International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 06 | June - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Automatic Fire Extinguishing System Using Internet of Things

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***Abstract*— Fire accidents are the most dangerous and fatal accidents that occur as a result of worker negligence and inadequate supervision. The primary goal of this research work is put out the fire as quickly and effectively as possible. This project effectively extinguishes the fire by spraying water at that specific location, requiring less water than the traditional approach. The proposed design includes a flame sensor, a temperature sensor, and a gas sensor to determine whether a fire accident has happened. To do this, the sensors are positioned on top of a rotating platform that is connected to the servo motor. Due to this effective detection, the fire will be detected at an early stage and extinguished using the nozzle linked to the rotating base. All logical processes are performed by using controller. Furthermore, the fire activity can be monitored using IoT with the help of Blynk**

I. INTRODUCTION

Prevention of fire and fire risk level control difficulty are increased day by day. Fire-fighting and monitoring situations are very serious today. Public security keeps on insisting in increase of technology in firefighting and monitoring. They give special attention to improve the science and technology in resisting fire disasters. They are concerned about the application of new technology such as IoT and wireless sensor network in fire-fighting and monitoring field. IoT is very suitable for fire-fighting with wide scope along with wireless sensor network (WSN). IoT has high degree of intelligence for maintaining many product categories, quantities, complex fire danger factors and large range of equipment's for fire monitoring and fighting. IoT has high scalability and high resource sharing capabilities for handling various complex business information. IoT combined with WSN plays an important role in the fire alarm, fire control facility monitoring and fire equipment management. IoT technology is combined with fire fighting for hazard source monitoring, fire monitoring, fire-fighting rescue, fire early warning, prevention and early disposal. It is used effectively to enhance the fire brigade fire frightening and emergency rescue capabilities. Fire's accidents are becoming more series because of bigger building density and higher urban

buildings. Accidental fires caused 6% of all unnatural deaths in India. Exploding cooking gas cylinders and stoves accounted for nearly one-sixth of all deaths from accidental fires between 2010 and 2014, with a total of 19,491 deaths.

LITERATURE SURVEY

Much of the research and work has been done In the field of **AUTOMATIC FIRE EXTINGUISHING SYSTEM USING INTERNET OF THINGS**

[1] Tawfiqur Rakib, M.A. Rdshid Sarkar, "Design and fabrication of an autonomous firefighting robot with multi- sensor fire detection using PID controller", ICIEV Volume 23 issue-1 JUNE 2016.

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EXISTING SYSTEM

The existing fire extinguishing systems primarily rely on traditional methods such as manual fire extinguishers, sprinkler systems activated by heat sensors, and alarm systems that notify occupants to take action. These systems often have limited connectivity and lack real-time monitoring and control, leading to potential delays in response time and inefficiencies in fire management.

PROPOSED SYSTEM

The proposed automatic fire extinguishing system leverages the Internet of Things (IoT) to enhance fire detection and suppression capabilities. This system employs interconnected sensors to continuously monitor environmental conditions, detect fire outbreaks in real-time, and automatically activate the appropriate extinguishing mechanisms. The IoT integration allows for remote monitoring and control, providing instant alerts and status updates to emergency services and building management, thereby improving response times and minimizing damage.

METHODOLOGY

The theme of this project is to automatically sense the environmental fire and extinguish it without human intervention. The methodology is divided into three parts. The first part is on the design structure, followed by hardware description and the finally on the programming design.

All these three parts were assembled together and experiments were then performed to build a system that can extinguish the fire that was carried out.

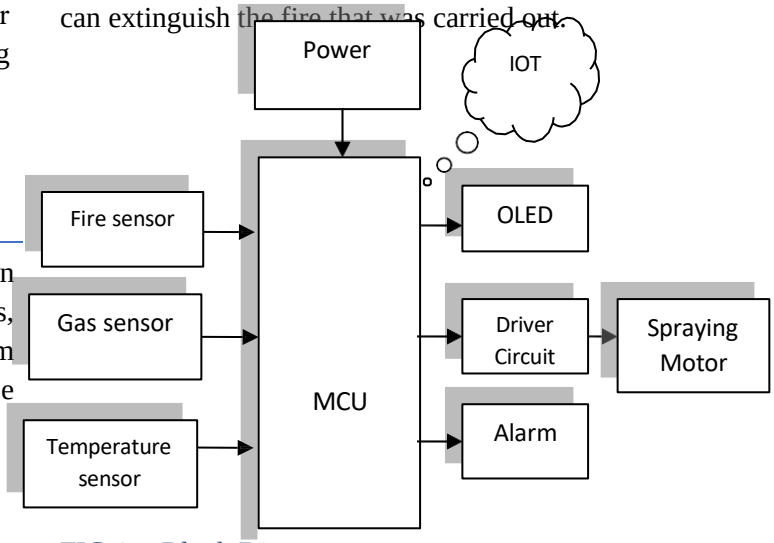


FIG 1: - Block Diagram

Applications

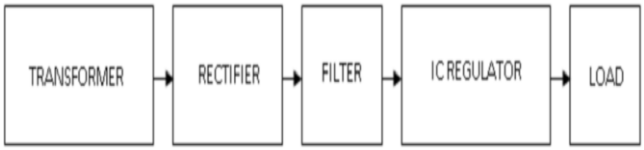
This Automatic fire Extinguishing System can be applied to a wide array of setting to enhance safety and protection against fire Hazards. In smart homes, commercial buildings, industrial facilities, it can provide an extra layer of security, detecting and responding to fires quickly, even when residents are away. In industrial facilities, it can valuable assets and prevent major disruption.

HARDWARE DETAILS

POWER SUPPLY

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.

The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.



Transformer

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC.

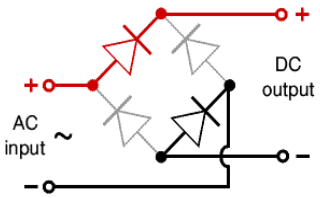
Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in India) to a safer low voltage.

Rectifier

There are different ways to connect diodes for converting AC to DC. The bridge rectifier is the most common, producing full-wave DC without needing a centre- tap transformer. A two-diode full-wave rectifier requires a centre-tap transformer. A single-diode rectifier gives only half-wave DC, using just the positive half of the AC signal.

Bridge rectifier

A bridge rectifier uses four diodes arranged so that input is applied across one diagonal and output is taken from the other. When point A is positive and B is negative, diodes D3 and D1 conduct, while D2 and D4 block. This allows current to flow in one direction through the load.



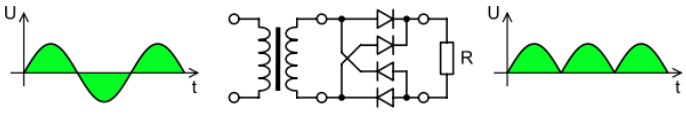
Bridge Rectifier

Advantages:

No need for a centre-tapped transformer, reducing size and cost. Uses a single secondary winding.

Output is pulsating DC with double the frequency of the input AC.

Produces nearly twice the output voltage of a conventional full-wave rectifier using the same transformer. Output waveform of DC

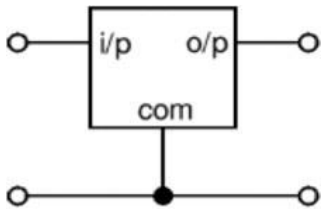


Smoothing

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.

Voltage Regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.



MICROCONTROLE
R

Raspberry Pi Pico W Overview

The Raspberry Pi Pico W is the first wireless microcontroller board from Raspberry Pi, designed for physical computing. It builds on the original Pico with the same RP2040 dual-core ARM Cortex-M0+ chip, but adds Wi-Fi and Bluetooth 5.2 support via the Infineon CYW43439 chip.

Pico vs Pico W – Key Differences

- Wireless Connectivity: Pico W includes Wi-Fi and Bluetooth; Pico does not.
- Power Regulator: Pico W uses RT6154A, while Pico uses RT6150B.
- Debug Port: Relocated in Pico W to make room for the Wi-Fi antenna.

Powering the Pico W

- USB Port (5V): Easiest option; VBUS pin also provides 5V for peripherals.
- VSYS Pin (1.8–5.5V): For battery or external sources; onboard regulator converts it to 3.3V.

Programming the Pico W

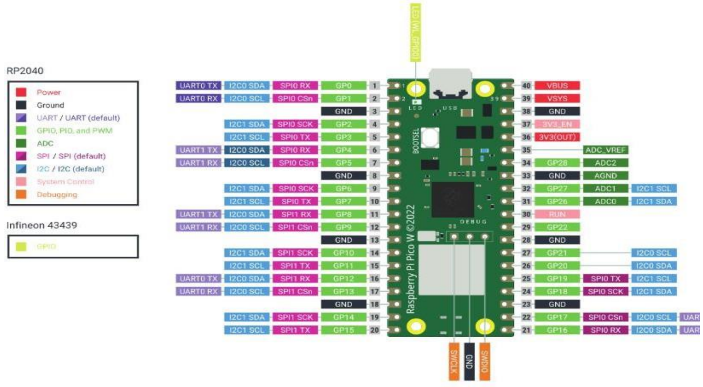
- Can be programmed using C/C++, MicroPython (e.g., with Thonny IDE), or the Arduino IDE.
- Supports drag-and-drop programming over USB.

Pico W Specifications

- RP2040 microcontroller: Dual-core ARM Cortex- M0+ @ 133 MHz
- 264 KB SRAM, 2 MB Flash
- 802.11n Wi-Fi (2.4 GHz)
- USB 1.1 Host/Device, drag-and-drop support
- Low-power sleep/dormant modes
- 26 GPIO pins, with:
    - 2× SPI, 2× I2C, 2× UART
    - 3× 12-bit ADC, 16× PWM channels
    - On-chip temperature sensor and clock
        - 8× Programmable I/O (PIO) for custom peripherals

RASPBERRY PI PICO W PINOUT

The Pico W is pin-to-pin compatible with the original Pico and has 40 pins, including 26 multipurpose GPIOs (GP0–GP28, excluding GP23, GP24, GP25, GP29). All GPIOs use
3.3V logic. A 3-pin debug header is also available near the RP2040 chip.



Pico W Power Pin Summary

- VBUS (Pin 40): 4.5–5.5V from USB.
- VSYS (Pin 39): Main power input (1.8–5.5V), powers onboard 3.3V regulator.
- 3V3_EN (Pin 37): Enables 3.3V regulator; pulled high via 100kΩ resistor.
- 3V3(OUT) (Pin 36): Regulated 3.3V output (max ~300mA) for external use.
- GND: 8 ground pins.
- ADC_VREF (Pin 35): 3.3V reference for ADC.
- AGND (Pin 33): ADC ground.
- RUN (Pin 30): Used to reset the RP2040; pulled up to 3.3V.

If not using USB, power Pico W via VSYS with 1.8–5.5V (e.g., Li-ion battery or AA cells).

OLED (Organic Light Emitting Diodes)

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive displays that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight).

FIRE SENSOR

The Fire sensor, as the name suggests, is used as a simple and compact device for protection against fire. The module makes use of IR sensor and comparator to detect fire up to a range of 1-2 meters.
The device, weighing about 5 grams, can be easily mounted on the device body. It gives a high output on detecting fire. This output can then be used to take the requisite action. An on-board LED is also provided for visual indication.

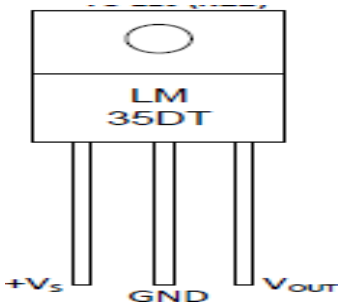
Feature

- Typical Maximum Range :2 m .
- Indicator LED with 3 pin easy interface connector.
- Operating Voltage 5v

Fire sensor

TEMPARATURE SENSOR

Temperature is the most measured variable in industrial automation. Temperature sensors convert temperature into electrical signals for accurate reading and control. Sensors vary by contact method, temperature range, calibration, and sensing element. They typically have a sensing element housed in plastic or metal, with conditioning circuits to reflect environmental temperature changes.



Features

- Calibrated directly in Celsius (centigrade)
- 0.5^0 C Ensured accuracy (at $+25^0$ C)
- Suitable for remote applications
- Operate from 4 to 30 V

GAS SENSOR

A gas detector is a safety device that detects gas leaks and alerts users or triggers automatic shutdowns. It's crucial in protecting humans and animals from harmful gases. Gas High sensitivity to LPG, natural gas, town gas.

sensors are widely used from home appliances to industrial safety systems—to monitor gas concentrations. They react to the presence of gases and send electrical signals to control systems. Sensors vary by gas type, sensitivity, and size. For example, a methane gas sensor can also detect gases like ammonia. When gas contacts the sensor, it's ionized and adsorbed, creating a potential difference that is sent as a signal to the processor.

GAS SENSOR

FEATURES

- Fast response.
- Stable and long life.
- Simple drive circuit.

DRIVER CIRCUIT (L293D)

L293D IC generally comes as a standard 16-pin DIP (dual-in line package). This motor driver IC can simultaneously control two small motors in either direction; forward and reverse with just 4 microcontroller pins

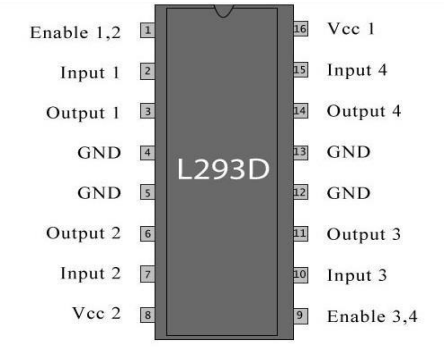


Fig showing pin diagram of L293D

DC MOTOR

A DC motor converts direct current into mechanical energy and is widely used in industry. The most common types are brushed and brushless motors.

In our project, we use a brushed DC motor rated at 12V, 0.6A. Its speed can be controlled by adjusting the armature voltage or field current. Modern DC motors often use DC drives for precise speed control

MOTOR

BUZZER

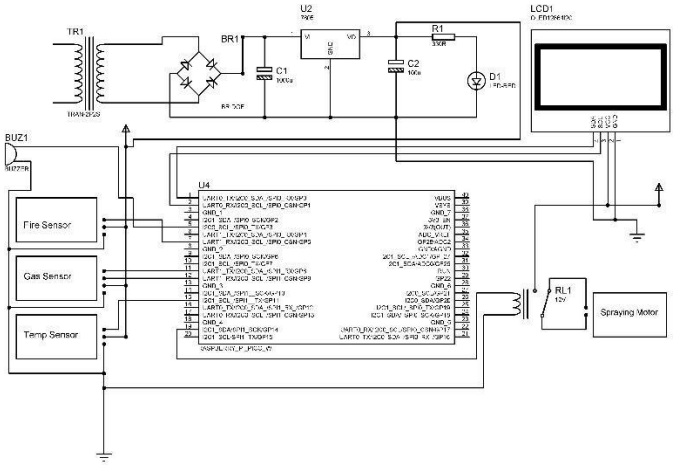


FIG 3: - Schematic Diagram

SOFTWARE DETAILS

THE ARDUINO INTEGRATED DEVELOPMENT ENVIRONMENT

Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

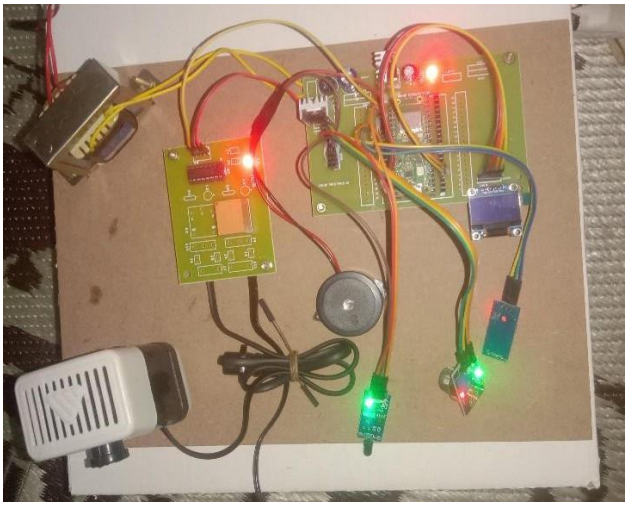


FIG 5 Prototype of The System

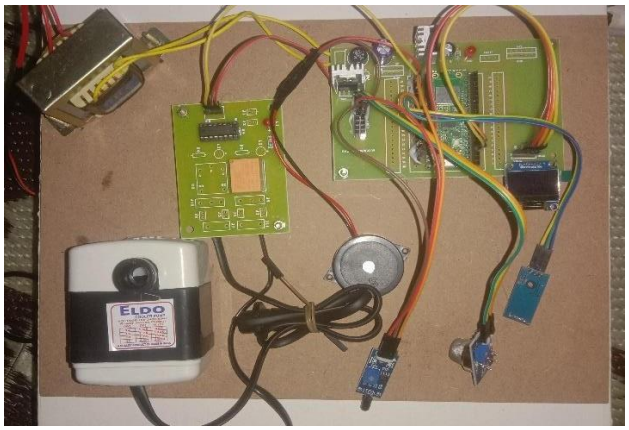


FIG 4 Prototype of The System

CONCLUSION

This study presents an IoT-based fire detection system using flame, smoke, and temperature sensors.

It ensures fast, accurate detection and sends data via Wi-Fi to a central control unit.

The system responds in about 5 seconds, triggering a water sprinkler to control the fire.

A water pump activates to minimize damage until help arrives.

It improves affordability, effectiveness, and responsiveness over existing systems.

The setup is designed for real-time monitoring and automatic fire suppression.

Future upgrades may include machine learning for fire prediction and prevention.

This can help identify and address building vulnerabilities before fires occur.

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