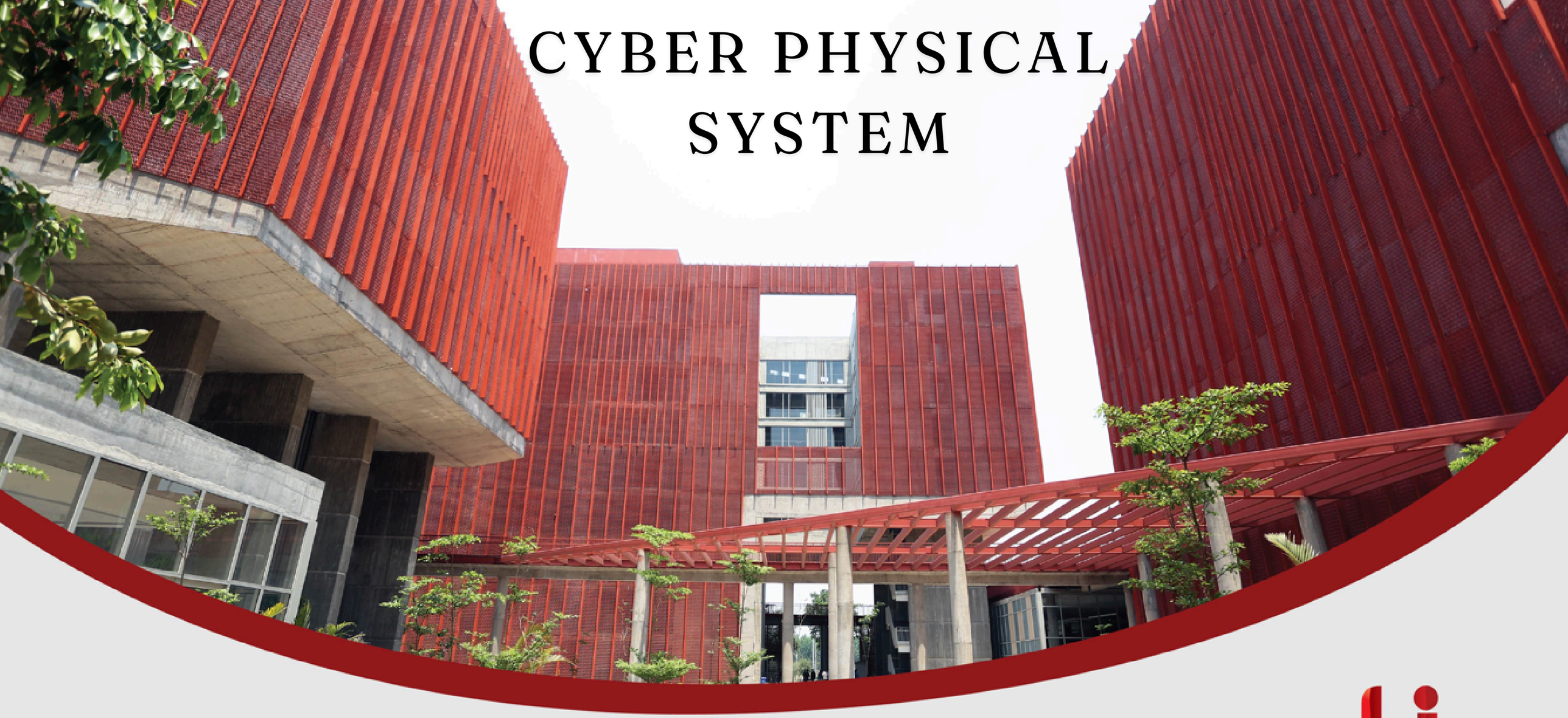
CYBER PHYSICAL SYSTEM



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Overview

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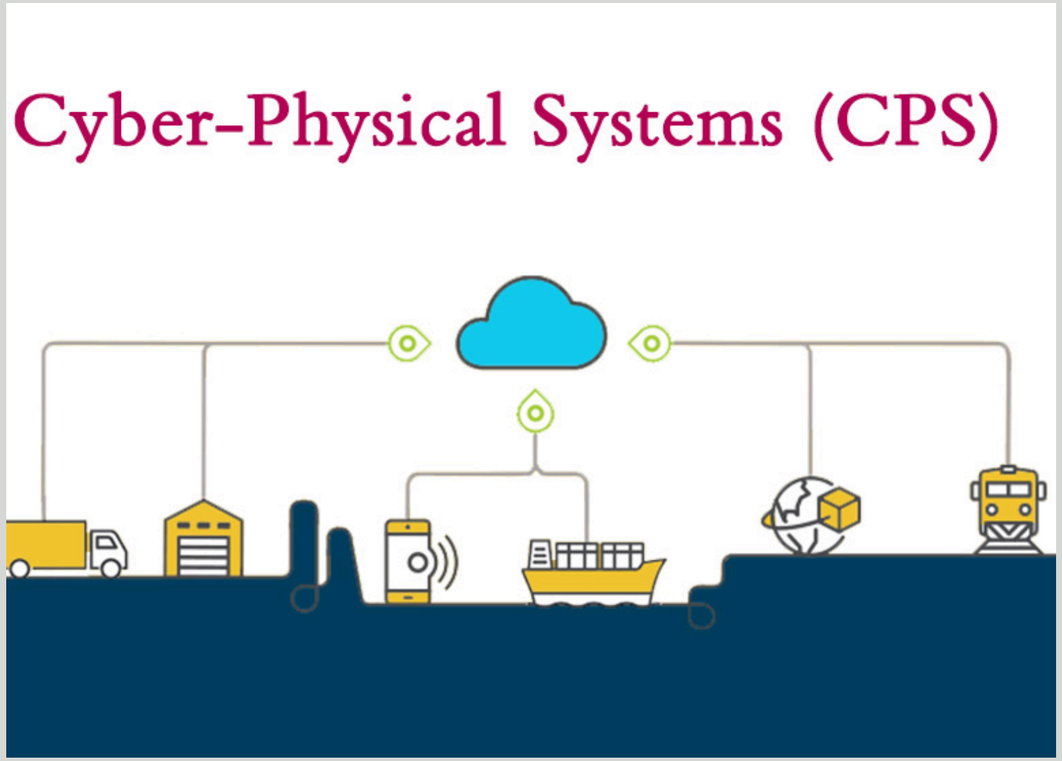
Introduction

- A cyber-physical system is a collection of computing devices communicating with one another and interacting with the physical world via sensors and actuators in a feedback loop.
- CPS serves as the foundation for Internet of Things (IoT), providing the necessary hardware and software infrastructure to connect and control the physical devices in the IoT ecosystem.
- For this project we are primarily using the Nordic Development Kit: BLE Development Board , various sensors: SHT40,STTS751,LIS3DH , buzzers and LCD.

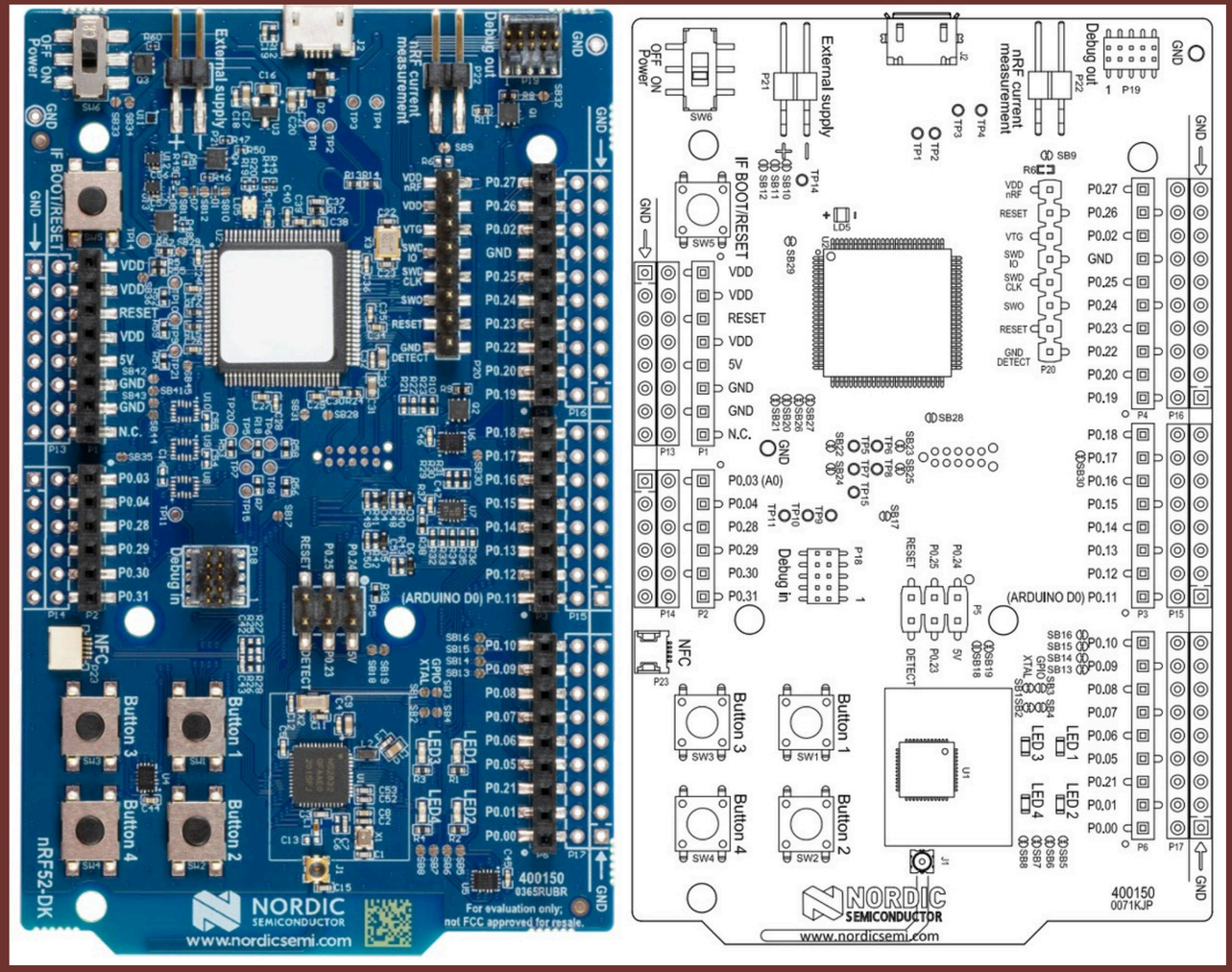


Specifications

BLE Development Kit

The nRF52832 is a general-purpose multiprotocol SoC. It meets the challenges of a broad range of applications that need advanced Bluetooth® LE features, protocol concurrency and a rich and varied set of peripherals and features. In addition, it offers generous memory availability for both Flash and RAM.

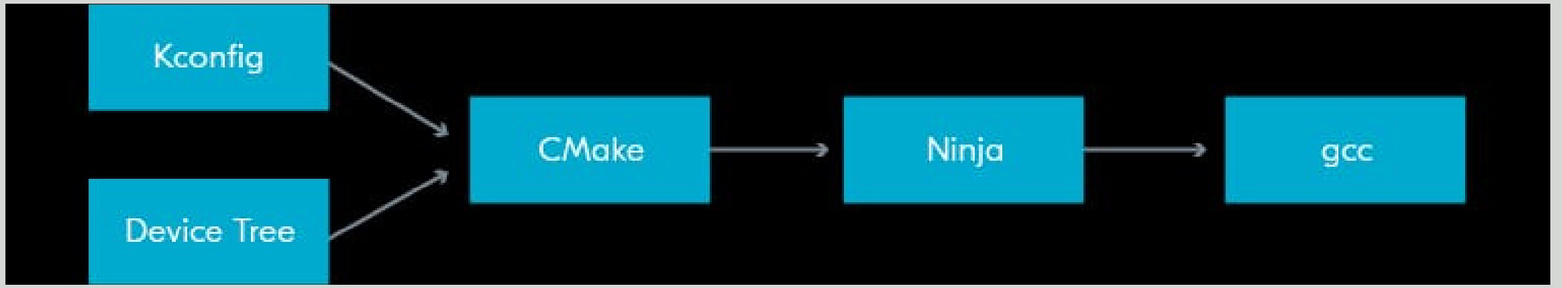
The kit gives access to all I/Os and interfaces via edge connectors and has 4 LEDs and 4 buttons which are user programmable.



Specifications

nRF Connect SDK

- The nRF Connect SDK is a versatile and unified software development kit designed for creating low-power wireless applications using Nordic Semiconductor's nRF52, nRF53, nRF70, and nRF91 Series devices.
- It incorporates the Zephyr Real-Time Operating System (RTOS) and includes a wide array of complete applications, samples, and protocol stacks, such as Bluetooth Low Energy, Bluetooth mesh, Wi-Fi, and Matter.



- With a single code base for all Nordic devices and software components, the nRF Connect SDK facilitates the easy transfer of modules, libraries, and drivers between applications, significantly reducing development time.
- Kconfig generates definitions that configure the whole system, for example, which wireless protocol or which libraries to include in your application.
- Devicetree describes the hardware.
- CMake then uses the information from Kconfig and the devicetree to generate build files, which Ninja (comparable to make) will use to build the program.
- The GCC compiler system is used to create the executables.

Milestones

Milestone 01

- Developed a basic understanding of the nrf board , serves as the core component of our system.
- Key sensors include the SHT40 for temperature and humidity, STTS751 for precise digital temperature readings, and LIS3DH for motion detection. Actuators such as buzzers provide audible alerts, while LCDs display sensor data.

Milestone 02

- Working with a variety of sensors and learning about their capabilities while incorporating them into our project through a node-based approach ,
- Approach involving structuring our system architecture around individual nodes, where each node typically represents a device or a component equipped with sensors or actuators.

Milestone 03

- Successfully integrated and synergized two key sensors: the SHT40 and LIS3DH.
- This integration allows us to simultaneously monitor environmental conditions with high accuracy and detect motion and orientation changes.

PROBLEMS 3 OUTPUT DEBUG CONSOLE TERMINAL PORTS

```
Temperature= 28.086900 C; Humidity= 42.043029 %RH
Temperature= 28.068207 C; Humidity= 42.084991 %RH
Temperature= 28.062867 C; Humidity= 42.018234 %RH
Temperature= 28.038834 C; Humidity= 41.957183 %RH
Temperature= 28.078889 C; Humidity= 41.953369 %RH
Temperature= 28.084229 C; Humidity= 41.924758 %RH
Temperature= 28.068207 C; Humidity= 41.974349 %RH
Temperature= 28.081559 C; Humidity= 42.006790 %RH
Temperature= 28.089570 C; Humidity= 41.976257 %RH
Temperature= 28.076218 C; Humidity= 41.960998 %RH
Temperature= 28.089570 C; Humidity= 42.001068 %RH
Temperature= 28.081559 C; Humidity= 41.955276 %RH
Temperature= 28.102922 C; Humidity= 41.985794 %RH
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Temperature= 28.102922 C; Humidity= 41.873260 %RH
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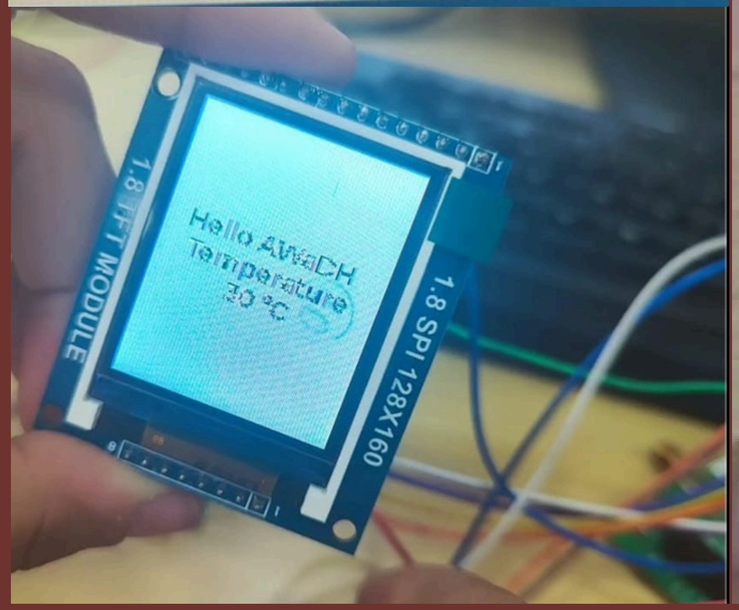

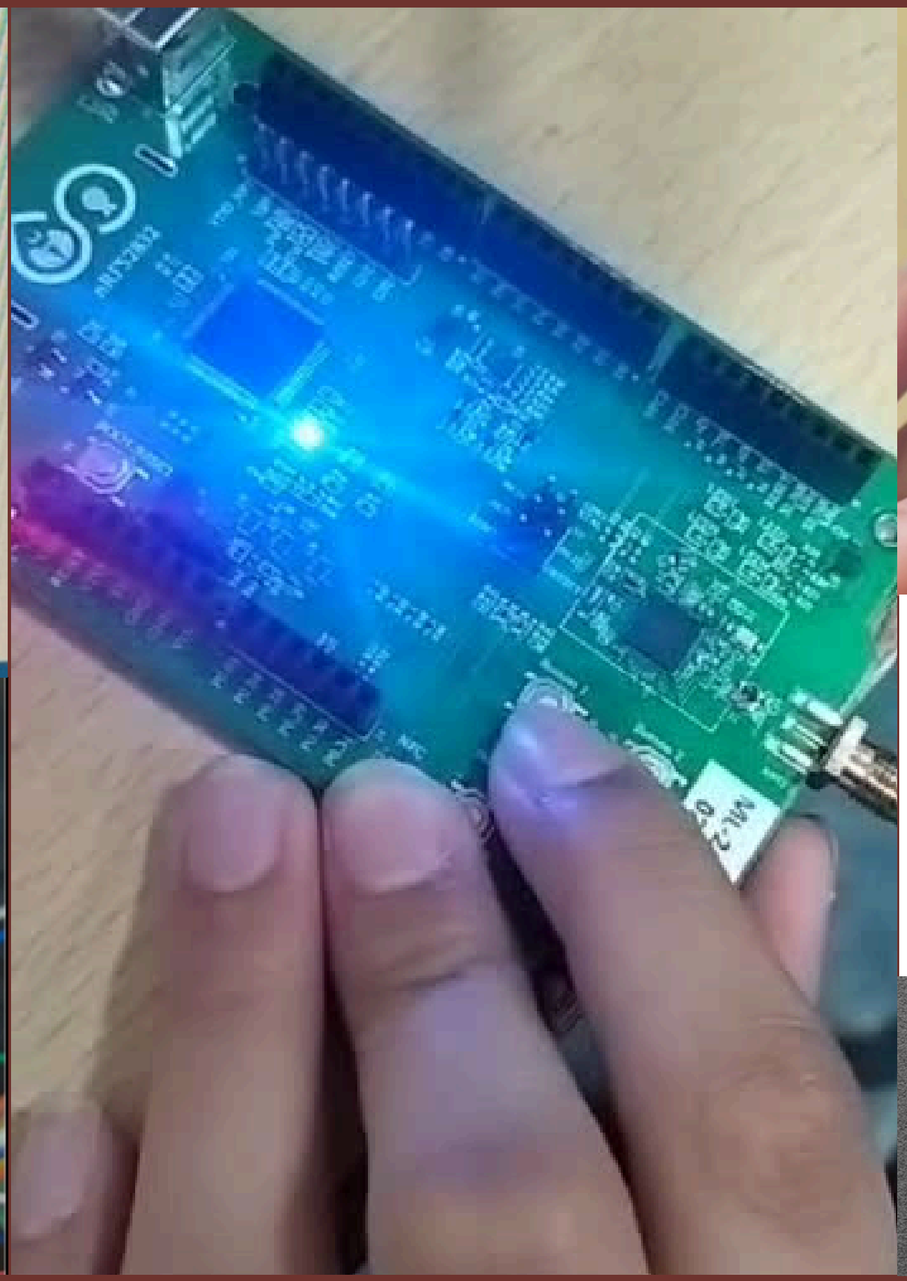

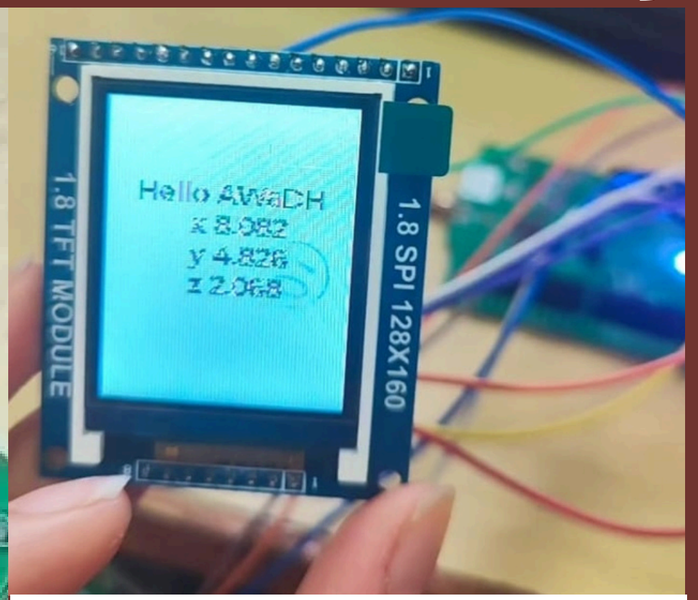

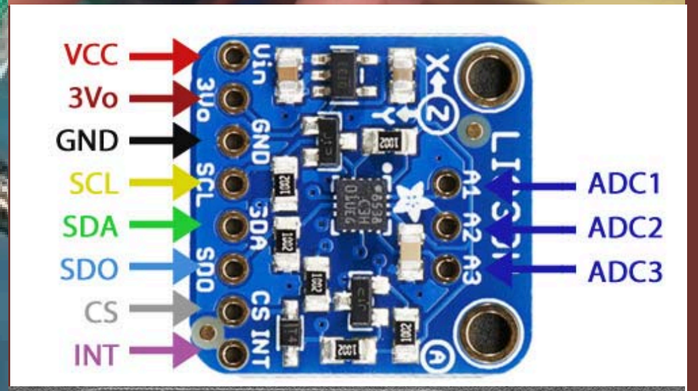

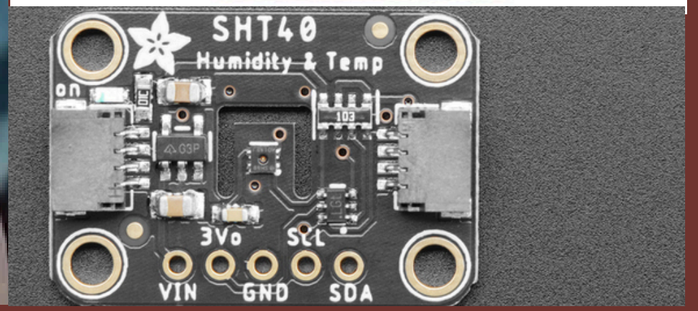

Current Task

Objective 01

Expanding our understanding of all aspects of the NRF development board and in-depth analysis of each of the sensors.

Objective 02

Uploading data collected by sensors to the cloud via ThingSpeak, cloud-based IoT analytics platform that provides tools for data analysis and visualization, enabling you to monitor and manage your data remotely in real time.

Challenges

Problem 01

- We encountered several challenges while working with the BLE node, which can be described as a compact variant of the BLE development board.
- These challenges included compatibility issues with the nRF SDK version being utilized and significant modifications in the code.
- We eventually managed to resolve these issues and achieve a functional outcome.

Problem 02

- We also encountered numerous challenges when dealing with multiple versions of the software and the associated issues in the code.
- The process of constantly switching and modifying the code was exhausting.
- Eventually, we resolved this issue by adopting version 2.5.1 of the nRF Connect SDK.

Moving Forward

Phase 1

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.

Phase 2

Develop a fitness tracker or smartwatch using the nRF52832 board. You can integrate sensors for monitoring heart rate, step count, and other health metrics, and use BLE to communicate with a smartphone app.

Phase 3

Develop an environmental monitoring system using nRF52832 boards to measure air quality, noise levels, or pollution levels. Data can be sent to a cloud server for analysis and visualization.

Phase 4

Implement a water quality monitoring system for ponds, reservoirs, or irrigation systems using nRF52832 boards. Sensors can measure parameters such as pH, dissolved oxygen, turbidity, and conductivity. Data collected can be transmitted wirelessly to a central monitoring station for analysis and early detection of water quality issues.

THANK YOU