PRODUCT SIZE BASED AUTOMATIC PRODUCT SORTING SYSTEM WITH CONVEYOR BELT

A Project
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May, 2025

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Of

Bachelor of Science in Mechanical Engineering

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Approval

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DECLARATION

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We further undertake to indemnify the university against any loss or damage arising from breach of the foregoing obligation.

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ABSTRACT

The Product Size-Based Automatic Product Sorting System is an innovative solution designed to efficiently sort products of varying sizes using a conveyor belt system. The system employs sensors and advanced algorithms to detect and classify products based on their dimensions in real-time. As the products move along the conveyor belt, the sensors measure their size, and the system processes this data to determine the appropriate sorting path.

The sorting mechanism uses a combination of servo motors to direct the products into designated bins or sections based on their size. Key advantages of the system include high accuracy, increased speed, and reduced manual labor. It is capable of handling a wide range of product types, including those with irregular shapes, ensuring that items are placed in the correct bins.

The system is controlled by a microcontroller that manages sensor readings, processing algorithms, and sorting mechanisms. By automating the sorting process, the system significantly enhances production line efficiency and accuracy, particularly in industries such as packaging, logistics, and manufacturing. This solution reduces human error, improves operational productivity, and supports scalable and adaptable sorting operations in diverse industrial environments.

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CHAPTER 1
INTRODUCTION

1.1 Overview

Manufacturing organizations are increasingly transitioning to industrial automation, which is becoming a global trend. Packaging and sorting procedures are among the most common in business. Automation of production is a result of control system development in industry. Production automation aims to run the entire system automatically and computerized, in addition to increasing productivity and lowering labor expenses. An industry's growth mostly hinges on how effectively it uses new, cutting-edge technologies. Every industry aspires to a higher rate of output. For this reason, every industry's key objective in order to advance in the cutthroat market is mass production. It is simple to make when the entire production process is totally automated. The industry is working to increase output rates in today's modern society. To achieve speedy production, everything is becoming automated. Economic growth, a more efficient division of labor, and a shift from relying on uncontrollable external forces to problem-solving through technical innovation are all characteristics of industrialization.



Figure 1.1 : Parcel Size Sorting System [1]

Every sector is experiencing an increase in automation as the daily industry develops. The manufacturer now creates products of a similar style with little variety in terms of size, height, and shape. So, sorting plays a vital role here to separate the desired height-based product together. When a product is sorted using Size different parameters, the accuracy of the actual product is increased. When counting multiple parameters for sorting purposes, the accuracy and precision will increase. Without sorting, it is difficult to gather the same height products

together. So, sorting is important in every production system. Sorting by hand is an extremely challenging and drawn-out process. When sorting is done mechanically, it takes a lot of time to complete the whole sorting process, and there is also a chance of sorting the wrong product. So bringing automation to the sorting sector is more important. An automated sorting method is also more effective. When sorting is done automatically rather than mechanically, the sorting time is decreased, which also increases the sorting accuracy for accurate products. For this reason, an Automation System is created and implemented in this project to categorize things according to their height.

1.2 Problem Statement

The Product Size-Based Automatic Product Sorting System addresses the challenge of efficiently categorizing products of varying dimensions in industrial settings. Traditional manual sorting methods are labor-intensive, error-prone, and time-consuming, leading to reduced productivity and higher operational costs. This project aims to develop an automated solution using a conveyor belt equipped with sensors and servo motors to detect, classify, and direct products into designated bins based on their size. By leveraging real-time measurement and intelligent sorting algorithms, the system enhances accuracy, minimizes human intervention, and optimizes production line efficiency, making it ideal for packaging, logistics, and manufacturing industries.

1.3 Objectives

The objectives of this project are

- To study,design and construct the **Product Size Based Automatic Product Sorting System with Conveyor Belt.**
- To efficiently sort products of varying sizes using an automated conveyor belt system.
- To integrate sensors to detect and classify product dimensions in real-time.
- To enhance sorting accuracy and speed for improved productivity.
- To utilize servo motors for precise product placement in designated bins.
- To reduce manual labor and human error in the sorting process.
- To support seamless operation in packaging, logistics, and manufacturing sectors..
- To put the whole system into action so that we can observe its practical effects and verify our work.
- To study the system performance for future reference and improvement purpose.

1.4 Methodology

Our used methodology for the project:

- Creating an idea for design and construction of an **Product Size Based Automatic Product Sorting System with Conveyor Belt**. And designing a block diagram & circuit diagram to know which components we need to construct it.
- Collecting all the components and programming the micro controller to control the whole system.
- Setting up all the components in a PCB board & then soldering. Lastly, assembling all the blocks in a board and to run the system & for checking purposes.

1.5 Work Flow Diagram

The Product Size-Based Automatic Product Sorting System with Conveyor Belt is designed to efficiently categorize products based on their size. The project follows five main stages: analyzing sorting requirements, designing conveyor layouts with integrated sensors, sourcing components like servo motors, microcontrollers, and conveyor belts, assembling the system for seamless operation, and testing for accuracy and performance. The system uses sensors to measure product dimensions and automatically directs them to designated bins. This solution enhances sorting speed, reduces manual labor, and optimizes productivity in industries such as packaging and logistics.

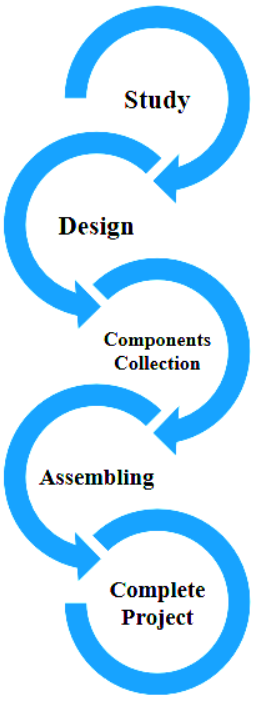


Figure 1.2 : Work Flow Diagram

1.6 Report Overview

This project book consists of Six chapter. The first chapter contains the statement of the Introduction, Overview, Problem Statement, Work Flow Diagram, objectives of the study and Methodology. Chapter two contains system Literature e Review details. Chapter three System Architecture, Discussed in Block Diagram, Circuit Diagram, Working principle and Cost analysis. Chapter Four describes the hardware implementation with component details and the software which we have used for our work. Chapter Five deals with the result Analysis, shows the complete prototype, Advantage, Application and Limitation of the project that we have built. In the final chapter, we have discussed the , Future Scope, conclusion of the project.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

In this chapter we discuss our system overview. In this paper we are also work about **Product Size Based Automatic Product Sorting System with Conveyor Belt**. In below section we will describe some previous literature review. From previous literature we gather more knowledge to build this project and we successfully made it .

2.2 Literature Review

Shen and Hassan [19] states that an approach for continuous recognition and the sorting of objects into their respective and desired location can be implemented as an image of colour processing that can attract an enormous attention leading to a possible widening scope of application in a different field in a modern technology. A colour-sorting robot is designed and developed using an Arduino Uno microcontroller, SG90 Tower Pro Servo Motor, TCS3200D colour sensor and several other electronic components. The system has the potential to sortthe objects according to their colours into their relevant colour station in a less time. A distinct code for this system is developed.

According to Yunardi et al. [2], a 3D volume of the packed box is well quantified from the 2D images using the techniques of image processing. The 2D image consists of two images captured on the camera with a horizontal view and a vertical view. With the parameters, that is, the length, width and the height, a multiplication program is used to obtain the result of the volume. Consequently, contour based object detection can be appertained to the automatic sorting system to measure the volume of an object in a computer-based vision.

According to Babita [3], sensors are embedded at several places that detects and senses the materials of various sizes that gets sorted at different stations based on their sizes. For sensing, the material used is an infrared sensor that is so sensitive. All the process is controlled and handled by a PLC.

Kulkarni et al. [4] has implemented the sorting of the boxes using a barcode, which is decoded by raspberry pi. This raspberry pi sends a signal to the motor driver to start and stop the motor accordingly. Proximity switches are implanted on every cylinder to sense the box position, which again sends back the signal to raspberry pi. Relay is used as an interface for the motor driver and motor. The relay used is of solid relay type. Raspberry pi uses cameras of five megapixels to capture the image, which will then be decoded

Sandesh Prajapati *et al.* [5] developed sorting of objects based on height, weight and color on a conveyor line. In the project, force resistive, ultrasonic, and TCS 230 color sensors were used. The entire apparatus was controlled by a microcontroller. S. V. Rautu *et al.* [6] have developed sorting of objects based on color, weight, and type on a conveyor line using PLC. Here two types of sorting systems included, color and weight. The load cell is used for weight sorting and the TCS34725 color sensor is used for color detecting purposes. Overall process control by Siemens 300 series PLC.

Algitta *et al.* [7] developed a PLC-based automatic packaging process which is currently being employed in the manufacturing industry. This project's major objective is to develop a simple, compact conveyor belt system to automate the packaging of small cubic components. Data was provided to the controller using inductive and photoelectric sensors. Driven by electrical DC motors, the conveyor belt moves products. A ladder logic diagram is used to automate and manage the entire system using a programmable logic controller (PLC). S. N. Kulkarni *et al.* [8] put up a model for an automated system for sorting objects using a Raspberry Pi. This study uses a Raspberry Pi, a servo motor driver, a USB webcam, a MySQL database, a robotic arm, and an ultrasonic sensor. In this study, sorting operations are carried out using a Raspberry Pi.

Amin Nasiri *et al.* [9] developed an idea about sorting unwashed eggs using deep learning This paper suggests an innovative and accurate way for evaluating egg sorting using a deep convolutional neural network (CNN), a cutting-edge technique for performing classification problems in computer vision. Several layers, including a global average pooling layer, dense layers, a batch normalization layer, and a dropout layer, were added to the VGG16 architecture to help categorize photos of unwashed eggs. The modified model was trained using eggs that were clean, intact, bleeding, and fractured (having a break, crack, or hole in

the eggshell). It was determined through 5-fold cross-validation that the CNN model outperformed conventional machine vision-based models.

Eied, simran *et al.* [10] developed an idea named development of automatic sorting conveyor belt using PLC .Here, the object is sort based on height and the sensor used for sensing the height is a diffused beam type photo-electric sensor. The development of a ladder logic program for the PLC that drives the pneumatic actuator used to sort the items is explained in the paper. Dezaki *et al.* [11] developed a pneumatic conveyor robot for color identification and sorting. Here, an autonomous, intelligent mechatronic conveyor system is developed to place and move circular goods in the manufacturing and packaging industries. The operation is run by a PLC, a color sensor, and an electronic switch. Ramachandran Natarajan *et al.* [12] developed the automatic weight sorting system by using a Load cell and Microcontroller. Here a feeding mechanism was used to feed the objects into the container according to their weight.

H. Hassan *et al.* [13] developed a prototype named A Low-Cost Automated Sorting Recycle Bin powered by an Arduino Microcontroller. Sorting is done in this location in order to recycle waste items like aluminum, paper, and plastic. A recycle bin is created that automatically separates various types of rubbish using an Arduino microcontroller. Varma *et al.* [14] an idea named Automatic Pneumatic Power Based Object Sorting System by Using MITSUBISHI PLC. Here, a MITSUBISHI PLC is used to create an automatic pneumatic power-based object sorting system. The primary goal of this project is to push the thing onto the conveyor belt once IR detectors determine its size. K. M. C. Babu *et al.* [15] developed a paper about Design and Development of a Cost Effective Arduino based Object Sorting System. The Arduino NANO served as the hub of this study's color sorting system, bringing all the other parts together and allowing them to work together. A UV sensor is used to identify the object's presence. In this instance, objects are sorted using a TCS3200 sensor's color identification feature.

Harshita Borkar (2022) *et al.* [16] did the work on A Review on Arduino Based Color Sorting Machine. Here Arduino is the core element and, in this work, they showed by using Arduino a more feasible output is found easily. Nilima Bargal *et al*. [17] have developed a project about object sorting system using PLC. They have created an LCA system that uses DC geared motors to sort light things according to height difference. The Programmable Logic

Controller (PLC) passes the object in front of the sensors, which subsequently detect it and decide the sorting logic. M.M. Sofu *et al.* [18] developed an idea name design of an automatic apple sorting system using machine vision. This study suggests a real-time processing-based automated apple sorting and quality checking system. Apple cultivars such as Granny Smith, Golden and Starking Delicious are divided into many classes based on their size, weight, and color. Additionally, it can identify apples with rot, taint, and scab. The suggested system consists of conveyors for rollers, transporters, and classes along with an enclosed cabin that has load cell, control panel, and machine vision units.

2.3 Summary

From the literature discussed above, we gained a lot of knowledge and we inspired to do this project. We were able to do it with everyone tireless work.

CHAPTER 3
SYSTEM ARCHITECTURE

3.1 Introduction

The project objectives, methods, literature evaluation, and other details were all clarified in the preceding chapter. The block diagram, circuit diagram, Working principle,Project final Image and cost analysis will all be covered in this chapter.

3.2 Block Diagram

Here is the block diagram of the **Product Size Based Automatic Product Sorting System with Conveyor Belt** with all the essential components. All of the components are shown in below as a block in this diagram.Here we use Arduino UNO Micro-controller of our project. Other equipment's are attached with this micro-controller and work together for perform as our desire outcome.

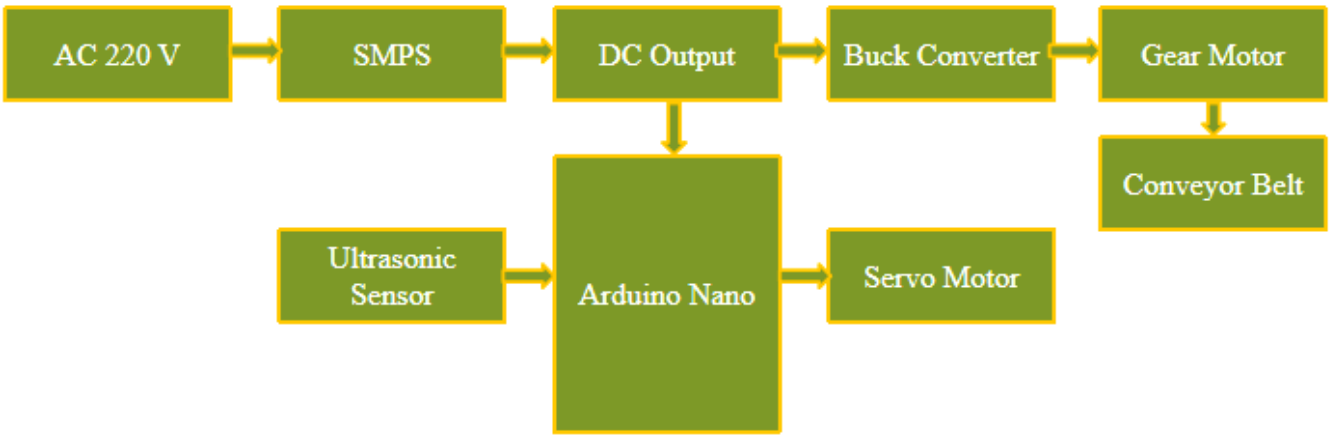
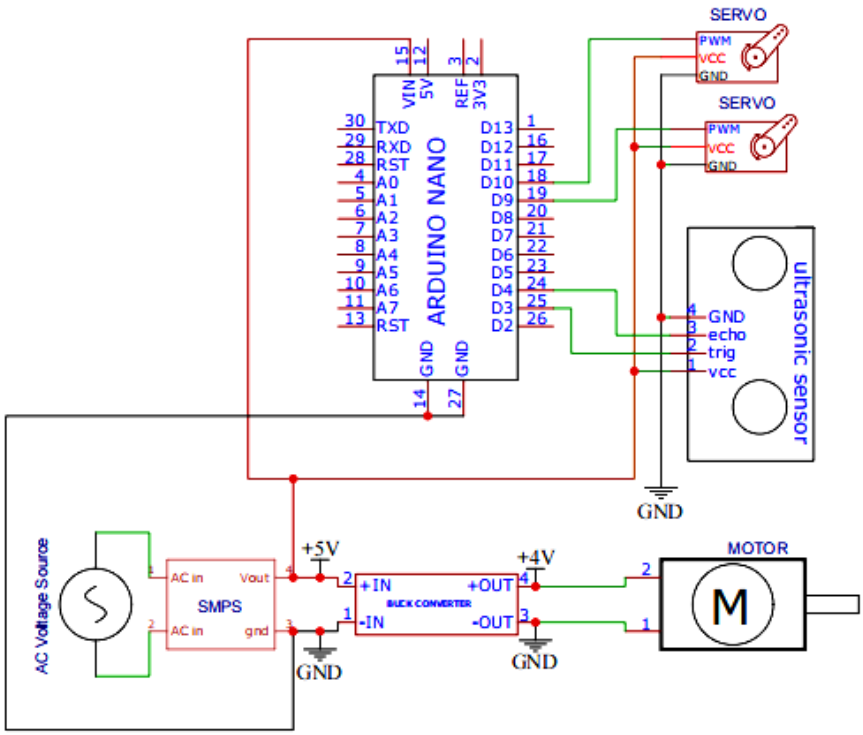


Figure 3.1: Block Diagram of Our Project

3.3 Circuit Diagram

In this part we show our project circuit design and connect out instrument through standard wire



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Figure 3.2 : Schematic Design of our Project

3.4 Working principle

The Product Size-Based Automatic Product Sorting System operates through a structured sequence of component interactions. An SMPS (Switched Mode Power Supply) provides stable voltage to the entire system. The main controller, Arduino Nano, manages the sorting logic and sensor data processing.Products are placed on the Conveyor Belt, which is driven by a Gear Motor. A Buck Converter is used to regulate the voltage supplied to the gear motor, allowing precise control over the conveyor speed. As products move along the belt, an Ultrasonic Sensor measures their dimensions in real-time. This data is sent to the Arduino, which determines the appropriate sorting path based on pre-set size criteria.When a product reaches its sorting point, the Servo Motor activates, diverting the item into its designated bin.

The system is designed for efficiency, reducing manual labor and improving sorting accuracy in industrial applications.

3.5 Cost Analysis

Table 3.1: List of Component with Price

Sl.no	Particulars	Specification	Qty.	Unit Price (Taka)	Total Price (Taka)
1	Arduino Nano	ATmega328p	4	600	2400
2	SMPS	5V 7A	1	650	650
3	Buck Converter	LM2596	1	200	200
4	Gear Motor	37GB	1	1100	1100
5	Servo Motor	SG90	2	400	800
6	Ultrasonic Sensor		1	350	350
7	Conveyor Belt			400	400
8	Others				3500
				Total	9400/=

CHAPTER 4
HARDWARE & SOFTWARE ANALYSIS

4.1 Introduction

In this section, we will discuss elaborately about " **Product Size Based Automatic Product Sorting System with Conveyor Belt**" and the component description, features, working procedure of our all equipment. The system hardware fabricates composed of micro-controller unit, power unit, source unit, power store unite, sensor unit and many more related components.

4.2 Hardware & Software

Hardware

- Arduino Nano
- SMPS
- Buck Converter
- Gear Motor
- Ultrasonic Sensor
- Servo Motor
- Conveyor Belt

Software

- Arduino IDE
- Easy EDA

4.3 Arduino Nano

Arduino is open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino can sense the environment by receiving

input from a variety of sensors and can affect its surroundings by controlling Lights, motors, and other actuators.

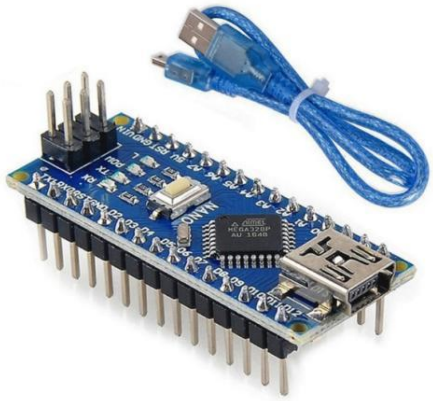


Figure 4.1: Arduino Nano [20]

The micro-controller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, Maxims'). Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a small, complete, and breadboard friendly component. It has everything that Decimal/ Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack. The Nano can automatically sense and switch to the higher potential source of power.

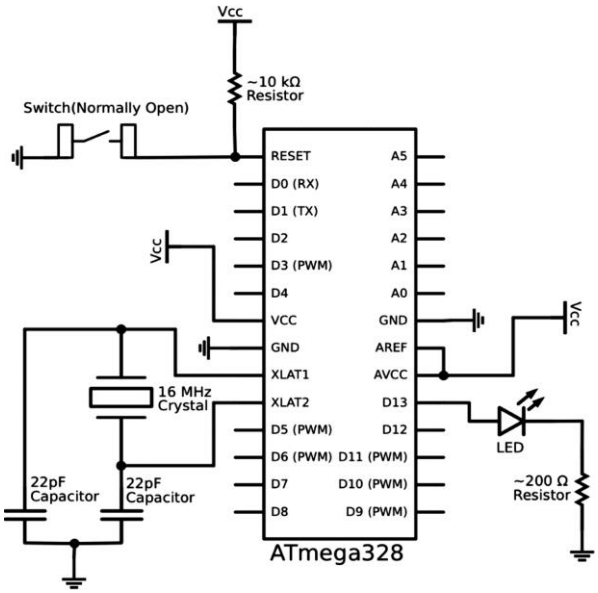


Figure 4.2: Arduino Nano Schematic Diagram [21]

Nano's got the breadboard-ability of the Boarding and the Minibus with smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, and GND on one top, power and ground on the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It has two layers. That make it easier to hack and more affordable. One of the best features of Arduino Nano is, it's easy to use, compact and also small.

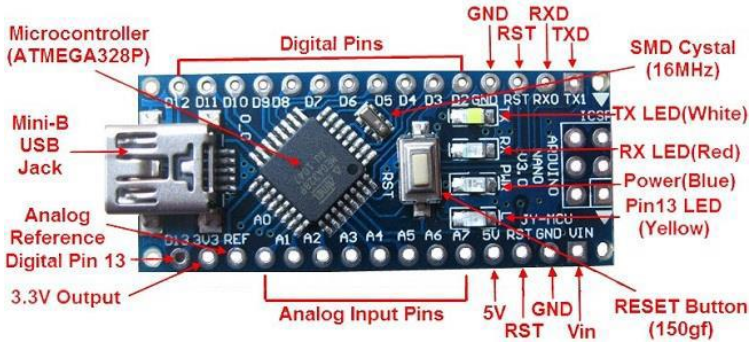


Figure 4.3: How Arduino Nano looks like [22]

4.3.1 Specifications

- Micro-controller: Atmel ATmega328
- Operating Voltage (logic level): 5 V
- Input Voltage (recommended): 7-12 V
- Input Voltage (limits): 6-20 V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 8
- DC Current per I/O Pin: 40 mA
- Flash Memory: 32 KB (of which 2KB used by boot loader)
- SRAM : 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Dimensions: 0.70" x 1.70"

4.3.2 Features

- Automatic reset during program download
- Power OK blue LED
- Green (TX), red (RX) and orange (L) LED
- Auto sensing/switching power input
- Small mini-B USB for programming and serial monitor
- ICSP header for direct program download
- Manual reset switch

Micro-controller IC ATmega328p

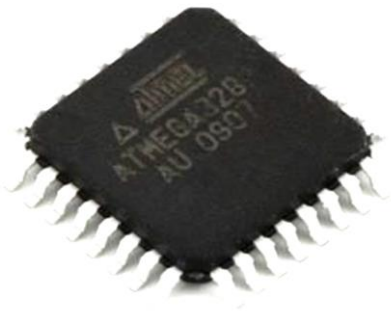


Figure 4.4: Micro-controller IC AT mega 328p [23]

The high-performance Microchip Pico Power 8-bit AVR RISC-based micro-controller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughput's approaching 1 MIPS per MHz, balancing power consumption and processing speed.

4.4 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) to DC loads, such as a personal computer, while converting voltage and current characteristics. 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.



Figure 4.5: SMPS [24]

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.

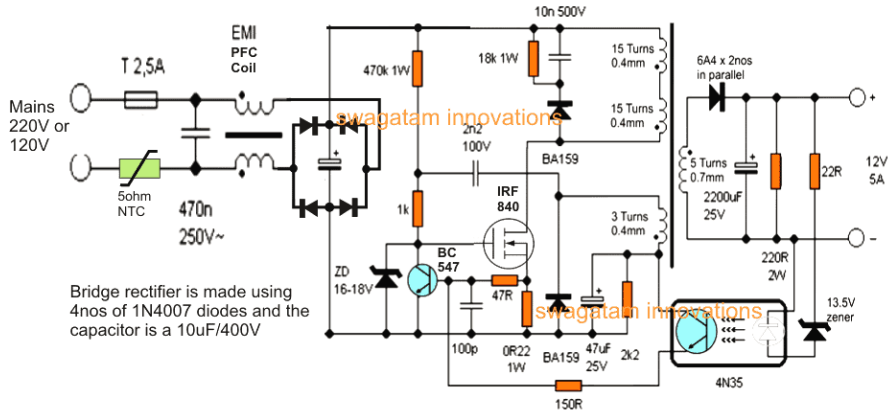


Figure 4.6: SMPS Circuit [25]

4.4.1 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.

4.4.2 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 pin outs, 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.

4.4.3 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. 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 the 78… positive output voltage series, and the 79… negative output voltage series.

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.

Switch Mode Power Supply

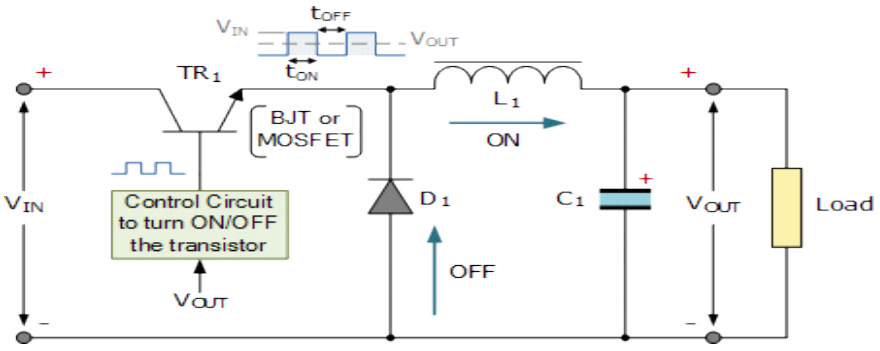


Figure 4.7: SMPS Circuit Connection [26]

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:

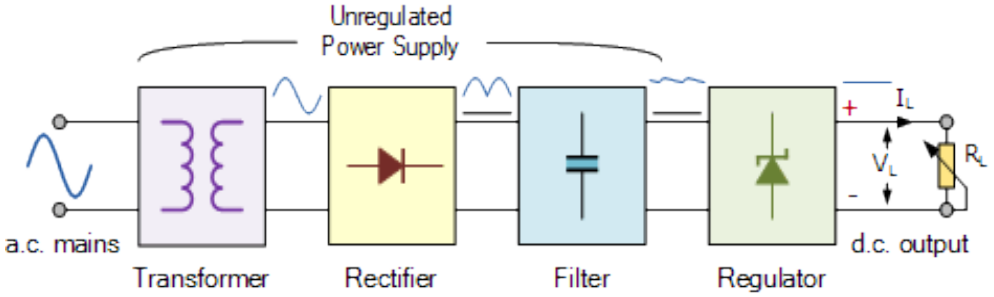


Figure 4.8: DC Power supply way [27]

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.

4.5 Ultrasonic Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound.

4.5.1 HC-SR04 Ultrasonic Sensor - Working

As shown above the HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that –

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

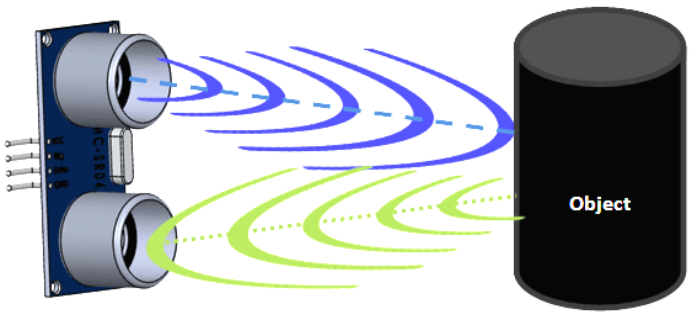


Figure 4.9: Ultrasonic Sensor Working Procedure [28]

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a micro-controller or microprocessor.

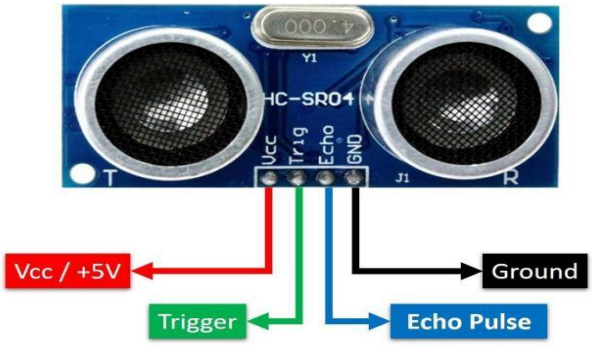


Figure 4.10: Ultrasonic Sensor Pin Out [29]

4.5.2 Ultrasonic Sensor Pin Configuration

Table 4.1: Pin Configuration of Ultrasonic Sensor

Pin Number	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

4.5.3 HC-SR04 Sensor Features

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

4.6 Gear Motor

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.



Figure 4.11: DC Gear Motor [30]

4.6.1 Specification

- Voltage: 12V DC
- Gear ratio: 1/31
- No-load speed: 200 RPM
- Rated Speed: 140 RPM
- Rated torque: 10 kg.cm

- Rated current: 2.5 Amp
- Length of Motor(including spindle): 106 mm/4.17″
- Diameter: 37 mm/1.45″
- Shaft length: 21 mm/0.82″
- Shaft diameter: 6 mm/0.24″

4.7 Buck Converter

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter). It is called a buck converter because the voltage across the inductor "bucks" or opposes the supply voltage.



Figure 4.12: DC -DC Buck Converter [31]

DC-DC Buck Converter Step Down Module LM2596 Power Supply is a step-down(buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. The LM2596 series operates at a switching frequency of 150kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators.

4.7.1 Specifications of DC-DC Buck Converter Step Down Module LM2596 Power Supply

- Conversion efficiency: 92% (highest)
- Switching frequency: 150KHz
- Output ripple: 30mA9maximum)
- Load Regulation: ± 0.5%
- Voltage Regulation: ± 0.5%
- Dynamic Response speed: 5% 200uS
- Input voltage:4.75-35V
- Output voltage:1.25-26V(Adjustable)
- Output current: Rated current is 2A, maximum 3A (Additional heat sink is required)
- Conversion Efficiency: Up to 92% (output voltage higher, the higher the efficiency)
- Switching Frequency: 150KHz
- Rectifier: Non-Synchronous Rectification
- Module Properties: Non-isolated step-down module (buck)
- Short Circuit Protection: Current limiting, since the recovery
- Operating Temperature: Industrial grade (-40 to +85) (output power 10W or less)

4.8 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 packages. These are being used in various applications like toy cars, RC helicopters and planes, robotics, machines etc.



Figure 4.13: Servo Motor [32]

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.

4.8.1 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 sardo 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 pentiometer server is connected to the output trench to calculate the angle and stop the DC motor at the required angle.

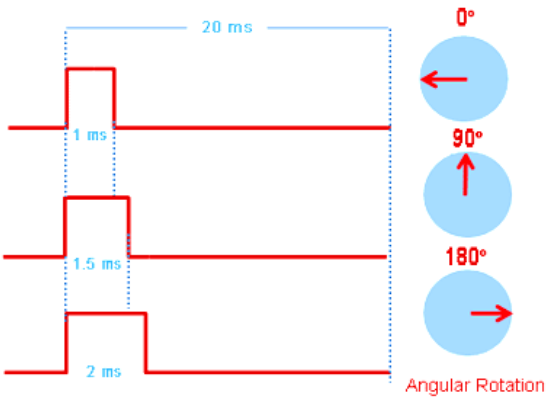


Figure 4.14: Schematic Diagram of servo motor [33]

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.

4.9 Conveyor Belt

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with a closed loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley.

4.9.1 Overview

Conveyors are durable and reliable components used in automated distribution and warehousing, as well as manufacturing and production facilities. In combination with computer-controlled pallet handling equipment this allows for more efficient retail, wholesale, and manufacturing distribution. It is considered a labor-saving

system that allows large volumes to move rapidly through a process, allowing companies to ship or receive higher volumes with smaller storage space and with less labor expense.

Belt conveyors are the most commonly used powered conveyors because they are the most versatile and the least expensive. Products are conveyed directly on the belt so both regular and irregular shaped objects, large or small, light and heavy, can be transported successfully. Belt conveyors are also manufactured with curved sections that use tapered rollers and curved belting to convey products around a corner. These conveyor systems are commonly used in postal sorting offices and airport baggage handling systems.

4.9.2 Types of Conveyor Belt

"There are three different types of conveyor belts: the basic belt, snake sandwich belt and long belt. A basic belt conveyor consists of two or more pulleys that hold one continuous length of material. These types of belts can be motorized or require manual effort.



Figure 4.15: Conveyor Belt [34]

4.9.3 Application

Today there are different types of conveyor belts that have been created for conveying different kinds of material available in PVC and rubber materials. Material flowing over the belt may be weighed in transit using a belt weigher. Belts with regularly spaced partitions, known as elevator belts, are used for transporting loose materials up steep inclines. Belt Conveyors are used in self-unloading bulk freighters and in live bottom trucks. Belt conveyor technology is also used in conveyor transport such as moving sidewalks or escalators, as well

as on many manufacturing assembly lines. Stores often have conveyor belts at the check-out counter to move shopping items, and may use checkout dividers in this process. Ski areas also use conveyor belts to transport skiers up the hill. Industrial and manufacturing applications for belt conveyors include package handling, trough belt conveyors, trash handling, bag handling, coding conveyors, and more. Integration of Human-Machine Interface(HMI) to operate the conveyor system is in the developing stages and will prove to be an efficient innovation.

SOFTWARE

4.10 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.

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 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.

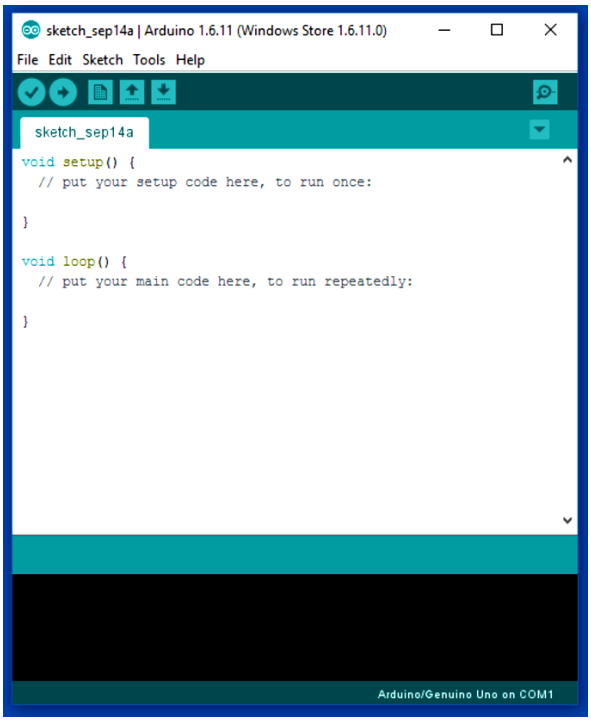


Figure 4.16: Arduino Software Interface IDE [35]

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 and communicate with them.

4.10.1 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 righthand 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.

4.10.2 Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog. Beginning with version 1.0, files are saved with a .ino file extension. Previous versions use the .pde extension. You may still open .pde named files in version 1.0 and later, the software will automatically rename the extension to .ino.

4.10.3 Tabs, Multiple Files, and Compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

4.10.4 Uploading

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyACMx ,

/dev/ttyUSBx or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino boot loader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The boot loader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

4.10.5 Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #include statements from the top of your code.

There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these instructions for installing a third-party library.

4.10.6 Third-Party Hardware

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, bootloaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

For details on creating packages for third-party hardware, see the Arduino IDE 1.5 3rd party Hardware specification.

4.10.7 Serial Monitor

This displays serial sent from the Arduino or Genuino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down menu that matches the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor. Please note that the Serial Monitor does not process control characters; if your sketch needs a complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board.

4.11 Easy EDA

Easy EDA is a web-based EDA tool suite that enables hardware engineers to design, simulate, share-publicly and privately-and discuss schematics, simulations and printed circuit boards. Other features include the creation of a bill of materials, Gerber files and pick and place files and documentary outputs in PDF, PNG and SVG formats. Easy EDA allows the creation and editing of schematic diagrams, SPICE simulation of mixed analogue and digital circuits and the creation and editing of printed circuit board layouts and, optionally, the manufacture of printed circuit boards.

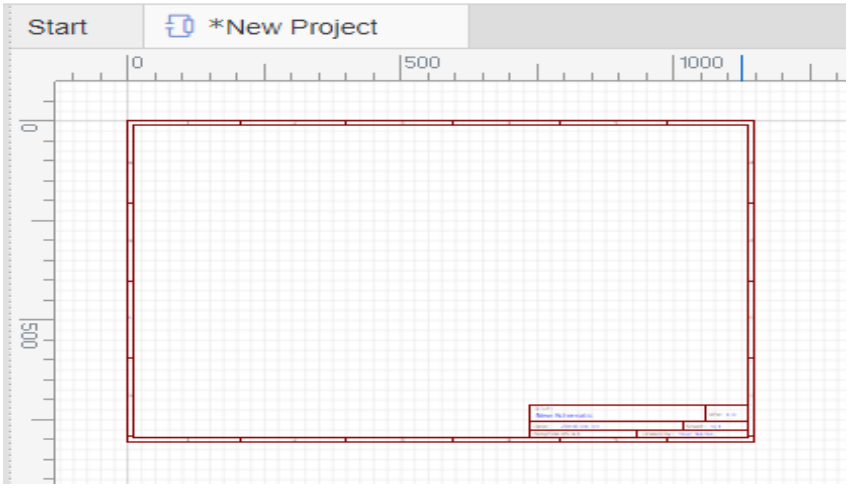


Figure 4.17: Easy EDA Software Interface [36]

Subscription-free membership is offered for public plus a limited number of private projects. The number of private projects can be increased by contributing high quality public projects, schematic symbols, and PCB footprints and/or by paying a monthly subscription.Registered users can download Gerber files from the tool free of charge; but for a fee, Easy EDA offers a PCB fabrication service. This service is also able to accept Gerber file inputs from third party tools.

CHAPTER 5
RESULT ANALYSIS

5.1 Project Output

After finally completing this project, we ran it & we observed the output of this project. We can see that it is working well as expected. After making our project we observe it very careful. It works as we desire. Our project give output perfectly and all equipment are work perfectly. We check how much it works and we get perfect output from this project.

- Finally, we have completed our project successfully & check our project its run accurately according to our objective.
- At first, we start our system.
- Following are The outputs of our project.
- Efficiently sorts products based on size with high accuracy.
- Real-time size detection using ultrasonic sensors enhances precision.
- Servo motors ensure smooth and reliable product diversion.
- Reduces manual labor and minimizes human error in sorting processes.
- Demonstrates scalability for various industrial applications like packaging and manufacturing.

5.2 Final Project

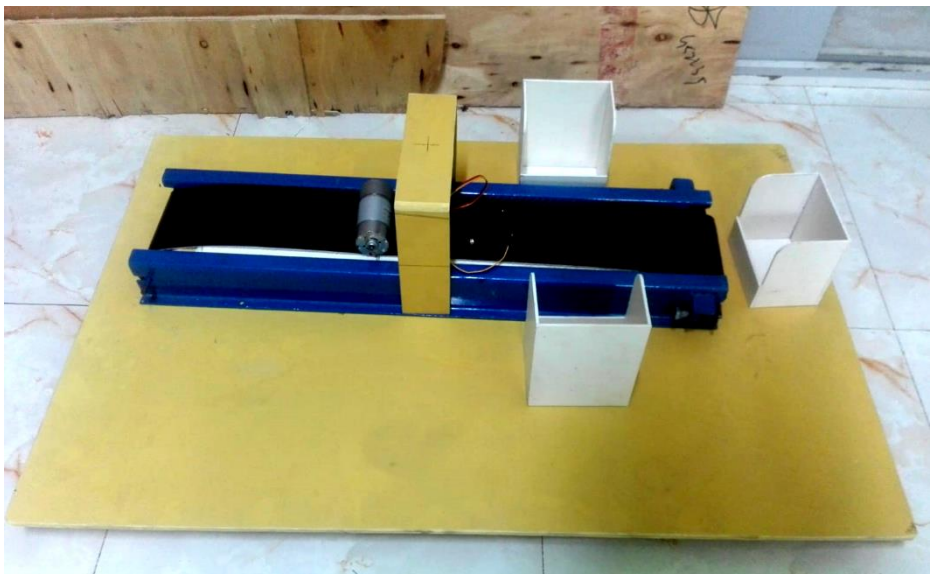


Figure 5.1: Project Progress Image

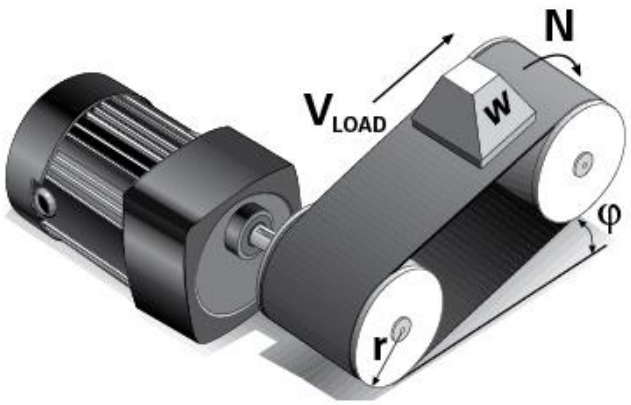
5.3 Calculations

Linear Velocity

$V = \omega r$

Where:

- Roller diameter D = 30 mm = 0.03 m
- Motor RPN, N = 140 RPM



So, $V = \omega r$

$= 2\pi N/60 \times D/2$

$= 2\pi \times 140/60 \times 0.03/2$

$= 0.22$ m/s

$= 13.2$ m/min

Table 5.1 Testing Data Sheet

1cm to 4cm = A box,

4cm to 7cm = B box

under 1cm = C box.

Work pic:

a = 6.3cm,

b = 3.4cm,

c = 1.4cm

d = 0.5 cm go through size slotting conveyor for 3times.

Workpiece	Size (cm)	Expected Category	Round 1 Result	Round 2 Result	Round 3 Result	Errors (Total)	Performance Summary
a	6.3	B	B ✅	B ✅	B ✅	0	Perfect accuracy
b	3.4	A	A ✅	A ✅	A ✅	0	Perfect accuracy
c	1.4	A	A ✅	A ✅	A ✅	0	Perfect accuracy
d	0.5	C	C ✅	C ✅	A ❌	1	2 correct / 3 total

Legend:

- ✓✓ = Correct classification
- ✗ = Misclassified

Error & Performance Summary:

- Total workpieces: 4
- Total runs: 12
- Total errors: 1

Overall accuracy: **91.7%**

5.4 Advantages

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

- Automated Sorting Process
- High Sorting Efficiency
- Enhanced Accuracy Levels
- Reduced Operational Costs
- Conveyor Mechanism Efficiency
- Optimized Conveyor Speed
- Flexible Product Handling
- Low Maintenance Requirements
- Minimal Human Intervention
- Real-time Size Detection
- Low installation cost.
- Simple in construction.
- User-Friendly

5.4 Limitation

It is a demo project so we found some limitation. In future we will work for reduce this kind of limitation. These limitations are -

- This project can now be only used for small scale purposes
- No energy backup.
- Limited to size-based sorting only.
- Not suitable for extremely fragile products.

5.5 Application

Some of the application areas of the project has been pointed out below-

- Industrial packaging and product sorting automation.
- Pharmaceutical packaging and sorting operations.
- Logistics and warehouse inventory management systems.
- Mining industry for mineral sorting processes.

5.6 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.

The Product Size-Based Automatic Product Sorting System with Conveyor Belt demonstrates a significant advancement in automated material handling. By integrating sensors, Arduino control, and servo motors, the system effectively identifies and sorts products based on size. This reduces dependency on manual labor, increases sorting accuracy, and enhances overall production efficiency. The use of a buck converter to regulate gear motor speed optimizes conveyor operation. However, limitations include dependency on precise sensor calibration and challenges with extremely fragile or irregularly shaped items. Despite these constraints, the system is highly scalable and adaptable for applications in packaging, logistics, and manufacturing industries.

CHAPTER 6
CONCLUSION

6.1 Conclusion

The Product Size-Based Automatic Product Sorting System with Conveyor Belt represents an innovative solution for efficient and accurate sorting of products based on size. By integrating key components such as Arduino Nano, Ultrasonic Sensors, Servo Motors, Gear Motor, SMPS, and Buck Converter, the system is capable of real-time detection and classification of items. The conveyor belt mechanism, powered by a gear motor with speed regulation via a buck converter, ensures smooth and consistent movement of products through the sorting process.

One of the primary advantages of this system is its ability to significantly reduce manual labor while increasing productivity and accuracy. Automated size detection through ultrasonic sensors allows for precise product sorting, minimizing human error and optimizing workflow in industrial environments. Furthermore, the scalability of the system makes it adaptable to various sectors, including packaging, logistics, and manufacturing.

Despite its numerous benefits, the system does have limitations, such as dependency on sensor accuracy and potential challenges with fragile or irregularly shaped items. However, these limitations can be mitigated through careful calibration and design improvements.

6.2 Future Scope

We are thinking about adding many features to our project in the future to get more desirable out comes. Some of the steps that we are thinking about taking are given below:

- In future development this project can be develop by more sensor & alarm system.
- In future, I will try it to apply in real field.
- In Future we will add extra power system.
- We can add a monitoring based control to automate control.
- In future develop in IoT system Controlled our project
- We will add Counting Sensor.

6.3 Environmental Impact

The Product Size-Based Automatic Product Sorting System with Conveyor Belt improves resource efficiency, reduces waste, and lowers emissions by minimizing sorting errors and manual handling. Energy-efficient motors and recyclable materials can further reduce its environmental impact, supporting sustainable manufacturing and recycling applications.

- Enhances resource efficiency and reduces waste through accurate sorting.
- Lowers emissions by minimizing manual handling and idle time.
- Supports sustainable manufacturing with energy-efficient motors.
- Can be built with recyclable materials for eco-friendliness.
- Promotes recycling applications, aiding in waste management.

6.4 Positive Environmental Impact:

- Reduced Waste:

Accurate sorting helps ensure only defective or wrongly-sized products are removed, reducing material waste.

- Improved Efficiency:

Automated sorting is faster and more consistent than manual labor, reducing downtime and overproduction.

- Lower Energy per Unit Processed:

Efficient motors and control systems can optimize power use compared to manual sorting or less intelligent machines.

- Minimized Human Error:

Reduces product rejection due to size mismatches, leading to more efficient use of raw materials.

- Recyclable Material Sorting:

Can be adapted to sort recyclable products by size, supporting recycling efforts.

6.5 Negative Environmental Impact:

- Energy Consumption:

Continuous conveyor operation and sensors require electricity, which can contribute to carbon emissions if not powered by renewable sources.

- E-Waste Generation:

Use of electronics (sensors, controllers, actuators) can lead to electronic waste at end-of-life.

- Material Use:

Construction of the system involves plastic, metals, and electronics — all of which have upstream environmental costs.

- Maintenance & Disposal:

Parts wear out and need replacement, contributing to resource consumption and waste.

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APPENDIX

Micro-Controller Programming Code :

```
#include <Servo.h>

Servo myservo;  // create servo object to control a servo
Servo myservo1;  // create servo object to control a servo
Servo myservoe;  // create servo object to control a servo

int motor = 2;
//int ir_sensor = 3;
//int ir;
#define trigPin 4
#define echoPin 5
long duration;
long distance;


void setup() {
  // put your setup code here, to run once:
Serial.begin(9600);
pinMode(motor,OUTPUT);
//pinMode(ir_sensor,INPUT);
pinMode(trigPin,OUTPUT);
pinMode(echoPin,INPUT);
myservo.attach(8);  // attaches the servo on pin 9 to the servo object
myservo1.attach(9);  // attaches the servo on pin 9 to the servo object
myservoe.attach(13);  // attaches the servo on pin 9 to the servo object

myservo.write(90);                  // sets the servo position according to the scaled value
myservo1.write(0);



}

void loop() {
  // put your main code here, to run repeatedly:
//ir = digitalRead(ir_sensor);
//  Serial.println(ir);

digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
```

```
  duration = pulseIn(echoPin, HIGH);
  distance= duration*0.034/2;

   Serial.print("distance ");
  Serial.println(distance);
  delay(500);
if(distance < 6){///big
myservo.write(0);                  // sets the servo position according to the scaled value
delay(3000);
myservo.write(90);                  // sets the servo position according to the scaled value
  }
if(distance < 9 &&  distance >= 6){
 myservo1.write(90);                  // sets the servo position according to the scaled value
delay(3000);
myservo1.write(0);
  }
if(distance > 9 ){
  }
  }
```