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# IoT Based Smart Exhaust Fan

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**Abstract**: There is a lot of technology improvement in exhaust fan. The world is moving rapidly towards the automated or smart mechanism. Although there is a lot of system, but there is some drawbacks in exhaust fan which could operate on its own with human interface. Manual operate exhaust fan may not work efficiently in terms of human error and also high electric consumption. The real support for this problem is due to the inability of the user or humans to define the most appropriate temperature and air quality in a space. The user will have difficulty to sense temperature and air quality directly by their body. Besides that, humans tend to forget things, it will be difficulty for the user to turn ON and OFF the fan on right time. They will forget to turn ON or OFF the device or let the device turn ON without noticing or forget about it. This cost waste in power consumption and rises the electric bill because of inefficient performance from the device. In this project, an IoT based smart exhaust fan will be developed to control and monitor the exhaust fan automatically without human interface. This device able to sense the difference in temperature and air quality in space. If the sensor sense the level of the temperature and air quality exceeded more than required, a notification will be send to the device display and also any device which can access internet. Then the exhaust fan will turn ON and OFF automatically when the level is reduced below than critical level.

**Keywords**: Exhaust Fan, Temperature, Air Quality

## 1. Introduction

Nowadays, most of the factories, industries, school, office and also houses have at least an exhaust fan. It has become a common device or tool for these users. Exhaust fan was built to control the temperature, remove moisture and eliminate odors in a space [1]. Exhaust fan can cool downs a space quickly, which have become too hot. If an area get too hot, people body will start to giving some Symptoms like muscle cramps and nausea. These are early warning signs of heat exhaustion or heat stress. If a body get hotter than 40°C, It starts shutting down and sees damage to vital organs like the kidneys and brain [2]. For an example, if a space is too hot, by turning on the exhaust fan help to

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remove the hot air in a space by pushing it out to outdoor, and it causes reducing the temperature of the space without using the air conditioning system.

Air quality is important in human life. Each day an adult breathes 15000 liter of air [3]. At the point when we inhale contaminated air poisons get into our lungs, they can enter the bloodstream and be carried to our internal organs such as the brain. This can cause extreme medical issues, for example, asthma, cardiovascular diseases and even cancer and reduces the quality and number of years of life [4]. So it is important for us to know the air around us is safe to breathe.

Most of worker who working in closed room with heavy machine running around in it, have high possibility of suffering serious health problems [5]. Smoke and toxic gas from the machine and tools which used in closed room can cause the gas to trap in. This causes the people or the workers in the room to breathe in the toxicities air. Without a proper exhaust fan the toxicities air cannot been remove in closed space.

The motivation for this project is due to the movement of the world is moving slowly towards the automated system. Although, there is a lot of technology improvement in the exhaust fan still it is not smart enough. There are a lot of concerns when dealing with "traditional" exhaust fan especially in the operations of the exhaust fans. The real support for this problem is due to the inability of the user to define the most appropriate temperature and air quality in a space. The user will have difficulty to sense temperature and air quality directly by their body. Besides that, because of this difficulty the user will forget to turn ON the device or let the device turn ON for very long period time. This will cost waste in power consumption and inefficient performance from the device. The only way to overcome this problem is to have a system or any device which can automatically control and monitor the exhaust fan. In this project, IoT based smart exhaust fan is introduced which can control the exhaust fan depending on the temperature and air quality in a space without any human interference [6]. This device uses gas sensor and temperature sensor to detect and turning the exhaust fan ON to push the air or gas outdoor [7]. This IoT based smart exhaust fan is very useful if it is fixed in factories, industries, office, school, and also houses.

Therefore, this project aims to design and build an IoT based smart exhaust fan which can turn ON and OFF automatically depend on temperature and air quality. Then, the system is able to measure and record data for data collection of temperature and air quality in a space and finally, the IoT system was implemented in the prototype.

## 2. Materials and Methods

There are three phases lead the project towards success through recognize each functions of hardware and software in this part.

### 2.1 IoT Based Smart Exhaust Fan Block Diagram

The inputs of this project are temperature DHT-22 and air quality MQ-135 sensors, control unit is Arduino Mega and output is 12 V dc fan and LCD1602. Figure 1 shows the block diagram of this project.

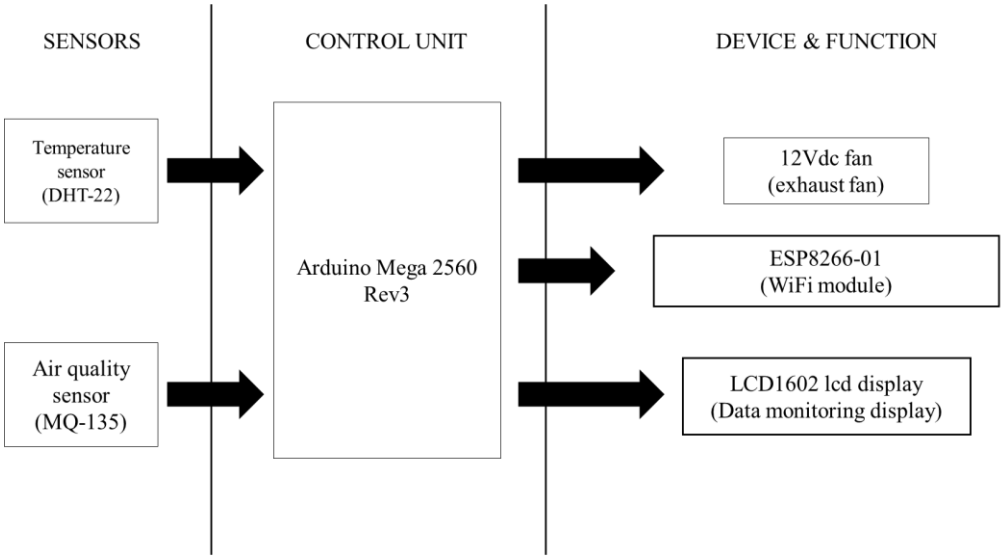


**Figure 1: Block diagram of IoT based smart exhaust fan**

## 2.2 Process Flow

Figure 2 and 3 shows the process flowchart in automatic mode .Process flow of an automatically working exhaust fan describe to follow the correct path in doing its task. It shows the flows of actions or activities that need to be done in its correct order. In this project, the flowchart will give an overview of the steps on the exhaust fan process automatically.

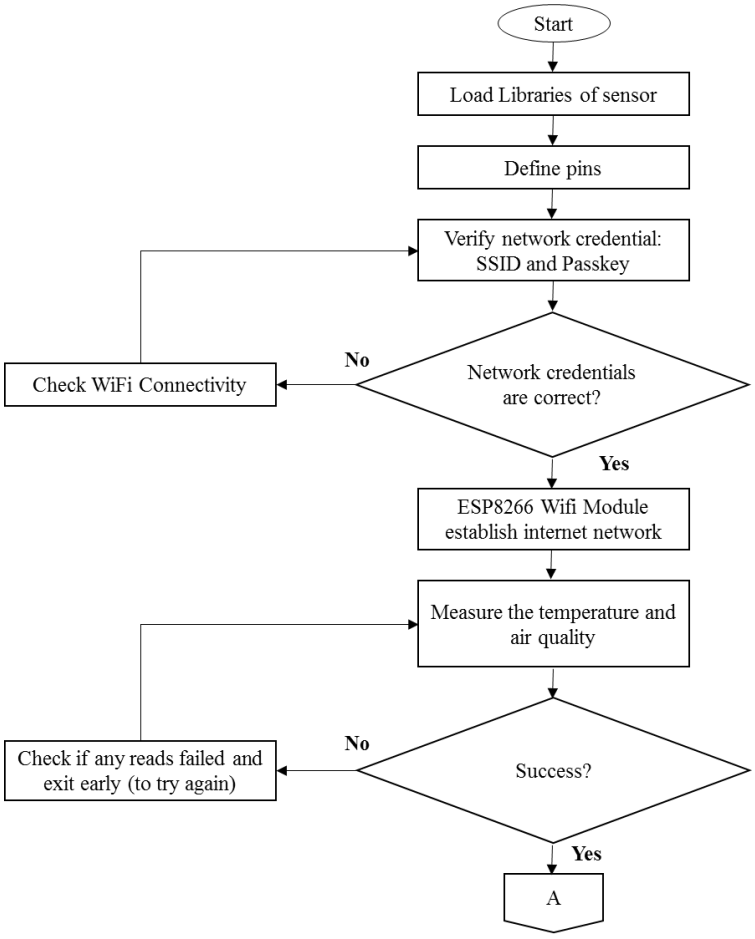


**Figure 2: Process flowchart (automatic mode)**

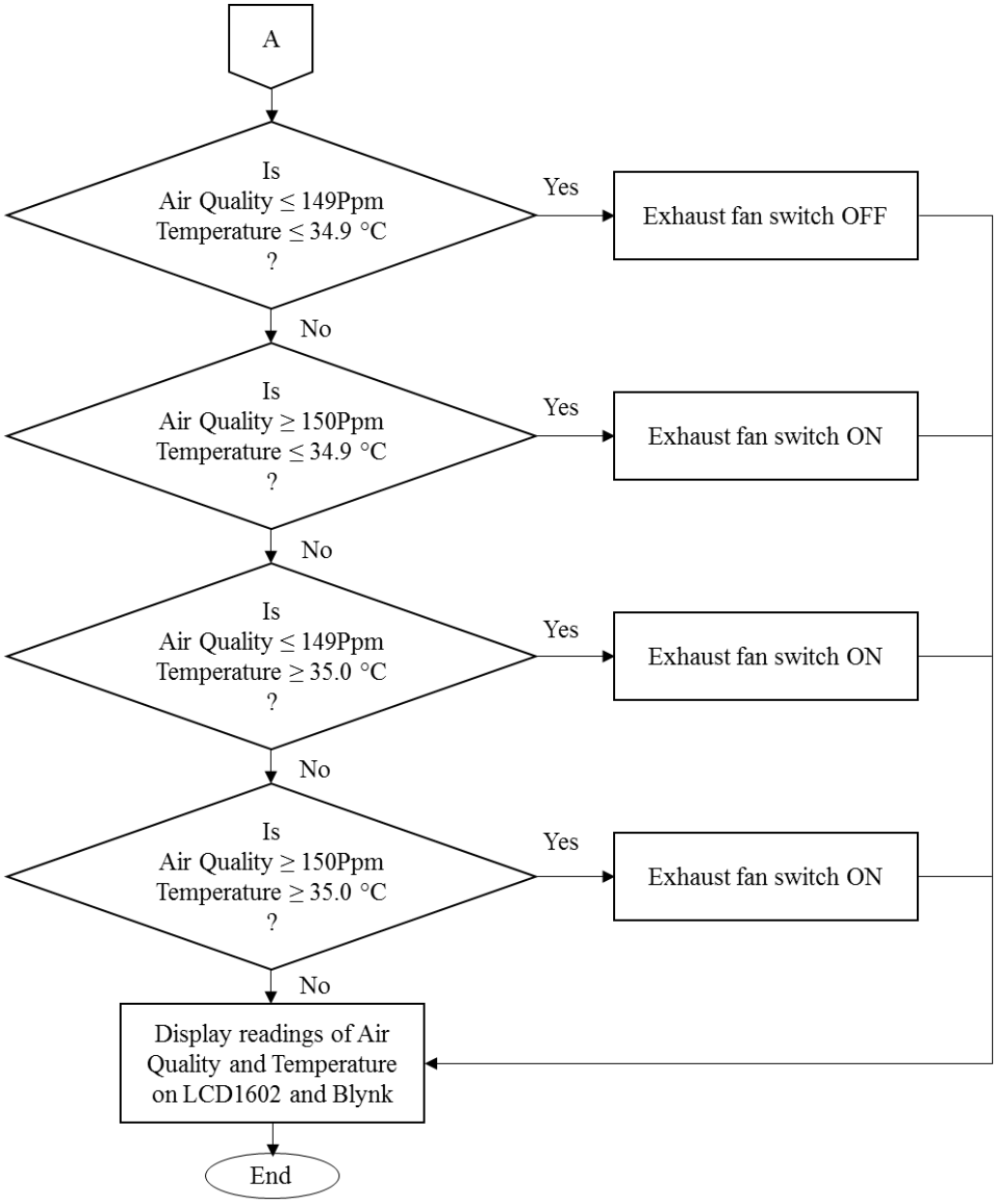


**Figure 3: Process flowchart (automatic mode)**

Figure 4 shows the process flowchart manual mode. Process flow of manually working exhaust fan describe to follow the correct path in doing its task. It shows the second way which manual mode to operate the device and the flows of actions or activities that need to be done in its correct order. The manual mode is made in this project is for the user to utilize it if the automatic mode is failed or the user to make use of it anyway for maintenance purposes or any other reasons. In this project, the flowchart will give an overview of the steps on the exhaust fan process manually.

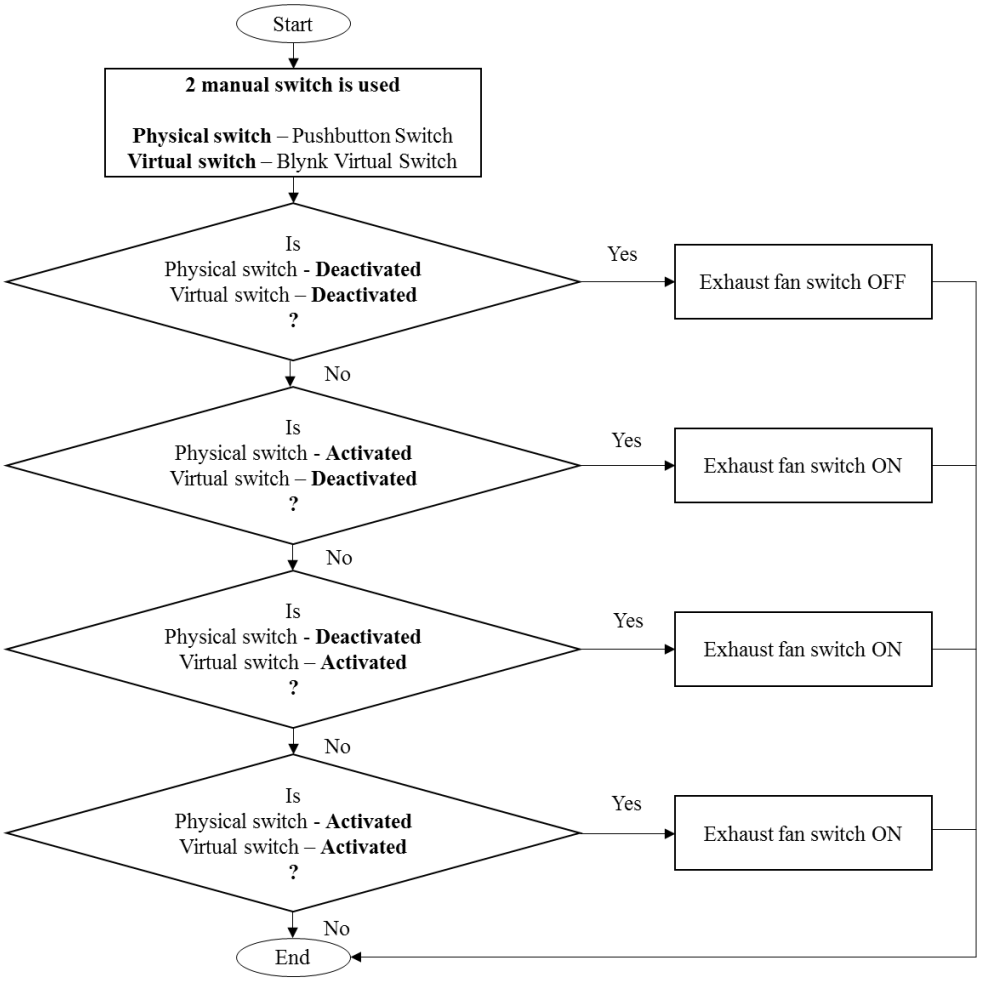


**Figure 4: Process flowchart (manual mode)**

## 2.3 Electronic Setup

All the sensors connection are combined together in this circuit diagram. Figure 5 shows the circuit diagram of this project.

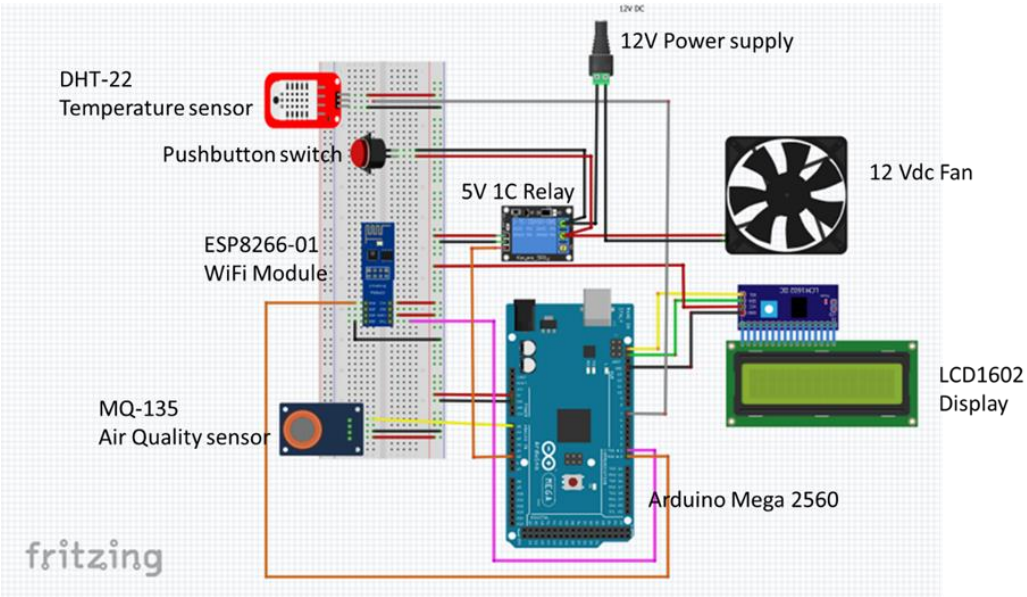


**Figure 5: Circuit diagram of IoT based smart exhaust fan**

## 3. Results and Discussion

### 3.1 Prototype Setup-Up

The prototype of IoT-based smart exhaust fan has two fundamental points. First, designing and developing the hardware with several mechanical and electronic parts for the device. Second, designing the IoT application using Blynk domain to monitor the device.

The initial output records of the system is the analysis of temperature and air quality to make sure the fan is turn ON and OFF automatically depending with temperature and air quality sensors. The data which is obtained by temperature and air quality sensor, DHT-22 and MQ-135 can be displayed through Blynk application on mobile phone.

Secondly, the critical part in making of IoT based smart exhaust fan is where it is going to be placed for conducting the testing and obtain data. So, acrylic house model was built so that the prototype can be fit in the model to test and record data. Figure 6 shows the arrangement of sensors and fan inside the acrylic house model.

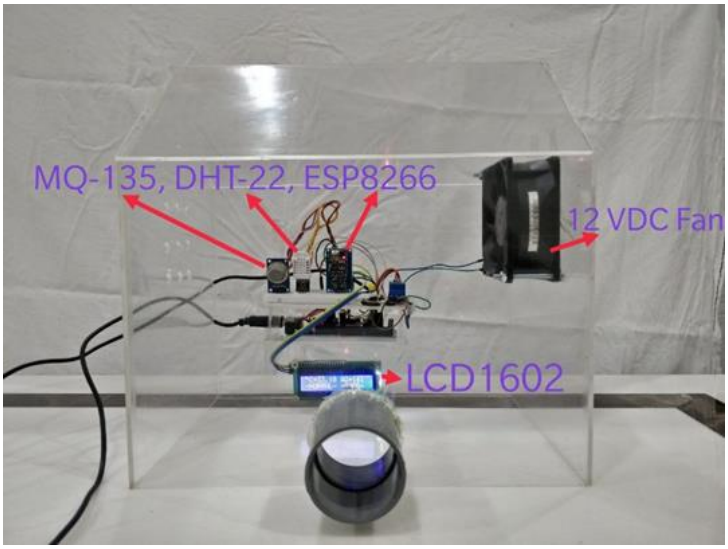


**Figure 6: Prototype of IoT based smart exhaust fan**

After all the setup is complete, assembly and troubleshoot is needed to analyze the effectiveness of the prototype. This proves the performance of the device design. Following experiments was done using different test field in order to analyze the performance and effectiveness of the IoT based smart exhaust fan.

i. Experiment 1: Device testing with hair dryer to raise the temperature in surrounding. To trigger temperature sensor.
ii. Experiment 2: Device testing with burning paper to make smoke in surrounding.
iii. Experiment 3: Device testing with lighter gas to make flammable gas in surrounding. To trigger air quality sensor.

### 3.2 Experiment 1: Device testing with hair dryer to raise the temperature in surrounding.

In this experiment, initially, the exhaust fan was OFF, when hot air from hair dryer increases the surrounding temperature inside the acrylic house model. The exhaust fan is turned ON when the temperature level was exceeded more than required level which is 34.9 °C. The exhaust fan turn OFF when the hot air is removed and the surrounding temperature inside the acrylic house model is maintained to its required temperature level. Figure 7 shows the hair dryer heating the DHT-22 sensor making the exhaust fan to turn ON.

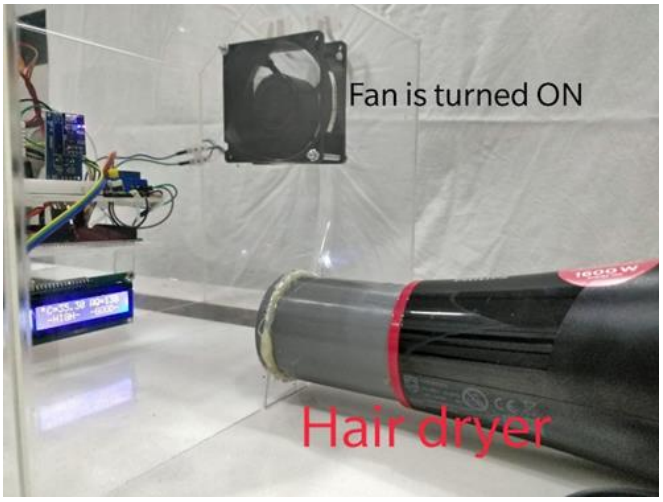


**Figure 7: Hair dryer heating dht-22 sensor making exhaust fan to turn ON**

3.3 Experiment 2: Device testing with burning paper to make smoke in surrounding.

In this experiment, initially, the exhaust fan was OFF, when smoke from burnt newspaper affect the surrounding air quality level inside the acrylic house model. The exhaust fan is turned ON when the air quality level was exceeded more than required level which is 149 Ppm. The exhaust fan turn OFF when the harmful smoke was removed from the surrounding and the surrounding air inside the acrylic house model is maintained to its required air quality level. Figure 8 shows the smoke from burning newspaper reducing air quality level of MQ-135 sensor making the exhaust fan to turn ON.

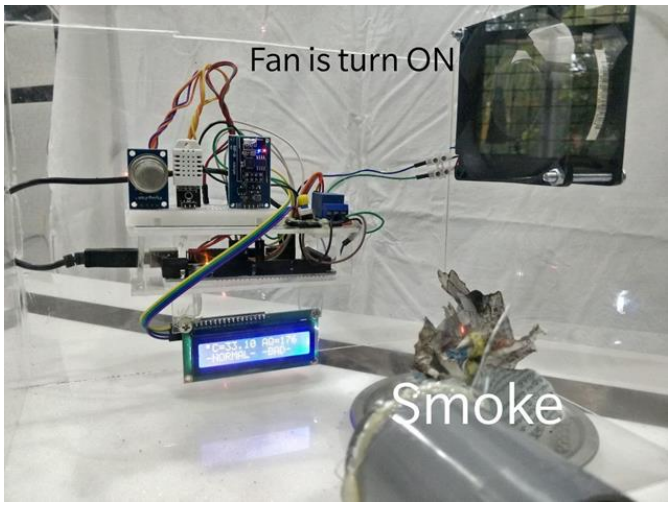


**Figure 8: Smoke from burning newspaper reducing air quality level of mq-135 sensor making the exhaust fan to turn ON**

3.4 Experiment 3: Device testing with lighter gas to make flammable gas in surrounding.

In this experiment, initially, the exhaust fan was OFF, when flammable gas from lighter affect the surrounding air quality level inside the acrylic house model. The exhaust fan is turned ON when the air quality level was exceeded more than required level which is 149 Ppm. The exhaust fan turn OFF when the poisonous harmful gas removed from the surrounding and the surrounding air inside the acrylic house model is maintained to its required air quality level. Figure 9 shows the flammable gas from lighter reducing air quality level of MQ-135 sensor making the exhaust fan to turn on.

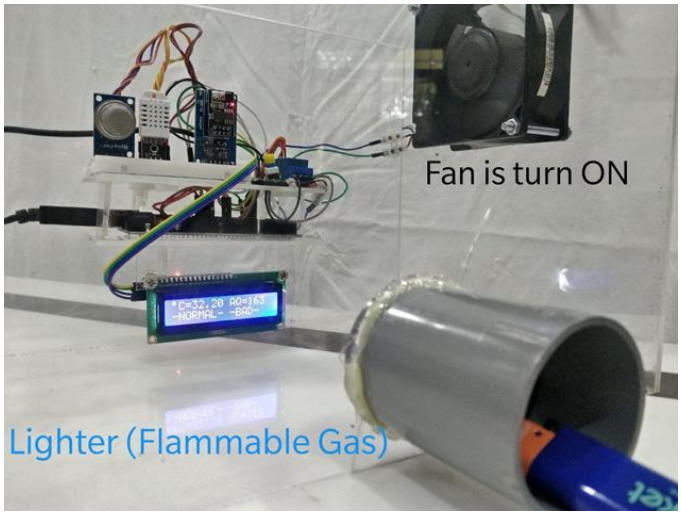


**Figure 9: Flammable gas from lighter reducing air quality level of mq-135 sensor making the exhaust fan to turn ON**

The summary result of the operation of temperature and air quality can be referred in Table 1.

**Table 1: Output result of exhaust fan depending on temperature and air quality value**

| Output Result Exhaust Fan | Temperature (°C) | Air Quality (Ppm) |
|---|---|---|
| **OFF** | ≤ 34.9 | ≤ 149 |
| **ON** | ≤ 34.9 | ≥ 150 |
| **ON** | ≥ 35 | ≤ 149 |
| **ON** | ≥ 35 | ≥ 150 |

3.5 Blynk System

The profile for IoT Based Smart Exhaust Fan was created in Blynk application by using a mobile phone. The application is available to be downloaded from any application store in mobile phone. Figure 10 shows the completed Blynk profile for this project. The profile is named as IoT Based Smart Exhaust Fan. There are two gauge meters which are for the temperature and air quality readings. A line chart was added for monitoring purpose.

Notification is also built in this app so that the user can get notify when the temperature or air quality level exceeded more the required level and cause the exhaust fan to turn ON. Figure 10 shows the completed Blynk profile for this project.

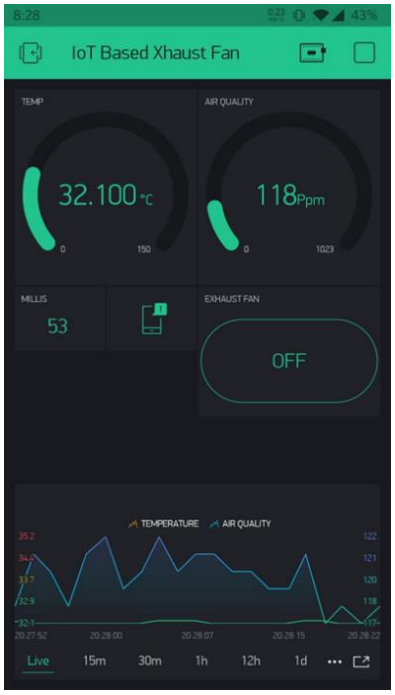


**Figure 10: Blynk profile for this project**

### 3.6 Manual Switch

The IoT Based Smart Exhaust Fan also has built with manual switch for the user to ON, the exhaust fan even though it is not required depending on temperature and air quality level on surrounding. Even though when the manual switch is used to ON and OFF the exhaust fan but the data collection for the temperature and air quality value still can be monitored and saved in the BLYNK application. The switch can use for maintenance purposes and the user can test the exhaust fan working fine. There are two type of switch is used physical switch and virtual switch.

## 4 Conclusion

In conclusion, IoT Based Smart Exhaust Fan is well-designed, easy and affordable for home user. This project is an IoT based exhaust fan which can control and monitor the performance of the exhaust fan. This device can help the user to monitor, control and can reduce power consumption because it works automatically. The first objective have been achieved as a profile was design and build an IoT based smart exhaust fan which can turn ON and OFF automatically when temperature and air quality exceeded more than required level in a space. Next, the second objective is to measure and record data for data collection of temperature and air quality in a space also have been successfully done. Lastly, through this project, the objective of to optimize IoT implementation for the prototype is succeeded. The electronic system to monitor and control the temperature and air quality of the exhaust fan have been obtained by the usage of various components such as Arduino Mega, DHT22, MQ-135, ESP8266-01, and fan. The acrylic house block was successfully built to set up the device or prototype into it so that to make experiment or testing process easier for result purpose. The electronic system was successfully integrated with the exhaust fan inside the acrylic house block which satisfied the objective of this project.

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