Faculty of Electrical and Electronic Engineering Technology

SMART HOME COOKING GAS SAFETY SYSTEM AND COMBUSTION TEMPERATURE USING NODE MCU

VISNUR RADHAKRISHNAN

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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Disahkan oleh:

Ts. Dr. Abdul Halim Bin Dahalan
Ketua Jabatan / Pensyarah
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik
Universiti Teknikal Malaysia Melaka

(TANDATANGAN PENULIS)
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Supervisor Name : TS. DR. ABDUL HALIM BIN DAHALAN

Date : 11/01/2022

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ABSTRACT

In the wake of the sudden replacement of wood and kerosene by gas cookers for several purposes in Malaysia, gas leakage has caused several damages in our homes, Laboratories among others. High concentrations of harmful gases in the surrounding air might become poisonous, lead to fires or suffocation, and most likely, if no action is taken it might lead to injury or even death. As a matter of fact, it is critical to have a low-cost, smart system capable of detecting and responding to threats. Here we have come out with a project which is used to notify user about the fire at home or leakage of gas in the absence of people. Otherwise, user can monitor their house wherever they are using android application. The objective is to reduce the risk of more severe fire damage when the fire broke and make it minimum. With this system, it can help users in many aspects, especially to notify the user by making a call and sending a message to user, so you can take early steps that can overcome the blaze spread rapidly or the extensive leakage of gas. Renewal is done by doing research on the problem or deficiency in any part of the system we did. Problems and weaknesses are reviewed in detail and found the source to obtain the desired product quality. The hardware implementation in this project is ESP8266 Wifi Module, Gas and Temperature Sensor, Buzzer, Servo Motor and also Fan. The result from this project is useful to be implemented in home an industry to help in the risk of death and injuries furthermore to avoid the losses that need to be borne by the victims. Lastly, this system can also be enhanced by using gas sensor, light sensor and IR sensor to make it more efficient.

ABSTRAK

Susulan penggantian tiba-tiba kayu dan minyak tanah oleh periuk gas untuk beberapa tujuan di Malaysia, kebocoran gas telah menyebabkan beberapa kerosakan di rumah kita, Makmal antara lain. Kepekatan tinggi gas berbahaya di udara sekitar mungkin menjadi beracun, membawa kepada kebakaran atau sesak nafas, dan kemungkinan besar, jika tiada tindakan diambil, ia mungkin membawa kepada kecederaan atau kematian. Sebenarnya, adalah penting untuk mempunyai sistem pintar kos rendah yang mampu mengesan dan bertindak balas terhadap ancaman. Di sini kami telah mengeluarkan projek yang digunakan untuk memberitahu pengguna tentang kebakaran di rumah atau kebocoran gas tanpa kehadiran orang. Jika tidak, pengguna boleh memantau rumah mereka di mana sahaja mereka menggunakan aplikasi android. Objektifnya adalah untuk mengurangkan risiko kerosakan kebakaran yang lebih teruk apabila kebakaran pecah dan menjadikannya minimum. Dengan sistem ini, ia dapat membantu pengguna dalam banyak aspek, terutamanya untuk memberitahu pengguna dengan membuat panggilan dan menghantar mesej kepada pengguna, supaya anda boleh mengambil langkah awal yang boleh mengatasi api merebak dengan cepat atau kebocoran gas yang meluas. Pembaharuan dilakukan dengan membuat kajian tentang masalah atau kekurangan di mana-mana bahagian sistem yang kami lakukan. Masalah dan kelemahan disemak secara terperinci dan mencari sumber untuk mendapatkan kualiti produk yang diingini. Perlaksanaan perkakasan dalam projek ini ialah ESP8266 Wifi Module, Gas and Temperature Sensor, Buzzer, Servo Motor dan juga Fan. Hasil daripada projek ini berguna untuk dilaksanakan di rumah sebuah industri untuk membantu dalam risiko kematian dan kecederaan seterusnya untuk mengelakkan kerugian yang perlu ditanggung oleh mangsa. Akhir sekali, sistem ini juga boleh dipertingkatkan dengan menggunakan sensor gas, sensor cahaya dan sensor IR untuk menjadikannya lebih cekap.

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1. PPM	-	Parts-per-million
2. ℃	-	Degree Celsius
3. mV	-	milli Volt
4. V	-	Volt
5. -Vs	-	Negative Voltage Source
6. MHz	-	Mega Hertz
7. K	-	Kilo

LIST OF ABBREVIATIONS

GSM - Global System for Mobile Communications
LPG - Liquefied Petroleum Gas
NGV - Natural Gas Vehicle
ADC - Analog-to-Digital Converter
DAC - Digital-to-Analog Converter
SMS - Short Message Service
CO - Carbon Monoxide
FM - Frequency Modulation
FPGA - Field Programmable Gate Area
DC - Direct Current
AC - Alternate Current
GND - Ground
RISC - Reduced Instruction Set Computer
3GPP - 3rd Generation Partnership Project
SIM - Subscriber Identity Module
PCB - Printed Circuit Board
TX - Transmitter
RX - Receiver
COM - Communication
SOP - Standard Operating Procedure
IOT - Internet of Things
GSM - Global System of Mobile Communication
PPM - Parts of Million
GPC - Gel Permeation Chromatography
NGV - Natural Gas Vehicles
CPU - Central Processing Unit
RAM - Random Access Memory
ROM - Read-only Memory
I/O - Input / Output
A/D - Analog / Digital
CMOS - Complementary Metal Oxide Semiconductor

RISC - Reduced Instruction Set Computer

MCU - Microcontroller Unit

USB - Universal Serial Bus

LED -Light Emitting Diode

LCD - Liquid Crystal Display

PC - Personal Computer

IDE - Integrated Development Environment

NL - New Line

CR - Carriage Return

Bps - Bit Per Second

mV - Milli Volt

V - Volt

MHz - Mega Hertz

K - Kilo

CHAPTER 1

INTRODUCTION

1.1 Introduction

One of the most popular forms of energy sources utilized in the home is propane, which is found as liquefied gas. Although corporations are concerned about safety, gas leaks have become a routine occurrence that can endanger human life and property. Gas leaks cause a variety of incidents that result in financial damage as well as injury and human loss. LPG is delivered in pressurized steel cylinders. Because this gas is heavier than air, it flows down the floor and tends to settle in a low spot, such as a basement, when it leaks from a cylinder. If not treated, this might result in a fire or drowning. The project presents low cost, centralized monitoring and an efficient alarm system. The system has four main devices: gas and temperature units; centralized control unit; alarm unit and IoT platform unit. The gas and temperature sensor units are located close to the gas barrels and distribution boxes of the house and are operated by a 12V supply. A centralized guard unit was built using an Node MCU shield to communicate with the Blynk app to alert homeowners about gas leaks in their units; and high temperatures (abnormal temperatures of 50 to 100).

1.2 Background of Study

We cannot afford to take security matters lightly. The level of protection from risk and loss is defined as safety. Nowadays, in a technologically advanced society, people rely on technology to provide early warning indications so that they have ample time to avoid danger. The hazardous sources that have been highlighted in the design of this project include gas leaks and flames. This is because both of these have the potential to be catastrophic disasters if proper precautions are not taken ahead of time.

Sensors nowadays offer great sensitivity to a wide variety of gases, are small in size, and have lower power consumption to better adapt to portable solutions. Building a system with a gas detector is more difficult than it appears. Although the sensor may be viewed as a

variable resistor whose value varies on the gas concentration in the air, practical implementation in the project is required due to different design techniques, particularly if the tool end circuit is utilised in an area where reliability is critical. Internal sensor elements such as heaters and gas sensitive resistors, for example, should constantly be kept under control to avoid failures that result in false warning signs. Furthermore, if the application requires high measurement precision, considerations such as ambient temperature and sensor life should be considered.

Based on the Global system for mobile networks, the project will create an early warning system (Node MCU). It will detect the presence of both natural gas and fire. When a gas leak or a fire happens, the detector in the circuit detects it and the Node MCU sends an notification alert to the user. Owners' response time is increased when they use a system that offers real-time notifications. This will immediately alleviate the condition. The system may be put in a kitchen, a Liquefied Petroleum Gas (GPC) Storage Room, alongside a Natural Gas Vehicle (NGV) tank in a moving automobile, or anywhere else the mind takes you.

The combination of gas and heat detectors can contribute significantly to these safety processes. If the set concentration of gas is exceeded or a fire develops, the detector can deliver a message. This can provide early notice of issues and help to protect people's safety. However, the detector will not prevent a leak or suggest what action should be done. It is not a replacement for safe work practises and routine maintenance.

This system's architecture incorporates two distinct types of sensors. A gas detector was the first sensor utilised. Gas detectors can typically detect gas concentrations ranging from 300 parts per million (ppm) to 500 ppm. Other sensors utilised include temperature sensors capable of measuring temperature changes ranging from -55 ° C to 150 ° C. A rise in temperature indicates that hell has broken loose.

A microprocessor connects and controls both of these detectors. Costs will be reduced by the usage of microcontrollers in such equipment. Notably, this microcontroller can store and programme data. Microcontrollers include a CPU (central processing unit), RAM (random access memory), ROM (read only memory), IO (Input/Output), parallel and serial ports, timers, and occasionally hidden peripherals such as A/D (Analog-to-Digital) and D/A (SM) Converters. In this example, rather of using microchip technology, the Arduino Uno has been chosen as the microcontroller.

In the event of a fire or excessive gas production, the result of this system is communicated to the Android application to inform the user within a few seconds.

1.3 Problem Statement

Overall, Malaysia has an average fire incidence rate of around 1024.67 fires per million population per year in the 9 years from 2006 to 2014. The fire victim rate was 7.53 per million population per year, with 3.07 deaths per million population per year. Each year, there are about 90 residential fires per million residents each year. The most common cause of fire in residential fires is electrical failure (39.3%). Electrical failures include short circuits, resistance heating and overcurrent electrical distribution and electrical equipment. There were nearly 30%of residential fires caused by carelessness or negligence during human activities such as cooking, followed by heat sources close to flammable materials (8.7%) and gas leaks (7.7%). Since overheating temperatures and gas leaks are also contributing factors, the project helps reduce the risk of residential fires by monitoring and alerting homeowners on any instability with heat (temperature) and gas releases in their units. Based on this, a literature review has been conducted to use the appropriate elements to form a good and efficient monitoring system for both the parameters which are gas and temperature. The scope of the project is to help owners monitor parameters while they are inside the unit or outside the unit. Literature is also done on Blynk application development. Blynk is a Platform with iOS and Android applications to control Arduino, Raspberry Pi and likes over the Internet. This is a digital dashboard where you can build a graphical interface for your project by simply dragging and dropping widgets.

1.4 Objective

The project's main objectives are:

a) Create a system that can detect the presence of cooking gas in the kitchen as well as a rise in temperature in the house, as excessive temperatures can be produced by fire.
b) Sends "notification" alerts to users using the android application which is the "Blynk" application and this application always monitors the condition of the sensor
c) The system makes sure the flammable gas is sucked out of the kitchen through exhaust fan.

1.5 Scope of Project

When the owner is overseas or away from home, the project is meant to protect house safety against leaking gas in the kitchen near gas barrels or fires in the home. The initiative would notify people via Blynk app. Users will be able to take rapid action in the event of a gas leak or an unintentional fire if they get notification.

The Node MCU ESP8266 will be used as a microprocessor, as well as a gas and temperature detector, in this project. The MQ-5 gas detector has a high sensitivity to Liquefied petroleum gas (GPC), propane, smoke, and hydrogen, and it can also detect methane and other dangerous vapours. At concentrations ranging from 300 to 10,000 ppm, these semiconductor gas detectors detect the presence of combustible gases and vapours. The sensor's basic analogue voltage interface requires only one microcontroller analogue input pin. The utilised DHT 11 sensor can work at temperatures ranging from 0 to 100 ° C and draws less than 150 mA at 5 V.

The Node MCU was programmed using ArduinoIDE programming software, and the circuit was designed using Proteus software, which featured ARES, ISIS, and Fritzing. This programme may be used to design and simulate circuits.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will go through earlier projects as well as various journals linked to those initiatives. These journals and reports are thoroughly examined in order to improve the project's efficacy and quality. The possibilities that impact quality in their initiatives may be analysed and assessed by reviewing past journals and study. Ideas from the last project that can be applied and improved on. Previous efforts employed Global mobile communications system (GSM) modules that could only transmit SMS, as opposed to mobile phones that could send messages and call numbers. Thus, the process of literary research begins from the beginning and ends at the completion of the project. For this project, in addition to analysing past initiatives, reviews from the internet and very effective literature were used. Special aspects in the project were decided during the analysis at the start of the project, as were the components employed in the project.

2.2 Concept

The primary goal of this project is to design and install a low-cost gas and temperature monitoring system with effective and competitive application. The technology has been created to make outdoor operations safer and easier for users. The project is also intended to represent a vision of working with little technology and at a lower level of processing. This system is designed for certain purposes. The system is divided into three parts: input, controller circuit, and output. The input and output sections are linked to the controller circuit, which controls the system's function.

2.2.1 Input Appliances

A detector device, such as a gas and temperature detector, is used as an input to the system. There are several types of heat detectors on the market, including "thermistor," "thermocouple," "resistance temperature device," and "diode-based temperature sensor." All devices have advantages and downsides, but we will focus on certain gadgets that best meet our requirements.

2.2.1.1 Thermocouple

The thermocouple's key benefit is its temperature range. It can be utilized for a broad variety of temperatures, but it is also quite insensitive.

2.2.1.2 Temperature Resistance Devices (JPJ)

Temperature resistor device provides a linear change of voltage with temperature. It also has a range suitable for our application. The cost of the JPJ sensor is also less than the temperature. For our application JPJ is the best choice especially as it varies linear voltage with temperature and the limited temperature range it has is good enough to meet our goal.

2.2.1.3 Thermistor

This gadget has a non-linear scale yet has a very high sensitivity for a wide range of temperatures. To account for this nonlinearity, substantial mathematical computations are necessary.

2.2.1.4 Semiconductor Diode

Diodes are very low-cost devices but have scale disadvantages and poor rates on nonlinear reliability scales.

2.2.1.4.1 DHT 11 Sensor series temperature

The DHT11 is an accuracy circuit integrated temperature sensor with a linearly proportional output voltage to the Celsius scale. These sensors have a full temperature range of -55°C to 150°C with a linear scale factor of 10mV/oC. It runs between 4 and 30 volts, has a drain current of less than 60 amps, and has a low self-heating temperature of 0.08 degrees Celsius in still air. Because the DHT11 has a low-impedance-only output, a linear output, and exact calibration, the control or interface circuit is quite simple. The DHT11 series is available in air-resistant transistor packages, whereas the TO-92 transistor packages are available for the DHT11, DHT22. The DHT22 is also available in a plastic TO-220 package and an 8-lead surface-mount tiny line package. Reprinted from DHT11 datasheet. The DHT11 may be used as a centigrade temperature base sensor to detect temperatures between 2 ° C and 150 ° C, as well as a complete range of centigrade temperature sensors to detect temperatures between -55 ° C and 150 ° C, as well as a circuit to utilize them as a base or full range sensor. R1 is the connecting resistance between -Vs and Vout, while +Vs is the voltage provided to the LM35 (output voltage). Simply measuring the sensor output voltage yields the temperature in degrees Celsius. Temperature has an effect on the output voltage.

2.2.2.4.2 Gas Sensor MQ-5

Detects the concentration of flammable gas in the air and issues its reading as an analog voltage. When a combustible gas target exists, the conductivity of the sensor is higher along with an increase in the gas concentration. The sensor can measure flammable gas concentrations between 300 to 10,000 ppm.

2.2.2 Controller Circuit

The controller circuit is a chip to store various communication information, time measurement, on and off control switch. Examples of controller circuits are the ATmega328P Microcontroller and Arduino.

2.2.2.1 Microcontroller ATmega328P

The microcontroller is an AVR upgraded RISC (Reduced Instruction Set Computer) 8-bit CMOS (Complementary Metal Oxide Semiconductor) microcontroller with low power consumption. The efficient use of a single clock cycle manual results in throughputs of 1 MIPS per MHz, allowing designers to balance power consumption and processing performance.

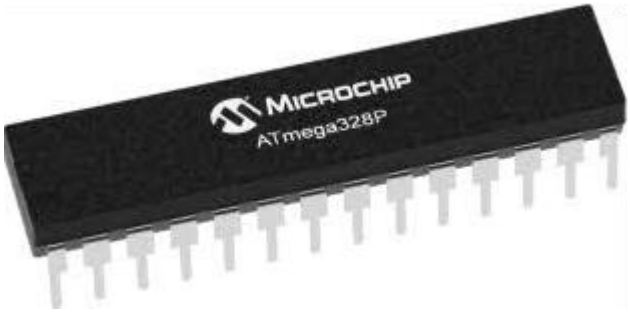

Figure 2.1: Atmega328P Microcontroller

The microcontroller's brain, the central processing unit (CPU), is in charge of programmed execution. The MCU (microcontroller unit) is made up of 4K/8K bytes in a read-write programmed flash system, 256/412/1K bytes of EEPROM, and 512/1K/2K bytes of SRAM. Aside from it, the MCU has a number of other features:

- There are 23 general purpose I/O lists and 32 general work purpose lists.

- A flexible timer/counter featuring a comparison mode, internal and external interrupts, and a serial programmable USART.
- 2-cable series-oriented byte interface, SPI series port, 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), programmable watch-dog timer with inbuilt oscillator, and 5 software configurable power-saving modes

2.2.2.2 Arduino Platform

Arduino is versatile hardware and software-based open-source electronics prototyping platform. The Arduino is a basic yet complex gadget built around the ATmega At-mail microcontroller. Despite the fact that most microcontrollers are confined to Windows operating systems, Arduino software is supported by Windows, Macin-nonsense OSX, and Linux. The software