Design and Fabrication of Conveyor Belt System for Automatic Metal Sorting And Transportation

A thesis report submitted to the department of mechanical engineering for the partial fulfillment of the degree of Bachelor of Science in Mechanical Engineering.

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APPROVAL

This is to certify that the project on **"Design and Fabrication of Conveyor belt system for Automatic Metal Sorting and Transportation"** By Kawsar Hossain, (ID No: BME1803016259), Md.Saiful Islam, (ID No: BME1803016206), Md.Polash Ali, (ID No: BME-1803016041), Plabon Biswas, (ID No: BME1701011376), Md.Saiful Islam, (ID No: BME-1603010293), MD.Zannatun Darus Salam, (ID No: BME1701011497), Md.Shoel Mahmud, (ID No: BME1701011572) has been 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 years of 2022 and has been approved as to its style and contents.

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DECLERATION

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 **Md. Din Al-Amin**, 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 sorting system has been reported to be complex and a global problem. This because of the inability of sorting machines to incorporate flexibility in their design concept. This research therefore designed and developed an automated shorting object of a conveyor belt. The developed automated sorting machine is able to incorporate flexibility and separate pieces of nonmetal object and at the same time move object automatically to the bucket as define buy the regulation of the micro controller with a capacitive proximity sensor to detect a value rang of object. The result obtained shows that metal and nonmetal were sorted in to their respective and correct position with a good average time. The project detects the objects totally different of various materials and segregate in 2 different boxes. By usage of sensors decreases the errors in sorting and reduces the human uses. The projected system involves sensing element, mini limit switch for sensing elements and for sorting purpose linear motion electrical actuators area unit used.

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Chapter 1 Introduction

1.1 Introduction

The sorting of materials in garbage industries square measure created manually at this time days. There could also be likelihood of errors in sorting. We've enforced an answer for substitution human by automatic management while not manual power. The project detects the objects completely different of various} materials and segregate in 3 different boxes. By usage of sensors decreases the errors in sorting and reduces the person power. The projected system involves detector, IR sensor, mini limit switch for sensing weight and for sorting purpose linear motion electrical actuators square measure used [1]. The motor shaft is connected to the roller and also the conveyor belt is placed on the roller these provides sensible tension over the belt.

The conveyor motors input gets from electrical device. The negative feedback circuit consists of ARDUINO board, relay interfacing board, transformer, input interfacing board, DC motors [2]. The logic used for sensors for characteristic materials is finished in program by weight and inductive means that it's sorted as metal. By weight and reflection it's sorted as glass and if solely reflection it's known as plastic. The material sorter has been designed in such the simplest way it will fulfill all the wants of the packaging industries wherever merchandise of various materials square measure factory-made. It has innumerous application like garbage industries, packaging fields. The project is intended in such the simplest way that may manufacture high productivity and may type materials while not smashup. By this packaging system becomes easier.

1.2 Proposed of the method

In the time of speedy running technology, the automation is gone to a higher-level development. In this project the system is proposed to develop a conveyor belt which can able to detect metal and non-metal product with shorting 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 Nano micro controller.

1.3 Objectives

The objectives of this project are:

- To construct about **Design and Fabrication of Conveyor belt system for Automatic Metal Sorting Separation System and Transportation.**
- To design and construct metal nonmetal product separate system.
- To test the performance of the system.

1.4 Methodology

Our used methodology for the project:

- **Design and Fabrication of Conveyor belt system for Automatic Metal Sorting and Transportation** and designing a block diagram & circuit diagram to know which components need to construct 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 A **Design and Fabrication of Conveyor belt system for Automatic Metal Sorting Separation System and Transportation** are included. These provide a sampling of problems appropriate for application of 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 plc”, which describes that the objects are sorted using sensors so that the safe and reliable conveyor operation is ensured. For the selection of the appropriate sensors, various studies were made and, in the journal, “automatic industrial sorting machine by the different sensors for automation-an innovative model-based approach” where the photo sensor register items by contrast, color, or any property. Since our project is fully automated using plc and automated dvd drives are also had significant role, many studies were done and one of the research papers “automatic sorting 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]

Ghazi abu taher, yousuf howlader, 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 shop like supply and distribution of molding sand, molds and removal of waste. On the other hand, bucket elevator 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: 2278-1684,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 facilitate 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 try 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 5V DC. Here we input 220V AC input of SMPS. SMPS will converted it AC to DC. Here we use a micro-controller, proximity sensor, IR Senor, Relay , Motor and Servo Motor etc. All are in layout in below block diagram.

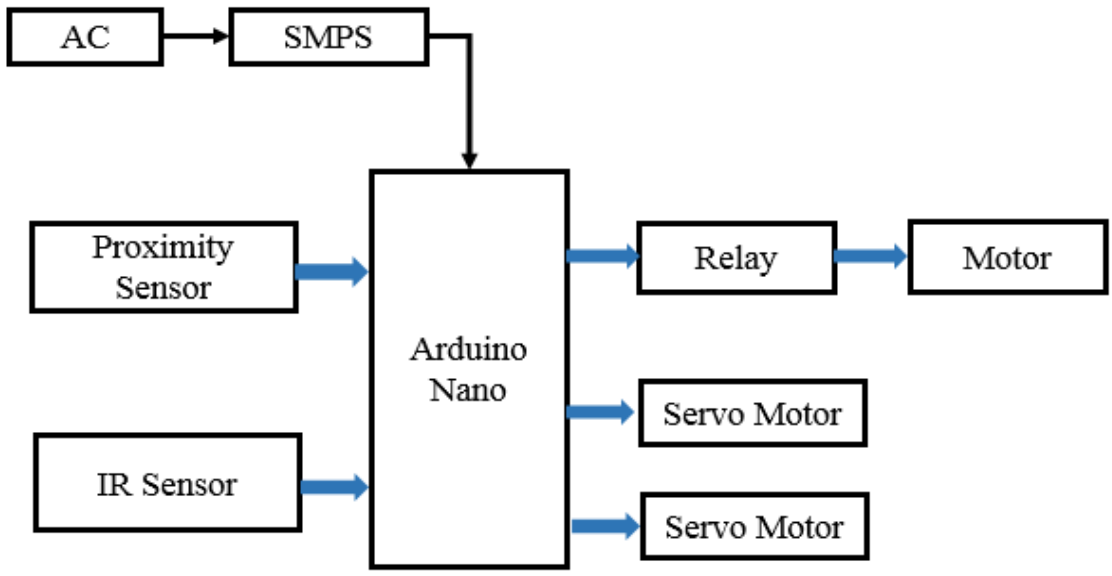


Figure 3.1: Block Diagram of Our System

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.

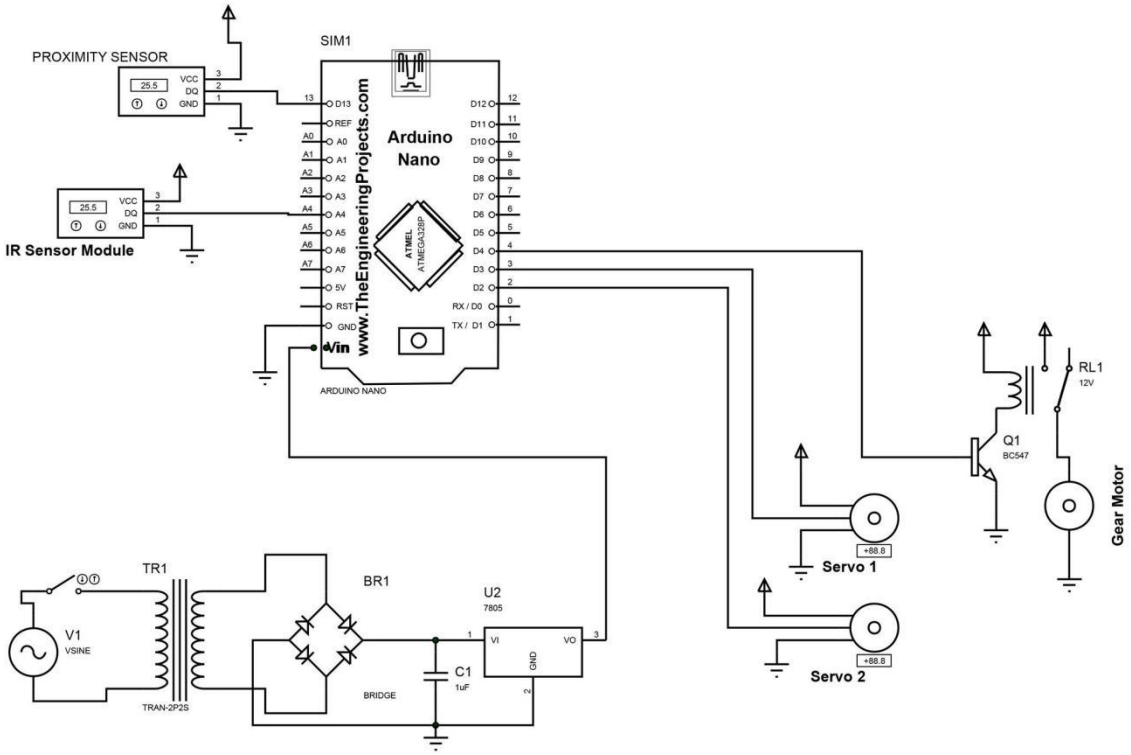


Figure 3.2: Circuit Diagram of Our Project

3.4 Working Principle

Our project is designed to separate metal non-metal objects. We are using Arduino controller for controlling our project, which is acting as the main controller here. Also used here sensors, relays, servo motor, dc gear motors. Everything comes connected with Arduino. Here the current from AC is entering the circuit at 5V volts via SMPS. The proximity sensor is useful for sensing the product. The proximity sensor detects whether it is metal 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

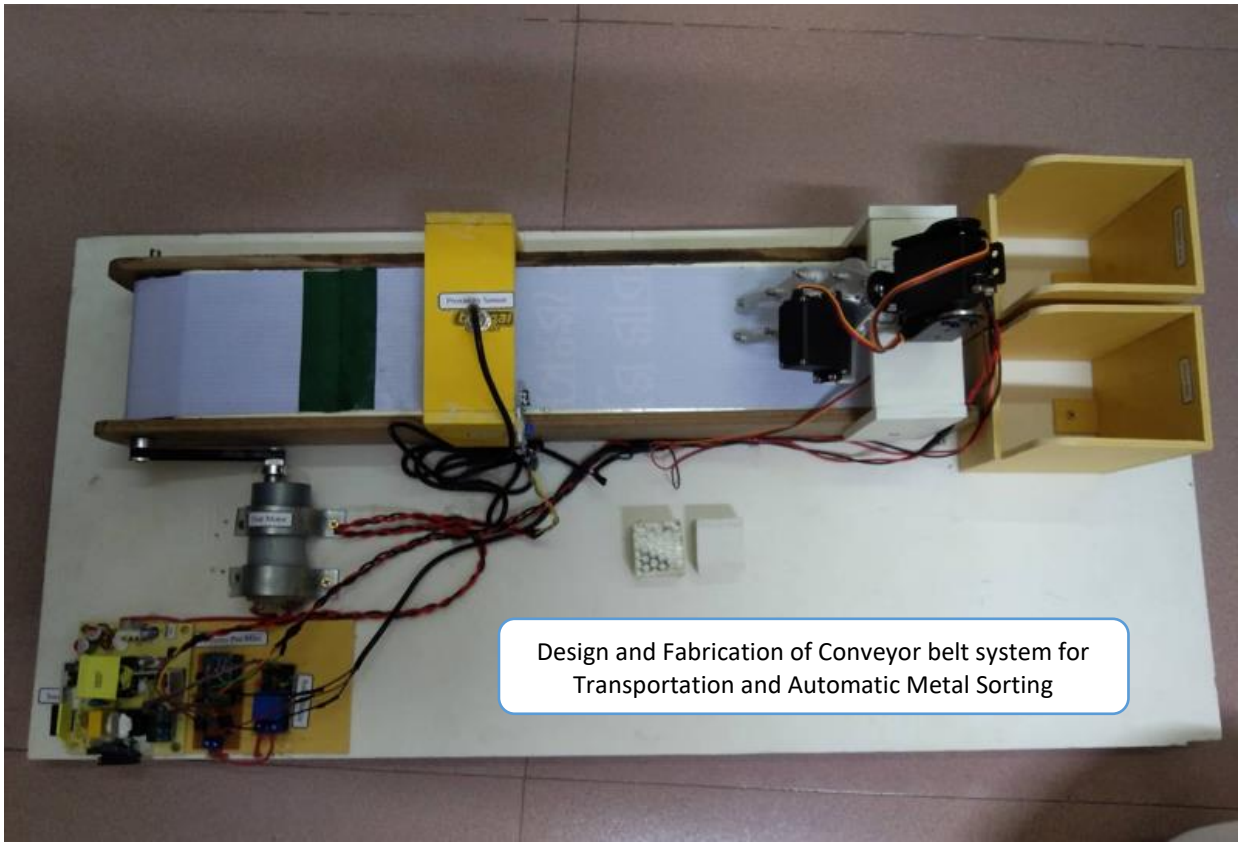


Figure 3.3: Project Prototype Image

3.6 Required Instrument

- DC Gear Motor.
- Proximity Sensor.
- SMPS
- Relay
- Arduino Pro Mini .
- Servo Motor
- Resistor
- Voltage Regulator

3.7 Arduino Pro Mini

The Arduino Pro Mini is a micro-controller board based on the ATmega168. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, an on-board resonator, a reset button, and holes for mounting pin headers. A six pin header can be connected to an FTDI cable to provide USB power and communication to the board.

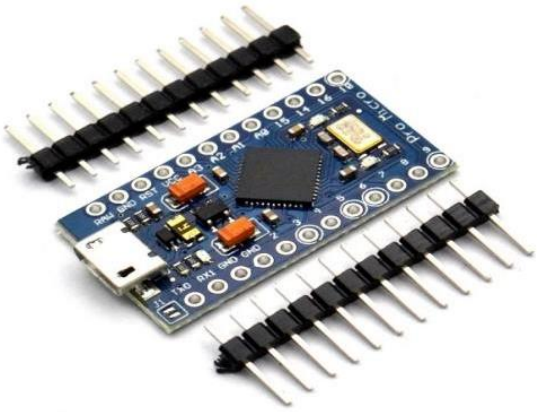


Figure 3.4: Arduino Pro Mini

Specification

- Micro-controller ATmega168
- Operating Voltage: 3.3V or 5V (depending on model)
- Input Voltage: 3.35 -12 V (3.3V model) or 5 - 12 V (5V model)
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- Flash Memory: 16 KB (of which 2 KB used by boot loader)
- SRAM: 1 KB
- EEPROM: 512 bytes
- Clock Speed: 8 MHz (3.3V model) or 16 MHz (5V model)

Pin Out

Each of the 14 digital pins on the Pro Mini can be used as an input or output, using pin Mode(), digital Write(), and digital Read() functions. They operate at 3.3 or 5 volts (depending on the model). Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the TX-0 and RX-1 pins of the six pin header.

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

  The Pro Mini has 6 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). Four of them are on the headers on the edge of the board; two (inputs 4 and 5) on holes in the interior of the board. The analog inputs measure from ground to VCC. Additionally, some pins have specialized functionality:

- I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library.

There is another pin on the board:

- Reset. Bring this line LOW to reset the micro controller. Typically used to add a reset button to shields which block the one on the board.

See also the mapping between Arduino pins and ATmega168 ports.

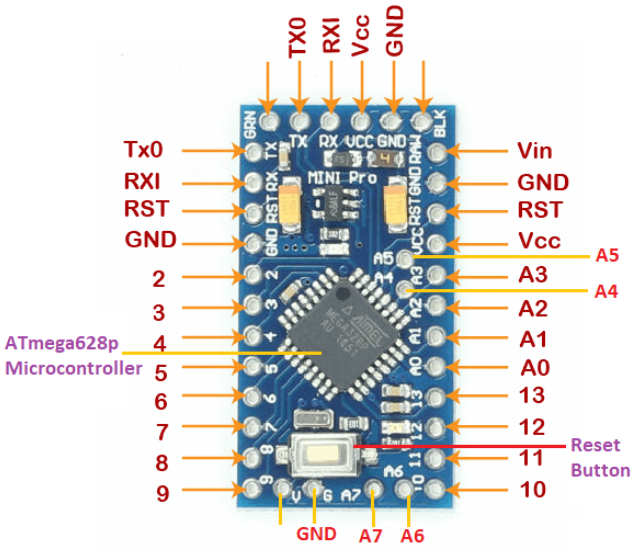


Figure 3.5: Arduino Pro Mini Pin Out

3.8 Switch Mode Power Supply (SMPS)

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power).



Figure 3.6: SMPS

Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.

Switched-mode power supplies are classified according to the type of input and output voltages. The four major categories are:

- AC to DC
- DC to DC
- DC to AC
- AC to AC

A basic isolated AC to DC switched-mode power supply consists of:

- Input rectifier and filter
- Inverter consisting of switching devices such as MOSFETs
- Transformer
- Output rectifier and filter
- Feedback and control circuit

The input DC supply from a rectifier or battery is fed to the inverter where it is turned on and off at high frequencies of between 20 KHz and 200 KHz by the switching MOSFET or power transistors. The high-frequency voltage pulses from the inverter are fed to the transformer primary winding, and the secondary AC output is rectified and smoothed to produce the required DC voltages. A feedback circuit monitors the output voltage and

instructs the control circuit to adjust the duty cycle to maintain the output at the desired level.

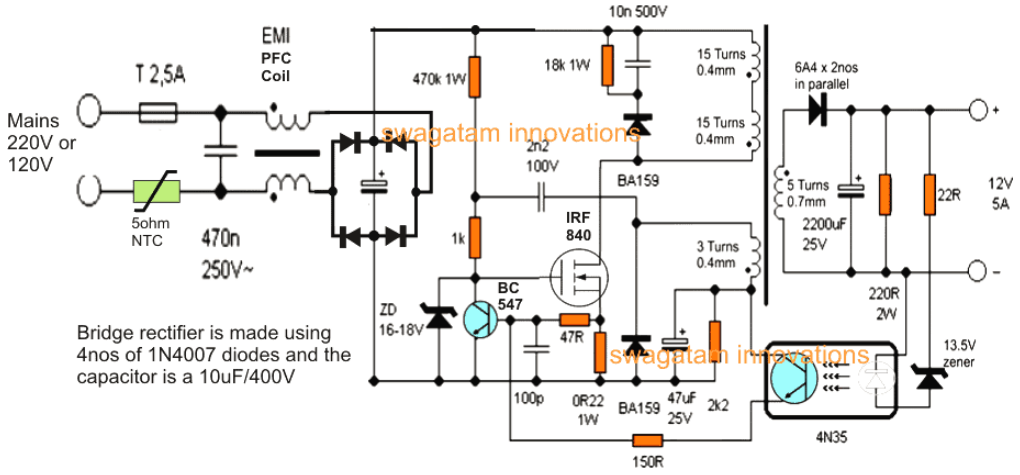


Figure 3.7: Basic working concept of an SMPS

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.

Advantages of switched-mode power supplies:

- Higher efficiency of 68% to 90%
- Regulated and reliable outputs regardless of variations in input supply voltage
- Small size and lighter
- Flexible technology
- High power density

Disadvantages:

- Generates electromagnetic interference
- Complex circuit design
- Expensive compared to linear supplies

Switched-mode power supplies are used to power a wide variety of equipment such as computers, sensitive electronics, battery-operated devices and other equipment requiring high efficiency.

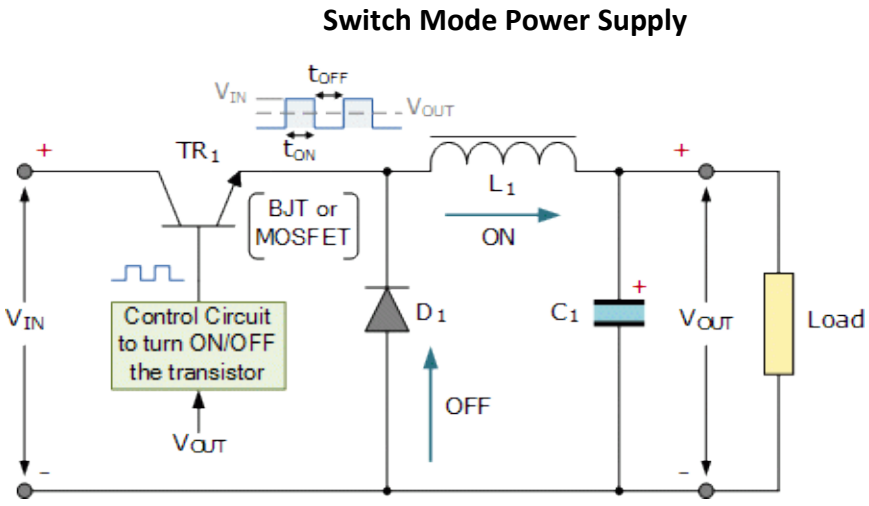


Figure 3.8: SMPS Diagram

Linear voltage IC regulators have been the basis of power supply designs for many years as they are very good at supplying a continuous fixed voltage output.Linear voltage regulators are generally much more efficient and easier to use than equivalent voltage regulator circuits made from discrete components such a zener diode and a resistor, or transistors and even op-amps.The most popular linear and fixed output voltage regulator

types are by far. These two types of complementary voltage regulators produce a precise and stable voltage output ranging from about 5 volts up to about 24 volts for use in many electronic circuits.

There is a wide range of these three-terminal fixed voltage regulators available each with its own built-in voltage regulation and current limiting circuits. This allows us to create a whole host of different power supply rails and outputs, either single or dual supply, suitable for most electronic circuits and applications. There are even variable voltage linear regulators available as well providing an output voltage which is continually variable from just above zero to a few volts below its maximum voltage output.Most d.c. power supplies comprise of a large and heavy step-down mains transformer, diode rectification, either full-wave or half-wave, a filter circuit to remove any ripple content from the rectified d.c. producing a suitably smooth d.c. voltage, and some form of voltage regulator or stabiliser circuit, either linear or switching to ensure the correct regulation of the power supplies output voltage under varying load conditions. Then a typical d.c. power supply would look something like this:

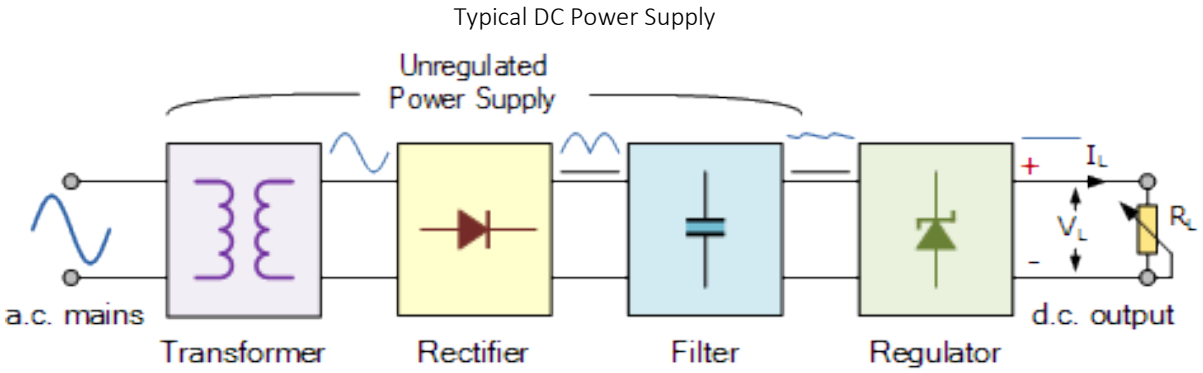


Figure 3.9: DC Power supply way

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 Servo Motor

A servo motor is an electrical device that can push or rotate an object with great precision. If you want to rotate and object at certain angles or distances, you use servo motors. It is made by a simple motor which is driven by a servo mechanism. If the motor is DC driven then it is called DC servo motor and if it is AC driven motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight package. These are being used in various applications like toy cars, RC helicopters and planes, robotics, machines etc.



Figure 3.10: Servo Motor

Servo motors are rated at kg / cm (centimeters per kilogram). Most hobby servo motors are rated at 3 kg / cm or 6 kg / cm or 12 kg / cm. This kg / centimeter tells you how much weight your servo motor can lift at a certain distance. For example: A 6 kg / cm servo motor should be able to lift 6 kg if the load is suspended 1 cm away from the motor shaft, to be less than the carrying capacity. The position of the servo motor is determined by the electric pulse and its circuitry is placed next to the motor.

Servo Mechanism

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

All motors have three wires. Of which two will be used for the supply (positive and negative) and one will be used for the signal transmitted from the MCU. The servo motor is controlled by PWM (Pulse with Modulation) which provides the control wires. Has minimum pulse, maximum pulse and repetition rate. The servo motor can rotate 90 degrees in two directions, creating its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the pulse length will determine how far the motor rotates. For example, a 1.5 mm pulse will turn the motor to 90 °, for example, if the branch is less than 1.5 mm shaft, it will move to 0 to, and if it is longer than 1.5 mm, the servo will turn to 180 to.

The servo motor operates on the PWM (pulse width modulation) principle, meaning that the angle of rotation is controlled by the duration of the pulse applied to its control pin. Basically, the servo motor is made up of a DC motor which is controlled by a variable resistor (potentiometer) and some gears. The high-speed force of the DC motor is converted to torque by the gears. We know that work = force x DISTANCE, less in DC motor force and more in distance (speed) and in servo, forces are higher and distance is less. The potentiometer server is connected to the output trench to calculate the angle and stop the DC motor at the required angle.

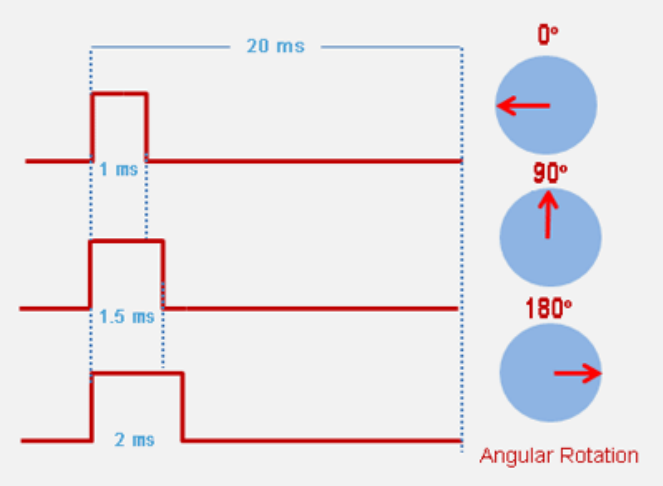


Figure 3.11: Schema Diagram of servo motor

The servo motor can be rotated from 0 to 180 degrees but depending on the output it can go up to 210 degrees. This degree of rotation can be controlled by applying an electric

pulse of appropriate width to its control pin. Servo examines pulses every 20 milliseconds. The 1 ms (1 millisecond) width pulse servo can rotate 0 degrees, 1.5 mm 90 degrees (neutral position) and 2 ms pulse it can rotate 180 degrees. All servo motors work directly with your + 5V supply rails but we need to be careful about how much current the motor will use. If you plan to use more than two servo motors, you should design a suitable servo solder.

3.10 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

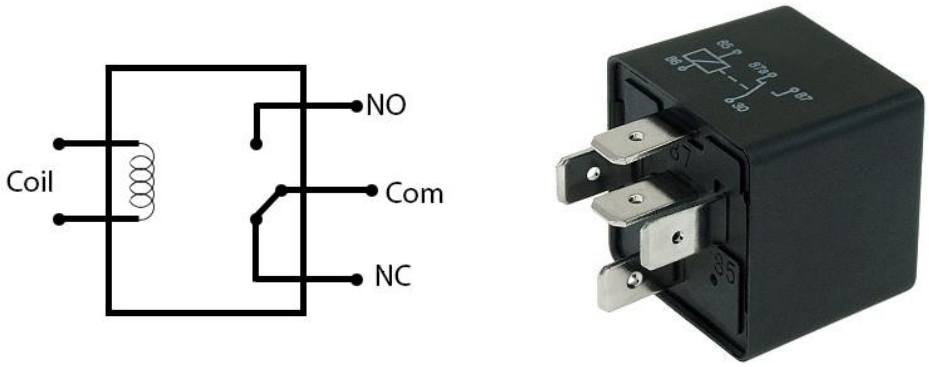


Figure 3.12: Relay

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts.

Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands.

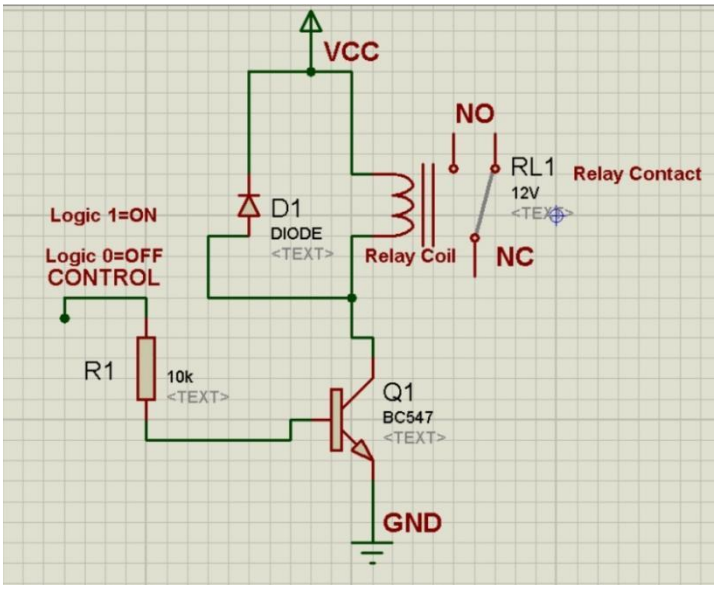


Figure 3.13: Transistor Switching Circuit.

The circuit above is called a low-side switch, because the switch – our transistor – is on the low (ground) side of the circuit. Alternatively, we can use a PNP transistor to create a high-side switch: Similar to the NPN circuit, the base is our input, and the emitter is tied to a constant voltage. A relay is an electrically operated switch of mains voltage. It means that it can be turned on or off, letting the current go through or not. Controlling a relay with the Arduino is as simple as controlling an output such as an LED. The relay module is the one in the figure below.



Figure 3.14 : Relay Module

This module has two channels (those blue cubes). There are other varieties with one, four and eight channels.

Mains voltage connections:

In relation to mains voltage, relays have 3 possible connections:

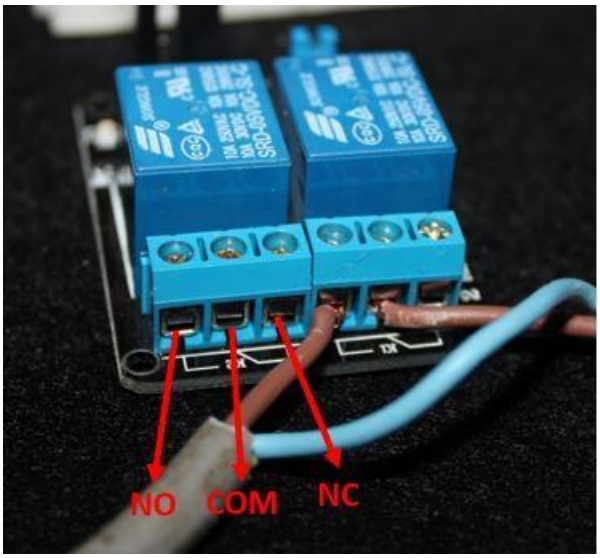


Figure 3.15: Pin diagram of Relay Module

COM: common pin

NO (Normally Open): there is no contact between the common pin and the normally open pin. So, when you trigger the relay, it connects to the COM pin and supply is provided to a load

NC (Normally Closed): there is contact between the common pin and the normally closed pin. There is always connection between the COM and NC pins, even when the relay is turned off. When you trigger the relay, the circuit is opened and there is no supply provided to a load.

Pin wiring:

The connections between the relay module and the Arduino are really simple:

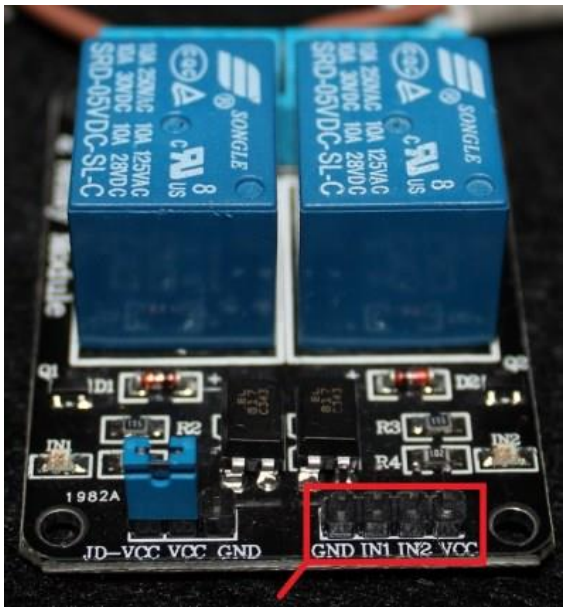


Figure 3.16: Main Voltage Connection

GND: goes to ground

IN1: controls the first relay (it will be connected to an Arduino digital pin)

IN2: controls the second relay (it should be connected to an Arduino digital pin if you are using this second relay. Otherwise, you don't need to connect it) **VCC**: goes to 5V

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 Proximity Sensor:

A **proximity sensor** is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. For example, a capacitive proximity sensor or photoelectric sensor might be suitable for a plastic target; an inductive proximity sensor always requires a metal target.

Proximity sensors can have a high reliability and long functional life because of the absence of mechanical parts and lack of physical contact between the sensor and the sensed object. Proximity sensors are also used in machine vibration monitoring to measure the variation in distance between a shaft and its support bearing. This is common in large steam turbines, compressors, and motors that use sleeve-type bearings.

Types of Proximity Sensor

- Inductive Proximity Sensor.
- Optical Proximity Sensor.
- Capacitive Proximity Sensor.
- Magnetic Proximity Sensor.
- Ultrasonic proximity Sensor.

Proximity sensors are suitable for damp conditions and wide temperature range usage, unlike your traditional optical detection. Proximity sensors are also applicable in phones as well, be it your Andriod or IOS devices. It consists of simple IR technology that switches on and off display accordingly to your usage. Proximity sensors are used in phones, recycling plants, self-driving cars, anti-aircraft systems, and assembly lines. There are many types of proximity sensors, and they each sense targets in distinct ways.

Specification:

- Model: LJ12A3-4-Z/BY
- Wire Type - Cylindrical DC 3 Wire Type
- Switch Appearance Type - Cylinder Type

- Theory - Inductive Sensor
- Output Type - PNP NO(Normal Open)
- Diameter of Head - 12mm
- Detecting Distance - 4mm
- Supply Voltage - DC 6-36V
- Current Output - 300mA
- Response Frequency - 0.5KHz
- Detect Object - Iron
- Operating Temperature -25°C to +55°C (Non-freezing Condition)
- Size 6.2 x 2cm/2.4" x 0.8" (L*Max. Dia)
- Cable Length 110cm/43.3"
- External Material Plastic, Alloy
- Net Weight 46g



Fig 3.18 : Proximity Sensor .

3.13 5V REGULATOR IC

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

7805 IC Rating

Input voltage range 7V- 35V

Current rating Ic = 1A

Output voltage range VMax=5.2V ,VMin=4.8V

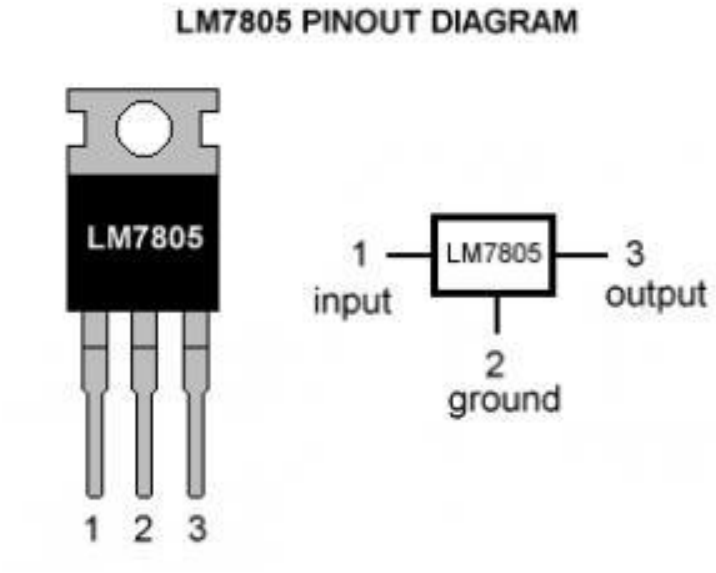


Figure 3.19 : 5V Regulator IC

3.14 Resistor

A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage.

Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Two typical schematic diagram symbols are as follows:



(a) resistor, (b) rheostat (variable resistor), and (c) potentiometer



Figure 3.20: IEC resistor symbol

The notation to state a resistor's value in a circuit diagram varies.

One common scheme is the RKM code following IEC 60062. It avoids using a decimal separator and replaces the decimal separator with a letter loosely associated with SI prefixes corresponding with the part's resistance. For example, *8K2* as part marking code, in a circuit diagram or in a bill of materials (BOM) indicates a resistor value of 8.2 kΩ. Additional zeros imply a tighter tolerance, for example *15M0* for three significant digits. When the value can be expressed without the need for a prefix (that is, multiplicator 1), an "R" is used instead of the decimal separator. For example, *1R2* indicates 1.2 Ω, and *18R* indicates 18 Ω.

Specifications:

- Resistance: 220 Ohms
- Power (Watts): 0.25W, 1/4W
- Temperature Coefficient: 350ppm/Celcius
- Tolerance: +/- 5%
- Case: Axial

3.15 Arduino IDE

The digital microcontroller unit named as Arduino Nano can be programmed with the Arduino software IDE. There is no any requirement for installing other software rather than Arduino. Firstly, Select "Arduino Nano from the Tools, Board menu (according to the microcontroller on our board). The IC used named as ATmega328 on the Arduino Nano 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 Nano 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.

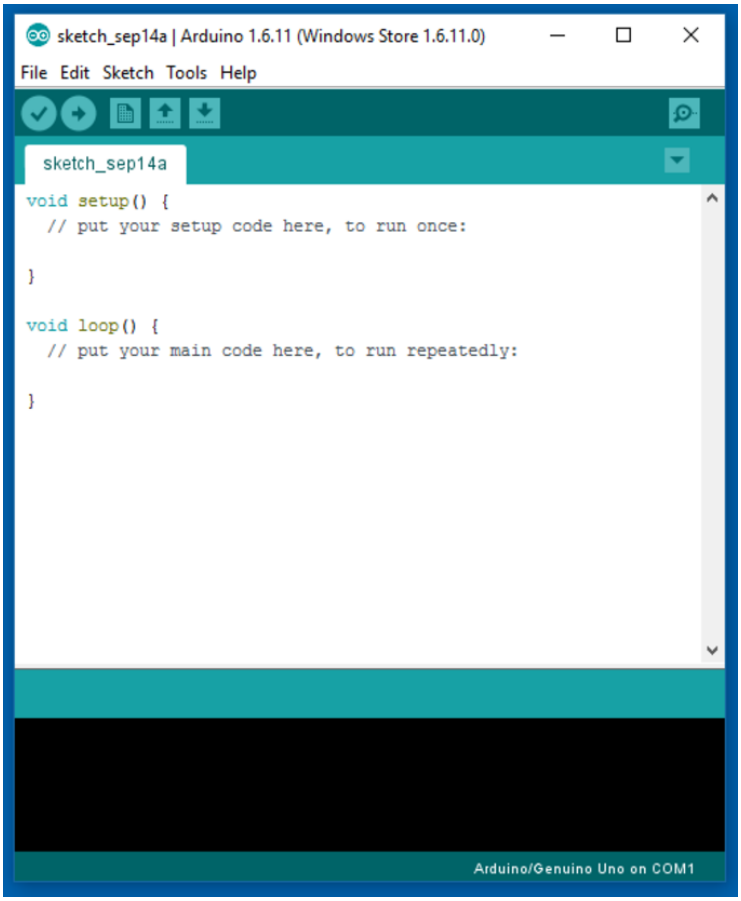


Figure 3.21: Arduino Software Interface IDE

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 Nano'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 Genuino 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 Proteus Software

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronics design engineers and technicians to create schematics and electronics prints for manufacturing printed circuit boards.

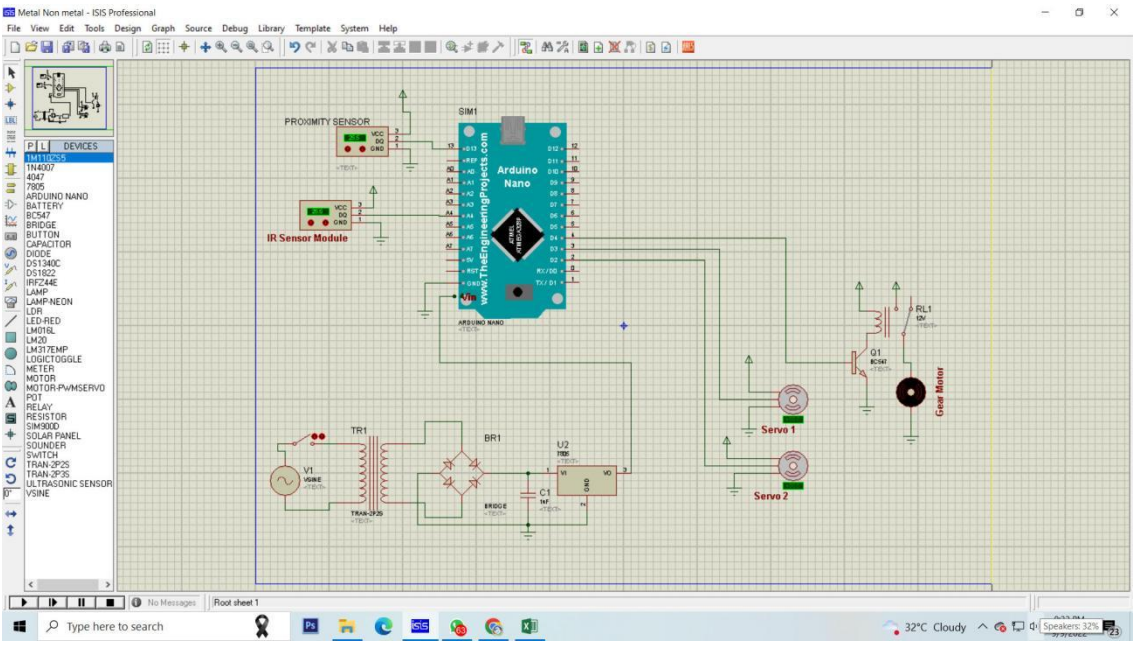


Figure 3.22: Our Project Design in Proteus Software

The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990 with a port to the Windows environment shortly thereafter.

Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and micro controller simulation then arrived in Proteus in 1998.

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 proximity 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 will go 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 involves improvement in system design and wiring, adding features for more efficient.

4.3 Advantages

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

- Good accuracy to find metal and non-metal object.
- Time saving machine for industrial work.
- Very effectively work for product peak and place.
- Reduce energy waste.
- No Oil consumption.
- Less skill 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 pharmacy.
- It can be used for metal no-metal separator.

Chapter 5 Conclusion

5.1 Conclusion

The main objective of this project was to develop an object sorting 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. Sorting operation can be improvised using a piston 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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