Design & Construction of Automatic Conveyor Belt with Size Based Product Sorting System

A report submitted to the Department of Mechanical, Sonargaon University of Bangladesh in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Mechanical Engineering.

Submitted by

Saiful Islam	**ID: BME2001020588**
Md. Mahfuzur Rahman Nahid	**ID: ME2003022159**
Bahar Uddin	**ID: ME2003022089**
Remon Hossen	**ID: ME2003022163**
Hafiza Aktar Mim	**ID: ME2003022387**
Nusrat Jahan Tonny	**ID: ME2003022393**

Supervised by

M.A Faisal Junaeat Imrul (Lecturer)
Department of Mechanical Engineering
Sonargaon University (SU)
Dhaka, Bangladesh

MAY, 2024

APPROVAL

This is to certify that the whole work submitted as a thesis work entitled **"Design & Construction of Automatic Conveyor Belt with Size Based Product Sorting System"** to the Faculty of Science and Engineering. Sonargaon University (SU) for the degree of Bachelor of Science in Mechanical Engineering was carried out under the supervising of **M.A Faisal Junaeat Imrul.** This study has been carried out in the Mechanical Engineering, Sonargaon University Dhaka, Bangladesh. This is also to certifying that the research work presented here is an original work for the partial fulfillment of the degree of Bachelor of Science in Mechanical Engineering. To the best of our knowledge this thesis has not been submitted elsewhere.

Supervised By:

M.A Faisal Junaeat Imrul
Lecturer, Department of Mechanical Engineering
Sonargaon University (SU)
Dhaka, Bangladesh.

DECLARATION

This dissertation has been submitted as thesis entitled **"Design and Construction of an Automatic Conveyor Belt With Size Based Product Sorting System"** to the Sonargaon University (SU) in partial fulfillment to the requirements for the degree of Bachelor of Science in Mechanical Engineering, Sonargaon University Dhaka, Bangladesh. No part of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Signature of Author

Saiful Islam
ID: BME2001020588

Remon Hossen
ID: ME2003022163

Md. Mahfuzur Rahman Nahid
ID: ME2003022159

Bahar Uddin
ID: ME2003022089

Hafiza Aktar Mim
ID: ME2003022387

Nusrat Jahan Tonny
ID: ME2003022393

ACKNOWLEDGEMENT

First, we started in the name of Almighty Allah. This thesis is accomplished under the supervision of M.A Faisal Junaeat Imrul, Lecturer, Department of Mechanical, Sonargaon University. It is a great pleasure to acknowledgement our profound gratitude and respect to our supervisor for this consistent guidance, encouragement, helpful suggestion, constructive criticism and endless patience through the progress of this work. The successful completion of this thesis would not have been possible without his persistent motivation and continuous guidance.

The authors are also grateful to **Professor Md. Mostofa Hossain,** Head of the Department of Mechanical Engineering and all respect teachers of the Mechanical Engineering Department for their co-operation and significant help for completing the thesis work successfully.

[Authors]

Saiful Islam
BME2001020588

Md. Mahfuzur Rahman Nahid
ME2003022159

Remon Hossen
ME2003022163

Bahar Uddin
ME2003022089

Hafiza Aktar Mim
ME2003022387

Nusrat Jahan Tonny
ME2003022393

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 different sized object and at the same time move object automatically to the bucket as define buy the regulation of the Arduino with ultrasonic sensor to detect a value rang of object. The result obtained shows that different sized objects 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 3 different boxes. By usage of sensors decreases the errors in sorting and reduces the human uses.

TABLE OF CONTENTS

SL No **Page No**

1. Approval…. ……..i

2. Declaration……ii

3. Acknowledgement…….....iii

4. Abstract……iv

5. Table of Contents…….....v

6. List of Table……vii

7. List of Figure……...viii

CHAPTER 1 INTRODUCTION

1.1 Theory……1

1.2 Purpose of the method……2

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction…….....3

2.2 Literature Review……..3

CHAPTER 3 THEORY & WORKING PROCEDURE

3.1 History……...6

3.2 Methodology…….6

3.3 Block Diagram……..7

3.4 Working Principle…….7

3.5 Project Prototype……...8

3.6 Component List…….8

3.7 Cost Estimation…….9

3.8 Arduino UNO…….9

3.9 Switch Mode Power Supply…….13

3.10 DC Gear Motor……...18

3.11 Buck Converter……...19

3.12 Servo motor…….....22

3.13 Ultrasonic Sensor……....24

3.14 Conveyor Belt…….27

3.15 Roller Conveyor……..31

3.16 Ball Bearing…….32

3.17 Coupler…….34

3.18 Jumper wires……36

CHAPTER 4 RESULT AND DISCUSSION

4.1 Result……..38

4.2 Discussion…….....38

4.3 Advantage…….....38

4.4 Application……...39

4.5 Limitation…….39

CHAPTER 5 CONCLUSION

5.1 Future Scope…….40

5.2 Conclusion……40

Reference……...41

Appendix……43

LIST OF TABLE

Table No. **Table Name** **Page No**

3.1 Cost Analysis……...9

3.2 Arduino Uno Pinout Configuration……..10

LIST OF FIGURE

Figure No. Figure Name Page No

3.1 Circuit Diagram of Size Based Product Sorting System with Conveyor Belt……6

3.2 Block Diagram of Project Model……7

3.3 Project Prototype Image……..8

3.4 Arduino UNO…….10

3.5 Arduino UNO Pinout…….13

3.6 SMPS……..14

3.7 Basic Working Concept of an SMPS……..15

3.8 SMPS Diagram……....17

3.9 DC Power supply way…….18

3.10 DC Gear Motor……..19

3.11 Buck Converter……..…….20

3.12 Buck Converter Circuit Diagram……20

3.13 Servo Motor……22

3.14 Schema Diagram of Servo Motor……...23

3.15 Ultrasonic Sensor……....24

3.16 Ultrasonic Sensor Sensing Object……...26

3.17 Conveyor Belt……..29

3.18 Roller Conveyor……...31

3.19 Ball Bearing……..33

3.20 Coupler…….....35

3.21 Jumper Wires……..36

Chapter 1

INTRODUCTION

1.1 Theory:

The conveyor belt, a fundamental component of modern industrial automation, stands as a testament to human ingenuity and technological progress. Originating in the early 20th century, the conveyor belt has evolved from a simple mechanized transport system to a sophisticated and integral part of diverse industries worldwide. Its ubiquity spans manufacturing, logistics, mining, agriculture, and more, showcasing its adaptability and indispensable role in streamlining processes.

The marriage of traditional conveyor belt technology with the innovative capabilities of Arduino microcontrollers has ushered in a new era of precision and intelligence in material handling and sorting systems. In this integration, the conveyor belt transforms from a mere transporter to an intelligent agent capable of real-time decision-making, thanks to the computational power and versatility offered by Arduino. This synergy opens avenues for enhanced efficiency, adaptability, and streamlined processes across various industrial applications.

Conveyor belts have long been the backbone of material transport in industries, ensuring the seamless flow of goods from one point to another. The evolution of these belts has taken a significant leap with the infusion of Arduino, an open-source electronics platform celebrated for its programmability and affordability. This integration introduces a paradigm shift, elevating the conveyor system to a dynamic tool capable of sorting items based on specific attributes, thus addressing the growing need for automation and precision in material handling.

This introduction seeks to explore the transformative potential of combining conveyor belts with Arduino-based sorting systems. By delving into the technical intricacies, applications, and implications of this integration, we aim to elucidate how these smart conveyor systems are reshaping industrial processes. From the fundamental principles of sorting algorithms to the practicalities of real-world implementation, the synthesis of conveyor belts and Arduino introduces a novel chapter in the realm of intelligent automation, promising heightened efficiency and adaptability in contemporary material handling.

1.2 Purpose 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 various size of product with shorting system. The working of this project is easy to explain and less costly. This project is developed for sorting of various size of object like small, medium and large size. Where logic is controlled by Arduino Nano micro controller.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this section topics related to **Design and Construction of an Automatic Conveyor Belt with Size Based Product Sorting System** 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 the project were studied. Since the products are sorted through the conveyors, the status of sorting is an important factor in this 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 this 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 4 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 5 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.

i.

Chapter 3

Theory and Working Principle

3.1 History

These provide a sampling of problems appropriate for application of Conveyor Belt System Product Detection and Servo Separation System. It is mainly used in factory and industrial area. The use of it can reduce manpower and time. And good efficiency can be gained. Where very difficult to move company product from here to another location perfectly that moment this machine will be very useful. This machine is very easy to use and it works very effectively. A relevant picture is added below -

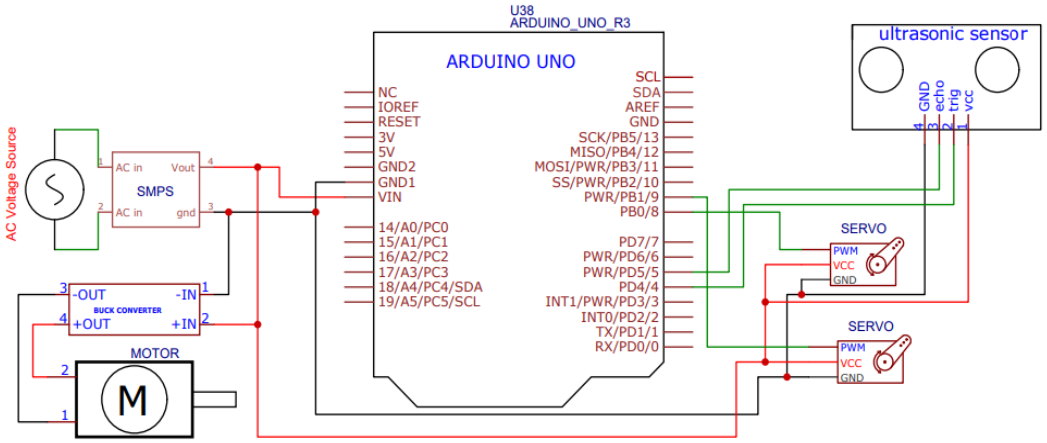


Figure 3.1: Circuit Diagram of Size Based Product Sorting System with Conveyor Belt.

3.2 Methodology

Here the current from AC is entering the circuit at 5 volts via SMPS. The Arduino UNO is equipped with one sensor. The ultrasonic sensor are useful for sensing the product. The ultrasonic sensor senses the object and detects whether it is Small, Medium or Big. The conveyor belt rotates repeatedly and the object comes in front of the sensor. Then check the object if it is small, medium or big, then the servo motor will put it in a specific box.

3.3 Block Diagram

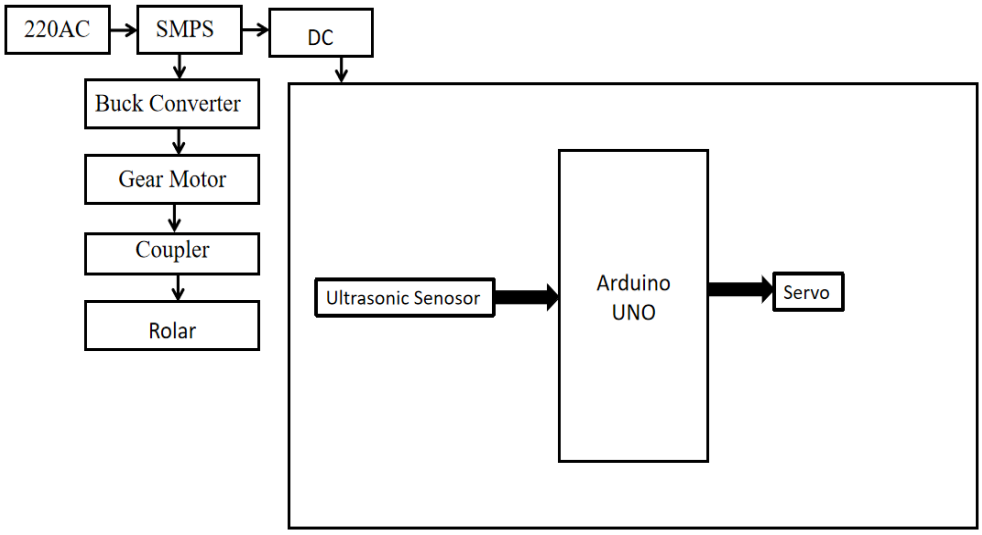


Figure 3.2: Block Diagram of Project Model

3.4 Working Principal

The project is designed to separate different sized objects. Arduino UNO is used for controlling the project, which is acting as the main controller here. Also ultrasonic sensor, buck converter, DC gear motor and servo motors are used. Everything comes connected with Arduino. Here the current from AC is entering the circuit at 5 volts via SMPS. The Arduino UNO is equipped with ultrasonic sensor. The ultrasonic sensor is useful for sensing the product. The ultrasonic sensor senses the object and detects whether it is small, medium or big. When the conveyor belt rotates, the object comes in front of the ultrasonic sensor. Then check the object, if it is small, medium or big then servo motors will push it in specific box. In this way this machine can easily distinguish between 3 different sized objects.

i.

3.5 Complete Prototype Image:

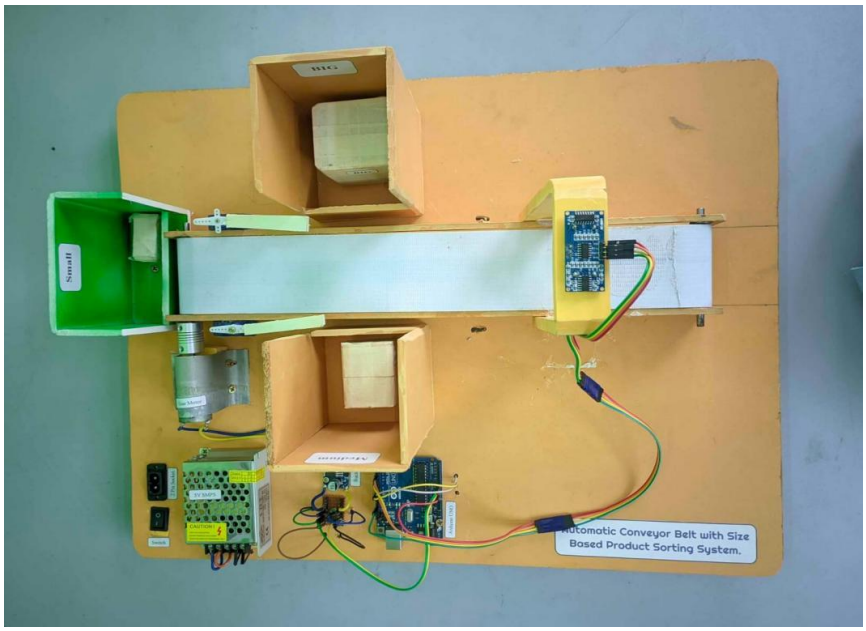


Figure 3.3: Project Prototype Image

3.6 Components List:

1. DC Gear Motor
2. Conveyor Belt
3. Switch Mode Power Supply
4. Ultrasonic Sensor
5. Buck Converter
6. Servo Motors
7. Arduino UNO
8. Roller Conveyor
9. Ball Bearing
10. Jumper Wires
11. Coupler

3.7 Cost Analysis

No	Product Name	Specification	Qty	Unit Price	Total Price
01	Arduino	**UNO**	**1**	**780**	**780**
02	SMPS	**5V**	**1**	**800**	**800**
03	Ultrasonic Sensor	**HC-SR04**	**1**	**90**	**90**
04	DC Gear Motor	**12V**	**1**	**500**	**500**
05	Servo Motor	**SG90**	**2**	**140**	**280**
06	Buck Converter	**LM2596S**	**1**	**90**	**90**
07	Coupler	**D- 5 x 18, L- 25 mm**	**1**	**90**	**90**
08	Roller	**D- 5 x 12 x 5 mm L- 85 mm**	**2**	**100**	**200**
09	Bearing	**D- 5 x 15 mm T- 5 mm**	**4**	**150**	**600**
10	Others				**2000**
				Total Cost	**5430/=**

Table 3.1: Cost Analysis

3.8 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. [7]

i.



Figure 3.4: Arduino UNO [9]

Specification

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB (ATmega328) of which 0.5 KB used by bootloader
- SRAM 2 KB (ATmega328)
- EEPROM 1 KB (ATmega328)
- Clock Speed 16 MHz [7]

Arduino Uno Pinout Configuration:

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 - 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.[8]

Table 3.2: Arduino Uno Pinout Configuration

How to use Arduino Board:

The 14 digital input/output pins can be used as input or output pins by using pinMode(), digitalRead() and digitalWrite() functions in arduino programming. Each pin operate at 5V and can provide or receive

i.

a maximum of 40mA current, and has an internal pull-up resistor of 20-50 KOhms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

- **Serial Pins 0 (Rx) and 1 (Tx):** Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
- **External Interrupt Pins 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.
- **PWM Pins 3, 5, 6, 9 and 11:** These pins provide an 8-bit PWM output by using analogWrite() function.
- **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK):** These pins are used for SPI communication.
- **In-built LED Pin 13:** This pin is connected with an built-in LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, it's off.

Along with 14 Digital pins, there are 6 analog input pins, each of which provide 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using AREF pin with analog Reference () function.

- Analog pin 4 (SDA) and pin 5 (SCA) also used for TWI communication using Wire library.

Arduino Uno has a couple of other pins as explained below:

- **AREF:** Used to provide reference voltage for analog inputs with analogReference() function.
- **Reset Pin:** Making this pin LOW, resets the microcontroller.[8]

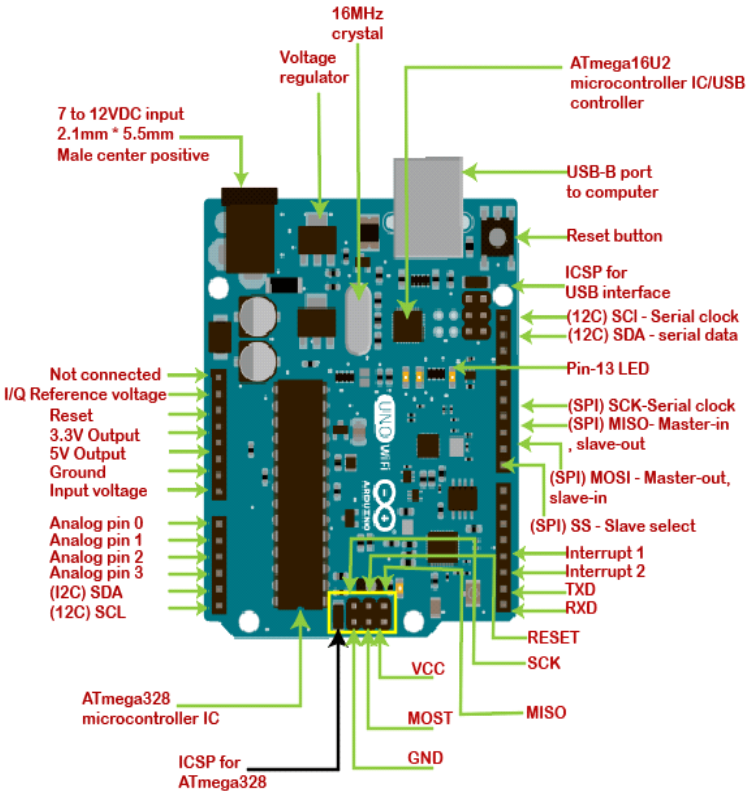


Figure 3.5: Arduino UNO Pinout [9]

3.9 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).

i.



Figure 3.6: SMPS [18]

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.

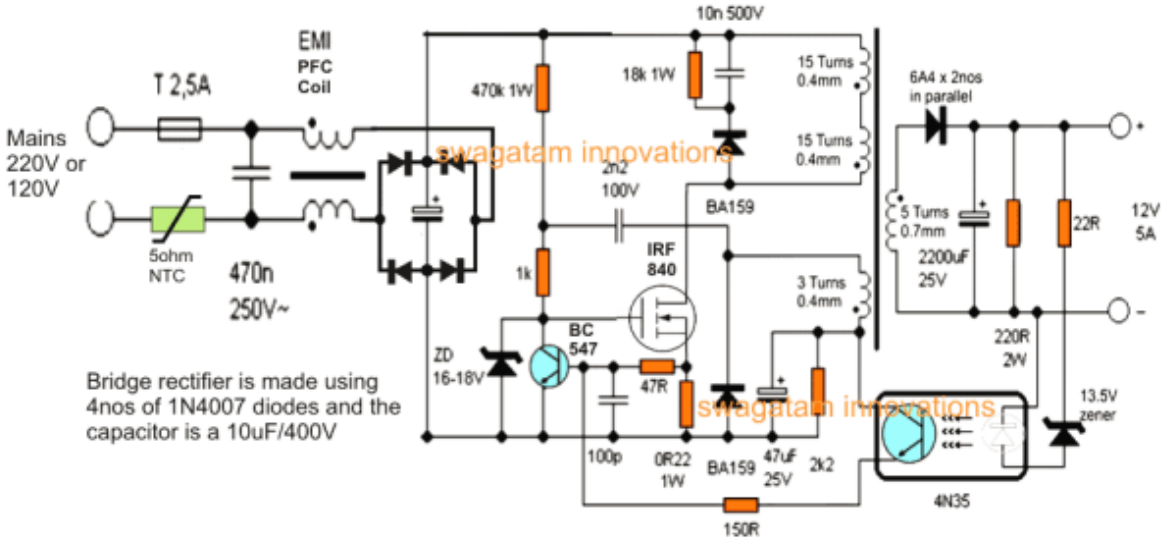


Figure 3.7: Basic working concept of an SMPS [19]

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.

i.

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.

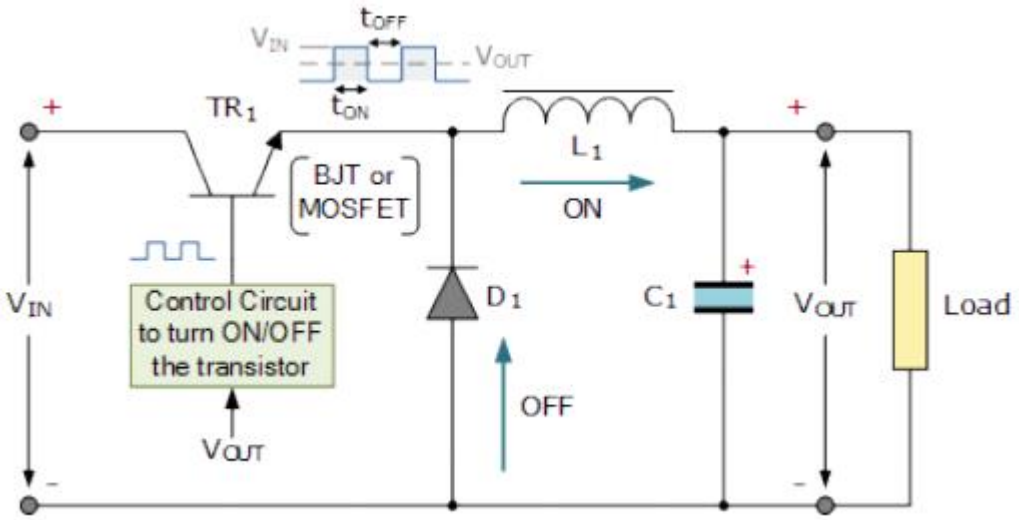


Figure 3.8: SMPS Diagram [19]

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 DC 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 DC producing a suitably smooth DC voltage, and some form of voltage regulator or stabilizer circuit, either linear or switching to ensure the correct regulation of the power supplies output voltage under varying load conditions. Then a typical DC power supply would look something like this:

i.

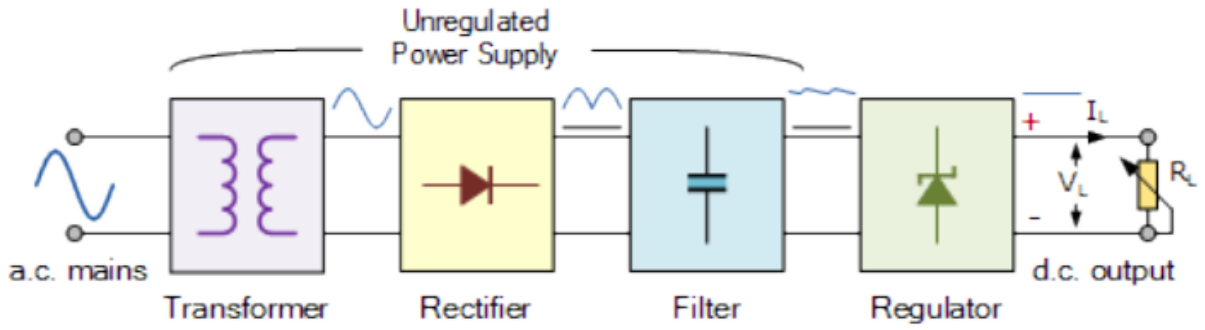


Figure 3.9: DC Power supply way [19]

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. [19]

3.10 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″



Figure 3.10: DC Gear Motor [20]

3.11 Buck Converter

Buck Converter is a dc-to-dc converter designed to perform the step down conversion of applied dc input. In a buck converter, the applied fixed dc input is reduced to a specific dc output voltage i.e. output voltage of the buck converter is always less than the input voltage. So, the Buck converter is also called the step-down converter or step-up chopper.

The efficient power conversion in bulk converter extends battery life and reduces the heat produced. So, it is mostly preferred for the production of smaller gadgets. It can be used in lots of cool applications. It is widely used in SMPS (switched-mode power supply) where the output dc voltage required is less than the input dc voltage.

i.



Figure 3.11 Buck Converter [16]

Operating Principle of Buck Converter

The operation of the buck converter is based on the principle of storing energy in an inductor. The voltage drop across an inductor is proportional to the change in the electric current flowing through the device. A switching transistor is used in between input and output for continuous switches on and off at high frequency. To maintain a continuous output, the circuit uses the energy stored in the inductor.

The circuit diagram for a typical buck converter is shown in the figure below.

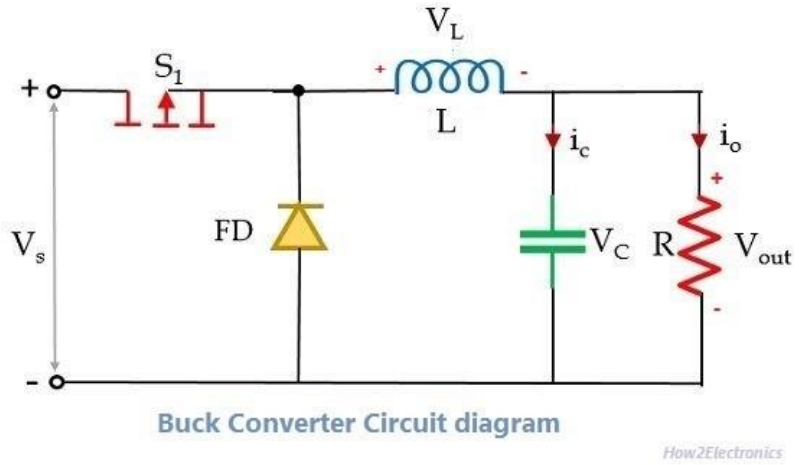


Figure 3.12: Buck Converter Circuit Diagram [16]

In this circuit, the input voltage is connected to a controllable solid state device which operates as a switch. In circuit diagram represent that switch which is power MOSFET. There is another switch used in the

circuit which is a freewheeling diode (FD). The switch and diode FD are connected to a low pass LC filter in order to reduce the current and voltage ripples which help in generating regulated dc output.

Here, the load is purely resistive load. The input voltage and current through load are constant. And the load can be seen as a current source.

The controlled switch is turned on and off by using PWM (Pulse Width Modulation). PWM can be time-based or frequency based. Time-based Modulation is mostly used for buck converters because it is simple to construct and use. The frequency remains constant in this type of PWM modulation. Whereas Frequency-based modulation has a wide range of frequencies to achieve the desired control of the switch and has a complicated design for the low-pass LC filter.

There are two modes of operation of the Buck converter. They are:

1. Mode I: Switch1 is ON and Diode FD is OFF
2. Mode II: Switch1 is OFF and Diode FD is ON

Applications

Buck converter is basically used for conversion of high dc voltage to low dc voltage. It is mostly used in the following applications:

- It is used in battery power systems such as battery chargers for mobile phones, laptops, and power banks
- It is used in self-regulating power systems such as SMPS
- It is used point of load converters for PCs and motherboards
- It is used in solar chargers
- It is used in adaptive control applications
- It is used in power audio amplifier applications[16]

3.12 Servo Motor

A servo motor is a type of motor that can rotate with great precision. To rotate an object at some specific angles or distance, then servo motor is used. It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply then it is called DC servo motor and if it is AC-powered 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 many applications like toy car, RC helicopters and planes, Robotics, etc.

i.



Figure 3.13: Servo Motor [11]

Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motors shaft, the greater the distance the lesser the weight carrying capacity. The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

Servo Motor Working Mechanism

It consists of three parts:

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

Controlling Servo Motor:

All motors have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU.

Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.

Servo motor works on PWM (Pulse width modulation) principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears. High speed force of DC motor is converted into torque by Gears. We know that WORK= FORCE X DISTANCE, in DC motor Force is less and distance (speed) is high and in Servo, force is High and distance is less. The potentiometer is connected to the output shaft of the Servo, to calculate the angle and stop the DC motor on the required angle.

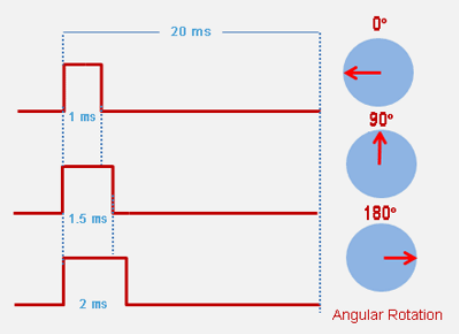


Figure 3.14: Schema Diagram of Servo Motor [11]

Servo motor can be rotated from 0 to 180 degrees, but it can go up to 210 degrees, depending on the manufacturing. This degree of rotation can be controlled by applying the **Electrical Pulse** of proper width, to its Control pin. Servo checks the pulse in every 20 milliseconds. The pulse of 1 ms (1 millisecond) width can rotate the servo to 0 degrees, 1.5ms can rotate to 90 degrees (neutral position) and 2 ms pulse can rotate it to 180 degree.

All servo motors work directly with your +5V supply rails but we have to be careful about the amount of current the motor would consume if you are planning to use more than two servo motors a proper servo shield should be designed. [11]

Specification of servo motor

- Weight: 55 gm
- Dimension: 40.7 x 19.7 x 42.9 mm approx.

i.

- Stall torque: 9.4 kgf.cm (4.8 V), 11 kgf.cm (6 V)
- Operating speed: 0.17 s/60º (4.8 V), 0.14 s/60º (6 V)
- Operating voltage: 4.8 V a 7.2 V
- Running Current 500 mA – 900 mA (6V)
- Stall Current 2.5 A (6V)
- Dead band width: 5 µs
- Stable and shock proof double ball bearing design¬
- Temperature range: 0 ºC – 55 ºC

3.13 Ultrasonic Sensor

The Ultrasonic Sensor is an electronic device which measures distances by sending out sound waves and collecting the returning echoes. It can measure items up to 4.5 meters away, making it a versatile tool for measuring both short and long distances accurately without contact with the target item - essential in many applications such as obstacle avoidance systems in robotics or autonomous vehicles. Ultrasonic sensors are used as proximity sensors. They can be found in parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems and manufacturing engineering. Compared to infrared (IR) sensors in proximity sensing applications, ultrasonic sensors are less susceptible to interference from smoke, gases, and other airborne particles (although the physical component is subject to variables such as heat).

Ultrasonic sensors are also used as level sensors to detect, monitor, and control liquid levels in closed vessels (such as chemical plant drums). Most notably, ultrasound technology has enabled the medical industry to image internal organs, identify tumors, and ensure the health of babies in the womb.



Figure 3.15: Ultrasonic Sensor [12]

Working of Ultrasonic Sensor:

An ultrasonic sensor is an electronic device that measures the distance to an object by emitting ultrasonic waves and converting the reflected sound into electrical signals. The Ultrasonic sensor working principle involves the utilization of ultrasound, which travels faster than audible sound, to determine distance. This sensor comprises two primary elements: a transmitter, which utilizes a piezoelectric crystal to emit sound waves, and a receiver, which detects the reflected ultrasonic waves.

While some sensors use separate sound emitters and receivers, it is also feasible to merge both functions into a single device by using an ultrasonic element to switch between sending and receiving signals in a continuous cycle. The transmitter of the module transmits an ultrasonic sound. This sound will be reflected if an object is present in front of the ultrasonic sensor. The reflected sound is received by the receiver present in the same module. An ultrasonic signal is propagated by a wave at an angle of 30°. The above-depicted Figure illustrates how the ultrasonic signal propagates from the transmitter. Measuring angles should be at least 15° for maximum accuracy. In this case, external objects that fall under this measurement angle interfere with determining the distance to the desired object. The distance is determined by measuring the travel time of ultrasonic sound and its speed.

Distance = Time x Speed of sound / 2

Use multiple sensors to avoid interference:

When using multiple sensors in an application, it is important to connect them in a way that avoids problems such as crosstalk and other interference. It is important to keep the front of the ultrasonic transducer clear to avoid interference with the ultrasonic signal from the sensor.

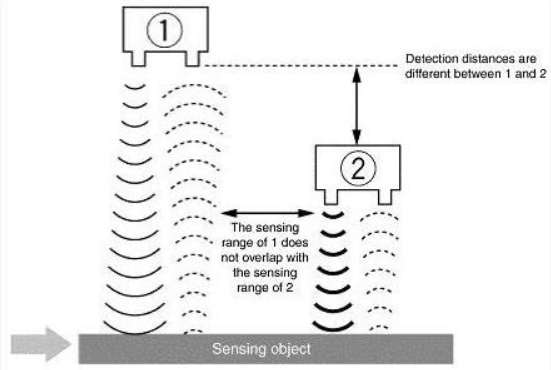


Figure 3.16: Ultrasonic Sensor Sensing Object [12]

i.

Specifications:

- Supply voltage +5 V
- Consumption in silent mode 2 mA
- Consumption at work of 15 mA
- Measurement range - 2 to 400 cm
- Effective measuring angle 15°
- The dimensions are 45×20×15 mm

Advantage of Ultrasonic Sensors

1. Ultrasonic sensors are an excellent way to measure the distance, speed and position of objects. They offer superior accuracy compared to traditional technologies such as lasers or infrared sensors.
2. The ultrasonic wave is generated through a transducer that sends out high-frequency sound waves which travel faster than the speed of light due to their higher frequency range (ultrasonic is in the kilohertz range).
3. These sensors enable manufacturers and engineers for detailed detection over wide ranges with minimal complexity involved when setting up certain systems; they can even detect objects at distances greater than 200m away accurately!
4. Ultrasonic sensors also do not rely on visible light like other types of technology so they can be used indoors/outdoors without worrying about environmental conditions affecting performance levels – this makes them ideal for use in dark areas or lowlight situations where visibility would otherwise be compromised by regular sensing techniques
5. These devices have self-diagnostics capabilities allowing users quick access to system status by checking errors & fault codes and reading back calibration parameters, thus providing easy maintenance routines.
6. With no external power source needed, these types of tools operate more reliably with less downtime thus leading to improved productivity levels across applications relying heavily on its

usage ranging from robotics automation industrial monitoring security surveillance activities etc.

Limitations of Ultrasonic Sensors

1. Ultrasonic sensors have a limited range which makes them less effective when larger distances need to be covered or detected.
2. They are prone to interference from other sources and can provide false readings due to these Interferences, including reflections off of non-metallic objects that may not be correctly identified by the sensor's recognition capabilities.
3. Response times for ultrasonic sensing technology is relatively slow in comparison with some other types of distance measurement equipment such as Infrared devices meaning they take longer periods of time before an accurate reading is provided back on screen, making it inconvenient where fast responses are needed immediately upon detection.
4. High-density materials, extreme temperatures and small target surfaces are also unable to detect properly using ultra-sonic sensors since their performance gradually reduces under those conditions leading them to underestimate the actual values being measured within their vicinity environment. [12]

3.14 Conveyor Belt

A conveyor system systematically carries and transports materials, typically in an industrial or controlled environment. Conveyor belts are a tried-and-true energy saver designed to increase efficiency. Let’s take a look at how conveyor belts work and why they’ve stood the test of time. A conveyor belt works by using two motorized pulleys that loop over a long stretch of thick, durable material. When motors in the pulleys operate at the same speed and spin in the same direction, the belt moves between the two.

If objects are particularly heavy or bulky — or if the conveyor belt is carrying them for a long distance or duration — rollers may be placed on the sides of the conveyor belt for support.

Parts of the Conveyor Belt System

While there are numerous types of conveyor systems, all serve the same purpose of transporting materials. Some products may require a system without a belt, using only rollers or wheels for flexible movement. However, many conveyor systems rely on a frame with a belt and possible support rollers to carry materials

i.

and products efficiently.

Parts and functions of a new conveyor belt system might include:

- **The frame:** The system's framework holds all of the moving parts together for safe and secure operation.
- **The belt:** A long stretch of thick, durable material upon which materials are transported from one place to another.
- **The conveyor belt support:** Rollers assist the belt to stay on course and swiftly maintain movement. Rollers keep objects in place and prevent the belt from sagging.
- **The driving unit:** Motors may use either variable or constant speed-reduction gears to power the conveyor belt. An efficient driving unit must continually assist the belt with continuous running, smooth reversing and repeatedly adjusting direction.
- **The pulleys:** The conveyor belt should loop over two or more strategically positioned pulleys. The pulley controls the belt's movement and performs critical functions such as driving, redirecting, turning, tensioning and tracking the belt.
- **The clamping straps:** Clamping straps are used on various machines to hold down fixtures and work components.
- **Add-on modules:** Most additional parts are installed for further reinforcement. While rollers support the belt from within the system, stands and lateral guides support the outer framework.

Conveyor belting can be crafted from various materials, including rubber, metal, leather, fabric and plastic. Consider the conditions that your system will operate under to ensure the conveyor belting material is of suitable thickness and strength.



Figure 3.17: Conveyor Belt [13]

Conveyor belting usually falls under two categories:

1. Lightweight
2. Heavyweight.

Lightweight belting is designed to meet various material handling requirements in diverse industries. A lightweight belting system has a working tension of less than 160 pounds per inch of width. The four main types of light-duty conveyor belts are:

- Solid plastic
- Non-woven
- Thermoplastic covered
- Lightweight rubber

Top industries that use lightweight belting include:

- Food processing
- Unit package handling
- Pharmaceutical
- Paper goods

i.

Top industries that use heavyweight belting include:

- Mining
- Manufacturing
- Waste/recycling
- High-temperature food processing

Conveyor Belt Uses:

A conveyor system has a wide variety of uses, such as:

- Quickly and reliably transport a large amount of material
- Stack materials at the end of a transportation line
- Streamline the process to get something from Point A to Point B
- Move a product vertically or horizontally with a high degree of flexibility

The advantages of using a conveyor belt system include:

- Reduce labor while massively increasing productivity and time efficiency
- Protect workers from any injuries caused by carrying heavy loads
- Keep the product safe from damage during transportation
- Easily transfer a product onto a different route
- Enjoy relatively simple maintenance of this durable, long-lasting system [13]

3.15 Roller Conveyor

Roller conveyors are part of material handling systems that use a series of evenly spaced cylindrical rollers to move boxes, supplies, materials, objects, and parts across an open space or from an upper level to a lower level. The frame of roller conveyors is at a height that makes it easy to access and load materials manually. Items transported by roller conveyors have rigid, flat surfaces that allow materials to move smoothly across the rollers.

The uses for roller conveyors include accumulation applications, reduction of product inertia, and high speed sorting. Drive roller conveyors have rollers attached to a motor by a chain, shaft,or belt. The use of drive rollers equalizes the velocity at which materials are moved, can be reversible, and can have the

capability of moving goods from a lower level to a higher one. They are used in bi-directional applications where the conveyor's motor can change a product's directional movement.



Figure 3.18: Roller Conveyor [14]

Construction of Roller Conveyor

Roller conveyors have design features that enable them to serve the needs of specific applications. Although roller conveyors vary according to their structure, mode of movement, and other manufacturer features, all roller conveyors have the same basic characteristics.

Powered roller conveyors have small belts and plastic spools that give traction to the rollers. Friction belts or chains placed beneath the conveyor of a powered roller conveyor are used to power its heavy duty rollers and are connected to a shaft that spans the length of the conveyor's frame, which is linked to an electric motor that drives the rollers.

Rollers

Rollers for roller conveyors are metal cylinders fitted into its frame with sets of bearings on either end of the cylinder. There are several types of conveyor rollers each of which is designed to fit the needs of the product being transported. Rubber and plastic rollers increase friction while steel and aluminum rollers have a smooth surface. Rollers are selected for their ability to keep products on the conveyor, and their ability to maintain the integrity of products.

Plastic Rollers

Plastic conveyor rollers are an economical roller and are designed to handle light loads. They are easy to install and require little maintenance. Plastic conveyor rollers meet the noise standards of the Occupational Safety and Health Administration (OSHA). Since plastic does not corrode, rust, and is resistant to the effects of moisture, they have a longer useful life. Plastic conveyor rollers are easy to clean and are used to transport food packaging in the food industry.

Nylon Rollers

Nylon rollers are used for medium to heavy loads and have the durability and strength that enables them to withstand constant use. They are made of synthetic polymers that are resistant to abrasion, chemicals, and corrosion. Nylon conveyor rollers, like plastic conveyor rollers, are lightweight, easy to install, and produce limited noise due to their low vibration.

Rubber Coated Rollers

Rubber coated rollers have a rubber coating placed over steel, stainless steel, or solid plastic rollers. The rubber layer improves the grip of the roller and provides protection for the roller and products. The types of rubber coatings vary in accordance with the industry where they are used. Rubber coated rollers are resilient, soft, and have the ability to grip smooth materials.

As with all rubber products, rubber coated rollers are anti-static, chemical resistant, customizable and durable. They are used by the automotive industry, printing, and packaging and fabrication. Rubber coated rollers have increased friction between the roller and materials that prevents slippage.

Steel and Stainless Steel Rollers

Steel and stainless steel rollers are the most popular conveyor roller materials due to their durability and smooth surface. They are simple to clean, long lasting, strong and capable of moving heavy materials. Steel and stainless steel are used as the core for plastic, nylon, and rubber rollers due to their smooth surface and exceptional strength.

Stainless steel rollers are compatible with any material, can accommodate smaller diameters, have precision bearings or are fixed shafts and can be adjusted to meet shipping needs. [14]

3.16 Ball Bearing

Ball bearings are crucial components in various mechanical systems, providing smooth and efficient rotation for shafts and other moving parts. Here's an overview:

Structure and Function:

Ball bearings consist of an outer race (outer ring), an inner race (inner ring), a cage (or separator), and the balls themselves. The balls are typically made of steel or ceramic and are arranged in a circular track

between the inner and outer races. When a load is applied, the balls roll along the track, reducing friction and enabling smooth rotation.

Types of Ball Bearings:

There are several types of ball bearings, including:

Deep groove ball bearings: Suitable for radial and axial loads in both directions.

Angular contact ball bearings: Designed to handle combined radial and axial loads by angling the races relative to each other.

Thrust ball bearings: Designed to handle axial loads in one direction.

Self-aligning ball bearings: Able to accommodate misalignment and shaft deflection.

Applications:

Automotive industry: Ball bearings are used in engines, transmissions, wheels, and steering systems to facilitate smooth rotation and reduce friction.

Industrial machinery: They are essential components in machinery such as electric motors, pumps, fans, and compressors, enabling reliable operation and efficiency.

Aerospace: Ball bearings are used in aircraft engines, landing gear, and control systems, where reliability and precision are paramount.

Household appliances: They are found in appliances like washing machines, dishwashers, and refrigerators, contributing to smooth and quiet operation.

Robotics and automation: Ball bearings play a critical role in robotics, CNC machines, and automation systems, providing precise motion control and reducing wear and tear.



Figure 3.19: Ball Bearing [21]

i.

Advantages:

Low friction: Ball bearings offer low friction and reduced energy consumption compared to plain bearings, making them efficient for various applications.

High precision: They provide precise rotational movement, crucial for applications requiring accurate positioning and alignment.

Longevity: Properly maintained ball bearings can have a long service life, reducing the need for frequent replacement and downtime.

Versatility: Ball bearings come in various sizes, configurations, and materials, making them suitable for a wide range of industrial and commercial applications.

Maintenance:

Proper lubrication: Regular lubrication is essential to reduce friction and prevent premature wear. The type and amount of lubricant depend on factors such as speed, load, and operating conditions.

Inspection: Periodic inspection of ball bearings for signs of wear, damage, or contamination is crucial to identify issues early and prevent costly failures.

Proper installation: Correct installation and alignment of ball bearings ensure optimal performance and longevity. Improper installation can lead to premature failure and equipment damage.

Ball bearings are fundamental components in countless mechanical systems, providing smooth and efficient rotational motion. Understanding their structure, function, and maintenance requirements is essential for ensuring reliable operation and maximizing their lifespan in various applications.

3.17 Coupler

A bellows coupling is basically a type of coupling design which consists of a thin walled, flexible corrugation (bellows) that is connected between two clamping hubs.

“These types of couplings are traditionally used for servo motion control applications that have high positioning accuracy, speed, and torque requirements.”

He says that a bellows coupling is unique because of the construction of the bellows. It can flex and compensate for minor shaft misalignments (axial, lateral, radial), while still providing a zero backlash and torsional rigid connection. "They are a unique blend of rigidity and flexibility.



Figure 3.20: Coupler [17]

Application

To specify a bellows coupling, the first parameters we typically look at are the torque and connecting shaft sizes which will help to give a general sense of the coupling size," Parzych says. "The nominal torque rating (continuous torque transmission) of the coupling should be greater than the peak torque of the application to ensure a secure connection."

"The connecting shaft sizes must also be within the acceptable range of the coupling. If the shaft diameter is smaller than the specified range on the coupling, the torque transmission value of the coupling can decrease due to inadequate clamping force between the hub and shaft," He adds.

"Importantly, when we are working on a project like this, we always check with the customer as to the amount of shaft misalignment present in the application, if known. Axial misalignment occurs during operation when the connecting shafts either advance towards each other which causes compression, or retract apart which causes tension."

"Radial (also known as angular) misalignment is when there is an angle between the centerlines of the two shafts. Lateral (also known as parallel) misalignment is when the centerlines of the two shafts are on different planes."

"Each form of misalignment creates stress in the bellows which can eventually lead to distortion and failure. However, if the misalignment values are not exceeded and the operating torque is below the rated torque of the coupling, then an infinite number of cycles without failure is possible."[17]

i.

3.18 Jumper wires

Generally, jumpers are tiny metal connectors used to close or open a circuit part. They have two or more connection points, which regulate an electrical circuit board.

Their function is to configure the settings for computer peripherals, like the motherboard. Suppose your motherboard supported intrusion detection. A jumper can be set to enable or disable it.

Jumper wires are electrical wires with connector pins at each end. They are used to connect two points in a circuit without soldering.

You can use jumper wires to modify a circuit or diagnose problems in a circuit. Further, they are best used to bypass a part of the circuit that does not contain a resistor and is suspected to be bad.

This includes a stretch of wire or a switch. Suppose all the fuses are good and the component is not receiving power; find the circuit switch. Then, bypass the switch with the jumper wire.



Figure 3.21: Jumper Wires [15]

Types of Jumper Wires

Jumper wires come in three versions:

- Male-to-male jumper
- Male-to-female jumper
- Female-to-female jumper

And two types of head shapes: **square head** and **round head**.

Uses of Jumper Wires:

Jumper wires are great for modifying a circuit or diagnosing problems in a circuit. The following steps show you how to use these wires in different applications safely.

Step 1

Your first step is to follow electrical safety precautions. Be cautious, especially when dealing with high-voltage circuits. But even with low-voltage circuits, you still need to be attentive.

Step 2

Know the suitable type of connector for the jumper wire. In some cases, you can use the bare wire ends to connect two circuit points. This is recommended if you have steady hands.

But to be safe, particularly if it is your first time, use alligator clips. Or soldering or some other type of connection for the jumper wire.

Step 3

Use the jumper wire to bypass part of the circuit or establish a connection between two points. This helps determine if a part of the circuit is faulty or broken.

Step 4

Connect the jumper wire to a voltmeter or ammeter for circuit property measurements. This allows you to get numbers between or across two points.

Step 5

Choose the right type of jumper wire if you are making a permanent modification to a circuit. The gauge and type of insulation are also essential considerations.

Step 6

Test circuit modifications with a temporary jumper wire before making a permanent connection. You can do this with solder.

Check the performance of the circuit with the temporary connection. This is to ensure that it works as you expect. [15]

i.

CHAPTER 4

RESULT AND DISCUSSION

4.1 RESULT

It has been able to build this system by following all the objects and methodologies. At first all components are set up well for the system. Here the ultrasonic sensor is used to detect various size of objects. Here, if it is a small object then it will go forward. If it is a medium object it will be moved by servo motor 1, if it is a big object it will be moved by servo motor 2. Servo motors will separate the products into separate boxes. The efficiency of this project is very good. It is capable of working for long time. The performance of this machine is good.

4.2 Discussion

While working on the project, some difficulties and problems appeared as it is a very complex system. But at the end, the results were quite satisfactory. Have put the whole system through several tasks to validate the work and also have taken necessary notes for future improvements. Some future recommendations that involves improvement in system design and wiring, adding features for more efficient operation.

4.3 Advantages

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

- 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.

- Reduced electrical energy
- Ease of operation.

4.4 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.
- Good accuracy to find different sized object.
- Manufacturing and Assembly Lines
- Food Processing and Packaging
- Automated Retail Systems
- Airport Baggage Handling
- Automotive Manufacturing
- Mining and Material Handling

4.5 Limitation

It is a demo project so some limitations have been found. In future this work will help to reduce this kind of limitation. These limitations are -

- It is a demo project so its accuracy is 90%.
- Our project may delay in work.
- High Initial Investment
- Maintenance Requirements
- Risk of Mechanical Failures

i.

Chapter 5

Conclusion

5.1 Future Scope of Work

The model can be improved by making some changes in the program and components.

Some suggestions are given below-

- Monitoring-based control can be added to automate control.
- In future, IOT monitoring and counting systems can be added.
- Can add more servo motors for more sizes.

5.2 Conclusion

The main objective of this project was to develop an object sorting system based on certain specifications. This was successfully implemented. This project can be considered as a journey where the knowledge acquired and also gained some insights into the subject which 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.

References:

1. Lim Jie Shen & Irda Hassan, Design and Development of Colour Sorting Robot, Journal of Engineering Science and Technology EURECA 2014, (2015), 71-81. http://jestec.taylors.edu.my/eureca 2014(1)_1_2015/eureca_14(1)_71_81.pdf
2. Riky Tri Yunardi, Winarno and Pujiyanto, Contour-based object detection in Automatic Sorting System for a parcel boxes, International Conference on Advanced Mechatronics, Intelligent Manufacture, and Industrial Automation (ICAMIMIA), (2015) 38-41, DOI:https://doi.org/10.1109/ICAMIMIA.2015. 7507998
3. Riky Tri Yunardi, Winarno and Pujiyanto, Contour-based object detection in Automatic Sorting System for a parcel boxes, International Conference on Advanced Mechatronics, Intelligent Manufacture, and Industrial Automation (ICAMIMIA), (2015) 38-41, DOI:https://doi.org/10.1109/ICAMIMIA.2015. 7507998
4. Moe Win Khaing, Aye Mya Win and Daw Thida Aye, Automatic Sorting Machine, International Journal of Science and Engineering Applications, 7(8), (2018) 138-142. DOI: https://doi.org/10.7753/IJSEA0708.1002
5. Shreeya Vasant Kulkarni, Swati Rajendra Bhosale and Priyanka Pramod Bandewar, Automatic Box Sorting Machine, International Journal for Scientific Research & Development, 4(4) (2016), 57-58.
6. Yoshito Nagaoka, Tomo Miyazaki, Yoshihiro Sugaya and Shinichiro Omachi, Automaic Mackeral Sorting Machine Using Global and Local Features, IEEE Access Volume:7, (2019) 63767-63777. DOI: https://doi.org/10.1109/ACCESS. 2019.2917554
7. farnell.com/datasheets/1682209.pdf
8. https://components101.com/microcontrollers/arduino-uno
9. https://www.javatpoint.com/arduino-uno-pinout
10. https://circuitdigest.com/article/servo-motor-working-and-basics
11. https://robocraze.com/blogs/post/what-is-ultrasonic-sensor
12. https://www.semcor.net/blog/how-do-conveyor-belts-work/
13. https://www.iqsdirectory.com/articles/conveyors/roller-conveyors.html
14. https://www.wiltronics.com.au/wiltronics-knowledge-base/what-are-jumper-wires/

i.

15. https://www.google.com/url?sa=i&url=https%3A%2F%2Fus.misumi-ec.com%2Fblog%2Ftiming-belts-pulleys-speed-ratio-formula%2F&psig=AOvVaw3JlkCq2DLG-k_P9dKM-jIN&ust=1714302740828000&source=images&cd=vfe&opi=89978449&ved=0CBIQjRxqFwoTCJCXrL-h4oUDFQAAAAAdAAAAABAE
16. https://how2electronics.com/buck-converter-basics-working-design-application/
17. https://www.couplingtips.com/bellows-couplings/understanding-bellows-couplings/
18. https://www.google.com/url?sa=i&url=https%3A%2F%2Fsharvielectronics.com%2Fproduct%2F12v-5a-60w-smps-metal-power-supply-non-water-proof%2F&psig=AOvVaw3oYe3y9BHQEdAVFnTv5F91&ust=1715514563110000&source=images&cd=vfe&opi=89978449&ved=0CBIQjRxqFwoTCOD5uOnDhYYDFQAAAAAdAAAAABAJ
19. https://www.tutorialspoint.com/electronic_circuits/electronic_circuits_smps.htm
20. https://static-01.daraz.com.bd/p/6c0bbaa189aba71bed4f38dfdcdae065.jpg
21. https://image.lily-bearing.com/blog/202305091453272849.png

APPENDIX

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 ultrasonic_sensor = 3;
//int ultrasonic;
#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(ultrasonic_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);
```

i.

```
}

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

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 ){
  }
  }
```