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INDUSTRIAL INTELLIGENT LINE FOLLOWER VEHICLE WITH COLOUR TRACK DETECTION

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***Abstract*— The Line follower robot is a mobile machine that can detect and follow the line drawn on the floor. Generally, the path is predefined and can be either visible like a black line on a white surface. Here the robot can differentiate among various colors and choose a desired one to find its target. This line follower robot is a light (IR) sensor based. The design includes knowledge of Arduino programming, electrical circuit integration with the designed coding. In this study, the line-follower robot is designed to detect different color lines which represent different targets.**

The sensor includes Infrared Ray (IR) sensor that is installed under the robot . The microcontroller used here is Arduino Mega 2560. For differentiating color lines color sensor is kept at the bottom of the robot. Based on the color sensed the decision as well as the speed of the robot will be controlled. Hence, the controller is going to decide the proper commends and then it sends them to the driver and thus the path will be followed by the line follower robot

***keywords*— Line Follower; Infrared Sensor; Color Sensor; Microcontroller; Arduino Programming**

I. INTRODUCTION

A robot is a machine that is usually designed to reduce the amount of human work. It is developed for reducing risk factor for human work and increase comfort of any worker. Basically line follower is first stepping stone of automated intelligent robotics, it will reach the destination by the pathway drawn by the person.

In this paper we propose a line-follower robot system that is able to detect some kind of color, in this case the basic colors Red, Green, Blue (RGB). Most of them propose to use PIC microcontrollers since it has an on-board driver circuit for the motors for building line followers or obstacle avoiders. It is also more compact than an Arduino board. But the two features cannot be so easily integrated into a single system. Since it suffers from several setbacks like having insufficient analog input pins to aid usage of multiple sensors, cost, software for programming the microcontroller is not available free of cost etc. So Arduino Mega 2560 which has several

features apart from several different kind of pins on it compared to PIC is preferred in this particular application.
This robot is usable for carrying things from one phase of industry to another with given messages without any human interaction. It also can be used to transport important things for military purposes where it secures human safety for the operation.

II. BLOCK DIAGRAM

A basic configuration to develop a line follower will have only two infrared sensors interfaced with Micro Controller and movement regulated to motor through motor driver IC (LM293). The block diagram illustrates the major blocks present in our line follower with proper signal ranges.

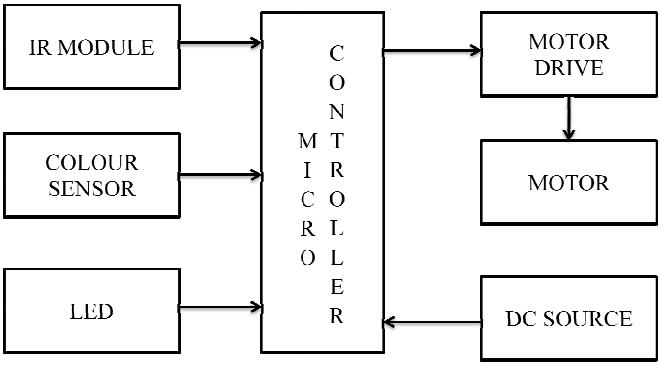

Fig.1. Block diagram of a line follower robot

Major blocks with explanation

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1. IR MODULE

It is an arrangement of Infrared source and Photo diode(Detector) for the determination of obstacles near the module. It also consist of the logical comparator (LM358) for delivering a digital signal as an output based on the presence of object in front of module. The sensitivity of the module will be altered by the potentiometer given in the module. The operating voltage range +5V DC as supply and (0,1)V as an output. It helps in determination of the black and white line followed by the robot.

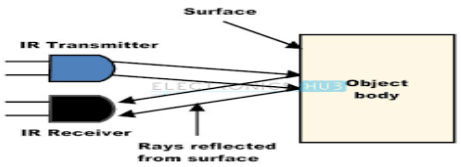

Fig.2. Operation of infrared sensor

2. COLOR SENSOR

Almost all the line follower robots, whose are previously implemented have a limitation that they can only follow either black line on a white surface and vice versa. This color sensor device is sensitive to Red, Green and Blue region spectrum in miniature SMD package. It is the good effective and low cost solution to white color balance, color detection and color management applications. This color Sensor gives analog output voltage proportional to intensity of Incident/Reflected light color e.g. (Red, Green, Blue), whichever light color's intensity is more that color's output voltage is more as compared to others.

Implemented at the back side of the chassis. Color sensor filters the Red, Green, Blue (RGB) . This color Sensor gives analog output voltage proportional to intensity of reflected light color e.g. (Red, Green, Blue). High sensitivity for Red, Green, and Blue light source. Works on simple +5V. The corner four leds emitts white light and reflects the color of the surface.

3. MICRO CONTROLLER

Among the number of several micro controller the most suitable micro controller for our needs will be Arduino Mega 2560. Its operating voltage of ports will be 5V dc with PWM signals. Voltage supply given to the Microcontroller will be in range of 7-12V DC. Current rating of the I/O ports will be 20mA dc. The total number of digital signal input /output ports in Microcontroller is 54. The total number of analog signal input / output ports in Microcontroller is 16. Clock speed of the microcontroller is 16MHZ. The memory of Microcontroller is classified into 3 major subdivision;

I). SRAM : 8KB
II). EEPROM : 4KB
III). Flash memory : 256 KB

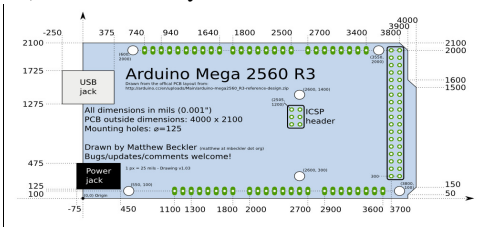

Fig.3.Specifications of Arduino Mega 2560

4. MOTOR DRIVE

The controller is build around the IC L293D that has H-Bridge design that can provide1.15A per channel. **INPUTS (IN1, IN2, IN3, IN4) -** These are receiving the analog or digital signals that can be sent from a microcontroller. **ENABLE (EN1, EN2) -** These activate the inputs from the L293D. The supply voltage can't be higher than 7V. **OUTPUTS (+M1, -M1, +M2, -M2) -** Here is where the motors should be connected. Here's where is connected a supply voltage that will give power to the motors. This input, gives voltage in the L293D and the H-Bridge, the supplied voltage have to be 36V max, but for the H-Bridge it's recommendable to use 24V max. **+5V.** This input receive the logic supply voltage for the L293D. You can connect a supply voltage higher than 5V because this input it's connected to a voltage regulator (LM7805).

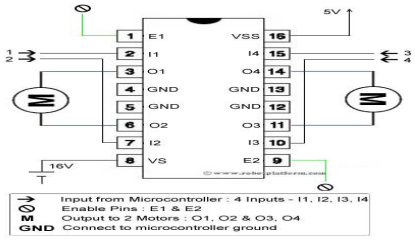

Fig.4.Pin diagram of L293D

5. MOTOR

A normal 200 RPM Side Shaft Super Heavy Duty DC Gear Motor is suitable for bigger robots / small automation systems. It has sturdy construction with large gears. Gear box is built to handle the stall torque produced by the motor. Drive shaft is supported from both sides with metal bushes. Motor runs smoothly from 4V to 12V and gives 200 RPM at 12V. Motor has 8mm diameter, 19mm length drive shaft with D shape for

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excellent coupling. The Stall torque produced by the motor will be 47.19 Kg-cm at stall current of 10.6 A. Gear assembly of the motor is Spur type. It is a normal carbon brush dc motor weighted of average 370 gms.

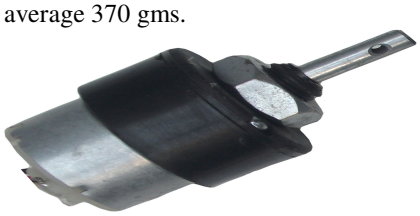


Fig.5.Motor

6. LED

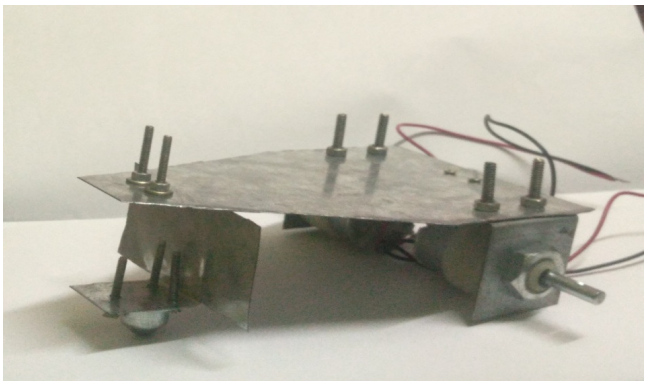
A light-emitting diode (LED) is essentially a PN junction semiconductor diode that emits light when current is applied. By definition, it is a solid-state device that controls current without heated filaments and is therefore very reliable. LEDs are highly monochromatic, emitting a pure color in a narrow frequency range. The color emitted from an LED is identified by peak wavelength (lpk) and measured in nanometers (nm). Peak wavelength is a function of the LED chip material. Although process variations are ±10 NM, the 565 to 600 NM wavelength spectral region is where the sensitivity level of the human eye is highest. Therefore, it is easier to perceive color variations in yellow and amber LEDs than other colors. The main application of the led in this robot is to indicate the colour sensed by colour sensors.

Fig.6. LED's

7. POWER SOURCE

9V dc battery is used as a power source for the robot. Some modules requires a 5V dc, it will be regulated from 9 to 12V by means of voltage regulator 7805.

III. CHASIS DESIGN



The overall length of the chassis is 16cm. The total breadth of the chassis is 8cm.The total space for the left and right motor is 8cm, each 4cm.The space for the castor wheel is 3cm. The castor wheel is kept in the front of the chassis for balancing purpose. The motors are connected to wheels of 7cm diameter, this will increase the speed and regulate movement in direction to be programmed in microcontroller. This will gives the mechanical support to withstand the Arduino board and the power supply without any malfunctioning.

IV. MODES OPERATIONS

There will be three modes of operation in the robot based on the sensors used. The primary color sensor is implemented in the left side of the robot. The second sensor will be IR module in the bottom of front and back of the chassis. The Third sensor is color sensor 2 it will be placed in front bottom of the robot with servo movement of linear displacement.

1. Tertiary mode

In this mode, the color sensor on the left side of the robot is used for speed controlling. The color sensor 1 will sense the color by tracing the specified color line. The color sensor senses the color by decision making concept.

2. Basic mode

In this mode, the robot will act as a general line follower. The sensor used here will be IR. After passing through the colored line the robot will trace the black line and will go to the next colored line. The robot will enter the next process.

3. Primary mode

In this mode, the robot will satisfy the certain angles. The color sensor 2 kept near the castor wheel will sense the color. The sensed color will be compared with the servo value. Based on the satisfied conditions the robot will turn left, right .

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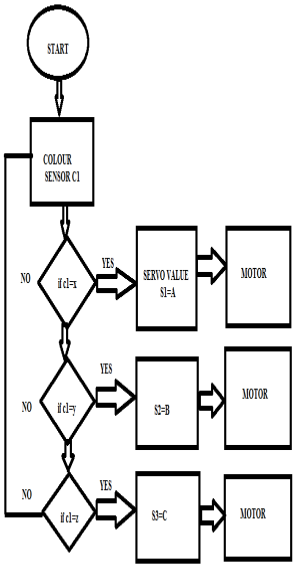
When the color sensor sense the green color the robot will turn right according to the conditions specified. Similarly the robot will turn left, if it senses blue color. The robot will move forward, if it senses red color. The movement will be stopped, if it senses yellow color.

V. FLOW CHART

The color sensor valve will be calibrated for the predefined colors and the decisions to be made will be implemented in program with the basis of flow chart given below.



VI. CONCLUSION

The concept of line follower vehicle with color track detection is implemented using color sensor. Simultaneously, makes the use of instructions from sensors and on board logic circuits performs physical movements. This robot can follow not only black and white colors but also some other different colors. Based on the programming, the robot can detect the color using sensor and the robots movement can be controlled.

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