A Report on five days
Faculty Development Program through ICT
on
"Digital Systems Design "
28th January – 1st February, 2019
Jaipur Engineering College and Research Centre, Jaipur

Organized By: Departments of ECE ,JECRC and

Department of ECE,NITTTR, Chandigarh .

Objective:

After undergoing this program, the participant should be able to do the designing of combinational and sequential circuits. Simulation, Synthesis & implementation of circuits using VHDL. Learnt about XC4000e and 9500 Series of reconfigurable devices. Implementation of digital systems on FPGAs.

Target:

Faculty members of ECE and EE,CSE and IT departments.

About the FDP:

The Faculty Development Program is organized with a vision to enhance the technical and practical aspects of fundamental and advanced subjects of engineering technology which play vital role in making the roots of education stronger.

ICT Based STC program on "Digital Systems Design " ,28th January – 1st February, 2019 was conducted in association with Department of Electronics & Communication Engineering, JECRC Jaipur and NITTTR, Chandigarh. It all begin with the decision of HOD, ECE that department will conduct FDP on Digital Systems Design. Mr S.S.Manaktala was asked to prepare a proposal for the same to take the permission of the Principal . Mr S.S.Manaktala interacted with Dr. Kanika ,who is HOD and resource person as well as co-ordinator to get formal permission for the same. Mr. Manaktala received the password for connecting through ICT Mode during the FDP.

Inaugral session begin at 9:30 am on 28 th January ,2019 with interacton of Dr.Kanika with all the institutes connected through ICT mode to conduct FDP.After tea break first technical session of workshop at 11:30 was delivered by Dr Kanika on Architecture of XC-9500

Session after lunch break on 28th was delivered on Digital System Hardware by supreet singh
Session on 29th January , before lunch was on CMOS Inverter by BABBAN KUMAR
Session on 29th January, after lunch was on was on Semiconductor Memory Types

Session on 30th January , before lunch was on Realtime System Validaton using Hardware in

Loop(HIL) Digital Platform by – Dr SL Shimmi , Assistant Professor , Department of EE , NITTTR,Chandigarh. Session on 30th January , after lunch was on Analog VLSI Design by HS Jatana , SCL/ISRO.

Session on 31th Janury , before tea was on Role of Embedded Systems in DSD-DEEPAK SHARMA
Session on 31th January , after lunch was role of DSD in IOT's- SANDEEP SANGHAI
Session on 1st February , before lunch was on DSD and its Applications ,delivered by Dr. Kanika

Valedictory Session on 1stth February , after lunch was coordinated by Dr.Kanika, as she interacted with all the program coordinators at 28 Centre connected through ICT.

The pragramme was attended by 38 faculty members of ECE Department. Visual and Graphic Aid used by the resource person was of a great help for learning of participants.

Outcome:

- Faculty members enriched their knowledge on Review of digital circuits, XC 4000e series of FPGA, XC 9500 series CPLDs, Combinational logic design principles & practices, Sequential logic design principles & practices.

- ICT based FDP involved two-way communication in which faculties solved their queries by interaction with eminent senior faculties.

Report on five days Faculty Development Program through ICT

on

"Introduction to Embedded Systems"

From February 8 -12, 2016

at

Jaipur Engineering College and Research Centre, Jaipur

Organized By

1. **Department of ECE, JECRC and 2. Department of ECE, NITTTR, Chandigarh**

Objective:

The objective of the course is to focus on **"Introduction to Embedded Systems"**, the latest technological advancements and trends in various Microcontrollers, their overview, their features, programming and their applications in real life and industries.

Target:

Faculty members of ECE and EE departments including students

About the FDP

The Faculty Development Program is organized with a vision to enhance the technical and practical aspects of fundamental and advanced subjects of engineering technology which play vital role in making the roots of education stronger.

ICT Based STC program on "Introduction to Embedded Systems" during 8th – 12th February, 2016 was conducted in association with Department of Electronics & Communication Engineering, JECRC Jaipur and NITTTR, Chandigarh. The pragramme was attended by 44 faculty members and 40 students. The resource person was Dr. Kanika Sharma, Assistant Professor. They gave a brief idea about recent developments that are taking place in the area of Processor Architectures; C Language Fundamentals also stressed on the industrial research contents like GP –OS and Real Time OS. They covered content beyond the syllabus for the students in the area of embedded software Engineering.

Overview of Embedded Systems

Embedded systems have become an integral part of daily life. Be it a cell phone, a smartcard, a music player, a router, or the electronics in an automobile - these systems have been touching and changing modern lives like never before. An embedded system is a combination of computer hardware, software, and additional mechanical or other technical components, designed to perform a dedicated function. Most of the embedded systems need to meet real-time computing requirements.

The major building blocks of an Embedded System are listed below:

- Microcontrollers / digital signal processors (DSP)
- Integrated chips
- Real time operating system (RTOS) - including board support package and device drivers
- Industry-specific protocols and interfaces
- Printed circuit board assembly

Usually, an embedded system requires mechanical assembly to accommodate all the above components and create a product or a complete embedded device.

1. **Recent advances in Micro-Electro-Mechanical systems are highly integrated Digital Electronics have led to the development of Micro sensors.**

2. Such sensors are generally equipped with data processing and communication capabilities.

3. A wireless sensor network is collection of nodes organized into co-opetative network.

4. Each node > consists of processing capability (one or more microcontrollers, CPIUs and DSP CHIPS > Have a RF Transreceiver.

An Overview of Advanced versions of MCU

The Advanced Microcontroller Bus Architecture (AMBA) is a widely used interconnection standard for System on Chip (SoC) design. An AMBA-based microcontroller typically consists of a high-performance system backbone bus (AMBA AHB or AMBA ASB), able to sustain the external memory bandwidth, on which the CPU, on-chip memory and other Direct Memory Access (DMA) devices reside. This bus provides a high-bandwidth interface between the elements that are involved in the majority of transfers.

- **PIC** is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to *Peripheral Interface Controller*. The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.
- **Silicon Labs** is a worldwide fabless semiconductor company headquartered in Austin, Texas, United States, that develops silicon, software and tools for the Internet of Things (IoT), Internet infrastructure, industrial automation, consumer and automotive markets. Its products include microcontrollers (MCUs), wireless SoCs, timing devices, low-power sensors, and broadcast solutions. The company's software stack solutions include firmware libraries, protocol-based software, and the Simplicity Studio development platform. Silicon Labs provides solutions and software for use in a variety of electronic products in a range of applications including portable devices, AM/FM radios and other consumer electronics, networking equipment, test and measurement equipment, industrial monitoring and control, home automation and customer premises equipment. These products integrate complex mixed-signal functions that are frequently performed by numerous discrete components in competing products into a single chip or chipset.
- **Atmel** is an American-based designer and manufacturer of semiconductors, founded in 1984. The company focuses on embedded systems built around microcontrollers. Its products include microcontrollers (8-bit AVR, 32-bit AVR, 32-bit ARM-based, automotive grade, and 8-bit Intel 8051 derivatives) radio frequency (RF) devices including Wi-Fi, EEPROM, and flash memory devices, symmetric and asymmetric security chips, touch sensors and controllers, and application-specific products. Atmel supplies its devices as standard products, application-specific integrated circuits (ASICs), or application-specific standard product(ASSPs) depending on the requirements of its customers.
- **Philips:** The Philips Bridge IC is a new generation of interface solutions for managing high-speed serial data communication among various bus interfaces such as SPI, I2C-bus, and UART including RS-232 and RS-485. The Bridge IC is commonly used to overcome the limitation of the host bus interface to peripherals and to provide easy interface with existing different serial buses. The description of the block diagram, hardware, firmware, and software are described in the next paragraphs for users to quickly understand the implementation of the Philips LPC900 Series microcontroller to Philips Bridge IC serial interface for RS-232 point-point communication, RS-485 multi-drop application, IrDA wireless links communication, and GPIO interface. The source code in C language is provided to show how to write a simple

communication program between the microcontroller and the Bridge IC serial interface. The goal is to help users to design the Bridge IC in their application and also shorten their product development cycle.

Role of MCU in Embedded System

Microprocessors and microcontrollers are widely used in embedded system products. An embedded product uses a microprocessor (or microcontroller) to do one task and one task only. A printer is an example of embedded system since the processor inside it performs only one task; namely, getting the data and printing it. Contrast this with a Pentium-based PC (or any x86 IBM-compatible PC). A PC can be used for any number of applications such as word processor, print server, bank teller terminal, video game player, network server, or internet terminal. Software for a variety of applications can be loaded and run. Of course the reason a PC can perform myriad tasks is that it has RAM memory and an operating system that loads the application software into RAM and lets the CPU run it. In an embedded system, there is only one application software that is typically burned into ROM. An x86 PC contains or is connected to various embedded products such as the keyboard, printer, modem, disk controller, sound card, CD-ROM driver, mouse, and so on. Each one of these peripherals has a microcontroller inside it that performs only one task. For example, inside every mouse there is a microcontroller that performs the task of finding the mouse position and sending it to the PC. Table 1-1 lists some embedded products. There are four major 8-bit microcontrollers. They are: Freescale's 6811, Intel's 8051, Zilog's Z8, and PIC 16X from Microchip Technology. Each of these microcontrollers has a unique instruction set and register set; therefore, they are not compatible with each other. Programs written for one will not run on the others. There are also 16-bit and 32-bit microcontrollers made by various chip makers. With all these different microcontrollers, what criteria do designers consider in choosing one? Three criteria in choosing microcontrollers are as follows: (1) meeting the computing needs of the task at hand efficiently and cost effectively, (2) availability of software development tools such as compilers, assemblers, and debuggers, and (3) wide availability and reliable sources of the microcontroller. Next we elaborate further on each of the above criteria.

Criteria for choosing a Microcontroller

The first and foremost criterion in choosing a microcontroller is that it must meet the task at hand efficiently and cost effectively. In analyzing the needs of a microcontroller-based project, we must first see whether an 8-bit, 16-bit, or 32-bit microcontroller can best handle the computing needs of the task most effectively. Among other considerations in this category are:

- Speed. What is the highest speed that the microcontroller supports?
- Packaging. Does it come in a 40-pin DIP (dual inline package) or a QFP (quad flat package), or some other packaging format? This is important in terms of space, assembling, and prototyping the end product.
- Power consumption. This is especially critical for battery-powered products.
- The amount of RAM and ROM on chip.
- The number of I/O pins and the timer on the chip.
- How easy it is to upgrade to higher-performance or lower power-consumption versions.

- Cost per unit. This is important in terms of the final cost of the product in which a microcontroller is used. For example, there are microcontrollers that cost 50 cents per unit when purchased 100,000 units at a time.

What is Arduino?

Arduino is an open-source prototyping platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

Why Arduino?

Thanks to its simple and accessible user experience, Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- **Inexpensive** - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50
- **Cross-platform** - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- **Simple, clear programming environment** - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.
- **Open source and extensible software** - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- **Open source and extensible hardware** - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

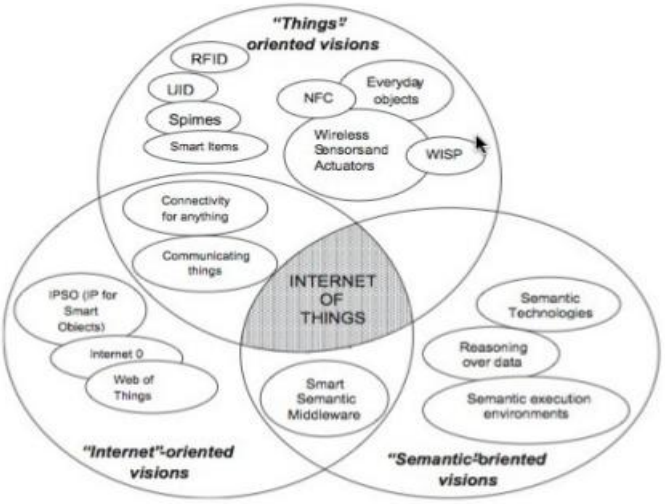
Arduino Programming Basics

Command	Description
`pinMode(n,INPUT)`	Set pin *n* to act as an input. One-time command at top of program.
`pinMode(n,OUTPUT)`	Set pin *n* to act as an output
`digitalWrite(n,HIGH)`	Set pin *n* to 5V
`digitalWrite(n,LOW)`	Set pin *n* to 0V
`delay(x)`	Pause program for *x* millisec, *x* = 0 to 65,535
`tone(n,f,d)`	Play tone of frequency *f* Hz for *d* millisec on speaker attached to pin *n*
`for()`	Loop. Example: for (i=0;i<3;i++){} Do the instructions enclosed by {} three times
`if (expr) {}`	Conditional branch. If *expr* true, do instructions enclosed by {}
`while (expr) {}`	While *expr* is true, repeat instructions in {} indefinitely

The Internet of Things (IoT) refers to everyday appliances and gadgets ('things') such as televisions, medical devices and cars connected to the internet via tiny machine-readable radio frequency identifier (RFID) tags. The RFID tags enable devices to automatically transfer data over a network without requiring human-to-human or human-to-computer interaction.

Although variations have sprung up since, including M2M (machine-to-machine) and Cisco's Internet of Everything, it's the original term that has passed into the general lexicon. The IoT now encompasses pretty much any device with embedded technology – from RFID through to sensor-based computing and QR codes – that allows the device to interact with other devices and the environment.

IOT Paradigm



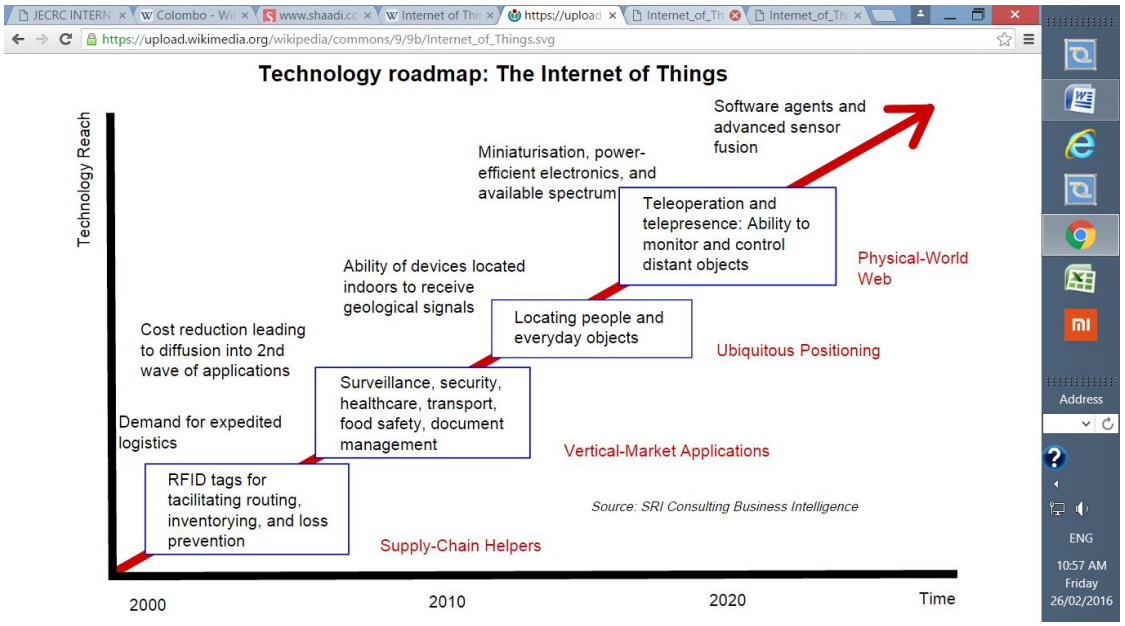
The Internet of Things (IoT) is a new paradigm that combines aspects and technologies coming from different approaches. Ubiquitous computing, pervasive computing, Internet Protocol, sensing technologies, communication technologies, and embedded devices are merged together in order to form a system where the real and digital worlds meet and are continuously in symbiotic interaction. The smart object is the building block of the IoT vision. By putting intelligence into everyday objects, they are turned into smart objects able not only to collect information from the environment and interact/control the physical world, but also to be interconnected, to each other, through Internet to exchange data and information. The expected huge number of interconnected devices and the significant amount of available data open new opportunities to create services that will bring tangible benefits to the society, environment, economy and individual citizens. In addition to identifying the application scenarios and the correspondent potential applications, we focus on research challenges and open issues to be faced for the IoT realization in the real world.

Enabling Technologies For IOT

There are many technologies that enable IOT:

1. RFID and near-field communication - In the 2000s, RFID was the dominant technology. Later, NFC became dominant (NFC). NFC have become common in smartphones during the early 2010s, with uses such as reading NFC tags or for access to public transportation.
2. Optical tags and quick response codes - This is used for low cost tagging. Phone cameras decodes QR code using image-processing techniques. In reality QR advertisement campaigns gives less turnout as users need to have another application to read QR codes.
3. Bluetooth low energy - This is one of the latest tech. All newly releasing smartphones have BLE hardware in them. Tags based on BLE can signal their presence at a power budget that enables them to operate for up to one year on a lithium coin cell battery.
4. Low energy wireless IP networks - embedded radio in system-on-a-chip designs, lower power WiFi, sub-GHz radio in an ISM band, often using a compressed version of IPv6called 6LowPAN.

Trends and Characteristics



Zigbee and Internet Of Things

The explosion in wireless technology has seen the emergence of many standards, especially in the industrial, scientific and medical (ISM) radio band. There have been a multitude of proprietary protocols for control applications, which bottlenecked interfacing. It was this Zigbee Alliance that created **Zigbee**. Both Bluetooth and Wi-Fi have been developed for communication of large amount of data with complex structure like the media files, software etc. Zigbee on the other hand has been developed looking into the needs of communication of data with simple structure like the data from the sensors.

Zigbee is a low power spin off of WiFi. It is a specification for small, low power radios based on IEEE 802.15.4 – 2003 Wireless Personal Area Networks standard. The specification was accepted and ratified by the Zigbee alliance in December 2004. Zigbee Alliance is a group of more than 300 companies including industry majors like Philips, Mitsubishi Electric, Epson, Atmel, Texas Instruments etc. which are committed towards developing and promoting this standard.

The ZigBee® mesh networking wireless technology is already enabling the growing machine-to-machine (M2M) and Internet of Things (IoT) trends and providing utilities and energy service providers with new consumer energy management and efficiency capabilities. "ZigBee was purposefully designed to address capabilities not supported by other wireless technologies and continues to be the only standard capable of securely, economically and efficiently connecting thousands of electrical switches, lights, door locks, thermostats, cable set-top-boxes and a myriad of other devices, seamlessly into an Internet of Things,"

ZigBee is a low-cost, low-power; wireless mesh network standard targeted at the wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB flashes memory. ZigBee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and Australia. Data rates vary from 20 kbit/s (868 MHz band) to 250 kbit/s (2.4 GHz band).

The ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. ZigBee builds on the physical layer and media access control defined in IEEE standard 802.15.4 for low-rate WPANs. The specification includes four additional key components: network layer, application layer, ZigBee device objects (ZDOs) and manufacturer-defined application objects which allow for customization and favor total integration.

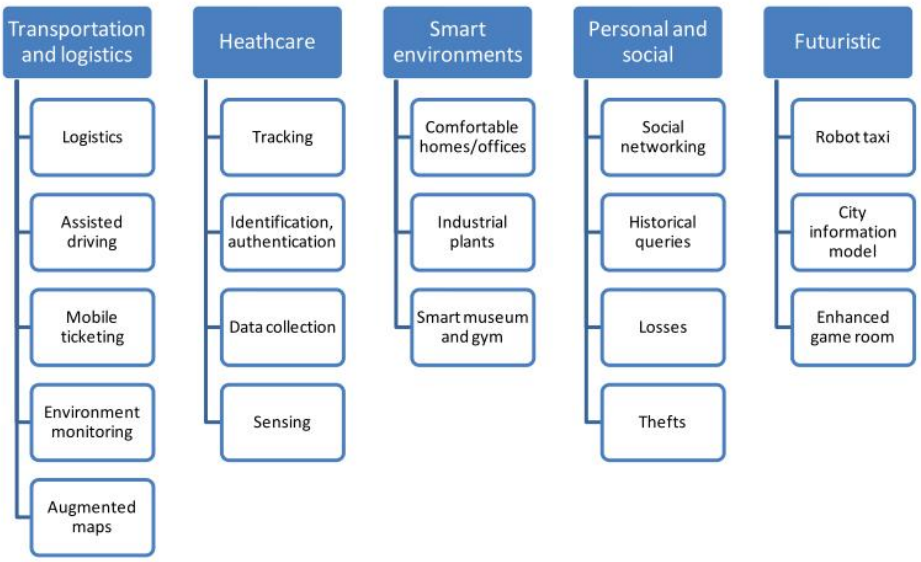
ZigBee devices are of three kinds:

- **ZigBee Coordinator (ZC):** The most capable device, the Coordinator forms the root of the network tree and might bridge to other networks. There is precisely one ZigBee Coordinator in each network since it is the device that started the network originally (the ZigBee LightLink specification also allows operation without a ZigBee Coordinator, making it more usable for over-the-shelf home products). It stores information about the network, including acting as the Trust Center & repository for security keys.
- **ZigBee Router (ZR):** As well as running an application function, a Router can act as an intermediate router, passing on data from other devices.
- **ZigBee End Device (ZED):** Contains just enough functionality to talk to the parent node (either the Coordinator or a Router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and, therefore, can be less expensive to manufacture than a ZR or ZC.

"As the Internet of Things moves from a theory and simply a buzzword into a tangible reality ZigBee will be one of the key technologies wherever scalable, low cost, low power networking is required".

APPICATIONS

An overview of some of the most prominent application areas is provided here. Based on the application domain, IoT products can be classified broadly into five different categories:



"The Internet of Things is rendering many incumbent embedded engineering technologies and design processes insufficient and antiquated."

List of Duties and Responsibilities

S. No.	Particulars	Description		Remark
1	Design & Print	Brochure Flex Invitation Letter Schedule Attendance Sheet Feedback form Registration Form **Sanjay + Bhoopesh**	Printer for designing and printing	
2	Duties and Responsibilities	faculty participation in workshop S S Manaktala	List of volunteers **Samiksha + Vikas Sharma**	2 Girls – Tilak welcome 1 - anchoring
3	Venue	Seminar Hall C-401	Availability and Permission Vikash mishra	Requisition in advance Open Timely
4	Invitation	All HOD's Dean / Director JECRC, Foundation Other Institutes	Personally and through e mail Anil / Lokesh	Done
5	Registration Desk	1 Desk + 2 Chair White desk cloth **Swati + Anshul**	Entrance Lobby At Ground floor C-Block	Vijay Admn c block
6	Decoration	Garlands Floral welcome **Vinita + Ankur**	Entrance venue Maa Saraswati Lamp Stand Tilak Thal 2 Bouquet	2 volunteer Students Admin c block
7	Inauguration	Lighting of Lamp **Ritu Vyas + Parul**	Lamp Stand Ghee, Batti, Candle, Match box	

8	Anchoring	Inauguration Anchoring Samiksha	Volunteer Student III Sem	
9	Stationary	1Notepad + 1pen **Naresh Kumar + Katru Anand**	60 sets Handover to registration desk	Store Requisition
10	Refreshment	Lunch Ashish	For Delegates from other institutions	Coupons
		Tea + Cookies **Ashish**	60 for Inauguration session at 11am 40 for Regular session at 11 am	Mr. Gopiji Canteen
11	Media Coverage	Photography **Jitendra**	Student Coordinator Photography	
		Press note Hindi & English	English – Mr. Sidharth/ Ms. Shruti Kalra Hindi – Mr. Sanjay Singhal	Media coordination with Sh. ABL Mathur

Workshop Brochure

About JECRC Foundation, Jaipur

Education is the foundation upon which a progressive nation stands and its citizens, made responsible by the education, are the building blocks of that foundation. JECRC Foundation, since its inception (2000), has taken over the mission of nurturing students.

JECRC Foundation is ascribed as one of the leading educational groups in North India and strengthening the engineering culture. The Foundation is a leading education group, with institutes for Engineering, Management and Pure & Applied sciences.

These are:

- Jaipur Engineering College & Research Centre (JECRC)
- JECRC UDML College of Engineering (JECRC UDML)
- JECRC University

The Foundation encourages the development of faculties and the students through FDP, workshops, seminars and other activities. Both faculty & students have been benefited from the foundation's strong industry collaborations and secured training & career opportunities with leading organizations.

About NITTTR, Chandigarh

The ministry of Human Resource Development, established four Regional Technical Teachers' Training Institutes now National Institute of Technical Teachers Training & Research, NITTTR at Bhopal, Chandigarh, Chennai and Kolkata in 1967. The Institute at Chandigarh is one of these four NITTTR's. The institute started with long term teacher's training programmes to improve the competence of teachers for implementing new curriculum designed by this institute, short term courses have been offered since 1967. Since June 2001, this institute has been conducting short term courses in various subjects for faculty of engineering colleges in addition to organizing AICTE sponsored Induction Training Programmes. The Institute undertakes the following spectrum of activities: Education and Training Programmes, Curriculum Development, Instructional Material Development, Research and Development, Extension Services.

About Electronics & Communication Engineering Department

It is one of the oldest departments of the institute, offering a fine blend of experience and innovation in teaching in UG. The department provides a life-long learning experience, through its state of art laboratories, well structured courses, and industry orientation. A vast collaborative framework with reputed universities world over, the department offers ample opportunities for individual growth.

About Jaipur

Jaipur, well known as the pink city of India is a heritage city. It is the capital of state of Rajasthan. There are several places of historical architectural and scenic interest in and around the walled city of Jaipur. The worlds famous are Hawa Mahal, Amber Fort, Nahargarh Fort, Galtaji, Birla Temple, Jantar Mantar, Albert Hall, Chokhi Dhani, Ramniwas Park etc.

Jaipur is worldwide famous for unique architecture, vastu, astrology, forts, monuments, palaces, art and craft, culture and last but not least for unique food. Jaipur is renowned on international tourism map as one vertex of Golden Triangle of Indian tourism.

ICT Based Short Term Course

on

"Introduction to Embedded Systems"

8th – 12th February, 2016

Department of Electronics & Communication Engineering

Jaipur Engineering College and Research Centre, Jaipur

In association with

National Institute of Technical Teachers Training & Research, Chandigarh

Patron

Sh. O.P. Agrawal, Chairman
Sh. Amit Agrawal, Director
Sh. Arpit Agrawal, Director
Dr. V. K. Chandna, Principal

Head of the Department

Ms. Shruti Kalra

Course Coordinator

Mr. Sanjay Singhal

Objectives of the Course

The objective of the workshop is to make the participants understanding the concepts of embedded systmes. The hands on training using an industry standard tool will help the participant to learn the architecture of a processor.

Contents of the Course

- Processor Architectures
- C Language Fundamentals
- Difference between GP –OS and RT-OS

Department of Electronics & Communication Engineering
Jaipur Engineering College and Research Centre Jaipur
In Association with NITTTR, Chandigarh
Organizing a ICT Based STC on

"Introduction to Embedded Systems"
8th – 12th February, 2016

Registration Form

Full Name: _____
Designation: _____
Organization: _____
_____
Qualification: _____
Specialization: _____
Mailing Address: _____

Advisory Committee

Prof. Victor Gambhir, VC, JECRC University
Prof. Ram Rattan, Principal, JECRC UDML
Sh. M. L. Sharma, Vice Chairman
Sh. O. P. Jain, Sr. Advisor
Sh. P. K. Tiwari, Sr. Advisor
Prof. S. N. Gupta, Sr. Advisor
Sh. R. S. Agarwal, Registrar
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Sub - Advisory Committee

Mr. Ram Singh, Assistant Professor
Mr. Gopal Tiwari, Assistant Professor

Organizing Committee

Dr. Lokesh Kumar Bansal, Professor
Mr. S. S. Manaktala, Assistant Professor
Mr. Anil Jain, Assistant Professor

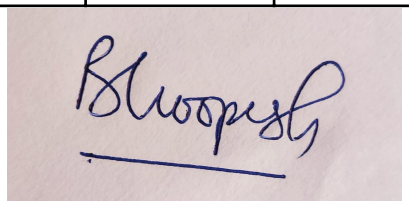
S. No.	Name of Faculty	Name of the Institute	Department	Designation
1	S S Manaktala	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
2	Ragini Khandelwal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
3	Bhoopesh Kumawat	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
4	Sidharth Chaturvedy	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
5	Shivam Upadhyay	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
6	Veni madhav Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
7	Dr. S. K. Dixit	JECRC, Jaipur	Applied Science	Professor
8	Atul Sharma	JECRC, Jaipur	Computer Science	Lab Technician
9	Shikha Gaur	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
10	Ankur Gangwar	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
11	Anil Jain	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
12	Honey Agarwal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
13	Vikas Mishra	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
14	Naresh Kumar	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
15	Jisha Varghese	JECRC, Jaipur	Electrical Engineering	Assistant Professor
16	Md. Yusuf	JECRC, Jaipur	Electrical Engineering	Assistant Professor
17	Dr. U K Pareek	JECRC, Jaipur	Applied Science	Professor
18	Gopal Tiwari	JECRC, Jaipur	Electrical Engineering	Assistant Professor
19	Dilip Prajapati	JECRC, Jaipur	Mechanical Engineering	Assistant Professor
20	Jitendra Gupta	JECRC, Jaipur	Mechanical Engineering	Assistant Professor
21	Veenu Kamra	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
22	Aruna Yadav	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
23	Ashok Kumar	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
24	Devendra Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
25	Jitendra Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
26	Deepmala	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
27	Mangilal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor

28	Ritu Vyas	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
29	K. Anand	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
30	Samiksha Yadav	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
31	Swati Gaur	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
32	Kritika Bansal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
33	Diksha	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
34	Rakesh Kardam	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
35	Vikas Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
36	Lokesh Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
37	Parindra	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
38	Nitin Dhar Dwivedi	Global Technical Campus, Jaipur	Electronics & Communication Engineering	Assistant Professor
39	Sanjay Singhal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
40	Sandeep Kumar	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
41	Pravin Kr. Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
42	Raj Kumar Jain	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
43	Ram Singh	JECRC, Jaipur	Electrical Engineering	Assistant Professor
44	Ashish Kulshrestha	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
45	Parul Tyagi	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
46	Anshul Gupta	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
47	Neha Singh	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor

List of Session Coordinators

Day / Date	Session I 9:30 – 11:00 am	Session Coordinators	Session II 11:30 – 1:00 pm	Session Coordinators	Session III 2:00 – 4:00 pm	Session Coordinators
Monday 8th Feb 2016	Inauguration	-	Embedded Systems Design Aspects	Praveen Sharma & Neha Singh	Android Platform for Embedded Systems	Katru Anand & Anshul Gupta
Tuesday 9th Feb 2016	Embedded Controller PIC	Ashok Kumar & Sandeep Dotya	Interfacing of PIC with real world	Vikas Sharma & Sidharth Chaturvedy	Challenges and trends in embedded Systems	S S Manaktala & Honey Agrawal
Wednesday 10th Feb 2016	Distributed Real Time Embedded	Parindra Chouhan &	Role of Embedded	Ritu Vyas & Kritika Bansal	Embedded Systems in IOTs	Aruna Yadav & Shikha Gaur

	Systems – DRES	Devendra Sharma	Systems in WSN			
Thursday 11th Feb 2016	ARM Processor and its Applications in Embedded Systems	Naresh Kumar & Swati Gaur	Arduino Microcontroller in Embedded Systems	Parul Tyagi & Shivam Upadhyay	Recent Developments in Service Robots	VeniMadhav Sharma Lokesh Sharma
Friday 12th Feb 2016	Industrial Applications of Embedded Systems	Ashish Kulshreshtha & Vikas Mishra	Recent Development of Embedded Systems in Biomedical Applications	Ragini Khandelwal & Jitendra Sharma	Valediction	-



-

Report on five days Faculty Development Program through ICT

on

"Introduction to Embedded Systems"

From February 8 -12, 2016

at

Jaipur Engineering College and Research Centre, Jaipur

Organized By

2. **Department of ECE, JECRC and 2. Department of ECE, NITTTR, Chandigarh**

Objective:

The objective of the course is to focus on **"Introduction to Embedded Systems"**, the latest technological advancements and trends in various Microcontrollers, their overview, their features, programming and their applications in real life and industries.

Target:

Faculty members of ECE and EE departments including students

About the FDP

The Faculty Development Program is organized with a vision to enhance the technical and practical aspects of fundamental and advanced subjects of engineering technology which play vital role in making the roots of education stronger.

ICT Based STC program on "Introduction to Embedded Systems" during 8th – 12th February, 2016 was conducted in association with Department of Electronics & Communication Engineering, JECRC Jaipur and NITTTR, Chandigarh. The pragramme was attended by 44 faculty members and 40 students. The resource person was Dr. Kanika Sharma, Assistant Professor. They gave a brief idea about recent developments that are taking place in the area of Processor Architectures; C Language Fundamentals also stressed on the industrial research contents like GP –OS and Real Time OS. They covered content beyond the syllabus for the students in the area of embedded software Engineering.

Overview of Embedded Systems

Embedded systems have become an integral part of daily life. Be it a cell phone, a smartcard, a music player, a router, or the electronics in an automobile - these systems have been touching and changing modern lives like never before. An embedded system is a combination of computer hardware, software, and additional mechanical or other technical components, designed to perform a dedicated function. Most of the embedded systems need to meet real-time computing requirements.

The major building blocks of an Embedded System are listed below:

- Microcontrollers / digital signal processors (DSP)
- Integrated chips
- Real time operating system (RTOS) - including board support package and device drivers
- Industry-specific protocols and interfaces
- Printed circuit board assembly

Usually, an embedded system requires mechanical assembly to accommodate all the above components and create a product or a complete embedded device.

1. **Recent advances in Micro-Electro-Mechanical systems are highly integrated Digital Electronics have led to the development of Micro sensors.**

2. Such sensors are generally equipped with data processing and communication capabilities.

3. A wireless sensor network is collection of nodes organized into co-opetative network.

4. Each node > consists of processing capability (one or more microcontrollers, CPIUs and DSP CHIPS > Have a RF Transreceiver.

An Overview of Advanced versions of MCU

The Advanced Microcontroller Bus Architecture (AMBA) is a widely used interconnection standard for System on Chip (SoC) design. An AMBA-based microcontroller typically consists of a high-performance system backbone bus (AMBA AHB or AMBA ASB), able to sustain the external memory bandwidth, on which the CPU, on-chip memory and other Direct Memory Access (DMA) devices reside. This bus

provides a high-bandwidth interface between the elements that are involved in the majority of transfers.

- **PIC** is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to *Peripheral Interface Controller*. The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.
- **Silicon Labs** is a worldwide fabless semiconductor company headquartered in Austin, Texas, United States, that develops silicon, software and tools for the Internet of Things (IoT), Internet infrastructure, industrial automation, consumer and automotive markets. Its products include microcontrollers (MCUs), wireless SoCs, timing devices, low-power sensors, and broadcast solutions. The company's software stack solutions include firmware libraries, protocol-based software, and the Simplicity Studio development platform. Silicon Labs provides solutions and software for use in a variety of electronic products in a range of applications including portable devices, AM/FM radios and other consumer electronics, networking equipment, test and measurement equipment, industrial monitoring and control, home automation and customer premises equipment. These products integrate complex mixed-signal functions that are frequently performed by numerous discrete components in competing products into a single chip or chipset.
- **Atmel** is an American-based designer and manufacturer of semiconductors, founded in 1984. The company focuses on embedded systems built around microcontrollers. Its products include microcontrollers (8-bit AVR, 32-bit AVR, 32-bit ARM-based, automotive grade, and 8-bit Intel 8051 derivatives) radio frequency (RF) devices including Wi-Fi, EEPROM, and flash memory devices, symmetric and asymmetric security chips, touch sensors and controllers, and application-specific products. Atmel supplies its devices as standard products, application-specific integrated circuits (ASICs), or application-specific standard product(ASSPs) depending on the requirements of its customers.
- **Philips:** The Philips Bridge IC is a new generation of interface solutions for managing high-speed serial data communication among various bus interfaces such as SPI, I2C-bus, and UART including RS-232 and RS-485. The Bridge IC is commonly used to overcome the limitation of the host bus interface to peripherals and to provide easy interface with existing different serial buses. The description of the block diagram, hardware, firmware, and software are described in the next paragraphs for users to quickly understand the implementation of the Philips LPC900 Series microcontroller to Philips Bridge IC serial interface for RS-232 point-point communication, RS-485 multi-drop application, IrDA wireless links communication, and GPIO interface. The source code in C language is provided to show how to write a simple communication program between the microcontroller and the Bridge IC serial interface. The goal is to help users to design the Bridge IC in their application and also shorten their product development cycle.

Role of MCU in Embedded System

Microprocessors and microcontrollers are widely used in embedded system products. An embedded product uses a microprocessor (or microcontroller) to do one task and one task only. A printer is an example of embedded system since the processor inside it performs only one task; namely, getting the data and printing it. Contrast this with a Pentium-based PC (or any x86 IBM-compatible PC). A PC can be used for any number of applications such as word processor, print server, bank teller terminal, video game player, network server, or internet terminal. Software for a variety of applications can be loaded and run. Of course the reason a PC can perform myriad tasks is that it has RAM memory and an operating system that loads the application software into RAM and lets the CPU run it. In an embedded system, there is only one application software that is typically burned into ROM. An x86 PC contains or is connected to various embedded products such as the keyboard, printer, modem, disk controller, sound card, CD-ROM driver, mouse, and so on. Each one of these peripherals has a microcontroller inside it that performs only one task. For example, inside every mouse there is a microcontroller that performs the task of finding the mouse position and sending it to the PC. Table 1-1 lists some embedded products. There are four major 8-bit microcontrollers. They are: Freescale's 6811, Intel's 8051, Zilog's Z8, and PIC 16X from Microchip Technology. Each of these microcontrollers has a unique instruction set and register set; therefore, they are not compatible with each other. Programs written for one will not run on the others. There are also 16-bit and 32-bit microcontrollers made by various chip makers. With all these different microcontrollers, what criteria do designers consider in choosing one? Three criteria in choosing microcontrollers are as follows: (1) meeting the computing needs of the task at hand efficiently and cost effectively, (2) availability of software development tools such as compilers, assemblers, and debuggers, and (3) wide availability and reliable sources of the microcontroller. Next we elaborate further on each of the above criteria.

Criteria for choosing a Microcontroller

The first and foremost criterion in choosing a microcontroller is that it must meet the task at hand efficiently and cost effectively. In analyzing the needs of a microcontroller-based project, we must first see whether an 8-bit, 16-bit, or 32-bit microcontroller can best handle the computing needs of the task most effectively. Among other considerations in this category are:

- Speed. What is the highest speed that the microcontroller supports?
- Packaging. Does it come in a 40-pin DIP (dual inline package) or a QFP (quad flat package), or some other packaging format? This is important in terms of space, assembling, and prototyping the end product.
- Power consumption. This is especially critical for battery-powered products.
- The amount of RAM and ROM on chip.
- The number of I/O pins and the timer on the chip.
- How easy it is to upgrade to higher-performance or lower power-consumption versions.
- Cost per unit. This is important in terms of the final cost of the product in which a microcontroller is used. For example, there are microcontrollers that cost 50 cents per unit when purchased 100,000 units at a time.

What is Arduino?

Arduino is an open-source prototyping platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

Why Arduino?

Thanks to its simple and accessible user experience, Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- **Inexpensive** - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50
- **Cross-platform** - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

- **Simple, clear programming environment** - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.
- **Open source and extensible software** - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- **Open source and extensible hardware** - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

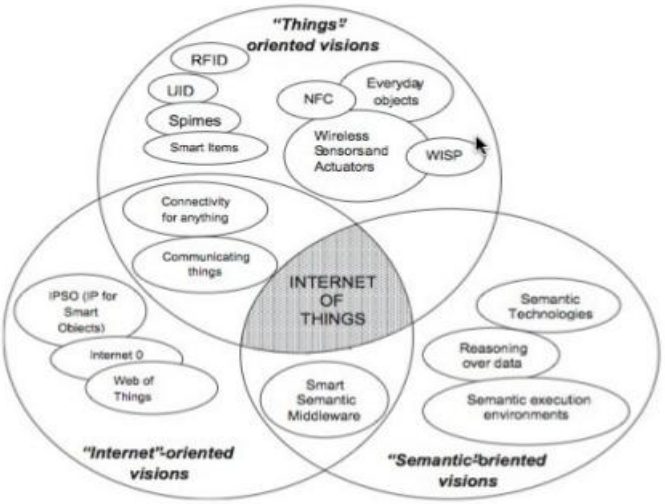
Arduino Programming Basics

Command	Description
`pinMode(n,INPUT)`	Set pin *n* to act as an input. One-time command at top of program.
`pinMode(n,OUTPUT)`	Set pin *n* to act as an output
`digitalWrite(n,HIGH)`	Set pin *n* to 5V
`digitalWrite(n,LOW)`	Set pin *n* to 0V
`delay(x)`	Pause program for *x* millisec, *x* = 0 to 65,535
`tone(n,f,d)`	Play tone of frequency *f* Hz for *d* millisec on speaker attached to pin *n*
`for()`	Loop. Example: for (i=0;i<3;i++){} Do the instructions enclosed by {} three times
`if (expr) {}`	Conditional branch. If *expr* true, do instructions enclosed by {}
`while (expr) {}`	While *expr* is true, repeat instructions in {} indefinitely

The Internet of Things (IoT) refers to everyday appliances and gadgets ('things') such as televisions, medical devices and cars connected to the internet via tiny machine-readable radio frequency identifier (RFID) tags. The RFID tags enable devices to automatically transfer data over a network without requiring human-to-human or human-to-computer interaction.

Although variations have sprung up since, including M2M (machine-to-machine) and Cisco's Internet of Everything, it's the original term that has passed into the general lexicon. The IoT now encompasses pretty much any device with embedded technology – from RFID through to sensor-based computing and QR codes – that allows the device to interact with other devices and the environment.

IOT Paradigm



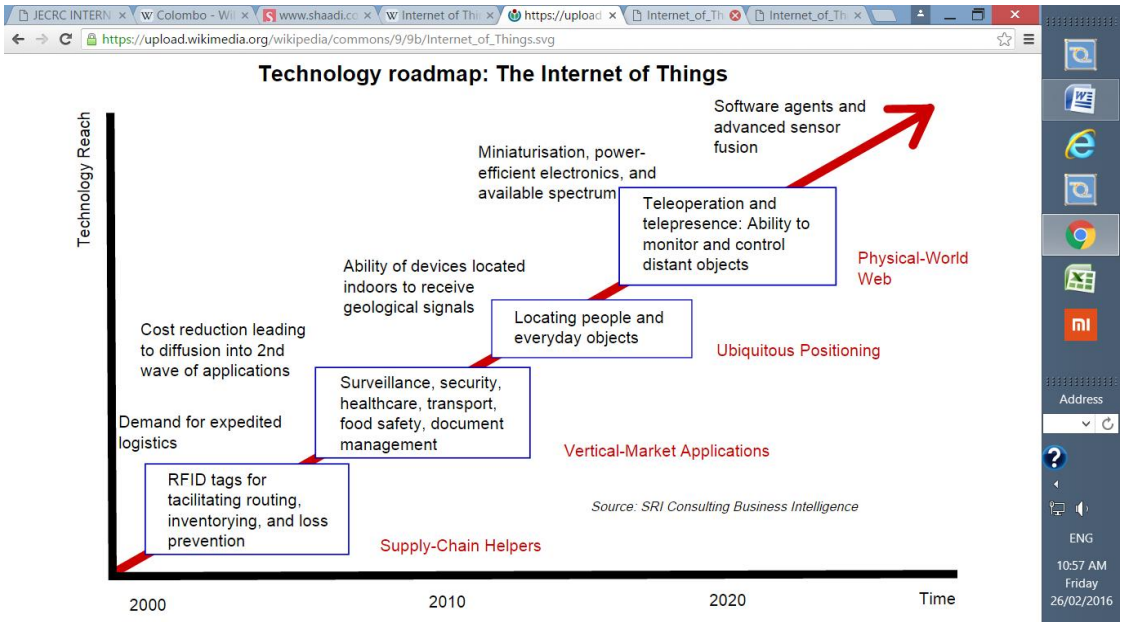
The Internet of Things (IoT) is a new paradigm that combines aspects and technologies coming from different approaches. Ubiquitous computing, pervasive computing, Internet Protocol, sensing technologies, communication technologies, and embedded devices are merged together in order to form a system where the real and digital worlds meet and are continuously in symbiotic interaction. The smart object is the building block of the IoT vision. By putting intelligence into everyday objects, they are turned into smart objects able not only to collect information from the environment and interact/control the physical world, but also to be interconnected, to each other, through Internet to exchange data and information. The expected huge number of interconnected devices and the significant amount of available data open new opportunities to create services that will bring tangible benefits to the society, environment, economy and individual citizens. In addition to identifying the application scenarios and the correspondent potential applications, we focus on research challenges and open issues to be faced for the IoT realization in the real world.

Enabling Technologies For IOT

There are many technologies that enable IOT:

5. RFID and near-field communication - In the 2000s, RFID was the dominant technology. Later, NFC became dominant (NFC). NFC have become common in smartphones during the early 2010s, with uses such as reading NFC tags or for access to public transportation.
6. Optical tags and quick response codes - This is used for low cost tagging. Phone cameras decodes QR code using image-processing techniques. In reality QR advertisement campaigns gives less turnout as users need to have another application to read QR codes.
7. Bluetooth low energy - This is one of the latest tech. All newly releasing smartphones have BLE hardware in them. Tags based on BLE can signal their presence at a power budget that enables them to operate for up to one year on a lithium coin cell battery.
8. Low energy wireless IP networks - embedded radio in system-on-a-chip designs, lower power WiFi, sub-GHz radio in an ISM band, often using a compressed version of IPv6called 6LowPAN.

Trends and Characteristics



Zigbee and Internet Of Things

The explosion in wireless technology has seen the emergence of many standards, especially in the industrial, scientific and medical (ISM) radio band. There have been a multitude of proprietary protocols for control applications, which bottlenecked interfacing. It was this Zigbee Alliance that created **Zigbee**. Both Bluetooth and Wi-Fi have been developed for communication of large amount of data with complex structure like the media files, software etc. Zigbee on the other hand has been developed looking into the needs of communication of data with simple structure like the data from the sensors.

Zigbee is a low power spin off of WiFi. It is a specification for small, low power radios based on IEEE 802.15.4 – 2003 Wireless Personal Area Networks standard. The specification was accepted and ratified by the Zigbee alliance in December 2004. Zigbee Alliance is a group of more than 300 companies including industry majors like Philips, Mitsubishi Electric, Epson, Atmel, Texas Instruments etc. which are committed towards developing and promoting this standard.

The ZigBee® mesh networking wireless technology is already enabling the growing machine-to-machine (M2M) and Internet of Things (IoT) trends and providing utilities and energy service providers with new consumer energy management and efficiency capabilities. "ZigBee was purposefully designed to address capabilities not supported by other wireless technologies and continues to be the only standard capable of securely, economically and efficiently connecting thousands of electrical switches, lights, door locks, thermostats, cable set-top-boxes and a myriad of other devices, seamlessly into an Internet of Things,"

ZigBee is a low-cost, low-power; wireless mesh network standard targeted at the wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB flashes memory. ZigBee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and Australia. Data rates vary from 20 kbit/s (868 MHz band) to 250 kbit/s (2.4 GHz band).

The ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. ZigBee builds on the physical layer and media access control defined in IEEE standard 802.15.4 for low-rate WPANs. The specification includes four additional key components: network layer, application layer, ZigBee device objects (ZDOs) and manufacturer-defined application objects which allow for customization and favor total integration.

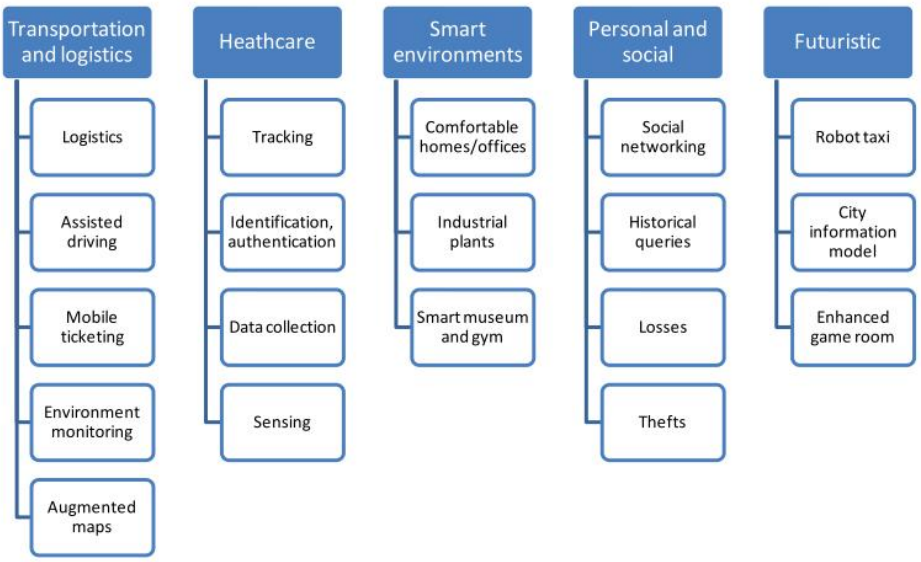
ZigBee devices are of three kinds:

- **ZigBee Coordinator (ZC):** The most capable device, the Coordinator forms the root of the network tree and might bridge to other networks. There is precisely one ZigBee Coordinator in each network since it is the device that started the network originally (the ZigBee LightLink specification also allows operation without a ZigBee Coordinator, making it more usable for over-the-shelf home products). It stores information about the network, including acting as the Trust Center & repository for security keys.
- **ZigBee Router (ZR):** As well as running an application function, a Router can act as an intermediate router, passing on data from other devices.
- **ZigBee End Device (ZED):** Contains just enough functionality to talk to the parent node (either the Coordinator or a Router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and, therefore, can be less expensive to manufacture than a ZR or ZC.

"As the Internet of Things moves from a theory and simply a buzzword into a tangible reality ZigBee will be one of the key technologies wherever scalable, low cost, low power networking is required".

APPICATIONS

An overview of some of the most prominent application areas is provided here. Based on the application domain, IoT products can be classified broadly into five different categories:



"The Internet of Things is rendering many incumbent embedded engineering technologies and design processes insufficient and antiquated."

List of Duties and Responsibilities

S. No.	Particulars	Description		Remark
1	Design & Print	Brochure Flex Invitation Letter Schedule Attendance Sheet Feedback form Registration Form **Sanjay + Bhoopesh**	Printer for designing and printing	
2	Duties and Responsibilities	faculty participation in workshop S S Manaktala	List of volunteers **Samiksha + Vikas Sharma**	2 Girls – Tilak welcome 1 - anchoring
3	Venue	Seminar Hall C-401	Availability and Permission Vikash mishra	Requisition in advance Open Timely
4	Invitation	All HOD's Dean / Director JECRC, Foundation Other Institutes	Personally and through e mail Anil / Lokesh	Done
5	Registration Desk	1 Desk + 2 Chair White desk cloth **Swati + Anshul**	Entrance Lobby At Ground floor C-Block	Vijay Admn c block
6	Decoration	Garlands Floral welcome **Vinita + Ankur**	Entrance venue Maa Saraswati Lamp Stand Tilak Thal 2 Bouquet	2 volunteer Students Admin c block
7	Inauguration	Lighting of Lamp **Ritu Vyas + Parul**	Lamp Stand Ghee, Batti, Candle, Match box	

8	Anchoring	Inauguration Anchoring Samiksha	Volunteer Student III Sem	
9	Stationary	1Notepad + 1pen **Naresh Kumar + Katru Anand**	60 sets Handover to registration desk	Store Requisition
10	Refreshment	Lunch Ashish	For Delegates from other institutions	Coupons
		Tea + Cookies **Ashish**	60 for Inauguration session at 11am 40 for Regular session at 11 am	Mr. Gopiji Canteen
11	Media Coverage	Photography **Jitendra**	Student Coordinator Photography	
		Press note Hindi & English	English – Mr. Sidharth/ Ms. Shruti Kalra Hindi – Mr. Sanjay Singhal	Media coordination with Sh. ABL Mathur

Workshop Brochure

About JECRC Foundation, Jaipur

Education is the foundation upon which a progressive nation stands and its citizens, made responsible by the education, are the building blocks of that foundation. JECRC Foundation, since its inception (2000), has taken over the mission of nurturing students.

JECRC Foundation is ascribed as one of the leading educational groups in North India and strengthening the engineering culture. The Foundation is a leading education group, with institutes for Engineering, Management and Pure & Applied sciences.

These are:

- Jaipur Engineering College & Research Centre (JECRC)
- JECRC UDML College of Engineering (JECRC UDML)
- JECRC University

The Foundation encourages the development of faculties and the students through FDP, workshops, seminars and other activities. Both faculty & students have been benefited from the foundation's strong industry collaborations and secured training & career opportunities with leading organizations.

About NITTTR, Chandigarh

The ministry of Human Resource Development, established four Regional Technical Teachers' Training Institutes now National Institute of Technical Teachers Training & Research, NITTTR at Bhopal, Chandigarh, Chennai and Kolkata in 1967. The Institute at Chandigarh is one of these four NITTTR's. The institute started with long term teacher's training programmes to improve the competence of teachers for implementing new curriculum designed by this institute, short term courses have been offered since 1967. Since June 2001, this institute has been conducting short term courses in various subjects for faculty of engineering colleges in addition to organizing AICTE sponsored Induction Training Programmes. The Institute undertakes the following spectrum of activities: Education and Training Programmes, Curriculum Development, Instructional Material Development, Research and Development, Extension Services.

About Electronics & Communication Engineering Department

It is one of the oldest departments of the institute, offering a fine blend of experience and innovation in teaching in UG. The department provides a life-long learning experience, through its state of art laboratories, well structured courses, and industry orientation. A vast collaborative framework with reputed universities world over, the department offers ample opportunities for individual growth.

About Jaipur

Jaipur, well known as the pink city of India is a heritage city. It is the capital of state of Rajasthan. There are several places of historical architectural and scenic interest in and around the walled city of Jaipur. The worlds famous are Hawa Mahal, Amber Fort, Nahargarh Fort, Galtaji, Birla Temple, Jantar Mantar, Albert Hall, Chokhi Dhani, Ramniwas Park etc.

Jaipur is worldwide famous for unique architecture, vastu, astrology, forts, monuments, palaces, art and craft, culture and last but not least for unique food. Jaipur is renowned on international tourism map as one vertex of Golden Triangle of Indian tourism.

ICT Based Short Term Course

on

"Introduction to Embedded Systems"

8th – 12th February, 2016

Department of Electronics & Communication Engineering

Jaipur Engineering College and Research Centre, Jaipur

In association with

National Institute of Technical Teachers Training & Research, Chandigarh

Patron

Sh. O.P. Agrawal, Chairman
Sh. Amit Agrawal, Director
Sh. Arpit Agrawal, Director
Dr. V. K. Chandna, Principal

Head of the Department

Ms. Shruti Kalra

Course Coordinator

Mr. Sanjay Singhal

Objectives of the Course

The objective of the workshop is to make the participants understanding the concepts of embedded systmes. The hands on training using an industry standard tool will help the participant to learn the architecture of a processor.

Contents of the Course

- Processor Architectures
- C Language Fundamentals
- Difference between GP –OS and RT-OS

Department of Electronics & Communication Engineering
Jaipur Engineering College and Research Centre Jaipur
In Association with NITTTR, Chandigarh
Organizing a ICT Based STC on

"Introduction to Embedded Systems"
8th – 12th February, 2016

Registration Form

Full Name: _____
Designation: _____
Organization: _____
_____
Qualification: _____
Specialization: _____
Mailing Address: _____

Advisory Committee

Prof. Victor Gambhir, VC, JECRC University
Prof. Ram Rattan, Principal, JECRC UDML
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Sh. O. P. Jain, Sr. Advisor
Sh. P. K. Tiwari, Sr. Advisor
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Sub - Advisory Committee

Mr. Ram Singh, Assistant Professor
Mr. Gopal Tiwari, Assistant Professor

Organizing Committee

Dr. Lokesh Kumar Bansal, Professor
Mr. S. S. Manaktala, Assistant Professor
Mr. Anil Jain, Assistant Professor

S. No.	Name of Faculty	Name of the Institute	Department	Designation
1	S S Manaktala	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
2	Ragini Khandelwal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
3	Bhoopesh Kumawat	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
4	Sidharth Chaturvedy	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
5	Shivam Upadhyay	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
6	Veni madhav Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
7	Dr. S. K. Dixit	JECRC, Jaipur	Applied Science	Professor
8	Atul Sharma	JECRC, Jaipur	Computer Science	Lab Technician
9	Shikha Gaur	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
10	Ankur Gangwar	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
11	Anil Jain	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
12	Honey Agarwal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
13	Vikas Mishra	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
14	Naresh Kumar	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
15	Jisha Varghese	JECRC, Jaipur	Electrical Engineering	Assistant Professor
16	Md. Yusuf	JECRC, Jaipur	Electrical Engineering	Assistant Professor
17	Dr. U K Pareek	JECRC, Jaipur	Applied Science	Professor
18	Gopal Tiwari	JECRC, Jaipur	Electrical Engineering	Assistant Professor
19	Dilip Prajapati	JECRC, Jaipur	Mechanical Engineering	Assistant Professor
20	Jitendra Gupta	JECRC, Jaipur	Mechanical Engineering	Assistant Professor
21	Veenu Kamra	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
22	Aruna Yadav	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
23	Ashok Kumar	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
24	Devendra Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
25	Jitendra Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
26	Deepmala	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
27	Mangilal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor

28	Ritu Vyas	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
29	K. Anand	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
30	Samiksha Yadav	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
31	Swati Gaur	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
32	Kritika Bansal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
33	Diksha	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
34	Rakesh Kardam	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
35	Vikas Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
36	Lokesh Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
37	Parindra	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
38	Nitin Dhar Dwivedi	Global Technical Campus, Jaipur	Electronics & Communication Engineering	Assistant Professor
39	Sanjay Singhal	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
40	Sandeep Kumar	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
41	Pravin Kr. Sharma	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
42	Raj Kumar Jain	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
43	Ram Singh	JECRC, Jaipur	Electrical Engineering	Assistant Professor
44	Ashish Kulshrestha	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
45	Parul Tyagi	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
46	Anshul Gupta	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor
47	Neha Singh	JECRC, Jaipur	Electronics & Communication Engineering	Assistant Professor

List of Session Coordinators

Day / Date	Session I 9:30 – 11:00 am	Session Coordinators	Session II 11:30 – 1:00 pm	Session Coordinators	Session III 2:00 – 4:00 pm	Session Coordinators
Monday 8th Feb 2016	Inauguration	-	Embedded Systems Design Aspects	Praveen Sharma & Neha Singh	Android Platform for Embedded Systems	Katru Anand & Anshul Gupta
Tuesday 9th Feb 2016	Embedded Controller PIC	Ashok Kumar & Sandeep Dotya	Interfacing of PIC with real world	Vikas Sharma & Sidharth Chaturvedy	Challenges and trends in embedded Systems	S S Manaktala & Honey Agrawal
Wednesday 10th Feb 2016	Distributed Real Time Embedded	Parindra Chouhan &	Role of Embedded	Ritu Vyas & Kritika Bansal	Embedded Systems in IOTs	Aruna Yadav & Shikha Gaur

	Systems – DRES	Devendra Sharma	Systems in WSN			
Thursday 11th Feb 2016	ARM Processor and its Applications in Embedded Systems	Naresh Kumar & Swati Gaur	Arduino Microcontroller in Embedded Systems	Parul Tyagi & Shivam Upadhyay	Recent Developments in Service Robots	VeniMadhav Sharma Lokesh Sharma
Friday 12th Feb 2016	Industrial Applications of Embedded Systems	Ashish Kulshreshtha & Vikas Mishra	Recent Development of Embedded Systems in Biomedical Applications	Ragini Khandelwal & Jitendra Sharma	Valediction	-