



Internet of Things (IoT) Lab

DEPARTMENT OF ELECTRONICS & COMMUNICATIONS ENGINEERING

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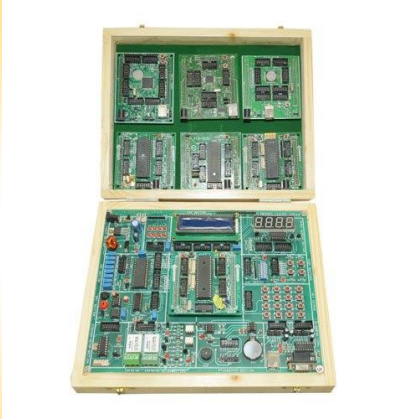
Location: Aryabhata II, 2nd Floor, Sector 62 Campus

Objective

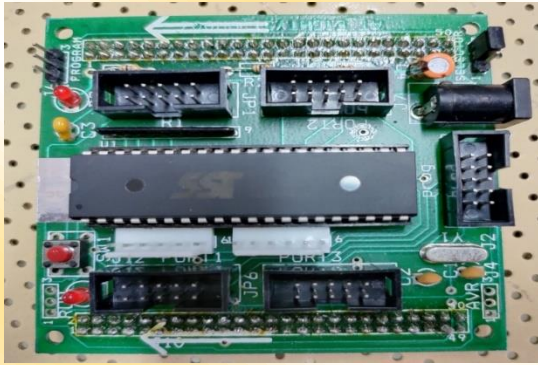
This lab has been setup to fulfil the following objectives

- To skill the undergraduate and postgraduate students in the IoT and Embedded system design utilizing state of the art hardware boards and softwares as per industry standards.
- To enhance research activities in different application areas of IoT like smart home, smart village, smart healthcare, smart grid, smart agriculture, industry 4.0 and wearable IoT devices etc.

Hardware/Software Availability

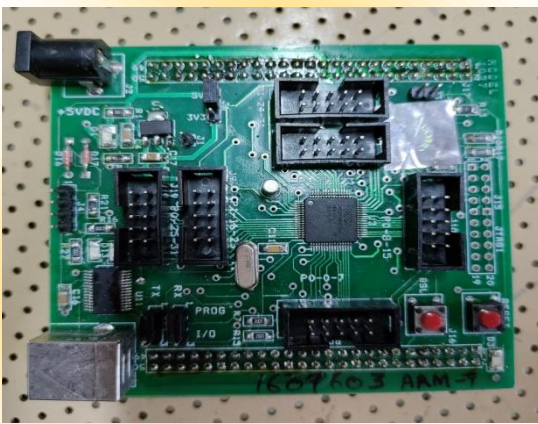
Name	Description
Universal Embedded Microcontroller Development Board 	The universal microcontroller development board is equipped with various on board sensors and actuator interfaces that are required to design the embedded and IoT applications. The board is designed in such a manner that it can be utilized with different microcontroller interfaces by changing the daughter cards at the central part of the board.

8051 Daughter Board



This daughter card consist of 8051-based SST SST89V564RD Microcontroller having following specifications: 25MHz, 3 volt with 32 I/O lines, 3 Timers/Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

ARM 7 Daughter Board



This daughter card consist of LPC2148 microcontroller (founded by Philips) which is an ARM7TDMI-S based high-performance 32-bit RISC microcontroller with thumb extensions 512KB on-chip Flash ROM with In-System Programming (ISP) and In-Application Programming (IAP), 32KB RAM, Vectored Interrupt Controller, Two 10bit ADCs with 14 channels, USB 2.0 Full Speed Device Controller, Two UARTs, one with full modem interface. Two I2C serial interfaces, Two SPI serial interfaces Two 32-bit timers, Watchdog Timer, PWM unit, Real Time Clock with optional battery backup, Brown out detect circuit General purpose I/O pins. CPU clock up to 60 MHz, On-chip crystal oscillator and On-chip PLL.

AVR Daughter Board



This daughter card consist of high-performance, low-power Microchip 8-bit AVR 8515 RISC-based microcontroller combines 8 KB of programmable Flash memory, 512B SRAM, up to 64 KB external SRAM, and 512B EEPROM. The device supports a throughput of 16 MIPS at 16 MHz and operates between 2.7-5.5 volts.

Arduino Daughter Board



This daughter card is an Arduino Uno board ATmega328P microcontroller and developed by Arduino.cc. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, boasting

Raspberry Pi 3B+ Original



a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT. The board has following specifications:
Processor: Broadcom BCM2837B0, Cortex-A53 64-bit SoC @ 1.4GHz
Memory: 1GB LPDDR2 SDRAM
Access: Extended 40-pin GPIO header
Video & sound: 1 × full size HDMI, MIPI DSI display port, MIPI CSI camera port, 4 pole stereo output and composite video port.
Micro SD format for loading operating system and data storage

Digital Storage Oscilloscope



A digital storage oscilloscope (DSO) is an oscilloscope which stores and analyses the input signal digitally rather than using analog techniques. It is now the most common type of oscilloscope in use because of the advanced trigger, storage, display and measurement features which it typically provides.

Wireless Communication Interfaces

Zigbee Interface



XBee radio family consist of various XBee RF modules. Each having different specification. Generally, XBee modules operate within ISM 2.4 GHz (Unlicensed) frequency band. XBee modules support ZigBee protocol which is based on IEEE 802.15.4 standard. XBee modules have source/destination addressing feature with unicast and broadcast communication support. They support point to point, point to multipoint, peer to peer etc. communication topologies. XBee modules uses DSSS (Direct Sequence Spread Spectrum) modulation technique for communication. XBee has on board features like Digital I/O pins, analog ADC (10-bit) input pins, PWM output etc. It has serial UART pins for communication with PC and Microcontrollers serially. Some XBee modules (e.g. S2C) has support for SPI interface too.

GSM Interface



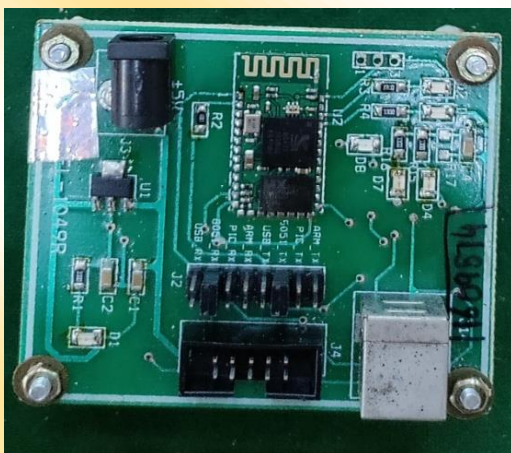
SIM900A Modem can work with any GSM network operator SIM card just like a mobile phone with its own unique phone number. SIM900A GSM/GPRS modem is plug and play modem with RS232 serial communication supported. Hence Advantage of using this modem will be that its RS232 port can be used to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed. SIM900 modem supports features like voice call, SMS, Data/Fax, GPRS etc.

RFID Interface



Radio frequency Identification (RFID) is a wireless identification technology that uses radio waves to identify the presence of RFID tags. Just like Bar code reader, RFID technology is used for identification of people, object etc. RFID is used in many applications like attendance system in which every person will have their separate RFID tag which will help identify person and their attendance. RFID is used in many companies to provide access to their authorized employees. It is also helpful to keep track of goods and in automated toll collection system on highway by embedding Tag (having unique ID) on them.

Bluetooth Interface



HC-05 is a Bluetooth module which is designed for wireless communication. It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air. It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).

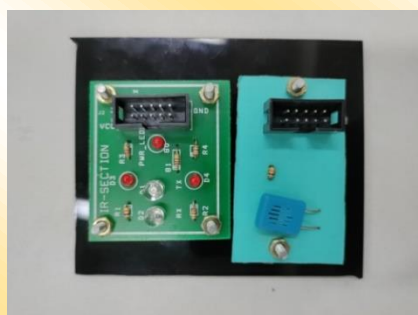
Embedded Interfaces

Traffic Light Controller Interface



Traffic light controller helps to manage the traffic and to maintain proper traffic management. These systems are placed at the intersections of the road or at the crossings to avoid congestions and accidents. The systems indicate to the driver by using different colours of light. Therefore it is simple to avoid congestion at the intersections.

Humidity + IR Sensor Interface



The DHT11 is a basic, low cost digital temperature and humidity sensor. DHT11 is a single wire digital humidity and temperature sensor, which provides humidity and temperature values serially with one-wire protocol. DHT11 sensor provides relative humidity value in percentage (20 to 90% RH) and temperature values in degree Celsius (0 to 50 °C). DHT11 sensor uses resistive humidity measurement component, and NTC temperature measurement component.

IR light is like visible light but it is invisible to our eyes, because of which they are suitable in application of wireless communication. The band for IR (Infrared) in electromagnetic spectrum is 300GHz to 430 THz and wavelength range of around 700nm to 1mm. Along with the IR LED some other sources like sun, light bulbs, human and animal bodies etc. also emit infrared energy. IR communication is used for short and medium distance applications.

Accelerometer Sensor Interface



Accelerometer is an electromechanical device that measures the force of acceleration due to gravity in g unit. It can be used in applications requiring tilt sensing. The ADXL335 sensor measures acceleration along X, Y and Z axes and gives analog voltage output proportional to the acceleration along these 3 axes. Microcontrollers can process these voltages by converting them to digital signals using ADC.

STEVAL-MKI-119V1 Board



The STEVAL-MKI190V1 is an adapter board designed to facilitate the evaluation of MEMS devices in the LISDTW12 product family. The board offers an effective solution for fast system prototyping and device evaluation directly within the user's own application. The STEVAL-MKI190V1 can be plugged into a standard DIL 24 socket. The adapter provides the complete LISDTW12 pin-out and comes ready-to-use with the required decoupling capacitors on the VDD power supply line. This adapter is supported by the STEVAL-MKI109V3 motherboard which includes a high performance 32-bit microcontroller functioning as a bridge between the sensor and a PC, on which it is possible to use the downloadable graphical user interface (Unico GUI), or dedicated software routines for customized applications.

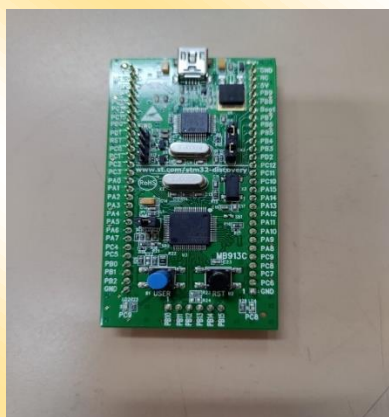
STM3240G-EVAL Board



The STM3240G-EVAL evaluation board is a complete demonstration and development platform for the STM32F407IGH6 high-performance 32-bit microcontroller with ARM®Cortex®-M4F processor. The full range of hardware features on the board helps users to evaluate all the peripherals (USB-OTG HS, USB-OTG FS, and Ethernet, motor-control, CAN, microSD™-card, smartcard, USART, audio-DAC, RS-232, IrDA (up to board MB786 C-07), SRAM, ST-MEMS, EEPROM and others) and to develop applications.

The in-circuit ST-LINK/V2 tool can easily be used for JTAG and SWD interface debugging and programming.

STM32 VL Discovery Board



The STM32VLDISCOVERY discovery kit includes an STM32F100 Value line microcontroller in a 64-pin LQFP and an in-circuit ST-LINK debugger/programmer to debug discovery applications and other target board applications.

All features:

Can supply target application with 3 V and 5 V

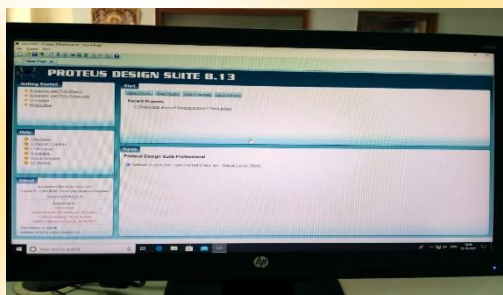
Two user LEDs (green and blue)

One user push-button

Extension header for all QFP64 I/Os

Softwares in IoT Lab

Proteus VSM Design Suite 8.13



The lab is equipped with licensed Proteus VSM software for IoT and embedded systems and circuit designing, simulation and PCB designing. The software has virtual support of following microcontrollers:

8051/52, Atmel AVR ARM Cortex M4, IoT builder for Arduino AVR with robotics and IoT solution, Advanced simulation and multilayer PCB designing. This software supports integration of various compilers corresponding to different microcontrollers for debugging and compiling firmware (code) like KEIL, and AVR GCC.

Computer System Configurations

Around 25 computer systems with following configuration are available in the lab:

Make: HP 280G3MT

Processor-Intel(R) Core i7-7700 @3.00 GHz

RAM – 8GB RAM, HDD-1TB, Keyboard, Mouse, Monitor

OS: Windows 10 Pro and CentOS 6

Glimpses of the Venue

