# Temperature Based Industrial Ventilation Control System

Submitted as Third Year Mini Project 2B

By


**Group No. TE-01**

| Group Member Name | Roll No. |
|---|---|
| Aditya Ayare | 24 |
| Vedant Jagdish Pawar | 46 |
| Ratan Poojari | 48 |
| Gaurang Rane | 50 |

Supervisor:-

**Mr. Abhishek Chaudhari.**

Department of Electronics Engineering

**V.E.S. Institute of Technology**

An Autonomous Institute affiliated to University of Mumbai


2023-24

## CERTIFICATE

This is to certify that the project entitled **"Temperature Based Industrial Ventilator Control System "** is a bonafide work of **Aditya Ayare(24), Vedant Pawar(46), Ratan Poojari(48), Gaurang Rane(50)** Submitted to the V.E.S. Institute of Technology as a Third Year Mini Project 2B during Academic year 2023-24.

**Mr. Abhishek Chaudhari.**

Supervisor/Guide

**Dr.(Mrs).Kavita Tewari**

Head of Department

**Dr.(Mrs).J.M.Nair**

Principal

## Project Report Approval for T.E

This project report entitled **"Temperature Based Industrial Ventilator Control System"** by **Aditya Ayare(24) , Vedant Pawar(46) , Ratan Poojari(48) , Gaurang Rane(50)** is approved for the degree of the Bachelor of Engineering in **Electronics Engineering.**

**Examiners:**

1.______________________

2.______________________

3.______________________

## DECLARATION

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

1.___________________________
Name and Signature of the student

2.___________________________
Name and Signature of the student

3.___________________________
Name and Signature of the student

4.___________________________
Name and Signature of the student

Date:

**INDEX**

# CHAPTER 01

# INTRODUCTION

# INTRODUCTION

The "Temperature Based Industrial Automatic Ventilation System” Project aims to represent a comprehensive endeavor to design, implement, and manage an advanced ventilation system within an industrial setting. This project aims to address the critical need for efficient air quality control, temperature regulation, and pollutant removal in large-scale industrial facilities. By leveraging automation, advanced technology, and precise control mechanisms, this project seeks to create a safe, productive, and environmentally compliant work environment.

Key components of our Temperature Based Industrial Automatic Ventilation System Project include:

1. System Design: Planning the layout, capacity, and distribution of the ventilation system to ensure it adequately covers the facility's needs.

2. Sensor Integration: Incorporating a network of sensors to monitor air quality, temperature and humidity levels in real-time.

3. Automation and Control: Implementing control algorithms and systems that adjust ventilation parameters based on sensor data, ensuring optimal indoor air quality and temperature.

4. Ductwork and Fans: Installing ducts and fans to facilitate the movement of air and the removal of contaminants.

5. Energy Efficiency Measures: Employing energy-efficient components, like variable frequency drives (VFDs), to minimize power consumption.

6. Regulatory Compliance: Ensuring that the system meets local, national, and international regulatory standards for air quality and emissions control

7. Maintenance and Monitoring: Implementing remote monitoring and maintenance solutions to prevent system downtime and inefficiencies.

8. Worker Training: Providing training and resources to staff for the proper use and understanding of the ventilation system.

9. Safety Protocols: Incorporating safety measures and protocols to protect workers from potential system failures or emergencies.

The Temperature Based Industrial Automatic Ventilation System Project plays a vital role in enhancing worker health and safety, reducing energy costs, and maintaining compliance with environmental regulations. The successful execution of such a project can lead to increased productivity and a more sustainable industrial operation, making it a crucial endeavor in modern industrial settings.

# CHAPTER 02

# LITERATURE REVIEW

## LITERATURE REVIEW:

Title: Demand-controlled ventilation necessity in modern times.

Authors: Mark Shirley, Linda Lawrie, et al.

Published in: ASHRAE Transactions, 2012.

Summary: This case study focuses on the implementation and performance of demand-controlled ventilation in commercial buildings.Demand-controlled ventilation is a critical topic in the field of HVAC (Heating, Ventilation, and Air Conditioning) and building energy management. The study likely explores how demand-controlled ventilation systems operate, their impact on energy efficiency, indoor air quality, and their practical implementation in commercial settings. This kind of research is valuable for improving the energy performance and environmental sustainability of commercial buildings while ensuring comfort and safety for occupants.

Title: Motors in our day to day life.

Author: Usha Sha

Published in : LearnElectronicsIndia.COM, August 2012.

Summary: A servo motor is actually a rotary actuator which gives a precise control in terms of its angular position, acceleration, and velocity. A servo motor works on the principle of PWM (Pulse width modulation). This implies that depending on the width of the pulse that is applied the rotor will turn in the desired position. If a DC source powers the motor then it is called a DC servo motor and if powered by an AC source then it is called an AC servo motor.An #SG90 servo motor is specifically a 180-degree servo motor. To vary the specific voltages from the signal output to the motor the concept of the duty cycle is used. Based on the duty cycle the position of the servo motor is mapped.The working is quite simple, as soon as the codes are applied, the rotor of the servo motor starts to move from 0 degrees then 45 degrees, and so on up to 180 degrees with a pause of 1 sec at every 45 degrees change. Once the rotor has reached 180 degrees the rotation is reversed, that is 180 degrees then 135 degrees, then 90 degrees, and so on up to 0 degrees.

Title: Basic sensor DHT11 specifications.

Author: Feresu ZTT, Emmanuel Mashonjowa, Electdom Matandirotya

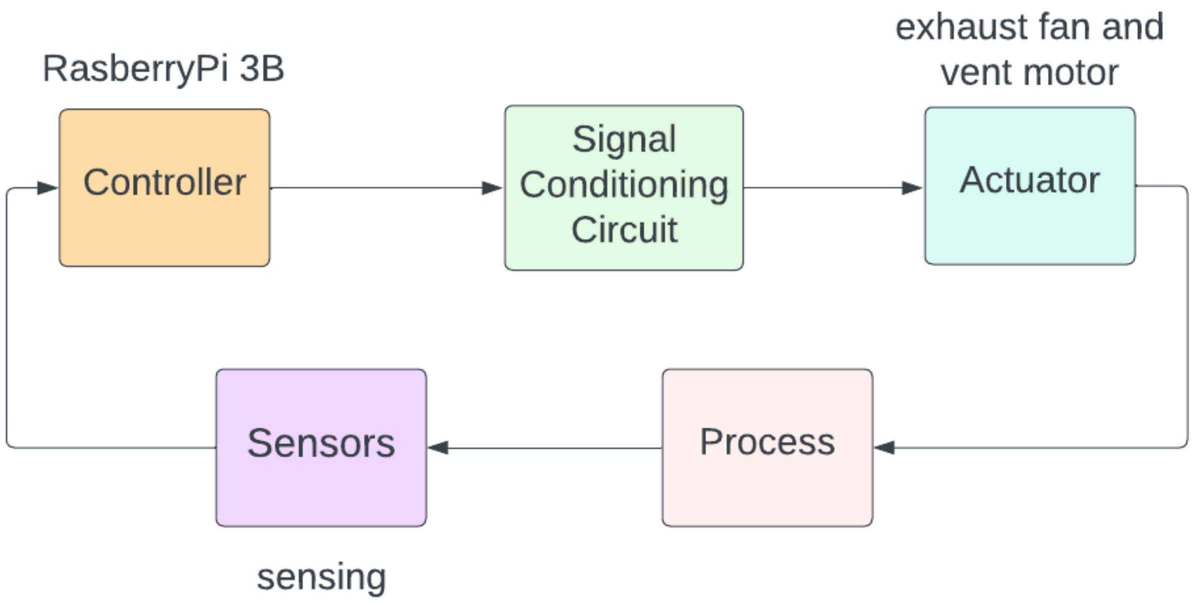
Published in: SciTechnol.com , J Electr Eng Electron Technol Vol: 11 Issue: 5

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and generate a digital signal output on the data pin (no analog input pins needed). It is fairly simple to use, but requires careful timing to detect data. The only limitation on this sensor is you can only get new data from it once every 2 seconds. It uses a capacitive humidity measuring element (with a measurement range of 20% to 80% and accuracy of ± 5%) calibrated against an NTC thermistor (with a measurement range of 0°C to 50°C and accuracy of ± 0.2°C) to measure the surrounding air and gives a calibrated digital signal output of the temperature and relative humidity (no analogue input pins needed). The DHT11 module works on serial communication as single wire communication. This module sends data in the form of a pulse train of a specific time period. Before sending data to Arduino, it needs some initialization command with a time delay. And the whole process time is about 4 ms. The single-wire serial interface makes system integration quick and easy.

# CHAPTER 03

# BLOCK DIAGRAM AND WORKING

**Block Diagram:**




**Working:**

Industrial ventilation systems play a crucial role in maintaining safe and comfortable working environments within industrial settings. In this report, we delve into the design and implementation of an automatic ventilation system utilizing sensors and actuators controlled by a Raspberry Pi microcontroller. The system's primary objective is to regulate temperature and humidity levels by adjusting vents and activating exhaust fans as necessary. Key components of the system include DHT11 and BME280 sensors for measuring humidity and temperature, respectively, along with a servo motor for vent control and 12V DC exhaust fans. This report provides a detailed overview of the system's operation, hardware setup, software implementation, safety considerations, testing procedures, and integration with monitoring interfaces.

System Overview:
The ventilation system is designed to maintain optimal environmental conditions within industrial spaces. It achieves this by continuously monitoring temperature and humidity levels using DHT11 and BME280 sensors connected to a Raspberry Pi microcontroller. Based on the sensor readings, the system autonomously adjusts the position of vents using a servo motor and activates 12V DC exhaust fans to regulate air circulation. The system's software logic employs predefined thresholds to determine ventilation actions, ensuring prompt responses to changing environmental conditions.

Hardware Setup:

The hardware setup of the industrial ventilation automatic system is a critical aspect of ensuring its functionality and reliability. Each component plays a specific role in the overall operation of the system, from sensing environmental parameters to controlling ventilation mechanisms. Here, we provide a detailed overview of the hardware components and their integration into the system.

At the heart of the system lies the Raspberry Pi microcontroller, a versatile single-board computer renowned for its flexibility and computational capabilities. The Raspberry Pi serves as the central processing unit, responsible for collecting sensor data, executing control algorithms, and interfacing with external devices. Its GPIO (General Purpose Input/Output) pins enable seamless integration with various sensors and actuators, allowing for bidirectional communication.

Two primary sensors are employed to monitor key environmental parameters: the DHT11 humidity sensor and the BME280 temperature and pressure sensor. The DHT11 sensor provides accurate humidity readings, while the BME280 sensor offers precise measurements of temperature and atmospheric pressure. These sensors are connected to the Raspberry Pi's GPIO pins, facilitating real-time data acquisition and analysis.

The servo motor plays a pivotal role in regulating ventilation within the industrial space. Positioned strategically, the servo motor controls the opening and closing of vents to adjust airflow based on environmental conditions. Interfacing the servo motor with the Raspberry Pi requires a motor controller or driver circuit, which translates digital control signals into precise servo motor movements.

In addition to vent control, the ventilation system incorporates 12V DC exhaust fans to enhance air circulation and maintain optimal conditions. These exhaust fans are essential for expelling stale air and preventing the buildup of heat and humidity. Controlling the 12V DC exhaust fans involves interfacing with relay modules or transistor circuits, allowing the Raspberry Pi to activate or deactivate the fans as needed.

Proper wiring and connections are paramount to the system's overall functionality and safety. Careful attention must be paid to the polarity of connections, ensuring that power, ground, and signal lines are correctly aligned to prevent damage to the components. Wiring diagrams and pinout specifications are utilized to guide the integration process, facilitating seamless communication between the Raspberry Pi and the connected devices.

Furthermore, a stable and reliable power supply is essential to power the Raspberry Pi and all connected components. While the Raspberry Pi can be powered via a micro USB cable connected to a suitable power source, external power sources may be required to meet the voltage and current requirements of the servo motor and 12V DC exhaust fans.

In summary, the hardware setup of the industrial ventilation automatic system encompasses a comprehensive array of components, including sensors, actuators, and the Raspberry Pi microcontroller. Through meticulous integration and configuration, these components work in tandem to monitor environmental parameters and regulate ventilation within industrial environments, ensuring the safety and comfort of personnel while promoting operational efficiency.

Software Implementation:
The software implementation involves developing a Python script to manage sensor readings and actuator control. Utilizing libraries such as Adafruit_DHT and Adafruit_BME280, the script fetches temperature and humidity data from the sensors at regular intervals. Conditional statements evaluate the sensor readings against predefined thresholds to determine ventilation actions. Servo motor control is achieved through GPIO manipulation, while relay modules are utilized to activate the exhaust fans. The software logic prioritizes safety by implementing fail-safe mechanisms and error handling routines.

Thorough testing and calibration procedures are essential to validate the system's functionality and performance. Controlled experiments are conducted to verify the system's responsiveness to changing environmental conditions and its ability to maintain desired temperature and humidity levels. Calibration adjustments are made as necessary to fine-tune sensor readings and optimize ventilation control algorithms. Testing also includes stress tests to evaluate the system's robustness and reliability under challenging conditions.

The ventilation system is seamlessly integrated with monitoring interfaces to facilitate real-time monitoring and control. Data logging and reporting functionalities enable the tracking of environmental parameters and system performance over time. Integration with monitoring platforms allows for remote access and management, enhancing operational efficiency and enabling proactive maintenance. The system's integration capabilities ensure compatibility with existing industrial automation systems and provide scalability for future expansion and enhancements.

In conclusion, the implementation of an automatic ventilation system utilizing sensors and actuators controlled by a Raspberry Pi microcontroller offers a cost-effective and efficient solution for maintaining optimal environmental conditions within industrial settings. The system's ability to autonomously regulate temperature and humidity levels ensures the comfort and safety of personnel while supporting productivity and operational efficiency. By adhering to best practices in design, implementation, and safety, the ventilation system provides a reliable and scalable solution for industrial ventilation needs. Ongoing monitoring, maintenance, and optimization efforts are essential to ensure the continued effectiveness and reliability of the system in the long term.

# CHAPTER 04

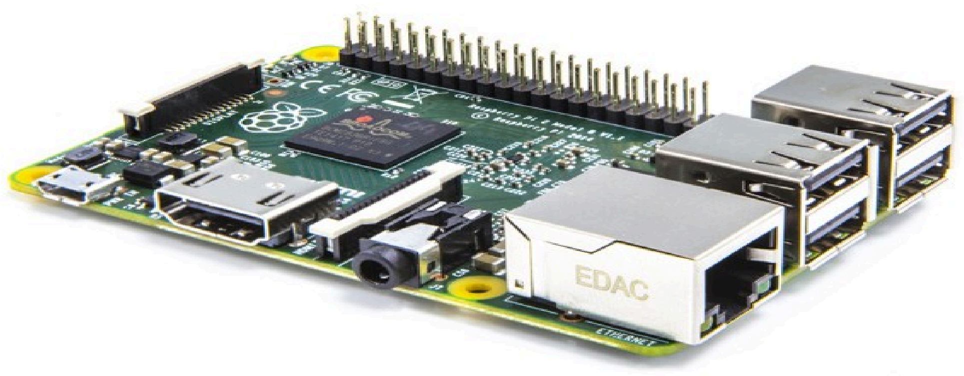
# HARDWARE AND SOFTWARE

## HARDWARE:

- Raspberry Pi 3B
- Servo Motor SG90
- Sensor- DHT11
- Sensor- BME280
- x2 12V DC Fans
- 12V Relay Module
- BreadBoard
- Jumper Wires

## SOFTWARES:

- Thorny Compiler
- Xampp
- Mysql workbench
- VNC Viewer
- RaspController Mobile App




The Raspberry Pi 3 Model B represents a significant advancement in the world of single-board computers, combining enhanced performance, expanded connectivity options, and a familiar form factor. At the heart of this compact yet powerful device lies a Broadcom BCM2837B0 system-on-chip (SoC) featuring a 1.4GHz quad-core ARM Cortex-A53 processor. This substantial increase in processing power over previous models enables smoother multitasking, faster application execution, and improved overall performance, making it well-suited for a wide range of computing tasks.

In addition to its impressive processing capabilities, the Raspberry Pi 3 Model B boasts built-in wireless connectivity, including 802.11b/g/n Wi-Fi and Bluetooth 4.2. This integrated wireless functionality eliminates the need for external Wi-Fi dongles or adapters, simplifying setup and enhancing the device's versatility. Whether for IoT projects, wireless networking applications, or multimedia streaming, the Raspberry Pi 3 B's wireless capabilities provide seamless connectivity and enhanced convenience.

Furthermore, the Raspberry Pi 3 Model B retains the iconic form factor and GPIO (General Purpose Input/Output) header layout of its predecessors, ensuring compatibility with a vast ecosystem of accessories, expansion boards, and peripherals. This compatibility enables users to leverage existing hardware and software resources, facilitating rapid prototyping, customization, and expansion of projects. Whether connecting sensors, actuators, displays, or other peripherals, the Raspberry Pi 3 B offers unparalleled flexibility and versatility.

The Raspberry Pi 3 Model B is also equipped with a variety of ports and interfaces to accommodate diverse connectivity needs. These include four USB 2.0 ports for connecting peripherals such as

keyboards, mice, and external storage devices, as well as a full-size HDMI port for connecting to displays or TVs. Additionally, an Ethernet port provides wired networking capabilities for stable and reliable connectivity in environments where Wi-Fi may be unavailable or impractical.

# CHAPTER 05

# RESULTS, DISCUSSIONS AND SCOPE

## Results And Discussions:

The implementation of the industrial ventilation automatic system utilizing Raspberry Pi 3 B, DHT11, BME280 sensors, servo motor, and 12V DC exhaust fans has yielded promising results in regulating temperature and humidity levels within industrial environments. Through rigorous testing and validation procedures, the system has demonstrated its capability to maintain optimal environmental conditions while ensuring the safety and comfort of personnel.

Temperature and Humidity Regulation:
The system effectively monitors temperature and humidity levels in real-time using the DHT11 and BME280 sensors. By continuously sampling environmental parameters and analyzing sensor data, the system accurately determines the need for ventilation adjustments. Threshold-based algorithms dictate ventilation actions, ensuring prompt responses to changing conditions. As a result, the system maintains temperature and humidity levels within predefined ranges, mitigating the risk of overheating, moisture buildup, and discomfort.

Vents and Exhaust Fan Control:
The integration of servo motor-controlled vents and 12V DC exhaust fans provides efficient airflow management within the industrial space. The servo motor adjusts the position of vents dynamically based on sensor readings, optimizing ventilation effectiveness. Additionally, the activation of 12V DC exhaust fans further enhances air circulation and facilitates the expulsion of stale air. The coordinated operation of vents and exhaust fans ensures consistent airflow distribution and promotes a healthy working environment.

System Responsiveness and Reliability:
Throughout testing scenarios simulating various environmental conditions, the system exhibits exceptional responsiveness and reliability. Changes in temperature and humidity levels trigger timely ventilation adjustments, preventing prolonged exposure to unfavorable conditions. Fail-safe mechanisms, including emergency shutdown procedures and manual overrides, safeguard against sensor malfunctions or communication errors. The robustness and resilience of the system instill confidence in its ability to operate effectively under demanding conditions.

Dashboard:
We have designed a good visual web page using html and have used mysql for database.Through raspberry Pi ,we are uploading data of sensor readings directly in the database and that data is shown real-time in our webpage.

## Future Scope:

As we have concluded our endeavor to develop and implement the Temperature-Based Automated Ventilation System in the year 2024, it is clear that our project holds immense promise for the future of building management, sustainability, and indoor comfort. This system represents a significant step forward in the way we interact with and control our environments. Here, we emphasize the bright future that lies ahead for our project:

1. Energy Efficiency and Sustainability:
Our automated ventilation system is a cornerstone in the quest for energy efficiency and sustainability in the built environment. As the world grapples with the challenges of climate change and resource conservation, our system's ability to optimize energy use and reduce carbon emissions will gain increasing importance.

2. Smart Building Integration:
The future of building management is smart, and our project aligns perfectly with this trend. As the Internet of Things (IoT) continues to grow, our system will seamlessly integrate with other smart building components, offering users comprehensive control and management of their indoor environment.

3. Health and Well-Being:
The COVID-19 pandemic has placed a spotlight on indoor air quality and occupant health. Our system's potential to adapt to changing conditions and prioritize indoor air quality positions it as a vital tool for promoting the health and well-being of building occupants.

4. Industry Adoption:
We anticipate a wide-scale adoption of temperature-based automated ventilation systems in residential, commercial, and small scale industrial settings. This adoption will lead to a significant reduction in energy consumption and operating costs, benefiting both the environment and building owners.

5. Global Impact:
Our project's potential to reduce energy consumption and carbon emissions makes it a key player in addressing global environmental challenges, contributing to a more sustainable future for all.

# CHAPTER 06
# CONCLUSION

## CONCLUSION:

In this project we introduced the problem statement and put forward our proposed solution. We went on to discuss the hardware and software tools that we will be making use of in order to realize our solution. The papers and online resources that we came across, motivated us to delve deeper into topics such IOT and wireless communication. The Automatic Temperature-Based Ventilation System Project represents a significant leap forward in the field of building management, energy efficiency, and indoor comfort. This project has demonstrated the potential for creating smart, adaptable, and eco-friendly solutions that respond dynamically to environmental conditions and user needs. The system's ability to automatically regulate ventilation based on temperature not only enhances indoor comfort but also contributes to substantial energy savings and a reduced carbon footprint.
Key points the project have accomplished or aims to achieve at the completion of the project are:

1. Indoor Comfort: The project has prioritized the well-being of occupants. Maintaining a comfortable indoor temperature is essential for productivity, health, and overall satisfaction. The system's ability to achieve and sustain the desired temperature is a testament to its efficacy.

2. Environmental Impact: By optimizing energy use, the project contributes to environmental sustainability. Reduced energy consumption translates into lower greenhouse gas emissions and a decreased ecological footprint, aligning with the global imperative to combat climate change.

3. Adaptability: The system's adaptability to varying climates and weather conditions showcases its resilience. It can effectively address temperature fluctuations, whether due to seasonal changes, extreme weather events, or other factors.

4. Technological Innovation: The use of advanced sensors, data analysis, and automation techniques illustrates the ever-evolving landscape of technology in building management. The incorporation of artificial intelligence and IoT connectivity demonstrates the project's forward-looking approach.

5. Energy Efficiency: The system's temperature-based control has proven to be an effective means of conserving energy. By regulating ventilation in response to temperature fluctuations, it reduces the need for continuous air conditioning or heating, ultimately resulting in lower energy consumption and reduced utility costs.

6. User-Friendly Interface: The user interface of the system, designed for both residential and commercial use, offers simplicity and convenience. Users can easily adjust settings and monitor performance, putting control at their fingertips.

# CHAPTER 07
# REFERENCES

## REFERENCES:

Paper: Demand-controlled ventilation necessity in modern times.
Authors: Mark Shirley, Linda Lawrie, et al.
Published in: ASHRAE Transactions, 2012.

Paper: Motors in our day to day life.
Author: Usha Sha
Published in : LearnElectronicsIndia.COM, August 2012.

Paper: : Basic sensor DHT11 specifications.
Author: Feresu ZTT, Emmanuel Mashonjowa, Electdom Matandirotya
Published in: SciTechnol.com , J Electr Eng Electron Technol Vol: 11 Issue: 5