Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

A

Report on

Centre of Excellence for Internet of Things (CoE-IoT)

Department of Computer Science Engineering

and

Information Technology

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1. Introduction

This Internet of Thing lab which was established in 2018-19 as the Centre of excellence (CoE) for Internet of things (IoT) at SKIT, Jaipur, Rajasthan as a part of Digital India Initiative to jump start the IoT ecosystem. The department of Computer Science & Engineering and Information Technology aims at educating and training students with sound knowledge and awareness in recent developments in Internet of Things technology. It is well equipped laboratories with latest hardware and software including Raspberry Pi (Mini Computers), Arduino Uno R3Microcontroller Boards, Xilinx Vivado Design Software Suite for high-level Synthesis, Nexys 4 DDR FPGA Boards, ZYBO FPGA boards, NODEMCU ESP8266-12 CH340 Wireless Micro-Controller Boards, Proteus Simulator for Industrial IoT, Lab View Software for System Design and Analysis , NI MYRIO (Mechatronics kits, Embedded Kits, Starter kits),MY RIO 1900 Microcontroller Boards etc., which complement the high standards of the Institute. The Centre of Excellence also comprises distributed facility within the campus such as E-Yantra lab, Printed Circuit Board (PCB) Lab, Field Programmable Gate Arrays (FPGA) Lab etc for developing Industry 4.0 Standard IoT enabled products.

Experts from the industry are periodically invited to give lectures/demonstrations to the students/faculty members on the latest developments in the field. Students are given exposure to industries by industrial visits and industrial training sessions. The Centre will organize and propose specific FDP, Conference, Short Term training programs and workshops for benefits of students and research fellow's start-ups.

It is proposed to have a centralized dedicated administration office comprising of one coordinator from each department, a chief coordinator and other administrative staff under one roof. Coordinator of each department will be synchronizing the activities of the labs under their department for IoT activities.

2. Centre of Excellence for Internet of Things (CoE-IoT)

Vision:

The Centre of Excellence in near future will be able to enable it as innovation hub with Proper standardization, realization of prototypes, and provide complete support to the

solutions for IoT applications. It will help entrepreneurs by providing ideas, research, and development facilities to build up the Atmnirbhar bharat.

Aims:

The aims of the CoE-IoT are to enable India as the innovation hub in the emerging technology of Internet of Things through democratization of Innovation, Standardization, Realization of prototype, products before deployment of the IoT devices in the public domain/ infrastructure and support Government Initiatives on IoT solutions for specificareas like water, energy, agriculture, health, security, and privacy of data.

3. Objectives:

The main objective of the centre is to create innovative applications and domain capability by harnessing the innovative nature of start-up community and leveraging the experience of corporate players. The other objectives are as follows:

1. To create innovative applications and domain capability across vertical for country's needs such as Smart City, Smart Health, Smart Manufacturing, Smart Agriculture, and others.
2. To build industry capable talent, start-up community, and entrepreneurial ecosystem for IoT.
3. To provide an ecosystem for innovation to thrive and embrace entrepreneurship.
4. To energies research mind-set and reduce cost in Research and Development by providing neutral and interoperable, multi technology stack laboratory facilities.
5. To reduce import dependency on IoT components and promote in digitization.
6. To promote Indianization by providing development facilities to researchers as well as to those who need to develop prototypes using reverse engineering and required library of equivalent components.

4. Benefits of Center of Excellence on IoT

Stakeholder	Benefits
Start-up/Small Medium Enterprises	✓ Use of Open Technology Stack, ✓ Access to Industry experts /Consultants ✓ Showcasing the prototype/project to companies. Access to students to work on projects.
Investors	✓ Future products for cross functional business process

	Enhancement in various industry verticals.
Engineering Service providers, Global MNCs	✓ "Risk free" demand technology lab on demand proficiency centre for skill up-gradation. ✓ Access to industry ready talent, technical experts, and consultants
Academia / Researchers	✓ Availability of technology lab for faculty/researchers. ✓ Industry standard proficiency courses for upgrading skills ✓ Platform for offering special course/consulting projects ✓ Innovative ideas from stack holders, start-up starters, self, etc. ✓ Access to current research papers related to their work. ✓ Team of experts helping them to find research solutions.
Industry	✓ Trained Industry ready students ✓ Innovative Ideas ✓ Prototypes for new products.
Students/jobseekers	✓ Internships on IoT projects ✓ Access to Industry experts/ courses/ showcase of talent

5. Strengths and Resources to support the CoE for Internet of Things

In the subsequent sections, we have highlighted the resources, summary of related FDP/Conferences/workshop/STTPs, research publications, patents, and student's projects with glimpse of Internet of Things lab.

Research Facility available in Internet of Things Lab

S. No.	Name of software/ Hardware	Details	Quantity	Features	Area in which students are expected to Enhance learning
1	Raspberry Pi	Raspberry Pi 4modelwith 4GbRam	12	TheRaspberryPi4includes 1.5GHz quad-core Broadcom processor, two micro-HDMIports,2 USB 3.0 ports, and supportfor4Kvideo output at 60 fps	IOT, Embedded Systems

2	Arduino Uno R3 - compatible	Arduino Uno is a Microcontroller board	13	The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a16MHz crystal scillator, a USB connection, a power jack, an ICSP header, and are set button.	IOT, Embedded Systems
3	Xilinx Vivado Design suite	25 users licensed, Xillinx vivado 2017.4 version	25 user	Synthesis and analysis of HDL designs	IOT, VLSI, Embedded system, FPGA based design
4	Nexys 4 DDR	7 kits available, based on Artix-7 FPGA from Xilinx	7	Synthesis and hardware interfacing of HDL design	IOT, VLSI, Embedded system, FPGA based design
5	ZYBO board	2 kits available, Zynq series FPGA	2		

6	NODEMCU ESP8266-12 CH340 BASED		20	Node MCU has ESP-12 based serial WiFi integrated on board to provide GPIO, PWM,ADC,I2C and 1-WIRE resources at your fingertips, built-in USB-TTL serial with super reliable industrial strength CH340 for superior stability on all supported platforms.	IOT, Embedded Systems
7	Proteus	VSM software	10	Simulation software for microcontroller and analog and digital circuit, PCB design package	Analog and digital circuits, embedded system design and PCB design
8	Lab View	NI/Academic FD Steaching	2	Real time simulation and sensor interfacing for embedded system design	IOT, Embedded system design
10	NIMYRIO Mechatronics kit	3axis digital compass, 3 axis digital accelerometer , 3 axis digital gyro	1		
11	NIMYRIO Embedded kit	BT interface, temp sensor, LCD display, Serial EEPROM	1		
12	NIMYRIO starter kit	Breadboard, adapter, power cable	1		
13	MYRIO1900	WIFI and MSP connector	1		

14	NIUSB-6008 Lab View interfacing module	NI/12bit,10 ks/s	1	Multifunction Input output and NI DAQ mx software with NI USB	
15	Spectrum Analyzer	HM 5012-2 150kHzto1 GHz Caddo8010 150kHzto 1050MHz	1+1	Circuit testing, measurement and troubleshooting	Electronic Devices and circuits
16	DSO	Model No. 401-DSO-Scientech50 MHz,500 ms/s, Channel-2	2	Circuit testing, measurement and troubleshooting	Electronic Devices and circuits
		Model No. HM1507-3, 150 MHz, 200 ms/s, Channel-2 (Analog and digital)	1		
		Key sight DSO1012A/ 100 MHz/ Two channel	1		
17	Proto Cure PCB Curing Machine (Oven)	Maximum allowable PCB size: 250X300 mm (10”X 12”), finned heaters with thermostat controls	1	Table top unit for curing of liquid photoresist	PCB fabrication
18	Photoresist dip coating	Maximum allowable	1	Coating of laminates with photoresist	

	machine	PCB size: 250X300 mm(10”X 12”), Rectangular tank 2 L capacity			PCB fabrication
19	PCB artwork film maker	Working area:250X 300mm(10” X 12”) with diffused light	1	Negative making contact printer as well as an Illuminated art work table	PCB fabrication
20	PCB etching machine	Usable etching area: 250 X 300 mm(10”X 12”),Tank capacity20L	1	For fast etching of single sided and double sided PCB	PCB fabrication
21	Tina Pro Simulation Software	1User License	1	Simulation software for microcontroller and analog and digital circuit, PCB design package	Analog and digital circuits, embedded system design and PCB design
22	Digital microscope	USB digital microscope magnifier	1	Circuit testing, measurement, and troubleshooting	Electronic devices and circuits
23	CRO	Caddo 803/ Scientech ST251/30 MHz/Two Channel	4		
24	Milli ohm meter	scientific SM 5081	3		

25	Frequency counter	scientific SM5051/1 GHz	5	Circuit testing, measurement and troubleshooting	Electronic devices and circuits
26	Distortion meter	scientific SM 5027	1		
27	Digital LCR meter	Caddo9302	4		
28	Pulse generator	scientific SM5035/20 MHz	1		
29	Digital Multimeter	scientific SM 7022/ metravi 19 F/Agilent U-1252 A	14		
30	Function generator	scientific SM 5070/caddo 4061/3MHz	3		
31	Universal IC tester	VPL -VICT	1	Circuit testing, measurement, and troubleshooting	Digital IC testing
32	Project interfacing board	TI	5	Designing and developing of electronics and embedded systems	Electronic circuits and embedded system design
33	Microcontroller development board	Dynalog/NVIS NV 5001, NV5002,	6		
34	Programmable multiplier	scientific SM 5015	4		
35	Power scope	Scientific SM 901/30 MHz	1		

36	Power Supply	Scientech ST-4070,ST-4077	3		
37	Project Board	Scientech ST-2610	5		
38	ADC interfacing kit	TI/ AD58364M-EVM	1		
39	DAC interfacing kit	TI	1		
40	GSM modem interface kit	TI	1		
41	Fingerprint sensor	TI	1	Designing and developing of electronics and embedded systems	Electronic circuits and embedded system design
42	GLCD interfacing kit	TI	1		
43	Video interfacing kit	TI/6713 DSK	1		
44	CCD camera & TV Tuner	TI	1		
45	RF development kit	TI	1		
46	USB EPROM Eraser	VPLEE-1	6		
47	USB based EPROM programmer	VPL UPROG-VX	6		
48	R-pi Camera module		2		
49	AVR programmer	Micronics	1	USB programmer for AVR development	Embedded system

				board	
50	Spartan2 FPGA kit	ST102, ST103, ST104, ST105	4	Design and implement digital circuits of all kinds	VLSI, Embedded system, FPGA based design
51	Spartan3 FPGA Protoboard	Spartan 3 IM Board MXS3FK-IM	1	Development platform for realizing various digital designs	VLSI, Embedded system, FPGA based design
52	Spartan3DSP Protoboard	MXS3FK-004-DSP	1	Used to physically verify DSP algorithms	VLSI, Embedded system, FPGA based design
53	Spartan6DSP Protoboard		1	Used to physically verify DSP algorithms	VLSI, Embedded system, FPGA based design
54	CPLD Trainer kit	XC9572	1	Provides advanced in system programming and test capabilities	VLSI, Embedded system, FPGA based design
55	FPGA trainer kit XCS05	XCS05	1	Have generous routing resources to accommodate most complex interconnect patterns	VLSI, Embedded system, FPGA based design

Equipment and Sensors available in the IoT Lab

S. No	Items	Quantity
1	Raspberry Pi Casing	12
2	ERD Mobile Charger TC55	12
3	Bread Board	12
4	HDMI To VGA Converter	10
5	1*40 Female To Female	13
6	1*40 Male To Female	13
7	1*40 Male To Male	100
8	LED 5 MM	100

9	Potention Meter	20
10	Resistance 1K	100
11	Resistance 10K	100
12	Sound Sensor Module	10
13	IR Sensor Module	10
14	PIR HC-SR 501	10
15	MQ-6 gas sensor Module	5
16	Display 20*4 (Green)	3
17	Display 16*2 (Green)	10
18	1 CHANNEL RELAY BOARD without OPTO 5V	10
19	Bluetooth HC-05	4
20	Sensor DHT-11	8
21	HC-SR -04 Ultrasonic	3
22	Soil Moisture Sensor	3
23	LDR MODULE	3
24	Switch	10
25	Peltier	3
26	Heat Sink	2
27	Relay 2 channel	3
28	Relay 4 channel	2
29	Water Level Sensor	2
30	Dust Sensor	1
31	Flame	2
32	GSM 900	2
33	GPS	3
34	Camera Pi	1
35	Camera UNO	2
36	Water Temp	1
37	Solenoid valve	2
38	DC motor(water pump) 5-12 V	5
39	Wi-Fi	4
40	Vibration Sensor	2
41	Pulse Sensor	2

42	Small passive buzzer module	1
43	2-color LED module	1
44	Hit sensor module	1
45	Vibration switch module	1
46	Photo resistor module	1
47	Key switch module	1
48	Tilt switch module	1
49	3-colorfull-color LED SMD modules	1
50	Infrared emission sensor module	1
51	3-color LED module	1
52	Mercury open optical module	1
53	Yin Yi2-color LED module 3 MM	1
54	Active buzzer module	1
55	Temperature sensor module	1
56	Node 32	1
57	Lilipad	1
58	Water Meter	1

6. IoT Related FDPs/Workshops/Conferences and Other Events Organized

S. No	Year	Name of the Workshop/ Seminar	Date From-To	Link to the Activity Report on the Website	Numbe r of Participation
1	2022-23	One Week Student workshop on IoT	07-12, Nov., 2022 (6 Days)	https://www.skit.ac.in/images/cs-files/One_Week_Student_Workshop_Nov-2022.pdf	200
2	2022-23	IOT Workshop	07-08 Oct., 2022 (2 Days)	https://www.skit.ac.in/images/cs-files/IEEE_IOT_Workshop_Octber-2022.pdf	30

7. IoT Related Selected Publications

1. Cyber-Internet Security Framework to Conquer Energy-Related Attacks on the Internet of

Things with Machine Learning Techniques, Pankaj Dadheech, Computational Intelligence and Neuroscience, Special Issue: Lightweight Deep Learning Models for Resource Constrained Devices, 2022, DoI: https://doi.org/10.1155/2022/8803586, ISSN: 1687-5265 (Print), ISSN: 1687-5273 (Online).

2. Deep Learning Models for Cyber Security in IoT Networks, Pankaj Dadheech, In: Alex Noel Joseph Raj, Vijayalakshmi G. V. Mahesh, Ruban Nerssison, Ang Yu and Jennifer Gentry, Aiding Forensic Investigation Through Deep Learning and Machine Learning Frameworks, IGI Global, 2022, ISBN 13: 9781668445587, ISBN 10: 1668445581, EISBN 13: 9781668445600, ISBN 13: Softcover: 9781668445594.
3. IoT-Deep Learning-Based Detection of Cyber Security Threats, Pankaj Dadheech, In: Alex Noel Joseph Raj, Vijayalakshmi G. V. Mahesh, Ruban Nerssison, Ang Yu and Jennifer Gentry, Aiding Forensic Investigation Through Deep Learning and Machine Learning Frameworks, IGI Global, 2022, ISBN 13: 9781668445587, ISBN 10: 1668445581, EISBN 13: 9781668445600, ISBN 13: Softcover: 9781668445594.
4. Location-aware IT system security using IoT in multizone, Mukesh Kumar Gupta, ACM MobiCom '22: The 28th Annual International Conference on Mobile Computing and Networking, Sydney NSW Australia, October 17 - 21, 2022, ISBN: 978-1-4503-9181-8.
5. Intelligent Wearable Devices Enabled Automatic Vehicle Detection and Tracking System with Video-Enabled UAV Networks Using Deep Convolutional Neural Network and IoT Surveillance, Pankaj Dadheech, Journal of Healthcare Engineering, 2022, DoI: https://doi.org/10.1155/2022/2592365, ISSN: 2040-2295 (Print), 2040-2309 (Online).
6. Intelligent Wearable Devices Enabled Automatic Vehicle Detection and Tracking System with Video-Enabled UAV Networks Using Deep Convolutional Neural Network and IoT Surveillance, Pankaj Dadheech, Journal of Healthcare Engineering, 2022, ISSN: 2040-2295 (Print), 2040-2309 (Online).
7. Internet of Things Based Real-Time Monitoring System for Grid Data, Pankaj Dadheech, In: Balas, V. E., Sinha, G. R., Agarwal, B., Sharma, T. K., Dadheech, P., Mahrishi, M. (eds) Emerging Technologies in Computer Engineering: Cognitive Computing and Intelligent IoT. ICETCE 2022. Communications in Computer and Information Science, Vol. 1591, 2022, ISBN: 978-3-031-07011-2(Print), ISBN: 978-3-031-07012-9(Online).

8. IOT Related International Patent

1. Dr. Pankaj Dadheech, A Novel System for Wind-Powered IoT based Sustainable Organic Compost Machine, South Africa, Application ID 2022/07879, Publication date 28, Sep,

2022.

2. Dr. Pankaj Dadheech, Intelligent System & Method for Home Surveillance with Warning of Robber Activities Using IoT & Artificial Intelligence Approach, Australia Application ID 2021105181, Publication date 20, Apr, 2022.

9. IOT Related National Patents

Following Patentshave beenregistered and published inIntellectual Property India, Office of the Controller General of Patents, Design and Trade Marks, Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India:

1. Mrs. Priyanka, Artificial Intelligence and IoT based Automatic rainfall detection and alert system at early stages using rainfall threshold, WSN, Cloud and Machine learning algorithms, India Application ID 202241071994, Publication date 30, Dec, 2022

2. Mr. Sumit Kumar, Mr. Manish Bhardwaj, IOT based Facemask Detecting and Body Temperature Measuring Device, India Application ID 364106-001, Publication date 23, Sep, 2022.

3. Dr. Pankaj Dadheech, IoT Enabled Device for Monitoring Oxygen and Blood Pressure in Human Body, India Application ID 355475-001, 2021, Cbr Number: 211232, Publication date 4, Mar, 2022

10. Student Projects

1. **IoT- Based impertinent Electric vehicles battery management system to avoid battery explosion**

   Battery is the most essential component of any vehicle. So perfect maintenance of any battery is very much essential for it to function properly. Li-ion batteries which are more commonly used in the vehicular batteries, need to be efficiently monitored, for it to perform better under all circumstances. So, a more systematic battery management system needs to be implemented so that the performance of the battery can be monitored continuously. When it comes to battery, the two most important parameters are the State of Charging (SoC) and State of Health (SoH) of the battery Over charging of the battery leads to blast of battery pack. A battery-management system overcomes these traditional challenges and enhances the performance of managing battery modules. The integration of advancements and new technologies enables the provision of real-time monitoring This Battery Management System (BMS) aims at detects, when it is overcharged, and monitors the other basic parameters such as Voltage, Current, Temperature of the battery using microcontroller and sensors. It is also equipped with Internet connectivity, which enables real time monitoring of battery pack. Also these values are displayed in Cloud, which brings the concept of Internet of Things (IoT).

2. **Smart sanitizer ultraviolet light cleaning system**

   An object may be contaminated with the new corona virus by an infected person coughing or sneezing or touching the object. Preliminary information suggests the new corona virus can survive on surfaces for a few hours or more whether it is plastic, steel, pvc or paper. The risk of being infected with the new coronavirus by touching coins, bank notes, credit cards and other objects like mobile phones, e-commerce couriers and products is extremely high and in hospitals we have lack of sanitizing devices to sterilize instruments as there are maximum chances of covid-19 spread among patients and infants. Although we are using other devices at these places

but they are less efficient and require high maintenance like more and more liquid sanitizer and they also waste chemicals which are harmful for environment and skin.

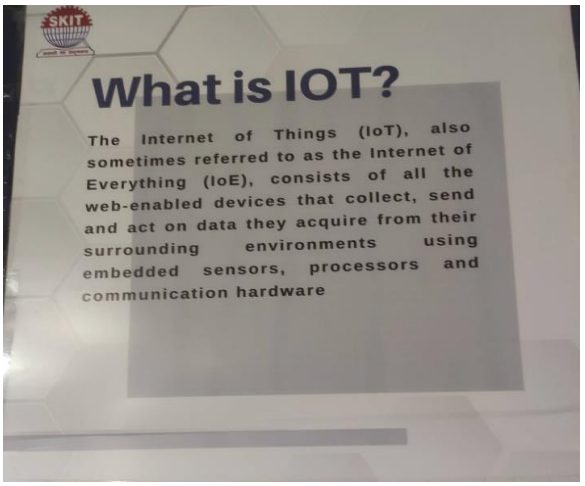
3. **Iot Based smart cradle security system**

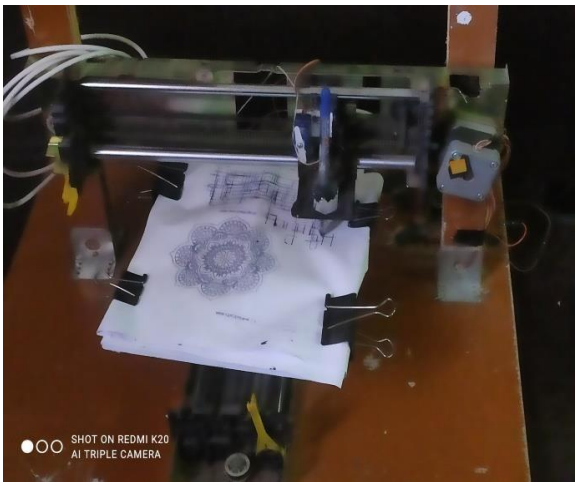
During the last three decades, our society has witnessed a rise in number of nuclear families and a revolutionary trend of both parents working and rise. Though with two working hands in a family, there are more earnings in families but handling newly born babies and infants is a prominent and challenging issue.

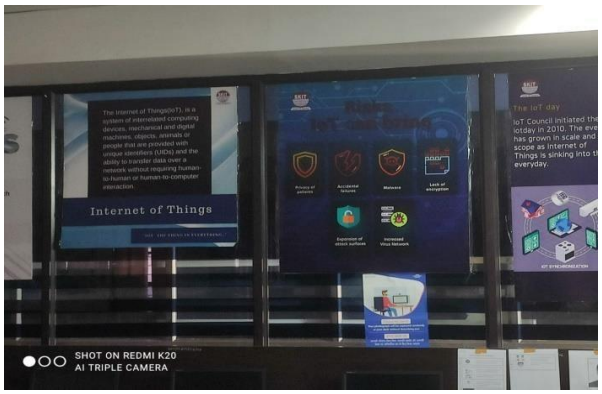
4. **Divyang - A Bionic Arm**

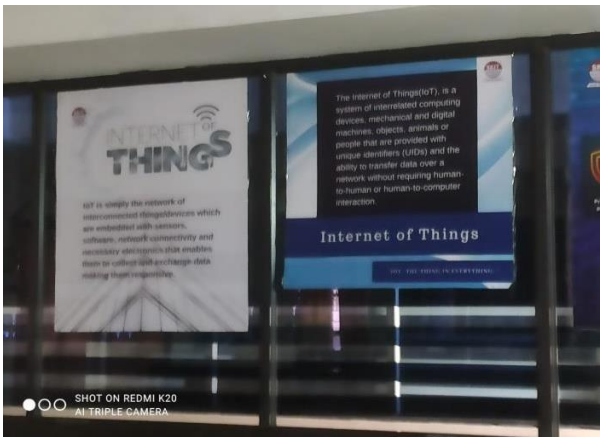
Designing a bionic arm involves integrating advanced technologies to create a functional and versatile prosthetic limb that mimics the movements and capabilities of a natural arm.

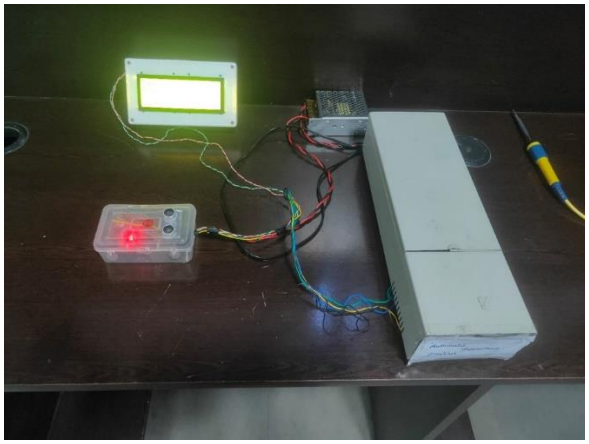
11. Glimpse of IoT Lab



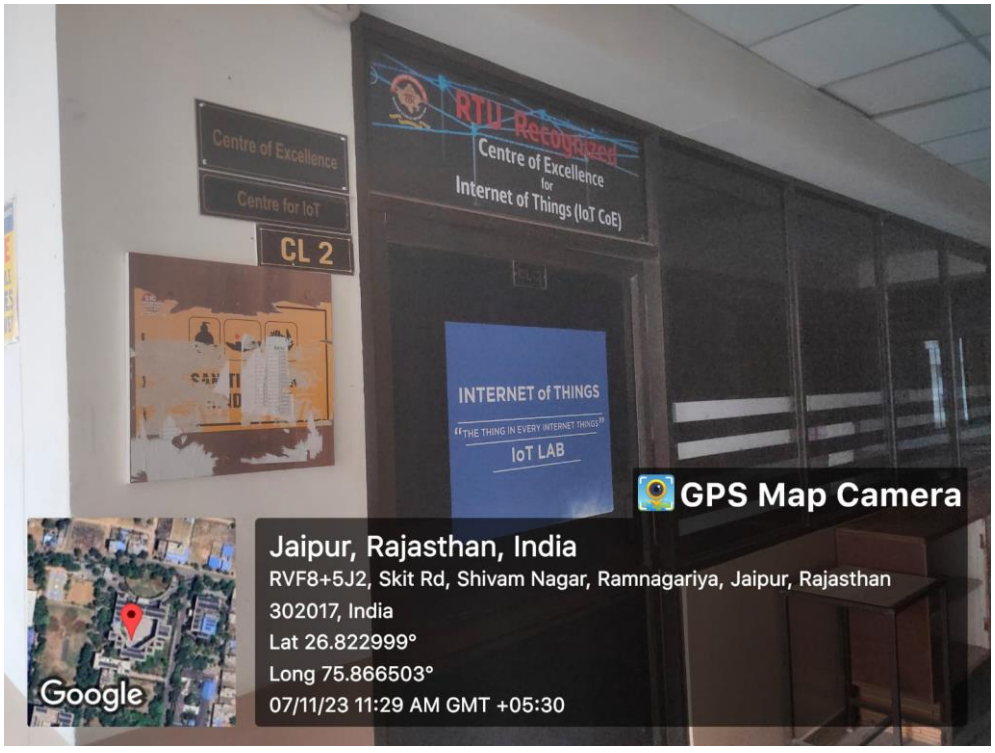


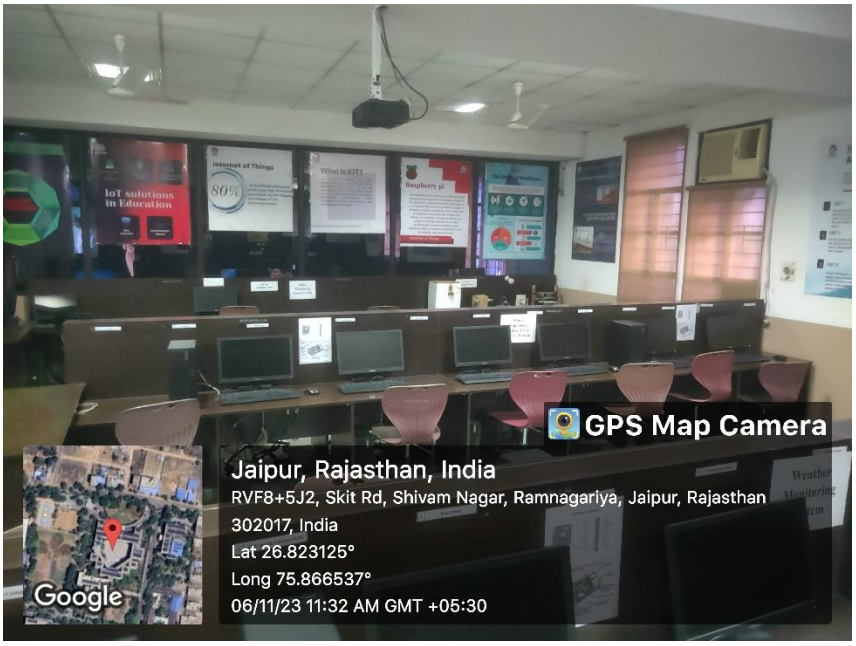


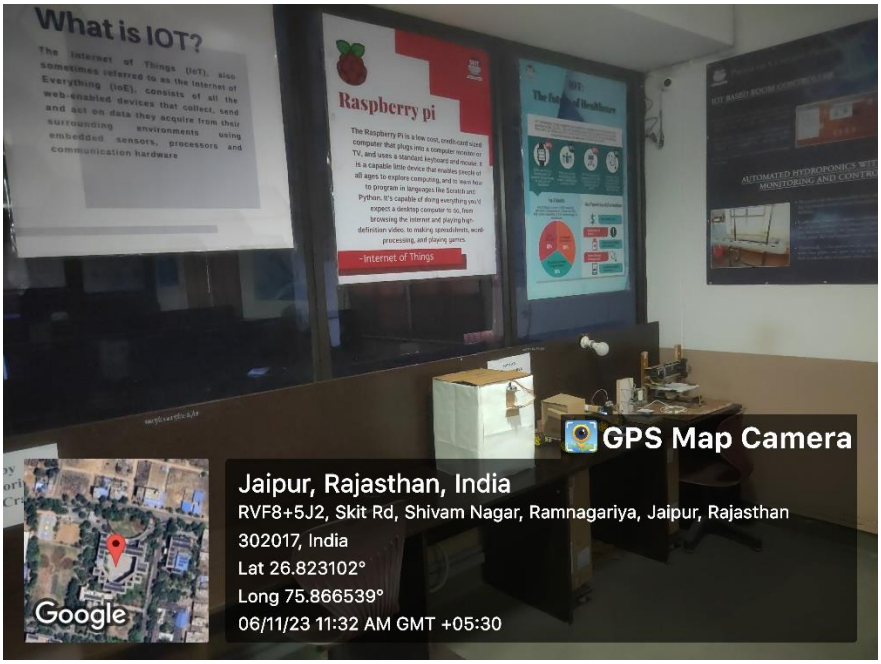




12. GEO TAGGED PHOTOS OF IOT LAB







13. IoT Faculty Expert Group

Department of Computer Science Engineering & Information Technology **Research Group: IoT & Big Data Analytics**			
S. No.	**Faculty Name**	**Designation**	**Area of Expertise**
1.	Prof. (Dr.) Anil Chaudhary	Head of Department (IT)	Programming, Hadoop, IoT, High-Performance Computing

2.	Prof. (Dr.) Mukesh Kumar Gupta	Head of Department (CSE)	Big Data Analytics in Machine Learning, IoT Devices, IoT Security
3.	Dr. Pankaj Dadheech	Associate Professor (CSE)	High-Performance Computing, IoT, Hadoop, Big Data Analytics in Machine Learning, Information Security
4.	Mr. Mehul Mahrishi	Associate Professor (IT)	Machine Learning in Image Processing, Intelligent IoT
5.	Dr. Yogendra Gupta	Assistant Professor (CSE)	Embedded Systems, IoT Devices, Smart Sensors, VLSI
6.	Dr Vinay Kanungo	Associate Professor (CSE)	Communication System

14. IoT Software Components (Open Source & Other Platforms)

S. No.	Name of Component	Description
1.	**IBM Watson IoT Platform**	SKIT is IBM CoE under which the faculty members and student scan access IBM software tools like WID, RAD, DB2, WAS etc. and has access to IBM Cloud. Certifications like Robotics and TJBot are also provided under this initiative.
2.	**Microsoft Azure IoT Central**	Under Microsoft Ed-vantage Initiative, SKIT is recognized Microsoft Cloud Competency Center under which the faculty members and students can access various features and services of Azure Cloud. Certifications like IOT-BOT, Microsoft Innovative Educator are also provided to students And faculty members under this initiative.
3.	**Shakti Processors (IIT Madras)**	Open-source processor development initiative by the RISE group at IIT-Madras.
4.	**Shakti Software (IIT Madras)**	Software Development Kits and IDE's readily available to build applications on SHAKTI
5.	**RISC-VISA**	Free and open-source ISA
6.	**Arduino**	Integrated development environment (IDE)
7.	**Devicehub.net**	Universal interface for IoT and M2M
8.	**IoT Tool kit**	Intelligent object API gateway service
9.	**Open WSN**	Repository for IoT hardware and software projects
10.	**Particle**	Suite of hardware and software for building IoT devices, applications and services

11.	**Site Where**	Deployment tool
12.	**Thing Speak**	IoT application and API
13.	**Webinos**	web-based application platform for the IoT
14.	**Zetta**	API based IoT platform based on Node.js
15.	**Node-RED**	Visual tool for lining the Internet of Things
16.	**Flutter**	Programmable processor core
17.	**M2M Labs Mainspring**	Application framework for developing M2M applications
18.	**Things Board**	Data collection, Processing, Visualization, and Device Management tool kit
19.	**Kinoma**	Marvell Semiconductor hardware prototyping platform
20	**Kaa IoT Platform**	Multi-purpose middleware platform
21.	**DSA**	Open-Source Platform & Tool kit for Internet of Things Devices, Services and Applications.
22.	**Thinger**	Scalable cloud base for connecting devices. It supports Raspberry Pi, Intel Edison, ESP8266.
23.	**Open Remote**	Open-Source IoT platform
24.	**gem5**	Simulator for computer-system architecture

15. FUTURE SCOPE of IOT LAB

The future of IoT has the potential to be limitless. In general, AI and machine learning programs are paired with IoT devices to provide proper automation. As a result, the Internet of Things (IoT) has broadened its field of application across various industries. IoT has found many applications in the fields of medicine, transportation, farming, manufacturing and automation. In the present scenario, the appliances of a laboratory like lights and fans are left on, even when not in use, which leads to a rise in power consumption of the laboratory. IoT can be used to automate the laboratory which will help in effective power consumption, minimal human assistance required and easy monitoring of the laboratory.