Proc. of Int. Conf. on Current Trends in Eng., Science and Technology, ICCTEST

Path Following Robot using Arduino and Labview

Sindhu.K.M [1] and Suresha.H.S [2]
[1]Don Bosco Institute of technology/Electronics and communication Dept., Bangalore, India
sindhu.matad@gmail.com
[2]Don Bosco Institute of technology/Electronics and communication Dept., Bangalore, India
srisuri75@gmail.com

***Abstract*—Path-following is an important task in the applications of autonomous robots. This paper presents a new control method for the control of path-following of mobile robots. This path follower robot is basically designed to follow a black path on a white surface. The entire hardware of this simple path follower robot using arduino can be divided into three parts. The sensor, arduino-board and the motor driver circuit. Here we used the LabVIEW as the platform.**

***Index Terms*— Robot, LabVIEW, arduino, sensor, motor driver circuit.**

I. INTRODUCTION

A path follower robot is basically a robot designed to follow a path or line already predetermined by the user. This path or line may be as simple as a physical white path on the floor or as complex path marking schemes e.g. embedded paths, magnetic markers and laser guide markers. In order to detect these specific markers or paths, various sensing schemes can be employed. These schemes may vary from simple low cost path sensing circuit to expansive vision systems. The choice of these schemes would be dependent upon the sensing accuracy and flexibility required. From the industrial point of view, path following robot has been implemented in semi to fully autonomous plants. In this environment, these robots functions as materials carrier to deliver products from one manufacturing point to another where rail, conveyor and gantry solutions are not possible. Apart from path following capabilities, these robots should also have the capability to navigate junctions and decide on which junction to turn and which junction ignore. This would require the robot to have 90 degree turn and also junction counting capabilities. To add on to the complexity of the problem, sensor positioning also plays a role in optimizing the robots performance for the tasks mentioned earlier.

Path-following robots with pick- and- placement capabilities are commonly used in manufacturing plants. These move on a specified path to pick the components from specified locations and place them on desired locations. Basically, a path-following robot is a self-operating robot that detects and follows a path drawn on the floor. The path to be taken is indicated by a black path on a white surface. The control system used must sense the path and maneuver the robot to stay on course while constantly correcting the wrong moves using feedback mechanism, thus forming a simple yet effective closed- loop system.

II. SENSOR DESIGN

To detect infra-red energy radiated by the heat trail a pyro-electric sensor based lithium tentalateis formed

Grenze ID: 02.ICCTEST.2017.1.92

into a thin plate capacitor and has a temperature dependent spontaneous polarization perpendicular to the electrode surface, infra-red radiation rises the temperature of the lithium tentalateis, which in turn changes its polarization and this can be measured as a voltage across the capacitor electrodes, proportional to the incident radiation. Due to current leakage paths through the sensor and associated amplifier, the capacitor voltage decays away with time. For this reason the sensor only gives an output for changes in the incident infra-red radiation.

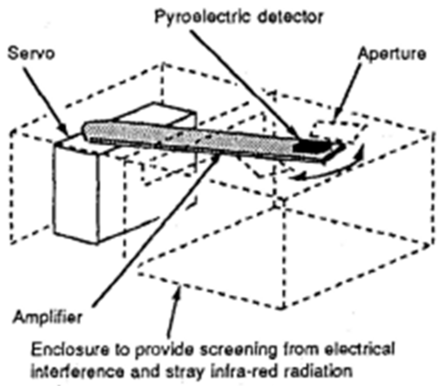

Figure 1. A diagram of the underside of the thermal sensor

In order to provide a differential signal for guiding a mobile robot two sensor readings are taken at points 5 cm. apart. A single pyroelectric sensor is mounted at the end of a servo controlled arm and this system is contained inside an aluminium enclosure. The servo positions the pyroelectric sensor over one of two apertures in the enclosure or at a central location where it is screened from external radiation. Because only one sensor is used for both measurements there are no problems of matching the characteristics of two individual devices. However, this arrangement means that there is a time difference between readings at the two sensor sites. Figure 1 shows a diagram illustrating the major components of the sensor. The signal from the pyroelectric sensor is amplified and converted to digital form by an 8- bit analogue to digital convener.

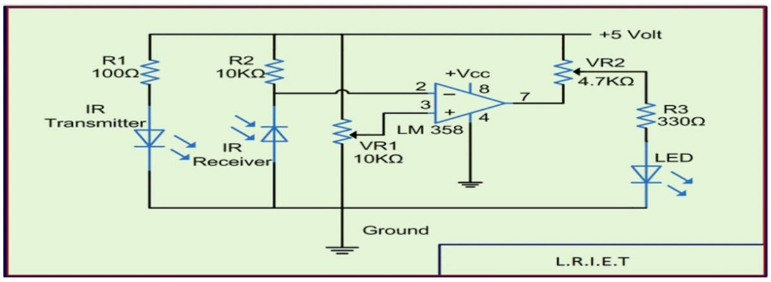

Figure 2. Circuit Diagram of IR Sensor

A Motorola 68HCll microcontroller coordinates the functions of the sensor by controlling the position of the servo and digitizing the resulting heat reading. Sensor readings are requested by sending an Is' to the sensor over an asynchronous serial communications link at 9600 Baud and thermal readings are returned over the same link as two consecutive bytes. One sensor scan is completed in 1.2 seconds. The first version of the thermal sensor had the servo mounted in the same enclosure as the pyroelectric sensor. Heat generated by the servo caused substantial drift in the sensor characteristics. This effect has been minimised by mounting the servo outside the enclosure and running the sensor for some time before performing uacking experiments to allow its tempera- to stabilize.

III. AURDINO UNO

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

Figure 3. Arduino UNO

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

IV. DC MOTOR

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight path.

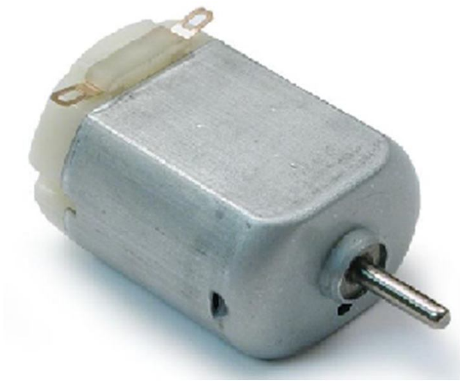

Figure 4. DC Motor

A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. The direction and magnitude of the magnetic field produced by the coil can be changed with the direction and magnitude of the current flowing through it.

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallel current paths.

The ends of the wire winding are connected to a commutator. The commutator allows each armature coil to be energized in turn and connects the rotating coils with the external power supply through brushes. (Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes.)

The total amount of current sent to the coil, the coil's size and what it's wrapped around dictate the strength of the electromagnetic field created. The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed.

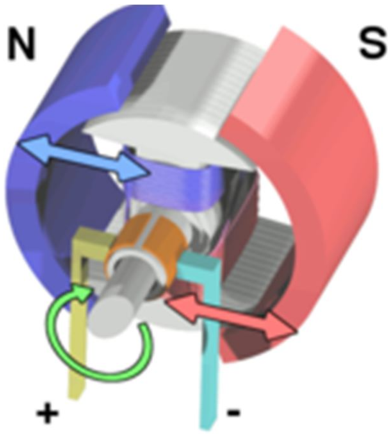

Figure 5. DC Motor Working

By turning on and off coils in sequence a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a force on the armature which causes it to rotate. In some DC motor designs the stator fields use electromagnets to create their magnetic fields which allow greater control over the motor.

V. DC MOTOR DRIVER L293D

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC.

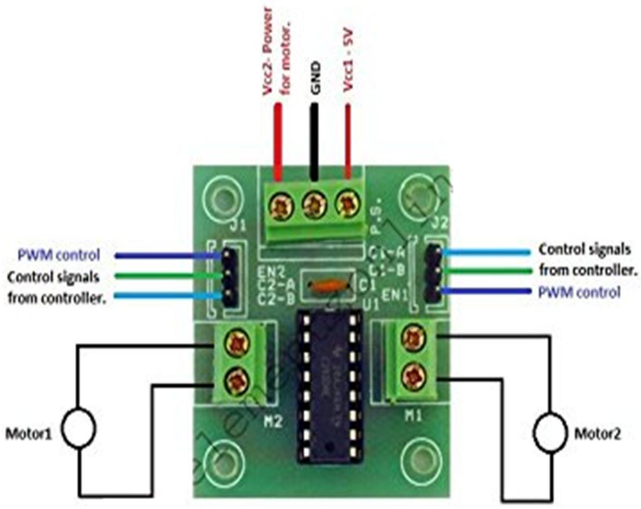

Figure 6. Driver circuit L239D

It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction,

Hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.

There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high. And for right H-Bridge you need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It’s like a switch.

VI. BLOCK DIAGRAM

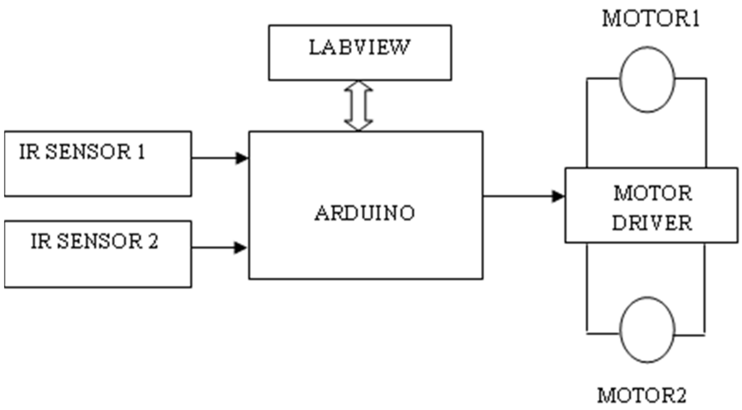

Figure 7.block diagram

VII. FLOW CHART OF WORKING OF PATH FOLLOWER ROBOT

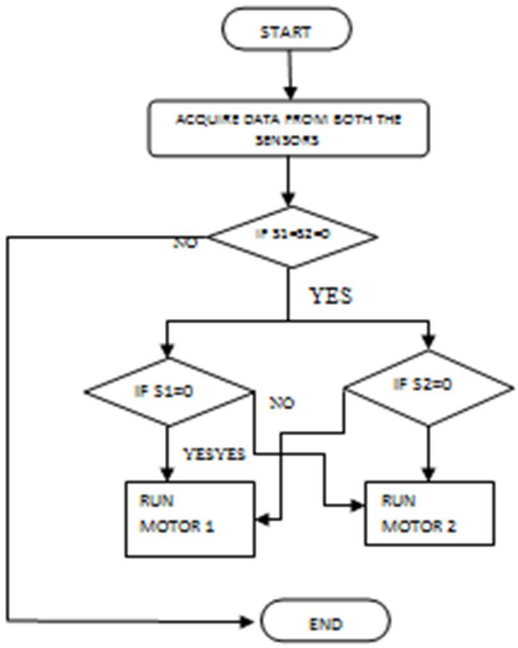

Figure 8.flow chart for working

VIII. ADVANTAGES

- Robot movement is automatic.
- Fit and Forget system.
- Used for long distance applications.
- Defense applications.
- Used in home, industrial automation.
- Cost effective.
- Simplicity of building

IX. Applications Of Path Follower Robot

- Industrial Applications: These robots can be used as automated equipment carriers in industries replacing traditional conveyer belts.
- Automobile applications: These robots can also be used as automatic cars running on roads with embedded magnets.
- Domestic applications: These can also be used at homes for domestic purposes like floor cleaning etc.
- Guidance applications: These can be used in public places like shopping malls, museums etc to provide path guidance.

X. Disadvantages

- PFR follows a black path about 1 or 2 inches in width on a white surface.
- PFR are simple robots with an additional sensors placed on them.
- Needs a path to run either white or black since the IR rays should reflect from the particular path.
- Slow speed and instability on different path thickness or hard angles.

XI. Conclusion

Thus we conclude that the design of path follower robot is implemented automatically by using LabVIEW has been achieved. This model can be used in various applications like defense, hazardous industry for safety, navigation, surveillance and security purposes. There may be other software used for designing the Robot but LabVIEW is the simplest of them all. Is because it uses the drag and drop principle , it does not need any code to run the software since it follows graphical coding.

References

[1] National Instruments. PID Theory Explained. National Instruments Products & services, [Online]National Instruments, March 29, 2011. http://www.ni.com/white-paper/3782/en/.

[2] G. Galvan, Chavez, Bonilla, Mendoza, Raygoza, L. Flores, and B. Zhang, "Preciseindustrial robot Positioning and path-tracking over large surfaces using non-calibratedvision," in Proceedings of the IEEE International Conference on Robotics and Automation(ICRA),May 2011,pp.5160-5166.

[3] Y. Liao, J. Huang, and Q. Zeng, "Preview fuzzy control method for intelligent vehicle path tracking," inProceedings of the IEEE International Conference in informatics and Computing (PIC), vol. 2, 2010, pp. 1211–1214.

[4] C. Ferreira, "Gene expression programming: a new adaptive algorithm for solving problems," Complex Systems, vol. 13, no. 2, pp. 87–129, 2001.

[5] J. Zhong, J. Wang, W. Peng , Z. Zhang, K. John and Y. Pan, "Prediction of essential proteins based on Gene expression programming," BMCGenomics, vol. 14, no. 4, pp. 1–8, 2013.

[6] Ashutosh, B. Z. Laskar, S. Kumar, and S. Majumder, "Gene expression programming based age estimation using facial features," in Proceedings of the IEEE Second International Conference on Image Information Processing (ICIIP), Dec. 2013, pp. 442–446.

[7] G. Indiveri and M. L. Corradini, "Switching linear path following for bounded curvature car - like vehicles," in Proc. 5th IFAC/EURON Symp.Intell.Auton.Vehicles, Jul. 2004.

[8] O. H. Dag˘ci, U . Y . Ogras, and U. O ¨ zguner, "Path following controller design using sliding mode control theory," in Proc. 2003 Am. Control Conf., Jun. 2003, vol. 1, pp 903–908.