SMART WASTE MANAGEMENT SYSTEM

NTI -DEY(March 2023)

Under supervision

Dr. Mohamed
Dr. Eman Sayed

Team Members

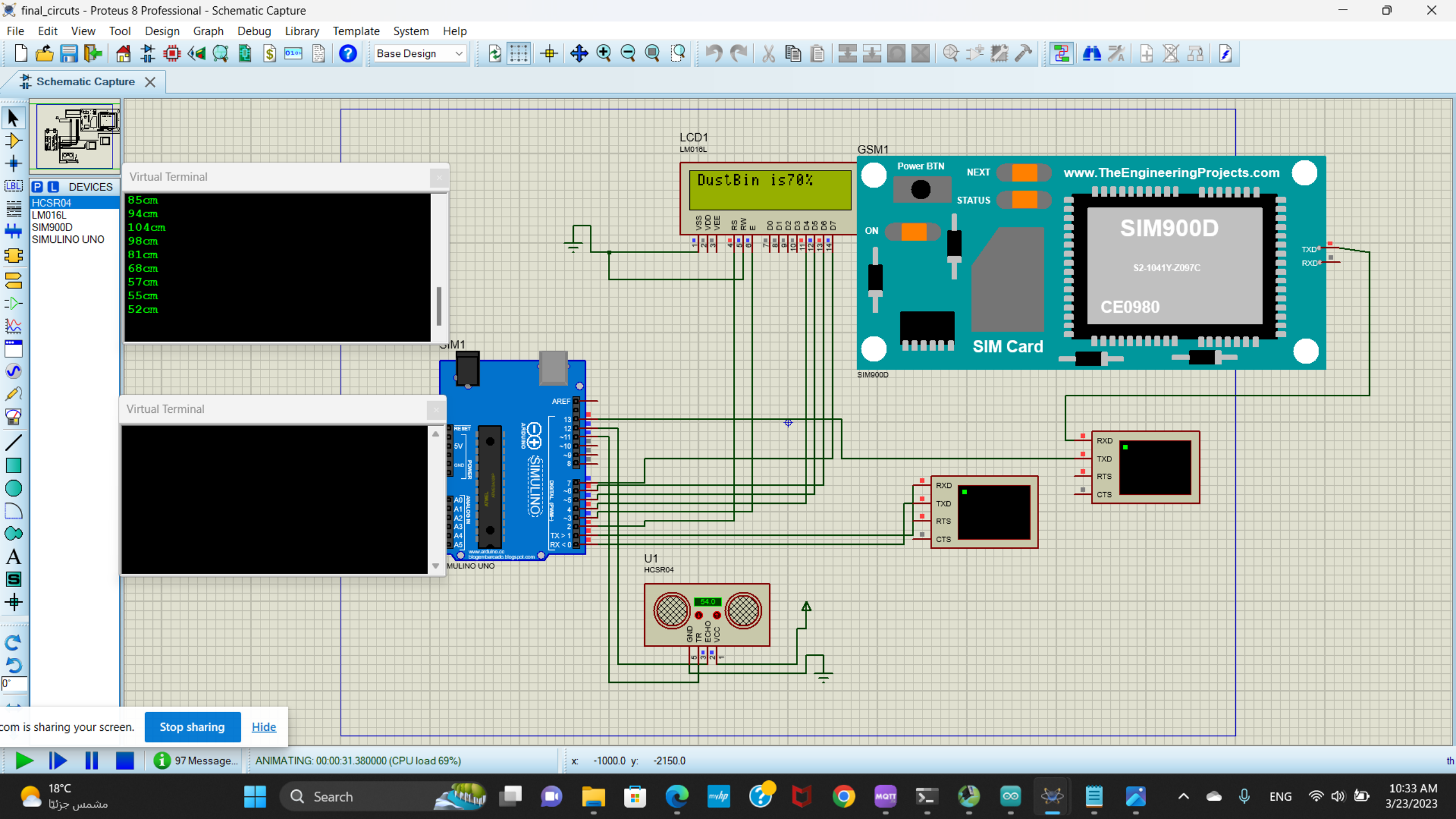
Sarah Alaa
Maryam Sameh
Aya Abaas
Yasmin Mohamed

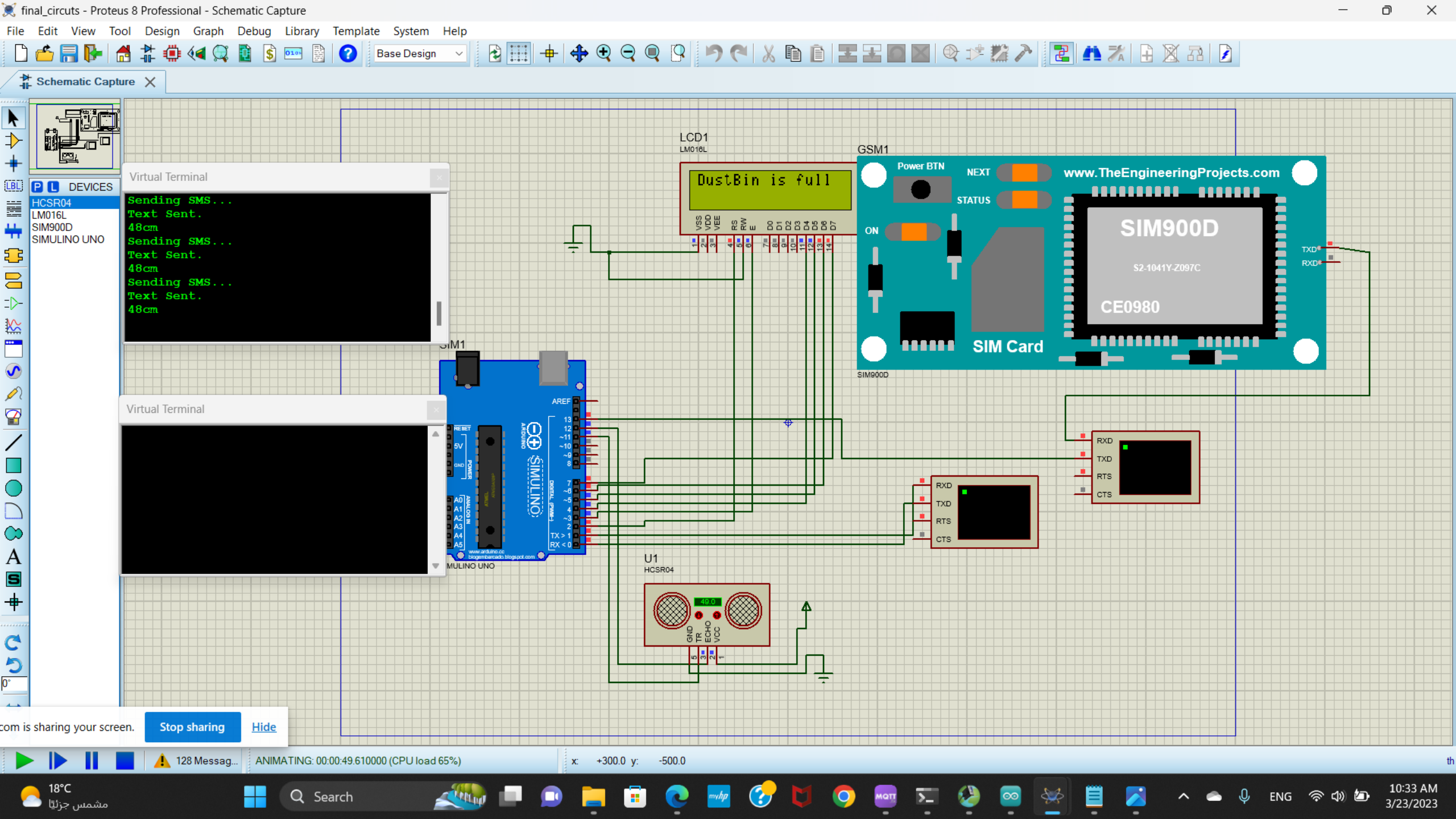
INTRODUCTON

- A smart city is a interconnected system that applies new technologies to manage a wide variety of city services more efficiently.
- Therefore , we do this project.
- Smart bins are an intelligent waste management system.
- Recycling is the best way to manage waste that helps preserve natural resources and reduce environmental pollution
- One of the most important benefits of recycling is that it helps reduce the amount of waste that is stored in landfills.

IOT INTEGRATION

- Arduino uno
- Ultrasonic Sensor (HCSR04)
- LED
- Node-red
- HiveMQ server
- Arduino IDE
- Proteus 8 professional
- Sim900d (GSM Module)
- LCD


final_circuts - Proteus 8 Professional - Schematic Capture
File Edit View Tool Design Graph Debug Library Template System Help
Base Design
Schematic Capture
DEVICES
HCSR04
LM016L
SIM900D
SIMULINO UNO
Virtual Terminal
85cm
94cm
104cm
98cm
81cm
68cm
57cm
55cm
52cm
Virtual Terminal
LCD1
LM016L
DustBin is70%
GSM1
Power BTN
NEXT
STATUS
ON
www.TheEngineeringProjects.com
SIM900D
S2-1041Y-Z097C
CE0980
SIM Card
SIM900D
SIM1
MULINO UNO
U1
HCSR04
54.0
RXD
TXD
RTS
CTS
com is sharing your screen.
Stop sharing
Hide
97 Message...
ANIMATING: 00:00:31.380000 (CPU load 69%)
x: -1000.0 y: -2150.0
18°C
مشمس جزئيًا
Search
ENG
10:33 AM
3/23/2023


final_circuts - Proteus 8 Professional - Schematic Capture
File Edit View Tool Design Graph Debug Library Template System Help
Base Design
Schematic Capture
DEVICES
HCSR04
LM016L
SIM900D
SIMULINO UNO
Virtual Terminal
Sending SMS...
Text Sent.
48cm
Sending SMS...
Text Sent.
48cm
Sending SMS...
Text Sent.
48cm
Virtual Terminal
LCD1
LM016L
DustBin is full
GSM1
Power BTN
NEXT
STATUS
ON
SIM Card
www.TheEngineeringProjects.com
SIM900D
S2-1041Y-Z097C
CE0980
SIM900D
SIM1
MULINO UNO
U1
HCSR04
RXD
TXD
RTS
CTS
Stop sharing
Hide
128 Messag...
ANIMATING: 00:00:49.610000 (CPU load 65%)
x: +300.0 y: -500.0
18°C
Search
ENG
10:33 AM
3/23/2023

sketch_mar22a | Arduino IDE 2.0.4

File Edit Sketch Tools Help

Arduino Uno

sketch_mar22a.ino

```
#include <SoftwareSerial.h>


SoftwareSerial sim800l(0, 1); // RX,TX for Arduino and for the module it's TXD RXD, they should be inverted

# include "LiquidCrystal.h"  //lcd libary
LiquidCrystal lcd(2, 3, 4, 5, 6, 7);   //LCD object Parameters: (rs, enable, d4, d5, d6, d7)
const int trigPin = 11; //trig pin connection
const int echoPin = 12;  //echopin connection
long duration;
int distanceCm;
float liquid;

void setup() {
  Serial.begin(9600);     // setup perameter
  lcd.begin(16,2);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  lcd.setCursor(0,0);
  lcd.print("  Distance    ");
  lcd.setCursor(0,1);
  lcd.print("  Measurement  ");
  delay(1000);
  lcd.clear();
  sim800l.begin(9600);   //Module baude rate, this is on max, it depends on the version
  Serial.begin(9600);
  delay(1000);
```

Output

```
Using library SoftwareSerial at version 1.0 in folder: C:\Users\marya\AppData\Local\Arduino15\packages\arduino\hardware\avr\1.8.6\libraries\SoftwareSerial
Using library LiquidCrystal at version 1.0.7 in folder: C:\Users\marya\AppData\Local\Arduino15\libraries\LiquidCrystal
"C:\\Users\\marya\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-size" -A "C:\\Users\\marya\\AppData\\Local\\Temp\\arduino\\sketches\\9000C77
Sketch uses 5690 bytes (17%) of program storage space. Maximum is 32256 bytes.
Global variables use 477 bytes (23%) of dynamic memory, leaving 1571 bytes for local variables. Maximum is 2048 bytes.
```

com is sharing your screen. Stop sharing Hide

Ln 26, Col 22 Arduino Uno [not connected] 1

18°C مشمس جزئيًا

Search

ENG 10:35 AM 3/23/2023

sketch_mar22a | Arduino IDE 2.0.4

File Edit Sketch Tools Help

Arduino Uno

sketch_mar22a.ino

```
  sim800l.begin(9600);   //Module baude rate, this is on max, it depends on the version
  Serial.begin(9600);
  delay(1000);
}

void loop() {   // loop of flow program
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distanceCm= duration*0.034/2;
//distanceCm = microsecondsToCentimeters(duration)

Serial.print(distanceCm);
Serial.print("cm");
Serial.println();
if(distanceCm < 50 ){
  lcd.setCursor(0,0);
  lcd.print("DustBin is");
  lcd.print(" full");
  delay(1000);
  lcd.clear();
  if (sim800l.available()){           //Displays on the serial monitor if there's a communication from the module
  Serial.write(sim800l.read());
  }
```

Output

```
Using library SoftwareSerial at version 1.0 in folder: C:\Users\marya\AppData\Local\Arduino15\packages\arduino\hardware\avr\1.8.6\libraries\SoftwareSerial
Using library LiquidCrystal at version 1.0.7 in folder: C:\Users\marya\AppData\Local\Arduino15\libraries\LiquidCrystal
"C:\\Users\\marya\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-size" -A "C:\\Users\\marya\\AppData\\Local\\Temp\\arduino\\sketches\\9000C77
Sketch uses 5690 bytes (17%) of program storage space. Maximum is 32256 bytes.
Global variables use 477 bytes (23%) of dynamic memory, leaving 1571 bytes for local variables. Maximum is 2048 bytes.
```

com is sharing your screen. Stop sharing Hide

Ln 26, Col 22 Arduino Uno [not connected] 1

18°C مشمس جزئيًا

Search

ENG 10:35 AM 3/23/2023

sketch_mar22a | Arduino IDE 2.0.4

File Edit Sketch Tools Help

Arduino Uno

sketch_mar22a.ino

```
    Serial.write(sim800l.read());
    }
    SendSMS();
  }
  else if(50<=distanceCm < 100){
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("DustBin is");
    lcd.print("70%");
    delay(1000);

  }
  else if(100<=distanceCm < 250){
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("DustBin is");
    lcd.print("50%");
    delay(1000);

  }
  else if(distanceCm > 250){
    lcd.setCursor(0,0);
    lcd.print("DustBin is");
    lcd.print("10%");
    delay(1000);
    lcd.clear();
  }
```

Output

```
Using library SoftwareSerial at version 1.0 in folder: C:\Users\marya\AppData\Local\Arduino15\packages\arduino\hardware\avr\1.8.6\libraries\SoftwareSerial
Using library LiquidCrystal at version 1.0.7 in folder: C:\Users\marya\AppData\Local\Arduino15\libraries\LiquidCrystal
"C:\\Users\\marya\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-size" -A "C:\\Users\\marya\\AppData\\Local\\Temp\\arduino\\sketches\\9000C77
Sketch uses 5690 bytes (17%) of program storage space. Maximum is 32256 bytes.
Global variables use 477 bytes (23%) of dynamic memory, leaving 1571 bytes for local variables. Maximum is 2048 bytes.
```

com is sharing your screen. Stop sharing Hide

Ln 26, Col 22 Arduino Uno [not connected] 1

18°C مشمس جزئيًا

Search

ENG 10:35 AM 3/23/2023

sketch_mar22a | Arduino IDE 2.0.4

File Edit Sketch Tools Help

Arduino Uno

sketch_mar22a.ino

```
77  }
78  void SendSMS()
79  {
80    Serial.println("Sending SMS...");               //Show this message on serial monitor
81    sim800l.print("AT+CMGF=1\r");                   //Set the module to SMS mode
82    delay(100);
83    sim800l.print("AT+CMGS=""+201224924884""\r");  //Your phone number don't forget to include your country code, example +212123456789"
84    delay(500);
85    sim800l.print("SIM800l is working");       //This is the text to send to the phone number, don't make it too long or you have to modify the SoftwareSerial buffer
86    delay(500);
87    sim800l.print((char)26);// (required according to the datasheet)
88    delay(500);
89    sim800l.println();
90    Serial.println("Text Sent.");
91    delay(500);
92
93  }
94
95
96  /*
97  lcd.setCursor(0,0);
98  lcd.print("Distance Measur.");
99  delay(10);
100 lcd.setCursor(0,1);
101 lcd.print("Distance:");
102 lcd.print(distanceCm);
```

Output

```
Using library SoftwareSerial at version 1.0 in folder: C:\Users\marya\AppData\Local\Arduino15\packages\arduino\hardware\avr\1.8.6\libraries\SoftwareSerial
Using library LiquidCrystal at version 1.0.7 in folder: C:\Users\marya\AppData\Local\Arduino15\libraries\LiquidCrystal
"C:\\Users\\marya\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-size" -A "C:\\Users\\marya\\AppData\\Local\\Temp\\arduino\\sketches\\9000C77
Sketch uses 5690 bytes (17%) of program storage space. Maximum is 32256 bytes.
Global variables use 487 bytes (23%) of dynamic memory, leaving 1571 bytes for local variables. Maximum is 2048 bytes.
```

com is sharing your screen. Stop sharing Hide

Ln 26, Col 22 Arduino Uno [not connected] 1

18°C مشمس جزئيًا

Search

ENG 10:36 AM 3/23/2023

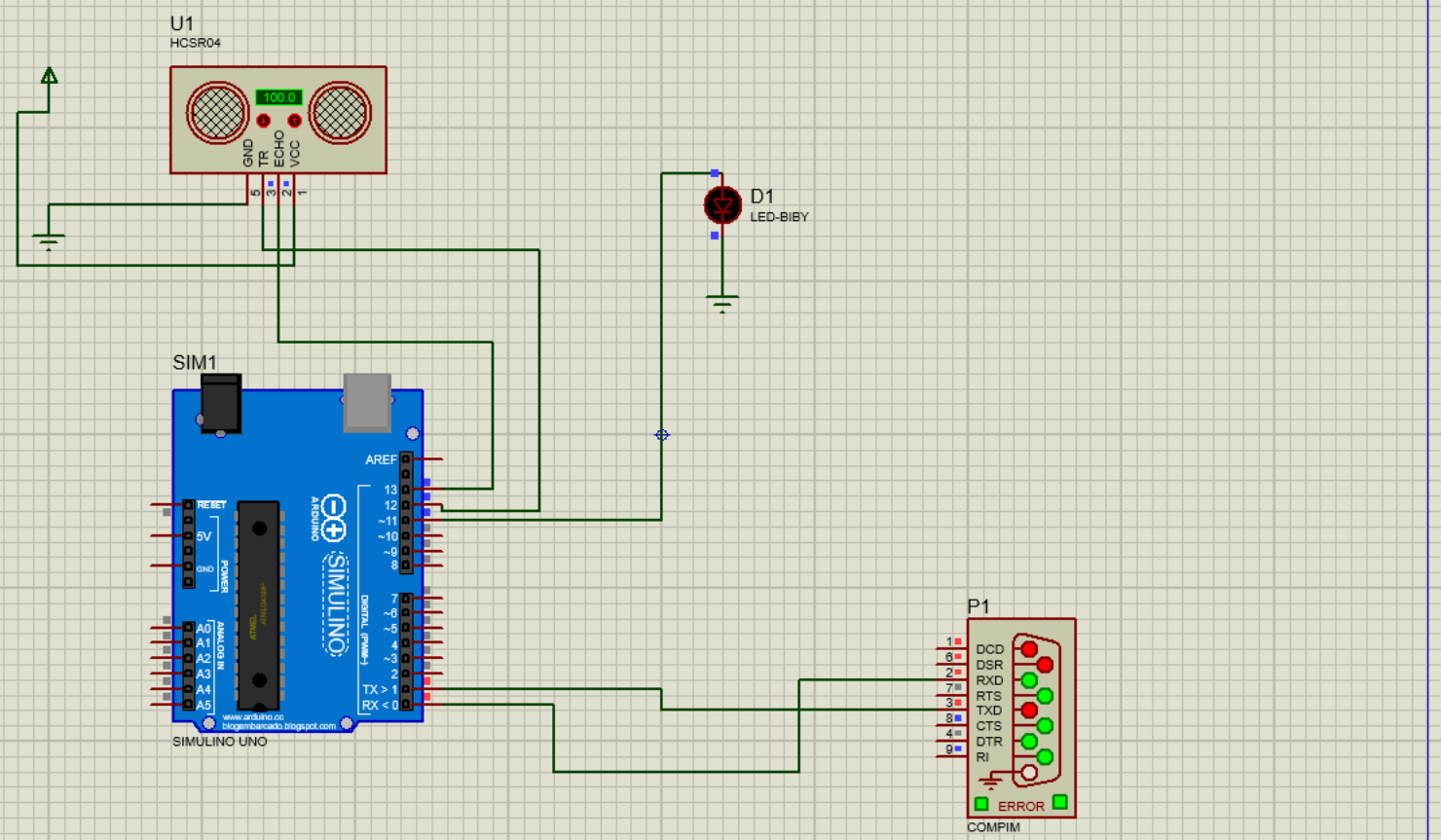
Final project isa - Proteus 8 Professional - Schematic Capture

File Edit View Tool Design Graph Debug Library Template System Help

Base Design

Schematic Capture

TERMINALS
DEFAULT
INPUT
OUTPUT
BIDIR
POWER
GROUND
CHASSIS
DYNAMIC
BUS
NC



com is sharing your screen. Stop sharing Hide

266 Messag...

ANIMATING: 00:28:21.100000 (CPU load 40%)

x: -7100.0 y: -3000.0

18°C مشمس جزئيًا

Search

ENG

10:37 AM
3/23/2023

File Edit Sketch Tools Help

Arduino Uno

sketch_mar23a.ino

```
const int trigPin = 12; //trig pin connection
const int echoPin = 13;
const int ledpin = 11;  //echopin connection
long duration;
int distanceCm;
int state = LOW;

void setup() {
Serial.begin(9600);
pinMode (11 ,OUTPUT);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);

}
void loop() {
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distanceCm= duration*0.034/2;
  // put your main code here, to run repeatedly:
  if(Serial.available()){
    char cmd = Serial.read();
    if(cmd=='A'){
      digitalWrite(trigPin, LOW);

    Serial.println(distanceCm);
    }

```

Output

```
Compiling libraries...
rs\marya\AppData\Local\Temp\arduino\cores\arduino_avr_uno_9dc40fe23a197ebd51721ad4abbcd94f\core.a
Linking everything together...
```

com is sharing your screen. Stop sharing Hide

Ln 11, Col 26 Arduino Uno [not connected] 1

18°C مشمس جزئيًا

Search

ENG 10:38 AM 3/23/2023

Not secure | www.hivemq.com/demos/websocket-client/?

Connection

connected

Publish

Topic: iot/print

QoS: 0

Retain

Publish

Message

Subscriptions

Add New Topic Subscription

Qos: 2
iot/distance
X

Messages

2023-03-23 10:50:46 Topic: iot/distance Qos: 2
38

2023-03-23 10:50:46 Topic: iot/distance Qos: 2
38

2023-03-23 10:50:45 Topic: iot/distance Qos: 2
38

2023-03-23 10:50:45 Topic: iot/distance Qos: 2
38

2023-03-23 10:50:44 Topic: iot/distance Qos: 2
38

2023-03-23 10:50:44 Topic: iot/distance Qos: 2
38

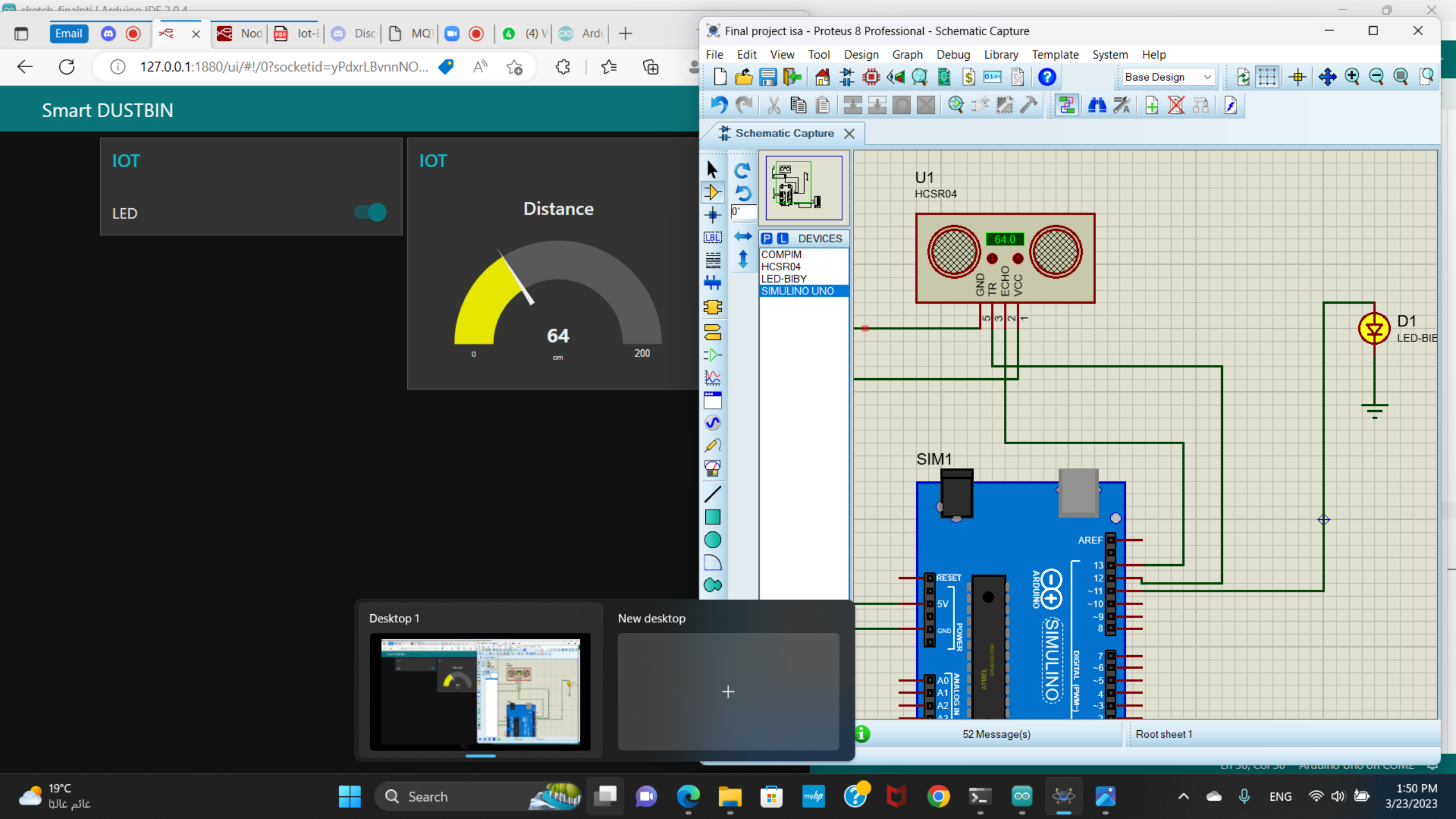
discord.com is sharing your screen. Stop sharing Hide

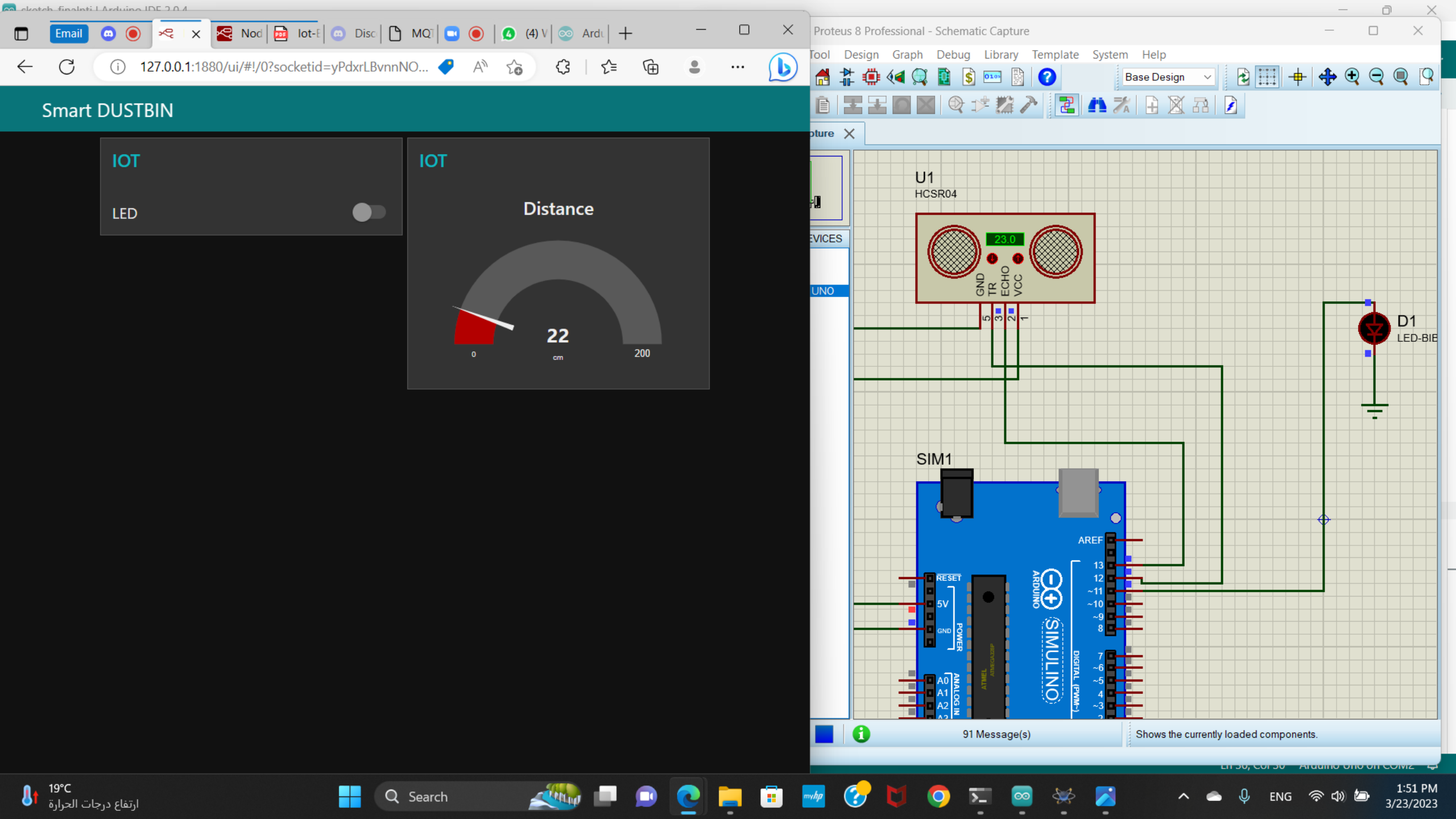
EURUSD +0.44%

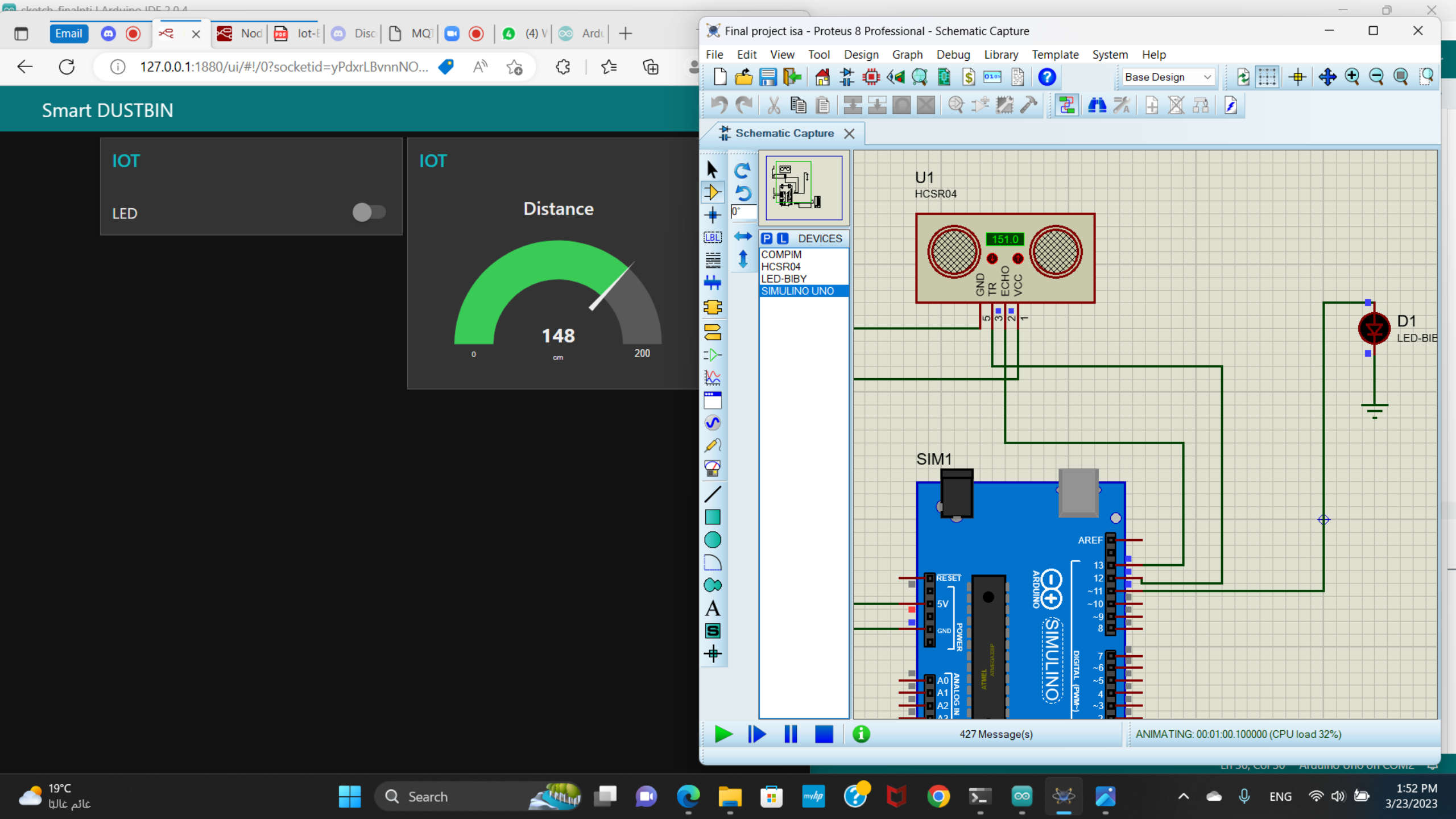
Search

ENG

10:50 AM
3/23/2023


Smart DUSTBIN
IOT
LED
IOT
Distance
64
cm
0
200
127.0.0.1:1880/ui/#!/0?socketid=yPdxrLBvnnNO...
Final project isa - Proteus 8 Professional - Schematic Capture
File Edit View Tool Design Graph Debug Library Template System Help
Base Design
Schematic Capture
DEVICES
COMPIM
HCSR04
LED-BIBY
SIMULINO UNO
U1
HCSR04
64.0
GND TR ECHO VCC
D1
LED-BIB
SIM1
AREF
RESET
5V
GND
POWER
A0
A1
A2
ANALOG IN
ARDUINO
SIMULINO
DIGITAL (PWM~)
52 Message(s)
Root sheet 1
Desktop 1
New desktop
19°C
غائم غالبًا
Search
ENG
1:50 PM
3/23/2023


Email
127.0.0.1:1880/ui/#!/0?socketid=yPdxrLBvnnNO...
Smart DUSTBIN
IOT
LED
IOT
Distance
22
cm
0
200
Proteus 8 Professional - Schematic Capture
Tool Design Graph Debug Library Template System Help
Base Design
U1
HCSR04
23.0
GND TR ECHO VCC
D1
LED-BIB
SIM1
AREF
RESET
5V
GND
POWER
A0 A1 A2
ANALOG IN
ARDUINO
SIMULINO
DIGITAL (PWM~)
91 Message(s)
Shows the currently loaded components.
19°C
ارتفاع درجات الحرارة
Search
ENG
1:51 PM
3/23/2023


Smart DUSTBIN
IOT
LED
IOT
Distance
148
cm
0
200
Final project isa - Proteus 8 Professional - Schematic Capture
File Edit View Tool Design Graph Debug Library Template System Help
Base Design
Schematic Capture
DEVICES
COMPIM
HCSR04
LED-BIBY
SIMULINO UNO
U1
HCSR04
151.0
GND TR ECHO VCC
D1
LED-BIB
SIM1
AREF
RESET
5V
GND
POWER
A0
A1
A2
ANALOG IN
ARDUINO
SIMULINO
DIGITAL (PWM~)
427 Message(s)
ANIMATING: 00:01:00.100000 (CPU load 32%)
19°C
Search
ENG
1:52 PM
3/23/2023

Introduction:

- Recycling is the best way to manage waste that helps preserve natural resources and reduce environmental pollution. Through recycling, we can save energy, prevent the depletion of natural resources, and reduce toxic gases released from waste burning.
- One of the most important benefits of recycling is that it helps reduce the amount of waste that is stored in landfills. Landfills pose a serious threat to the environment and public health. Recycling reduces the need for new landfills and helps preserve natural spaces, But due to the lack of recycling bins used in waste classification, the recycling process often takes a lot of time and effort to divide this waste.

Dataset Preparation:

We used Garbage classification dataset in Kaggle which contains 2527 images of garbage classified into 6 classes: (cardboard , glass , metal , paper , plastic , trash). Then to use it, resized the images into 224x224 to prepare the data. After that we split the data into train : test 60:40.

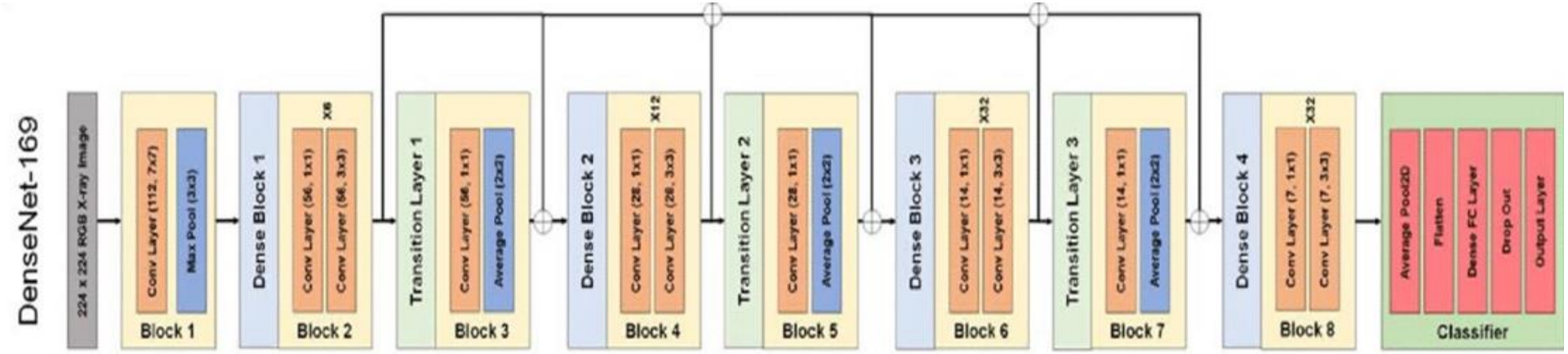
Models

- To improve the accuracy, we used 4 models to choose the best one (the highest accuracy):
- (VGG19, ResNet50V2, MobileNet, DenseNet169)
- Finally, we used DenseNet169 with accuracy 95.7%.

Our model:

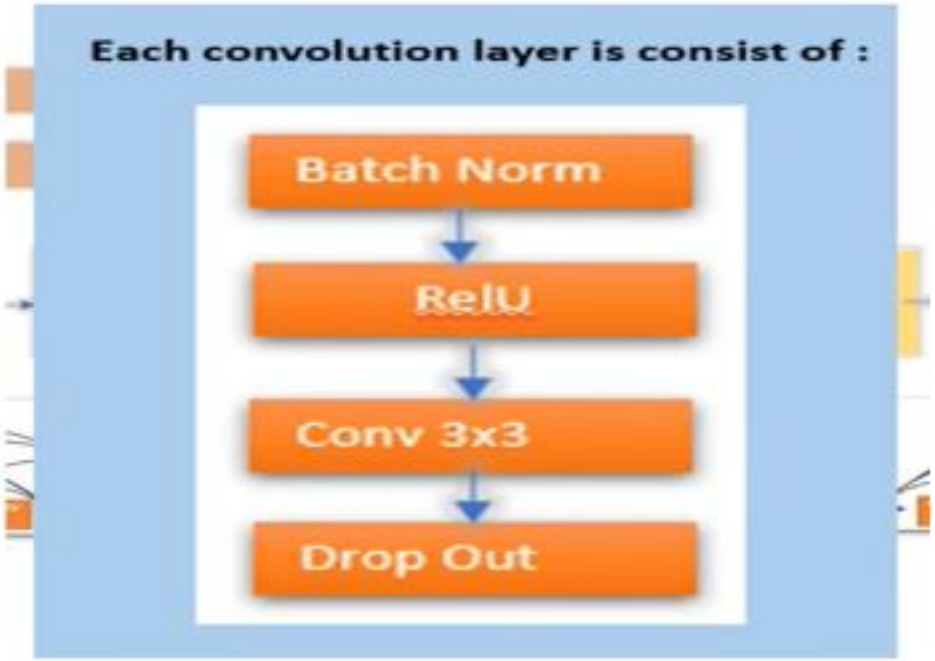
1.DenseNet169 Model:

The model architecture depends on the blocks of residual, it contains convolution layer, maxpool layer, 4 dense blocks,3 transition layers (1 transition layer between the dense blocks) and fully connected layer

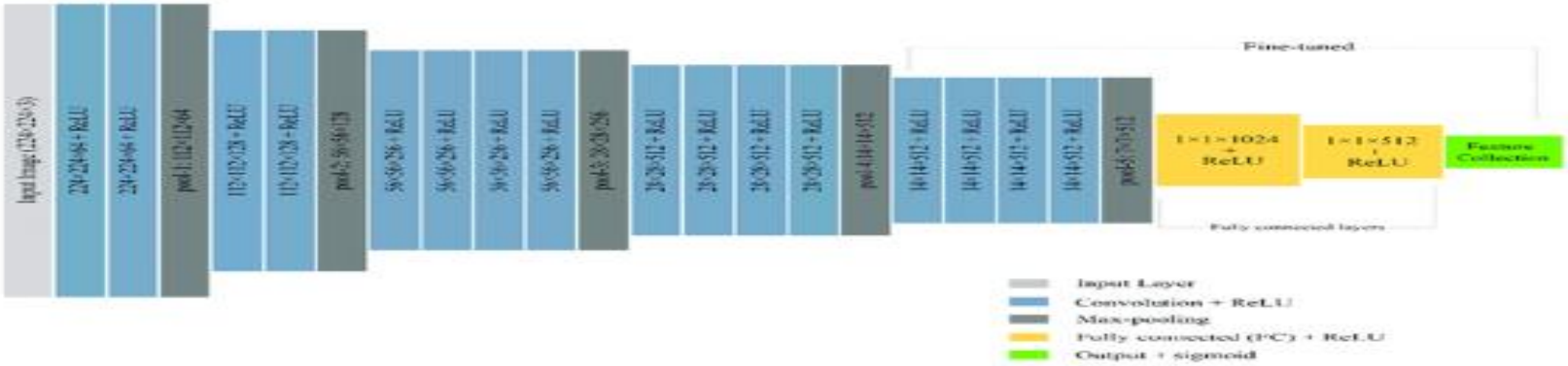


Layers	Output Size	DenseNet 169
Convolution	112×112	7×7 conv, stride 2
Pooling	56×56	3×3 max pool, stride 2
Dense Block (1)	56×56	$\begin{bmatrix} 1 \times 1 \text{ conv} \\ 3 \times 3 \text{ conv} \end{bmatrix} \times 6$
Transition Layer (1)	56×56	1×1 conv
	28×28	2×2 average pool, stride 2
Dense Block (2)	28×28	$\begin{bmatrix} 1 \times 1 \text{ conv} \\ 3 \times 3 \text{ conv} \end{bmatrix} \times 12$
Transition Layer (2)	28×28	1×1 conv
	14×14	2×2 average pool, stride 2
Dense Block (3)	14×14	$\begin{bmatrix} 1 \times 1 \text{ conv} \\ 3 \times 3 \text{ conv} \end{bmatrix} \times 32$
Transition Layer (3)	14×14	1×1 conv
	7×7	2×2 average pool, stride 2
Dense Block (4)	7×7	$\begin{bmatrix} 1 \times 1 \text{ conv} \\ 3 \times 3 \text{ conv} \end{bmatrix} \times 32$
Classification Layer	1×1	7×7 global average pool
	1000	1000D fully-connected, softmax

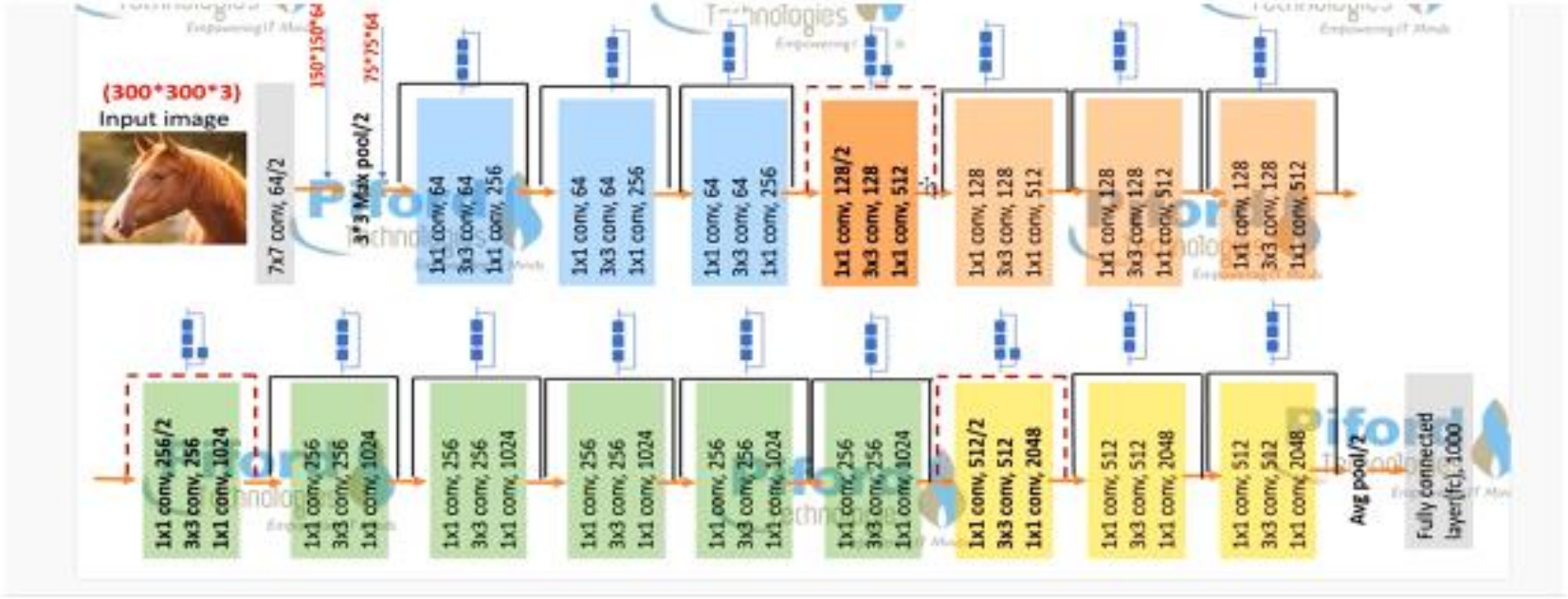
Model in details:



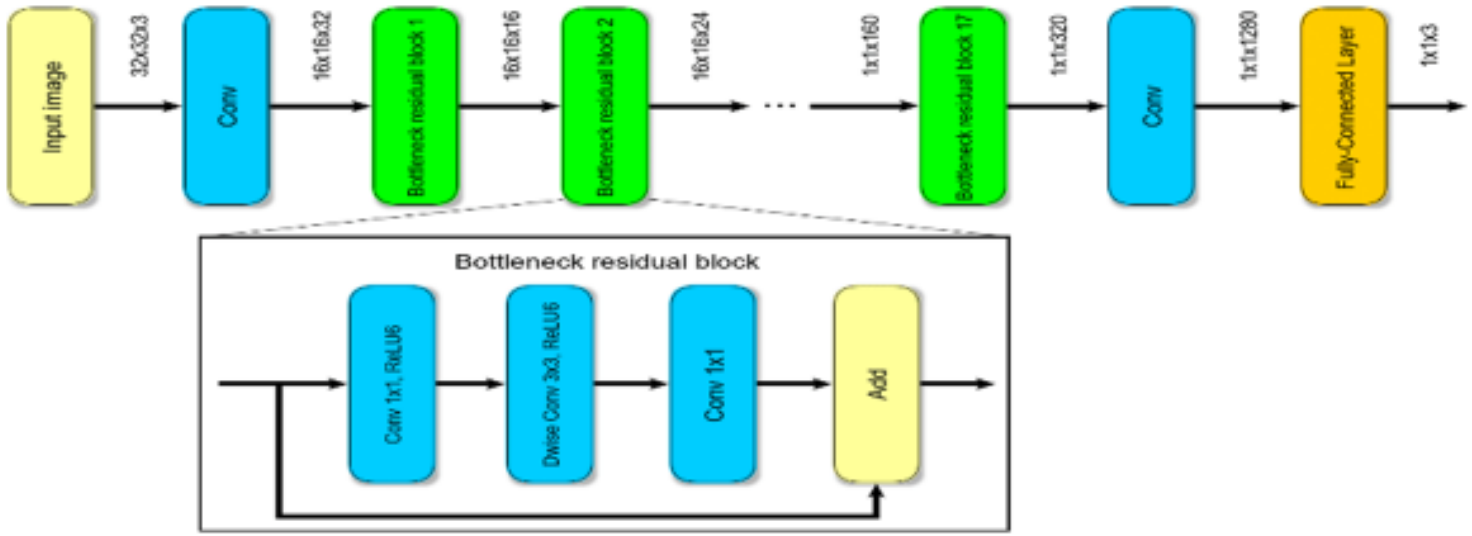
VGG19 Model:


Fine-tuned
1×1×1024
ReLU
1×1×512
ReLU
Feature Collection
Fully connected layers
Input Layer
Convolution + ReLU
Max-pooling
Fully connected (FC) + ReLU
Output + sigmoid

Resnet50V2 Model:



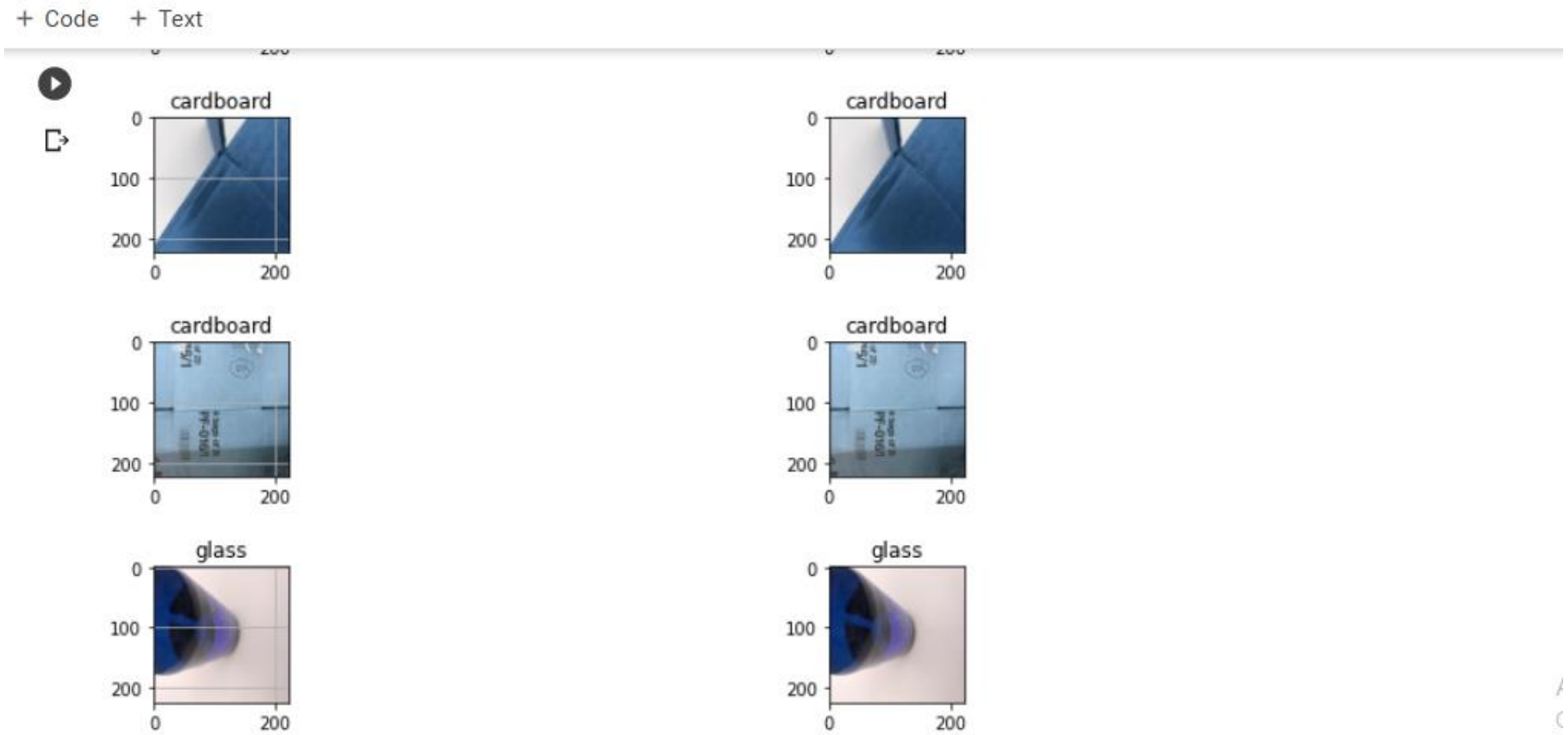
MobileNet Model



This is a comparison of the models used in classification

models	accuracy	loss	Total Parameters	Trainable Parameters
DenseNet169	0.9574	0.1323	3,538,984	3,504,872
MobileNetV2	0.9347	0.1945	14,307,880	14,149,480
ResNet50V2	0.9159	0.298	25,613,800	25,568,360
VGG19	0.9238	0.4075	143,667,240	143,667,240

Results:


+ Code
+ Text
cardboard
cardboard
cardboard
cardboard
glass
glass
0
100
200
0
200