Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

A

Report on

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

(2023-2024)

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 4model with 4Gb Ram	12	TheRaspberryPi4includes1.5GHz 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		
26	Distortion meter	scientific SM 5027	1		
27	Digital LCR meter	Caddo9302	4		
28	Pulse generator	scientific SM5035/20 MHz	1	Circuit testing, measurement and troubleshooting	Electronic devices and circuits
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		
33	Microcontroller development board	Dynalog/NVIS NV 5001, NV5002,	6	Designing and developing of electronics and embedded systems	Electronic circuits and embedded system design
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

Sr.no.	Item	Quantity
1	Raspberry Pi 3 model b	12
2	Arduino Uno R3 -compatible	15
3	NODEMCU ESP8266-12 CH340 BASED	6
4	ERD Mobile Charger TC55	12
5	Bread Board	15
6	HDMI To VGA Converter	6
7	1*40 Female To Female	520
8	1*40 Male 2 Female	520
9	1*40 Male 2 Male	1000
10	9 Volt Battery cap	9
11	RF-ID 522	5
12	LM 35	30

13	Relay 5V	30
14	7805 IC	10
15	Resistance 1/4 470 E	15
16	Arduino Motor Shield	5
17	Preset	12
18	Arduino lilly	1
19	DC Motor	4
20	293 D Sheild	2
21	Screw Driver	1
22	Cutter	1
23	IR Sensor Module	30
24	Display 20*4 (Green)	10
25	Display 16*2 (Green)	10
26	Bluetooth HC-05	5
27	HC-SR -04 Ultrasonic	30
28	Switch	10
29	Dust Sensor	1
30	GSM 900	2
31	GPS	3
32	Camera Pi	1
33	Camera UNO	2
34	WiFi 8266	12
35	Arduino Uno R3 -compatible DIP with cable	5
36	RGB LED 5MM	100
37	WIFI Module	5
38	ERD Mobile Charger (USB type B 5V/3A) for Pi-3	5
39	1*40 Male 2 Male	10
40	Potentiometer	30
41	Resistance 1K ohm, 1/4w	500
42	Resistance 330 ohm, 1/4w	500
43	Resistance 10K ohm, 1/4w	500
44	Active and Passive Buzzer	10
45	soldering Wire	1
46	Heart beat Rate Pulse Sensor Module	2
47	1CHANNEL RELAY BOARD with OPTO 5V	5
48	Sensor DHT-11 Module	10
49	HC-SR -04 Ultrasonic	10
50	LDR Without MODULE	20
51	Switch pcb type push button	100
52	soldering stand	1
53	tester tapadiya	1
54	Hot Glu gun	1
55	soldering flux	1
56	Multimeter mastech 830 L	1
57	LED Bulb 5w	10
58	Bulb Holder	10

59	2 Pin Plastic Plug top	10
60	2 Core Flexible Copper Wire & Cable (30 Meter)	1
61	B type USB cable	10

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	2023-24	15 Days Internship on IoT	16-08-2023 to 01-09-2023	https://www.skit.ac.in/images/cs-files/IoT_Internship_Report_2023.pdf	31
2	2023-24	One Week Student Workshop On Applications of Artificial Intelligence and Machine Learning IOT	11-09-2023 to 15-09-2023	https://www.skit.ac.in/images/cs-files/Application_of_AI_and_ML_IOT_11to15Sept_2023.pdf	74
3	2023-24	45 Days internship	24-07-2023 to 06-09-2023	https://www.skit.ac.in/images/cs-files/Full_Stack_Cloud_Native_Java_JEE_Development.pdf	30

7.   IoT Related Selected Publications

1.   Sethi, S.S., Sharma, P. New Developments in the Implementation of IoT in Agriculture. SN COMPUT. SCI. 4, 503 (2023). https://doi.org/10.1007/s42979-023-01896-w ISSN 2661-8907.

2.   Sarabjeet Singh Sethi, Dinesh Kumar, Lalit Kumar Lata An Assessment on the State of Art of Internet of Things (IoT), SKIT Research Journal, Vol 13 Issue 1 (2023) pp. 23-28, https://dx.doi.org/10.47904/IJSKIT.13.1.2023.23-28, ISSN 2278-2508.

3.   Pankaj Dadheech An Efficient Hybrid Approach for Intrusion Detection in Cyber Traffic Using Autoencoders Vol. 4, No. 498 pp. 1-https://doi.org/10.1007/s42979-023-01865-3, ISSN 2661-8907.

4.   Priyanka Sharma AI-Equipped IoT Applications in High-Tech Agriculture Using Machine Learning International IGI Global https://doi.org/10.4018/978-1-6684-9231-4.ch003 ISBN 9781668492314.

5.   Pankaj Dadheech The Design of Microstrip Patch Antenna for 2.4 GHz IoT Based RFID

and Image Identification for Smart Vehicle Registry Nova Science Publishers, Network, United States https://doi.org/10.52305/ATJL4552, ISBN: 979-8-88697-832-2.

8.   IOT Related National Patents

1.   Dr. Pankaj Dadheech, Dr. Sunil Dhankhar, Dr. Sanwta Ram Dogiwal, Mr. Mahender Kumar Beniwal, Ms. Anjana Sangwan, "IoT based Face Mask Detecting and Body Temperature Measuring Device", Inventor and Applicant of the Patent, Indian Design Patent Application Number/ Design Number-387735-001, 2023, Cbr Number: 207051, Date of Registration/ Date of Filing (Cbr Date)-06/06/2023, Publication Date-26/04/2024, Design Accepted and Published, Publication Number (Journal No.)- 17/2024 and   Journal   Date is 26/04/2024, https://search.ipindia.gov.in/IPOJournal/Journal/ViewJournal, Page-40848.

2.   Dr. Neha Verma, Dr. Pankaj Dadheech, Jatin Kumar Gupta, Dr. Brijesh Patel, Dr. Rityuj Singh Parihar, Dr. Nagendra Tripathi, Dr. Veeresh Rampur, Sanjay Kumar Sahu, Dr. Mohit Kumar Sahu, Dr. Nitin Kumar Jaiswal, "A Vehicle-to-Vehicle Alerting Mechanism Equipped Swappable Electric Battery System to Notify Requirements", Inventor and Applicant of the Patent, Patent Publication Number (Journal No.)-48/2022, Indian Patent Application Number-202221036594 A, 2022, Date of Filing-26/06/2022, Publication Date-02/12/2022, Date of Certificate Issue: 21/05/2024, Granted Application, Patent   Number   :538748, Doi: https://search.ipindia.gov.in/IPOJournal/Journal/ViewJournal, Page-76084 (Patent Granted)

9.   Student Projects

1. IoT- Based Solar Pannel Monitoring

The integration of Internet of Things (IoT) technology with solar panels allows for real-time monitoring and management of solar power systems. This technology enhances the efficiency, reliability, and performance of solar energy systems by providing detailed insights into various parameters and enabling proactive maintenance.

2. IoT based Smart Dustbin

An IoT-based smart dustbin leverages Internet of Things (IoT) technology to optimize waste management. These dustbins are designed to monitor and manage waste levels efficiently, providing real-time data to improve waste collection processes, reduce costs, and enhance environmental sustainability.

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.

10. Glimpse of IoT Lab
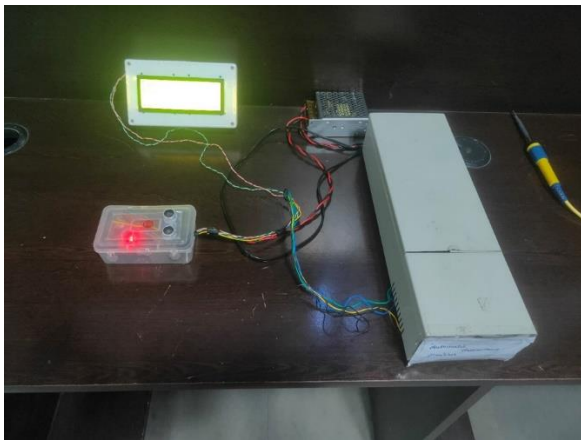
11. IoT Faculty Expert Group

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.) Mehul Mahrishi	Head of Department (CSE)	Big Data Analytics in Machine Learning, IoT Devices, IoT Security
3.	Dr. Yogendra Gupta	Associate Professor (CSE)	Embedded Systems, IoT Devices, Smart Sensors, VLSI
4.	Dr Vinay Kanungo	Associate Professor (CSE)	Communication System
5.	Dr. Amit Kumar Sharma	Assistant Professor(CSE)	Quantum Computing, Electronic Circuit Design
6.	Mr. Dinesh Kumar	Assistant Professor (ECE)	IoT Circuit Design, Embedded Systems

12. 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

13. 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.