TAMILNADU STATE COUNCIL FOR SCIENCE AND TECHNOLOGY
DOTE Campus, Chennai-600025

STUDENT PROJECTS SCHEME

Proposals invited for 2018-2019

Tamilnadu State Council for Science and Technology has been implementing Student Projects Scheme in order to harness the talent and potential available with students for the benefit of our State. Under this scheme final year UG students (Engineering) / PG Science Students / PG professional Students who have dissertation work in their curriculum may apply. Financial support up to a maximum of Rs.10, 000/- will be provided to each project. Those who want to apply under this scheme are requested to read the instructions carefully and apply only in the prescribed format. The format and instructions in which the proposals are to be submitted is available in the Council's website. **(www.tanscst.nic.in).**

Two copies of proposals complete in all aspects are to be submitted through proper channel to **The Member Secretary, Tamilnadu State Council for Science and Technology, DOTE Campus, Chennai - 600 025** on or before **24 SEPTEMBER 2018, 5 pm.**

Instructions

1. The scheme is instituted for the purpose of providing assistance in the form of grant to **final year** students of **UG/PG (Engineering-Civil: Mechanical: :EEE/ECE/EIE/ICE:CSE/IT/Computer Application / Software : Chemical), PG (Professional Courses) and PG (all Sciences)** for scientific research work, with particular relevance to the State of Tamilnadu, for economic and industrial development.
2. Student projects will be eligible for a **maximum grant of Rs.10, 000/-.**
3. **Any One** sector in format (at Sl.NO.4) must be chosen and filled carefully. Incorrect filling or filling more than one sector will lead to rejection of your application.
4. The project team (batch) can have up to a maximum of four students. The project team should send only one proposal.
5. It may be noted that the project proposal should be of original, innovative and novel. They should have utility and applicability for implementation. Kindly note that the evaluation of the project is also based on these factors.
6. The Project Guides / HODs needs to evaluate the project proposals and scrutiny them before sending the project proposals to TNSCST.

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Peruvoyal, Kavaraipettai,
Gummidipoondi Taluk,
T[illegible]3.

7. The project team **should not** change the topic and should not deviate from the objectives of the sanctioned project proposal. In the event of any such changes, grant will be treated as cancelled and the institution should return the sanctioned amount to TNSCST.

8. Project proposals received will be reviewed and evaluated by a team of experts and those selected will be announced in TNSCST website www.tanscst.nic.in. The project sanction letter and the money will be sent to the Principal/Registrar of the institution with a copy to the Project guide.

9. The sanctioned projects should be completed and the report should be submitted before end of **April 2019**.

10. The Utilization Certificate (UC) and Statement of Expenditure (SE) should be signed by the guide, HOD and Principal/Registrar with official seal as the case may be. The guides are responsible for timely submission of seminar paper, UC and SE.

11. If the guide wishes to leave the institution where the project is based, the Institute/Guide will inform the same to the Council and in consultation with Council, evolve steps to ensure successful completion of the project, before relieving the GUIDE.

12. Project proposals not in the prescribed format and incomplete will not be considered. **Advance copy and soft copy** of the proposals will not be considered.

13. Two copies of the proposal should be signed and forwarded by the Guide through HOD and Principal / Registrar as the case may be to reach the council office on or before **31 AUGUST 2018, 5.00 PM.**

14. Proposals received after the deadline will not be considered and no communication will be entertained in this regard. Postal delays will not be accepted on any ground.

-sd-

MEMBER SECRETARY

PRINCIPAL
T.J.S. ENGINEERING COLLEGE
Peruvoyal, Kavaraipettai,
Gummidipoondi Taluk,
Thiruvallur Dist - 601 206.

T.J.S. ENGINEERING COLLEGE T.J.S.E.C. PERUVOYAL, KAVARAIPETTAI

FORMAT FOR STUDENT PROJECT PROPOSAL

1. Name of the Student (s) : EKNATH. N, NIRMAL RAGAVAN. R, BANU PRAKASH. R
   one valid e-mail id : eknathnarayanan744@gmail.com.
2. Name of the Guide : SHUNMUGA SANKARI. M,
   Department / Designation : EEE / ASSISTANT PROFESSOR,
   Institutional Address : TJS ENGINEERING COLLEGE, PERUVOYAL,
   Phone No. & Mobile No. : 044-22301428.
3. Project Title : DESIGN AND CONSTRUCTION OF BLDC MOTOR TO REPLACE THE SEWING MACHINE CLUTCH MOTOR FOR HANDICAPPED PERSON
4. Sector in which your Project proposal is to be Considered : **Agriculture/Biology/Physical/ Environment/ Medicine/ Veterinary/Social Sciences/Engineering& Tech.(Chemical /Computer Science/ Civil/ Mechanical/ Electrical, Electronics, Instrumentation, Communication) (Specify only one sector)**
5. Project Details : (write up (max. 5 pages only) is to be given for each item including justification for acquiring / fabricating equipments / apparatus in the budget)

   1. Introduction
   2. Objectives
   3. Methodology
   4. Work Plan
   5. Budget
   6. Any other details

7. Has a similar project been carried out in your college / elsewhere? If so furnish details of the previous project and highlight the improvements suggested in the present one : NO

CERTIFICATE

This is to certify that Mr./Miss. R. Banu Prakash, N. Eknath, R. Nirmal Ragavan. is a bonafide final year student of P.G. Science / U.G. Engineering / P.G. professional courses of our college and it is also certified that two copies of utilization certificate and final report along with seminar paper will be sent to the Council after completion of the project by the end of April 2019.

Signature of the Guide

Signature of the HOD
Head
Department of EEE
T.J.S. Engineering College
Peruvoyal, Kavaraipettai,
Gummidipoondi Taluk,
Thiruvallur Dist - 601 206.

Signature of the Principal/
Head of the Institution
PRINCIPAL
T.J.S. ENGINEERING COLLEGE
PERUVOYAL, GUMMIDIPOONDI T.K.
(NEAR KAVARAIPETTAI)
THIRUVALLUR DIST. PIN-601206

1128
Board of Secretary, TNSCST, DOTE Campus, Chennai - 600 025

Two copies of the proposals are to be submitted through proper channel to the Member-Secretary, TNSCST, DOTE Campus, Chennai - 600 025 on or before 21 SEPTEMBER 2018, 5 pm.

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TJS ENGINEERING COLLEGE
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
Design and Fabrication of BLDC Motor Based Sewing Machine
PROJECT PROPOSAL

GENERAL INTRODUCTION

Before there were brushless DC motors there were brushed DC motors, which were brought on in part to replace the less efficient AC induction motors that came before. The brush DC motor was invented all the way back in 1856 by famed German inventor and industrialist Ernst Werner von Siemens. Near the end of the 1980s, Robert E. Lordo of the POWERTEC Industrial Corporation unveiled the first large brushless DC motors, which had at least ten times the power of the earlier brushless DC motors.

The high-speed industrial sewing machine clutch motor is normally 1/2 horse power 2850 rpm and is used on machines that require high speed production such as clothing straight sewers and over lockers. The low speed industrial sewing machine clutch motor is normally 1/2 horse power 1425 rpm and is used on machines that require a lower speed or are trying to sew heavier work like walking foot and compound feed machines.

EXISTING SYSTEM

In existing system clutch motor is used to run the sewing machine. In this system the clutch plates are used to control the speed of a sewing machine. By applying pressure on the clutch plate it isolates the motor and sewing machine so, that the won't run.

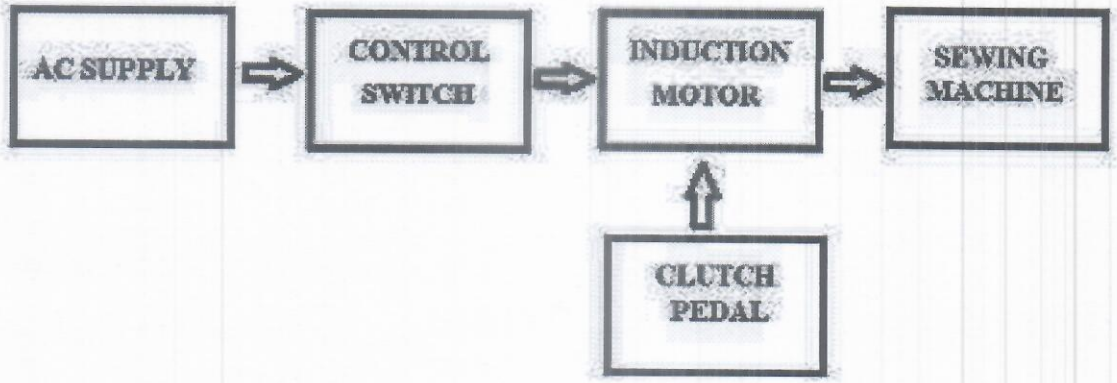


Fig 3.1 Block Diagram of Existing System

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All modern household sewing machines have an induction motor. Home sewing machines and industrial sewing machine models have different types of electric motor drives. All are equipped with a clutch motor at which a sewing machine is able to work 24 hours a day without interruption and at a high speed.

The clutch motor drives an industrial sewing machine with a special belt. Tension of this belt is adjusted by loosening these adjustment nuts on both sides of motor. Industrial clutch motors can operate on the network 400/690 or 220/110 volts. This option allows you to use a sewing machine at home, in sewing studio and small workshops having mains voltage 220/100 volts. In conditions of garment factories is used three-phase mains voltage 400 /690 volts.

The more tightly the motor and pulley discs are pressed, the more is speed of rotation of sewing machine. Frictional device has and another function. It provides an abrupt stopping of sewing machine after removing your leg from pedal platform.

The existing system in the sewing machine is the normal induction type motor and it is connected through the mechanical system it is known as clutch system so the total assembly is commonly called as clutch motor. This clutch motor working in AC so that it has the more losses like copper loss, core loss, eddy current loss this are all the electrical losses. In resources side we need more amount of copper and laminated steel. In mechanical side there is a friction loss in the clutch are drawback of the clutch motor. Speed control is not possible is the big drawback of this system.

A clutch motor is an AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. An induction motor can therefore be made without electrical connections to the rotor. An induction motor's rotor can be either wound type or squirrel-cage type.

The induction motor stator's magnetic field is therefore changing or rotating relative to the rotor. This induces an opposing current in the induction motor's rotor, in effect the motor's secondary winding, when the latter is short-circuited or closed through an external impedance. The rotating magnetic flux induces currents in the windings of the rotor; in a manner similar to currents induced in a transformer's secondary winding.

The clutch motor is connected to the sewing machine with the help of belt, the footer is used control the motor speed where the efficiency of the motor has been reduced and the maintenance cost has been increased.

PROPOSED SYSTEM

The hardware system of proposed voice recognition in sewing machine using BLDC motor and ESC. The design for the system is made by using Motor Analysis-PM.ESC is designed in order to control the BLDC motor.

The proposed system is the BLDC motor; it is the latest technology in the industry field.

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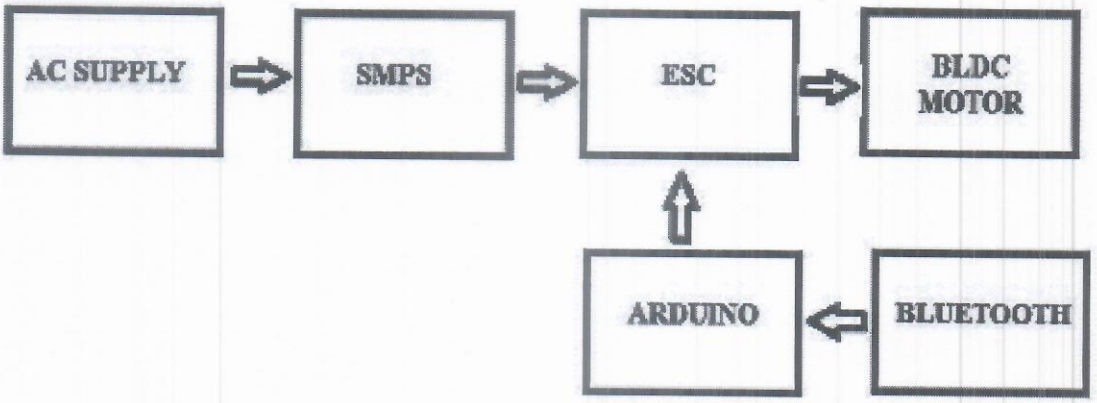


Fig 3.2 Block Diagram of Proposed System

It is more efficient and compact in size, good controllability, more power full when compare to other motors and life time is high. There is no damage in the motor due to absence of clutch. BLDC motor have the special driving system due to this we can also include the voice command control in the system this is the fetcher of this system. The main advantage of this system when compare to the existing system is speed control, in this we also included the voice control of the sewing machine. This system helps to physically challenged to control the sewing machine.

In order to control all our motors for a suitable and effective operation time with each of the quadcopter models, every operating motor requires its own Electronic Speed Control (ESC) component. First, to understand an ESC, it must be stated that it doesn't interpret mechanical motion like a servo, but instead through varying the switching rate of a network of field effect transistors (FETs). The fast switching of FET, allows for a smooth and precise variation of motor speed.

The Arduino UNO is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The design of BLDC motor has been made by using Motor AnalysisPM software where the simulation has been done, the BLDC motor has been chosen based on the size, efficiency.

Brushless motors fulfil many functions originally performed by brushed DC motors, but cost and control complexity prevent brushless motors from replacing brushed motors completely in the lowest-cost areas. Nevertheless, brushless motors have come to dominate many applications, particularly devices such as computer hard drives and CD/DVD players. Small cooling fans in electronic equipment are powered exclusively by brushless motors. They can be found in cordless power tools where the increased efficiency of the motor leads to longer periods of use before the battery needs to be charged. Low speed, low power brushless motors are used in direct-drive turntables for gramophone records.

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BLDC motors are a type of synchronous motor. This means the magnetic field generated by the stator and the magnetic fields generated by the rotor rotate at the same frequency. BLDC motors do not experience the "slip" that is normally seen in induction motors. BLDC motors come in single-phase, 2-phase and 3-phase configurations. Corresponding to its type, the stator has the same number of windings. Out of these, 3- phase motors are the most popular and widely used. This application note focuses on 3- phase motors. The brushless motor, unlike the DC brushed motor, has the permanent magnets glued on the rotor.

WORK PLAN

DURATION	WORK
DEC (21st to 24th)2018	Practical survey in the industrial designing & Fabrication field
DEC (27th to 30th)2018	Theoretical analyses based on IEEE latest Paper regarding to BLDC motor
JAN 2nd to FEB 9th 2019	Calculation designing on BLDC motor design Designing in 3D simulation software
FEB (10th to 20th) 2019	Resources purchasing and Fabrication of BLDC motor
FEB (21th to 23rd) 2019	Selection of controller and testing the sweing machine
FEB(24th to 25th) 2019	Final testing and analysis
FEB 27th 2019	report submission and project testing

BUDGET ESTIMATION SUMMARY

S.NO	ITEM	QUANTITY	PRICE (in rupees)
1.	Robiothe-05 6pin Bluetooth module	1	500
2.	Arduino UNO ATmega328	1	500
3.	Switch power supply driver	1	2500
4.	BLDC motor	1	5900
5.	Sewing Machine	1	6000

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Thiruvallur Dist - 601 206.

19/3/19

From

Shunmuga Sankari. M
HOD/EEE
TJSEC

To

The Principal
TJSEC

Sir,

With reference to the letter no. TNSCST/SRS/APP/2018-19 dated 18/2/19 from TNSCST, We have received a cheque for an amount of Rs 1500/-. Kindly Transfer the amount to our Association Account so that the amount may be dispersed to the concern.

Thank You,

Yours truly,

AD
Sir, Message
19/3/19

Cheque
Girls - 1500
Students 3 - 2000/-
2
19/3/19

Shunmuga
HOD/EEE 19/3/19

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Thiruvallur Dist - 601 206.

Students Name

1. EKNATH. N - Ekt. N — Rs 2500
2. NIRMAL RAGHAVAN. R - R. Nirmal Raghavan — Rs 2500
3. BANU PRAKASH. R. - R — Rs 2500

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9/3/19.

தமிழ்நாடு அறிவியல் தொழில்நுட்ப மாநில மன்றம்
TAMILNADU STATE COUNCIL FOR SCIENCE AND TECHNOLOGY
(Established by Government of Tamilnadu)
Directorate of Technical Education Campus, Chennai – 600 025.
Ph : 044-22301428, Telefax : 044-22301552 www.tanscst.nic.in

Dr.R.SRINIVASAN, M.Sc., Ph.D.,F.I.C.S., M.A.C.S.(USA)
Member Secretary

T.J.S. ENGINEERING COLLEGE
09 MAR 2019
PERUVOYAL, KAVARAIPETTAI-601 206

Lr.No.TNSCST/SPS/AR/2018-2019 18.02.2019

To
The Principal
TJS Engineering College
Kavarapettai
Peruvoyal-601206, Tiruvallur - Dt.

Sir/Madam,

Sub: TNSCST – Student Project Scheme – 2018-2019 – approval intimation–grant release- reg.

With respect to the above scheme, the list of projects approved by the State Council is enclosed along with terms and conditions. Kindly read and ensure adherence to the terms and conditions such as submission of UC and seminar paper in time.

Kindly find enclosed here with the cheque for the approved grant and disburse the grant to the concerned students through the guides at the earliest.

Kindly send the utilisation certificate (format enclosed) and seminar paper (ref.T&C-no.5&6) on completion of the project.

Thanking you,

Yours faithfully,

14/2/19
Member Secretary.

Enc: a) Terms & Conditions (T&C)
b) Format of Utilisation Certificate (UC)
c) Cheque for Rs 7500/- No: 795224 dt:18.02.2019.

Copy to: Individual Guides

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892

156	M.Shunmuga Sankari Head Dept. of EEE TJS Engineering College Kavarapettai Peruvoyal-601206, Tiruvallur - Dt.	Design of construction of BLDC motor to replace the sewing machine clutch motor for handicapped motor	R.Banuprakash Eknath N Nirmal Ragavan R	EEE-031	The Principal TJS Engineering College Kavarapettai Peruvoyal-601206, Tiruvallur - Dt.	7500/-

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Design and Fabrication of BLDC Motor Based Sewing Machine

M.Shunmuga Shankari,Assistant proffessor
R Banu Prakash, R Nirmal Ragavan and N Eknath
DEPARTMENT OF ELECTRICAL ENGINEERING
TJS ENGINEERING COLLEGE
Tamil Nadu, India.

ABSTRACT: BLDC motor have the more efficiency when compare to induction motor, speed control characteristics like DC series motor, stable speed to torque characteristics like shunt motor and high-power rating in small size. Therefore, we are intent to reduce size and power consumption of the motor so that we have chosen the BLDC motor to replace the clutch motor. Because at present BLDC motor is most efficient and new electrical machines technology in industrial field for that we are chosen the BLDC motor. This design process includes mathematical calculation, testing and design in 3D simulation software, real time fabrication of laminated stator, rotor with permanent magnet and driving the motor with required speed and torque in stable region with suitable motor.

INTRODUCTION:

Brushless DC motors are primarily used in servo, actuation, positioning, and variable speed applications where precise motion control and stable operation are critical for the satisfactory operation of the manufacturing or industrial process. They are commonly used as: Linear motors. In addition, brushless motors can be more powerful overall. Because the copper windings are on the outside of the motor configuration, there is room to make them larger. Brushless motors also don't have the friction and voltage drop that brushes create by dragging against the spinning commutator Brushless motors have significantly higher efficiency and performance, and a lower susceptibility to mechanical wear than their brushed counterparts. Brushless motors offer several other advantages, including: Higher torque to weight ratio. Increased torque per watt of power input (increased efficiency).

The sewing machine is the normal induction type motor and it is connected through the mechanical system it is known as clutch system so the total assembly is commonly called as clutch motor. This clutch motor working in AC so that it has the more losses like copper loss, core loss, eddy current loss this are all the electrical losses. In resources side we need more amount of copper and laminated steel. In mechanical side there

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TAMILNADU STATE COUNCIL FOR SCIENCE AND TECHNOLOGY
DOTE CAMPUS, CHENNAI - 600 025

STUDENT PROJECT SCHEME 2018-2019
UTILISATION CERTIFICATE

(TWO COPIES)

1. Name of the guide and address : SHUNMUGA SANKARI.M
AP/EEE
TJS ENGINEERING COLLEGE
PERUVOYAL

2. Name of the student(s)
BANU PRAKASH.R
EKNATH.N
NIRMAL RAGAVAN.R

3. Title of the project : DESIGN AND CONSTRUCTION OF BLDC MOTOR TO REPLACE THE SEWING MACHINE CLUTCH MOTOR FOR HANDICAPPED PERSON

4. Project code : EEE 031

It is certified that a sum of Rs. 7500 (Rupees SEVEN THOUSAND FIVE HUNDRED) Sanctioned by the council for carrying out above mentioned student project has been utilized for the purpose for which it was sanctioned and sum of Rs. .....remaining unutilized is refunded.

Signature of the guide — 9/4/19

Signature of the HOD — 9/4/19

Signature of the REGISTRAR/PRINCIPAL/DEAN with SEAL — 9.4.19

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DESIGN AND CONSTRUCTION OF BLDC MOTOR TO REPLACE THE SEWING MACHINE CLUTCH MOTOR FOR HANDICAPPED PERSON

PROJECT EXPENDITURE

S.NO	COMPONENTS	COST IN Rs
1	Robiot hc-05 6pin bluetooth module	435
2	Arduino UNO ATmega328	519
3	Switch Power Supply Driver	2076
4	BLDC motor	5815
5	SEWING MACHINE	5000
TOTAL		13845

10/4/19 10/4/19 10.4.19

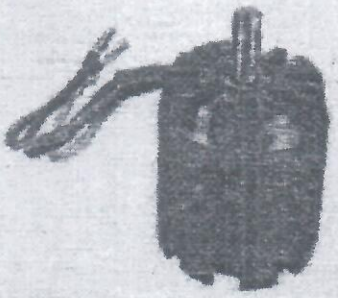
Signature of the guide **Signature of the HOD** **Signature of the PRINCIPAL**

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₹2,789.63 x 1



N5065 320KV 1820W Outrunner Brushless Motor For Electric Scoote...

₹3,061.91 x 1 REVIEW

Total

Payment Method:	Credit or Debit Card
Order Total:	₹5,851.54
Shipping Fee:	₹71.50
Coupon Discount:	₹-185.15
Shipping Insurance: ⓘ	₹77.28
Grand Total:	₹5815.67

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10:14

← Order Detail

Product Information



DC 24V Universal Regulated Switching Power Supply Driver LED ...

Power:400W

₹1,768.69 x 1 REVIEW

Total

Payment Method:	Credit or Debit Card
Order Total:	₹2000.00
Shipping Fee:	₹71.50
Coupon Discount:	₹-30.00
Shipping Insurance: ⓘ	₹35.39
Grand Total:	₹2076.89

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Thiruvallur Dist - 601 206

DESIGN AND FABRICATION OF BLDC MOTOR BASED SEWING MACHINE

A PROJECT REPORT
Submitted by

BANU PRAKASH.R (112815105006)

EKNATH.N (112815105009)

NIRMAL RAGAVAN.N (112815105026)

in partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

T.J.S.ENGINEERING COLLEGE, PERUVOYAL

ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2019

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Thiruvallur Dist - 601 206.

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "**DESIGN AND FABRICATION OF BLDC MOTOR BASED SEWING MACHINE**" is the bonafide work of the following students.

BANU PRAKASH.R (112815105006)

EKNATH.N (112815105009)

NIRMAL RAGAVAN.R (112815105026)

Who carried out the project work under my supervision.

SIGNATURE

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TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF ABBREVIATION	
1.	**INTRODUCTION**	**01**
	1.1 INTRODUCTION TO BLDC MOTOR	01
	1.2 AIM OF PROJECT	01
	1.3 SCOPE OF THE PROJECT	02
2.	**LITERATURE SURVEY**	**03**
3.	**EXISTING AND PROPOSED SYSTEM**	**05**
	3.1 EXISTING SYSTEM	05
	3.1.1 Disadvantages of Existing System	07
	3.2 PROPOSED SYSTEM	07
	3.2.1 Advantages of Proposed System	10
4.	**SOFTWARE IMPLEMENTATION**	**11**
	4.1 MOTORANALYSIS-PM	11

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Thiruvallur Dist - 601 206.

	4.2 BRIEF THEORETICAL BACKGROUND	11
	4.2.1 D-Q Model of a Permanent Magnet Machine	11
	4.2.2 Iron Loss Calculation	12
	4.2.3 Demagnetization of Permanent Magnets	12
	4.3 WORKING WITH SIMULATION FILES	17
	4.3 ARDUINO	17
	4.3.1 Arduino IDE: Initial Setup	18
	4.3.2 IDE: Board Setup	18
	4.3.3 IDE: COM Port Setup	19
	4.3.4 Uploading Blink	19
5	**HARDWARE IMPLEMENTATION**	**20**
	5.1 HARDWARE DESCRIPTION	20
	5.2 SEWING MACHINE	20
	5.2.1 Motive Source	22
	5.2.2 Needle Movement	22

T.J.S. ENGINEERING COLLEGE T.J.S.E.C. PERUVOYAL, KAVARAIPETTAI

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Thiruvallur Dist - 601 206.

5.2.3 Stitch Making 22

5.2.4 The Hook Ring 22

5.2.5 Fabric Movement 23

5.2.6 Fabric Control 23

5.2.7 Stitch tension 23

5.3 MOTOR 24

5.3.1 Brushless Direct Current Motors 24

5.3.2 Stator 28

5.3.3 Rotor 30

5.3.4 Magnetic Materials 31

5.3.4.1 Samarium cobalt magnets 31

5.3.4.2 Neodymium magnets 32

5.3.4.3 Ferrite or ceramic magnets 33

5.4 Electronic Speed Controller (ESC) 34

5.6.1 Sensorless BLDC Motor Control 34

5.6.2 Pulse width modulation inverter

Technology 35

5.4.2.1 PWM Fundamentals 35

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Gummidipoondi Taluk,
Thiruvallur Dist - 601 206.

5.4.2.2 Modulation mode of

Pwm control circuit 36

5.5 AC to DC CONVERTER 39

5.5.1 AC to DC Converter SMPS Working

Principle 39

5.5.2 Inverter Stage 42

5.5.3 Voltage Converter and Output

Rectifier 43

5.5.4 Regulation 44

5.5.5 Advantages 45

5.6 ARDUINO UNO MICRO CONTROLLER

(ATmega 328) 45

5.6.1 Summary 46

5.6.2 Memory 47

5.6.3 Communication 48

5.6.4 Programming 49

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Gummidipoondi Taluk,
Thiruvallur Dist - 601 206.

	5.7 BLUETOOTH MODULE	50
	5.7.1 Software Features	51
	5.8 HARDWARE PROTOTYPE SNAPSHOT	54
6	**CONCLUSION AND FUTURE SCOPE**	**55**
	6.1 CONCLUSION	55
	6.2 FUTURE SCOPE	55
	REFERENCE	

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CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

Before there were brushless DC motors there were brushed DC motors, which were brought on in part to replace the less efficient AC induction motors that came before. The brush DC motor was invented all the way back in 1856 by famed German inventor and industrialist Ernst Werner von Siemens. Near the end of the 1980s, Robert E. Lordo of the POWERTEC Industrial Corporation unveiled the first large brushless DC motors, which had at least ten times the power of the earlier brushless DC motors.

The high-speed industrial sewing machine clutch motor is normally 1/2 horse power 2850 rpm and is used on machines that require high speed production such as clothing straight sewers and over lockers. The low speed industrial sewing machine clutch motor is normally 1/2 horse power 1425 rpm and is used on machines that require a lower speed or are trying to sew heavier work like walking foot and compound feed machines.

1.2 AIM OF PROJECT

This project presents high efficiency and low maintenance cost for sewing machine by using BLDC motor. The design of the motor has been done by using MotorAnalysisPM software. Voice recognition system has been made by using Bluetooth module connected to the Arduino UNO, which makes easily accessible for physically challenged. The aim of the project to run the sewing machine using BLDC motor, which the speed is controlled by voice recognition system in order to help physically challenged. The project has been carried out based on solving the disadvantage of clutch motor, by using the BLDC motor where the maintenance cost and efficiency is more.

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1.3 SCOPE OF THE PROJECT

This project is tried to develop the sewing machine which can be made for easily accessible for physically challenged. The BLDC motor used has the application of high efficiency, low maintenance cost, low consumption of power. The BLDC motor consumes only one-third power of clutch motor. The voice recognition system made by using Bluetooth module which is useful for physically challenged people.

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CHAPTER 2
LITERATURE SURVEY

According to author the [1], Permanent magnet brushless dc (PM BLDC) motors offer various advantages such as high efficiency, compactness and easy controllability which are absolutely beneficial in domestic appliances. Ceiling fans, in general, are driven by single-phase induction motors with an overall system efficiency of about 30%. This paper presents the design, analysis, and development of a 170 V, 20 W, 360 rpm, single-phase PM BLDC motor meant for use in ceiling fan, which becomes a cost-effective high efficiency solution for this high-volume domestic appliance. The developed motor, on testing gave an efficiency of about 50% when fitted to a ceiling fan delivering the same air delivery.

According to author the [2], novel winding method and its inverter circuit to drive a brushless dc (BLDC) motor to high speed with large starting torque. The proposed winding coils are composed of dual windings, i.e., main and auxiliary windings, and the proposed inverter circuit has nine switches. In the starting period, it energizes both main and auxiliary windings in parallel connection to generate large starting torque. After the motor is accelerated, the proposed inverter circuit is automatically switched to energize main winding, which generates small back-electromotive force, to reach high speed. The proposed method is applied to the spindle motor of a hard disk drive and its effectiveness is verified through experiment.

According to author the [3], novel technology for PMDC motor by adding second commutator at the same shaft for Solar PV/T Pumps. This idea opens the new methodology to run a machine i.e. generate energy while running for the torque. This machine is designed and fabricated and tested in real time conditions

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for various applications. A comparison amongst conventional PMDC Motor, first generation Modified PMDC Motor and Dual Commutator PMDC Motor including second generation BLDC motor has been discussed. Several combinations of modes of operations are explained for various applications.

According to author the [4], The novel topology of dual rotor radial flux-BLDC motor with Halbach array magnets as an efficient solution for drives. Due to advent of high permeability, high saturation magnetic materials, high energy product permanent magnets, BLDC motors are suitable candidate for electric vehicle propulsion. Traditionally, outer rotor BLDC motor is a wide choice which is being used in commercially available electric vehicles. New topologies of BLDC motors are being proposed by research activities which aim at improvement of torque density of motors. Dual rotor brushless DC machine (DR-BLDC) is one of the consequences of such research and claimed to have very high torque density and power density. In this paper, a new topology of Dual Rotor Halbach (DR-HB) BLDC motor is proposed which is aimed to increase the torque density of motor.

According to author the [5], The design techniques for reducing the cogging torque in surface-mounted PM motors. Several techniques are adapted in designing surface-mounted permanent-magnet motors in order to reduce the cogging torque. This paper describes various classical and innovative techniques, giving a theoretical justification for each one of them. A simple original motor of the cogging torque mechanism and a Fourier analysis are introduced. As a result, it is highlighted that some techniques are not always utilizable, and some of them may even be deprecatory when not used correctly. In addition, effects of cogging torque elimination on back electromotive force are discussed.

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CHAPTER 3

EXISTING AND PROPOSED SYSTEM

3.1 EXISTING SYSTEM

In existing system clutch motor is used to run the sewing machine. In this system the clutch plates are used to control the speed of a sewing machine. By applying pressure on the clutch plate it isolates the motor and sewing machine so, that the won't run.

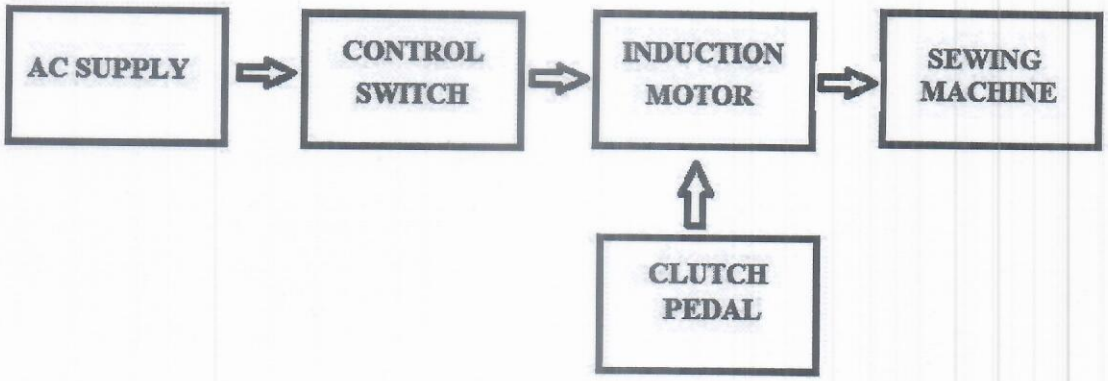


Fig 3.1 Block Diagram Of Existing System

All modern household sewing machines have an induction motor. Home sewing machines and industrial sewing machine models have different types of electric motor drives. All are equipped with a clutch motor at which a sewing machine is able to work 24 hours a day without interruption and at a high speed.

The clutch motor drives an industrial sewing machine with a special belt. Tension of this belt is adjusted by loosening these adjustment nuts on both sides of motor.Industrial clutch motors can operate on the network 400/690 or 220/110 volts. This option allows you to use a sewing machine at home, in sewing studio and small workshops having mains voltage 220/100 volts. In conditions of garment factories is used three-phase mains voltage 400 /690 volts.

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The more tightly the motor and pulley discs are pressed, the more is speed of rotation of sewing machine. Frictional device has and another function. It provides an abrupt stopping of sewing machine after removing your leg from pedal platform.

The existing system in the sewing machine is the normal induction type motor and it is connected through the mechanical system it is known as clutch system so the total assembly is commonly called as clutch motor. This clutch motor working in AC so that it has the more losses like copper loss, core loss, eddy current loss this are all the electrical losses. In resources side we need more amount of copper and laminated steel. In mechanical side there is a friction loss in the clutch are drawback of the clutch motor. Speed control is not possible is the big drawback of this system.

A clutch motor is an AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. An induction motor can therefore be made without electrical connections to the rotor. An induction motor's rotor can be either wound type or squirrel-cage type.

The induction motor stator's magnetic field is therefore changing or rotating relative to the rotor. This induces an opposing current in the induction motor's rotor, in effect the motor's secondary winding, when the latter is short-circuited or closed through an external impedance. The rotating magnetic flux induces currents in the windings of the rotor; in a manner similar to currents induced in a transformer's secondary winding.

The clutch motor is connected to the sewing machine with the help of belt, the footer is used control the motor speed where the efficiency of the motor has been reduced and the maintenance cost has been increased.

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3.1.1 Disadvantages Of Existing System

- During light load conditions, the power factor of the motor drops to a very low value. This is because during the start, the motor draws a large magnetising current to overcome the reluctance offered by the air gap between the Stator and the Rotor. Also, the induction motor will take very less current from the supply main. The vector sum of Load current and Magnetising current lags the voltage by around 75-80 degrees and hence, the power factor is low. Due to high magnetising current, the copper losses of the motor increase. This in turn leads to decrease in the efficiency of the motor.
- Speed control of an induction motor is very difficult to attain. This is because a 3-phase induction motor is a constant speed motor and for the entire loading range, the change in speed of the motor is very low.
- Induction motors have high input surge currents, which are referred to as Magnetising Inrush currents. This causes a reduction in voltage at the time of starting the motor.
- Due to poor starting torque, the motor cannot be used for applications which require high starting torque.
- Maintenance cost is high

3.2 PROPOSED SYSTEM

The hardware system of proposed voice recognition in sewing machine using BLDC motor and ESC. The design for the system is made by using Motor Analysis-PM.ESC is designed in order to control the BLDC motor.

The proposed system is the BLDC motor; it is the latest technology in the industry field.

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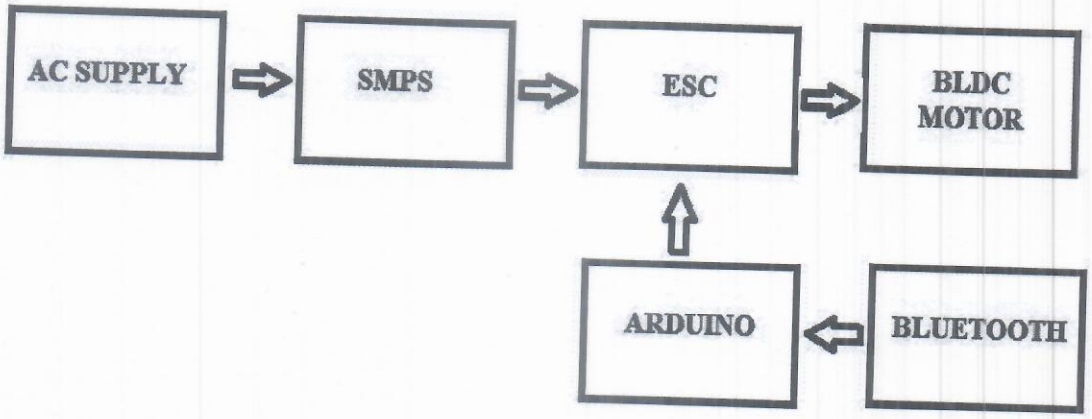


Fig 3.2 Block Diagram Of Proposed System

It is more efficient and compact in size, good controllability, more power full when compare to other motors and life time is high. There is no damage in the motor due to absence of clutch. BLDC motor have the special driving system due to this we can also include the voice command control in the system this is the fetcher of this system. The main advantage of this system when compare to the existing system is speed control, in this we also included the voice control of the sewing machine. This system helps to physically challenged to control the sewing machine.

In order to control all our motors for a suitable and effective operation time with each of the quadcopter models, every operating motor requires its own Electronic Speed Control (ESC) component. First, to understand an ESC, it must be stated that it doesn't interpret mechanical motion like a servo, but instead through varying the switching rate of a network of field effect transistors (FETs). The fast switching of FET, allows for a smooth and precise variation of motor speed.

The Arduino UNO is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power

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jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The design of BLDC motor has been made by using MotorAnalysisPM software where the simulation has been done, the BLDC motor has been chosen based on the size, efficiency.

Brushless motors fulfil many functions originally performed by brushed DC motors, but cost and control complexity prevent brushless motors from replacing brushed motors completely in the lowest-cost areas. Nevertheless, brushless motors have come to dominate many applications, particularly devices such as computer hard drives and CD/DVD players. Small cooling fans in electronic equipment are powered exclusively by brushless motors. They can be found in cordless power tools where the increased efficiency of the motor leads to longer periods of use before the battery needs to be charged. Low speed, low power brushless motors are used in direct-drive turntables for gramophone records.

BLDC motors are a type of synchronous motor. This means the magnetic field generated by the stator and the magnetic fields generated by the rotor rotate at the same frequency. BLDC motors do not experience the "slip" that is normally seen in induction motors. BLDC motors come in single-phase, 2-phase and 3-phase configurations. Corresponding to its type, the stator has the same number of windings. Out of these, 3- phase motors are the most popular and widely used. This application note focuses on 3- phase motors. The brushless motor, unlike the DC brushed motor, has the permanent magnets glued on the rotor.

- **Converter**

In this we are using the AC to DC converter to convert the 230V AC to 48V DC.

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- **ESC**

  ESC stands for electronic speed controller, It is used to control the speed of the BLDC motor by controlling the electrical commutation speed by PWM method.

- **Micro phone**

It is just a converter, It converts the sound waves to electrical signal, In our project it converts the voice command to electrical command signal it is given to Arduino.

- **Arduino**

Arduino is a micro controller; it is programmed to produce the PWM signal in different pulse width with respect to electrical command signal.

- **BLDC motor**

It is a 3 Phase 3 wire motor with high starting torque, we replaced the rotor wounded with permanent magnet.

- **Load**

In our block diagram the load is sewing machine, it is connected with motor with help of belt.

3.2.1 Advantages Of Proposed Technique

- High torque to weight ratio.
- More torque per watt.
- Enhanced reliability.
- Reduction in noise.
- Longer lifespan.
- Better speed versus torque characteristics.
- High dynamic response.
- High efficiency.
- Long operating life due to a lack of electrical and friction losses.

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CHAPTER 4

SOFTWARE IMPLEMENTATION

4.1 MOTORANALYSIS-PM

MotorAnalysis-PM is a free software for design and analysis of permanent magnet machines including brushless DC and permanent magnet synchronous machines with surface-mounted and interior magnets. MotorAnalysis-PM is based on automated finite element analysis (FEA) simulations and establishes a complete set of tools for design and analysis of permanent magnet machines. MotorAnalysisPM is available as a MATLAB-based application and standalone version working without MATLAB.

We believe that our work will help to save our environment supporting green technologies like electric vehicles or wind turbine energy generation as well as enhancing the efficiency and effectiveness of electric machines.

4.2 BRIEF THEORETICAL BACKGROUND

4.2.1 D-Q Model Of A Permanent Magnet Machine

The dq-axes reference frame is a convenient way to represent sinusoidal quantities as constants. The dq-axes reference frame is fixed to the rotor and turning with the same speed as the rotor. As the example of a two-pole surface-mounted permanent magnet rotor, the d-axis is always lying in the direction of the magnetic field of the permanent magnets. The q-axis is turned by 90 electrical degrees, i.e. it always lies between two magnetic poles of the machine. As shown in the q-axis current Iq creates a magnetic field in the q-axis that interacts with the magnetic field of the permanent magnets Ψmd lying in the d-axis to generate torque. The d-axis current Id creates a magnetic field in the d-axis, which can be used to weaken the magnetic field of the permanent magnets when chosen negative (field weakening operation above base speed). the current vector is defined by its

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peak value I and the advance angle γ towards the q-axis. The relationship between the amplitude and advance angle of the current vector and the dq-axes components is given by the following equations.

4.2.2 Iron Loss Analysis

Iron core losses in MotorAnalysis-PM are calculated during the post processing so it assumes that the iron losses do not influence the magnetic field distribution. The iron loss estimation is based on the Steinmetz equation together with the eddy current term.

First term represents hysteresis losses, the second one – eddy current loss term. Coefficients Kh, α, β and Ke are determined by fitting to the measured iron loss data from the manufacturer at different frequencies. For the magneto static FEA the iron losses are estimated at a single frequency, which is a supply frequency for the stator, and zero frequency for the rotor (no iron losses in the rotor assumed). For the transient FEA (Dynamic FE Analysis) iron losses are calculated with the multiple harmonics approach i.e. the average value of iron loss is estimated over the specified time interval and FFT is used to take into consideration the non-sinusoidal shape of the flux density waveform. It allows one to include into analysis the iron loss contribution from higher harmonics of the flux density such as slot harmonics and PWM produced harmonics. Be aware that D-Q analysis in MotorAnalysis-PM does not take into account iron losses.

4.2.3 Demagnetization Of Permanent Magnets

Irreversible demagnetization occurs if the working point in any part of the permanent magnet exceeds the linear range, i.e. falls below the "knee" of the demagnetization curve. It means that the magnet irreversibly changes its properties (remanence flux density is irreversibly reduced) and the new demagnetization curve shown by dotter line emerges.

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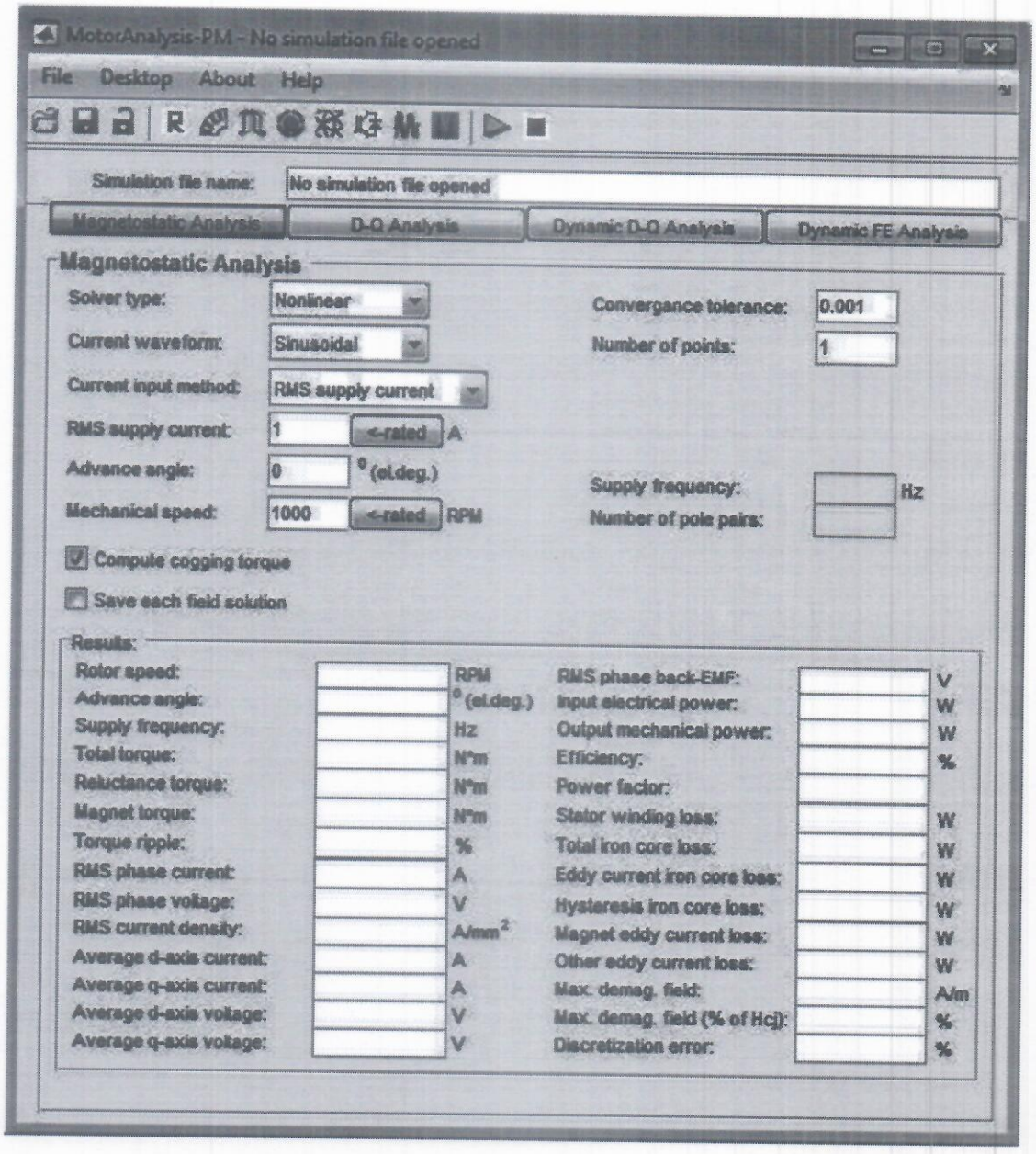


Fig 4.1 MotorAnalysis-PM Main Window

Important parameter which characterizes the ability of permanent magnet to resist the irreversible demagnetization is intrinsic coercivity. Intrinsic coercivity is the applied demagnetizing field required to fully demagnetize the permanent magnet material so when the demagnetizing field is removed the material does not act like a magnet anymore. The higher intrinsic coercivity the higher

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demagnetizing field can be sustained by the permanent magnet without risk of demagnetization.

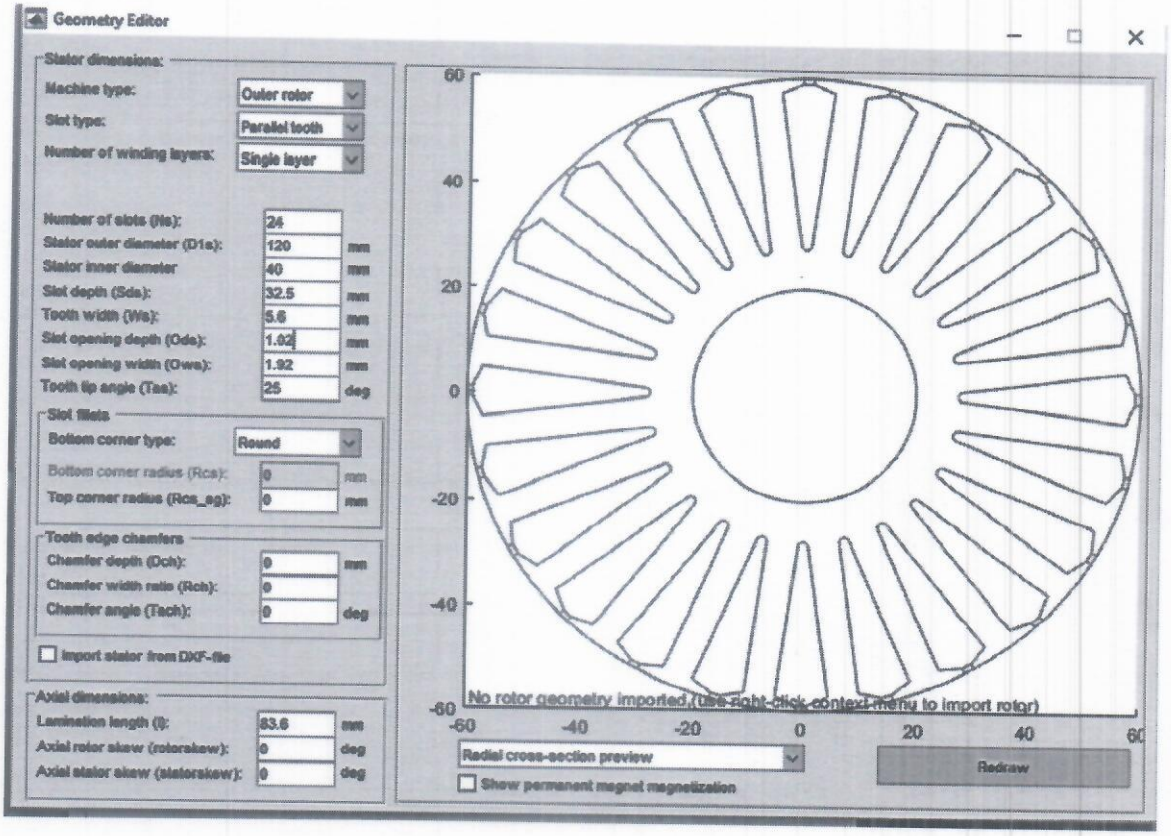


Fig 4.2 Design Of Stator Slot

It is a good practice to always check your simulations for the possible risk of demagnetization at worst operating conditions (maximum current and advance angle) including possible fault conditions. In MotorAnalysis-PM the risk of demagnetization can be estimated from the maximum demagnetizing field intensity experienced by the permanent magnet during simulation. The maximum demagnetizing field intensity is available measured in A/m or in percentage of intrinsic coercivity. If the demagnetization curve for the given permanent magnet material is available, make sure that the maximum demagnetizing field value is to the right of the "knee" of the demagnetization curve. For neodymium magnets

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there is usually no risk of demagnetization if the maximum demagnetizing field is less than 70% of intrinsic coercivity.

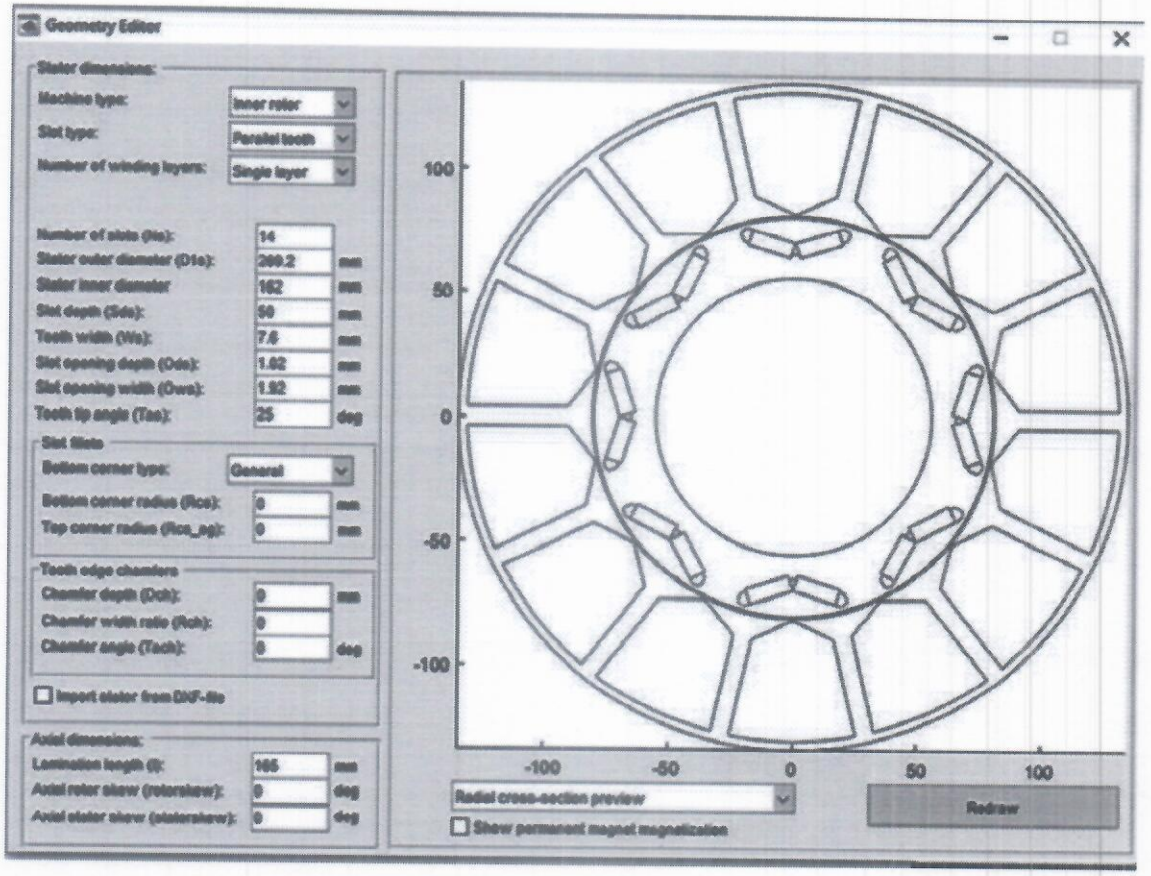


Fig 4.3 Design Of Stator Depth And Open Width

The demagnetization curve changes significantly with the temperature and the risk of demagnetization increases at higher temperatures of the permanent magnet. MotorAnalysis-PM varies properties of the permanent magnet depending on the temperature so to better estimate the risk of demagnetization it is recommended to check simulation results with the maximum expected temperature of the permanent magnet. You should also keep in mind that the material data and demagnetization curves represent typical properties that may vary due to magnet shape and size with tolerances of up to ±10%.

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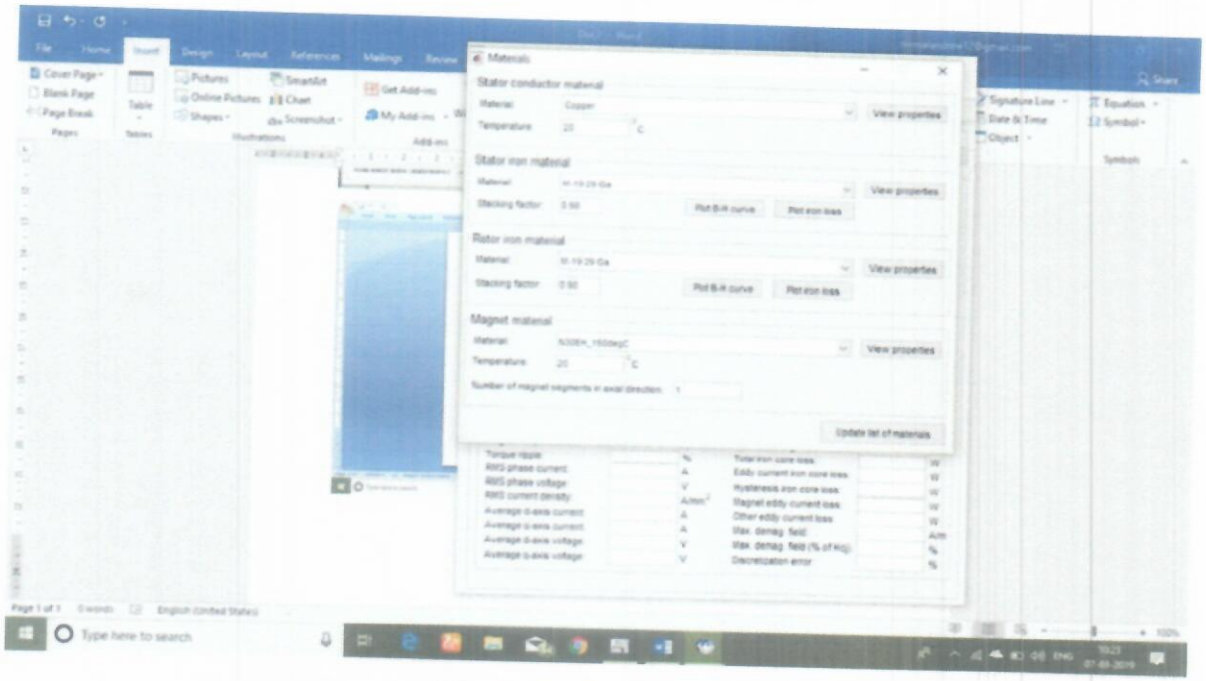


Fig 4.4 Design Of Rotor



Fig 4.5 Magnetic Analysis Of BLDC Motor

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All machine parameters, simulation settings, finite element mesh and simulation results are stored in a simulation file. The simulation file is a MATLAB data-file with .mat extension.

Standard file commands of opening and saving simulation files are available from the File menu or using toolbar buttons. Machine parameters, materials and finite element mesh represented in the Geometry Editor, Winding Editor, Materials and Mesh Editor windows should be defined before any analysis is started and cannot be changed afterwards in order not to confuse simulation results for different design prototypes. Once you started any analysis the simulation file gets locked (Geometry Editor, Winding Editor, Materials and Mesh Editor windows become not available for editing). If you want to change any parameter in Geometry Editor, Winding Editor, Materials or Mesh Editor window after the simulation file got locked, use the Unlock toolbar button to unlock the simulation file. Be aware that all simulation data of all analysis types will be deleted.

Open as New (Empty) Simulation File item of the File menu allows you to create a new simulation file based on another simulation file. All machine parameters, materials and analysis setting will be copied in the new simulation file while the finite element mesh and analysis results will not be included. This is a convenient way to create several design prototypes (each design prototype corresponding to the separate simulation file) changing one or several parameters to find an optimal design.

4.3 ARDUINO

Arduino first and foremost is an open-source computer hardware and software company. The Arduino community refers to the project and user community that designs and utilizes microcontroller-based development boards. These development boards are known as Arduino Modules, which are open-source

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prototyping platforms. The simplified microcontroller board comes in a variety of development board packages.

The most common programming approach is to use the Arduino IDE, which utilizes the C programming language. This gives you access to an enormous Arduino Library that is constantly growing thanks to open-source community.

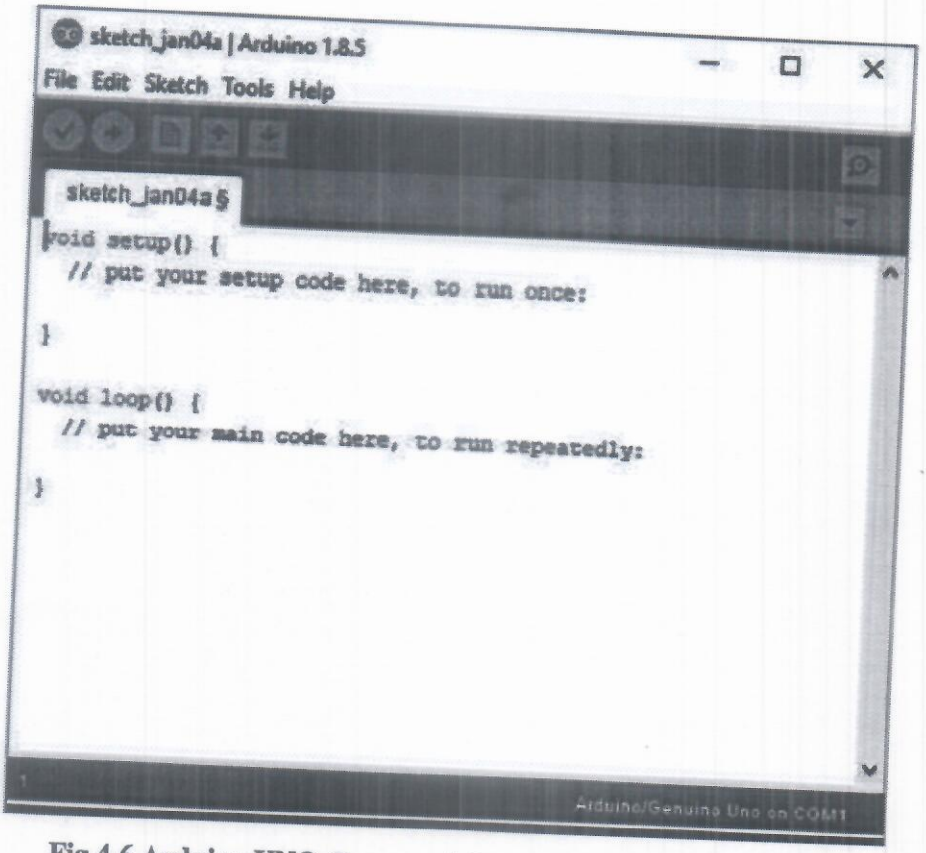


Fig 4.6 Arduino UNO Command Prompt

4.3.1 Arduino IDE: Initial Setup

This is the Arduino IDE once it's been opened. It opens into a blank sketch where you can start programming immediately. First, we should configure the board and port settings to allow us to upload code. Connect your Arduino board to the PC via the USB cable

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4.3.2 IDE: Board Setup

You have to tell the Arduino IDE what board you are uploading to. Select the Tools pulldown menu and go to Board. This list is populated by default with the currently available Arduino Boards that are developed by Arduino. If you are using an UNO or an UNO-Compatible Clone (ex. Funduino, SainSmart, IEIK, etc.), select Arduino UNO. If you are using another board/clone, select that board.

4.3.3 IDE: COM Port Setup

If you downloaded the Arduino IDE before plugging in your Arduino board, when you plugged in the board, the USB drivers should have installed automatically. The most recent Arduino IDE should recognize connected boards and label them with which COM port they are using. Select the Tools pulldown menu and then Port. Here it should list all open COM ports, and if there is a recognized Arduino Board, it will also give its name. Select the Arduino board that you have connected to the PC. If the setup was successful, in the bottom right of the Arduino IDE, you should see the board type and COM number of the board you plan to program. Note: The Arduino UNO occupies the next available COM port; it will not always be COM3.

4.3.4 Uploading Blink

One common procedure to test whether the board you are using is properly set up is to upload the "Blink" sketch. This sketch is included with all Arduino IDE releases and can be accessed by the File pull-down menu and going to Examples, 01. Basics, and then select Blink. Standard Arduino Boards include a surface-mounted LED labelled "L" or "LED" next to the "RX" and "TX" LEDs, that is connected to digital pin 13. This sketch will blink the LED at a regular interval, and is an easy way to confirm if your board is set up properly and you were successful in uploading code. Open the "Blink" sketch and press the "Upload" button in the upper-left corner to upload "Blink" to the board.

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CHAPTER 5

HARDWARE IMPLEMENTATION

5.1 HARDWARE DESCRIPTION

The hardware system of proposed voice recognition in sewing machine using BLDC motor and ESC. THE design for the system is made by using Motor Analysis-PM.ESC is designed in order to control the BLDC motor.

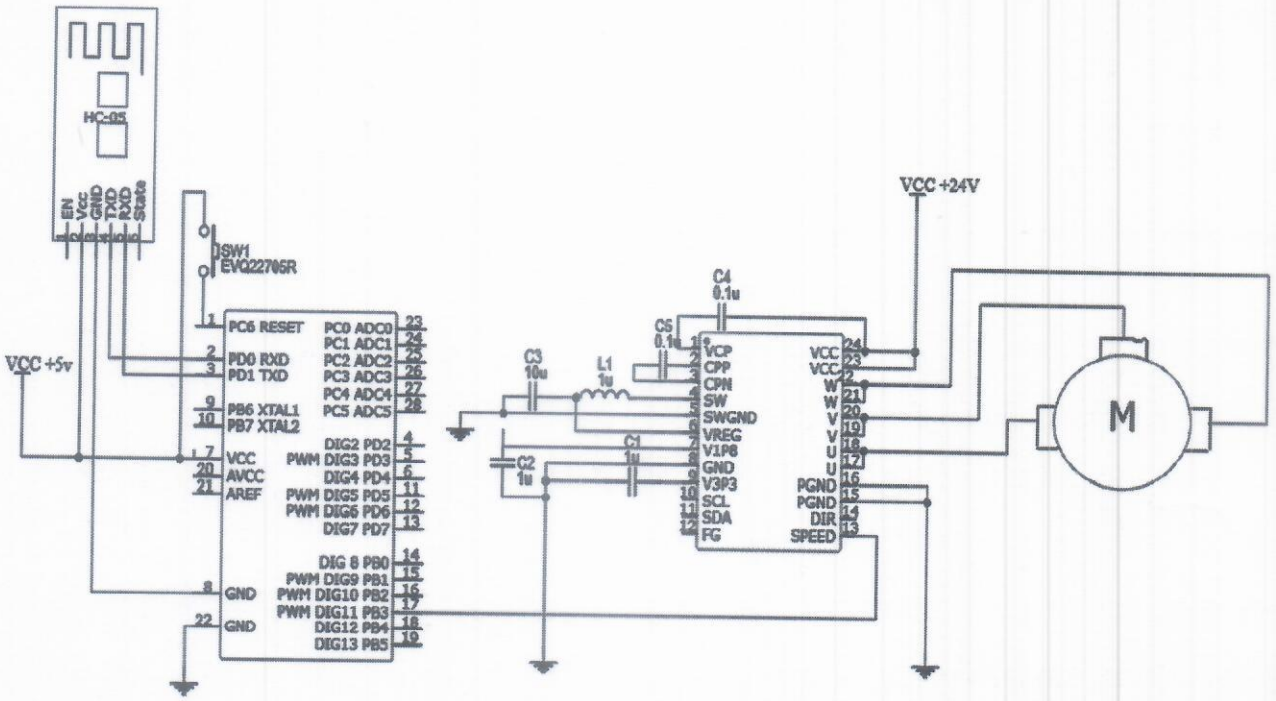


Fig 5.1 Hardware Circuit Diagram Of Proposed System

5.2 SEWING MACHINE

A sewing machine is a machine used to sew fabric and other materials together with thread. Sewing machines were invented during the first Industrial Revolution to decrease the amount of manual sewing work performed in clothing companies. Since the invention of the first working sewing machine, generally considered to have been the work of Englishman Thomas Saint in 1790, the sewing

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machine has greatly improved the efficiency and productivity of the clothing industry.

Home sewing machines are designed for one person to sew individual items while using a single stitch type. In a modern sewing machine, the fabric easily glides in and out of the machine without the inconvenience of needles and thimbles and other such tools used in hand sewing, automating the process of stitching and saving time.

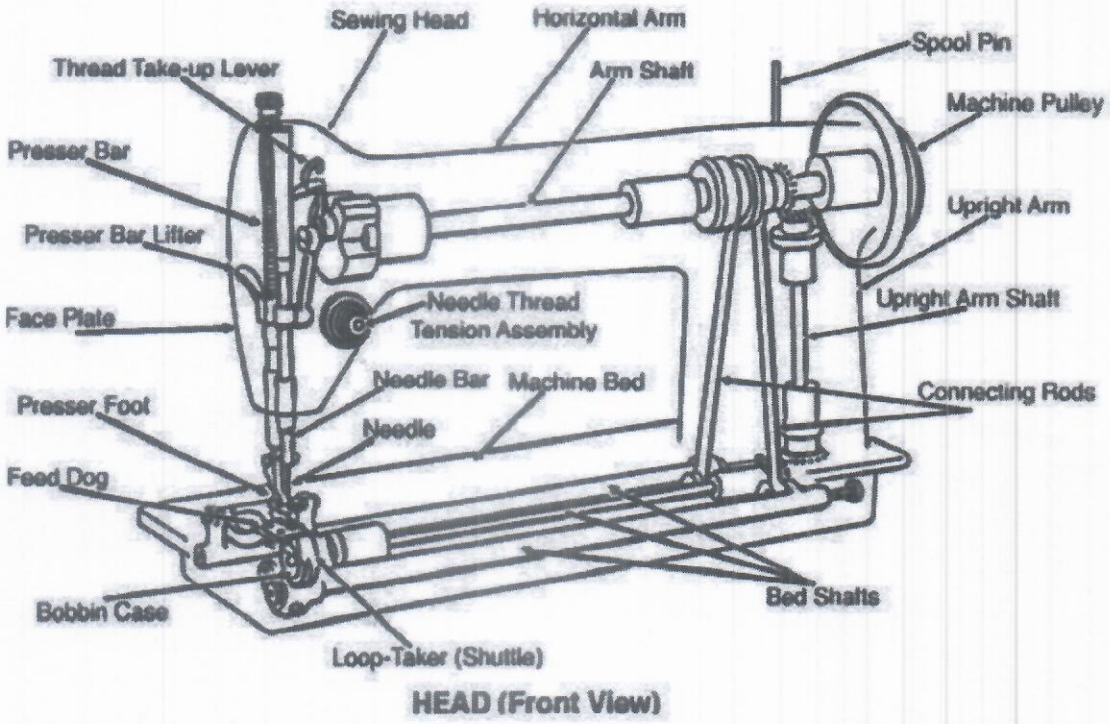


Fig 5.2 Sewing Machine

The mechanism of a sewing machine can be divided into the four areas:

1. Motive Source
2. Stitch Formation
3. Fabric Movement
4. Thread Control

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5.2.1 Motive Source

Whether hand driven or powered by an electric motor or treadle belt, the connection to the machine is the balance wheel. This serves to even out any 'lumpiness' in the machine to give a smooth action.

5.2.2 Needle Movement

The rotating driveshaft in the arm of the machine connects to the needle bar through levers in the head to produce the up and down movement of the needle. The sewing machine needle is a highly sophisticated piece of design which we look at in detail on the following page.

5.2.3 Stitch Making

The drive shaft has a vertical crank attached to it, going down under the base plate. Again, by a series of levers, this connects to a hook ring. The hook ring picks up the upper thread and guides it round the bobbin holding the lower thread. Using the up and down movement of the needle and the rotation of the hook ring the two threads are looped together to form the stitch.

5.2.4 The Hook Ring

As the hook ring turns in its part circle, the hook picks up the loop made by the needle and drags it round the lower bobbin. The thread then slips off the hook and, as the needle bar rises, is pulled round the lower bobbin to make the stitch. On the far right, you can see that the bobbin thread has been encircled by the stitch loop formed by the top thread. This action in the stitch cycle is the most important combination of movements performed by the machine. And yet, at normal sewing speed, it only takes about a fifth of a second to complete, which is approximately the time required to wink your eye. Accurate synchronisation (or timing) between the simultaneous tasks of stitch formation is essential for the machine to work. If you thread up a machine, and sew a few stitches slowly on the edge of a piece of cloth with the cover plate open, you can see this stitch formation for yourself.

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5.2.5 Fabric Movement

At each revolution of the machine the teeth of the feed dog rise slightly above the base plate. The teeth grip the underside of the cloth and feed it forward a tiny measured amount determined by the setting of the stitch length regulator. The movement of the feed dog is generated through yet more levers, from another vertical shaft working from the drive shaft.

5.2.6 Fabric control

The fabric is held tight during stitching by the presser foot squeezing the fabric against the teeth of the feed dog or the throat plate while the feed dog is below the plate. The amount of pressure can be regulated by the presser regulating screw on top of the head and released completely by raising the presser bar lifter.

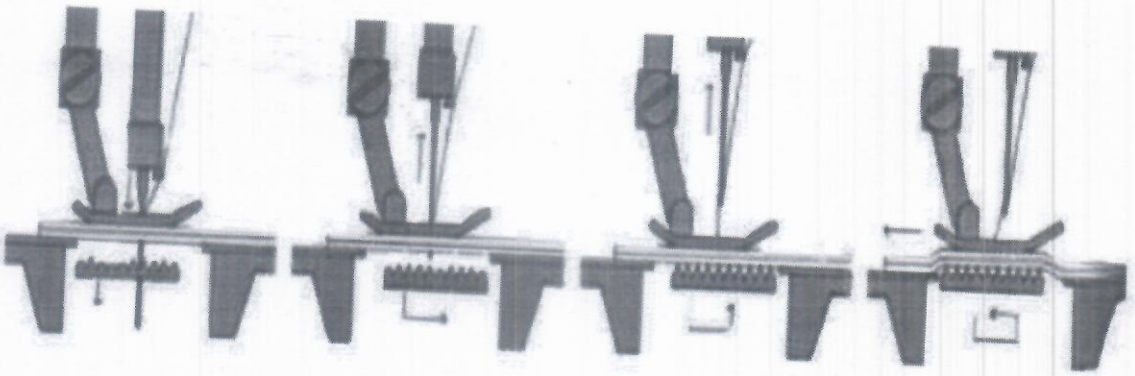


Fig 5.3 Stich Tension

5.2.7 Stitch tension

The tightness of the stitch is controlled by two different tension mechanisms:

1. The bobbin has a small spring on its case, which delivers the thread under a slight tension.

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2. The main tension mechanism is on the upper thread, on the head of the machine. The thread passes between two saucer shaped discs. The pressure between the discs can be varied by the tension regulating thumb nut.

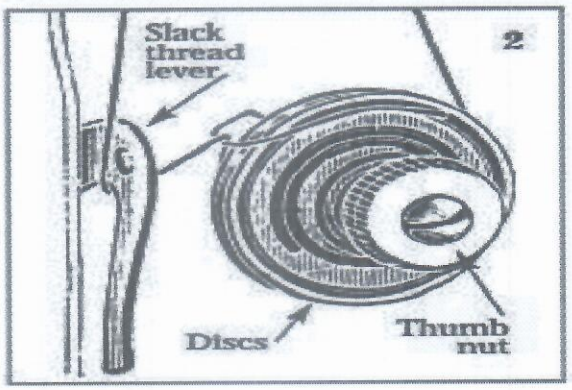


Fig 5.4 Tension Regulating Thumb Nut

5.3 MOTOR

Motor is made up of skilful wrapping of coils on a stator, a rotor for the rotation, and magnets to influence the rotations. The magnets used their work electromagnetically.

That means electricity influences this iron to behave like a magnet, having both attraction and repulsion characteristics of a magnet into this, thereby helping it to generate the motion accompanying this. The principle in this is to switch the direction of the forces to keep the motor to move continuously, once it is started until the time it is stopped.

5.3.1 Brushless Direct Current Motor

In a brushless motor, as there is no physical contact from any parts of the motor inside, therefore there is virtually no wear and tear possibilities, making the motor's durability limitless.

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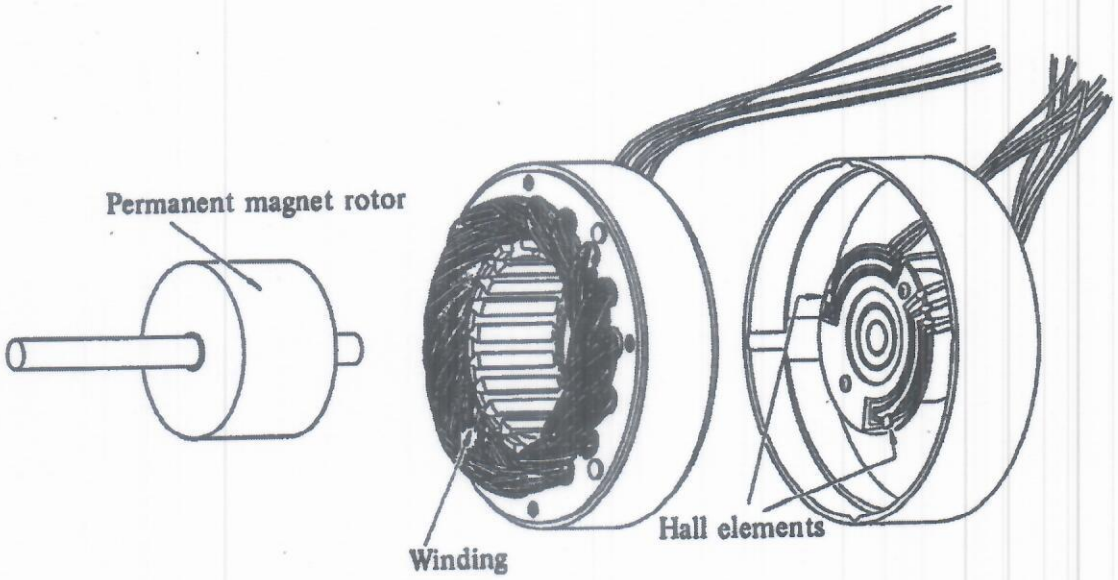


Fig 5.5 Brushless Direct Current (BLDC) Motor

These motors have more sophisticated controllers, and it makes it possible for using three different windings, and power is supplied individual windings according to the position they are in the movement. When the motor passes one winding, the controller passes the power to another winding, making the movement to continue without stopping. These types of motors are quite popular nowadays.

Conventional DC motors are highly efficient and their characteristics make them suitable for use as servomotors. However, their only drawback is that they need a commutator and brushes which are subject to wear and require maintenance. When the functions of commutator and brushes were implemented by solid-state switches, maintenance-free motors were realised. These motors are now known as Brushless DC motors.

Brushless Direct Current (BLDC) motor is a type of synchronous motor, where magnetic fields generated by both stator and rotate have the same frequency. The BLDC motor has a longer life because no brushes are needed. Apart from that, it has a high starting torque, high no-load speed and small energy losses.

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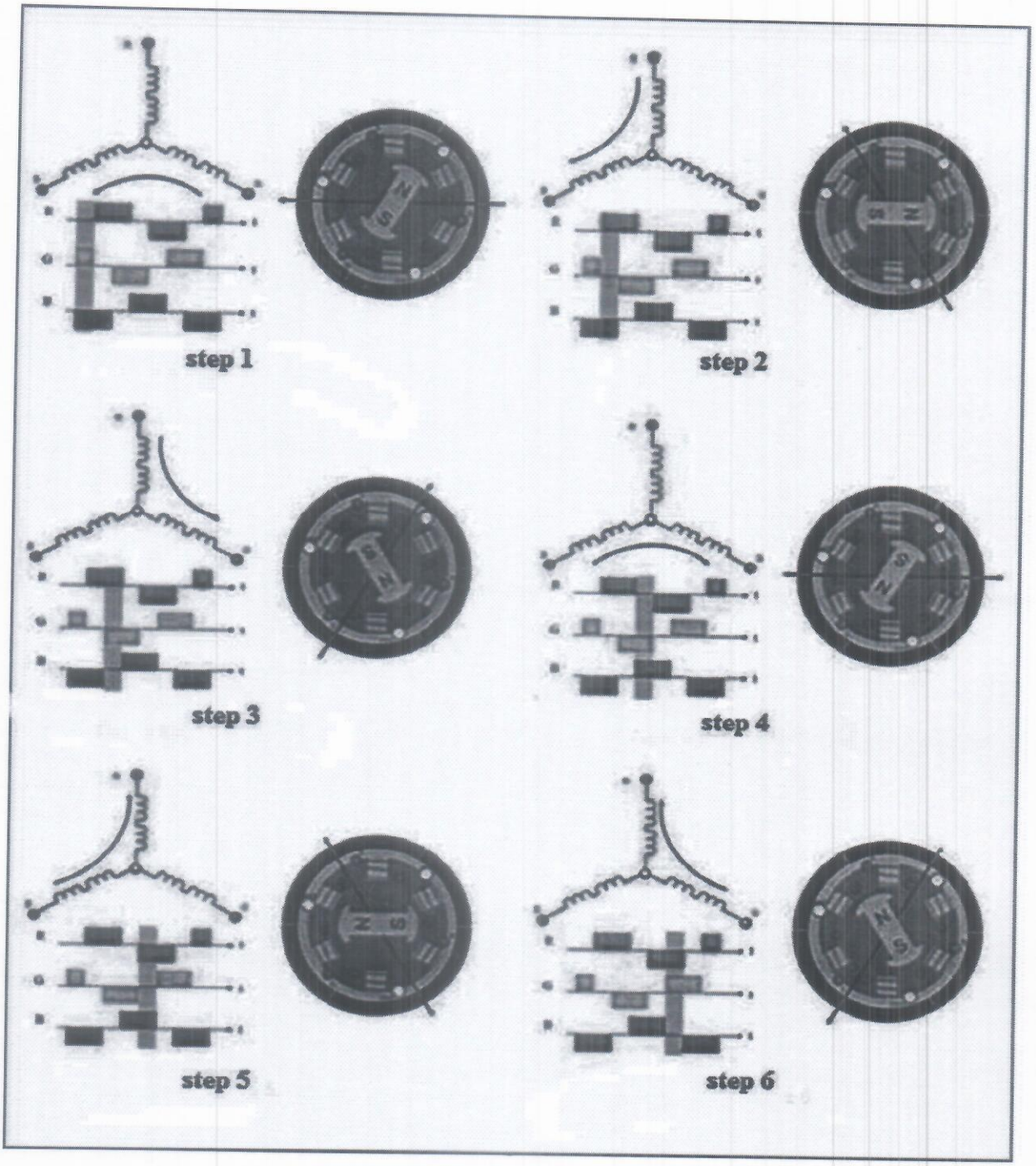


Fig 5.6 Steps Of Rotation

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The structure of a BLDC motor is divided into two parts:

- Moving part called the rotor, represented by permanent magnet
- Fixed part called the stator, represented by phase windings of magnetic circuit

The underlying principles for the working of a BLDC motor are the same as for a brushed DC motor; i.e., internal shaft position feedback. In case of a brushed DC motor, feedback is implemented using a mechanical commutator and brushes. With an in BLDC motor, it is achieved using multiple feedback sensors. The most commonly used sensors are hall sensors and optical encoders.

In a commutation system – one that is based on the position of the motor identified using feedback sensors – two of the three electrical windings are energized at a time as shown in figure. In figure (1), the GREEN winding labelled "001" is energized as the NORTH pole and the BLUE winding labelled as "010" is energized as the SOUTH pole. Because of this excitation, the SOUTH pole of the rotor aligns with the GREEN winding and the NORTH pole aligns with the RED winding labelled "100". In order to move the rotor, the "RED" and "BLUE" windings are energized in the direction shown in figure (2). This causes the RED winding to become the NORTH pole and the BLUE winding to become the SOUTH pole. This shifting of the magnetic field in the stator produces torque because of the development of repulsion (Red winding – NORTH-NORTH alignment) and attraction forces (BLUE winding – NORTH-SOUTH alignment), which moves the rotor in the clockwise direction.

This torque is at its maximum when the rotor starts to move, but it reduces as the two fields align to each other. Thus, to preserve the torque or to build up the rotation, the magnetic field generated by stator should keep switching. To catch up with the field generated by the stator, the rotor will keep rotating. Since the

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magnetic field of the stator and rotor both rotate at the same frequency, they come under the category of synchronous motor.

This switching of the stator to build up the rotation is known as commutation. For 3-phase windings, there are 6 steps in the commutation; i.e., 6 unique combinations in which motor windings will be energized.

5.3.3 Stator

The stator of a BLDC motor consists of stacked steel laminations with windings placed in the slots that are axially cut along the inner periphery. Traditionally, the stator resembles an induction motor; however, the windings are distributed in a different manner. Most BLDC motors have three stator windings connected in star fashion.



Fig 5.7 Laminated Steel Stampings-Stator

Each winding is constructed with numerous coils that are interconnected to form a winding. One or more coils are placed in the slots and they are interconnected to make a winding. Each winding is distributed over the stator periphery to form an even number of poles.

Similar to an Induction AC motor, the BLDC motor stator is made out of laminated steel stacked up to carry the windings. Windings in a stator can be arranged in two patterns; i.e. a star pattern (Y) or delta pattern (Δ). The major

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difference between the two patterns is that the Y pattern gives high torque at low RPM and the Δ pattern gives low torque at low RPM. This is because in the Δ configuration, half of the voltage is applied across the winding that is not driven, thus increasing losses and, in turn, efficiency and torque Steel laminations in the stator can be slotted or slot less as shown in Figure. A slot less core has lower inductance, thus it can run at very high speed.

Because of the absence of teeth in the lamination stack, requirements for the cogging torque also go down, thus making them an ideal fit for low speeds too (when permanent magnets on rotor and tooth on the stator align with each other then, because of the interaction between the two, an undesirable cogging torque develops and causes ripples in speed).

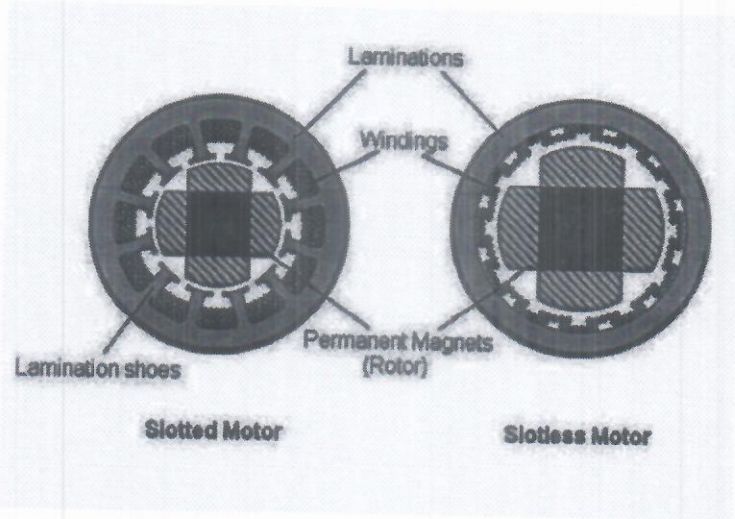


Fig 5.8 Slotted And Slotless Motor

The main disadvantage of a slot less core is higher cost because it requires more winding to compensate for the larger air gap. Proper selection of the laminated steel and windings for the construction of stator are crucial to motor performance. An improper selection may lead to multiple problems during production, resulting in market delays and increased design costs.

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5.3.4 Rotor

The rotor is made of permanent magnet and can vary from two to eight pole pairs with alternate North (N) and South (S) poles Unlike a brushed DC motor, BLDC motor can be controlled electronically. To rotate the BLDC motor, the stator windings must have energized in a special sequence. The rotor position must be known in order to understand which winding will be energized next. The rotor position is sensed using Hall Effect sensors that are embedded in the stator.

Most BLDC motors have three Hall sensors embedded in the stator on the non-driving end of the motor. Whenever the rotor magnetic poles pass near the Hall sensors, they generate a high or low signal, which indicates that N or S pole is passing near the sensors.

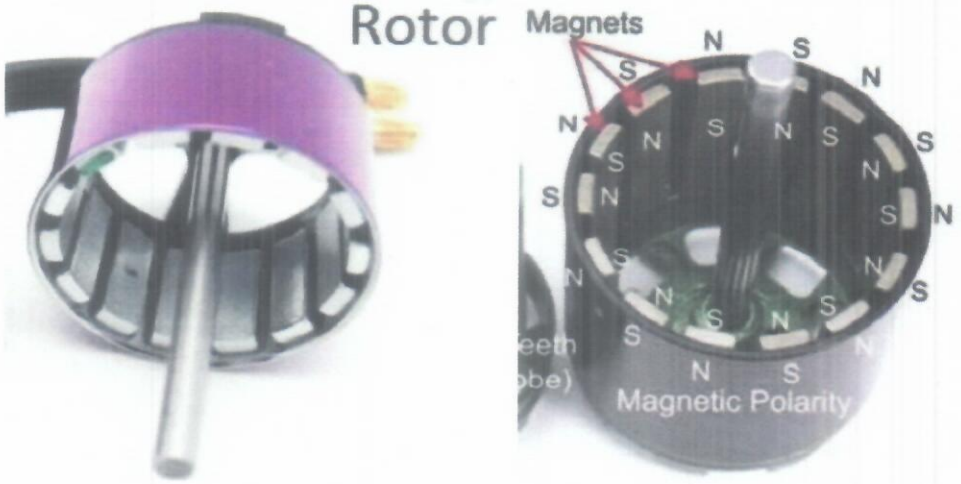


Fig 5.9 Permanent Magnet Rotor

Based on the combination of these Hall Sensor signals, the exact sequence of commutation can be determined.

The rotor of a typical BLDC motor is made out of permanent magnets. Depending upon the application requirements, the number of poles in the rotor may

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vary. Increasing the number of poles does give better torque but at the cost of reducing the maximum possible speed.

Another rotor parameter that impacts the maximum torque is the material used for the construction of permanent magnet; the higher the flux density of the material, the higher the torque.

5.3.5 Magnetic Material

Types of magnetic material

- Samarium Cobalt Magnets
- Neodymium Magnets
- Ceramic Magnets

5.3.5.1 Samarium cobalt magnets



Fig 5.10Samarium Cobalt Magnets

Samarium Cobalt (SmCo) magnetsare optimal for high temperature motor applications due to their high magnetic strength, exceptional temperature resistance, and reliable performance without oxidation protection.

Corrosion Resistance

SmCo magnets offer outstanding corrosion resistance (neodymium magnets do not). Plating or surface coatings are not necessary for most applications, making them advantageous for medical applications as well.

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Temperature Stability

A SmCo magnet can withstand higher temperatures than a Neodymium magnet. The maximum operating temperatures for Samarium Cobalt magnets are between 250 and 550 °C; Curie temperatures range from 700 to 800 °C.

5.3.5.2 Neodymium magnets

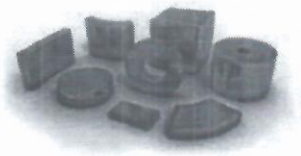


Fig 5.11Neodymium Magnets

Neodymium magnetsare also used in electric car motor applications. From the motor that spins a DVD disc to the wheels of a hybrid car, neodymium magnets are used throughout the vehicle. The decision between Samarium Cobalt or Neodymium as a vehicle magnet is usually based on either operating temperature and/or corrosion resistance.

Operating temperature

A low coercivity grade Neodymium magnet may begin to lose strength if heated above 176°F (80°C). High coercivity grade Neodymium Magnets have been developed to function at temperatures up to 428°F (220°C) with little irreversible loss. The need for low temperature coefficient in neodymium magnet applications has triggered several grades to be developed to meet specific operating requirements. Please refer to our chart of magnetic properties to compare the characteristics of each grade.

Corrosion

Neodymium magnets are vulnerable to corrosion, especially along grain boundaries of a sintered magnet. This type of corrosion can cause serious

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deterioration, including crumbling of a magnet into a powder of small magnetic particles. This vulnerability is addressed by adding a protective coating to prevent exposure to the atmosphere. Nickel plating or two-layered copper-nickel plating are the standard methods, although plating with other metals or polymer and lacquer protective coatings are also available.

5.3.5.3 Ferrite or ceramic magnets



Fig 5.12Ferrite Magnets

Although they offer low energy compared to rare earth magnets, ferrite magnets have won wide acceptance due to their strong resistance to demagnetization, exceptional corrosion resistance and low price. It is the most common magnet used in most types of DC electric motors.

Operating temperature

Maximum operating temperature for a ceramic magnetis 250°C. Although you will experience magnetic losses when operating at elevated temperatures, the losses are recovered when the material is brought down to normal ambient temperature. However, operating in very cold temperatures (-20°C) can result in permanent losses of magnetic strength unless the circuit has been designed for such extremes.

Corrosion

Ceramic magnets offer good corrosion resistance and generally do not require a coating or plating.

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5.4 ELECTRONIC SPEED CONTROLLER (ESC)

5.4.1 Sensorless BLDC Motor Control

An electronic speed control follows a speed reference signal (derived from a throttle lever, joystick, or other manual input) and varies the switching rate of a network of field effect transistors (FETs). By adjusting the duty cycle or switching frequency of the transistors, the speed of the motor is changed. The rapid switching of the transistors is what causes the motor itself to emit its characteristic high-pitched whine, especially noticeable at lower speeds.

Different types of speed controls are required for brushed DC motors and brushless DC motors. A brushed motor can have its speed controlled by varying the voltage on its armature. (Industrially, motors with electromagnet field windings instead of permanent magnets can also have their speed controlled by adjusting the strength of the motor field current).

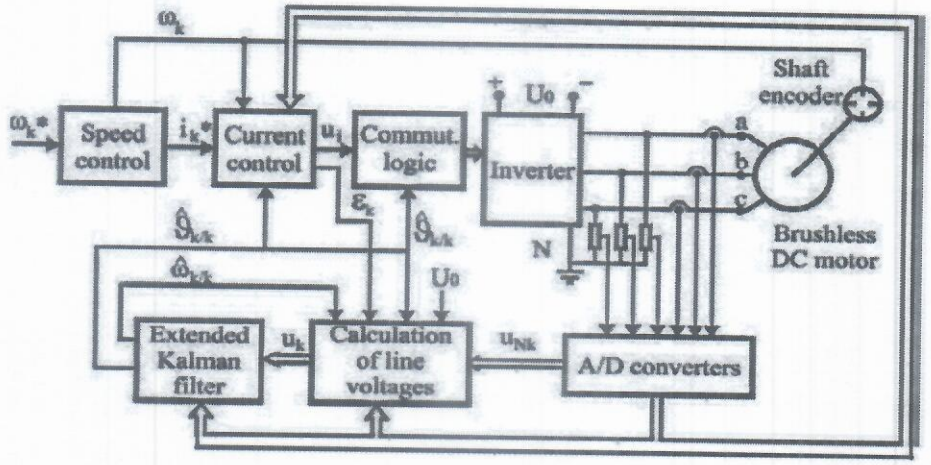


Fig 5.13 Block Diagram of ESC

A brushless motor requires a different operating principle. The speed of the motor is varied by adjusting the timing of pulses of current delivered to the several windings of the motor. Brushless ESC systems basically create three-phase AC power, as in a variable frequency drive, to run brushless motors. Brushless motors

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are popular with radio controlled airplane hobbyists because of their efficiency, power, longevity and light weight in comparison to traditional brushed motors. Brushless AC motor controllers are much more complicated than brushed motor controllers.

The correct phase varies with the motor rotation, which is to be taken into account by the ESC: Usually, back EMF from the motor is used to detect this rotation, but variations exist that use magnetic (Hall effect) or optical detectors.

Computer programmable speed controls generally have user-specified options which allow setting low voltage cut-off limits, timing, acceleration, braking and direction of rotation. Reversing the motor's direction may also be accomplished by switching any two of the three leads from the ESC to the motor.

5.4.2 Pulse Width Modulation Inverter Technology

5.4.2.1 PWM fundamentals

a). Pulse width modulation inverter circuit Definition: to control the output voltage by changing the pulse width, to control the output frequency of the circuit by changing the modulation cycle.

b). Pulse width modulation classification: 1. To modulate the pulse polarity can be divided into unipolar and bipolar modulation two kinds; 2. To the carrier frequency signal and the reference signal relationship between the frequency can be divided into two kinds of asynchronous and synchronous modulation.

c). PWM inverter circuit features: you can get quite close to the sine wave output voltage and current, it is also known sinusoidal pulse width modulation SPWM (Sinusoidal PWM).

d). SPWM control: that is to control the inverter circuit switching device on and off so that the output to give a series of equal amplitude and pulse width ranging, from using these pulses to instead of sinusoidal waveform required. According to certain rules of each pulse width modulated, it can change the size of

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the output voltage of the inverter circuit and the output frequency may also be varied.

5.4.2.2 Modulation mode of PWM control circuit

a). Carrier ratio is defined: In the 3-phase PWM power inverter circuit, the ratio of the carrier frequency fc and the modulated signal fr called the carrier frequency ratio, that is, N=fc/fr.

b). 3-phase PWM inverter circuit control mode: According to whether the carrier wave and the modulation signal are synchronized has asynchronous and synchronous modulation two control mode. Asynchronous modulation control: When the entire carrier ratio is not a multiple of 3, carrier wave with the modulation signal is not synchronized modulation. Synchronous modulation control: In the three-phase inverter circuit when the carrier ratio is an integer multiple of 3, the carrier modulation signal modulation wave can be synchronized.

5.4.3 Modes Of Operation

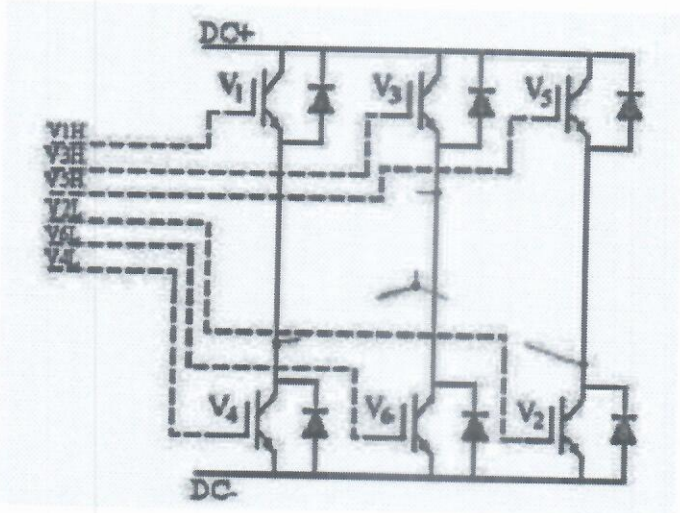


Fig 5.14 Control Circuit For 3 Phase BLDC Windings

As discussed in the previous part of this article, based on the position of the motor (identified using feedback sensors), two of the three electrical windings are energized at a time. To be able to energize the windings, external circuitry is

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required to be able to meet the current requirements of the motor. A typical control circuit with a 3-phase winding connection is shown in Figure. V1, V3, V5 and V2, V4, V6 make a 3-phase voltage source inverter connected across the power supply. V1 and V4 form one bridge. V1 is high side, which is connected to the high voltage DC source while V4 is low side, which is connected to ground.

By adjusting the high-side and low side of the power device (via signals V1H, V3H, V5H and V2L, V4L, v6L), the current flow through the stator winding can be controlled. For example, if current has to flow in to the RED winding and flow out from the BLUE winding, turning on V1 and V6 while keeping the other signals will cause the current to flow in the required direction, as shown in Figure (5.15). Next, by switching ON V5 and V6 and turning all other signals OFF, the current can be switched to flow in from the GREEN winding and out from the BLUE winding, shown in Figure (5.16).

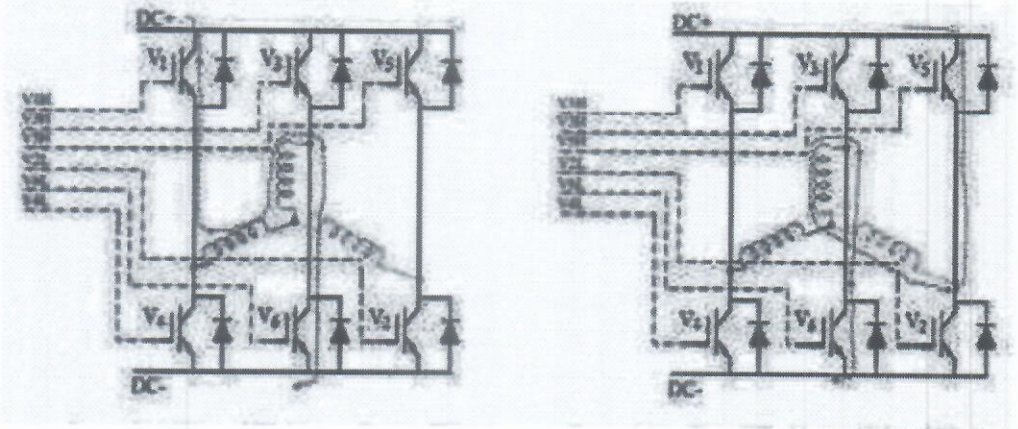


Fig (5.15) - V1 and V6 ON; remaining all OFF

Fig (5.16) – V5 and V6 ON; remaining all OFF

Following the same procedure, the 6-step driving sequence for a BLDC motor can be generated.

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Hall C	Hall B	Hall A	Green	Red	Blue	Sector No	MOSFET-ON
0	0	1	DC+	NC	DC+	0	V5,V6
0	1	1	DC+	DC-	NC	1	V4,V5
0	1	0	NC	DC-	DC+	2	V3,V4
1	1	0	DC-	NC	DC+	3	V2,V3
1	0	0	DC-	DC+	NC	4	V1,V2
1	0	1	NC	DC+	DC-	5	V1,V6

Table 5.1 Switching Sequence

Table provides the switching sequence for power circuitry based on a Hall sensor output. To build up the rotation, the motor should be periodically switched from one phase to another as shown above

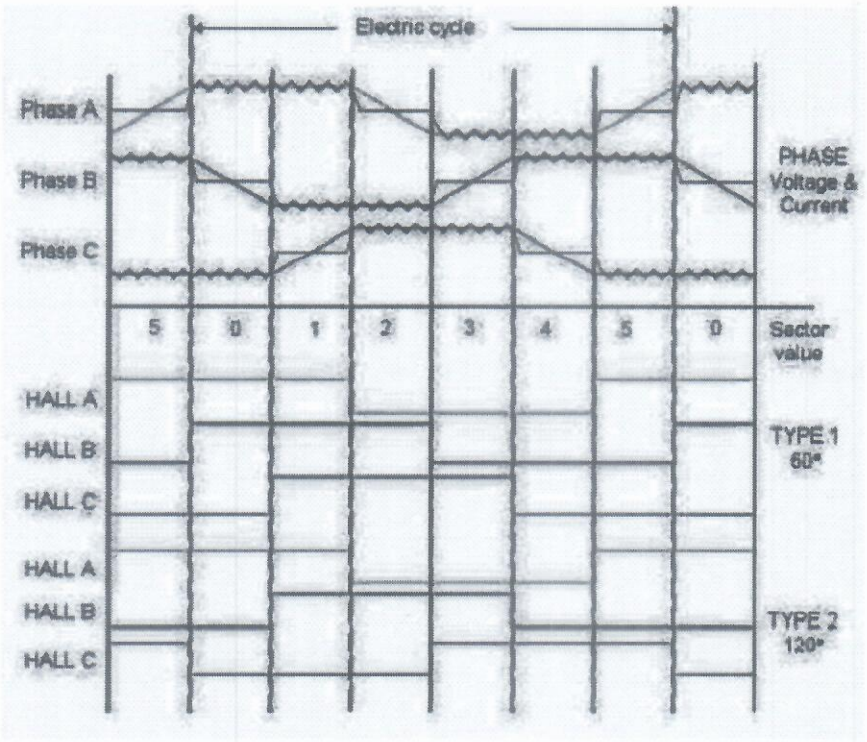


Fig 5.17 Voltage And Current Through The Windings Waveform

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However, if the rotation has to be reversed, then the sequence needs to be reversed as well. Figure shows the excitation waveform, including phase current, phase voltage, Hall sensor, and sector value. The top half of the figure shows the 3phase winding excitation current and voltage in which black lines are phase current, while green, red, and blue lines are the phase voltage. As the phase current is trapezoidal, we call 6-step BLDC control trapezoidal control.

The Hall sensor and the excitation have a fixed relationship. Typically, there are two types of Hall sensors. For the first type, for each HALL phase, their waveforms have a 60-degree time-lapse. For the second type, the waveform time lapse is 120 degrees.

5.5 AC TO DC CONVERTER

In our project we are using SMPS type ac to dc converter due to its voltage controllability at output side. The electronic power supply integrated with the switching regulator for converting the electrical power efficiently from one form to another form with desired characteristics is called as Switch-mode power supply. It is used to obtain regulated DC output voltage from unregulated AC or DC input voltage.



Fig 5.18 Block Diagram Of SMPS

Similar to other power supplies, switch-mode power supply is a complicated circuit that supplies power from a source to loads. switch-mode power supply is essential for power consuming electrical and electronic appliances.

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5.5.1 AC To DC Converter SMPS Working Principle

The AC to DC converter SMPS has an AC input. It is converted into DC by rectification process using a rectifier and filter. This unregulated DC voltage is fed to the large-filter capacitor or PFC (Power Factor Correction) circuits for correction of power factor as it is affected. This is because around voltage peaks, the rectifier draws short current pulses having significantly high-frequency energy which affects the power factor to reduce.

It is almost similar to the DC to DC converter, but instead of direct DC power supply, here AC input is used. So, the combination of the rectifier and filter, shown in the block diagram is used for converting the AC into DC and switching is done by using a power MOSFET amplifier with which very high gain can be achieved. The MOSFET transistor has low on-Resistance and can withstand high currents.

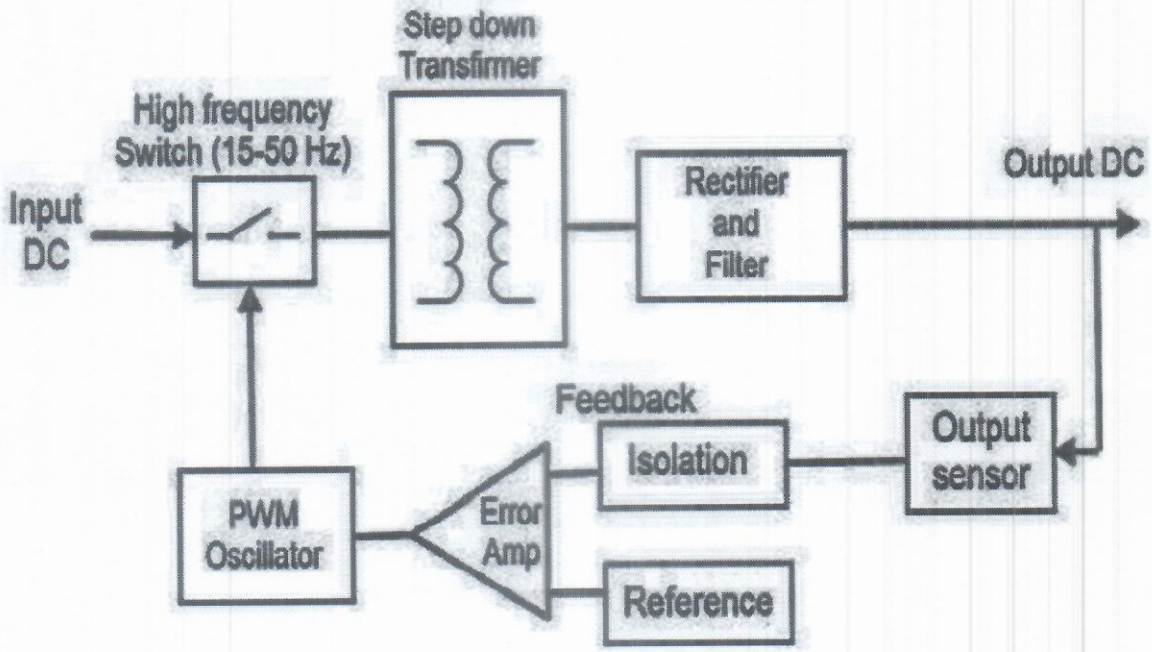


Fig 5.19 Internal Block Diagram Of SMPS

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The switching frequency is chosen such that it must be kept inaudible to normal human beings (mostly above 20KHz) and switching action is controlled by a feedback utilizing the PWM oscillator.

This AC voltage is again fed to the output transformer shown in the figure to step down or step up the voltage levels. Then, the output of this transformer is rectified and smoothed by using the output rectifier and filter. A feedback circuit is used to control the output voltage by comparing it with the reference voltage.

The SMPS working stages

- Input rectifier stage
- Inverter stage
- Voltage converter and output rectifier
- Regulation

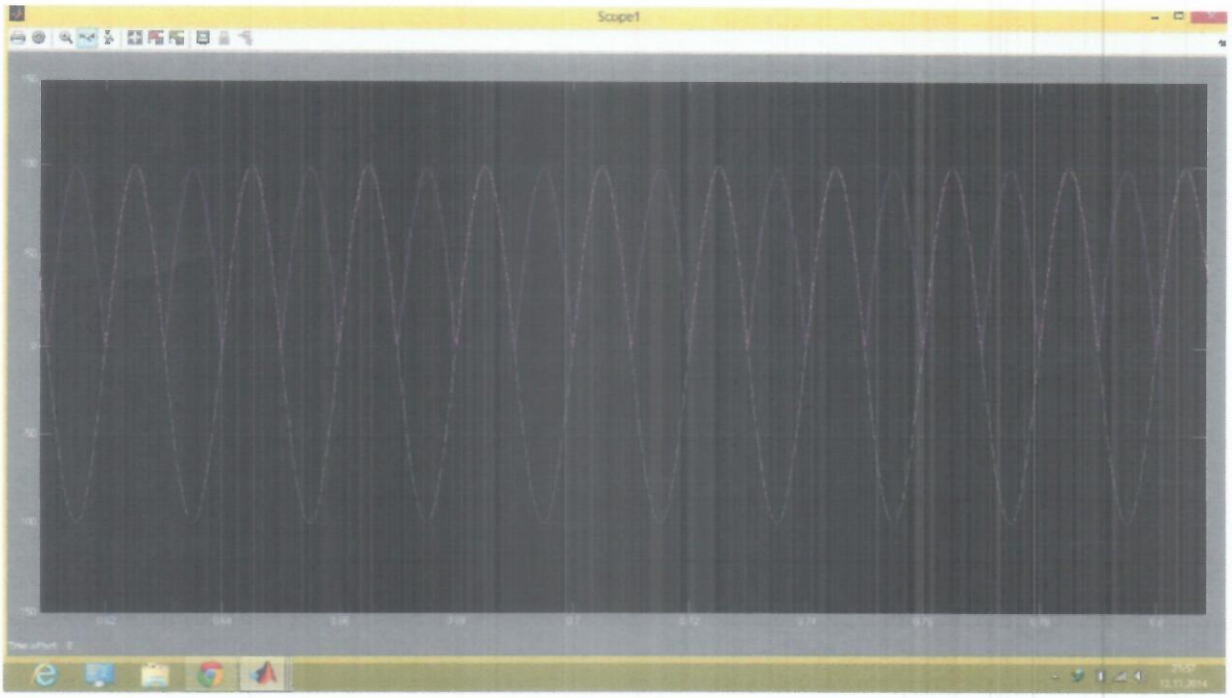


Fig 5.20 SMPS Rectifier Output Waveform

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If the SMPS has an AC input, then the first stage is to convert the input to DC. This is called rectification. An SMPS with a DC input does not require this stage. In some power supplies (mostly computer ATX power supplies), the rectifier circuit can be configured as a voltage doubler by the addition of a switch operated either manually or automatically. This feature permits operation from power sources that are normally at 115 V or at 230 V. The rectifier produces an unregulated DC voltage which is then sent to a large filter capacitor.

The current drawn from the mains supply by this rectifier circuit occurs in short pulses around the AC voltage peaks. These pulses have significant high frequency energy which reduces the power factor. To correct for this, many newer SMPS will use a special PFC circuit to make the input current follow the sinusoidal shape of the AC input voltage, correcting the power factor. Power supplies that use active PFC usually are auto-ranging, supporting input voltages from ~100 VAC – 250 VAC, with no input voltage selector switch.

An SMPS designed for AC input can usually be run from a DC supply, because the DC would pass through the rectifier unchanged. If the power supply is designed for 115 VAC and has no voltage selector switch, the required DC voltage would be 163 VDC ($115 \times \sqrt{2}$). This type of use may be harmful to the rectifier stage, however, as it will only use half of diodes in the rectifier for the full load. This could possibly result in overheating of these components, causing them to fail prematurely. On the other hand, if the power supply has a voltage selector switch, based on the Delon circuit, for 115/230 V (computer ATX power supplies typically are in this category), the selector switch would have to be put in the 230 V position, and the required voltage would be 325 VDC ($230 \times \sqrt{2}$). The diodes in this type of power supply will handle the DC current just fine because they are rated to handle double the nominal input current when operated in the 115 V mode, due to the operation of the voltage doubler. This is because the doubler, when in

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operation, uses only half of the bridge rectifier and runs twice as much current through it.

5.5.2 Inverter Stage

The inverter stage converts DC, whether directly from the input or from the rectifier stage described above, to AC by running it through a power oscillator, whose output transformer is very small with few windings at a frequency of tens or hundreds of kilohertz. The frequency is usually chosen to be above 20 kHz, to make it inaudible to humans. The switching is implemented as a multistage (to achieve high gain) MOSFET amplifier. MOSFETs are a type of transistor with a low on-resistance and a high current-handling capacity.

5.5.3 Voltage Converter And Output Rectifier

If the output is required to be isolated from the input, as is usually the case in mains power supplies, the inverted AC is used to drive the primary winding of a high frequency transformer. This converts the voltage up or down to the required output level on its secondary winding. The output transformer in the block diagram serves this purpose.

If a DC output is required, the AC output from the transformer is rectified. For output voltages above ten volts or so, ordinary silicon diodes are commonly used. For lower voltages, Schottky diodes are commonly used as the rectifier elements; they have the advantages of faster recovery times than silicon diodes (allowing low-loss operation at higher frequencies) and a lower voltage drop when conducting. For even lower output voltages, MOSFETs may be used as synchronous rectifiers; compared to Schottky diodes, these have even lower conducting state voltage drops.

The rectified output is then smoothed by a filter consisting of inductors and capacitors. For higher switching frequencies, components with lower capacitance and inductance are needed.

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Simpler, non-isolated power supplies contain an inductor instead of a transformer. This type includes boost converters, buck converters, and the buck–boost converters. These belong to the simplest class of single input, single output converters which use one inductor and one active switch. The buck converter reduces the input voltage in direct proportion to the ratio of conductive time to the total switching period, called the duty cycle. For example, an ideal buck converter with a 10 V input operating at a 50% duty cycle will produce an average output voltage of 5 V. A feedback control loop is employed to regulate the output voltage by varying the duty cycle to compensate for variations in input voltage. The output voltage of a boost converter is always greater than the input voltage and the buck–boost output voltage is inverted but can be greater than, equal to, or less than the magnitude of its input voltage. There are many variations and extensions to this class of converters but these three forms the basis of almost all isolated and non-isolated DC to DC converters. By adding a second inductor is the SEPIC converters can be implemented, or, by adding additional active switches, various bridge converters can be realized.

Other types of SMPSs use a capacitor–diode voltage multiplier instead of inductors and transformers. These are mostly used for generating high voltages at low currents (Cockcroft-Walton generator). The low voltage variant is called charge pump.

5.5.4 Regulation

A feedback circuit monitors the output voltage and compares it with a reference voltage, as shown in the block diagram above. Depending on design and safety requirements, the controller may contain an isolation mechanism (such as an optocoupler) to isolate it from the DC output. Switching supplies in computers, TVs and VCRs have these opto-couplers to tightly control the output voltage.

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Open-loop regulators do not have a feedback circuit. Instead, they rely on feeding a constant voltage to the input of the transformer or inductor, and assume that the output will be correct. Regulated designs compensate for the impedance of the transformer or coil. Monopolar designs also compensate for the magnetic hysteresis of the core.

5.5.5 Advantages

- The main advantage of the switching power supply is greater efficiency than linear regulators
- Smaller size and lighter weight from the elimination of heavy line-frequency transformers
- Comparable heat generation and Standby power loss is often much less than transformers.

5.6 AURDINO UNO MICRO CONTROLLER (ATmega 328)

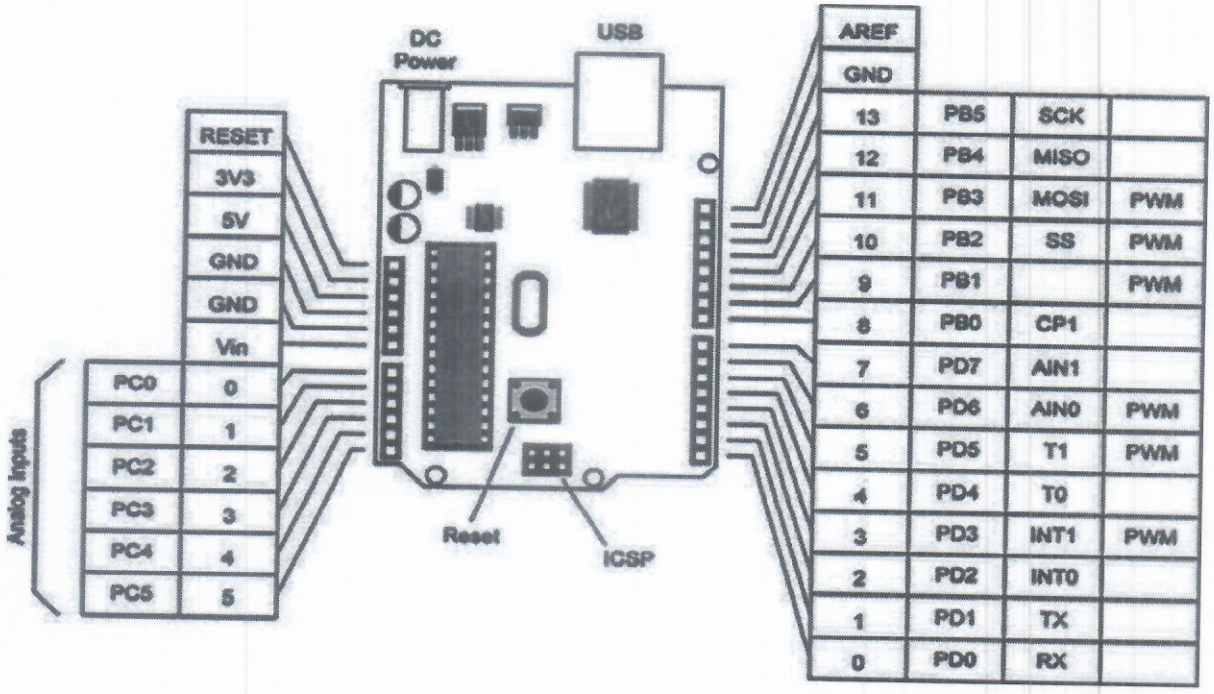


Fig 5.21 Pin Diagram Of Arduino UNO

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Arduino UNO is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

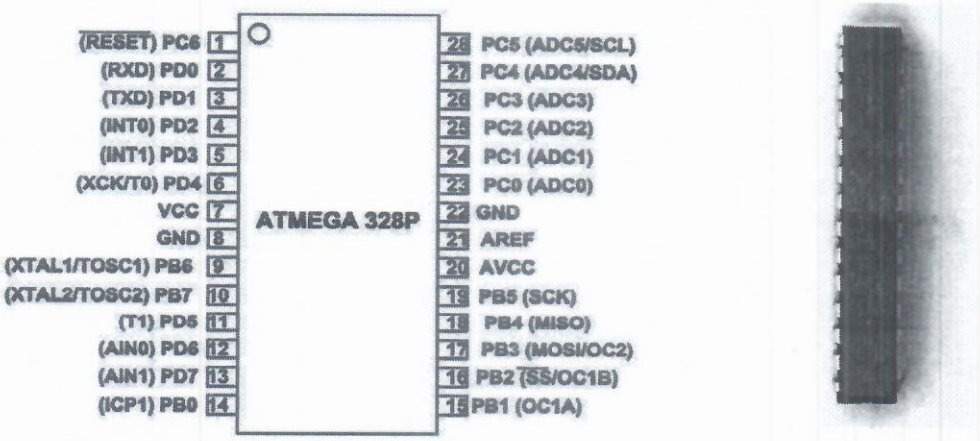


Fig 5.22 Pin Diagram Of ATmega 328

5.6.1 Summary

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14(of which 6 provide PWM)
Analog Input Pins	6
DC Current per I/O Pin	40 Ma
DC Current for 3.3V Pin	50 mA
Flash Memory	32KB
SRAM	2 KB

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EEPROM	1 KB
Clock Speed	16 MHz

5.6.2 Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

Each of the 14 digital pins on the UNO can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor
(disconnected by default) of 20-50 kOhms. In addition, some pins have specializedfunctions:

- **Serial**: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts**: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt() function for details.
- **PWM**: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- **SPI**: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- **LED**: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- **Pin**: The UNO has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default

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they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogue Reference() function. Additionally, some pins have specialized functionality:

- **TWI**: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library. There are a couple of other pins on the board:
- **AREF**: Reference voltage for the analogue inputs. Used with analogReference().
- **Reset**: Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

5.6.3 Communication

The Arduino UNO has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board.

The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the UNO's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

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5.6.4 Programming

The Arduino UNO can be programmed with the Arduino software (download). Select "Arduino UNO from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino UNO comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

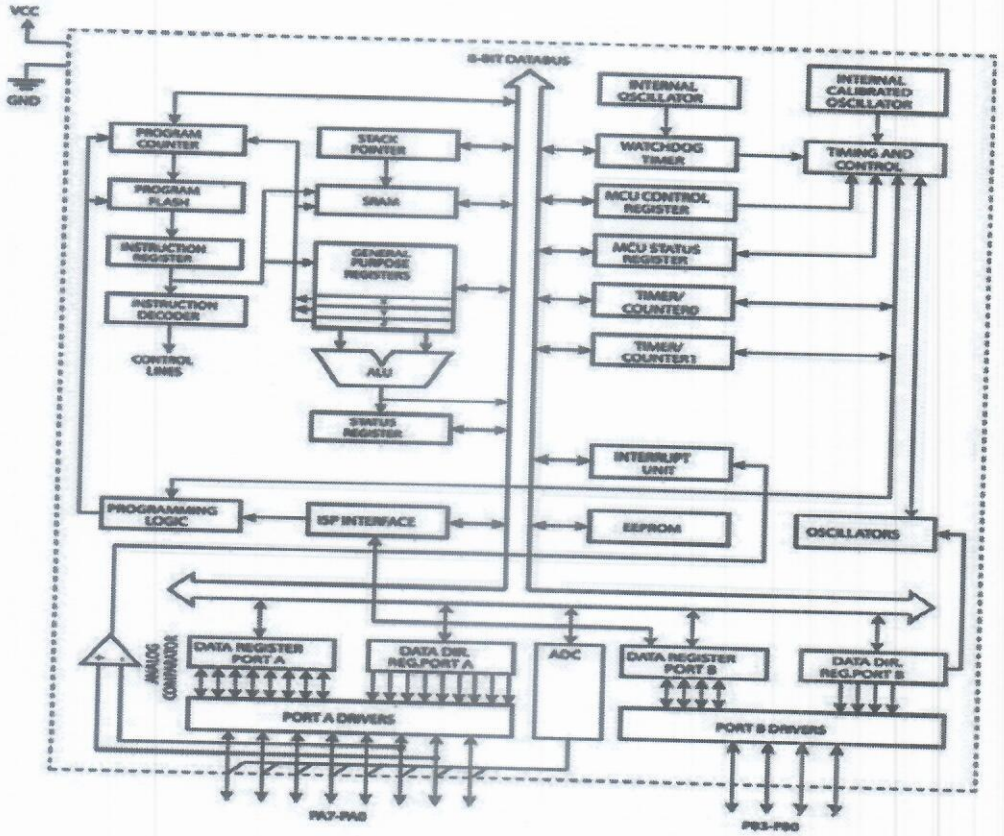


Fig 5.23 Architecture Of Arduino UNO

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You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.
- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.
- You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU bootloader). See this user-contributed tutorial for more information.

5.7 BLUETOOTH MODULE

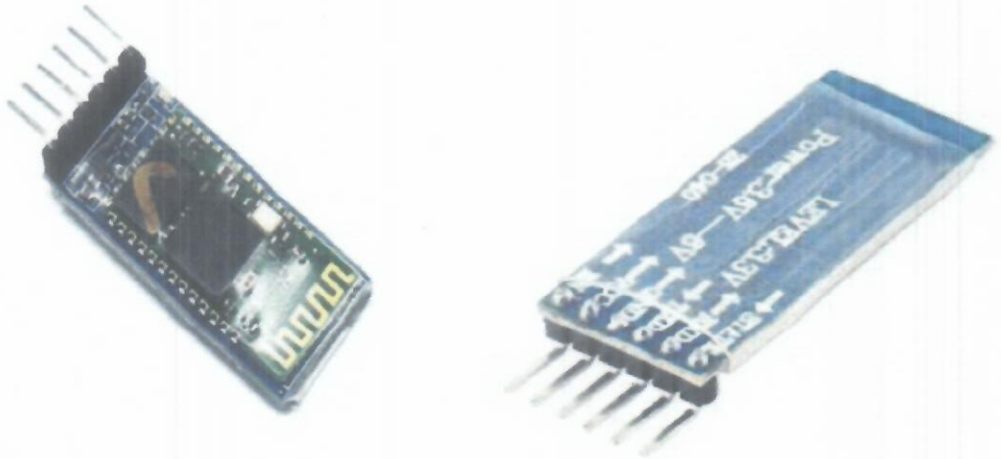


Fig 5.24 Bluetooth Module

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In our project we are using HC-05 Bluetooth module.The HC-05 Bluetooth module a chip which is used for establishing a Bluetooth connection between these two devices. It is a very small chip that can be connected to the input/output pins of the Arduino USB host shield which itself will be connected to the Arduino UNO board.

The HC-05 Bluetooth module is a serial port chip which allows to create a connection with the paired devices. Serial port Bluetooth module is completely qualified Bluetooth V2.0 with enhanced data rate of 3 Mbps modulation. It is a CSR single chip system that uses CMOS technology. It has a small dimension of 12.7 x 27 mm. It can be operated on 1.8 V power supply. It also has an integrated antenna for transmission and receiving purpose.

specifications

- Typical -80dBm sensitivity
- Up to +4dBm RF transmit power
- Low Power 1.8V Operation ,1.8 to 3.6V I/O
- PIO control
- UART interface with programmable baud rate
- With integrated antenna
- With edge connector

5.7.1 Software Features

- Default Baud rate: 38400, Data bits:8, Stop bit:1, Parity: No parity, Data control: has.
- Given a rising pulse in PIO0, device will be disconnected.
- Status instruction port PIO1: low-disconnected, high-connected;
- PIO10 and PIO11 can be connected to red and blue led separately.
- When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.

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- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:"0000" as default

AT commands: (all end with \r\n)

1.Test command:

Command	Respond	Parameter
AT	OK	

2.Reset

Command	Respond	Parameter
AT+RESET	OK	

3.Get firmware version

Command	Respond	Parameter
AT+VERSION?	+VERSION:<Param> OK	Param : firmware version

Example

AT+VERSION?\r\n

+VERSION:2.0-20100601

OK

4.Restore default

Command	Respond	Parameter
AT+ORGL	OK	

Default state:

Slave mode, pin code :1234, device name: H-C-2010-05-01 ,Baud 38400bits/s.

5.Get module address

Command	Respond	Parameter
AT+ADDR?	+ADDR:<Param> OK	

Param: address of Bluetooth module

Bluetooth address: NAP: UAP : LAP

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Example

AT+ADDR?\r\n

+ADDR:1234:56:abcdef

6.Set/Check module name:

Command	Respond	Parameter
AT+NAME=<Param>	OK	Param: Bluetooth module name (Default :HC-05)
AT+NAME?	+NAME:<Param> OK (/FAIL)	Param: Bluetooth module name (Default :HC-05)

Example

AT+NAME=HC-05\r\n set the module name to HC-05

OK

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5.8 HARDWARE PROTOTYPE SNAPSHOT

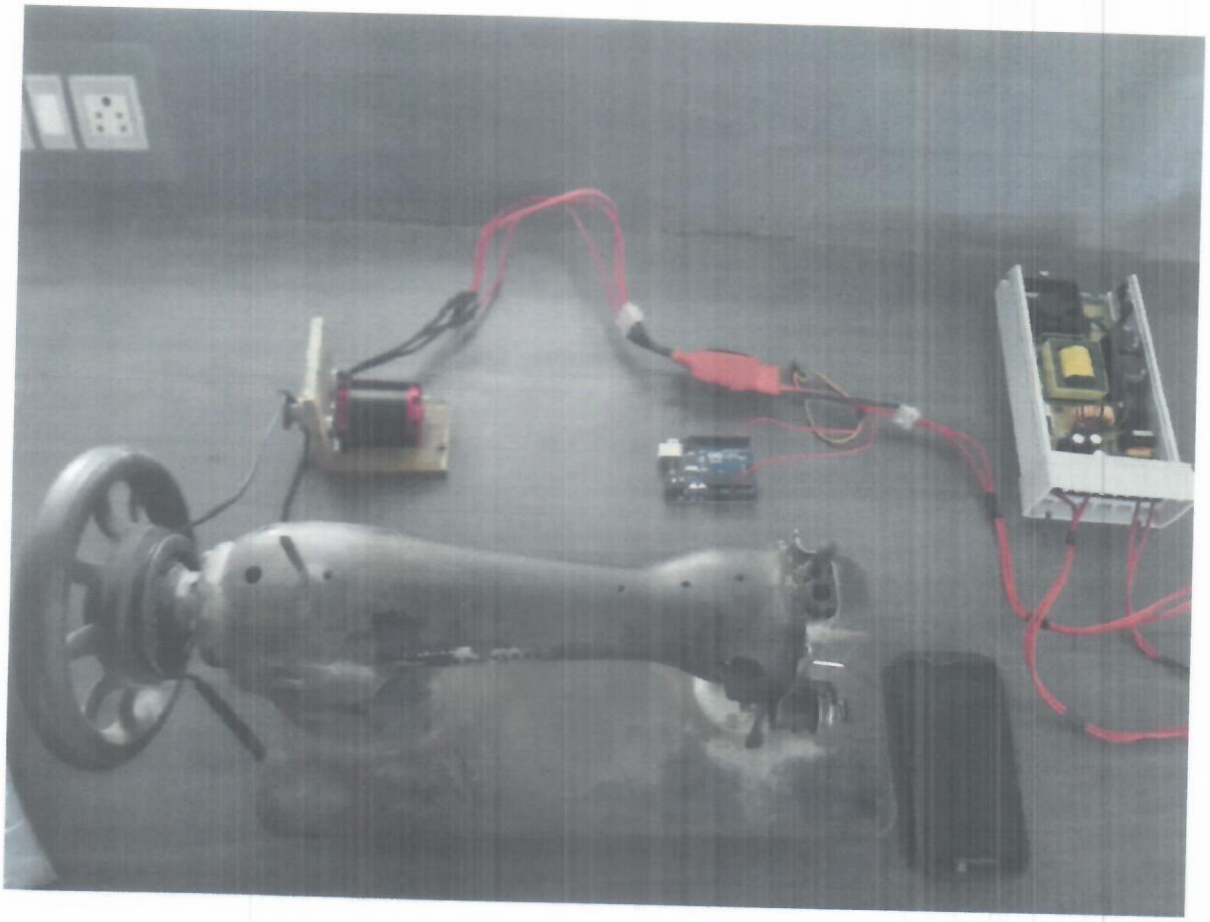


Fig 5.25 Hardware Prototype Snapshot

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CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

Design and development of a BLDC motor based on sewing machine concept has been carried out. This approach helps to prevent manufacturing multiple proto types and reduces the product development cycle time. The developed motor gives better performance than the clutch motor used in such sewing machine. The efficiency has been increased from 70% to 85%. As the motor is a three-phase one, the cost of the drive circuit will also be less and the motor overall cost will be comparable to that of the clutch motor. The voice recognition system connected to the motor makes easier access for physically challenged person. It is found that the developed motor gives performance fairly matching with the calculated results. The size of the BLDC motor is much smaller than the clutch motor. It is calculated that one-third power of clutch motor is consumed by BLDC motor.

6.2 FUTURE SCOPE

In future, the Bluetooth module is replaced by voice recognition, so that the control of the motor becomes much easier when and increasing the speed of motor with respect to increasing the efficiency of motor avoids the maintenance cost, the consumption of power will be reduced by reducing the poles in the rotor.

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APPENDIX

```
#include <SoftwareSerial.h>
#include <Servo.h>

Servo myServo;
int TxD = 11;
int RxD = 10;
int servoposition;
int servopos;
int new1;
SoftwareSerialbluetooth(TxD, RxD);

void setup() {
  int pos=0;
myServo.attach(9);
myServo.write(0);
Serial.begin(9600);       // start serial communication at 9600bps
bluetooth.begin(9600);
}

void loop() {
```

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```
 if (bluetooth.available())
   {
    String value = bluetooth.readString();
servoposition = value.toInt();

    if (value.toInt() == 0)
    {
Serial.println(servoposition);
myServo.write(0);
     }

     if (value.toInt() == 45)
   {
Serial.println(servoposition);
myServo.write(45);
     }

     if (value.toInt() == 90)
   {
Serial.println(servoposition);
myServo.write(90);
     }

    if (value.toInt() == 135)
   {
Serial.println(servoposition);
myServo.write(135);
```


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```
    }

    if (value.toInt() == 180)
   {
Serial.println(servoposition);
myServo.write(180);
    }

   while(value.toInt()==1){
   if (bluetooth.available())
   {
   value = bluetooth.readString();
Serial.println(value);
   if (value.toInt()==2)
   {Serial.println("YYY");  break; }

   }

servopos++;
delay(30);
Serial.println(servopos);
myServo.write(servopos);
   if (servopos ==180 )
   {servopos=0;break;}

}
  }
```


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