



राष्ट्रीय इलेक्ट्रॉनिकी एवं सूचना प्रौद्योगिकी संस्थान  
National Institute of Electronics & Information Technology

Ministry of Electronics & Information Technology  
Government of India



arm



with support from:



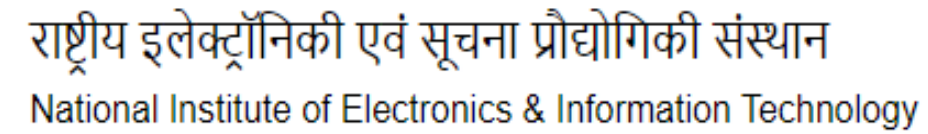
Faculty Workshop 2022

# Remote Hardware Lab

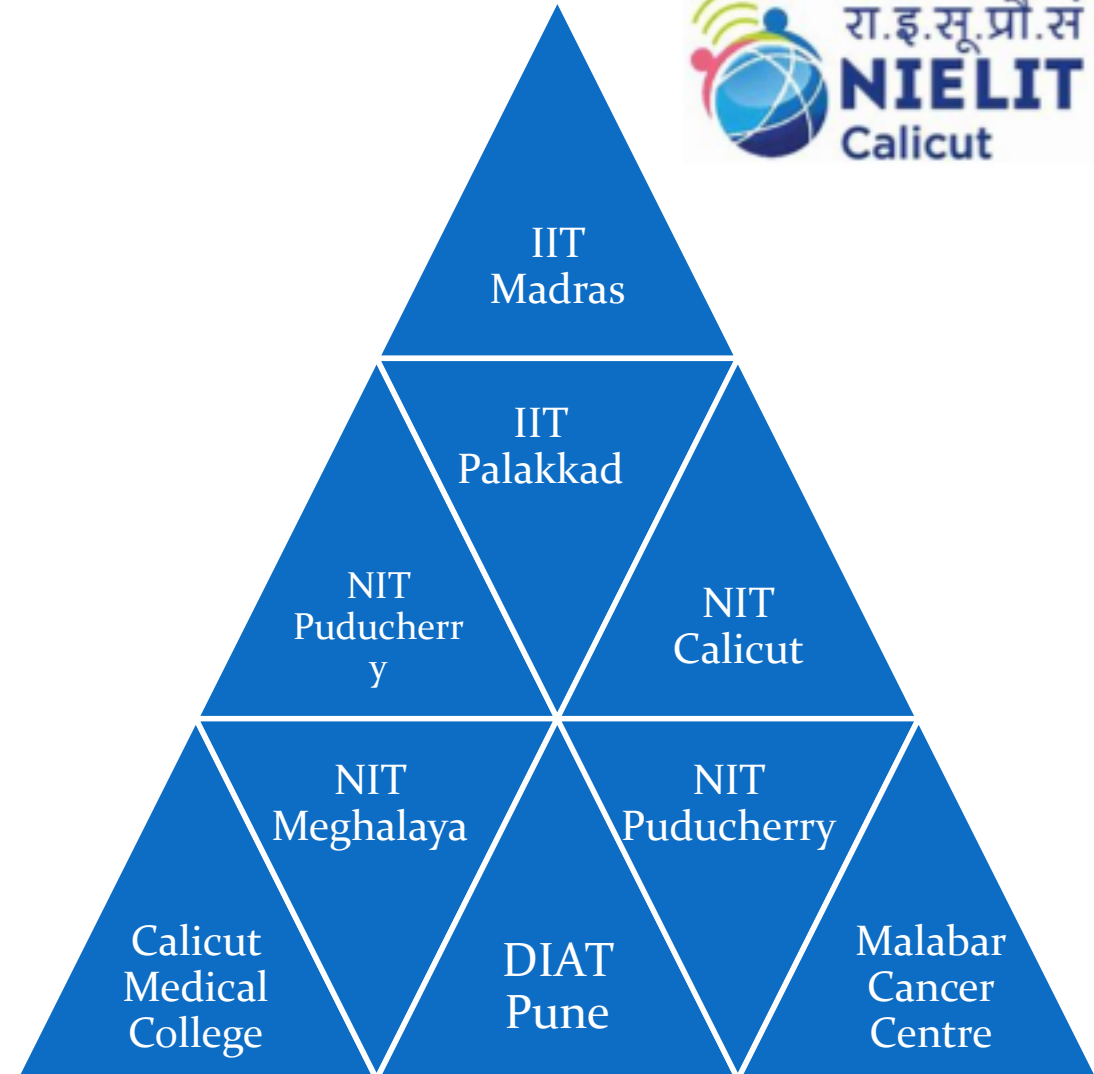
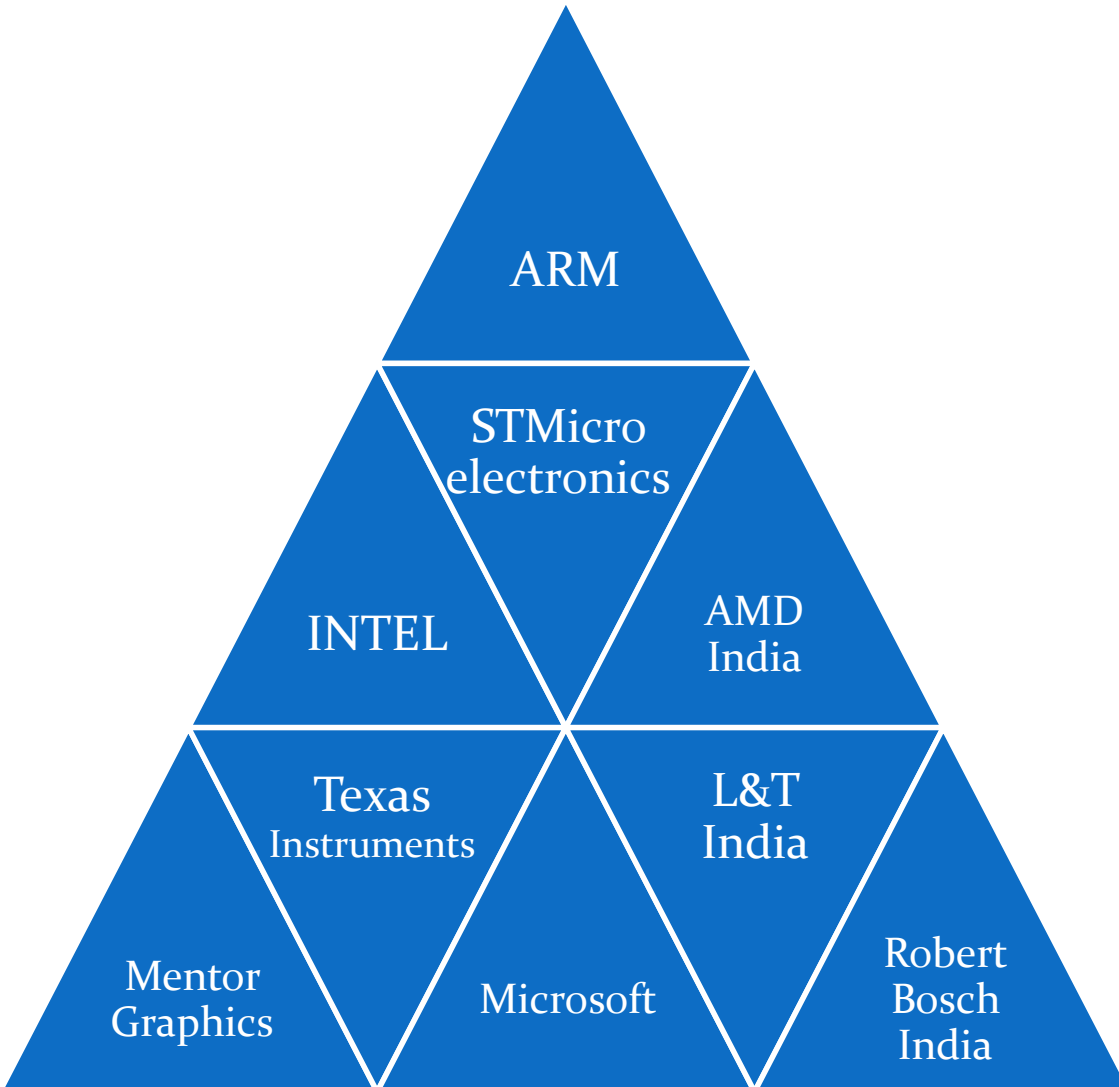
Rajesh M.  
rajesh.m@nielit.gov.in

# Agenda

- About NIELIT Calicut
- Remote Lab Overview
- Demo



# Collaborations with Leading Academia / Industries



# Industry Oriented Training Programs

## Non- Formal Training Programs

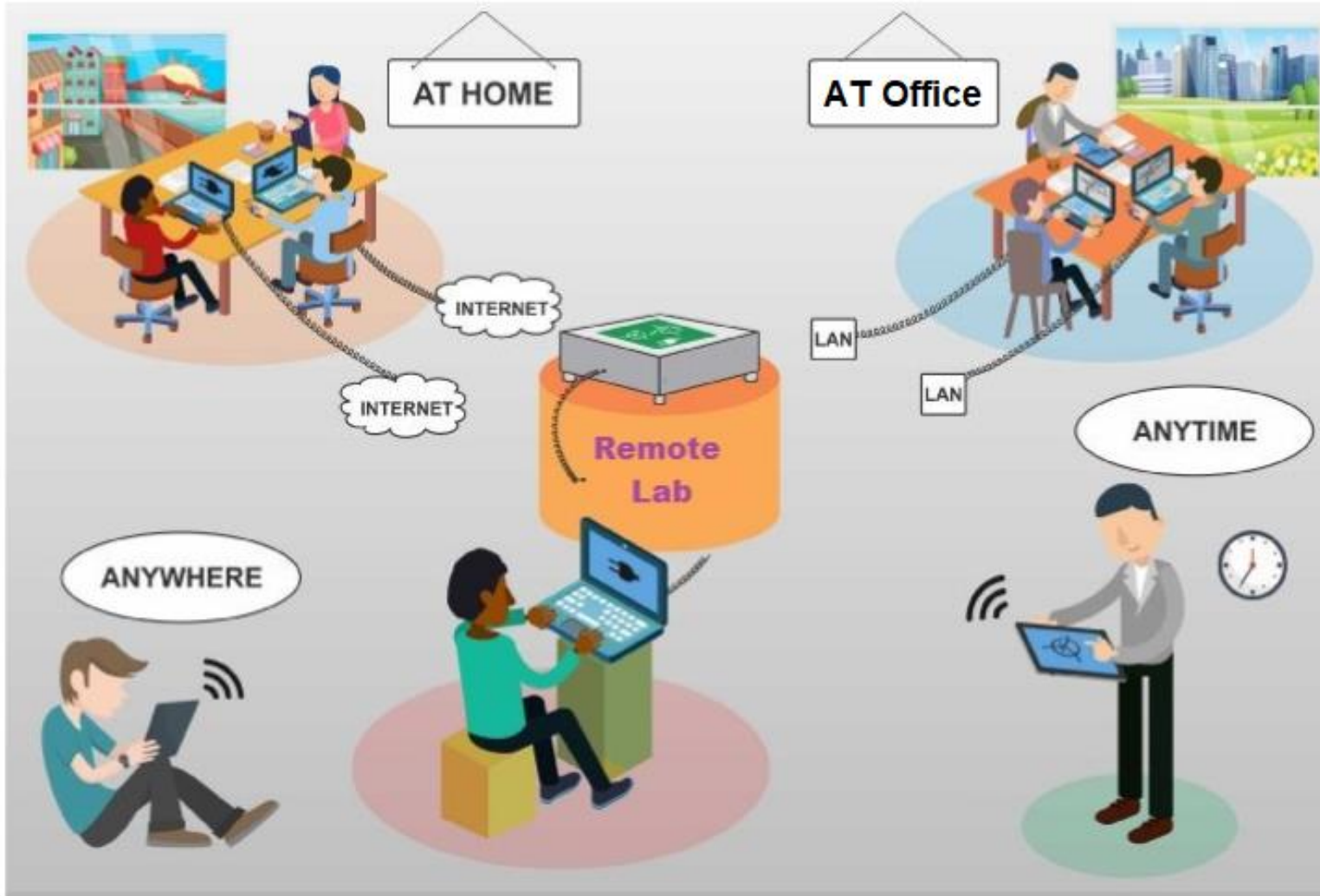
- PG Diploma in Embedded Systems and IoT.
- PG Diploma in VLSI SoC Design and Verification.
- PG Diploma in Industrial Automation

## Formal Training Programs

- M.Tech in Embedded Systems
- M.Tech in Electronic Design Technology
- M.Tech in VLSI and Embedded (Joint program with Defence Institute of Advanced Studies (DIAT- Pune), Ministry of Defence, Govt. of India)




# Introducing Remote Hardware Labs: The innovation arm of Remote Hardware Access



**AnyOne**  
**AnyTime**  
**AnyWhere**

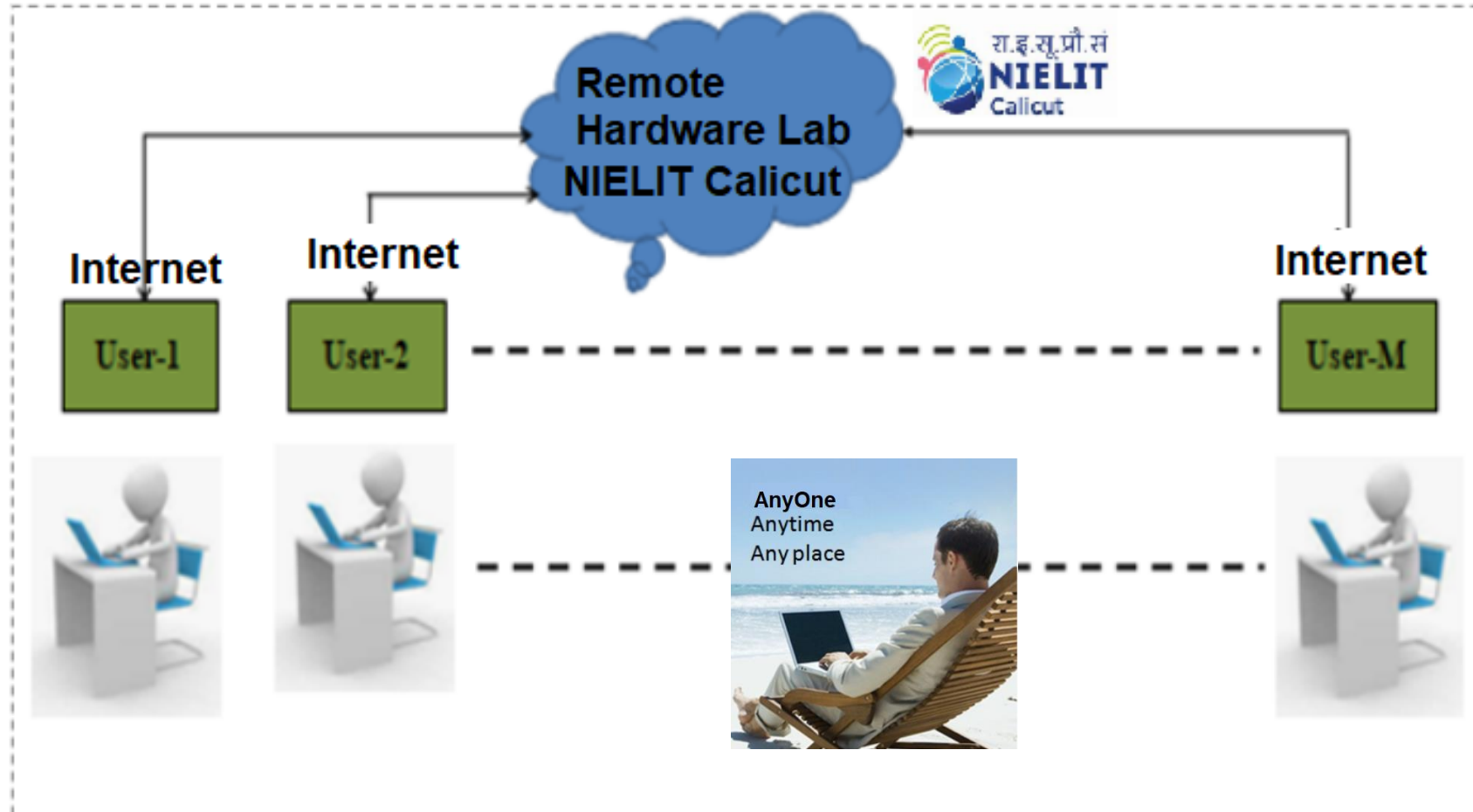
# Why Remote Lab?

- A paradigm shift from offline to online instruction mode was resulted due to COVID-19
    - Software courses were suiting to the online mode
    - Hardware courses needed access to physical devices and was a challenge to provide online.
      - Centralized positioning
      - Affordability
      - Long procurement lead time
- 
- An infographic with a teal background featuring a large white circle. Inside the circle, there are several small icons representing different aspects of online learning: a smartphone, a laptop, a person at a desk, a gear, a lightbulb, a magnifying glass, a document, and a person with a speech bubble. The text "SAFE ONLINE LEARNING IN TIMES OF" is written in bold black capital letters across the middle of the circle.



*This necessitated looking for innovative solutions to offer lab-based courses efficiently and conveniently to all students regardless of their location and time.*

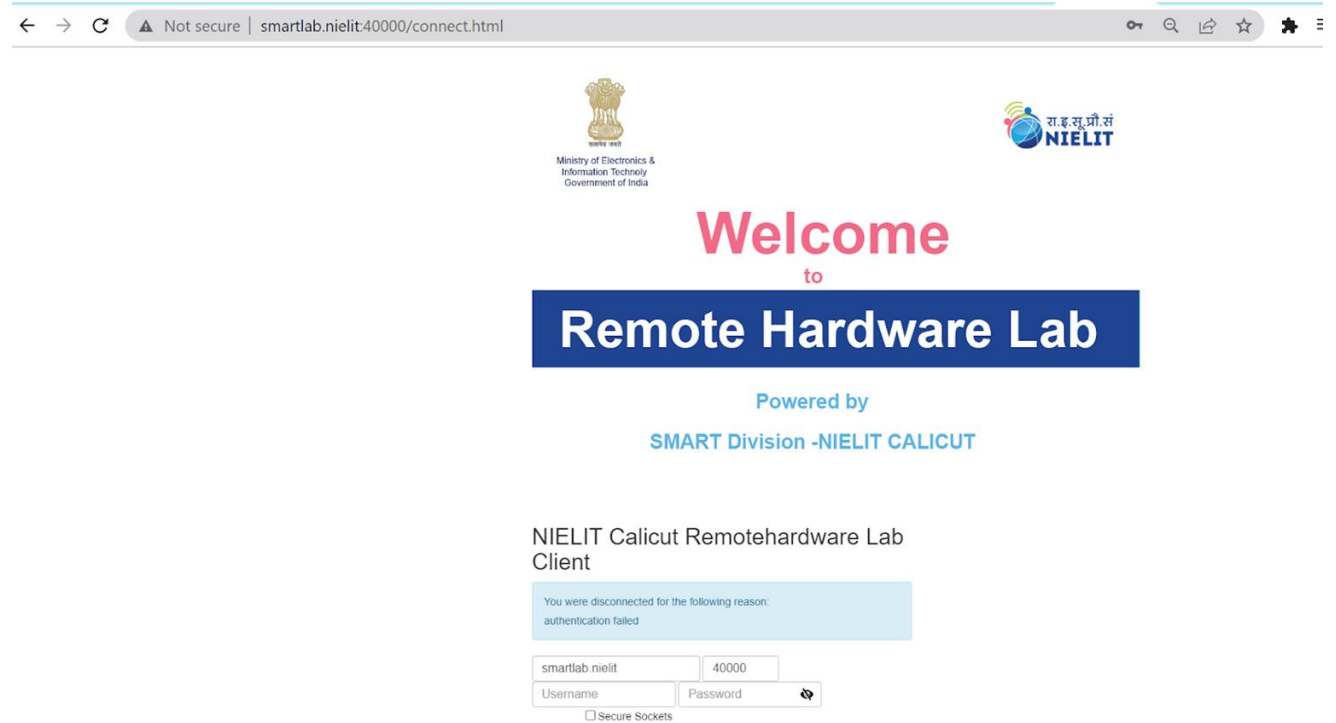
# What is a Remote Lab ?






# Remote Lab Access requirements


- Laptop/ Desktop/ iPad/ Smart TV/ Smart Phone with any OS
- Login Credentials
- Any web browser



The screenshot shows a web browser window with the address bar displaying "Not secure | smartlab.nielit:40000/connect.html". The page features the Government of India logo and the NIELIT logo. The main heading reads "Welcome to Remote Hardware Lab" in a blue box, with "Powered by SMART Division -NIELIT CALICUT" below it. A message states "NIELIT Calicut Remotehardware Lab Client". A light blue box contains the text: "You were disconnected for the following reason: authentication failed". The login form includes fields for "smartlab.nielit" (containing "40000"), "Username", and "Password". A "Secure Sockets" checkbox is at the bottom.

← → ↻ ⚠ Not secure | smartlab.nielit:40000/connect.html 🔑 🔍 📄 ☆ ⚙ ☰

  
Ministry of Electronics & Information Technology  
Government of India

  
रा.इ.सू.प्रौ.सं  
**NIELIT**

**Welcome**  
to  
**Remote Hardware Lab**

Powered by  
SMART Division -NIELIT CALICUT

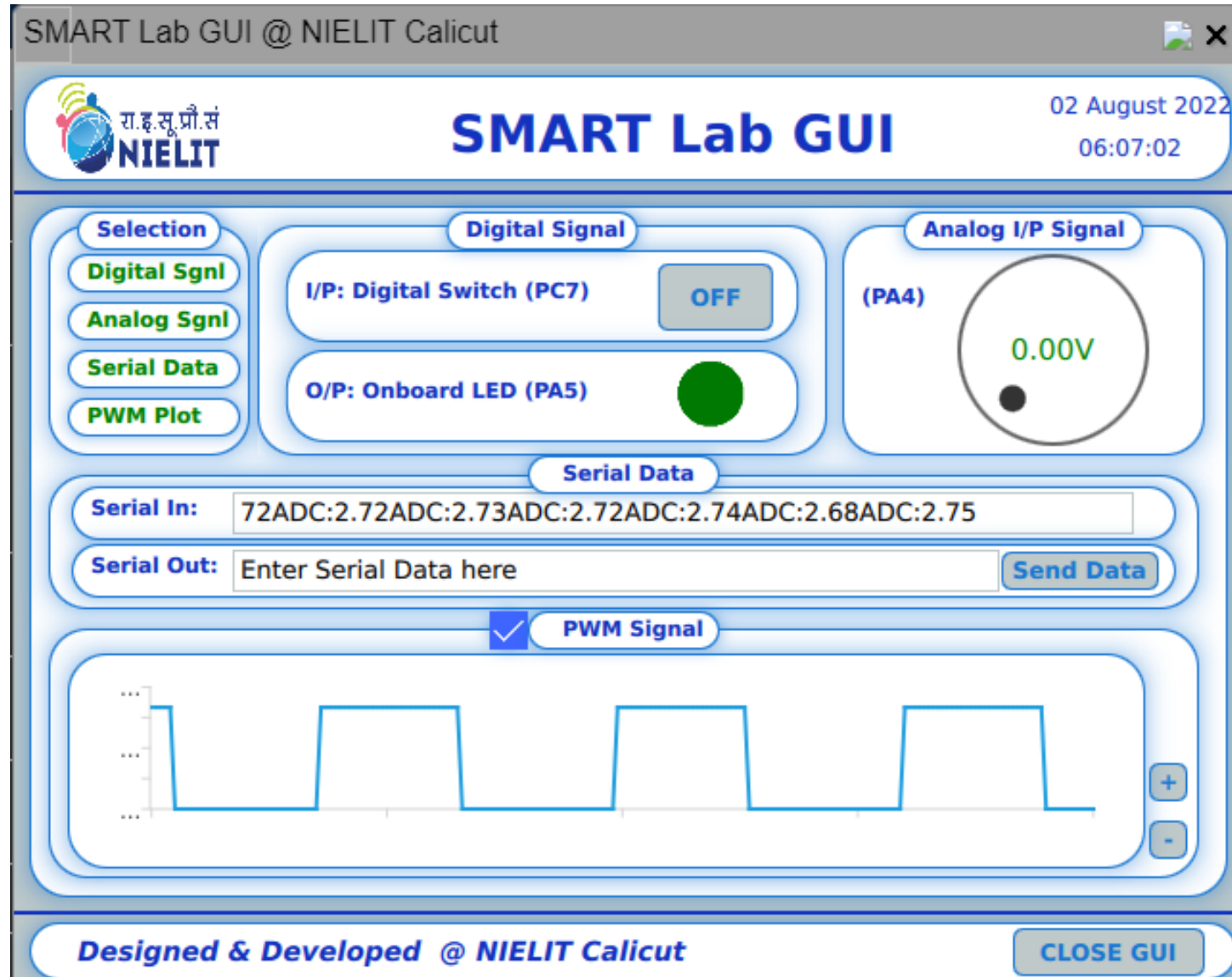
NIELIT Calicut Remotehardware Lab Client

You were disconnected for the following reason:  
authentication failed

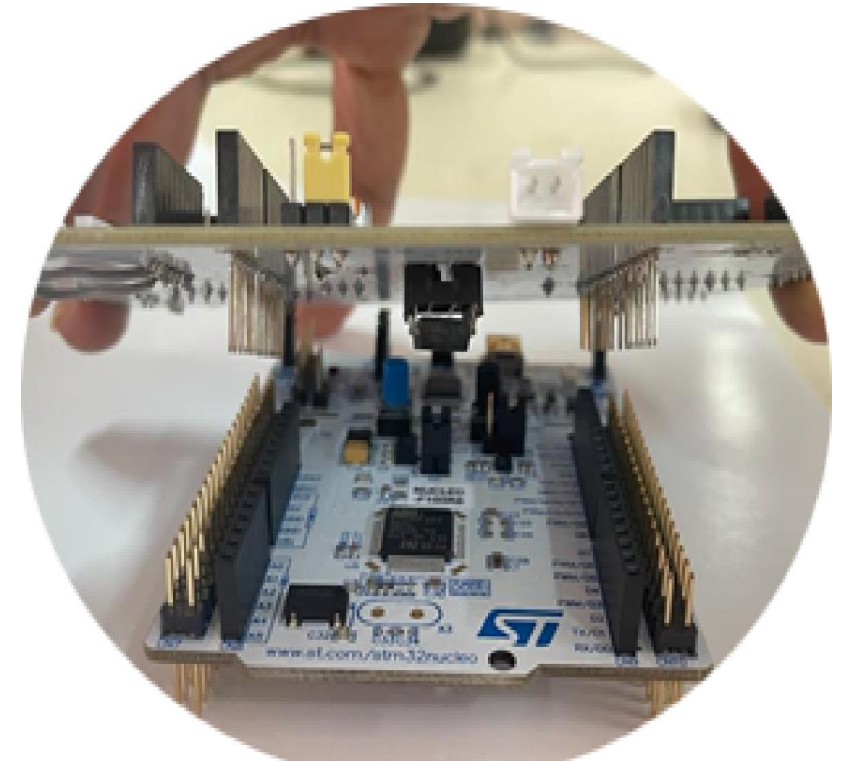
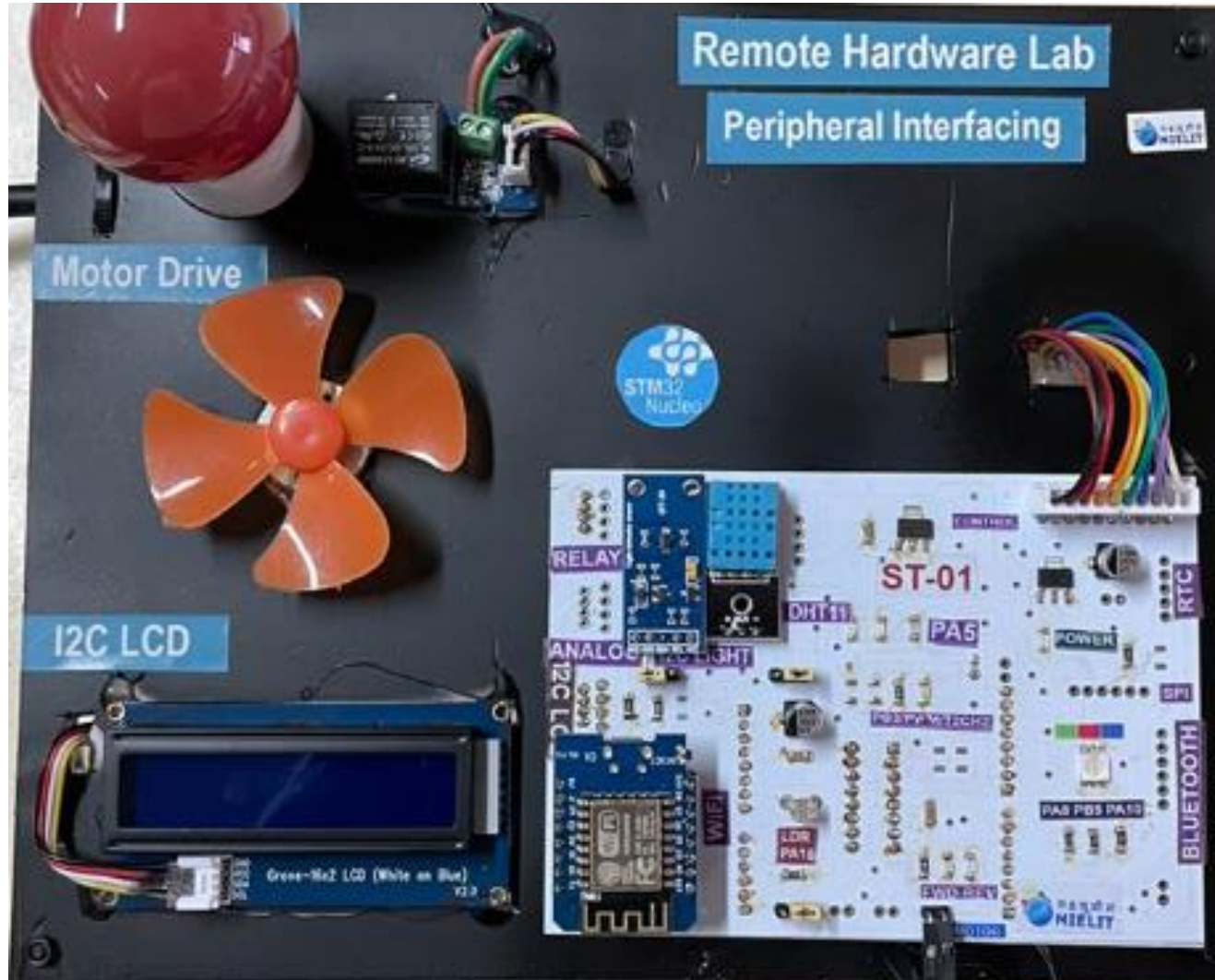
smartlab.nielit 40000  
Username Password

☐ Secure Sockets

# User Inputs via GUI



# Live view of Hardware Targets



# Beneficiaries

- Engineering College students
- Faculty
- R&D scholars
- Industry professionals
- Startup Companies

# Remote Lab outcomes

- NIELIT Calicut offers various online training programs targeting students/Faculties/startup companies and provide hardware access through the remote lab infrastructure
- **Benefits for the students**
  - Enhances their skills and inculcates a Practical oriented approach in them
  - Enables them to **earn Credits** through practical oriented training
  - Exposed to the latest Industry standard design practices and tools
  - Gets a practical exposure of the various subjects of industry relevance which increases placement chances
  - Can attend these workshops according to the student's convenience as well as enhance the knowledge and skills
  - Can result in better ideas and better projects
- **Benefits for the Industry & startups**
  - Embedded/ IoT/ VLSI companies can get skilled students which reduces their training expenditure
  - There will be profound impact on the product turnaround time.

# Remote Lab Target areas

- Embedded Systems
  - Embedded Microcontrollers
  - Embedded Software development
    - Embedded Firmware development, Embedded Linux
    - Embedded Linux Device Driver Development
    - Embedded OS & RTOS
- Internet of Things
- VLSI
  - RTL Design & Verification
  - VLSI Physical Design
  - Circuit Design & Characterisation
  - RTL to GDS Design Flow
  - FPGA based SoC Design
  - Scripting Language for Electronic Design Automation
- Cyber Physical Systems
- Industrial IoT
- Robotics



# Past Remote Lab based Trainings

- Conducted Remote Lab based Courses
  - **Online Lab Workshops Jointly with ARM and NPTEL**
  - Embedded Training Program - IEPs sponsored by MeitY, Govt. of India, jointly with IIT Madras & CDAC Trivandrum.
  - Joint Training programs with IITM & IITM.
  - VLSI & Embedded training
    - NIT Meghalaya
    - VIT
  - Online hardware access trainings supported by industries.
  - More than 1350 people utilized this training within 1 year

# User Experiences

### SUCCESS STORY

**GEETHU MOHANDAS**  
Working in Broadcom LMT

"NIELIT is one of the best institutes to learn VLSI Hardware Design. Most of the class time we spend in LAB for doing practical works related to digital designs. This helped me a lot in my industry. LAB facility is very good and well experienced and friendly faculties always there to help. NIELIT provided a proper interview trainings and tests, which helped me a lot in attending interviews in industries with full confidence."

Completed **Mtech in Embedded Design Technology** during 2014-2016

"NIELIT Calicut is one of the best institutes to learn VLSI Physical design. I am very glad to say that the faculty here are very friendly. I spent most of the class time in LAB for doing practical works related to CMOS schematic designs. I got a lot of exposure to the culture tools which really helped me in doing well in industry. I am very happy to say that the time which I had spent in NIELIT was the turning point of my life. The environment was quite friendly and helped me to gain more knowledge from the resource persons. The contribution from the faculty was so encouraging and I am very thankful to them."

**Completed Advance Diploma- VLSI Physical Design Engineer from NIELIT Calicut**

Year: 2018- November- 2017 February

**Review: Vishnu Vibishna Vithaladevi Aravind**

Present Working Company: **National Oceanography Centre, United Kingdom**

Designation: **Electronics Engineer/Programmer for PCN**

Previous: **Cyprus Semiconductor Corporation**

Designation: **Systems Engineer Staff**

Course completed from NIELIT Calicut: **PG Diploma in VLSI Design**

Year: 2016

Email: [vishnuvib@gnail.com](mailto:vishnuvib@gnail.com)

Phone: +91944746524488

Comments about NIELIT

"NIELIT is where I was able to sharpen my expertise in Electronic hardware, software and firmware designs. Along with the highly skilled lab projects, teachers also encourage students to try out their own projects. The course is targeted for anyone who needs required practical skills, along with the theoretical knowledge, preparing you to succeed in your future endeavor."

"I treasure my memories in receiving the grand prize at Place Invention Design Challenge (2008) conducted by Cyprus Semiconductor Corporation, under the guidance of Mr. Nandakumar K."

"I express my gratitude to all the staff at NIELIT for their help and support in doing this project"

**George Thotton**  
Analog Engineer  
Texas Instruments Pvt.Ltd

"Courses in NIELIT Calicut are more focused on developing talents as desired by the demanding IT industry. Practically inclined coursework helps in better understanding of core concepts. Guidance from well informed and supporting staff makes the transition from a student to a professional with an effortless."

Completed **Mtech in Embedded Design Technology** during 2014-2016

**Review: Anand Joseph**

"After completing engineering degree in Electronics & Communication Engineering, it was a great first step to work in core field. The VLSI was my choice. I am very fortunate to be able to attend VLSI & EMBEDDED HARDWARE DESIGN course in NIELIT Calicut. NIELIT has given a unique opportunity to study and learn in a place where I could receive my practical and lab work. The excellent teachers and their teaching methods gave the best advice and helped in every step of my way. The practical skills and digital tools I got there is a monthly reminder from NIELIT to work hard to be the best. The change which came in for me that I did in a positive impact I can now say that I achieved a lot more in VLSI Design."

I really appreciate NIELIT and staff there for their support and encouragement."

Submitted's Website: [www.nielit.gov.in/calicut](http://www.nielit.gov.in/calicut)  
Official Facebook Page: <https://www.facebook.com/NIELITCalicut>  
Official Twitter Account: <https://twitter.com/NIELITCalicut>

**Ruchika Chandran**  
Placed in HCL Technologies  
Completed VLSI and Embedded Hardware design from NIELIT Calicut  
Batch: August 2016 - February 2017

It has been truly an invaluable learning experience at NIELIT Calicut. Over the duration of course, I have enhanced my knowledge through the constructive inputs from teaching staff. Teachers are very supportive and always ready to solve our problems with their incredible knowledge. The theory classes as well as the lab classes have improved my programming skills. The course has exceeded my expectations significantly.

I had a great time doing my project with the guidance and support of staff using the latest technologies. This is the best institute that offers opportunity to make potential career in the field of VLSI Design.

Visit us at [calicut.nielit.gov.in](http://calicut.nielit.gov.in) / [www.facebook.com/NIELITCalicut](https://www.facebook.com/NIELITCalicut)

### Success Stories ...

**Anil Joseph**  
Wipro Technologies

"NIELIT is one of the best institutes to learn VLSI Physical design. I am very glad to say that the faculty here are very friendly. I spent most of the class time in LAB for doing practical works related to CMOS schematic designs. I got a lot of exposure to the culture tools which really helped me in doing well in industry. I am very happy to say that the time which I had spent in NIELIT was the turning point of my life. The environment was quite friendly and helped me to gain more knowledge from the resource persons. The contribution from the faculty was so encouraging and I am very thankful to them."

Completed **Mtech in Embedded Design Technology** during 2014-2016

**Anil Joseph**  
Wipro Technologies

"NIELIT is one of the best institutes to learn VLSI Physical design. I am very glad to say that the faculty here are very friendly. I spent most of the class time in LAB for doing practical works related to CMOS schematic designs. I got a lot of exposure to the culture tools which really helped me in doing well in industry. I am very happy to say that the time which I had spent in NIELIT was the turning point of my life. The environment was quite friendly and helped me to gain more knowledge from the resource persons. The contribution from the faculty was so encouraging and I am very thankful to them."

Completed **Mtech in Embedded Design Technology** during 2014-2016

**Vibishna B**  
Senior Research Assistant  
University of Southampton, United Kingdom  
Previously Scientist C  
Electronics and Radar Development Establishment (LRDE), DRDO, Bangalore

"NIELIT helps students in bridging the gap between what has been learned and what is required for the industry. The infrastructure and the lab facilities are fabulous and hands-on sessions are really useful in developing the right technical skills. The teaching faculty are very knowledgeable, experienced and supportive. It is a stimulating learning atmosphere"

Completed **PG Diploma in VLSI Design from NIELIT, Calicut in 2009**

**Geethu Mohandas**  
April 2 at 10:31pm

Hi, I got placed in Dexel Electronics Designs Pvt Ltd,

**Review: Anand Joseph**

"NIELIT gives you an opportunity to add on to your knowledge along with the practical experience, dedicated and able people there to help students to achieve their goals. I like the lab facility and the class room where they see their real life examples. NIELIT is a place where you can gain more knowledge in VLSI Design. I am very happy to say that the time which I had spent in NIELIT was the turning point of my life. The environment was quite friendly and helped me to gain more knowledge from the resource persons. The contribution from the faculty was so encouraging and I am very thankful to them."

Completed **Mtech in Embedded Design Technology** during 2014-2016

**Kiran Prakash**  
System Engineer  
Alberne Geophysical Services  
Mehar International

Course in NIELIT: **Process Control Instrumentation- PC 100**

"PC 100 is really a bridge course between college and industry. It fills the student with what is required for the industry. It changes our perspective in approaching a technical problem. The theory sessions start from where we have stopped at graduation and practical sessions are really practical. I think NIELIT is the only place where we get the equipment to try any thing logical. We learn by doing"

Listen what our students say about our courses

**Review: Vishnu Vibishna Vithaladevi Aravind**

Present Working Company: **National Oceanography Centre, United Kingdom**

Designation: **Electronics Engineer/Programmer for PCN**

Previous: **Cyprus Semiconductor Corporation**

Designation: **Systems Engineer Staff**

Course completed from NIELIT Calicut: **PG Diploma in VLSI Design**

Year: 2016

Email: [vishnuvib@gnail.com](mailto:vishnuvib@gnail.com)

Phone: +91944746524488

Comments about NIELIT

"NIELIT is where I was able to sharpen my expertise in Electronic hardware, software and firmware designs. Along with the highly skilled lab projects, teachers also encourage students to try out their own projects. The course is targeted for anyone who needs required practical skills, along with the theoretical knowledge, preparing you to succeed in your future endeavor."

"I treasure my memories in receiving the grand prize at Place Invention Design Challenge (2008) conducted by Cyprus Semiconductor Corporation, under the guidance of Mr. Nandakumar K."

"I express my gratitude to all the staff at NIELIT for their help and support in doing this project"

**Review: Anand Joseph**

"NIELIT gives you an opportunity to add on to your knowledge along with the practical experience, dedicated and able people there to help students to achieve their goals. I like the lab facility and the class room where they see their real life examples. NIELIT is a place where you can gain more knowledge in VLSI Design. I am very happy to say that the time which I had spent in NIELIT was the turning point of my life. The environment was quite friendly and helped me to gain more knowledge from the resource persons. The contribution from the faculty was so encouraging and I am very thankful to them."

Completed **Mtech in Embedded Design Technology** during 2014-2016

**SojanR Thomas**  
Placed in HCL Technologies  
Completed PG Diploma in VLSI and Embedded Hardware design from NIELIT Calicut

Choosing this institution had been one of the best decisions for my career growth. Inspiring facilities, practical oriented curriculum along with well facilitated labs gave me apt knowledge on languages, tools, techniques, etc. used in VLSI industries. Since government projects were going on during the course period, learning within the industry improved my level of confidence and passion to aspire profession in the same field. This course is great for anyone seeking career in VLSI domain. I highly recommend it."

### SUCCESS STORIES...

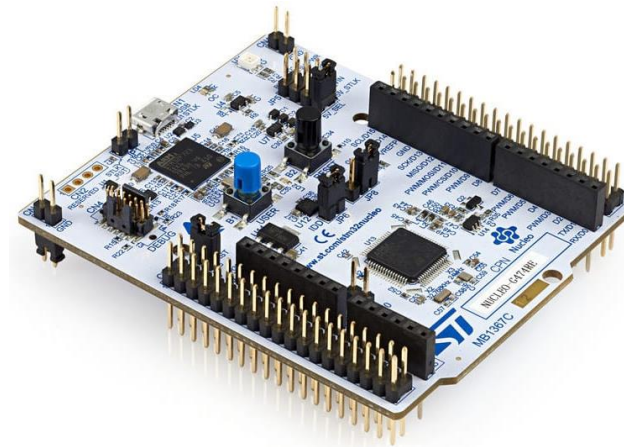
**Review: Anand Joseph**

"NIELIT gives you an opportunity to add on to your knowledge along with the practical experience, dedicated and able people there to help students to achieve their goals. I like the lab facility and the class room where they see their real life examples. NIELIT is a place where you can gain more knowledge in VLSI Design. I am very happy to say that the time which I had spent in NIELIT was the turning point of my life. The environment was quite friendly and helped me to gain more knowledge from the resource persons. The contribution from the faculty was so encouraging and I am very thankful to them."

Completed **Mtech in Embedded Design Technology** during 2014-2016

# Embedded Microcontroller Lab Access

- All Microcontrollers with access to following peripherals to users
  - GPIO
  - ADC
  - PWM
  - DAC
  - Timer
  - Serialport
  - USB



**ARM<sup>®</sup>mbed<sup>™</sup>**  
IoT Device Platform

## mbed Ecosystem

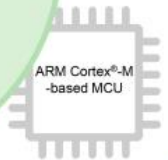
- Partners
- Developers
- Enabled Services
- Enabled Products

## mbed Device Server

- Free for development
- Licensable for commercial use
- Application data and device management

## mbed OS

- Free on ARM architecture
- Energy-efficiency, productivity, connectivity, security



**ARM**

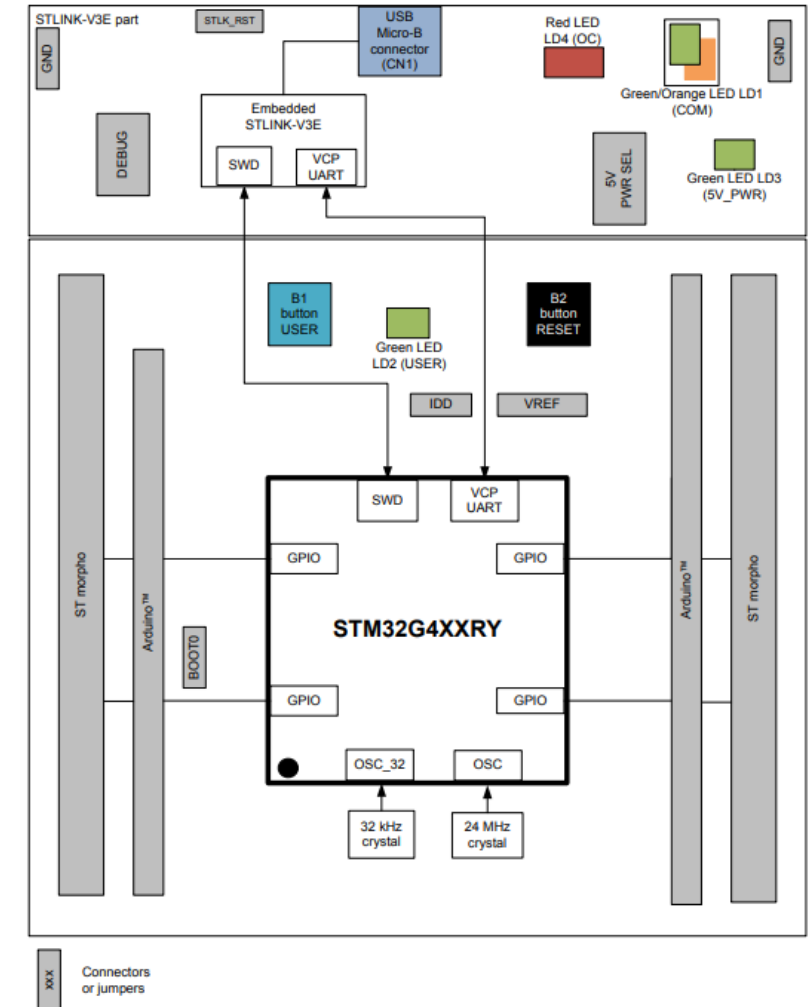
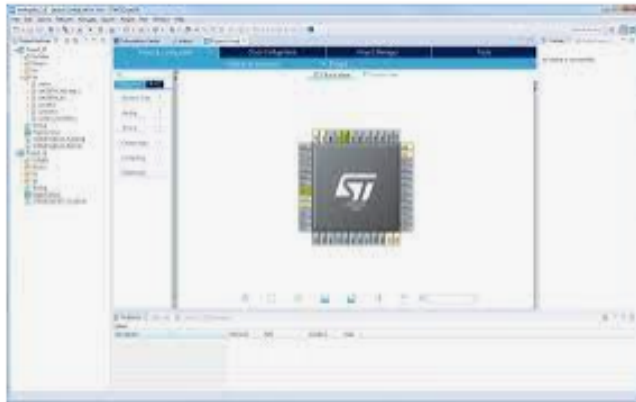
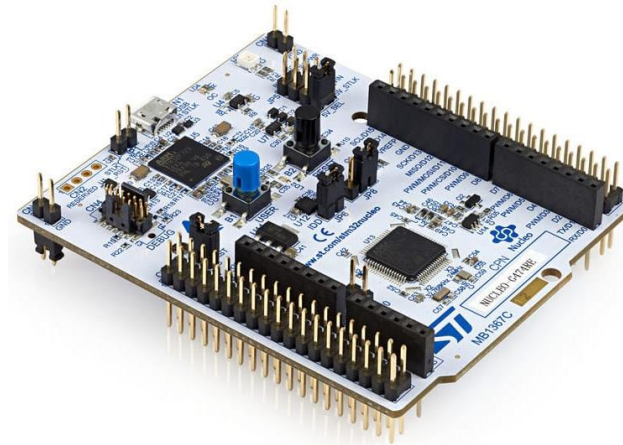
Source:

1. <https://www.st.com/en/microcontrollers-microprocessors/stm32q474re.html>
2. <https://os.mbed.com>

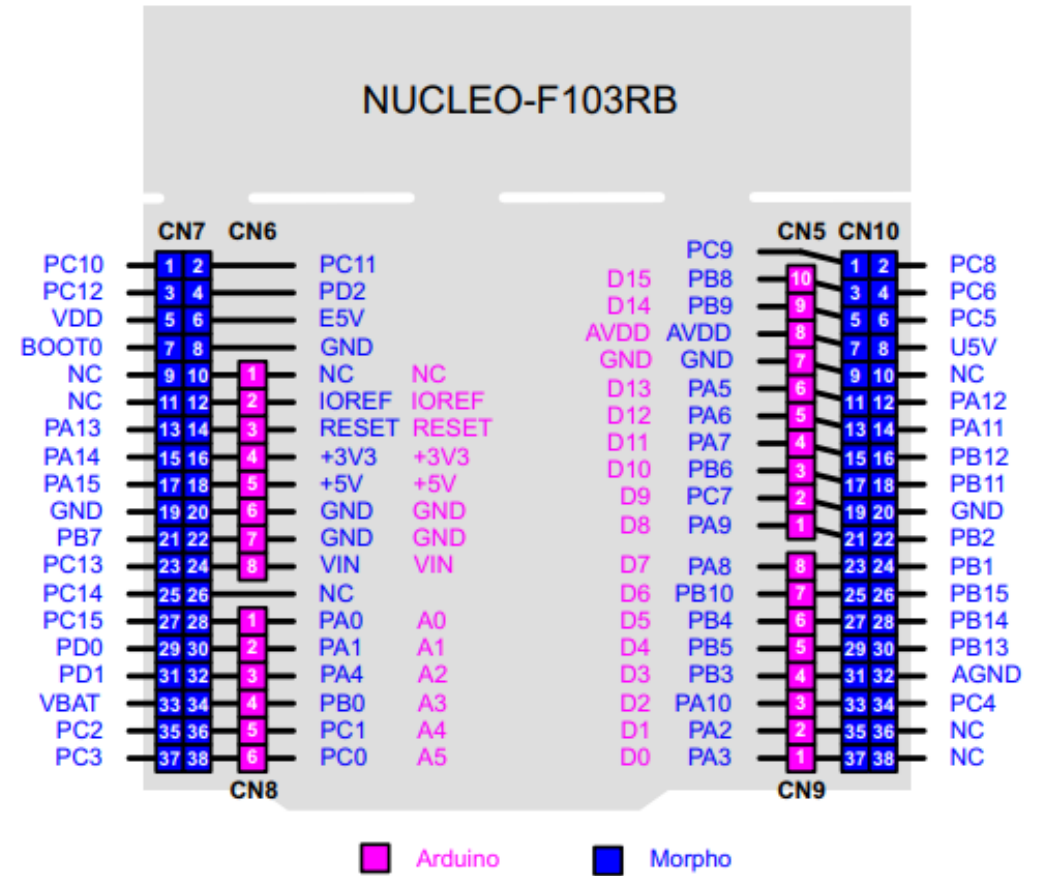
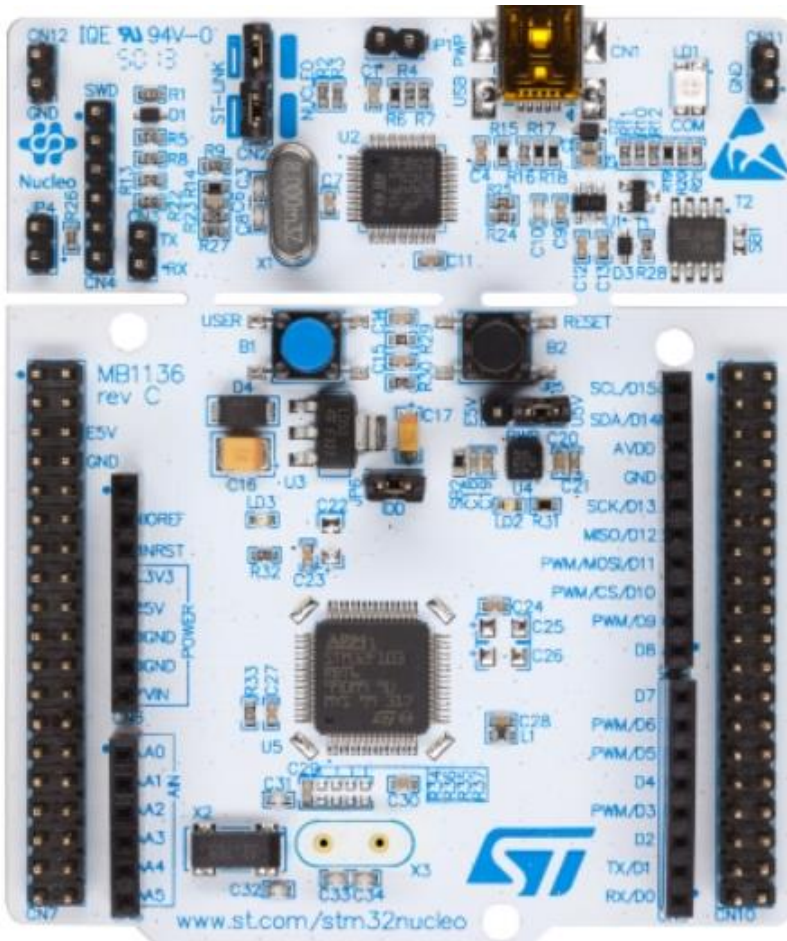


# Embedded ARM Cortex Microcontroller Lab Demo

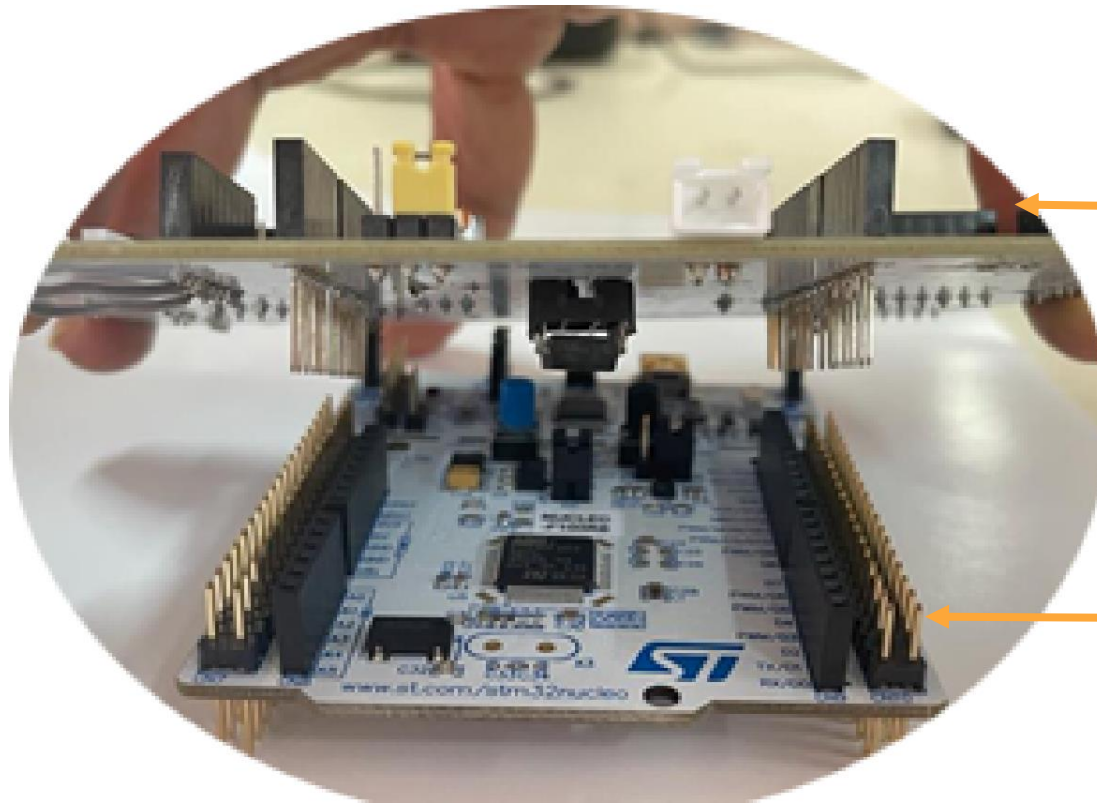
NUCLEO-G474RE



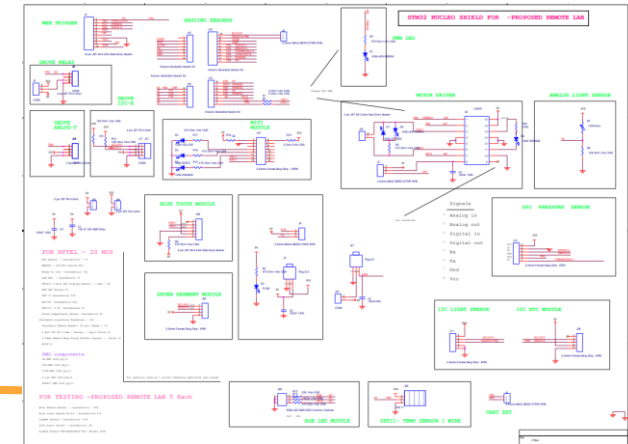
# Embedded ARM Cortex Microcontroller Peripheral Lab



# STM32 NUCLEO SHIELD - Developed by NIELIT Calicut



Nucleo Shield

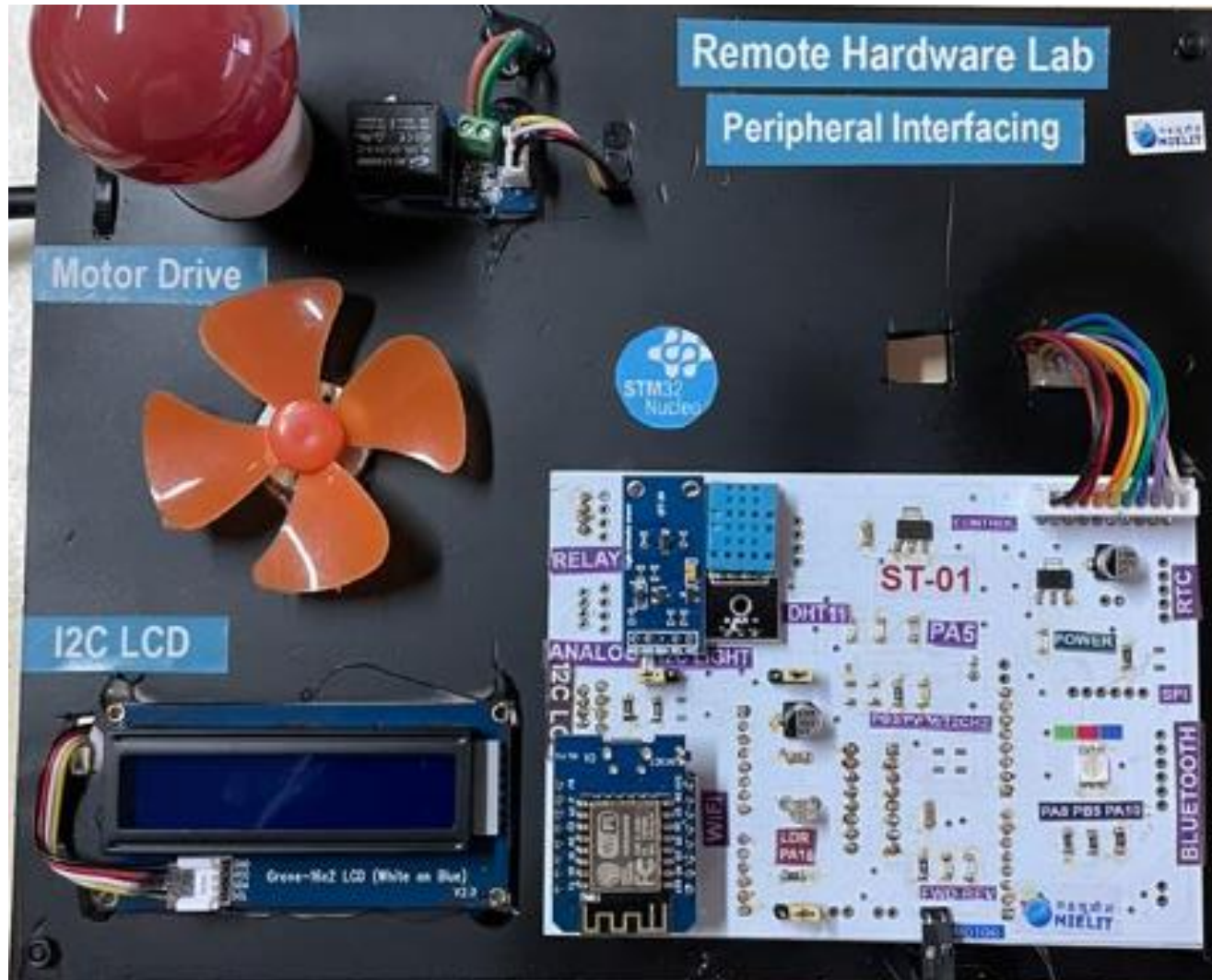


Schematic

ST Nucleo Board



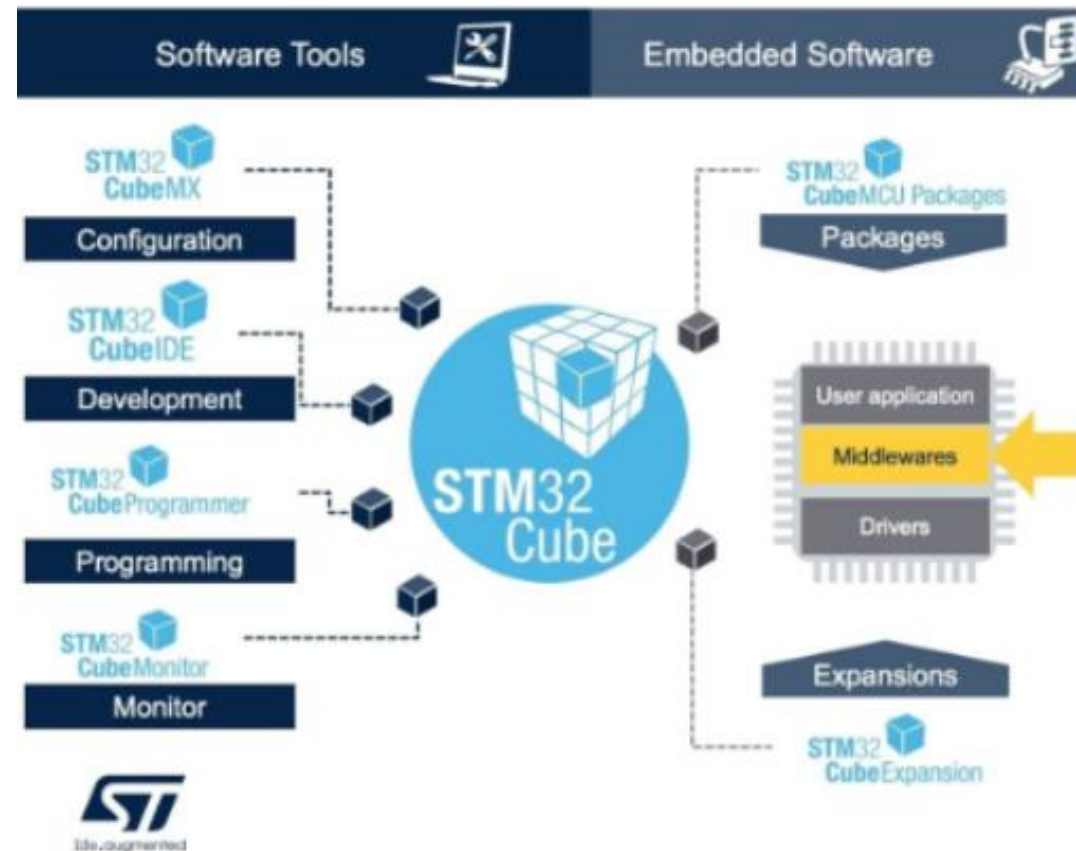
# Interfacing Sensors and Actuators



- GPIO
  - Onboard LED - PA5
  - Relay - PA9
  - RGB - LEDs - PA8, PA10, PB5
- UART
  - WiFi Module
  - Bluetooth
- I2C
  - LCD
  - RTC
  - Light Sensor
- Analog
  - Light Sensor
  - Temperature - PB0
  - Humidity - PB0
- PWM
  - Brightness Control - PB3
  - Motor Speed Control - PB3
    - Direction - PB4, PB10
- SPI
  - Pressure Sensor

# Real-Time OS (RTOS) Lab access

- Keil RTX Real-Time OS
- FreeRTOS
- ChibiOS/RT
- Real-Time Linux



**RTX5 RTOS**  
**CMSIS**  
**COMPLIANT**  
ARM® Cortex™ Microcontroller  
Software Interface Standard

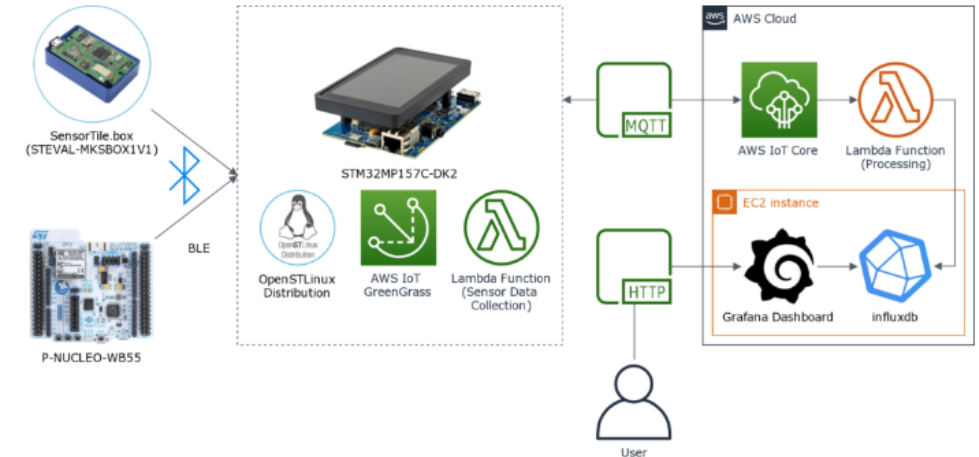
**freeRTOS**



**ChibiOS/RT**  
A compact and fast  
real-time operating  
system

# IoT Lab Access

- IoT Node setup
- Interfacing with sensors and actuators
- IoT Gateway setup
- Cloud connectivity
- IoT dashboard & user access



**ARM<sup>®</sup>mbed<sup>™</sup>**  
IoT Device Platform



Productivity



Security



Connectivity



Management



Efficiency

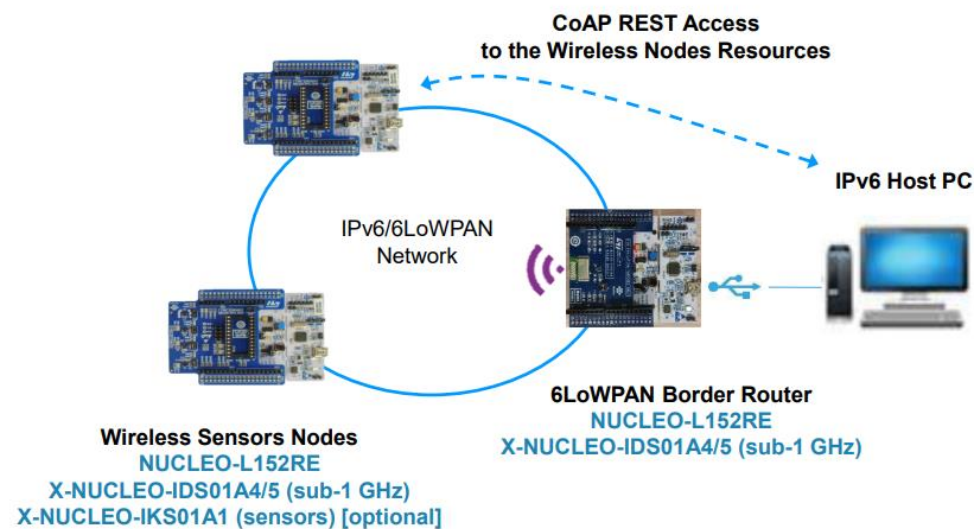
The end-to-end **software ecosystem** for the Internet of Things





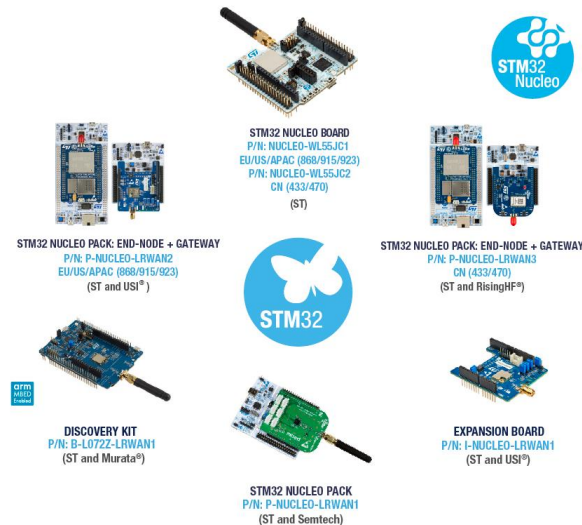
# Wireless Communication Lab Access

- Wireless PAN
- WSN setup
- Contiki OS
- Wireless Modem based Labs
  - GSM
  - Bluetooth
  - BLE
  - Zigbee/ Zwave
  - Sub1GHz



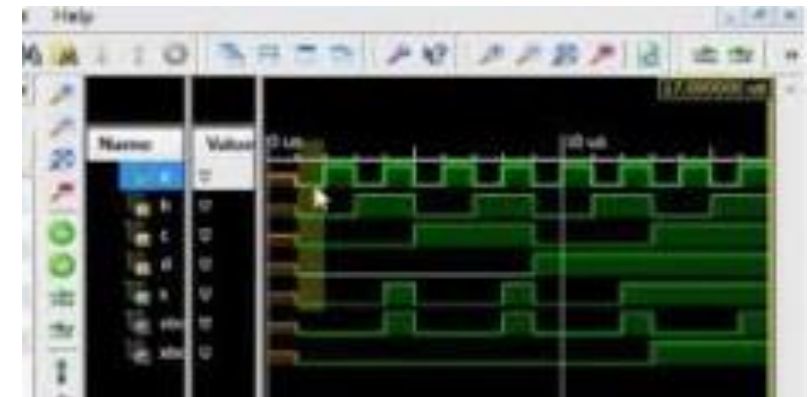
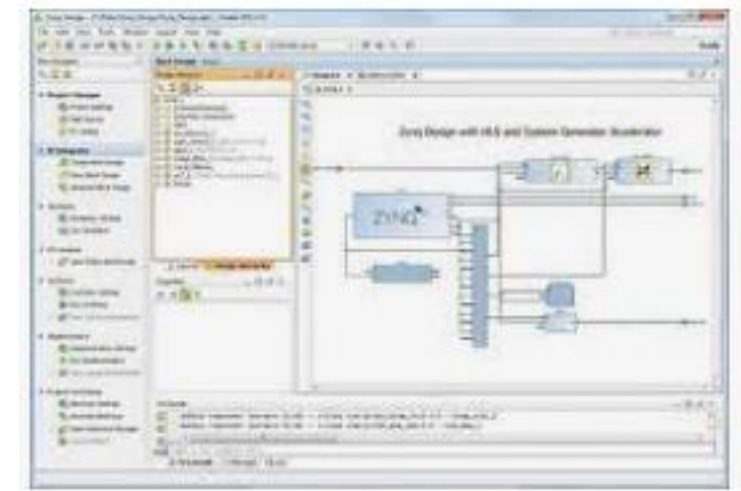
# LoRaWAN & Industrial IoT Lab Access

- LoRaWAN node setup
- LoRaWAN Gateway setup
- LoRaWAN cloud based solutions
- Industrial IoT Nodes
- Industrial IoT Gateway



# VLSI Lab Access

- VLSI
  - RTL Design
  - RTL Verification
  - VLSi Physical Design
  - Circuit Design & Characterisation
  - RTL to GDS Design Flow
  - FPGA based SoC Design
  - Scripting Language for Electronic Design Automation





# Embedded Linux Lab Access

- Linux internal programming
- Linux Kernel Module Programming
- Linux Device Driver Development
- Embedded Linux Customisation and porting to hardware targets
- Real Time Linux



```
ifneq ($(KERNELRELEASE),)
obj-m := foo.o
else
KERNEL_DIR= /lib/modules/$(shell uname -r)/build
PWD := $(shell pwd)
all:
    make -C $(KERNEL_DIR) M=$(PWD) modules
endif
```



# Upcoming Trainings through Remote Hardware Lab

## **Embedded Stream starting from September 2022 onwards**

1. Embedded C and ARM Cortex Microcontrollers
2. Embedded Linux
3. Internet of Things
4. Real Time OS
5. Industrial IoT
6. Embedded Product Design

**PG Diploma in Embedded Systems and IoT**

## **VLSI Stream next batch starting from September 2022 onwards**

1. Embedded C and ARM Cortex Microcontrollers
2. VLSI Fundamentals
3. FPGA Architecture and Programming using Verilog HDL
4. ARM based SoC Design
5. Advanced ARM SoCs and OS Porting
6. ARM based SoC Verification

**PG Diploma in VLSI SoC Design and Verification**

# Remote access for Startup companies

- EMI/EMC test setup
- Logic Analyser
- DSO/MSO
- High-end development boards / Software Tools

## MEITY FUNDED PROJECTS (R & D)

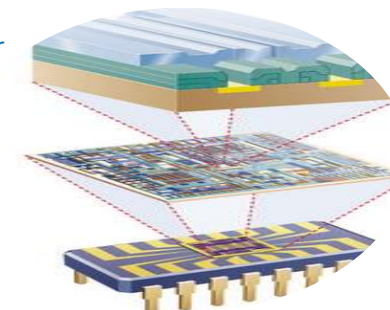
### ❑ Indigenous Color Doppler Ultrasound Scanner with PNDT Compliance.

- ✓ Indigenous design is First time in India
- ✓ High Social relevance by making the system PNDT Compliance.
- ✓ Huge Money savings for the Nation, by import substitution.
- ✓ Plethora of Applications and very few researchers in India.
- ✓ Ultrasound research platform, enables high end research ,First time in India.
- ✓ High quality manpower development in Electronic Product design, R & D in Medical Imaging etc .



### ❑ Special manpower Development Program for Chips to System Design (C2SD )

- ✓ Design and Development of Array Signal Processor ASIC (Single chip solution for under water acoustic CAMERA/SONAR and medical imaging)
- ✓ Training of Minimum 180 candidates in VLSI/Electronics System Design and Manufacturing area.
- ✓ Training of candidates at Doctoral level (PhD)
- ✓ To introduce new PG Programme in VLSI Design
- ✓ Capacity building in ASIC Design & Verification , Manufacturing and Chip to System Design.



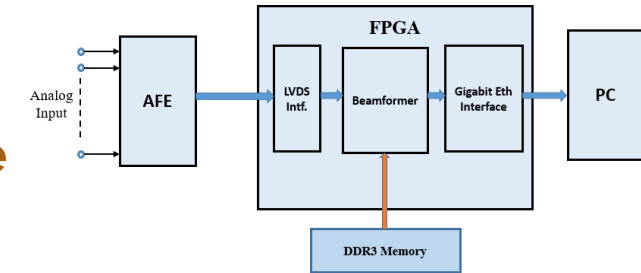
Array Signal Processor ASIC For NPOL Cochin



## R&D PROJECTS – DRDO

### ❑ Study on Analog Frontend (AFE) and design of hardware field beamformer for Imaging Sonar.

- ✓ Supports up to 128 Channels
- ✓ Parallel beam formation up to 28 beams.
- ✓ Field of View up to 90 Degree
- ✓ High Speed SERDES Interface
- ✓ Gigabit Eth Interface
- ✓ Delay Tables in External DDR3 Mem
- ✓ Porting on Custom Designed Board



### ❑ Development of a new scheduling algorithm for Multi-Core architectures in Real-time Linux platform

- ✓ Development of application specific scheduling algorithm for Embedded Linux Platform for multi-core architecture.
- ✓ Targeted application – Sonar Signal Processing

33

## R & D Projects

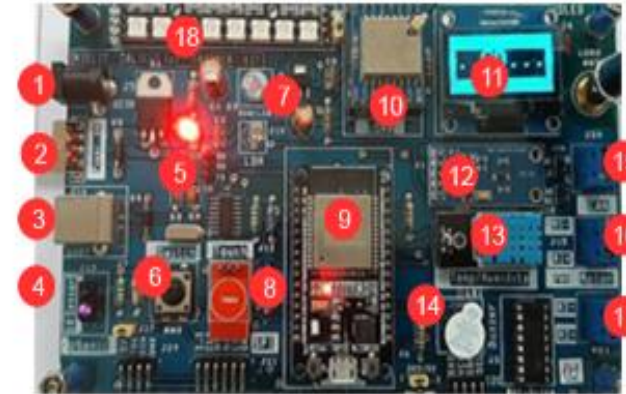
### ❑ Indigenous Portable Ventilator-SAMIRA

- ✓ Invasive Closed Loop Ventilator
- ✓ BLDC Blower based Air Source
- ✓ CPAP, BiPAP, CMV and SIMV Modes.
- ✓ FiO<sub>2</sub> : 21% - 80%
- ✓ LCD/TFT display and remote access display with IoT connectivity to laptop / Mobile app



### ❑ IoT Trainer Kit

- |                        |                            |
|------------------------|----------------------------|
| 1. Power supply Socket | 10. LoRa                   |
| 2. Power On switch     | 11. OLED                   |
| 3. Power on USB/UART2  | 12. Digital Light sensor   |
| 4. IR Proximity Sensor | 13. Temperature & humidity |
| 5. Power on LED        | 14. Buzzer                 |
| 6. Tactile Switch      | 15. CAN bus                |
| 7. User LED            | 16. DC motor 1/PWM1        |
| 8. Touch switch        | 17. DC motor 2/PWM2        |
| 9. ESP32 module        | 18. Neo pixel LED          |





# THANK YOU

You can find us at:



राष्ट्रीय इलेक्ट्रॉनिकी एवं सूचना प्रौद्योगिकी संस्थान  
National Institute of Electronics & Information Technology



[www.nielit.gov.in/calicut](http://www.nielit.gov.in/calicut)



[rajesh.m@nielit.gov.in](mailto:rajesh.m@nielit.gov.in)