Project report on

RPM READING OF DC MOTOR

Submitted in partial fulfillment of the award of the degree

Of

Bachelor of Technology

In

Electronics and Communication Engineering

Of

APJ Abdul Kalam Technological University

By

Abhijith Anand N	PTA19EC001
Ananthakrishnan N	PTA19EC007
Aswathy MT	PTA19EC012

Under the guidance of

Ms. ARYA S
(Assistant Professor in Electronics & Communication, College of Engineering Kallooppara)

June 2022

Department of Electronics and Communication Engineering
College of Engineering Kallooppara, PIN Code-689 583
Phone: (0469) 2677890, 2678983 Fax: (0469) 2677890

Project report on

RPM READING OF DC MOTOR

Submitted in partial fulfillment of the award of the degree

Of

Bachelor of Technology

In

Electronics and Communication Engineering

Of

APJ Abdul Kalam Technological University

By

Abhijith Anand N	PTA19EC001
Ananthakrishnan N	PTA19EC007
Aswathy MT	PTA19EC012

Under the guidance of

Ms. Arya S
(Assistant Professor in Electronics & Communication, College of Engineering Kallooppara)

June 2022

Department of Electronics and Communication Engineering
College of Engineering Kallooppara, PIN Code-689 583
Phone: (0469) 2677890, 2678983 Fax: (0469) 2677890

COLLEGE OF ENGINEERING KALLOOPPARA

Department of Electronics and Communication Engineering

CERTIFICATE

This is to certify that the project entitled

RPM READING OFDC MOTOR

Submitted by

Abhijith Anand N	PTA19EC001
Ananthakrishnan N	PTA19EC007
Aswathy MT	PTA19EC012

Is a bona fide work done by them .

Guide	Co-ordinator	Head of the Department
Ms. Arya S	**Mr. Saajeesh PTK**	**Dr. Philip Cherian**
Assistant Professor	**Assistant Professor**	**Associate Professor**
Department of ECE	**Department of ECE**	**Department of ECE**

ACKNOWLEDGEMENT

We take this opportunity to express our gratitude and respect to all those who have helped us throughout this project.

First of all, we are deeply grateful to the **Almighty God** for his grace and mercy that enabled us in the finalization of this project.

We express our sincere gratitude to our principal **Dr. Nisha Kuruvila** for giving us an opportunity to reach beyond the knowledge of textbook and enter into the vastness of practical knowledge.

We would like to thank our Head of the Department **Dr. Philip Cheriyan** who always guided us in the right direction.

We owe a deep sense of gratitude to our project coordinator **Mr. Sajeesh PTK**. We were privileged to experience a sustained enthusiastic and involved interest from his side. This fueled our enthusiasm even further and encouraged us to boldly step into what was a totally dark and unexplored expanse before us.

We are greatly obliged to our project guide **Ms. Arya S**, Assistant Professor of Electronics & Communication. She always fueled our thoughts to think broad and out of the box.

We also extend our heartfelt thanks to the entire staff members, our friends and our family for their motivation, guidance and support.

ABSTRACT

The objective of the project is to read RPM of DC Motor. Nowadays it is necessary to read RPM of various motors because it is needed to be used at particular speed for different purposes. So for adjusting the speed of motor, RPM reading and displaying it is inevitable. Here we used a DC motor and with the help of IR sensor the number of revolutions per minute is calculated and using Arduino UNO board RPM is counted and displayed on the LCD Display. When we press the switch the RPM of the motor is counted and is displayed in the LCD display.

CONTENTS

LIST OF FIGURES

1. INTRODUCTION

In this project, we made an RPM Reader of DC Motor using Arduino Nano which is interfaced with IR sensor, LCD Display and DC Motor. When we press start button the RPM of the revolving disc which is connected with the DC Motor is calculated by using IR sensor circuit and the RPM of the DC Motor is displayed on the LCD Display

2. PROBLEM DEFINITION AND OPTIMISED SOLUTION

2.1 PROBLEM DEFINITION

In many rice mills and wheat mills the motor should revolve in a particular RPM for obtaining maximum output. So while adjusting RPM of Motor for a particular use it is relevant to know the current speed of the Motor.

2.2 OPTIMISED SOLUTION

Taking the above concern in regard there is a need of a display which shows the current RPM of a motor. For that we executed a simple circuit. RPM of the motor is read with the use of IR sensor, Arduino nano board and LCD Display.

3. BLOCK DIAGRAM

3.1 BLOCK DIAGRAM OF THE RPM READER OF A DC MOTOR

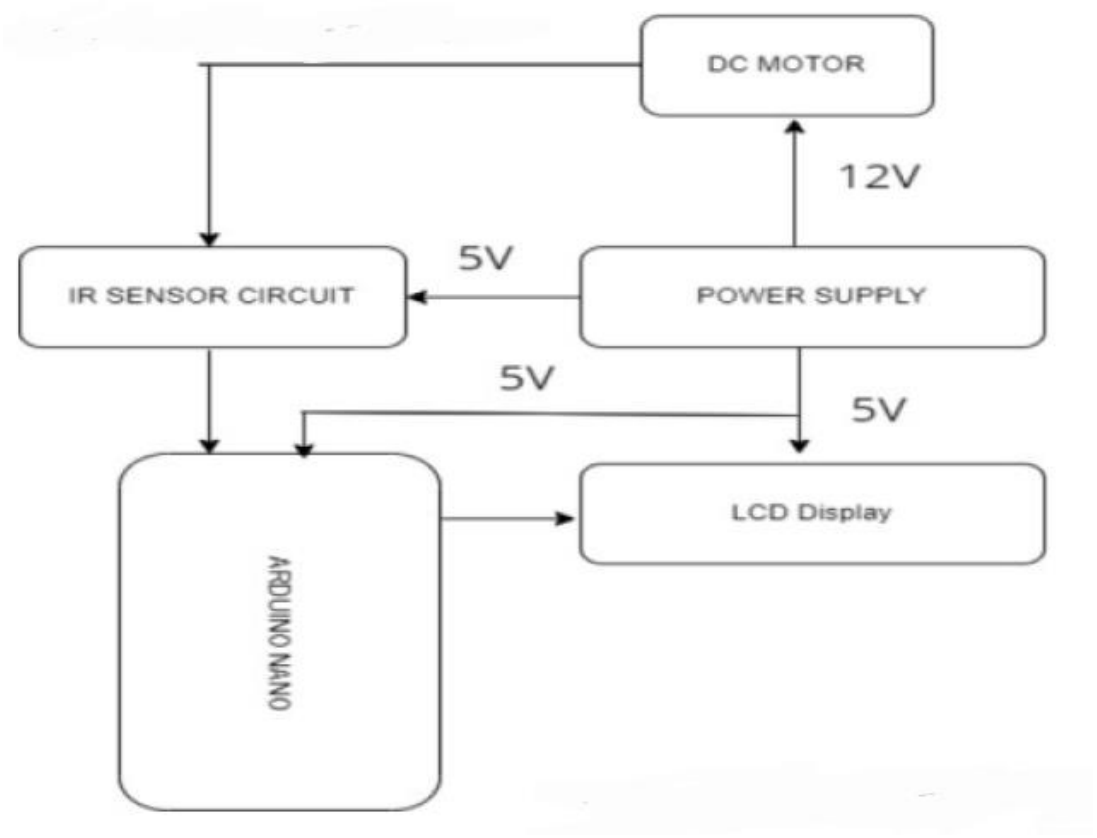


Fig. 3.1 Block diagram of RPM Reader

3.2 BLOCK DIAGRAM DESCRIPTION

Here from power supply Arduino nano board, LCD Display, IR sensor circuit gets 5V for their working. Power supply also provides 12V for the DC Motor. DC Motor starts revolving and when we press the start button the count collected using IR sensor circuit is analyzed by Arduino uno board and the RPM of DC Motor is displayed on the LCD Display

4. CIRCUIT DIAGRAM

4.1 CIRCUIT DIAGRAM OF POWER SUPPLY

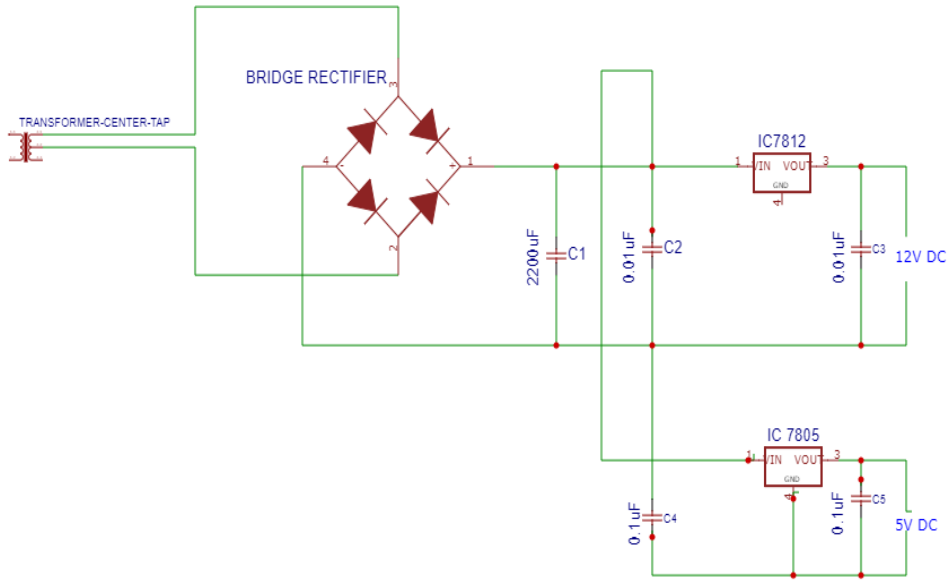


Fig. 4.1 Circuit diagram of Power supply circuit

4.2 CIRCUIT DIAGRAM OF IR SENSOR

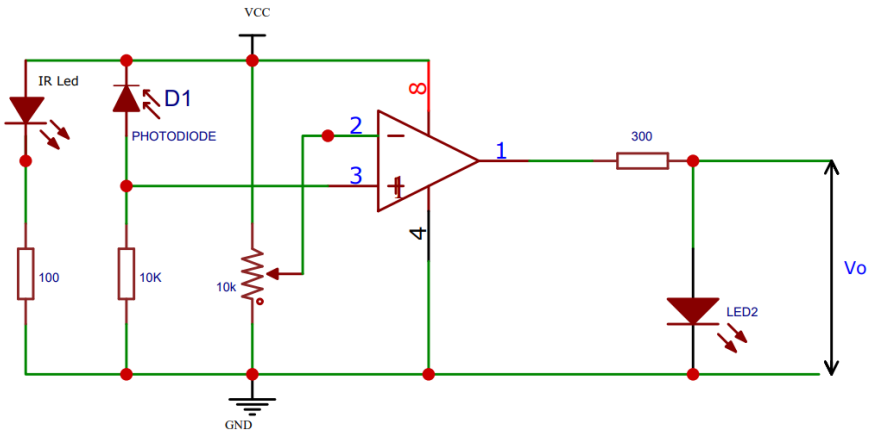


Fig. 4.2 Circuit diagram of IR Sensor circuit

4.3 CIRCUIT DIAGRAM OF COMPLETE PROJECT

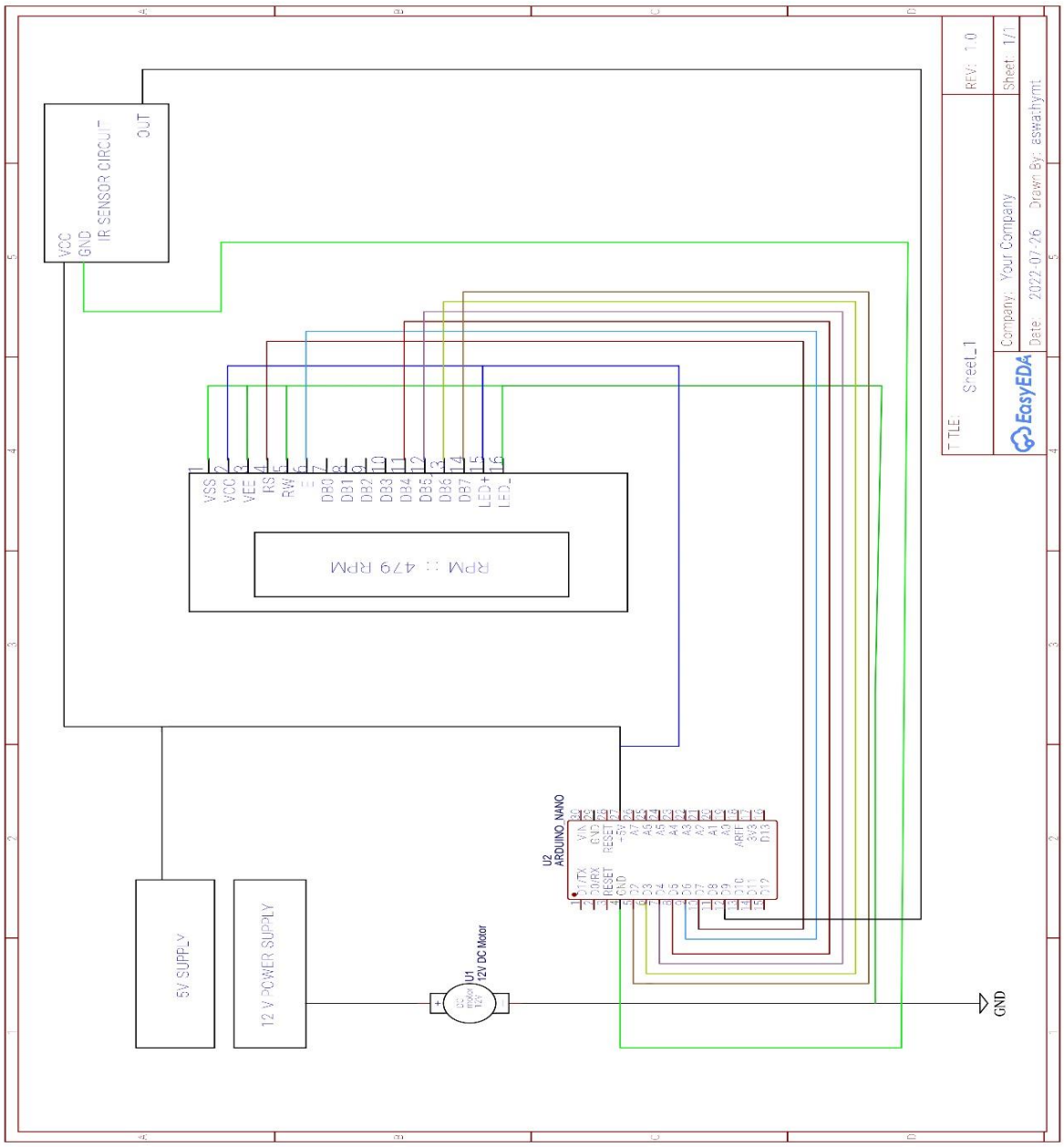


Fig. 4.3 Circuit diagram of RPM Reader

4.4 CIRCUIT DIAGRAM DESCRIPTION

The motor starts revolving when it gets 12V from the power supply. We need to interface adruino nano with LCD display and IR sensor circuit as shown in above figures. When the IR sensor circuit gets the sufficient voltage(5v) the LED bulb in the circuit start blinking whenever the opaque part of the disc appears during the rotation and the output is provided to the arduino nano board when we press the start button. Now following the Embedded C Program uploaded in the board RPM of the DC Motor is calculated and displayed in the LCD Display

5. HARDWARE DESCRIPTIONS

5.1 ATMEGA328P

Features:

- High performance, low power Atmel AVR 8-bit Microcontroller family.
- Advanced RISC architecture -131 powerful instructions – most single clock cycle execution – 32-8 general purpose working registers - Fully static operation - Up to 16MIPS throughput at 16MHz - On-chip 2-cycle multiplier.
- High endurance non-volatile memory segments - 32K bytes of in-system self-programmable flash program memory - 1Kbytes EEPROM - 2Kbytes internal SRAM - write/erase cycles: 10,000 flash/100,000 EEPROM - Optional boot code section with independent lock bits.
- In-system programming by on-chip boot program.
- True read-while-write operation - Programming lock for software security.

Peripheral features:

- Two 8-bit Timer/Counters with separate prescaler and compare mode - One 16-bit Timer/Counter with separate prescaler, compare mode, and capture mode - Real time counter with separate oscillator - Six PWM channels - 8-channel 10-bit ADC in TQFP and QFN/MLF package.
- Temperature measurement - 6-channel 10-bit ADC in PDIP Package – Two Master/slave SPI serial interface - One Byte-oriented 2-wire serial interface – One Programmable serial USART –Programmable watchdog timer with separate on-chip oscillator – One On-chip analog comparator - Interrupt and wake-up on pin change.

Special microcontroller features:

- Power-on reset and programmable brown-out detection - Internal calibrated oscillator - External and internal interrupt sources - Six sleep modes: Idle, ADC noise reduction, power-save, power-down, standby and extended standby.
- I/O and packages - 23 programmable I/O lines – 28 pin PDIP - 32-lead TQFP, and 32-pad QFN/MLF
- Operating voltage:2.7V to 5.5V for ATmega328P
- Temperature range: –40°C to +125°C
- Speed grade: 0 to 8MHz at 2.7 to 5.5V - 0 to 16MHz at 4.5 to 5.5V
- Power consumption at 1MHz,2.7V, 25°C - Active mode: 1.5mA at 3V - 4MHz - Power-down mode: 1µA at 3V – Power save mode: 0.75 µA

Fig. 5.1 ATMEGA328P
(Courtesy: https://upload.wikimedia.org/wikipedia/commons/0/0c/ATMEGA328P-PU.jpg)

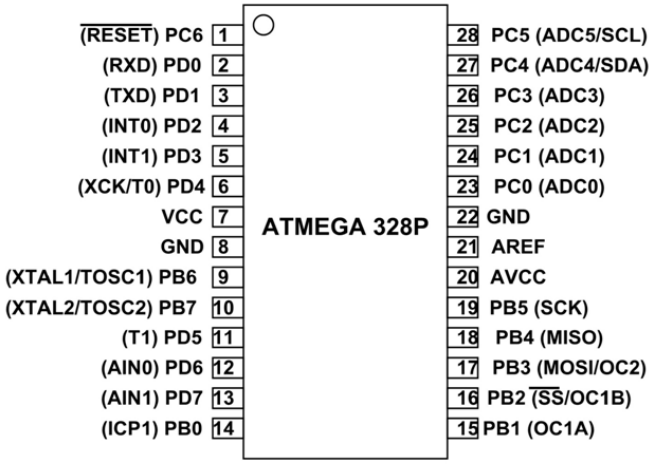


Fig. 5.2 ATMEGA328P Pin out
(Courtesy: https://components101.com/sites/default/files/component_pin/ATMega328P-Pinout.png)

5.2 7805 Voltage Regulator

All voltage sources cannot able to give fixed output due to fluctuations in the circuit. For getting constant and steady output, the voltage regulators are implemented. The integrated circuits which are used for the regulation of voltage are termed as voltage regulator ICs. Here, we can discuss the IC 7805.

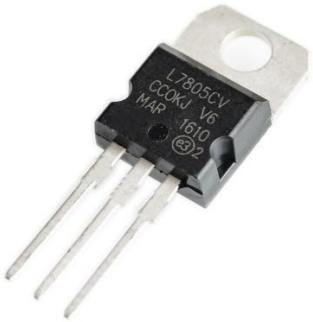
The voltage regulator IC 7805 is actually a member of the 78xx series of voltage regulator ICs. It is a fixed linear voltage regulator. The xx present in 78xx represents the value of the fixed output voltage that the particular IC provides. For 7805 IC, it is +5V DC regulated power supply. This regulator IC also adds a provision for a heat sink. The input voltage to this voltage regulator can be up to 35V, and this IC can give a constant 5V for any value of input less than or equal to 35V which is the threshold limit.

Specifications

- 5V Positive Voltage Regulator
- Minimum Input Voltage is 7V
- Maximum Input Voltage is 25V
- Operating current(I_Q) is 5mA
- Internal Thermal Overload and Short circuit current limiting protection is available.
- Junction Temperature maximum 125 degree Celsius
- Available in TO-220 and KTE package

Applications

- Constant +5V output regulator to power microcontrollers and sensors in most of the projects
- Adjustable Output Regulator
- Current Limiter for certain applications
- Regulated Dual Supply
- Output Polarity-Reversal-Protection Circuit



5.3 7812 Voltage Regulator

The 7812 is a commonly used linear regulator. Input voltage can range from 14 – 35VDC and it outputs a fixed 12V at over 1A of current and up to 2.2A of surge current. For basic operation, no external components are required. Just hook up the input voltage and ground and you have 5V available on the output. If the 7812 input is 15V and it is providing 1A of current, then Power Dissipation = (15V – 12V) * 1A = 3W. The 7812 TO-220 package will need to dissipate 3W of power. Under typical conditions, the device can dissipate about 1 – 1.25W before a heat sink becomes necessary, so in our example here, the device would need a heat sink. Maximum output current without a heat sink in this case would be limited to about 300 – 350mA and the device will be running in the range of 85-95°C

Specifications

- Fixed voltage linear regulator
- 14-35V input voltage range
- 12V fixed output voltage
- 1A continuous current with 2.2A surge capability
- TO-220 package

Application

- Voltage step down circuits
- 12V Power Supplies
- Motor Drivers
- Battery Chargers
- Solar Power Supplies
- Microcontroller Related Applications

5.4 1N4007 Diode

The 1N4007 belongs to a sort of 1 A general-purpose silicon rectifier diode, commonly used in AC adapters for common household appliances. It is fairly low-speed rectifier diode, being inefficient for square waves of more than 15 kHz. The 1N4007 diode is a standard recovery rectifier with a molded plastic case. 1N4007 is a rectifier diode, designed specifically for circuits that need to convert alternating current to direct current. It can pass currents of up to 1 A, and have peak inverse voltage (PIV) rating of 1,000 V.

Specifications

- Peak Reverse Voltage: 1000 Volts
- Average Forward Current: 1A
- Non-Repetitive Peak Forward Current: 30A
- Operating Junction Temperature : -550C – 1750C
- Power Dissipation : 3 Watts
- Forward Voltage: 1.1 Volts
- Reverse Current: 5 uA
- Package Type: DO-41

Applications

- Rectifiers
- Freewheeling diode applications
- Embedded systems for switching
- Power supplies
- Protection Circuits

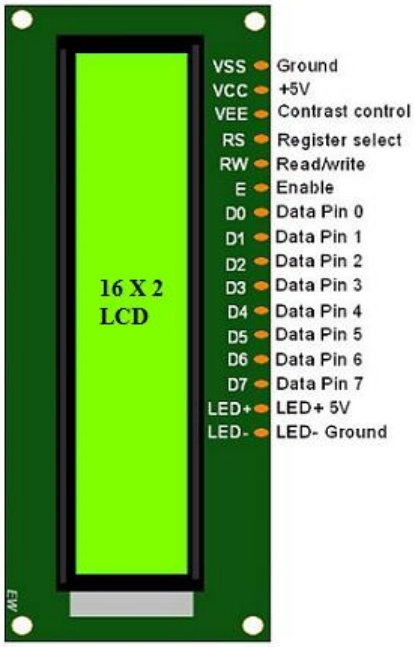
)

5.5 16*2 Lcd display

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

Specifications

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated characters



5.6 DC Motor

DC Motor – 500RPM – 12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly. A DC motor or direct current motor is an electrical machine that transforms electrical energy into mechanical energy by creating a magnetic field that is powered by direct current. When a DC motor is powered, a magnetic field is created in its stator. The field attracts and repels magnets on the rotor; this causes the rotor to rotate. To keep the rotor continually rotating, the commutator that is attached to brushes connected to the power source supply current to the motors wire windings

Specifications

- RPM: 500.
- Operating Voltage: 12V DC
- Gearbox: Attached Plastic (spur)Gearbox
- Shaft diameter: 6mm with internal hole
- Torque: 1 kg-cm
- No-load current = 60 mA(Max)
- Load current = 300 mA(Max).

5.7 IR Led

An Infrared light-emitting diode (IR LED) is a special purpose LED emitting infrared rays ranging from 700 nm to 1 mm wavelength. Different IR LEDs may produce infrared light of differing wavelengths, just like different LEDs produce light of different colors.IR LEDs are usually made of gallium arsenide or aluminium gallium arsenide. In complement with IR receivers, these are commonly used as sensors.

Specifications

- Forward current (IF) is 100mA (normal condition) and 300mA (max.)
- 1.5A of surge forward current
- 1.24v to 1.4v of forward voltage
- Temperature for storage and operation varies from -40 to 100 ℃
- Soldering Temperature should not exceed 260 ℃
- Power Dissipation of 150mW at 25℃ (free air temperature) or below
- Spectral bandwidth of 45nm
- Viewing angle is 30 to 40 degree

5.8 Photodiode

It is a form of light sensor that converts light energy into electrical energy (voltage or current). Photodiode is a type of semi conducting device with PN junction. Between the p (positive) and n (negative) layers, an intrinsic layer is present. The photo diode accepts light energy as input to generate electric current

Specifications

- Wavelength Sensitivity (λP): 940nm.
- Open Circuit Voltage: 0.39V.
- Reverse breakdown voltage: 32V.
- Reverse Light current: 40μA.
- Reverse Dark current: 5nA.
- Rise Time/ Fall Time: 45/45nS.
- View Angle: 80 deg.

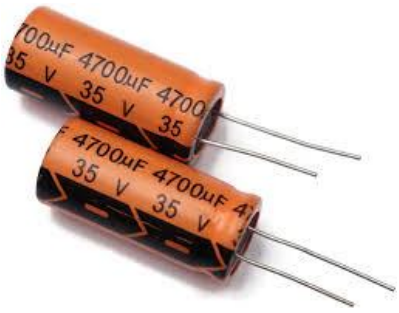
5.9 CAPACITORS

5.9.1 Ceramic capacitor

A ceramic capacitor is a fixed-value capacitor where the ceramic material acts as the dielectric. It is constructed of two or more alternating layers of ceramic and a metal layer acting as the electrodes. The composition of the ceramic material defines the electrical behavior and therefore applications

5.9.2 Electrolytic capacitor

An electrolytic capacitor is a polarized capacitor whose anode or positive plate is made of a metal that forms an insulating oxide layer through anodization. This oxide layer acts as the dielectric of the capacitor.



5.10 Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

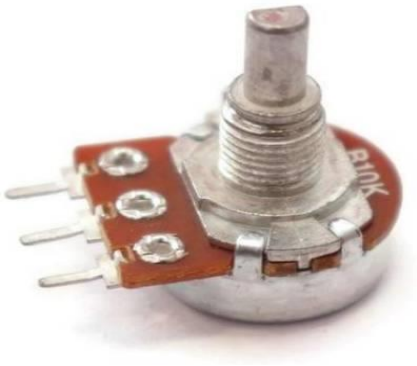
5.11 Potentiometer

The potentiometer is an instrument used for measuring the unknown voltage by comparing it with the known voltage. It can be used to determine the emf and internal resistance of the given cell and also used to compare the emf of different cells. The comparative method is used by the potentiometer. A potentiometer is defined as a 3 terminal variable resistor in which the resistance is manually varied to control the flow of electric current. A potentiometer acts as an adjustable voltage divider

Specifications

- Type: Rotary a.k.a Radio POT.
- Available in different resistance values like 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1 M.
- Power Rating: 0.3W.
- Maximum Input Voltage: 200Vdc.

  Rotational Life: 2000K cycles



5.12 Connectors

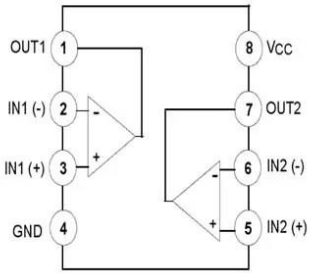
Connectors are used to join subsections of circuits together. Usually, a connector is used where it may be desirable to disconnect the subsections at some future time: power inputs, peripheral connections, or boards which may need to be replaced. The gender of a connector refers to whether it plugs in or is plugged into and is typically male or female, respectively (kids, ask your parents for a more thorough explanation). Unfortunately, there are cases where a connector may be referred to as "male" when it would appear to be female; in the examples section, we'll point a few of those out as we discuss individual component types and explain why that's the case.

5.13 LM358

LM358 consists of two independent compensated operational Amplifier with high gain frequency. LM 358 IC is available in the cheap sized package so this must be used in real-life applications include DC gain block, conventional OP-AMP circuits design, active filters, transducer amplifier, this post also gives some information about this ICs like Pinout of LM358, features, Applications, advantages, Pin configuration of LM358, also give some real-life applications of LM358

Specifications

It consists of 2 OP-AMP internally.
The output voltage swing is high.
The large DC voltage gain is around 100 dB.
Wider bandwidth in 1 MHz(Temperature compensated).
The supply current drain is very low.
2mV low input offset voltage.
Common mode input voltage range comprises ground.
The differential input voltage range is similar to the power supply voltage.
Internally frequency compensated for unity gain.
Short circuit protected outputs.
Soldering pin temperatures in 260 C.
The available package is TO-99, SOIC, DSBGA, CDIP.



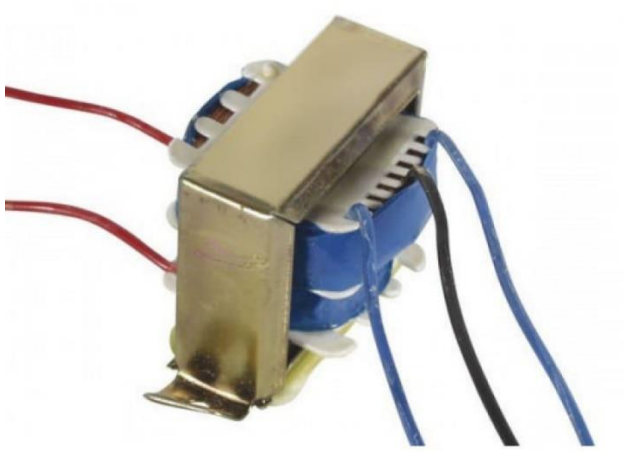
5.14 Centre tapped Transformer

A Centre Tap transformer functions almost in the same way as an ordinary transformer. The only difference is that the tap present in the secondary winding of the centre tap transformer divides the transformer into two parts, therefore, we can get two individual voltages across the two line ends if the transformer. A center tap transformer is a device that has tapping through the middle of its secondary winding. This way, we can get half of the voltage induced in the secondary winding from the center tap to either of the tap ends

Specifications

- Mounting: Vertical mount type.
- Input Voltage: 220 Volts AC.
- Input Voltage Frequency: 50 Hertz.
- Output Voltage: 0V, 12V, 24V.
- Output Current: 1 Ampere.

  Winding: Copper



5.15 Arduino NANO

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery. In 2019, Arduino released the Arduino Nano Every, a pin-equivalent evolution of the Nano. It features a more powerful ATmega4809 processor and twice the RAM.

Specification

Microcontroller: Microchip ATmega328P
Operating voltage: 5 volts
Input voltage: 6 to 20 volts
Digital I/O pins: 14 (6 optional PWM outputs)
Analog input pins: 8
DC per I/O pin: 40 mA
DC for 3.3 V pin: 50 mA
Flash memory: 32 KB, of which 0.5 KB is used by bootloader
SRAM: 2 KB
EEPROM: 1 KB
Clock speed: 16 MHz
Length: 45 mm
Width: 18 mm
Mass: 7 g
USB: Mini-USB Type-B [5]
ICSP Header: Yes
DC Power Jack: No

6. SOFTWARE DESCRIPTION

6.1 ARDUINO IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, mac OS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

6.2 EMBEDDED C

Embedded C is an extension to C programming language that provides support for developing efficient programs for embedded devices. It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing. Embedded C uses most of the syntax and semantics of standard C, e.g., main() function, variable definition, data type declaration, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc. Embedded C remains popular due to its efficiency, less development time and portability.

6.2.1. BASIC STRUCTURE OF AN EMBEDDED C PROGRAM

The following part shows the basic structure of an Embedded C Program.

- Multiline Comments . . . . . Denoted using /*……*/
- Single Line Comments . . . . . Denoted using //
- Preprocessor Directives . . . . . #include<…> or #define
- Global Variables . . . . . Accessible anywhere in the program
- Function Declarations . . . . . Declaring Function
- Main Function . . . . . Main Function, execution begins here
  {
  Local Variables . . . . . Variables confined to main function
  Function Calls . . . . . Calling other Functions
  Infinite Loop . . . . . Like while(1) or for(;;)
  Statements . . . . .
  ….
  ….
  }
  - Function Definitions . . . . . Defining the Functions
    {
    Local Variables . . . . . Local Variables confined to this Function
    Statements . . . . .
    ….
    ….
    }
  -

6.2.2. COMPONENTS OF AN EMBEDDED C PROGRAM

Comments: Comments are readable text that are written to help us (the reader) understand the code easily. They are ignored by the compiler and do not take up any memory in the final code (after compilation). There are two ways you can write comments: one is the single line comments denoted by // and the other is multiline comments denoted by /*….*/.

Preprocessor Directive: A Preprocessor Directive in Embedded C is an indication to the compiler that it must look in to this file for symbols that are not defined in the program. In C Programming Language (also in Embedded C), Preprocessor Directives are usually represented

using #include… or #define .We usually use the preprocessor directive to indicate a header file specific to the microcontroller, which contains all the SFRs and the bits in those SFRs.

Global Variables: Global Variables, as the name suggests, are Global to the program i.e., they can be accessed anywhere in the program.

Local Variables: Local Variables, in contrast to Global Variables, are confined to their respective function.

Main Function: Every C or Embedded C Program has one main function, from where the execution of the program begins.

7. PCB DESIGN AND ASSEMBLY

7.1 DIPTRACE

DipTrace is an EDA/CAD software for creating schematic diagrams and printed circuit boards. The developers provide a multi-lingual interface and tutorials (currently available in English and 21 other languages). DipTrace has 4 modules: schematic capture editor, PCB layout editor with built-in shape-based autorouter and 3D-preview & export, component editor, and pattern editor.

Basic Features

- Simple user interface
- Multi-sheet and hierarchical schematics
- High-speed and differential signal routing.
- High-speed shape-based autorouter.
- Real-time 3D PCB preview.
- Export of PCB to STEP 3D file format.

7.1.1 SCHEMATIC CAPTURE

Advanced circuit design tool delivers a number of features for visual and logical pin connections. Cross-module management ensures that principal circuits can be easily converted into a PCB, back-annotated, or imported/exported from/to other EDA software, CAD formats and net-lists.

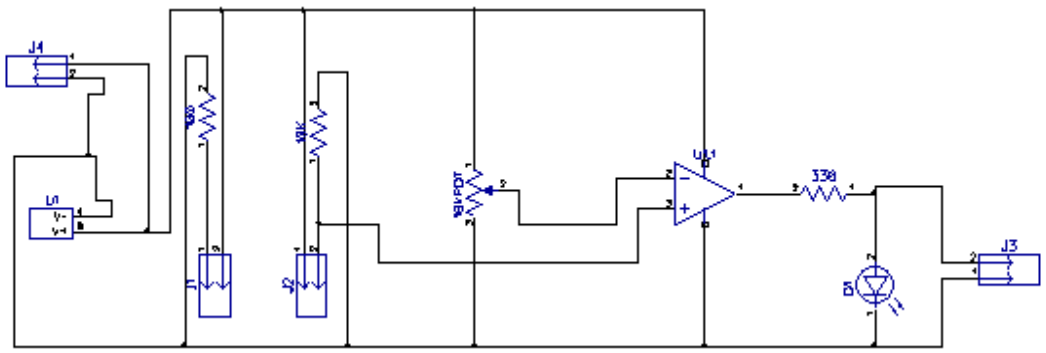


Fig. 7.1 Schematic Capture of IR Sensor Circuit

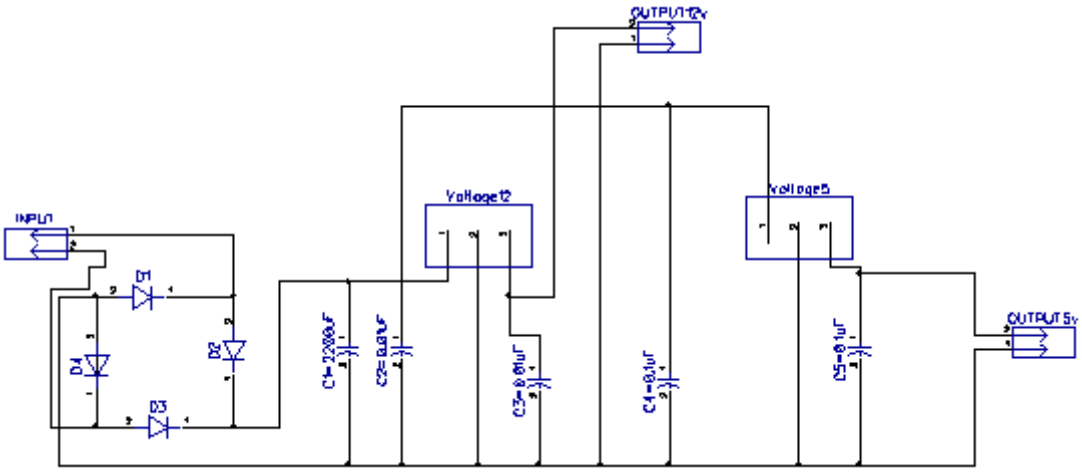


Fig 7.2 Schematic Capture of Power Supply

7.1.2 PCB Layout

Design requirements are defined by net classes, class-to-class rules, and detailed settings by object types for each class or layer. DRC also checks length and phase tolerances for differential pairs and controls signal synchronization for nets and buses. The board can be previewed in 3D and exported to STEP format for CAD modeling.

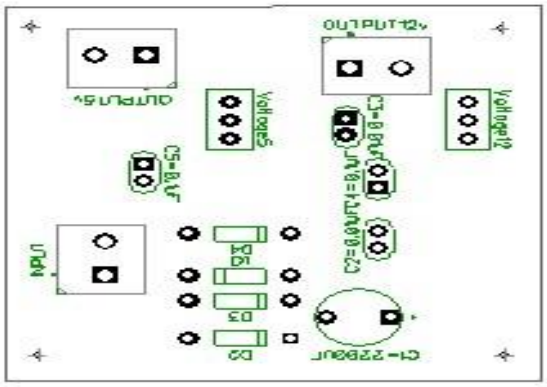


Fig. 7.3 PCB layout of power supply from Dip Trace

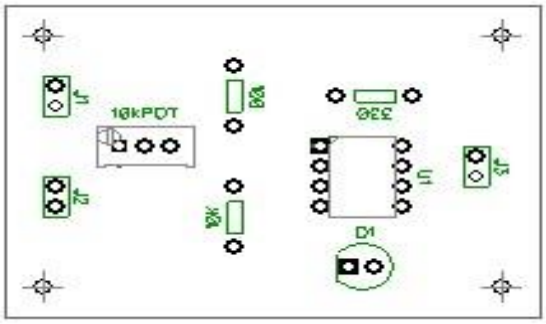


Fig. 7.4 PCB layout of IR Sensor circuit from DipTrace

7.2 PRINTED CIRCUIT BOARD (PCB)

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. A printed circuit board has pre-designed copper tracks on a conducting sheet. The pre-defined tracks reduce the wiring thereby reducing the faults arising due to lose connections. One needs to simply place the components on the PCB and solder them. PCB is developed by etching process. First of all, the required circuit is designed and a layout is prepared. The layout can be either done with PCB designing software "PROTEUS", "ORCAD".

Advantages of PCB over normal wiring:

1. PCB's are simulated for less mass production with less chance of wiring error.
2. Small components are easily mounted.
3. Wiring micro phony is avoided.
4. Serving is simplified.

STEP 1: Take printout of circuit board layout

Take a print out of your PCB layout using the laser printer and the A4 photo paper/glossy paper.

Keep in mind the following points:

1. Select the output in black both from the PCB design software and printer driver settings.
2. You should take the mirror print out.
3. Make sure that the printout is made on the glossy side of the paper.

STEP 2: Cutting the copper plate for the circuit board

- Cut the copper board according to the size of layout using a hacksaw or a cutter.
- Next, rub the copper side of PCB using steel wool or abrasive spongy scrubs.
- This removes the top oxide layer of copper as well as the photo resists layer. Sanded surfaces also allow the image from the paper to stick better.

STEP3: Transferring the PCB print onto the copper plate

Method 1: Iron on glossy paper method (for complex circuits):

Transfer the printed image from the photo paper to the board. Make sure to flip top layer horizontally. Put the copper surface of the board on the printed layout. And use tape to hold the board and the printed paper in the correct position.

Method 2: Circuit by hand on PCB (for simple and small circuits):

Taking the circuit as reference, draw a basic sketch on copper plate with pencil and then by using a permanent black marker.

STEP 4: Ironing the circuit from the paper onto the PCB plate

- After printing on glossy paper, we iron it image side down to copper side. Heat up the electric iron to the maximum temperature.
- Put the board and photo paper arrangement on a clean wooden table (covered with a tablecloth) with the back of the photo paper facing you.
- Using pliers or a spatula, hold one end and keep it steady. Then put the hot iron on the other end for about 10 seconds. Now, iron the photo paper all along using the tip and applying little pressure for about 5 to 15 mins.
- Pay attention towards the edges of the board-you need to apply pressure, do the ironing slowly.
- Doing a long hard press seems to work better than moving the iron around. Here, the heat from the iron transfers the ink printed on the glossy paper to the copper plate

After ironing, place printed plate in Luke warm water for around 10 minutes. Paper will dissolve, then remove paper gently. Remove the paper off by peeling it from a low angle.

In some cases, while removing the paper, some of the tracks get fainted. In the figure below, you can see that the track is light in colour hence we can use a black marker to darken it as shown.

STEP 5: Etching the plate

You need to be really careful while performing this step

- First put rubber or plastic gloves.
- Place some newspaper on the bottom so that the etching solution does not spoil your floor.
- Take a plastic box and fill it up with some water.
- Dissolve 2-3 tea spoon of ferric chloride powder in the water.
- Dip the PCB into the etching solution (Ferric chloride solution, FeCl3) for approximately 30mins.
- The FeCl3 reacts with the unmasked copper and removes the unwanted copper from the PCB.

- This process is called as Etching. Use pliers to take out the PCB and check if the entire unmasked area has been etched or not. In case it is not etched leave it for some more time in the solution.

Gently move the plastic box to and fro so that etching solution reacts with the exposed copper.

The reaction is given as:

Cu + FeCl3 = CuCl3 + Fe

After every two minutes check if all the copper has been removed. If it hasn't then place it back in the solution and wait.

Always use gloves while touching the plate having the solution.

Fig. 7.7 Etching the PCB

STEP 6: Cleaning, disposing and final touches for the circuit board

Be careful while disposing the etching solution, since its toxic to fish and other water organisms. And don't think about pouring it in the sink when you are done, it is illegal to do so and might damage your pipes. So dilute the etching solution and then throw it away somewhere safe.

A few drops of thinner (nail polish remover works well) on a pinch of cotton wool will remove completely the toner/ink on the plate, exposing the copper surface. Rinse carefully and dry with a clean cloth or kitchen paper. Trim to final size and smoothen edges with sandpaper. Now drill holes using a PCB driller.

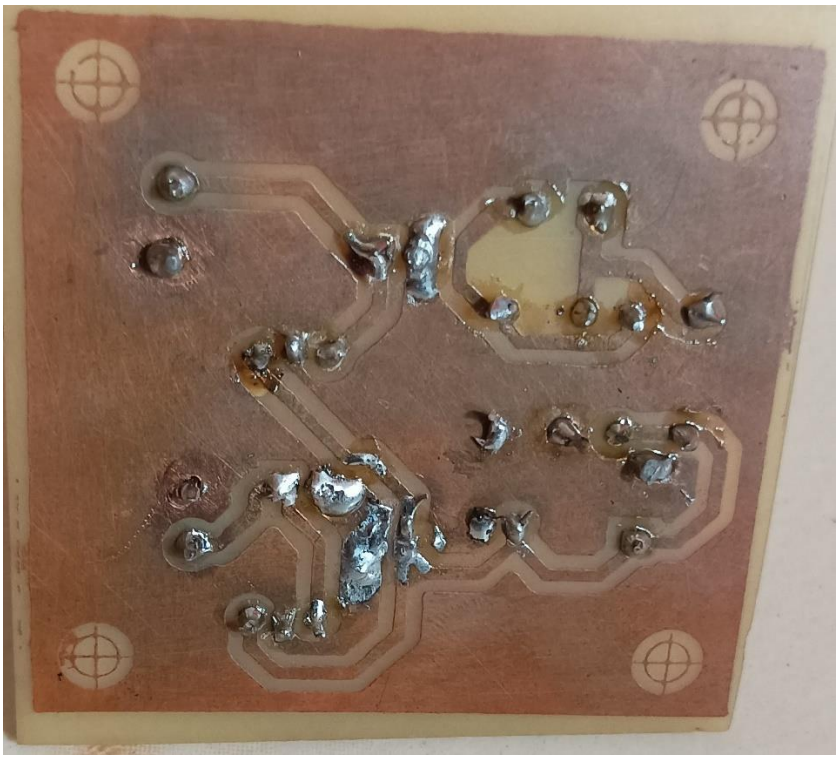


Fig. 7.8 Circuit board of power supply

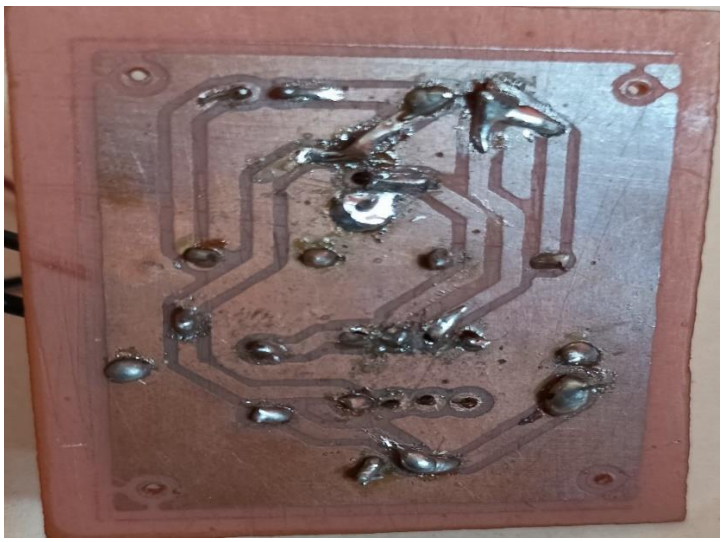
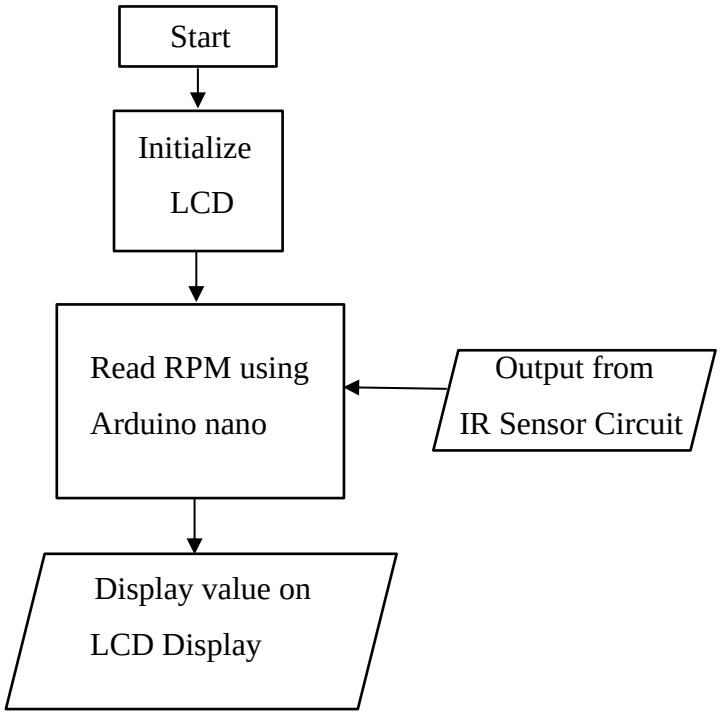


Fig. 7.9 Circuit board of IR Sensor

8. MICROCONTROLLER PROGRAMMING

8.1 FLOWCHART



9. PRODUCT TESTING

The model we proposed consist of power supply circuit, IR Sensor circuit Arduino nano board and LCD Display. DC motor rotates smoothly when it gets 12v supply. IR Sensor circuit works properly and the led blinks according to the appearance of opaque part of disc connected with DC motor. Arduino nano board receives output from the IR Sensor circuit and displayed RPM of DC motor in the LCD Display interfaced with the board

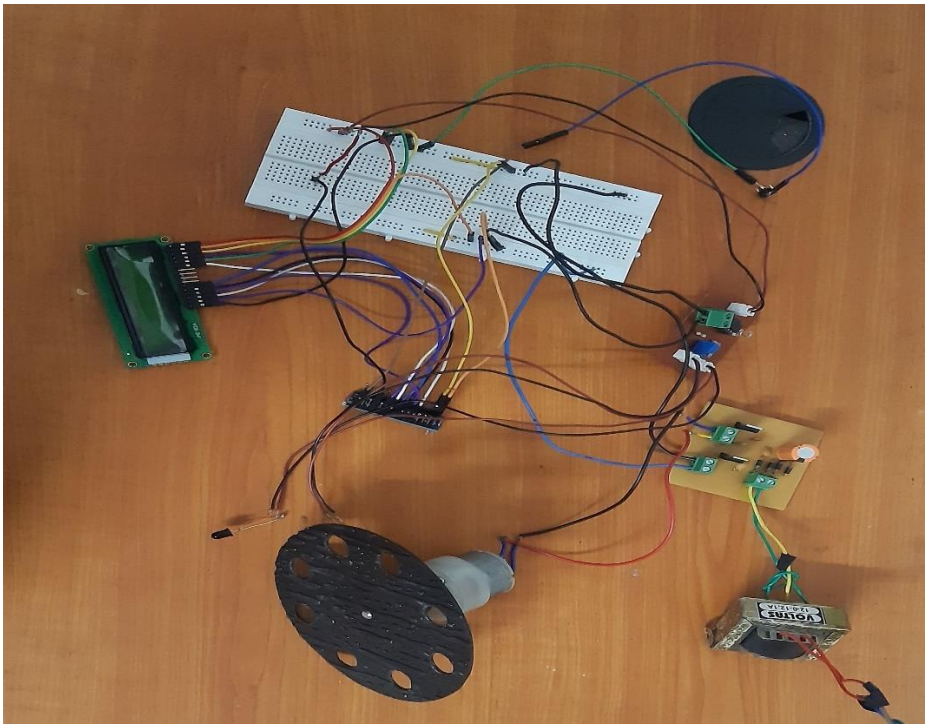


Fig. 9.1 Final product

10. CONCLUSION

RPM reader for DC Motor is made using IR sensor circuit, Arduino nano board and LCD Display. It is a simple circuit and it is useful in various mills for displaying of RPM of different motors. It works effectively according to the need, made in less expense and power saving.

REFERENCES

[1] Linear Integrated Circuits by D.Roy Choudhury, Shail B. Jain

[2] https://how2electronics.com/digital-tachometer-ir-sensor-arduino/

[3] https://nevonprojects.com/rpm-display-for-bldc-motor-with-speed-controller/

[4] https://youtu.be/BerAGlPNHYU

EXPENSES

SL. NO	NAME OF THE COMPONENT	PRICE(RS)
1.	Copper clad, etchant	140
2.	DC Motor	135
3.	LCD Display	190
4.	IR Sensor circuit components	102
5.	Power supply components	114
	Total	681/-