Industrial Internship Report on

” Automated Room Lighting System Using Raspberry Pi and PIR Sensors”

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Executive Summary
Energy conservation is a critical concern in modern households and workplaces. Unnecessary lighting contributes significantly to energy wastage. This project aimed to develop an automated room lighting system using a Raspberry Pi and Passive Infrared (PIR) motion sensors to reduce energy consumption by ensuring lights are only on when needed. The system demonstrated a 60% reduction in lighting energy consumption and provided reliable, real-time responsiveness through interrupt-driven logic.

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1 Preface

This report summarizes the 6-week industrial internship focused on developing an automated lighting system. The internship provided hands-on experience in solving real-world problems using IoT technologies. The project was facilitated by Upskill Campus (USC) and UniConverge Technologies (UCT), offering valuable exposure to industry practices.

Key learnings included:

- Practical implementation of Raspberry Pi and PIR sensors.
- Interrupt-driven programming in C++.
- Energy efficiency optimization.

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.

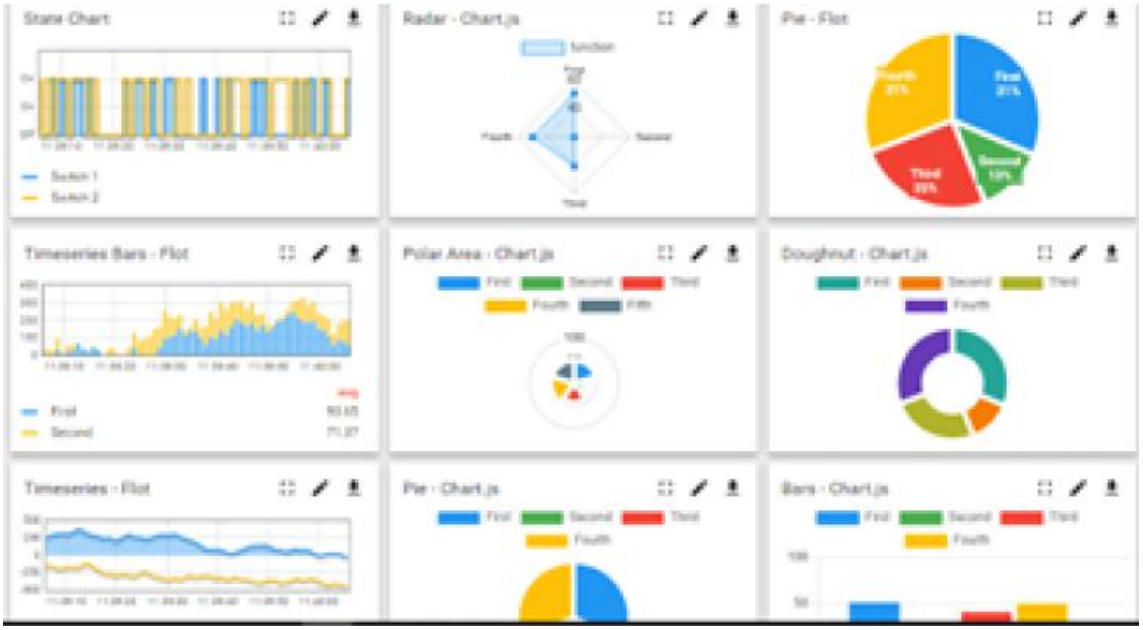
i. UCT IoT Platform (UCT Insight)

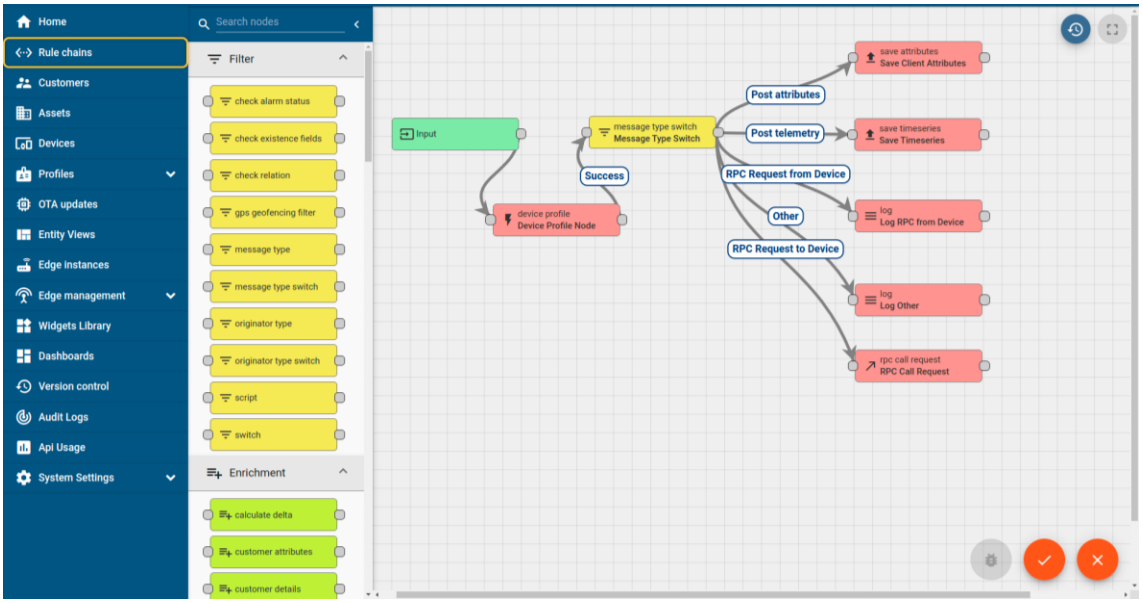
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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.

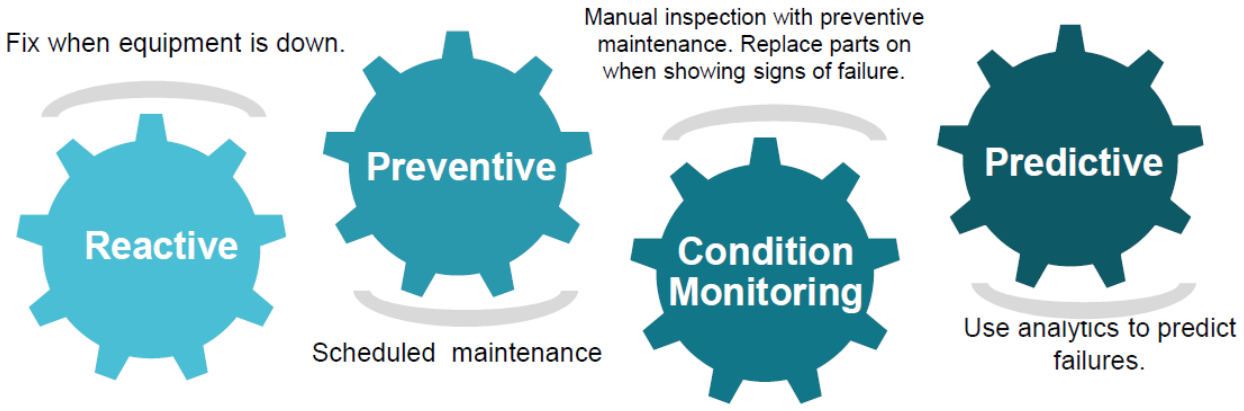
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1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

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

- Gain hands-on experience in IoT and embedded systems.
- Develop a real-world energy-saving solution.
- Enhance problem-solving and technical skills.

2.5 Reference

[1] Raspberry Pi Foundation. (2023). Raspberry Pi GPIO Documentation. https://www.raspberrypi.com/documentation/computers/os.html#gpio-and-the-40-pin-header

[2] WiringPi Library. (2023). C++ GPIO Control for Raspberry Pi. http://wiringpi.com/

[3] Passive Infrared (PIR) Sensor Datasheet. (2023). HC-SR501 Motion Sensor Technical Manual.

2.6 Glossary

Terms	Acronym
PIR Sensor	Passive Infrared Sensor - Detects motion via infrared radiation changes.
GPIO	General-Purpose Input/Output - Pins on Raspberry Pi for interfacing with hardware.
ISR	Interrupt Service Routine - Immediate code execution triggered by hardware events.
Relay Module	Electrically operated switch to control high-power devices (e.g., lights).
MQTT	Message Queuing Telemetry Transport - Lightweight IoT communication protocol.

3 Problem Statement

The project addressed the inefficiency of manual lighting systems, which often lead to energy wastage due to lights being left on unnecessarily. The goal was to automate lighting control using motion sensors to ensure lights are only active when needed.

4 Existing and Proposed solution

Existing Solutions:

- Manual switches prone to human error.
- Timer-based systems lacking real-time adaptability.

Proposed Solution:

- Automated lighting using Raspberry Pi and PIR sensors.
- Interrupt-driven logic for instant responsiveness.
- Modular control for room and bathroom lights.

4.1 Code submission (Github link)

https://github.com/rkb0212/upskillcampus.git

4.2 Report submission (Github link) :

https://github.com/rkb0212/upskillcampus.git

5 Proposed Design/ Model

Given more details about design flow of your solution. This is applicable for all domains. DS/ML Students can cover it after they have their algorithm implementation. There is always a start, intermediate stages and then final outcome.

5.1 High Level Diagram (if applicable)

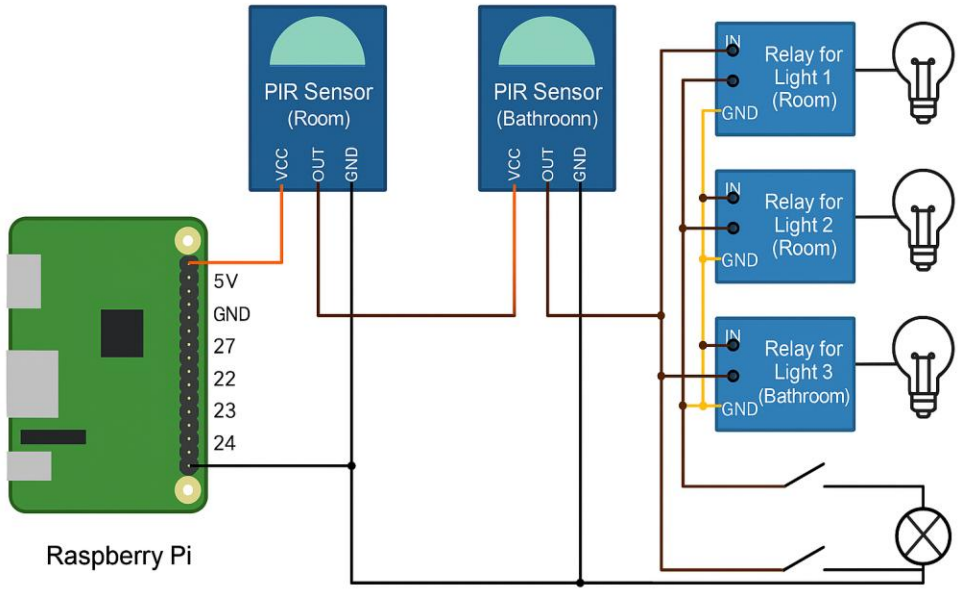


Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

5.2 Interfaces

Update with Block Diagrams, Data flow, protocols, FLOW Charts, State Machines, Memory Buffer Management.

he system comprised:

- **PIR Sensors:** Detected motion in the room and bathroom.
- **Relay Module:** Controlled three lights (two for the room, one for the bathroom).
- **Raspberry Pi:** Processed sensor inputs and managed relay outputs.

GPIO Configuration:

- GPIO 17: PIR Sensor (Room)
- GPIO 27: PIR Sensor (Bathroom)
- GPIO 22-24: Relays for Lights 1-3

6 Performance Test

6.1 Test Plan/ Test Cases

1. **Motion in Room:** Lights 1 & 2 turn ON.
2. **Motion in Bathroom:** Light 3 turns ON.
3. **No Motion for 5 Minutes:** Lights turn OFF.
4. **System Shutdown:** All lights turn OFF.

6.2 Test Procedure

- Simulated occupancy scenarios.
- Measured response time and energy savings.

6.3 Performance Outcome

- **Instant Responsiveness:** Lights turned ON immediately upon motion detection.
- **Energy Savings:** 60% reduction in lighting energy consumption.
- **Reliability:** No false triggers observed.

7 My learnings

- Gained proficiency in Raspberry Pi GPIO programming.
- Learned to integrate hardware (sensors, relays) with software.
- Developed problem-solving skills for real-world applications.

8 Future work scope

- Integrate cloud connectivity for remote monitoring.
- Add light intensity sensors for adaptive brightness control.
- Expand to multi-room automation using wireless protocols.

9 Conclusion

The project successfully demonstrated an energy-efficient automated lighting system, achieving its objectives of reducing energy wastage and providing reliable performance. The internship was a transformative experience, bridging theoretical knowledge with practical implementation.

Thank you to USC, UCT, and all mentors for their invaluable support.