Microcontroller based Smart Coil Winder System

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Abstract - The aim of this paper is to develop the control circuit for smart automatic coil winder, which functions with respect to the PIC Microcontroller program. The conventional coil winding machine winds copper wire on a former and the former is attached to the iron rod, which is to be actuated manually. Moreover, the manual coil winding machine does not have any control circuit for the smart functionality. But in this design, the controller has more memory to operate and save the data and also to improve the winder program. Additionally, it also reduces the time of operation and the requirement of Manpower. This coil winder control circuit uses PIC Microcontroller (16F887), which runs the winder system according to main program and also the motor step sequencing program.

Key words: PIC Microcontroller, Stepper Motor, Stepper motor driver module, 16*2 LCD.

1.INTRODUCTION

In Electrical and Electronics Engineering, coil winding process is mandatory and it is used to wind electromagnetic coils and transformer coils. Coils are used as essential components in various circuits and also to provide the magnetic field for motors, transformers, generators, and in the manufacture of loudspeakers and microphones. The shape and dimensions of a winding are designed to fulfil the particular purpose. Parameters such as inductance, Q factor, insulation strength, and strength of the desired magnetic field greatly influence the design of coil windings. Coil winding can be structured into several groups regarding the type and geometry of the wound coil. Mass production of electromagnetic coils relies on automated machinery.Efficient coils minimize the materials and volume required for a given purpose. The ratio of the area of electrical conductors, to the provided winding space is called "fill factor". Since round wires will always have some gap, and wires also have some space required for insulation between turns and between layers, the fill factor is always smaller than one. To achieve higher fill factors, rectangular or flat wire can be used.

2.PROPOSED SYSTEM

In the speed running world everyone is considering the time factor as an important issue. To reduce this time or managing this time, reducing labour cost and reducing the labours, a small implementation this is mainly used in transformer producing industries and training institutions. We have proposed simple, low cost, low power consumption components. The system is PIC Microcontroller based automatic carriage movement of the coil winder. The carriage is placed on the coil winder it is moved by the help of a stepper motor is interfaced with the PIC Microcontroller. In the proposed project the carriage is moved by an automated way instead of using manual way. Its vision is used to reduce human effort and at the same time increase the productivity & accuracy levels that cannot be achieved with manual operations. The automatic coil winder in this article uses stepper motors to position the wire. The machine winds the coil within the size of the bobbin. The machine is controlled by the PIC16F877A microcontroller.

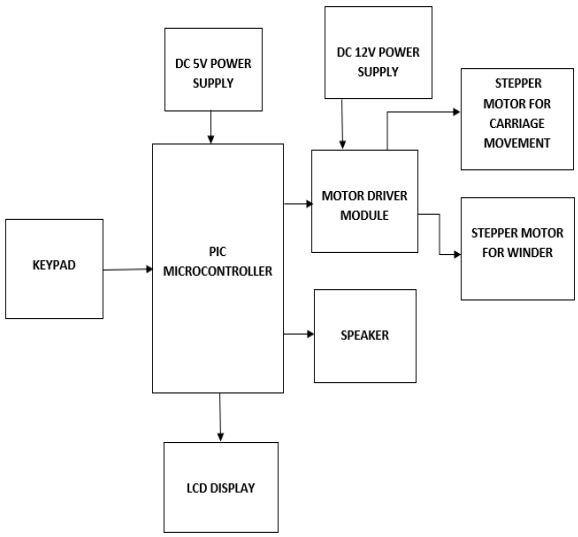

Fig.1 Block diagram of Coil winder

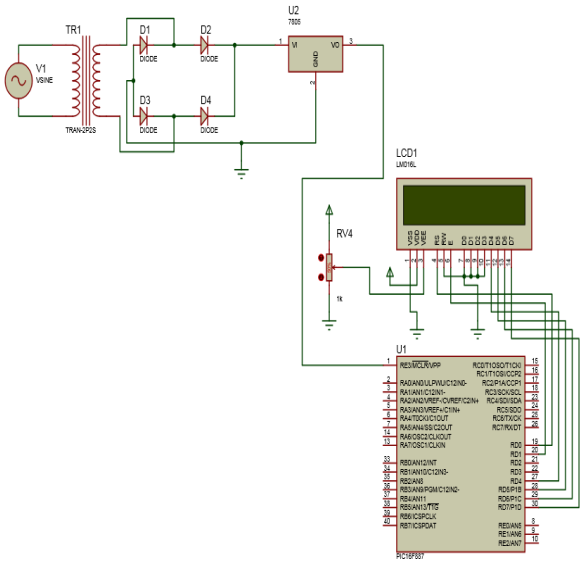

Fig.2 Circuit diagram of Interfacing LCD

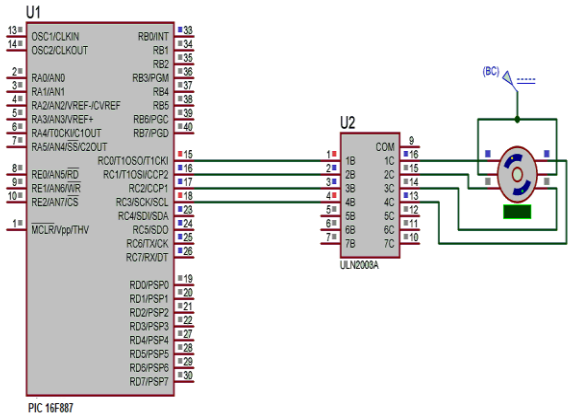

Fig.3 Circuit diagram of Interfacing Stepper motor

3.HARDWARE DESCRIPTION

This project consists of the following components.

a) PIC Microcontroller (PIC16F887)
b) Stepper Motor (28BYJ-48)
c) Stepper Motor Driver Module (ULN2003)
*d) 16*2 LCD display*
e) PIC Microcontroller programming kit

a)PIC Microcontroller (PIC16F887)

PIC microcontrollers are a family of specialized microcontroller chips produced by Microchip Technology in Chandler, Arizona. The acronym PIC stands for "peripheral interface controller," although that term is rarely used nowadays. A microcontroller is a compact microcomputer designed to govern the operation of embedded systems in motor vehicles, robots, office machines, medical devices, mobile radios, vending machines, home appliances, and various other devices. A typical microcontroller includes a processor, memory, and peripherals.

The PIC microcontrollers appeal to hobbyists and experimenters, especially in the fields of electronics and robotics. Key features include wide availability, low cost, ease of reprogramming with built-in EEPROM (electrically erasable programmable read-only memory), an extensive collection of free application notes, abundant development tools, and a great deal of information available on the Internet. The PIC microcontrollers often appear under the brand name PIC Microcontroller.

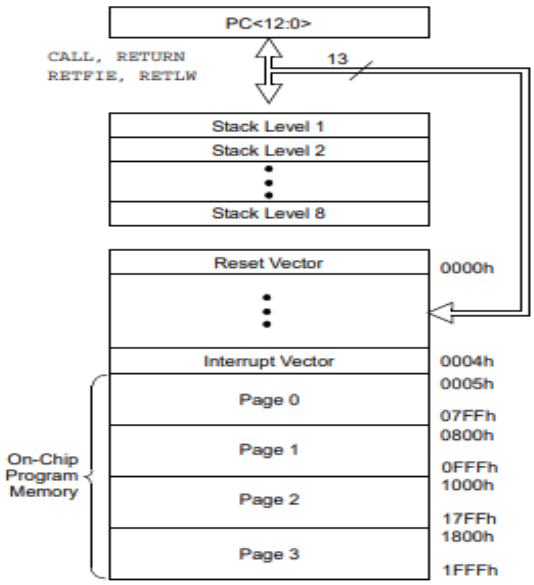

Fig.4 Program memory map and stack for the PIC16F887

b)Stepper Motor (28BYJ-48)

Stepper motor, also known as step motor or stepping motor, is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. Switched reluctance motors are very large

stepping motors with a reduced pole count, and generally are closed-loop commutated.

The most commonly used stepper motor is the **28-BYJ48 Stepper Motors**. It can be mostly used in DVD drives, Motion camera and many more places. The motor has a 4coil unipolar arrangement and each coil is rated for +5V hence it is relatively easy to control with any basic microcontrollers. These motors have a stride angle of 5.625°/64, this means that the motor will have to make 64 steps to complete one rotation and for every step it will cover a 5.625° hence the level of control is also high. However, these motors run only on 5V and hence cannot provide high torque, for high torque application you should consider the **Nema17 motors**.

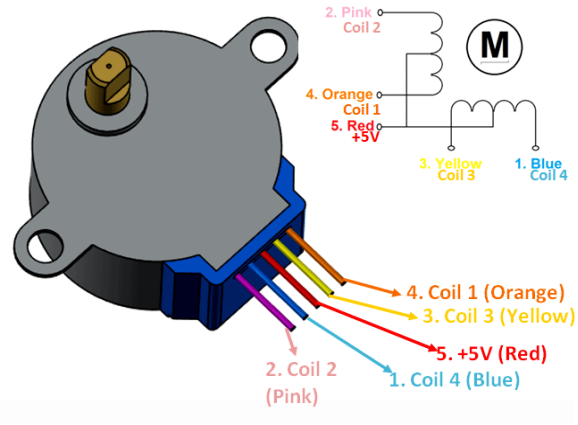

Fig.5 Pin out of 28BYJ-48 Stepper motor

c)Stepper Motor Driver Module (ULN2003)

Stepper motor drivers are specifically designed to drive stepper motors, which are capable of continuous rotation with precise position control, even without a feedback system. Our stepper motor drivers offer adjustable current control and multiple step resolutions, and they feature built-in translators that allow a stepper motor to be controlled with simple step and direction inputs. These modules are generally basic carrier boards for a variety of stepper motor driver Ics that offer low-level interfaces like inputs for directly initiating each step. An external microcontroller is typically required for generating these low-level signals.

The ULN2003 is high voltage, high current 3Darlington arrays each containing seven open collectors3Darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout. Fig. 5.1 shows the ULN2003 stepper motor driver board. These versatile devices are useful for driving a wide range of loads including solenoids, relays DC motors, LED displays filament lamps, thermal printheads and high-power buffers.

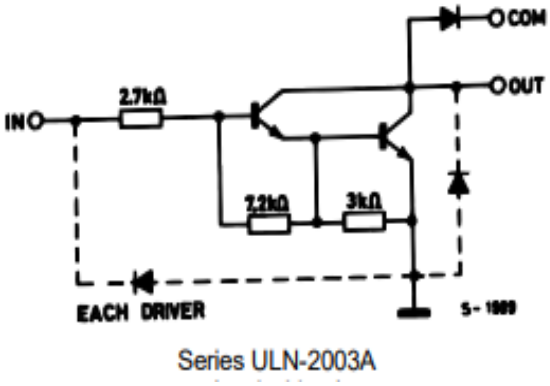

Fig.6 Schematic diagram of ULN2003 driver module

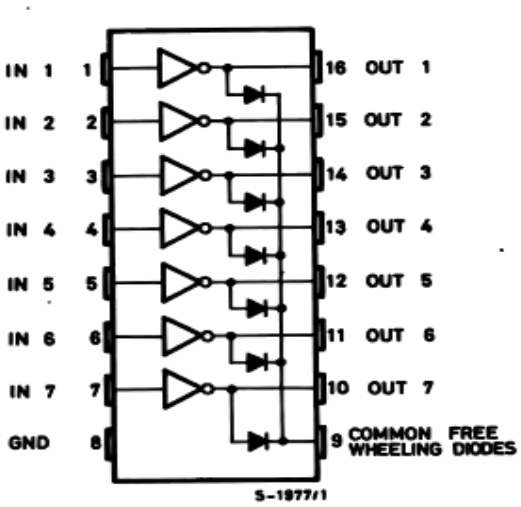

Fig.7 Pin diagram of ULN2003

d)16*2 LCD Display

A liquid crystal display or LCD draws its definition from its name itself. It is combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games. LCD's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology. Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. Light is

projected from a lens on a layer of liquid crystal. This combination of coloured light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the coloured image. The LCD is either made up of an active matrix display grid or a passive display grid. Most of the Smartphone's with LCD display technology uses active matrix display, but some of the older displays still make use of the passive display grid designs. Most of the electronic devices mainly depend on liquid crystal display technology for their display.

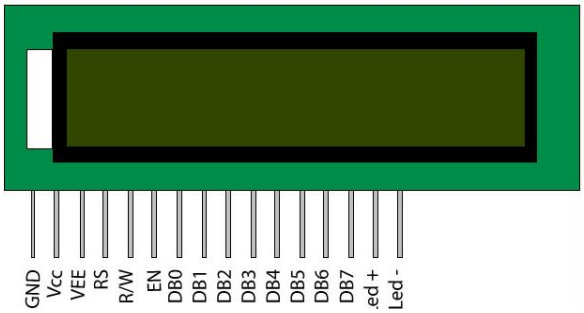

Fig.8 Pin out of LCD

The liquid crystals are the organic compound which is in liquid form and shows the property of optical crystals. The layer of liquid crystals is deposited on the inner surface of glass electrodes for the scattering of light. The liquid crystal cell is of two types; they are Transmittive Type and the Reflective Type.

TABLE 1 PIN DETAILS OF LCD

PIN NO	Symbol	Fuction
1	VSS	GND
2	VDD	+5V
3	V0	Contrast adjustment
4	RS	H/L Register select signal
5	R/W	H/L Read/Write signal
6	E	H/L Enable signal
7	DB0	H/L Data bus line
8	DB1	H/L Data bus line
9	DB2	H/L Data bus line
10	DB3	H/L Data bus line
11	DB4	H/L Data bus line
12	DB5	H/L Data bus line
13	DB6	H/L Data bus line
14	DB7	H/L Data bus line
15	A	+4.2V for LED
16	K	Power supply for BKL(0V)

e)PIC Microcontroller programming kit

PIC kit is a family of programmers for PIC microcontrollers made by Microchip Technology. They are used to program and debug microcontrollers, as well as program EEPROM. Some models also feature logic analyser and serial communications (UART) tool. The people who develop open-source software for the PIC kit use a mailing list for collaboration.

The PIC kit 2 introduced in May 2005replaced the PIC kit 1. Fig. 3.2 shows the PIC kit- 2 programmer kit. The most notable difference between the two is that the PIC kit 2 has a separate programmer/debugger unit which plugs into the board carrying the chip to be programmed, whereas the PIC kit 1 was a single unit. This makes it possible to use the programmer with a custom circuit board via an in-circuit serial programming (ICSP) header. This feature is not intended[3] for so-called "production" programming, however.

The PIC kit 2 uses an internal PIC18F2550 with Full Speed USB. The latest PIC kit 2 firmware allows the user to program and debug most of the 8- and 16-bit PIC micro and ds PIC members of the Microchip product line. The PIC kit 2 is open to the public, including its hardware schematic, firmware source code (in C language) and application programs (in C# language). End users and third parties can easily modify both the hardware and software for enhanced features. e.g. Linux version of PIC kit 2 application software, DOS style CMD support, etc.

Fig.9 PIC kit

4.ADVANTAGES

- Reduction of material cost.
- Reduction of overall cost.
- Increased production.
- Increased storage capacity.
- Increased safety.
- Reduce in fatigue.
- Improved personnel comfort
- Efficiency is improved.
- Fully automatic winding machine saves energy.

5.APPLICATIONS

- It is very useful in Transformer manufacturing, to wind the transformer quickly.
- To wind the stator or rotor in motor or submersible pump.
- To wind the condensers coil and fan coils quickly.
- It is very useful in small scale industries where ever winding coils are used.
- It used to train students for wind the small transformers & relay coils.

6.CONCLUSION

The main objective of this machine is to replace the manual labour and optimize the process. The inference is that, this automated system has increased the production and also provided solution for lack of human labour for such hectic jobs is compensated. In general, it needs one worker for one machine but by implementing this automation it needs one worker for four machines. All electrical components such as stepper motor, motor driver module and the microcontroller were assembled and the machine was tested. The manual carriage movement of coil winder is automated for high reliability. The project can be extended by using another one stepper motor for the winder and a buzzer is provided for intimating the worker that the process is over.

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