

FABRICATION OF AUTOMATIC WINDOW USING GAS SENSOR

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering degree in
Mechatronics

By

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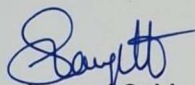
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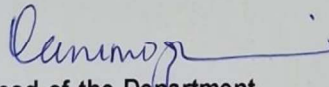
BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of NITESHWAR D (Reg. No. 40090022) and KEERTHI VASAN S (Reg. No. 40090022) who carried out the project entitled "FABRICATION OF AUTOMATIC WINDOW USING GAS SENSOR" under our supervision from November 2023 to April 2024.



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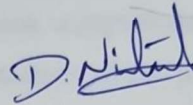
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DECLARATION

We NITESHWAR D (Reg. No. 40090022) and KEERTHIVASAN S (Reg. No. 40090014) hereby declare that the Project Report entitled **"FABRICATION OF AUTOMATIC WINDOW USING GAS SENSOR"** done by us under the guidance of **Dr. M. Sangeetha, M.E., Ph.D.**, is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Mechatronics.

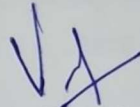


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ABSTRACT

In the rapidly evolving landscape of modern building automation and security systems, the search for efficient and seamless access control solutions is on the rise. New technologies with great potential in this area include the integration of gas sensors into automatic door systems. This innovative approach leverages gas sensing capabilities to develop an intelligent and responsive automatic door opening/closing system. The concept is very simple. In confined spaces, gas sensors detect changes in air quality (AQL), particularly decreases in gas concentrations that are often caused by exhaled air or changes in air composition. This significant change in gas concentration causes the automatic door to open, initiating a paradigm shift in access control. It provides easy access without the need for physical contact or manual activation. This feature has become extremely important in a world that is increasingly health conscious and safety conscious. This project delves into the development and implementation of such automatic door opening and closing systems, carefully examining the underlying technology, sensor calibration, and seamless integration into existing access control systems. In addition to the obvious benefit of improved accessibility, they are also important for improving hygiene standards, especially in high-traffic areas where minimizing contact with surfaces is essential. Additionally, the system has an environmentally friendly aspect by reducing energy consumption, making a significant contribution to sustainable construction practices. Furthermore, this innovative technology goes far beyond traditional entrance areas and is being used in a variety of areas such as healthcare facilities, public transport hubs, and commercial spaces. This multi-layered approach not only modernizes access control, but also takes us into a future where smart, health-conscious, energy-efficient solutions redefine the built environment.

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LIST OF SYMBOLS AND ABBEREVIATIONS

HVAC	Heater Ventilation Air Conditioning
GSM	Global System for Mobile Communication

CHAPTER 1

INTRODUCTION

In today's rapidly evolving world, there is an increasing demand for intelligent and sustainable solutions to enhance the quality of health and promote energy efficiency. Indoor air quality refers to the physical, chemical, and biological characteristics of air in the indoor environment within a home, building, or an institution or commercial facility thus, it is essential to actively monitor and develop innovative technologies to improve the air we breathe. Automated window systems have emerged as a promising solution to address the challenges posed by inadequate IAQ. In closed environments like car there is high possibility of increase in carbon monoxide level in the air that can lead to sever damage to the occupant's health. These systems offer the advantage of regulating the exchange of outdoor and indoor air, thereby maintaining optimal conditions for occupants. Gas sensors play an important role in detecting and quantifying various pollutants such as volatile organic compounds (VOCs), carbon dioxide (CO₂), and harmful indoor gases. The purpose of this review article is to provide a comprehensive overview of the integration of gas sensors into automatic window systems for closed environments. By critically reviewing the latest developments and research results, we hope to highlight the potential benefits, challenges, and future prospects of this innovative approach. The integration of gas sensors not only facilitates real-time monitoring but also enables automation of window operations based on IAQ parameters, providing a comprehensive solution for indoor air quality management. This review examines the basic principles of gas sensors, their types, and their suitability for different indoor environments. We also consider the technical aspects of integrating these sensors into automated window systems, including data processing, communication protocols, and control algorithms. Additionally, we discuss the practical implications of such integration, including energy savings, increased occupant comfort, and health benefits.

1.1 HISTORY OF AUTOMATED WINDOW USING SENSOR

The history of automated window systems with sensors is an interesting journey through the evolution of building automation and the impact of technology on our living and working environments. It would be difficult to fill a page and a half on this subject, but we can explore this story in more detail to provide a comprehensive overview. The concept of automatic window systems can be traced back to the mid-20th century, when the foundations of automation were laid. During this time, the world has seen significant technological advances in various fields, and the construction industry is no exception. The advent of electronics and the potential to automate building functions such as climate control and access control provided the spark that ultimately led to sensor-controlled window automation. In the 1950s and 1960s, early sensor variations were primarily used to perform basic automation tasks in commercial and industrial settings. These early sensors were often based on basic mechanical and electrical principles and were used for functions such as automatically opening and closing doors and controlling lighting. While these were modest steps toward automation, they were limited in functionality and lacked the sophistication of modern sensor technology. The real change in the history of sensor-based window automation was brought about by advances in sensor technology. An important milestone was the development of high-precision gas and environmental sensors in the second half of the 20th century. Able to precisely measure gas concentrations and environmental parameters, these sensors opened new horizons in building automation. The second half of the 20th century saw increased efforts to integrate gas sensors into building automation systems. The installation of gas sensors has significantly improved indoor air quality control and energy efficiency. Accurately detecting gas levels and environmental conditions allows buildings to dynamically respond and create healthier and more comfortable living and working spaces. The 21st century marked a turning point for sensor-based window automation. With the emergence of smart home and green building trends, the adoption of these systems has become more widespread. Homeowners and building managers have recognized the potential of sensor-driven window automation to create sustainable and energy-efficient spaces. This technology not only provided an opportunity to improve comfort, but also contributed to energy savings and sustainability goals. Sensor-based window automation systems are

currently used in both residential and commercial buildings. These systems contribute to improving comfort, safety and a sustainable living environment. Benefits include automatic temperature control, improved indoor air quality, and increased energy efficiency. Additionally, integrating sensors with other smart technologies has created a holistic approach to building management, allowing buildings to respond intelligently to changing conditions. In conclusion, the history of automatic window systems with sensors is a history of technological progress and innovation. From its humble beginnings in the mid-20th century, sensor technology has evolved into an integral part of modern building automation. The continued development and integration of sensor technology is expected to enable even more sophisticated and efficient window automation solutions in the future, further improving our living and working environments.

1.2 PRINCIPLE OF AUTOMATED WINDOW WITH GAS SENSOR

The principle of automatic window systems with gas sensors embodies a sophisticated approach to indoor environmental management. The core of this system is based on continuous monitoring of gas concentrations within a sealed room. Gas sensors come in various types, including metal oxide semiconductor sensors (MOS) and optical sensors, which detect specific gases such as carbon dioxide (CO₂), volatile organic compounds (VOCs), and carbon monoxide (CO). It plays an important role in detection.), others. These sensors work by responding to changes in electrical conductivity or optical properties when exposed to these gases. Predefined gas concentration thresholds are set to ensure safety, comfort and energy efficiency. These thresholds serve as boundary markers for acceptable gas levels in the environment. Gas sensor data is passed to a central control unit (often a microcontroller or building automation system) that performs real-time analysis. If the gas level exceeds a predefined limit, it indicates poor air quality or the presence of harmful gases and the control unit takes action. Send commands to the automatic window mechanism (either a sliding window or a pivoting window) and adjust its position accordingly. For example, if CO₂ levels exceed acceptable limits, the system opens the windows to bring in fresh outside air and improve indoor air quality. Conversely, if a dangerous gas such as CO is detected, the window opens to promote gas circulation and ensure safety. Beyond safety and comfort, this system promotes energy efficiency. By opening windows only, when necessary, you

reduce reliance on mechanical ventilation and air conditioning, saving energy and contributing to sustainability goals. This intelligent and proactive approach to indoor space management not only represents a technological advancement, but also provides a comprehensive solution to optimize the quality of indoor spaces. This is especially true in today's world where health, comfort and sustainability are paramount.

1.2.1 Proposed System:

The planned automatic door opening and closing system, cleverly equipped with gas sensors, represents a significant advance in technology, the main purpose of which is to improve the safety and comfort of enclosed spaces. This sophisticated system is particularly suitable for use in environments where careful monitoring of gas levels is essential. These environments include a variety of areas such as laboratories, industrial facilities, and rooms with critical gas concentration control requirements. At the heart of this innovation is a gas sensor, an accurate and responsive device that monitors air quality. Its main function is to continuously measure oxygen levels in the environment and act as an ever-vigilant sentinel. When these values fall below predefined safety thresholds, the gas sensor instantly transmits this important information to the system's central control unit. The central control unit, often in the form of a microcontroller or building automation system, is the brain of this dynamic process. It quickly interprets the data received from the gas sensor and, based on this real-time analysis, issues a command to activate the automatic door opening/closing mechanism. Depending on the architectural requirements and the spatial conditions of the environment, these mechanisms can take the form of sliding or swinging doors. This strategic automation ensures the safety of those inside the room by automatically opening the door when oxygen levels become insufficient for human health. In addition to important security aspects, this system also promotes comfort as it eliminates the need for physical contact with the door. This feature is particularly useful in environments where hands-free access plays a critical role, such as laboratories and industrial facilities. In these environments, hands-free access can be a hygiene and safety measure due to the operation of equipment and materials. In conclusion, the proposed gas sensor automatic door opening and closing system is an innovative technological solution that provides an advanced way to control gas levels in enclosed spaces. Its

core principle is to carefully monitor oxygen levels through gas sensors and actuate the door opening mechanism accordingly, ensuring safety, comfort and efficient access control. This system proves that technology can be used to improve quality of life and safety in a variety of specialized environments.

1.3 SENSORS USED IN AUTOMATED WINDOW

Automated windows integrate a diverse array of sensors to effectively respond to changing environmental conditions and enhance the overall performance of the window system. Light sensors, for instance, measure the amount of natural light available and adjust window shading or tint to optimize daylighting, reducing the need for artificial lighting and conserving energy. Temperature sensors continuously monitor indoor and outdoor temperatures, enabling the windows to open or close as needed to maintain a comfortable interior climate while maximizing energy efficiency. Humidity sensors play a crucial role in preventing issues like condensation and mold growth by regulating ventilation in response to moisture levels. CO₂ sensors focus on indoor air quality, ensuring adequate ventilation and fresh air circulation by detecting elevated carbon dioxide levels. Motion sensors detect human presence within a room, allowing the windows to automatically open or close when occupants enter or leave, contributing to energy savings and security. Rain sensors are essential for protecting the interior from water damage, automatically closing the window when rain is detected. Wind sensors gauge wind speed and direction, and when strong winds are detected, they prompt the window to close to prevent damage or drafts. Gas sensors, including those for carbon monoxide (CO) and volatile organic compounds (VOCs), are crucial for safety and air quality control, taking action when harmful gases are detected. Smoke detectors integrated with automated windows enhance fire safety by facilitating smoke ventilation in case of a fire emergency. Finally, security sensors, such as intrusion detectors, can be linked to these windows to enhance overall building security, sounding alarms or alerting occupants to unauthorized entry attempts. In concert, these sensors enable automated windows to respond intelligently to environmental variables, improving energy efficiency, indoor comfort, safety, and security while seamlessly automating these adjustments to enhance the overall building experience.

CHAPTER 2

LITERATURE SURVEY

D. Bala Aditya et al, examines the Accident Detection and Alert System, which is an essential technology tool for quickly identifying and reporting accidents. It works by keeping an eye on people or cars using a combination of technology like sensors, cameras, and GPS systems. The system initiates an alert mechanism when an accident or emergency is identified, which may involve notifying emergency services, selected contacts, or even the affected individuals directly via channels including SMS, phone calls, or app alerts. Accident detection and alert systems help assure quick reactions in emergencies by seamlessly integrating various technologies and alarm mechanisms, potentially saving lives and cutting down on response times in urgent situations.[1]

Sayantani Bhattacharya et al, investigates the use of wireless sensor networks (WSNs) in the field of monitoring indoor air quality. It goes in-depth on the techniques and tools used to measure and keep track of several aspects of indoor air quality, including contaminants, temperature, humidity, and more. In order to improve indoor air quality management, the study addresses the benefits of using wireless sensor networks for real-time data gathering and analysis. It also looks at case studies and real-world uses of this technology, highlighting how important it is for creating healthier and safer indoor environments.[2]

Angana Das et al, focuses on the creation of a mechanism for automated power windows, such as those commonly found in vehicles or architectural settings. The term "five-bar linkage" refers to a specific mechanical design consisting of five rigid bars connected by pivot joints. In this context, it suggests that the project involves creating a mechanism with five interconnected bars to control the movement and positioning of the power window. The primary objective of this project is to develop an efficient and reliable system that can automate the operation of a power window. Instead of manually winding the window up or down, the automated system aims to provide a more convenient and user-friendly solution. It might involve the use of motors, sensors, and control logic to precisely regulate the window's movement.

The outcome of this project could have implications for various industries, particularly the automotive sector, where automated power windows are prevalent. Additionally, it may contribute to enhancing the overall user experience by making window operation more convenient and user-friendly. The specific details of the design, components used, and the technology employed would be outlined in the project documentation. If you require more specific information or have particular questions about this project, please feel free to provide additional details, and I can offer more targeted assistance.[3]

Neera Batra et al, explores an innovative system designed to automatically open car windows when carbon monoxide (CO) is detected in the vehicle. Carbon monoxide is a toxic gas that can pose significant health risks, especially when trapped in a closed environment like a car. The "Smart CO detect" system is engineered to enhance safety by continuously monitoring CO levels in the car's interior. If the CO concentration exceeds safe limits, the system triggers the automatic opening of the car windows to allow fresh air circulation and prevent CO buildup, thereby reducing potential health risks. This technology is especially crucial in scenarios where occupants may be unaware of CO exposure or unable to manually open the windows. The paper likely delves into the technical details of the system, including the types of sensors used for CO detection, the control logic for window operation, and the mechanisms for ensuring user safety. Additionally, it may discuss the implications and applications of such a system, such as in vehicles with internal combustion engines or potential use in other enclosed spaces.[4]

Minu A Pillai et al, explores the development and implementation of a smart sensor network that utilizes the Controller Area Network (CAN) communication protocol to monitor indoor air quality. This innovative system is designed to continuously collect data from various smart sensors strategically placed within indoor environments. These sensors measure critical air quality parameters such as temperature, humidity, carbon dioxide (CO₂) levels, volatile organic compounds (VOCs), and other pollutants. The key emphasis of this paper is likely on the application of CAN bus technology for efficient data exchange and communication among the smart sensors and a central control unit. The central control unit processes the incoming

data, performs real-time analysis, and can initiate responses or alerts when air quality deviates from predefined safe levels. The paper may delve into the technical aspects of the system, including the types of sensors employed, the CAN bus architecture, and the control algorithms for air quality management. The significance of this system lies in its potential to ensure safe and healthy indoor environments, especially in settings where air quality is a critical concern, such as smart buildings, industrial facilities, and healthcare environments. The CAN-based smart sensor network offers real-time monitoring and control, contributing to occupant health, safety, and energy efficiency.[5]

Gour Karmakar et al, offers a forward-looking approach to enhance smart homes by leveraging the power of the Internet of Things (IoT). The system described in this paper focuses on the dynamic control of both exterior and interior window coverings, making use of IoT devices and sensors to collect real-time data on environmental conditions and user preferences. By doing so, it optimizes natural light, privacy, and energy efficiency in residential spaces, ultimately contributing to energy savings and environmental sustainability. This innovative approach is not only about convenience but also about fostering eco-friendly living environments that respond intelligently to changing circumstances. The work by Gour Karmakar showcases the potential of IoT in reshaping our living spaces to be more adaptable, efficient, and environmentally conscious. The application of this technology to window coverings is a promising step toward creating smart homes that enhance user comfort, reduce energy consumption, and align with a broader goal of sustainability.[6]

Sheng-Hui Meng et al, focuses on the development of an intelligent control system for curtains using Arduino. This project likely explores the integration of Arduino microcontroller technology to enable dynamic and automated control of curtains in various settings, such as homes, offices, or smart buildings. The paper might delve into the technical details of the system, including the use of sensors, motors, and control logic to provide efficient and user-friendly curtain automation. The significance of this work lies in its potential to enhance convenience, energy efficiency, and user experience in different environments by automating the control

of curtains. It also aligns with the broader trend of integrating IoT and automation technologies into everyday life. If you have specific questions or need more information about this paper's content or applications, please feel free to provide additional details, and I'll be happy to assist you further.[7]

Nurfarah Diana Tan et al, introduces a forward-thinking mechatronic system that brings innovation to home and building automation. By harnessing the power of Light-Dependent Resistors (LDRs), this system offers an intelligent solution for automating window curtains in response to ambient light levels. The mechatronic design seamlessly integrates mechanical components, electronics, and LDR technology to create an automated curtain control system that dynamically manages natural light and privacy. This innovation not only enhances the user experience in homes and smart buildings but also promotes energy efficiency by ensuring curtains adjust automatically as light conditions change. Her work highlights the potential for mechatronics to play a crucial role in modern living environments, offering responsive and energy-efficient solutions. By enabling curtains to adapt to varying light levels, this system aligns with the broader trend of integrating smart technologies into architecture and interior design, ultimately contributing to user comfort and environmental sustainability.[8]

M. Sathish et al, introduces a novel system designed to enhance the automotive experience by leveraging the capabilities of sensors. The project canters on oxygen and sound sensors that continuously monitor the car's interior environment. When the system detects changes in oxygen levels or external noise, it automatically adjusts the car's window openings. This feature is designed to improve passenger safety and comfort, responding to factors like air quality during traffic congestion or external noise, creating a more serene and enjoyable in-car experience. The project exemplifies the integration of sensors and automation technologies in vehicles, ultimately enhancing the overall driving experience and well-being of passengers. This seeks to employ innovative solutions to improve the quality of life for drivers and passengers. By using oxygen and sound sensors to inform window control, this project contributes to the broader trend of creating intelligent and responsive automotive systems that prioritize safety and passenger comfort.[9]

Waheb A. Jabbar et al, represents a significant step forward in the realm of smart home technology. By ingeniously combining the power of the Internet of Things (IoT) with fabrication and design expertise, this project aims to create an intelligent and responsive living space. At its core, the project involves integrating a multitude of IoT devices and sensors to enable the automation and control of various aspects of the home environment. This project's significance lies in its potential to revolutionize conventional homes, ushering in a new era of efficiency, security, and user convenience. IoT technology enables the smart home to be not just a collection of automated devices but a cohesive system that optimizes energy consumption, enhances security through smart locks and cameras, and offers user-friendly control through smartphone applications or central hubs. The ultimate outcome is an elevated quality of life for residents, where their homes adapt to their preferences and needs, leading to substantial energy savings and bolstered security. It showcases how IoT technology can be harnessed to bring about a holistic transformation, turning residences into intelligent, efficient, and secure environments that cater to the diverse needs and desires of their inhabitants.[10]

CHAPTER 3

AIM AND SCOPE

Our overall goal revolves around the development and seamless implementation of advanced automatic window opening and closing systems controlled by real-time gas level monitoring in a variety of environments. This innovative system is designed with versatility for application in a wide range of environments including automobiles, hotels, educational institutions, hospitals, and homes. In the automotive sector, the system autonomously adjusts window openings according to fluctuating gas levels, promoting fresh air circulation and reducing potential health risks from air pollutants. It serves as a pioneer in improving passenger safety and comfort. In the hospitality industry, technology has proven to be a catalyst for increasing energy efficiency and guest satisfaction. It works by adjusting indoor ventilation to gas concentrations, ensuring a harmonious indoor environment that promotes both comfort and health. In the educational field, especially in schools and universities, this system helps maintain safe gas levels during laboratory experiments, optimize conditions for scientific investigations, and promote a safe learning environment. Even in critical areas of healthcare, such as hospitals, this system plays an important role in maintaining the cleanliness and safety of the air in patient rooms and healthcare facilities, thereby ensuring the maintenance of the highest standards of healthcare. Furthermore, this technology is expected to expand its scope of application to living spaces, improving indoor air quality and comfort in homes and apartment complexes. At the same time, it also contributes to reducing energy consumption and is compatible with today's aspirations for sustainable and environmentally friendly living. By adapting to different environments, our automatic window opening and closing systems comprehensively aim to improve air quality, safety, energy efficiency, and improve living and working conditions in different scenarios. In this way, we aim to highlight that technology can have a significant impact on improving the quality of life in an ever-evolving world.

3.1 SCOPE OF THIS TECHNOLOGY

The future application fields of automatic window opening and closing systems based on gas level monitoring are promising and diverse. As society increasingly focuses on indoor air quality, energy efficiency, and automation, this technology is poised to play an important role in a variety of sectors.

First, demand for systems related to smart homes and smart buildings is expected to surge. As IoT devices and home automation become more prevalent, integrating gas-based window automation into these ecosystems provides homeowners and building managers with an effective tool to ensure optimal indoor air quality. provided. This technology works seamlessly with other smart devices such as thermostats, air purifiers, and Heater Ventilator Air Conditioning (HVAC) systems to provide a holistic approach to indoor climate control. Additionally, selectively opening windows when outdoor conditions are favorable reduces reliance on mechanical ventilation and air conditioning, contributing to energy savings.

Future applications of technology are important in the medical field, where patient safety and infection control are paramount. Hospitals and healthcare facilities can implement gas level monitoring to ensure clean and safe air in patient rooms, operating rooms, and laboratories. Advanced sensors and automation systems respond quickly to gas leaks and contamination, reducing the risk of healthcare-associated infections and ensuring the health of patients and staff. As healthcare continues to evolve, this technology is becoming an integral part of facility management and patient care. The automotive industry is also a promising area for this technology. As electric vehicles and autonomous driving become more popular, passenger comfort and health become increasingly important. Gas level monitoring increases vehicle safety by automatically adjusting windows and ventilation systems based on gas concentrations, ensuring a healthy and comfortable ride. Additionally, optimizing vehicle interior temperatures through intelligent window management can contribute to battery efficiency in electric vehicles.

The future of this technology is bright in industrial and laboratory settings, especially those involving hazardous or sensitive gases. Labs, chemical plants, and manufacturing plants can leverage advanced gas monitoring and window automation to create a safer working environment. This technology can be

integrated with existing security protocols and alarm systems to reduce risk, protect workers, and improve overall operational efficiency.

Finally, it is important to incorporate this technology into environmental monitoring efforts. It can be used in outdoor environments to measure air quality in urban areas, industrial areas, and areas prone to environmental hazards. This data can be used for urban planning, environmental management, and disaster preparedness, ultimately contributing to improved public health and environmental sustainability. In summary, the future applicability of automatic window opening and closing systems based on gas level monitoring is wide-ranging and adaptable to different industries. With continued advances in sensor technology, IoT integration, and the growing importance of indoor air quality and energy efficiency, this technology is poised to play a key role in creating a safer, healthier, and more sustainable living and working environments.

CHAPTER 4

MATERIALS AND METHODOLOGY

4.1 METHODOLOGY:

4.1.1 *Sensor Selection and Setup:*

The thorough selection of suitable gas sensors was part of our project's initial phase. Based on the gases we wanted to identify, we selected particular gas sensors, such as MQ2 for gases like methane and butane. To assure their precision and sensitivity, these sensors underwent careful calibration. They were then included in the structure of our project.

4.1.2 *Hardware Integration:*

The automatic window-opening mechanism easily integrated the gas sensors. To do this, we linked the gas sensors to an Arduino-compatible microcontroller unit (MCU), which would act as the system's central processing unit. The MCU has been designed to read data from the sensors and, based on the sensor readings, to carry out predetermined control logic.

4.1.3 *Programming:*

A critical component of the project is writing the software. During the programming stage, code is created to interact with gas sensors, process data, and operate the window mechanism. The logic for monitoring gas levels must be established, as must the threshold values that cause window actions.

4.1.4 *Control Logic:*

To implement the system's control logic, we programmed the MCU. The logic was created to keep track of gas concentrations and to turn on the window-opening mechanism when such concentrations went above certain safety limits. It was essential for the windows to open automatically in order to maintain a secure and healthy inside atmosphere.

4.1.5 Testing and Validation:

An extensive testing and validation process was used to evaluate the system's performance. To test the system's responsiveness and dependability, we subjected it to a range of gas concentrations and environmental factors. In order to make sure the system worked precisely and consistently; testing was crucial.

Each of these processes is essential to the creation and effective use of an automatic window system using gas sensors, ensuring that it achieves varied environments' goals for energy economy, comfort, and safety.

4.2 HARDWARE COMPONENTS

4.2.1 Gas Sensors:

Gas sensors are a central component of automatic window opening and closing systems, serving as a warning monitor and operating continuously and systematically to assess gas concentrations in the environment. Their selection and integration are critical to the success of these systems, as they are responsible for ensuring the safety, comfort, and air quality of confined spaces. The choice of gas sensor type is determined by the requirements of the specific application. Two common options are available: galvanic cell sensors and optical sensors. Galvanic sensors are known for their robustness and ability to detect a variety of gases, including potentially dangerous gases such as carbon monoxide and hydrogen sulfide. These sensors rely on electrochemical reactions, ensuring long-term accuracy and durability. The ability to detect a wide range of gases makes it essential in environments where control of gas concentrations is paramount, such as: B. Laboratory or industrial plant. Conversely, optical sensors offer a different approach to gas detection. They work on the principle of light absorption or emission and can quickly and accurately identify gases such as carbon dioxide and volatile organic compounds. The speed and accuracy of optical sensors makes them particularly suitable for environments where real-time monitoring and immediate action are essential, such as smart buildings, hotels, and energy-efficient homes. Purposeful selection of these sophisticated gas sensor types serves two purposes in automatic window systems. First and foremost, it ensures accurate monitoring

and detection of gases, promoting indoor air quality and occupant safety. Second, it allows for adaptability, allowing the system to respond to a wide range of environmental monitoring needs. This adaptability is a testament to the versatility and intelligence of modern automated window systems, effectively addressing the unique needs of a variety of applications and ultimately creating safer, more comfortable and energy-efficient interiors.

4.2.1.1 MQ2:

The gas sensor module (Fig:4.1) is the central component of the gas detection system and is based on the principles of metal oxide semiconductor technology (MOS). This sensor is specifically designed to detect a variety of potentially hazardous gases, including but not limited to methane, butane, LPG (liquefied petroleum gas), smoke, etc. Its working mechanism relies on changes in electrical conductivity when exposed to these gases, resulting in measurable resistance fluctuations that can be interpreted as gas concentration levels. This versatile sensor module serves as a key advantage in a variety of applications such as workplace safety, home gas leak detection, and air quality monitoring. It provides real-time information on the presence and concentration of these gases, promoting safety, environmental awareness, etc., and facilitating efficient gas management in various environments.



Fig:4.1: MQ2 Gas sensor

4.2.1.2 MQ3:

The MQ3 gas sensor module (Fig:4.2) is very useful in the field of gas detection and has applications in both domestic and industrial environments, especially in the critical task of gas leak detection. The sensor can detect a wide range of

gases, including alcohol, benzene, CH₄ (methane), hexane, LPG (liquefied petroleum gas), and CO (carbon monoxide), making it useful for addressing a variety of safety and environmental concerns. It's extremely versatile. Its effectiveness lies in its outstanding sensitivity and fast response time, characteristics that allow it to measure gas concentrations quickly and accurately. Whether in the personal home to prevent potentially harmful gas leaks or in industrial settings to ensure workplace safety and compliance, the Gas Sensor Module (MQ3) is a reliable solution for proactive gas monitoring, improving safety protocols, and has proven invaluable in facilitating timely interventions to reduce associations risk.



Fig:4.2: MQ3 Gas sensor

4.2.1.3 MQ5:

The MQ5 Gas Sensor Module (Fig:4.3) is an invaluable tool in the field of gas detection, offering important applications in both domestic and industrial environments, especially in the important task of detecting *gas* leaks. This versatile sensor can identify a variety of gases including H₂ (hydrogen), LPG (liquefied petroleum gas), CH₄ (methane), CO (carbon monoxide), and alcohol. Its adaptability and sensitivity make it a reliable choice to address a variety of safety and environmental concerns related to gas detection. Whether you're protecting against potentially dangerous gas leaks in your home or maintaining workplace safety and regulatory compliance in an industrial setting, the Gas Sensor Module (MQ5) provides proactive gas monitoring, enhancing safety measures., serves as an essential tool to effectively facilitate timely gas-related interventions to reduce risk.



Fig:4.3: MQ5 Gas sensor

4.2.2 Arduino UNO:

Within the automatic window system, the Arduino microcontroller unit (Fig:4.4) plays a central role, acting as the cognitive center of the system. It handles the important task of collecting and processing the data emitted by the oxygen sensor and coordinates the operation of the door opening/closing mechanism. Essentially, the Arduino MCU acts as the brain of the system, expertly executing predefined logic and commands that are tightly integrated into the system's programming. These commands are carefully designed to respond to real-time sensor readings and precisely open and close windows as needed to maintain optimal indoor air quality and safety conditions. Therefore, the processing power and adaptability of the Arduino MCU is at the heart of this automation system, which can work seamlessly when interpreting and responding to sensor data, creating a harmonious balance of comfort.



Fig:4.4: Arduino UNO

4.2.3 **Actuators:**

In the field of automatic window systems, actuators (Fig:4.5) play a central role as the physical forces responsible for the mechanical movement when opening and closing doors. These actuators are typically driven by electric motors or pneumatic cylinders and are carefully selected for their ability to perform precise and controlled movements. Importantly, their operation is coordinated by an Arduino microcontroller unit (MCU), which acts as the central intelligence of the system. The MCU converts sensor data and predefined logic into executable commands and signals the actuators to operate the door as needed to achieve optimal indoor climate conditions. This seamless synergy between the MCU and actuators embodies the core mechanism of automatic window systems, effectively translating digital intelligence into physical motion so that windows react dynamically and precisely to changing conditions. This ultimately improves indoor comfort and safety.



Fig:4.5: Stepper motor (Actuator)

4.2.4 **Power Supply:**

The system derives its operation from a reliable power source (usually AC power) to ensure consistent and uninterrupted functionality. This primary energy source provides the system with the energy it needs to efficiently maintain normal operation. Installing a backup battery system is a wise and proactive measure in case of power outages or unexpected disruptions. This auxiliary power solution ensures continuous operation of the system, working seamlessly even if the main AC power fails, and ensuring uninterrupted functionality during power outages. This power redundancy not only ensures system reliability but also emphasizes the system (Fig:4.6).

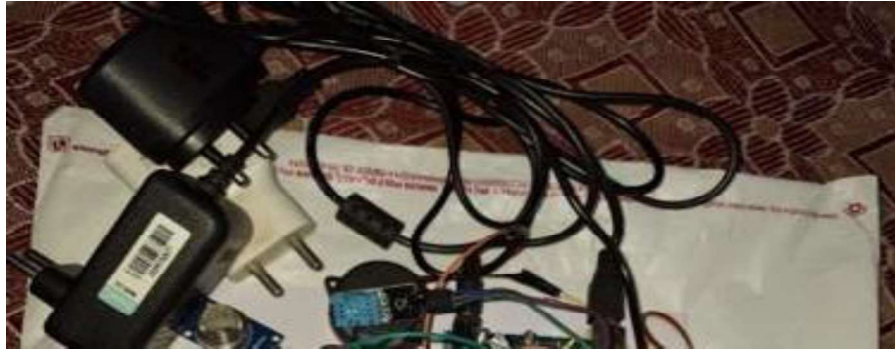


Fig:4.6: Power supply

4.2.5 User Interface:

The user interface (Fig:4.7) represents an interactive gateway between the automatic window system and its users, providing important information in real time. This interface is often designed with ease of use in mind and may include items such as an LCD display for detailed oxygen level readings and an LED indicator for at-a-glance system status updates. there is. This interface gives users instant access to important indoor oxygen level data, providing valuable insights into air quality. Additionally, system status information such as operating modes, alerts, and notifications is easier to understand. This user-friendly design promotes transparency, allowing users to make informed decisions and quickly respond to changes or abnormalities in oxygen levels, ensuring a safe and comfortable indoor.

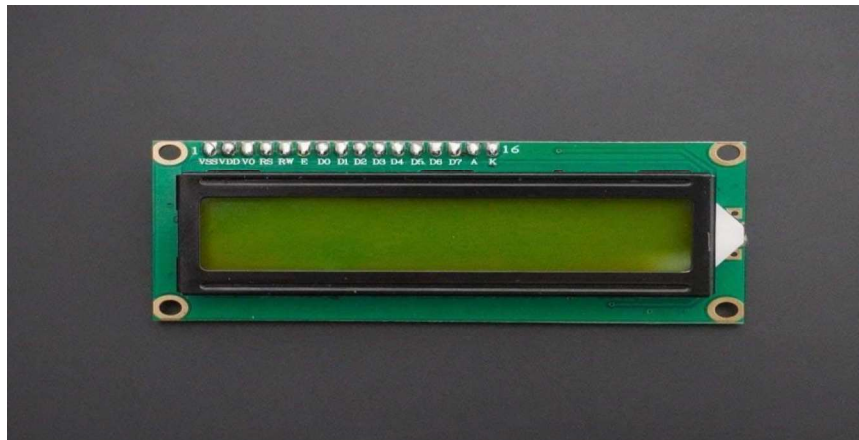


Fig:4.7: LCD Display

4.2.6 Window Mechanism:

The choice of window mechanism represents an important decision within an automation system, offering the flexibility to choose between automatic sliding or pivoting windows, based on individual needs and the characteristics of each environment. Featuring horizontal movement along a track, automatic sliding windows offer an elegant and space-saving solution, perfect for environments where space is at a premium or a modern aesthetic is desired. On the other hand, single-hinged, inward- or outward-swivel pivot windows are a more traditional and visually striking option that may be preferred for their simplicity and suitability in environments where full ventilation and accessibility are essential. It happens often. The flexibility to choose between these two window mechanisms ensures that the automation system precisely adapts to the spatial, functional, and design requirements of the environment it serves, and the overall architecture of the system. and optimized solutions that are seamlessly integrated into functional aspects.

4.2.7 DHT- 11(Temperature Sensor):

DHT-11 (Fig:4.8) sensor in automated window systems offers a data-driven approach to environmental control. By interfacing the sensor with microcontrollers or programmable logic controllers (PLCs), engineers can implement sophisticated algorithms to analyze temperature and humidity data.

This

enables the development of smart window systems that dynamically respond to environmental changes.

For instance, using feedback from the DHT11, the system could autonomously adjust window positions through actuators or motorized mechanisms, optimizing energy efficiency and maintaining desired indoor conditions. This engineering approach combines sensor technology with automation to create responsive and energy-conscious systems

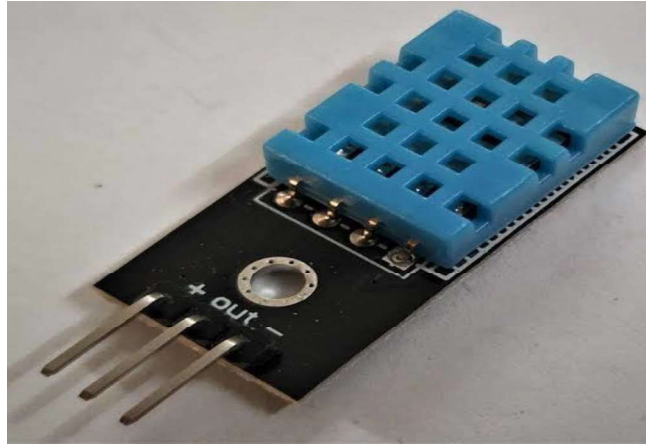


Fig:4.8: DHT- 11 (Temperature sensor)

4.2.8 Flame Sensor:

Flame sensor (Fig:4.9) into automated window systems adds a crucial layer of safety and fire detection. By integrating the flame sensor with a microcontroller or a programmable logic controller (PLC), the system gains the capability to respond dynamically to the presence of flames. In the event of a fire, the flame sensor triggers the automated windows to open, aiding in smoke ventilation and facilitating a quicker response to emergency situations. This application not only enhances safety measures within buildings but also underscores the adaptability of automated window systems to diverse environmental conditions. The integration of a flame sensor aligns with the overarching goal of creating intelligent and responsive building systems that prioritize occupant safety and well-being.

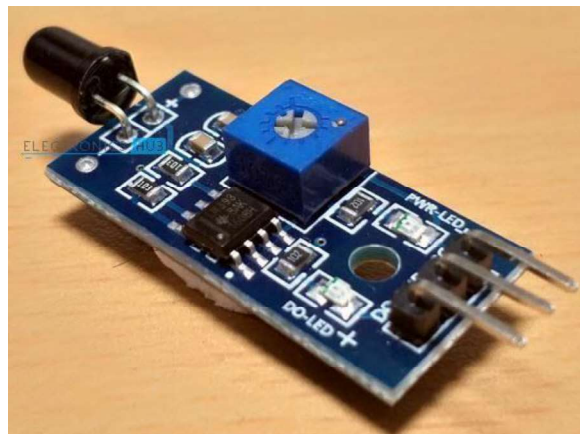


Fig:4.9: Flame sensor

4.2.9 **ESP8266(Wi-Fi Module):**

In an automated window system, the ESP8266 (Fig:4.10), a versatile Wi-Fi module, serves as a pivotal component, enabling seamless connectivity and control. Interfacing the ESP8266 with microcontrollers allows for the creation of intelligent and remotely accessible window systems. Through IoT (Internet of Things) integration, users can remotely monitor and manipulate window operations based on environmental conditions or preferences.

This system can autonomously adjust window positions for optimal ventilation or respond to external factors such as weather conditions. The ESP8266's capability to connect to Wi-Fi networks enhances the system's flexibility, providing a scalable solution for smart window automation that aligns with the broader trend of IoT-driven advancements in building automation and connectivity.

Overall, the ESP8266 plays a crucial role in driving the evolution of smart window automation, enabling intelligent control and monitoring capabilities that enhance comfort, energy efficiency, and overall user experience. As IoT continues to reshape the landscape of building automation, the integration of technologies like the ESP8266 opens up new opportunities for innovation and advancement in smart home and building solutions.

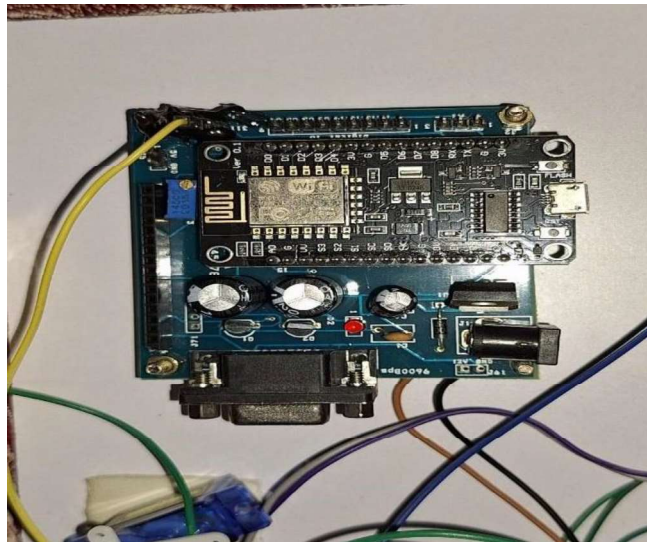


Fig:4.10: ESP8266(Wi-Fi Module)

4.2.10 GSM (Global System for Mobile Communications):

In an automated window system, the integration of Global System for Mobile Communications (Fig:4.11) technology provides a sophisticated layer of remote control and monitoring capabilities. By incorporating GSM modules into the system, we can enable communication between the automated windows and a central control unit. This allows users to remotely operate and monitor the windows through mobile devices or web interfaces.

Additionally, GSM integration facilitates real-time status updates and notifications, enabling users to receive alerts about window positions, security features, or environmental conditions. This technology not only enhances the user experience by providing convenient remote control but also contributes to increased security, energy efficiency, and overall smart functionality within the automated window system

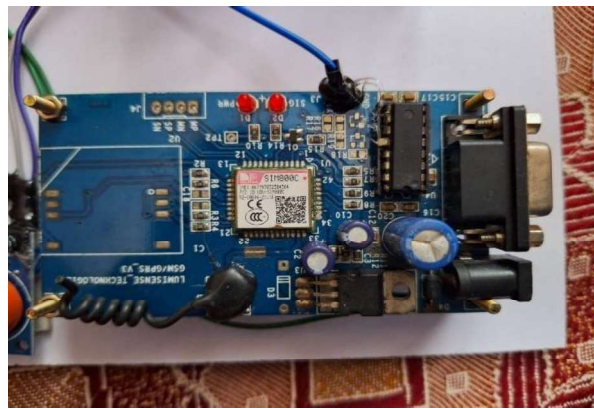


Fig:4.11: Global System for Mobile Communication

4.3 SOFTWARE COMPONENT:

4.3.1 Arduino IDE:

The Arduino IDE (Integrated Development Environment) is a versatile and user-friendly software platform that plays a central role in the world of microcontroller-based development. It is specifically tailored to simplify the process of programming and developing projects using Arduino microcontroller boards. Arduino IDE's hallmark is its accessibility, making it an excellent choice for both beginners and experienced developers. This open-source software offers a wide range of features that contribute to widespread adoption and success. The Arduino IDE interface is known for its simplicity and ease of use.

This is an important feature that will appeal to both beginners and experienced developers. Provides an easy environment to write, compile, and upload code to an Arduino board. An easy-to-understand interface streamlines the development process, allowing users to focus on their projects instead of getting lost in complex software. Arduino IDE is compatible with multiple operating systems such as Windows, macOS, and Linux, allowing users to access it regardless of their preferred platform. Cross-platform compatibility allows the IDE to be used in a variety of computing environments, increasing its versatility. This flexibility is especially important in the diverse and dynamic world of embedded systems and microcontroller programming. The IDE uses a variant of the C/C++ programming language. A user writes code in her Arduino IDE, and the software converts the code into machine-readable instructions for the microcontroller and compiles it. This abstraction simplifies the coding process and makes it more accessible to those with limited programming experience. The Arduino IDE also has an extensive library of built-in functions and libraries. These resources simplify common tasks and operations and cover a wide range of functionality, from operating sensors and controlling displays to handling communication modules. The availability of these libraries accelerates project development and reduces the need for users to reinvent the wheel when implementing common functionality. The IDE provides several useful features that improve the coding and debugging process. For example, it provides automatic code completion and syntax highlighting, which streamlines code creation and reduces the chance of errors. Additionally, the Arduino IDE includes built-in tools for reviewing and uploading code to the Arduino board, as well as a serial monitor for debugging and viewing program output. The Arduino IDE benefits from a large and active community of users and developers. an extensive library of built-in functions and libraries. These resources simplify common tasks and operations and cover a wide range of functionality, from operating sensors and controlling displays to handling communication modules. The availability of these libraries accelerates project development and reduces the need for users to reinvent the wheel when implementing common functionality.

These resources simplify common tasks and operations and cover a wide range of functionality, from operating sensors and controlling displays to handling communication modules. The availability of these libraries accelerates project development and reduces the need for users to reinvent the wheel when implementing common functionality. The IDE provides several useful features that improve the coding and debugging process. For example, it provides automatic code completion and syntax highlighting, which streamlines code creation and reduces the chance of errors. Additionally, the Arduino IDE includes built-in tools for reviewing and uploading code to the Arduino board, as well as a serial monitor for debugging and viewing program output. The Arduino IDE benefits from a large and active community of users and developers. This community support is a huge benefit for anyone using the platform, especially beginners. We provide extensive documentation, tutorials, forums, and plenty of examples. Users can find help, share knowledge, and participate in discussions about projects, problems, and innovative solutions.

The extensibility of the Arduino IDE is another feature that increases its versatility. Users can extend the functionality of the IDE by integrating additional libraries and hardware add-ons called "shields." This adaptability allows for a wide range of applications and customization depending on specific project requirements. The flexibility to extend the functionality of the IDE fosters an environment of innovation and creativity among developers. Finally, the Arduino IDE is open-source software based on the principles of the Arduino ecosystem. The open-source approach isn't just limited to software. This also extends to the hardware design of the Arduino board. This openness fosters collaboration and exchange of knowledge and ideas between developers and manufacturers. In summary, the Arduino IDE is an easy-to-use cross-platform software environment that simplifies microcontroller-based project development. It offers an easy programming language, comprehensive function library, active user community, and extensibility. These features contribute to its popularity and make it a valuable tool for those in the manufacturing and electronics industries. Whether you're a beginner looking to start your journey into microcontroller programming or an experienced developer looking for a versatile platform, the Arduino IDE is a versatile and accessible choice.

4.4 Block Diagram:

All components are interconnected to the Arduino UNO microcontroller board (Fig:4.12) to create a comprehensive sensor and actuator system. Gas sensors including the MQ2, MQ3, and MQ5 are interfaced via analog pins to detect various gases. The stepper motor, serving as an actuator, is controlled through digital pins for precise movements. A power supply unit provides the necessary power to all components. An LCD display is linked to digital pins for real-time data visualization. The DHT-11 temperature sensor is integrated into the system for temperature monitoring. Additionally, a flame sensor is connected to digital pins for fire detection. The ESP8266 Wi-Fi module enables wireless communication, facilitating remote monitoring and control. The inclusion of the Global System for Mobile communication suggests further connectivity options, enhancing the system's versatility and potential applications.

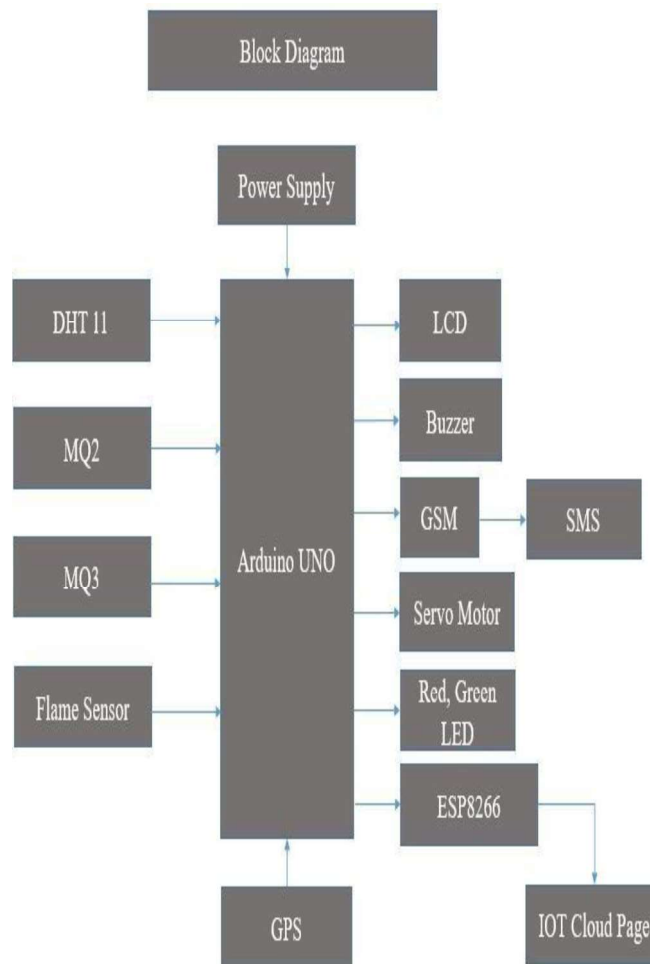


Fig:4.12: Block Diagram

4.5 Software:

```
#include <Servo.h>
#include <string.h>
#include <ctype.h>
// include the library code:
#include <LiquidCrystal.h>

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);
#include <SoftwareSerial.h>
SoftwareSerial mySerial2(6,7); // RX,

#include <Adafruit_Sensor.h>
#include <DHT.h>
#include <DHT_U.h>

#define DHTPIN A0      // Pin which is connected to the DHT sensor.

// Uncomment the type of sensor in use:
#define DHTTYPE        DHT11   // DHT 11
// #define DHTTYPE        DHT22   // DHT 22 (AM2302)
// #define DHTTYPE        DHT21   // DHT 21 (AM2301)

// See guide for details on sensor wiring and usage:
//  https://learn.adafruit.com/dht/overview

DHT_Unified dht(DHTPIN, DHTTYPE);

uint32_t delayMS;

char fy=0;

int buttonState = 0;      // variable for reading the pushbutton status
```

```

// These constants won't change. They're used to give names
// to the pins used:
const int analogInPine = A0; // Analog input pin that the potentiometer is attached to
const int analogInPinb = A1; // Analog input pin that the potentiometer is attached to

int sensorPin = A5; // select the input pin for the potentiometer
int sensorValue = 0; // variable to store the value coming from the sensor
int sensorValue1 = 0; // variable to store the value coming from the sensor
int sensorValue2 = 0; // variable to store the value coming from the sensor
int sensorValue3 = 0; // variable to store the value coming from the sensor
int sensorValue4 = 0; // variable to store the value coming from the sensorValue
int sensorValue5 = 0; // variable to store the value coming from the sensor

int count=0,f1;
int count1;
int f1,f2,f3,f4;
int oc,oc1;
int x;
char linea[3] = "";
char lat[30] = "";
char lon[30] = "";
char inChar;
int i;

float latff,lonff;

Servo myservo; // create servo object to control a servo
// twelve servo objects can be created on most boards

int pos = 0; // variable to store the servo position

void setup() {

```

// initialize serial communications at 9600 bps:

myservo.attach(5);

Serial.begin(9600);

mySerial2.begin(9600);

lcd.begin(16, 2);

dht.begin();

sensor_t sensor;

dht.temperature().getSensor(&sensor);

dht.humidity().getSensor(&sensor);

delayMS = sensor.min_delay / 1000;

myservo.write(180);

lat[0]='.';

lat[1]='.';

lat[2]='.';

lat[3]='.';

lat[4]='.';

lat[5]='.';

lat[6]='.';

lat[7]='.';

lat[8]='.';

lon[0]='.';

lon[1]='.';

lon[2]='.';

lon[3]='.';

lon[4]='.';

lon[5]='.';

lon[6]='.';

lon[7]='.';

lon[8]='.';

```
mySerial2.print("AT");  
mySerial2.write(13);  
mySerial2.write(10);  
delay(1000);  
mySerial2.print("AT+CMGF=1");  
mySerial2.write(13);  
mySerial2.write(10);  
delay(1000);
```

```
pinMode (2,OUTPUT);//attach pin 2 to vcc  
pinMode (3,INPUT);//attach pin 5 to GND  
pinMode (4,OUTPUT);//attach pin 2 to vcc  
pinMode (5,INPUT);//attach pin 5 to GND
```

```
pinMode (7,OUTPUT);//attach pin 2 to vcc  
pinMode (6,INPUT);//attach pin 5 to GND
```

```
digitalWrite(2,1);  
digitalWrite(3,0);  
digitalWrite(4,0);
```

```
}  
char rval,rc;  
String latss;
```

```
long duration1,duration2,duration3, inches, cm;  
float distance1,distance2;
```

```

void loop() {
  // read the analog in value:
  delay(delayMS);
  // Get temperature event and print its value.
  sensors_event_t event;
  dht.temperature().getEvent(&event);
  sensorValue1=event.temperature;

  lcd.setCursor(0,0);
  lcd.print("T=");
  lcd.print(sensorValue1);
  lcd.print(" ");

  dht.humidity().getEvent(&event);
  sensorValue2=event.relative_humidity;
  sensorValue2=sensorValue1*2-10;
  lcd.setCursor(5,0);
  lcd.print("H");
  lcd.print(sensorValue1*2-10);
  lcd.print(" ");

  sensorValue3=analogRead(A1)/2;
  lcd.setCursor(9,0);
  lcd.print("MQ2=");
  lcd.write(((sensorValue3/100)+0x30);
  lcd.write((((sensorValue3%100)/10)+0x30);
  lcd.write((sensorValue3%10)+0x30);

  sensorValue4=analogRead(A2)/2;
  lcd.setCursor(0,1);
  lcd.print("MQ3=");
  lcd.write(((sensorValue4/100)+0x30);
  lcd.write((((sensorValue4%100)/10)+0x30);
  lcd.write((sensorValue4%10)+0x30);

```

```

sensorValue5=analogRead(A3)/2;
sensorValue5=512-analogRead(A3)/2;
lcd.setCursor(8, 1);
lcd.print("F");
lcd.write((sensorValue5/100)+0x30);
lcd.write(((sensorValue5%100)/10)+0x30);
lcd.write((sensorValue5%10)+0x30);

if(sensorValue1>40)
{

if(f1==0)
{
f1=1;
digitalWrite(2,0);
digitalWrite(3,1);
digitalWrite(4,1);
lcd.setCursor(13,1);
lcd.print("Alert      ");

myservo.write(0);
mySerial2.print("AT");
mySerial2.write(13);
mySerial2.write(10);    delay(1000);
mySerial2.print("AT+CMGS=");           // send sms to corresponding numner
mySerial2.write(34);
mySerial2.print("9840118605");
mySerial2.write(34);
mySerial2.write(13);
mySerial2.write(10);
delay(1000);
mySerial2.print("TEMP:"+String(sensorValue1));

```

```

mySerial2.print("_Alert");
mySerial2.write(13);
mySerial2.write(10);
mySerial2.print("https://www.google.com/maps/place/");
latss=String(latff,3);
mySerial2.print(latss);
mySerial2.print("+");
latss=String(lonff,3);
mySerial2.print(latss);
mySerial2.write(13);
mySerial2.write(10);
mySerial2.write(26);

```

```

Serial.print("**Temperature_Alert:");
Serial.write((sensorValue1/100)+0x30);
Serial.write(((sensorValue1%100)/10)+0x30);
Serial.write((sensorValue1%10)+0x30);
Serial.print(" ");
Serial.print(lat[0]);
Serial.print(lat[1]);
Serial.print(lat[2]);
Serial.print(lat[3]);
Serial.print(lat[4]);
Serial.print(lat[5]);
Serial.print(lat[6]);
Serial.print(lat[7]);
Serial.print(" ");
Serial.print(lon[0]);
Serial.print(lon[1]);
Serial.print(lon[2]);
Serial.print(lon[3]);
Serial.print(lon[4]);
Serial.print(lon[5]);
Serial.print(lon[6]);

```

```

Serial.print(lon[7]);
Serial.print('#');

lcd.setCursor(13,1);
lcd.print("      ");
digitalWrite(2,1);
digitalWrite(3,0);
digitalWrite(4,0);
myservo.write(180);
}
delay(2000);
}
else
{

f1=0;
}

if(sensorValue3>150)
{

if(f2==0)
{
f2=1;
digitalWrite(2,0);
digitalWrite(3,1);
digitalWrite(4,1);
lcd.setCursor(13,1);
lcd.print("Alert      ");
mySerial2.print("AT");
myservo.write(0);
mySerial2.write(13);
mySerial2.write(10);    delay(1000);
mySerial2.print("AT+CMGS=");    // send sms to corresponding numner

```

```

mySerial2.write(34);
mySerial2.print("9840118605");
mySerial2.write(34);
mySerial2.write(13);
mySerial2.write(10);
delay(1000);
mySerial2.print("MQ2:"+String(sensorValue3));
mySerial2.print("_Alert");
mySerial2.write(13);
mySerial2.write(10);
mySerial2.print("https://www.google.com/maps/place/");
latss=String(latff,3);
mySerial2.print(latss);
mySerial2.print("+");
latss=String(lonff,3);
mySerial2.print(latss);
mySerial2.write(13);
mySerial2.write(10);
mySerial2.write(26);

```

```

Serial.print("*MQ3_Alert:");
Serial.write((sensorValue3/100)+0x30);
Serial.write(((sensorValue3%100)/10)+0x30);
Serial.write((sensorValue3%10)+0x30);
Serial.print("_");
Serial.print(lat[0]);
Serial.print(lat[1]);
Serial.print(lat[2]);
Serial.print(lat[3]);
Serial.print(lat[4]);
Serial.print(lat[5]);
Serial.print(lat[6]);
Serial.print(lat[7]);
Serial.print("_");

```

```

Serial.print(lon[0]);
Serial.print(lon[1]);
Serial.print(lon[2]);
Serial.print(lon[3]);
Serial.print(lon[4]);
Serial.print(lon[5]);
Serial.print(lon[6]);
Serial.print(lon[7]);
Serial.print('#');

lcd.setCursor(13,1);
lcd.print("      ");
digitalWrite(2,1);
digitalWrite(3,0);
digitalWrite(4,0);
myservo.write(180);
}
delay(2000);
}
else
{

f2=0;
}
if(sensorValue4>160)
{

if(f3==0)
{
f3=1;
digitalWrite(2,0);
digitalWrite(3,1);
digitalWrite(4,1);
lcd.setCursor(13,1);

```

```

lcd.print("Alert      ");
myservo.write(0);
mySerial2.print("AT");
mySerial2.write(13);
mySerial2.write(10);    delay(1000);
mySerial2.print("AT+CMGS=");          // send sms to corresponding numner
mySerial2.write(34);
mySerial2.print("9840118605");
mySerial2.write(34);
mySerial2.write(13);
mySerial2.write(10);
delay(1000);
mySerial2.print("MQ3:"+String(sensorValue4));
mySerial2.print("_Alert");
mySerial2.write(13);
mySerial2.write(10);
mySerial2.print("https://www.google.com/maps/place/");
latss=String(latff,3);
mySerial2.print(latss);
mySerial2.print("+");
latss=String(lonff,3);
mySerial2.print(latss);
mySerial2.write(13);
mySerial2.write(10);
mySerial2.write(26);

Serial.print("*MQ3_Alert:");
Serial.write((sensorValue4/100)+0x30);
Serial.write((((sensorValue4%100)/10)+0x30);
Serial.write((sensorValue4%10)+0x30);
Serial.print(" _ ");
Serial.print(lat[0]);
Serial.print(lat[1]);
Serial.print(lat[2]);

```

```

Serial.print(lat[3]);
Serial.print(lat[4]);
Serial.print(lat[5]);
Serial.print(lat[6]);
Serial.print(lat[7]);
Serial.print(" _ ");
Serial.print(lon[0]);
Serial.print(lon[1]);
Serial.print(lon[2]);
Serial.print(lon[3]);
Serial.print(lon[4]);
Serial.print(lon[5]);
Serial.print(lon[6]);
Serial.print(lon[7]);
Serial.print('#');

lcd.setCursor(13,1);
lcd.print("      ");
digitalWrite(2,1);
digitalWrite(3,0);
digitalWrite(4,0);
myservo.write(180);
}

}
else
{

f3=0;
}
if(sensorValue5>40)
{

if(f4==0)

```

```

{
f4=1;
digitalWrite(2,0);
digitalWrite(3,1);
digitalWrite(4,1);
lcd.setCursor(13,1);
lcd.print("Alert      ");
myservo.write(0);
mySerial2.print("AT");
mySerial2.write(13);
mySerial2.write(10);    delay(1000);
mySerial2.print("AT+CMGS=");           // send sms to corresponding numner
mySerial2.write(34);
mySerial2.print("9840118605");
mySerial2.write(34);
mySerial2.write(13);
mySerial2.write(10);
delay(1000);
mySerial2.print("Fire:"+String(sensorValue5));
mySerial2.print("_Alert");
mySerial2.write(13);
mySerial2.write(10);
mySerial2.print("https://www.google.com/maps/place/");
latss=String(latff,3);
mySerial2.print(latss);
mySerial2.print("+");
latss=String(lonff,3);
mySerial2.print(latss);
mySerial2.write(13);
mySerial2.write(10);
mySerial2.write(26);

```

```

Serial.print("*Fire_Alert:");
Serial.write((sensorValue5/100)+0x30);
Serial.write(((sensorValue5%100)/10)+0x30);
Serial.write((sensorValue5%10)+0x30);
Serial.print("_");
Serial.print(lat[0]);
Serial.print(lat[1]);
Serial.print(lat[2]);
Serial.print(lat[3]);
Serial.print(lat[4]);
Serial.print(lat[5]);
Serial.print(lat[6]);
Serial.print(lat[7]);
Serial.print("_");
Serial.print(lon[0]);
Serial.print(lon[1]);
Serial.print(lon[2]);
Serial.print(lon[3]);
Serial.print(lon[4]);
Serial.print(lon[5]);
Serial.print(lon[6]);
Serial.print(lon[7]);
Serial.print('#');

```

```

digitalWrite(2,1);
digitalWrite(3,0);
digitalWrite(4,0);
myservo.write(180);
lcd.setCursor(13,1);
lcd.print("      ");

```

```

}

```

```

}

```

```

else
{

f4=0;
}

if(oc==50)
{

Serial.print("**Temp=");
Serial.print(sensorValue1);
Serial.print("_Humi:");
Serial.print(sensorValue1*2-10);
Serial.print("_MQ2=");
Serial.write((sensorValue3/100)+0x30);
Serial.write((((sensorValue3%100)/10)+0x30);
Serial.write((sensorValue3%10)+0x30);
Serial.print("_MQ3=");
Serial.write((sensorValue4/100)+0x30);
Serial.write((((sensorValue4%100)/10)+0x30);
Serial.write((sensorValue4%10)+0x30);
Serial.print("_Fire:");
Serial.write((sensorValue5/100)+0x30);
Serial.write((((sensorValue5%100)/10)+0x30);
Serial.write((sensorValue5%10)+0x30);
Serial.print("_");
Serial.print(lat[0]);
Serial.print(lat[1]);
Serial.print(lat[2]);
Serial.print(lat[3]);
Serial.print(lat[4]);
Serial.print(lat[5]);

```

```

Serial.print(lat[6]);
Serial.print(lat[7]);
Serial.print("_");
Serial.print(lon[0]);
Serial.print(lon[1]);
Serial.print(lon[2]);
Serial.print(lon[3]);
Serial.print(lon[4]);
Serial.print(lon[5]);
Serial.print(lon[6]);
Serial.print(lon[7]);
Serial.print('#');

oc=0;
}

oc++;
delay(200);

while(i<150)
{
if (mySerial2.available() > 0)
{
linea[i]=mySerial2.read();    // Read a byte of the serial port
i++;
}
}

for (int i=0;i<100;i++){ //
//Serial.print(linea[i]);
if(linea[i]=='G')
if(linea[i+1]=='P')
if(linea[i+2]=='R')

```

```

if(linea[i+3]=='M')
if(linea[i+4]=='C')
{
lat[0]=linea[i+18];
lat[1]=linea[i+19];
lat[2]=linea[i+20];
lat[3]=linea[i+21];
lat[4]=linea[i+22];
lat[5]=linea[i+23];
lat[6]=linea[i+24];
lat[7]=linea[i+25];
String lats=String(lat);
float latf=lats.toFloat();
latf=latf/60;
latff=((linea[i+18]-0x30)*10)+((linea[i+19]-0x30)*1);
latff=latff+latf;

lon[0]=linea[i+31];
lon[1]=linea[i+32];
lon[2]=linea[i+33];
lon[3]=linea[i+34];
lon[4]=linea[i+35];
lon[5]=linea[i+36];
lon[6]=linea[i+37];
lon[7]=linea[i+38];

lats=String(lon);
latf=lats.toFloat();
latf=latf/60;
lonff=((linea[i+32]-0x30)*10)+((linea[i+33]-0x30)*1);
lonff=lonff+latf;
}

```

CHAPTER 5

RESULT AND DISCUSSION

5.1 RESULT:

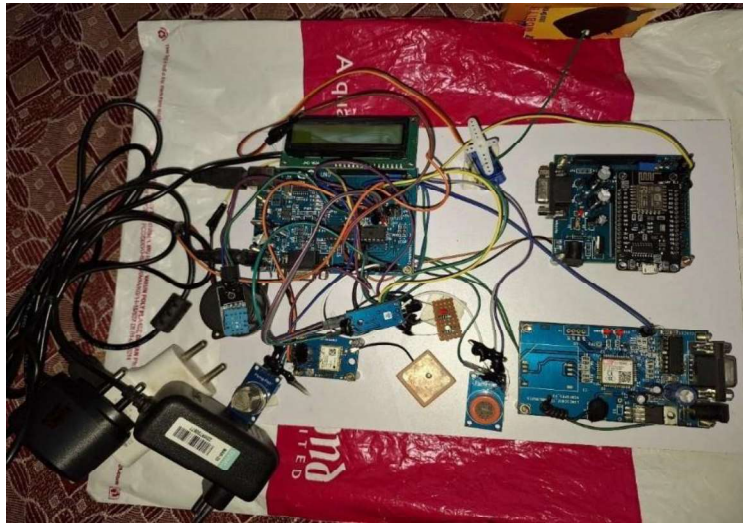


Fig:5.1: Top view



Fig:5.2: Front view

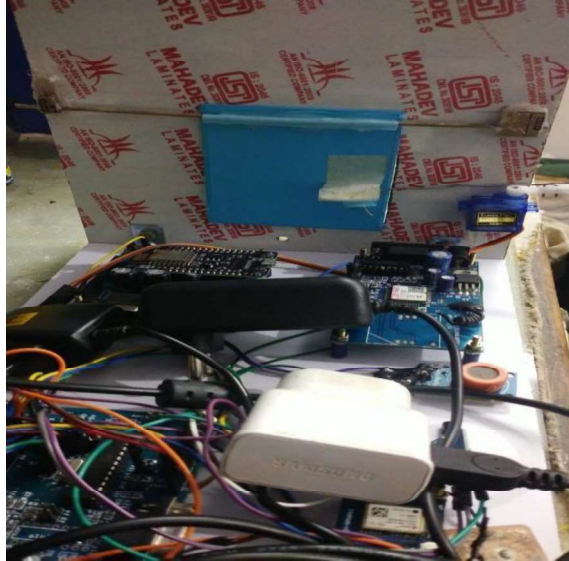


Fig:5.3: Back view

Fabricating an automated window integrated with a gas sensor involves several key steps. Firstly, in the hardware setup phase (Fig:5.1), essential components are assembled, including a window actuator capable of opening and closing the window, a gas sensor chosen based on the gases to be monitored (e.g., CO, CO₂, methane), a microcontroller (e.g., Arduino or Raspberry Pi) for system control and sensor interfacing, and a reliable power supply to ensure consistent operation. Next, the gas sensor is integrated into the system by establishing the necessary connections with the microcontroller and calibrating it to obtain precise gas level readings. The microcontroller is then programmed to read data from the gas sensor and interpret gas levels accurately. In the logic for window (Fig:5.2) control, thresholds for gas levels triggering window operations are defined, and the microcontroller is programmed to analyze the gas sensor data accordingly, deciding whether to open, close, or maintain the window position based on the predefined thresholds. Window operation logic is implemented to control the drive of the window, allowing the system to open and close the window based on gas sensor readings and predefined thresholds. Safety features (Fig:5.3) are important and include manual overrides and emergency shutdowns to prioritize user safety and system reliability. Following the coding and integration phase, extensive testing and optimization is performed. The system is tested under various

conditions to verify functionality and accuracy depending on gas levels. Based on the test results, code and system behavior is optimized.

5.2 ANALYSIS:

The data logs of the graph (Fig:5.4) illustrate a comprehensive snapshot of environmental conditions within the monitored space. Temperature fluctuations are meticulously tracked, providing insights into thermal dynamics over time. Concurrently, humidity levels are meticulously recorded, offering a nuanced understanding of atmospheric moisture content. Moreover, the graph meticulously charts fire occurrences, ensuring prompt detection and mitigation of potential hazards. Additionally, the levels of various gases are meticulously logged, facilitating the identification of any anomalies or safety concerns. Together, these data points form a comprehensive framework for environmental monitoring, enabling proactive measures to maintain optimal conditions and ensure the safety and comfort of occupants.

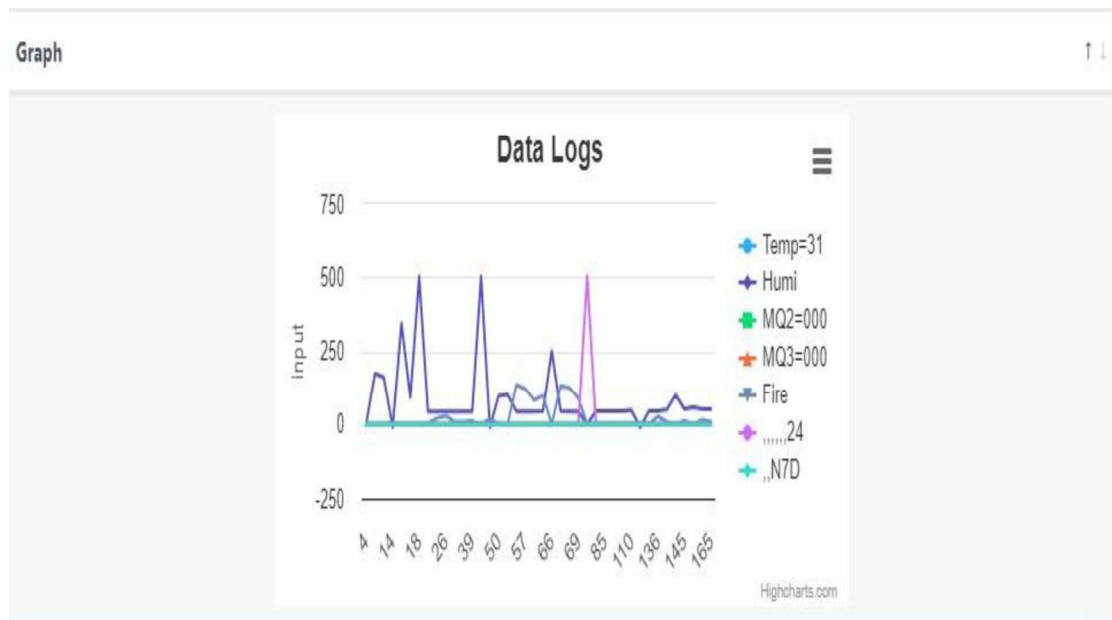


Fig:5.4: Output Data Observation

Table 5.1: Air Quality Index

Air Quality Index values	Level of Health Concern	Colors
0TO50	Good	Green
51TO100	Moderate	Yellow
101TO130	Unhealthy for Sensitive Groups	Orange
151TO200	Unhealthy	Red
201TO500	Hazardous	Maroon

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 SUMMARY:

The automatic windows project with gas sensors represents a breakthrough in window automation technology, offering a versatile solution that skillfully combines gas sensors and window control mechanisms. This innovative system has been carefully designed to take advantage of the accuracy and reliability of gas sensors and is particularly suited for environments where monitoring of gas concentrations is paramount, such as: Medical facilities, laboratories, industrial parks. By continuously monitoring gas levels and comparing them to preset thresholds, the system takes immediate autonomous actions to seamlessly open and close windows to ensure both safety and comfort. One of the great features of this system is its smart approach to energy conservation. Windows only operate when needed, effectively reducing energy waste and contributing significantly to maintaining a desirable indoor climate. This is especially important in today's climate of sustainable living and energy efficiency. Additionally, the project emphasizes inclusivity by providing automated window controls, eliminating the physical effort typically required to manually open and close windows. This increased accessibility is particularly beneficial for people with limited mobility, as it makes indoor environments more comfortable and easier to use. In conclusion, the automatic windows project with gas sensors is an example of the transformative potential of this technology. The combination of gas sensors and window automation not only improves safety, accessibility and energy efficiency in a variety of environments, but also opens up a wide range of innovative technologies in improving our daily lives and the environments in which we operate. The impact will also be highlighted.

6.2 CONCLUSION:

The development and introduction of automatic door opening and closing systems with gas sensors represents a significant advance in technology and convenience. This innovative system leverages the accuracy and reliability of gas sensors to detect changes in air quality, with particular emphasis on environments where gas levels must be closely monitored, such as medical facilities, laboratories, and industrial environments. By automatically triggering door opening and closing when oxygen levels fall below a set threshold, this system provides an important safety net in locations where gas shortage or the presence of harmful gases is at risk. functions as Beyond security, the system eliminates the need for physical intervention at the door, thus promoting inclusivity and easy access, especially for people with reduced mobility. Additionally, selectively opening doors only when warranted promotes energy efficiency and maintains temperature and climate control in enclosed spaces. Fundamentally, the integration of gas sensors into door automation not only improves safety and accessibility, but also highlights the far-reaching impact of technology in optimizing our daily lives.

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