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AUTOMATIC COIL WINDING MACHINE

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Abstract- *An improved version of a manual winding machine is an automatic coil winding machine. The goal of this project is to switch out a manual coil winding machine for an automated one. In India's rural areas, manual coil winding machines were employed instead of automatic ones. Unexpectedly high rates are charged for automated coil winding equipment. In addition to winding ceiling fans, this machine can wind motor slots. While it has the same advantages as the existing model, this prototype is more inexpensive for those in rural regions. The industry professional can reduce the amount of time needed to create a coil by employing this technology. This project's aim is that reduce the time required for making coils. The automatic coil winding machine consists of a system that has a digital display for showing the number of turns and, ON and OFF switches, can place his order. In this prototype, the servo motor is used which gives precise winding and reduces time requirement. The Servo motor ad Arduino plays important role in this project. The Arduino processes the given data and gives a signal to the servo motor after processing. The benefits of this project are to reduce manufacturing costs and also increase the rate of productivity. In the future, the prototype can be fully automatic by adding an extra servo motor and programming.*

Key Words: **Winding Machine, Arduino, Servo Motors, Tactile Switch, Coil**

1. INTRODUCTION

Automatic Coil Winding Machines are used to wind coils for Motors, Transformers, Inductors, and Chokes. Other coil winding instruments are used in the making of solenoids, speaker and microphone winding, or air heating elements.

Nevertheless, this machine often has material tension constraints, operator interaction, and low productivity, and because motors are a basic requirement for all operations requiring automation, stator winding has emerged as a growing and crucial process in automation solutions. For perfect wire bonding and wrapping, special instruments intended for electrical coil wrapping are employed. First off, an automatic winding machine is a tool that winds materials that resemble ribbon, tape, wire, or thread onto a spool or disc. For hundreds of years, weavers have used hand-operated devices to employ such technology. But since the industrial revolution, mechanised winding systems have been employed, particularly when higher-value things, like copper wire, needed to be wrapped.

Coils are used to coil engines, transformers, and other related devices. However, the winding process is difficult because it requires precision and becomes a very laborious process if done mechanically. In this case, we suggest an automatic coil winding system that can fully automate this procedure.

The number of rounds required and the winding tightness are the two most important variables. Loosely wound coils do not work as intended, so this is also an essential consideration.

A winding is created in the linear winding technique by wrapping the wire onto a revolving coil body, component, coil carrying, or coil forming device. The wire is taken from a 400 kg stock coil of enamelled copper wire. A guidance rod directs the wire. The wire is attached to a frame or clamping device of the coil body or winding device before the real winding process begins.

The component to be wound is rotated in such a way that the wire is spread throughout the winding space of the coil body by the linear laying action of the wire guiding tube. The rotating and laying movements are accomplished with computer-controlled actuators.

The method winding technology has evolved as automation technologies have advanced in many production sectors. Nowadays, it is possible to find a range of features with automatic winding machines that were not previously possible. These automatic features shorten working times, ensure quality is upheld, and reduce the need for staff. In this area of winding device technology, Tuboly Astronic is a pioneer. This definitely holds true for automated winding devices, of which there are numerous varieties available at the moment.

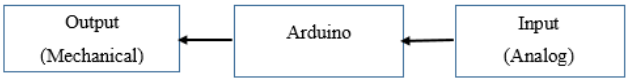

Fig-1.1 Block Diagram

2. METHODOLOGY

The Automatic Coil Winding Machine is upgraded version of manual winding machine. In this we just need to give the number turns of rotation as a input and it will make the coil of the winding respected to the turns. The main important aspects of this machine is Arduino. The Arduino make process on all the data given by user and give signal to motor respected to that. There are 2 LCD Display, one shows the given data input and another indicate the actual rotation done by the motor. This winding machine can do motor slot winding as well as fan winding. There are two types of motor suitable for this project.

1. Stepper motor- Stepper motor has its own advantages. Stepper motor has step angle at which it rotates, that is also its drawback. In this project precision is more important. We can't rotate stepper less than its step angle.

2. Servo Motor- Servo motor is best suitable motor for this project. It is more accurate than a stepper motor. It doesn't have step angle. It stops immediately, that is important because we don't need inertia. The primary advantage of servo motors is that they can deliver large amounts of power at high speeds, which stepper motors are incapable of. They also operate at 80 – 90% efficiency. Servo motors are vibration- and resonance-free and can operate with either an AC or DC transmission. The Servo motor consists of an electric motor coupled with a sensor for position feedback. As the output devices in feedback control systems, servomotors are employed. Hence, servomotors are also called control motors. Servomotors are not used for continuous energy conversion. Servomotor power ratings range from a fraction of a watt to a few hundred watts. Because the servomotors' rotational inertia is minimal, they respond quickly to inputs. The speed control of the DC servo motor is done by armature voltage control. The design of the servo motor is done with high armature resistance therefore its torque-speed characteristic becomes linear and negative slope.

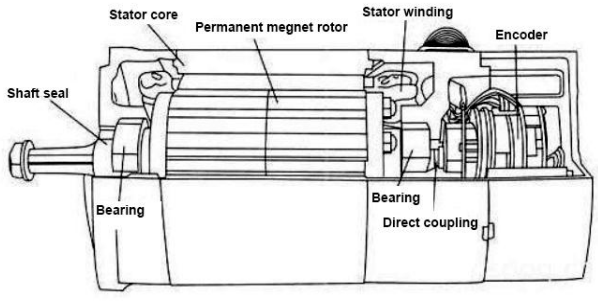

Fig-2.1 Servo Motor

A servo motor is a basic electrical device that is used to rotate or move gadgets with great precision and accuracy at various angles and speeds. It is a feedback-controlled closed-loop system. The primary feature that sets it apart from other motors is its ability to work with exact distances and angles. It has the capacity to spin the item in both anticlockwise and clockwise directions. Other motors are typically rated in KVA, whereas servo motors are usually rated in kg/cm. It refers to how much weight a motor can lift if the load is suspended at a specific distance from the motor's shaft. It is critical in industrial applications where precise motions are needed.

The motor used here is a standard DC motor, complete with a field winding that is stimulated independently. Servo motors are further classified into armature-controlled and field-controlled servo motors based on their energising nature.

The load in this case is a basic fan or industrial load that is simply attached to the mechanical shaft of the motor.

Depending on the application, the gearbox in this design acts as a mechanical transducer to alter the motor's output such as acceleration, location, or velocity.

The transfer function is described as the ratio of the o/p variable's Laplace transform (LT) to the i/p variable's LT (Laplace transform). In general, the DC motor converts electrical energy to mechanical energy. The electrical energy given to the armature terminals is converted into regulated mechanical energy. When compared to the field-controlled dc servo motor, the armature-controlled dc servo motor offers better efficiency due to the closed-loop system. Furthermore, the field management system's reaction time is slow. The armature's inductance is insignificant in the armature-controlled situation, but not in the field-controlled case. However, better dampening is not possible in infield control, but it is possible in armature control.

Construction-

The error signal is created by comparing this feedback signal to the input instruction position, which corresponds to the intended location of the actuator for a weight (if there exists a difference between them). The error detector's output error indication is insufficient to operate the engine. Therefore, the error detector increases the voltage and power level of the error signal before the servo amplifier turns the motor shaft to the intended position. Servo motors are basically divided into AC and DC servo motors based on the power supply needed for operation. Because they are inexpensive, efficient, and straightforward to use, brushed permanent magnet servo motors are frequently used in straightforward applications.

Working-

The pulse width modulation technique is the basis for how the servo motor operates. In this, the length of the pulse applied to the control wire governs the rotation's orientation. The servo motor can be thought of as a particular kind of DC motor that is managed by a changeable resistor (potentiometer) and a few gears. A DC servo motor is made

up of a DC motor, a gear arrangement, a position-sensing device, and a control circuit. For moving the loads at an exact pace and location, the DC servo motor has a small DC motor. The DC reference voltage has now been adjusted to the intended output in accordance with it. Depending on the control circuitry, this voltage is administered using a potentiometer by adjusting the pulse breadth to the voltage converter or via a timer. A corresponding voltage is produced by the potentiometer's gauge and transferred to the error amplifier. To generate a DC reference voltage that corresponds to the intended position or speed of the motor, some circuits employ the pulse control technique. The pulse breadth is then used to apply it to the voltage transformer. When the pulse is strong, this rectifier causes the battery to start charging steadily. When the pulse is low, the charge on the capacitor is then passed to the buffer amplifier, where it is then applied to the error amplifier. In order to generate the required speed or position, the voltage applied at the error amplifier is determined by the duration of the pulse. A position sensor is used to acquire the return signal relating to the load's current position. The typical form of this gauge is a potentiometer, which generates a voltage in accordance with the exact angle of the motor shaft as seen through the gear mechanism.

Another main component the is Processing mechanism, we are using Arduino for programming. There is also one option i.e., Microprocessor. In this project, we thought about using Arduino for programming.

The open-source Arduino platform is used to create electrical creations. With Arduino, you can create and send computer code to a physical programmable circuit board (often called a microcontroller) using a bit of software called the IDE (Integrated Development Environment), which operates on your computer. For the purpose of adding new code to the board, the Arduino does not require an additional physical component known as a driver. Because the hardware boards are inexpensive, the software is free, and both the software and hardware are simple to use, there is a large user group that has donated code and published directions for a wide range of Arduino-based projects. It has 6 analogue inputs, a USB port, a power jack, a restart switch, and 14 digital input/output ports, 6 of which can be used as PWM outputs. It comes with everything required to support the microcontroller; to use it, just plug in a USB connection, an AC to DC adapter, or a battery to charge it.

The microprocessor is also superior to Arduino. Microprocessors are relatively affordable to produce because to their usage of IC technology. This means that the usage of microprocessors can significantly lower the cost of the system in which they are utilized. The Arduino UNO has a port connector configuration that is quickly becoming the mainstream technology for programmable devices, making it interoperable with the majority of available development board shields.

The UNO has a power jack that allows it to be charged by an exterior wall wart. A VIN alternative is also available for linking the UNO to batteries. The UNO's actual measurements (69mm x 54mm) make it a compact programming platform that can fit neatly into many projects, and the four screw holes enable makers to hold it in position.

The Arduino Nano is basically an Arduino UNO compressed down into a very tiny footprint, making it ideal for confined areas and tasks that require as little weight as possible. The Nano, unlike the UNO, cannot link to Arduino shields, but it does have pin headers that make it helpful for breadboard development or using a socket in Boards. Arduino Nano boards are frequently the inexpensive Arduino board choice, allowing them cost-effective for bigger tasks. I2C LCD is a simple display module that can help with display. It can lessen the difficulties of making, allowing creators to focus on the heart of the task. We created the Arduino library for I2C LCD, which allows users to accomplish complicated graphics and text display capabilities with just a few lines of code. It may be used in place of the Arduino serial monitor to obtain operating information without the need of a computer.

The technology utilized to build current microprocessors has allowed them to run at extraordinarily fast speeds—microprocessors today's can execute millions of instructions per second. Because microprocessors are made utilizing metal oxide semiconductor technology, their power consumption is substantially lower than that of other types of computers. This significantly improves the energy efficiency of microprocessor-equipped devices. Because microprocessors are compact and require little power, machines that use them may be built to be portable (like smartphones). Because microprocessors are manufactured using semiconductor technology, their failure rate is exceptionally low. As long as the code is altered, the same microprocessor chip may be used for several purposes, making it extremely adaptable. But, because our project is about creating a low-cost coil wrapping machine, we chose Arduino to lower total project costs.

3. HARDWARE IMLEMENTATION

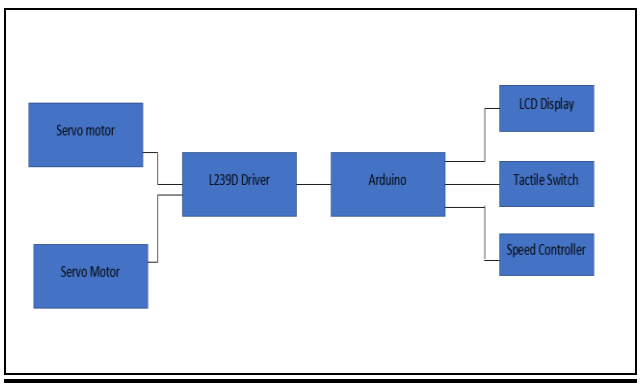

Fig.3.1 Block Diagram

Entire projects is depending upon servo motors and Arduino.

This are essential components for the project. We will use Arduino Uno R3 with an ATmega8 microprocessor for this. We can give the input data with tactile switches. Switches will provide signal in form of data to Arduino. This data will give to the Arduino, there are two LCDs one of them shows the data given by the user and another one indicates the rotation done by the motor. The speed controller is also connected to the Arduino to control the speed of the motors. We can use one motor at a time with the help of Arduino programming. Arduino takes the action on given data and gives the signal to the L239D driver. Servo motors are connected to this driver. In this project, fractional HP DC servo motors are used. Servo motor has unique advantages over stepper motor. It provides instant acceleration and retardation. When the Servo motor rotates then the L-type mechanism which is connected to the shaft also rotates. Master Die is a part which place the wire in slot with the help of its structure. Master Die is connected to the shaft in such a way that it doesn't rotate. The master die is triangular and has two teeth-type structures that fit into a slot. When this structure is fitted in a slot then the triangular type structure helps the copper wire to place in the slot perfectly. For example if we put 50 turns by tactile switch then this input will given to the Arduino and Arduino is connected to servo motor with the help of drive. The DPDT switch is provided to rotate the motor in clockwise and anticlockwise direction.

Servomotors are frequently regarded as a high-performance option to stepper motors. Because stepper motors have built-in output steps, they have some inherent ability to regulate position. Because their drive signal defines the number of steps to spin, they are frequently used as open-loop control design without any feedback encoder. However, the controller must be conscious of the location of the stepper motor when it is powered on. As a result, upon initial power-up, the controller must initiate the stepper motor and move it to a given location until an end limit button is activated. An inkjet printer is an illustration of this. The controller guides the jet carrier to the extreme left and right when it is turned on to set the finish locations.

Because stepper motors can only move loads that are well within their capacity, their absence of input limits their effectiveness. Otherwise, missed movements under greater loads may result in positioning mistakes, requiring the motor to be restarted or recalibrated. Servomotors are more expensive than stepper motors due to the encoders and controllers needed, but they enhance total system efficiency compared to the capability of the basic motor. Servomotors have an edge in larger systems where a powerful motor accounts for a significant part of the system expense.

4. CONCLUSIONS

Manual coil winding was the previous way of coil production, which was stressful and time consuming. The time necessary to make the coil is pretty long; even a spacing between two consecutive coils could not be achieved, nor could a tight coil formation. While the Automatic coil making machine. Is less costly, tight coil formation and increase the coil production rate the main aim of this Automatic coil winding machine is to replace the required manual labor and minimize the time required for making coils. The main objectives of this machine are to replace the worker or a labor and also the hard work. The increases rate of production and time required for the work is saved by the machine. An automatic winding machine will be able to eliminate the disadvantage of the current (manual) technique, namely the need for skilled (trained) labour. This will eventually boost productivity and speed of manufacturing.

5. FUTURE SCOPE

In addition, we can add a microprocessor for multitasking purposes so we can operate both servo motors at a time. Since it's a semi-automatic coil winding machine so we can m, we can make it completely automatic by adding components. We can also add more protection to the machine because there are electronic components in it. If we remove unnecessary components through it then we can make it compact in size which is more portable than the existing machine. This also helps to reduce the cost of the overall machine.

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