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Design of Arduino-Based Automatic Motor Wire Rewinding System

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Abstract
In the industrial world, the motor winding process is one of the important stages in the manufacture and rewinding of electric motors. Many electric motors are damaged and even the motor can burn because in the operation of electric motors often serve loads that exceed the limits of the motor's ability (overload), contaminated with foreign objects, age, bearing problems, which can cause the effect of changing the current, causing heat which if left for a long time can cause burning of the motor wire winding. With the damage to the motor wire winding, a cost-effective solution that can be done is to rewind the motor wire. the motor rewinding process is carried out so that the winding can return to normal and work properly. The research was conducted using the experimental method. In the research, an automatic rolling device using an Arduino microcontroller was designed. The test results that the system can function normally in the process of inputting the value of the number of rolls, rolling driven by stepper motors and LCD has functioned properly in displaying each data on the system designed.
Keywords: Arduino, Stepper Motor, Electric Motor, Roll Motor

Introduction
In the industrial world, electric motors are one of the products that are very often used in human life. Electric motors in use often experience several problems such as a decrease in rotational speed and even total death, forcing consumers to buy new or service their electric motors (Hapsari et al., 2020). The motor winding process is one of the important stages in the manufacture and rewinding of electric motors. However, this process requires special skills and high accuracy from the operator. In addition, the manual motor rewinding process is also prone to human error and less efficient in terms of time and cost (Muhammad Faizal Kurniawan, 2023).

In general, many small and medium-sized companies and electromechanical shops still use human-powered manual dynamo winding systems to repair transformer/dynamo windings. Because automatic packaging machines are very expensive. The use of hand tools when winding enameled wire is time consuming, resulting in poor accuracy in counting the number of wire turns, the speed and accuracy of work results are needed in the process of maintenance or maintenance and repair of industrial machines (J. Napitupulu & L. Siahaan, 2020), (Syahwil, 2020).

Therefore, the development of an Arduino Microcontroller-based automatic motor winding system is an innovative and effective solution, which can help the community and facilitate various human activities (Dwi Putra et al., 2021). By utilizing Arduino controller technology that can regulate the rotation of the Stepper Motor in the motor rolling process can be done automatically with high precision. In addition, the use of Arduino also allows monitoring using 16x2 LCD Display and better control using Pushbutton, thus reducing the risk of errors and speeding up the production process. With this automated system, it is expected to increase efficiency, precision, and productivity in the motor wire winding process.

Arduino is a chip that functions as an electronic circuit controller, consisting of an integrated CPU (Central Processing Unit), memory, I/O (Input/Output), and ADC (Analog Digital Converter). The main advantage of microcontrollers is the size of the microcontroller board which is very compact due to the availability of RAM (Random Access Memory) and support for I / O equipment (Anshori et al., 2022). One type of Arduino is the Arduino Uno. Arduino Uno is a microcontroller system board that is open-source. In addition, Arduino has an advantage over other microcontroller boards, because it has used a programming language developed with software (Puspasari et al., 2020).

Literature Review
Stepper Motor
Stepper Motor, Electronic pulses are converted into discrete mechanical movements by stepper motors, which are electromechanical devices. Stepper motors operate by responding to a predetermined sequence of pulses. Therefore, a stepper motor controller that generates periodic pulses to drive the stepper motor is required (M. Shandika Drajat, 2019), (Soedjarwanto et al., 2021). In general, stepper motors can be positioned in a certain position or rotate in the desired direction, clockwise or vice versa. Stepper motor speed is basically determined by the speed of giving data to the

commutator. The faster it rotates. In most stepper motors, it will also rotate faster (Sindak Hutauruk et al., 2021). Stepper motors are used because they are usually applied in systems that require movement with a certain degree of precision (Kurniawan & Taufik, 2021).

Figure 1. Stepper Motor

Stepper Motor Driver (TB6600)

TB6600 stepper motor driver is a professional two-phase stepper driver that supports speed and direction control. Using 6 DIP switches, this driver can set the micro-step and output current, offering 7 types of micro-step and 8 types of overall current control. All signal terminals are equipped with high-speed optocoupler isolation, which improves the high-frequency anti-interference capability. In addition, this driver is capable of delivering high power with a maximum current between 4.5 amperes to 5 amperes, and supports voltages up to 45 Volts, so it can drive stepper motors with the desired speed and torque(DF. Robot, 2022), (Widiatmoko et al., 2022).

This driver has several features including: Supports 8 types of controls, supports 7 types of customizable micro steps, the interface adopts high-speed optocoupler isolation, semi-automatic flow to reduce heat, large area cooling, high anti-frequency interference ability, input anti-reverse protection.

Figure 2. Stepper Motor Driver

Push Button

Push Button (Tacticle switch) is a push-on button that when pressed results in a path closure (ON). When the button is released, the path reopens (OFF) which is usually represented by the numbers 1 and 0. These two conditions are crucial in operating electrical devices that require an energy source. In industry, push buttons are very important because they are directly related to the operator and are used to start and stop machines. Even though a machine may be highly sophisticated, it still requires a switch such as a push button to set the On and Off conditions that are the basis of its system operation (Eka Maulana & Nurpulaela, 2024), (Devita et al., 2022).

Figure 3. Push button

LCD

An electronic component called an LCD (Liquid Crystal Display) is tasked with displaying data in the form of desired characters, letters, symbols, or graphics by sandwiching a liquid crystal between two sheets of polarizing material. LCDs are often used in conjunction with microcontrollers due to their small size. LCD modules with data pins, power supply control, and contrast settings are available (Utama Putra et al., 2021), (Rahardjo, 2021).

Table 1. LCD Specifications

No.	Name	Specifications
1	Backlight	Blue color
2	Display Format	32 Characters, 16 column & 2 lines
3	Supply voltage	5V
4	Module dimensions	80 x 36 x 12 mm
5	Contrast Adjust	Potentiometer
6	Backlight Adjust	Jumper

Figure 4. LCD 16 x 2

I2C Module

I2C/TWI module LCD2004 is a trainer system using 16x2 character dot matrix LCD based on Hitachi HD44780 IC with high speed I2C serial bus produced by DFRobot. t is a module that is used to reduce the use of legs in LCD 1602. This module has 4 pins that will be connected to Arduino (Fatahillah Murad et al., 2022). The HD44780 IC-based 16x2 character dot matrix LCD display system can be connected to the Arduino Uno board using only 2 Analog legs A4 and A5 of the Arduino Uno connected to the SDA leg and SCL leg of the serial board (Wisnu Adi Perdana, 2019).

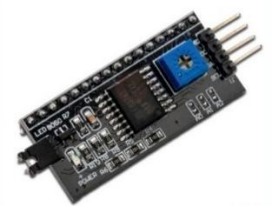

Figure 5. I2C Module

LED

An LED (light emitting diode) is a semiconductor (diode) that can emit light. LEDs are available in various colors such as red, green, orange, yellow, and blue, and in various shapes. Like diodes, LEDs are components that become active (light up) when biased forward and become inactive when biased backward (Widiastuti, 2023).

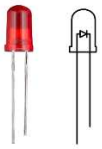

Figure 6. LED and Symbols

Methods

Basically, the working principle of this system requires energy from a 12V adapter that is continuously connected to 220 VAC electricity as an energy source, then the energy is channeled to each material that requires electric current.

The way the designed tool works is in the initial stage of entering the rotation value to be carried out by pressing the Plus button to increase the number of rolls and pressing the minus button to reduce the number of rolls given the red Led indicator will light up when the value is added or reduced, and to find out what value you want to do can be seen on the 16x2 LCD screen.

To start the rotation can press the Start button with the Green Led indicator that will light up, then the stepper motor will rotate according to the input value that has been entered at the beginning. Then to reset the input value that has been given, you can press the Reset button with the blue Led indicator that lights up and the rotation value and the number of revolutions that have been done on the LCD returns to the value 0.

Tool Design Schematics

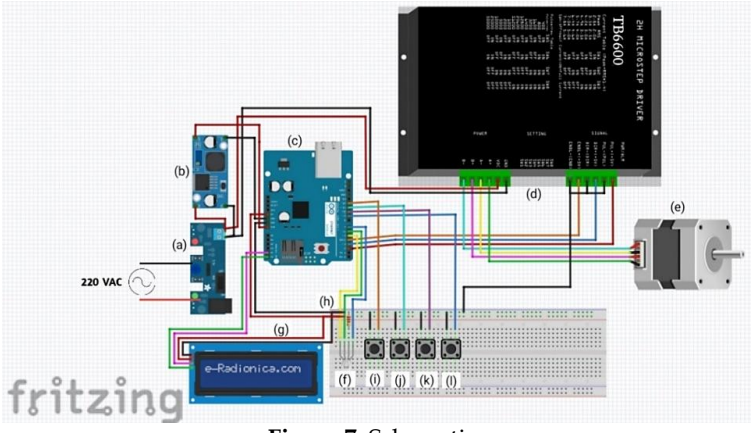

Figure 7. Schematics

All the legs on the support device are connected to the pins on the Arduino, allowing for effective communication and control between the two. This connection is crucial to ensure that the data sent and received can be processed properly, supporting the various functions expected. In addition, with this configuration, users can easily change and modify the program to suit the required performance of the support tool. The integration between the support tool and Arduino also creates opportunities for the development of more complex and innovative projects.

Flowchart

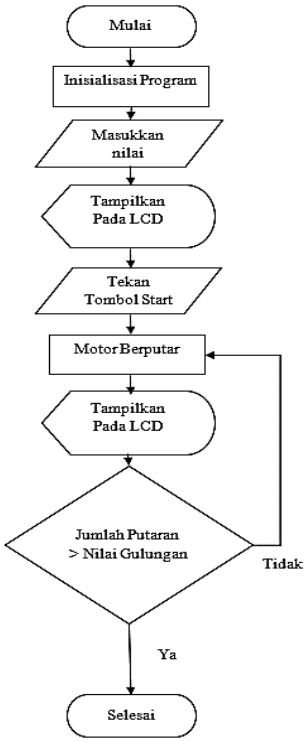

Figure 8. Flowchart

Results and Discussion

Tool Operation

Operation of this tool begins with connecting the adapter plug to a 220 VAC source then the switch is positioned in the ON state, the indicator LED will light up. As in Figure 9.

Figure 9. Tool in Standby State

The second step, inserting the wire reel in the place shown in Figure 10 then the end of the wire is inserted into the hole on the mall and the end of the wire is bent in so that the wire can be rolled properly.

Figure 10. Holder for Wire Reels

Step Three, Provide input values by pressing the pushbutton "+" to add the number of rolls to be performed and pressing the pushbutton "-" to reduce the number of rolls to be performed, the number of numbers entered can be seen on the LCD as shown in Figure 11. If the input number is as desired, you can press the "Start" pushbutton to start the rolling process.

Figure 11. LCD Display

In Figure 11, it can be explained that for image (a) is the number of rolls to be performed, while for (b) the display value of the rolls that have been performed. The fourth step, if the rolling is complete, the roll is taken and moved to the next Mal lane. And if you want to do the next roll then press the "Reset" pushbutton first so that the input value and the value that has been done can return to zero.

Test Results

The test was carried out by entering an input value of 20 rolls using Copper Wire with a size of 0.5mm. In the test, the rolling done is very precise, worth 20 rolls with a time of 8 seconds, which means that 1 roll is done with only 0.4 seconds.

Conclusions

In this design there are several things that are concluded, as for the conclusions in this study are as follows.

1. The rolling is done using 0.5mm copper wire, which produces highly precise and accurate results, ensuring optimal quality and performance of the final product.
2. The winder consisting of 20 rolls can operate very well and efficiently, producing optimal results in accordance with the expected specifications.
3. Rolling is automated using a sophisticated system that has been specifically designed, improving efficiency and consistency in the production process.

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References

Anshori, M., Sari, N., & Vijai Nasrulloh, A. (2022). Rancang Bangun Alat Ukur Kekeruhan Air Layak Pakai Berbasis Arduino Uno R3 Pada Sungai Martapura. *Jurnal Ilmiah Fisika FMIPA Universitas Lambung Mangkurat*, *19*(3), 2541–1713. https://doi.org/10.20527/flux19i3.12959

Devita, R., Wirawan, N. T., & Syafni, D. A. (2022). Perancangan Prototipe Keamanan Pintu Rumah Menggunakan Kamera

Ttl Dan Aplikasi Telegram Berbasis Arduino. *JUISIK*, *2*(2). http://journal.sinov.id/index.php/juisik/indexHalamanUTAMAJurnal:https://journal.sinov.id/index.php

DF. Robot. (2022). *Panduan Pengguna Driver Motor Stepper TB6600*. www.DFRobot.com

Dwi Putra, W., Ishak, & Halim, J. (2021). Implementasi Teknik Counter Pada Penggulung Tembaga Berbasis Mikrokontroller. *Jurnal CyberTech*, *4*(8). https://ojs.trigunadharma.ac.id/

Eka Maulana, F., & Nurpulaela, L. (2024). Konfigurasi Mikrokontroler STM32 Untuk Membaca Push Button Dengan Arduino IDE Pada Prototipe Smart Charger Di PT. Pasifik Satelit Nusantara. In *Jurnal Mahasiswa Teknik Informatika* (Vol. 8, Issue 4).

Fatahillah Murad, R., Almasir, G., & Ronald Harahap, C. (2022). Pendeteksi Gas Amonia Untuk Pembesaran Anak Ayam Pada Box Kandang Menggunakan MQ-135. *Jurnal Ilmiah Mahasiswa Kendali Dan Listrik*, *3*(1). https://doi.org/10.33365/jimel.v1i1

Hapsari, F. K., Bhakti, G. F., & Dewantoro, D. M. (2020). *Pemilihan Mekanisme Unit Penggulungan Coil Pada Perancangan Winding Coil Machine*.

Kurniawan, S. A., & Taufik, M. (2021). Rancang Bangun Solar Tracker Sumbu Tunggal Berbasis Motor Stepper Dan Real Time Clock. *Jurnal Ilmiah Teknologi Dan Rekayasa*, *26*(1), 1–12. https://doi.org/10.35760/tr.2021.v26i1.3685

M. Shandika Drajat. (2019). *Sistem Kontrol Kabel Suspensi Untuk Pergerakan Objek Pada Ruang 3 Dimensi*.

Muhammad Faizal Kurniawan. (2023). *Implementasi Mikrokontroler Sebagai Pengendali Penggulungan Kawat Motor Industri*.

Puspasari, F., Satya, T. P., Oktiawati, U. Y., Fahrurrozi, I., & Prisyanti, H. (2020). Analisis Akurasi Sistem Sensor DHT22 berbasis Arduino terhadap Thermohygrometer Standar. *Jurnal Fisika Dan Aplikasinya*, *16*(1), 33. https://doi.org/10.12962/j24604682.v16i1.5717

Rahardjo, P. (2021). Sistem Penyiraman Otomatis Menggunakan RTC (Real Time Clock) Berbasis Mikrokontroler Arduino Mega 2560 Pada Tanaman Mangga Harum Manis Buleleng Bali. In *Maret* (Vol. 8, Issue 1). www.labelektronika.com

Sindak Hutauruk, I., Lourenzaí, S., & Jogi. (2021). Miniatur Sistem Pemindahan Barang Pada Konveyor Dengan Penggerak Motor Stepper. In *Telecommunications & Control System-ELPOTECS Jurnal ELPOTECS* | (Vol. 4, Issue 2).

Soedjarwanto, N., Forda Nama, G., & Astu Nugroho, R. (2021). *Prototipe Smart door lock Menggunakan Motor Stepper Berbasis IoT (Internet of Things)*.

Syahwil, M. (2020). Modifikasi Alat Penggulung Dinamo Sistem Manual Menjadi Otomatis Berbasis Arduino. In *JOURNAL OF LABORATORY ISSN* (Vol. 3, Issue 1). Online.

J. Napitupulu, & L. Siahaan. (2020). Studi Flicker Pada Start Motor Asinkron. In *Jurnal Teknik Elektro* (Vol. 9, Issue 1).

Utama Putra, I., Bakri, M., & Darwis, D. (2021). Pengukur Tinggi Badan Digital Ultrasonik Berbasis Arduino Dengan Lcd Dan Output Suara. *Jurnal Teknik Dan Sistem Komputer (JTIKOM)*, *2*(2).

Widiastuti, S. (2023). Analisa Efisiensi Biaya di Rumah Susun pada Pemakaian Lampu LED. *Elektriese: Jurnal Sains Dan Teknologi Elektro*, *13*(01), 95–106. https://doi.org/10.47709/elektriese.v13i01.3059

Widiatmoko, D., Made Tulus Adi, I., & Suryadi, K. (2022). Pengisi Munisi Pada Magazen Senjata Ss2-V4 Berbasis Arduino Mega 2560 Guna Mendukung Latihan Menembak. In *Jurnal Elkasista* (Vol. 3).

Wisnu Adi Perdana. (2019). *Alat Pemantau Kondisi Seorang Gamer*.