



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

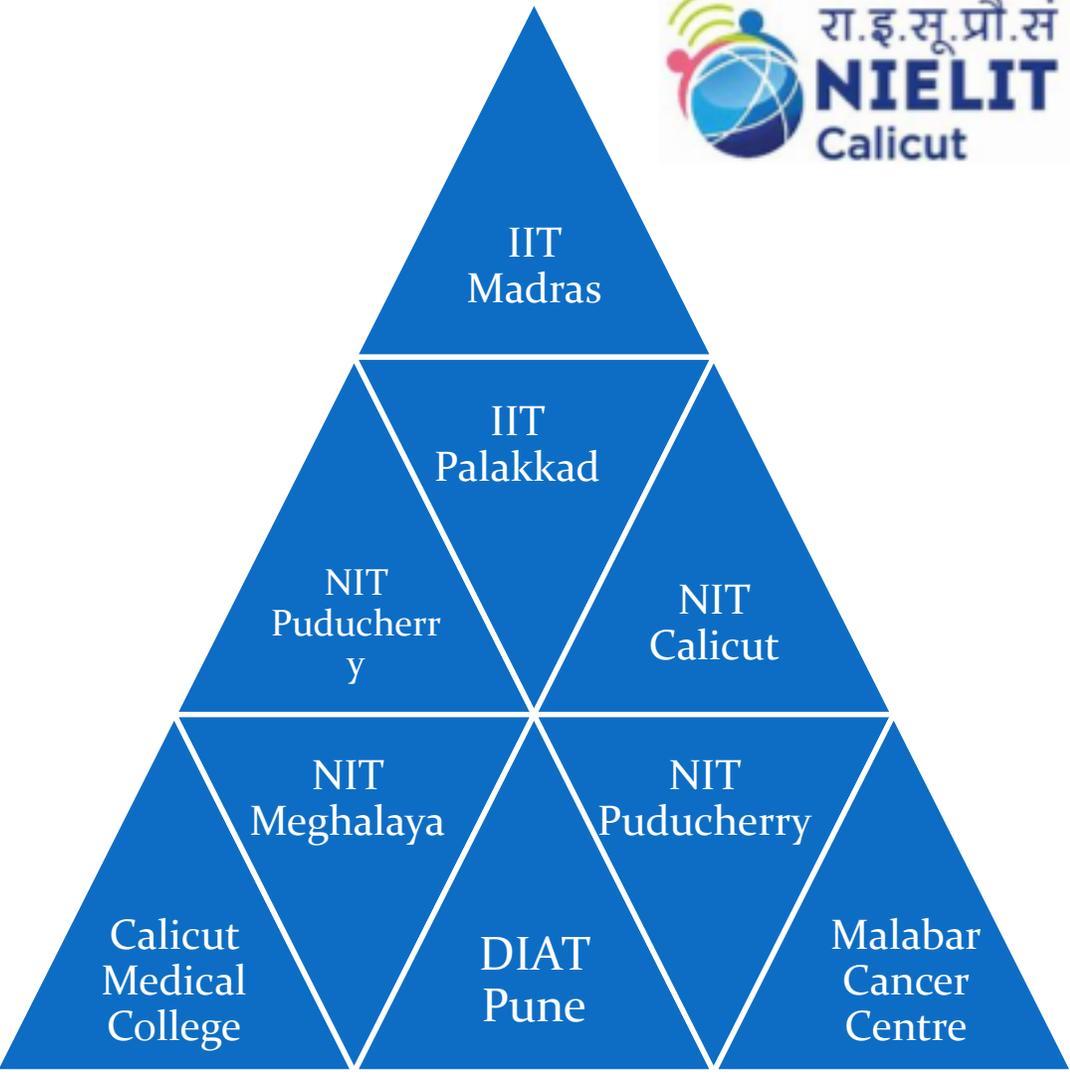
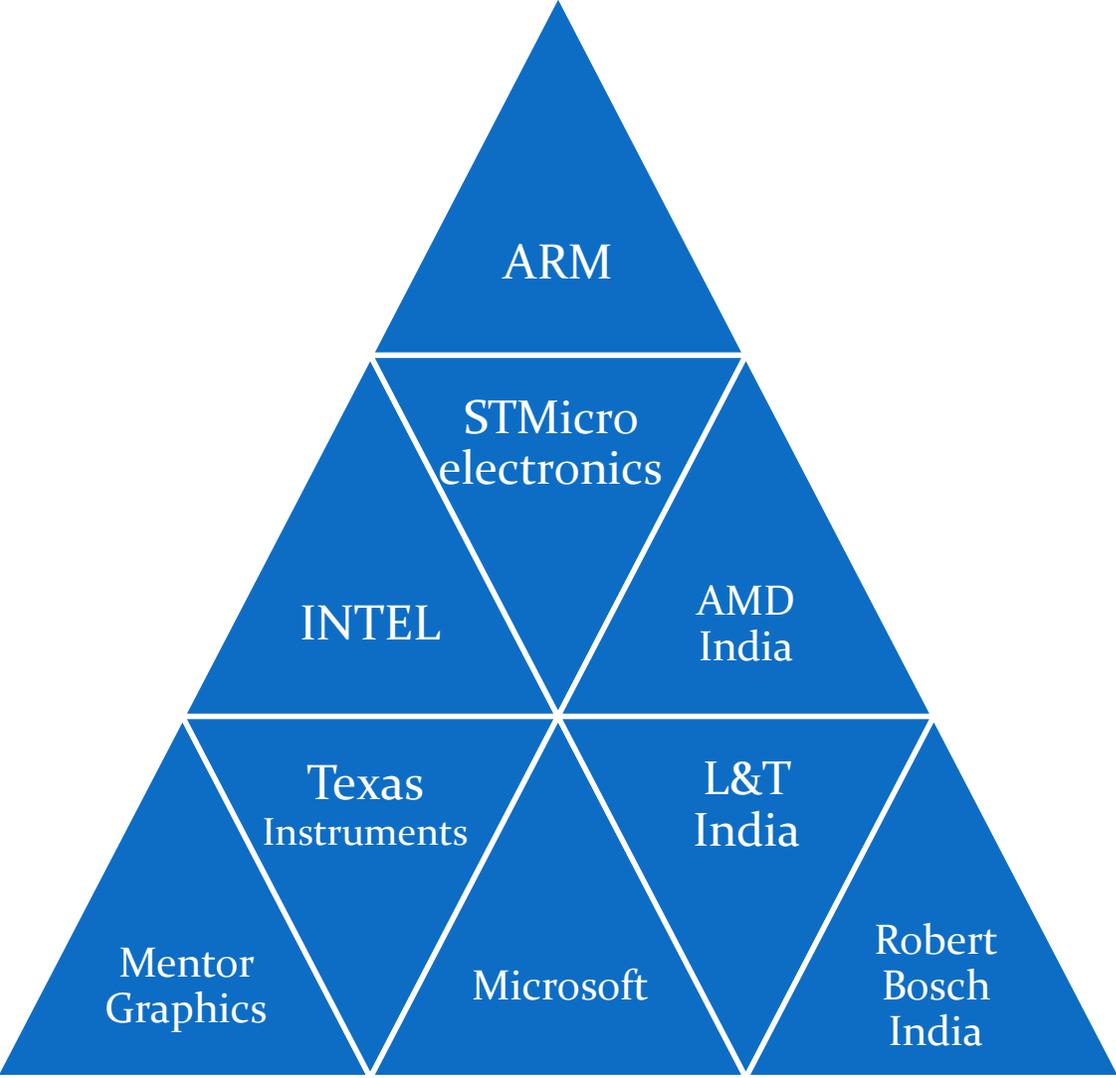
Remote Hardware Lab

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

Agenda

- About NIELIT Calicut
- Remote Lab Overview
- Demo

Collaborations with Leading Academia / Industries



Industry Oriented Training Programs

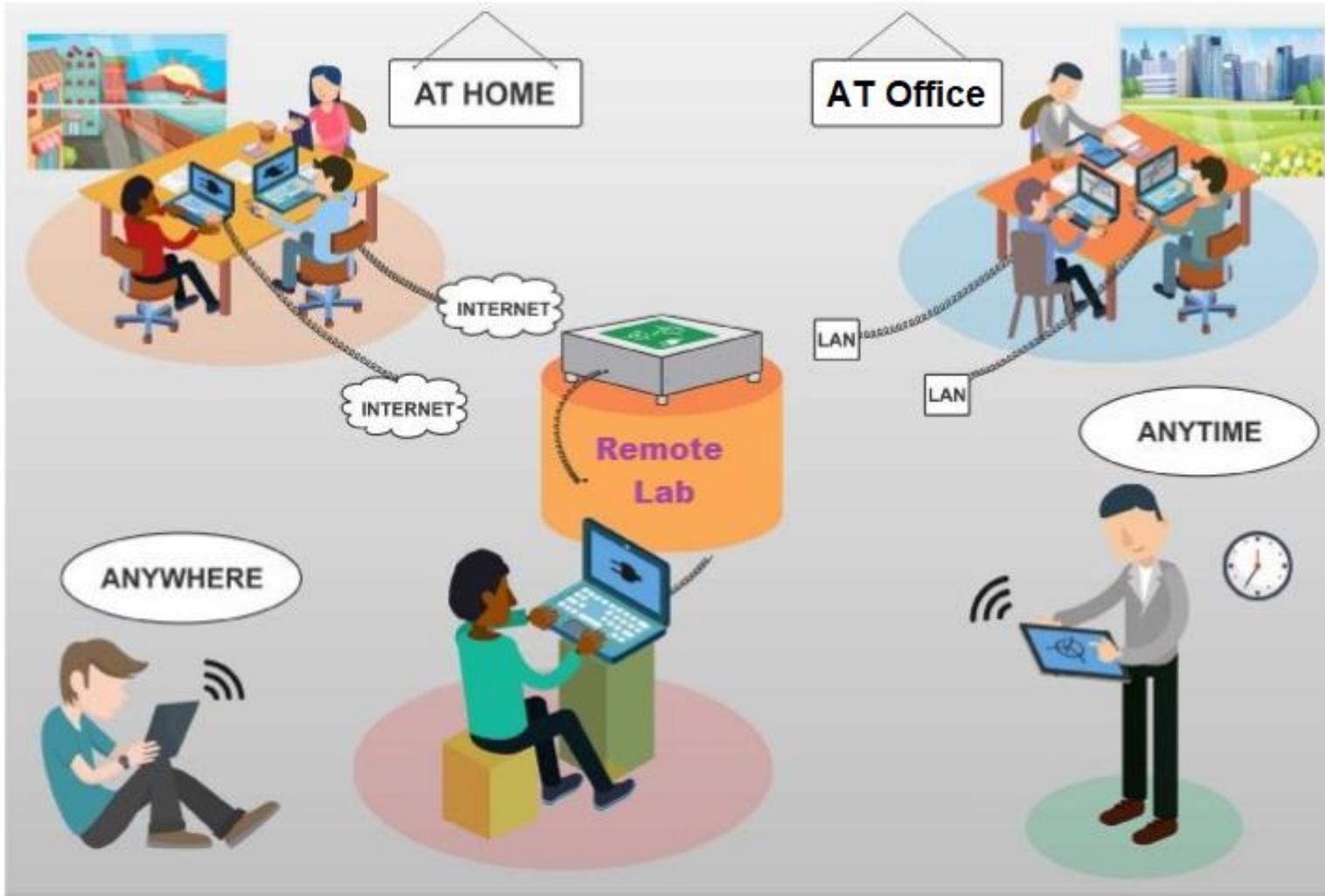
Non- Formal Training Programs

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

Formal Training Programs

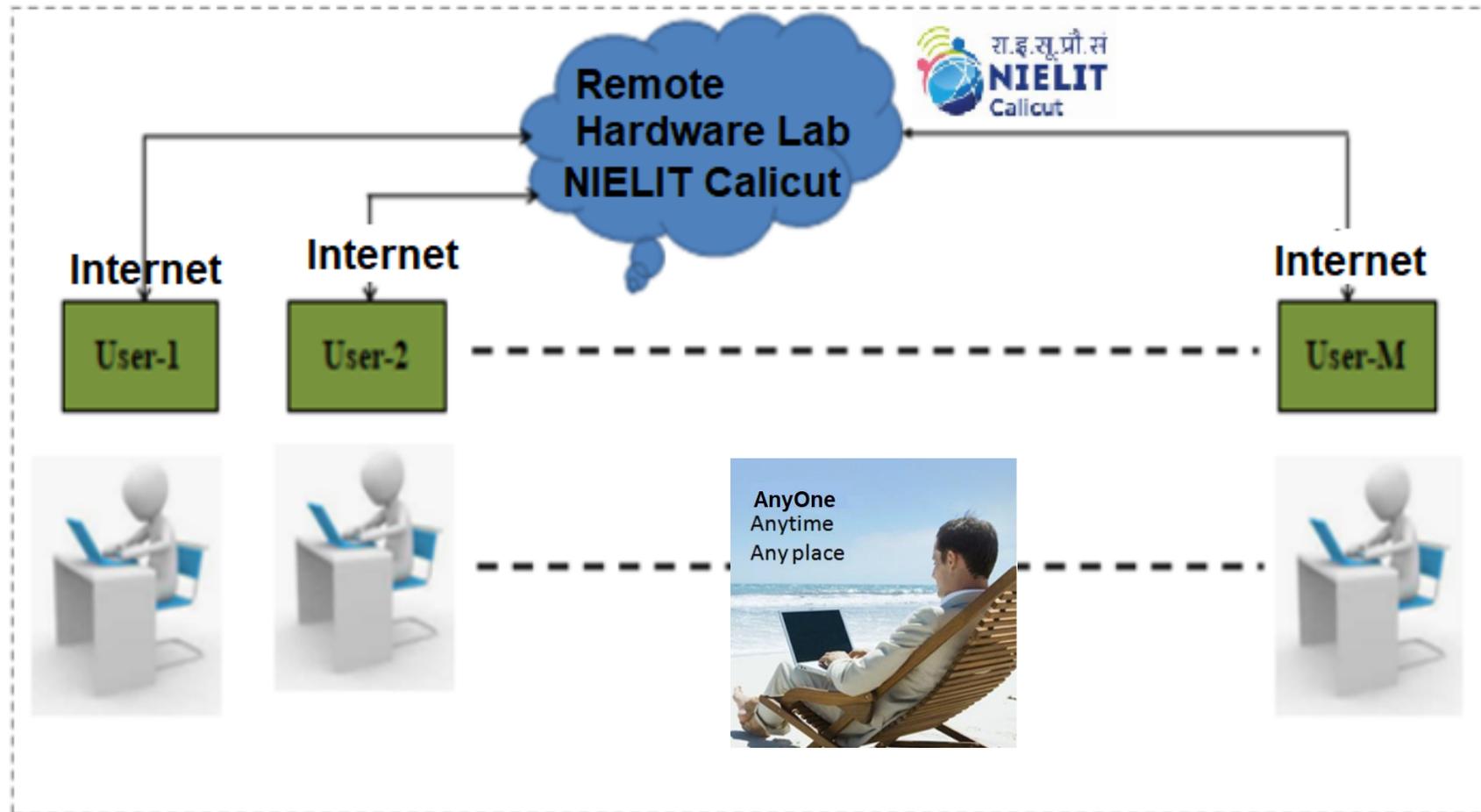
- M.Tech in Embedded Systems
- M.Tech in Electronic Design Technology
- M.Tech in VLSI and Embedded (Joint program with Defence Institute of Advanced Studies (DIAT- Pune), Ministry of Defence, Govt. of India)

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



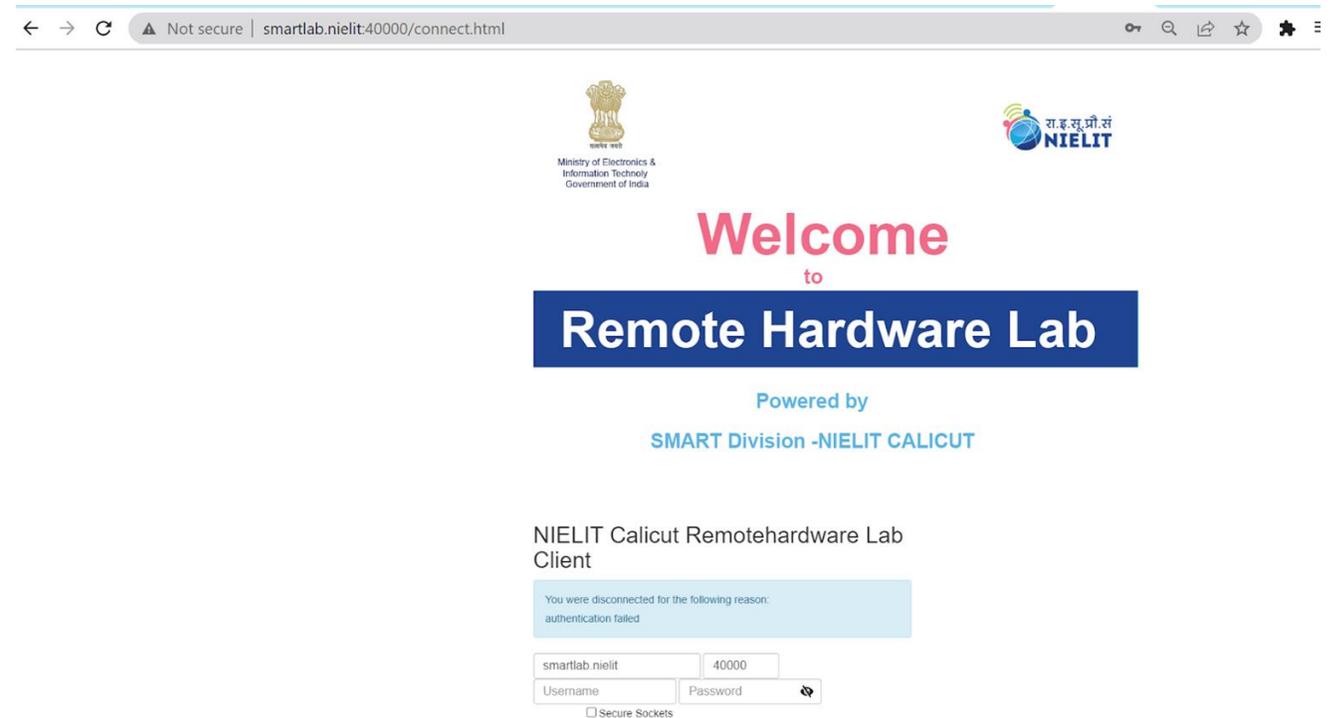
AnyOne
AnyTime
AnyWhere

What is a Remote Lab ?



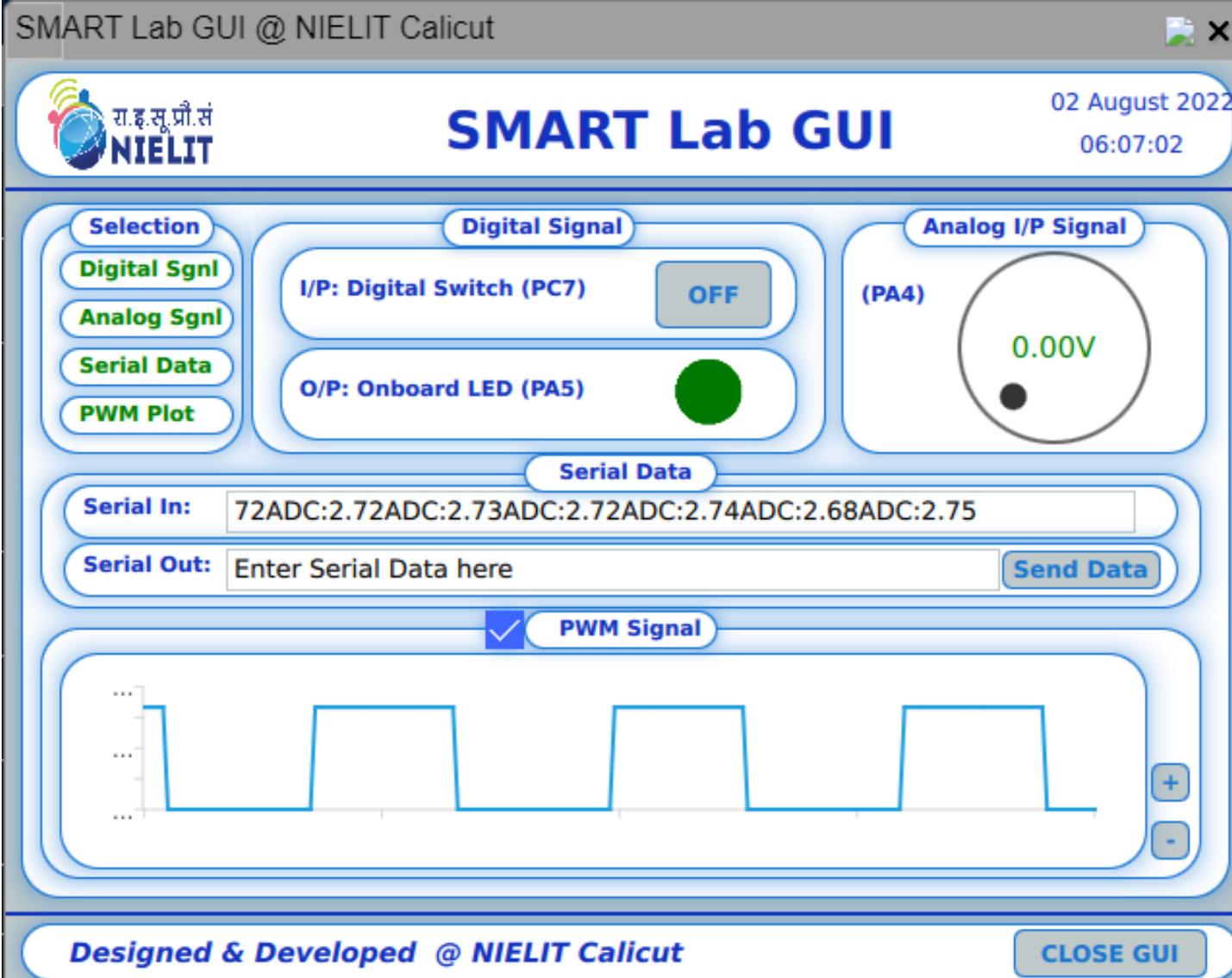
Remote Lab Access requirements

- 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, followed by "Powered by SMART Division -NIELIT CALICUT". Below this, the text "NIELIT Calicut Remotehardware Lab Client" is displayed. A light blue error message states: "You were disconnected for the following reason: authentication failed". At the bottom, there are input fields for "Username" (containing "smartlab.nielit") and "Password" (containing "40000"), a "Secure Sockets" checkbox, and a "Go" button.

User Inputs via GUI



SMART Lab GUI @ NIELIT Calicut

रा.इ.सू.प्रौ.सं
NIELIT

SMART Lab GUI

02 August 2022
06:07:02

Selection

- Digital Sgnl
- Analog Sgnl
- Serial Data
- PWM Plot

Digital Signal

I/P: Digital Switch (PC7)

O/P: Onboard LED (PA5)

Analog I/P Signal

(PA4) 0.00V

Serial Data

Serial In: 72ADC:2.72ADC:2.73ADC:2.72ADC:2.74ADC:2.68ADC:2.75

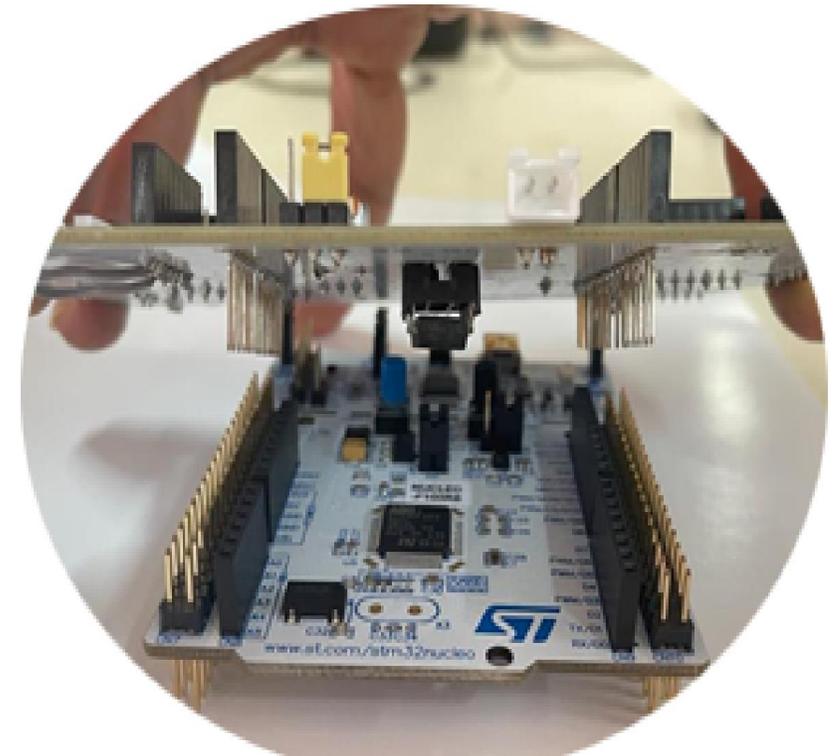
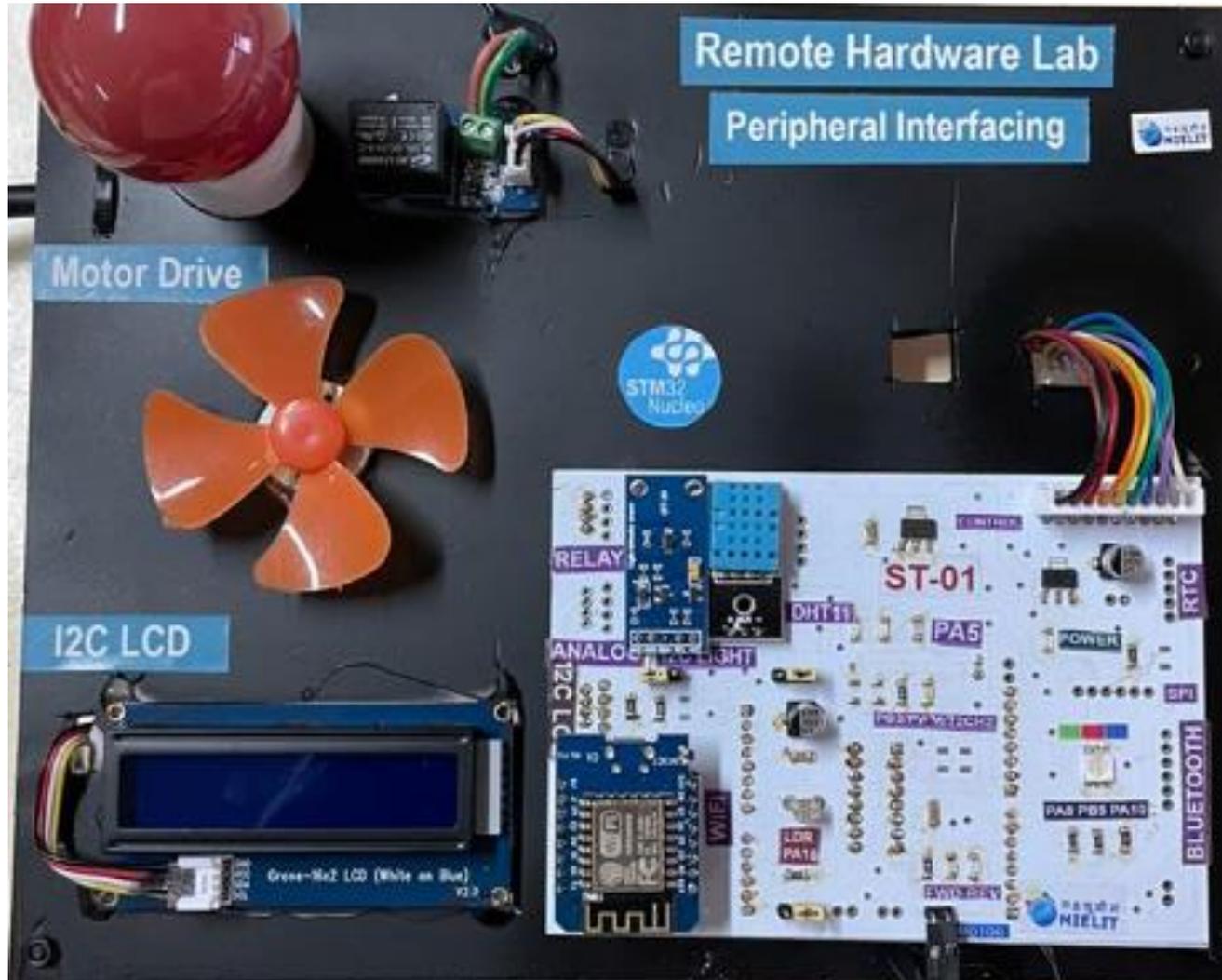
Serial Out: Enter Serial Data here

PWM Signal

Graph showing a square wave signal.

Designed & Developed @ NIELIT Calicut

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 faculty 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.

Help: <http://www.nielit.gov.in/>

Facebook: [NIELITIndia](https://www.facebook.com/NIELITIndia)

Twitter: [NIELITIndia](https://twitter.com/NIELITIndia)

SUCCESS STORY

GEETHU MOHANDAS
Working in Broadcom LMT

"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 timings in LAB for doing practical works related to CMOS schematic designs. I got a lot of exposure to the cadence 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."

Nandini Pradeep
HCL Technologies Ltd.
(ASIC Physical Design Engineer)

Completed Advance Diploma - VLSI Physical Design Engineer from NIELIT Calicut

Year: 2018 November - 2017 February

Help: <http://www.nielit.gov.in/>

Facebook: [NIELITIndia](https://www.facebook.com/NIELITIndia)

Twitter: [NIELITIndia](https://twitter.com/NIELITIndia)

SUCCESS STORY

Vibishna B
Senior Research Assistant
University of Southampton, United Kingdom
Precision Scientist C
Electronics and Radar Development Establishment (ERDEL), 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

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

SUCCESS STORY

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 ease and effortless."

Completed Mtech in Embedded Design Technology during 2014-2016

Success Stories ...

Ant Joseph
Wipro Technologies

"I had an enriching and pleasant experience at NIELIT. Professors with their incredible skills provided students with clear and deep knowledge. The quality and way of teaching were an inspiration to attend every class and grasp as much as we can from the faculty. We were provided with ample facilities for practical experience which helped in improving our skill set."

I think NIELIT for guiding me towards the right direction and would recommend it to all graduates looking for a career in VLSI.

Paaja Rajagopalan
Working in HCL Technologies
Student of VLSI and Embedded Hardware design, 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.

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 STORY

George Thotton
Analog Engineer
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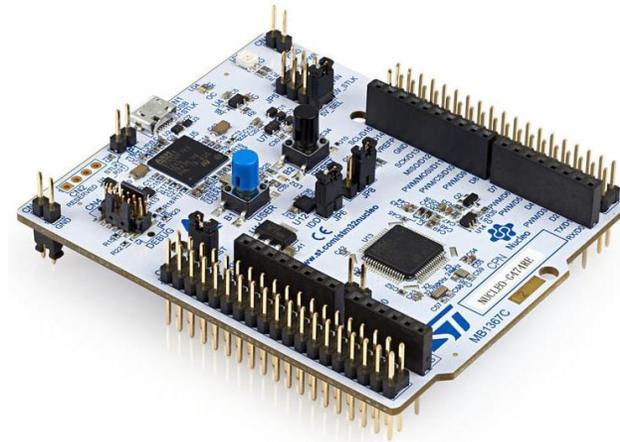
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Embedded Microcontroller Lab Access

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



ARM[®]mbed[™]
IoT Device Platform

mbed Ecosystem

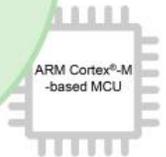
- Partners
- Developers
- Enabled Services
- Enabled Products

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



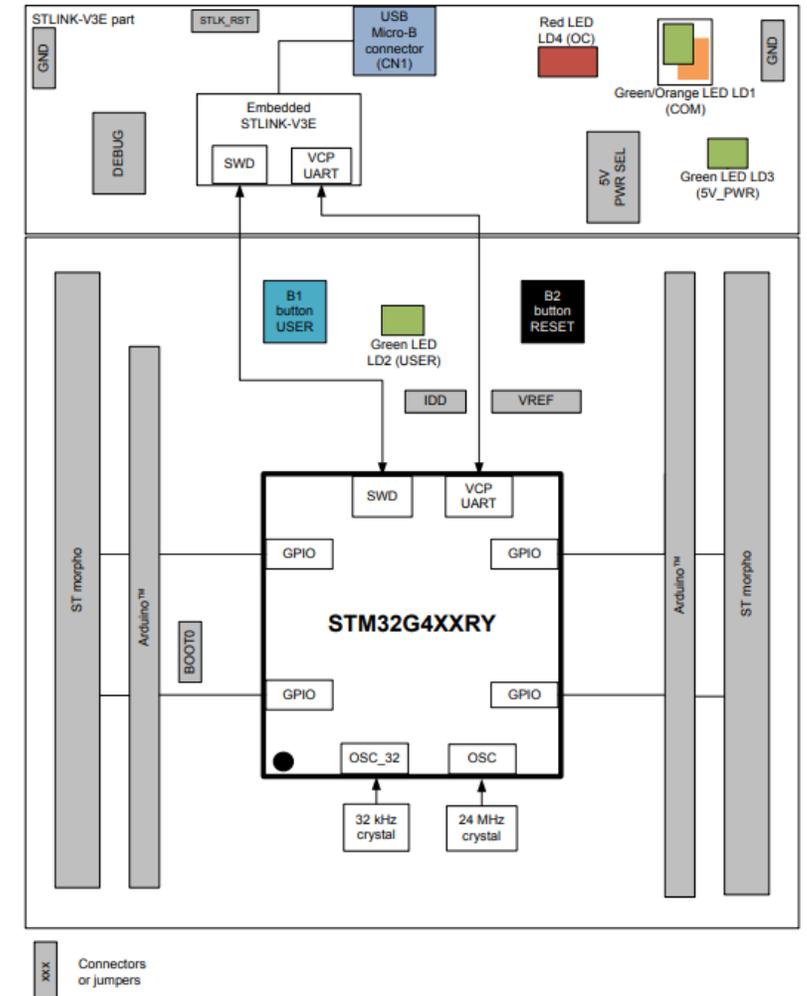
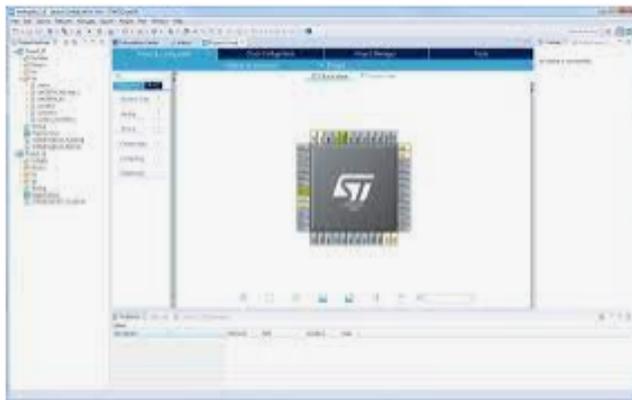
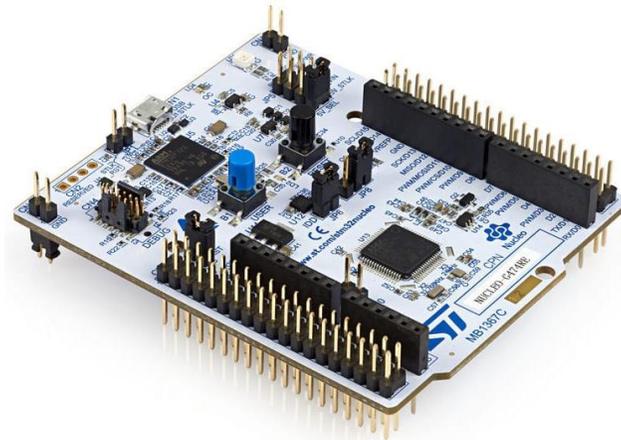
ARM

Source:

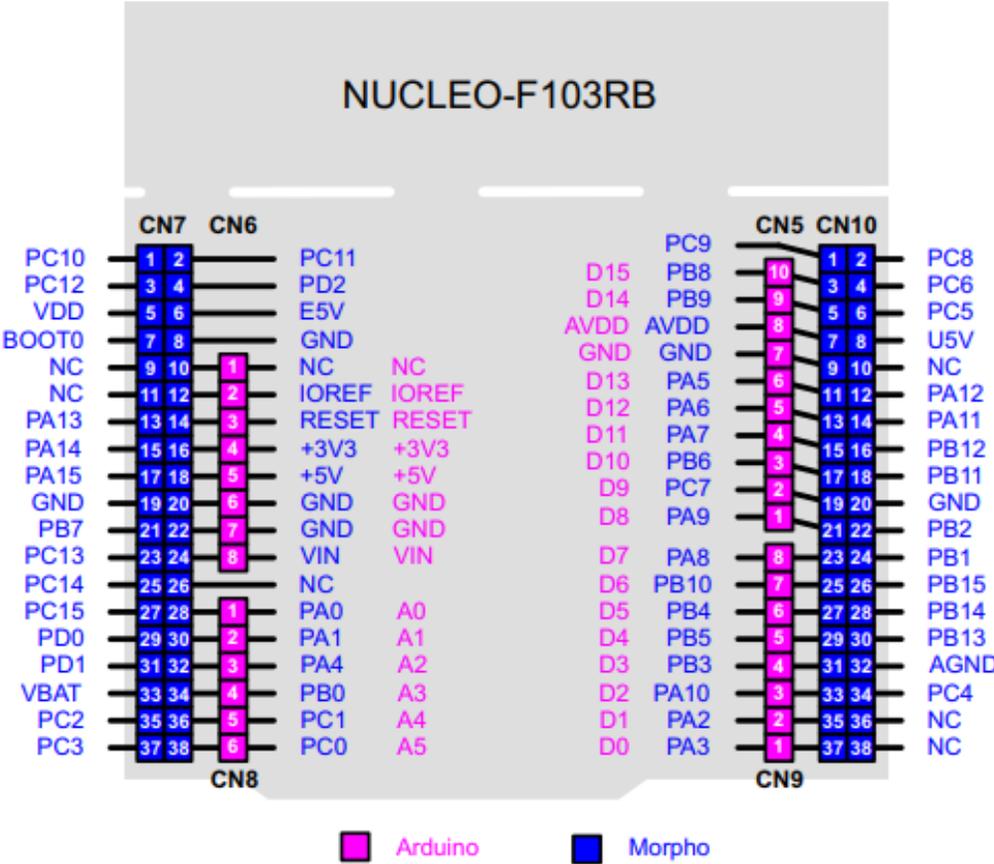
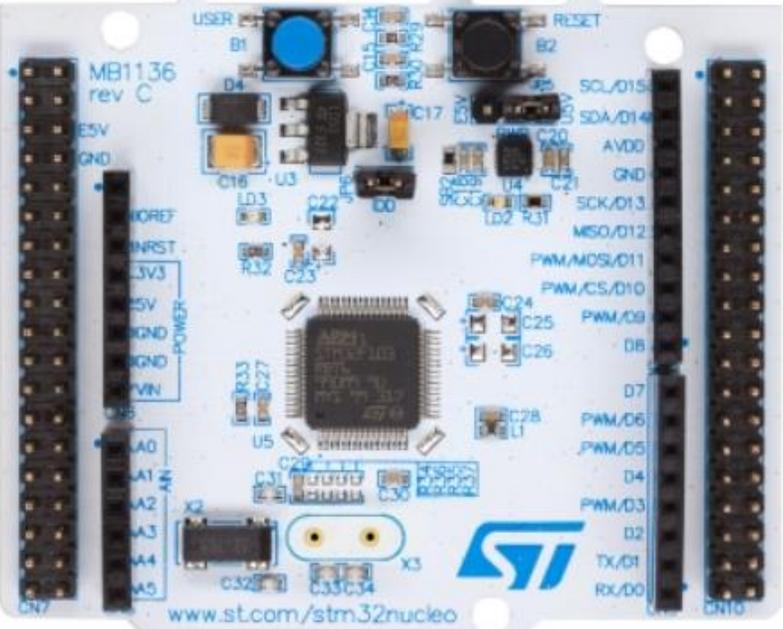
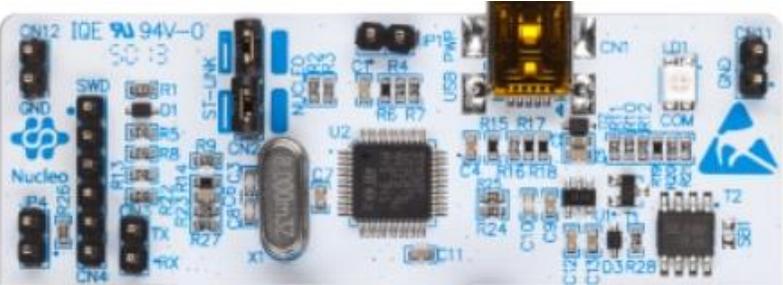
1. <https://www.st.com/en/microcontrollers-microprocessors/stm32q474re.html>
2. <https://os.mbed.com>

Embedded ARM Cortex Microcontroller Lab Demo

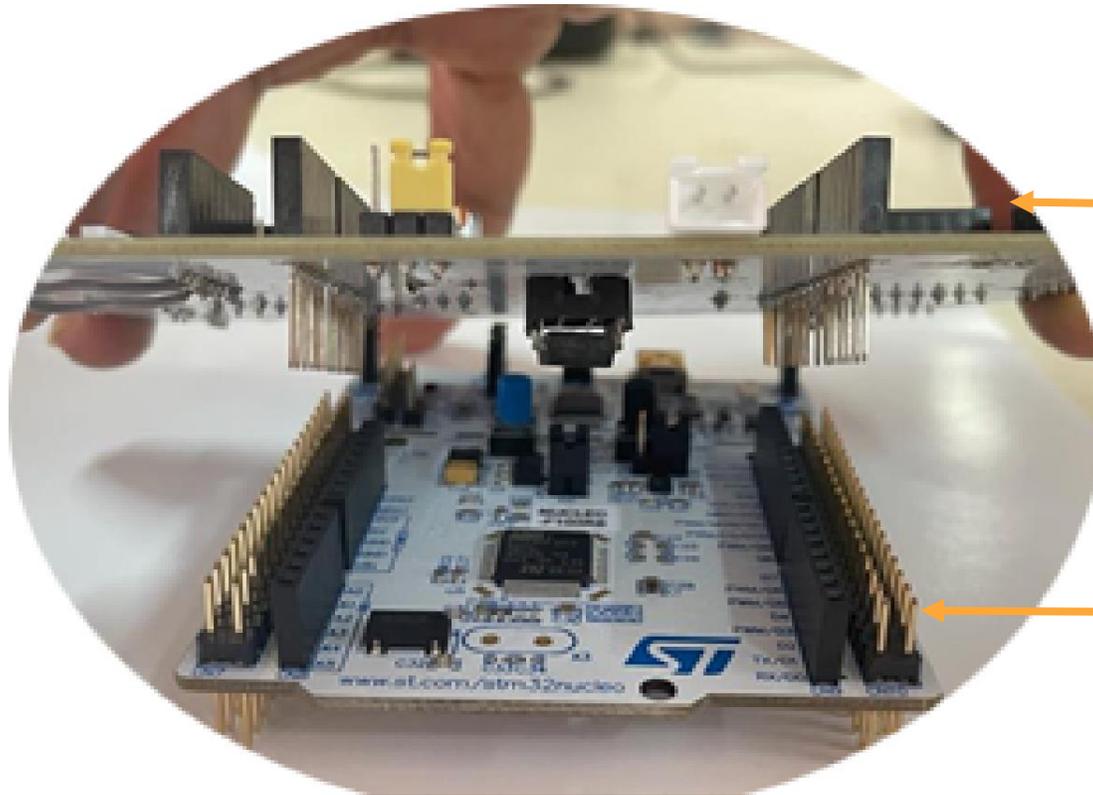
NUCLEO-G474RE



Embedded ARM Cortex Microcontroller Peripheral Lab

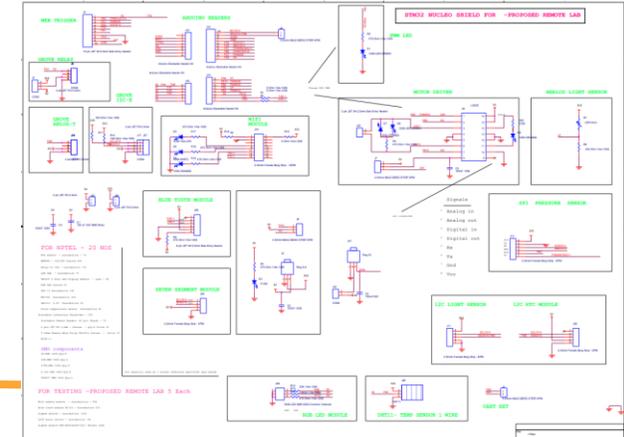


STM32 NUCLEO SHIELD - Developed by NIELIT Calicut



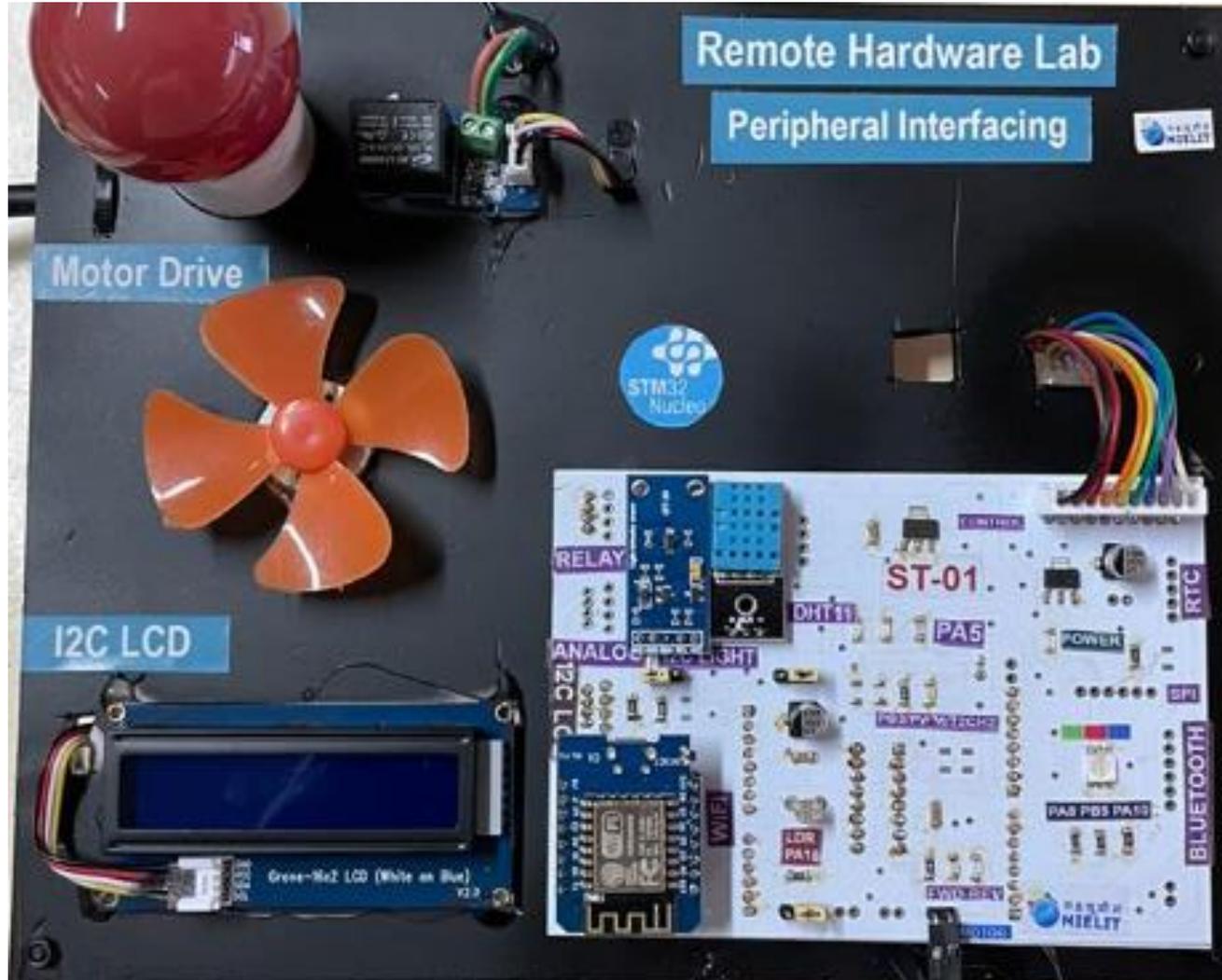
Nucleo Shield

ST Nucleo Board



Schematic

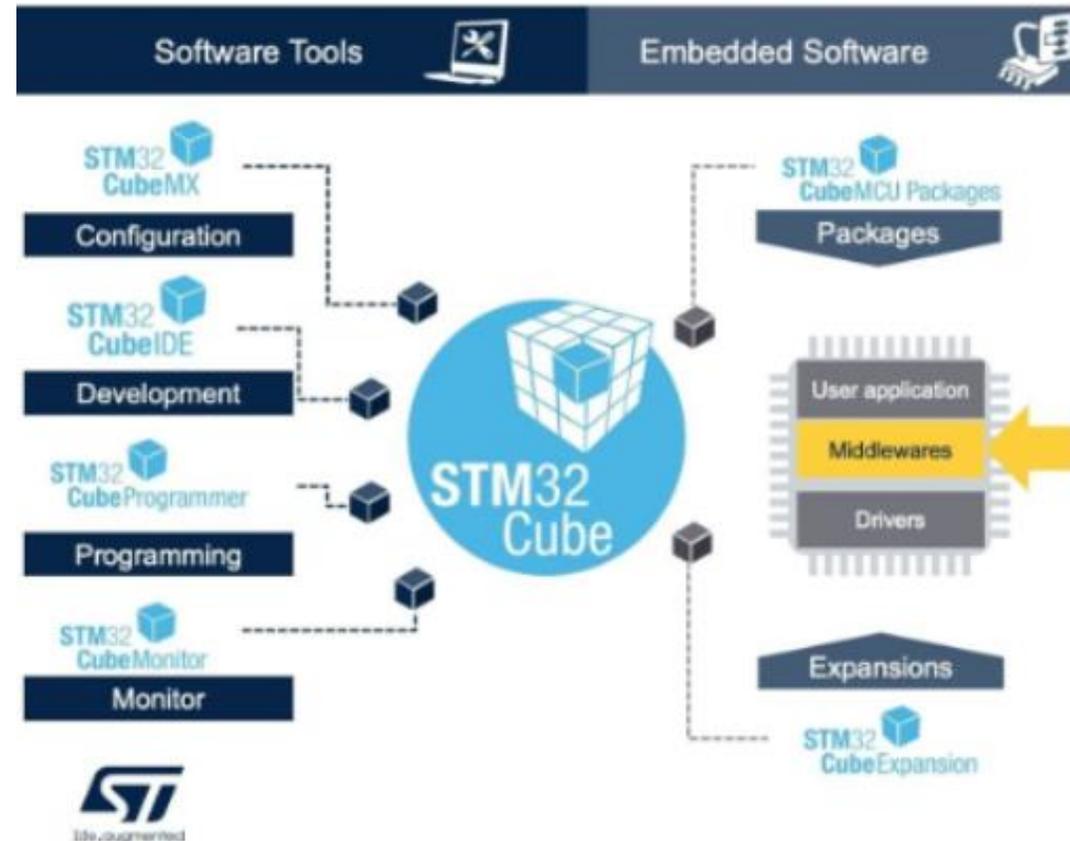
Interfacing Sensors and Actuators



- 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



IoT Lab Access

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



ARM[®]mbed[™]
IoT Device Platform



Productivity



Security



Connectivity



Management



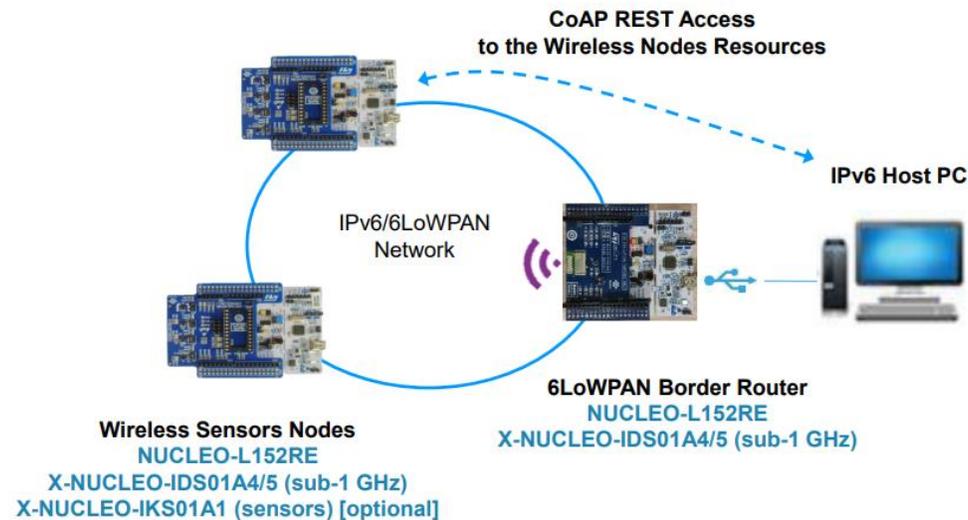
Efficiency

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



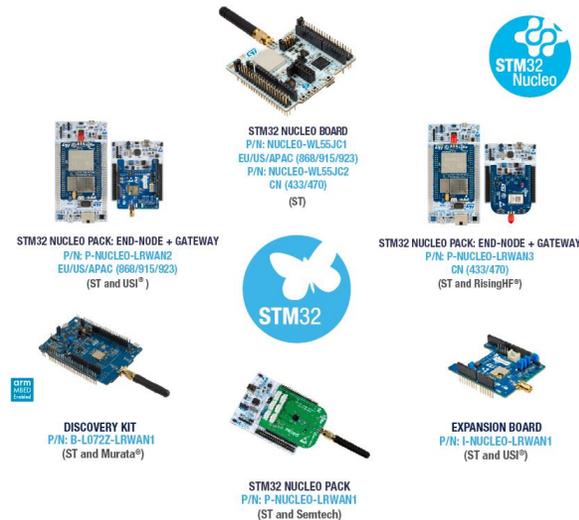
Wireless Communication Lab Access

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



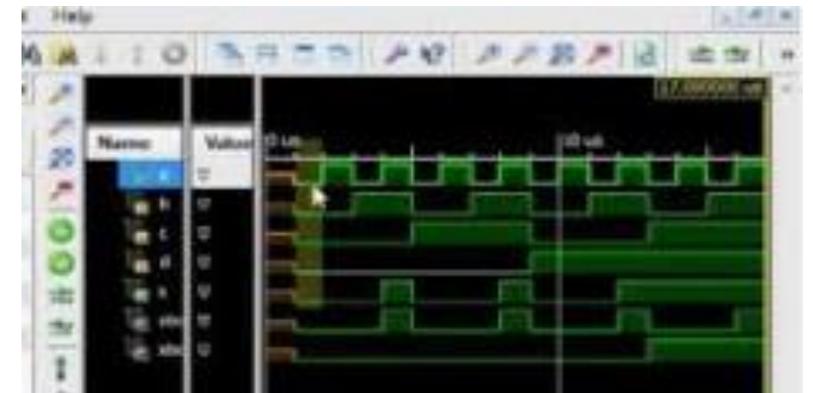
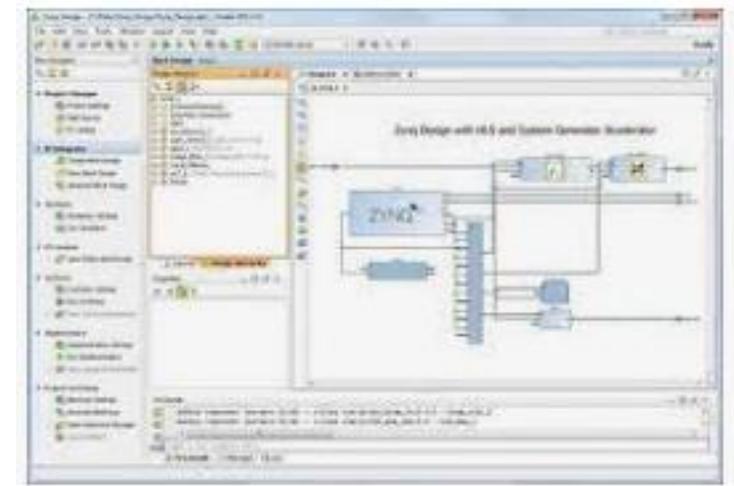
LoRaWAN & Industrial IoT Lab Access

- 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)

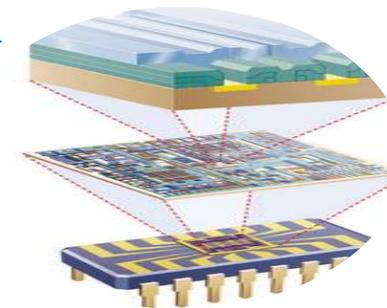
□ Indigenous Color Doppler Ultrasound Scanner with PNDT Compliance.

- ✓ 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.

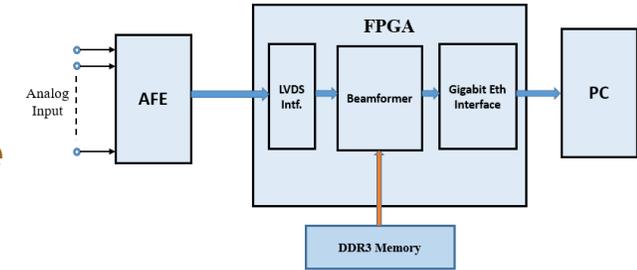


Array Signal Processor ASIC For NPOL Cochin

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

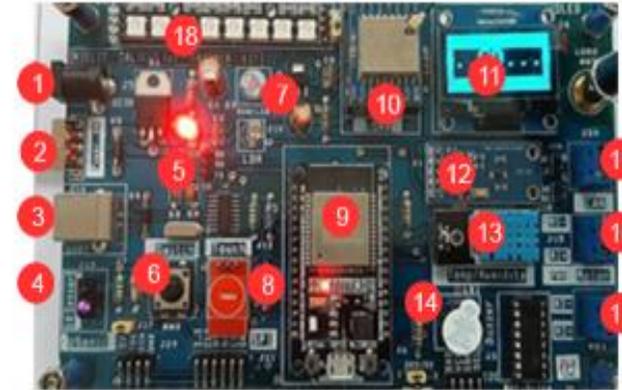
□ Indigenous Portable Ventilator-SAMIRA

- ✓ Invasive Closed Loop Ventilator
- ✓ BLDC Blower based Air Source
- ✓ CPAP, BiPAP, CMV and SIMV Modes.
- ✓ FiO₂ : 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 |





You can find us at:



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