

Arduino Based Photovore Robot

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Abstract— A brief description of the light following robot is given in this project report. Objective of the project is to design a robot which can be controlled by using light. The chapters written in this report aims at various aspects of design, construction and application of the robot.

Chapter 1 gives the brief introduction of the Photovore Robot and its various version and variants. **Chapter 2** aims at design of robot. It also gives the sensor circuit that we used in the robot. Block diagram given in this chapter summarizes the working of the robot. **Chapter 3** is devoted to the various hardware and software used in the robot. It provides the specifications of the components used in it. It gives a brief introduction of software used. **Chapter 4** gives the detail of the Arduino board and software programming used in making robot. **Chapter 5** is all about Project Implementation. It includes various stages of interfacing of the hardware used. **Chapter 6** aims at the various applications of Photovore Robot. **Chapter 7** is the gives the result, conclusion and future scope.

Index Terms— Application of Photovore Robot, Conclusion, Introduction, Future Scope, Introduction to Arduino, Project Implementation, Sensor, Hardware and Software Used, Result

1 INTRODUCTION

1.1 Project Introduction

The project is a Robot which chases the light. This type of Robot is best suitable for military application. Light can be chased using a light sensor. The Photovore is a robot that chases light, for this to work, robot needs at least two light detecting sensors, typically photoresistor or IR emitter/detectors, out in front and spaced apart from each other. One on left side of robot, the other located on the right side as shown in fig 1.1.

Arduino Board is used for implementing the Robot. The analog pins of Arduino board read the analog value from both sensors. Then do a comparison - the sensor that reads more light is the direction robot should turn. For example, if the left photoresistor reads more light than the right photoresistor, robot should turn or tend towards the left. If both sensors read about the same value, meaning the both get the same amount of light, then robot

should drive straight.

Pseudo Code

```
read left_photoresistor
read right_photoresistor
if left_photoresistor detects more light than
right_photoresistor
then turn robot left
if right_photoresistor detects more light
than left_photoresistor
then turn robot right
if right_photoresistor detects about the
same as left_photoresistor
then robot goes straight
loop
```

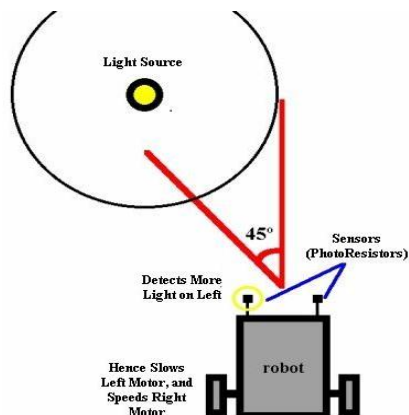


Fig. 1.1.1 Light detection by sensor

1.2 Object Avoidance

By using the same exact code, and same exact robot, by doing a small modification we can give Photovore the ability to avoid objects. By bending photoresistor downwards, and close to the ground, depending on the lighting, objects will all cast shadows onto the ground. Avoiding darkness, your Photovore robot is naturally an object avoider. Of course if the lighting shines directly onto an object, or if we have dark floors with white walls, it might not work so well. But its easy and it will work... For making a **line following robot**, make a Photovore, point the photoresistor towards the ground, and space the photoresistor so that the distance is less than the width of the white line. Exactly same algorithm can be used.

1.3 Photovore Algorithm Improved

This algorithm does the same as the original, but instead of case-based it works under a more advanced Fuzzy Logic control algorithm. Our robot will no longer just have the three modes of turn left, turn right, and go forward.

Pseudo code:

```

Readleft_photoresistor
read right_photoresistor
right_motor=(right_photoresistor-
left_photoresistor) * arbitrary_constant
loop
    
```

1.4 Photovore, Split Brain Approach

This algorithm works without comparison of photoresistor values. Instead, just command the right motor based on light from the left sensor, and the left motor with only data from the right sensor. You can also get interesting variations by reversing the sensors for a cross-brain algorithm shown in fig 1.3.1.

Pseudo code:

```

Readleft_photoresistor
read right_photoresistor
moveleft_wheel_speed=right_photoresistor
*arbitrary_constant
moveright_wheel_speed=
left_photoresistor * arbitrary_constant
loop
    
```

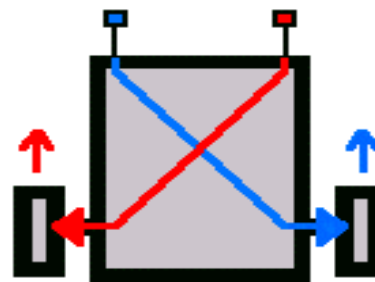


Fig 1.4.1 Split brain approach

1.5 Photophobe

The Photophobe robot is a robot that runs away from light instead of chases light. There are two ways to do this. The first is simply to reverse the left and right photoresistor, so that the left sensor is on the right side, and the right sensor is on the left side. With no changes of code, it will avoid light as shown in the fig 1.5.1.

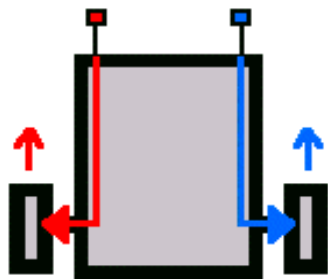


Fig 1.5.1 Photophobe schematic

```

read left_photoresistor
read right_photoresistor
if left_photoresistor detects more light than
right_photoresistor
then turn robot right
if right_photoresistor detects more light
thanleft_photoresistor
then turn robot left
if right_photoresistor detects about the same
asleft_photoresistor
then robot goes straight
loop
    
```

1.6 Project Overview

The project uses Arduino as the controlling element. It uses Light Dependent Resistor (LDR). When light comes in the path of sensor then sensor gives +5V to arduino board. This +5v is detected then arduino board decides to run the robot by taking left or right turn. If the sensor gives 0v to arduino board that means there is no light present in it path so it would be stop until any light is detected.

The two light detector resister are fitted on front of robot. The connection can be given from main circuit to sensor using simple connecting wires.

Two motors namely right motors and left motors are connected to driver IC (L293D). L293D is interface with the arduino board. Arduino board sends logic 0 & logic1 as per the programming to driver IC which moves motor left, right and forward direction.

The solar panels used today are mostly stationary and do not have the ability to grasp all the energy of the sun because of its inability to shift its position according to the movement of the sun. Because of the still stature of the harnessing methods used today it may not be able to re-

ceive the best part of the energy which is hitting the surface of the earth. The machine which has been designed (Photovore) for this particular job has the ability of detecting the presence of light in an area and following the path illuminated by it. This is a really good application of an LDR (light dependent resistor) since it involves the detection of light with the help of the LDR and the intelligent independent behavior of the machine based on the reception of solar energy.

2 SENSOR

2.1 Sensor Schematic

The sensor that we used in our project is Light Dependant Resistor (LDR). It is made up of Cadmium Selenide (CdS). CdS is mainly used as a pigment. CdS and Cadmium Selenide are used in manufacturing of photoresistor (light dependent resistors) sensitive to visible and near infrared light. The photoresistor is shown in the fig. 2.1.1

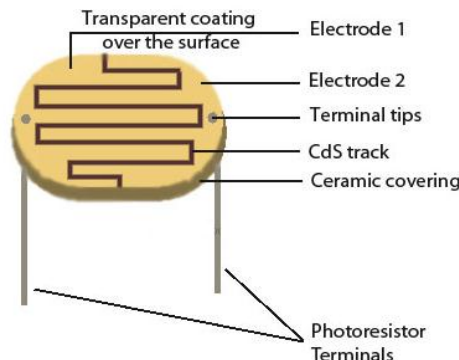


Fig. 2.1.1 Internal structure of photoresistor

In thin-film form, CdS can be combined with other layers for use in certain types of solar cells. CdS was also one of the first semiconductor materials to be used for thin film Transistors (TFTs). However interest in compound semiconductors for TFTs largely waned after the emergence of amorphous silicon technology in the late 1970s.

2.1.1 Sensor Behavior

It exhibits photoconductivity. It can also be referred as photoconductor. Its resistance decreases with increasing light intensity and vice versa. In bright light its resistance can go down to few ohm. IN dark, its resistance goes in the range

of mega ohms.

2.1.2. Sensor Circuit

To use them as a sensor, we need to measure the voltage drop across the resistor with the analog port of Arduino board (because a change in resistance means a change in voltage). There are two ways to implement photoresistor:

Voltage Increases with Light

To choose resistor values, solve this equation:

$$(R * V_{in}) / (R + R_{photo}) = V_{out}$$

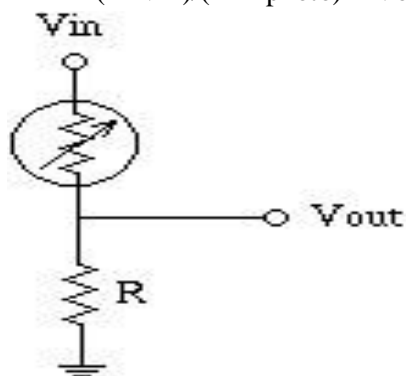


Fig.2.1.2 a Voltage divider circuit with light

Voltage Decreases with Light

To choose resistor we solved this equation

$$(R_{photo} * V_{in}) / (R_{photo} + R) = V_{out}$$

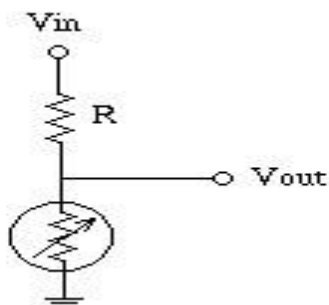


Fig2.1.2.b Measuring resistance in dark

Solving the Equations to mine Resistance, R:

There are three steps to determining what resistor we should use for R. To do this, we first need to get out a multi-meter and measure the resistance across the photoresistor in two situations. The first situation is the darkest light my robot photoresistor will see.

The second situation is for the brightest light my robot will see. Now all we need to do is multiply both resistance values, then find the square root of the total. This is the resistor you should use.

$$\text{Resistor} = \sqrt{R_{\text{dark}} * R_{\text{bright}}}$$

The first photoresistor that we used gave the following value:

$$R_{\text{photo}} = 4 \text{ K}\Omega$$

$$R_{\text{dark}} = 0.8 \text{ M}\Omega$$

$$R1 = \sqrt{4 \text{ K ohm} * 0.8 \text{ M ohm}} = 5.65 \text{ K}\Omega$$

The second photoresistor that we used gave the following value:

$$R_{\text{photo}} = 18 \text{ K}\Omega$$

$$R_{\text{dark}} = 1.8 \text{ M}\Omega$$

$$R1 = \sqrt{18 \text{ K ohm} * 1.8 \text{ M ohm}} = 5.692 \text{ K}\Omega$$

2.1.3. Sensor Working

A photoresistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, e.g. silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities, also called dopants, added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump,

lower energy photons (i.e., longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor. Photoresistor are basically photocells.

2.2 Block Diagram of Photovore Robot:

Following block diagram shows the working of robot

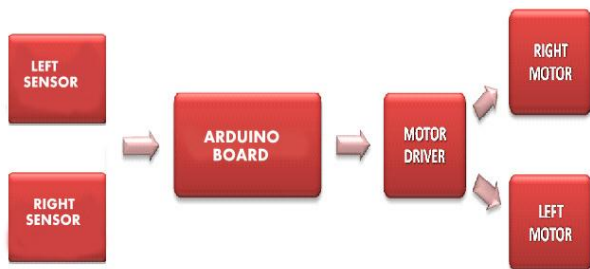


Fig 2.2.1 Block diagram of Photovore Robot

The block diagram shown above shows the working of Photovore robot. There are two sensors on the right and left side of the robot placed in front of the motor. Both the sensors are connected to the input pin of the Arduino board. The output of is taken from the PWM pin of the Arduino. This output goes to motor driver which drives the motor.

3. Hardware and Software Used

3.1. Photoresistors

It has been used as sensor. The purpose of two photoresistor is used for left and right movement of the robot. Some of the photoresistors are shown in the fig.3.1



Fig.3.1.1.Photoresistor

3.2. The Arduino Board

The Arduino board that is used Severino.

Arduino board has 28-pin DIP MCU. It could have any of the three MCU chips:

ATmega8 or 8L – 8K ROM, 512B RAM

ATmega168 – 16K ROM, 1024B RAM

ATmega328 – 32K ROM, 512B RAM

All have same number of Input /Output Lines - 14 Digital I/O Lines + 6 Analog Inputs.

The more information of ATmega8 is given in the Appendix A. The board is shown in the fig 3.2.1

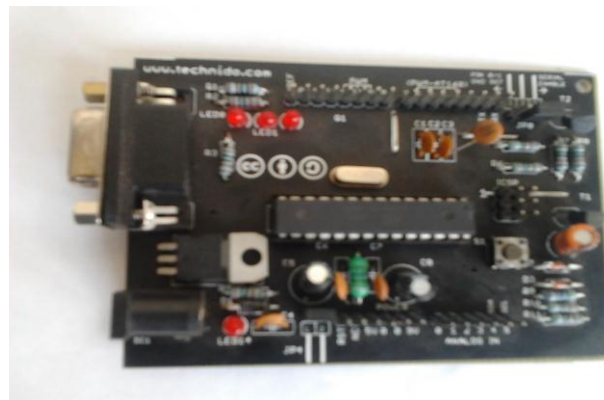


Fig.3.2.1. Arduino board

3.3. Motor

Two 12V DC motors are used. The motor has the following specifications:

It is a geared motor

RPM of motor is 200



Fig.3.3.1.Motor

3.4. The Motor Driver

The motor driver shield is used to drive the dc motor. We cannot get sufficient current from the pin of MCU to drive the motor. So we need a driver. It not only amplifies the current but also it helps in clockwise and anticlockwise movement of motor. It can drive two dc motor at a time. It uses motor driver IC L293D IC. For more information

about L293D refer to Appendix B. The motor driver is shown in the fig.3.4.1.



Fig.3.4.1 Motor driver

It is designed to introduce programming to artists and other newcomers unfamiliar with software development

It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. There is typically no need to edit [Makefiles](#) or run programs on the command line. The Arduino IDE comes with a C / C++ library called "Wiring" (from the project of the same name), which makes many common input/output operations much easier. Arduino programs are written in C/C++, although users only need to define two functions in order to make a runnable program:

setup() – a function run once at the start of a program which can be used for initializing settings, and

loop () – a function called repeatedly until the board is powered off.

3.5 Battery

For power supply we have used 12 V dc battery. The battery is shown in the fig.3.5.1

Its specifications are given below:

It is a rechargeable maintenance free battery

It is sealed lead acid battery

It is a 12v dc battery with current rating 1.2 amp.

For charging current limit should be 0.36 amp.





Fig.3.5.1 Battery



3.6 Software

The Arduino IDE is a cross-platform application written in Java which is derived from the IDE made for the Processing programming language and the *Wiring* project.



NB: Versions of the IDE prior to 1.0 saved sketches with the extension .pde. It is possible to open these files with version 1.0, you will be prompted to save the sketch with the .ino extension on save.

-  **Verify**
Checks your code for errors.
-  **Upload**
Compiles code and uploads it to the Arduino I/O board. See uploading below for details.

Note: If you are using an external programmer, you can hold down the "shift" key on your computer when using this icon. The text will change to "Upload using Programmer"
-  **New**
Creates a new sketch.
-  **Open**
Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window.



Note: due to a bug in Java, this menu doesn't scroll; if you need to open a sketch late in the list, use the **File | Sketchbook** menu instead.
-  **Save**
Saves your sketch.
-  **SerialMonitor**
Opens the serial monitor.

Fig 3.6.1 Snapshot of Arduino IDE

The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor:

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Additional commands are found within the five menus: **File, Edit, Sketch, Tools, Help**. The menus are context sensitive which means only those items relevant to the work currently being carried out are available.

4 Introduction to Arduino

4.1 Arduino

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform

based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicate with software running on your computer (e.g. Flash, Processing, MaxMSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

4.2 Arduino Advantages

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$50
- Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- Simple, clear programming environment - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the environment will be familiar with the look and feel of Arduino

- Open source and extensible software- The Arduino software and is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- Open source and extensible hardware - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontrollers. The plans for the modules are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

4.3 Arduino Development Environment

The Arduino development environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Software written using Arduino are called **sketches**. These sketches are written in the text editor. Sketches are saved with the file extension .`ino`. It has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino environment including complete error messages and other information. The bottom right hand corner of the window displays the current board and serial port.

5. Project Implementation

5.1 Connection of Motor Driver and Arduino Board

Interfacing of motor driver with arduino board. Below table shows the connection of respective pin of motor driver with the arduino board . In the fig module 3 is the motor driver and module 4 is the arduino board.

Motor Driver	Arduino Board
+9V	+9V
+5V	+5V
Gnd	+Gnd
IN1	PWM pin 9
IN2	digital pin 2
IN3	PWM pin 10
IN4	digital pin 1

Table 5.1.1 Connection of motor driver with arduino board

5.2 Connection of Motor

Now connect the motor pin to the motor driver. The left motor connected to the pin of left motor driver and the right motor connected to the right pin of motor driver. The module 2 is the motor.

5.3. Sensor Interfacing

The fig 5.2.1 shows the interfacing of sensor with the arduino board. There are three terminals in the sensor viz. Ground, Power supply and output. Sensors are interfaced in a way such that it controls the motor. Left sensor controls the right motor and right sensor controls the left motor.

In the above fig module 5 is the sensor. The interfacing of these two is as follows.

Table 5.3.1. Connection of sensor with the Arduino board

Sensor	Arduino Board
+5V	+5V
Gnd	Gnd
Left sensor	analog pin 1
Right sensor	analog pin 0

5.4. Power Supply connection and Final Assembly

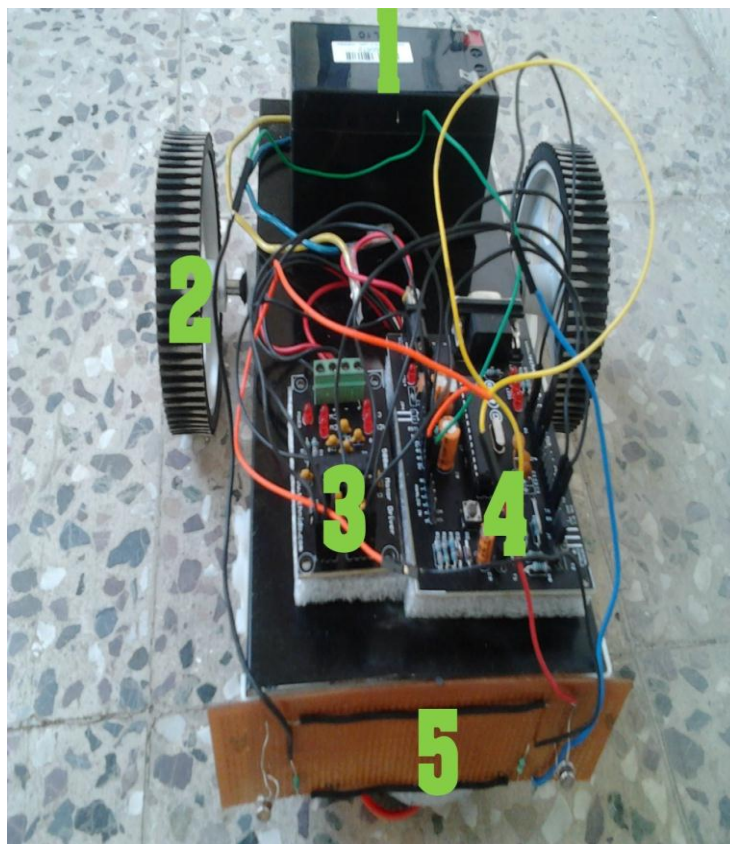


Fig 5.4.1 Connection of power supply and final assembly

The module 1 is power supply. The power supply connected to the arduino board. In the Fig 5.4.1 the final assembly is shown.

5.5 Source Code

Following source code is used for controlling the robot.

```
/*  
  
program for Photovore robot  
  
The circuit:  
  
* Left sensor attached to analog input 1  
  
* Right sensor attached to analog input 0  
  
* One terminal (either one) to ground  
  
* The other terminal to +5V  
  
* Motor wires connected to RIGHT Motor pins on  
L293D Board  
  
* Pin D10 - PWM giving signal to IN1 of L293D  
Board  
  
* Pin D9 - PWM giving signal to IN3 of L293D  
Board  
  
FWD direction: pin 10 = 1, pin 9 =0  
  
STOP: pin 10 = 0, pin 9 =0  
  
*/  
  
//define then motor driver pin:  
  
#define IN3 9  
  
#define IN4 1  
  
#define IN1 10  
  
#define IN2 2  
  
#define sensor_left 0  
  
#define sensor_right 1
```

```
int sensorValue_left=0;  
  
int sensorValue_right=0;// variable to store the value  
coming from the sensor  
  
const int threshold = 1023; //define the threshold  
  
void setup()// run once, when the sketch starts  
{  
  
//declaration of output pin  
pinMode(IN1, OUTPUT);  
pinMode(IN2 , OUTPUT);  
pinMode(IN3, OUTPUT);  
pinMode(IN4 , OUTPUT);  
}  
  
void loop() {  
  
// read the value from the sensor right:  
sensorValue_right = analogRead(sensor_right);  
if(sensorValue_right >= threshold)  
{  
  
//turn robot right:  
analogWrite(IN1,sensorValue_right/4);  
analogWrite(IN2,0);  
}  
  
sensorValue_left = analogRead(sensor_left);  
  
// read the value from the sensor left:
```

```
if (sensorValue_left >= threshold)
{
// turn the robot left:
    analogWrite(IN3,sensorValue_left/4);
    analogWrite(IN4,0);
}
else {
// move the robot straight:
    analogWrite(IN1,sensorValue_right);
    analogWrite(IN2,0);
    analogWrite(IN3,sensorValue_left);
    analogWrite(IN4,0);
}
}
```

6 Application of Photovore Robot

6.1. Smoke detector is a device that detects smoke, typically as an indicator of fire. Commercial, industrial, and mass residential devices issue a signal to a fire alarm system while household detectors, known as smoke alarms, generally issue a local audible or visual alarm from the detector itself. This home smoke detector circuit warns the user against fire accidents. It relies on the smoke that is produced in the event of a fire and passes between a bulb and an LDR, the amount of light falling on the LDR decreases. This type of circuit is called optical smoke detector. Do not use it as a home smoke detector it's just for electronic projects.

This causes the resistance of LDR to increase and the voltage at the base of the transistor is pulled high due to which the supply to (COB) chip on board is completed. The sensitivity of the smoke detector depends on the distance between bulb and LDR as well as setting of preset VR1. Thus by placing the bulb and the LDR at appropriate distances; one may vary preset VR1 to get optimum sensitivity.

6.2. Laser Computer Tomography Scanner

A laser CT scanner (Fig.5.2.1) based on the principle of a first generation X-ray CT was constructed. This scanner consisted of an aquarium, a turntable with angular graduation, a red diode laser (~633 nm) as light source, light dependent resistors (LDR) in series with a resistor as detectors. A Pentium PC controlled the translate-rotate motion and also served as the data acquisition system. The aquarium of size 26 x 26 x 20 cm³ was fabricated using Perspex with wall thickness of 3 mm on the laser transmission sides. The turntable fixed in the aquarium was rotated using a 4-pole stepper motor. Reduction gears were used such that the turntable rotated 0.35° for each pulse sent to the stepper motor.

The linear motion of the source and the detector was achieved with two parallel 'gear and belt' arrangements driven by a single DC motor. The DC motor used for the linear motion and the stepper motor for the rotational motion were driven by the PC through the parallel port. The laser beam was tilted to a small angle (~ 5°) to avoid reflected light falling on the detector. The position of the detector was determined by a 10-turn 20K linear potentiometer. A regulated 10 Volt DC was applied to the potentiometer and the LDR. The change in resistance was measured as the variation in the voltage and fed to the PC through a DT 9812 ADC

6.3. Pulse Oximeters

Pulse oximetry is a non-invasive method allowing the monitoring of the oxygenation of a patient's hemoglobin.

A sensor is placed on a thin part of the patient's body, usually a fingertip or earlobe, or in the case of an infant, across a foot. Light of two different wavelengths is passed through the patient to a photodetector. The changing absorbance at each of the wavelengths is measured, allowing determination of the absorbances due to the pulsing arterial blood alone, excluding venous blood, skin, bone, muscle, fat, and (in most cases) nail polish. With NIRS it is possible to measure both oxygenated and deoxygenated hemoglobin on a peripheral scale (possible on both brain and muscle)

This method does not require a thin section of the patient's body and is therefore well suited to more universal application such as the feet, forehead and chest.

A blood-oxygen monitor displays the percentage of arterial hemoglobin in the oxyhemoglobin configuration. Acceptable normal ranges for patients without COPD with a hypoxic drive problem are from 95 to 99 percent, those with a hypoxic drive problem would expect values to be between 88 to 94 percent, values of 100 percent can indicate carbon monoxide poisoning. For a patient breathing room air, at not far above sea level, an estimate of arterial pO_2 can be made from the blood-oxygen monitor SpO_2 reading.

Pulse oximetry is a particularly convenient noninvasive measurement method. Typically it utilizes a pair of small light-emitting diodes (LEDs) facing a photodiode through a translucent part of the patient's body, usually a fingertip or an earlobe. One LED is red, with wavelength of 660 nm, and the other is infrared, 905, 910, or 940 nm. Absorption at these wavelengths differs significantly between oxyhemoglobin and its deoxygenated form; therefore, the oxy/deoxyhemoglobin ratio can be calculated from the ratio of the absorption of the red and infrared light. The absorbance of oxyhemoglobin and deoxyhemoglobin is the same isosbestic point for the wavelengths of 590 and 805 nm; earlier equipment used these wavelengths for correction of hemoglobin concentration.

The monitored signal bounces in time with the heart beat because the arterial blood vessels expand and contract with each heartbeat. By examining only the varying part of the absorption spectrum (essentially, subtracting minimum absorption from peak absorption), a monitor can ignore other tissues or nail polish, (though black nail polish tends to distort readings and discern only the absorption caused by arterial blood. Thus, detecting a pulse is essential to the operation of a pulse oximeter and it will not function if there is none.

6.4 Energy Detection

It can be used in detecting maximum energy received from the sun. If the solar plate is kept in the one direction whole day it cannot get maximum intensity of the sunlight. So Photovore robot can be used to detect maximum intensity

and it will also change its direction. Hence solar plate can get maximum intensity whole day.

7.Result, Conclusion & Future Scope

7.1 Result

The photovore is a robot which primarily focuses on the need for detection of the most easily available source of energy in our planet. The machine has the capability of detecting the presence of solar energy in a particular area and follows it. The device is totally autonomous and it requires no human interference or attention.

7.2 Conclusion

The Photovore robot has fulfilled all its objectives that were planned at the time of planning.

7.3 Future Scope

This robot may find its application at various situations. Some of the applications are discussed in CHAPTER 6. There are various scope of improvement in it. It can be upgraded to color sensor.

8. Acknowledgments

I would express my deep gratitude to the initiator and the guide of my Project Ms. Kirti Panwar who suggested the project and guided throughout the course of the project. She was always there to favor and motivate us whenever it was needed. I would also like thanks to my friend Mr. Mukund Kumar who worked as a coauthor during all the project.

9.References

1. <http://www.robotplatform.com/electronics/photoresistor/photoresistor.html>
2. <http://www.societyofrobots.com/>
3. <http://www.arduino.cc/>
4. <http://www.engineersgarage.com/microcontroller/8051projects>
5. <http://www.atmel.com/>
6. http://sbolt.home.xs4all.nl/e-fotovoor_prestaties.html
7. <http://www.scribd.com/doc/63071973/Photovore-Robot>
8. <http://www.azom.com/article.aspx?ArticleID=5816>
9. <http://www.sccs.swarthmore.edu/users/06/adem/engin/e72/lab7/>
10. <http://www.faadooengineers.com/index.php>
11. <http://www.faadooengineers.com/threads/5219-Relay-coordination-seminar-report-pdf-download>.

