Course Title : Embedded Systems and IoT
Course Code : CSE233

Assignment - 1

Submitted To :

Mr. Bakhtiar Muiz
Lecturer
Department of CSE
Daffodil International University

Submitted By :

Pijus Saha
ID : 221-15-5809
Section : 61_J
Department of CSE
Daffodil International University

Submission Date : 26-06-2025

ID: 221-15-50

Q1: What Percent of a capacitor's total charge is stored after 1 time constant and discharge after one time constant? Explain with graph.

Ans.:

A capacitor charges gradually, not instantly. So after 1 time constant (τ), the capacitor stores about 63% of its maximum charge. Because the capacitor follows an exponential charging curve at 1 time constant:

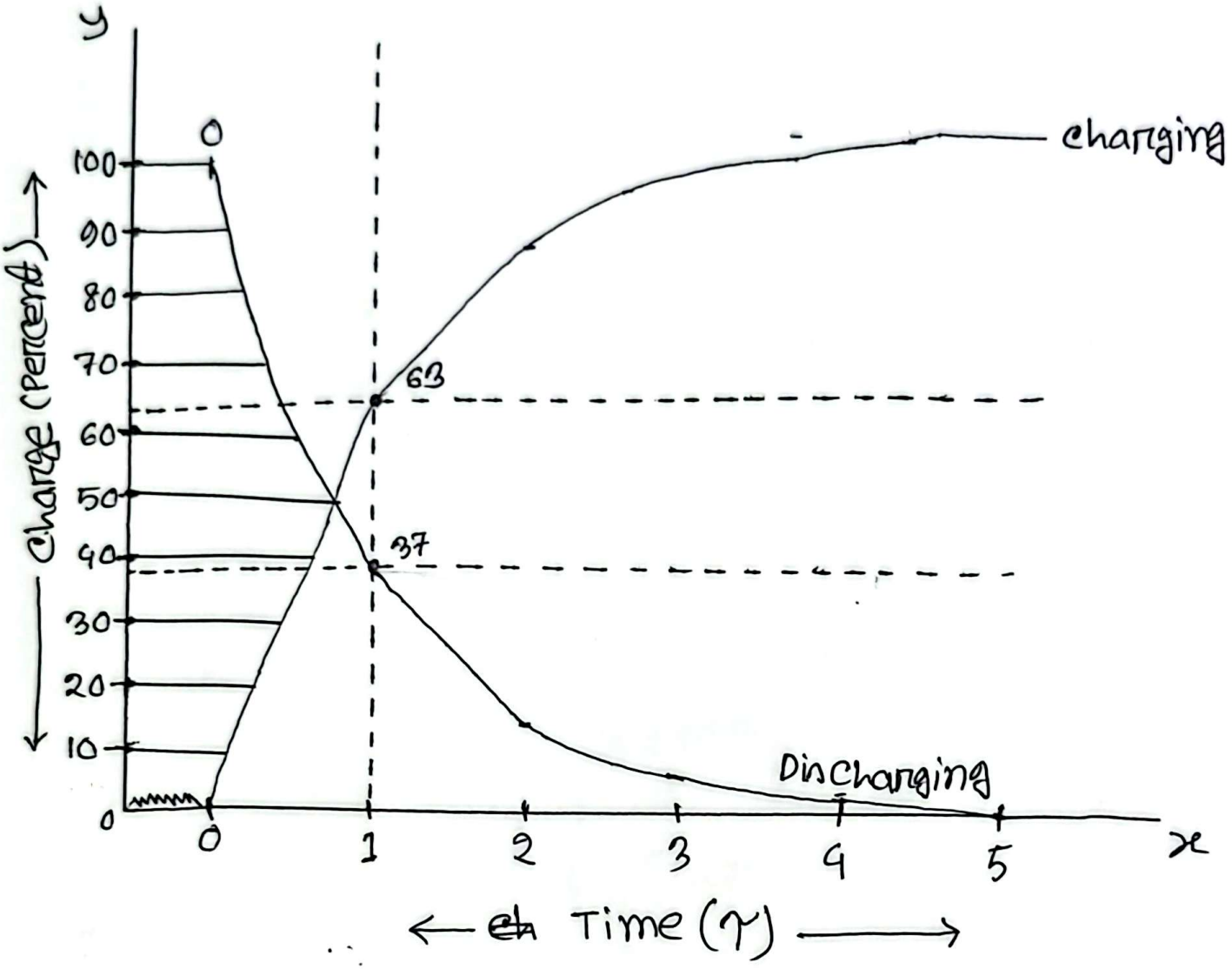
$$Q = Q_{max} \times (1 - e^{-1})$$
$$\approx Q_{max} \times 0.63$$

A discharging capacitor also loses charge gradually. After 1 time constant (τ), about 37% of the original charge remains, which means it has discharged about 63%.

$$Q = Q_{initial} \times e^{-1}$$
$$\approx Q_{initial} \times 0.37$$

ID: 221-15-5809

Graph:



Here

The x axis is time and Y axis is charge.

The curve starts at 0 and rises towards 100%. (Max charge). At 1τ, the charge is 63%.

The curve starts at 100 and drops down. At 1τ, only 37% charge remains.

ID: 221-15-5809

Q2: How would you design a smart energy management system for a commercial building using appropriate microcontrollers, sensors and actuators to monitor and optimized energy consumption? The system should track occupancy, lighting, HVAC (Heating, ventilation and Air conditioning) usage and power loads from veriious appliances, automatically adjusting based on occupancy and time of the day. It should also trigger alertes, when energy usage exceeds certain limits or when equipment failures are detected. Develop a schematic of the systems and provide a comprehensive list of required components.

Ans.:

According to the scenario, we can devide the system in 4 parts.

Brain: central microcontroller coordinating task and logic.

sensors: Detect occupancy, light levels, temparature and appliance status.

Actuators: switch or modulate lights, HVAC.

Alerts: Dashboard + Notification for threshold.

ID: 221-15-5809

Diagram:

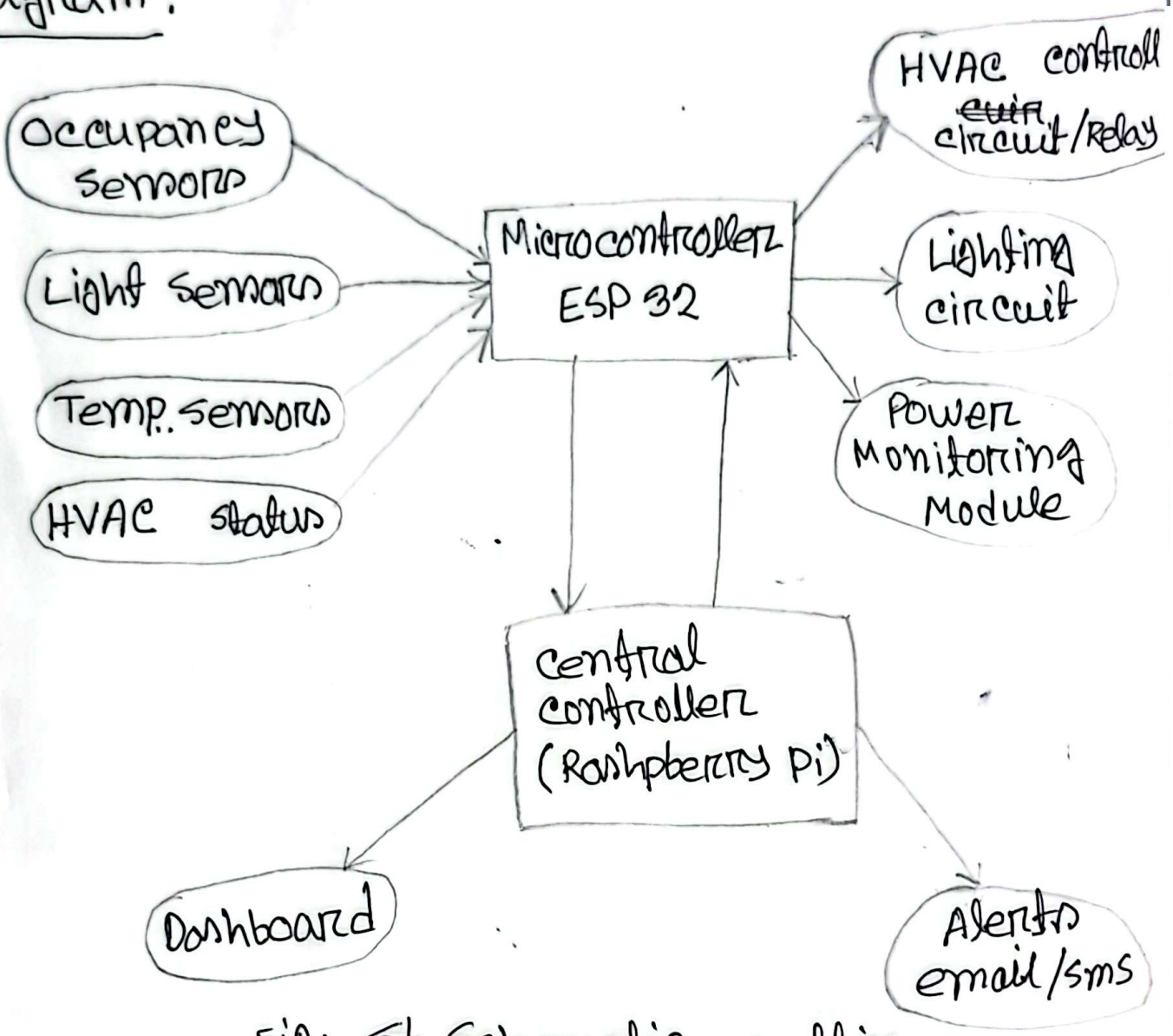


Fig: Schematic outline

Here,

For Data aggregation, ~~we can~~ UI, scheduling, analytic we can use Raspberry PI.

For WIFI communication and sensor interfacing we can use ESP 32 (Microcontroller).

ID: 221-15-5809

For motion detection in rooms and hall ways we can use PIR Sensor.

For detected ambient light we can use LDR.
For switch lighting circuits we can use SSR.

For HVAC power control we can use Relay+SSR.
For measure zones we can use Temperature Sensors.

For power monitoring clamp-on CT sensors can measure current of major loads.
ADC modules can read CT outputs.
Energy-monitoring board will also help.

For communication and Hub ESP32 and Pi will connect wifi network and MQTT broker can handle lightweight massege.

For store data we can use Sqlite and we can also intgrete web UI for Dashboard.

For Notification SMTP + SMS API will help so send emails and texet sms.
Buzzer and LED Pannel will help to on site alerts.