Humidity Mapping and Recommendation System

CSE 321 - Realtime Embedded Systems

Project 3 Stage 1

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Part A: Project Statement

This proposal is for a household humidity mapping and recommendations Embedded system. The purpose of the system is to monitor a household's humidity levels within multiple rooms. Based on those levels an LED dot matrix will display the safety of the humidity in those rooms, specific colors will be used to represent whether the rooms humidity levels are safe, fair, or dangerous. There will also be and LCD screen displaying whether the user should turn on/off a dehumidifier or humidifier in a specific room. If a rooms level reaches a certain danger point a buzzer will go off until the level is safe. This application focuses on consumer safety while being autonomous in its data collection and corresponding behavior. When humidity levels become too high or low multiple risks are posed to the both the individuals house and personal wellbeing. When humidity crosses below the lower threshold, individuals are at risk of spreading aerial diseases easier and are more prone to nosebleeds[1]. When humidity crosses above the upper threshold, individuals' houses are at risk of mold and dampness which is a factor in over 20% of annual asthma cases[1]. Multiple rooms will be sensed for differing levels of humidity because certain rooms i.e. the laundry room, basement, or attic can all have drastically different levels of humidity[2].

Part B: Initial Constraints and Specifications

Constraints:

- System Watchdog must make sure program doesn't get stuck grabbing weather API data or user keypad data
- System must continuously monitor and map humidity levels as well as make recommendations
- The LED mapping will be limited to 3 colors; red, orange, and green
- Must use outdoor temperature API data to check the optimal indoor humidity levels
- Buzzer must continually buzz when humidity is at extremely dangerous levels and do so until it crosses behind that threshold again
- Without wireless interfacing between the DHT11s and the microcontroller, long wires will be needed to sample each room

Specifications:

- Keypad will trigger interrupt to input the users zip code
- Code will continuously update the dot matrix to reflect humidity levels
- Code will pull weather API data every 30 minutes to update the internal humidity calculations
- 5 DHT11s will be used as humidity sensors meaning there will be 5 data pins connected to the microcontroller
- LCD has 2 data connections to the controller

- Buzzer has 1 data connection to the controller
- Dot matrix has 2 data connections to the controller
- Breadboard is used to disperse 5V Vcc to all components
- Resistors used to help pull-up network for the DHT11s

Part C: Asks

Purpose:

Monitors a household's humidity levels within multiple rooms. Based on those levels an LED dot matrix will display the safety of the humidity in those rooms. If a room gets so unsafe a buzzer will alert the individual.

Inputs:

- Weather API
  - Outdoor temperature data for area code
- DHT11
  - Sense a rooms current humidity level
- Keypad
  - Lets the user enter their zip code to grab their locations weather data
  - When setting up the humidity sensors the user must give relative locations of each sensor to create an accurate LED dot mapping

Outputs:

- LCD
  - Humidifier/dehumidifier recommendations
- Buzzer
  - Reacts to extremely dangerous humidity levels
- Dot Matrix
  - Visual representation of all the rooms humidity levels

Constraints:

- See constraints above

Part D: Preliminary BOM

RGB LED Matrix Panel

https://www.amazon.com/BTF-LIGHTING-Individual-Addressable-Flexible-Controllers/dp/B088BTSPYD/ref=sr_1_7?keywords=dot%2Barray%2Bmatrix&qid=1637214773&sr=8-7&th=1

DHT11

https://www.amazon.com/gp/product/B01DKC2GQ0/ref=ox_sc_act_title_1?smid=A30QSGOJR8LMXA&psc=1

Buzzer

https://www.amazon.com/3-3-5V-Passive-Trigger-Buzzer-Arduino/dp/B00XT0PO18/ref=sr_1_1?keywords=C.J.+Shop+5PCS+DC+3.3-5V+Passive+Low+Level+Trigger+Buzzer+Alarm+Sound+Module+for+Arduino&qid=1637221236&sr=8-1

LCD

104020111 Seeed Studio | Mouser

1 kOhm Resistors

https://www.amazon.com/smseace-Resistor-Tolerance-Projects-Experiments/dp/B08P2NXT6Q/ref=sr_1_4?crid=3IKGJSAMVW1M5&keywords=1kohm+resistor&qid=1637221511&sprefix=1+kOhm+%2Caps%2C179&sr=8-4

Breadboard

https://www.amazon.com/Breadboards-Solderless-Breadboard-Distribution-Connecting/dp/B07DL13RZH/ref=sr_1_1_sspa?keywords=breadboard&qid=1637221556&sr=8-1-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUFJQUQwTFZWSVkxSFgmZW5jcnlwdGVkSWQ9QTA2NDcwNjkzUFY5NUhOTkI2Q1JLJmVuY3J5cHRlZEFkSWQ9QTA3ODI1MDYzOTdGQVNNODVCT0g1JndpZGdldE5hbWU9c3BfYXRmJmFjdGlvbj1jbGlja1JlZGlyZWN0JmRvTm90TG9nQ2xpY2s9dHJ1ZQ==

Keypad

https://www.amazon.com/YETAIDA-Arduino-Universial-Keyboard-Membrane/dp/B07Q7FW8B9/ref=sr_1_2_sspa?keywords=4x4+matrix+keypad&qid=1637272228&sr=8-2-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzTzQxQjIzR0w1M0UyJmVuY3J5cHRlZElkPUEwMTUxODk5MVFRSTRLUksxTFNPOSZlbmNyeXB0ZWRBZElkPUEwNTg1OTIxMkNQWjkzT0dBNkdHOCZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=

Long Jumper Wires

https://www.amazon.com/Elegoo-EL-CP-004-Multicolored-Breadboard-arduino/dp/B01EV70C78/ref=sr_1_1_sspa?keywords=100cm%2Bbreadboard%2Bjumper%2Bw

ires&qid=1637357014&sr=8-1-
spons&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEyQlVPVlY2TEJPR0NLJmVuY3J5cHRlZ
ElkPUEwMTEwMTQ5MVJFVFFHN0FUWEhKTSZlbmNyeXB0ZWRBZElkPUEwOTQ1MzI
xMUVLUFZPSjk1OTFYOSZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRp
cmVjdCZkb05vdExvZ0NsaWNrPXRydWU&th=1

References

1- Dangers of humidity

https://www.airthings.com/resources/everything-you-need-to-know-about-humidity

2- Differing humidity levels within a single home

http://www.airreflect.com/humidity-levels/

3- Weather API

https://openweathermap.org/price

4- C++ JSON conversion library

https://github.com/nlohmann/json/blob/develop/single_include/nlohmann/json.hpp