



e-Yantra Robotics Competition

KOLKATA ROBOSOME

Team leader name	SOUMYADIP GHOSH
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Email	soumyadip93@gmail.com
Theme assigned	LINE FOLLOWER
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Scope

State the scope of the theme assigned to you.

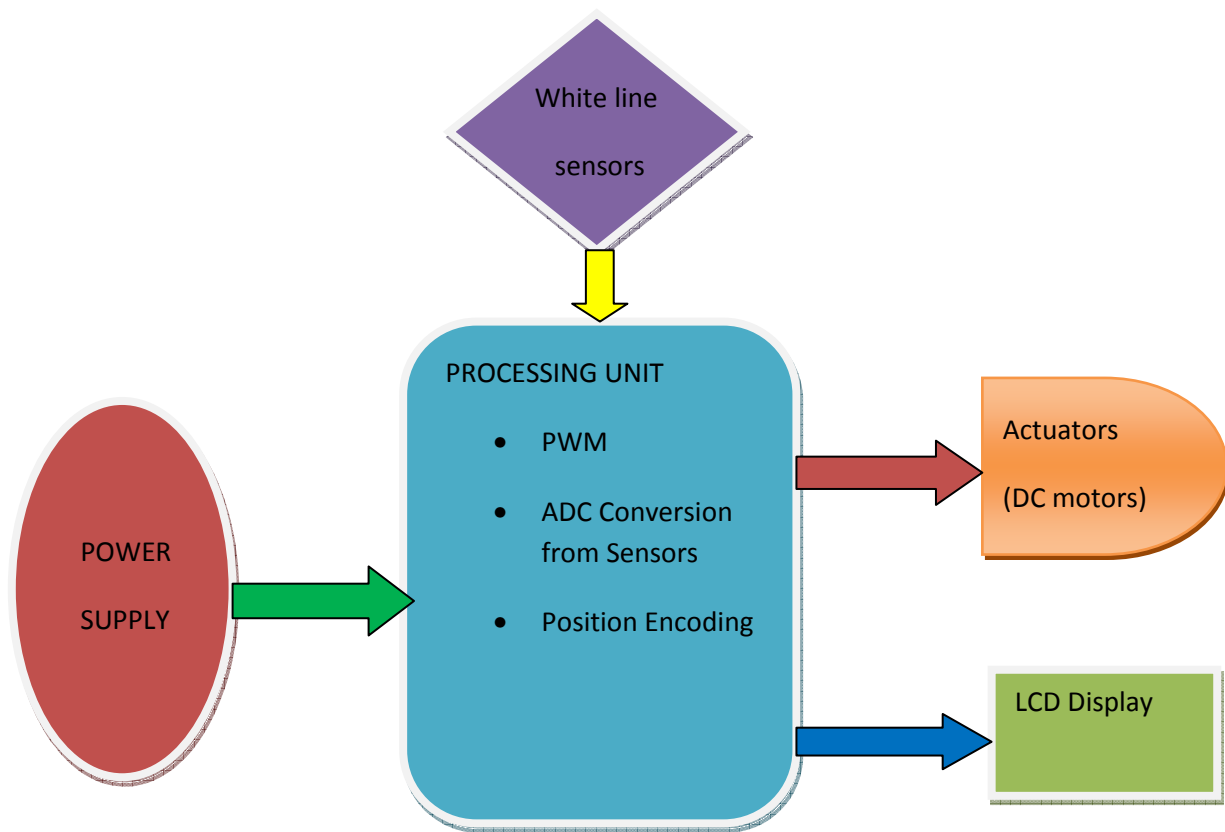
The line follower theme is based on idea of making the robot follow an optimized path in the arena within the shortest possible time. The robot has to be completely autonomous and use its sensor inputs to follow the path.

Such line follower robots can be utilized to deliver cargo within factories, letters within buildings, medication within hospitals, etc. Automated transit systems can be developed using this technology where only a painted line is required for the path as against railways with steel tracks. They can be used as tour guides in tourist spots or library inventory management system for fetching and placing books.

Building Modules

Identify the major building blocks in the robotic system that needs to be designed for your theme.

- 1) Power supply (auxiliary or battery power)
- 2) Processing unit (Atmega2560 as master and Atmega8 as slave)
- 3) Sensors(white line sensors primarily needed)
- 4) Actuators (left motor and right motor for movement)
- 5) Display (optional, can be used to display current status of bot which can help debugging processes)



MAJOR BUILDING BLOCKS IN FIREBIRD V FOR LINE FOLLOWER

Actuators

List all the actuators currently present on FIREBIRD V robot and also the essential actuators required for designing the robotic system in your theme.

- 1) Two 75 RPM DC geared motors powered by L293D motor driver

These two motors are sufficient for the line follower theme. No other actuator is needed.

Explain the mechanism for controlling the actuators on your robot.

- The 75 RPM DC motors are controlled via L293D dual motor driver ICs which can provide upto 600 mA of current to each motor. L293D's direction control pins are used to change the direction of the motor while velocity control is done using PWM. Pins 0 & 1 and pins 2 & 3 of port A are reserved for left and right motor direction controls respectively. Pins 3 and 4 of port L are used for PWM for left and right motors respectively. Position encoders are implemented along with the motors to give position (and velocity) feedback to the microcontroller. Optical encoders MOC7811 are connected with pins 4 and 5 of port E to generate the external interrupts for position encoding.

For the line follower theme, the speed of the motors is controlled according to the white line sensor values.

Environment sensing

Explain the functioning of environment sensing technique used by FIREBIRD V robot in your theme.

- For the line follower theme, the primary requirement is the white line sensor. These sensors are used to distinguish the white line from the black background in the 1st half of the arena and then to distinguish the black line from the white background in the 2nd half.
- Position encoders can be used to provide position feedback to the microcontroller, especially when the robot is traversing the white line square grid.

Power Management

Explain the power management system required for a robot in general and for FIREBIRD V robot in particular.

For any robot in general, there must have a stabilized power supply so that the microcontroller and other devices can function smoothly. If too much harmonics or fluctuations are present, offset voltages may arise resulting in unwanted consequences.

FIREBIRD V has a robust power supply comprising of two modes – Auxiliary power(220 V AC supply) or Battery power (NiMH batteries). The auxiliary supply provides 12 V, 1 A regulated supply. In battery mode, maximum of 2 A current can be utilized while auxiliary supply ensures maximum of 1 A.

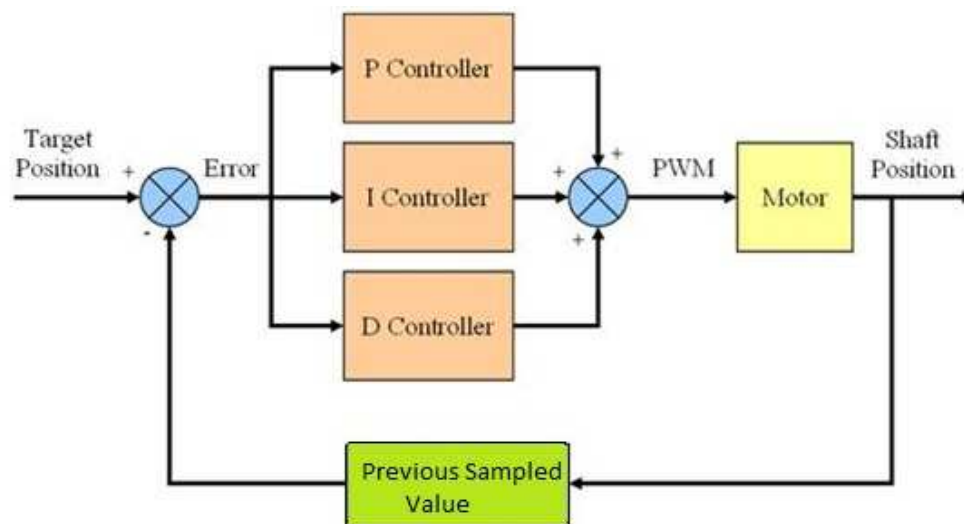
For line follower theme, we intend to use the battery mode of power supply so that the robot can navigate freely. Also, battery mode can provide higher current than auxiliary mode.

Navigation Scheme

Explain in brief the basic navigation technique for path traversal in the arena. Explain the concept and list the components required for basic navigation.

For the line follower theme, we have to develop an intelligent algorithm for following the line. The PID(proportional – integral – derivative) control method of line following can be used in which the error of the current average sensor value from the required sensor value is calculated and accordingly, the motor speeds are varied to initiate turning action. For the white line grid, we have to ensure that the robot does not run over the black spots which is really challenging. After a certain time, the robot has to follow a black line instead of a white line which can be done by reversing the entire conditional logic.

The white line sensors are enough for navigation. The required sensor values are continuously flashed on the LCD Display.



BLOCK DIAGRAM OF PID CONTROLLER ALGORITHM

Challenges

What are the major challenges that you can anticipate in addressing this theme?

- Implementing the PID algorithm for line following.
- Traversing the white line grid in such a way so as to avoid the black spots.
- Changing white line following to black line following as needed.
- Making robot stop at end point and beeping the buzzer.