Research Article

Visualization of Home Security Sensor System Based on IoT Server

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Home security is something that people really need. In Indonesia, security threats that often occur are theft caused by social inequality factors and fires which are usually due to the negligence of the homeowner. Therefore, the authors conducted this research with the aim of realizing a visualization plan of a home security system using motion sensors and gas sensors. This is done because of the need for home and family security to avoid crime and material losses. The author has planned and designed a tool that is built or designed to provide convenience in monitoring home security when the house is empty and no one is around. This study will use a qualitative research method which will be carried out using an experimental method with several steps, namely testing the system both from the hardware and software side in order to be able to explain, control the phenomenon in detail and completely. And using data collection methods, namely literature study, field research, and observation. On that basis, the author wants to examine how effective the home security system with this IoT-based Arduino is if it is actually implemented as a security system at home. It is hoped that by using this tool unwanted incidents related to home security can be avoided with good anticipation.

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1. Introduction

As time goes by and rapid technological advances, information in various aspects of life is needed very quickly, one of which is the security aspect. Security is something that must be considered in everyday life, everyone wants security to be guaranteed. The house is where the owner generally keeps valuables in the hope that they will be safe. To meet these security needs, various useful technologies have been developed to provide homeowners with a sense of security and protection for their valuables with the

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aim that the existing security system can be implemented.In Indonesia, there are still many criminal acts that occur, such as house robbery. And robberies often occur when the homeowner is not at home and the house is empty. Another case that needs to be considered in the aspect of home security is a house fire. One of the causes is LPG gas leakage, where with a spark source, a fire can occur.The security system that the author wants to develop at this time is a security system based on the Internet of Things (IoT) that provides information quickly to homeowners by sending information on the condition of the home environment to a device in order to prevent and anticipate losses that can be caused by a less stringent home security system. such as theft or fire. IoT is a continuous system between one device and another with the help of the internet network. Because IoT makes it easier to connect with devices and also ensures the effectiveness of monitoring, the authors decided to use an IoT-based system to detect movement in the house and to monitor the temperature and gas levels in the air when the house is empty.

2. Literature Review

2.1. Mikrokontroler

In everyday discussions, microcontrollers are usually called C, uC, or MCU. So it can be said that the size of a computer microcontroller. Micro in one IC chip (integration circuit) consists of a processor and memory, can be programmed so it is called a microcontroller because it is located in the IC. or a microcontroller chip consisting of a CPU,. memory, and I/O which we can control through programming. I/O is also commonly referred to as 2 [1].GPIO (General Purpose Input Output Pins). Meaning: we can program it as an input or output pin according to our needs. Microcontroller can be said as a computer. in one chip. The word "micro" means the device is very small, the term "controller" means this tool can be used., Control object, one or more process functions of an object. Microcontroller is often also called controller [2].

2.2. NodeMCU ESP8266

The NodeMCU is a microcontroller board made with a very small Wi-Fi chip, the ESP8266. The chip has a low price with the same advantages as other Wi-Fi modules. NodeMCU can be programmed with Arduino IDE using C Language. NodeMCU works with ESP8266 system and hardware based on ESP-12 module.

This microcontroller also provides access to GPIO (General Process Input/Output) for the development process [3].

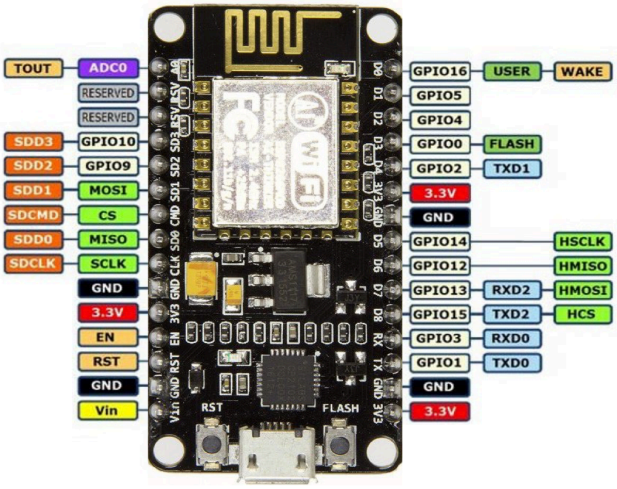

Figure 1. NodeMCU E-12

The ESP8266 uses the JEDEC voltage standard (3.3V) to function. For more details, Table 1 describes the function of each pinout [4].

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Category Pin	Pin Name	Description
Daya	Vin; 3,3V; 5V; GND	• Vin: Current Aruino input voltage • use external power • 3,3V: Generates output power with • voltage 3.3V • GND: Ground
Pin Kontrol	RST & EN	Pins that reset and enable the microcontroller
Pin Analog	A0	Used to measure analog voltage 0~3.3V
GPIO	GPIO1 ~ GPIO16	General purpose input-output pins, there are 16 pins
SPI	SD1, CMD, SD0, CLK	Used for SPI communication
UART	TXD0, RXD0, TXD2, RXD2	NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD2 & TXD2). UART1 is used to upload programs

Table 1. Pinout Module HC-SR501

2.3. PIR (Passive Infra Red) Sensor HC-SR501

PIR sensor is a sensor that serves to capture or detect motion with infrared energy generated from human or animal waves. Usually the detected wave or motion has a wavelength with a certain value resulting from human or animal movement [5].

Figure 2. PIR Sensor HC-SR501

One type of PIR sensor is the HC-SR501 PIR module which works to produce high value output when it detects humans in front of the sensor, and low values when the sensor does not detect humans according to the sensor range. The following is the pinout table of the HC-SR501 PIR module [6]:

Pin Name	Description
VCC	Voltage Source 5~20V
GND	Ground
Out	Sensor Output (3.3V or 0 V)

Table 2. Pinout Module HC-SR501

2.4. Sensor MQ-2

The MQ-2 sensor module is a sensor module that has high sensitivity to levels of CO, LPG, hydrogen, methane, and other combustible gases in the air. This sensor is suitable for a variety of applications, be it industrial or residential gas level detectors. [7].

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Figure 3. DHT11. Sensors

The working voltage of the MQ-2 sensor is 5 ± 0.1 V, the power consumption is 800mW with two sensor output pinouts, namely digital output and analog output. This sensor has a working temperature of -10 ~ 50°C with dimensions of 38.1x25.4x25.4mm. Table 3 shows the pinout of the MQ-2 sensor module [8].

Pin Name	Description
VCC	5 V
GND	Ground
Ao	Analog Output (0 V or 5 V)
Do	Digital Output (0~5V)

Table 3. Pinout of MQ-2. Module

2.5. AC – DC Converter

AC – DC converter or rectifier is an electrical circuit that functions to convert AC (Alternating Current) voltage into DC (Direct Current) voltage. By using this circuit, a system that works using DC-voltage power can be supplied by power with AC voltage such as a laptop supplied by AC power supplied by PLN [9].

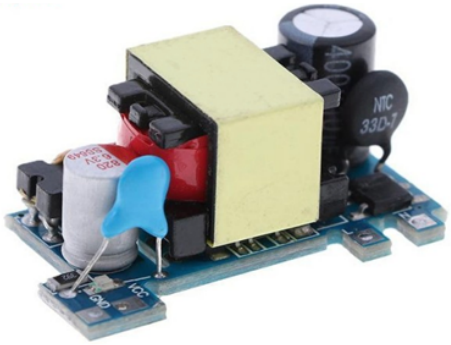

Figure 4. AC-DC Converter

2.6. Buzzer

The buzzer is an electronic component that can convert electrical waves or vibrations into sound waves or vibrations. The buzzer has a function that is almost the same as a speaker which consists of a coil contained in the diaphragm, which is energized by a changing current so that electromagnetic energy will be attracted in or out, thus producing air vibrations and producing sound. The function of the buzzer is usually used as a signal or sign of the reaction of the tool or something has gone wrong so that it produces a sound or sound that becomes a reminder alarm in accordance with the function specified.

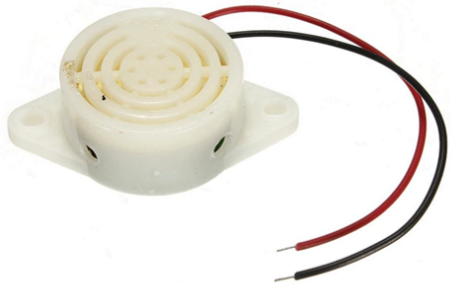

Figure 5. Buzzers

2.7. Thinger Io

Thinger.io is an IoT server platform that provides various features to create tools, or prototypes that can be processed with simple data. Thinger.io is an open source platform that is easy to learn and develop.

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Thinger.io can produce many applications to control and monitor various devices connected to the internet network, making it easier for users.

3. Methods

3.1. Problem Identification

Problems from several bad events that occurred in residential areas such as explosions due to gas leaks and also burning houses due to forgetting to turn off the stove. Research on home security systems to prevent these incidents has been carried out, but the research conducted is only for one incident. Therefore, it is necessary to design a home security system by integrating temperature, humidity, and gas sensors that were carried out in previous studies. The system will detect critical or abnormal events which will be displayed on web pages in the form of numbers and graphs in real time. The security system will be created using the Thinger.io IoT platform service.

3.2. Software Requirements Analysis

In supporting the making of a visualization prototype for this home security system, software such as Arduino IDE Ver is needed. 1.8.7, Windows OS, and Thinger.io.

3.3. Hardware Requirements Analysis

In making a home security system visualization prototype, hardware is needed such as the HC-SR501 PIR Sensor (motion sensor), MQ-2 sensor (gas sensor), NodeMCU ESP8266 12E (microcontroller slave and wifi module), bread board, male jumper cable male and female-female, AC-DC converter, buzzer

3.4. System planning

The home security system designed uses two sensors, namely the PIR sensor HC-SR501 as a motion detection sensor, and the MQ-2 sensor which detects CO levels, LPG gas leaks and smoke. These two types of sensors are used as inputs connected to the microcontroller which performs data processing. After the microcontroller has finished processing the incoming data, it will send data to the Iot Server so that the detected data can be known by the user through the thinger.io web page. The system is also designed to use a buzzer as a warning when there is no internet connection.

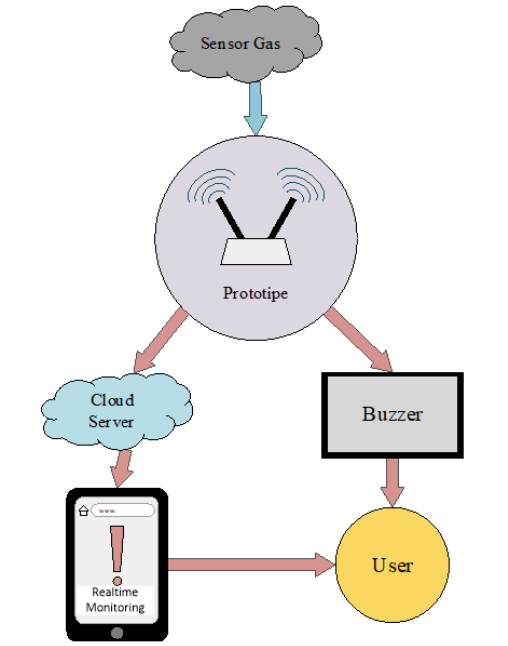

Figure 6. Illustration of Prototype Work

3.5. Prototype Modeling

The gas sensor output is connected to the analog I/O pin A1. The VCC pin of the sensor is then connected to the VCC pin of the AC-DC converter and the gas sensor is connected to the GND pin of the AC-DC converter so that electrical power can be supplied to the sensor. The NodeMCU is connected directly to the PIR sensor using the I/O pin D2 on the NodeMCU with the PIR sensor output. Then I/O pin D5 NodeMCU is connected to I/O pin 6 Arduino UNO and I/O pin D6 NodeMCU is connected to I/O pin 5 Arduino UNO. And the last buzzer is connected to pin D7 and pin GND NodeMCU. The entire prototype system is powered directly by an AC-DC Converter which is connected to an AC 220V power source. For more details, Table 4 shows the hardware I/O connection used on the system.

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NodeMCU	HC-SR501	MQ-2	Buzzer
5V	Vin	Vin	-
GND	GND	GND	-
GND	-	-	GND
-	-	-	-
-	-	-	-
Pin D7	-	-	VCC
-	-	-	-
A0	-	Ao	-
Pin D2	Pin Out	-	-

Table 4. I/O System

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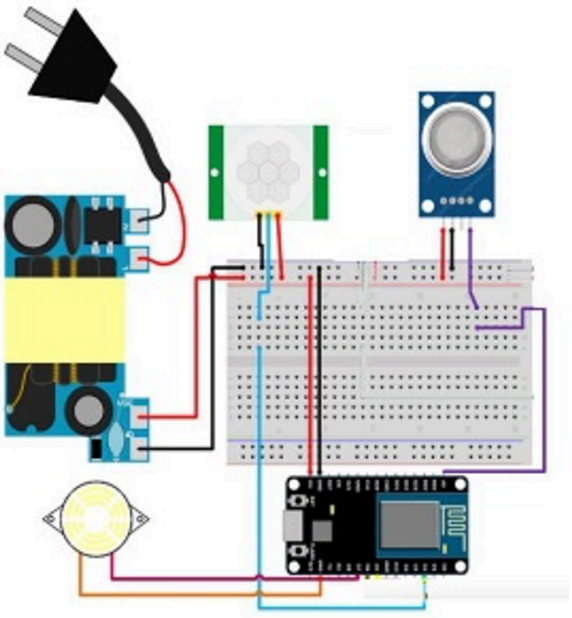

Figure 7. Schematic of a Home Security System Prototype

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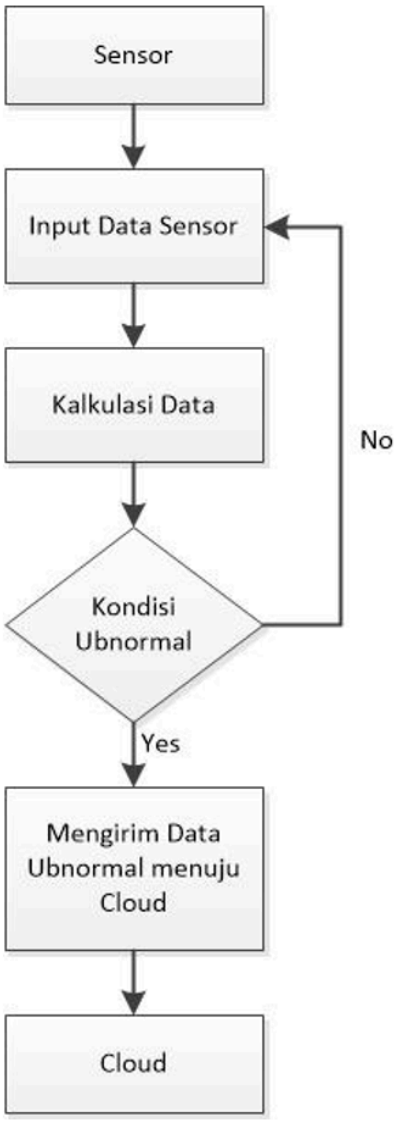

Figure 8. Data Delivery Flow to the Cloud

3.6. Thinger.io Visual visualization

After adding several widgets to the dashboard, the dashboard display in this study can be seen in the following image:

Figure 9. Dashboard Display

4. Experiment and Analysis

After the dashboard display is complete, then further testing is carried out to see the performance of the tool. The test is carried out under several conditions, namely normal conditions, gas leaks, when there are people and the sensors are disabled.

4.1. Normal Condition

Under normal conditions, when the two sensors do not read any movement or smoke or gas, the thinger.io dashboard will look like this:

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Figure 10. Dashboard Normal Condition

4.2. Gas Leakage Condition

In this condition, an experiment was conducted by giving smoke to the sensor by burning the paper and directing the smoke from the paper to the MQ-2 sensor. When this experiment is carried out, the buzzer is active to notify the residents of the house or people around that an abnormal condition has occurred.

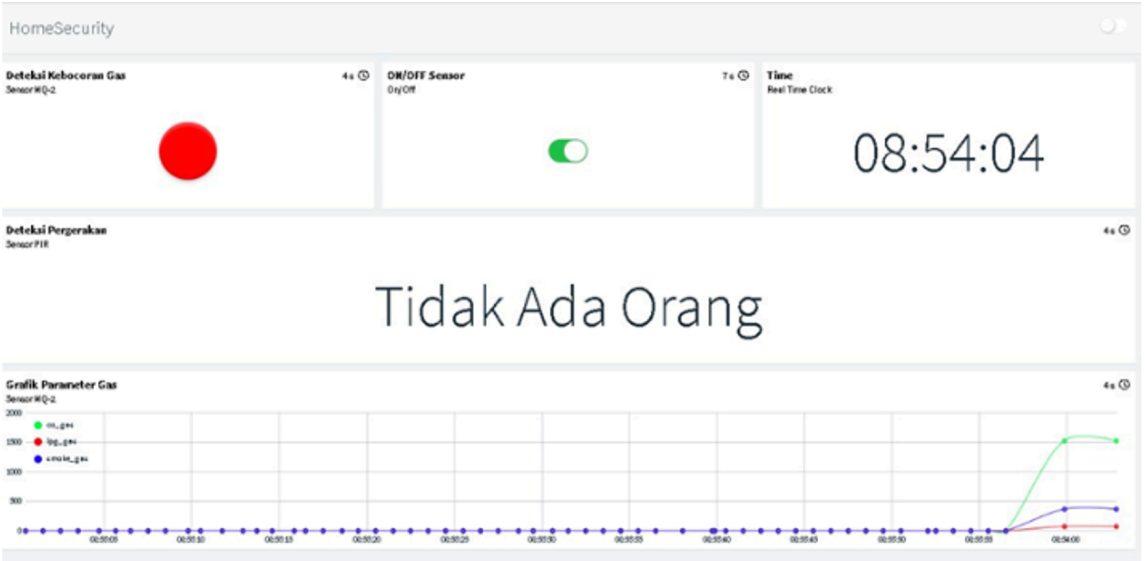

Figure 11. Gas Leakage Condition Dashboard

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4.3. Condition of Movement

Experiments for this condition are carried out by standing or pointing the limb at the PIR sensor in the range of the sensor. When this experiment is carried out, the buzzer is active to notify the residents of the house or people around that an abnormal condition has occurred. The text widget will display the phrase 'There are people'. The sentence will continue to be displayed as long as the PIR sensor still detects a human being within the sensor reading radius.

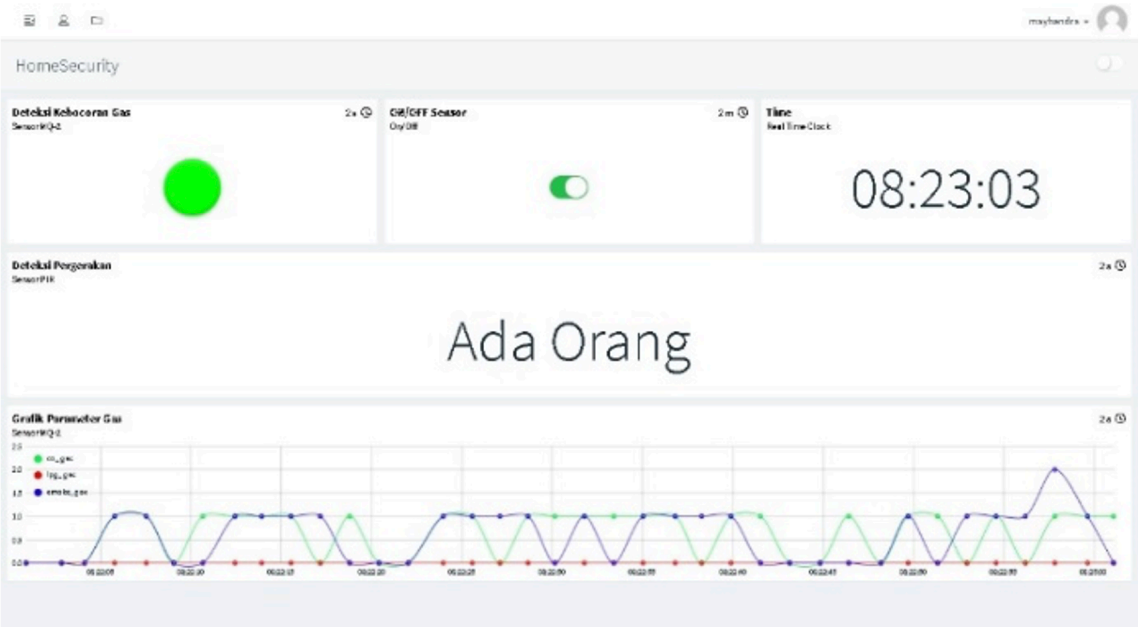

Figure 12. Dashboard Conditions There is Movement

4.4. Sensor Condition is Disabled

Experiment with this condition is done by pressing the on/off switch button located on the dashboard. Furthermore, the experiment was carried out by applying smoke to the MQ-2 sensor and directing the limbs to the reading radius of the PIR sensor. As a result, the dashboard page still displays a safe condition, because the abnormal condition is ignored by the microcontroller.

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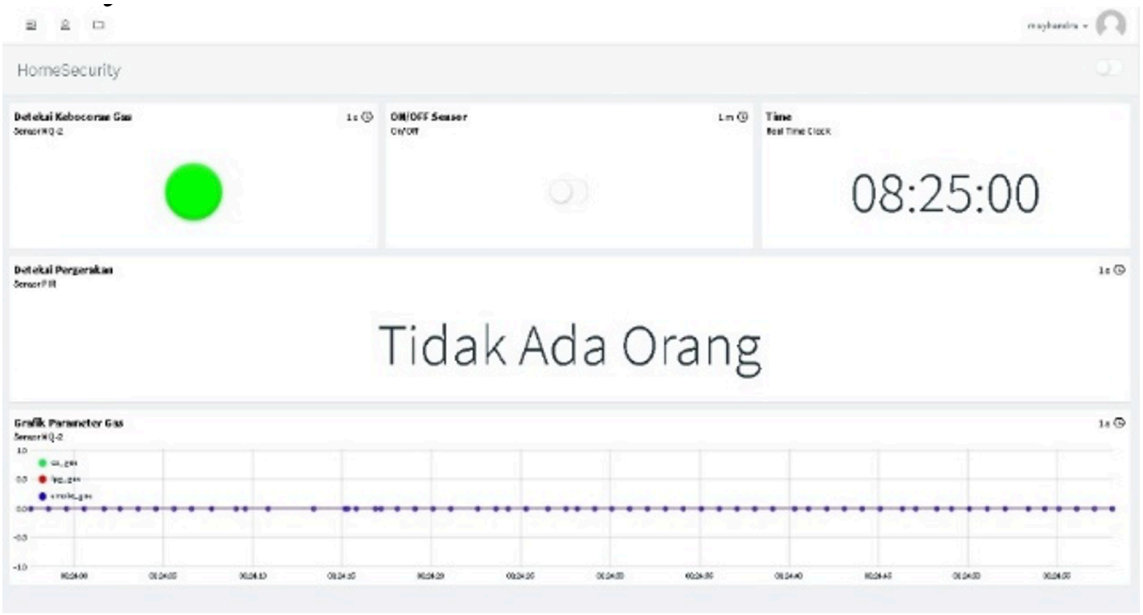

Figure 13. Sensor Condition Dashboard is Disabled

5. Conclusion

Home security that uses an IoT-based microcontroller can be made using the ESP8266 as a microcontroller, the MQ-2 sensor as a gas leak detection sensor and also a fire detector, and a PIR sensor that functions as a human presence detector. This tool can be implemented as a home security system, where if an abnormal situation occurs in the form of a fire, gas leak, or a thief, this tool will provide information to homeowners through the thinger.io dashboard which can be accessed via the internet network. Visualization of the gas sensor using a led indicator widget where when conditions are normal the indicator will be green, while when an abnormal condition occurs the indicator will be red. Motion sensor visualization uses text in the form of writing where when no one is detected, the text displayed is "No People" while if someone is detected, the text that will be displayed is "There are People". In addition to using thinger.io as an online data visualization, a 16x2 character LCD is also used as a data visualization to display the parameters read by the gas sensor.

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Declarations

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