PROPOSAL FOR SMART CAMPUS

ELECTRICAL ENERGY CONSERVATION

PROBLEM FORMULATION

A significant quantity of energy is consumed by educational blocks from our institution. The appliance runs on a set schedule in most of the blocks. As a result, the appliance remains switched ON whether the user needs it or not. This inefficient electrical energy management results in significant energy waste and high electricity bills.

OBJECTIVES

1. **Monitoring**: Study of the environment in view of electrical energy consumption
2. **Intelligence-enabled electrical energy automation system**: Development of an IoT-driven building toward an energy-automated environment
3. **Electric energy consumption prediction**: Including prediction capabilities in smart buildings, the electric energy consumption can be estimated for the near future. Thus, the required amount of energy can be generated and supplied as needed to meet the demands of the electric loads.

TECHNICAL ASPECTS

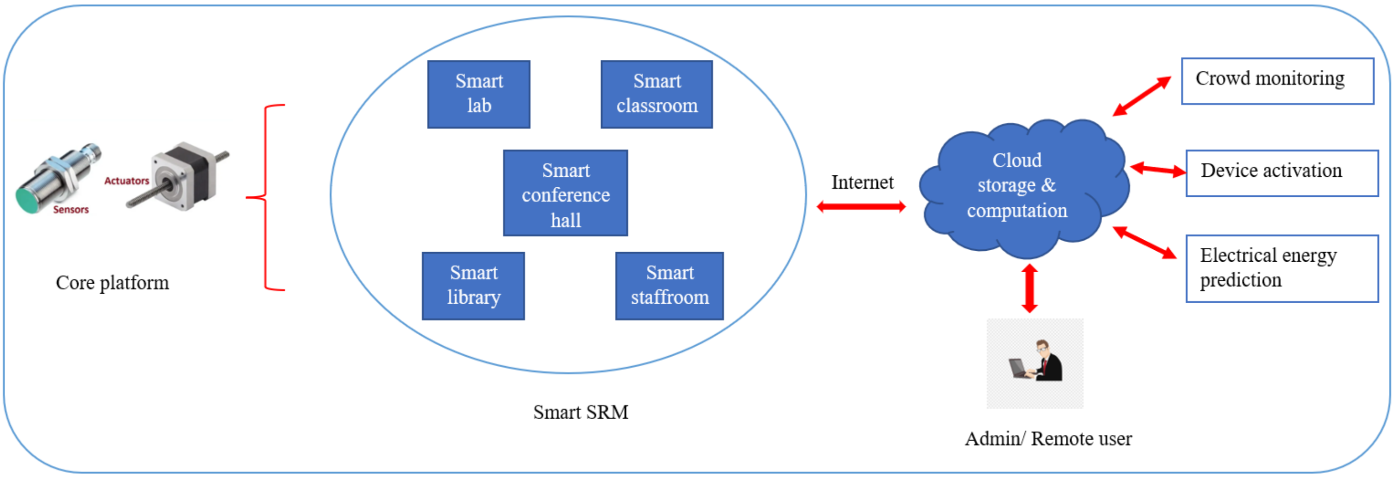


Figure1. Architecture diagram of IoT-enabled smart SRM building

Currently, the university class schedule works with two batches and separate slots for the theory, lab. At any time, t_i, there are two possibilities such as free classroom and active classroom. When faculty is not available in class or lab (CSE, civil, mechanical etc.), there is a possibility that electrical energy is wasted with a smaller number of students in the room. Hence, electrical energy allocation should be done based on faculty/student availability in the classroom. To overcome this problem, we propose an intelligent energy conservation system that automatically identifies the student count and ensures the accurate number of electrical devices turned on. Thus, the first module is to create an intelligent monitoring system using IoT devices.

MODULE 1: IoT-BASED MONITORING SYSTEM

- Observe the number of active classes/ labs per day
- Identify the strength in each class/lab
- Utilizing sensors to count every person entering the class/lab

In an intelligent system, the data collected by one device is analyzed to instruct another device for working. This process happens without human intervention. The outcome of the event is recorded, interpreted, and analyzed at the admin site. Thus, the second module intelligently triggers the required electrical devices based on the count of students/faculty collected in the monitoring phase.

MODULE 2: ELECTRICAL ENERGY CONSERVATION

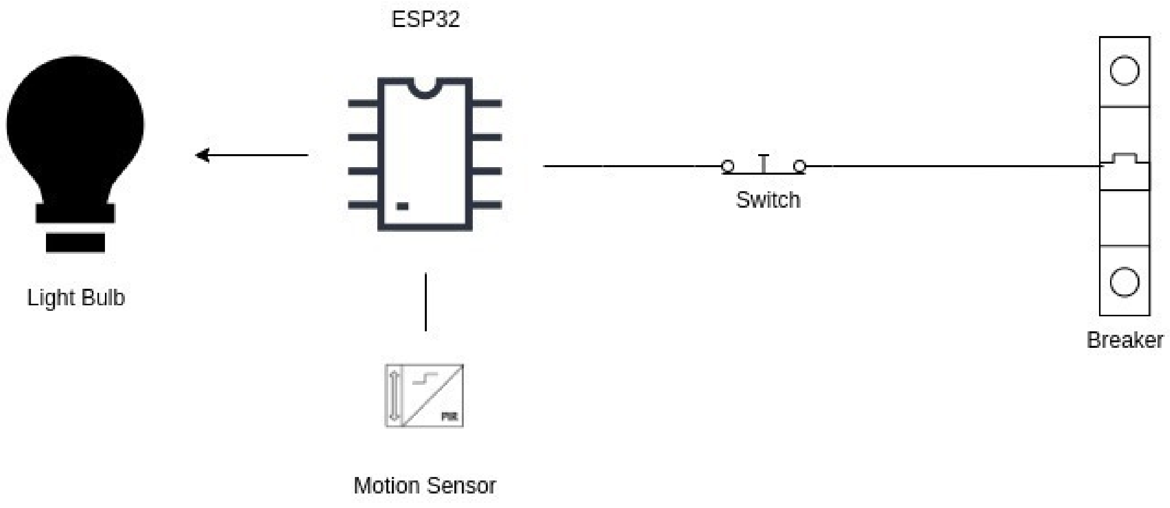
- Automatically triggering the electrical devices used in a classroom like a fan, bulbs, etc. based on the percentage of persons identified in the classroom

Finally, after the successful implementation of automation for electrical device usage, the statistics of energy usage are recorded and compared with the history. Further, with this data, our system will predict the required energy load in the future.

MODULE 3: ENERGY REQUIREMENT PREDICTION

- Predict the energy consumption in the future by applying machine learning techniques to the energy consumed statistics.
- It is used to report the saved energy.
- This helps to predict billing costs as well.

WORKING

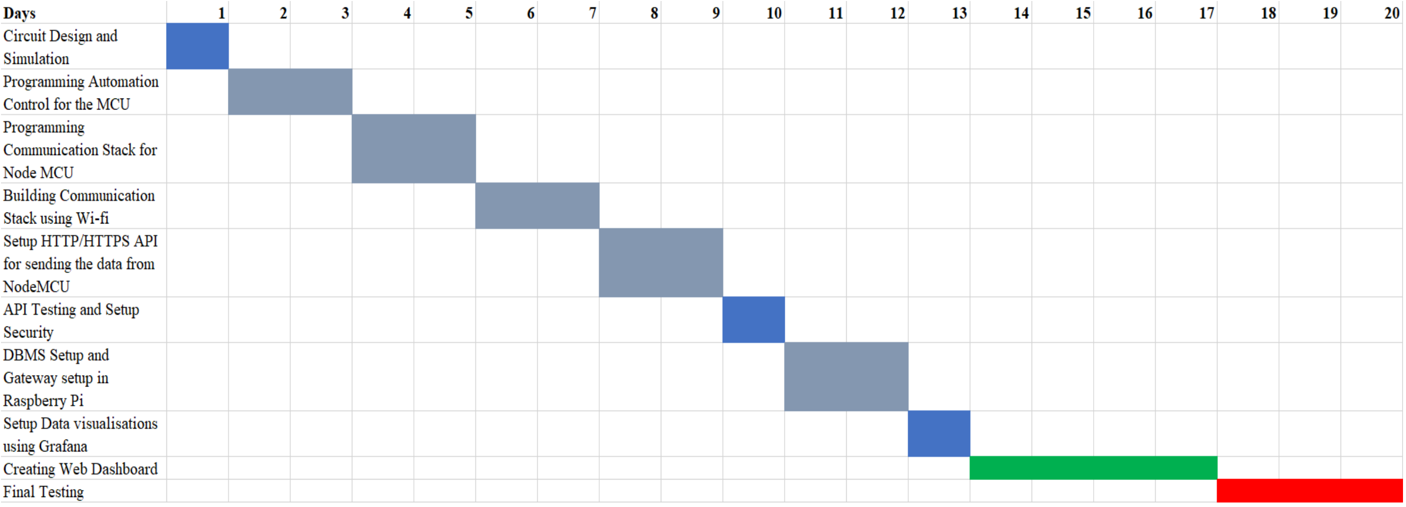


The ESP32 Microcontroller serves as an interface between the motion sensor and the electrical equipment in order for the prototype to function. The motion sensor signals the classroom's fan and lights when it notices activity The circuit breaker comes into action whenever there is an overload/short circuit. This is connected through an electrical switch to the microcontroller which prevents causing damage to the circuit.

EXPECTED DELIVERABLES

- Provide an automated environment with reduced cost
- Optimizing the electrical energy usage
- Meet the growing demand for affordable and sustainable energy in SRM.
- Supply electric energy as needed to meet the demands of the electric loads.
- Minimize electrical energy wastage, reduces carbon emissions, and achieve cost savings.

TIMELINE



BUDGET

For prototype:

Component	Amount (in Rs.)	Quantity	Total (in Rs.)
ESP Wi-fi Module	120	1	120
Relay Module	100	3	300
Atmega328p Microcontroller	130	1	130
Raspberry Pi (Min: 3B+, 2 GB Ram)	8000	1	8000
Voltage Sensor	110	1	110
Current Sensor	130	1	130
		Total:	Rs. 8790

For Tech Park implementation:

1. **Components required per classroom**

Component	Amount (in Rs.)	Quantity	Total (in Rs.)
ESP Wi-fi Module	120	1	120
Solid State Relays 8CH	900	1	900
Atmega328p Microcontroller	130	1	130
BMS for the system	1000	1	1000
Voltage Sensor: Industrial Grade	-	1	-
Current Sensor: Industrial Grade	-	1	-
		Subtotal:	Rs. 2150

2. **Components required for the entire building:**

Component	Amount (in Rs.)	Quantity	Total (in Rs.)
Raspberry Pi (Min: 4B, 4GB Ram)	13000	4	52000
AWS EC2	Depending on usage	-	Depending on usage
AWS IoT Central and Core	Depending on usage	-	Depending on usage

Total Cost for entire Tech Park building (assuming 90 classrooms)**: Rs. 2,45,500** (not including labs, library, staff rooms, washrooms)

TEAM MEMBERS

S. No.	Name	Designation	Department
1.	Raghav Gupta	Student	NWC
2.	Vijay Kumar Velpuri	Student	NWC
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MENTORS

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