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Design of Automatic Transformer Winding Machine

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***Abstract*- In this Paper "Design of Automatic transformer Winding Machine" main attention is to reduce effort behind manually operated machine. And implement the idea of automation in coil winding machine at minimum manufacturing cost also in increases productivity of automated machine. This work will provide low operational cost, low power consumption, accuracy and flexibility to the system. In practical world of electrical engineering transformer coil is very sensitive and important part. By this Paper we can also improve quality of winding as well as life of product. Automatic plants can work continuously and can decrease the gap between demand and supply. For such machine there is no need of labor so there is no human error. Without human error the quality of product is better and the cost of production would definitely decrease. The main motivation factor of this research is cost effective automation.**

This paper consists of an AVR-controller (Arduino ATmega2560), PMDC motor, Liner motor driver, coil winding machine, keypad, Display. Numbers of turns of winding, gauge of wire, length of job is programmed in arduino. Today's fast growing industries require an automated machine instead of manually operated machines. Highly advance automation is uneconomical for small scale industries. We design machine for Automatic transformer winding for low cost and high Accuracy.

***Keywords*-AVR-controller,PMDCMotor,IRSensor,Linermotordriver,PWMinterconnection**

I. INTRODUCTION

We know that the entire world is rapidly switching to advanced technology like Automation. Now question arises what is automation?

Automation is a process in which all the process is done by using different instruments i.e. less man power is involved. So human errors are reduced in this process, due to this, system is accurate enough. All the lengthy processes included in the conventional processes are eliminated in automation process. So time required for getting result is decreased in automation process. Automation gives effective & correct work with less time & less manpower. Now a day, automation rapidly spreads all over sector for e.g. Agricultural, Industrial, Educational, Robotics etc. This gives increase in profit of that sector. So we are interested in doing automation in Transformer Winding Machine Manufacturing.

Design of Automatic Transformer Winding Machine is one of the easiest ways to manufacture the accurate job for different transformer rating reactors with accurate dimensions. Also this paper consists of an AVR-controller (Arduino ATmega2560), PMDC motor, linear motor driver, Coil winding machine, keypad, and display. It's an upgrade version of existing manual coil winding machine. The issues in present version of coil winding machine such as excessive tension in coil while winding, wastage of insulation material in existing controlling mechanism, has been overcome in this proposed design of coil winding machine, that is achieved by use of modern electronic circuits with wireless controlling and monitoring devices.

This paper is divided into 7 sections: Bobbin speed control, Liner Motor drive, Insulation paper cutting, Turns measurement, Coil holding pointer, Protection of coil and controlling part. The whole sections are controlled by the Microcontroller. The mechanical part of the project consists of mechanical drawing, measuring, welding and fabricating process, while electrical part consists of electrical drawing: electrical wiring and programming. The software of the Microcontroller theory includes the electrical and mechanical actuators for the hardware will be showing a good result to fulfill the objective of this paper.

II. BASIC BLOCK DIAGRAM

A. Working

Transformer winding machine first require proper tension on the coil so that quality is increase for that bobbin speed control is main part of machine by accurate control of dc motor. For that we use PWM speed controlling method. Further important part is slider for

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moving pointer on bobbin, here accuracy is main part to adjust distance between coils is less as possible for accurate control we use PWM inter operation of all motors so that all operation on of machine is depend on other part insulation paper roller solenoid paper cutter.

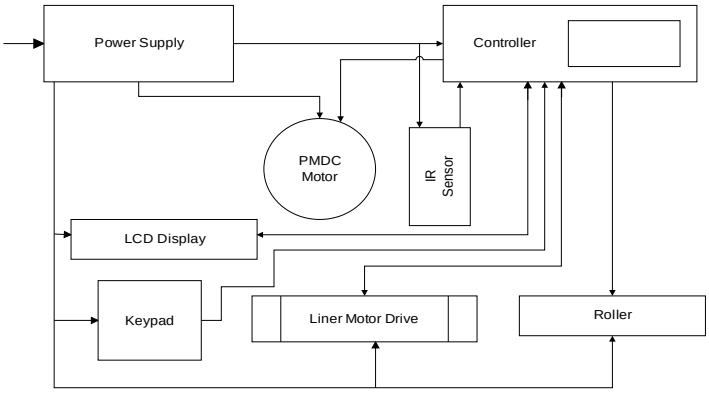


Fig.1: Basic Block Diagram

Co-ordination of all part of machine is done by Arduino ATmega2560 is one of the fast processor and best features in build, other electronic part is display and keypad, operating switch and sensors. This paper is a complete application of automation. The various process of this system is controlled by Microcontroller. Microcontroller is heart of the system and the system is controlled according to the programmed Microcontroller. Figure 1 shows the basic block diagram of the whole process. There are four inputs to the controller and five outputs from the controller. First switch ON main power supply, which indication shows on control panel at that time it gives power supply to controller. Then through keypad we can enter the no of turns to done the job. Then counter count it, and then next step is to enter the layer of mica sheet. After entering all the required values, it indicates that our machine is ready to run. Then press the start button instantly main motor start to run along with Linear motor drive start to run linearly. After that coil is wound on the job through linear drive. After completing all the no. of turns, roller start to roll the mica paper on that job and at that instant cutter mechanism cut hat paper. Then this same process will be done up to the next end position of the job.

Microcontroller provide the advantages of high reliability in operation, flexibility in control techniques, small space and computing requirements, expandability, high power handling, reduced human efforts and complete programming and reprogramming in a plant. The Controller is designed to operate in the industrial environment with wide ranges of ambient temperature, vibration, and humidity and is not usually affected by the electrical noise that is inherent in most industrial locations. It also provides the cost effective solution for controlling complex systems.

B. The Main component

A. PMDC Motor: A permanent magnet D.C. (PMDC) is similar to an ordinary D.C shunt motor except that its field is provided by permanent magnets instead of salient-pole wound-field structure.

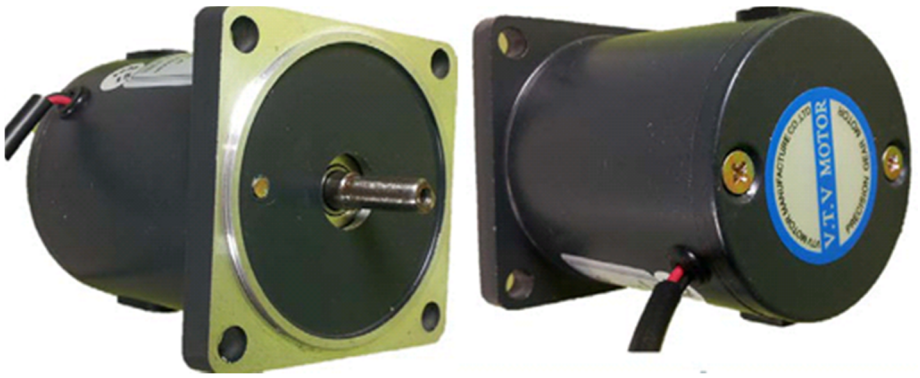


Fig.2: PMDC Motor

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Most of these motor usually run on 6V, 12V or 24V dc supply obtained either from batteries or rectifier alternating current in such motors, torque is produced by interaction between axial current-carrying rotor conductors and the magnetic flux produced by the permanent magnets [1].

B. IR Sensor:

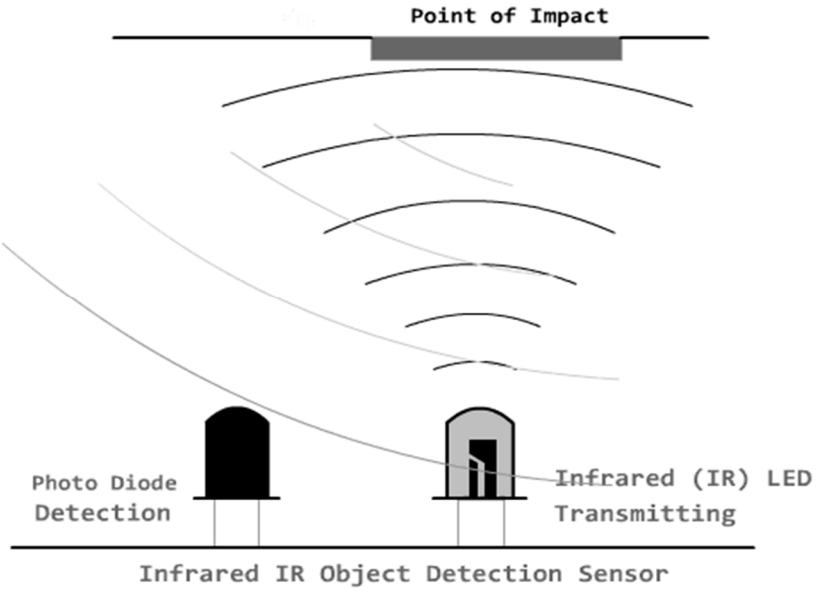


Fig.3 Infrared (IR) Sensor

This Medium Range Infrared sensor offers simple, user friendly and fast obstacle detection using infrared; it is non contact detection. The implementations of modulated IR signal immune the sensor to the interferences caused by the normal light of a light bulb or the sun light. The sensing distance can be adjusted manually. The product features include:
5V powered, low current consumption, less than 10mA
3 pin interface which are signal, GND and 5V
Small LED as indicator for detection status
Obstacle detection up to 8 cm
Adjustable sensing range (2cm – 8cm)
Small size makes it easy to assembly
Single bit output
Compatible with all types of microcontrollers and Arduino

a) Specification and Limitations: Infrared sensor uses special sensor to modulate IR signal emitted from 2 IR transmitters and detects the modulated IR signal reflected back from a nearby object. This sensor has a built-in IR LED driver to modulate the IR signal at 38 KHz to match the built-in detector. The modulated IR signal immunes the sensor from the interferences caused by the normal light of a light bulb or the sun light. The module will output a HIGH if no object is detected and a LOW if an object is detected.

III. PIN DEFINITIONS AND RATINGS

Table.1: Pin Definitions and Ratings

Pin	Name	Function
+	VCC	Connects to VCC (+4V to +6V)
-	Ground	Connects to Ground
S	Output Signal	Connects to an I/O pin of Microcontroller which set to INPUT mode (or transistor/MOSFET)

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IV. ABSOLUTE MAXIMUM RATING

Table.2: Absolute Maximum Rating

Parameter	Min	Max	Unit
Operating Voltage	4	6	Volt
Sensing Range	2	8	Cm

V. SENSITIVITY

The Medium Range Infrared Sensor has a sensing range of approximately 2cm to 8cm. The sensitivity can vary with the reflectivity of the object and the ambient lighting. The modulated IR signal will reflect more on white surface and reflect less on black surface. The sensor is designed to adjustable sensing range. User may adjust sensing range by using the preset on infrared sensor for different application [2].

A. Microcontroller (Arduino)

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicated with software running on your computer (e.g. Flash, Processing, and MaxMSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free. The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

1) Features

a) Schematic design of the open source development interface free download, and also according to the needs of their own changes.
b) Download the program is simple and convenient.
c) Simply with the sensor, a wide range of electronic components connection (such as: LED light, buzzer, keypad, photo resistor, etc.), make all sorts of interesting things.
d) Using the high-speed micro-processing controller (ATMEGA328).
e) The development of language and development environment is very simple, easy to understand, very suitable for beginners to learn.

2) Performance

a) Digital I/O 0~13.
b) Analog I/O 0~5. (R3 is 0~7)
c) Input voltage: when connected to the USB without external power supply or external 5 v output and external power input.
d) Atmel Atmega328 micro-processing controller. Because of its many supporters, the company has developed 32-

3) Arduino size

Width of 70 mm X high 54 mm.

4) Special Port

a) *VIN*. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can Supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
b) *AREF*. Reference voltage for the analog input [3].

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B. Power supply

The machine is working on single phase 230V AC, 50 Hz supply. This supply is then converted to 24V DC supply, By Switch Mode Power Supply (SMPS) input: 230V AC output: 24V DC.

VI. FLOW CHART

The processes start first when a start button is press; the next process is to be load the job, after loading the job enters the number of turns, length of job, & gauge of wire through the keypad. After entering all the information related to the job then next process is to start the PMDC motor, as soon as motor start, it will wound the coil on the job. At that time counter reduces the value of number of turns from first entered value & we get new number of turns. During this whole process it will continuously check the both the end position of job. When LMD pointer is in end position of job that time motor & LMD will stop automatically. If the job is not in the end position then it will again check the new number of turns.

After completing one layer of turns on the job, it starts to load the mica-paper on the job. After loading the paper on the job, then that time instantly PMDC motor start by taking two revolutions of coil & LMD start to run in reverse direction.

Proper loading of paper, then cutter mechanism energizes & cut the paper. At this process if total number of turns is non-zero then again check the remaining number of turns. If turns are equal to zero then press the stop button. At that time one job is to be done.

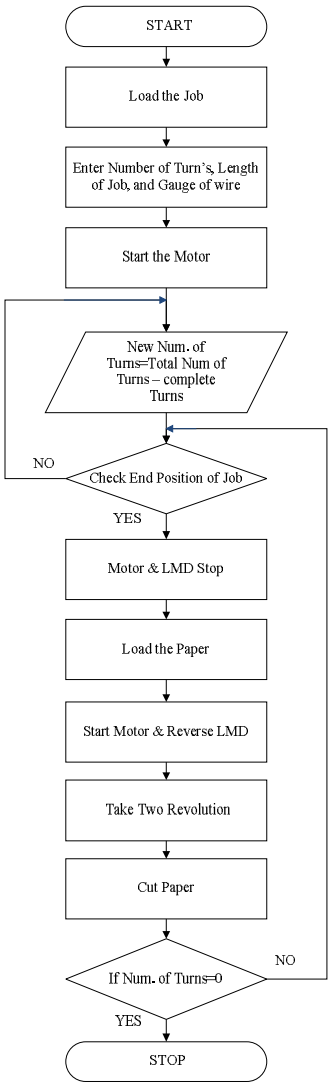


Fig.4: Flow Chart

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VII. ADVANTAGES

A. Reduction in operating costs as compare to manual operated machine.
B. Fully automatic system so that quality production achieved in less time.
C. Efficiency & Maintenance easy.
D. Affordable price.
E. Simple control.
F. It can be manufactured on large scale.
G. It will provide economical constant over current version of coil winding machine.
H. Reduce insulation paper and coil wastages.
I. Accuracy and control.

VIII. APPLICATIONS

A. Reactor manufactures industry.
B. Solenoid coil.
C. Solenoid valve, actuator

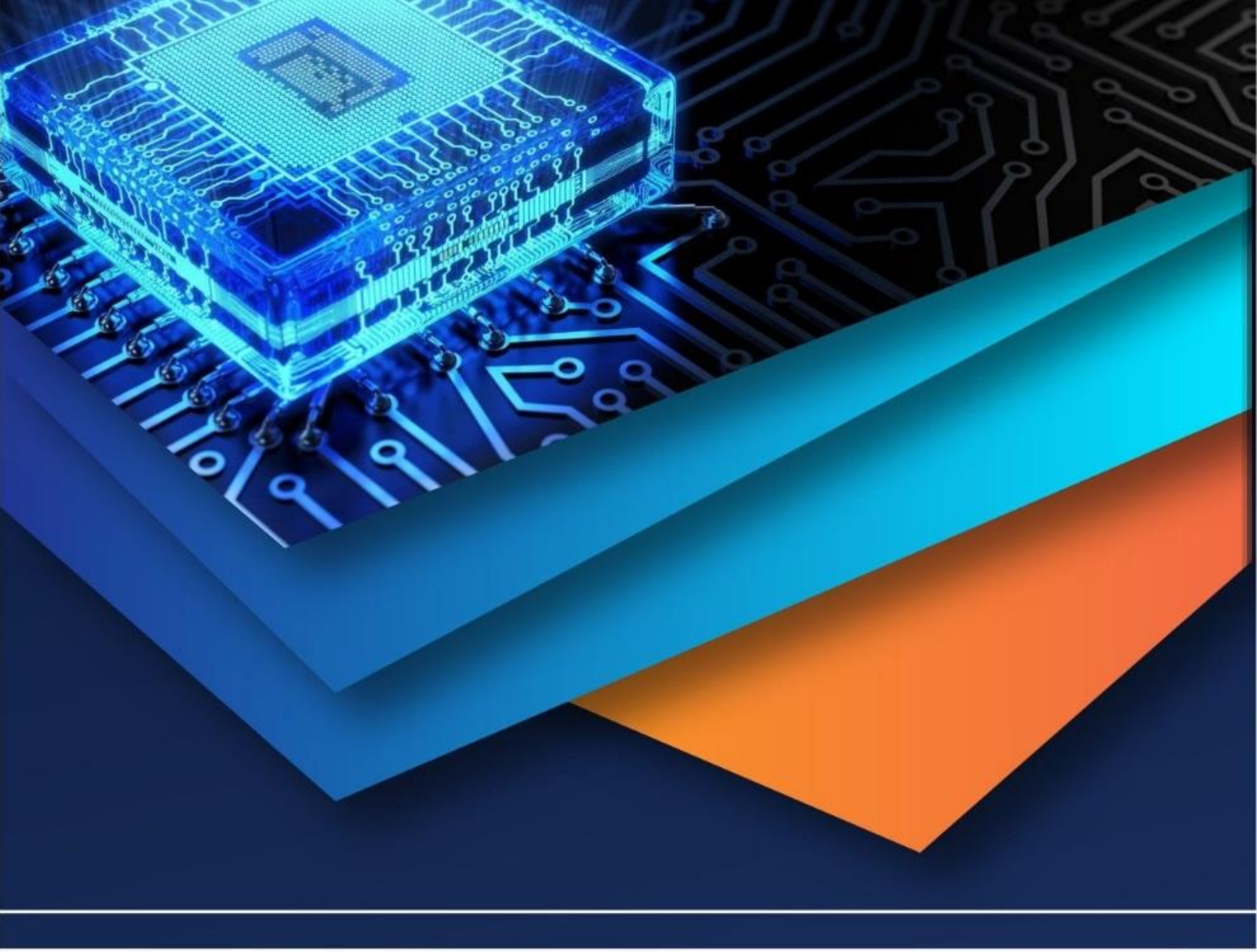
IX. CONCLUSION

This paper has proposed an application of automation illustrating a Microcontroller based. The system meets the demand of high-speed production using the least mechanism requirements. The system has proved to work effectively avoiding unnecessary wastage of copper and paper material. The system also provides high accuracy and precision in proportion of transformer coil winding.

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