

# Wireless Manoeuvre Control of Fire Bird V Robot Using ZigBee Communication

Amreen Saba<sup>1</sup>, Asfiya Muhammadi Basheer<sup>2</sup>

B.E Student, Department of Information Science and Engineering, GSSSIETW, Mysuru, Karnataka, India<sup>1,2</sup>

**ABSTRACT:** Fire Bird V serves as a universal research robot and provides an excellent environment for algorithm development and testing. Wireless manoeuvre control of Fire Bird V is accomplished using zigBee module. The path to be traced by the robot is specified on the computer application. This path is transmitted to the robot using a zigBee transmitter which is attached to the computer. The path to be traced by the robot is received using a zigBee receiver embedded in Fire Bird V. The ATMEGA 2560 microcontroller is embedded in Fire Bird V, this microcontroller is programmed to trace the path received by the robot. Any obstacle in the specified path is detected by the sharp range IR sensors and can overcome the obstacle by heading with the alternate path. The dual motor drives the robot giving movement to the back wheels and front caster wheel.

**KEYWORDS:** ZigBee module, sensors, computer application, microcontroller, obstacle.

## I. INTRODUCTION

Robot is a machine capable of carrying out complex series of actions automatically, especially one programmable by a computer. By considering the complexities in the traditional approaches the proposed ideology makes the operation computerised. The process begins with the development of application window using programming language C#, to specify the path to be traced by the robot. The zigBee module used for wireless communication. The path is drawn on the application window using the mouse event handler, the pixels of the drawn path starts filling once the robot starts executing the specified path. Fire Bird V is powered by 9.6V rechargeable Nickel Metal Hydride battery pack. When fully charged, battery pack gives 12V and when it is fully discharged, voltage drops to about 8V. NiMH battery pack has 5 pin 2510 connector which will fit into the connector on the main board only in one orientation. The ATMEGA 2560 microcontroller embedded in Fire Bird V is responsible for the functioning of robot, hence it should be programmed appropriately.

This microcontroller drives the two DC geared motors in differential drive configuration and caster wheel at front as support are responsible for locomotion of the robot. There are two types of indicators used in the robot, a 2X16 LCD display which is used to display the appropriate message on the robot and a buzzer with indicator LED's which produces a beep sound and the LED glows when the respective sensors are activated, eg. when a robot encounters an obstacle it alerts the user by producing a beep sound. Wireless ZigBee Communication (2.4GHZ) is controlled by ATMEGA 2560. The sharp IR range sensors which are controlled by ATMEGA 2560 are used to detect the obstacle when the robot is tracing the path. We can overcome the obstacle by specifying appropriate operations. The block diagram of Fire Bird V robot is shown in Fig.1 All the components interact with each other for the appropriate functioning of the robot.

The path tracing application is enhanced with calculating the exact angles between the two co-ordinates on the x-y plane, which also aids in perceiving the 360 degree turn. The application developed for the path tracing does not approximate the distance from one point to another, it calculates the values in terms of accurate angles to trace the exactly specified path by giving the 360 degree, smooth and non-jerky movement of the robot. The wireless zigBee module can be used as a star topology for various robots in operation at the same time. The sharp IR sensors in the

robot detects the obstacle in its way by alarming using the buzzer, the robot is programmed to control the delay and take the alternate path permitting the overcoming of the obstacle.

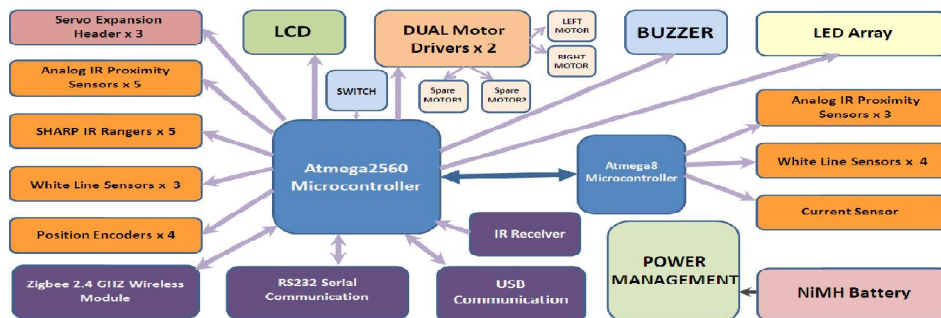


Fig.1

Fig.1 Shows the block Diagram of FIRE BIRD V robot and the interaction of the microcontroller with the other components, where ATMEGA 2560 acts as a master microcontroller which drives the slave microcontroller ATMEGA8.

## II. RELATED WORK

We have considered some of the research work related to the manoeuvre of the robot using different technologies . These are illustrated in the following

Abdul Hannan<sup>1</sup>, M.A. Jobayer Bin Bakkre, Md. Selim Hossain, Rajib Chandra Ray . [1] The methodology implemented in this paper directs a robot along a black mark on a white surface , the robot is fabricated using a 700gm weight of LDR sensor. The amount of light reflected is read by the sensor . The microcontroller speeds up or slows down the motor of robot depending on the value of the light reflected. Actuators , sensors and controllers constitute system requirement. Inian Roy. A, Karthick raja. B, Chakkaravarthy. G, Arun Prakash. C .[3] Machine vision technique is used for the movement of the robot. The image of the track is captured by the camera mounted on the robot. The obtained image is processed by the microcontroller which is programmed such that the robot follows the path obtained by the camera. Ebiesuwa O. O, Adekunle Y. A, Akinyemi L. A, Oyerinde O. D [5] The implementation of this project uses sophisticated colour sensors . These sensors guide the robot to follow a path in the shortest possible time. This robot implemented here moves faster compared to all the existing robot. Deepak Punetha, Neeraj Kumar, Vartika Mehta [6] . This project was implemented to improve the existing health care management . Here the robot is designed to carry the medicines to the patient whenever they need it. It uses light dependant resistor sensors for its movement. Md Zabiuddin, Pushpalatha R . [2] The methodology used in this project reduced the complexity of manoeuvre control of the existing robots to greater extent by transferring the path drawn on the computer to the robot. This methodology is implemented using RF module. The path is given to the microcontroller which turns the motor of the robot in appropriate directions in order to trace a given path. The speed of the robot is controlled using H-bridge circuit.

## III. ARCHITECTURE

The system architecture gives a one shot view of the entire system. In the proposed architecture the computer is connected to the zigbee module through the RS232 via the COM port. The co-ordinate values of the path traced on the application window are initially in the hexadecimal form, and later converted into the corresponding digital data to be displayed on the window space.

The zigbee receiver then receives the four-bit data and is processed through the ATMEGA2560 microcontroller by accessing dual motor for movement, sharp range IR sensors for obstacle detection, the LCD display to provide the movement information and the buzzer for the error indication operations.

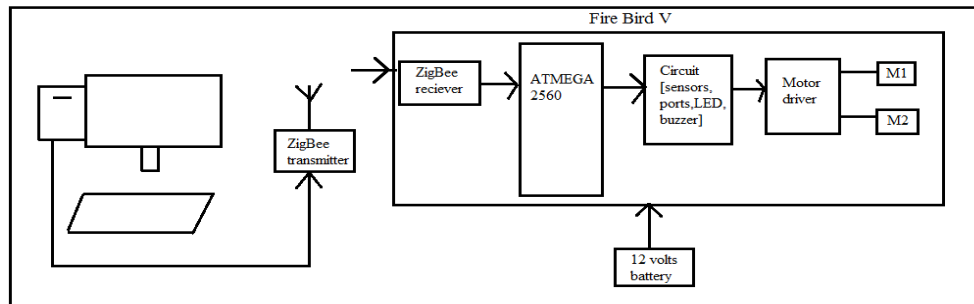


Fig.2

#### IV. METHODOLOGY

The methodology includes the working of both, the application and the Fire Bird V robot. The working principle of the computer program is the aspect to be initially considered, therefore we use microsoft visual studio to develop the application for both front end and also the core backend program. Grids are used to draw the path on the window. The grid is mapped with the scaling of the window size and is co-ordinated to detect the path specified on the screen. The X and Y co-ordinates are exactly calculated using the 400x400 grid.

Manoeuvre control algorithm:

1. If the current X-Y co-ordinates are equal to the previous X-Y co-ordinates and the angle  $\leq -67.5$  and  $\text{angle} \geq -112.5$ , the state of robot is considered as ideal and therefore moves in the forward direction.
2. If the current X co-ordinate is greater than previous X co-ordinate and the current Y co-ordinate is equal to previous Y co-ordinate and if the angle  $\leq 22.5$  and  $\text{angle} \geq 0$ , the robot turns to its right and moves along the same direction until the next turn is detected.
3. If the current X co-ordinate is greater than previous X co-ordinate and the current Y co-ordinate is lesser than previous Y co-ordinate and if the angle  $\leq -22.5$  and  $\text{angle} \geq -67.5$ , the robot turns slightly to its right taking the forward right path and moves along the same direction until the next turn is detected.
4. If the current X co-ordinate is lesser than previous X co-ordinate and the current Y co-ordinate is lesser than previous Y co-ordinate and if the angle  $\leq -112.5$  and  $\text{angle} \geq -157.5$ , the robot turns slightly to its left taking the forward left path and moves along the same direction until the next turn is detected.
5. If the current X co-ordinate is lesser than previous X co-ordinate and the current Y co-ordinate is equal to previous Y co-ordinate and if the angle  $\leq 180$  and  $\text{angle} \geq 154.5$ , the robot turns to its left and moves along the same direction until the next turn is detected.
6. If the current X co-ordinate is lesser than previous X co-ordinate and the current Y co-ordinate is greater than previous Y co-ordinate and if the angle  $\leq 157.5$  and  $\text{angle} \geq 112.5$ , the robot turns slightly to its right taking the backward right path and moves along the same direction until the next turn is detected.
7. If the current X co-ordinate is equal to the previous X co-ordinate and the current Y co-ordinate is greater than previous Y co-ordinate and if the angle  $\leq 112.5$  and  $\text{angle} \geq 67.5$ , the robot moves backward.
8. If the current X co-ordinate is greater than previous X co-ordinate and the current Y co-ordinate is greater than previous Y co-ordinate and if the angle  $\leq 67.5$  and  $\text{angle} \geq 22.5$ , the robot takes a slight backward turn resulting in the backward left path and moves along the same direction until the next turn is detected.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

The flowchart of the algorithm is as shown in Fig.3

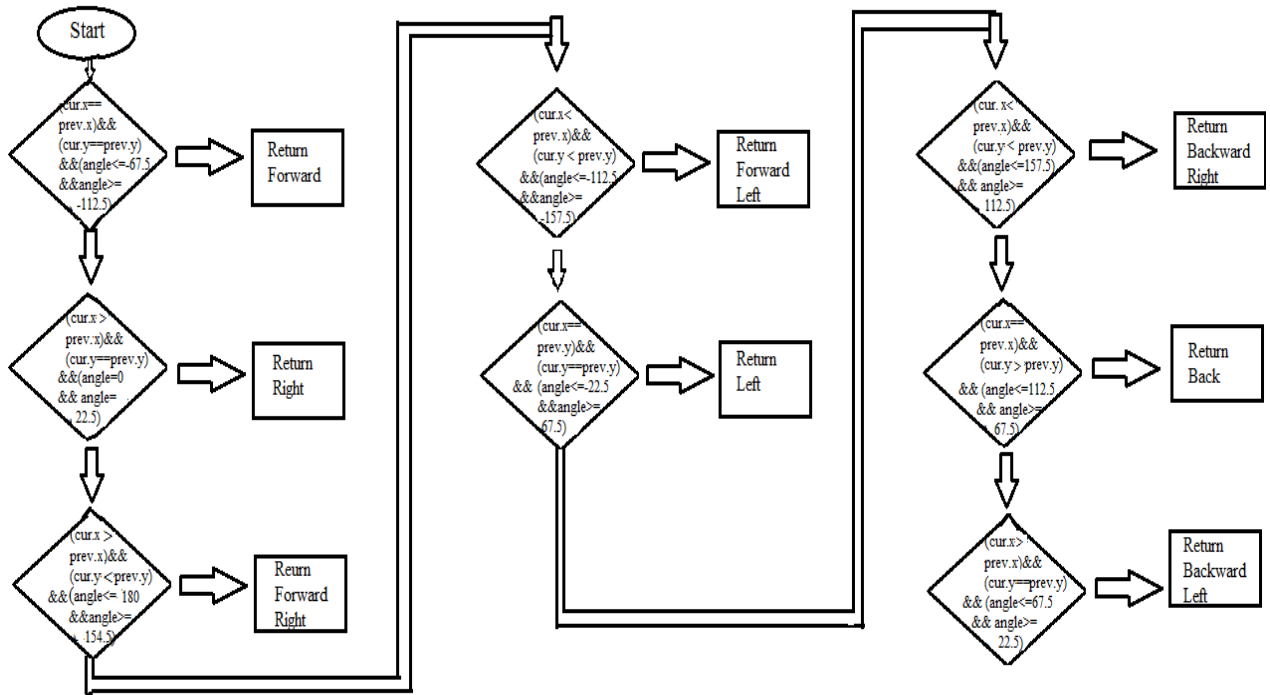


Fig.3

For the obstacle detection and overcoming mechanism we use the sharp range IR sensors, which are five in number and are mounted one in each direction. The IR sensors have a transmitter and a receiver IR, here the transmitter IR transmits the light continuously and upon finding the obstacle in its way the IR rays fall on the obstacle, the IR rays reflect back and fall on the receiver IR, and the distance of the obstacle is calculated using the formula: Distance = Speed/Time

Obstacle overcoming algorithm:

1. If the Flag == 1 for the ports PK1,PK2,PK3,PK4,PK5
2. Buzzer == 1 && LCD = Distance
3. Turn left and move 200mm forward
4. Turn right and move 200mm forward
5. Turn right and move 200mm forward
6. If Flag == 1 go to step 1 else terminate

## V. EXPERIMENTAL RESULTS

The initial GUI view of the application with a curved path drawn on it is shown in Fig.4 The line is drawn on the window space using the mouse event handler, two of the options are provided one for specifying the path and one more to reset the path and provide the desired path each time there is a requirement. On the left of the tool bar the values present give the exact values of the X-Y co-ordinates by scaling it along the grids. In the Fig.4 we can view a path specified with the curves and the correspondingly mapping with the directions as per the Manoeuvre control algorithm.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

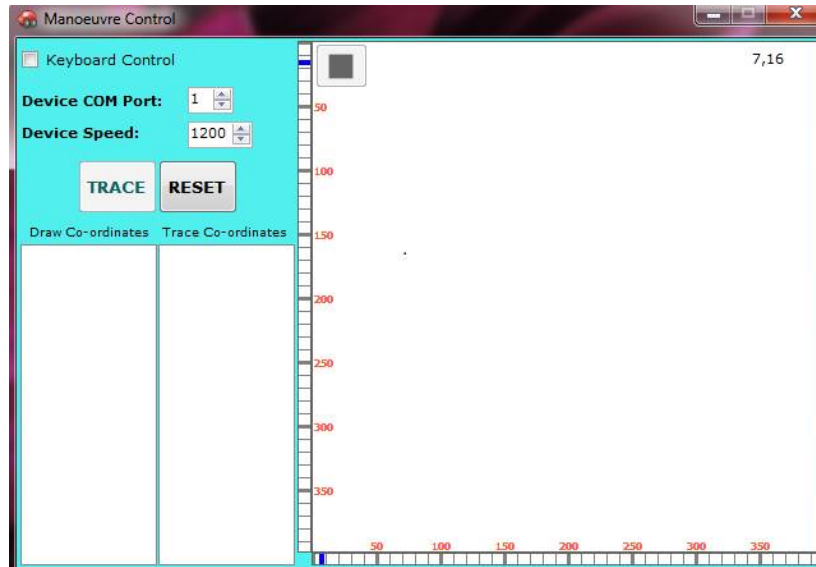


Fig.4

Fig.4 depicts the view of window application on start up. The window consists of a drop down menu to select the COM port followed by the option to select the device speed and the two buttons, one to give the trace command and the other to reset the path to give a fresh path. The two information boxes provides the space to display the information about the co-ordinates taking the path.

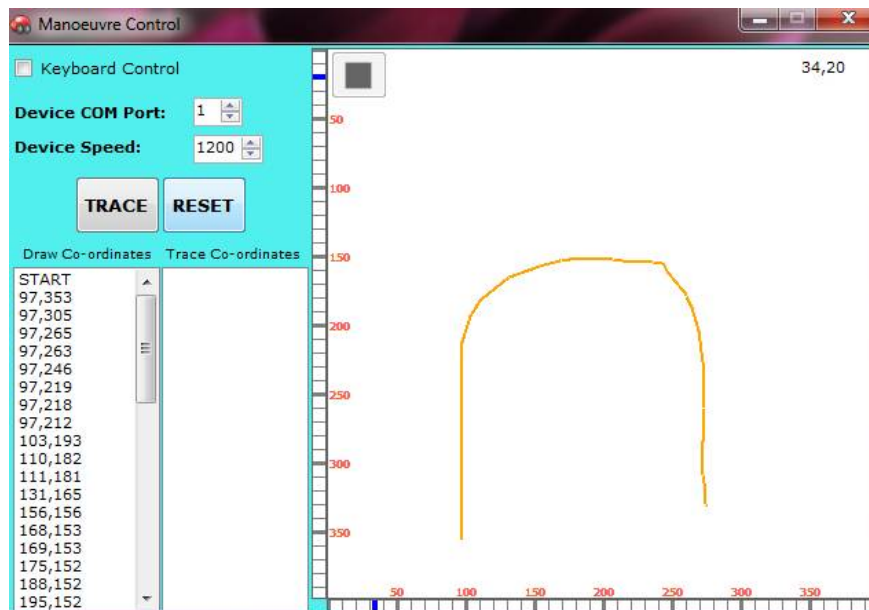


Fig.5

Fig.5 depicts the view of how the path is traced using mouse event handler and in the information box the co-ordinates required to trace the path has been listed, now at this point once the trace button is enabled, the path will be traced.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

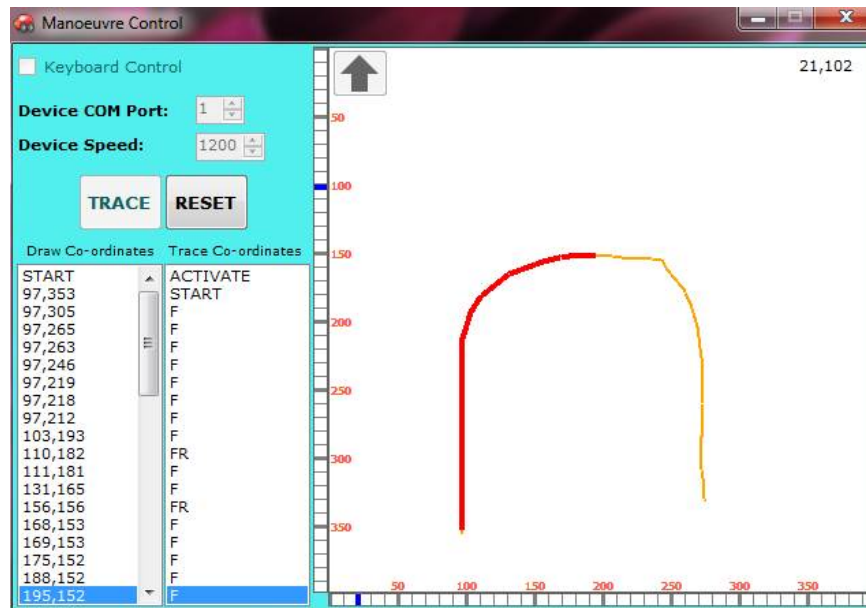


Fig.6

In the Fig.6 we see that a list of alphabets are being generated which corresponds to the movement of the robot specified in the Manoeuvre control algorithm. The overlapped red line starts conquering once the robot starts its movement through Zigbee communication.

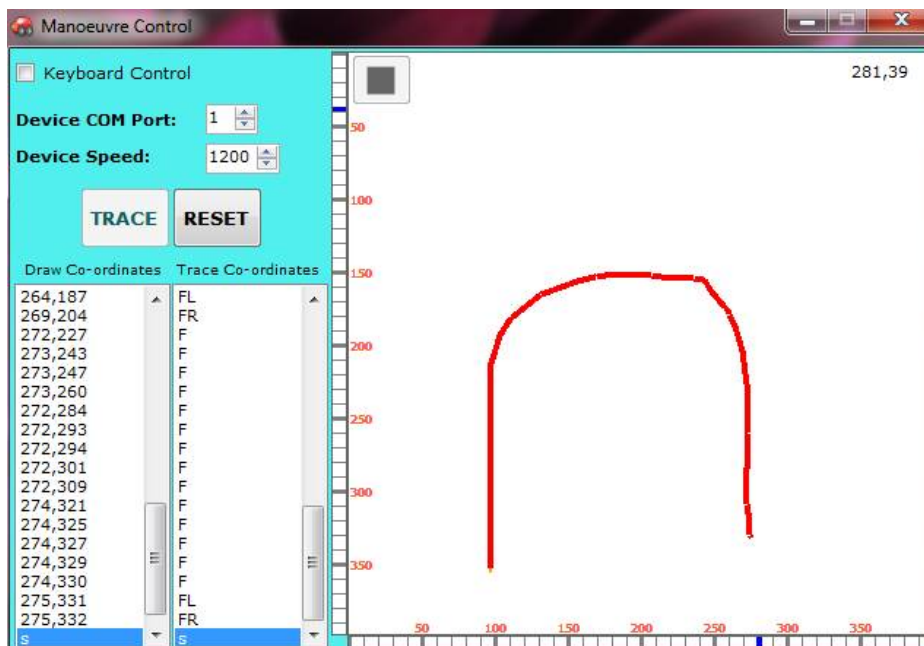


Fig.7

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

Fig.7 shows the tracing of the complete path specified on the window screen, the stop indication at the end of the tracing depicts the complete operation of the manoeuvre control algorithm.



Fig.8

Fig.8 depicts the view of FIRE BIRD V robot displaying the distance of the obstacle present, along with that it also displays the direction taken by the robot.

### VI. CONCLUSION AND FUTURE WORK

The project aims at replacing the traditional line following technology into a computerised control of robot, and the path can be specified as desired. The introduction of the zigbee module provides the wireless communication up to a wider range compared to the Bluetooth technology, usage of sharp IR sensors to detect and overcome the obstacle provides a great way to manoeuvre Fire Bird V. Robot can follow more complicated courses and traverse them more quickly. The overall working complexity is reduced by this approach.

Future enhancement can be implemented by advancing the computer applications by adding features such as exact distance to be traced along the particular direction by providing a text box for numeric entries.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

### REFERENCES

- [1] Abdul Hannan, M.A. Jobayer Bin Bakkre, Md. Selim Hossain, Rajib Chandra Ray "An intelligent line follower using LDR sensor" AJER, e-ISSN: 2320-0847 p-ISSN : 2320-0936 Vol-4, Issue-11, pp-92-102 , 2015.
- [2] Md Zabiuddin, Pushpalatha R "Implementation of line tracing algorithm for path tracking" IJRET, Vol-4 , eISSN: 2319-1163 | pISSN: 2321-7308 , 2015.
- [3] Inian Roy. A, Karthick raja. B, Chakkaravarthy. G, Arun Prakash. C "Line following robot based on vision techniques" IJATES , Volume No.03, Special Issue No. 02, 2015
- [4] Zarith Liyana Zahari, Amir Ahmad, Najiyah Saleh, Nor Shafiqin Shariffuddin "Development of mobility line following car ",IJIRSET, Vol. 4, Issue 10, October 2015
- [5] Ebiesuwa O. O, Adekunle Y. A, Akinyemi L. A, Oyerinde O. D "Line follower robot using a using a sophisticated sensor approach" ,IJERT, Vol-3, ISSN: 2278-0181 , 2013.
- [6] Deepak Punetha, Neeraj Kumar, Vartika Mehta "Development and applications of line following robot based health care management system ", IJAR CET, Vol-2, issue-8,2013.
- [7] Lucky Gautam, Rahul Kr. Verma, Chinoy Sharma "Development manual control for a line follower robot", AEEE, Vol-3, 2014.
- [8] S.Akash, Binek Kabi, Mr. S.Karthick "Implementing a line tracing robot as an effective sensor and closed loop system",International Journal of Recent Trends in Engineering, Vol 2, No. 7, 2009
- [9] M.Z.A Rashid, H.N.M Shah, M.S.M Aras, M.N Kamaruddin, A.M Kaassim, H.I Jaafar "Metal line detection" JATIT, Vol-64,2014.
- [10] M.S.Islam & M.A.Rahman "Design and Fabrication of line follower robot" Asian Journal of Applied Science and Engineering, Vol-2, ISSN 2305-915X 2013.