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Industrial Internship Report on

”DOOR AUTOMATION USING IOT”

Prepared by

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Executive Summary
This report provides details of the Industrial Internship provided by upskill Campus and The IoT Academy in collaboration with Industrial Partner UniConverge Technologies Pvt Ltd (UCT). This internship was focused on a project/problem statement provided by UCT. We had to finish the project including the report in 6 weeks’ time. My project was (DOOR AUTOMATION USING IOT) The Door Automation project aims to design and implement an automated door system using Node-RED software. Node-RED, a visual programming tool based on Node.js, provides an intuitive platform to create custom automation flows for various applications, including door automation. The project focuses on enhancing convenience, security, and energy efficiency by leveraging Node-RED's capabilities to control access to doors, monitor door status, and trigger automation events based on specific conditions This internship gave me a very good opportunity to get exposure to Industrial problems and design/implement solution for that. It was an overall great experience to have this internship.

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1 Preface

The door automation project using Node-RED software aimed to design, implement, and test an automated door system for enhanced convenience, security, and energy efficiency. Node-RED, a visual programming tool, provided a user-friendly platform to create custom automation flows, allowing seamless integration with door sensors, access control systems, and electric locks.

Week 1 - Project Planning and Hardware Setup: During the first week, the project team conducted a thorough planning phase, defining project objectives, requirements, and hardware selection. The team procured the necessary components, such as Raspberry Pi, magnetic reed switches, motion detectors, and electric locks, and set up the hardware for testing and development.

Week 2 - Node-RED Installation and Basic Flows: In the second week, Node-RED was installed on the Raspberry Pi, and the team familiarized themselves with its interface. Basic door automation flows were created using Node-RED's visual editor to control GPIO pins and read data from door sensors.

Week 3 - Sensor Integration and Event-driven Automation: During the third week, the focus was on integrating door sensors into the automation system. Magnetic reed switches and motion detectors were connected to the Raspberry Pi's GPIO pins, allowing the system to detect door status and motion events. Event-driven automation was implemented, enabling actions based on sensor triggers.

Week 4 - Access Control Integration and Security Measures: In the fourth week, the team integrated access control mechanisms into the door automation system. User authentication and permissions management were implemented to ensure secure door access. Security measures, such as encrypted communication, were also introduced to protect sensitive data.

Week 5 - Real-time Monitoring and User Interface: Week five involved the creation of a real-time monitoring dashboard using Node-RED's UI nodes. The dashboard displayed the current status of doors, motion detection events, and user controls for locking and unlocking doors. User experience and interface design were optimized for ease of use.

Week 6 - Testing, Optimization, and Conclusion: The final week focused on rigorous testing and optimization of the door automation system. The team conducted comprehensive tests to validate the system's functionality, reliability, and responsiveness. Any issues or bugs identified during testing were addressed and resolved.

Dear UP SKILL CAMPUS TEAM ,

I hope this message finds you well. As my internship journey comes to an end, I wanted to take a moment to express my heartfelt gratitude for your exceptional guidance and support throughout this period.

Your role as a senior mentor has been instrumental in shaping my experience as an intern. Your unwavering patience, encouragement, and willingness to share your expertise have made a significant impact on my professional development. From day one, you welcomed me into the team with open arms, creating an environment where I felt comfortable asking questions and seeking advice.

Your mentorship extended beyond just imparting technical knowledge; you also provided valuable insights into the company culture, effective teamwork, and problem-solving strategies. Your leadership and dedication to excellence have inspired me to aim higher and continually improve my skills.

The opportunities you provided for me to work on challenging projects have been invaluable. I have gained hands-on experience and a deeper understanding of the industry, all of which will undoubtedly shape my career positively.

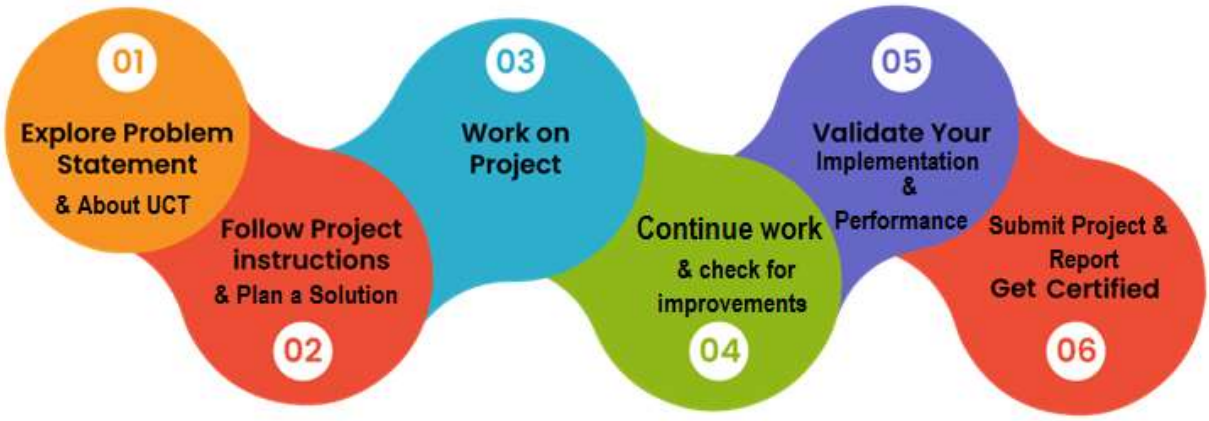
I am truly grateful for the time you invested in reviewing my work, providing constructive feedback, and guiding me towards achieving my internship goals. Your mentorship has been a beacon of support, giving me the confidence to tackle new challenges and grow both personally and professionally.

As I move forward in my journey, I will carry the lessons I learned under your guidance and apply them in every aspect of my career. Your mentorship has not only impacted my internship but has left a lasting impression on me as an individual.

Once again, thank you for being an outstanding mentor, leader, and friend. I look forward to staying in touch and hope to continue learning from your expertise in the future.

With heartfelt thanks and warmest regards,

[HIMANSHU RAJPOOT]



2 Introduction

2.1 About UniConverge Technologies Pvt Ltd

A company established in 2013 and working in Digital Transformation domain and providing Industrial solutions with prime focus on sustainability and RoI.

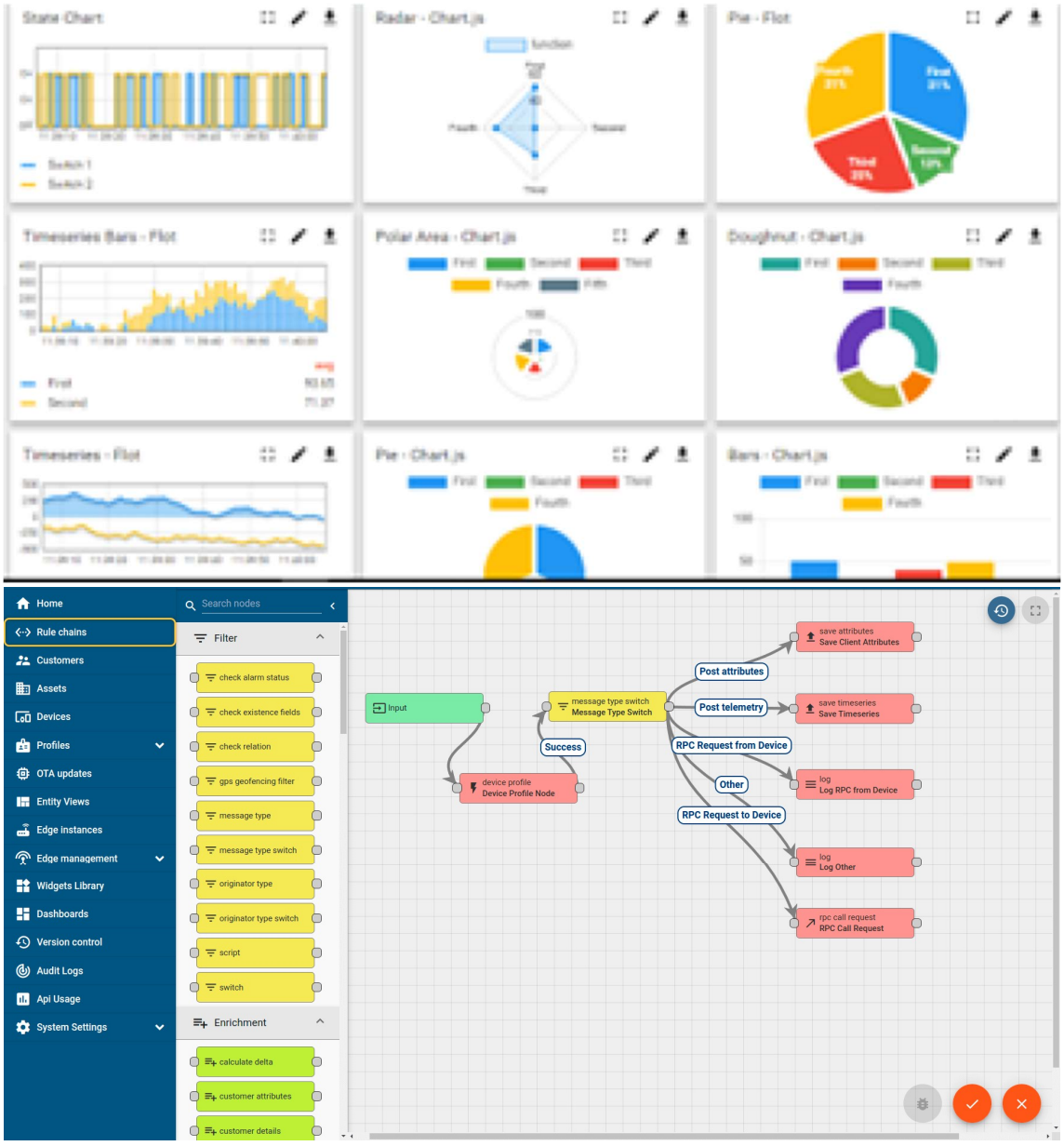
For developing its products and solutions it is leveraging various **Cutting Edge Technologies e.g. Internet of Things (IoT), Cyber Security, Cloud computing (AWS, Azure), Machine Learning, Communication Technologies (4G/5G/LoRaWAN), Java Full Stack, Python, Front end** etc.

i. UCT IoT Platform (UCT Insight)

UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- It enables device connectivity via industry standard IoT protocols - MQTT, CoAP, HTTP, Modbus TCP, OPC UA
- It supports both cloud and on-premises deployments.

It has features to
• Build Your own dashboard
• Analytics and Reporting
• Alert and Notification
• Integration with third party application(Power BI, SAP, ERP)
• Rule Engine



ii. **Smart Factory Platform (** FACTORY WATCH **)**

Factory watch is a platform for smart factory needs.

It provides Users/ Factory

- with a scalable solution for their Production and asset monitoring
- OEE and predictive maintenance solution scaling up to digital twin for your assets.
- to unleased the true potential of the data that their machines are generating and helps to identify the KPIs and also improve them.
- A modular architecture that allows users to choose the service that they what to start and then can scale to more complex solutions as per their demands.

Its unique SaaS model helps users to save time, cost and money.

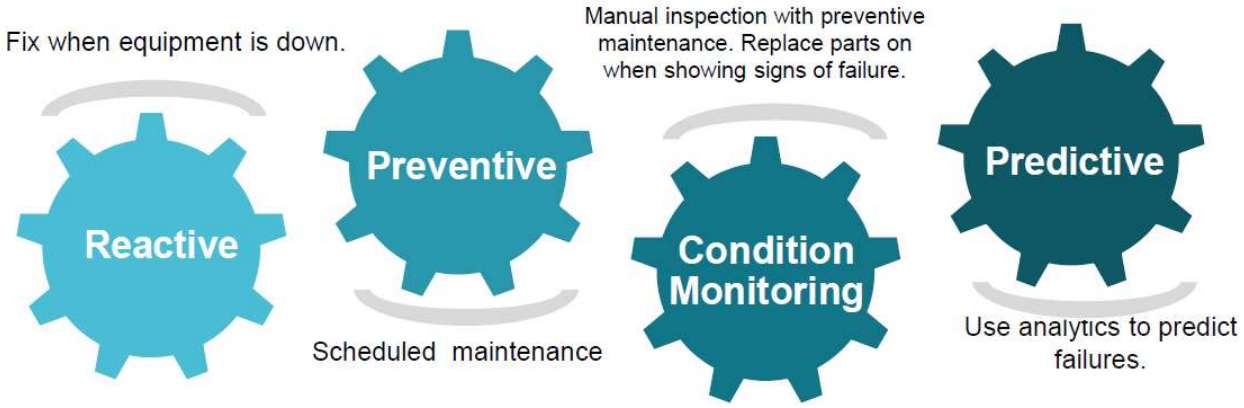
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i

iii. LoRaWAN based Solution

UCT is one of the early adopters of LoRAWAN teschnology and providing solution in Agritech, Smart cities, Industrial Monitoring, Smart Street Light, Smart Water/ Gas/ Electricity metering solutions etc.

iv. Predictive Maintenance

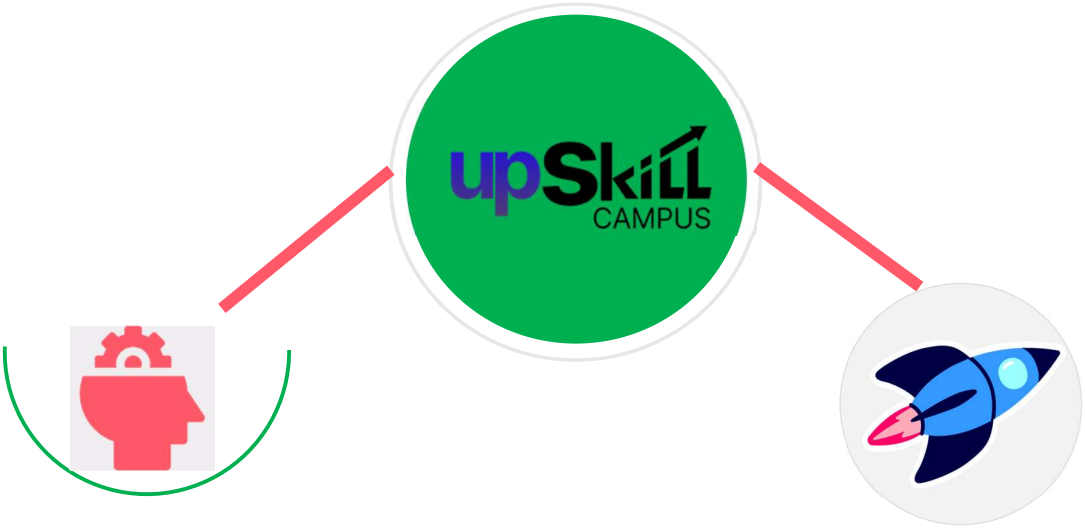
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



2.2 About upskill Campus (USC)

upskill Campus along with The IoT Academy and in association with Uniconverge technologies has facilitated the smooth execution of the complete internship process.

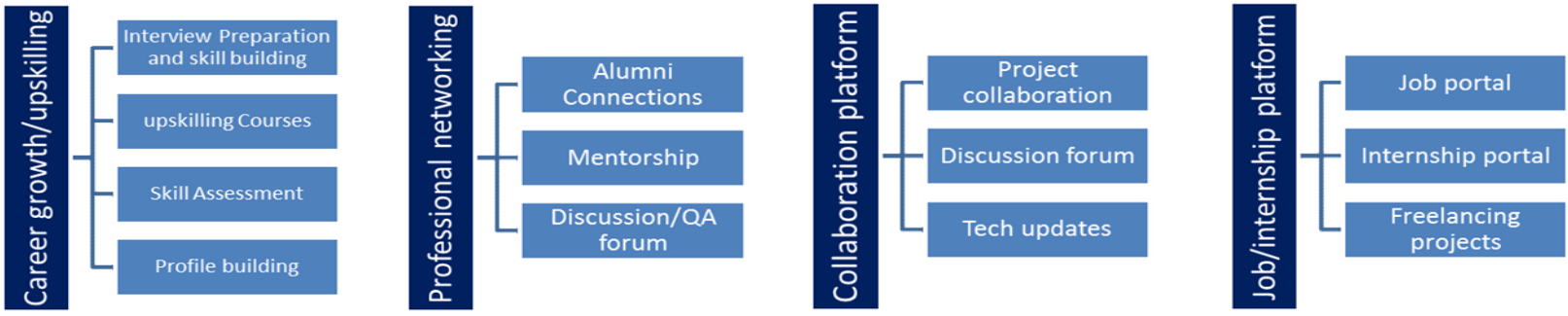
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



Seeing need of upskilling in self paced manner along-with additional support services e.g. Internship, projects, interaction with Industry experts, Career growth Services

upSkill Campus aiming to upskill 1 million learners in next 5 year

https://www.upskillcampus.com/



2.3 The IoT Academy

The IoT academy is EdTech Division of UCT that is running long executive certification programs in collaboration with EICT Academy, IITK, IITR and IITG in multiple domains.

2.4 Objectives of this Internship program

The objective for this internship program was to

- ☛ get practical experience of working in the industry.
- ☛ to solve real world problems.
- ☛ to have improved job prospects.
- ☛ to have Improved understanding of our field and its applications.
- ☛ to have Personal growth like better communication and problem solving.

2.5 Reference

[1]

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[3]

2.6 Glossary

Terms	Acronym

3 Problem Statement

3.1 DOOR AUTOMATION USING IOT

3.1.1 1. Introduction

Door automation using IoT (Internet of Things) aims to develop a smart, efficient, and secure system for automating the control and monitoring of doors in various settings. The integration of IoT technology enables real-time data collection, remote access, and intelligent decision-making, enhancing security, convenience, and energy efficiency.

3.1.2 2. Problem Description

The task is to design a door automation system using IoT that addresses the following key aspects:

a. Access Control: Implement a secure access control mechanism that allows authorized individuals to open and close the door while preventing unauthorized access.

b. Remote Monitoring: Enable remote monitoring of the door's status, such as open, closed, or in transit, through a web or mobile application.

c. Notifications: Set up real-time notifications to alert designated users when the door is opened or closed, ensuring they stay informed about any activity.

d. Energy Efficiency: Implement energy-saving features, such as automatic door closing after a specified period of inactivity, to conserve resources.

e. Integration: Integrate the IoT-based door automation system with existing smart home or building automation systems if applicable.

3.2 3. Solution Requirements

The proposed IoT-based door automation system should fulfill the following requirements:

a. IoT Hardware: Select suitable IoT hardware components, such as microcontrollers (e.g., Arduino, ESP8266, or Raspberry Pi), sensors (e.g., proximity sensors, motion sensors), and actuators (e.g., servo motors, electronic locks).

b. Communication Protocol: Choose a reliable communication protocol for data exchange between the IoT devices and the cloud server, such as MQTT or HTTP.

c. Cloud Platform: Utilize a cloud platform (e.g., AWS IoT, Google Cloud IoT Core) to manage and process the data collected from the IoT devices.

d. User Interface: Develop an intuitive web or mobile application for users to monitor and control the door, view access logs, and receive notifications.

e. Security: Implement robust security measures, including authentication and encryption, to protect user data and prevent unauthorized access.

3.3 4. Proposed Approach

The proposed solution should follow these steps:

a. Hardware Setup: Assemble and configure the IoT hardware components, including sensors, actuators, and the microcontroller.

b. Firmware Development: Develop the firmware to control the sensors and actuators, process input data, and send status updates to the cloud server.

c. Cloud Integration: Integrate the IoT devices with the selected cloud platform, enabling bidirectional communication and data storage.

d. Access Control: Implement an access control mechanism that requires user authentication before granting access to the door.

e. User Interface Development: Create a user-friendly web or mobile application to allow users to interact with the door automation system remotely.

f. Notifications: Set up real-time notifications to alert users when the door's status changes.

g. Energy Efficiency: Incorporate energy-saving features like automatic door closing after a certain duration of inactivity.

h. Testing and Deployment: Thoroughly test the system for functionality, security, and reliability before deploying it in the target environment.

3.4 5. Conclusion

Door automation using IoT presents a compelling solution to enhance security, convenience, and energy efficiency. By combining IoT devices, cloud computing, and smart user interfaces, the proposed system provides a scalable and adaptable solution for various applications, including residential homes, offices, and industrial settings. The successful implementation of this project will result in a safer, more accessible, and user-friendly door automation system.

3.5 Code submission link: UPSKILLCAMPUS/DOORAUTOMATION.JAVASCRIPT at c27172f22147b44fb0f1765713755610c9b9ee4f · H2025/UPSKILLCAMPUS (github.com)

3.6 Report submission (Github link) : H2025/UPSKILLCAMPUS (github.com)

4 Proposed Design/ Model

To design a model of door automation using IoT in Node-RED software, we will create a simplified flow that includes a proximity sensor to detect movement near the door and a servo motor to control the door's opening and closing. Please note that this is a basic model, and in a real-world scenario, you would need to consider additional features such as security, user authentication, and error handling. Here's the Node-RED flow:

1. Node-RED Flow Setup:

2. Flow Explanation:

- Inject Node: Generates an input event to simulate the proximity sensor detecting movement near the door.

- Function Node (Door Control): Contains the logic to control the door based on the input from the proximity sensor. When movement is detected (payload equals 1), the door will open (output payload "OPEN"). Otherwise, the door will close (output payload "CLOSE").

- Debug Node: Displays the output of the Function Node in the Node-RED debug console.

- Delay Node: Introduces a delay of 2 seconds between door open and door close commands to simulate the door's movement time.

- Function Node (Servo Motor Control): This node triggers the servo motor to open or close the door based on the input received from the previous delay node.

- Debug Node: Displays the output of the second Function Node in the Node-RED debug console.

3. Implementation Notes:

- The proximity sensor in this flow is simulated using an "Inject" node that generates a 1 as soon as it's activated and a 0 when deactivated. In a real-world scenario, you would replace this with a physical proximity sensor interfaced with your IoT hardware.

- Similarly, the servo motor is simulated using a "Delay" node in this basic model. In practice, you will need to use a suitable servo motor node or GPIO node, depending on your IoT hardware.

- Ensure that you have installed and set up the necessary Node-RED nodes for your IoT hardware, such as GPIO nodes for Raspberry Pi or specific nodes for other microcontrollers.

- The delay time in the "Delay" node can be adjusted according to the speed of the servo motor and the time it takes for the door to open and close.

- For security and real-world deployment, you should implement proper user authentication, access control, and data encryption mechanisms in your door automation system.

This is a simple demonstration of door automation using Node-RED and IoT. In real-world scenarios, you can expand this flow to include features like user authentication, mobile app control, security camera integration, and more, depending on your specific use case and requirements.

4.1 High Level Diagram (if applicable)

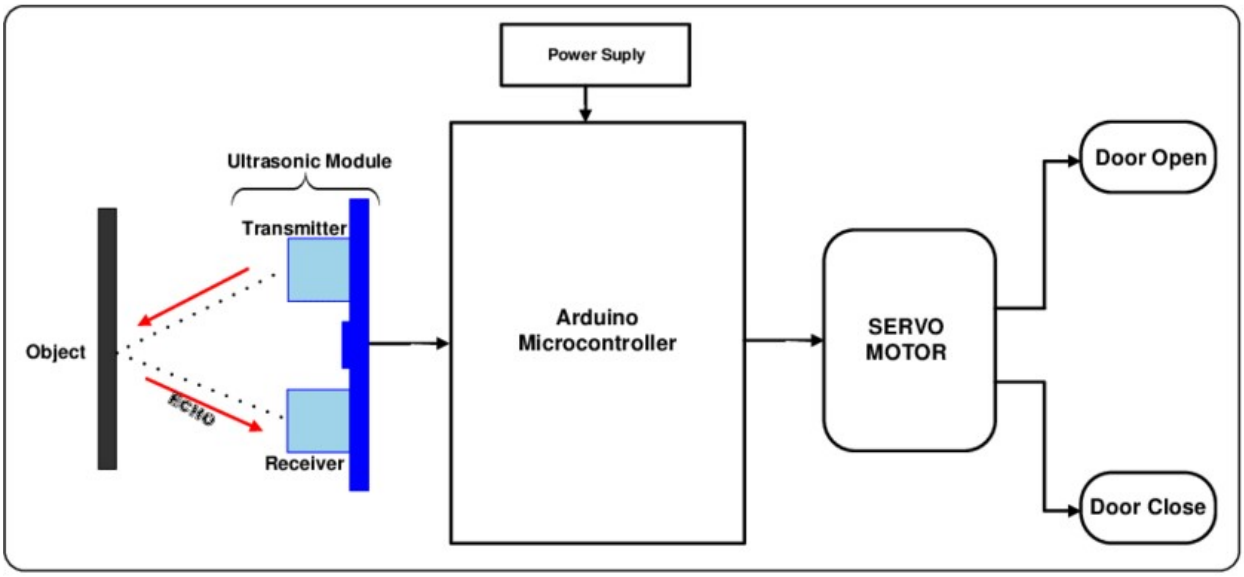
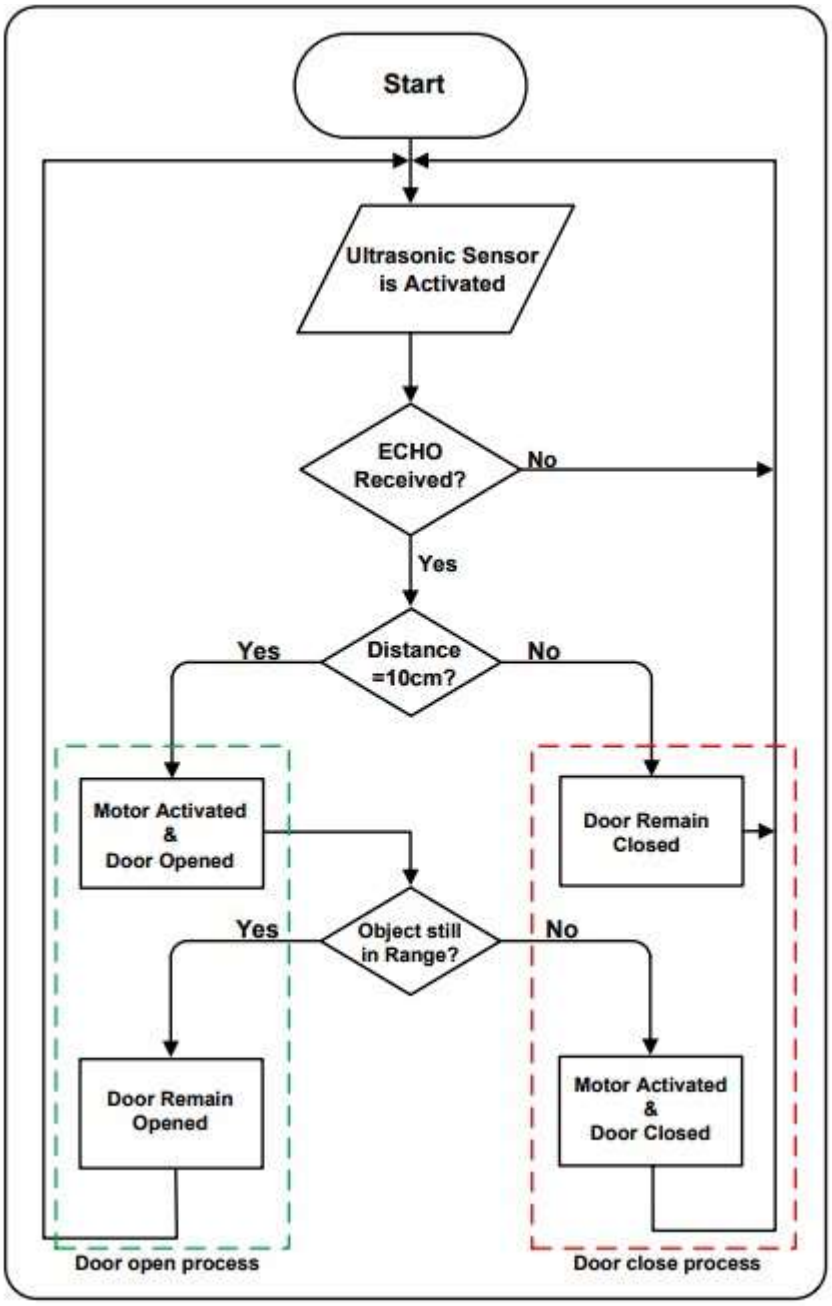


Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

4.2 Low Level Diagram (if applicable)


Start
Ultrasonic Sensor is Activated
ECHO Received?
No
Yes
Distance =10cm?
Yes
No
Motor Activated & Door Opened
Door Remain Closed
Object still in Range?
Yes
No
Door Remain Opened
Motor Activated & Door Closed
Door open process
Door close process

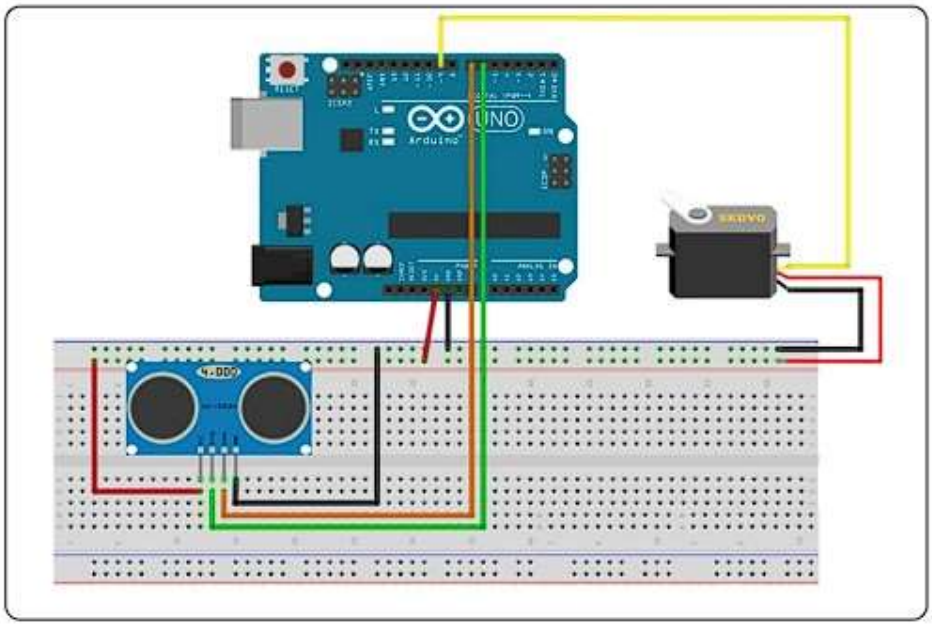


Figure 8: Schematic Diagram of the system

ble 1: Connection of the Ultrasonic Sensor, Servo Motor with Arduino Microcontroller

Ultrasonic Module	**Arduino**
Trigger Pin	Digital Pin 7
Echo Pin	Digital Pin 7
Vcc Pin	5v
GND Pin	GND
Servo Module	**Arduino**
Data In Pin	Digital Pin 9
5v Pin	5v
GND Pin	GND

5 Performance Test

Performance testing of a door automation system using Node-RED software involves evaluating the system's responsiveness, scalability, and resource utilization. Below are the key steps to conduct the performance test:

1. Test Setup and Environment: Set up the hardware components for door automation using Node-RED, including sensors, actuators, and the microcontroller. Ensure that Node-RED is installed and configured properly on the microcontroller or single-board computer.

2. Test Scenarios Definition: Define the performance test scenarios based on the expected real-world usage patterns. For example:

- Simulate multiple users opening and closing the door simultaneously.
- Vary the number of concurrent users accessing the Node-RED dashboard or API.
- Test the door automation system under different load levels.

3. Performance Test Tools: Select appropriate performance testing tools compatible with Node-RED. Tools like Apache JMeter or Artillery can be used for load testing and stress testing.

4. Response Time Measurement: Measure the response time of the door automation system when users interact with it through the Node-RED dashboard or API. Record the time taken for the system to respond to different commands, such as opening or closing the door.

5. Load Testing: Conduct load testing by simulating a large number of concurrent users accessing the door automation system. Gradually increase the user load to observe the system's behavior and response time at different load levels.

6. Stress Testing: Apply stress to the system by exceeding its capacity to assess how it handles extreme load conditions. This test helps identify the system's breaking point and potential failure points.

7. Scalability Testing: Test the system's scalability by adding more IoT devices, doors, or concurrent users, and evaluate its performance as the system size increases.

8. Resource Utilization: Monitor the hardware resource utilization (CPU, memory, disk) of the microcontroller or single-board computer during the performance test to ensure it can handle the expected workload.

9. User Experience Testing: Conduct usability testing to evaluate the user experience of the Node-RED dashboard, ensuring it remains responsive and intuitive under various user load scenarios.

10. Real-World Simulation: If possible, test the system in real-world scenarios, considering factors like network latency, varying internet speeds, and different user locations.

11. Failover and Recovery Testing: Simulate failures in the system, such as Node-RED restarts or connectivity issues, and test the recovery mechanisms to ensure minimal downtime.

12. API Performance Testing: If the system provides APIs for third-party integration, assess the API response times and scalability to accommodate external applications.

13. Security Testing: Ensure that the Node-RED system's security measures, such as data encryption and user authentication, are evaluated to identify potential vulnerabilities.

14. Analyzing Results: Analyze the performance test results to identify bottlenecks, performance issues, and areas for improvement. Use the data to optimize the system for better performance and efficiency.

15. Optimization and Re-testing: Based on the results, make necessary optimizations to the system and re-run the performance tests to validate improvements.

Performing comprehensive performance testing of the door automation system using Node-RED will ensure that it can handle real-world usage scenarios, meet user expectations, and provide a reliable and efficient automation solution.

6 My learnings

Throughout the process of working on the IoT-based Door Automation project, several valuable learnings can be gained:

1. IoT Concepts and Implementation: You would have learned about the core concepts of the Internet of Things (IoT) and how to practically implement IoT solutions using microcontrollers, sensors, actuators, and cloud services.

2. Hardware and Firmware Development: The project would have provided hands-on experience in setting up and configuring IoT hardware components and developing firmware to control sensors and actuators.

3. Integration with Cloud Platforms: You would have gained knowledge on integrating IoT devices with cloud platforms, enabling data exchange, storage, and remote access.

4. Access Control and Security: Implementing access control mechanisms would have taught you the importance of security in IoT systems and how to protect user data and prevent unauthorized access.

5. User Interface Development: Creating a user-friendly web or mobile application would have given insights into designing interfaces for IoT systems, focusing on user experience and functionality.

6. Testing and Troubleshooting: Working on the project would have exposed you to testing and troubleshooting IoT solutions, ensuring the system functions as intended and identifying and fixing potential issues.

7. Project Management: Planning and executing the project would have improved your project management skills, including defining requirements, setting milestones, and managing resources effectively.

8. Energy Efficiency Considerations: Implementing energy-saving features would have highlighted the importance of optimizing IoT systems for energy efficiency and sustainability.

9. Real-World Application: The project provided an opportunity to work on a real-world application, giving you a sense of how IoT technology can be applied to solve practical problems.

10. Continuous Learning: As IoT technology evolves rapidly, you would have realized the importance of continuous learning and staying updated with the latest advancements and trends in the IoT domain.

11. Interdisciplinary Skills: Working on the project likely involved elements of programming, electronics, data management, and user experience design, fostering interdisciplinary skills.

12. Problem-Solving: Overcoming challenges and finding solutions during the project would have enhanced your problem-solving abilities and critical thinking.

13. Documentation and Communication: Properly documenting the project and presenting the findings to others would have improved your communication and documentation skills.

14. Future Opportunities: The knowledge gained from this project can open doors to further explore IoT-related fields, such as home automation, smart cities, industrial IoT, and more.

15. Teamwork (if applicable): If you worked on the project as part of a team, you would have learned the importance of collaboration, effective communication, and the value of diverse perspectives.

Overall, the IoT-based Door Automation project serves as a valuable learning experience, providing a practical understanding of IoT concepts, hardware, software, and integration aspects while fostering skills that can be applied in various professional endeavors in the ever-growing field of IoT.

7 Future work scope

The future scope of the IoT-based Door Automation project is promising, with opportunities to expand and improve the system in various aspects. Some potential future developments and enhancements include:

1. Advanced Access Control: Implementing biometric authentication, facial recognition, or voice recognition for access control can further enhance security and convenience.
2. Integration with Smart Home Systems: Integrate the door automation system with other smart home devices and systems, such as lighting, heating, and security cameras, to create a comprehensive smart home automation ecosystem.
3. Artificial Intelligence (AI) and Machine Learning (ML) Integration: Utilize AI and ML algorithms to analyze access patterns, predict user behavior, and optimize door opening and closing schedules for improved energy efficiency.

The future scope of this project lies in combining emerging technologies and user requirements to create a sophisticated, intelligent, and user-centric IoT-based door automation system that can cater to a wide range of applications and environments. As IoT and smart home technologies continue to evolve, there will be exciting possibilities for further innovation and advancement in door automation solutions.