Project Report On

Project 1
IoT Based Smart Home Monitoring using B-U585I-IOT02A

For The Subject Term Work Submission Of

CPE – 556 Computing Principles for Mobile and Embedded Systems

By

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Abstract:

This project demonstrates a smart environmental monitoring system leveraging the capabilities of the STM32 B-U585I-IOT02A Discovery Kit. The aim is to capture ambient environmental conditions such as temperature and humidity using the onboard HTS221 sensor and transmit this data wirelessly to the ThingSpeak IoT cloud platform for visualization and analysis. Communication between the STM32 and the ESP8266 NodeMCU is established through a USART interface using AT commands. The implementation is designed using bare-metal programming techniques, focusing on direct register-level configuration of I2C and USART peripherals without relying on abstraction layers like STM32 HAL or RTOS frameworks. This approach ensures optimized control, precise timing, and a deeper understanding of embedded communication protocols. The system successfully demonstrates the integration of embedded sensing, low-level firmware development, and cloud connectivity.

Introduction:

The Internet of Things (IoT) continues to revolutionize modern embedded systems by enabling real-time environmental monitoring and data-driven decision-making. Microcontroller-based IoT nodes play a pivotal role in acquiring, processing, and transmitting data from sensors to cloud platforms for remote accessibility and analysis. In this project, we utilize the STM32 B-U585I-IOT02A board—a powerful and feature-rich development kit from STMicroelectronics—as the core processing unit. The system is designed to measure environmental parameters such as temperature and humidity using the HTS221 sensor and communicate the collected data to ThingSpeak via an ESP8266 Wi-Fi module. By choosing bare-metal programming, we highlight the granular control and performance benefits of low-level development while learning how to manually configure hardware interfaces. The system reflects a practical, scalable IoT framework capable of integration into larger monitoring and automation applications.

System Overview

- STM32 B-U585I-IOT02A serves as the sensing and processing unit
- ESP8266 NodeMCU used for Wi-Fi and cloud communication
- Data is uploaded to ThingSpeak using HTTP GET via AT commands

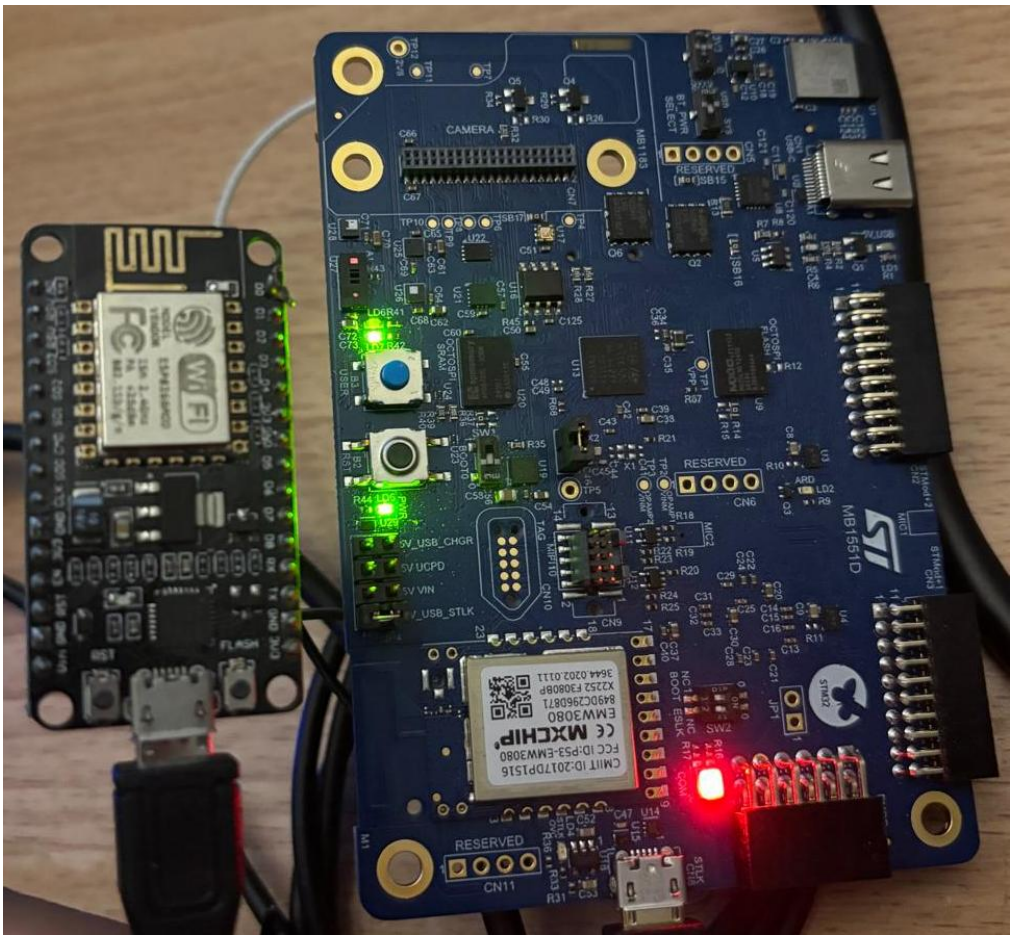

Figure 1: Hardware setup

Hardware

- STM32 B-U585I-IOT02A Discovery Kit
- Onboard Sensors:
  - HTS221 (Humidity & Temperature) via I2C2
- ESP8266 NodeMCU via USART3

Software Design

- Bare-metal STM32 project in C (Keil uVision)
- Direct register configuration for I2C, USART, GPIO
- HTS221 enabled and read over I2C2
- USART3 communicates with ESP8266
- AT command-based interaction: CWJAP, CIPSTART, CIPSEND, HTTP GET
- wait_for_response() function used for polling AT replies

Results

- Real-time temperature and humidity data on Thingspeak
- Successful ThingSpeak channel updates
- LED indicators confirm success (green) or failure (red)
- Stable UART and I2C performance

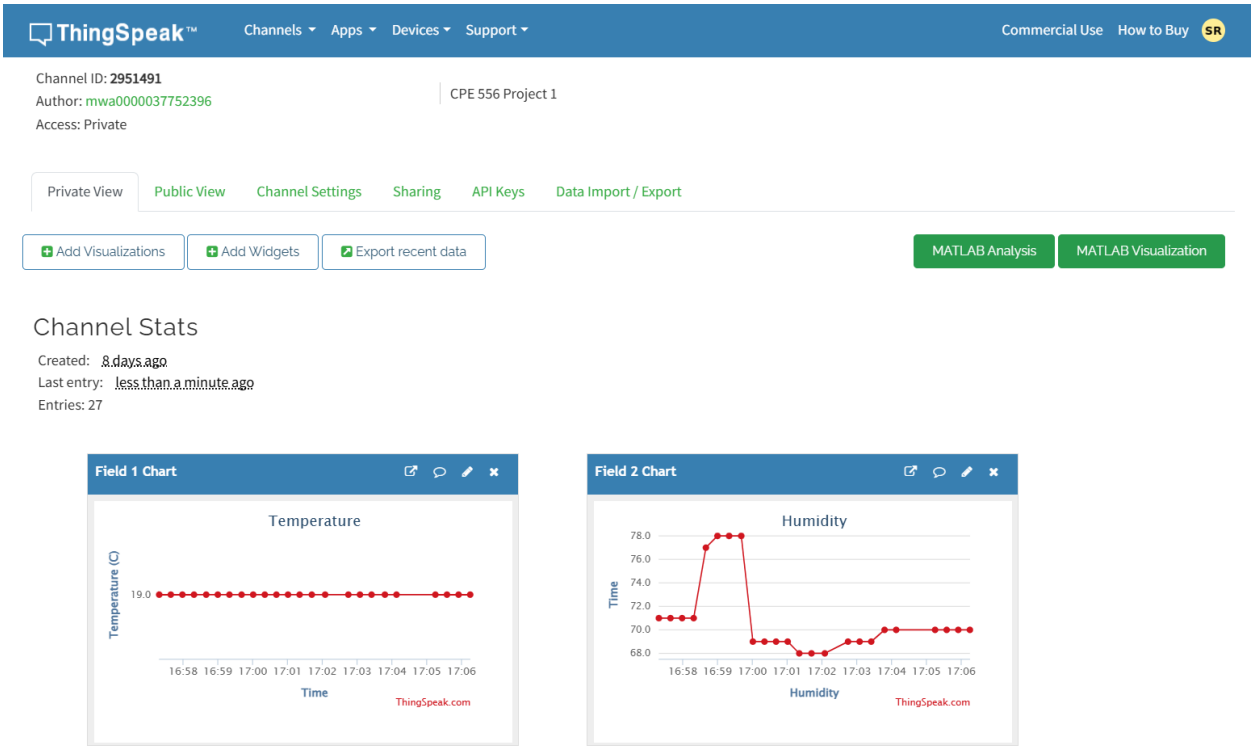

Figure 2: Thingspeak Panel

Conclusion

This project confirms that the STM32U5-based discovery board can operate as a robust data acquisition system. Combined with ESP8266, it becomes an effective IoT node with cloud connectivity.

Future Work

- Implement EEPROM to store SSID/password
- Enable pressure and light sensor reading (LPS22HH, VL53L0X)
- Replace ESP8266 AT commands with onboard TCP/IP stack