



Jacob Jack

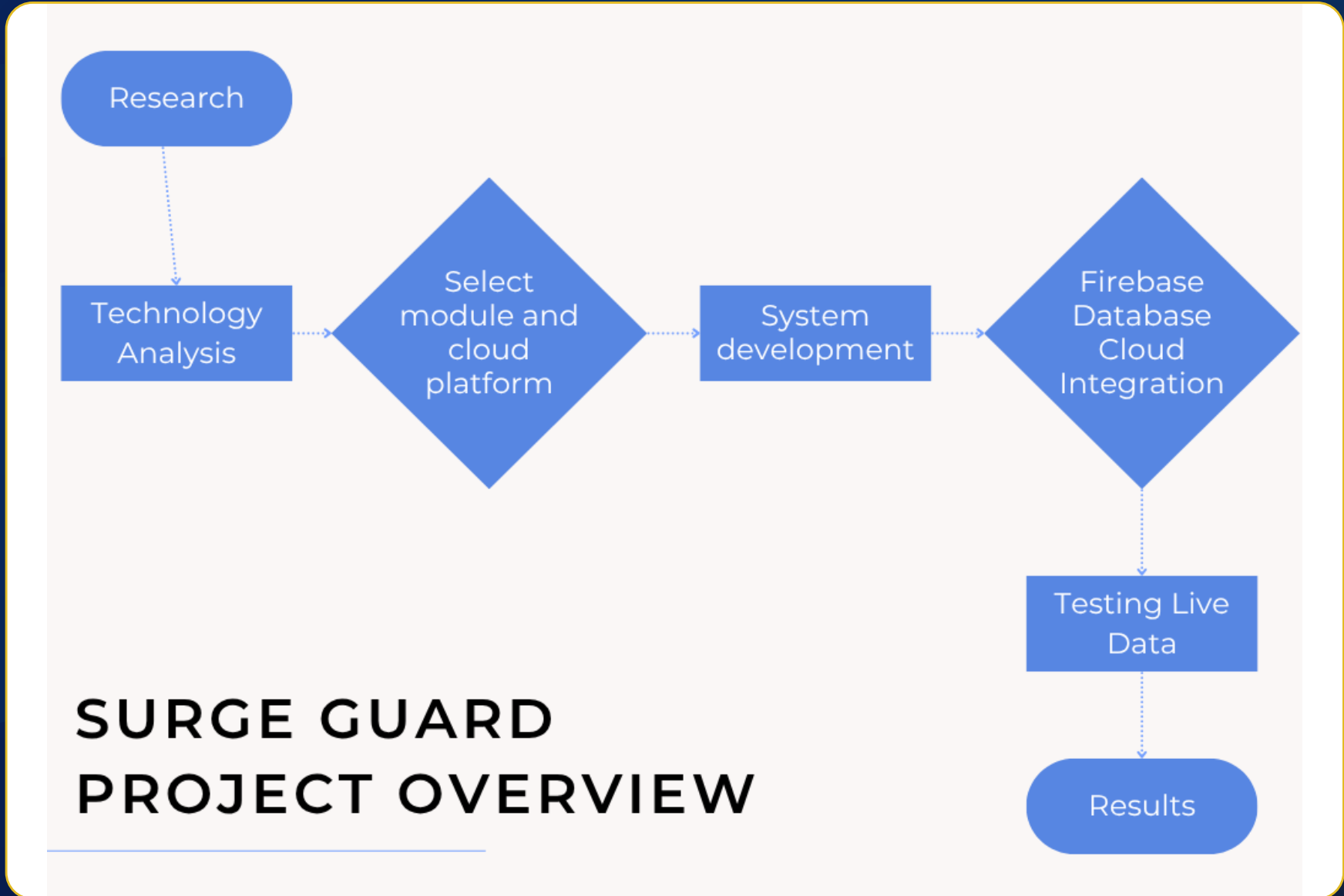
Bankoff/Hardin Award
Applied Physics and Computer Engineering Majors
Second Year ARCS Scholar



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Upgrading SurgeGuard: Cloud-Connected ESP32 for Real-Time Monitoring

Enhancing an electrical monitoring device by integrating an ESP32 with Wi-Fi, BLE, and Firebase Cloud Database. Enabling users to remotely track voltage, current, and fault history in real time through a mobile app.



BLE Provisioning

```
"wifiName": "jacob",
"wifiPassword": "esp32test",
"userUid": "abc123",
"id": "device001",
"userEmail": "firebase.dev.intern@gmail.com",
"userPassword": "1234567",
"faultStrTest": "OVERVOLT"
```

UART Parsing

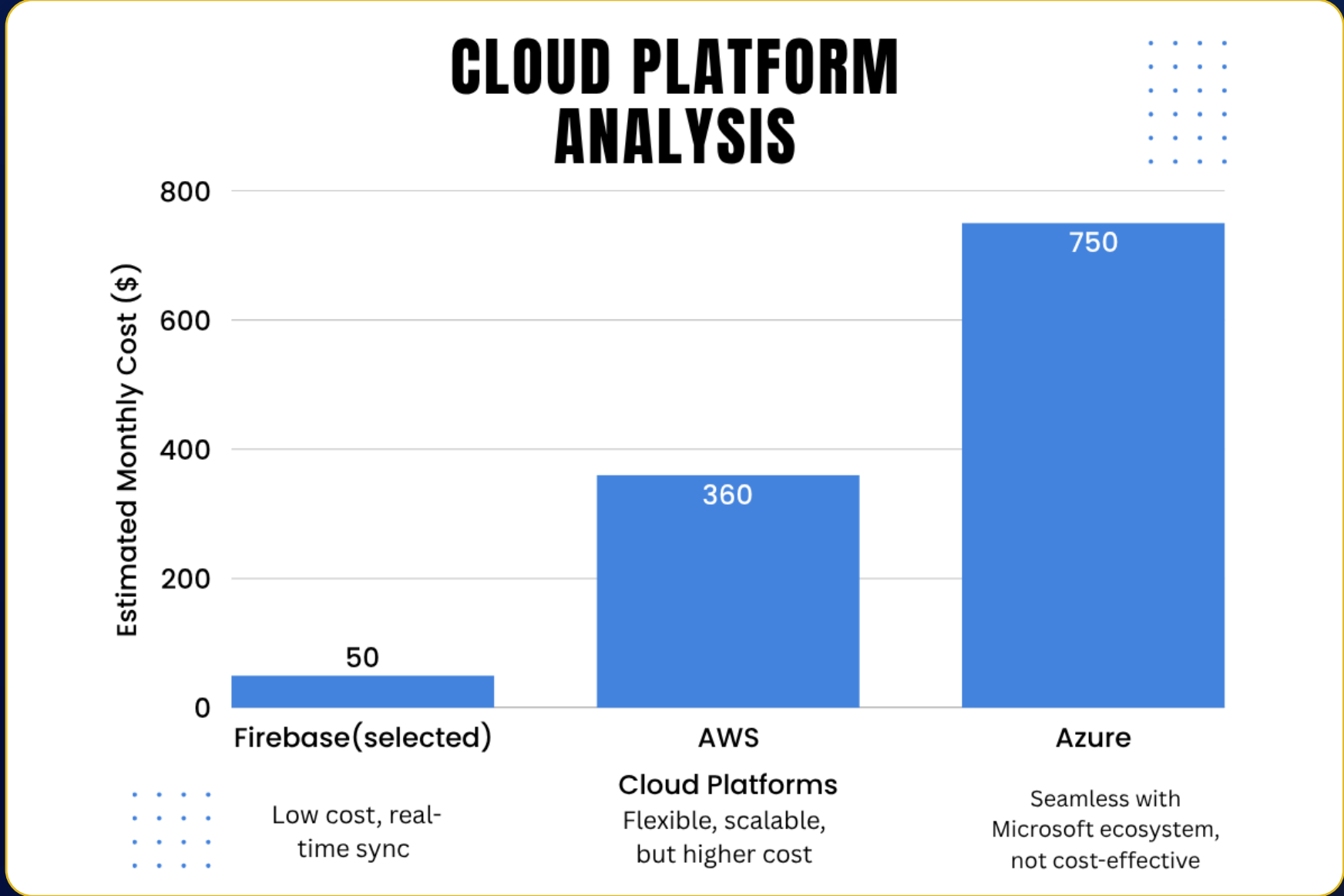
```
// Parse and assign values
L1volt = fields[2].toInt();
L2volt = fields[3].toInt();
L1current = fields[4].toInt();
L2current = fields[5].toInt();
gndVolt = fields[6].toInt();
NEUcurrent = fields[9].toInt();
tempPlugOutput = fields[10].toInt();
int power = fields[11].toInt();
runtime_sec = fields[12].toInt();
```

Cloud Integration

```
Database.set(aClient, basePath + "L1volt", String(L1volt));
Database.push(aClient, basePath + "Fault/FaultX/OVERVOLT", timestamp);
```

END-TO-END DATA FLOW

ESP32 advertises over BLE
App sends config JSON in BLE chunks
ESP32 parses JSON
Saves credentials in Preferences
Reboots → connects to Wifi



Module Comparison

Module	Pros	Cons
ESP32-C6-MINI (Selected)	Lowest overall cost, reliable BLE + Wi-Fi, strong community and Arduino/ESP-IDF support.	Limited memory compared to larger ESP32 variants.
ESP32-WROOM-32E-N16	Stable performance and widely adopted, supports multiple cloud platforms.	Higher cost (~\$4,856) makes it less efficient for scaling.
ESP32-WROOM-32E-N4	Good stability, broad cloud compatibility, solid programming ecosystem.	Still expensive (~\$4,107) compared to C3-MINI.
Realtek RTL8720DN	Very low unit price and supports MQTT/HTTPS connections.	Low adoption, SDK less mature, and supply is inconsistent.

