Power Termination, Diversion and Notification using “COSMIC”

Carbon Monoxide - Smoke - Interrupting - Circuit

Team Atlas

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Sponsor: Dan Combe, COEVAC, LLC

Introduction

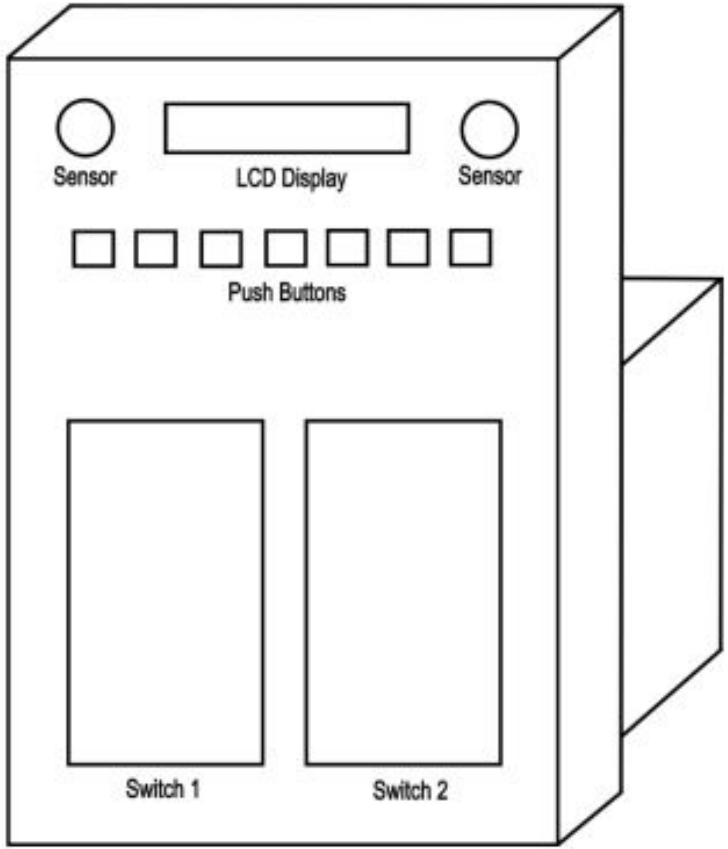
Team Atlas

- In the US, 1.1 million people require medical attention due to burns annually
- Of these, 40,000 require hospitalization and 10,000 die
- 3,275 people die from smoke inhalation every year and 500 die from carbon monoxide poisoning

The Goal

A smart home device that can

- Detect toxic gases
- Notify user of danger via a mobile app
- Cut off main power supply
- Start ventilation systems

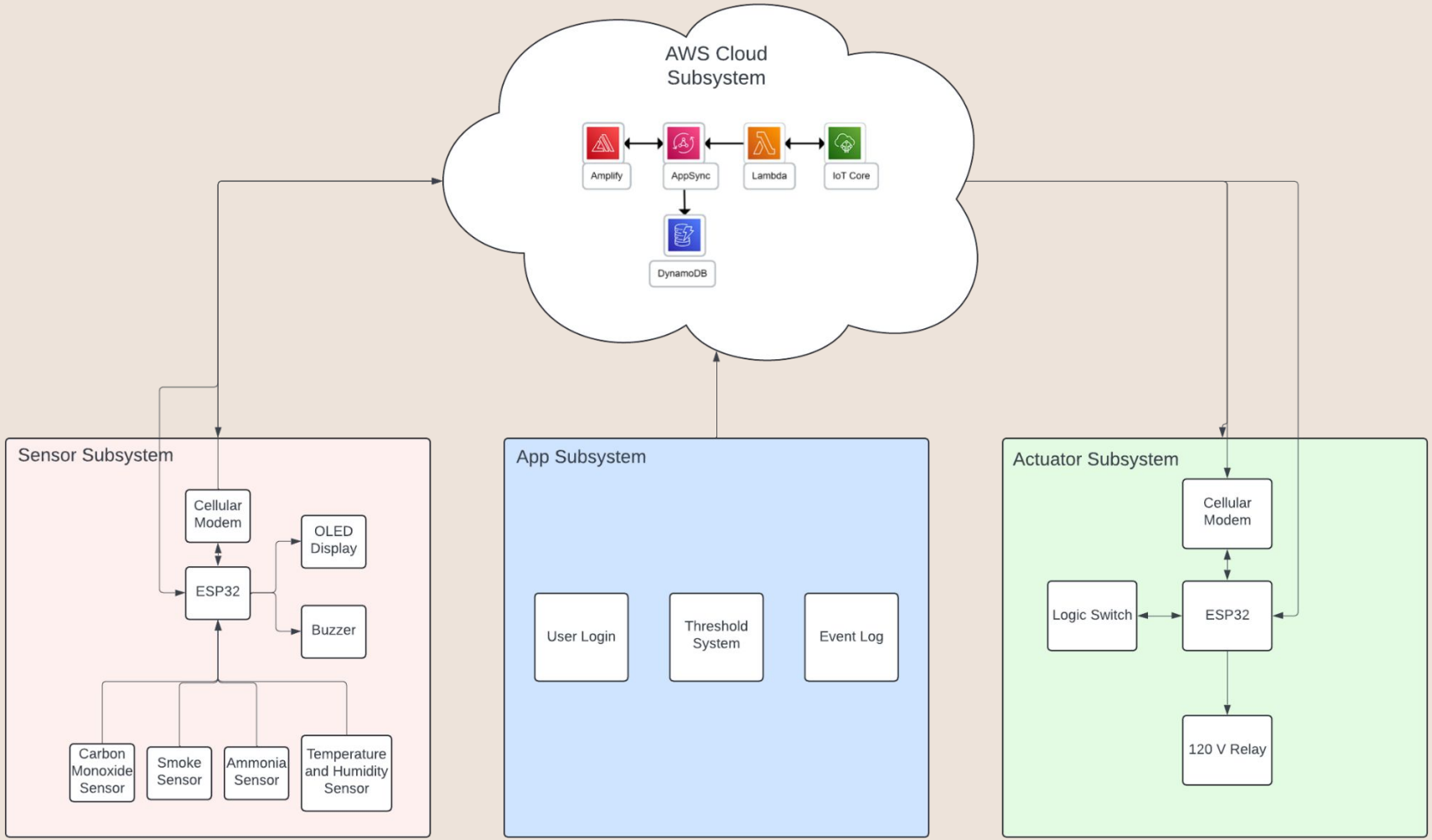


The Design

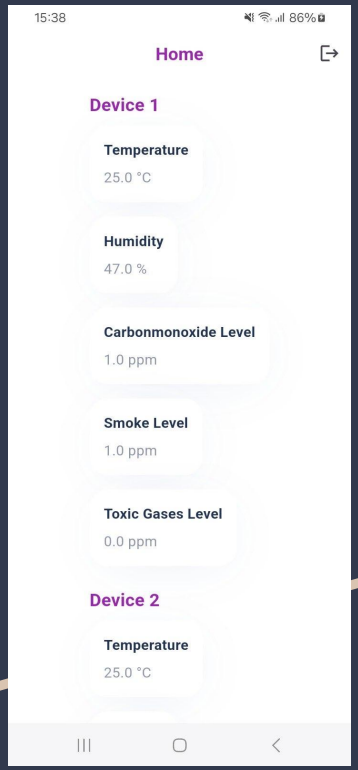
- Sensor Subsystem
  - Two (2) sensor subsystems
  - CO, CO2, Ammonia, Temperature, and Humidity sensors
  - Retrofit a two-gang electrical box
  - Will connect to WiFi and 4G LTE in case WiFi fails
  - Will display sensor values to the user
- Actuator Subsystem
  - Three (3) actuator subsystems
  - Will use relays to enable or disable an actuator
  - Will connect to WiFi and 4G LTE in case WiFi fails
- Cloud Subsystem
  - Will use AWS to communicate with the sensor/actuator subsystems
  - Will use a database to store data any time thresholds are exceeded
- Mobile App Subsystem
  - Will allow users to change the threshold in PPM of each detectable gas
  - Allows real-time look at sensor data

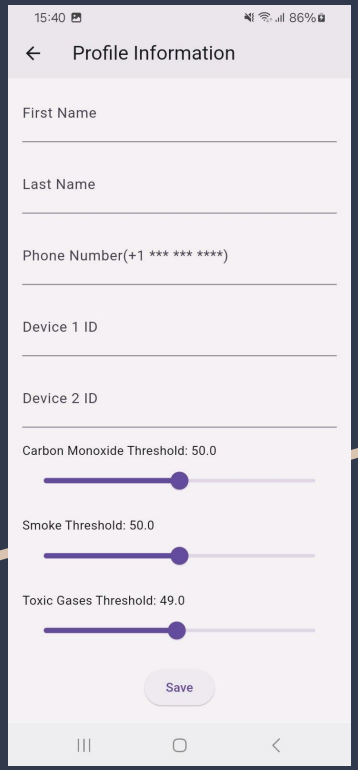
Implementation

- Sensor Subsystem
  - Custom 3D printed housing
  - Custom PCB
  - Power from the wall (90-240V)
  - OLED Display
  - Backup battery
  - Wireless communication (WiFi/4G LTE)
  - Status LED
- Actuator Subsystem
  - Commercial enclosure
  - Custom PCB
  - Wireless communication
  - Powered by wall outlet
  - Configurable switch on enclosure
  - Status LEDs
- Cloud Subsystem
  - Amazon Web Services (AWS)
- Mobile App Subsystem
  - Flutter for cross platform compatibility
  - Primary programming in Dart
  - Integrated AWS for backend
- Constraints
  - Budget - $2000
  - Size - two-gang switch (12.5 x 25 x 2.5 cm)


AWS Cloud Subsystem
Amplify
AppSync
Lambda
IoT Core
DynamoDB
Sensor Subsystem
Cellular Modem
OLED Display
ESP32
Buzzer
Carbon Monoxide Sensor
Smoke Sensor
Ammonia Sensor
Temperature and Humidity Sensor
App Subsystem
User Login
Threshold System
Event Log
Actuator Subsystem
Cellular Modem
Logic Switch
ESP32
120 V Relay

Results





- Sensor Subsystem
  - PCB with CO, CO2, ammonia, temperature, and humidity sensors
  - Displays each sensor value in real time in PPM using an OLED display
  - Can connect to WiFi / 4G LTE
  - Retrofits on two-gang light switch
- Actuator Subsystem
  - PCB prototype that powers an electronic device
  - Configurable switch for positive/negative logic
  - Can connect to WiFi and AWS
  - Can connect to 4G/LTE network
    - Uses AWS SSL certificates to function with SIM7000A cellular chip
- Cloud Subsystem
  - Can handle login and signup functions
  - Can send sensor value data to the mobile app
  - Can save user threshold values from the mobile app
  - Sends threshold value to sensors
  - Sends status values to actuators
- Mobile App Subsystem
  - Frontend enabling login and sign up processes
  - Frontend allowing the user to view the test sensor values from the cloud
  - Frontend allows the user to set threshold values

Conclusion

- We learned to plan for issues to arise ahead of time, so they can be dealt with while still meeting our deadlines
- It was fun to collaborate as a team to accomplish our goals.
- We enjoyed seeing many of the ideas and topics we learned in previous classes come to light in the projects design phase.
- Overall, our project has solved the problems we were presented with.

Future Work

- Sensor Subsystem
  - Streamlined PCB Layout
  - Smaller Sensors/Slimmer Enclosure
  - Improved battery charger circuit
  - Integrated ESP32/SIM7000A chips
  - Temperature Resistant Enclosure Material
- Actuator Subsystem
  - Smaller Design
  - Integrated ESP32/SIM7000A chips
- Cloud Subsystem
  - Streamline for reduced cost
  - Scalability implementation
- Mobile App Subsystem
  - Improved UI

Acknowledgements

Dr. Robin Pottathuparambil - Mentor

Dan Combe, COEVAC LLC. - Sponsor

References

- **Dan Combe -** Description/Requirements document
- SIM7000 AT Command Manual - Link
- SIM7000 MQTT Command Manual - Link
- MQ-2 Datasheet - Link
- MQ - 135 Datasheet - Link
- MQ - 7 Datasheet - Link
- Software Serial Library - Link
- Tiny GSM Library - Link

Questions?