Smart Controlling system for Kitchen Fire Protection based Internet of Things

Haryanto¹, L Anifah², D Rahmawati³, A K Sahputra⁴, D T Laksono⁵

¹, ³, ⁴ Electrical Engineering Department, Faculty of Engineering, University of Trunojoyo Madura
Jl. Raya Telang, Kamal, Bangkalan, Indonesia 69162
² Electrical Engineering Department, Faculty of Engineering, Universitas Negeri Surabaya
Jl. Raya Ketintang Surabaya, Indonesia

e-mail: ¹Haryanto@trunojoyo.ac.id, ²lilikanifah@unesa.ac.id, ³diana rahmawati@trunojoyo.ac.id, ⁴adi.kurniawan@trunojoyo.ac.id, ⁵Deni.laksono@trunojoyo.ac.id

Abstract. The use of IoT is urgently needed, its use makes life efficient both in terms of energy and time. In order to minimize the danger of fire in the kitchen, we proposed smart controlling system for kitchen fire protection based Internet of Things. The controlled part in this study are stove and LPG’s lid. Data received by the temperature sensor, smoke sensor and human sensor will be sent to the server, so the user can acces from yheir smartphone. If the condition is dangerous, a warning will be given to the user's smartphone, and the user can control stove and LPG’s lid through the application on their smartphone. The design phase consists of designing hardware, software, servers, IoT, and applications to control the hardware. The implementation phase is implementing the design that has been made and then testing all elements. Testing phase by testing the harware, software, and system integration. The testing process aims to ensure that all elements work well according to the design. The results show that the system managed to anticipate early on from fires.

Keyword: Smart, controlling, IoT, fire, protection.

1. Introduction
The Internet of things is used in order to obtain smart administration, positioning, , monitoring, tracing, and recognitions [1]. New contributions regarding the IoT framework are location-based automated energy control and improving the energy efficiency [2]. Another advantages using IoT are reducing human efforts, multitasking, and reducing time [3]. Evolution of Internet of Things in future will be the nex big concept to support economic and social growth [4], and it will change lifestyles’ of human being in many aspects [5-6].

One part of the house is the kitchen because this place is used for cooking. Lots of tools in the kitchen, especially the stove, gas, and plugs. Stove, gas, and plugs are always used when cooking. These objects are useful for others, but if the use is wrong will cause substantial losses. When we turn on the stove sometimes we do other things, for example washing clothes, sweeping, watching television, and other things. This causes forgotten when the stove or other equipment is working. Negligence when cooking is not trivial. Negligence can trigger a fire in the kitchen.
Some researchers have discussed about kitchen safety, it caused kitchen monitoring becomes important for safety and security things [7]. Smart Monitoring System based Internet of Things has investigated [8-16] and fire alarm also discussed [17-19]. The same pattern is also research about controlling technology to anticipate fire is also important to discussed [20]. These studies have several similarities, including using various types of temperature sensors and smoke sensors. The above research still does not consider human existence in the kitchen. Our proposed system considers the existence of humans in the kitchen with a microwave sensor. All sensor data is sent to the sensor so that it can be controlled according to the algorithm that has been designed. Besides that users can control remotely by using their gadget. In addition, the advantages of the system that we propose are equipped with controls on the stove and LPG lid, which the user can control through the application on their smartphone.

In order to minimize the danger of fire in the kitchen, we proposed smart controlling system for kitchen fire protection based Internet of Things (IoT). Hopefully, this system give contribution so that it can reduce the risk of house fires, considering that house fires are very detrimental to the homeowner and neighbors around him.

2. Method

There are several stages in realizing this system: design, implementation, and testing. The design phase consists of designing hardware, software, servers, IoT, and applications to control the hardware. The implementation phase is implementing the design that has been made and then testing all elements. Testing phase by testing the harware, software, and system integration. The testing process aims to ensure that all elements work well according to the design.

This smart security system uses several main components namely Arduino, ESP8266, LM35, MQ2, microwave sensors and buzzers. LM 35 IC temperature sensor LM 35 is an IC chip that functions to determine the temperature of a room. LM 35 is an electronic component that can change the temperature amount into an electrical quantity that is the voltage or voltage (Volt). The LM35 IC temperature sensor requires a DC +5 volt voltage source and a DC current consumption of 60 µA in operation.

MQ2 functions as a smoke sensor, some of the gases that can be detected by MQ2 are detection of Alcohol, H2, LPG, CH4, CO, smoke, and propane, so this sensor is suitable when used for emergency equipment such as LPG gas leak detection, and smoke detection for prevention fire. The microwave sensor in this study has a function to detect the existence of humans. The design of this tool is if humans are not detected in the kitchen, the tool will provide information on whether there is a hot temperature in the kitchen and the presence of LPG smoke and leakage.

Buzzer serves as an alarm that warns whether there is a LPG leakage in the kitchen or heat in the kitchen. The alarm will warn residents of the house to take immediate action in the kitchen, adjusted to the existing conditions. Arduino Uno is used to control the entire process of this tool. Arduino Uno has input and output. Inputs on this device are LM35, MQ2, and microwave as human sensors. The output on this system is buzzer and data that will sent to server. Data sent by LM35, MQ2, and microwave sensors to arduino will be processed and it will be decided whether the buzzer will sound or not. The design of this tool is illustrated in Fig 1. Next stage is we have to do the programming in accordance with the design used.
Figure 1. Hardware design

The design of the system integration is illustrated in Figure 2. Data on the presence of smoke, kitchen temperature, and human presence is sent to the sensor using ESP 8266. Users can access these data through gadged users. If there are dangerous conditions such as smoke or LPG leak there is a warning to the gadged user. If the temperature in the kitchen is not safe, the system will also send information to the user. Including if the temperature, gas leakage occurs, and there is unnatural smoke in the kitchen, it will be alerted to the user. Users can turn off their stove and close the LPG/gas by controlling the LPG lid motor.

Figure 2. IoT design on smart kitchen safety systems

3. Results and Analysis

The algorithm used in this study is if there is no or detected human presence in the kitchen, while the data received by the temperature sensor is more than 40o Celsius, the alarm will sound. When MQ2 detects LPG or smoke, the sensor will sound. When the temperature reaches 40o Celsius and MQ2 detects smoke or LPG that leaks, the alarm will sound. A person is detected in the kitchen then an alarm will not sound. After programming finished, system integration is carried out, which consists of hardware and software. System integration produces tools that can work in accordance with previously designed.

Testing process are carried out by giving treatment to the sensor. The first test was carried out microwave sensor. If there is a human then the system does not work, and if there is no human, then the system will work.

Further testing by giving treatment to the temperature sensor or LM35. This sensor is given a hot temperature but the alarm sounds as a sign of the temperature exceeds the set limit. Tests at temperatures are illustrated in Table 1.

Table 1. Testing of LM35 and alarm

| No | Temperatur (° Celsius) | Alarm/buzzer Respon |
|----|------------------------|---------------------|
| 1. | 25                     | off                 |
| 2. | 35                     | off                 |
| 3. | 40                     | on                  |
| 4. | 45                     | on                  |
| 5. | 50                     | on                  |

Testing the MQ2 by applying heat conditions to the sensor as illustrated in Figure 3. If the given heat exceeds the setpoint, the alarm sounds. While if the conditions are below 40oC, the alarm will not
sound. Also given the condition of the gas leak, the alarm will sound, if there is no gas leak, the alarm is off. The condition of the presence of smoke is also tested on the system, if there is smoke exceeding the setpoint that has been set then the alarm will sound. This condition proves that the MQ2 sensor has worked well.

![Image of sensor MQ2](image-url)

**Figure 3.** Pengujian pada sensor MQ2

To anticipate the condition of the house if there is no one at home is to connect and send human sensor data, LM35 sensors, and MQ2 sensors through online. The third data is sent to the server online as shown in Figure 4.

![Image of data monitoring system](image-url)

**Figure 4.** Data monitoring system

When we are not at home, we can monitor the temperature in our kitchen, what is the condition of our LPG whether there is a leak or not, and anticipate whether there is someone in the house. With this data, and our ability to monitor online, it is hoped that a fire or LPG leak can be anticipated early.

In order to be accessed online, Internet of Thing (IoT) technology is needed. This technology used electronic components that can connect the device to WiFi. Esp 8266 will send data to the server and users can access the data sent by sensors via labtop or user gadget. The results of an IoT based tool are illustrated in Figure 5. System integration needs to be tested to find out whether it works in accordance with the design. The test results are presented in Table 2.
Figure 5. Electronic circuit and IoT system integration

Table 2. Integrated system testing results

| No | Microwave sensor | Sensor LM35 (° Celcius) | Sensor MQ2 | Alarm Respon | Motor of LPG lid |
|----|------------------|-------------------------|------------|--------------|-----------------|
| 1. | Yes              | 25                      | LPG gas is leaking | off          | on              |
| 2. | Yes              | 35                      | LPG gas is leaking | off          | on              |
| 3. | Yes              | 40                      | LPG gas is leaking | off          | on              |
| 4. | Yes              | 45                      | LPG gas is leaking | off          | on              |
| 5. | Yes              | 50                      | LPG gas is leaking | off          | on              |
| 6. | No               | 25                      | LPG gas is safe   | off          | off             |
| 7. | No               | 35                      | LPG gas is safe   | off          | off             |
| 8. | No               | 40                      | LPG gas is safe   | on           | off             |
| 9. | No               | 45                      | LPG gas is safe   | on           | off             |
| 10.| No               | 50                      | LPG gas is safe   | on           | off             |
| 11.| No               | 25                      | LPG gas is leaking | on           | on              |
| 12.| No               | 35                      | LPG gas is leaking | on           | on              |
| 13.| No               | 40                      | LPG gas is leaking | on           | on              |
| 14.| No               | 45                      | LPG gas is leaking | on           | on              |
| 15.| No               | 50                      | LPG gas is leaking | on           | on              |

When there is someone in the kitchen the human sensor will read the whereabouts of that person, and send this data to arduino, so that the alarm does not sound. When there are no humans in the kitchen, arduino makes LM35 and MQ2 to send data to Arduino. If a temperature over 40° is detected and/or a gas leak is detected, the kitchen safety system will works. If a LPG leak occurs, the LPG motor cover will work, so that the danger of LPG leakage can be anticipated. In addition the user can control the stove and LPG lid through the application found on the user's smartphone.

4. Conclusion

Integrated Kitchen Control and Safety Technology as a Smart Anti Fire Solution will work if there is no one in the kitchen and the stove temperature is 40 ° and/or if a gas leak is detected. Users can monitor temperature and gas leakage in real time because sensor data is sent to the server. By monitoring the condition of the kitchen we can anticipate fires at home early. In addition the user can control the stove and LPG lid through the application on the user's smartphone.

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