# Cigarette Smoke Detectors for Non-Smoking Areas in the Building

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# Cigarette Smoke Detectors for Non-Smoking Areas in the Building

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***Abstract*— This Research aims to study and design cigarette smoke detectors for Non-Smoking Area in the building. In order to be used to detect smoke in various places. The design of the smoke detector is designed by the Gas Sensor (MQ-2) detect smoke and NodeMCU V2 (ESP8266-12e) to store the value of the sensor as a voltage. When the sensor detects fumes until the voltage is exceeded, NodeMCU V2 (ESP8266-12e) will and send a message to the administrator pushes notifications through LINE API on the LINE Application. From Experimental Summary the cigarette smoke detectors in this developed area. It is a system that can detect smoke in the area of not more than 20 square meters (m2) and a room height of not more than 3 meters (m) if the room width and height. The device can detect smoke in a short time and can send a message. Remind staff at the building to be aware that a person is smoking in a smoking area.**

***Keywords—Smoke detectors, NodeMCU, LINE API, IOT, Gas Sensor***

## I. INTRODUCTION

### A. Background

Cigarette addiction that most people give the most hits. If you continue to smoke. It is even harder to stop smoking cigarettes, it can be just one excuse for people who do not want to quit or no effort, because in the cigarette is filled with nicotine, if the body has been long. Will result in lung cancer. Heart disease and other adverse effects on the organs. Followed by many. Cigarette smoke is also effective in hurting people around.

Currently there is a campaign to stop smoking in public places. Because smoke can harm people. But there are some people who violate and smoke in the ban on smoking, as in School buildings in the hospital building. Or in place Government.

For this reason, the developer has developed a smoke detector in this intelligent building, which will be installed in various locations. Non-smoking When the smoke is detected beyond the specified level, the message will be sent through the LINE program to notify the officer or the administrator of the building.

### B. Research objective

This research aims to develop a study and design cigarette smoke detectors in the building in non-smoking areas using Gas Sensor (MQ-2), NodeMCU V2 (ESP8266-12e) and LINE API to detected beyond the specified level, the message will be sent through the LINE program to notify the officer or the administrator of the building.

## II. LITERATURE REVIEW

Usually in the room we have dust or particles suspended in the air. 10 micrograms per cubic meter If the room is smoking, the amount of dust can rise to 45 micrograms per cubic meter. In cigarette smoke, the main constituent is a particle smaller than 1 micron, and may be as small as 0.1 micron. The carbon dioxide particle is composed primarily of carbon. The components in the gas and organic components are Carbon dioxide ($CO_2$) Carbon monoxide (CO), Nitrogen oxide ($No_x$), which is the combustion gases, also contains volatile organic compounds such as Nicotine, Acetone, Benzene, Phenol, Tolune, Formaldehyde and Benzopyrene and also contains more than 4,000 other substances. The size of the particles in cigarette smoke is very small. The mass is so small that the gravitational pull on the particle is very high. This is called weight loss, which is much less intense than the buoyancy of cigarette smoke due to the movement of air. The smoke can spread. Float in the air Do not fall to the ground. Like dust large Particles can diffuse in the air like this Aerosols. The particles in cigarette smoke are formed into larger particles as shown in Figure 1. Based on the graph. Graphs showing the size and number of particles of cigarette smoke occur at different times. It can be seen that the particle size of cigarette smoke produced within 18 minutes is smaller than that of cigarette smoke for 300 minutes. The average particle size is larger. This is because the particles in cigarette smoke gather together because of the collision. Of small particles and combined into a larger particle size. But the number of particles in the smoke decreased.

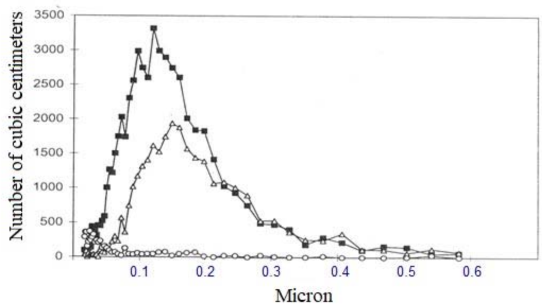


Fig. 1. Display size and number of particles in smoke at intervals of 18 minutes and 300 minutes.
■ Smoke particles after 18 minutes
△ Smoke particles after 300 minutes.
○ Particles in normal environment

ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) has defined a ventilation system for rooms with occupants. By setting a standard of 4 cubic feet per minute The people in the room to have enough oxygen to breathe. If the smoke is to be vented out of the room, the rate increases to 20-28 cubic feet per minute per person. To smoke and substances caused by smoking. Make sure that the room is air-conditioned. Consume more energy in the cooling system from the above information and from various media. Smoking is both harmful to the health of the smoker and neighbor. It also makes us need more energy.[1]

Gas Sensor (MQ-2) is module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer. In a concentration of 300 to 10000 ppm (part per million). The structure of the MQ-2 consists of a micro tube. Made from aluminum oxide ($Al_2O_3$) and tin oxide ($SnO_2$). [2]

NodeMCU is an open source IOT platform. It includes firmware which runs on the ESP8266 WI-FI SoC (System-on-chip) from Espressif Systems Company (from Shanghai, China). It is a 32 bit Microcontroller. In this research NodeMCU used an ESP-12 module or NodeMCU version 2. NodeMCU is similar to the Arduino which has built in input and output ports. NodeMCU is compatible with Arduino IDE where programming C++ can be written. For compiling and flashing programming codes, it can be done using microB-USB. NodeMCU has advantages on Arduino where it is smaller and can connect to WIFI system [3]

LINE API provides a service called LINE Notify that can send messages or notices to the LINE Application. The service used is a common HTTP POST. Access Token is applied as a code when using LINE API [4] and TridentTD_LineNotify Library is available for ESP8266 and ESP32 can send both text, stickers and images with URL [5]. In this research NodeMCU sends messages of the functional status when to detected beyond the specified level to the API service. Notifications are then sent to the LINE Application.

O. Chieochan, A. Saokew and A. Boonchieng.[6] Presented the IOT for Smart Farm: A case study of the Lingzhi Mushroom Farm at Maejo University.This research aims to prototype a smart Lingzhi mushroom farm. This research applied the use of IOT with a sensor to measure and monitors the humidity in the Lingzhi mushroom farm. The humidity data processed through NETPIE was developed and provided by NECTEC as a free service for IOT. Humidity data was stored into a NET FEED (a sub service from NETPIE) and displayed on mobile devices and computers through NET FREEBOARD (another sub service of NETPIE). This research also controlled sprinkler and fog pumps automatically and the functional status (switching on and off for periods of time) pushes notifications through LINE API on the LINE Application. The equipment and tools used in this research were NodeMCU, humidity sensor, RTC (real time clock), relay module, sprinkler and fog pumps. C++ and Node.JS were used as programming. The services and protocol used were NETPIE (Network Platform for internet of everything) with subservices such as NETPIE FEED, NETPIE FREEBOARD, and NETPIE REST API. The results of the research showed that using IOT with the sensor enhanced the prototype of smart farming.

S. Tunyala and P. Yanaso. [7] Presented the Simulator protection and fire alarm systems. This project has studied and developed a fire alarm system in building before developing for constructing a simulator of fire alarm protechin system. This system can apply with real work and install in other places by using the microcontroller as a operating controller. Due to the modern residence nowadays that is located n town is an apartment or a condominium, this building has also necessary to implement other security system such as the fire alarm system. The protecting systems will be alert rapidly for warning the fatal accident. This project has been modifying the warning system for residence to send a warning message by telephone as soon as possible. The design and construction the simulator of a fire alarm system has sketched a drawing on the plastwood board. The board dimension has two sheets of 666mm x 562mm, two sheets of 562 mm x706mm, one sheets of 666mm x706mm, and one sheet of 700mm x 600mm. When the boards were fitted together as a simulator of residency room in the building, the smoke detectors were also installed for detecting the smoke and sending the signal to the controller to alert a residency superintendent. From experiment the simulator of fire alarm system in each, the experiment results has different results, because the networks have dissimilar that make the inequality values. The distance of sending a short message (SMS) is injustice. The sending message of the simulator of fire alarm system cannot send all messages in one time because the program was designed by sending a message line per a telephone number.

## III. Research Methodology

Following the waterfall model of the system development life cycle (SDLC), there are 5 steps in this research. These steps are the requirement and feasibility study, system analysis and design, implementation, system validation, and maintenance.

### A. *Requirement and Feasibility study*

The requirement of this research was to study and design cigarette smoke detectors for Non-Smoking Area in the building. The smoke detector is designed by the Gas Sensor (MQ-2) detect smoke and NodeMCU V2 (ESP8266-12e) to store the value of the sensor as a voltage. When the sensor detects fumes until the voltage is exceeded, NodeMCU V2 (ESP8266-12e) will send data to the system and send a message to the administrator pushes notifications through LINE API on the LINE Application. Moreover, the system should be cost effective and requires simple maintenance. Smoke detect data was sent to LINE API and was shown and noticed on computers and mobile devices.

For this research, we selected Smoke Detectors as smart technology for Cigarette Smoke Detectors for Non-Smoking Areas in the Building. The tools, software and protocol used are shown in Figure 2 and table 1-3.

TABLE I. Hardware and Purpose of the use

| Hardware | Purposes of use |
|---|---|
| NodeMCU V2 (ESP8266 -12E) | Control devices and send data into internet via WIFI connection |
| Sensor Gas Sensor (MQ-2) | Detects smoke Sensor |
| Wireless Access Point | Enables wireless devices to connect to wired networks |

TABLE II. Software and Purpose of the use

| Software | Purposes of use |
|---|---|
| Arduino IDE | The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board |
| C++ on Arduino IDE | Programming language on NodeMCU |

TABLE III. SERVICE AND PROTOCOL AND PURPOSE OF THE USE

| Software | Purposes of use |
|---|---|
| Line API (Application Programming Interface) | Notify functional status of when to detected beyond the specified level on the LINE Application |
| TridentTD_LineNotify Library | Library to send both text, stickers and images with URL |

## B. System Analysis and Design

This design simulates indoor rooms to install smoke detectors, smoke detectors, sends signals to the control unit and alerts them to the building supervisor and Roomer.

*Concept diagram*

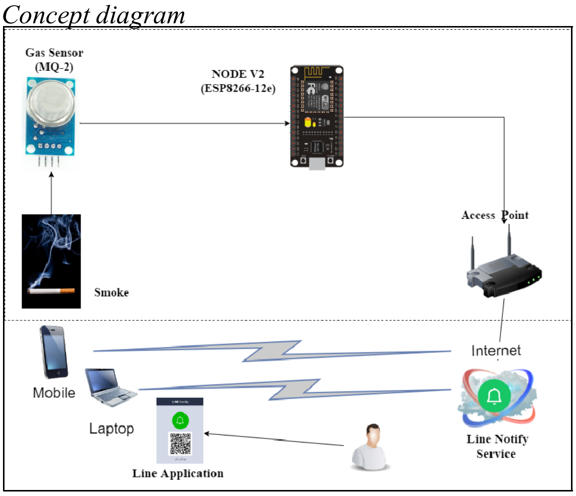


Fig. 2. System Conceptual Diagram

From Figure 2. When the smoke detector Gas Sensor (MQ-2) detects smoke, it sends the value to the microcontroller board. The microcontroller board then sends the signal to instruct NodeMCU V2 (ESP8266-12e) to send the message. Alert to the Administrators Line.

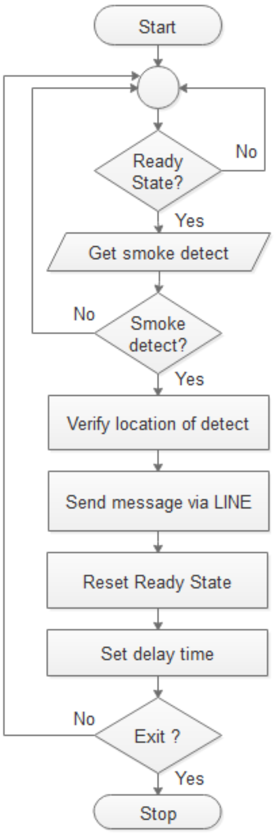


Fig. 3. System Flowchart Diagram

From Figure 3. The operation of the device will follow the process of running the system, it will start to check the status of the device is in the ready state. And when smoke is detected. Verify the location of detected sensors. To send a notification message via LINE and save it to the database.

*Main program design*

System of smoke detectors The operation of the system is an open-loop control system, which operates by receiving smoke detectors. When the signal is input into the system, the signal is the voltage from the sensor. The signal is connected to the A0 pin of the microcontroller. Receive the signal and then work to the parts that have been announced.

## C. Implementation

All electronic devices are put in a control box. The installation of the control box is located at Non-Smoking Areas in the Building. The room is equipped with a sensor size 3x5 square meters and 3.50 meters high.

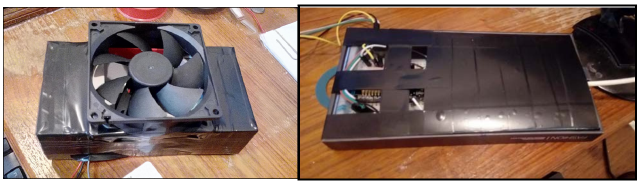

Fig. 4. Smoke Detector and Motherboard

Smoke detectors are placed in a fan-enclosed box at the bottom of the box. Use for smoke extraction as shown in Figure 4.

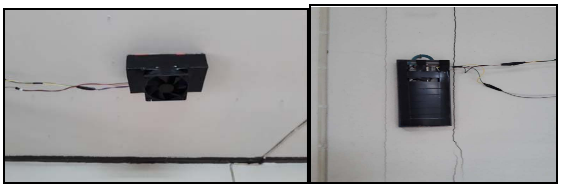

Fig. 5. Location to install Sensor and Motherboard

## D. System Validation and Maintenance

In order to make sure the gas sensor and smoke detectors measured the gas smoke correctly, the Gas Sensor (MQ-2), NodeMCU V2 (ESP8266-12e) and LINE API were used for validation. Experiment with three types of smoke: incenses, cigarettes and candles. Tested to cause smoke in the position and distance for 5 days, divided into 3 sets of 2 times in a different time. And test message sent via LINE and the duration of the alert messages after detecting the smoke was based on the setting. The delay and stability of the Internet system LINE will display the message received.

# IV. EXPERIMENTAL RESULTS

## A. System Testing and Sensors

Experiment with three types of smoke: incenses, cigarettes and candles. Tested to cause smoke in the position and distance for 5 days, divided into 3 sets of 2 times in a different time. The test schedule is as follows. Test at a distance of 50 centimeters (cm) and 1.5 meters (m) between the smoke location with the sensor, the smoke detector time and the transmission capacity. LINE warning message after the smoke detection system shown in Table 4 and 5.

TABLE IV. THE TABLE OF SMOKE DETECTORS AFTER SMOKE OCCURRING AT DIFFERENT DISTANCES.

| Day | No | Time | Smoke Detection Time Average(s). | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | *incenses* | | *cigarettes* | | *candles* | |
| | | | *50 cm* | *1.5 m* | *50 cm* | *1.5 m* | *50 cm* | *1.5 m* |
| Day 1 | 1 | 9.30 | 2 | 7 | 7 | 22 | n/a | n/a |
| | 2 | 9.35 | 3 | 10 | 6 | 25 | n/a | n/a |
| | 3 | 9.40 | 3 | 7 | 8 | 30 | n/a | n/a |
| | 4 | 9.45 | 2 | 6 | 7 | 25 | n/a | n/a |
| | 5 | 18.15 | 2 | 7 | 6 | 24 | n/a | n/a |
| | 6 | 18.20 | 2 | 9 | 5 | 32 | n/a | n/a |
| Day 2 | 1 | 8.00 | 3 | 5 | 8 | 18 | n/a | n/a |
| | 2 | 8.05 | 2 | 6 | 8 | 20 | n/a | n/a |
| | 3 | 14.15 | 2 | 5 | 7 | 20 | n/a | n/a |
| | 4 | 14.20 | 2 | 7 | 7 | 25 | n/a | n/a |
| | 5 | 17.15 | 3 | 5 | 5 | 25 | n/a | n/a |
| | 6 | 17.20 | 3 | 6 | 6 | 29 | n/a | n/a |
| Day 3 | 1 | 10.15 | 2 | 5 | 8 | 16 | n/a | n/a |
| | 2 | 10.20 | 2 | 7 | 7 | 18 | n/a | n/a |
| | 3 | 15.30 | 3 | 6 | 8 | 20 | n/a | n/a |
| | 4 | 15.35 | 2 | 7 | 6 | 18 | n/a | n/a |
| | 5 | 18.15 | 2 | 5 | 5 | 22 | n/a | n/a |
| | 6 | 18.20 | 3 | 5 | 6 | 17 | n/a | n/a |
| Day 4 | 1 | 10.05 | 2 | 7 | 6 | 22 | n/a | n/a |
| | 2 | 10.10 | 3 | 6 | 7 | 25 | n/a | n/a |
| | 3 | 14.00 | 2 | 5 | 6 | 18 | n/a | n/a |
| | 4 | 14.05 | 3 | 6 | 8 | 22 | n/a | n/a |
| | 5 | 18.05 | 2 | 6 | 5 | 18 | n/a | n/a |
| | 6 | 18.10 | 3 | 7 | 6 | 20 | n/a | n/a |
| Day 5 | 1 | 8.45 | 3 | 7 | 8 | 17 | n/a | n/a |
| | 2 | 8.50 | 3 | 6 | 7 | 20 | n/a | n/a |
| | 3 | 13.15 | 2 | 8 | 6 | 22 | n/a | n/a |
| | 4 | 13.20 | 3 | 10 | 8 | 27 | n/a | n/a |
| | 5 | 18.50 | 2 | 7 | 6 | 16 | n/a | n/a |
| | 6 | 18.55 | 2 | 6 | 7 | 20 | n/a | n/a |
| **Average** | | | **2** | **7** | **7** | **22** | **n/a** | **n/a** |

TABLE V. TABLE OF LINE NOTIFICATION AFTER DETECTION

| Day | No | Time | LINE notification after detection | | |
|---|---|---|---|---|---|
| | | | *incenses* | *cigarettes* | *candles* |
| | | | *1.5 m* | *1.5 m* | *1.5 m* |
| Day 1 | 1 | 9.30 | / | / | x |
| | 2 | 9.35 | / | / | x |
| | 3 | 9.40 | / | / | x |
| | 4 | 9.45 | / | / | x |
| | 5 | 18.15 | / | / | x |
| | 6 | 18.20 | / | / | x |
| Day 2 | 1 | 8.00 | / | / | x |
| | 2 | 8.05 | / | / | x |
| | 3 | 14.15 | / | / | x |
| | 4 | 14.20 | / | / | x |
| | 5 | 17.15 | / | / | x |
| | 6 | 17.20 | / | / | x |
| Day 3 | 1 | 10.15 | / | / | x |
| | 2 | 10.20 | / | / | x |
| | 3 | 15.30 | / | / | x |
| | 4 | 15.35 | / | / | x |
| | 5 | 18.15 | / | / | x |
| | 6 | 18.20 | / | / | x |
| Day 4 | 1 | 10.05 | / | / | x |
| | 2 | 10.10 | / | / | x |
| | 3 | 14.00 | / | / | x |
| | 4 | 14.05 | / | / | x |
| | 5 | 18.05 | / | / | x |
| | 6 | 18.10 | / | / | x |
| Day 5 | 1 | 8.45 | / | / | x |
| | 2 | 8.50 | / | / | x |
| | 3 | 13.15 | / | / | x |
| | 4 | 13.20 | / | / | x |
| | 5 | 18.50 | / | / | x |
| | 6 | 18.55 | / | / | x |
| **Average** | | | **/** | **/** | **x** |

### *B. Test the ability to send alerts via LINE*

Test messaging alerts via LINE notification of 10 consecutive found that the system can send a warning message to the 10 times and time to send a notification after it detects smoke depends on the setting. Delay and stability of the Internet LINE system displays a message received by the system shown in Figure 6

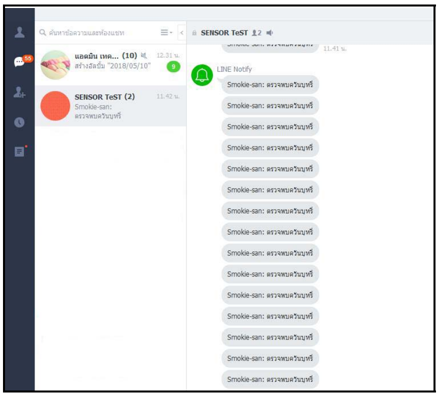

Fig. 6. Display messages received from the system.

## V. CONCLUSION AND FUTURE RESEARCH

*A* cigarette smoke detectors in this developed area. It is a system that can detect smoke in the area of not more than 20 square meters ($m^2$) and a room height of not more than 3 meters (m) if the room width and height, the additional design and increase the number of sensors. The device can detect smoke in a short time and can send a message. Remind staff at the building to be aware that a person is smoking in a smoking area. When the smoke is detected, the sensor will reset and delay itself to prevent redundant data transmission.

Future research could be done for the improvement. Firstly, Increasing the area for smoke detectors or to attach a camera to send Real-Time images to a smartphone and device. Secondly, Can be further used to detect smoke in other formats such as wildfire smoke etc.

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