Menofia STEM School **Grade 12**

20327

Shanghai Tower

2022/2023 **Semester 1**

Abstract:

Egypt suffers from many problems or challenges that face it and affect other aspects of its environment, so this year we will focus on climate change. Climate change refers to long-term shifts in temperatures and weather patterns. It is one of the problems that Egypt faces and it causes other problems that affect the environment like frequent and intense drought, storms, heat waves, rising sea levels, melting glaciers, and warming oceans it can directly harm animals, and destroy the places they live. Some many factors or causes affect climate change like greenhouse gases, particulate matter, and temperature. So we decide to focus on the smog. smog is formed by mixing air with pollutants and exhaust gases resulting from human activities. It is composed of nitrogen oxides, sulfur oxide, ozone, co2, and other particulates. And its results are reducing visibility and blocking sunlight, causing acid rain, and harming forests, wildlife, and agriculture. our project is about IoT project so we will use sensors to measure temperature and detect these particulate matters we will make an application to take us to the website called (thing speak) then we will use the website to get the data that the sensors will detect it then we will connect it via wi-fi with our project .so we will make a box and make smog in it .then, we will detect the proportions of the particulate matters in the smog or the environment that we will make and to detect the temperature of this smog.

Introduction

Modern problems require modern solutions, but what about solving hazardous problems that happen on the earth since a long time ago with modern technologies and techniques? Climate change is a current global issue that should be addressed in all aspects of our lives. communication, the internet of things (IoT), mobile devices, the development of new better sensing technologies, and hardware interfaces have great potential in reducing the negative impacts of climate change.

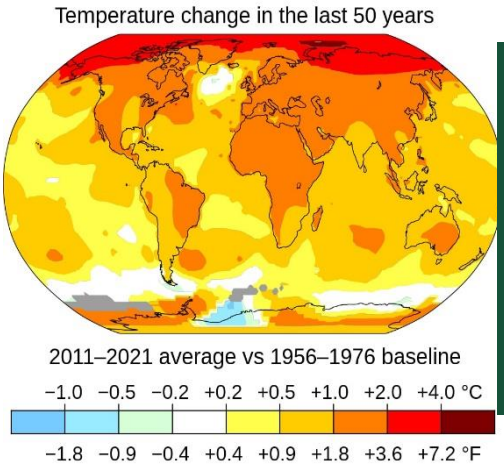


FIGURE 1

Many steps have been taken to solve the problem that happens as negative consequences of different climate actions. Those mentioned steps can be summarized in the Paris Agreement which commits all countries to take ambitious steps to guarantee a low-carbon future. This requires individual national governments to submit more ambitious emission reduction targets. In support of this urgent need to translate global trajectories to be in line with the Paris Agreement. Unfortunately, The Paris Climate Agreement has no

legal component. It merely states that countries should follow their mitigation plans. If countries do not follow their Paris Pledge, they do not face any punishment. International judgment is one risk of non-compliance, but because the vast majority of countries are currently not meeting their promises, few are judging. Also, there is the United Nations Intergovernmental Panel on Climate Change (IPCC) describes an aggressive approach to reducing carbon emissions. All new buildings must now meet a zero-carbon footprint, as statistics show even if all greenhouse gases

were to stop today, the world's temperature would still increase by 2 degrees. But sensors Surely can't be 100% renewable or long-lasting. We observed during our research that the most common factor in almost all of the climate actions is temperature or increasing any gasses that cause an increase in the temperature. Consequently, we decided to work on smog as climate action, we work on measuring its factors. We selected temperature as one of our design requirements in addition to particulate matters such as CO, NH4, toluene, and acetone; as they highly appear during high-temperature environments. Smog appears in many areas in Egypt as a sequence of many human factors and produces many poisonous gases that can affect human health with hazardous diseases in addition to agriculture and animal life. Our prototype has been chosen based on appearing and highlighting the problem of this climate action and measuring its controllers.

Materials

Total Cost: 475 L.E

TABLE 1

Name	Price	Photo
MQ-135	**45 L.E**	 FIGURE 3
DHT-22	**120 L.E**	 FIGUR4
ESP-32	**175 L.E**	 FIGUR5
PCB Board	**75 L.E**	 FIGUR6

TABLE 2

Name	Price	Photo
Glass Box	**50 L.E**	 FIGUR7
Foil Roll	**10 L..E**	 FIGUR8
Paper	**0 L.E**	 FIGUR9

Methods

Closed environment:

We made the required environment to highlight smog as climate action. We designed a glass box with dimensions of 15*15*15, we specified those dimensions to control the availability of smog inside the box. We chose the glass material as it is fairly priced compared to other materials such as acrylic. Also, it is suitable for the temperature that will be exposed to during the smog simulation.

FIGURE 10

We glued five faces of glass sheets with silicon glue and left the box without a lid. As shown in FIG., smog artificially can be prepared by using a foil sheet as a lid for the box. The box implicitly contained folded paper which has been fired. Consequently, smog started to form grey clouds on the box's lateral surface area.

PCB board:

Instead of using complicated jumpers and breadboards, we decided to substitute them by creating a PCB board with an internal circuit. Firstly, we drew our circuit by putting our components – two sensors and ESP-. Secondly, we printed our circuit on glossy paper. Also, we get a thermal paper transfer that dimensionally satisfied the circuit; we cleaned it to check its smoothness. After that, we used iron to make to press our draw into the thermal transfer paper. Consequently, we left it in an acidic medium for a few seconds, and then we left it in a water bowl. After a few minutes, we started to remove the glossy paper from the thermal transfer paper carefully. We sprayed it with a color to give it a more expert appearance. After a while, we started to use a presser to perforate the PCB board to make a stable space for the components to be fixed in. By finishing the

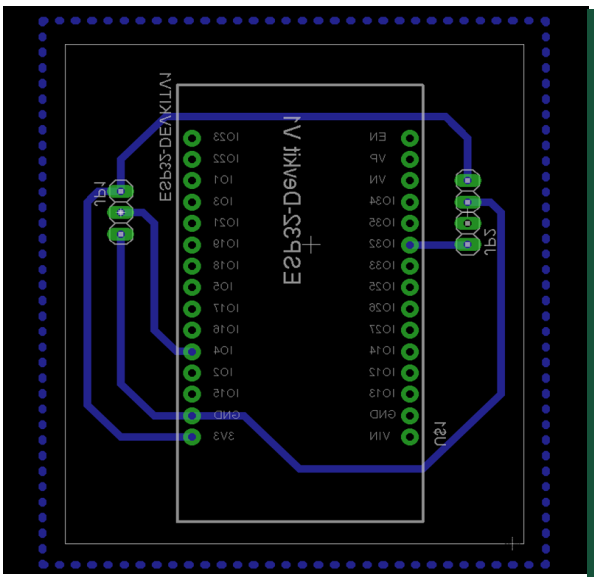


FIGURE 11

previous step, we have finished the PCB board and it has been ready to carry MQ 135 sensor, DHT 22 sensor, and ESP 32.

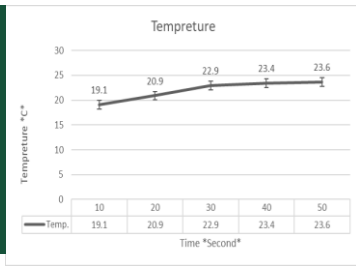
GUI:

We created a mobile application with GUI to connect the user with the server or the user can see the analysis directly. The website has been connected by WIFI through the WIFI module in ESP 32.

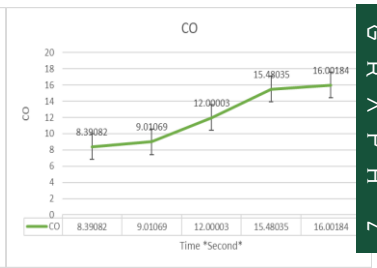
Results

When we started to test our prototype according to the plan that we set. Also, calculate the results and measures that are required to prove to design requirements to measure the success of the prototype in four different trials to check the precision and accuracy. After following some steps from flaming the folded paper in the wet surface glass box and using foil paper as a lid; putting ice cubes on it. After almost 20 seconds we started to make the sensors detect temperature and other three gases which are alcohol, carbon monoxide, and carbon dioxide. We measured it with a rate of one trial every ten seconds. DHT 22 sensor with error ±0.5. Additionally, our MQ135 sensor detected successfully NH4, acetone, and toluene–benzene derivatives-. We observed that our test is done as it was expected. The temperature has been increased as long as it is kept in a smog environment. Also, PMs have been raised with various ratios.

GRAPH 1

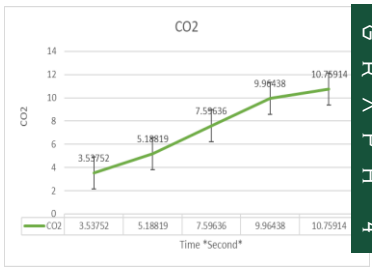


GRAPH 2

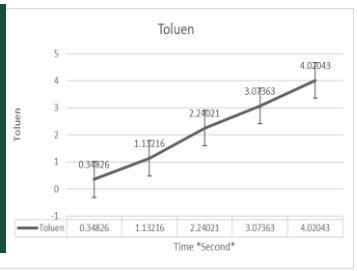


GRAPH 3

GRAPH 4



GRAPH 5



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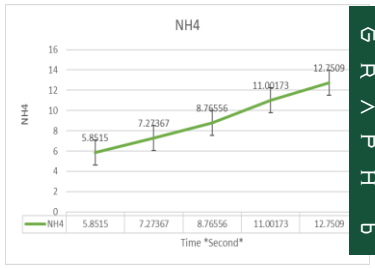
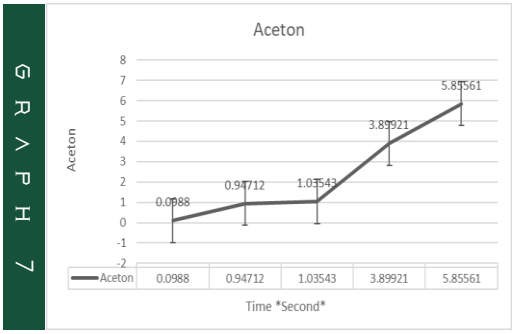


GRAPH 7



Analysis

Climate Change refers to long-time period shifts in temperatures And climate patterns. These shifts can be natural, inclusive of via versions withinside the sun cycle. Burning fossil fuels generates greenhouse fueloline emissions that act like a blanket wrapped across the Earth, trapping the sun's warmth and elevating temperatures. As a result, the Earth is now approximately 1.1°C hotter than it became withinside the overdue 1800s. The final decade became the warmest on record. Many humans suppose the weather extrude particularly method hotter temperatures. But temperature upward thrust is most effective the start of the story. Because the Earth is a system, in which the whole lot is connected, modifications in a single region can impact modifications in all others. PM size gadgets can assist quantify the influences that mining has on general air pleasant. So, we made the required environment to highlight smog as climate action.

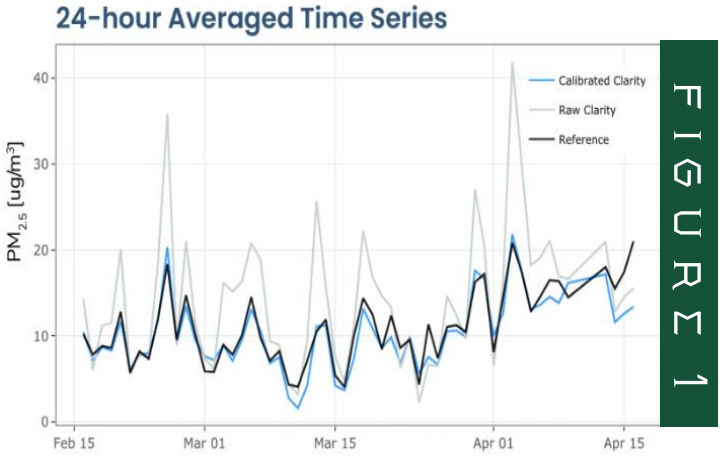


FIGURE 1

Come from each a part of the sector and have an effect on everyone, however a few international locations produce an awful lot extra than others. The a hundred least-emitting international locations generate three according to cent of overall emissions. With respect to the results, the project was successful. The grand challenge was solved in deft form. Moreover, the solution was proved that match the design requirements of:

Temperature:

The temperature had measured to determine how the temperature rise in the smog. To know what the ratio between every trail is.

Particulate matter:

The particulate matter had measured, especially (CO, CO2) had measured in the smog.

Accuracy:

We used a DHT22 temperature sensor ±0.5. To make sure that we have values of the particulate matter that approach the proportions of gases in the smoke.

Dynamic range:

It's the minimum value and the maximum value the sensors (MQ135, DHT22) can detect.

The Equation:

r=correlation coefficient, x=values of the x-variable in a sample, y=values of the y-variable in a sample, n=number of pairs of data Consequently, with table 3, we got the value of r, which has been found to be r=0.9168345623. The value indicates that is a directly strong, also called significant, between the CO and temperature. Hence, after verifying that the linear correlation is significant, we determined the equation of the line that can be used to predict the temperature for a given value percent of CO. The equation formula of a regression line is: $\hat{y}=ax+b$

a= 15.87162755, b=0.5016441602. Where $\hat{y}$ is the predicted y value for a given x-value, m is the slope, and b is the y-intersect. To the end, the equation of regression line is: $\hat{y}=15.87X+0.5016441602$.

TABLE 3

x	y	xy	x^2	y^2
8.39082	19.1	160.26	70.405	364.81
9.01069	20.9	188.309	81.192	436.81
12.00003	22.9	274.800	144.00	524.41
15.48035	23.4	362.240	239.641	547.56
16.00184	23.6	377.643	256.05	556.96
$\sum x$=60.883	$\sum y$=109.9	$\sum xy$=1363.252	$\sum x^2$=791.288	$\sum y^2$=2430.55

Coding:

The technology part was applied depending on collect data of each element in this system by the following code:

FIGURE 17

```
#include <WiFi.h>
#include "ThingSpeak.h"

const char* ssid = "Mayar";
const char* password = "AA854620";

WiFiClient  client;

unsigned long myChannelNumber = 1;
const char * myWriteAPIKey = "UJXFN75QAVDJ
```

We connect the Wi-Fi with including Wi-Fi library and Thing-Speak library. By putting our channel key in the code to define it. Then we put the timer variables. This is shown through Figure (13).

FIGURE 14

```
#include "DHT.h"
#define DHTPIN 4
#define DHTTYPE DHT22
DHT dht(DHTPIN, DHTTYPE);
```

We included the DHT library to define the pin of DHT22. Shown in figure (14).

By including MQ library and defining the type of MQ which is MQ-135 then determine the voltage resolution of ESP32. Figure (15).

FIGURE 15

```
#include <MQUnifiedsensor.h>
#define placa "ESP32"
#define Voltage_Resolution 3.3
#define pin A4
#define type "MQ-135"
#define ADC_Bit_Resolution 12
#define RatioMQ135CleanAir 3.6
```

We set every element that we can to measure in MQ-135 with their A and B points with respect that A and B in every element are different. Shown in figure (16).

FIGURE 16

```
MQ135.update();
 MQ135.setA(605.18); MQ135.setB(-3.937);
 float CO = MQ135.readSensor();

 MQ135.setA(77.255); MQ135.setB(-3.18);
 float Alcohol = MQ135.readSensor();

 MQ135.setA(110.47); MQ135.setB(-2.862);
 float CO2 = MQ135.readSensor();

 MQ135.setA(44.947); MQ135.setB(-3.445);
 float Toluen = MQ135.readSensor();

 MQ135.setA(102.2 ); MQ135.setB(-2.473);
 float NH4 = MQ135.readSensor();

 MQ135.setA(34.668); MQ135.setB(-3.369);
 float Aceton = MQ135.readSensor();
```

With this we defined the (x, y) points of each element. Which the X is the number of fields on

the website, and Y represented by name of element measured in this field. Shown in figure (17).

We created a mobile application with GUI to connect the user with the server or the user can see the analysis directly. The website has been connected by WIFI through the WIFI module in ESP 32. Shown in Figure (18).

```
ThingSpeak.setField(1, t);
ThingSpeak.setField(2, CO);
ThingSpeak.setField(3, Alcohol);
ThingSpeak.setField(4, CO2);
ThingSpeak.setField(5, Toluen);
ThingSpeak.setField(6, NH4);
ThingSpeak.setField(7, Aceton);

ThingSpeak.writeFields(myChannelNumber, myWrit

lastTime = millis();
```

FIGURE 17

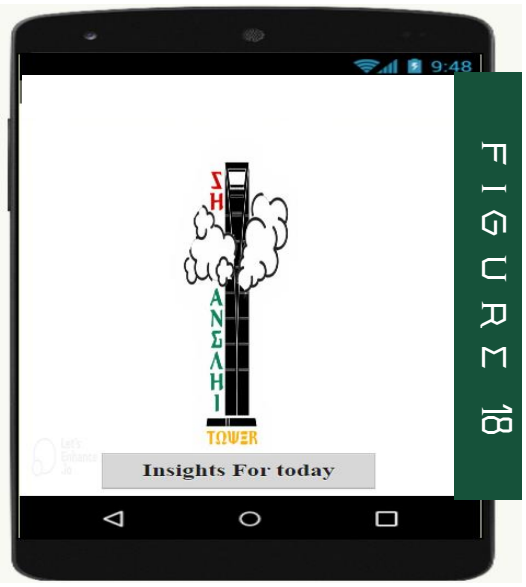


FIGURE 18

Learning Transfer

TABLE 4

Subject	CONNECTION
Math	**In (MA.03.01):** As in our project, we can determine the relationship between the rate of change in soil acidity and carbon dioxide gas as they have time as a parameter. **In (MA.03.02):** we learned about the critical points where the function's rate of change altered, either increasing or decreasing, and the derivative was zero or undefined. Knowing these critical points would help us examine the graph and its rate of change as well as its maximum and minimum points-more closely. **In (MA.03.04):** This learning result taught us about sequences, which made it easier for us to determine the order in which the variables moved on and to analyze and make conclusions about them.
Physics	**In (PH.03.04 & PH.03.05):** Throughout these two learning outcomes, we learned about the fundamentals of communication and wireless technology, such as WI modules that are used in our project. Since our project is about to, these learning outcomes particularly useful
Chemistry	**In (CH.03.01):** In this learning outcome, we learned about scientific methodology where we can objectively establish facts through testing and experimentation by using its seven steps. **In (CH.03.03):** We learned how to build a balanced chemical equation and the chemical compound formulas used in the chemical laboratory to prepare carbon dioxide gas
Earth Science	**In (ES.03.06):** We learned about Resonance which is a phenomenon that occurs when the matching vibrations of another object increase the amplitude of an object's oscillations. consequently, happening very strong winds (storms) that cause a lot of destructive events including resonance and you won't be prepared for it.
Biology	**In (BI.03.04):** In our project, the temperature sensor represents a Thermo receptor as its responsible for detecting changes happening in the temperature of our environment simulation. This sensor then sends the information as electric pulses to the WI-FI module in ESP32 (interneurons are WI-FI, and ESP32 is the motor neurons)) to integrate it and create the command with respect to it in the ESP32 which then carries it to the website (effector or target) to form a suitable response.

Conclusions

The way of climate change problem is one of Egypt's grand challenges. As a result, we believe that the first step in solving the problem is detecting its size to search for how can we control it. After simulating smog successfully, we connected the WIFI module which is in ESP 32. We started to write down the readings of six gases and temperatures. We observed a gradually increasing in temperature; as long as the sensors in the box, read numbers more in values. Those observations met our design requirements. We concluded that most of the reasons behind smog are human-made. Consequently, the country must enact strict rules to reduce smog and its consequences; reduce the number of car trips, eliminate fireplaces and avoid burning leaves, trash, and other materials, in addition, avoid using gas-powered lawn and garden equipment.

Recommendations

After making our prototype we recommended points for the new researchers who would work on developing our project to put them into consideration:

- We recommend using an Ozone sensor to be more specific in its reading, in addition, reach a more advanced level of precision and accuracy.
- We recommend using larger spaces to make a higher percentage of smog; as more, we put more variety and specificity in the results we get.
- We recommend to other researchers to make their trials in a natural environment instead of a closed one. They can find smog mostly located in basins surrounded by mountains because the smog is trapped in the valley and cannot be carried away by the wind.

Literature cited

- What is climate change? United Nations. (n.d.). Retrieved October 28, 2022, from https://www.un.org/en/climatechange/what-is-climate-change
- Abd El-Mawla, N., Badawy, M., & Arafat, H. (2019). Iot for the failure of climate-change mitigation and adaptation and IIot as a future solution. World J. Environ. Eng, 6(1), 7-16. DOI:10.12691/wjee-6-1-2
- Climate Adaptation – Particulate Matter and Health. (2022.). EPA. Retrieved December 4, 2022, from https://www.epa.gov/arc-x/climate-adaptation-particulate-matter-and-health
- IOT-based real-time weather monitoring and reporting system. (n.d.). Retrieved November 5, 2022, from https://rcciit.org/students_projects/projects/ee/2022/GR9.pdf
- University, C. M. (n.d.). Data Analysis Projects - Machine Learning - CMU - Carnegie Mellon University. Machine Learning | Carnegie Mellon University. Retrieved November 17, 2022, from https://www.ml.cmu.edu/research/data-analysis-projects.html

Acknowledgement

We want to express our special thanks of gratitude to our teacher as well as our principal, Mr. Yasser Abo Donia, who gave us the golden opportunity to do this wonderful project on the Capstone, which also helped us in doing much research and we came to know about so many new things. Mr. Haythem Makshat (Capstone leader), Mr. Kamel Reda (General Capstone Leader), Mr. Shokry Gorge (Fab Lab Manager), Mr. Tarek El-olemy (Capstone teacher), Mr. Sherif Aboul Khair for continuous supervision. We are thankful to them. Secondly, we would like to thank our parents and friends who helped us finish this project within a limited time. I am doing this project not only for marks but also to increase my knowledge.

Further Information