DESIGN AND FABRICATION OF AUTOMATIC COLOR SORTING CONVEYING MECHANISM

Course Title: Project and Thesis
Course code: ME 400

Supervised By:

MD RAKIBUL ALAM
Lecturer
Department of mechanical Engineering
Sonargaon University (SU)

Submitted By:

MD. BASIR MIA
ID No: BME 1502006081
RAHAT KHAN
ID No: BME 1602009113
POLLEN CHAKMA
ID No: BME 1602009267
MD SAZIBUL HASAN
ID No: BME 1602009360
DEBANGSHU DAS
ID No: BME 1601008113

DEPARTMENT OF MECHANICAL ENGINEERING

SONARGAON UNIVERSITY (SU)

FEBRUARY 2020

DESIGN AND FABRICATION OF AUTOMATIC COLOR SORTING CONVEYING MECHANISM

A Project

By

MD BASIR MIA
Student ID: BME 1502006081

In Cooperation With

RAHAT KHAN
Student ID: BME 1602009113

POLLEN CHAKMA
Student ID: BME 1602009267

MD SAZIBUL HASAN
Student ID: BME 1602009360

DEBANGSHU DAS
Student ID: BME 1601008113

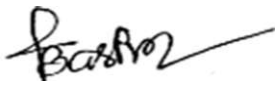
Supervisor: **MD RAKIBUL ALAM**
Lecturer (SU)

Submitted to the
DEPARTMENT OF MECHANICAL ENGINEERING
SONARGAON UNIVERSITY (SU)
In partial fulfillment of the requirements for the award of the degree
of
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

FEBRUARY 2020

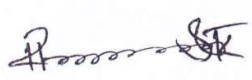
DECLARATION

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



.....

Md Basir Mia
Student ID: BME 1502006081



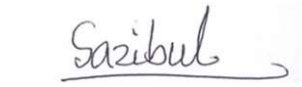
.....

Rahat Khan
Student ID: BME 1602009113



.....

Pollen Chakma
Student ID: BME 1602009267



.....

Md Sazibul Hasan
Student ID: BME 1602009360



.....

Debangshu Das
Student ID: BME 1601008113

In my capacity as supervisor of the candidate's thesis, I certify that the above statements are true to the best of my knowledge.

.....

Md Rakibul Alam
Lecturer
Department Of Mechanical Engineering,
Sonargaon University (SU).

APPROVAL

This is to certify that the project on "**Design and Fabrication of Automatic color sorting conveying mechanism.** by **(**Md Basir Mia, ID- BME1502006081, Rahat Khan, ID- BME1602009113, Pollen Chakma, ID- BME1602009267,Md Sazibul Hasan, ID- BME1602009360, Debangshu Das, ID- BME1601008113)has been carried out under our supervisor. The project has been carried out in partial fulfillment for the degree of Bachelor of Science (BSc) in Mechanical Engineering of the year 2020 and has approved as to its style and contents.

.....

Md Rakibul Alam
Lecturer
Department Of Mechanical Engineering,
Sonargaon University (SU).

TABLE OF CONTENTS

Page No.

Declaration…….....ii
Approval…….....iii
Table of Content……iv-v
Notation…….…….vi
Acknowledgement……..vii
Abstract…….....viii

CHAPTER-1 INTRODUCTION 1-1

1.1 Introduction ……..1
1.2 Objective…….……...1

CHAPTER-2 **LITERATURE REVIEW 2-4**

Literature review……...2-4

CHAPTER-3 DESIGN AND CONSTRUCTION 5-16

3.1 2D Drawing ……5-7
3.2 3D Assembly Drawing……..8
3.3 Our Prototype Output……9
3.4 Working Principal…….…...10
3.5 Block Diagram…….…….…….....11
3.6 Circuit Diagram ……..12
3.7 Practical Figures ……..…….…13-14
3.8 Application ……..15
3.9 Methodology…….……15
3.10 List of component with price…….……...……16

CHAPTER-4 HARDWARE ANALYSIS 17-25

4.1 Arduino Nano …….17-19
4.2 Color Sensor ……..…..20
4.3 SMPS Power Supply.……..…..…...21
4.4 DC Gear Motor.……...22
4.5 Servo motor ……..…23
4.6 Capacitor……..…….24
4.7 Resistor…….……25

CHAPTER-5 SOFTWARE DESCRIPTION 26-29

5.1 Arduino software……..26-27
5.2 Proteus…….28
5.3Circuit Test……...29

CHAPTER-6 RESULT & CONCLUSION 30-31

6.1 Result……..30
6.2 Conclusion……..30
6.3 Future Scope……...31

CHAPTER-7 REFERENCE 32-39

Reference……...……32-33
Program Code……...……..33-35

NOTATION

DC	:	Direct Current.
AC	:	Alternating Current
IDE	:	Integrated Development Informant
I/O	:	Input Output
SMPS	:	Switch Mode Power Supply
RX	:	Receiver
TX	:	Transmitter
PCB	:	Printed Circuit Board
PWM	:	Pulse Width Modulation
CRO	:	Cathode Ray Oscilloscope
IC	:	Integrated Circuit
MSP	:	Multiwii Serial Protocol
USB	:	Universal Serial Bus
CAD	:	Computer Aided Design

ACKNOWLEDGEMENT

This thesis is accomplished under the supervision of Md Rakibul Alam Lecturer, Department of Mechanical Engineering, Sonargaon University. It is a great pleasure to acknowledge 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 author 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

ABASTRACT

The purpose of this model is to design and implement a system which automatically separates products based on their color. This machine consists of four parts: Conveyor belt, color sensor, servo motor and DC Gear motor. The output and input of these parts was interfaced using Arduino microcontroller. Here we used Arduino Nano, color detecting sensor (TCS3200), DC Gear Motor(12V), Servo Motor. The Arduino Nano's operating voltage (logic level):5V, Input Voltage (recommended):7-12 V, Input Voltage (limits):6-20 V, it has 14 Digital I/O Pins and 8 Analog Input Pins. DC Gear motor Input Voltage 12V, Servo motor Capacity 1 kg. In our project the color detecting sensor works with two colors (red and green).

CHAPTER 1
INTRODUCTION

1.1 Introduction

The purpose of this model is to design and implement a system which automatically separates products based on their color. This machine consists of four parts: conveyor belt, color sensor, servo motor and DC Gear motor. The output and input of these parts was interfaced using Arduino microcontroller. Physical construction of the project is made of fiberboard cut, glued and aluminum box cut with respect to the 3D design. The Arduino Nano serves as the primary controller in which the components such as color sensor and servo motors are connected. It analysis the data received from color sensor and then transmit a command to the servo motors. The color sensor is attached facing down as it checked the object color and this checking correspond to a color frequency with a custom made function that helps to identify the color of the object. This Arduino color sorter project is applicable in organizing small objects considering the capabilities of the hardware that drives this project. Aside of organizing the small objects based on color, it is also a good reference for developing larger system that able to sort larger objects especially in industries.

1.2 Objective

The main objective of this project is-

- To design a color sorting conveying system.
- To fabricate a color sorting conveying system.

CHAPTER 2

LITERATURE REVIEW

Muhammed Kamrul Islam. [18] For sorting object in industry optical sorting is very much convenient. Color and size are the most important features for accurate classification and sorting of product which can be done by using some optical sensors or analyzing their pictures. The color sorting machine is mainly a device that can sense the different color of the object and assert them into different belt conveyor. When object moves from one place to another with the rotation of conveyor belt, sensors as the input devices will send signal to microcontroller where microcontroller as the controller will give command to the actuator to do action. The final result was quite satisfactory. The color detecting sensors worked well and it was able to detect red or green object quite nicely and change the direction of servo on right and left side to sort the object in proper place. The belt moved from starting point to the end point through the roller without conflicting with the walls. The system performed well as programmed and detects the object according to their color.

Shubhangi Wanve. [19] This paper presents development and design of automatic color object sorting system. The proposed system is low cost, low power. In this paper object sorting using robotic arm based on color detection is designed and implemented. Furthermore, the robotic arm is used to place the sorted object on conveyor belt. Existing sorting method uses a set of different capacitive, inductive, and optical sensors to differentiate object color. In the proposed system a mechatronics color sorting system is developed with the image processing technique. Image processing technique senses the objects captured in real-time by a webcam and then identifies color and information out of it. This information is processed by image processing technique for pick-and-place mechanism. The Arduino microcontroller sends signal to circuit which drives the various motors of the robotic arm to grip the object and place it at the specified location. Based upon the detection, the robotic arm moves to the specified location, releases the object and comes back to the original position. So, the proposed system will eliminate the monotonous work done by human and provides greater accuracy and speed in the work.

Muhammed Saifudeen K. K . [20] Sorting of products is a very difficult industrial process. Continuous manual sorting creates consistency issues. This paper describes a working prototype designed for automatic sorting of objects based on the color. TCS230 sensor was used to detect the color of the product and the PIC16F628A microcontroller was used to control the overall process. The identification of the color is based on the frequency analysis of the output of TCS230 sensor. Two conveyor belts were used, each controlled by separate DC motors. The first belt is for placing the product to be analyzed by the color sensor, and the second belt is for moving the container, having separated compartments, in order to separate the products. The experimental results promise that the prototype will fulfill the needs for higher production and precise quality in the field of automation.

V.A. Balogun. [21] The automatic sorting system has been reported to be complex and a global problem. This is because of the inability of sorting machines to incorporate flexibility in their design concept. This research therefore designed and developed an automated sorting object of a conveyor belt. The developed automated sorting machine is able to incorporate flexibility and separate species of non-ferrous metal objects and at the same time move objects automatically to the basket as defined by the regulation of the Programmable Logic Controllers (PLC) with a capacitive proximity sensor to detect a value range of objects. The result obtained shows that plastic, wood, and steel were sorted into their respective and correct position with an average, sorting, time of 9.903 s, 14.072 s and 18.648 s respectively. The proposed developed model of this research could be adopted at any institution or industries, whose practices are based on mechatronics engineering systems. This is to guide the industrial sector in sorting of object and teaching aid to institutions and hence produce the list of classified materials according to the enabled sorting program commands.

Amir Deshmukh . [22] In many packaging industries, color object sorting is the major task that needs to be done at final dispatch section. Sorting of various products in such industries is accomplished based on appearance i.e. color, shape and sizes. Manual sorting is the tradition approach that preferred by industries that involves visual inspection performed by human operators. This traditional approach is tedious, time-consuming, slow and non-consistent. It has become increasingly difficult to hire personnel who are adequately trained and willing to undertake the tedious task of inspection. Therefore the efforts are made to design and implementation of automatic technique to determine color of object, color based component sorting using microcontroller. In implemented system, colored object which is rolling over a conveyer belt has been detected by using color sensors. Using color sensors, the color of a component which may be red, green or blue has been determined. Once the color of a component is determined, implemented system will automatically count and sort the objects as per its color.

Dharmannagari Vinay Kumar Reddy . [23] In many situations, autonomous robots can provide effective solutions to grueling tasks. In this case, it is desirable to create an autonomous robot that can identify objects from the conveyor belt and relocate them if the object meets certain criteria. Dealing with a large number of objects is a very menial task, this is an excellent application for a robot of this type. In this case, to keep costs and design complexity low, the robot is designed around the platform and uses several different sensors to collect information about the robots environment to allow the robot to react accordingly. This paper aims at the problem I am attempting to solve is to create an autonomous robot that can identify objects when placed on the conveyor belt based on color sensing and then sort by relocating them to a specific location. It will be using a picking arm which uses a controller motor to pick the particular object from the conveyor belt and place it according to the color sensing. Micro controller (AT89S52) allows dynamic and faster control. Liquid Crystal Display (LCD) makes the system user-friendly. AT89S52 Micro controller is the heart of the circuit as it controls all the functions.

Kataphon Prewthaisong . [24] This research is to develop the automatic machine for sorting colored objects with conveyor belt. It was designed to classify colored objects such as red, green, blue and other colors by using fiber optic sensor. The microcontroller is automatically used to move the material objects along with the conveyor belt into the containers on the tray. The microcontroller is automatically used to move the materials along with the conveyor belt, and then fell into the defined containers on the tray. The fiber optic was used for the object detection to read the amount of the intensity of light that hits the object then reflected back to the sensor, after that converted into an electrical signal to the microcontroller to control the stepper motor in order to choose containers and color of objects to match each other. Design and experiments of this research can be used as a basis for practiced mechatronics engineering laboratory. In addition, the machine can be used as a model for related industries of colored sorting. From the result, it can be shown that the sorting machine classified the colored objects as red, green, blue and other color with high accuracy. The average time of the test objects is 9.96, 13.47, 16.58 and 9.04 seconds for objects as red, green, blue and other

Mahesh Nagane. [25]In many packaging industries, color object sorting is the major task that needs to be done at final dispatch section. Sorting of various products in such industries is accomplished based on appearance i.e. color, shape and sizes. Manual sorting is the tradition approach that preferred by industries that involves visual inspection performed by human operators. This traditional approach is tedious, time-consuming, slow and non-consistent. It has become increasingly difficult to hire personnel who are adequately trained and willing to undertake the tedious task of inspection. Therefore the efforts are made to design and implementation of automatic technique to determine color of object, color based component sorting using microcontroller. In implemented system, colored object which is rolling over a conveyer belt has been detected by using color sensors. Using color sensors, the color of a component which may be red, green or blue has been determined. Once the color of a component is determined, implemented system will automatically count and sort the objects as per its color

CHAPTER 3

DESIGN AND CONSTRUCTION

3.1 2D Drawing

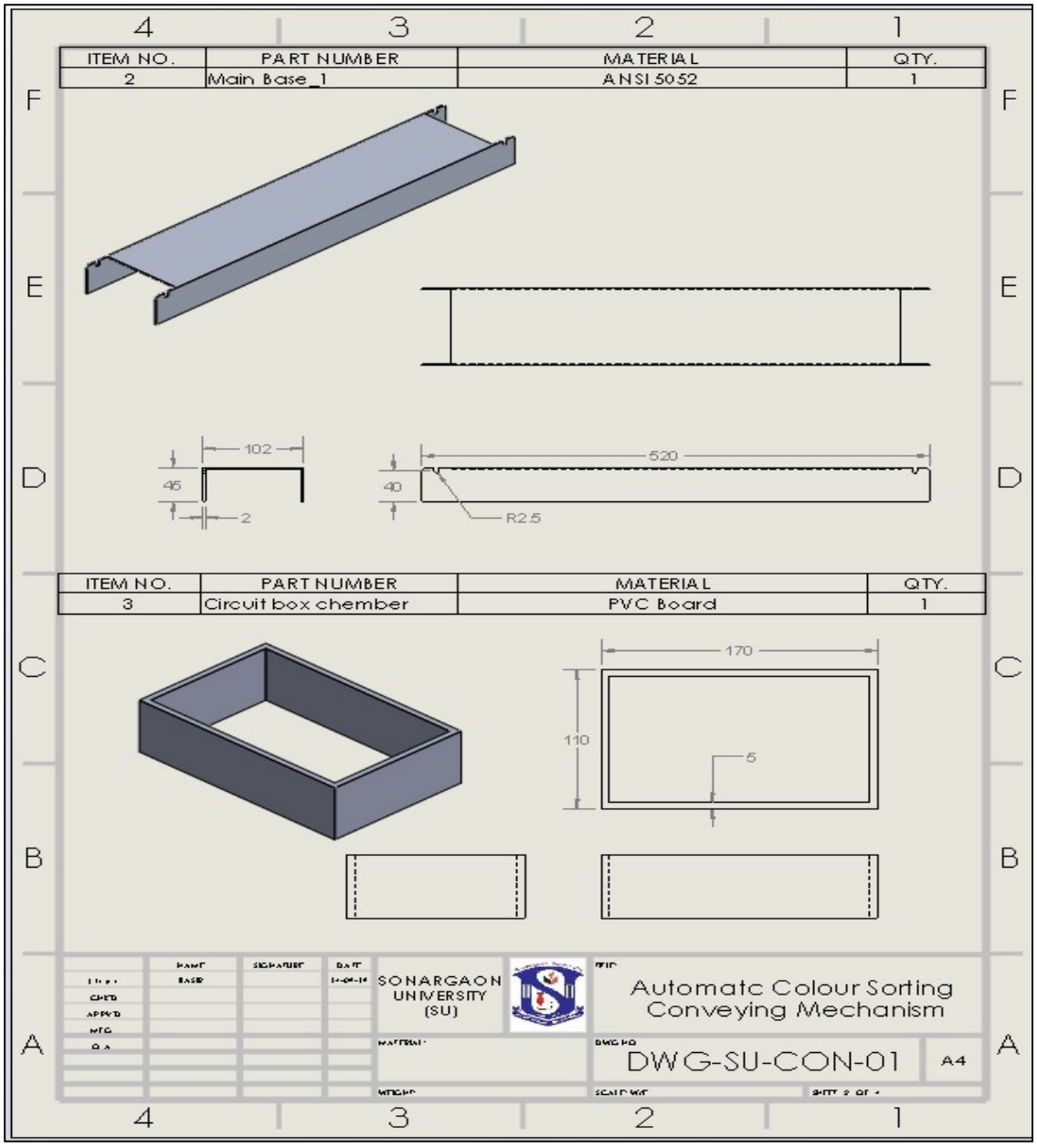


Figure 3.1: 2D Drawing Sheet 1.

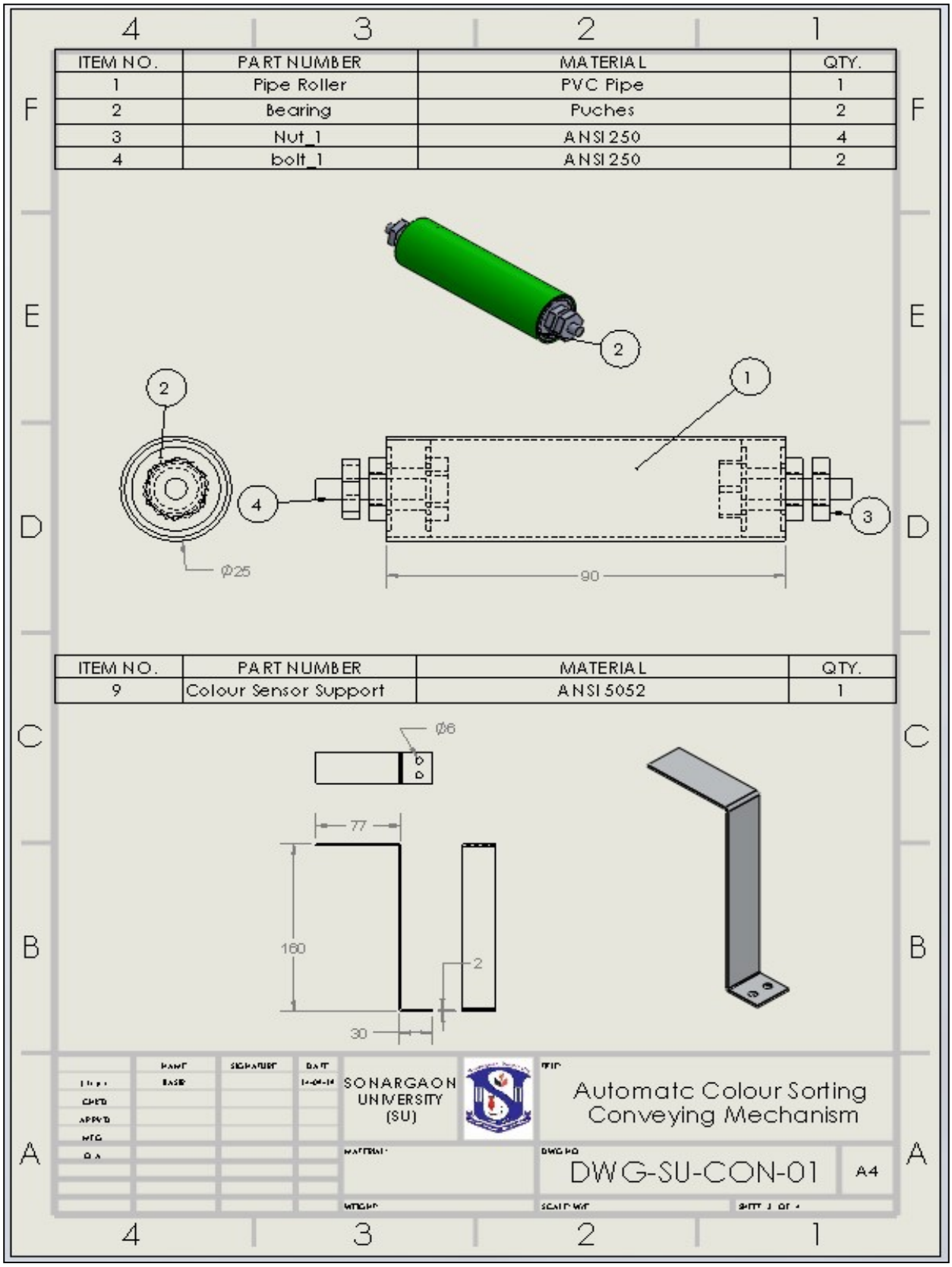


Figure 3.2: 2D Drawing Sheet 2.

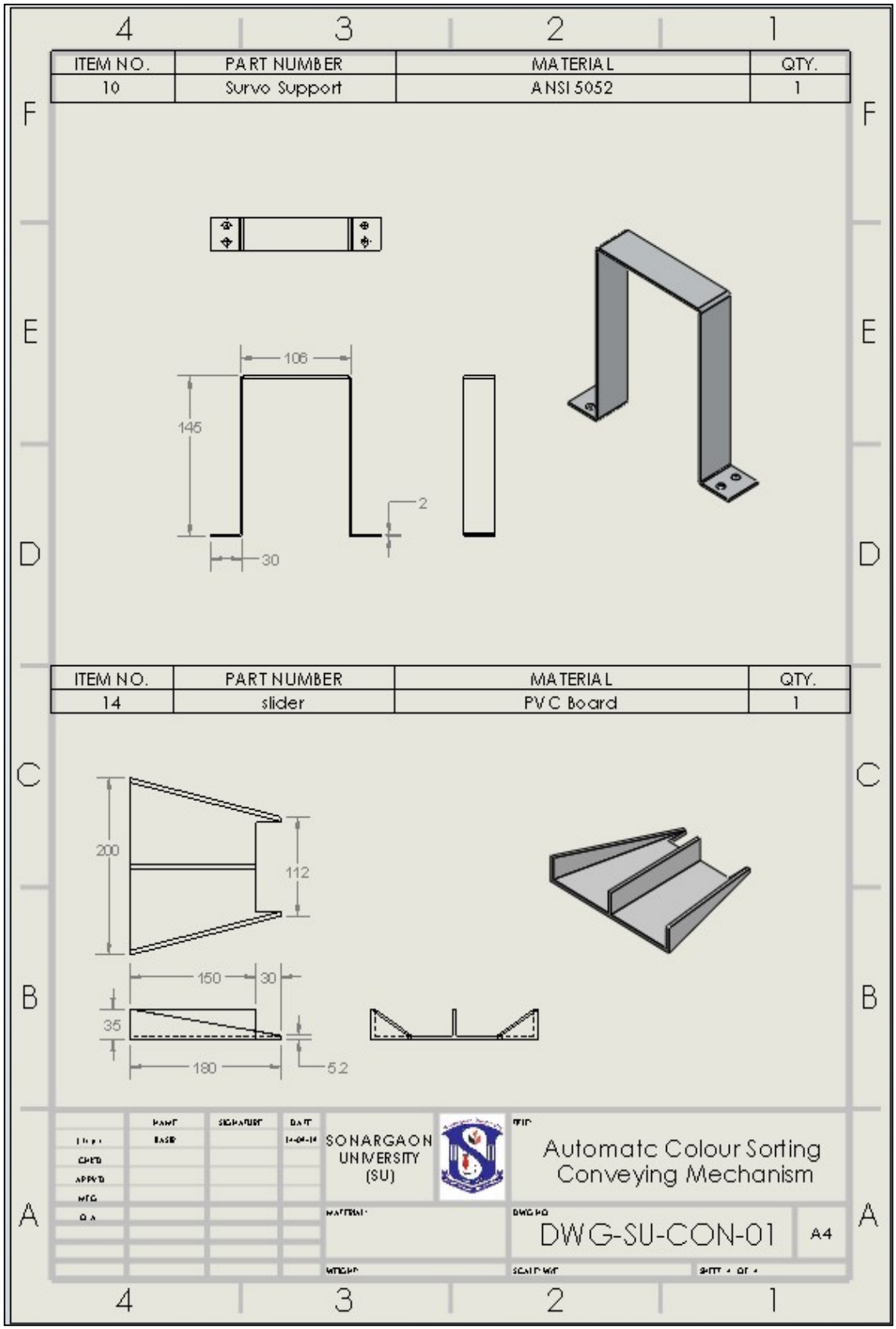
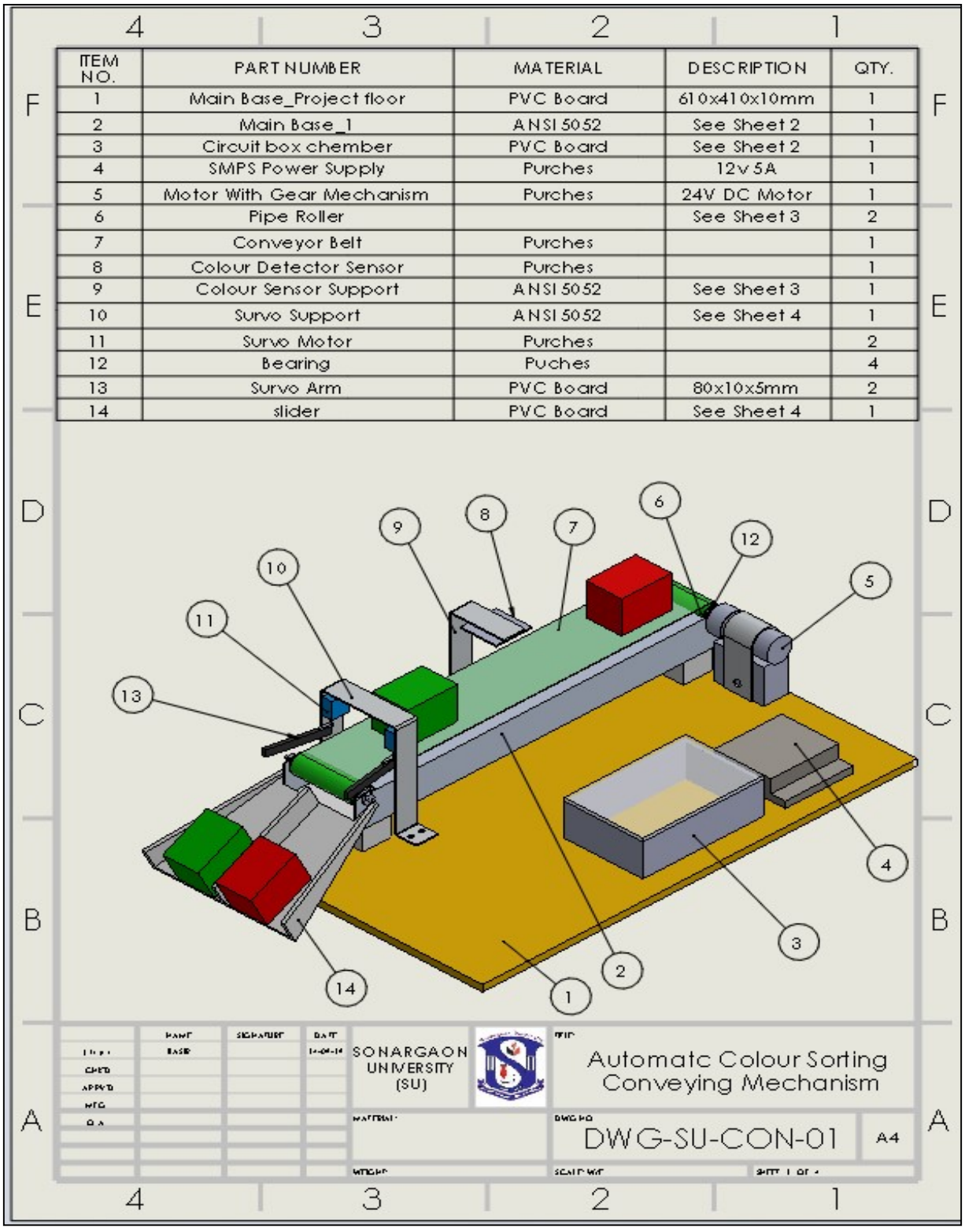


Figure 3.3: 2D Drawing Sheet 3

3.2 3D Assembly Drawing



ITEM NO.	PART NUMBER	MATERIAL	DESCRIPTION	QTY.
1	Main Base_Project floor	PVC Board	610x410x10mm	1
2	Main Base_1	ANSI 5052	See Sheet 2	1
3	Circuit box chember	PVC Board	See Sheet 2	1
4	SMPS Power Supply	Purches	12v 5A	1
5	Motor With Gear Mechanism	Purches	24V DC Motor	1
6	Pipe Roller		See Sheet 3	2
7	Conveyor Belt	Purches		1
8	Colour Detector Sensor	Purches		1
9	Colour Sensor Support	ANSI 5052	See Sheet 3	1
10	Servo Support	ANSI 5052	See Sheet 4	1
11	Servo Motor	Purches		2
12	Bearing	Puches		4
13	Servo Arm	PVC Board	80x10x5mm	2
14	slider	PVC Board	See Sheet 4	1

Figure 3.4: 3D Assembly Drawing.

3.3 Our Prototype Output:

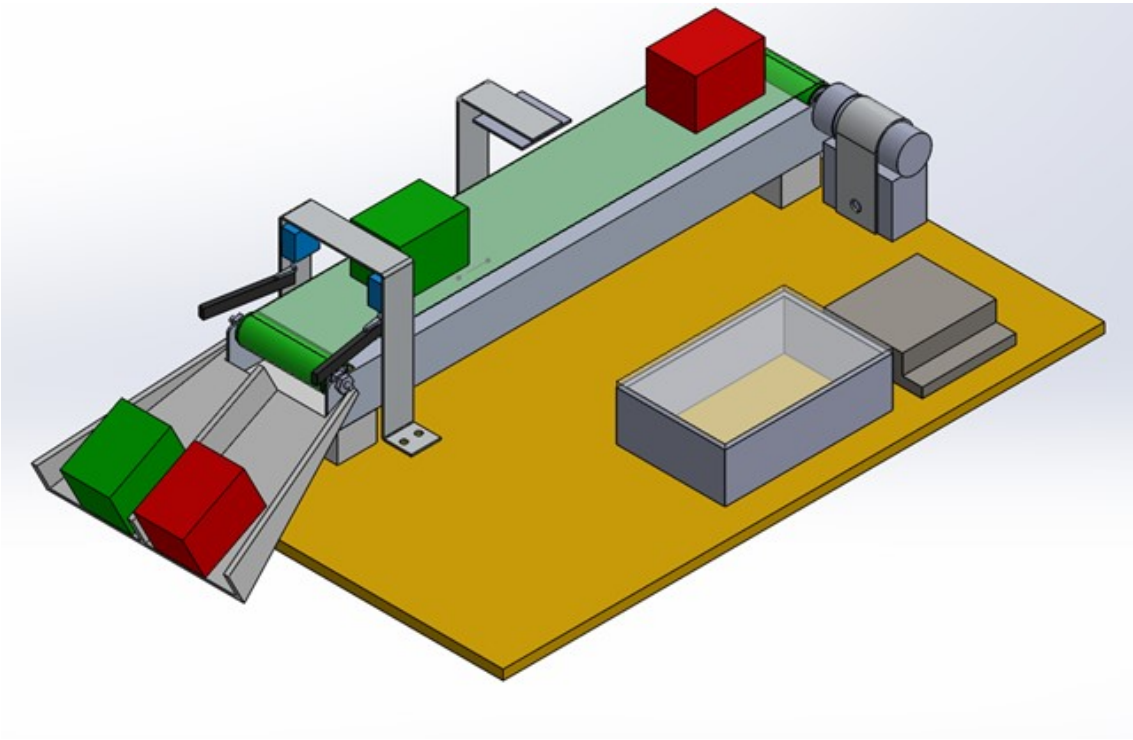


Figure 3.5: 3D Final Prototype of our Project.

3.4 Working Principle:

The proposed system is designed for automatic sorting of Red and Green colored products. The prototype consists of one DC motors, one conveyor belt, a Arduino Nano two servos and a color sensing circuit using TCS230(Figure 3.4). DC motors are used to control the conveyor belts. After integrating the programmed Arduino and the TCS230 circuitry with the structure of the model, we measure the frequency of signals corresponding to each color by observing them on a CRO. Based on the study the timer delay value is adjusted by reprogramming the Arduino. The time required for the product to reach the corresponding container in the separator placed servo motor. Here we used two servos for separation individual color product. When color sensor sensing individual color product then servo changes their direction &the product goes specific box. Finally, we check its & we observed this system works great.

3.5 Block Diagram:

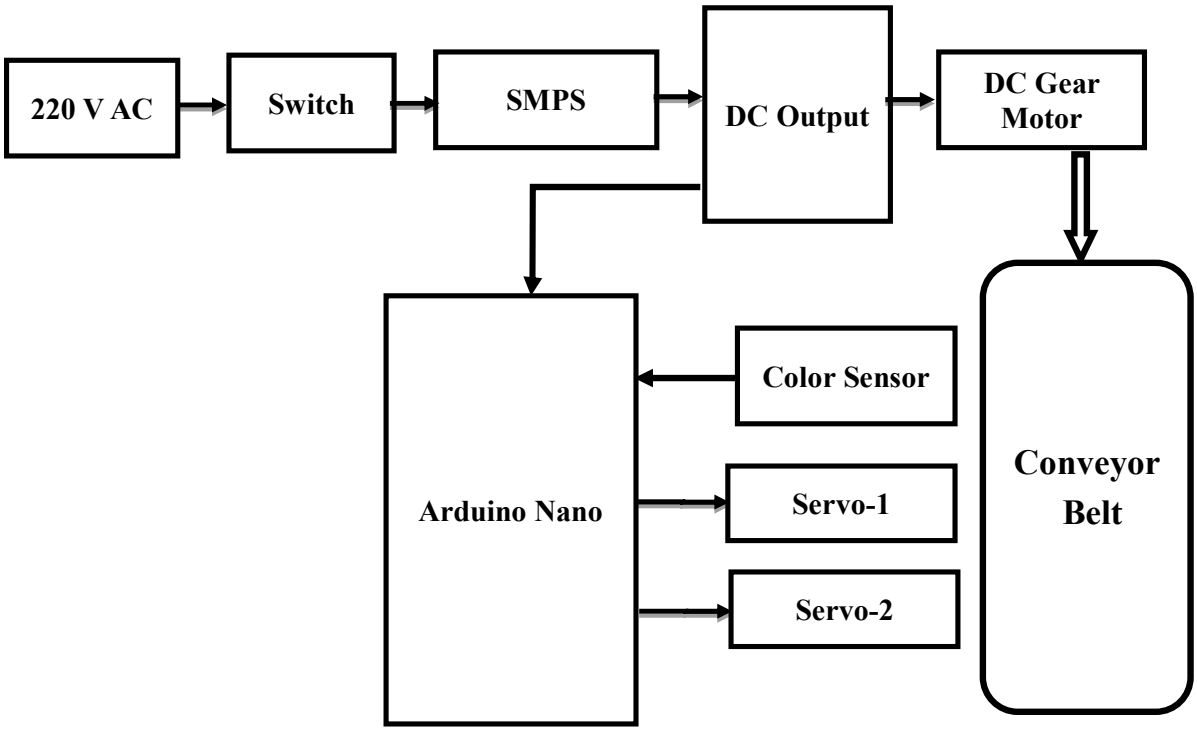


Figure 3.6: Block Diagram of Color Sorting System

220V AC supply to SMPS by a switch which will control AC supply on/off. From SMPS a line go to DC Gear motor of conveyor and a line go to Arduino Nano. Color sensor detects color and gives input into Arduino Nano. Arduino Nano receive input signal and give output signal to servo-1 or servo-2 according to the program code.

3.6 Circuit Diagram:

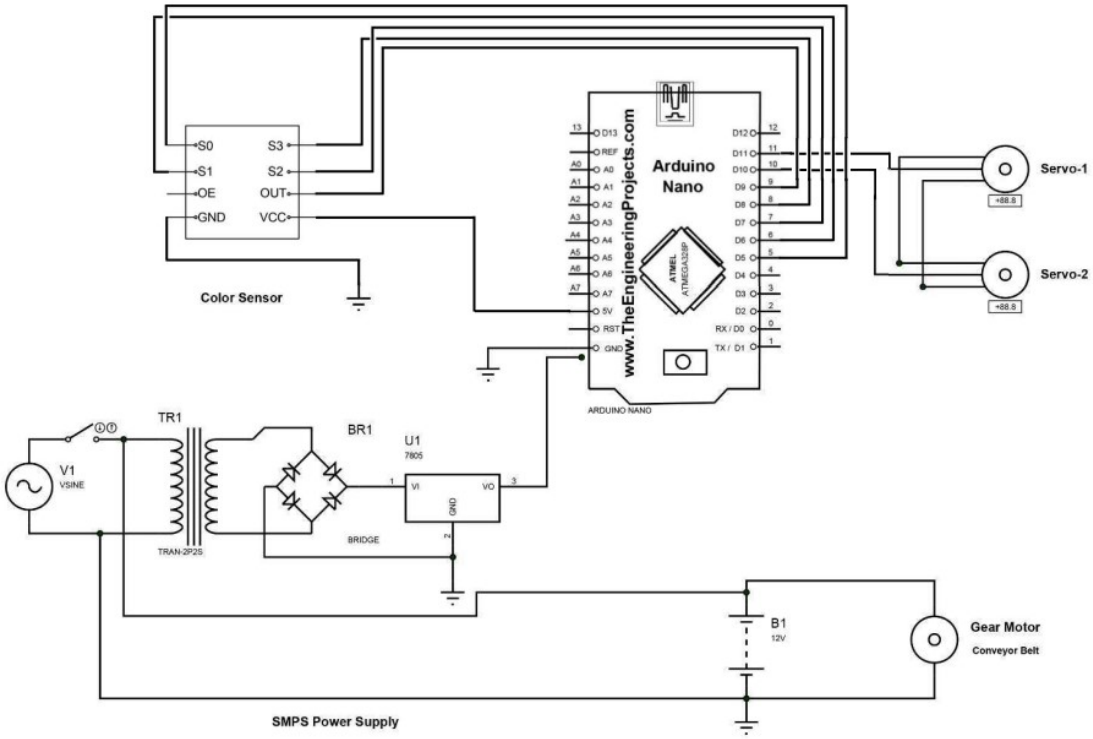


Figure 3.7: Circuit Diagram of Color Sorting System

From SMPS V+ connect in Vin and V- connect in GND of Arduino. Also two lines connected in gear motor from SMPS. The port of color sensor S0,S1,S2,S3,OUT,VCC and GND respectively connected in D5,D6,D7,D8,D9,5V and GND port of Arduino. Servo-1 connected in D11 and servo-2 connected in D10 pin of Arduino.

3.7 Practical Figures



Figure 3.8: Under Construction-1

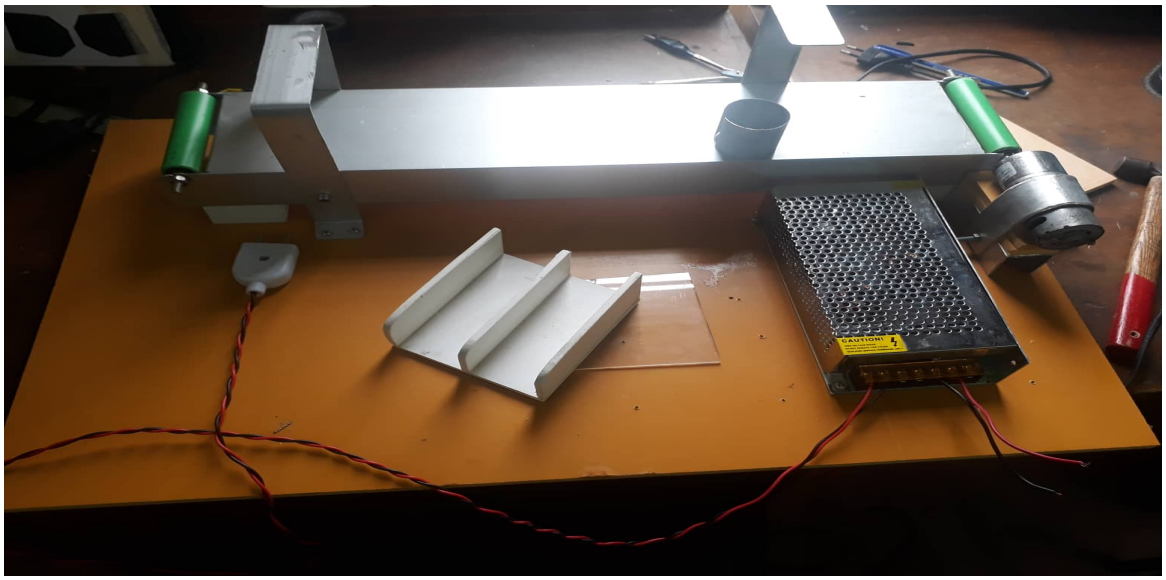


Figure 3.9: Under Construction-2

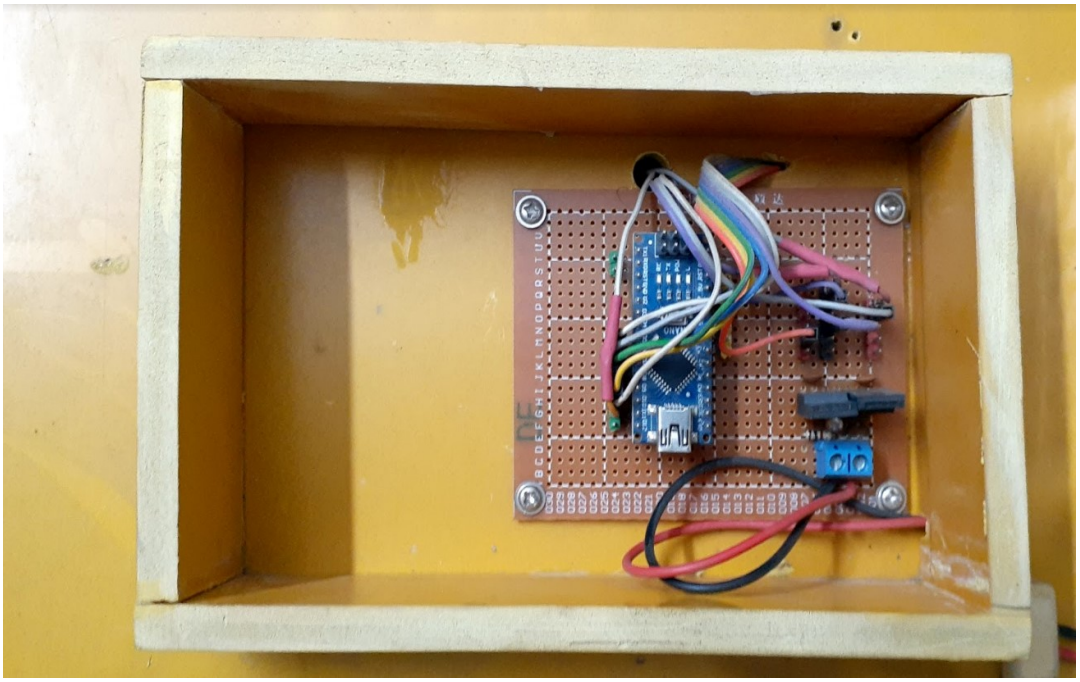


Figure 3.10: Circuit Board

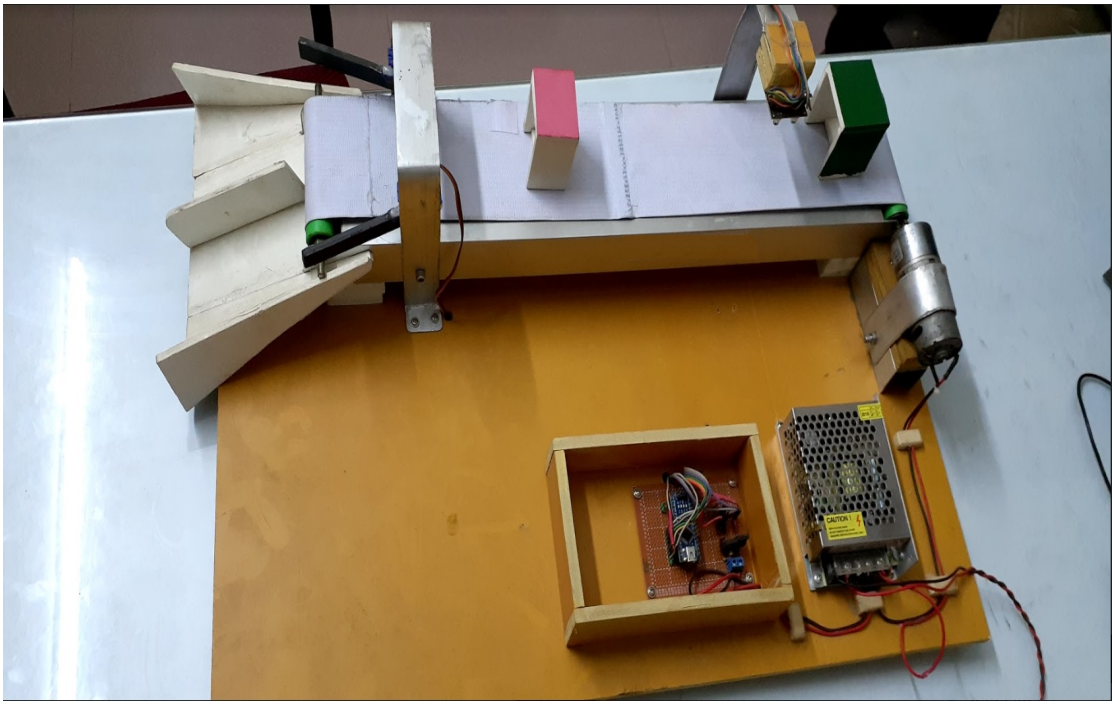


Figure 3.11: Final Output

3.8 Application

The project has major application in

- Sorting the product according to their color.
- Ensuring quality control in mass production.
- By some modification it can be used to detect any colored object.
- By some modification it can be used to measure the dimension of a product.
- By increasing its sensing capacity, it can be used in airport.
- It is also very useful in laboratories and workshops.
- It's can be widely used any productive industry.

3.9 Methodology

In this project we have used switch mode power supply (SMPS). We supply input 220v AC to SMPS, the SPMS convert 220v AC to 12V pure DC. This12V DC we provide directly to our DC gear motor which operate a conveyor belt. From conveyor color sensor detect the color of the product and send an input signal to Arduino. Then Arduino send a output signal to the servo-1 or servo-2 to rotate clockwise or anticlockwise in a specific angel according to the detected color and by this way servo sort the object according to the color. Here a regulator IC reduces 12v DC to 5v DC and give power to Arduino Nano.

3.10 List of Components with Price:

Sl.no	Particulars	Specification	Qty.	Unit Price (Taka)	Total Price (Taka)
1	Arduino Nano	At mega 328p	1	450	450
2	Color Sensor	TCS230	1	850	850
3	Gear Motor	12 volt DC	1	700	700
4	Servo Motor	1kg	2	320	640
5	SMPS	12volt	1	950	950
6	PCB		1	120	120
7	Others				2500
				Total	6210/=

Table 3.1: List of Components with Price

CHAPTER 4
HARDWARE ANALYSIS

4.1 Arduino Nano

Arduino is an 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.

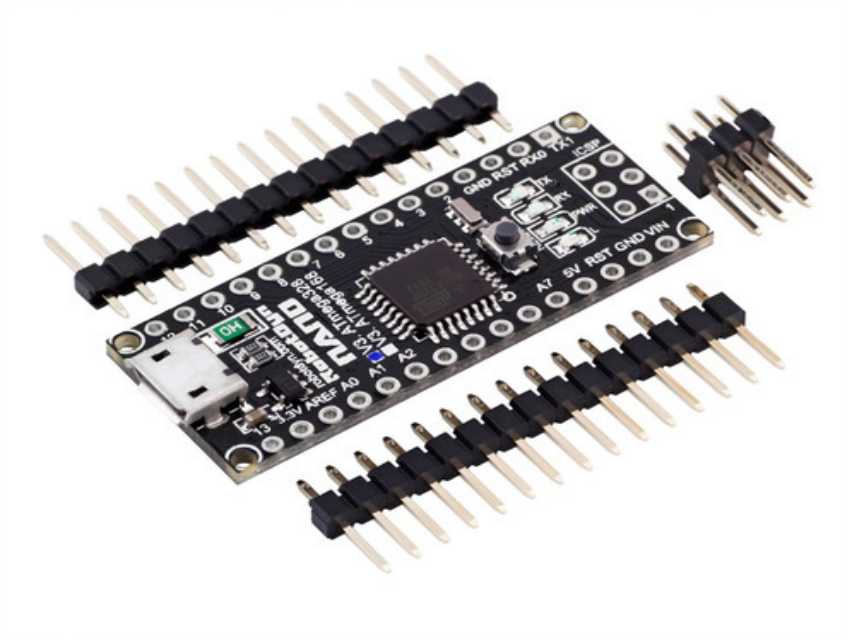


Figure 4.1:Arduino Nano

The microcontroller 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, Max MSP).
Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. It has everything that Diecimila/Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is

missing power jack. The Nano is automatically sense and switch to the higher potential source of power.

Nano's got the breadboard-ability of the Boarduino and the Mini+USB 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, 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 is two layers. That make it easier to hack and more affordable.[ref 1,2]

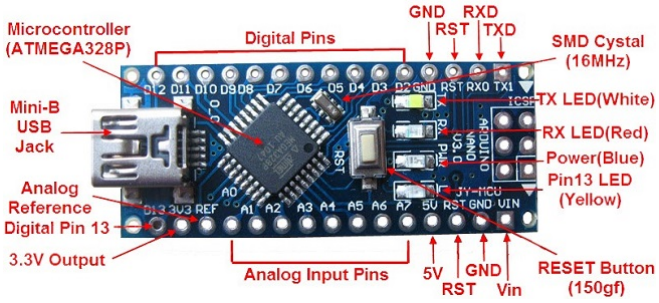


Figure 4.2: Section of Arduino Nano.

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"

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

• Standard 0.1 spacing DIP (breadboard friendly)

• Manual reset switch

Microcontroller IC ATmega328p:

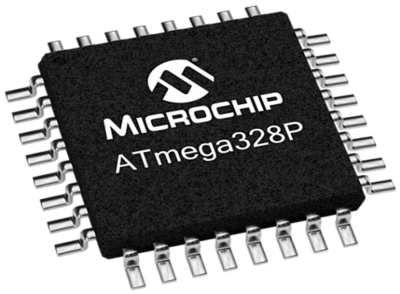


Figure 4.3: Microcontroller IC AT mega 328p.

The high-performance Microchip Pico Power 8-bit AVR RISC-based microcontroller 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 throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.[ref 3]

4.2 Color Sensor

The TCS3200 is a color sensor which has an array of photodiodes. To detect color, the photodiodes are arranged in groups of four with red, green, or blue filters on three of the photodiodes and no filter on the fourth. This allows the sensor to measure the amount of red, green, blue, and white light that hits the sensor. [ref 4,5]



Figure4.4: TCS3200 Color Sensor Module

4.3 SMPS Power Supply:

A switched-mode power supply 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 to DC loads, such as a personal computer, while converting voltage and current characteristics.



Figure 4.5: SMPS Power Supply

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. Ideally, a switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time. 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.[ref 6]

4.4 DC Gear Motor:

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters in regards to gear motors are speed (rpm), torque (lb-in) and efficiency (%). In order to select the most suitable gear motor for your application you must first compute the load, speed and torque requirements for your application. ISL Products offers a variety of Spur Gear Motors, **Planetary Gear Motors** and Worm Gear Motors to meet all application requirements. Most of our DC motors can be complimented with one of our unique gearheads, providing you with a highly efficient gear motor solution.[ref 7]

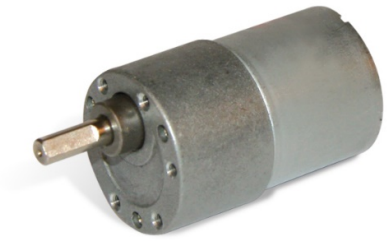


Figure 4.6: DC gear Motor

4.5 Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system.[ref 8]



Figure4.7: Servo Motor.

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.

The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

The very simplest servomotors use position-only sensing via a potentiometer and bang-bang control of their motor; the motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models.[ref 9]

4.6 Capacitor:

When there is a potential difference across the conductors (e.g., when a capacitor is attached across a battery), an electric field develops across the dielectric, causing positive charge (+Q) to collect on one plate and negative charge (-Q) to collect on the other plate. If a battery has been attached to a capacitor for a sufficient amount of time, no current can flow through the capacitor. However, if an accelerating or alternating voltage is applied across the leads of the capacitor, a displacement current can flow.



Figure4.8: Capacitor

An ideal capacitor is characterized by a single constant value for its capacitance. Capacitance is expressed as the ratio of the electric charge (Q) on each conductor to the potential difference (V). The SI unit of capacitance is the farad (F), which is equal to one coulomb per volt (1 C/V). Typical capacitance values range from about 1 pF (10−12 F) to about 1 mF (10−3 F).The capacitance is greater when there is a narrower separation between conductors and when the conductors have a larger surface area. In practice, the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, known as the breakdown voltage. The conductors and leads introduce an undesired inductance and resistance. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems they stabilize voltage and power flow.
[ref 10]

4.7 Resistor:

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the sometime, act to lower voltage levels within circuits. Resistors may have fixed resistances or variable resistances, such as those founding thermostats, visitors, trimmers, photo resistors, hamsters and potentiometers. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This relationship is represented by Ohm's law



Figure.4.9: Resistor

Theory of operation

The behavior of an ideal resistor is dictated by the relationship specified by Ohm ‘slaw:

$$V = I.R$$

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I), where the constant of proportionality is the resistance (R).

Equivalently, Ohm's law can be stated:

$$I = V/R$$

This formulation states that the current (I) is proportional to the voltage (V) and inversely proportional to the resistance (R). This is directly used in practical computations. For example, if a 300-ohm resistor is attached across the terminals of a12 volt battery, then a current of12 / 300 = 0.04 amperes flows through that resistor.[ref 11]

CHAPTER 5
SOFTWARE DESCRIPTION

5.1 Arduino software

The smart microcontroller unit named as Arduino Uno can be programmed with the Arduino software. 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 your board).The IC used named as ATmega328 on the Arduino Uno comes pre burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer.

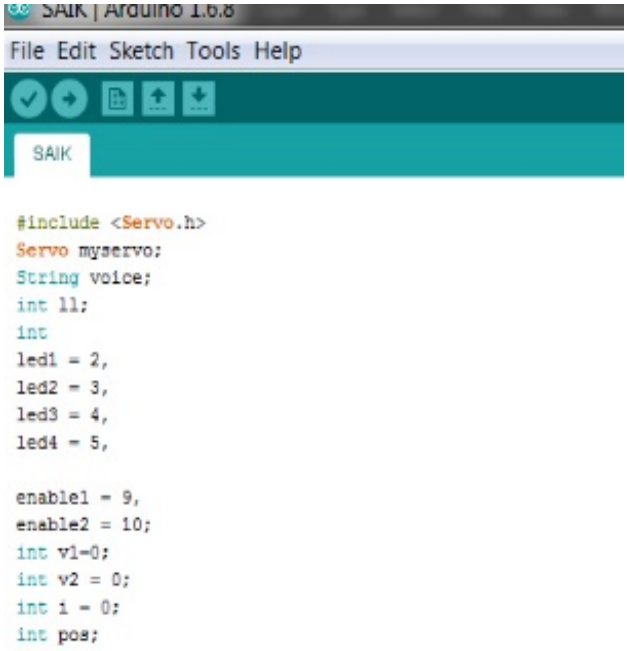


Figure 5.1**:** Arduino Software Interface IDE.

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 smart 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 .inf 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's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus. Arduino programs are written in C or C++ and the program code written for Arduino is called sketch. The Arduino IDE uses the GNU tool chain and AVR Libc 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. [ref 12,13]

5.2 Proteus:

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990, with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and microcontroller simulation then arrived in Proteus in 1998. Shape based auto routing was added in 2002 and 2006 saw another major product update with 3D Board Visualization. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Support for high speed design was added in 2017.Feature led product releases are typically biannual, while maintenance based service packs are released as required.[ref14]

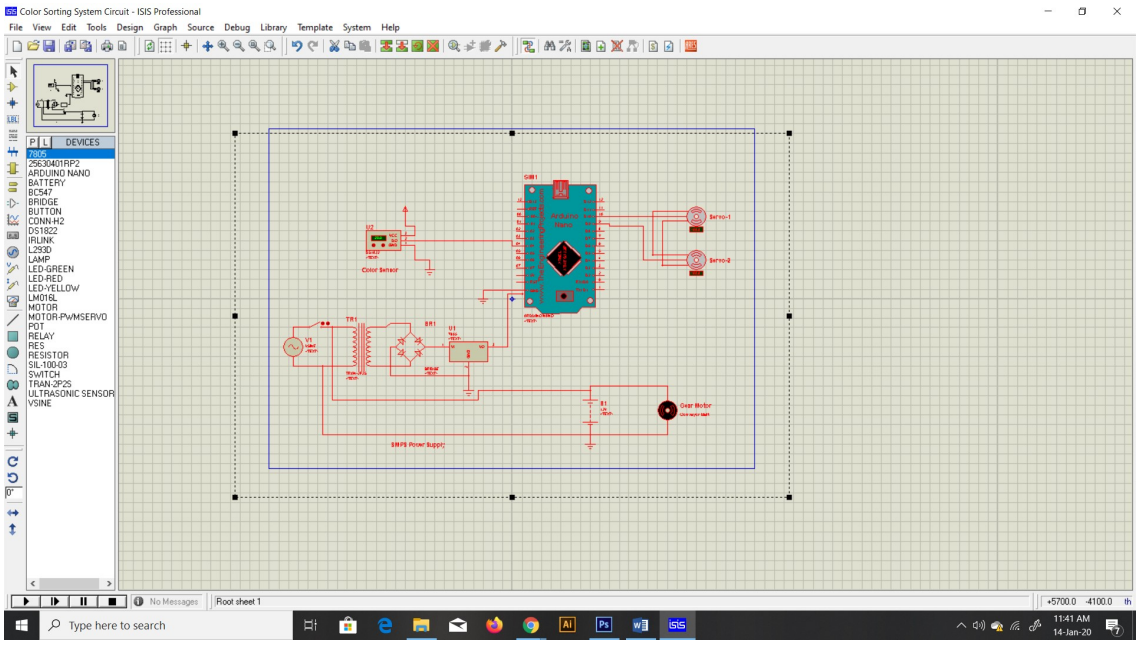


Figure 5.2: Proteus Software

5.3 Circuit Test

The 3D Viewer module allows the board under development to be viewed in 3D together with a semi-transparent height plane that represents the board's enclosure. **STEP** output can then be used to transfer to mechanical **CAD** software such as Solid works or Autodesk for accurate mounting and positioning of the board.

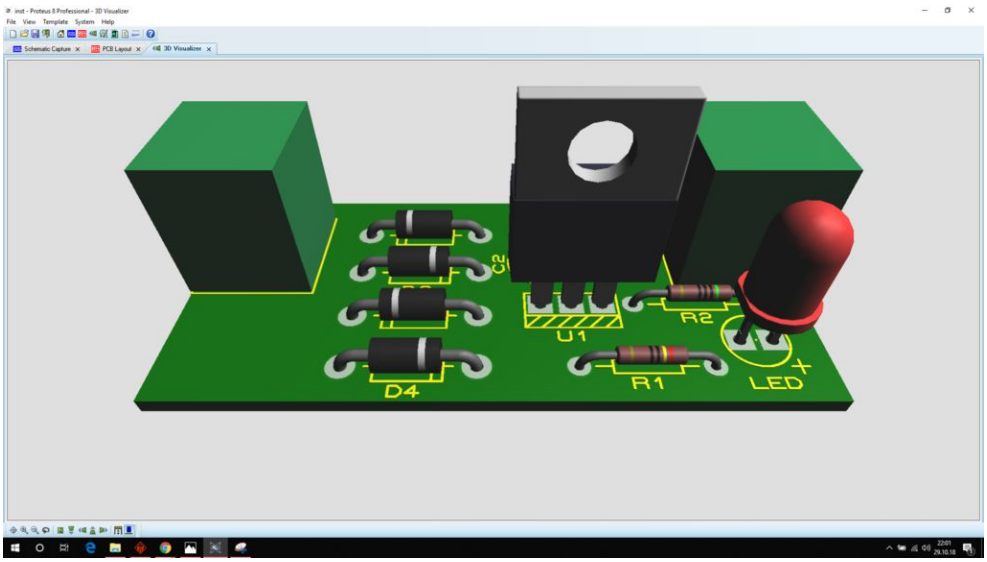


Figure 5.3: 3D verification

CHAPTER 6
RESULT& CONCLUSION

6.1 Result

The final result of the project was quite satisfactory. The color detecting sensor worked well and it was able to detect red and green color nicely and the sorting of the object with the help of servo arm was also done in proper direction. DC motors worked well in conveyor belt. The movement of the belt was smooth without any conflicts. The overall system performed well as programmed and detects objects according to their color. The program sometime does not work well when found variation of lights because the color sensor is not powerful as professional sensor. So the sensor sometime detects the color with different color code and make problem in program. Our porotype can sort 10 object/min. So 600 object/hr.

6.2 Conclusion

For sorting object in industry, optical sorting is very much convenient. Color and size are the most important features for accurate classification and sorting of product which can be done by using some optical sensors or analyzing their pictures. The color sorting machine is mainly a device that can sense the different color of the object and assert them into different belt conveyor. When object moves from one place to another with the rotation of conveyor belt, sensors as the input devices will send signal to microcontroller where microcontroller as the controller will give command to the actuator to do action. The final result was quite satisfactory. The color detecting sensors worked well and it was able to detect red green object quite nicely and change the direction of servo on right and left side to sort the object in proper place. The belt moved from starting point to the end point through the roller without conflicting with the walls. The system performed well as programmed and detects the object according to their color.

6.3 Future Scope

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

- Can be sort more object by adding servo motor and small modification of program.
- Can be add a load cell for measurement and control of weight of the product.
- Can be also add a counter for counting the number of products.
- The Arduino can be replaced with PLC.

CHAPTER 7
REFERENCE

Open-source electronic prototyping platform. [Online]

1. https://www.arduino.cc/en/guide/introduction
2. https://components101.com/microcontrollers/arduino-nano
3. https://www.microchip.com/wwwproducts/en/ATmega328p
4. https://randomnerdtutorials.com/arduino-color-sensor-tcs230-tcs3200/
5. https://components101.com/tcs3200-color-sensor-module
6. https://en.wikipedia.org/wiki/Switched-mode_power_supply
7. https://www.islproducts.com/designnote/dc-motor-dc-gearmotor-basics/
8. https://www.tutorialspoint.com/arduino/arduino_servo_motor.htm
9. https://en.wikipedia.org/wiki/Servomotor
10. https://learn.adafruit.com/circuit-playground-c-is-for-capacitor/what-is-a-capacitor.
11. https://en.wikipedia.org/wiki/Resistor
12. https://www.arduino.cc/en/main/software
13. https://en.wikipedia.org/wiki/Arduino_IDE
14. https://en.wikipedia.org/wiki/Proteus_Design_Suite
15. Mike McRoberts
    Edition-2010
    Beginning Arduino
16. Alan G. Smith
    First Edition-2009
    Introduction to Arduino
17. Robert boylestad
    11th Edition-2011
    Electronic devices and circuit theory
18. https://www.researchgate.net/publication/270878911_DEVELOPMENT_OF_AN_AUTOMATIC_COLOR_SORTING_MACHINE_ON_BELT_CONVEYER
19. https://ijmter.com/published_special_issues/07-02-2015/automatic-color-object-sorting-system.pdf

20. http://journals.saintgits.org/paper-submission/uploads/article/V2%20I2%2005.pdf
21. https://www.sciencedirect.com/science/article/pii/S2215098616302105
22. https://www.academia.edu/34232165/Design_and_Development_of_Automatic_Conveyor_Controlling_System_for_Sorting_of_Component_on_Color_basis
23. http://www.ijmerr.com/v3n1/ijmerr_v3n1_9.pdf
24. https://www.scientific.net/AMR.1025-1026.156
25. https://www.academia.edu/34232165/Design_and_Development_of_Automatic_Conveyor_Controlling_System_for_Sorting_of_Component_on_Color_basis

Program Code:

Program is the brain of our project. Arduino is an open-source computer hardware which works on the program's instructions.

```
#include <Servo.h>
Servo pickServo;
Servo dropServo;
constint S0 = 5;
constint S1 = 6;
constint S2 = 7;
constint S3 = 8;
constintsensorOut = 9;
int frequency = 0;
int color=0;

intdetectColor() {
  // activating red photodiodes to read
digitalWrite(S2, LOW);
digitalWrite(S3, LOW);
frequency = pulseIn(sensorOut, LOW);
int R = frequency;
Serial.print("Red = ");
Serial.print(frequency);//printing RED color frequency
```

```
Serial.print("    ");
delay(50);
  // activating green photodiodes to read
digitalWrite(S2, HIGH);
digitalWrite(S3, HIGH);
  // Reading the output frequency
frequency = pulseIn(sensorOut, LOW);
int G = frequency;
Serial.print("Green = ");
Serial.print(frequency);
Serial.println("    ");
delay(50);

delay(50);

if(R < 400){
color = 1; // Red
Serial.print("Detected Color is = ");
Serial.println("RED");
pickServo.write(45);
delay(5000);
  }
if(R > 400){
pickServo.write(0);
}
if(R > 1000){
color = 2; // Green
Serial.print("Detected Color is = ");
Serial.println("GREEN");
dropServo.write(130);
delay(5000);
  }
if(R < 1000){
color = 3; // Green
```

```
dropServo.write(180);
  }
return color;
}

void setup() {
pinMode(S0, OUTPUT);
pinMode(S1, OUTPUT);
pinMode(S2, OUTPUT);
pinMode(S3, OUTPUT);
pinMode(sensorOut, INPUT);
digitalWrite(S0, LOW);
digitalWrite(S1, HIGH);
pickServo.attach(10);
dropServo.attach(11);
Serial.begin(9600);
}
void loop() {
color = detectColor();
delay(500);
color=0;
}
```