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Department of Electronics & Communication Engineering

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Annexure I

1. Project Title: Color sensor based multiple line follower robot with obstacle detection

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1. ABSTRACT & OBJECTIVE

1.1 ABSTRACT

This paper introduces the multiple source Multiple Destination Robot (MDR-l) having the ability to choose a desired line among multiple lines autonomously. Every line has different colors as their identities. The robot can differentiate among various colors and choose a desired one to find its target. Unlike any other simple line follower robot, this robot can be considered as a true autonomous line follower robot having the ability to detect presence of obstacle on its path. A powerful close loop control system is used in the robot. The robot senses a line and endeavors itself accordingly towards the desired target by correcting the wrong moves using a simple feedback mechanism but yet very effective closed loop system. The robot is capable of following very congested curves as it receives the continuous data from the sensors.

A line following robot is a robot that basically follows a specific line. This line following robot is sensor based. Sensor based approach uses various kinds of sensors such as IR sensors and ultrasonic sensors. IR sensors are generally used for measuring the difference in reflectivity of surfaces depending on the properties like color, roughness etc. Which is this line follower is based on. The path can be visible like a black line on a white surface (or vice-versa). Sensing a line and maneuvering the robot to stay on course, while constantly correcting wrong moves using feedback mechanism forms a simple yet effective closed loop system. Here wireless sensor network Zigbee is used to receive the information from transmitter section to receiver section. This robot was developed based on a vision based system to navigate the robot through a black line marked in the white surface. It also extracted some features in the sensor to follow a line with automatic color detection and follow that color in white surface. This report is intended to describe the information regarding the project. It explains the requirements, the techniques and technologies used, design and implementation, details, problems faced, and future improvements of the project.

1.2 Motivation

A Robot is a machine which is completely automatic, i.e. it starts on its own, decides its own way of work and stops on its own. Robotics has greatly advanced in the developed countries. High performance, high accuracy, lower labor cost and the ability to work in hazardous places have put robotics in an advantageous position over many other such technologies but as for developing countries like Bangladesh it is still quite out of reach. But it is one of the most fascinating and interesting aspects to the new generations and a lot of development in robotics has been done in last couple of years. Robots have several useful applications in our daily. It is actually a replica of human being, which has been designed to ease human burden. It can be controlled pneumatically or using hydraulic ways or using the simple electronic control ways.

1.3 Objective

The objective of the project is paper the multiple source Multiple Destination Robot (MDR-l) having the ability to choose a desired line among multiple lines autonomously. Every line has different colours as their identities. The robot can differentiate among various colours and choose a desired one to find its target. Unlike any other simple line follower robot, this robot can be considered as a true autonomous line follower robot having the ability to detect presence of obstacle on its path. A powerful close loop control system is used in the robot. The robot senses a line and endeavours itself accordingly towards the desired target by correcting the wrong moves using a simple feedback mechanism but yet very effective closed loop system. The robot is capable of following very congested curves as it receives the continuous data from the sensors

2. BLOCK DIAGRAM & WORKING:

2.1 Block diagram :

Figure : Block Diagram of Transmitter Section

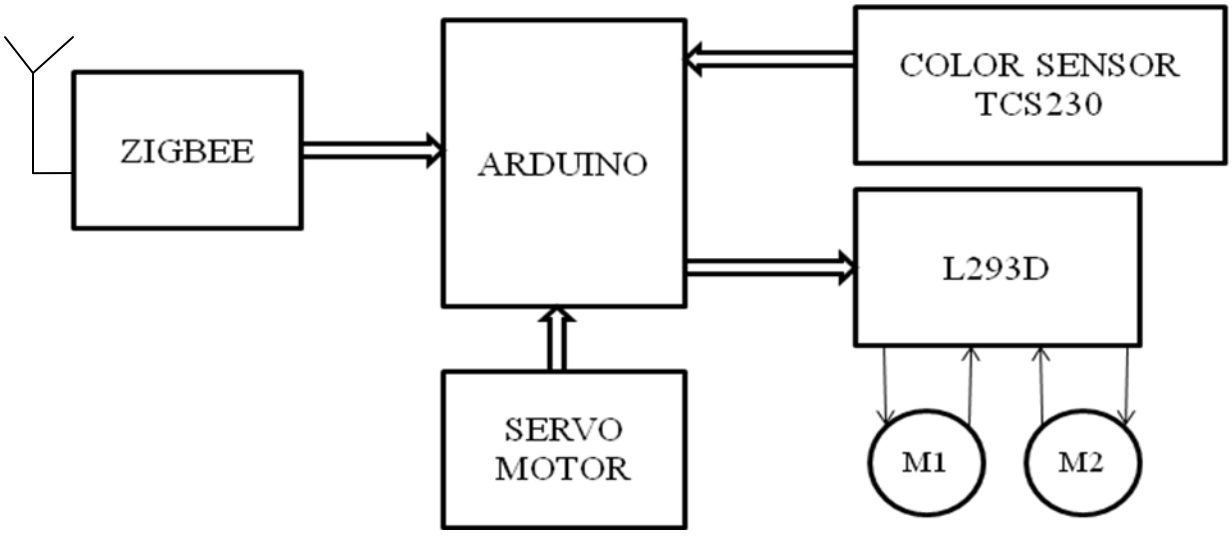

Figure : Block Diagram of Receiver Section

Working:

Functional description in general includes the block diagram representing every module of the project and working which specifies the function of each module in the project. The sensor in the block diagram is color sensor used to sense color path .We also have the LCD display for the purpose of displaying the color which is given as input. The project is designed with ARDUINO and ZIGBEE technology.

Working of Transmitter Section:

In Transmitter section the input switches combinations are given to select the particular destination to which the robot has to move from the source to destination. Here in this proto type we have given the three destinations for moving the robot from one place to another place. The

three destinations are assigned with the predefined colored paths. Each switch as its own color by its own and if we select any particular destination with its color then robot will move according to the path assigned to it and reaches its destination by tracking the color continuously.

The main part to move the robot is the arduino-uno this will control all the performance of the robot through the wireless Zigbee module. The wireless Zigbee module will transmit the signal to the Zigbee receiver. The block diagram of transmitter section is shown in Figure

Working of Receiver Section:

In receiver section the information from transmitter is received using Zigbee module. The destination which is selected by the user is received by this Zigbee module and it is given to the arduino-uno controller then this will give the required task to the color sensor (TCS230) that which is given at the transmitter and transmitted through the Zigbee module.

The color sensor will know sense all the color and then select the color required to it and this is done by using the servo motor in the color sensor then the motor driver (L293D) will give instruction to the motor to move the robot according to it and then it follow the color line and reaches the destination. The IR sensor which is present in the robot will detect the obstacle and stop the robot. The block diagram of receiver section is shown in Figure

Flowchart:

The below Figure shows the flow chart it indicates the sequence of operation carried out throughout the project It indicates the step by step procedure of operations performed this project.

2.2 Technical specifications:

2.2.1 Arduino-Uno:

2.2.1.1 Arduino-Uno technical specifications:

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V

Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

2.2.1.2 Arduino-Uno Pin Description:

- Vin : The input voltage to the Uno board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- Vcc : This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or

the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

- A 3.3V supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND: Ground pins.
- I/OREF: This pin on the Uno board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

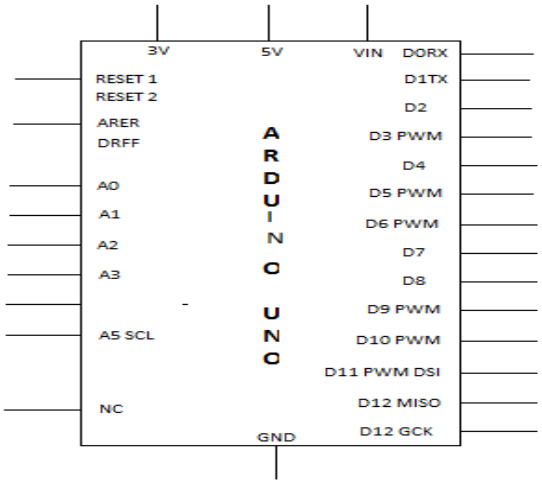

Figure 4.2: Pin Diagram of Arduino-Uno

2.2.2 DC MOTOR L293D

2.2.2.1 DC MOTOR L293D technical specifications:

600mA output current capability per channel

Internal clamp diodes

1.2A peak output current (non repetitive) per channel

Enable facility

Over temperature protection

Logical “0” input voltage up to 1.5 V

Internal clamp diodes

High Noise Immunity

2.2.2.2 Operating the L293D Motor Driver:

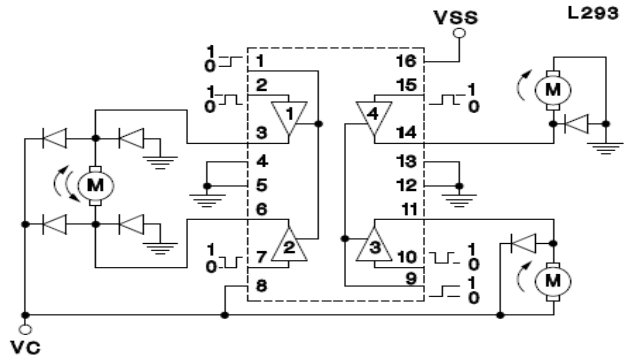

Figure : Schematic diagram for L293D with motors

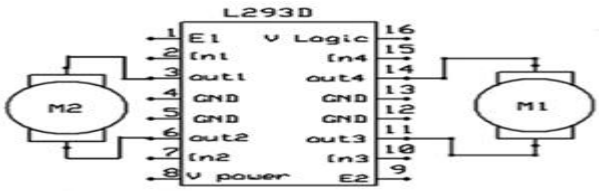

Figure : Motor connections

2.2.2.3 Motor Driver Interfacing to Arduino-Uno:

Arduino-uno is interfaced to the D2 and D3PWM pins of first motor and D4 and D5PWM of the motor driver. The shown below fig is the motor driver interfacing to the arduino-uno.

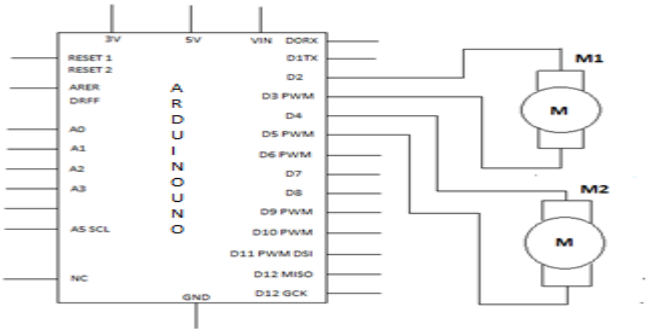

Figure: Motor Interfacing with Arduino Uno

2.2.3 Dual Ball Baring Servomotor technical specifications:

Required Pulse	:	3-5 Volt Peak to Peak Square Wave
Operating Voltage	:	4.8-6.0 Volts
Operating Temperature Range:		-10 to +60 Degree C
Operating Speed (4.8V)	:	0.20sec/60 degrees at no load
Operating Speed (6.0V)	:	0.16sec/60 degrees at no load
Stall Torque (4.8V)	:	5.5 kg/cm
Stall Torque (6.0V)	:	7 kg/cm
360 Modifiable	:	Yes
Potentiometer Drive	:	Indirect Drive
Bearing Type	:	Double Ball Bearing
Gear Type	:	All Nylon Gears
Connector Wire Length	:	12"
Dimensions	:	1.6" x 0.8"x 1.4" (41 x 20 x 36mm)
Weight	:	41gm

2.2.4. COLOR SENSOR (TCS230)

2.2.4.1 COLOR SENSOR (TCS230) technical specifications:

Single-Supply Operation (2.7 V to 5.5 V)

Power Down Feature

Nonlinearity Error Typically 0.2% at 50 kHz

Stable 200 ppm/μC Temperature Coefficient

Low-Profile Lead (Pb) Free and RoHS Compliant Surface-Mount Package

2.2.4.2 COLOR SENSOR (TCS230) Terminal Functions:

Table : Terminal Functions of Color Sensor

TERMINALNAME	NO	I/O	DESCRIPTION
GND	4		Power supply ground. All voltages are referenced to GND.
OE	3	I	Enable for fo (active low).
OUT	6	O	Output frequency (fo).

S0,S1	12	I	Outputfrequencyscaling selection inputs.
S2,S3	78	I	Photodiodetype selection inputs.
Vdd	5		Supply voltage

Table : Selectable Options of Color Sensor

S0	S1	Output frequency scaling(fo)	S2	S3	Photodiode type
L	L	power down	L	L	Red
L	H	2%	L	H	Blue
H	L	20%	H	L	clear(no filter)
H	H	100%	H	H	Green

2.2.4.3 COLOR SENSOR (TCS230) interfacing to aurdino:

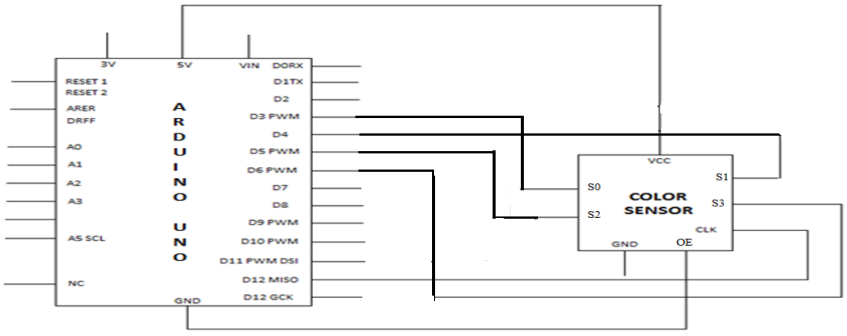

Figure: Color Sensors Interfacing With Arduino-Uno

2.2.5 LCD

2.2.5.1: LCD 2x16 pindiagram

FUNCTION	PIN NUMBER	NAME	LOGIC STATE	DESCRIPTION
Ground	1	Vss	-	0V
Power supply	2	Vdd	-	+5V
Contrast	3	Vee	-	0 – Vdd
			0	D0 – D7 are interpreted as commands
	4	RS	1	D0 – D7 are interpreted as data
			0	Write data (from controller to LCD)
	5	R/W	1	Read data (from LCD to controller)
			0	Access to LCD disabled
			1	Normal operating
Control of operating	6	E	From 1 to 0	Data/commands are transferred to LCD
	7	D0	0/1	Bit 0 LSB
	8	D1	0/1	Bit 1
	9	D2	0/1	Bit 2
	10	D3	0/1	Bit 3
	11	D4	0/1	Bit 4
	12	D5	0/1	Bit 5
Data / commands	13	D6	0/1	Bit 6
	14	D7	0/1	Bit 7 MSB

2.2.5.2: LCD Interfacing with Arduino Uno:

The shown fig: is the LCD interfacing to the arduino uno microcontroller. The pins of Arduino-uno D7, D10, D12GCK, D12MISO are interface to the D7, D8, D6,D5 pins of the Liquid Crystal Display.

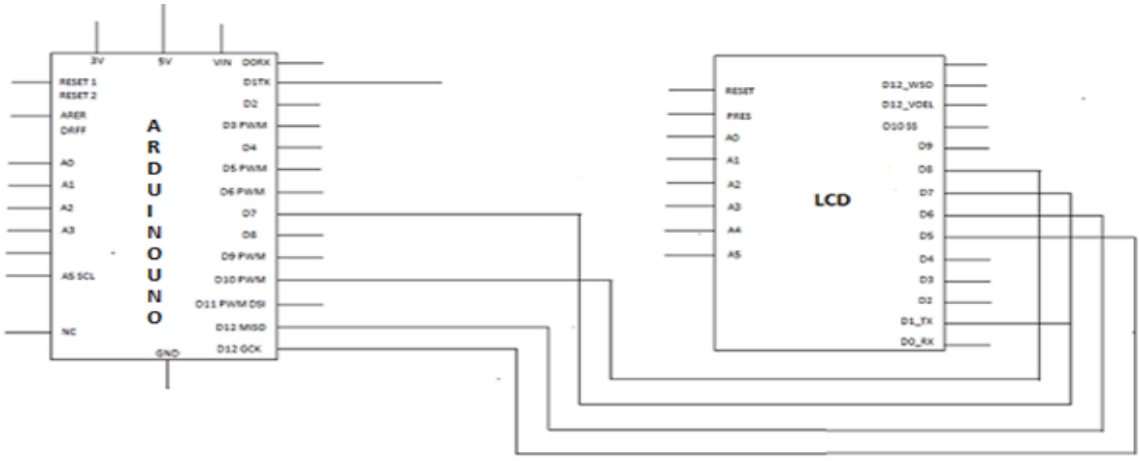

Figure : LCD Interfacing with Arduino-Uno

2.2.6.: IR Sensor

2.2.6.1: IR Sensor Operation:

IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold

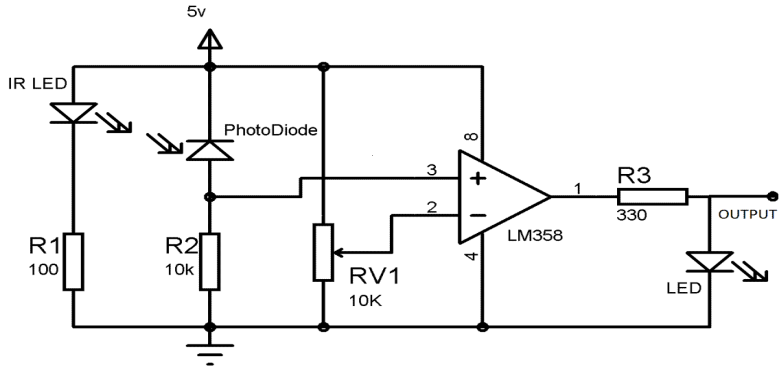

Figure : Circuit Diagram of IR Sensor

2.2.6.2: IR Sensor interfacing:

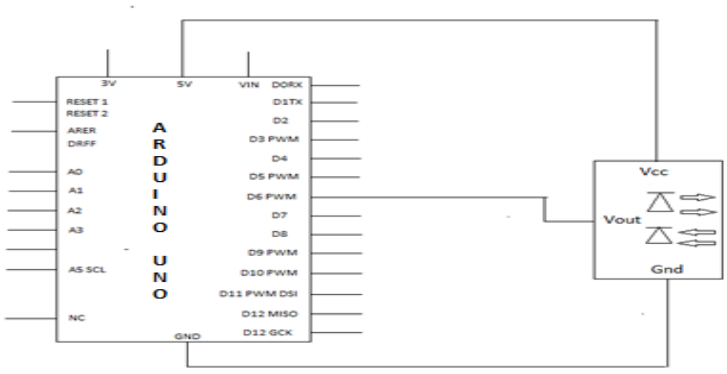

Figure: IR Sensors Interfacing To Arduino Uno Microcontroller

2.2.7: Zigbee

2.2.7.1: Zigbee operation:

ZigBee protocol was engineered by the ZigBee Alliance, a non-profit consortium of leading semiconductor manufacturers, technology providers, OEMs and end-users worldwide. The

protocol was designed to provide OEMs and integrators with an easy-to-use wireless data solution characterized by low-power consumption, support for multiple network structures and secure connections.

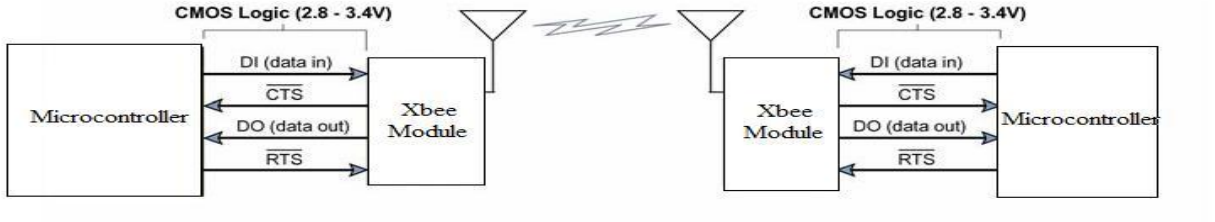

Figure : Zigbee Transmitter and Receiver

2.2.7.2: Zigbee interfacing to aurdino:

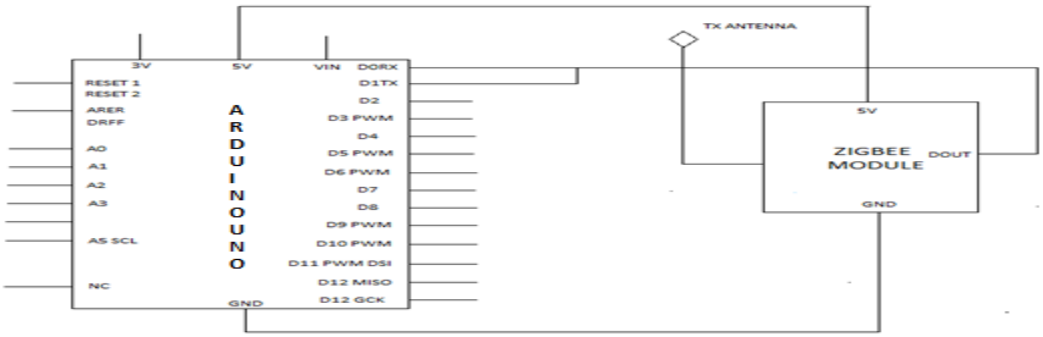

Figure : Zigbee(TX-section) Interfacing to Arduino Uno

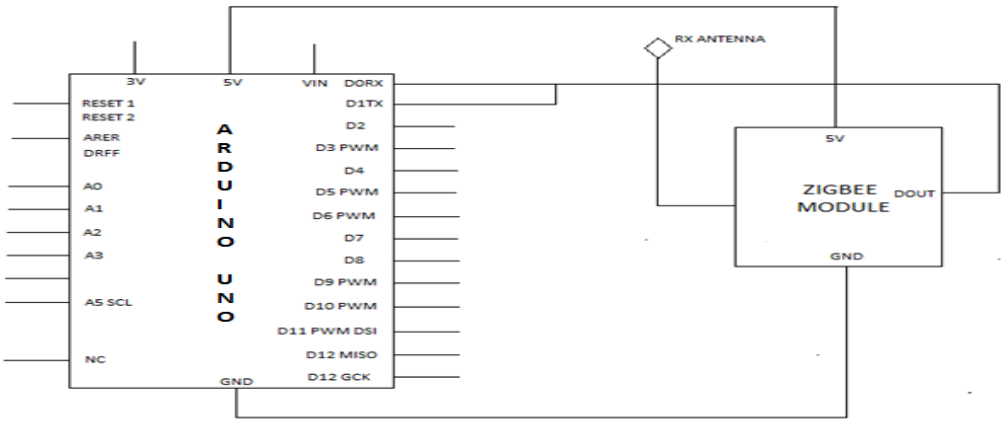

Figure : Zigbee(RX-section) Interfacing to Arduino Uno

2.2.8 SCHEMATIC DIAGRAMS

The schematic diagram of the entire project is shown in Figure In this we connect all modules like sensors i.e. color sensor (TCS230), motor driver (L293D), IR sensor, Zigbee module, switches, display present in project are connected to the arduino-uno microcontroller.

Transmitter Section:

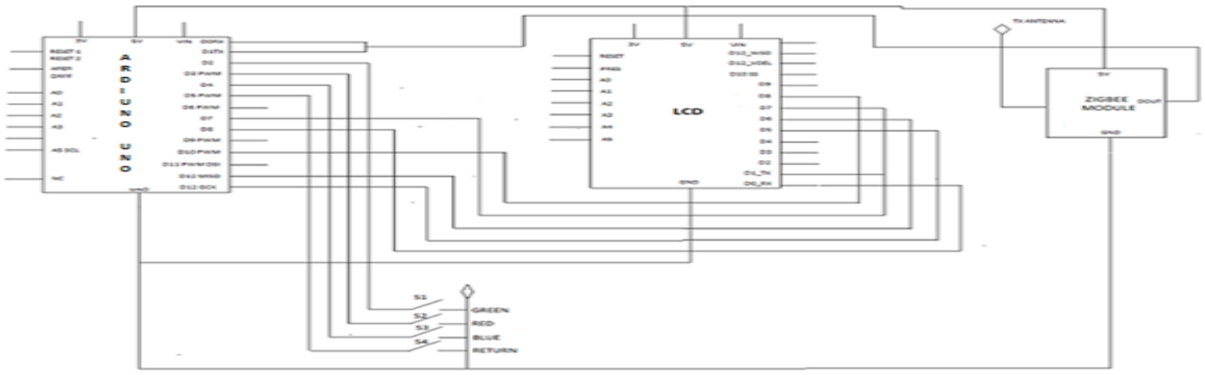

Figure : Schematic Diagram of Color Sensor Based Multiple Line Follower Robot With Obstacle Detection(TX-Section)

Receiver Section:

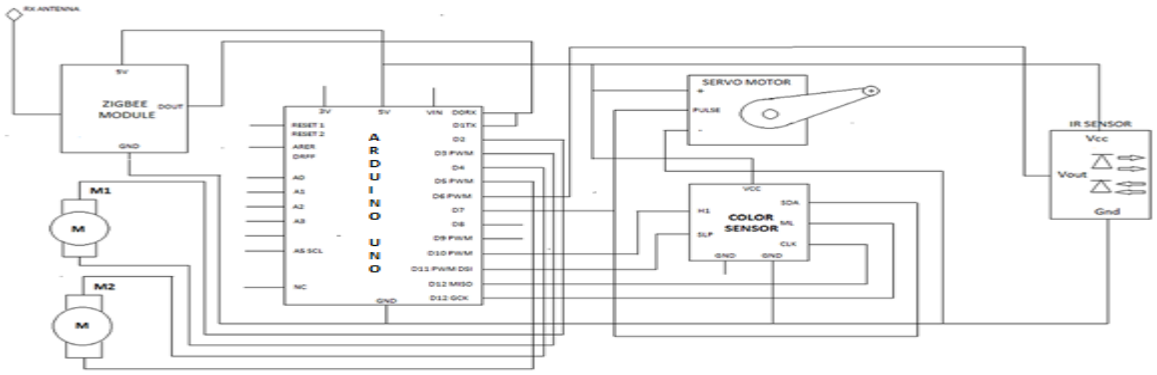

Figure : Schematic Diagram of Color Sensor Based Multiple Line Follower Robot With Obstacle Detection(RX-Section)

3. RESULTS & CONCLUSION:

3.1 RESULT

Below fig. shows Color Sensor Based Multiple Line Follower Robot With Obstacle

Detection which has ARDUINO, color sensor (TCS230), IR sensor and L293D Motor Driver, Servo Motor.

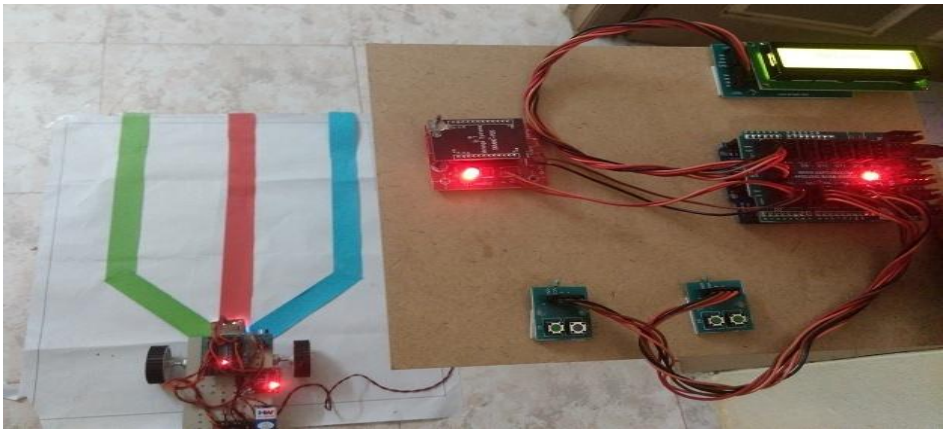

Figure: Initial State of Color Sensor Based Multiple Line Follower Robot with obstacle detection

Below figures shows when line follower robot sensing green, red, blue colors respectively and reaching the particular destination.

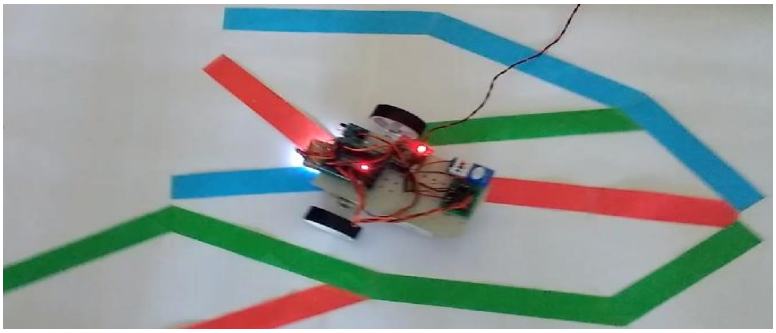

Figure: Sensing Red Color

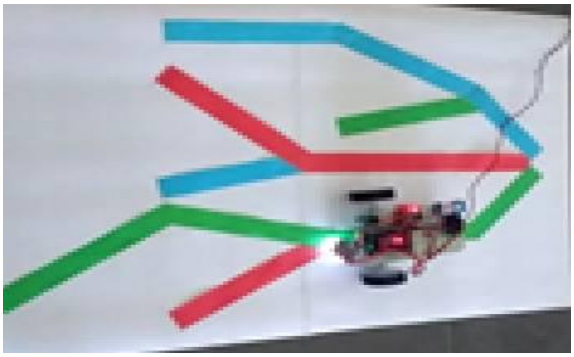

Figure: Sensing Green Color

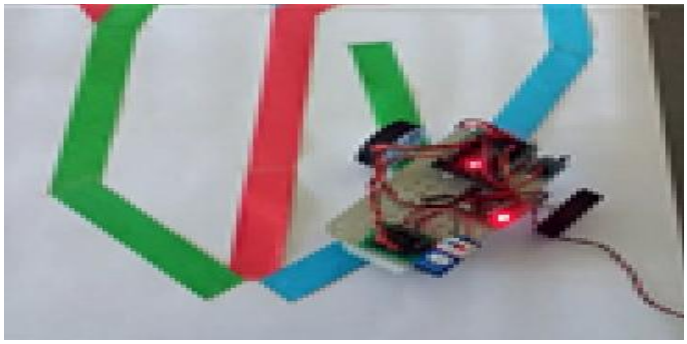

Figure: Sensing Blue Color

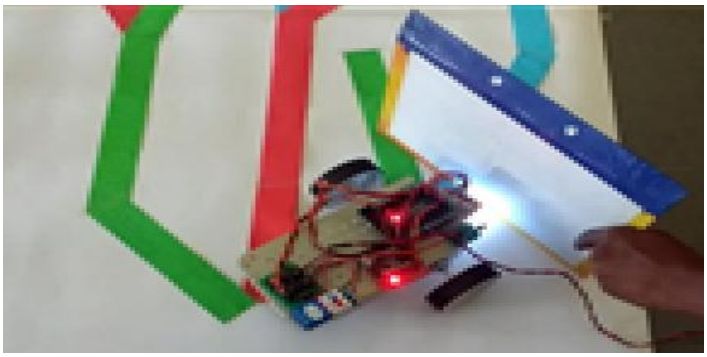

Figure: Detecting the Obstacle

3.2 Conclusion

The concept of the line follower robot is practically implemented in this paper based electronics logic circuit and sensors. Simultaneously, makes the use of instructions from sensors and on board logic circuits performs physical movements. The robot is succeeded to locate and follow target. This robot can follow different colors by comparing the voltage which is given as reference voltage. Further modification of this robot includes application of shortest path algorithm and neural network so that it can find its target more efficiently in shortest amount of time. The robot senses a line and endeavors itself accordingly towards the desired target by correcting the wrong moves using a simple feedback mechanism but yet very effective closed loop system. The robot is capable of following very congested curves as it receives the continuous data from the sensors.