19CSE303 - Embedded Systems

Advanced Clock-Based Real-Time Display System

Team members

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Components used

BH1750 (Light Sensor)

This component measures ambient light levels to provide real-time lighting data.

MAX4466 (Noise Sensor)

This sensor captures sound levels, allowing for noise monitoring in real-time.

DHT11 (Temperature and Humidity Sensor)

Utilized for measuring temperature and humidity levels, providing crucial environmental data.

OLED Display (128x64) SSD1306

A display module that shows real-time data visually, enhancing user interaction.

STM32F401CCU6 Board

A microcontroller board that processes data from all sensors and drives the display.

Bread Board (800 Pins)

Utilized for prototyping and connecting various components without soldering.

Jumper Wires

Flexible wires used to make connections between the components on the breadboard.

Concepts: I2C, SPI, ADC, Interrupt

Key communication protocols and modes that facilitate interaction between components.

Project Description

System Features

Real-Time Clock
- Accurate time display
- 24-hour format
- Battery backup capability

Environmental Monitoring
- Temperature: 0-50°C (±2°C)
- Humidity: 20-90% RH
- Light intensity: 1-65535 lux
- Noise level: 30-130 dB

Smart Display
- Dynamic emoji display based on environmental conditions
- Auto-brightness adjustment
- Multi-screen information cycling

Technical Challenges & Solutions

I2C Bus Management
Challenge: Multiple devices on same bus
Solution: Implemented device addressing and bus arbitration

Power Optimization
Challenge: Battery life constraints
Solution: Implemented sleep modes and adaptive sampling

Display Refresh
Challenge: Screen tearing during updates
Solution: Double buffering implementation

Results and Performance

System Performance

Display refresh rate: 1 Hz
Sensor sampling rate: 0.2 Hz
Power consumption: ~100mA at 3.3V

Accuracy Metrics

Time drift: <1 second/day
Temperature accuracy: ±0.5°C
Light sensing resolution: 1 lux

Future Enhancements

Hardware Upgrades

- WiFi module integration
- Additional environmental sensors
- Expanded display capabilities

Software Features

- Weather prediction
- Data logging capability
- Mobile app integration

Conclusion

Successfully implemented real-time environmental monitoring
Achieved reliable sensor integration
Created intuitive user interface with emoji feedback
Established foundation for future enhancements

Thank You