

TUTORIAL: FIROCEOUS

Problem Statement

Build a fully autonomous robot to traverse white line and capable to stop near the rooms; open the doors; detects whether a lit candle placed inside the room and extinguish that candle, if found.

How to approach

The task can be accomplished by the following steps:

1. A line follower mechanism to traverse the arena.
2. A mechanism to detect the presence of houses beside the white line while traversing.
3. A Light Intensity/Heat detection mechanism through which the robot will be able to check for the candle in the house.
4. A mechanism to extinguish the candle (if present).
5. A rack and pinion mechanism for opening the door of the house.

Mechanisms

The robot will consist of mainly three mechanisms:

1. Line follower.
2. Sonar/Proximity Sensor.
3. Light Detecting Sensors.
4. A high rpm motor with attached propellers to shaft.
5. A low rpm motor with attached rack and pinion mechanism.

Materials required

1. Light Detecting Sensors and light emitter pairs. eg. LED & LDR; LED & Photodiode; IR LED & Photodiode. In this combination LED/IR emit light which is reflected by the surface and received by the LDR/Photo Diode. This generates a variable voltage across the LDR/Photo Diode which helps in differentiating colors.
2. Microprocessor/Microcontroller. Eg. ATmega/Arduino. This is the brain of the BOT. All the inputs we receive from the sensors are sent to the microcontroller. Microcontroller processes the data and gives the required output to the motors. All the commands are given in the form of a code to the

microcontroller estimating all the possibilities. Detailed description of microcontroller is explained in microcontroller tutorial.

3. Sonar(s), which is attached to the left side of the bot. It sends and receives ultrasonic waves to detect the house.
4. Candle detection can be done using light detecting sensors.
5. Mechanism to extinguish candle can be made using a high rpm motor and a propeller attached to it
6. To open the door of the house we can use a low rpm motor with attached rack and pinion.

Line Follower

A line follower robot basically follows a line. It uses the principle that Black color reflects less light falling on it as compare to the White color.

We can use IR-LED sensors or LDR sensors to measure and compare the intensity of reflected light.

House Detection

A house on left side of the road can be detected using SONAR. Sonar is a device which uses ultrasonic waves to detect distance between obstacle and itself. HC-SR05 (Popular Sonar module) emits ultrasonic waves at 40 kHz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance. The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. In order to generate the ultrasound, you need to set the Trig on a High State for 10 μ s. That will send out 8 cycle sonic burst travelling at the speed of sound and automatically turn the Echo pin high. The Echo pin will be low as soon as the sound comes back as echo. So, time between the two will give us the distance of the object from sonar.

Light Intensity Detection

Light Intensity Difference can be detected in many ways. Here we will talk about LDR sensor. An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits.

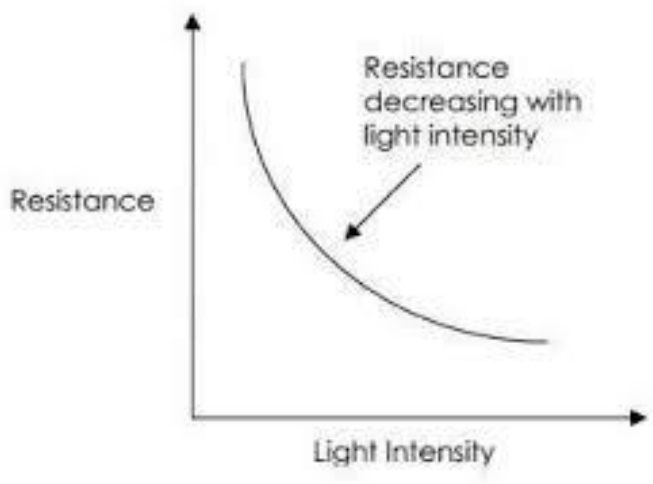


Fig:FT01:Typical LDR resistance vs light intensity

graph.

Light detection circuit

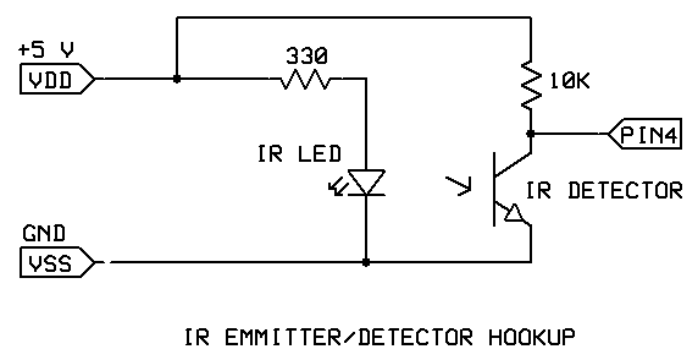


Fig:FT02:Light Detection circuit

The above circuit is a simple light intensity detection circuit, here the resistor and LDR pair serves as a potential divider. As the light intensity increases the resistance of the LDR decreases and hence the potential drop across the resistor increases, so the analog value read by the microcontroller is proportional to the intensity falling on the LDR.

The threshold has to be set accordingly for light ON and light OFF for the Candle light in the house.

Basic Idea

The microcontroller must read the sonar output and hence judging the presence of house. Then after opening the door of the house check voltage across the resistor (Light Detection Circuit) and hence judging the presence candle and blow it off.