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**Automatic Filling And Capping Machine Using Arduino Project**

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**ABSTRACT**

The current state of industries is to embrace new technologies to proceed towards automation. The identical vision is exercised in bottle-filling and capping plants. To help small-scale industries all operations are nearly automated. And in small-scale industries, the operations are still carried out by humans which involved some imperfections. The automation of bottle filling involves the use of PLC which are used in large-scale industries and are very costly.The study emphasizes on reduction in cost using the Arduino micro-controller. The manual filling process has many problems like spilling water while filling it in a bottle, etc. This work generally emphasizes small industries and we aim to make these small-scale industries more efficient and to eliminate problems faced by small-scale bottle filling industries. With this technique that operates automatically, every process can be smooth and the process of refilling will cut back the hands price and operation time.

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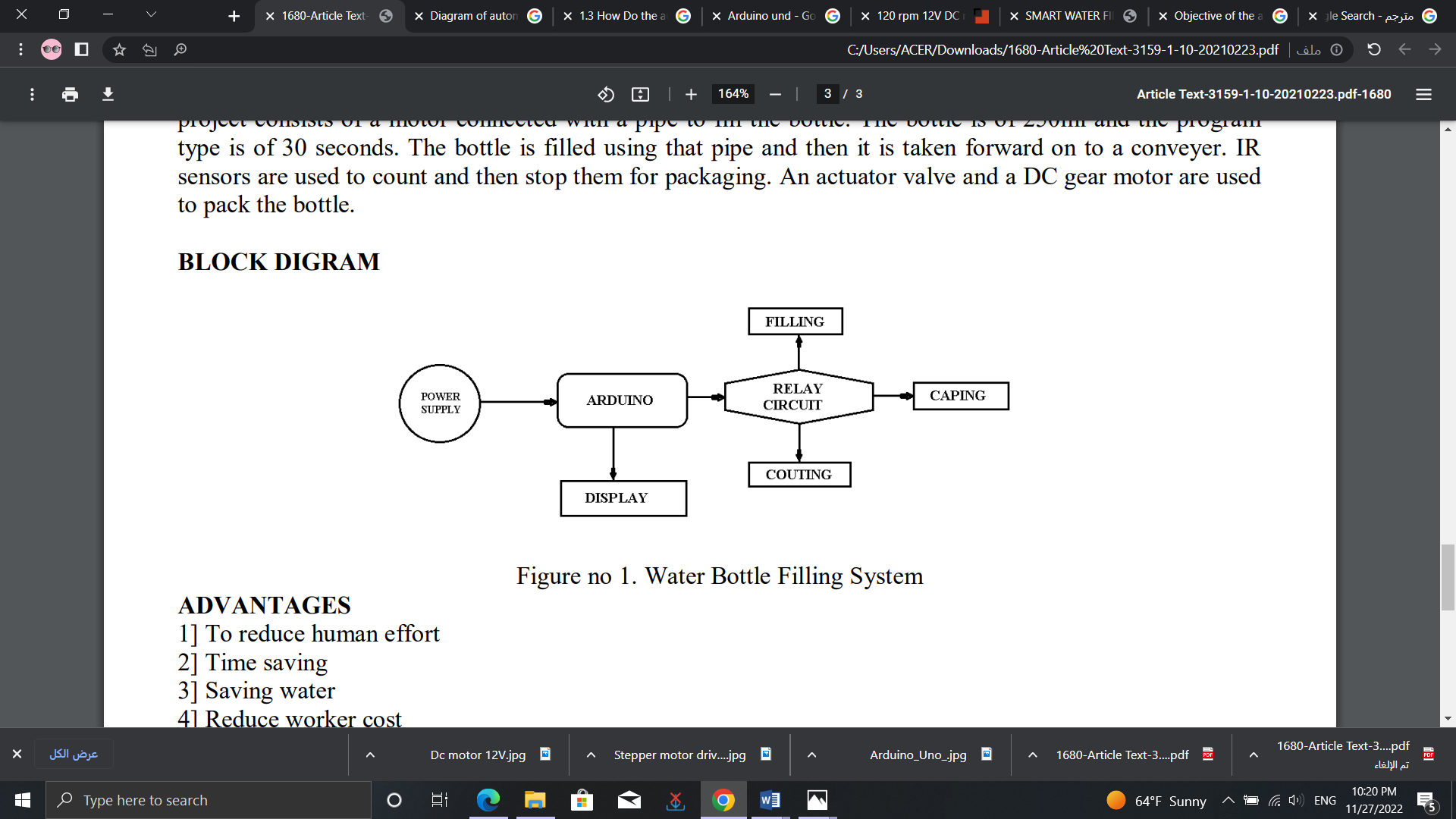
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# CHAPTER 1: WHAT IS THE AUTOMATIC BOTTLE FILLING AND CAPPING MACHINE SYSTEM USING ARDUINO

## Introduction

The Automation has a major impact in a wide range of industries and it plays a vital role in the development of various industries. The filling task is carried out by a machine to package liquid products. In past, humans were involved in the process of production. More recently, machines have taken over production of medicines, vaccines , chemical plants, etc. Micro controllers are now majorly used in many embedded systems to perform dedicated functions. The common use of micro-controllers is to make simple logical control decisions. The automation in the bottle filling industry comes with increasing demand currently and in the future. Each component in the system is important to be studied in ordered to comprehend how each part works in the system. This study mainly includes the designing and a control system for an automated bottle filling system which can be an alternative to or plc in the market in an affordable price.The control system which includes C programming in Arduino micro-controller is used to control various components in the system. For this purpose a conveyor system with sensors and an electromagnetic valve is fabricated. The entire sequence of operations is controlled by an Arduino micro-controller. The manual filling process in small scale industries are facing many problems because the operations are done manually. This problem faced by small industries compiles to design this system. This system is meant for small scale industries. It aims to eliminate problems faced by small scale industries which involve filling of bottles. With the help of this system that is automated every process can be done effortlessly and the cost be reduced and the production will be more efficient. [1]

Automatic bottle filling is the simplest project that we have seen nowadays. In industries that have a project like this are PLC-based projects and it is very expensive. The price of one PLC is around 1 to 2 lakh, and it is very expensive for the general people. So we have made a project on the automatic bottle filling system using Arduino UNO. The objective of this project, automatic bottle filling system using a Arduino microcontroller. [2]



## The Main Purpose of the Project

* To provide easy access to the company which cannot afford plc and are in need of an alternative which they can afford.
* This type of project is mainly used in the sanitizer and medicine manufacturing company in which liquid is Automatically Filled in the Bottle.

# CHAPTER 2

## Motivation

1. In small industries bottle filling operation is done manually. The manual filling operation has many shortcomings like spilling of water while filling it in bottle, equal quantity of water may not be filled, delay due to natural activities of human etc. This problem faced by small industries compels to design this system. This proposed system is meant for small industries. It aims to eliminate the problem faced by small scale bottle filling system for smooth process and can reduce worker cost and operation cost.

## Methodology

### **Equipment:**

1. 2\* DC motor (12v).
2. 1\* Stepper motor (12v) and Driver.
3. 1\*Micro Servo Motor.
4. 1\*Air Pump.
5. 1\* DC Submersible Water Pump.
6. 4\*Relay Module (5v).
7. 1\*Arduino Uno.
8. 1\*8mm shift 40cm
9. 1\* 20×4 LCD.
10. Wires.
11. 1\*Infrared Radiation.
12. 2\*Moving Columns 40cm.
13. 2\* Moving Columns 15cm.
14. 6\*Axis Mount.
15. 6\*Linear Bushing.
16. \*4Roller Bearing.
17. IR Infrared Sensor Module**.**
18. A4988 motor driver.

### **Procedures:**

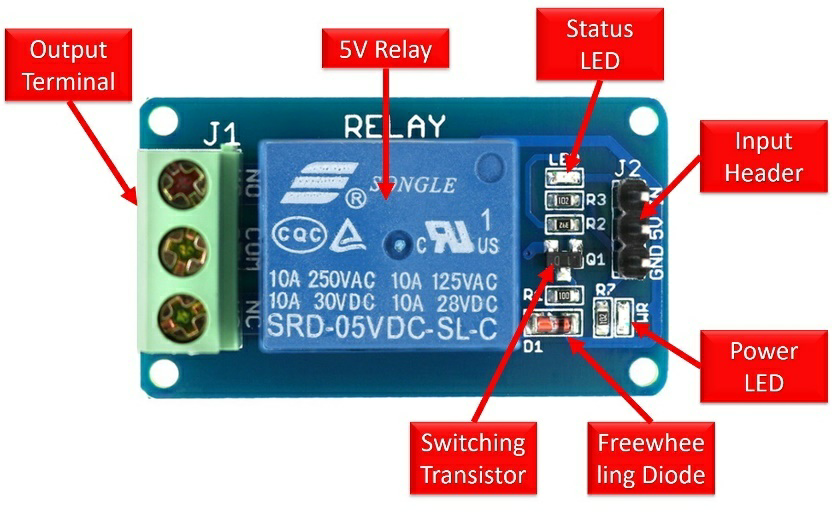
* + - 1. First of all we have the stepper motor:

Connect the black wire with 1B, the yellow wire with 1A, the second yellow wire with 2A, the red wire with 2B, GND with the right negative of the capacitor, Vmot with 12v, VDD with 5v, GND with GND of Arduino, SETEP with pin (11) and DIR with pin(10) and SLEEP with RESE.

* + - 1. Servo motor: Brown to GND, Red to 5v, and Yellow to pin(3).
      2. IR Sensor1:pin2 to GND, pin1 to 5v, and pin3 to pin(12).
      3. IR Sensor2 : pin2 to GND, pin1 to 5v, and pin3 to pin(13).
      4. DC Motor1:connect the positive wire to 12v power and the negative wire to the right outlet of Relay module GND of 12v power to the middle outlet of relay module on the upper side And on the lower side entries The first input is connected with 5vThe second input is with GND and the third input is with pin(2).
      5. DC Motor2: Connect the positive wire to 12v power and the negative wire to the right outlet of Relay module GND of 12v power to the middle outlet of relay module on the upper side,and on the lower side entries the first input is connected with 5vthe second input is with GND and the third input is with pin (5).

1. Water pump: connect the positive wire to 12v power and the negative wire to the right outlet of Relay module GND of 12v power to the middle outlet of relay module on the upper side, and on the lower side entries the first input is connected with 5v, the second input is with GND and the third input is with pin(4).

Air pump: connect the positive wire to 12v power and the negative wire to the right outlet of Relay module GND of 12v power to the middle outlet of relay module on the upper side,and on the lower side entries the first input is connected with 5v. The second input is with GND and the third input is with pin(7)

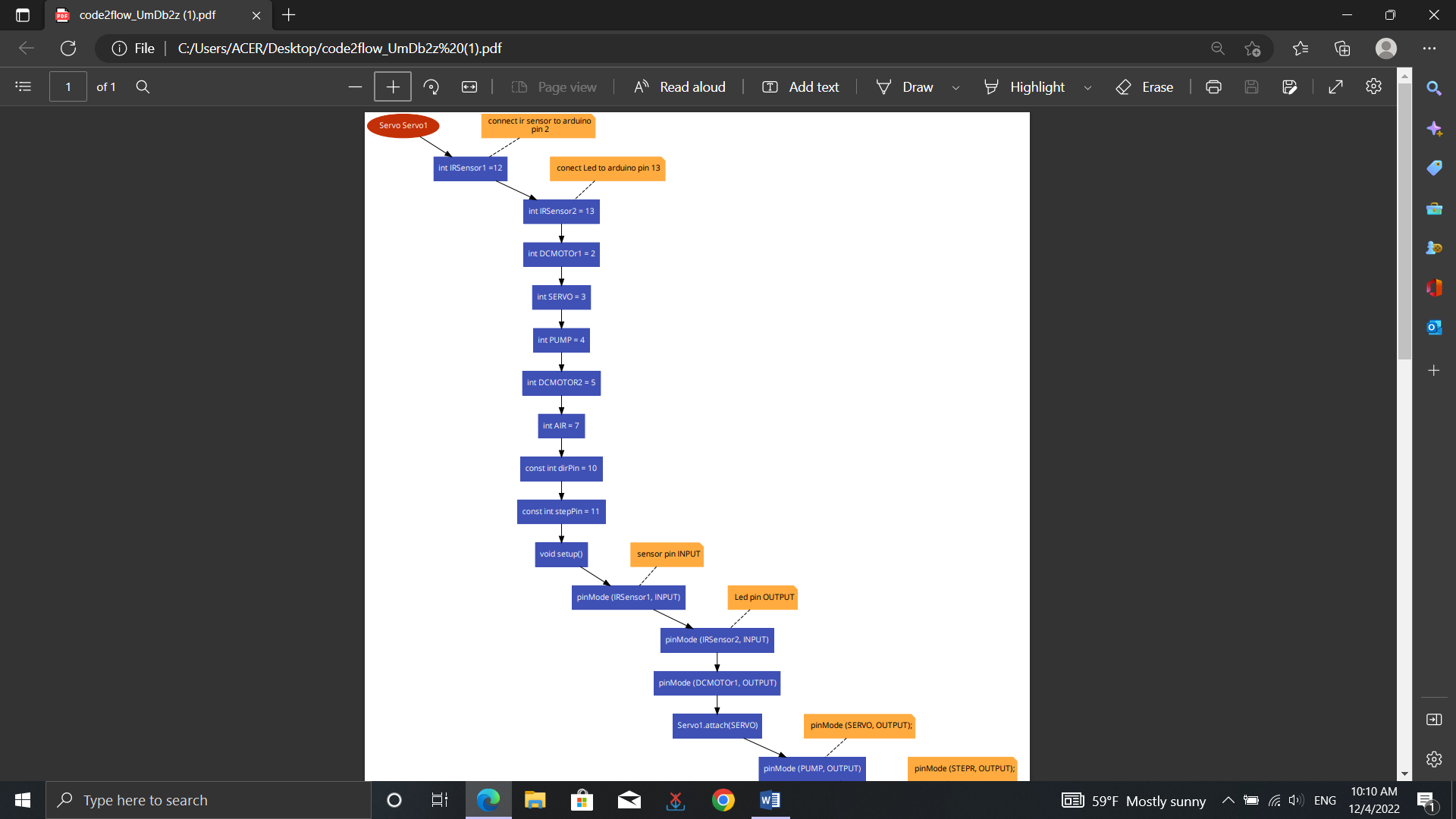


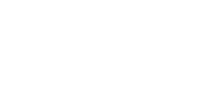
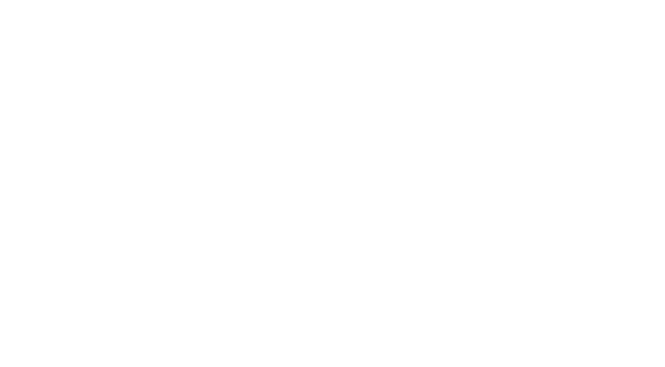
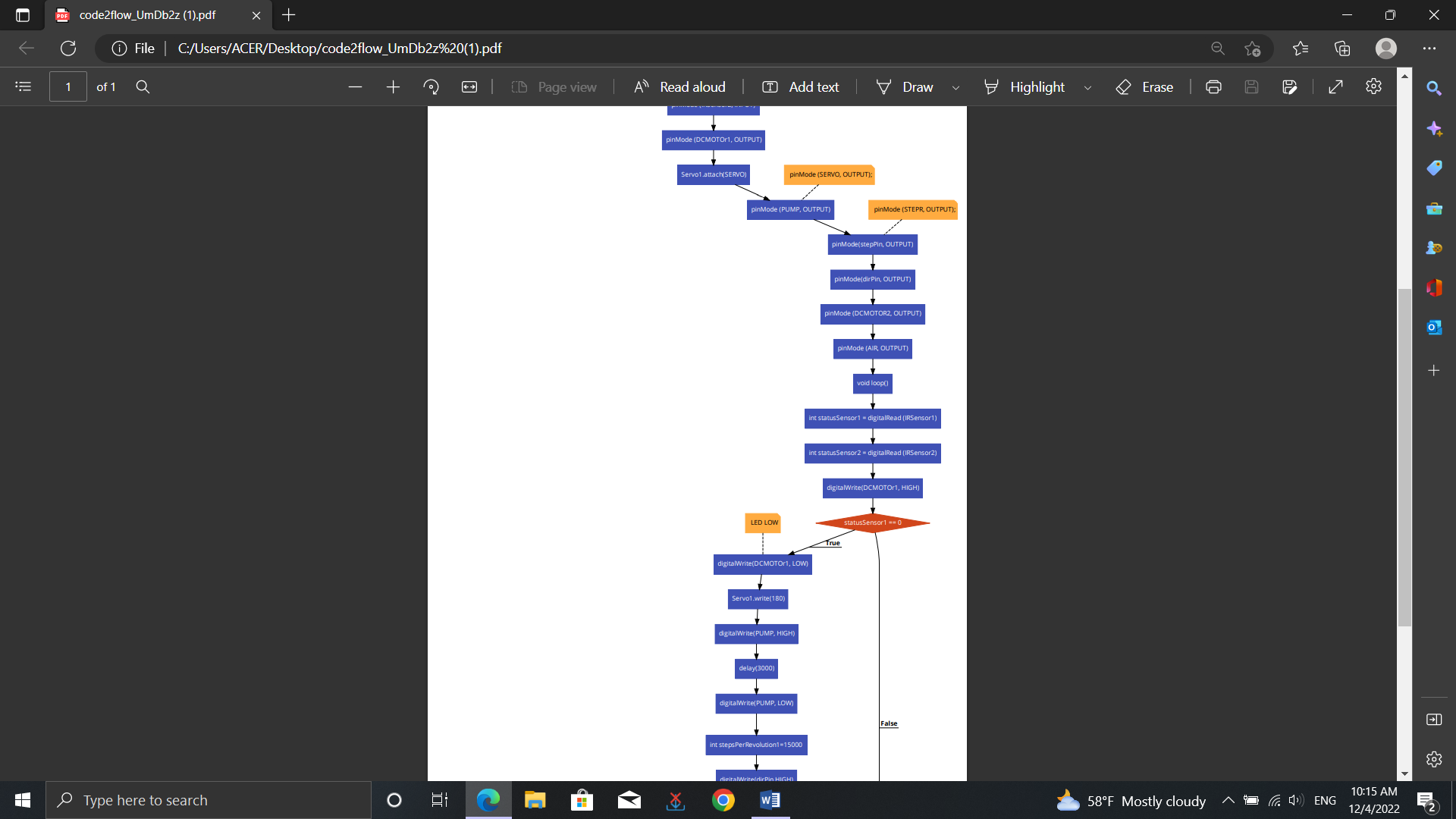
1. (DC motor 1 , DC motor 2 , Water pump , Air pump ) Connect with 12v power

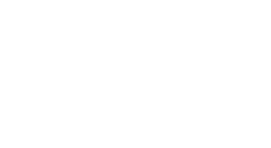
(IR sensor 1, IR sensor2 , 4 Relay module , servo motor) Connect with 5v of Arduino. All components are connects with the same (GND)

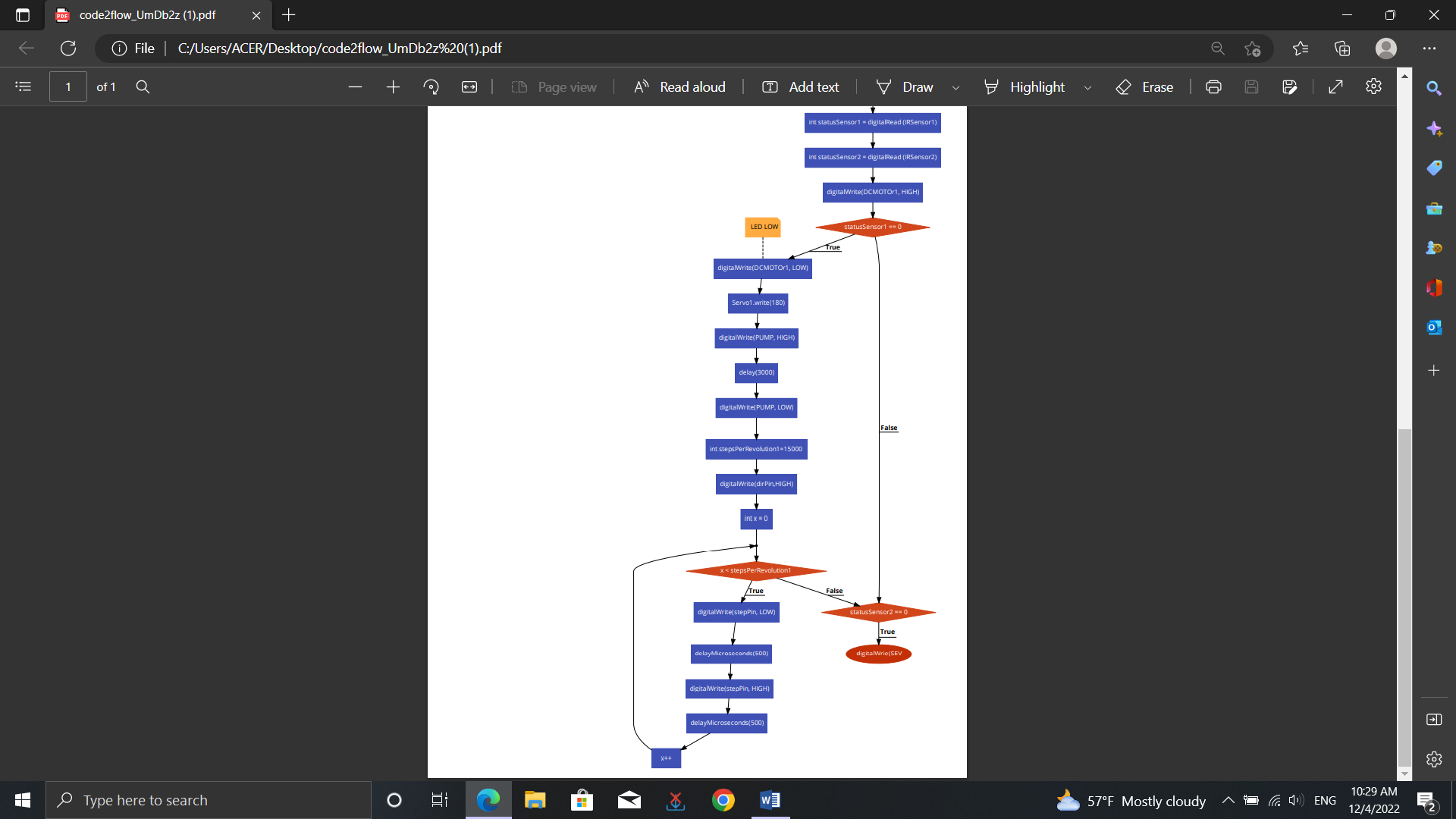
# CHAPTER 3

## Arduino Flow chart

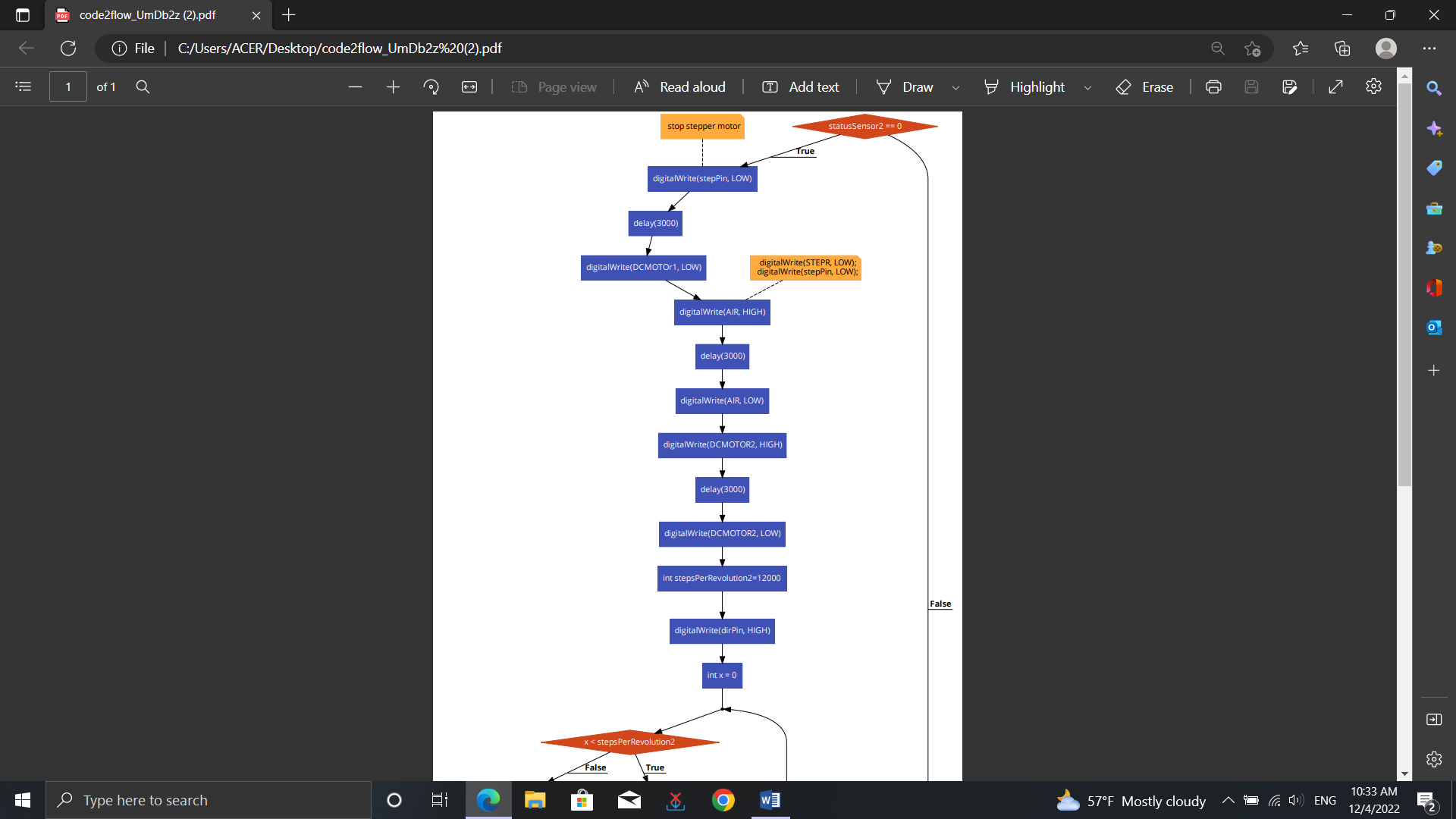


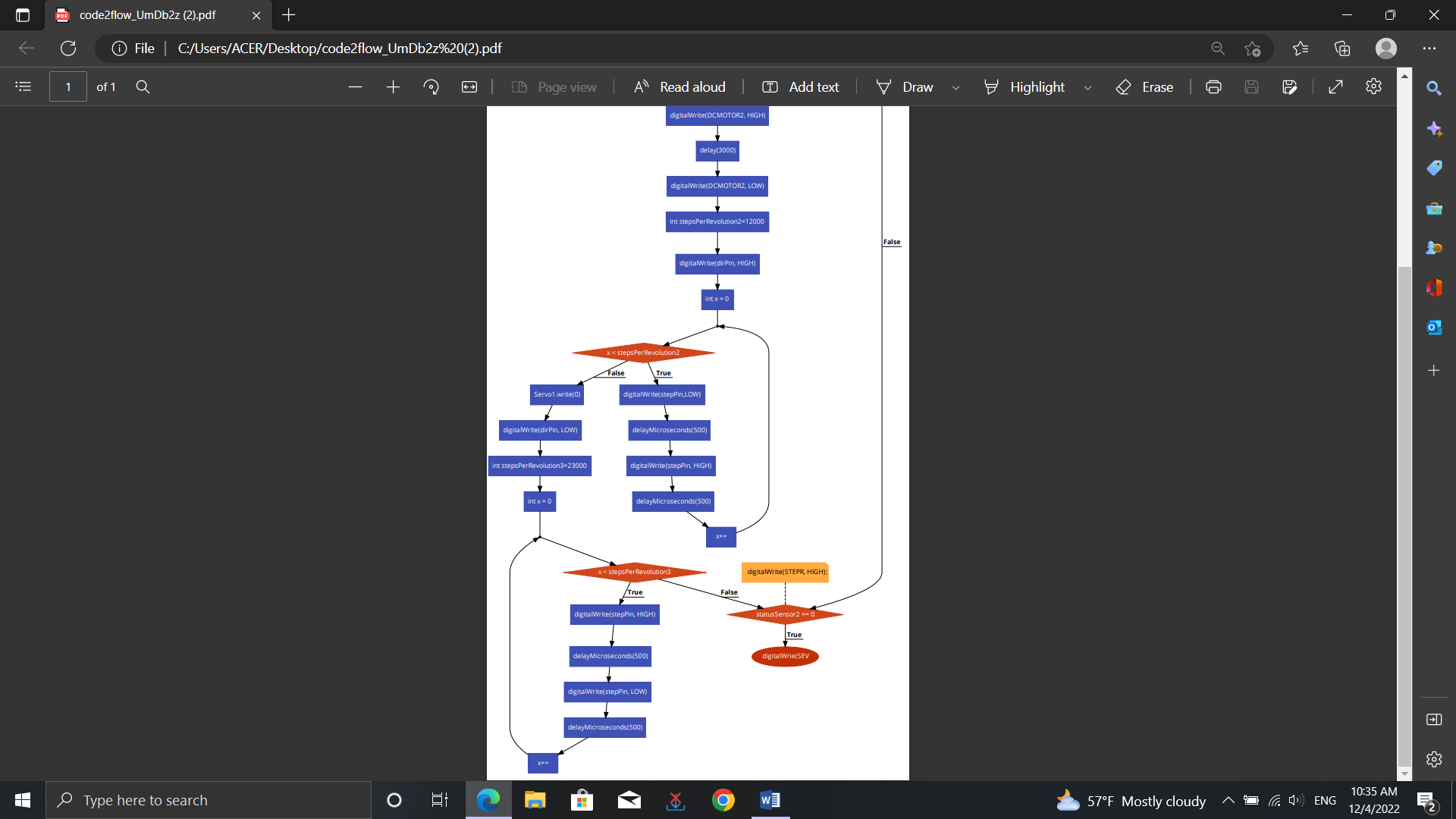






**Figure ‎3-3:**Follow the flow chart.





## The code of the Arduino

#include <Servo.h>

Servo Servo1;

int IRSensor1 =12; // connect ir sensor to arduino pin 2

int IRSensor2 = 13; // conect Led to arduino pin 13

int DCMOTOr1 = 2;

int SERVO = 3;

int PUMP = 4;

int DCMOTOR2 = 5;

int AIR = 7;

// stepper

const int dirPin = 10;

const int stepPin = 11;

//const int stepsPerRevolution = 1000;

void setup()

{

pinMode (IRSensor1, INPUT); // sensor pin INPUT

pinMode (IRSensor2, INPUT); // Led pin OUTPUT

pinMode (DCMOTOr1, OUTPUT);

Servo1.attach(SERVO);

// pinMode (SERVO, OUTPUT);

pinMode (PUMP, OUTPUT);

// pinMode (STEPR, OUTPUT);

pinMode(stepPin, OUTPUT);

pinMode(dirPin, OUTPUT);

pinMode (DCMOTOR2, OUTPUT);

pinMode (AIR, OUTPUT);

}

void loop()

{

int statusSensor1 = digitalRead (IRSensor1);

int statusSensor2 = digitalRead (IRSensor2);

digitalWrite(DCMOTOr1, HIGH);

//delay(3000);

// int statusSensor11=0;

if (statusSensor1 == 0){

digitalWrite(DCMOTOr1, LOW); // LED LOW

Servo1.write(180);

// digitalWrite(SERVO, HIGH);

digitalWrite(PUMP, HIGH);

delay(3000);

digitalWrite(PUMP, LOW);

// digitalWrite(STEPR, HIGH);

int stepsPerRevolution1=15000;

digitalWrite(dirPin,HIGH);

for(int x = 0; x < stepsPerRevolution1; x++)

{

digitalWrite(stepPin, LOW);

delayMicroseconds(500);

digitalWrite(stepPin, HIGH);

delayMicroseconds(500);

}

// digitalWrite(DCMOTOr1, HIGH);

// Servo1.write(0);

}

//int statusSensor21=0;

if (statusSensor2 == 0){

digitalWrite(stepPin, LOW);// stop stepper motor

delay(3000);

digitalWrite(DCMOTOr1, LOW);

//digitalWrite(STEPR, LOW);

//digitalWrite(stepPin, LOW);

digitalWrite(AIR, HIGH);

delay(3000);

digitalWrite(AIR, LOW);

digitalWrite(DCMOTOR2, HIGH);

delay(3000);

digitalWrite(DCMOTOR2, LOW);

int stepsPerRevolution2=12000;

digitalWrite(dirPin, HIGH);

for(int x = 0; x < stepsPerRevolution2; x++)

{

digitalWrite(stepPin,LOW);

delayMicroseconds(500);

digitalWrite(stepPin, HIGH);

delayMicroseconds(500);

}

Servo1.write(0);

digitalWrite(dirPin, LOW);

int stepsPerRevolution3=23000;

for(int x = 0; x < stepsPerRevolution3; x++)

{

digitalWrite(stepPin, HIGH);

delayMicroseconds(500);

digitalWrite(stepPin, LOW);

delayMicroseconds(500);

}

//digitalWrite(STEPR, HIGH);

}

}

# CHAPTER 3

## Discussion and Analysis

First, the bottle moves in the belt for a certain period of time. When it reaches the arm, the sensor works, which sends a signal to the belt line to stop, and also sends a signal to the air pump and the servo motor. Then the water pump works for a certain period of time, which we determine. Upon completion of filling, the arm moves. By the action of the stepper motor, when it moves for a certain period of time during the period of movement, the cover comes down, and the second sensor stops the stepper motor, then the pneumatic pump and the DC motor work and cover the bottle, and when it is finished, the stepper motor starts working to the end of the line and the bottle falls, and so on.

# CHAPTER 4

## Conclusion

This was created as fully automatic liquid filling system. The system meets the demand of high-speed production using the least mechanism requirements.The system has proved to work effectively avoiding unnecessary spill or wastage of liquids. This was to develop a liquid filling and capping system based on certain specifications. This was successfully implemented. A lot of additional features like user defined volume specification etc. Were added in the different stages in our work and the desired results were obtained. More features can be added to this system as follows: depending on the size, shape and weight of the containers, filling operations can be implemented.

## Reference

[1]Automatic Water Tank Filling System Controlled Using Arduino TM Based Sensor” for home application.

[2]Automatic Bottle Filling System Using Arduino.

<https://electronicsworkshops.com/2020/09/07/smart-filling-system>.

<https://baikalmachinery.com/pro>.

# CHAPTER 5

## DATA SHEET

| **NAME** | **PICTURE** | **FEATUR** |
| --- | --- | --- |
| * 12V DC Motor. |  | 1. 12V DC supply voltage. 2. Sintered bronze bearings. 3. Spur gear head. 4. All ratios with 4mm output shaft RE280,RE280/1 and RE280/5 motors available. 5. DC motor type is brushed. 6. The output speed (No Load) is 82 r.p.m. 7. Gearhead type is spur. 8. The power rating:1.31W. 9. The current rating:190Ma. 10. The maximum output torque is :1000g.cm. 11. The rated tolerance torque is:1.0 kgf-cm max. 12. The efficiency is:65%.   Application:   * Power tools, Water pumps, Camera Systems, Adjusting devices, Robotics, Fans. |

**Table ‎6-1**

| **NAME** | **PICTURE** | **FEATURE** |
| --- | --- | --- |
| * 12 V Stepper Motor. | **Figure ‎6-2:**Shows the stepper motor*.* | 1. small step angle:1.8 Degrees (200 steps per revolution). 2. High positioning accuracy 3. high torque to inertia ratio 4. stepping rate an accuracy:5%. 5. Phase current:0.16A. 6. Phase resistance:75 Ω. 7. Holding torque:9N.cm. 8. Detent torque:1.5N.cm. 9. Mass:0.22kg. 10. Shaft configuration: single. 11. Shaft Diameter:5mm. 12. Number of Leads:6. 13. Shaft Length: 24mm (inc recess) 24mm (inc recess). |
| * Micro Servo Motor |  | 1. Tiny and lightweight with high output power. 2. Can rotate approximately 180 degrees (90 in each direction). 3. To control the servo motor you can use any servo code, hardware or library. 4. Speed150r.p.m(4.8V),220r.p.m(6V). 5. Torque 3.2kg- cm(4.8V),4.1kgcm(6V) |

**Table ‎6-2**

| **NAME** | **PICTURE** | **FEATURE** |
| --- | --- | --- |
| * Air Pump Motor. | **Figure ‎6-4:**Air pump motor. | 1. Rated voltage: DC 12V 2. Load: Air 3. Current (With load): Less than 250mA 4. Flow: 3.0LPM 5. Size: D27 x 65mm 6. Maximum pressure: More than 600mmHg 7. Noise: Less than <60dB. |
| * 5V Relay Module. |  | 1. 5V – 12 V TTL control signal. 2. Maximum AC current and,voltage:10A 250VAC. 3. Maximum DC current and voltage : 10A 30VDC. 4. The control signal DC or AC, 220V AC load can be controlled. 5. There is a normally open and one normally closed contact. 6. To make the coil of relay energized you must need to have an input of 1 in the signal pin. |

**Table ‎6-3**

| **NAME** | **PICTURE** | **FEATURE** |
| --- | --- | --- |
| * IR Infrared Sensor Module**.** |  | 1. Up to 2 m for presence and proximity sensing 2. Uses modulated bursts of infrared light 3. PIN diode and sensor IC in one package 4. Low supply current 5. Shielding against EMI 6. Visible light is suppressed by IR filter 7. Insensitive to supply voltage ripple and noise 8. Supply voltage: 2.5 V to   5.5 V   1. Material categorization: for definitions of compliance please see |
| * Arduino Uno. | **Figure ‎6-7:**Shows the Arduino Uno. | 1. Microcontroller:ATmega328p. 2. Operating Voltage:5V. 3. Input Voltage(recommended):   7-12V.   1. Digital I/O Pins:14 2. PWM digital I/O pins:6. 3. Analog Input pins:6. 4. DC Current I/O pins:20. 5. DC Current I/O pins:50mA. 6. Flash Memory:32kB |

**Table ‎6-4**

| **NAME** | **PICTURE** | **FEATURE** |
| --- | --- | --- |
| * LCD. |  | 1. LED backlight brightness. 2. voltage and current vary widely, as does the quality of the display. 3. There is a resistor “Rf” which sets the speed of the LCD interface by controlling the internal oscillator frequency. 4. At 5V the resistor Rf should be 91 KΩ. 5. At 3V it should be 75 KΩ. 6. Using a 3V display at 5V is acceptable from a voltage standpoint (the display can operate on 3-5V) but the oscillator will then be running too slowly. |
| * DC Submersible Water Pump. |  | * Voltage: 2.5-6V • Maximum lift: 40-110cm / 15.75"-43.4" * Flow rate: 80-120L/H * Outside diameter: 7.5mm / 0.3" * Inside diameter: 5mm / 0.2" * Diameter: Approx. 24mm / 0.95" * Length: Approx. 45mm / 1.8" * Height: Approx. 30mm / 1.2" * Material: Engineering plastic * Driving mode: DC design, magnetic driving |

**Table ‎6-5**

| **NAME** | **PICTURE** | **FEATURE** |
| --- | --- | --- |
| * A49888 motor driver. | **Figure ‎6-9:**Shows A4988 motor driver. | 1. Operating voltage range: 8 to 35 V 2. Continuous current per phase, no cooling: 1.2A 3. Continuous current per phase, with cooling: 2 A 4. Logic voltage range: 3 to 5.5 V 5. Micro step resolutions: full, 1/2, 1/4, 1/8, 1/16 6. Form factor: 16-pin DIP, fully assembled 7. PCB Dimensions: 0.6 x 0.8 in (15.24 x 20.32 mm). 8. Control 8V to 35 V stepper motors 9. Compatible with both unipolar and bipolar stepper motors 10. Full-step, half-step, quarter-step, eighth-step, and sixteenth-step resolutions 11. Onboard current-limiting adjustment potentiometer protects the module and motors 12. Deliver up to 1.2A per phase as-is, or up to 2A per phase with additional cooling 13. Black four-layer, 2 oz copper PCB provides heat dissipation 14. Breadboard-friendly form factor with pre-soldered 0.1″ male header pins |

**Table ‎6-6**