of ultrasonic sensor it avoids obstacle and calls algorithm which will avoid obstacles and reaches to next co-ordinates to reach destination. To drive robot we have used Arduino, power supply with motor driver and ultrasonic sensor to avoid obstacle. All the processed data is transferred to LabVIEW by using RF receiver and Arduino. This data is then used to send location of robot co-ordinates. All processed data is then provided to LabVIEW through com port and path of robot with respect to x direct and y direct is captured. this Output of graph shows that robot follows algorithm and reaches destination with predefined path even when obstacles comes into path. with help of this we can achieve trajectory of robot in such areas where human cannot work efficiently

Final Setup of system-

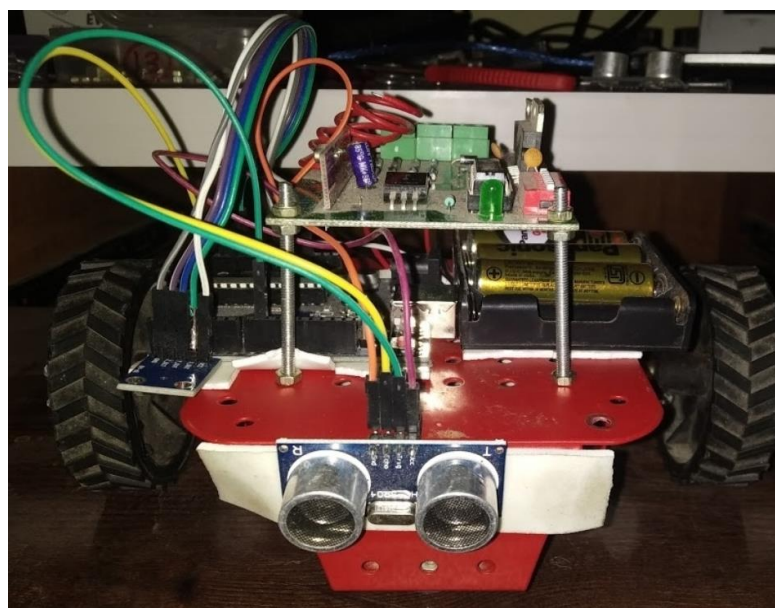
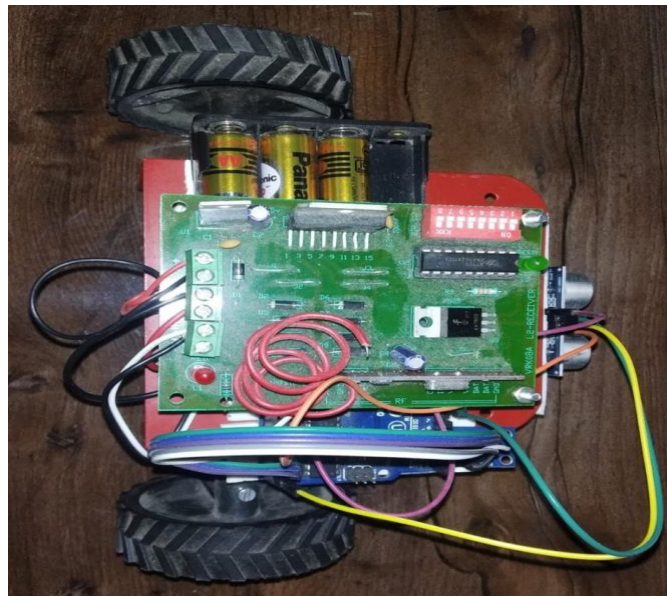
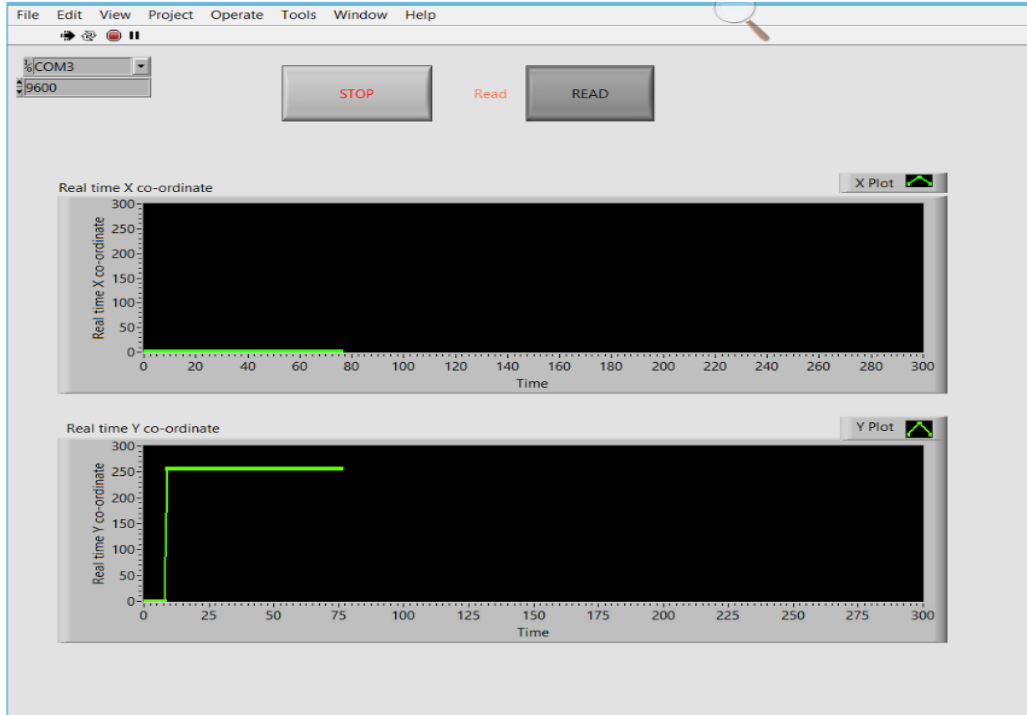


Fig. final set up of robot

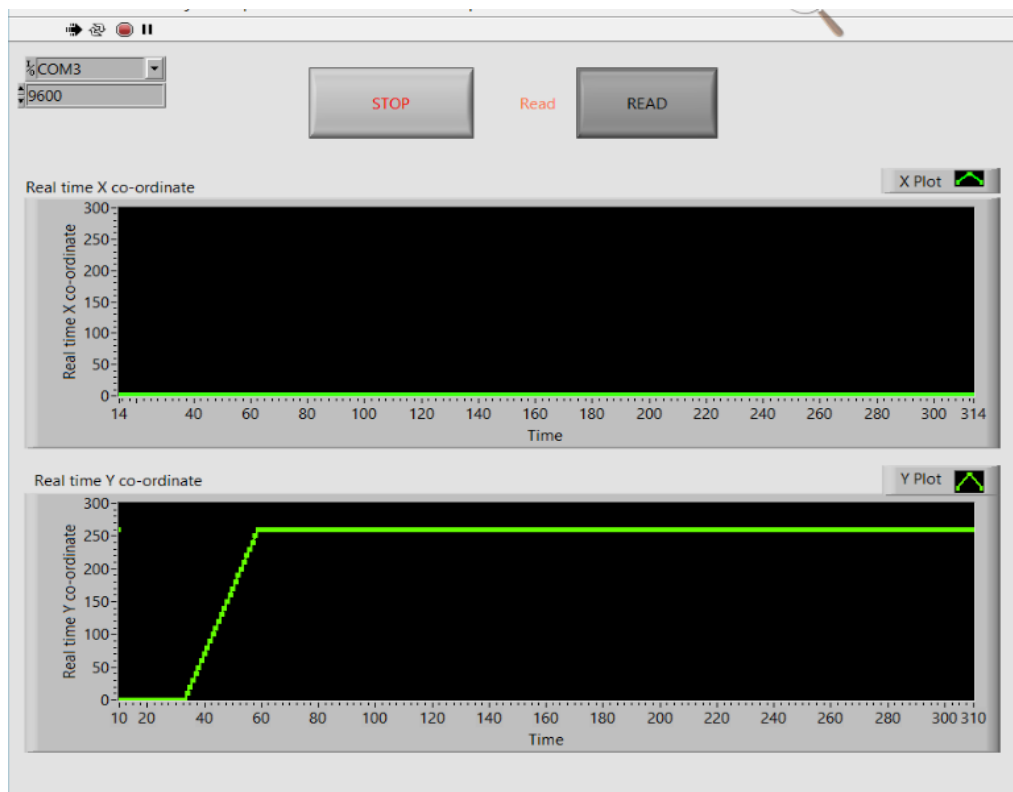
V. RESULT

Below graph show that robot movement from one co-ordinate to another.

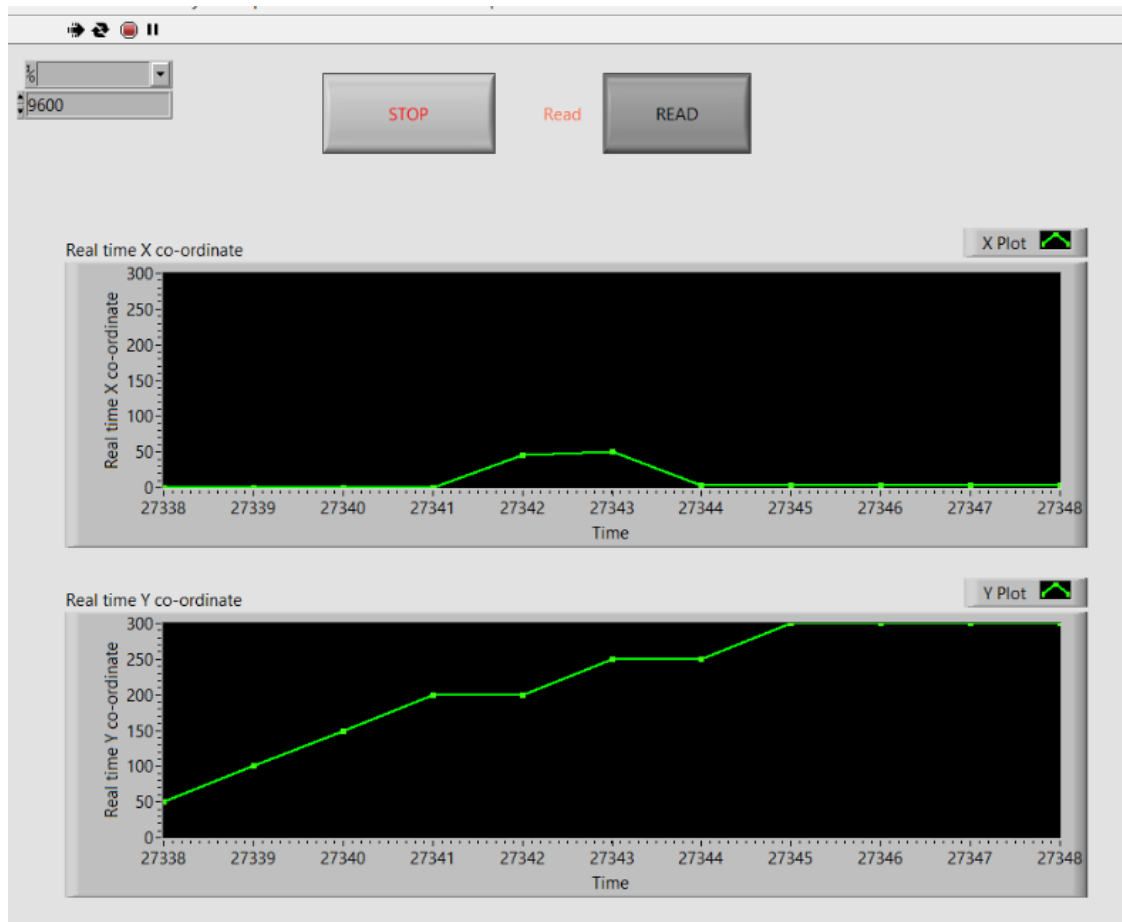


Graph. Robot moving from one co-ordinate to another

This graph show that robot movement from one co-ordinate to another without any obstacles coming into path



Graph. Robot faces obstacle



Graph. Robot reaches final-destination with obstacle avoidance

This graph shows that when robot stuck with object it changes direction avoids obstacle, so there is delay coming in the path and it reaches destination with all specified co-ordinates.

VI. CONCLUSION

As a result, kinematic model of moving wheel robot allows investigating movement of robot in task of achieving specified co-ordinates even if it faces obstacle in between, with ability to set starting and end point. It can be concluded that robot is able to go on set path and follows specified co-ordinates and reaches its destination.

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BIOGRAPHY

MS. Shraddha Arun Thakre, pursued Bachelor of Engineering in Electronics from Dr. Babasaheb Ambedkar Marathwada University in year 2016. And is currently pursuing Master of Engineering in Electronics & Telecommunication Engineering at Deogiri college of engineering, Aurangabad from Babasaheb Ambedkar Marathwada University (BAMU). Research interests in Trajectory tracking of moving wheeled robot using LabView.