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Prototype Design of Carbon Monoxide Box Separator as a Form of Ar-Rum Verse 41 and To Support Sustainable Development Goal's Number 13 (Climate Action)

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ABSTRACT The maritime sector is one of the paths to Golden Indonesia 2045. This is because 70% of Indonesia's territory is a sea with an area of 3.25 million km2. Additionally, this sea is supported by the large potential that can be utilized for the welfare of Indonesia. One of which is as a contributor to foreign exchange with foreign exchange potential from the maritime sector amounting to the US $ 28 million to the US $ 56 million. The problem lingers on how to possibly solve the problem regarding air pollution without shutting down industrial operations. Many multinational power plants have launched different campaigns in order to minimize the problem like planting trees and the like. But these small growing industries like grilling restaurants have given way to the arising problem of air pollution issues. On the other hand, the ocean is a contributor to half of the world's oxygen. But in a period of 50 years, areas with minimal oxygen levels in the oceans have increased. The leading cause is global warming, one of which comes from increasing levels of carbon monoxide in the air. One of these gases comes from incomplete combustion in motorized vehicles. This is also exacerbated by the growth of motorized vehicles, which has increased by 11.5% per year. If left like this, marine life will be destroyed, and Indonesia will not reach its peak of glory in 2045. Therefore, to overcome this problem, a prototype design of a carbon monoxide box separator was created. This prototype is a combination of detector sensors consisting of MQ7 to detect carbon monoxide, MQ135 to measure air quality, and DHT11 to measure humidity and air temperature, as well as a high voltage system on the L-Box (Lightning Box) which can produce O2 because of the copper plate. The L-Box will bind the element carbon to carbon monoxide using a voltage of 400 kV. With this prototype design, it is hoped that Indonesia can achieve its glory and also as a form of QS practice. Ar-Rum verse 41 regarding Allah's command to preserve nature and the environment and in this paper aims to produce a tool that can break dirty air into clean air.

INDEX TERMS Maritime, Oxygen, Carbon, Air.

I. INTRODUCTION

Indonesia is a tropical country with a sea area larger than the land area, where 70% of Indonesia's territory is a sea with an area of 3.25 million km2 and has a coastline of 99,093 kilometers which is the second-longest coastline in the world. Besides that, it is also supported by the enormous potential that can be utilized for the welfare of the Indonesian people. The known potential wealth of Indonesia reaches more than IDR 1,700 trillion, equivalent to 93 percent of the total Indonesian State Budget for 2018. This wealth comes from fish, mangroves, marine tourism, and so on. In addition, the sea is also a contributor to the country's foreign exchange, with foreign exchange potential from the maritime sector of US $ 28 million to the US $ 56 million.

On the other hand, the sea is a contributor to half the amount of oxygen in the world. However, in a period of 50

years, areas with minimal oxygen levels in the oceans have increased [1] [2]. a study entitled declining oxygen in the global ocean and coastal waters published in the Science Journal on January 15, 2018, states that the leading cause of the decline in oxygen levels on earth is global warming [3]. This global warming causes the air temperature at the sea surface to increase. Additionally, a high level of oxygen will be absorbed by the hot temperature at the sea surface. After that, oxygen with low concentrations will be attracted to the seabed, which in turn will cause the sea temperature to become cooler [4]. One of the causes of global warming is the increase in carbon monoxide (CO) levels in the air. The increase in carbon monoxide levels is also closely related to the rise in population in Indonesia, which is the second-most populous country in the world. According to the Ministry of National Development Planning (Bappenas) 2018, Indonesia's population has reached 265 million, where the latest data states that between 2025 and 2045, the total population of Indonesia is estimated to reach 296.4 million with a population growth rate of 1.49%. One of the sources of this gas formation is incomplete combustion by motorized vehicles. This is also exacerbated by the growth of motorized vehicles, which has increased by 11.5% per year. This gas is one of the dangerous gases. After all, in addition to causing global warming, it is dangerous because it can react with hemoglobin (CO-Hb). It will cause symptoms of mild toxicity or poisoning in large quantities, such as nausea and headaches [5].

The problem lingers on how to possibly solve the problem regarding air pollution without shutting down industrial operations. Many multinational power plants have launched different campaigns in order to minimize the problem like planting trees and the like. But these small growing industries like grilling restaurants have given way to the arising problem of air pollution issues. These may be small restaurants, but because they are in chains, they increase the risk of unnoticeable problems in the environment. The researchers believed that it is necessary to monitor these chains of grilling restaurants to evaluate their smoke level emissions.

The study is conducted primarily to provide smoke detectors that are affordable and readily available as well as monitor the carbon monoxide emissions of chicken grilling restaurants. Specifically, the study is conducted to develop a prototype that will detect and measure the concentration levels of carbon monoxide

If left like this, marine life will be destroyed, and Indonesia will not reach its peak of glory in 2045 [6]. Allah has stated in Surah Ar-Rum 41 that, in fact, the damage in the sea and on land is the result of human intervention himself, so that Allah will show a reward for what humans have done [7]. This is also explained by Ath Thobari in his book Jami` Al Bayan Fii Ta'wil Al Quran, where Allah reminds people that damage has appeared in the plains of the earth and sea. Additionally, it is all the result of human actions even though Allah has forbidden them. As an Indonesian citizen, especially a Muslim student, as an agent of change, it is proper to have an obligation to protect this country. So, to solve this problem, a prototype design of the Carbon Monoxide Box Separator was created. This prototype is a combination of detector sensors consisting of MQ7 to detect carbon monoxide. Moreover, the MQ135 was used to measure the air quality. Furthermore, the DHT11 is used to measure humidity and air temperature, as well as a high voltage system on the L-Box (Lightning Box) which can produce O2 because of the copper plate. The L-Box will bind the element carbon to carbon monoxide using a voltage of 400 kV. With this prototype design, it is hoped that Indonesia can achieve its glory and also as a form of QS practice. Ar-Rum verse 41 regarding Allah's command to preserve nature and the environment and in this paper aims to produce a tool that can break dirty air into clean air.

II. MATERIALS AND METHODS

A. MATERIALS AND EQUIPMENT

The tools and materials used in making prototypes include:

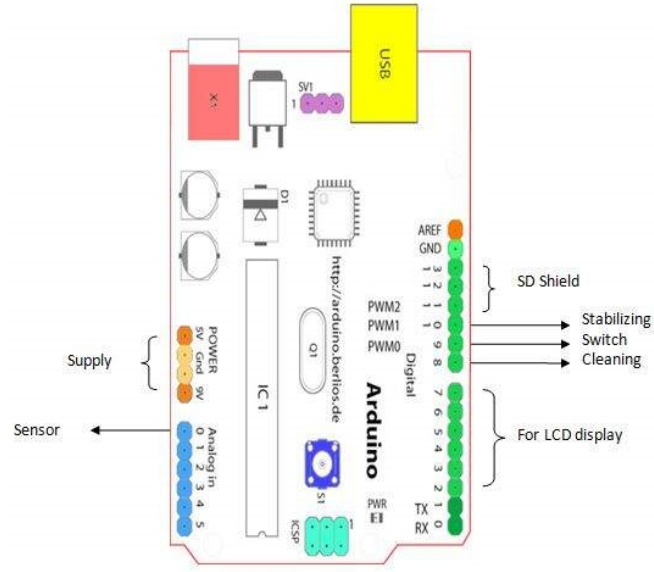

FIGURE 1. Arduino [1]

The sensor is programmed to achieve the required conditions that it will detect the carbon monoxide gas (FIGURE 1). Figaro TGS 203 is operated in two temperature level which is 300 o C (60 s) and 88 o C (90 s). In order to achieve these conditions, Vhh and Vlow must be applied to the circuit alternately. For the first 60 seconds Q1 and Vhh is set to high and the Vlow to low. After that, Vhh is set to low and Vlow to high for the next 90 seconds. All the connections then is cut off which is setting the Q1, Vhh and Vlow to low for another half a second for sensor reading.

B. DESIGN CONCEPT

Below (FIGURE 2) is the design concept of the CO Box Separator prototype, where the planning process of the CO Box Separator design is carried out using the AUTOCAD 2007 software. Where this prototype is equipped with fans on the right and left sides of the box, so it can help speed up air circulation in the box so that the process of separating carbon in carbon monoxide will be more efficient. The power source

used is two types of 18650 batteries with a voltage of 3.7V on each battery [8]. Where one battery is used to supply power to a series of detector sensor systems, and another battery is used to supply the Lightning Box (L-Box) system, which will be used to break down carbon from carbon monoxide [9].

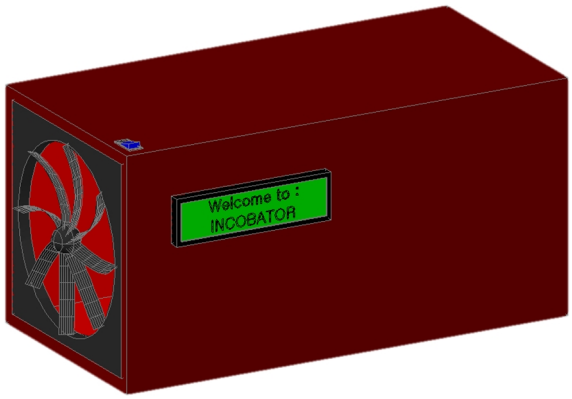

FIGURE 2. Prototype CO Box Separator Design

In addition to planning the design of the CO Box Separator prototype, the planning of the work scheme of the CO Box Separator prototype itself is also carried out. The working scheme of the CO Box Separator prototype can be seen in FIGURE 2.

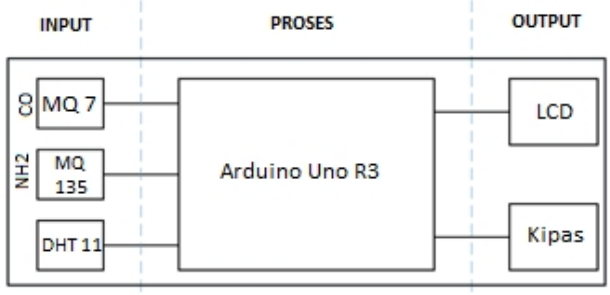

FIGURE 3. Block Schematic Work Schematic of CO Box Separator

The picture FIGURE 3 shows the working scheme of the CO Box Separator prototype, which is divided into three parts, namely "input," where the CO gas content in the input and output is measured using MQ7, NH3 as air quality parameters tested using MQ135, and air temperature and humidity are measured using DHT11, which is a series of detector sensors, has been calibrated first through calculations from the sensor datasheet itself. Furthermore, in the "process" section, the analog data that has been obtained will be processed by the Arduino Uno R3 microcontroller, which is then in the "output" section, the results of data processing will be displayed using the LCD. The electrical circuit can be seen in FIGURE 4.

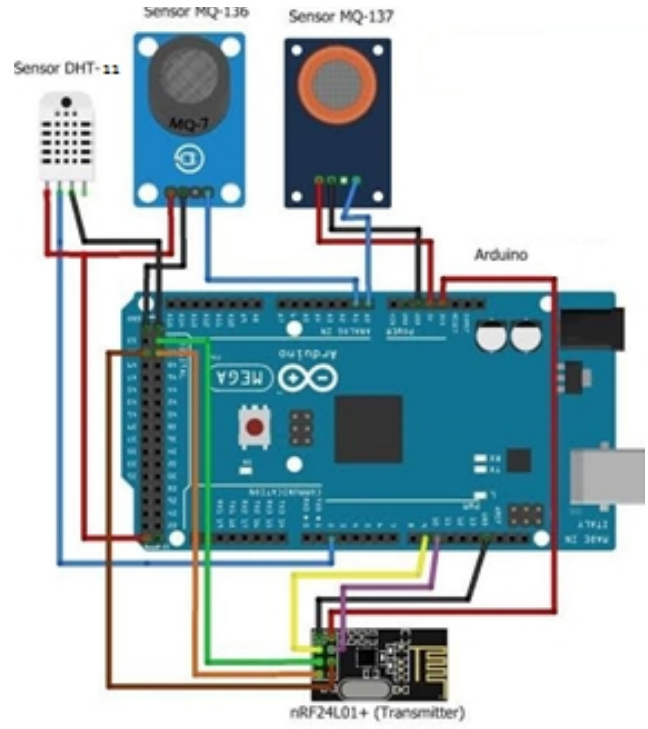

FIGURE 4. Sensor Design

C. DATA ANALYSIS

After the required data has been collected, data processing is carried out in a systematic and logical manner. After the required data has been collected, data processing is carried out in a systematic and logical manner. The data analysis technique chosen was to use regression techniques and the mean to determine the average levels of carbon monoxide, NH3 in the air, and the temperature and humidity of the air.

Table 1
National ambient air quality raw concentration (1 hour)

No.	Parameter	Quality Standard (µg / Nm3)	Quality Standard (ppm)
1.	SO_2	900	22,15
2.	CO	30.000	738,56
3.	NO_2	400	9,84
4.	HC	160	3,93

After that, it will be assessed whether the air quality in the area meets the standards or not. This study was carried out by analyzing data in a descriptive qualitative manner based on the national ambient air quality standards in Government Regulation number 41 of 1999 concerning Air Pollution Control which has been converted into units of ppm (TABLE I, AND TABLE II). This is intended to make observations easier because the output from the sensor has units of ppm. Where C indicates (ppm x BM / 24.45) x 103, C is the concentration of CO levels (µg / Nm3), ppm is calculated in pressure (ppm), and BM is the molecular weight.

Table 2
Air composition table

Composition	Formula	Percent Volume	Ppm
Nitrogen Oxygen	N_2O_2	78,0820	780820
Argon	Ar	0,934	9340
Carbon dioxide	CO_2	0,0314	314
Neon	Ne	0,00182	18
Helium	He	0,000524	5
Methane	CH_4	0,0002	2
Krypton	Kr	0,000114	1
Ammonia	NH_3	0,0025	25

D. MICROCONTROLLER AND SENSORS

Arduino is a microcontroller development board based on the ATmega328P. By using this development board, it is possible to assemble an electronic circuit [10]-[12]. Programming Arduino is also very easy. This is because Arduino uses a high-level programming language, namely C ++, which is easy to learn and is supported by the library from Arduino itself, which is quite complete [2]. MQ 7 is a gas sensor used to detect Carbon Monoxide (CO) gas. This sensor has a high level of sensitivity to CO, and the result of its calibration is stable and durable. MQ 7 comprises an Al2O3 micro ceramic tube, a tin dioxide (SnO2) sensitive layer, measuring and heating electrodes as a skin layer made of plastic and stainless steel having a surface. A heater provides the necessary working conditions for sensitive components to work [13].

MQ-135 is a gas sensor that can be used in air quality control equipment for buildings/offices to detect ammonia gas (NH3), Nitrogen Oxide (NOx), alcohol, benzene, smoke, carbon dioxide (CO2), and others. The sensitive material of the MQ-135 gas sensor is SnO2 [14]. This sensor has good sensitivity to harmful gases (Ammonia, Sulfide, Benzene). This sensor requires a power supply of 5V. This sensor is capable of detecting NH3 gas with a detection range from 10 to 300 ppm, detecting benzene gas with a detection range from 10 to 1000 ppm, and 10 to 300 ppm for alcohol. The DHT11 sensor has a digital signal output that is calibrated with its temperature and temperature sensor capabilities. This sensor can be integrated with an 8-bit microcontroller with high performance. The technology used in the DHT11 sensor is reliable, and it has a very good level of stability over a long period of time. This sensor has a resistive element and a sensor that can be used in negative temperature measurements. This sensor has excellent quality, fast response, "anti-interference" capability, and high performance [15].

Each DHT11 sensor features a highly accurate humidity detection feature. Calibration coefficients are stored in the OTP program memory, and the internal sensor detects signals in progress. Small size, low power, transmission signal distance of up to 20 meters, which allows the needs of various applications. L-box is a device used to separate carbon and oxygen (FIGURE 5). Carbon Monoxide is produced by biological oxidation, motor vehicle emissions, etc. This uses the high voltage generated by the step-up power where the voltage used is 400kV with an input voltage of 3.7V.

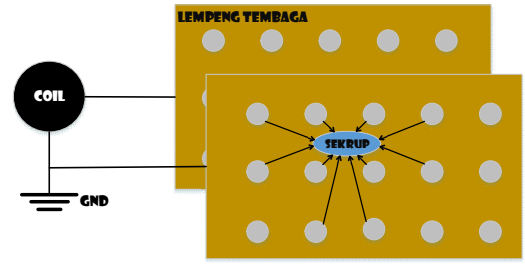

FIGURE 5. Rangkaian Lightning Box (L-Box)

III. RESULTS

A. MEASUREMENT OF CO LEVELS AT THE INPUT AND OUTPUT OF THE LIGHTNING BOX (L-BOX)

The test was carried out at the Keputih intersection, Sukolilo, Surabaya, on November 16, 2019. This test aims to determine the carbon monoxide content in the CO Box Separator input and output. Test result data can be seen in TABLE 3. FIGURE 6 shows a graph obtained from testing CO levels.

Table 3
CO measurement at the input and output of the co separator box

Time (seconds)	CO input (ppm)	CO output (ppm)
0	302	25
10	309	24
20	339	25
30	340	24
40	340	24
50	329	23
60	331	23
Average	336,807	27,22

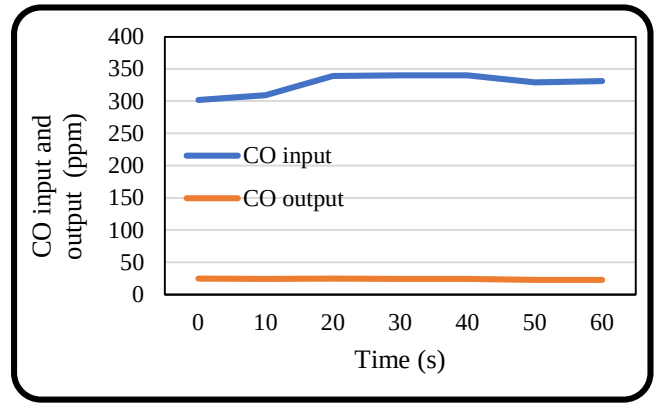

FIGURE 6. CO test chart

After testing the carbon monoxide levels at the Keputih intersection, Sukolilo, Surabaya, it is known that the carbon dioxide content from the CO Box Separator input is 336,807

ppm. In addition, it is also known that the carbon monoxide content on the output side of the CO Box Separator prototype is 27.22 ppm. With this test, it can be seen that this prototype can reduce carbon monoxide levels in the air by up to 91% so that the air that has been processed through this prototype can be classified in the clean air group. This is because according to the table of ambient air quality standards in PP number 41 of 1999 concerning Air Pollution Control, the maximum content of carbon monoxide is 738.56 ppm. Based on carbon monoxide levels, the ratio of air quality after and before being passed in the CO Box Separator prototype is 1: 12.44 (Fig. 10).

B. AIR QUALITY BASED ON NH3 LEVELS

This test was conducted to determine the air quality at the Keputih intersection, Sukolilo, Surabaya. This test was carried out at 0700, 16.00, and 20.00 WIB on November 16, 2019, using the MQ135 sensor, and the observed variable was the level of NH3 ¬di at the Keputih intersection, Sukolilo, Surabaya (TABLE 4). This is because NH3 can be used as a parameter for whether the air is clean or not. FIGURE 7 is a graph obtained from testing the NH3 concentration.

Table 4
Testing NH3 conditions

Time (seconds)	The concentration of NH¬3 (ppm)		
	07.00	16.00	20.00
0	5,92	7,01	5,41
10	4,55	5,64	4,04
20	6,05	7,14	5,54
30	7,86	8,96	7,35
40	8,33	9,41	7,86
50	13,9	14,99	13,6
60	7,56	8,65	7,55
Average		9,365	

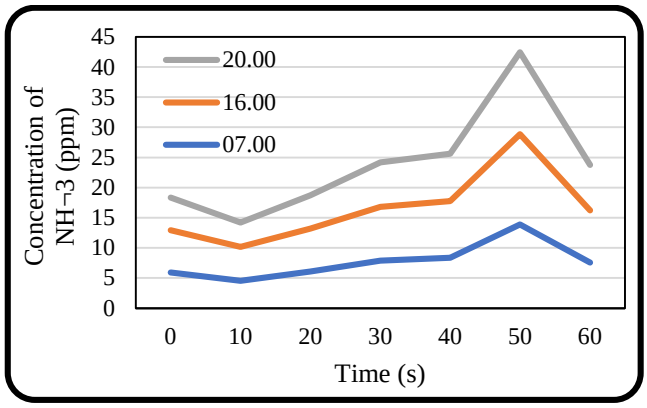

FIGURE 7. Graph of NH_3 levels testing

After conducting this test, it is known that the NH3 level at the intersection of Jalan Keputih, Sukolilo, Surabaya is 9,365 ppm. So the air quality at the junction of Jalan Keputih, Sukolilo, Surabaya is in the clean category because the range of NH3 levels in the air is still below 25 ppm.

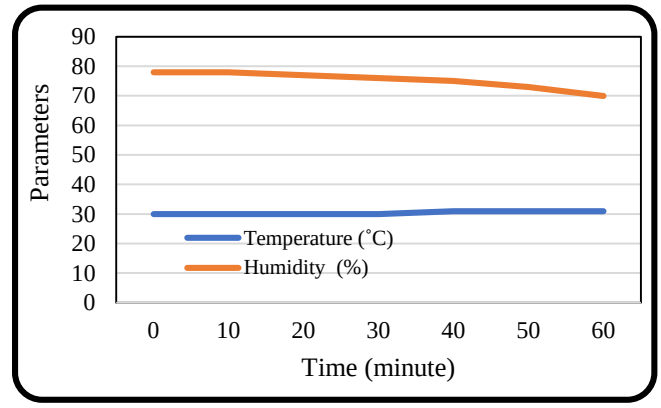

FIGURE 8. Graph of air temperature and humidity testing

C. TESTING OF AIR TEMPERATURE AND HUMIDITY

This test was carried out by observing the temperature and humidity at the intersection of Jalan Keputih, Sukolilo, Surabaya (FIGURE 8). This test is conducted to determine the temperature and average humidity of the air at the intersection of Jalan Keputih, Sukolilo, Surabaya. This test was carried out at 0700, 16.00, and 20.00 WIB by observing each session for one hour and recording data every 10 minutes. FIGURE 8 is a graph obtained from testing air temperature and humidity.

After conducting this test, it is known that the average temperature and humidity at the intersection of Jalan Keputih, Sukolilo, Surabaya is 30.28 C and 66.47% (TABLE 5).

Table 5
Measurement of temperature and air humidity

Time (minutes)	Temperature (˚C)	Humidity (%)
0	30	78
10	30	78
20	30	77
30	30	76
40	31	75
50	31	73
60	31	70
Average	30,28	66,47

IV. DISCUSSION

From the research that has been done, it can be seen that based on the carbon monoxide content, the air quality ratio after and before being passed in the CO Box Separator prototype is 1: 12.44. In addition, the reading of the MQ135 sensor for NH3 levels was 9,365 ppm, and based on this test. It was found that air quality was still in the clean category because NH3 levels were still below 25 ppm. Meanwhile, based on the DHT11 sensor readings, the temperature and humidity readings were 30.28 ˚C and 66.47%. The use of the MQ125, MQ 7, and DHT11 sensors are very recommended.

Furthermore, in previous research, the measurements were carried out using the MQ 8 and MQ 9 sensors, which resulted in the detection sensor having the lowest detection range, which was too high at 120 ppm so that the detector sensor that was owned still had a high error percentage of 17%.

In order to achieve reliability of results, the researchers used a device to secure that the prototype developed were reading and obtaining the measuring the correct concentration level; the researcher used a parallel tool in data gathering. The equipment is an Electronic Gas Analyzer, a technology of Bacharach. It specializes in measuring the concentration levels of the sensor in PPM (parts per million). The equipment serves as parallel data of the sensor. The researcher does not necessarily measure and reflect the data obtained by the Bacharach. Still, the researchers did record simultaneously of the sensor since the developed prototype has its display circuit.

The application of this prototype will have a positive impact on the environment because the design of this prototype can separate carbon compounds in carbon monoxide. Thus, it can produce an output in the form of oxygen gas. Therefore, with this prototype design, marine life can be preserved, which previously was threatened with extinction due to human behavior itself. By preserving marine life, humans can also use it to improve their welfare. In addition, with the preservation of marine life, Indonesia can take advantage of its wealth where the known potential of Indonesia's marine wealth reaches more than Rp.1,700 trillion, which comes from fish, mangrove ecosystems, tourism, etc. as a source of foreign exchange income because the sea is also a contributor to foreign exchange. Countries with foreign exchange potential from the maritime sector have amounted to US $ 28 million to US $ 56 million.

V. CONCLUSION

The design results of this prototype can be said to be portable and flexible. This is because this prototype can be brought to any place easily and can be placed in various polluting places. Based on carbon monoxide levels, the ratio of air quality after and before being passed in the CO Box Separator prototype is 1: 12.44. Based on the tests that have been done, the reading of the MQ135 sensor on NH3 levels is 9,365 ppm, and based on this test. It is found that air quality is still in the clean category because NH3 levels are still below 25 ppm. Meanwhile, based on the DHT11 sensor readings, the temperature and humidity readings were 30.28 C and 66.47%. The developed prototype has detected, measured, and log the concentration levels of carbon monoxide. Furthermore, among the establishments where a test run of the prototype was conducted, it must be noted that one of the chicken grilling restaurants has emitted beyond the safety standards of carbon monoxide concentrations.

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