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IoT-BASED AUTOMATIC EXHAUST FAN FOR COOKING SMOKE

Dr. A R. Jayasudha, PhD[1], T. Jegadeeshwar[2]

Head of the Department, Master of Computer Applications, Hindusthan College of Engineering and Technology, Coimbatore, India[1]

II MCA Students, Master of Computer Applications, Hindusthan College of Engineering and Technology, Coimbatore, India[2]

Abstract: This IOT-based application is called "IOT-BASED AUTOMATIC EXHAUST FAN FOR COOKING SMOKE." The advent of the Internet of Things (IoT) has made it possible for creative solutions to typical issues to be solved. This project presents an Internet of Things (IoT)-based Automatic Exhaust Fan system intended especially to reduce cooking smoke in home environments. The exhaust fan will automatically turn on when the system's clever sensors detect the presence of smoke in the kitchen. The system improves smoke extraction efficiency by providing real-time monitoring and responsiveness through the use of an integrated network of devices. By decreasing exposure to contaminants associated with cooking, the smooth integration of IoT technology not only promotes a better living environment but also fits with the larger trend of developing smart.

Keywords: IoT-based application, Automatic exhaust fan, Cooking smoke reduction, Smart kitchen solutions

I. INTRODUCTION

This IOT-based application is called "IOT-BASED AUTOMATIC EXHAUST FAN FOR COOKING SMOKE." The advent of the Internet of Things (IoT) has made it possible for creative solutions to common problems to be solved. This project presents an Internet of Things (IoT)-based Automatic Exhaust Fan system intended especially to reduce cooking smoke in domestic settings. When smoke is detected in the kitchen, the system's clever sensors cause the exhaust fan to turn on right away. The system improves smoke extraction efficiency by providing real-time monitoring and responsiveness through the use of an integrated network of devices. By reducing exposure to pollutants associated with cooking, the seamless integration of IoT technology not only promotes a better living environment but also fits with the larger trend of developing smart.

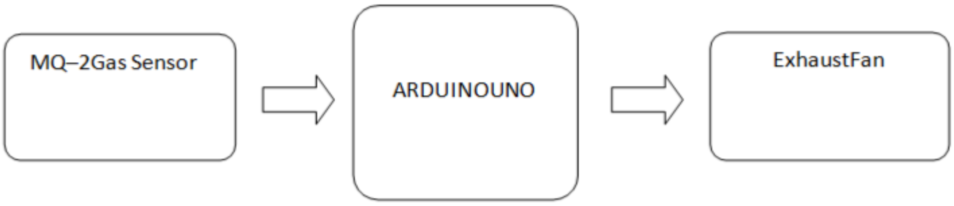

Figure 1: Illustrates the block diagram of the this project

Conventional exhaust fan systems frequently can't adjust to changing climatic conditions, which results in wasteful energy use and poor air quality. Because there are no automatic control systems, users must manually operate the exhaust fan. Based on their impressions, this can lead to insufficient ventilation or wasteful energy use. Further, in situations where users are not at home, the exhaust fan's incapacity to be remotely controlled reduces its adaptability to changing indoor air conditions.

To overcome these difficulties, the suggested Internet of Things (IoT)-based automatic exhaust fan proposes a clever, networked system that can independently modify its operation in real-time, ensuring effective air circulation and user comfort.

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II. HOW IT WORKS

Utilizing IoT technology's interconnection, the "IOT BASED AUTOMATIC EXHAUST FAN FOR COOKING SMOKE" effectively controls kitchen air quality. Strategically positioned smoke sensors in the kitchen keep an ongoing eye out for smoke. These sensors ensure that smoke extraction happens quickly by activating the exhaust fan as soon as they detect smoke above a preset threshold. With the help of an integrated network of devices that easily coordinate and communicate, the system uses real-time monitoring and responsiveness. Through a user interface on their smartphones or other linked devices, users may monitor and manage the system and receive real-time notifications. This automated method promotes a healthier living environment by lowering exposure to dangerous contaminants and increasing smoke extraction efficiency.

A new era of automation and connectivity has been brought about by the Internet of Things (IoT), which has provided creative ways to improve many parts of our daily lives. In this regard, the creation of an Internet of Things-based automatic exhaust fan system is the main goal of our project. The main goal is to use IoT technologies to create an exhaust fan with more intelligence and responsiveness that can easily adjust to changing conditions. Our system attempts to offer an effective and user-friendly solution for ventilation demands in residential and commercial environments by integrating sensors and connection elements. This project's scope includes designing and implementing a smart exhaust fan that can be remotely controlled and seen via a specialized application. By integrating environmental sensors, the system will automatically modify fan speed in response to variables like humidity.

III. SYSTEM OVERVIEW

A new era of automation and connectivity has been brought about by the Internet of Things (IoT), which has provided creative ways to improve many parts of our daily lives. In this regard, the creation of an Internet of Things-based automatic exhaust fan system is the main goal of our project. The main goal is to use IoT technologies to create an exhaust fan with more intelligence and responsiveness that can easily adjust to changing conditions. Our system attempts to offer an effective and user-friendly solution for ventilation demands in residential and commercial environments by integrating sensors and connection elements. This project's scope includes designing and implementing a smart exhaust fan that can be remotely controlled and seen via a specialized application. By integrating environmental sensors, the system will automatically modify fan speed in response to variables like humidity. The purpose of the proposed Internet of Things (IoT)-based automated exhaust fan system is to improve the ease and efficacy of exhaust fan operations in commercial or residential settings. Exhaust fans are now usually operated manually, which wastes energy and may cause delays in reacting to variations in air quality. This system integrates sensors to monitor conditions like humidity and air quality as part of its Internet of Things implementation. A central processing unit receives real-time data from these sensors and uses it to automatically calculate the ideal fan speed and activation based on the observed parameters. A user-friendly interface also makes it possible for customers to remotely control the system, monitoring and adjusting exhaust fan settings with smartphones or other connected devices. By quickly adapting to changes in air quality, this automated method not only increases energy efficiency but also promotes a healthier and more comfortable living or working environment.

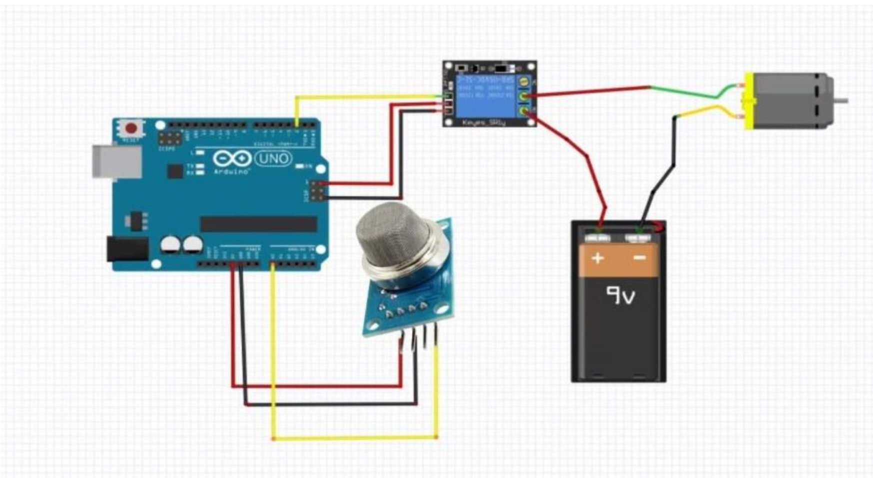

Figure 3: System Circuit Diagram

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IV. HARDWARE DESCRIPTION

ARDUINO UNO

UNO is an Italian word for "among". To distinguish the initial release of Arduino software, it was given the designation UNO. Additionally, it was the first Arduino-released USB board. It's regarded as the influential board that works on numerous projects. The Arduino UNO microcontroller is built around the ATmega328P. In contrast to other boards, like the Arduino Megaboard, etc., it is simple to use. The board is made up of shields, additional circuitry, and analog and digital input/output (I/O) pins. The acronym for the integrated development environment is IDE. It is compatible with offline and online platforms.

Figure 4.1: Arduino Uno

Using microcontroller kits, Arduino is an electronic software and hardware corporation, project, and community of users that creates interactive things and digital devices that are capable of controlling and sensing real-world items. The Free Software Foundation's General Public License (GPL) or the GNU Lesser Public Public License (LGPL) are the licenses under which the project's hardware and software are available, allowing anybody to share the software and build Arduino boards. Commercial preassembled Arduino boards are available, as well as DIY kits. The project's board designs make use of several controllers and microprocessors. These systems include sets of input/output (I/O) pins, both digital and analog, that may be interfaced with other expansion boards (also known as "shields") and other circuits. The boards provide serial communications ports for loading software from personal computers, including Universal Serial Bus (USB) on certain variants. A variant of the C and C++ programming languages is mainly used to program the microcontrollers. The Arduino project offers an Integrated Development System (IDE) based on the Processor language project in addition to utilizing conventional compiler toolchains.

The Arduino project began as a course for students at the Interaction Design Institute Ivrea in Ivrea, Italy, in 2005. Its goal was to give both experts and beginners a simple and affordable approach to designing gadgets that use sensors and actuators to interact with their surroundings. These kinds of gadgets are frequently designed for novice enthusiasts and include motion detectors, thermostats, and rudimentary robots. Hardware from Arduino is open-source. The Arduino website has hardware reference designs, which are made accessible under a Creative Commons Attribution Share-Alike 2.5 license. The GNU General Public License, version 2 governs the publication of the IDE's source code. However, there has never been an official Bill of Materials for Arduino boards. An early Arduino board with an Atmel ATmega8 microcontroller chip (black, bottom right) and an RS-232 serial interface (upper left); the power connector is at the lower left, the six analog input pins are at the lower right, and the top has 14 digital I/O pins.

Single-row pins or female headers are used on the boards to make connections easier for programming and integrating into other circuits. These might be connected to shield-named add-on modules. An I/C serial bus may be used to separately address many, potentially stacked shields. A 16 MHz crystal and a 5V linear regulator are standard on most boards.

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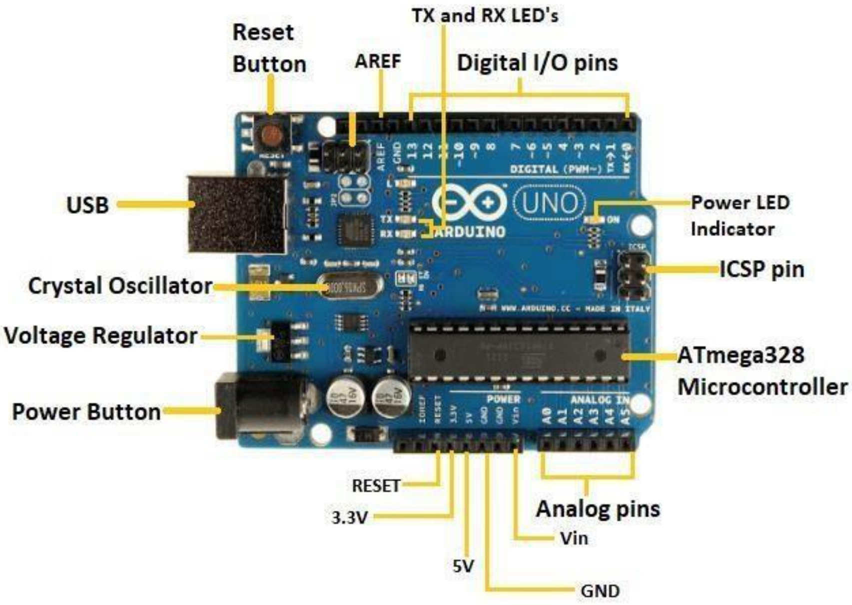

Figure 4.2: Pin Description of Arduino Uno

• **GND (3):** An acronym for "ground." The Arduino has multiple GND pins that you can utilize to ground your circuit.

• **3.3V (5) & 5V (4):** As one might expect, the 3.3V pin provides 3.3 volts of electricity, and the 5V pin provides 5 volts. The majority of the basic parts that are used with the Arduino gladly operate on 3.3 or 5 volts.

• **Analog (6):** The regions of pins on the UNO that are labeled "Analog In" (A0 through A5) are called "Analog In pins."These pins are able to read the signal from an analog sensor (such as a temperature sensor) and translate it into a readable digital value.

• **Digital (7):** The digital pins (0 to 13 on the UNO) are located across from the analog pins. These pins can be used for digital output, such as powering an LED, as well as digital input, such as signaling when a button is pushed.

• **PWM (8):** Some of the digital pins (3, 5, 6, 9, 10, and 11) may have had the tilde (~) next to them.

SPECIFICATIONS

Microcontroller	ATmega328P
Operating Voltage	5V
Digital I/O Pins	14 (D0 - D13)
Analog Input Pins	6 (A0-A5)
Clock Speed	16 MHz
Flash Memory	32 KB
Wi-Fi	Not supported
Operating Temperature Range	-40°C to +85°C
Input Voltage	5V (via USB or VIN pin)
Output Voltage	5V
Current Consumption	~varies
USB-to-Serial Chip	CH340G
Programming Interface	USB
GPIO Pins	PWM, I2C, SPI
Onboard Antenna	No
Dimensions	68.6mm x 53.4mm
Compatible IDEs	Arduino IDE

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WORKING

The Arduino uno is a development board that utilizes the ATmega328P microcontroller module, allowing digital and analog input/output capabilities.

- CPU and microcontroller: The Arduino Uno makes use of the ATmega328P microprocessor, which has an 8-bit AVR CPU. On the board, this processor controls input/output, assigns and performs commands.

- Voltage Regulation: The Arduino Uno runs at 5V and is controlled by an integrated voltage regulator, much like the NodeMCU. This guarantees steady voltage levels for dependable coupled component performance.

- Digital and Analog I/O: The Arduino Uno has six analog input pins (A0-A5) and fourteen digital I/O pins (D0-D13). Project designs are made more flexible by the fact that these pins can be set up as inputs or outputs to communicate with different digital and analog devices.

- Wi-Fi Connectivity: The Arduino Uno lacks integrated Wi-Fi connectivity, in contrast to the NodeMCU. Nevertheless, you may use extra modules or shields, such the ESP8266 module or the ESP32, to give the Arduino Uno Wi-Fi capabilities, allowing for communication across Wi-Fi networks.

- Programming and Communication: The Arduino IDE is usually used to program the Arduino Uno. The board communicates with the computer using a USB-to-Serial chip (such the ATmega16U2 or CH340G) to enable uploading code, tracking output, and debugging.

- GPIO and Communication Protocols: The Arduino Uno's GPIO pins support a number of communication protocols, including PWM, I2C, and SPI, much like the NodeMCU. By facilitating communication with various gadgets and sensors, these protocols increase the board's functionality.

- Operating System and Applications: Unlike the NodeMCU, the Arduino Uno does not have an operating system. Rather, it runs code that is uploaded straight to the board. Usually written in C/C++, this code can be used for a variety of tasks such as automation systems, robotics, Internet of Things projects, and more.

- Electricity Consumption: Depending on how it is operating, the Arduino Uno uses different amounts of electricity. Using sleep modes and optimizing code are two examples of effective power management techniques that can help lower energy usage, particularly in battery-powered apps.

GAS Sensor (MQ-2)

A device that uses ultrasonic sound waves to gauge an object's distance is called an ultrasonic sensor. It operates on the same echolocation mechanism as dolphins and bats. The ultrasonic pulses the sensor emits are used to measure the time it takes for sound waves to return back after colliding with an item. The distance that lies between the sensor and something is then computed using this information.

Figure 4.3: GAS Sensor

Pin Description

The MQ-2 gas sensor typically has four pins: VCC, GND, DO, and AO. Below is a detailed description of each pin:

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VCC (Voltage Supply)
Description: This pin is used to supply power to the gas sensor.
Typical Voltage: 5V.
Connection: Connect this pin to the 5V power supply of your microcontroller or power source.

GND (Ground)
Description: This pin is connected to the ground of the power supply.
Function: Provides a common ground for the sensor and the rest of the circuit.
Connection: Connect this pin to the ground (GND) of your power supply and microcontroller.

DO (Digital Output)
Description: This pin outputs a digital signal (HIGH or LOW) indicating the presence of gas.
Function: The signal is HIGH when the gas concentration is above a certain threshold and LOW otherwise.
Usage: Can be connected to a digital input pin on a microcontroller for simple gas detection.
Connection: Connect this pin to a digital input pin on the microcontroller.

AO (Analog Output)
Description: This pin outputs an analog voltage that corresponds to the gas concentration.
Function: Provides a variable voltage output that represents the concentration of the detected gas.
Usage: Can be connected to an analog input pin on a microcontroller for precise measurement of gas concentration levels.

Connection: Connect this pin to an analog input pin on the microcontroller.

Working

- VCC to 5V: Connect the VCC pin to the 5V pin on the Arduino.
- GND to Ground: Connect the GND pin to one of the GND pins on the Arduino.
- DO to Digital Pin: Connect the DO pin to a digital input pin on the Arduino (e.g., D2).
- AO to Analog Pin: Connect the AO pin to an analog input pin on the Arduino (e.g., A0).

Relay Module

Relay modules are electronic devices used to operate high-power appliances or equipment using low-power microcontrollers or digital signals. Relay modules are made up of one or more relays, also known as electromagnetic switches. Relays are essential for integrating with devices that run at different voltage levels because they offer electrical isolation between the high-voltage load circuit and the low-voltage control circuit.

Figure 4.4: Relay Modules

V. SYSTEM FLOW

Attach the Arduino Uno to the MQ-2 sensor:

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• Attach the Arduino's VCC to the sensor's 5V.
• Attach the GND of the sensor to the Arduino's GND.
• Attach the A0 pin of the sensor to an A0 pin on the Arduino.

Link the Arduino Uno and Relay Module together:

• Attach the Arduino's VCC to the relay module's 5V.
• Attach the GND of the relay module to the Arduino's GND.
• Attach the relay module's IN to an Arduino digital pin.

Link the Fan and Relay Module Together:

Attach the relay module to the fan. Three connections are usually present on the relay module: Common (COM), normally Open (NO), and Normally Closed (NC). Join COM and NO to the fan.

Connect the 9V battery as follows:

• Attach the positive (red) wire of the battery clip to Arduino pin Vin.

• Attach the negative (black) wire of the battery clip to the Arduino's GND.

Diagrammatic Representation of Initialization of Workflow:

Activate → Verify Connectivity Observing

Smoke Sensors → Data Transmission to Microcontroller Detection in Real-Time

Data Analysis → Activation of Threshold Excedance

An indication to the exhaust fan → Fan On

VI. RESULT AND DISCUSSION

The Internet of Things (IoT)-based automated exhaust fan system showed how to successfully integrate connection and sensor technology to improve exhaust fan operation efficiency. By using environmental sensors, the system was able to identify variations in humidity and air quality. Through the IoT platform, the exhaust fan was automatically turned on when predetermined criteria were surpassed, guaranteeing prompt and effective ventilation.

The outcomes showed increased energy efficiency as well as a more regulated and cozy setting. The system's capacity to adjust to changing circumstances was further shown by real-time data analysis, which also highlighted the system's potential for ventilation process optimization in a variety of contexts.

All things considered, the project effectively demonstrated the advantages of IoT in developing an automated and responsive exhaust fan system for improved indoor air quality.

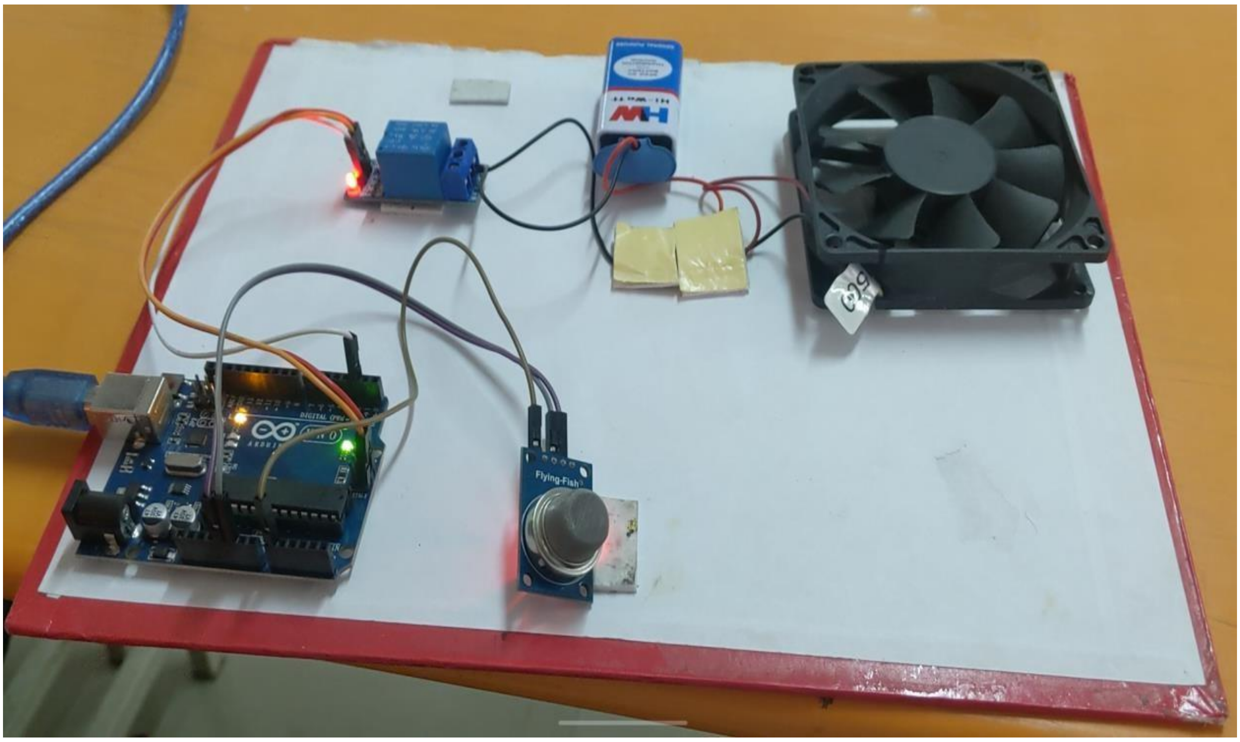

Figure 5.1 demonstrates the process of (IoT)-based automated exhaust fan for cooking smoke

VII. CONCLUSION

In summary, an important step has been taken toward improving road safety with the development of the IoT-based U-turn vehicle accident prevention system for blind spots. This system makes use of an Arduino Uno, an HC-SR04 ultrasonic sensor, 1kΩ resistors, and red, green, and orange LEDs. Using real-time distance measurements and LEDs for visual cues, the system successfully recognizes U-turns in blind places. The research showed that using straightforward yet efficient IoT solutions to solve certain road safety issues is feasible. The U-turn, which frequently results in accidents in blind areas, was precisely detected by the system through the use of ultrasonic sensor technology. The addition of LEDs provided nearby cars and pedestrians with an understandable and unambiguous visual alert. Notwithstanding the system's potential, it is critical to recognize its shortcomings and difficulties. Environmental elements that could affect the sensor's function include noise interference and different lighting. Furthermore, the current implementation is stand-alone; adding connectivity features for data transmission in real-time or vehicle-to-vehicle communication could improve usefulness even further.

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