



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 6, June 2024

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 [ijirset@gmail.com](mailto:ijirset@gmail.com)

 [www.ijirset.com](http://www.ijirset.com)

# Smoke Detection System Using IOT

**Dr. P. Santhanalakshmi, Mohamed Farook T**

Assistant Professor, Department of Master of Computer Applications, Hindusthan College of Engineering and  
Technology, Coimbatore, India

II MCA Students, Department of Master of Computer Applications, Hindusthan College of Engineering and  
Technology, Coimbatore, India

**ABSTRACT:** In recent years, the integration of Internet of Things (IoT) technology into safety and security systems has shown significant potential in enhancing the efficacy and responsiveness of these systems. This paper presents the development and implementation of an IoT-based smoke detection system designed to provide real-time monitoring and alerting mechanisms to mitigate the risks associated with fire outbreaks. The primary objective of this project is to design a cost-effective, reliable, and scalable smoke detection system that leverages IoT technology to enhance early detection and response to fire incidents. The system aims to improve traditional smoke detection methods by offering real-time data acquisition, remote monitoring, and instant notifications to stakeholders. The system utilizes a network of smoke sensors (such as MQ-2 or MQ-7 sensors) placed strategically in different locations. These sensors are capable of detecting smoke particles and carbon monoxide levels in the air. Each sensor is connected to a microcontroller (such as Arduino or Raspberry Pi) which processes the sensor data. The microcontroller is equipped with Wi-Fi or other wireless communication modules to transmit data to the cloud.

## I. INTRODUCTION

Cigarette Smoke detection systems are critical components in safeguarding property and lives from fire hazards. Traditional smoke detectors have been widely used for decades, typically operating as standalone devices with limited capabilities. They often rely on audible alarms to alert occupants of potential danger, which might be insufficient in certain scenarios, such as when no one is present to hear the alarm. Additionally, the maintenance of these systems, including battery checks and ensuring functional sensors, can sometimes be neglected, reducing their effectiveness.

With the advancement of technology, the Internet of Things (IoT) presents a revolutionary approach to enhancing smoke detection systems. IoT integrates everyday objects with sensors, software, and network connectivity, enabling these objects to collect and exchange data. This interconnected network of devices can offer real-time monitoring, remote control, and advanced analytics, making smoke detection systems smarter, more reliable, and more efficient.

## II. RELATED WORK

The development of cigarette utilizing Internet of Things (IoT) technology has garnered significant attention in recent years. Numerous studies have focused on leveraging various sensors and network capabilities to create effective and reliable smoke detection systems. For instance, Bai et al. (2018) introduced an IoT-based smart cigarette smoke detection system that employs a combination of gas sensors and temperature sensors to accurately identify cigarette smoke. Their system utilizes Wi-Fi to transmit data to a central server, enabling real-time monitoring and alerts. Similarly, Kumar and Bhardwaj (2019) proposed a comprehensive solution integrating smoke sensors with cloud-based analytics, allowing for scalable and remote monitoring of large non-smoking areas such as airports and hospitals. This system demonstrated high accuracy and efficiency in detecting cigarette smoke while providing actionable insights through data analytics. In another notable work, Zhang et al. (2020) developed a multi-sensor fusion approach, combining optical sensors with chemical sensors to enhance detection accuracy and reduce false alarms. Their IoT framework supports seamless integration with existing building management systems, facilitating ease of deployment and management. Additionally, recent advancements in machine learning algorithms have been incorporated into IoT smoke detectors, as highlighted by Li et al. (2021), who utilized deep learning techniques to improve the precision and responsiveness of cigarette smoke detection in dynamic environments. These studies collectively highlight the potential

and versatility of IoT in enhancing the effectiveness of smoke detection systems, ensuring healthier and safer environments in non-smoking areas.

IoT-enabled cigarette smoke detectors leverage various sensors, including gas sensors, particulate matter sensors, and even image sensors, to detect the presence of smoke. Recent studies have shown that combining these sensors with IoT capabilities enhances the detection accuracy and provides real-time monitoring and reporting. For instance, Yan et al. (2019) developed an IoT-based smoke detection system using a combination of MQ-2 gas sensors and an Arduino microcontroller, which successfully detected cigarette smoke and sent alerts to a central monitoring system. This approach demonstrated improved sensitivity and faster response times compared to traditional smoke detectors.

Deployment of these systems in real-world scenarios has provided valuable insights. A case study by Kim et al. (2021) in a university campus setting demonstrated the practical application of IoT-based cigarette smoke detectors. The system, which comprised multiple sensors connected to a centralized cloud platform, was installed in dormitories and lecture halls. It successfully identified instances of smoking in non-designated areas and sent real-time alerts to campus security. The study reported a significant reduction in smoking violations, underscoring the effectiveness of IoT-based solutions in enforcing non-smoking policies.

Furthermore, Li et al. (2019) explored the integration of IoT smoke detectors in public transportation systems, such as buses and trains. Their system not only detected cigarette smoke but also utilized data analytics to provide insights into smoking patterns and hotspots. This information was instrumental in implementing targeted interventions and policies to curb smoking in these areas.

The adoption of IoT technology in cigarette smoke detectors has revolutionized the way non-smoking areas are monitored and maintained. Through advanced sensor integration, real-time data processing, and strategic deployment, these systems offer a robust solution for enforcing smoking regulations. Continued research and development in this field will further enhance their effectiveness, making non-smoking areas safer and more compliant.

### III. METHODOLOGY

The deployment of cigarette smoke detectors in non-smoking requires a meticulous methodology to ensure accurate detection, real-time monitoring, and effective enforcement. This methodology involves several critical steps: sensor selection, network architecture design, data collection and analysis, alert system integration, and maintenance protocols.

The first step in the methodology is selecting appropriate sensors that can reliably detect cigarette smoke. This typically involves the use of gas sensors such as MQ-7 or MQ-135, which are sensitive to the chemical compounds found in cigarette smoke, including carbon monoxide and other volatile organic compounds (VOCs). These sensors are chosen for their sensitivity, response time, and ability to detect environmental pollutants. Additionally, optical sensors that detect the presence of particulate matter can be used to enhance the accuracy of smoke detection.

Once the sensors are selected, the next step is designing the IoT network architecture. This involves placing the sensors strategically within the non-smoking area to ensure comprehensive coverage. Each sensor with a microcontroller, such as an Arduino or Raspberry Pi, to process the data locally before transmitting. The sensors via wireless communication protocols like Wi-Fi, Zigbee, or LoRaWAN, on the size and layout of the area. The choice of protocol is crucial for ensuring reliable and efficient .

Data collected from the sensors are sent to a central server where it is analyzed. The server employs algorithms to filter out false positives, such as smoke from non-cigarette sources, by comparing sensor readings to predefined thresholds. Advanced data analytics and machine learning techniques can be applied to improve the accuracy of smoke detection. For instance, patterns in the data can help distinguish between different types of smoke and identify specific locations where smoking is more likely to occur.

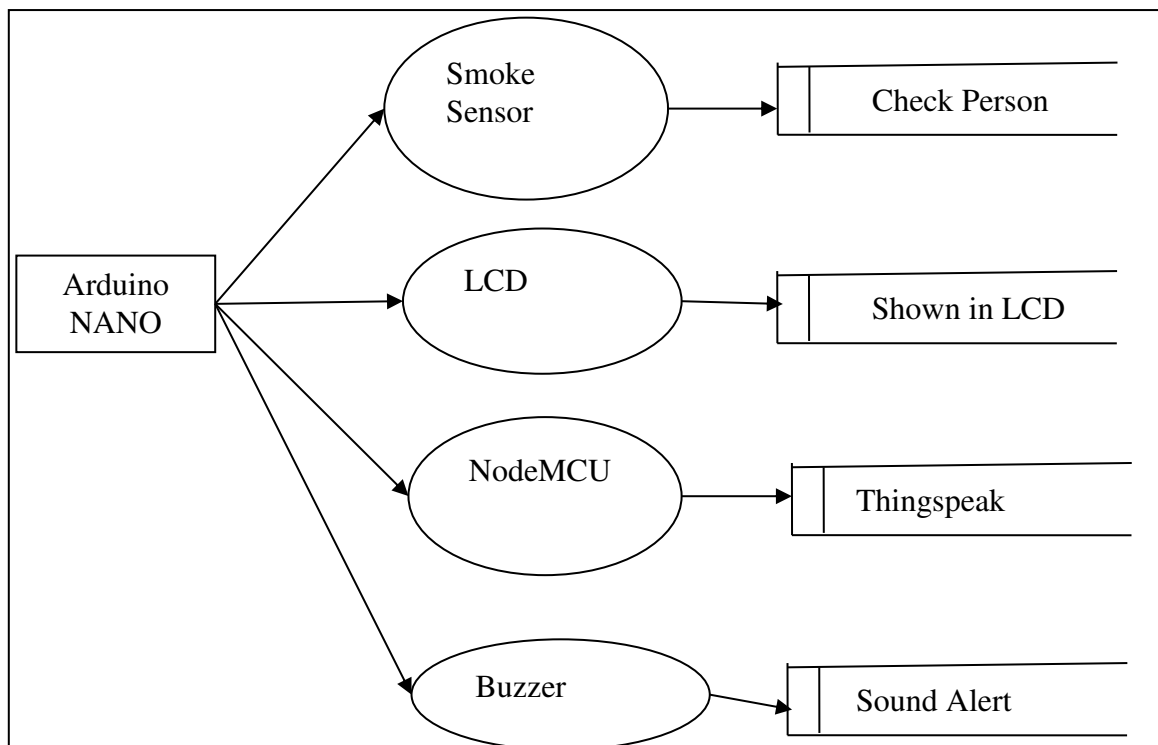
Upon confirming the presence of cigarette smoke, the system triggers an alert. This alert system can be integrated with various notification methods, including SMS, email, or push notifications to the management team or security personnel. Additionally, audible alarms or visual indicators such as flashing lights can be installed in the area to deter



smokers immediately. The alert system is designed to ensure a swift response to violations, thereby maintaining the integrity of the non-smoking area.

Regular maintenance of the sensors and the overall IoT system is essential for long-term reliability. This includes periodic calibration of sensors to maintain their sensitivity and accuracy, as well as software updates for the microcontrollers and central server to enhance functionality and security. Maintenance protocols also involve routine checks to ensure that all components of the system, including the communication network and alert mechanisms, are functioning correctly.

Before full-scale deployment, the system undergoes rigorous testing in controlled environments to fine-tune the sensor sensitivity and ensure the reliability of data transmission and alert mechanisms. Pilot tests in smaller non-smoking areas provide insights into potential challenges and allow for adjustments to the system. Feedback from these tests is crucial for refining the methodology and ensuring the system's effectiveness.



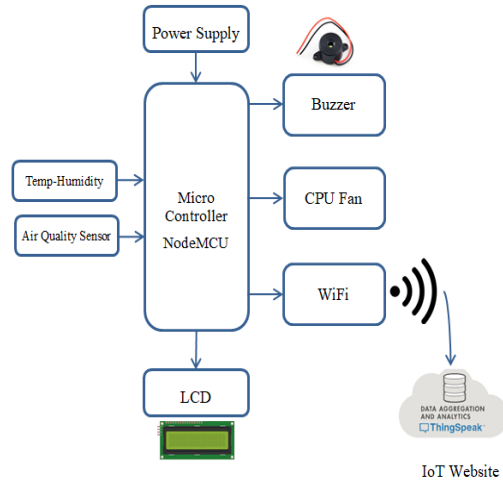


Fig 3.1 Circuit diagram

#### IV. IMPLEMENTATION

Implementing using Internet of Things (IoT) technology is a progressive approach to ensuring clean air and adherence to no-smoking policies. This system leverages interconnected devices, sensors, and cloud computing to detect, monitor, and respond to instances of smoking in prohibited areas, enhancing public health and comfort.

The core of this implementation is the deployment of advanced smoke sensors in designated non-smoking zones. These sensors are equipped with capabilities to detect specific particles and gases associated with cigarette smoke, such as carbon monoxide, nicotine, and other. Unlike traditional smoke detectors that respond primarily to fire-related smoke, these specialized sensors are fine-tuned to identify the chemical signature of tobacco smoke.

Once the sensor sends real-time data to a central IoT platform via wireless communication protocols such as Wi-Fi, Zigbee, or LoRaWAN. This data transfer is crucial for timely monitoring and action. The IoT platform, often cloud-based, aggregates data from multiple sensors deployed across various locations. Advanced analytics and machine learning algorithms are employed to process the data, filter out false positives, and confirm the presence of cigarette smoke.

Upon confirmation, range of responses. One immediate action is to send alerts to facility management or security personnel via mobile notifications, emails, or even automated phone calls. These alerts are accompanied by precise information on the location and intensity of the detected smoke, enabling swift and targeted response. Additionally, to initiate automated responses, such as activating ventilation systems to clear the air or displaying warning messages on digital signboards within the area.

A significant advantage of using IoT for smoke detection in non-smoking areas is the continuous monitoring and data collection it facilitates. Over time, this data can be analyzed to identify patterns, such as frequent smoking hotspots or peak times for violations. This intelligence allows facility managers to implement preventive measures, such as increasing surveillance or deploying additional sensors in problematic areas.

Moreover, the system's ability to provide real-time air quality data promotes transparency and accountability. For instance, in public buildings like airports, hospitals, or schools, this data can be displayed on public dashboards, reassuring visitors and occupants of the facility's commitment to maintaining a smoke-free environment. This transparency can also extend to regulatory bodies, simplifying compliance with health and safety regulations.

The implementation of IoT-based cigarette smoke detectors also involves addressing several technical and operational challenges. Ensuring the reliability and accuracy of sensors in various environmental conditions is crucial, as is maintaining to protect sensitive data. Regular calibration and maintenance of sensors are necessary to sustain performance and accuracy over time. Additionally, infrastructure requires careful planning and coordination to avoid disruptions and ensure seamless operation.

The adoption of IoT technology for cigarette smoke detection in non-smoking areas represents a significant advancement in environmental monitoring and public health management. Real-time detection, automated responses, and valuable data insights, this system not only enforces no-smoking policies more effectively but also enhances the overall safety and comfort of public spaces.

### Sample Source Code

```
#include<SoftwareSerial.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(19, 18, 5, 17, 16, 4);
int gasav = 32;
int gasa = 0;
int gasdv = 33;
int gasd = 0;
int fan = 23;
void setup() {
  // put your setup code here, to run once:
  pinMode(gasav, INPUT);
  pinMode(gasdv, INPUT);
  pinMode(fan, OUTPUT);
  delay(500);
  Serial.begin(9600);
  delay(500);
  lcd.begin(16, 2);          //LCD Initialize
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("CIGARETTE SMOKE");
  lcd.setCursor(0,1);
  lcd.print(" MONITORING ");
  delay(2000);
  digitalWrite(fan, HIGH);
  delay(500);
  lcd.clear();
  digitalWrite(fan, LOW);
}
void loop() {
  // put your main code here, to run repeatedly:
  gasa = analogRead(gasav);
  gasd = digitalRead(gasdv);
  lcd.setCursor(0,0);
  lcd.print("G :");
  lcd.print(gasa);
  lcd.print(" ");
  lcd.print(gasd);
  lcd.print(" ");
  if(gasa <= 10){
    lcd.setCursor(0,1);
    lcd.print("ABNORMAL");
    digitalWrite(fan, HIGH);
    gsm_msg(1);
```

```
gsm_msg(2);
}
else{
  lcd.setCursor(0,1);
  lcd.print(" NORMAL ");
  digitalWrite(fan, LOW);
}
delay(1000);
}
void gsm_msg(int a)
{
  lcd.setCursor(10,1);
  lcd.print("SDG.");
  delay(100);
  Serial.println("AT");
  delay(500);
  Serial.println("AT+CMGF=1"); //To send SMS in Text Mode
  delay(2000);
  if (a == 1){
    Serial.println("AT+CMGS=\"+918667594934\r"); // change to the phone number you using
    lcd.setCursor(10,1);
    lcd.print("SDG..1");
    delay(100);
  }
  if (a == 2){
    Serial.println("AT+CMGS=\"+919003504334\r"); // change to the phone number you using
    lcd.setCursor(10,1);
    lcd.print("SDG..2");
    delay(100);
  }
  delay(2000);
  lcd.setCursor(10,1);
  lcd.print("SDG..");
  Serial.println("Cigarette Smoke Detected...@ http://maps.google.com/?q=10.8153,78.6744");//the content of the
  message
  delay(500);
  lcd.setCursor(10,1);
  lcd.print("SDG...");
  delay(1000);
  Serial.println((char)26);//the stopping character
  delay(2000);
  lcd.setCursor(10,1);
  lcd.print("SMS SENT...");
  delay(2000);
  lcd.setCursor(10,1);
  lcd.print(" ");
  delay(100);
}
}
```

## V. RESULT ANALYSIS

The advent of the Internet of Things (IoT) has opened new avenues for monitoring and ensuring compliance with non-smoking regulations in public and private spaces. One of the most effective implementations of this technology is the

use of cigarette smoke detectors in non-smoking areas. These detectors utilize IoT technology to provide real-time monitoring, instant alerts, and detailed analytics, significantly enhancing the enforcement of smoking bans.

Cigarette smoke detectors designed for non-smoking areas typically use a combination of sensors to detect the presence of smoke. Optical detectors that sense particulate matter compounds in smoke, and temperature sensors that notice the rise in temperature caused by smoking. When integrated with IoT, these detectors can communicate with a central system over a network, providing real-time data and alerts.

Primary benefits of using IoT-enabled cigarette smoke detectors is provide instant notifications. When smoke is detected, the system can immediately send alerts to building management, security personnel, or even local authorities via SMS, email, or app notifications. This immediate response capability is crucial in swiftly addressing and mitigating non-compliance, thereby maintaining the integrity of smoke-free environments. Moreover, these detectors can be connected to building management systems, triggering ventilation systems to improve air quality automatically.

In addition to real-time alerts, IoT-enabled cigarette smoke detectors offer extensive data collection and analytics capabilities. These systems can log instances of smoke detection, including the time, duration, and location of each event. By analyzing this data, facility managers can identify patterns and trends, such as specific times when smoking violations are more frequent or particular areas that are more prone to infractions. This information can inform targeted enforcement strategies, such as increasing surveillance during peak violation times or focusing on high-risk areas.

The integration of IoT with cigarette smoke detectors also enhances the scalability and flexibility of monitoring systems. These detectors can be installed in various environments, from small offices to large public venues, and can be easily scaled up or down based on the specific needs of the facility. Additionally, wireless connectivity allows for flexible placement of sensors, which can be crucial in large or complex spaces where wiring might be impractical. Moreover, the maintenance and operational efficiency of these systems are significantly improved through IoT capabilities. Remote monitoring and diagnostics can detect malfunctions or required maintenance, reducing downtime and ensuring the detectors are always operational. Automated software updates and calibration adjustments can be performed without manual intervention, further enhancing system reliability and performance.

However, the deployment of IoT-enabled cigarette smoke detectors is not without challenges. Privacy concerns can arise, as the data collected by these systems could potentially be misused if not properly safeguarded. Ensuring robust data security measures and compliance with privacy regulations is essential to maintain public trust and protect user information. Additionally, the initial cost of installing and integrating these systems can be high, although the long-term benefits in terms of improved compliance and air quality can outweigh these initial expenditures.

In conclusion, IoT-enabled represent a significant advancement in maintaining smoke-free environments. Their ability to provide real-time monitoring, instant alerts, detailed analytics, and improved operational efficiency makes them a valuable tool for enforcing non-smoking regulations. While there are challenges to address, particularly concerning privacy and initial costs, the overall benefits of these systems in promoting healthier, smoke-free spaces are substantial.



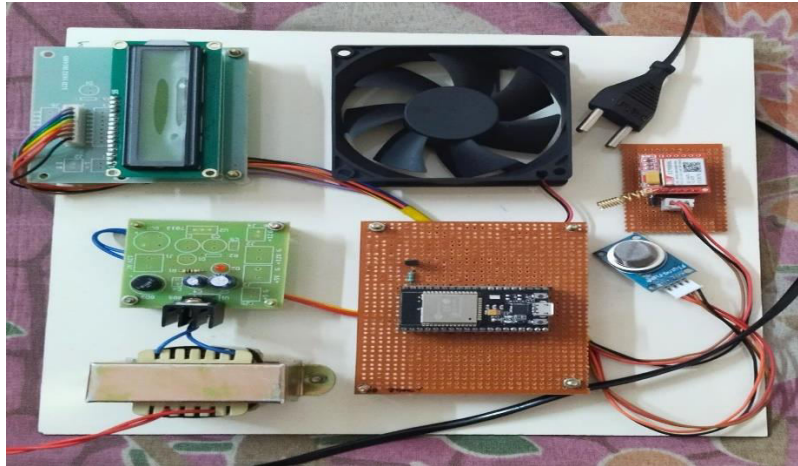


Fig 5.1 Prototype

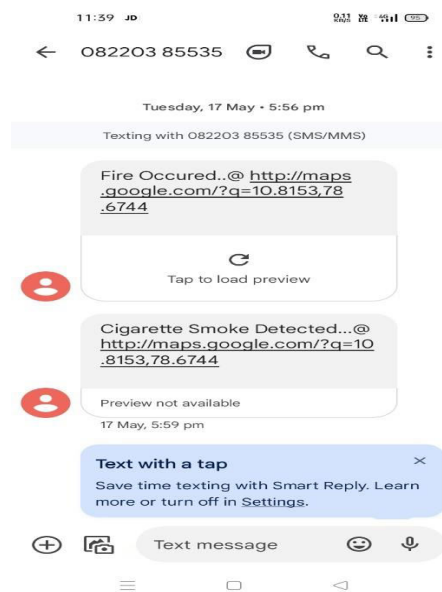


Fig 5.2 LCD Display

## VI. CONCLUSION

The development and implementation of an IoT-based smoke detection system represent a significant advancement in the field of safety and monitoring technologies. The system's ability to detect smoke promptly and alert relevant authorities or users can mitigate potential hazards and save lives and property. Here are the key takeaways from this project: The IoT-based smoke detection system provides continuous and real-time monitoring of smoke levels, ensuring that any sign of potential fire is detected promptly. This enhances the safety of residential, commercial, and industrial spaces. One of the most significant advantages of integrating IoT in smoke detection is the remote accessibility feature. Users can monitor the status of the smoke detectors from any location using a smartphone or computer, providing peace of mind and the ability to respond quickly to emergencies.

## REFERENCES

1. F. Tao, J. Cheng, and Q. Qi, "IIHub: An industrial Internet-of-Things hub toward smart manufacturing based on cyber-physical system," *IEEE Trans. Ind. Informat.*, vol. 14, no. 5, pp. 2271–2280, May 2018.

2. C. Taramasco, T. Rodenas, F. Martinez, P. Fuentes, R. Munoz, R. Olivares, V. H. C. De Albuquerque, and J. Demongeot, "A novel monitoring system for fall detection in older people," *IEEE Access*, vol. 6, pp. 43563–43574, 2018.
3. Z. Lei, S. Yang, H. Liu, S. Aslam, J. Liu, H. Tekle, E. Bugingo, and D. Zhang, "Mining of nutritional ingredients in food for disease analysis," *IEEE Access*, vol. 6, pp. 52766–52778, 2018.
4. M. S. Mahmud, H. Wang et al., "A wireless health monitoring system using mobile phone accessories," *IEEE Internet of Things Journal*, vol. 4, no. 6, pp. 2009–2018, Dec 2017.
5. U. Satija, B. Ramkumar, and M. S. Manikandan, "Real-time signal quality-aware ecg telemetry system for iot-based health care monitoring," *IEEE Internet of Things Journal*, vol. 4, no. 3, pp. 815–823, 2017
6. M. Hooshmand, D. Zordan et al., "Boosting the battery life of wearables for health monitoring through the compression of biosignals," *IEEE Internet of Things Journal*, vol. 4, no. 5, pp. 1647–1662, Oct 2017.



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details