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IR Sensor Based Obstacle Detection and Avoiding Robot

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ABSTRACT

An autonomous robot should be made in such a way that it does not require any human control i.e., it should work autonomously. To achieve this task, robots have to avoid obstacles coming in its path. Obstacle detection and avoidance plays major role in robotics. This robot is the first step in building an autonomous industrial robot. This robot uses an IR sensor to detect the objects or obstacles in its path. Then it uses a relay-based switching mechanism to control its motion and to avoid the obstacles. This can be done by a relay and transistor assembly. This is a small attempt to make use of basic electronic components in order to build detection and avoidance mechanisms so that anyone with basic knowledge of electronics can easily understand and implement it.

1. Introduction

Character The obstacle avoiding robot will avoid the obstacles in its path and reaches the destination. Due to the reliability, accessibility and cost effectiveness of using mobile robot in industry the obstacle avoiding robots became important. The military applications of obstacle avoiding robot are reconnaissance, surveillance, battle damage assessment and communications. It is also useful in civilian applications such as disaster management, remote sensing, traffic monitoring etc. In this documentation, we proposed an example of the obstacle avoiding robot using IR sensor. This robot can be used for several applications in education, research or industrial.

2. literature survey

[1]Faiza Tabassum, SusmitaLopa, Muhammad Masud Tarek & Dr. Bilkis Jamal Ferdosi developed an obstacle avoiding robot using Arduino microcontroller and ultrasonic sensors. [2]Mohammed nasucha in 2015 developed an obstacle avoiding robot with proximity sensor and microcontroller. [3] Kirti Bhagat Sayalee Deshmukh Shraddha Dhonde Sneha Ghag the engineering students also built an obstacle avoiding robot with ultrasonic sensor and microcontroller.[4][8] There is an article elprocus showing obstacle avoiding robot without using microcontroller using logical gates and ICs. [5] Akanksha Raghav, Pragati Mishra, Pooja Verma, Kawaljeet Singh Randhawa, Tejaswi Thakur made an obstacle avoiding robot with ultrasonic sensor, microcontroller and Bluetooth module. [6] Roland Philippsen made a robot of "Motion Planning and Obstacle Avoidance for Mobile Robots in Highly Cluttered Dynamic Environments" as his Ph.D Thesis in 2004. He also used microcontroller for this purpose. [7] [12] R Ismail made his research on obstacle avoiding robots using IR and PIR sensors.

3. Existing Work

The present working models include robots made with microcontrollers, ultrasonic sensors and PIR motion sensors [9][10]. They follow complex algorithms and complex structures. They also involve programming that may not be understandable or that requires some effort to learn them. To implement a simple robot one has to go through all the background work in order to implement it. This project makes it simple for anyone to understand the work easily and to use basic components in other way around.

4. Proposed System

This project uses IR sensor, relay module and transistor. It has a simple structure with two wheels and a base to hold circuitry. It consists of an IR sensor in front of the robot to detect the presence of any obstacles. This is connected to transistor which is then connected to relay module for further

communication. Here relay module act as a switching device and transistor acts as an amplifier that amplifies the output of IR sensor.

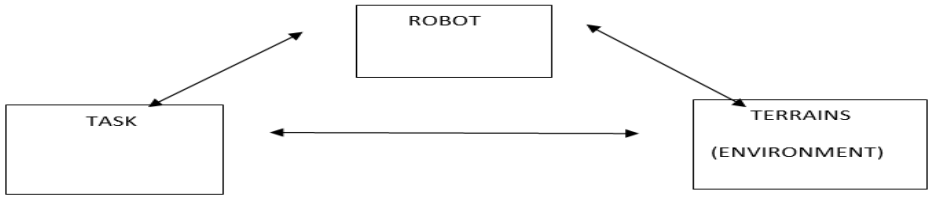

Fig1: Block diagram of proposed systems

5. Methodology

The IR module sends IR rays that will be reflected back if there is any obstacle present in its path. If there is no obstacle the rays go straight without reflecting back to the sensor. Then the relay is in NO mode making no change to the motion of the robot. On the other hand if there is an obstacle present in the path of robot the rays collide with the obstacle and get reflected back from the obstacle and reach the sensor which will then give a high output to the relay module and transistor that will make the desired wheel of motor to stop and move in the desired direction. This is a very simple mechanism which involves providing supply to the motors for motion control using relay and transistor that takes input from sensor module.

6. Ir Proximity Module

The areas of application of Infrared technology include sensing and remote controls. The infrared sensor senses its surroundings by emitting or receiving IR radiation. The working of any Infrared sensor is according to three laws viz. Planck's Radiation law, Stephen – Boltzmann law and Wien's Displacement law. The IR module consists of LED to emit IR radiation and a photo diode that detects the radiation. Then there is a comparator, which has a threshold value that can be altered by potentiometer, on which the output of sensor will depend. Normally, the output is LOW for no obstacle and HIGH for obstacle. It can however be changed at the time of manufacturing.

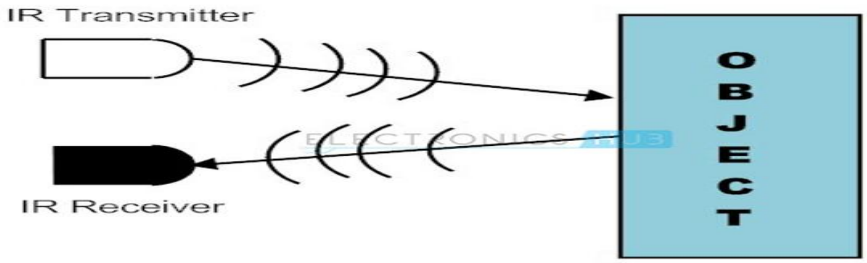

Figure2: IR sensing

6.1 IR Transmitter and Receiver

An LED is used as an IR transmitter to emit IR radiation which is invisible to human eye. So, they are called IR LED's. The transmitter consumes about 3 to 5 mA of current when it is operated at a supply of 5V. The most commonly used modulation in IR sensors is OOK (ON – OFF – KEYING) modulation. The transmitters can be modulated to produce any particular frequency of infrared light. Infrared receivers detect the radiation emitted from an IR transmitter. They are nothing but simple photodiodes and phototransistors and differ from normal photo diodes because they detect only infrared radiation. The picture of an IR receiver or a photodiode is shown below. While using them together we must ensure that the properties of receiver are matching with transmitter used. It consists of a MOSFET which allows the current to flow only when phototransistor receives IR radiation. So, the MOSFET turns on. This turns up the LED which acts as load to the MOSFET. The distance of detection can be controlled by adjusting the potentiometer at the photo transistor [13].

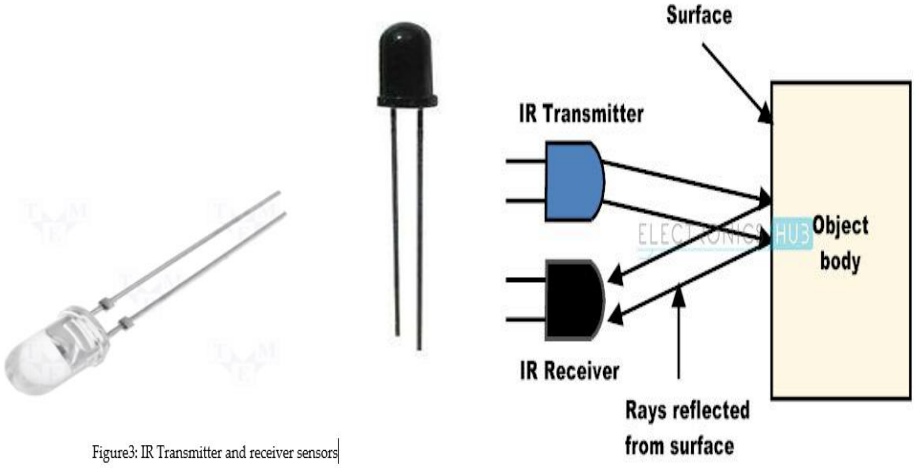

Figure3: IR Transmitter and receiver sensors

Figure 4: Working principle of IR Transmitter and receiver

6.2 Principle of working

The working of an IR sensor as an Object Detection Sensor can be explained as below. As discussed earlier, IR sensor consists of an IR LED and an IR Photodiode which together called as Photo – Coupler or Opto – Coupler. When there is an obstacle present in the path then a portion of emitted IR rays are reflected back to the receiver. The output of sensor depends on the intensity of reflected rays received by the receiver. There is an IC operational amplifier (as voltage comparator) which compares the intensity of reflected rays to the threshold value set by the photodiode (used to calibrate the output of the sensor) and gives the corresponding output. Also, the position of IR transmitter and receiver also plays a major role in detecting the radiation. When they are kept opposite to each other then it is called direct incidence where almost all radiation from the transmitter will be received by the receiver. In this

project we are using them in indirect mode i.e., they are kept adjacent to each other so the reflected radiation is detected and measured.

Figure5: IR Transmitter and receiver module

7. Relay

Relay module is a switching device which uses magnetic property of materials. This is illustrated in the figure below. When power is made to flow through the first circuit (1), it makes the electromagnet to generate a magnetic field that attracts a contact (magnetic device) and makes the second circuit closed (2). When the power is turned off, a spring pulls the contact back to its original position, there by switching the second circuit off again. This is an example for "normally open" (NO) relay. There are other types of relays which are said to be normally closed i.e., current flows through them by default. When there is a magnetic excitation then they make the secondary circuit open. However, NO relays are more common.

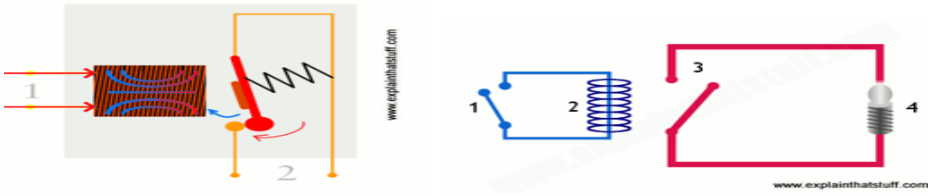

Figure6: Working principle of relays

8. BO Geared motors

A BO geared motor is a combination of general DC motor equipped with a gear assembly to increase torque. Increase in torque is used to increase load on the motor so that it can be used with any type of robotic vehicle having any type of body material. The BO geared motors can be used with any type of battery or a motor driver. But the amount of power supplied to the motors should not exceed the threshold value defined by the manufacturer. Speed reduction can also be done by using correct combination of gears. These can also be controlled by a controller using drivers that are available with various voltages.

Figure7: BO geared motors

9. Jumper wires

Jumper wires are simple wires that are used to connect electronic parts together to form a closed circuitry. They are flexible and easy to use since there are no twisting required as copper wires and no soldering needed as many modules now come with wire holders. According to the modules we are using we can use either male jumpers or female jumpers or male-female jumpers. To use with a bread board, we can use male-male jumper wires.

figure 8: jumber wire

10. Results and Discussions

The outcome of this paper is a simple robot that heads towards its destination detecting and avoiding all the obstacles coming in its path. The robot moves on its path without interruption until there is no obstacle detected by the sensor. If there is an obstacle detected then the left motor stops rotating making the bot to move towards right. After moving right since there is no obstacle in the path the left motor again starts rotating making the robot to move straight forward without collision. In future, we can add some more sensors to make it more efficient. It can also be made more efficient by adding array of IR sensors called PIR sensors. A small camera in front of the robot can be used for

surveillance purpose. The concept of obstacle avoidance can be used to build complex robots such as humanoid robots with simple modifications.

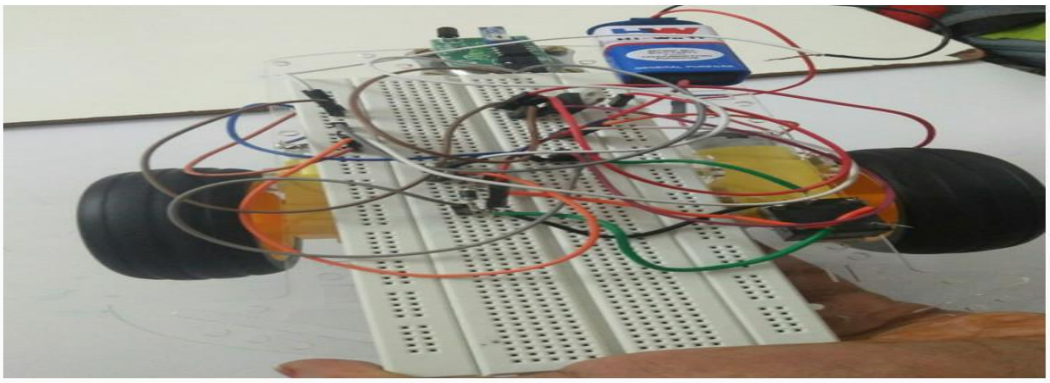

Figure9: Implemented hardware module - photo

11. Conclusion

This is an autonomous robot that does not require any human control. This robot is the first step in building an autonomous industrial robot. This robot uses IR sensor in front of it to sense obstacles and has a relay- transistor control instead of using microcontrollers and other complex algorithms which makes the newbies comfortable to learn and explore electronics. The intension of building this project is to make newbies understand the basics of electronic components and how they can be used in place of microcontrollers. This paper also tells that basic electronic components can replace microcontrollers to achieve the same task with small tradeoffs. This is simple to understand, analyze and build thus meeting the requirement of this paper.

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