Brett Sitzman
Dr. Winikus
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Project 3: Midpoint

Part A: Project Statement

What is it?
This project is an interior climate monitoring system. It will read and report the temperature and humidity information. The display will be updated every second with the current reading. The LEDs will light up according to which unit of measurement is shown on the display (Celsius or Fahrenheit). The user will be able to input a temperature and humidity range via the keypad. If the device detects the climate is outside of that range, it will sound an alarm using the buzzer and notify the user on the display.

What is the purpose?
This device will be designed to monitor the microclimate inside a greenhouse. This will allow growers to maintain optimal conditions for their crops. This can prevent crops from dying due to improper climate factors. It also has the potential to increase the yield of a harvest, since the plants will be given the most ideal climate to support their growth and development.

What is the area of application?
Food Waste Minimization

How does it help in that area? Or what purpose does it serve there?
Growing crops isn't always an easy task; plants often require specific conditions to reach maturity and produce a quality harvest. This device seeks to help indoor growers monitor and maintain their growing climate in a way that is tailored to the crop they are growing. This will minimize food waste by ensuring that crops have what they need to survive. Not only can this prevent crop death but providing the ideal growing conditions for a plant also creates the possibility for an improved harvest.

Part B: Initial Constraints & Specifications

Constraints
1. Temperature will be measured in 2 units: Celsius and Fahrenheit
2. The device will begin in INPUT mode. In this mode the device obtains the user inputted temperature and humidity window through LCD prompts and the keypad.
   a. If the temperature or humidity values are not valid or do not fall into the ranges listed in the specifications section below, this process will start over
   b. Pressing 0-9 on the keypad will allow the user to input the humidity and temperature values
   c. Pressing * on the keypad will reset the field (ex. Max Temperature) they are currently specifying, so that they may reenter the value
   d. Pressing # on the keypad will set the field the user is specifying. The user will then be prompted for the next field if there is one remaining. If not, the device will display a prompt asking the user to confirm the ranges on screen by pressing A on the keypad to enter MONITOR mode.
3. Pressing A on the keypad will put the device in MONITOR mode. In this mode the device will read the current climate data and alert the user through the LCD and buzzer if the climate isn't in the specified range.
4. Pressing B on the keypad will put the device into IDLE mode. In this mode the buzzer is turned off and the device only reads/displays the current climate data. It does not check to see if the measured conditions fall into the specified range.
5. Pressing C on the keypad will change the unit of measurement between Celsius and Fahrenheit. A unique LED will light up corresponding to which unit of measurement the device is using.
6. Pressing D on the keypad will put the device into INPUT mode. This will allow the user to enter a new specified range for the temperature and humidity conditions.

Specifications
1. Can measure humidity in range 20%-95%
2. Humidity readings have an error range of $\pm 5\%$
3. Can measure temperature in range 0-50°C
4. Temperature readings have an error range of ± 2°C

Part C: Asks

Purpose

The purpose of this device will be to monitor the temperature and humidity inside greenhouses. It will help growers be aware of and adjust their current microclimate to provide the ideal growing conditions for the plants they are growing.

Inputs

1. Keypad – allows user to input a temperature and humidity range for the device to monitor, change unit of measurement between Celsius and Fahrenheit
2. DHT11 – read the current temperature and humidity in the device's environment

Outputs

1. LCD – displays prompts asking user to input a duration, alerts user to an incorrect input, displays current temperature and humidity information, and notifies user when a the environment conditions are no longer in the desired range
2. LEDs – light up according to which unit the device is measuring in (Celsius or Fahrenheit)
3. Buzzer – A sound-based alarm that is triggered when the environment conditions are outside the user specified range

Constraints

- Contains at least one previous external output peripheral
- Contains one new external input and output peripheral
- Includes a properly configured watchdog timer
- Incorporates synchronization techniques
- At least 1 bitwise driver configuration
- Critical section resource management required for entire implementation
- Uses at least one task/thread
- Includes at least 1 interrupt

Part D: Preliminary BOM

List of Required Materials:
- Nucleo-L4R5ZI
- Micro USB cable
- Solderless Breadboard
- Jumper Wires
- Resistors
- LCD
- 2x LED
- Keypad
- DHT11 – Humidity & Temperature Sensor (new input peripheral)
- Buzzer – Sound Alarm (new output peripheral)