CONVEYER BELT PRODUCT COUNTING SYSTEM USING ARDUINO

A thesis report was submitted to the Department of Mechanical Engineering to partially fulfill the Bachelor of Science in Mechanical Engineering degree.

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20, September, 2023

APPROVAL

This is to certify that the project on " **CONVEYER BELT PRODUCT COUNTING SYSTEM USING ARDUINO**

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By being carried out under our supervision. The project has been carried out in partial fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of the year of 2023 and has been approved as to its style and contents.

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DECLARATION

We, hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision Of **M.I. WASHIF RAHMAN**, Lecturer, Department of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thesis has been or is being submitted elsewhere for the award of any degree.

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ABSTRACT

The automatic counting system has been reported to be complex and a global problem. This is because of the inability of counting of machines to incorporate flexibility in their design concept. This research therefore designed and developed an automated counting object of a conveyor belt. The developed automated counting machine can incorporate flexibility and counting pieces of nonmetal objects and at the same time move objects automatically to the conveyer as defined by the regulation of the microcontroller with a capacitive sensor to detect a value range of objects. The result obtained shows that metal and nonmetal were counted into their respective and correct position with a good average time. The project detects objects totally different from various materials and segregates them in huge different boxes. By usage of sensors decreases the errors in sorting and reduces human use. The projected system involves a sensing element, a mini limit switch for sensing elements, and for sorting purposes linear motion electrical actuators area unit used.

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Chapter 1 Introduction

1.1 Introduction

A conveyor belt product counting system is a pivotal component in modern manufacturing and logistics operations. This automated system employs sensors, cameras, or other detection technologies to accurately tally and monitor products as they traverse along a conveyor belt. It provides real-time data on production output, enabling businesses to maintain quality control, optimize inventory management, and streamline their workflow processes. Whether in warehouses, factories, or distribution centers, this system ensures the precision and efficiency of product counting, enhancing overall productivity and reducing human error. With the ability to handle diverse product sizes and shapes, conveyor belt counting systems have become indispensable tools for businesses seeking to maintain a competitive edge in today's fast-paced industrial landscape.

1.2 Proposed of the method

In the time of speedy-running technology, automation is gone to a higher level of development. In this project, the system is proposed to develop a conveyor belt which can able to detect product with counting system. The working of this project is easy to explain and less costly. This project is developed for sorting of metal and non-metal object with size like small and large size. Where logic is controlled by Arduino uno microcontroller.

1.3 Objectives

The objectives of this project are:

- To construct about “IOT BASED CONVEYER BELT PRODUCT COUNTING SYSTEM USING ARDUINO”
- To design and construct a product counting system.
- To test the performance of the system.

1.4 Methodology

Our used methodology for the project:

- IOT-BASED CONVEYER BELT PRODUCT COUNTING SYSTEM USING ARDUINO and designing a block diagram & circuit diagram to know which components need to be constructed it.
- Collecting the all components and programming for the micro-controller to controlled the system.
- Setting all components in a PCB board & soldering. Then assembling the whole block in a board and finally run the system & checking.

Chapter 02 Literature Review

2.1 Introduction

In this section topics related to IOT BASED CONVEYER BELT PRODUCT COUNTING SYSTEM USING ARDUINO are included. These provide a sampling of problems appropriate for the application of the Conveyor Belt System Metal Detection and Servo Separation System. The references are summarized below.

2.2 Literature Review

Articles for our project were studied. Since the products are sorted through the conveyors, the status of the sorting is an important factor in our project. So, this is identified in the research paper “automatic object sorting machine using sensor”, which describes that the objects are sorted using sensors so that safe and reliable conveyor operation is ensured. For the selection of the appropriate sensors, various studies were made and, in the journal, “Automatic Industrial Counting Machine by the Different Sensors for Automation Innovative model-based approach” where the IR sensor items by contrast, object, or any properly, many studies were done and one of the research papers “automatic counting machine using conveyor belt” helped us. From this research, it was found how plc can be effectively designed for a wide variety of control tasks with the simple ladder logic to control the entire system.[1]

Francis Lawrence, md. Asheke rabbi, Fahim Ahmed Touqir, automation of material handling with bucket elevator and belt conveyor, International Journal of scientific and research publications, volume 4, issue 3, march 2014 1 issn 2250-3153: belt conveyor & bucket elevator are the media of transportation of material from one location to another in a commercial space. Belt conveyor has huge load-carrying capacity, large covering area simplified design, easy maintenance and high reliability of operation. Belt conveyor system is also used in material transport in foundry shops like supply and distribution of molding sand, molds and removal of waste. On the other hand, bucket elevators can be of great use during bulk material handling. This paper is mainly based on the combination of belt & bucket conveyers to perform complex task within a short time and successfully in a cost-effective way. On account of this, a machine and its physical description is covered here with some basic calculation.[4]

Abhijit gaikwad, yogesh raut , Jitendra desale , akshay palhe, govinda shelar, prof. Shreekant Pawar, design and development of automated conveyor system for Material Handling, iosr journal of Mechanical and civil engineering (iosr-jmce) e-issn: 22781684,p-issn: 2320-334x, pp 31-34: in the process or manufacturing industry, raw materials and products need to be transported from one manufacturing stage to another. Material handling equipment are designed such that they facilitates easy, cheap, fast and safe loading and unloading with least human interference. For instance, belt conveyor system can be employed for easy handling of materials beyond human capacity in terms of weight and height. This project discusses the design calculations and considerations of belt conveyor system for press machines, in terms of size, length, capacity and speed, roller diameter, power and tension, idler spacing, type of drive unit, diameter, location and arrangement of pulley, angle and axis of rotation, control mode, intended application, product to be handled as well as its maximum loading capacity in order ensure fast, continuous and efficient movement of material. The successful completion of this project work is help to the development of an automated belt conveyor system which is fast, safe and efficient. It is aimed to reduce human effort and at the same time increase the productivity & accuracy levels that cannot be achieved with manual operations.[5]

Alhade a. Algitta, mustafa s., ibrahim f., abdalruof n. And yousef m automated packaging machine using plc, ijiset - international journal of innovative science, engineering & technology, vol. 2 issue 5, may 2015. Www.ijiset.com issn 2348 – 7968: this paper presents final year project prototype with the use of programmable logic controller in automation industry for packaging process. The main idea of the project is to design and fabricate a small and simple conveyor belt system, and automate the process for packaging small cubic pieces (2 × 1.4 × 1) cm3 of wood into small paper box (3 × 2 × 3) cm3. Inductive sensor and photoelectric sensor were used to provide the

information to the controller. Electrical dc motors used as output actuators for the system to move the conveyor belts after get the orders from the control system. Programmable logic controller Mitsubishi fx2n- 32mt was used to control and automate the system by ladder logic diagram software. The experimental result of the prototype was able to fully automate the packaging system. These results show that the machine was done to package 21 boxes in one minute. In addition, the results obtained show that the system able to decreases product time, and increase product rate as compared with traditional manual system.[6]

Konakalla naga sri ananth , vaitla rakesh , pothamsetty kasi visweswarao, design and selecting the proper conveyor belt, ananth et al., international journal of advanced engineering technology e-issn 0976-3945: belt conveyor is the transportation of material from one location to another. Belt conveyor has high load carrying capacity, large length of conveying path, simple design, easy maintenance and high reliability of operation. Belt conveyor system is also used in material transport in foundry shop like supply and distribution of molding sand, molds and removal of waste. This paper provides to design the conveyor system used for which includes belt speed, belt width, motor selection, belt specification, shaft diameter, pulley, gear box selection, with the help of standard model calculation.[3]

2.3 Summary

We tried to do this project by reading the above literature, and we have been able to make our project successful by reducing the mistakes of last year's project.

Chapter 03 Methodology

3.1 Introduction

In this chapter we describe our project block diagram, circuit diagram, project working principle and final project view.

3.2 Block Diagram

The way of whole project works is 12 V DC. Here we input 220V Dc input of and output of 12v dc current. Here we use a microcontroller, IR Senor, Display , Motor and Motor speed controller etc. All are in layout in below block diagram.

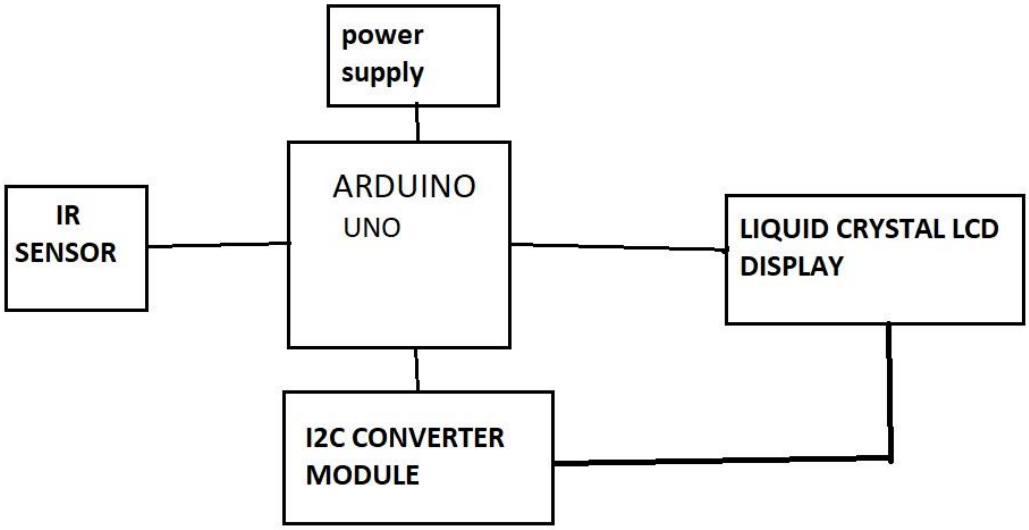

Figure 3.1: Block Diagram of Our System

3.3 Circuit Diagram

The schematic diagram here is representing the electrical circuit and the components of the project. Here we have used standardized symbols and lines.

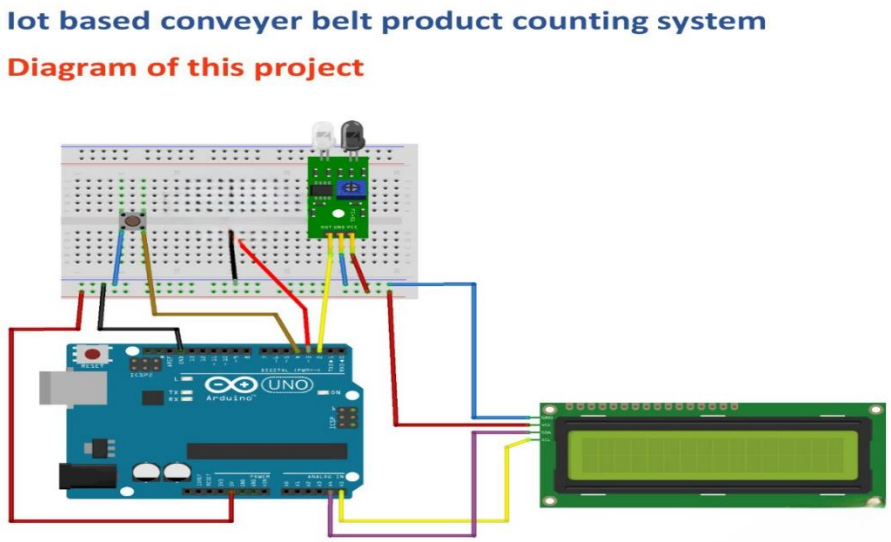

Figure 3.2: Circuit Diagram of product counting project

3.4 Working Principle

Our project is designed for a product counting system. We are using an Arduino controller for controlling our project, which is acting as the main controller here. Also used here are

sensors, Display, servo motor, d motors. Everything comes connected with Arduino. Here the current from AC TO Dc is entering the Adapter 220V volts into 12 volt. The IR sensor is useful for sensing the product. The ir sensor detects whether it is an object or not. If the conveyor belt rotates, the belt will stop when the object comes in front of the sensor. Then check the object if it is metal then a servo with handle will put it in a specific box . If it is non-metal product then another servo with handle is separate its way. In this way we can easily distinguish between metal and non-metal objects in this machine.

3.5 Project Prototype Image

This image of the project prototype

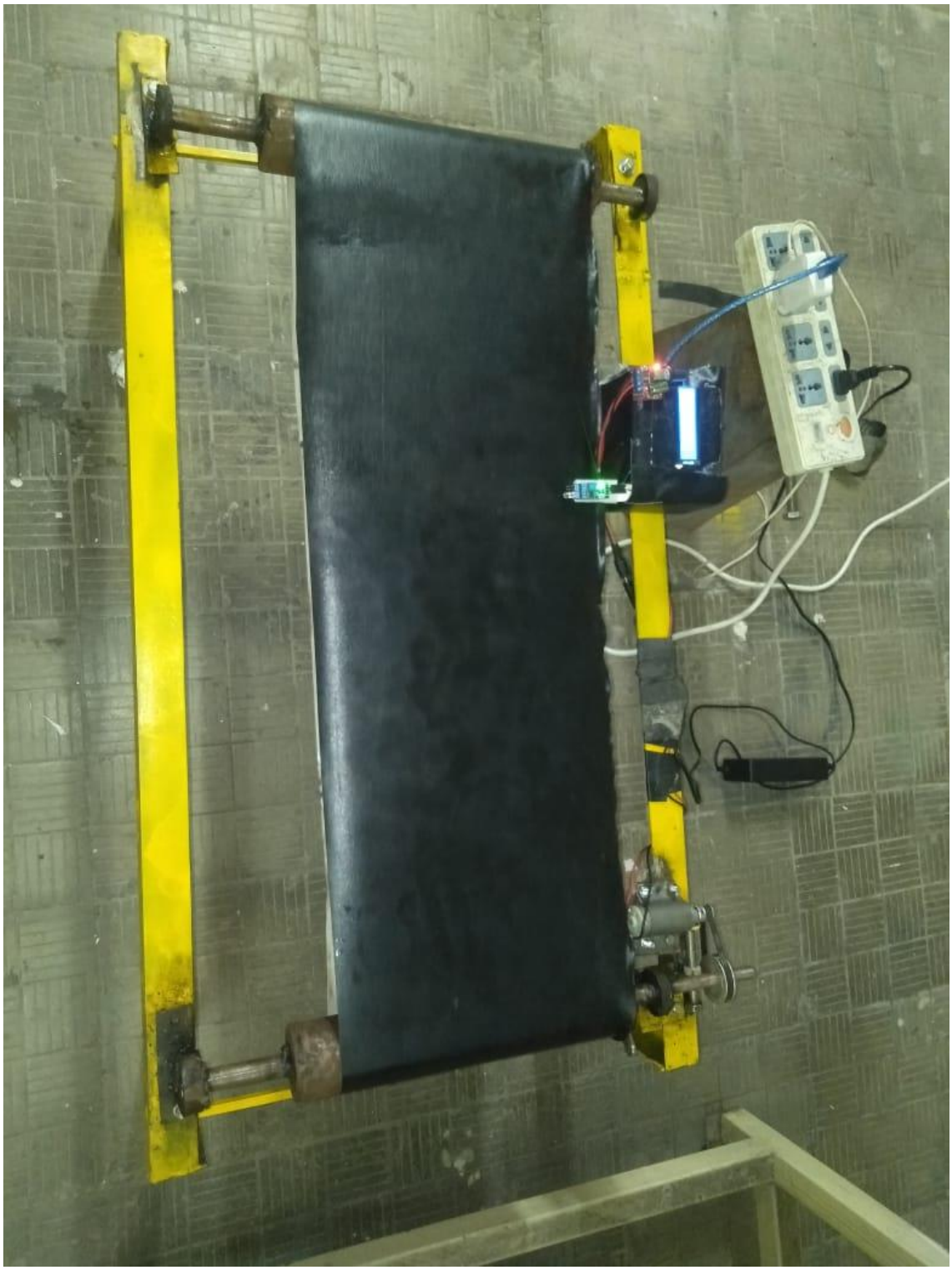

Figure 3.3: Project Prototype Image

3.6 Required Instrument

- DC Motor.

- IR Sensor.
- Liquid crystal display
- Belt and pully
- Arduino uno
- Jumper wire
- Metal frame
- Motor speed controller

3.7 Arduino uno R3

The Arduino Uno R3 is a popular microcontroller board that serves as a versatile and accessible platform for electronics enthusiasts, hobbyists, and professionals alike. Developed by Arduino, it is an upgraded version of the original Arduino Uno. The "R3" designation indicates the third revision of the board. Here are some key features and characteristics of the Arduino Uno R3:

Microcontroller: The Arduino Uno R3 is powered by the Atmega328P microcontroller, providing 32KB of Flash memory for storing your code and 2KB of SRAM for data storage.

Digital and Analog I/O: It offers 14 digital input/output pins, among which 6 can be used as PWM outputs, and 6 analog input pins.

Clock Speed: The board operates at a clock speed of 16 MHz, making it suitable for a wide range of applications.

USB Connectivity: It features a USB interface for easy programming and serial communication with a computer.

Power Options: The Arduino Uno R3 can be powered via USB or an external power supply. It also includes a voltage regulator for stable 5V operation.

Compatibility: It is compatible with a vast array of sensors, shields, and add-on modules, making it highly versatile for various projects.

Open-Source: Arduino is known for its open-source nature, and the Uno R3 is no exception. This means that the hardware design and software IDE (Integrated Development Environment) are open for modification and expansion.

Community Support: Due to its popularity, the Arduino Uno R3 has a large and active online community. You can find plenty of tutorials, projects, and forums to help you get started and troubleshoot any issues.

Programming: It can be programmed using the Arduino IDE, which is based on C/C++. The IDE offers a user-friendly interface for writing, compiling, and uploading code to the board.

Versatility: The Arduino Uno R3 can be used for a wide range of projects, from simple LED blinkers to complex

IoT (Internet of Things) applications, robotics, and more.

In summary, the Arduino Uno R3 is a versatile, user-friendly microcontroller board that is excellent for learning electronics and programming, prototyping projects, and building a wide variety of devices. Its open-source nature and strong community support make it a popular choice for both beginners and experienced

Figure 3.4: Arduino uno R3

Microcontroller : ATmega328P

Operating Voltage: 5V

Input Voltage (recommended): 7-12V

Input Voltage (limit): 6-20V

Digital I/O Pins: 14 (of which 6 provide PWM output)

Analog Input Pins: 6

DC Current per I/O Pin: 20 mA

DC Current for 3.3V Pin: 50 mA

Flash Memory: 32 KB (ATmega328P)

SRAM: 2 KB (ATmega328P)

EEPROM: 1 KB (ATmega328P)

Clock Speed: 16 MHz specification

Pin Out

The Arduino Uno pinout, or pin configuration, is a crucial reference for anyone working with the Arduino Uno R3 microcontroller board. It outlines the functions and capabilities of each of the pins on the board. Here's a brief overview of the key pins and their functions:

Digital Pins (0-13):

These pins can be used for both input and output operations.
Pins 3, 5, 6, 9, 10, and 11 provide Pulse-Width Modulation (PWM) output.
Pin 13 has an onboard LED and is often used for simple output testing.
Analog Pins (A0-A5):

These pins are used for analog input, allowing you to read voltage levels.
They can also be used as digital pins (14-19).
Power Pins:

5V: Provides a regulated 5V output for powering external components.
3.3V: Provides a 3.3V output.
GND (Ground): Ground pins for connecting to the ground reference.
I2C Pins (A4 (SDA) and A5 (SCL)):

Used for I2C (Inter-Integrated Circuit) communication with other devices, like sensors.
SPI Pins (MISO, MOSI, SCK):

Used for SPI (Serial Peripheral Interface) communication, typically with other microcontrollers, displays, or sensors.
UART Pins (TX and RX):

Used for serial communication with other devices or for programming the Arduino.
Reset (RESET):

This pin is used to reset the microcontroller.
AREF (Analog Reference):

This pin is used to set an external reference voltage for the analog-to-digital converter (ADC).
ICSP Header (In-Circuit Serial Programming):

Used for advanced programming and debugging.
The Arduino Uno's pinout provides flexibility for a wide range of projects. Understanding the pinout is crucial when connecting sensors, displays, motors, or other components to the board. It's essential to consult the official documentation or a pinout diagram specific to your Arduino Uno version to ensure accurate wiring and programming.

See also the mapping between Arduino pins and ATmega168 ports.

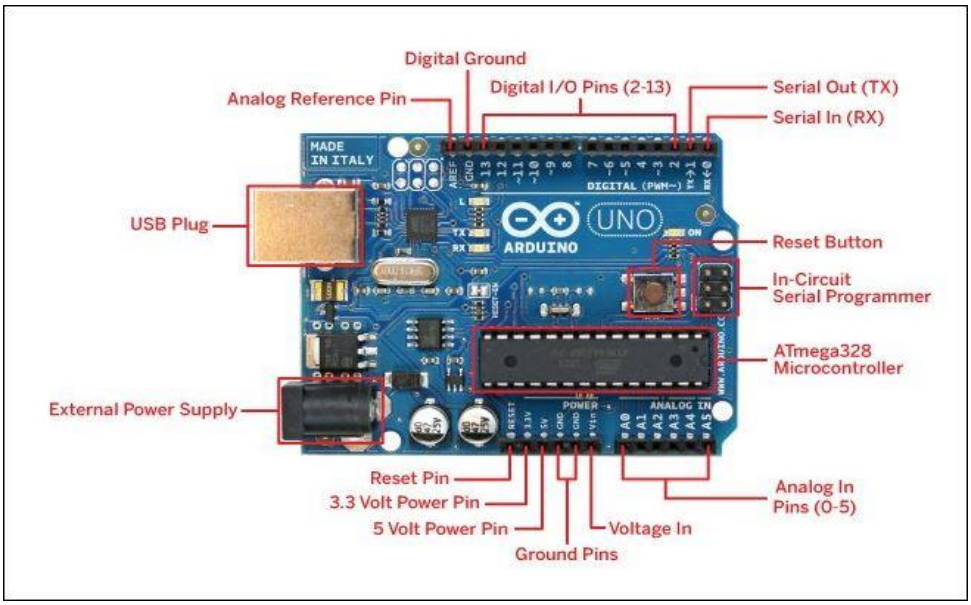

Figure 3.5: Arduino uno pin out

3.8 Power Supply 12 volt adapter

A 12-volt AC to DC adapter, often referred to simply as a "12V power adapter," is a versatile electrical device that converts alternating current (AC) voltage from a standard wall outlet into direct current (DC) voltage suitable for powering various electronic devices. These adapters are widely used in homes, offices, and industrial settings for a multitude of applications. They typically consist of a plug for connecting to the AC power source and a cord terminating in a DC connector, which is plugged into or hardwired to the device to be powered. Here are some key points about 12V AC to DC adapters:

fig: Ac to Dc adapter 12v

Adapter converter: A female adapter converter is a simple yet essential device used to bridge the gap between two different types of connectors or cables. Its primary function is to convert a male connector into a female one, or vice versa, allowing devices with incompatible connectors to connect and communicate effectively.

These adapters come in various shapes and sizes, depending on the specific connectors they are designed to convert. They are commonly used in electronics, audiovisual equipment, computer networking, and various other industries where different types of connectors are prevalent.

FIGURE: JUMPER WIREF

FIGURE: jumper wire

Voltage Conversion: The primary function of these adapters is to convert 120V AC or 230V AC voltage from the mains power supply into a stable 12V DC output.

Applications: 12V DC is a common voltage requirement for a wide range of electronics, including routers, modems, LED lighting, CCTV cameras, small appliances, and DIY electronics projects.

Variety of Connectors: Adapters come with various types of DC connectors to match the input requirements of different devices. It's essential to ensure compatibility between the adapter and the device you intend to power.

Regulated vs. Unregulated: Regulated adapters provide a consistent 12V output, even under varying loads or input voltages, while unregulated ones may have some variation in output voltage.

Current Rating (Amperage): Adapters are rated in terms of their maximum current output, typically measured in amperes (A). It's crucial to choose an adapter with an amperage rating equal to or higher than the device's power requirements to avoid overloading and potential damage.

Safety: High-quality adapters incorporate safety features such as over-voltage protection, over-current protection, and short-circuit protection to safeguard both the adapter and the connected device.

Efficiency: Modern adapters are designed to be energy-efficient, minimizing power loss during the conversion process.

Portability: Some 12V adapters are compact and portable, making them suitable for travel or use with mobile devices in cars.

Durability: The build quality of adapters can vary, so it's advisable to choose a reputable brand to ensure longevity and reliability.

In summary, a 12V AC to DC adapter is an essential component for powering a wide range of electronic devices and equipment safely and efficiently. It simplifies the process of converting mains AC power into a voltage suitable for the device, making it a fundamental tool in today's interconnected world. When selecting an adapter, consider factors like voltage, current rating, connector compatibility, and safety features to ensure it meets the specific requirements of your application. Figure 3.6:

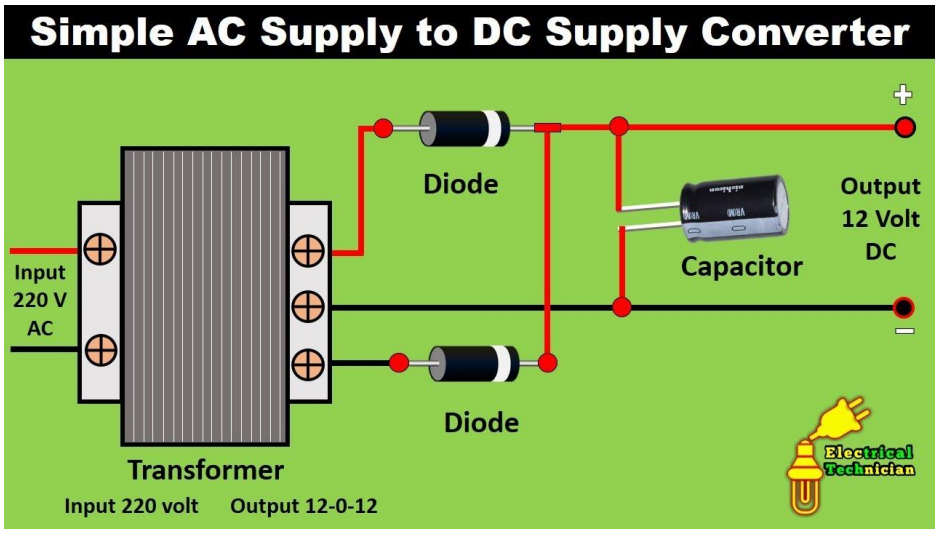

Figure 3.7: Basic working concept of AC to dc adapter

A switching regulator does the regulation in the SMPS. A series switching element turns the current supply to a smoothing capacitor on and off. The voltage on the capacitor controls the time the series element is turned. The continuous switching of the capacitor maintains the voltage at the required level.

Design basics

AC power first passes through fuses and a line filter. Then it is rectified by a full-wave bridge rectifier. The rectified voltage is next applied to the power factor correction (PFC) pre-regulator followed by the downstream DC-DC converter(s). Most computers and small appliances use the International Electrotechnical Commission (IEC) style input connector. As for output

connectors and pinouts, except for some industries, such as PC and compact PCI, in general, they are not standardized and are left up to the manufacturer.

There are different circuit configurations known as topologies, each having unique characteristics, advantages and modes of operation, which determines how the input power is transferred to the output. Most of the commonly used topologies such as flyback, push-pull, half bridge and full bridge, consist of a transformer to provide isolation, voltage scaling, and multiple output voltages. The non-isolated configurations do not have a transformer and the power conversion is provided by the inductive energy transfer.

high efficiency.

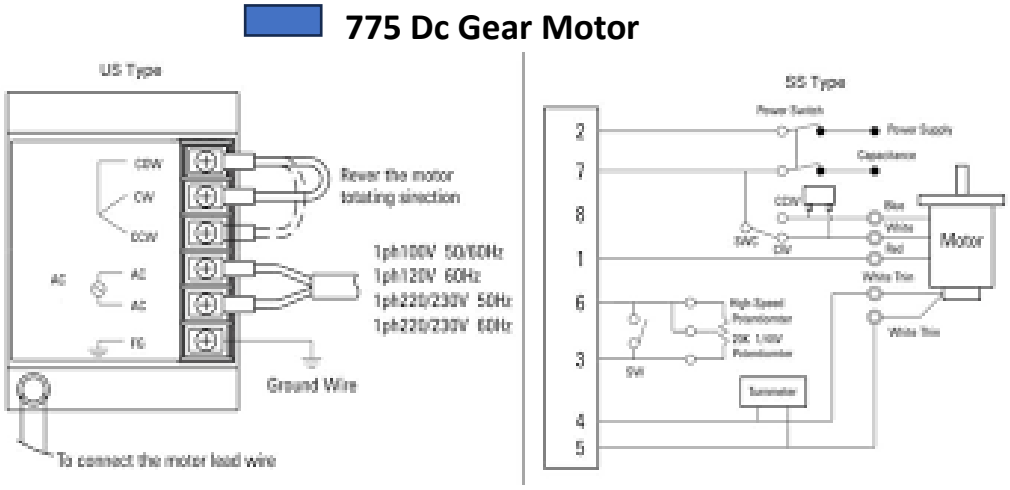

Figure 3.8 775 dc motor diagram

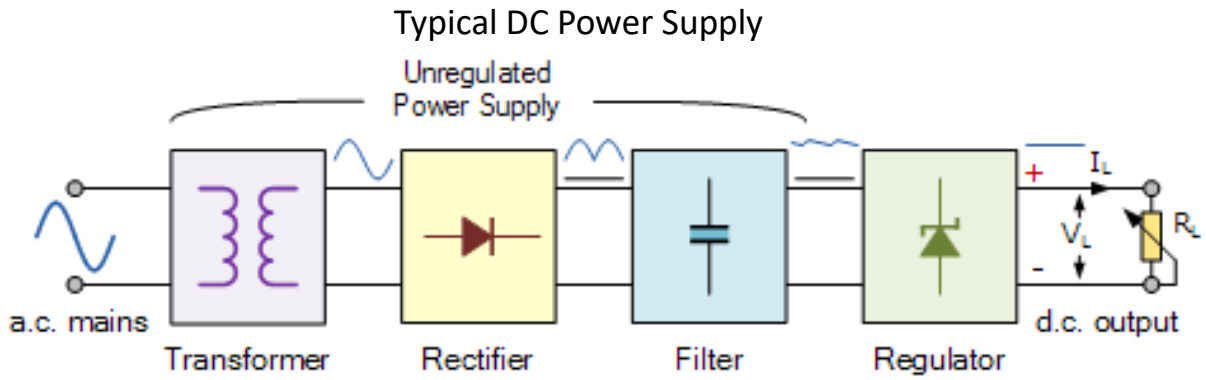

Figure 3.9: DC Power supply way

These typical power supply designs contain a large mains transformer (which also provides isolation between the input and output) and a dissipative series regulator circuit. The regulator circuit could consist of a single zener diode or a three-terminal linear series regulator to produce the required output voltage. The advantage of a linear regulator is that the power supply circuit only needs an input capacitor, output capacitor and some feedback resistors to set the output voltage

3.9

The "775 DC motor" is a popular and widely used type of direct current (DC) motor in various applications. Here are some key features and characteristics of the 775 DC motor:

Size and Form Factor: The 775 DC motor typically has a cylindrical shape with a diameter of around 42-43 mm and a length of about 77-78 mm, hence the name "775."

Voltage: These motors are commonly available in various voltage ratings, with 12V and 24V being among the most common options. The voltage determines the speed and torque characteristics of the motor.

Power Rating: 775 motors are available in a range of power ratings, with variations in terms of wattage and current consumption. The power rating typically corresponds to the motor's ability to deliver mechanical output.

RPM (Revolutions per Minute): The RPM of a 775 DC motor can vary depending on the voltage applied and the specific model. They can typically achieve speeds ranging from a few hundred RPM to several thousand RPM.

Construction: These motors typically have a brushed design, which means they use brushes and a commutator for electrical connections. This design is relatively simple and cost-effective but may require maintenance over time due to brush wear.

Mounting: 775 motors often have a standard mounting flange with holes for easy attachment to various mechanical structures or devices.

Applications: The versatility of 775 DC motors makes them suitable for a wide range of applications, including robotics, DIY projects, electric vehicles, power tools, and various industrial machinery. They are often used when a balance between power, size, and cost is needed.

Torque: These motors can provide significant torque, especially when operated at their rated voltage. The torque output is crucial for applications requiring the motor to move or rotate a load.

Control: 775 DC motors can be controlled using various methods, including PWM (Pulse Width Modulation) for speed control and H-bridge motor drivers for direction control.

IR sensor

Figure: IR sensor

An IR (Infrared) sensor, also known as an IR detector or IR receiver, is an electronic device that detects and responds to infrared radiation in its vicinity. Infrared radiation has wavelengths longer than those of visible light, and it is typically invisible to the human eye. IR sensors are commonly used in

various applications for detecting the presence or absence of objects, measuring distance, and communication. Here are some key aspects of IR sensors:

Working Principle: IR sensors work based on the principle that objects emit, reflect, or absorb infrared radiation. The sensor typically consists of an IR emitter and an IR receiver. The emitter emits infrared light, and the receiver detects the reflected or emitted radiation. When an object is in the sensor's field of view, it reflects or emits IR light back to the receiver, triggering a response.

Types of IR Sensors:

IR Reflective Sensors: These sensors have an IR emitter and receiver in close proximity to each other. They detect objects based on the reflection of IR light. Line-following robots often use these sensors.

IR Obstacle Avoidance Sensors: These sensors are designed to detect and avoid obstacles in a robot's path. They are widely used in autonomous navigation systems.

IR Distance Sensors: These sensors measure the distance between the sensor and an object by calculating the time taken for the IR light to travel to the object and back. They are often used for distance measurement in robotics, automation, and level sensing.

IR Remote Control Receivers: These sensors are found in TV remote controls and other consumer electronics. They receive IR signals from a remote control unit and convert them into electrical signals for device control.

IR Communication Modules: IR can be used for short-range wireless communication between devices. IR communication modules are used in applications like data transfer between smartphones or TV remotes and smart appliances.

Applications: IR sensors have a wide range of applications, including:

Object detection and counting in industrial automation.

Motion detection in security systems.

Presence detection in elevators and automatic doors.

Proximity sensing in smartphones for screen activation.

Distance measurement in rangefinders and robotics.

Remote control in consumer electronics.

Advantages: IR sensors are cost-effective, operate at room temperature, and are suitable for various environmental conditions. They are often used in low-power applications and can be easily integrated into electronic circuits.

Limitations: IR sensors are sensitive to ambient light, and their performance can be affected in bright environments. Additionally, they have a limited range compared to some other distance-sensing technologies like ultrasonic sensors and LiDAR.

In summary, IR sensors are versatile devices that play a crucial role in a wide range of applications, from consumer electronics to industrial automation and robotics. Their ability to detect or measure the presence and distance of objects using infrared radiation makes them valuable components in many electronic systems.

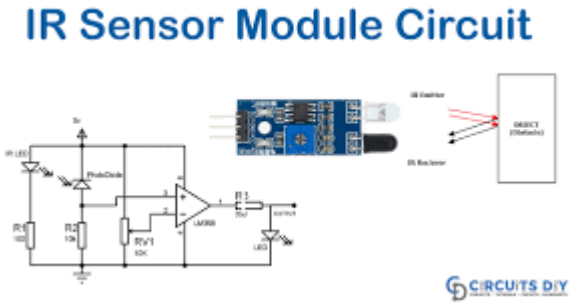

Figure: IR sensor circuit diagram

3.10 Motor speed controller

A DC motor speed controller, also known as a motor speed regulator or motor speed control module, is an electronic device designed to adjust and control the speed of a direct current (DC) motor. These controllers are widely used in various applications where precise control of motor speed is required. Here's a brief overview of DC motor speed controllers:

Working Principle: DC motor speed controllers work by varying the voltage or current supplied to the DC motor. By controlling the voltage or current, the motor's rotational speed can be adjusted. Higher voltage or current results in higher speed, while lower voltage or current leads to slower speed or even motor stoppage.

Types of DC Motor Speed Controllers:

Voltage Regulator: These controllers adjust the voltage supplied to the motor, providing a simple and cost-effective way to control speed. However, they may not offer very precise control.

PWM (Pulse Width Modulation) Controller: PWM controllers rapidly switch the power on and off, effectively controlling the average voltage supplied to the motor. By changing the duty cycle (the ratio of on-time to off-time), precise speed control can be achieved. PWM controllers are commonly used because they offer fine-grained control and are energy-efficient.

Chopper Controller: Chopper controllers are a type of PWM controller but are specifically designed for high-power applications. They use power electronic devices like insulated gate bipolar transistors (IGBTs) to control motor speed and direction.

Applications: DC motor speed controllers find applications in various industries and devices, including:

Robotics: Precise control of robot movement.
Industrial Automation: Conveyor belt speed control, process automation, and more.

Electric Vehicles: Controlling the speed of electric scooters, bikes, and small electric vehicles.
DIY Projects: Hobbyists and makers use these controllers in custom projects like drones, remote-controlled cars, and CNC machines.
HVAC Systems: Speed control of fans and blowers.
Home Appliances: Adjusting the speed of fans, mixers, and other household appliances.
Advantages:

Precise Speed Control: DC motor speed controllers offer fine-tuned control over motor speed.
Energy Efficiency: PWM controllers, in particular, are highly efficient, reducing power consumption.
Extended Motor Life: By avoiding abrupt starts and stops, these controllers can prolong the life of DC motors.
Considerations:

Compatibility: Ensure that the controller is compatible with your specific DC motor in terms of voltage, current, and power rating.
Heat Dissipation: Some controllers generate heat, so proper heat sinking or ventilation may be required.
Overload Protection: It's essential to have protection mechanisms in place to prevent motor damage due to overloads or overcurrent situations.
In summary, a DC motor speed controller is a valuable tool for adjusting the speed of DC motors in a wide range of applications. These controllers offer precision, efficiency, and motor protection, making them indispensable in industries and DIY projects that require motor speed control.

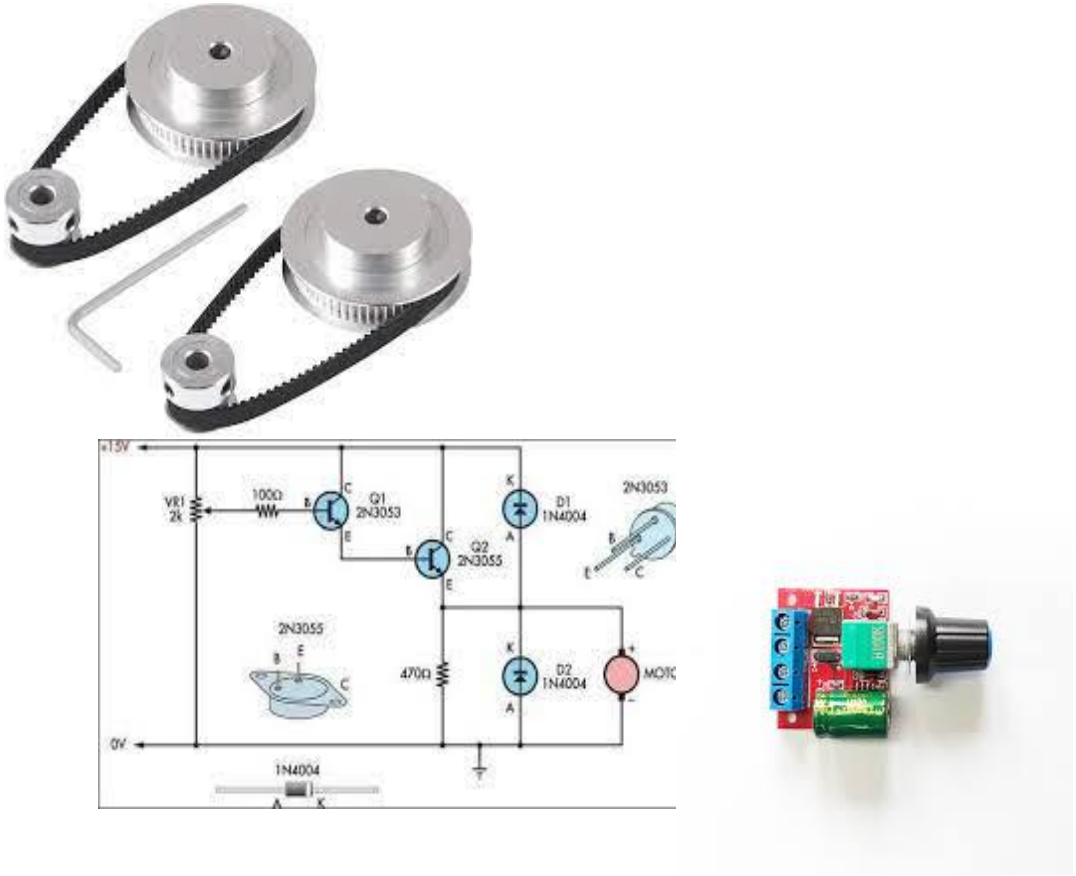

Figure 3.12: motor speed controller module

TIMING PULLY AND BELT

Timing pulleys and belts are mechanical components that play a critical role in synchronous power transmission systems. They are designed to ensure precise and synchronized motion between two or more rotating shafts. Here's a short note about timing pulleys and belts:

Timing Pulleys:

Timing pulleys, also known as toothed pulleys or synchronous pulleys, are typically made of materials like aluminum, steel, or plastic.

They have evenly spaced teeth on their circumferences, which engage with the matching teeth on the timing belt.

The teeth are designed to ensure positive engagement and prevent slippage, allowing for accurate power transmission.

Timing pulleys come in various sizes, shapes, and tooth profiles to accommodate different belt widths, speeds, and torque requirements.

They are commonly used in applications where precise positioning, speed control, and synchronization are crucial, such as CNC machines, 3D printers, robotics, and conveyor systems.

Timing Belts:

Timing belts, or synchronous belts, are flexible belts with teeth on their inner surface that mesh with the teeth on the timing pulleys.

They are typically made from materials like rubber, neoprene, or polyurethane, reinforced with fiber or steel cords for strength and durability.

Timing belts are known for their high power transmission efficiency, minimal maintenance requirements, and quiet operation.

They excel in applications where accurate positioning, high-speed transmission, and minimal backlash are essential.

Timing belts are widely used in automotive engines for camshaft synchronization, as well as in industrial machinery and manufacturing equipment.

Advantages:

Precise Synchronization: Timing pulleys and belts provide accurate and repeatable motion control, ensuring that components move in perfect harmony.

Low Maintenance: They require minimal lubrication and maintenance compared to other power transmission methods like chains.

Efficiency: Timing belts offer high power transmission efficiency with minimal energy loss.

Considerations:

Proper Sizing: Selecting the correct pulley size, belt width, and tooth profile is crucial for achieving the desired performance and synchronization.

Tension: Proper belt tension is essential to maintain the integrity of the tooth engagement and prevent slipping.

Wear and Replacement: Timing belts have a finite lifespan and should be inspected for wear and replaced as needed to avoid unexpected failures.

In summary, timing pulleys and belts are integral components in machinery and systems that require precise and synchronized motion. Their reliable performance, ease of maintenance, and efficiency make them essential in a wide range of industries, contributing to the accuracy and reliability of mechanical systems.

Figure 3.14 : Timing pully and belt

Liquid crystal display

A Liquid Crystal Display (LCD) is a flat-panel display technology that has become ubiquitous in various electronic devices, from smartphones and laptops to televisions and digital watches. It operates on the principle of manipulating the properties of liquid crystals to control the passage of light, producing images and text. Here's a short note on LCDs:

Working Principle:

LCDs consist of two glass panels with a layer of liquid crystal material sandwiched in between. The liquid crystal molecules can change their orientation when subjected to an electric field.

The LCD panel is divided into a grid of tiny cells, called pixels, each containing liquid crystal molecules.

When voltage is applied to a pixel, the liquid crystals twist and change their orientation, either allowing light to pass through or blocking it, depending on the pixel's design.

Types of LCDs:

Twisted Nematic (TN): Commonly used in consumer electronics, TN LCDs offer fast response times and are cost-effective but have limitations in terms of viewing angles and color reproduction.

In-Plane Switching (IPS): IPS LCDs provide wider viewing angles and better color accuracy compared to TN panels. They are often used in high-end displays.

OLED (Organic Light Emitting Diode): Although technically different from traditional LCDs, OLED displays are often considered as they offer self-emitting pixels for deeper blacks and vibrant colors. OLEDs are commonly used in smartphones and TVs.

Advantages:

Thin and Lightweight: LCDs are slim and lightweight, making them ideal for portable devices.

Low Power Consumption: They consume less power than some other display technologies, particularly when displaying static images.

Sharp Images: LCDs can provide high-resolution and sharp images with good contrast.

Versatility: LCDs are versatile and can be used in a wide range of applications, from small screens in calculators to large TVs and monitors.

Considerations:

Viewing Angles: Traditional TN LCDs may have limited viewing angles, meaning the image quality degrades when viewed from extreme angles.

Response Time: LCDs can have varying response times, which can be a consideration for applications requiring fast motion rendering.

Backlight: Most LCDs require a backlight source to illuminate the display, which can impact power consumption and thickness.

In summary, Liquid Crystal Displays (LCDs) are a fundamental technology for displaying visual information in numerous electronic devices. They have evolved over the years to offer improved image quality, color accuracy, and viewing angles, making them a key component in today's digital world.

Jumper wires

are simple electrical wires used in electronics and electrical circuits to create connections between various components on a breadboard, printed circuit board (PCB), or other prototyping platforms. They are typically made of insulated, flexible wire with connectors or pins on either end. Here are some key points about jumper wires:

1. Purpose: Jumper wires serve as a means to establish electrical connections between different points on a circuit or between components like microcontrollers, sensors, LEDs, and other electronic elements.

2. Types:

Male-to-Male: Both ends have exposed pins or connectors, allowing you to connect two female receptacles or components with male pins.

Male-to-Female: One end has exposed pins (male), while the other end has connectors or sockets (female). This type is commonly used to connect male pins to components with female connectors.

Female-to-Female: Both ends have connectors or sockets (female). These are less common but can be useful for specific wiring situations.

3. Lengths: Jumper wires come in various lengths, from a few centimeters to several inches or longer, depending on the application and the desired reach between components.

4. Colors: Jumper wires are often color-coded to help identify connections easily. Common colors include red, black, blue, green, yellow, and white.

5. Flexibility: They are made of flexible materials (usually stranded wire) that can be bent and positioned as needed, allowing for easy prototyping and circuit modifications.

6. Breadboarding: Jumper wires are commonly used on breadboards to create temporary connections for experimenting with circuit designs before finalizing them on a PCB.

7. Prototyping: In addition to breadboarding, jumper wires are widely used in prototyping electronic projects, making it convenient to establish and modify connections quickly.

8. Reparations and Troubleshooting: Jumper wires can be used to repair or troubleshoot circuits by replacing damaged connections or verifying connectivity between components.

9. Breadboard Compatibility: Jumper wires are often designed to fit snugly into the holes of standard breadboards, ensuring a secure and reliable connection.

10. Connection Types: The connectors at the ends of jumper wires can come in various styles, including pin headers, alligator clips, banana plugs, and more, depending on the specific application.

In summary, jumper wires are essential tools for electronics enthusiasts, hobbyists, engineers, and students. They simplify the process of creating, testing, and modifying electronic circuits, making it easier to experiment with different configurations and components without the need for soldering or permanent connections. Jumper wire

FIGURE: Jumper wire

Metal roller

A metal roller is a cylindrical device made of metal, often steel or aluminum, that is used for various industrial and manufacturing applications. Metal rollers are designed to rotate smoothly and efficiently, facilitating the movement or processing of materials, products, or components in a controlled and precise manner. Here are some key aspects and common uses of metal rollers:

1. Construction: Metal rollers are typically made from high-quality metal alloys, which provide strength, durability, and resistance to wear and corrosion. The rollers may be solid or hollow, depending on the application.

2. Types of Metal Rollers:

Conveyor Rollers: These rollers are an integral part of conveyor systems, assisting in the movement of goods, packages, or materials along a predefined path in manufacturing, logistics, and distribution.

Printing Rollers: In the printing industry, metal rollers are used in printing presses to apply ink to printing plates or transfer printed material onto paper or other substrates.

Rolling Mills: In metalworking, rolling mills use metal rollers to shape, flatten, and reduce the thickness of metal sheets or wire by passing them through a series of rollers.

Guide Rollers: These rollers are used to guide and support materials, wires, or cables as they move through various processes, such as wire drawing or textile manufacturing.

Idler Rollers: Idler rollers are stationary rollers that support and guide conveyor belts, helping to maintain tension and alignment.

Web Handling Rollers: In the paper, film, and textile industries, web handling rollers control the movement of continuous materials during manufacturing processes.

3. Bearings: Many metal rollers incorporate bearings, such as ball bearings or roller bearings, to reduce friction and allow for smooth rotation. This is essential for efficient and long-lasting operation.

4. Surface Finishes: Metal rollers can have various surface finishes, such as chrome plating or rubber coating, depending on their intended use. Rubber-coated rollers, for instance, provide traction and grip for materials.

5. Size and Configuration: Metal rollers come in a wide range of sizes and configurations to accommodate different applications and materials. They may be tapered, crowned, or straight, depending on the specific requirements.

6. Precision: Precision in the manufacturing of metal rollers is critical, especially in applications where precise alignment, minimal runout, and consistent performance are essential.

7. Maintenance: Regular maintenance, including cleaning, lubrication, and inspection, is necessary to ensure the continued smooth operation and longevity of metal rollers.

In summary, metal rollers are versatile components used in various industries to facilitate the movement, processing, and manipulation of materials. They are integral to numerous manufacturing processes, transportation systems, and industrial machinery, contributing to the efficiency and productivity of a wide range of applications**.**

Figure 3.16: metal roller

3.11 DC Gear Motor

Description:

A DC motor is any motor within a class of electrical machines whereby direct current electrical power is converted into mechanical power. ... A 12v DC motor is small and inexpensive, yet powerful enough to be used for many applications.

Specification:

- Voltage:12V DC
- Gear ratio: 1/31
- No-load speed: 200RPM
- Rated Speed: 140RPM
- Rated torque: 10kg.cm
- Rated current: 2.5Amp
- Length of Motor(including spindle): 106mm/4.17″
- Diameter: 37mm/1.45″
- Shaft length: 21mm/0.82″
- Shaft diameter: 6mm/0.24″

Fig: 3.17: DC Gear Motor

3.12 Motor mount

A 775 motor mount is an integral component in various mechanical and engineering applications, especially in robotics, DIY projects, and machinery

where powerful, high-torque electric motors are employed. Here's a brief overview of the 775 motor mount:

Purpose: The 775 motor mount serves as a secure and stable platform for mounting a 775-sized electric motor. The motor is typically used for applications that require a significant amount of power, such as driving wheels, propellers, or other heavy-duty mechanisms.

Compatibility: The term "775" refers to a standard motor size, with specific dimensions and mounting holes. The motor mount is designed to precisely accommodate this type of motor, ensuring a snug fit and optimal alignment.

Material and Construction: These mounts are commonly constructed from durable materials like metal or strong plastic. They are engineered to withstand the stresses and vibrations associated with high-torque motor operation.

Mounting Options: 775 motor mounts often provide multiple mounting options, such as various hole patterns or brackets, allowing users to attach them to different surfaces, frames, or structures with ease.

Adjustability: Some 775 motor mounts come with adjustable features, allowing users to fine-tune the motor's position for optimal performance and alignment within their specific application.

Cooling Considerations: Since 775 motors can generate significant heat during operation, some motor mounts incorporate provisions for cooling, such as ventilation holes or heat sinks, to prevent overheating

Applications: 775 motor mounts are utilized in a wide range of applications, including robotics, RC (remote-controlled) vehicles, conveyor systems, 3D printers, and other projects requiring high-power motors. They provide a reliable and stable foundation for the motor while allowing engineers and hobbyists to design and build custom solutions.

In summary, a 775 motor mount is an essential component in projects that involve powerful electric motors, offering stability, compatibility, and flexibility for mounting and securing

Fig 3.18 : Motor mount .

3.13 Our main coding

```
 #include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);
int Ir=11;
int count_value=0;

void setup() {
  pinMode(Ir,INPUT);
   lcd.init();
  lcd.init();
  lcd.backlight();
  Serial.begin(9600);
}
```

```
void loop()
{
 int val=digitalRead(Ir);

 if(val==0)
 {
  count_value++;

   lcd.setCursor(1,0);
  lcd.println("IR_Counter ");
  lcd.setCursor(1,1);
  lcd.println("IR_Count=");
  lcd.setCursor(11,1);
  lcd.println(count_value);
 }
 delay(1000);
}
```

3.15 Arduino IDE

The digital microcontroller unit named as Arduino uno can be programmed with the Arduino software IDE. There is no any requirement for installing other software rather than Arduino. Firstly, Select "Arduino uno from the Tools, Board menu (according to the microcontroller on our board). The IC used named as ATmega328 on the Arduino uno comes pre burned with a boot loader that allows us to upload new code to it without the use of an external hardware programmer.

Communication is using the original STK500 protocol (reference, C header files). We can also bypass the boot loader and programs the microcontroller through the ICSP (In Circuit Serial Programming) header. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU boot loader, 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.

The Arduino uno is one of the latest digital microcontroller units and has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL at (5V) with serial communication, which is available on digital pins 0 -(RX) for receive the data and pin no.1 (TX) for transmit the data. 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, an .in file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board.

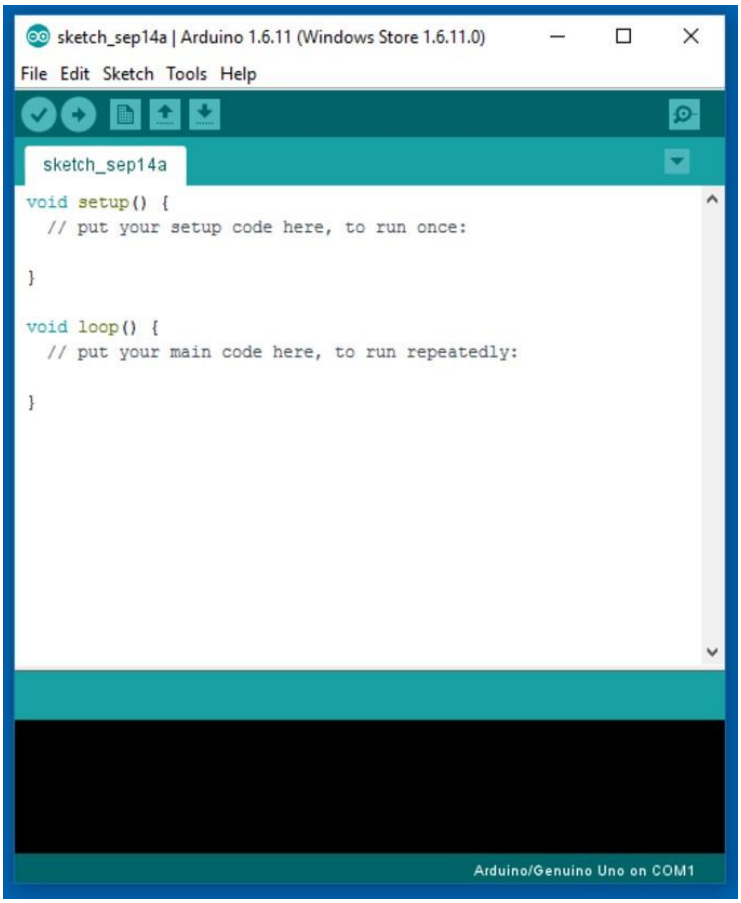

Figure 3.21: Arduino Software Interface IDE

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. Arduino programs are written in C or C++ and the program code written for Arduino is called sketch. The Arduino IDE uses the GNU tool chain and AVR Lab to compile programs, and for uploading the programs it uses argued. As the Arduino platform uses Atmel microcontrollers, Atmel's development environment, AVR Studio or the newer Atmel Studio, may also be used to develop software for the Arduino.

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs.

Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

3.16 Arduino IDE PROGRAMMING

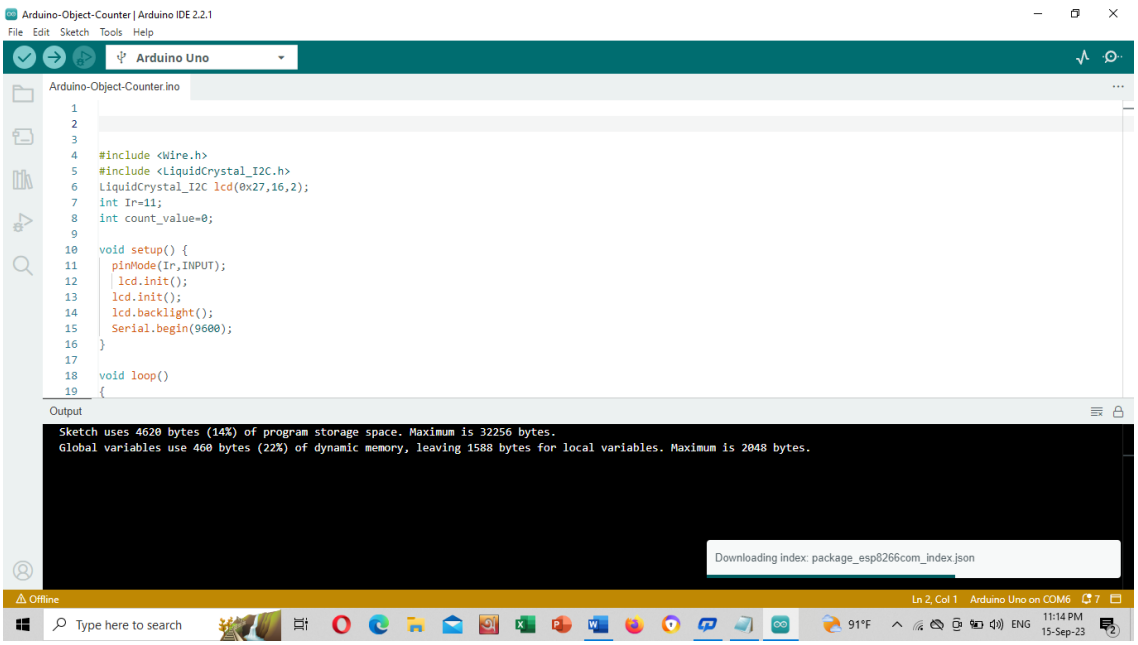

Figure 3.22: Our Project programming in Arduino ide

Arduino IDE (Integrated Development Environment) is a popular platform for programming and developing projects with Arduino microcontrollers. Here's a short note on Arduino IDE programming:

Introduction: Arduino IDE is an open-source software that provides a user-friendly interface for writing, compiling, and uploading code to Arduino boards. It simplifies the process of creating embedded systems and is widely used by hobbyists, students, and professionals in various fields.

Installation: To get started, you need to download and install the Arduino IDE on your computer. It's available for Windows, macOS, and Linux. Once installed, you can connect your Arduino board to your computer via USB.

Programming Language: Arduino IDE uses a simplified version of C/C++ programming language. Users write code in the form of "sketches," which consist of two primary functions: setup() for initialization and loop() for the main program execution. These functions make it easy to structure your code.

Library Support: Arduino IDE offers a vast collection of libraries that simplify complex tasks. These libraries include pre-written code for various sensors, modules, and functions, making it easier to interface with external hardware.

Upload Process: You can write your code within the Arduino IDE and upload it to your Arduino board by selecting the appropriate board type and COM port. The IDE compiles your code into machine code and transfers it to the board's microcontroller, where it runs.

Serial Monitor: Arduino IDE includes a Serial Monitor tool that allows you to send and receive data between your computer and the Arduino board. It's a valuable tool for debugging and monitoring your projects.

Community and Documentation: Arduino has a large and active community of users and developers. There are countless online resources, forums, and tutorials available to help you with your projects. The official Arduino website provides extensive documentation and guides.

Platform Flexibility: Arduino IDE supports a wide range of Arduino boards, from the popular Arduino Uno to more advanced boards like the Arduino Mega and

Arduino Due. It can also be used with various third-party boards and microcontrollers.

Extensions: Arduino IDE supports the installation of third-party extensions and custom board definitions. This flexibility allows you to work with non-standard hardware and expand the IDE's capabilities.

Open Source: Arduino IDE is open-source software, which means that you can modify and customize it to suit your needs. It's also under active development, so new features and improvements are regularly added.

In summary, Arduino IDE is a versatile and user-friendly development environment for programming Arduino boards and creating embedded systems. Its simplicity, extensive library support, and strong community make it an excellent choice for beginners and experienced developers alike.

Chapter 4 Result and Discussion

4.1 RESULT

We have been able to build our system by following all the objects and methodologies. At first, we have set up the all components well for our system. Here the IR sensor and IR sensor are used to detect metal and non-metal objects. Here, If it is an object then it will go forward. After that, when it goes in front of the proximity sensor, it will sense whether it is a metal or a non-metal product. It will take 1-2 seconds to detect it. After that, servo motor will separate the products into separate boxes. The efficiency of this project is very good. It is capable of working for a long time. We are satisfied its performance.

4.2 Discussion

While working on our project, we did face some difficulties as it is a very complex system but the end results, we came up with were quite satisfactory. We have put the whole system through several tasks to validate our work and also have taken necessary notes for future improvements. Some future

recommendations that we have involve improvement in system design and wiring, adding features for more efficiency.

4.3 Advantages

There are certainly many advantages of our project and some of the major ones have been given below:

- Good accuracy in counting metal and non-metal objects.
- Time-saving machine for industrial work.
- Very effectively works for product peak and place.
- No Oil consumption.
- Less skilled technicians is sufficient to operate.
- Installation is simplified very much.
- Less time and more profit.
- Simple construction
- Reduced weight of the system.
- Ease of operation.

4.4 Project Applications:

The project has a major application in the

- It can be used for Industrial work.
- It can be used in factories for peak and place.
- It can be used in big production
- It can be used for product moving and counting.

Chapter 5 Conclusion

5.1 Conclusion

The main objective of this project was to develop an object counting system based on certain specifications. This was successfully implemented. We consider this project as a journey where we acquired knowledge and also gained some insights into the subject which we have shared in this report. Arduino was used to control the various operations. More features can be added to this system as follows: depending on the size, shape, and weight of the objects, sorting operations can be implemented. Counting operations can be improvised using a IR sensor arrangement.

5.2 Future Scope of Work

The model can be improved by making some changes in the program and components. Some suggestions are given below-

- We can add a monitoring-based control to automate control.
- In future we can add IoT monitoring and counting system.

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