PROJECT REPORT

Course Information:

Course Name: Microprocessor Interfacing & Embedded System

Course Code: CSE331

Project Title: Temperature & Humidity Detection Using Embedded System.

Section: 2

Faculty: Dr. Mohammad Abdul Qayum (MAQM)

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Abstract:

The Microcontroller Unit (MCU) is a critical component of embedded system architecture. The STM32 microcontroller offers one of the best ecosystems, supporting various programmer kits and peripherals such as sensors, displays, and keypads to operate simultaneously. For our embedded system project that detects temperature and humidity, we will utilize the STM32 along with its peripherals. Specifically, we have selected the STM32F103C8T6 - Blue Pill as the primary MCU. Instead of an LCD module, we will use an I2C OLED display, along with the temperature and humidity sensors and a buzzer with red LED. Connections will be made using the jumper wires and a breadboard. STM32CubeIDE will be used for programming the system and ST Link V2 will be used to inject that programming code onto the microcontroller.

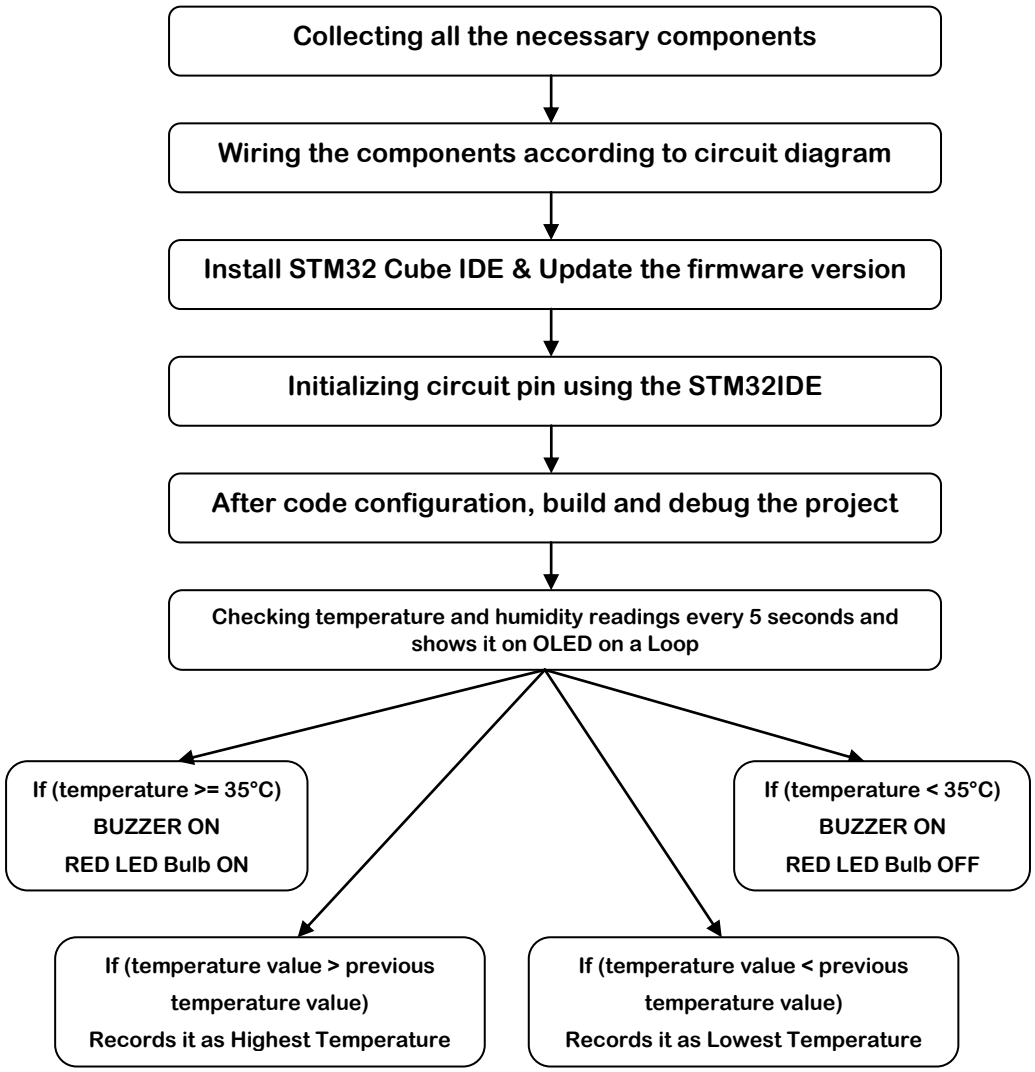
Theory:

In this project, we are dedicated to developing and constructing an embedded system centered on the STM32F103C8T6 - Blue Pill microcontroller, designed to accurately measure the humidity and temperature levels in the surrounding air using dedicated sensor DHT11 Temperature and Relative Humidity Sensor Module. The microcontroller serves as the core processing unit, managing the acquisition of environmental data. For enhanced and reliable electrical connections, we soldered the microcontroller pins. Instead of LEDs, our system integrates a buzzer that emits a beep when the temperature exceeds 35 degrees Celsius, providing an audible alert and the red LED bulb will glow. The temperature readings, along with highest and lowest temperature, are supposed to be displayed in both Celsius ('C') and Fahrenheit ('F'), with humidity readings, of which all are shown to the nearest one decimal point. The sensor data is presented on an I2C OLED display, establishing a practical and responsive solution for real-time monitoring and responding to environmental conditions.

Hardware & Software Requirements:

1. STM32F103C8T6 - Blue Pill
2. ST LINK V2 Mini STM8 STM32 Simulator Download Programmer
3. 0.96’’ Inch I2C OLED Display
4. DHT11 Temperature & Relative Humidity Sensor
5. Active Buzzer 5V & Red LED Bulb
6. Jumper wire
7. Bread Board
8. STM32 CUBE IDE

System Diagram:



Circuit Diagram:

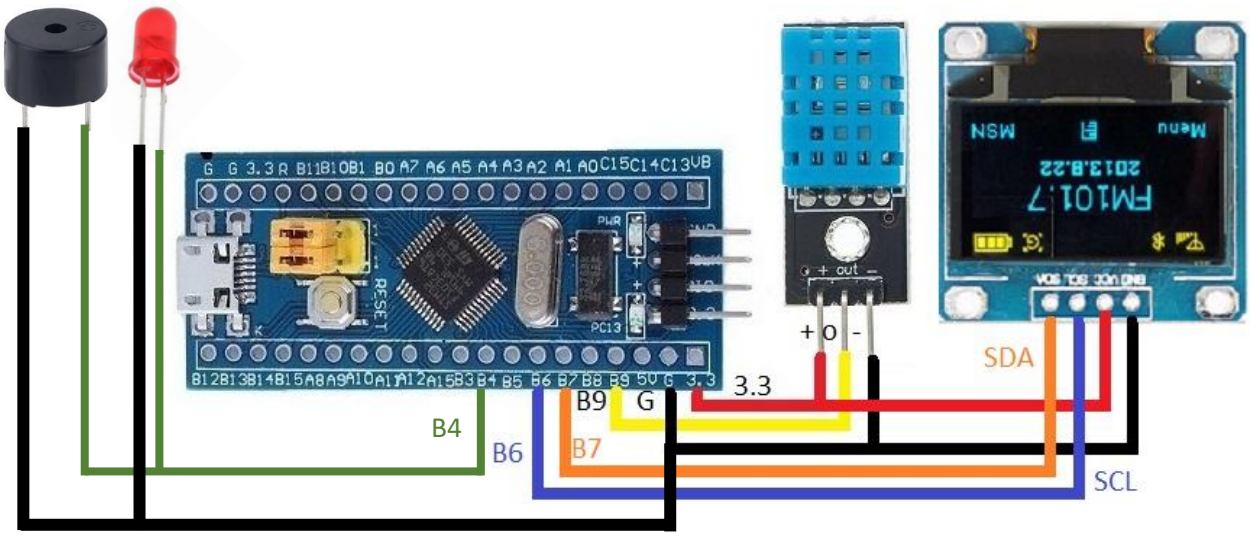


Figure: Circuit Diagram

Result:

In conclusion, we have successfully developed an embedded system capable of precisely measuring both temperature and humidity in the air. The system incorporates a DHT11 sensor for accurate environmental data acquisition. The temperature and relative humidity readings obtained from the DHT11 sensor are displayed on an I2C OLED display, ensuring user-friendly accessibility. We integrated a buzzer and a red LED that activates when the temperature exceeds 35 degrees Celsius, providing an audible and visual alert and also, it records the highest and lowest temperature by comparing the reading with its previous one i.e. if present temperature value > 5 seconds previous temperature value, then it is recorded as the highest temperature and if it is less than, then recorded as lowest. Temperature readings, presented in both Celsius ('C') and Fahrenheit ('F'), and humidity readings, all are displayed to the nearest one decimal point on OLED display. This comprehensive solution provides real-time insights into atmospheric conditions while ensuring a clear and convenient display of data, meeting our goal of creating a robust and user-friendly embedded system for temperature and humidity monitoring. Additionally, soldering the microcontroller pins ensured strong and reliable electrical connections, enhancing the overall performance and durability of the system.

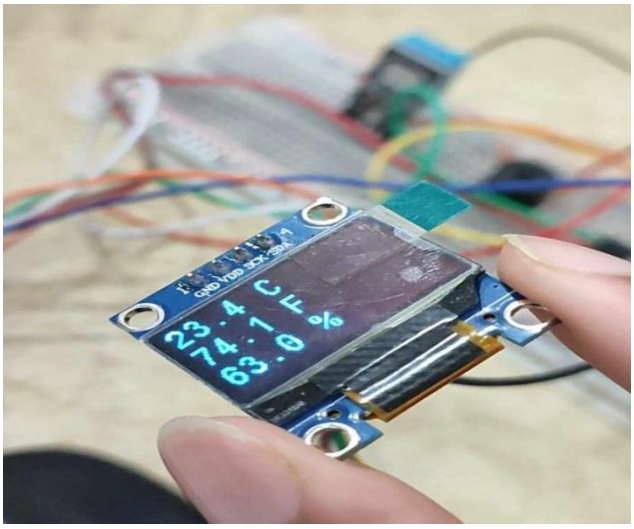
Total Cost:

Components	Price (TK)
STM32F103C8T6 Blue Pill	425
ST-LINK V2 Mini STM8 STM32 in-circuit debugger	585
16x2 LCD Module with I2C header	340
0.96’’ Inch I2C OLED Display	420
DHT11 Temperature & Relative Humidity Sensor	185
Wires	200
Bread board	88
Soldering	120
Active Buzzer 5V	18
Blue LED 5mm (5 packs)	30
Delivery	110
Total	**2521**

Source Code:

- GitHub Link: [Temperature-And-Humidity-Measure-With-STM32F1-Microcontroller]

Snapshots of our Output:

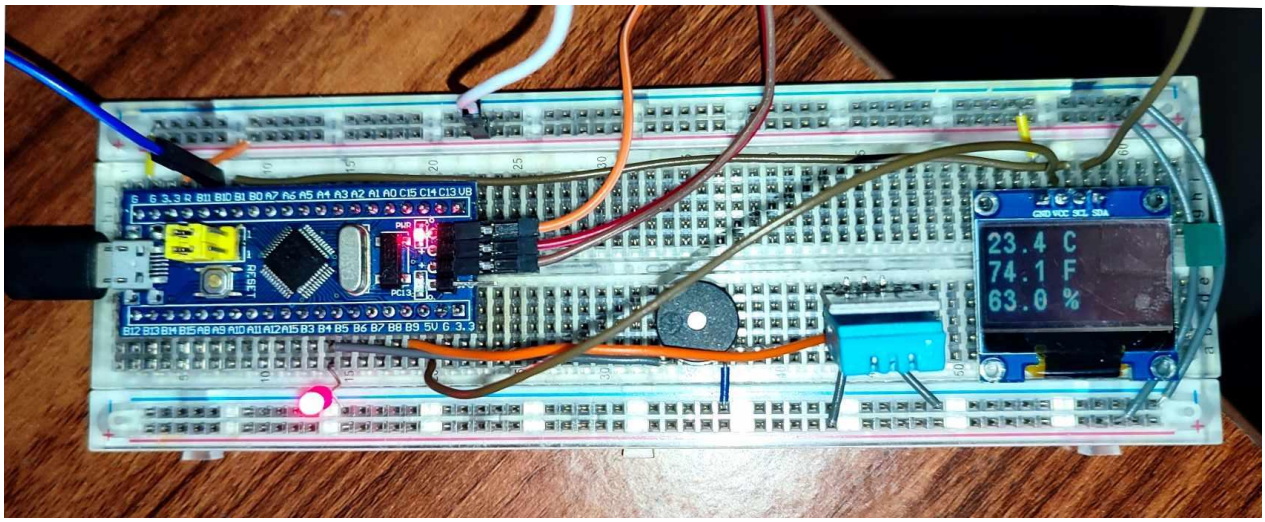


This shows:

Temperature in Celsius: 23.4

Temperature in Fahrenheit: 74.1

Humidity: 63.0%



Reference:

1. STM32 Tutorials: 40. STM32CubeIDE DHT11 Temperature and Humidity Sensor / OLED with STM32F103C8T6
2. STM32 labs: https://web.eece.maine.edu/~zhu/book/lab.php
3. Code Docs: https://www.micropeta.com/video40