

Humidity Mapping and Recommendation System

CSE 321 - Realtime Embedded Systems

Project 3 Stage 1

Andrew Schick

## 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 an LCD screen displaying whether the user should turn on/off a dehumidifier or humidifier in a specific room. If a room's 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 both the individual's 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<sup>1</sup>. 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<sup>1</sup>. 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<sup>2</sup>.

## 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 user's 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](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=A30QSGOJR8LMAXA&psc=1](https://www.amazon.com/gp/product/B01DKC2GQ0/ref=ox_sc_act_title_1?smid=A30QSGOJR8LMAXA&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](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](https://www.amazon.com/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&srefix=1+kOhm+%2Caps%2C179&sr=8-4](https://www.amazon.com/smseace-Resistor-Tolerance-Projects-Experiments/dp/B08P2NXT6Q/ref=sr_1_4?crid=3IKGJSAMVW1M5&keywords=1kohm+resistor&qid=1637221511&srefix=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=ZW5jcnlwdGVkUXVhbGlmaWVyPUEFJQUQwTFZWSVksSFgmZW5jcnlwdGVkSWQ9QTA2NDcwNjkzUFY5NUhOTkI2Q1JLJmVuY3J5cHRlZEFkSWQ9QTA3ODI1MDYzOTdGQVNNODVCT0g1JndpZGdldE5hbWU9c3BfYXRmJmFjdGlvbj1jbGlja1JlZGlzWVWN0JmRvTm90TG9nQ2xpY2s9dHJ1ZQ==](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=ZW5jcnlwdGVkUXVhbGlmaWVyPUEFJQUQwTFZWSVksSFgmZW5jcnlwdGVkSWQ9QTA2NDcwNjkzUFY5NUhOTkI2Q1JLJmVuY3J5cHRlZEFkSWQ9QTA3ODI1MDYzOTdGQVNNODVCT0g1JndpZGdldE5hbWU9c3BfYXRmJmFjdGlvbj1jbGlja1JlZGlzWVWN0JmRvTm90TG9nQ2xpY2s9dHJ1ZQ==)

## Keypad

[https://www.amazon.com/YETAIDA-Arduino-Universal-KeyBoard-Membrane/dp/B07Q7FW8B9/ref=sr\\_1\\_2\\_sspa?keywords=4x4+matrix+keypad&qid=1637272228&sr=8-2-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzTzQxQjIzR0w1M0UyJmVuY3J5cHRlZElkPUEwMTUxODk5MVFRSTRLUksxTFNPOSZlbnNyeXB0ZWZlZElkPUEwNTg1OTIxMkNQWjkzT0dBNkdHOCZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=](https://www.amazon.com/YETAIDA-Arduino-Universal-KeyBoard-Membrane/dp/B07Q7FW8B9/ref=sr_1_2_sspa?keywords=4x4+matrix+keypad&qid=1637272228&sr=8-2-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzTzQxQjIzR0w1M0UyJmVuY3J5cHRlZElkPUEwMTUxODk5MVFRSTRLUksxTFNPOSZlbnNyeXB0ZWZlZElkPUEwNTg1OTIxMkNQWjkzT0dBNkdHOCZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=)

## 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](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=ZW5jcnlwdGVkUXVhbGlmaWVyPUEyQlVPVlY2TEJPR0NLJmVuY3J5cHRIZElkPUEwMTEwMTQ5MVJFVFFHN0FUWEhKTSZlbnNyeXB0ZWRBZEIkPUEwOTQ1MzIxMUVLUFZPSjk1OTFYOSZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNRPXRYdWU&th=1](https://www.airthings.com/resources/everything-you-need-to-know-about-humidity)

## 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](https://github.com/nlohmann/json/blob/develop/single_include/nlohmann/json.hpp)