College of Engineering
College of Education

Smart Habitat Control

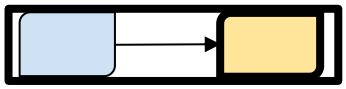
Project Overview
This Arduino-based project will be focused on making a habitat intended to have its temperature controlled.

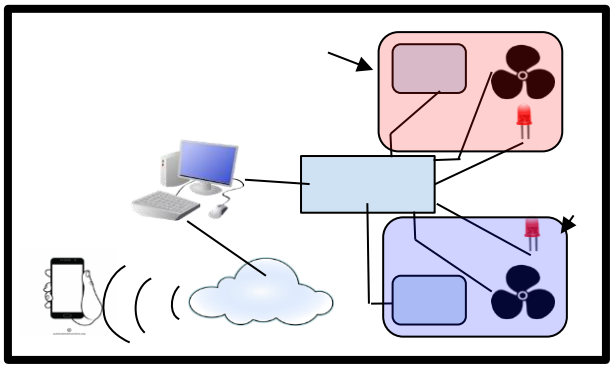
Course Connections	21st Century Skills	CTE Alignment
Middle School Science High School Physics High School Engineering	Communication, Critical Thinking, Collaboration	Energy, Environment, and Development Pathway

Objective
Students will make a habitat capable of controlling the temperature and reporting it via a smartphone interface

Materials
• ESP32 Microcontroller • 2 DHT11 Modules • 2 LED's, 2 red • 2 5v Fans • Breadboard • Wires (Male to female and Male to Male) • USB Cable • 220 ohm resistors • Computer

Block Diagram





Application

Many animals require special consideration in order to live. This is especially true for exotic animals that may require tropical conditions, or even different temperatures and conditions across multiple zones of the habitat. It would be convenient and useful if the owner of these sorts of animals could not just monitor the habitat from anywhere, but to be able to autonomously control the environment. This would make the care of these animals much more accurate and effective which would lead to a more comfortable environment for the animals. This can be scaled up to any size, perhaps even a full zoo.

Outline/Schedule

Part 1: Introduction to Smart Habitat Project (complete by Jun. 12)

- Introduce the problem of taking care of exotic animals as it relates to both home and zoos.
- Introduce the solution of a smart habitat and explain the benefits of using it.

- Discuss the materials needed for the project, draw the block diagram, explain how the system works.
- Describe the underlying function of the ESP32, DHT11 and the LEDs
- Assign team tasks, distribute materials, and plan the schedule.
- Record video clips for important steps.
- EQ: “What considerations should be taken into account when deciding what aspects of the project should be assigned to whom?”

Part 2: Programming the ESP32 Microcontroller (complete by Jun. 13/14)

- Introduce the ESP32 Microcontroller and its capabilities.
- Review the basics of programming with Arduino and ESP32.
- Describe how code works and the importance of comments
- Illustrate how code can be sectioned and written for ease of reading/maintenance
- Show variables and describe the difference between different scopes and types.
- Show how to turn on and use the serial monitor
- Show how to use and connect the DHT11 to the ESP32.
- Install the DHT11 library and show the connection between ESP32 and DHT11 modules.
- Demonstrate how to program the ESP32 to read temperature and humidity with the DHT11 modules and output the results to the serial monitor.
- Allow team time to program their microcontrollers and test them with the DHT11 modules.
- Record video clips for important steps.
- EQ: “What is the importance of easy to read/maintain code when designing a project?”

Part 3: Adding leds and fans (complete by Jun. 15/16)

- Introduce the “heaters” and the fans and introduce how they could be used to control the temperature of the system.
- Demonstrate how to connect and control the leds and fans with the ESP32 Microcontroller.
- Allow teams time to add leds and fans to their project and test it.
- Describe the idea of feedback control systems in general.
- Show how to design a feedback control system and relate it to temperature control
- Create variables for the control of the system (to be replaced in the next step with IOT).
- Record video clips for important steps.
- EQ: “What three components are in all feedback control systems?”

Part 4: Adding Arduino Cloud Integration (complete by Jun. 19/20)

- Introduce the concept of smart phone integration.
- Demonstrate how to use the Arduino Cloud with the ESP32 Microcontroller.
- Show the method of creating a project, variables, and building the app interface.

- Ensure that we cover the securing of the app using the secret code.
- Ask students about the importance of keeping our equipment secure.
- Allow teams time to integrate Arduino Cloud into their project and test it.
- Record video clips for important steps.

- EQ: “What are the benefits and problems of our increasingly connected world?”

Part 5: Finalizing and Testing the Project (complete by Jun. 21/22)

- Design the testing plan based on the project objectives and requirements.
- Discuss the troubles that students may encounter and how to troubleshoot.
- Describe testing procedure including creating tests
- Teach the importance of documentation for the future (including other workers who might need to maintain the code).
- Allow teams time to finalize their project and test it according to the testing plan provided.
- Have teams present their projects and demonstrate their functionality.
- Record video clips for important steps.
- Prepare the project presentation and make the video demo.
- EQ: “What are the long term costs/benefits of a bad/good Quality Assurance plan?”

Reflection

Have students reflect on their experience with the project and what they have learned about programming, robotics, and Arduino.

- Students should also reflect on what the most difficult part for them was. What could they use this for in their own lives?
- Discuss how STEM skills and knowledge can be applied to real-world problems and applications.
- Allow time for students to provide feedback on the project and suggest improvements for future iterations.

Sample Code

Sample Code