

CYBER PHYSICAL SYSTEM

**BlueNode Network:Advanced BLE Sensor
Integration**

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**THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY**
(Deemed to be University)

Overview

- ▶ Introduction
- ▶ GSM Module
- ▶ GSM Module with BLE
- ▶ ThingSpeak
- ▶ ThingSpeak with UART SHT40
- ▶ Specifications
- ▶ Wrap -Up

DEPARTMENT OF SCIENCE & TECHNOLOGY
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AWaDH CPS Labs

At Thapar Institute of Engineering and technology

100+ Experiments

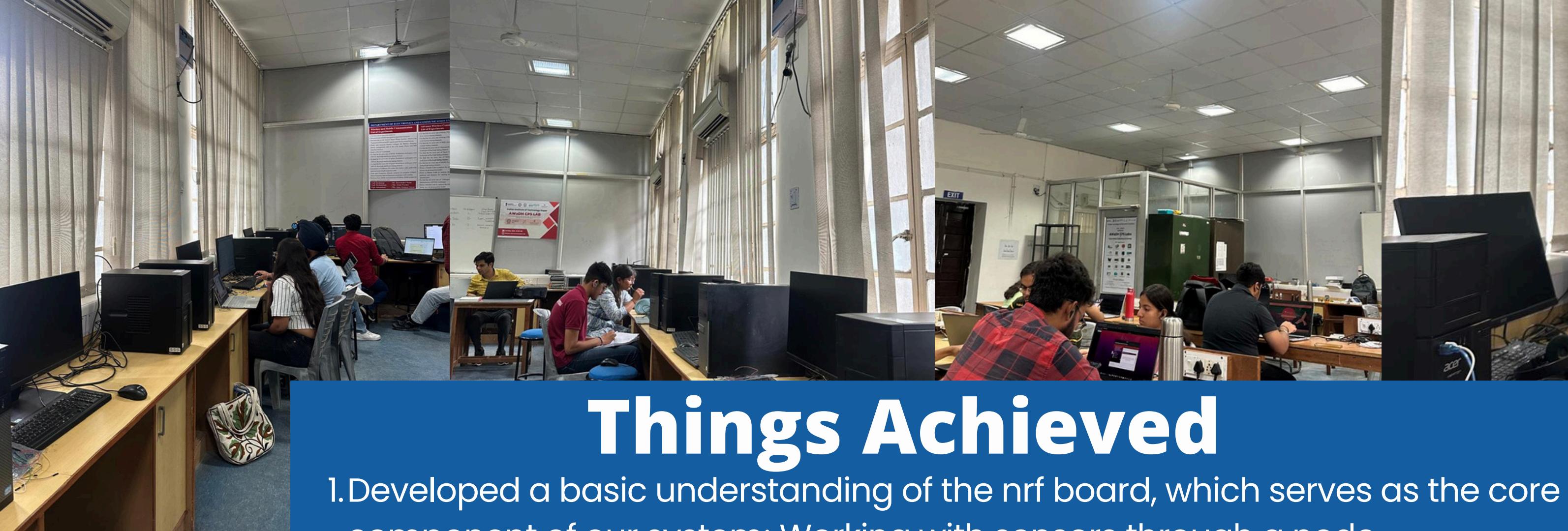
The grid contains 20 items, each with a small image and a label:
BLE GATEWAY, Low Power SNAP, Air Sense, Activity Monitor Kit
Weather Monitoring Sensor System, Solar Charging Module, BLE NODE, 4G/5G WITH BLE
BLE Grove Shield, FLASH TOOL, SOLAR BMS, LIS3DH Sensor Board
STTS751 Sensor Board, SHT40 Sensor Board, W25Q16 Memory, BLE Development Kit
LUX Sensor, Relay Board, Acoustic Module Node, Buzzer Board

CPS Lab Coordinators

Dr. Surbhi Sharma
Associate Professor
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CPS Lab Coordinator, TIET

Department of Electronics & Communication Engineering



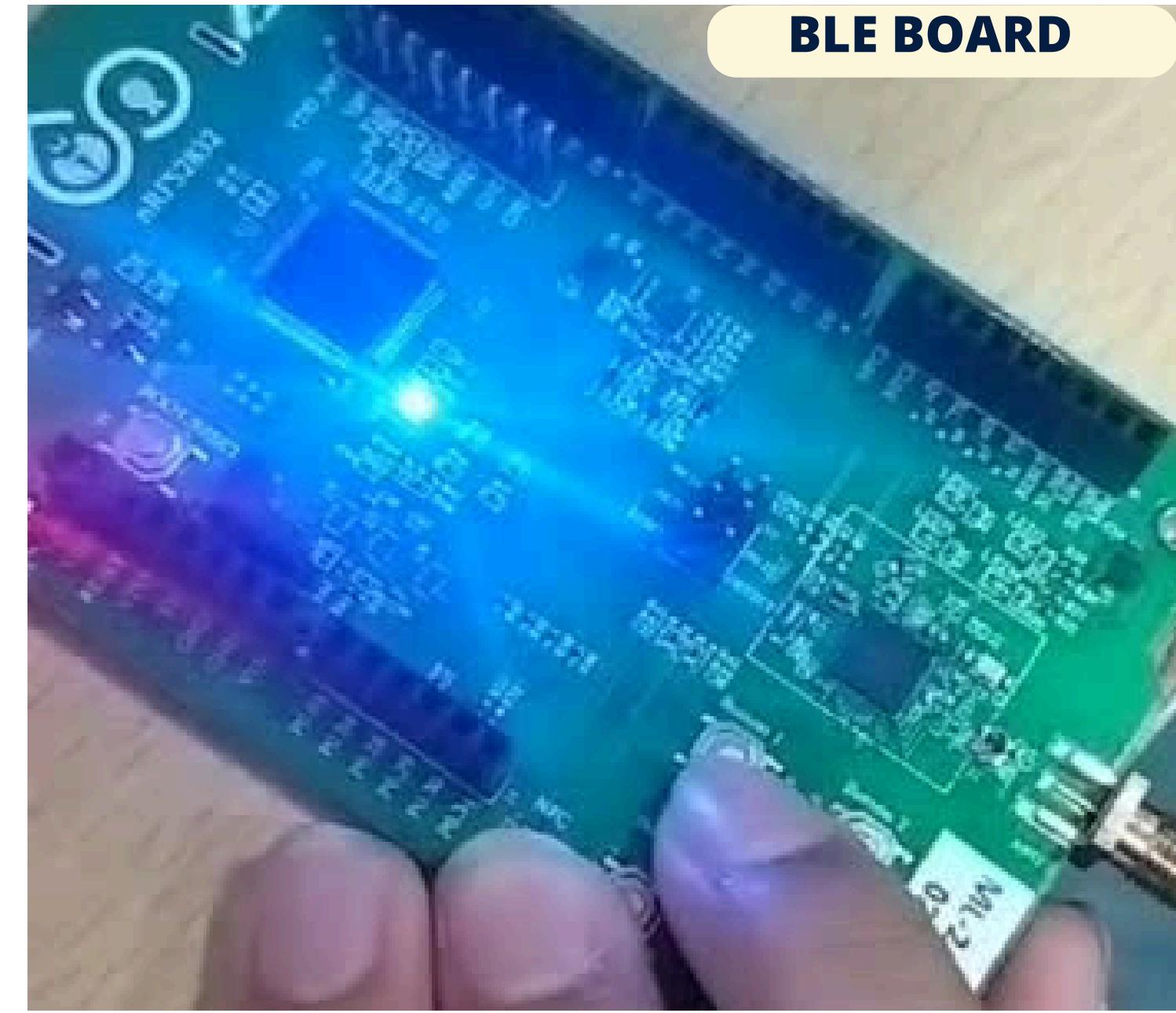
Things Achieved

1. Developed a basic understanding of the nrf board, which serves as the core component of our system; Working with sensors through a node.
2. Key sensors:-
 - SHT40 for temperature and humidity,
 - STTS751 for precise digital temperature readings,
 - and LIS3DH for motion detection.
 - Actuators such as buzzers provide audible alerts,
 - LCDs display sensor data
3. Successfully integrated and synergized two key sensors: the SHT40 and LIS3DH.
 - This allows us to simultaneously monitor environmental conditions with high accuracy and detect motion and orientation changes.

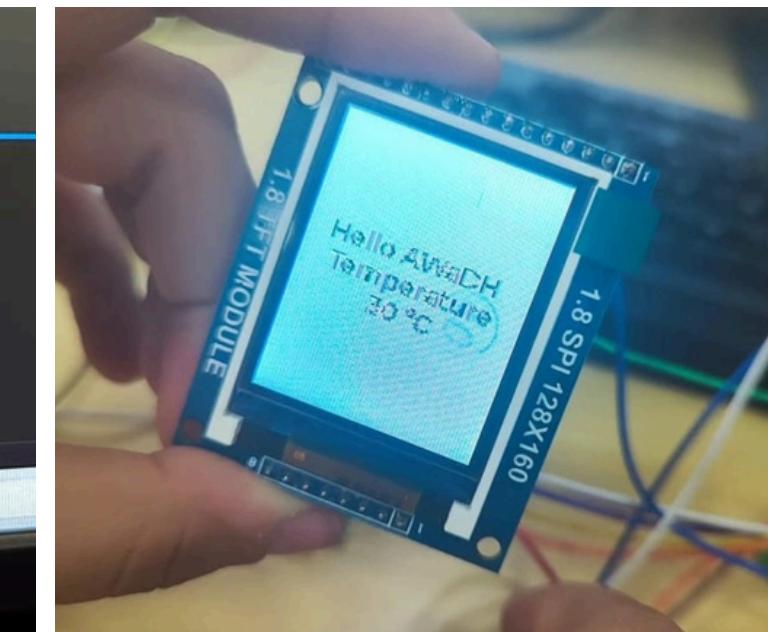
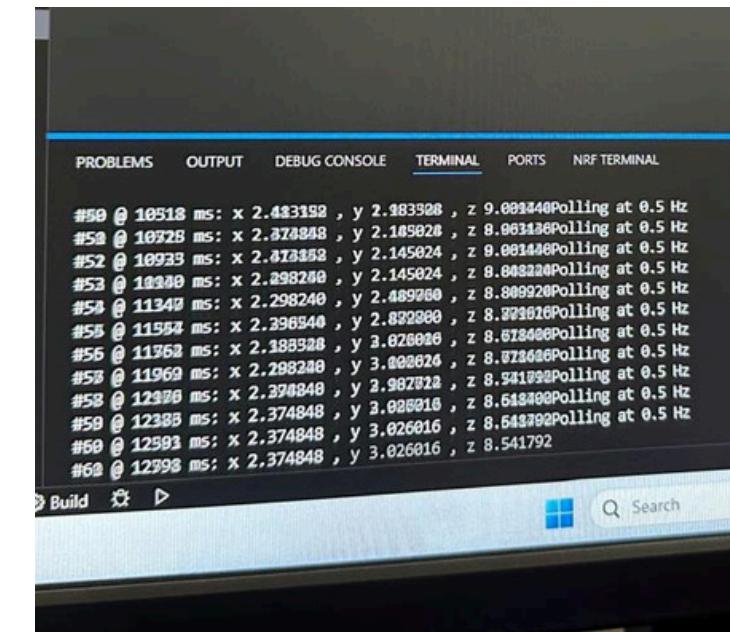
PROJECT HIGHLIGHTS

A visual review of some of the things we have achieved so far

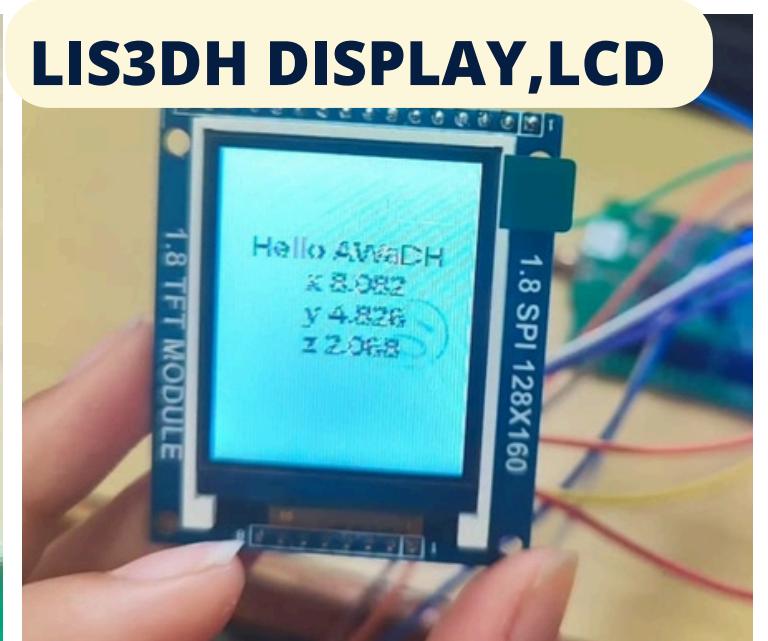
- BLE Board
- BLE Board with SHT40
- BLE Board with LIS3DH
- BLE Board with STTS751
- BLE Board with Integration of SHT40 and LIS3DH
- BLE Board with LCD Display and Sensors
- BLE Board with Node



BLE BOARD



SHT40 DISPLAY,LCD



LIS3DH DISPLAY,LCD



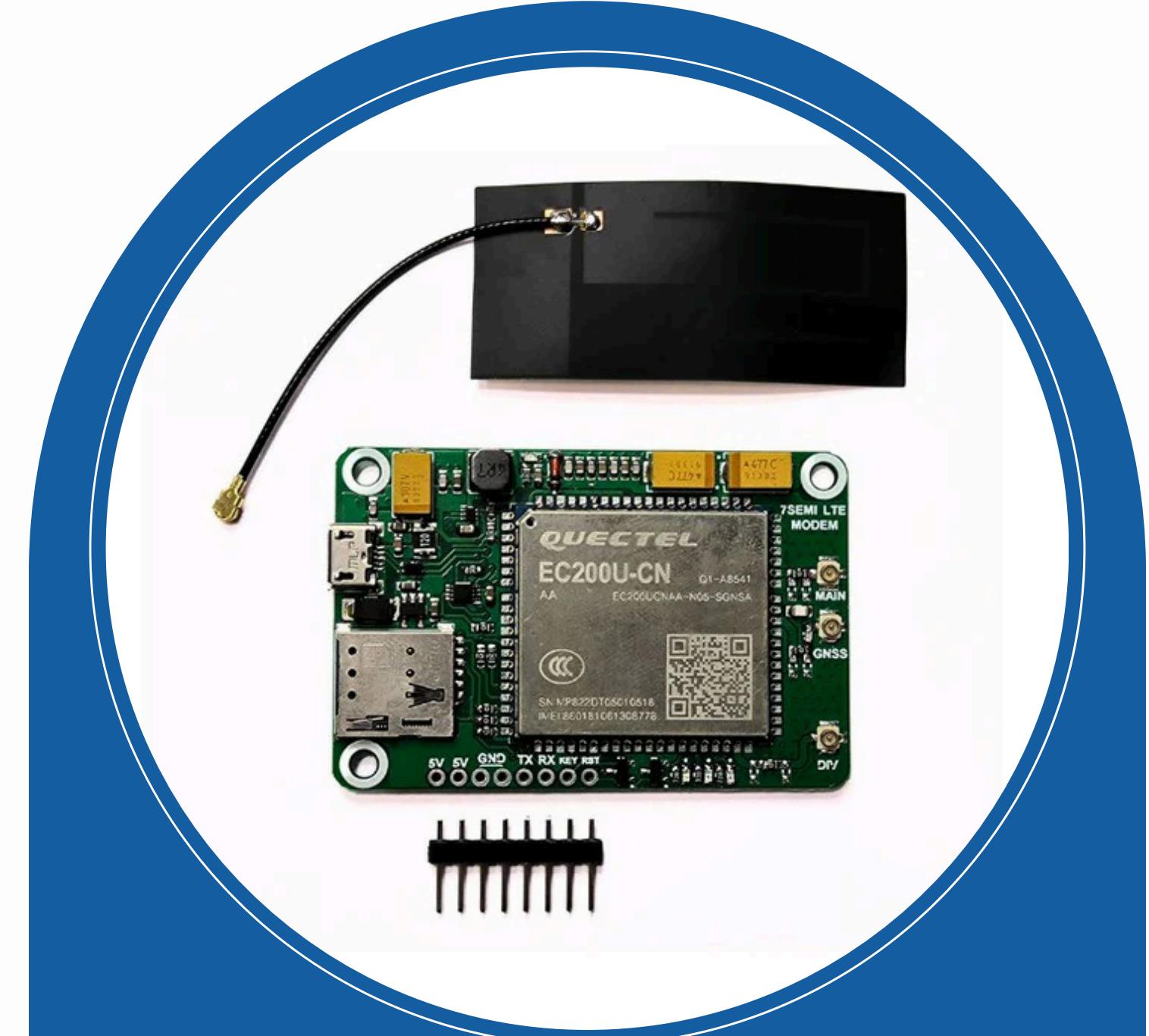
NODE

GSM MODULE

- High-Speed 4G LTE Connectivity
- Compact and Portable Design
- USB Interface for Easy Integration
- Nano SIM Slot for Cellular Access
- Enhanced Signal Reception with FPC Antenna

PINS

- | | |
|-----------------------------------|-----------------------------------|
| • VCC - Power Supply (3.3V or 5V) | GND - Ground |
| • USB_DP -USB Data Positive (D+) | USB_DM - USB Data Negative |
| • SIM_VCC - SIM Card Power | SIM_GND - SIM Card Ground |
| • SIM_CLK - SIM Card Clock | SIM_DATA - SIM Card Data |
| • SIM_RST - SIM Card Reset | TXD - UART Transmit Data |
| • RXD - UART Receive Data | PWRKEY - Power Key |
| • RESET - Reset | STATUS - Status Indicator |
| • GPIO1/GPIO2-General Purpose I/O | ANT - Antenna |



GSM MODULE WITH BLE

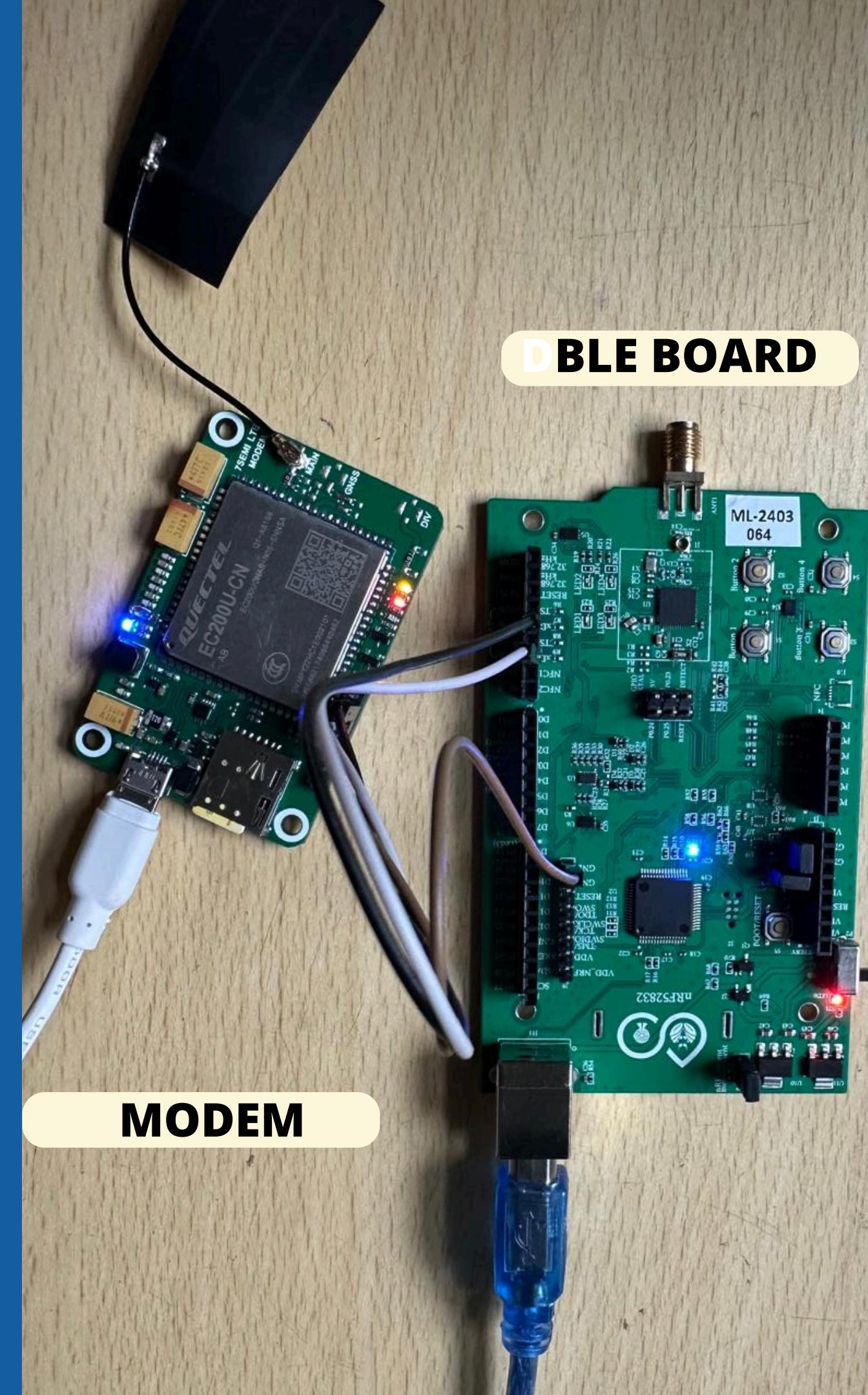
Integrating a GSM module with the nRF52832 microcontroller combines the strengths of cellular and Bluetooth Low Energy (BLE) technologies, creating a powerful platform for IoT applications.

Integration Process

- Power and Ground Connections
- UART Communication Setup
- SIM Card and Antenna
- UART Configuration in nRF52832
- Sending AT Commands
- Testing and Functionality

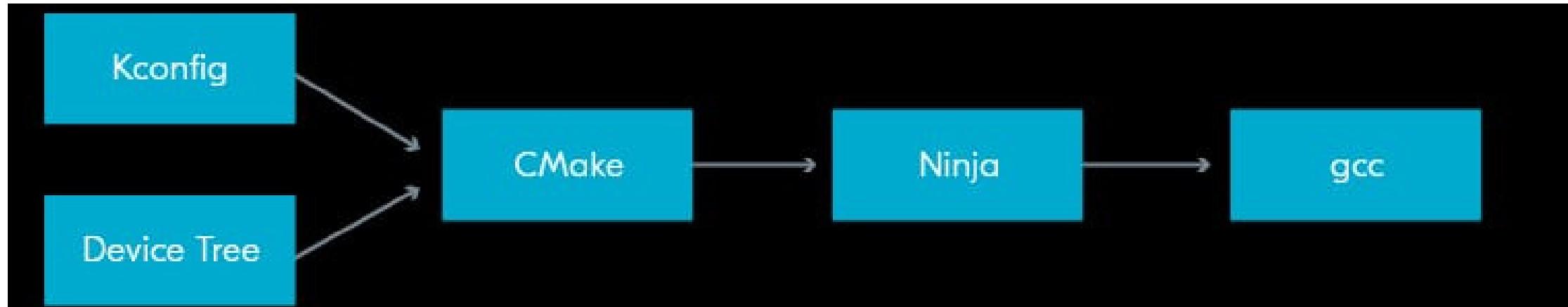
Integration Outcomes

- Reliable Communication
- Network Connectivity
- Expanded Functionality
- Remote Data Transmission
- Versatile Applications:
- Enhanced IoT Solutions
- Data Backup

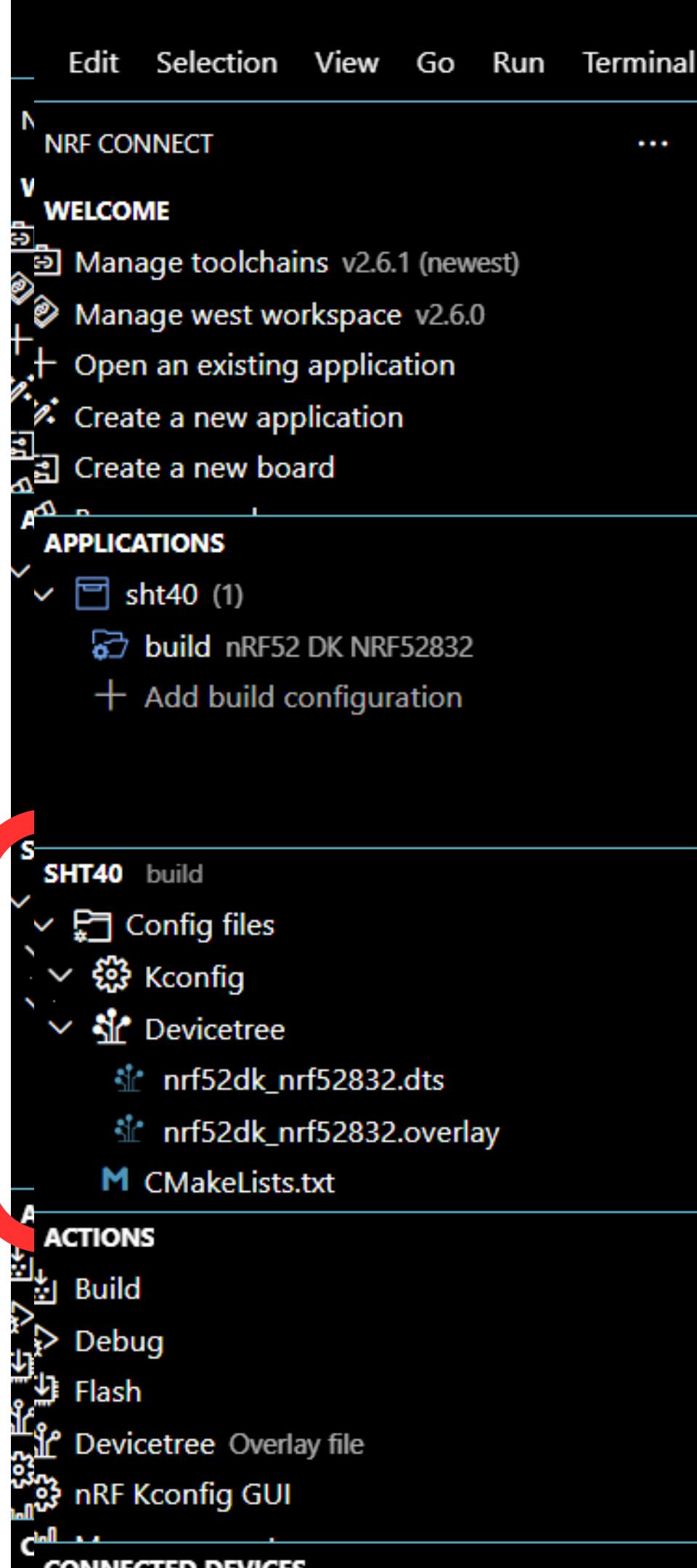


Specifications

nRF Connect SDK



- **SDK Purpose:** Designed for low-power wireless applications with Nordic Semiconductor devices.
- **Components:** Integrates Zephyr (RTOS), Bluetooth Low Energy, Bluetooth mesh, Wi-Fi, and Matter.
- **Module Transfer:** Facilitates easy transfer of modules, libraries, and drivers across applications, reducing development time.
- **Configuration**
 - **Kconfig** Generates definitions to configure the entire system.
 - **Devicetree** Describes the hardware configuration.
- **Build Process**
 - **CMake**
 - **Ninja**
 - **Compiler**



ThingSpeak for IoT Projects

Data collection in the cloud with advanced data analysis
using MATLAB

Get Started For Free

Learn More

- Open-Source IoT Platform
- Data Collection and Storage
- Data Analysis and Visualization
- User-Friendly Interface
- Actionable Insights

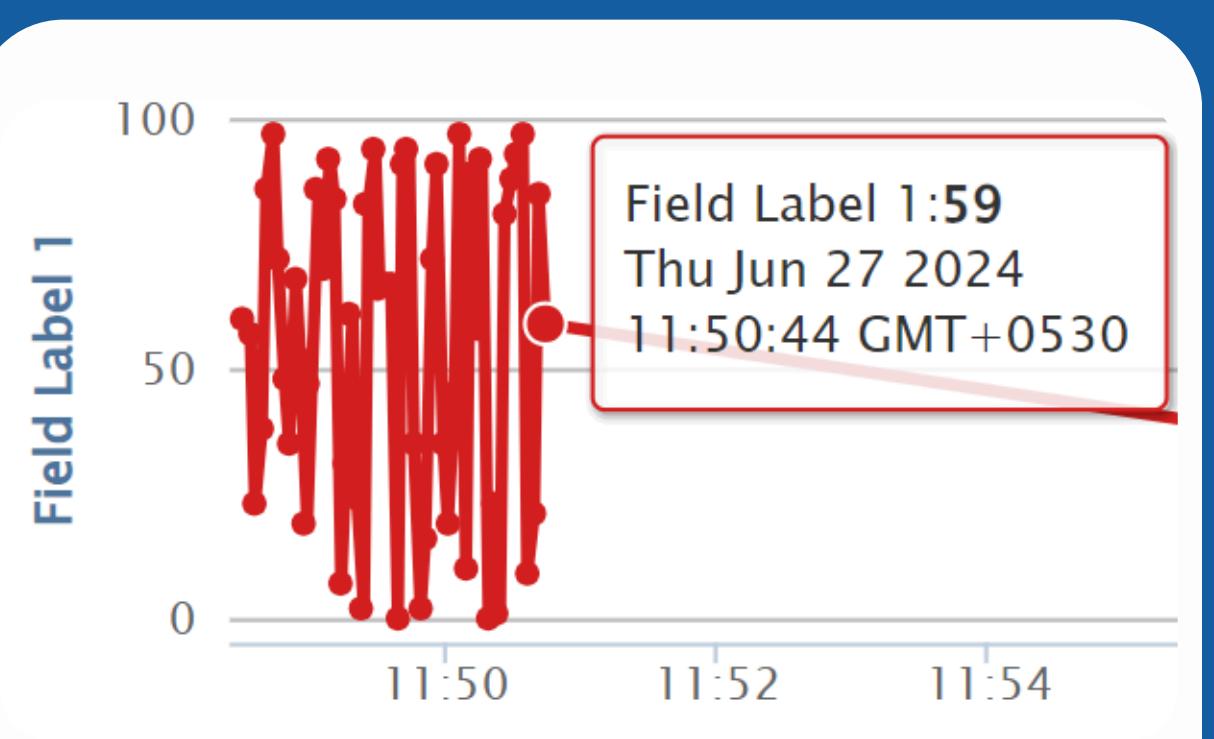


Random Number Generation & ThingSpeak

Name	Created	Updated
iot	2024-03-29	2024-03-29 06:2
nahichalega	2024-06-27	2024-06-27 05:0
SHT40	2024-06-27	2024-06-27 05:4

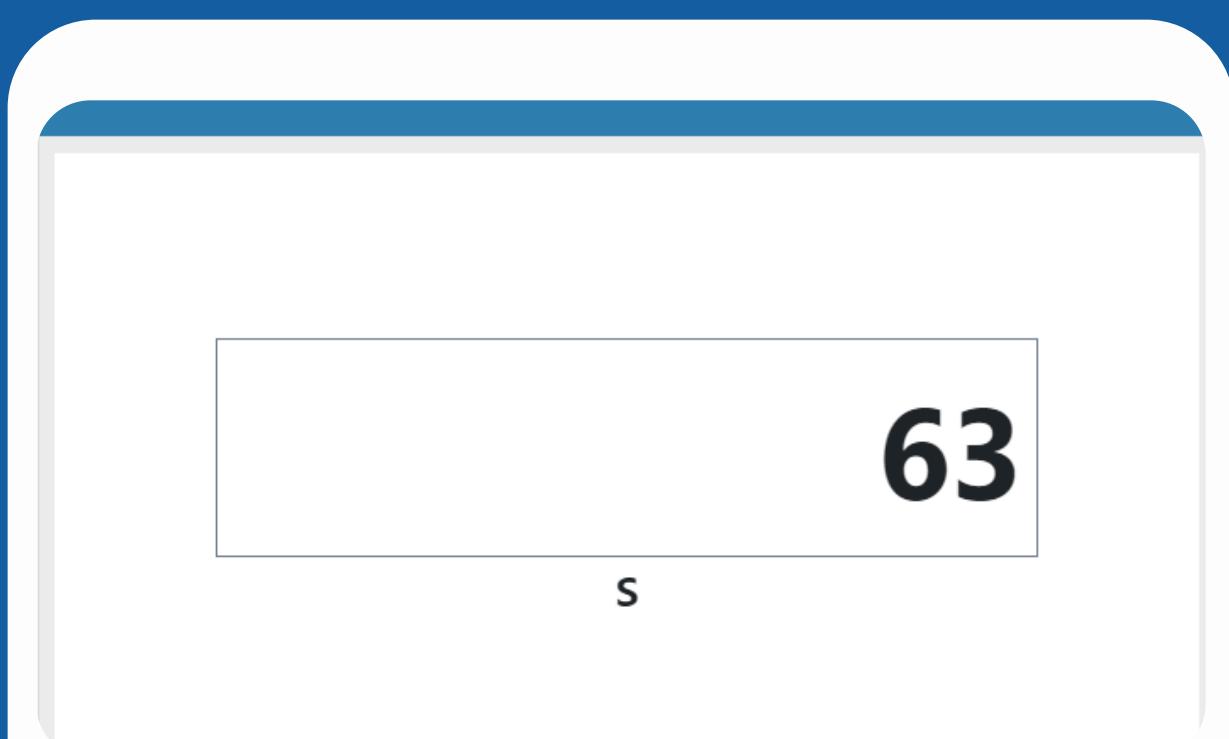
Channels

We first create a channel in ThingSpeak wherein the data collected is to be stored



Data

We can see data being uploaded to the cloud with the changes in graph



Widget

With the help of widgets we are able to see which number is generated

THINGSPEAK WITH UART SHT40

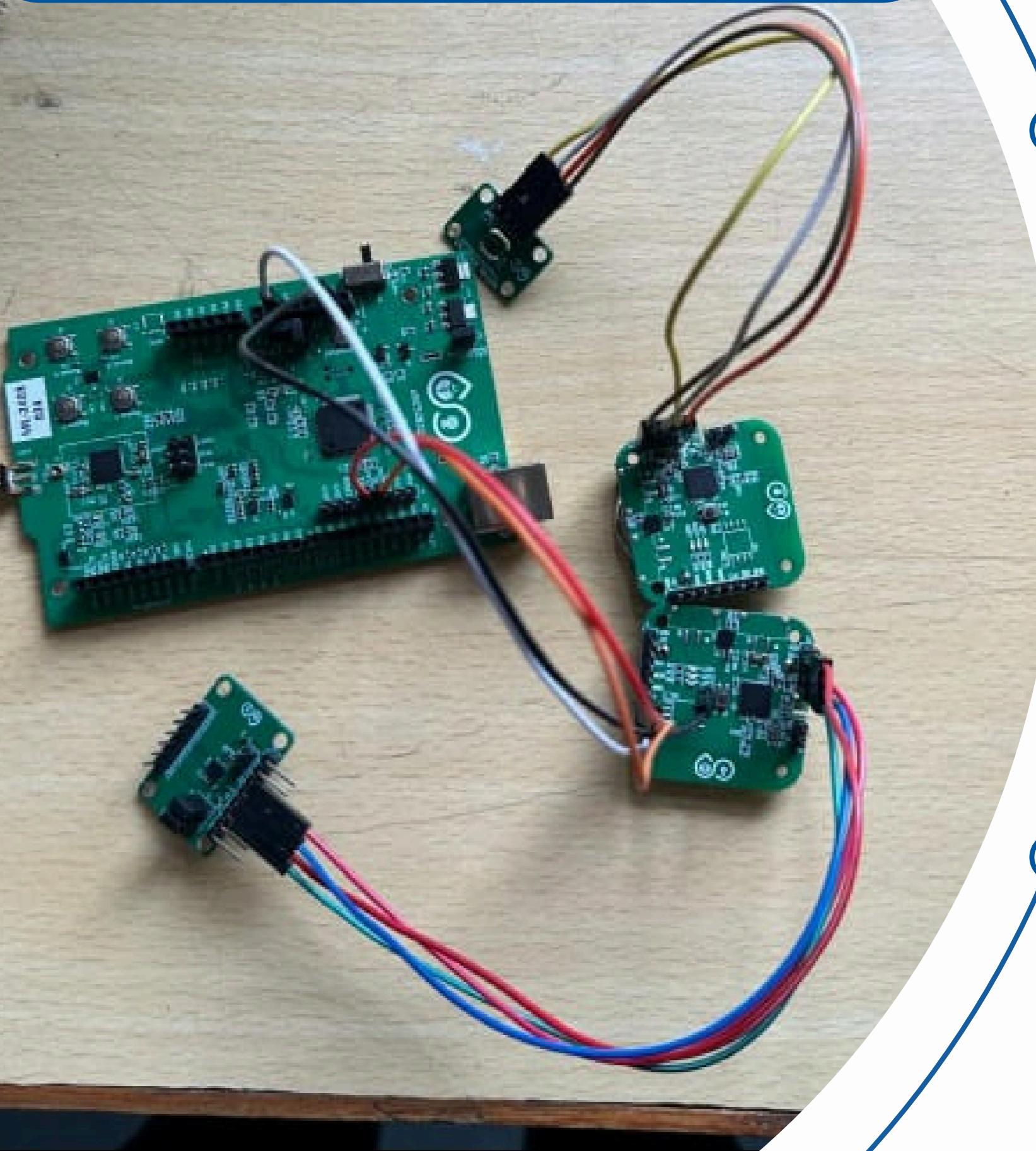
Key Points

- The SHT40 sensor detects temperature and humidity
- Data is uploaded real-time to the cloud using ThingSpeak an IoT Analytics Platform
- Visualize the data via plots and graphs in ThingSpeak
- Analyze collected data using MATLAB for deeper insights.
- Work on advanced data analysis and visualization techniques.

Humidity and Temperature Plots



BlueNode Network: Advanced BLE Sensor Integration



PROJECT PATHWAY

01

Explored , gathered in depth knowledge of BLE board ie nrf52832 and integrated different key sensors studying their outcomes.

02

Explored , gathered in depth knowledge with GSM Module , GSM Module with BLE and integrating different key sensors.

03

Uploading this data on cloud via ThingSpeak and further using that data for analysis and visualization.

04

- **Create a network of BLE sensors (temperature, humidity, motion, etc.) using nRF52832 boards.**
- **Each board can act as a sensor node and communicate data to a central node or a smartphone via BLE.**

**THANK
YOU**