Dr. D. Y. Patil Pratishthan's

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Department of Artificial Intelligence and Data Science

LAB MANUAL
Internet of Things Laboratory
(SE)
Semester II

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Internet of Things Laboratory

Course Code	Course Name	Teaching Scheme (Hrs./ Week)	Credits
217531	Internet of Things Laboratory	4	2

Course Objectives:

- Hardware platforms and operating systems commonly used in IoT systems.
- Help the students in providing a good learning environment and also work with real time problems faced in day to day life.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand IOT Application Development using Raspberry Pi/ Beagle board/ Arduino board CO2: Develop and modify the code for various sensor based applications using wireless sensor modules and working with a variety of modules like environmental modules.

CO3: Make use of Cloud platform to upload and analyse any sensor data

Operating System recommended: 64-bit Open source Linux or its derivative

Programming tools recommended: Use suitable programming language/Tool for implementation

Table of Contents

Lab Assignment No.	1
Title	Study of Raspberry-Pi/ Beagle board/ Arduino and other microcontroller (History & Elevation)
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 01

Title: Study of Raspberry-Pi, Beagle board, Arduino

Problem Statement: Study of Raspberry-Pi/ Beagle board/ Arduino and other microcontroller (History & Elevation)

Objective:

1. To understand of Raspberry-Pi
2. To study Beagle board
3. To study Arduino and other micro controller

Theory:

1. **Raspberry-Pi: -**

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science in schools and in developing countries. It does not include peripherals (such as keyboards and mice). The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. The Raspberry Pi is a credit-card-sized computer that costs between $5 and $35. It's available anywhere in the world, and can function as a proper desktop computer or be used to build smart devices. A Raspberry Pi is a general-purpose computer, usually with a Linux operating system, and the ability to run multiple programs. Raspberry Pi is like the brain. Its primary advantage comes in processing higher level processing capability. It’s a single board computer.

Figure: - Raspberry-Pi

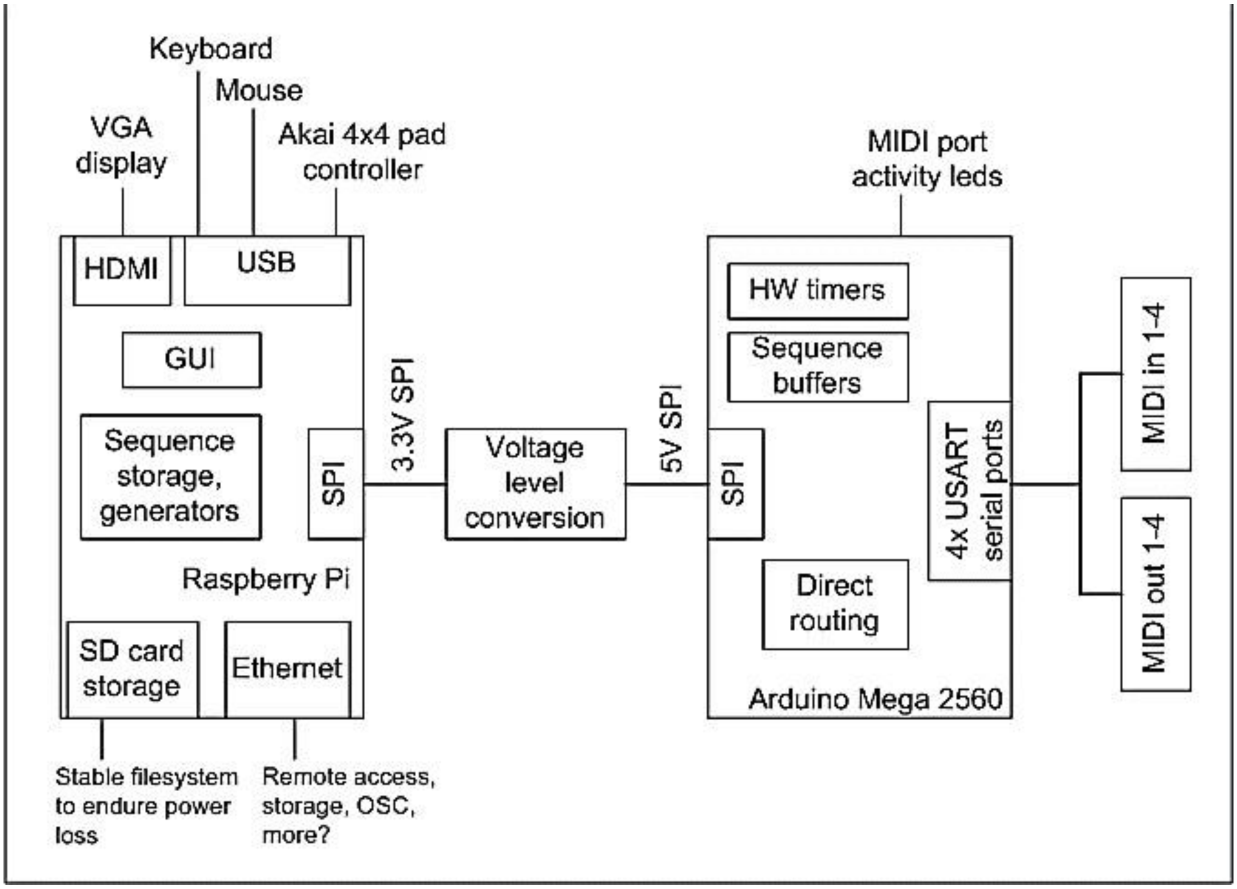


Figure: -Raspberry-Pi Architecture

Here are the various components on the Raspberry Pi board:

- **ARM CPU/GPU --** This is a Broadcom BCM2835 System on a Chip (SoC) that's made up of an ARM central processing unit (CPU) and a Video core 4 graphics processing unit (GPU). The CPU handles all the computations that make a computer work (taking input, doing calculations and producing output), and the GPU handles graphics output.
- **GPIO** -- These are exposed general-purpose input/output connection points that will allow the real hardware hobbyists the opportunity to tinker.
- RCA -- An RCA jack allows connection of analog TVs and other similar output devices.
- **Audio out** -- This is a standard 3.55-millimeter jack for connection of audio output devices such as headphones or speakers. There is no audio in.
- **LEDs** -- Light-emitting diodes, for your entire indicator light needs.
- **USB** -- This is a common connection port for peripheral devices of all types (including your mouse and keyboard). Model A has one, and Model B has two. You can use a USB hub to expand the number of ports or plug your mouse into your keyboard if it has its own USB port.
- **HDMI** -- This connector allows you to hook up a high-definition television or other compatible device using an HDMI cable.
- **Power** -- This is a 5v Micro USB power connector into which you can plug your compatible power supply.

- **SD card slot** -- This is a full-sized SD card slot. An SD card with an operating system (OS) installed is required for booting the device. They are available for purchase from the manufacturers, but you can also download an OS and save it to the card yourself if you have a Linux machine and the wherewithal.
- **Ethernet** -- This connector allows for wired network access and is only available on the Model B.

Benchmark:

Raspberry Pi:	**Model A+**	**Model B+**	**Pi 2 Model B**	**Pi Zero**	**Pi 3 Model B**
Release:	Nov 2014	July 2014	Feb 2015	Nov 2015	Feb 2016
Available:	Yes	Yes	Yes	Yes	Yes
Price(US$):	20	25	35	5	35
Processor:	700MHz single core ARM1176JZF-S	700MHz single core ARM1176JZF-S	900MHz 32-bit quad-core ARM Cortex-A7	1GHz ARM1176JZF-S single core	1.2GHz 64-bit quad-core ARM Cortex-A53
SoC:	Broadcom BCM2835	Broadcom BCM2835	Broadcom BCM2836	Broadcom BCM2835	Broadcom BCM2837
RAM:	512MB Shared	512MB Shared	1GB Shared	512MB Shared	1GB Shared
USB 2.0 Ports:	1	4	4	1	4

2. **Beagle Board: -**

The **Beagle Board** is a low-power open-source single-board computer produced by Texas Instruments in association with Digi-Key and Newark element14. The Beagle Board was also designed with open source software development in mind, and as a way of demonstrating the Texas Instrument's OMAP3530 system-on-a-chip.The board was developed by a small team of engineers as an educational board that could be used in colleges around the world to teach open source hardware and software capabilities. It is also sold to the public under the Creative Commons share-alike license. The board was designed using Cadence OrCAD for schematics and Cadence Allegro for PCB manufacturing; no simulation software was used. Beagle Bone Black is a low-cost, open source, community-supported development platform for ARM® Cortex™-A8 processor developers and hobbyists. Boot Linux in under 10-seconds and get started on Sitara™ AM335x ARM Cortex-A8 processor development in less than 5 minutes with just a single USB cable.

Figure: -Beagle Board Black

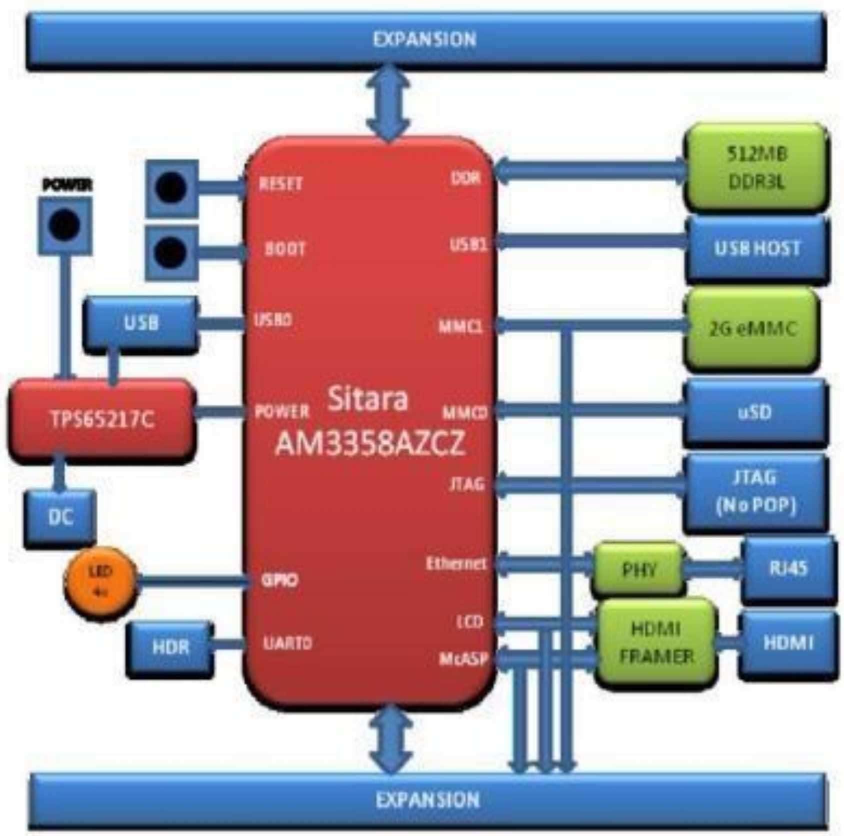


Figure: - Beagle Board Black architecture

Here are the various components on the Beagle board:
Processor: AM335x 1GHz ARM® Cortex-A8

- 512MB DDR3 RAM
- 4GB 8-bit eMMC on-board flash storage
- 3D graphics accelerator
- NEON floating-point accelerator
- 2x PRU 32-bit microcontrollers

Connectivity

- USB client for power & communications
- USB host
- Ethernet
- HDMI
- 2x 46 pin headers

Software Compatibility

- Debian
- Android
- Ubuntu
- Cloud9 IDE on Node.js w/ BoneScript library
- plus, much more

Product Comparison Table:

	PocketBeagle	**BeagleBone Black**	**BeagleBone Blue**	**BeagleBoard-X15**
Processor	AM3358 ARM Cortex-A8	AM3358 ARM Cortex-A8	AM3358 ARM Cortex-A8	AM5728 2x ARM Cortex-A15
Maximum Processor Speed	1GHz	1GHz	1GHz	1.5GHz
Co-processors	2x200-MHz PRUs, ARM Cortex-M3, SGX PowerVR	2x200-MHz PRUs, ARM Cortex-M3, SGX PowerVR	2x200-MHz PRUs, ARM Cortex-M3, SGX PowerVR	4x200-MHz PRUs, 2x ARM Cortex-M4, 2x SGX PowerVR, 2x HD video
Analog Pins	8 (3.3V), 6 (1.8V)	7 (1.8V)	4 (1.8V)	TBD
Digital Pins	44 (3.3V)	65 (3.3V)	24 (3.3V)	TBD
Memory	512MB DDR3 (800MHz x 16), microSD card slot	512MB DDR3 (800MHz x 16), 4GB on-board storage using eMMC, microSD card slot	512MB DDR3 (800MHz x 16), 4GB on-board storage using eMMC, microSD card slot	2GB DDR, 4GB on-board storage using eMMC, microSD card slot

USB	USB 2.0 Host/Client Port, USB 2.0 on expansion header	USB 2.0 Host/Client Port, USB 2.0 Host Port	USB 2.0 Host/Client Port, USB 2.0 Host Port	SS USB 3.0 Host, HS USB 2.0 OTG Port (TBD)
Network	add-ons	10/100 Ethernet	WiFi, Bluetooth, BLE	2x 10/100/1000 Ethernet
Video	SPI displays	microHDMI, cape add-ons	SPI displays	HDMI, TBD
Audio	add-ons	microHDMI, cape add-ons	add-ons, Bluetooth	3.5mm stereo jack
Supported Interfaces	TBD	4x UART, 8x PWM, LCD, GPMC, MMC1, 2x SPI, 2x I2C, A/D Converter, 2xCAN Bus, 4 Timers	TBD	TBD
MSRP	$25	$49	$79	$249

3. Arduino: -

Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (*shields*) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project. Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available.

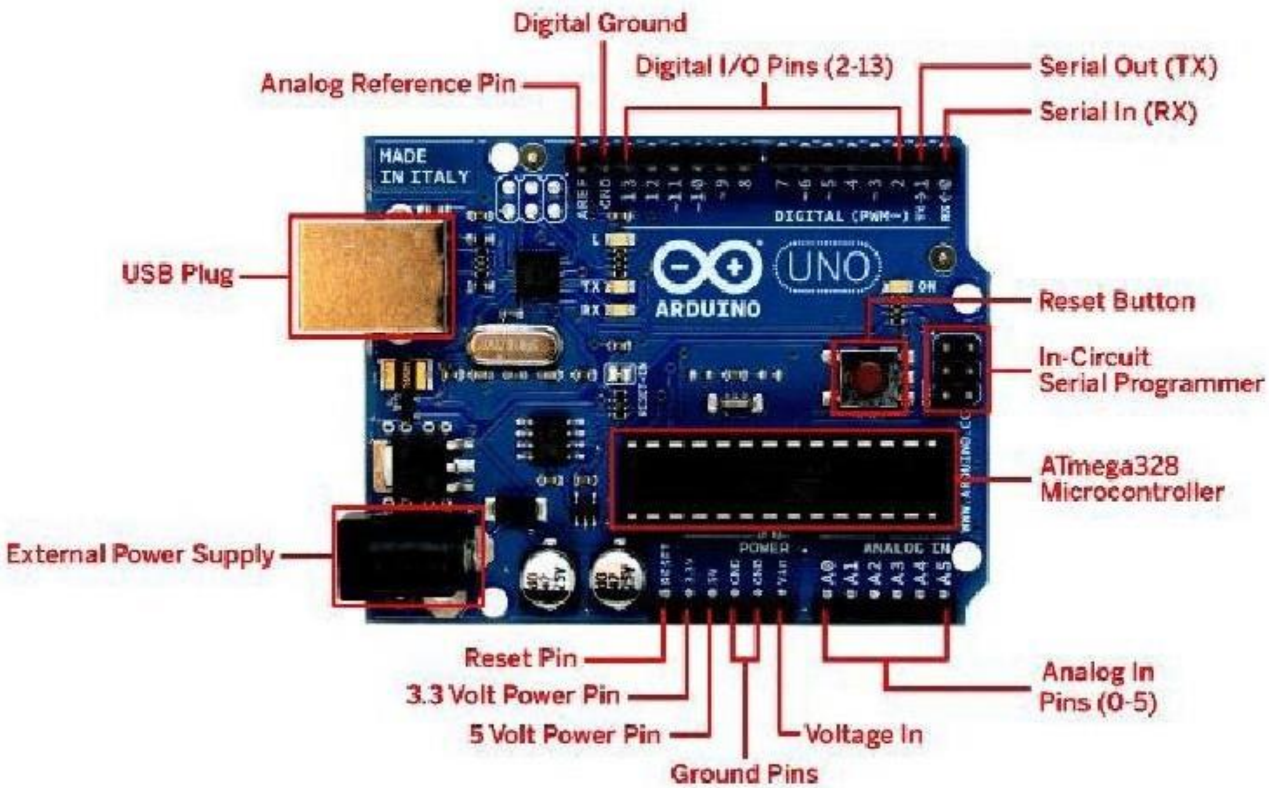


Figure: - Arduino Board

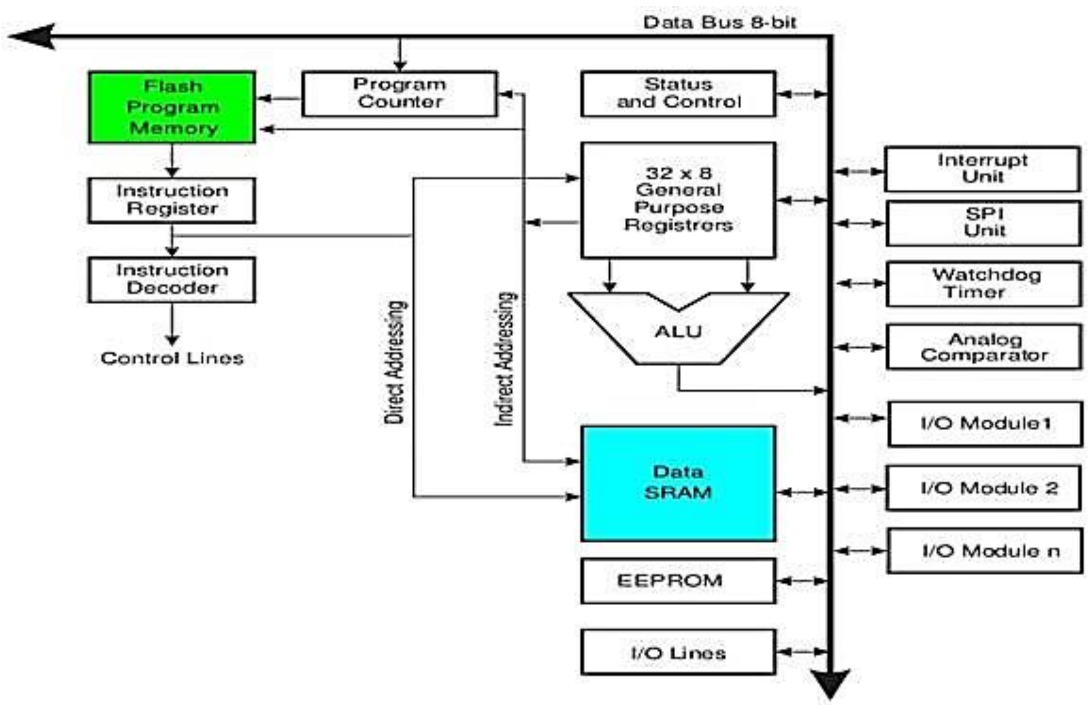


Figure: - Arduino Board Architecture.

Here are the various components on the Arduino board:
Microcontrollers

- ATmega328P (used on most recent boards)
- ATmega168 (used on most Arduino Diecimila and early Duemilanove)
- ATmega8 (used on some older board)

Digital Pins
In addition to the specific functions listed below, the digital pins on an Arduino board can be used for general purpose input and output via the pinMode(), digitalRead(), and digitalWrite() commands. Each pin has an internal pull-up resistor which can be turned on and off using digitalWrite() (w/ a value of HIGH or LOW, respectively) when the pin is configured as an input. The maximum current per pin is 40 mA.

Analog Pins
In addition to the specific functions listed below, the analog input pins support 10-bit analog-to-digital conversion (ADC) using the analogRead() function. Most of the analog inputs can also be used as digital pins: analog input 0 as digital pin 14 through analog input 5 as digital pin 19. Analog inputs 6 and 7 (present on the Mini and BT) cannot be used as digital pins.

Power Pins

- **VIN** (sometimes labelled "9V"). The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. Note that different boards accept different input voltages ranges, please see the documentation for your board. Also note that the LilyPad has no VIN pin and accepts only a regulated input.

Other Pins

- **AREF.** Reference voltage for the analog inputs. Used with analogReference().
- **Reset.** (Diecimila-only) Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.
- Analog Reference pin (orange)
- Digital Ground (light green)
- Digital Pins 2-13 (green)
- Digital Pins 0-1/Serial In/Out - TX/RX (dark green) - *These pins cannot be used for digital i/o (**digitalRead** and **digitalWrite**) if you are also using serial communication (e.g. **Serial.begin**).*
- Reset Button - S1 (dark blue)
- In-circuit Serial Programmer (blue-green)
- Analog In Pins 0-5 (light blue)
- Power and Ground Pins (power: orange, grounds: light orange)
- External Power Supply In (9-12VDC) - X1 (pink)
- Toggles External Power and USB Power (place jumper on two pins closest to desired supply) - SV1 (purple)
- USB (used for uploading sketches to the board and for serial communication between the board and the computer; can be used to power the board) (yellow)

4. **Microcontroller:**

What is a Microcontroller
Computer on a single integrated chip

- Processor (CPU)
- Memory (RAM / ROM / Flash)
- I/O ports (USB, I2C, SPI, ADC)

Common microcontroller families:

- Intel: 4004, 8008, etc.
- Atmel: AT and AVR
- Microchip: PIC
- ARM: (multiple manufacturers)

Used in:

- Cellphones,
- Toys
- Household appliances
- Cars
- Cameras

The ATmega328P Microcontroller used in Ardino has

- AVR 8-bit RISC architecture
- Available in DIP package
- Up to 20 MHz clock
- 32kB flash memory
- 1 kB SRAM
- 23 programmable I/O
- channels
- Six 10-bit ADC inputs
- Three timers/counters
- Six PWM outputs

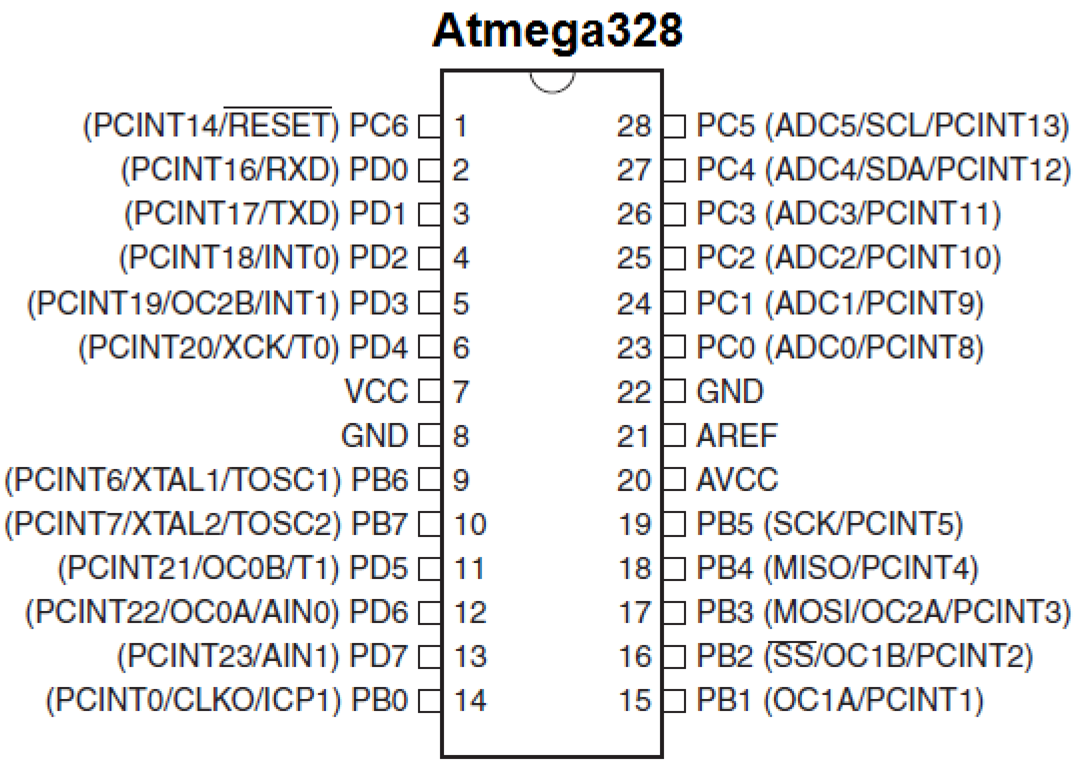


Figure: - ATmega328P Microcontroller

The table below gives a description for each of the pins, along with their function.

Pin Number	Description	Function
1	PC6	Reset
2	PD0	Digital Pin (RX)
3	PD1	Digital Pin (TX)
4	PD2	Digital Pin
5	PD3	Digital Pin (PWM)
6	PD4	Digital Pin
7	Vcc	Positive Voltage (Power)
8	GND	Ground
9	XTAL 1	Crystal Oscillator
10	XTAL 2	Crystal Oscillator
11	PD5	Digital Pin (PWM)
12	PD6	Digital Pin (PWM)
13	PD7	Digital Pin
14	PB0	Digital Pin
15	PB1	Digital Pin (PWM)
16	PB2	Digital Pin (PWM)
17	PB3	Digital Pin (PWM)

18	PB4	Digital Pin
19	PB5	Digital Pin
20	AVcc	Positive voltage for ADC (power)
21	Aref	Reference Voltage
22	GND	Ground
23	PC0	Analog Input
24	PC1	Analog Input
25	PC2	Analog Input
26	PC3	Analog Input
27	PC4	Analog Input
28	PC5	Analog Input

Conclusion: Thus we have studied of Raspberry-Pi/ Beagle board/ Arduino and other microcontroller

Lab Assignment No.	2
Title	Study of different operating systems for Raspberry-Pi /Beagle board/Arduino. Understanding the process of OS installation
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 02

Title: Study of different operating systems for Raspberry-Pi /Beagle board/Arduino.

Problem Statement: Study of different operating systems for Raspberry-Pi /Beagle board/Arduino. Understanding the process of OS installation

Objective:

- Study of different operating systems for Raspberry-Pi /Beagle board/Arduino.
- Understanding the process of OS installation on Raspberry-Pi /Beagle board/Arduino.

Theory:

1. **Raspberry-Pi: -**

The Pi can run the official Raspbian OS, Ubuntu Mate, Snappy Ubuntu Core, the Kodibased media centers OSMC and LibreElec, the non-Linux based Risc OS (one for fans of 1990s Acorn computers). It can also run Windows 10 IoT Core, which is very different to the desktop version of Windows, as mentioned below.

OS which install on Raspberry-Pi:

- Raspbian,
- Ubuntu MATE,
- Snappy Ubuntu,
- Pidora,
- Linutop,
- SARPi,
- Arch Linux ARM,
- Gentoo Linux, etc.

How to install Raspbian on Raspberry-Pi:

- **Step 1:** Download Raspbian
- **Step 2:** Unzip the file. The Raspbian disc image is compressed, so you'll need to unzip it. The file uses the ZIP64 format, so depending on how current your built-in utilities are, you need to use certain programs to unzip it.
- **Step 3:** Write the disc image to your microSD card. Next, pop your microSD card into your computer and write the disc image to it. The process of actually writing the image will be slightly different across these programs, but it's pretty self-explanatory no matter what you're using. Each of these programs will have you select the destination (make sure you've picked your microSD card!) and the disc image (the unzipped Raspbian file). Choose, double-check, and then hit the button to write.

- **Step 4:** Put the microSD card in your Pi and boot up. Once the disc image has been written to the microSD card, you're ready to go! Put that sucker into your Raspberry Pi, plug in the peripherals and power source, and enjoy. The current edition to Raspbian will boot directly to the desktop. Your default credentials are username pi and password raspberry.

2. **BeagleBone Black: -**

The BeagleBone Black includes a 2GB or 4GB on-board eMMC flash memory chip. It comes with the Debian distribution factory pre-installed. You can flash new operating systems including Angstrom, Ubuntu, Android, and others.

Os which install on BeagleBone Black:

- Angstrom,
- Android,
- Debian,
- Fedora,
- Buildroot,
- Gentoo,
- Nerves Erlang/OTP,
- Sabayon,
- Ubuntu,
- Yocto,
- MINIX 3

How to install Debian on BeagleBone Black:

- **Step 1:** Download Debian img.xz file.
- **Step 2:** Unzip the file.
- **Step 3:** Insert your MicroSD (uSD) card into the proper slot. Most uSD cards come with a full-sized SD card that is really just an adapter. If this is what you have then insert the uSD into the adapter, then into your card reader.
- **Step 4:** Now open Win32 Disk imager, click the blue folder icon, navigate to the debian img location, and double click the file. Now click Write and let the process complete. Depending on your processor and available RAM it should be done in around 5 minutes.
- **Step 5:** Alright, once that's done, you'll get a notification pop-up. Now we're ready to get going. Remove the SD adapter from the card slot, remove the uSD card from the adapter. With the USB cable disconnected insert the uSD into the BBB.
- **Step 6:** Now, this next part is pretty straight forward. Plug the USB cable in and wait some more. If everything is going right you will notice that the four (4) leds just above the USB cable are doing the KIT impression. This could take up to 45 minutes, I just did it again in around 5 minutes. Your mileage will vary. Go back and surf reddit some more.
- **Step 7:** If you are not seeing the leds swing back and forth you will need to unplug the USB cable, press and hold down the user button above the uSD card slot (next to the 2 little 10 pin ICs) then plug in the USB cable. Release the button and wait. You should see the LEDs swinging back and forth after a few seconds. Once this happens it's waiting time. When all 4 LEDs next to the USB slot stay lit at the same time the flash process has been completed.

- **Step 8:** Remove the uSD card and reboot your BBB. You can reboot the BBB by removing and reconnecting the USB cable, or hitting the reset button above the USB cable near the edge of the board.
- **Step 9:** Now using putty, or your SSH flavor of choice, connect to the BBB using the IP address 192.168.7.2. You'll be prompted for a username. Type root and press Enter. By default, there is no root password. I recommend changing this ASAP if you plan on putting your BBB on the network. To do this type password, hit enter, then enter your desired password. You will be prompted to enter it again to verify.

3. **Arduino: -**

The Arduino itself has no real operating system. You develop code for the Arduino using the Arduino IDE which you can download from Arduino - Home. Versions are available for **Windows**, **Mac** and **Linux**. The Arduino is a constrained microcontroller.
Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, **used** to write and upload computer code to the physical board. You are literally writing the "firmware" when you write the code and upload it. It's both good and its bad.

Conclusion: Thus, we have studied of how to install operating systems for platforms such as Raspberry-Pi/Beagle board/Arduino.

Lab Assignment No.	3
Title	Study of different GATES (AND, OR, XOR), Sensors and basic binary operations.
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 03

Title: Study of different GATES (AND, OR, XOR), Sensors and basic binary operations.

Problem Statement: Study of different GATES (AND, OR, XOR), Sensors and basic binary operations.

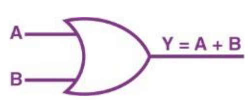
Objective:

- Study of different GATES (AND, OR, XOR),
- Study of different Sensors
- Study of different basic binary operations.

Theory:

1. **Basic Logic Gates:**
   Logic gates are an important concept if you are studying electronics. These are important digital devices that are mainly based on the Boolean function. Logic gates are used to carry out logical operations on single or multiple binary inputs and give one binary output. In simple terms, logic gates are the electronic circuits in a digital system.

   Types of Basic Logic Gates:
   There are several basic logic gates used in performing operations in digital systems. The common ones are:
   - **OR Gate:**
     In OR gate the output of an OR gate attains the state 1 if one or more inputs attain the state 1.

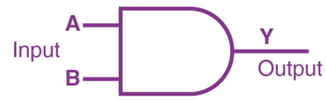


The Boolean expression of OR gate is Y = A + B, read as Y equals A 'OR' B.

The truth table of a two-input OR basic gate is given as;

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

- **AND Gate:**
  In AND gate the output of an AND gate attains the state 1 if and only if all the inputs are in state 1.

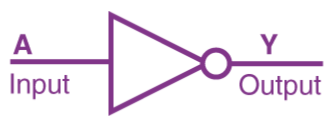


The Boolean expression of AND gate is Y = A.B

The truth table of a two-input AND basic gate is given as;

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

- **NOT Gate:**
  In NOT gate the output of a NOT gate attains the state 1 if and only if the input does not attain the state 1.

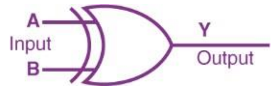


The Boolean expression is Y = \bar{A}$\bar{A}$, read as Y equals NOT A.

The truth table of NOT gate is as follows;

A	Y
0	1
1	0

- **XOR Gate:**
  In XOR gate the output of a two-input XOR gate attains the state 1 if one adds only input attains the state 1.



The Boolean expression of the XOR gate is $A.\bar{B}+\bar{A}.B$ or $Y = A \oplus B$

The truth table of an XOR gate is;

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

2. **Basic binary operations:**

Binary operations such as binary addition, binary subtraction, binary multiplication and binary division are calculated similarly as the arithmetic operations are calculated in numerals. These are four types of binary operations namely

- **Binary Addition**

The result obtained after adding two binary numbers is the binary number itself. Binary addition is the simplest method to add any of the binary numbers. It can be calculated easily if we know the following rules.
Rules

- 0 + 0 = 0
- 0 + 1 = 1
- 1 + 0 = 1
- 1 + 1 =10

Let us take any two binary numbers and add them.
Add: 10001 + 11101 = 101110

- **Binary Subtraction**

The result obtained after subtracting two binary numbers is the binary number itself. Binary subtraction is also the simplest method to subtract any of the binary numbers. It can be calculated easily if we know the following rules.
Rules

- 0 – 0 = 0
- 0 – 1 = 1 (with a borrow of 1)
- 1 – 0 = 1
- 1 – 1 = 0

Let us take any two binary numbers and subtract them.

- **Binary Multiplication**

The binary multiplications are calculated similarly as the other arithmetics numerals are calculated. Let us take any two binary numbers and multiply them.It can be calculated easily if we know the following rules.

Rules

- 0 × 0 = 0
- 0 × 1 = 0
- 1 × 0 = 0
- 1 × 1 = 1

Example

1101 * 1010 = 10000010

- **Binary Division**

The method of binary division is similar to the 10 decimal system other than the base 2 system. It can be calculated easily if we know the following rules.

- 1 ÷ 1=1
- 1 ÷ 0 =0
- 0 ÷ 1 = Meaningless
- 0 ÷ 0= Meaningless

3. Sensors:

The Internet of Things (IoT) offers great potential to change the way in which systems function and businesses operate – providing not only a leap in automation but deep visibility driven by the massive amounts of data that can be collected, analyzed, reported, and acted upon – often without the need for human interaction or involvement.

The ability to efficiently collect data starts with the use of sensors. Sensors are devices that respond to inputs from the physical world and then take those inputs and display them, transmit them for additional processing, or use them in conjunction with artificial intelligence to make decisions or adjust operating conditions. As applied to an Industrial Internet of Things, data collected from sensors is used to help business owners and managers make intelligent decisions about their operations, and help clients and users more efficiently use that business' products and services.

As the IoT initiative expands, more and more sensors are going to be used to monitor and collect data for analysis and processing. In this article, a review of some of the different types of sensors that will drive the data collection in the IoT initiative is presented.

IoT Sensor Types

Sensors are designed to respond to specific types of conditions in the physical world, and then generate a signal (usually electrical) that can represent the magnitude of the condition being monitored. Those conditions may be light, heat, sound, distance, pressure, or some other more specific situation, such as the presence or absence of a gas or liquid. The common IoT sensors that will be employed include:

- Temperature sensors
- Pressure sensors
- Motion sensors
- Level sensors
- Image sensors
- Proximity sensors
- Water quality sensors
- Chemical sensors
- Gas sensors
- Smoke sensors
- Infrared (IR) sensors
- Acceleration sensors
- Gyroscopic sensors
- Humidity sensors
- Optical sensors

A description of each of these sensors is provided below.

- **Temperature sensors**

Temperature sensors detect the temperature of the air or a physical object and concert that temperature level into an electrical signal that can be calibrated accurately reflect the measured temperature. These sensors could monitor the temperature of the soil to help with agricultural output or the temperature of a bearing operating in a critical piece of equipment to sense when it might be overheating or nearing the point of failure.

- **Pressure sensors**

Pressure sensors measure the pressure or force per unit area applied to the sensor and can detect things such as atmospheric pressure, the pressure of a stored gas or liquid in a sealed system such as tank or pressure vessel, or the weight of an object.

- **Motion sensors**

Motion sensors or detectors can sense the movement of a physical object by using any one of several technologies, including passive infrared (PIR), microwave detection, or ultrasonic, which uses sound to detect objects. These sensors can be used in security and intrusion detection systems, but can also be used to automate the control of doors, sinks, air conditioning and heating, or other systems.

- **Level sensors**

Level sensors translate the level of a liquid relative to a benchmark normal value into a signal. Fuel gauges display the level of fuel in a vehicle's tank, as an example, which provides a continuous level reading. There are also point level sensors, which are a go-no/go or digital representation of the level of the liquid. Some automobiles have a light that illuminates when the fuel level tank is very close to empty, acting as an alarm that warns the driver that fuel is about to run out completely.

- **Image sensors**

Image sensors function to capture images to be digitally stored for processing. License plate readers are an example, as well as facial recognition systems. Automated production lines can use image sensors to detect issues with quality such as how well a surface is painted after leaving the spray booth.

- **Proximity sensors**

Proximity sensors can detect the presence or absence of objects that approach the sensor through a variety of different technology designs. These approaches include:

  - Inductive technologies which are useful for the detection of metal objects
  - Capacitive technologies, which function on the basis of objects having a different dielectric constant than that of air
  - Photoelectric technologies, which rely on a beam of light to illuminate and reflect back from an object, or
  - Ultrasonic technologies, which use a sound signal to detect an object nearing the sensor

- **Water quality sensors**

The importance of water to human beings on earth not only for drinking but as a key ingredient needed in many production processes dictates the need to be able to sense and measure parameters around water quality. Some examples of what is sensed and monitored include:

  - chemical presence (such as chlorine levels or fluoride levels)
  - oxygen levels (which may impact the growth of algae and bacteria)
  - electrical conductivity (which can indicate the level of ions present in water)
  - pH level (a reflection of the relative acidity or alkalinity of the water)
  - turbidity levels (a measurement of the amount of suspended solids in water)

- **Chemical sensors**

Chemical sensors are designed to detect the presence of specific chemical substances which may have inadvertently leaked from their containers into spaces that are occupied by personnel and are useful in controlling industrial process conditions.

- **Gas sensors**

Related to chemical sensors, gas sensors are tuned to detect the presence of combustible, toxic, or flammable gas in the vicinity of the sensor.

- **Smoke sensors**

Smoke sensors or detectors pick up the presence of smoke conditions which could be an indication of a fire typically using optical sensors (photoelectric detection) or ionization detection.

- **Infrared (IR) sensors**

Infrared sensor technologies detect infrared radiation that is emitted by objects. Non-contact thermometers make use of these types of sensors as a way of measuring the temperature of an object without having to directly place a probe or sensor on that object. They find use in analyzing the heat signature of electronics and detecting blood flow or blood pressure in patients.

- **Acceleration sensors**

While motion sensors detect movement of an object, acceleration sensors, or accelerometers as they are also known, detect the rate of change of velocity of an object. This change may be due to a free-fall condition, a sudden vibration that is causing movement with speed changes, or rotational motion (a directional change).

- **Gyroscopic sensors**

Gyroscopes or gyroscopic sensors are used to measure the rotation of an object and determine the rate of its movement called the angular velocity, using a 3-axis system. These sensors enable the determination of the object's orientation without having to visibly observe it.

- **Humidity sensors**

Humidity sensors can detect the relative humidity of the air or other gas, which is a measure of the amount of water vapor contained in that gas. Controlling environmental conditions is critical in the production processes of materials and humidity sensors enable readings to be taken and changes made to mitigate increasing or decreasing levels. A common application is in HVAC systems to maintain desired comfort levels.

- **Optical sensors**

Optical sensors respond to light that is reflected off of an object and generate a corresponding electrical signal for use in detecting or measuring a condition. These sensors work by either sensing the interruption of a beam of light or its reflection caused by the presence of the object.

Conclusion: Thus, we have studied different GATES (AND, OR, XOR), Sensors and basic binary operations

Lab Assignment No.	4
Title	Study of Connectivity and configuration of Raspberry-Pi /Beagle board/Arduino circuit with basic peripherals like LEDS. Understanding GPIO and its use in the program.
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 04

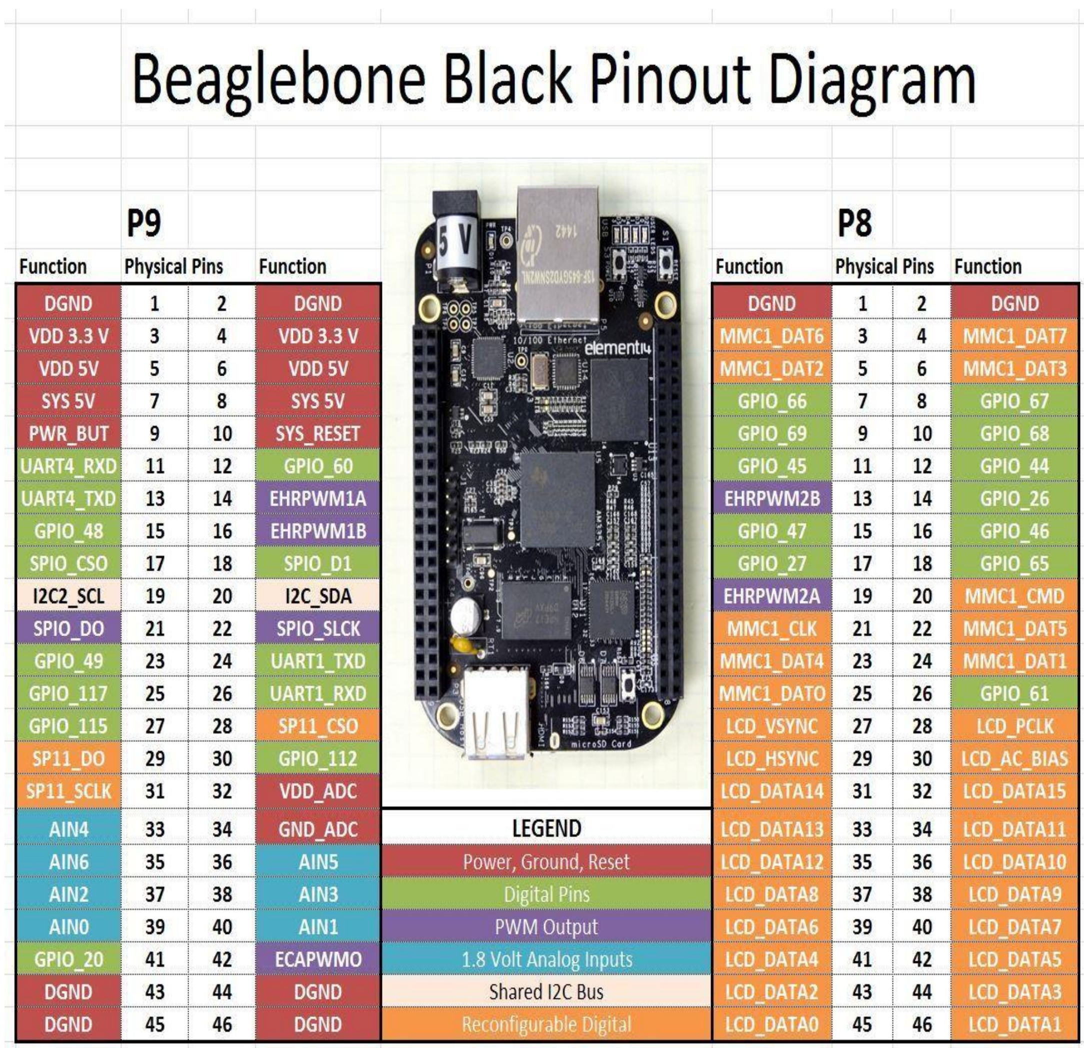
Title: Study of Connectivity and configuration of Raspberry-Pi /Beagle board/Arduino circuit with basic peripherals like LEDS.

Problem Statement: Study of Connectivity and configuration of Raspberry-Pi /Beagle board/Arduino circuit with basic peripherals like LEDS. Understanding GPIO and its use in the program.

Objective:

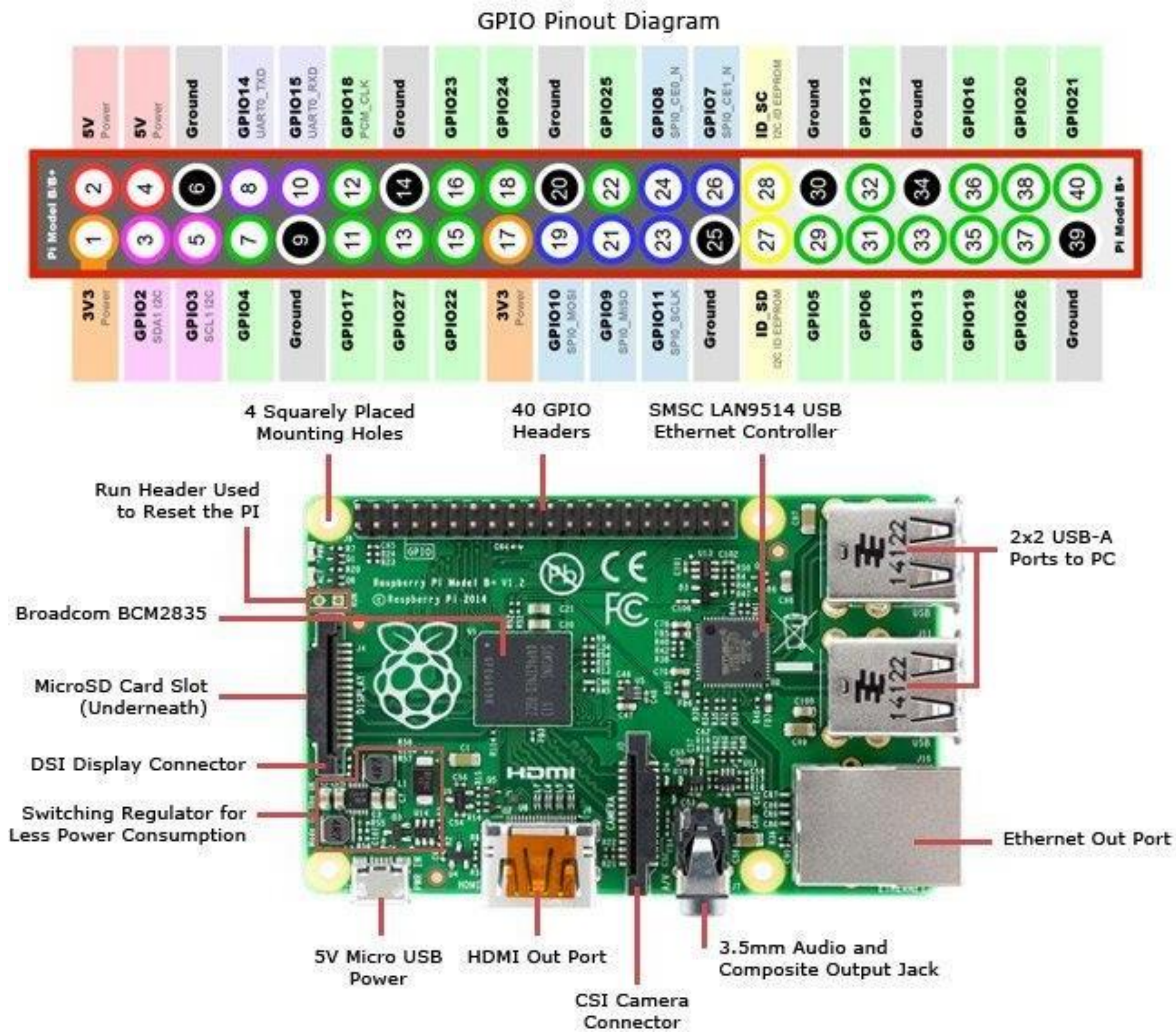
- Study of Connectivity and configuration of Raspberry-Pi /Beagle board/Arduino circuit with basic peripherals like LEDS.
- Understanding GPIO and its use in the program.

Theory:



You can see that the Beaglebone has a large number of pins. There are two headers. Make sure you orient your Beaglebone n the same direction as mine in the picture, with the five volt plug on the top. In this orientation, the pin header on the left is referred to as “P9” and the pin header on the right is referred to as “P8”. The legend in the diagram above shows the functions, or the possible functions of the various pins. First, we have shaded in red the various 5V, 3.3V, 1.8V and ground pins. Note that VDD_ADC is a 1.8 Volt supply and is used to provide a reference for Analog Read functions. The general purpose GPIO pins have been shaded in green. Note some of these green pins can also be used for UART serial communication. If you want to simulate analog output, between 0 and 3.3 volts, you can use the PWM pins shaded in purple. The light blue pins can be used as analog in. Please note that the Analog In reads between 0 and 1.8 volts. You should not allow these pins to see higher voltages that 1.8 volts. When using these pins, use pins 32 and 34 as your voltage reference and ground, as pin 32 outputs a handy 1.8 volts. The pins shaded in light orange can be used for I2C. The dark orange pins are primarily used for LCD screen applications.

Raspberry Pi 3 Model B Pin Diagram

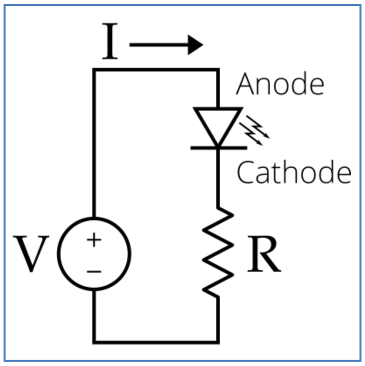


Basic Peripherals

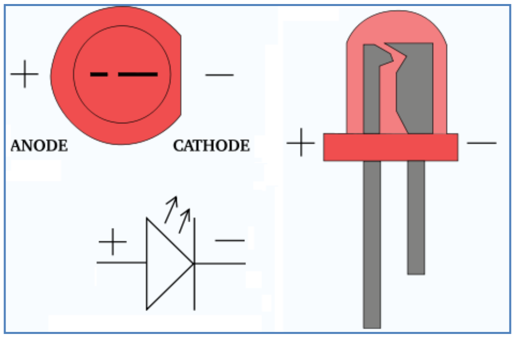
1. LED

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current is passed through it. Light is produced when the particles that carry the current (known as electrons and holes) combine together within the semiconductor material.

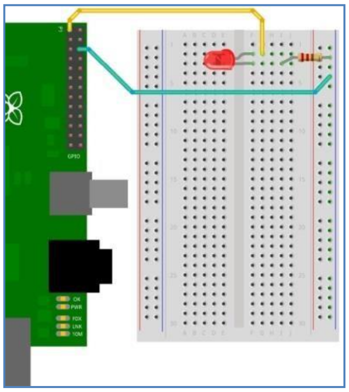
Since light is generated within the solid semiconductor material, LEDs are described as solid-state devices. The term solid-state lighting, which also encompasses organic LEDs (OLEDs), distinguishes this lighting technology from other sources that use heated filaments (incandescent and tungsten halogen lamps) or gas discharge (fluorescent lamps).



LED Circuit Diagram



LED Symbol



LED Connection with Raspberry pi

Program to Glow LED

- LED has two pins one is positive (long end) and one is negative(small end)
- Connect positive end to GPIO pin p8 10 of beaglebone or pin 17 of raspberry pi using jumper cable

- Connect negative end to any GND pin on beaglebone or raspberry pi as shown in diagram.
- Once connection is done run python code led.py

 # led.py for Beaglebone black where led is connected to pin p8 10

```
import Adafruit_BBIO.GPIO as GPIO
import time

GPIO.setup("P8_10", GPIO.OUT)

while True:
    GPIO.output("P8_10", GPIO.HIGH)
    time.sleep(0.5)
    GPIO.output("P8_10", GPIO.LOW)
   time.sleep(0.5)
```

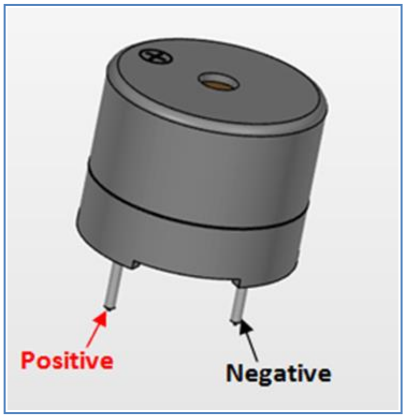
or

#led.py for Raspberry pi where led is connected to pin 17

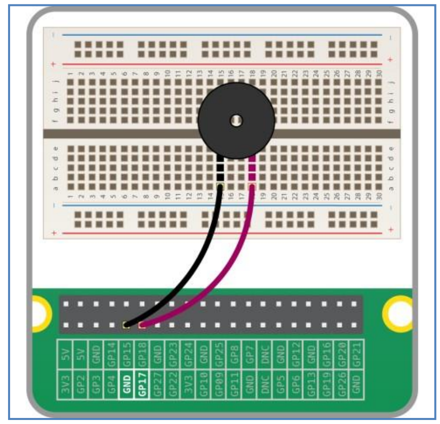
```
import RPi.GPIO as GPIO
import time
GPIO.setmode(GPIO.BCM)
GPIO.setup(17,GPIO.OUT)
try:

        while True:
                GPIO.output(17,True)
                time.sleep(2)
                GPIO.output(17,False)
                time.sleep(2)
except KeyboardInterrupt:
        GPIO.cleanup()
```

3. Buzzer

A buzzer is an electrical device that is used to make a buzzing sound.



Buzzer



Buzzer Connected to Raspberry pi

Program to ON/OFF Buzzer

- Buzzer has two pins one is positive (long end) and one is negative(small end)
- Connect positive end to GPIO pin 17 of raspberry pi using jumper cable
- Connect negative end to any GND pin of raspberry pi as shown in diagram.
- Once connection is done run python code buzzer.py

#buzzer.py

```
import RPi.GPIO as GPIO
import time
GPIO.setmode(GPIO.BOARD)
GPIO.setup(17,GPIO.OUT)
try:
    while True:
        GPIO.output(17,True)
        time.sleep(2)
        GPIO.output(17,False)
        time.sleep(2)
except KeyboardInterrupt:
    GPIO.cleanup()
```

2. IR Sensor

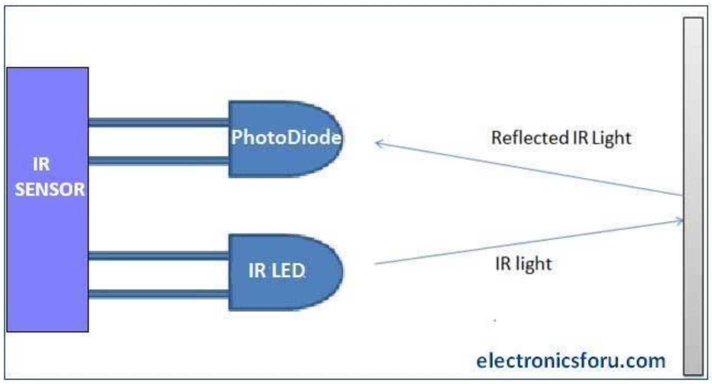
An IR sensor is a device that detects IR radiation falling on it. Proximity sensors (used in touchscreen phones and edge avoiding robots), contrast sensors (used in line following robots) and obstruction counters/sensors (used for counting goods and in burglar alarms) are some applications involving IR sensors.

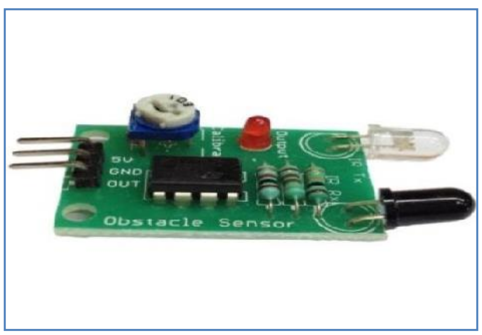
Principle of Working

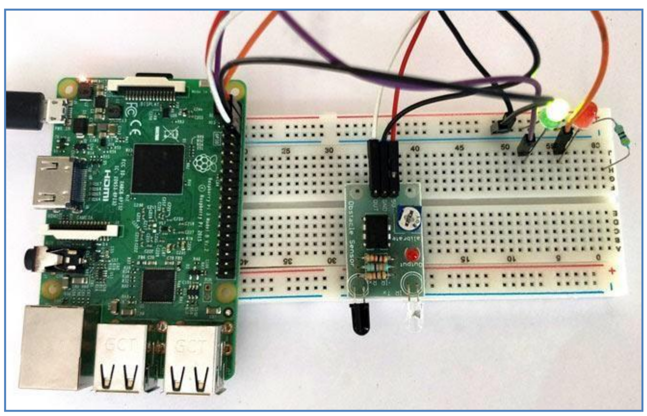
An IR sensor consists of two parts, the emitter circuit and the receiver circuit. This is collectively known as a photo-coupler or an optocoupler.

The emitter is an IR LED and the detector is an IR photodiode. The IR phototdiode is sensitive to the IR light emitted by an IR LED. The photo-diode's resistance and output voltage change in proportion to the IR light received. This is the underlying working principle of the IR sensor.

The type of incidence can be direct incidence or indirect incidence. In direct incidence, the IR LED is placed in front of a photodiode with no obstacle in between. In indirect incidence, both the diodes are placed side by side with an opaque object in front of the sensor. The light from the IR LED hits the opaque surface and reflects back to the photodiode.







IR Sensor **IR connected to Raspberry pi**

Program for IR Sensor

- Connect IR Sensor on breadboard.
- IR sensor has three pins: VCC, GND and Data.
- Connect VCC and GND pins to any VCC pin and GND pin of raspberry pi
- Connect data pin to 37 GPIO pin of raspberry pi.
- Once connection is done run IR.py code

#IR.py

```
import RPi.GPIO as GPIO
import time
GPIO.setmode(GPIO.BOARD)
GPIO.setup(37,GPIO.IN)#IR or PIR
try:
	while(True):
		if (GPIO.input(37)==1):
			print("IR Detected")
		else:
			print("IR not detected")
except:
	GPIO.cleanup()
```

Conclusion: Thus we have studied, connectivity and configuration of Raspberry-Pi with basic peripherals, LEDS, buzzer and IR understanding GPIO and its use in program.

Lab Assignment No.	5
Title	Write a program using Raspberry-Pi to control LED (One or moreON/OFF). Or Blinking
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 05

Title: Write a program using Raspberry-Pi to control LED (One or more ON/OFF). Or Blinking

Problem Statement: To blink a LED using Raspberry-Pi

Objective:

- blinks the on-board LED

Theory:

Apparatus: Raspberry-Pi board, Micro-IoT sensor actuator board, Power adaptor,Ethernet cabel.

Interface: LED	Pin
LED 1	LED(7)
LED 2	LED(22)
LED 3	LED(23)
LED 4	LED(25)

Procedure:

Step 1: Connect the Raspberry-Pi board to the Micro-IoT Sensor board using the FRC cable provided with the board.

Step 2: Connect the keyboard,mouse,monitor, Power supply adaptor and power on the circuit.

Step 3: Open Python IDLE and write a program for LED blinking using the above pins.

Step 4: Run the program

Step 5: When successfully the code will start running and you can observe the LED's blinking on the board.

Conclusion: You can observe the LED's turning ON and OFF. You can also change the delay and see the changes.

Lab Assignment No.	6
Title	Create a program that illuminates the green LED if the counter is less than 100, illuminates the yellow LED if the counter is between 101 and 200 and illuminates the red LED if the counter is greater than 200
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 06

Title: Create a program that illuminates the green LED if the counter is less than 100, illuminates the yellow LED if the counter is between 101 and 200 and illuminates the red LED if the counter is greater than 200

Problem Statement:

Objective:

- Illumination of LED as per counter value

Theory:

Apparatus: Raspberry-Pi board, Micro-IoT sensor actuator board, Power adaptor.

Interface: LED	**Pin**
LED 1	7
LED 2	22
LED 3	23

Procedure:
Step 1: Connect the Raspberry-Pi board to the Micro-IoT Sensor board using the FRC cable provided with the board.
Step 2: Connect the keyboard,mouse,monitor, Power supply adaptor and power on the circuit.
Step 3: Open Python IDLE and write a program for Illumination of LED as per counter value using the above pins.

Step 4: Run the program

Step 5: When successfully the code will start running and you can observe the LED's getting illuminated after the count is changed on the board.

Conclusion: You can observe the LED's turning ON after the specific counter has expired.

Lab Assignment No.	7
Title	Create a program so that when the user enters ‘b’ the green light blinks, ‘g’ the green light is illuminated ‘y’ the yellow light is illuminated and ‘r’ the red light is illuminated
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 07

Title: Create a program so that when the user enters ‘b’ the green light blinks, ‘g’ the green light is illuminated ‘y’ the yellow light is illuminated and ‘r’ the red light is illuminated

Problem Statement: To create a program so that when the user enters ‘b’ the green light blinks, ‘g’ the green light is illuminated, ‘y’ the yellow light is illuminated and ‘r’ the red light is illuminated using Raspberry-Pi.

Objective:

- Illumination of LED using keyboard

Theory:

Apparatus: Raspberry-Pi board, Micro-IoT sensor actuator board, Power adaptor.
Interface:

LED	Pin
LED 1	7
LED 2	22
LED 3	23
LED 4	25

Procedure:
Step 1: Connect the Raspberry-Pi board to the Micro-IoT Sensor board using the FRC cable provided with teboard.
Step 2: Connect the keyboard, mouse,monitor, Power supply adaptor and power on the circuit.
Step 3: Open Python IDLE and write a program for Illumination of LED as per user value
Using the above pins.

Step 4: Run the program

Step 5: When successfully the code will start running and you can observe the LED’s getting illuminated when the user enters ‘b’ the green light blinks, ‘g’ the green light is illuminated, ‘y’ the yellow light is illuminated and ‘r’ the red light is illuminated using Raspberry-Pi.

.

Conclusion: You can observe that when the user enters ‘b’ the green LED blinks, when the user enters ‘g’ the green light is turned ON, when the user enters ‘y’ the yellow LED is ON and when the user enters ‘r’ the red LED in ON.

Lab Assignment No.	8
Title	Write a program that asks the user for a number and outputs the number squared that is entered
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 08

Title: Write a program that asks the user for a number and outputs the number squared that is entered

Problem Statement: To calculate the square of the number given by the user, using Raspberry-Pi.

Objective:

- Square the number

Theory:

Apparatus: raspberry-Pi board, Micro-IoT sensor actuator board, Power adaptor.

Procedure:
Step 1: Connect the Raspberry-Pi board to the Micro-IoT Sensor board using the FRC cable provided with theboard.
Step 2: Connect the keyboard, mouse,monitor, Power supply adaptor and power on the circuit.
Step 3: Open Python IDLE and write a program to calculate the square of the number given by the user, using Raspberry-Pi

Step 4: Run the program

Step 5: We observe the square of number given by the user

Conclusion: When the program RUNs it prompts the user to input a number. Type (input) a number and observe that the program calculates and gives the square of the input number as output on the serial monitor.

Lab Assignment No.	9
Title	Write a program to control the color of the LED by turning 3 different potentiometers. One will be read for the value of Red, one for the value of Green, and one for the value of Blue
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 09

Title: Write a program to control the color of the LED by turning 3 different potentiometers. One will be read for the value of Red, one for the value of Green, and one for the value of Blue

Problem Statement: To change the color of the RGB LED using the input from 3 different potentiometers, using Arduino.

Objective:

- Control LED using potentiometer

Theory:

Apparatus: Arduino Uno board, Micro-IoT sensor actuator board, Power adaptor.
Interface:

Peripheral	Arduino Pin
RGB_red	5
RGB_green	6
RGB_blue	3
POT_red	A0
POT_green	A2
POT_blue	A3

Procedure:
Step 1: Connect the Arduino board to the Micro-IoT Sensor board using the FRC cable provided with the board.
Step 2: Connect the Power supply adaptor and power on the circuit.
Step 3: Open Arduino IDE and create a new sketch (program) using the above pins.
Step 4: In the Arduino IDE go to tools→Port and select the appropriate COM port.
Step 5: In the Arduino IDE click on the upload button () to compile and download the code into the Arduino UNO. When successfully downloaded the code will start running.
Step 6: change the Potentiometers Pot_P1, Pot_p2 and Pot_P3 and observe the colour change in the RGB LED.

Conclusion: When you change the value of Potentiometers P1, P2 and P3, we can observe that the corresponding color on the RGB led changes in intensity. Using all the 3 potentiometers we can see the whole spectrum of the color space.

Lab Assignment No.	10
Title	Write a program read the temperature sensor and send the values to the serial monitor on the computer
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 10

Title: Write a program read the temperature sensor and send the values to the serial monitor on the computer

Problem Statement: Read the temperature sensor and send the values to the serial monitor, using Arduino.

Objective:

- Study of temperature sensor
- Measure temperature using serial monitor

Theory:

Apparatus: Arduino Uno board, Micro-IoT sensor actuator board, Power adaptor.

Interface: Peripheral	Arduino Pin
LM35	A0

Procedure:
Step 1: Connect the Arduino board to the Micro-IoT Sensor board using the FRC cable provided with the board.
Step 2: Connect the Power supply adaptor and power on the circuit.
Step 3: Open Arduino IDE and create a new sketch (program) using the above pins.
Step 4: In the Arduino IDE go to tools→Port and select the appropriate COM port.
Step 5: In the Arduino IDE click on the upload button ( ) to compile and download the code into the Arduino UNO. When successfully downloaded the code will start running.
Step 6: Open the Serial Monitor in Arduino IDE Tools→Serial Monitor and observe the values of the temperature sensor.

Conclusion: The LM35 sensor is an analog sensor which outputs a voltage corresponding to the temperature. For every 1 degree the sensor outputs 10 mv voltage. E.g for 30 degrees it will give a voltage of 300 mv. We can sense this voltage using Arduino and convert it back to show the temperature.

Lab Assignment No.	11
Title	Write a program so it displays the temperature in Fahrenheit as well as the maximum and minimum temperatures it has seen
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 11

Title: Write a program so it displays the temperature in Fahrenheit as well as the maximum and minimum temperatures it has seen

Problem Statement: Read the temperature sensor LM35 and show the values in Fahrenheit using Arduino.

Objective:

- Read the temperature in Fahrenheit

Theory:

Apparatus: Arduino Uno board, Micro-IoT sensor actuator board, Power adaptor.

Interface: Peripheral	Arduino Pin
LM35	A0

Procedure:

Step 1: Connect the Arduino board to the Micro-IoT Sensor board using the FRC cable provided with the board.

Step 2: Connect the Power supply adaptor and power on the circuit.

Step 3: Open Arduino IDE and create a new sketch (program) using the above pins.

Step 4: In the Arduino IDE go to tools→Port and select the appropriate COM port.

Step 5: In the Arduino IDE click on the upload button () to compile and download the code into the Arduino UNO. When successfully downloaded the code will start running.

Step 6: Open the Serial Monitor in Arduino IDE Tools→Serial Monitor and observe the values of the temperature sensor.

Conclusion: The LM35 sensor is an analog sensor which outputs a voltage corresponding to the temperature. For every 1 degree the sensor outputs 10 mv voltage. E.g for 30 degrees it will give a voltage of 300 mv. We can sense this voltage using Arduino and convert it back to show the temperature.

Lab Assignment No.	12
Title	Write a program to show the temperature and shows a graph of the recent measurements
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 12

Title: Write a program to show the temperature and shows a graph of the recent measurements

Problem Statement: Read the temperature sensor LM35 and show the values on a graph using Arduino.

Objective:

- Read the temperature and generate the graph

Theory:

Apparatus: Arduino Uno board, Micro-IoT sensor actuator board, Power adaptor.

Interface:

Serial Plotter Peripheral	Arduino Pin
LM35	A0

Procedure:

Step 1: Connect the Arduino board to the Micro-IoT Sensor board using the FRC cable provided with the board.

Step 2: Connect the Power supply adaptor and power on the circuit.

Step 3: Open Arduino IDE and create a new sketch (program) using the above pins.

Step 4: In the Arduino IDE go to tools→Port and select the appropriate COM port.

Step 5: In the Arduino IDE click on the upload button () to compile and download the code into the Arduino UNO. When successfully downloaded the code will start running.

Step 6: Open the Serial Monitor in Arduino IDE Tools→Serial Plotter and observe the graph of values from the temperature sensor.

Conclusion: When you output the values using ***serial.println()*** function and use the serial plotter the plotter will plot the graph of the values.

Lab Assignment No.	13
Title	Write a program using piezo element and use it to play a tune after someone knocks
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 13

Title: Write a program using piezo element and use it to play a tune after someone knocks

Problem Statement: Detect a knock and play a tune using a Piezo element, using Arduino.

Objective:

- Interfacing of piezo element

Theory:

Apparatus: Arduino Uno board, Micro-IoT sensor actuator board, Power adaptor.

Interface: Peripheral	Arduino Pin
Piezo Element	A1

Procedure:

Step 1: Connect the Arduino board to the Micro-IoT Sensor board using the FRC cable provided with the board.

Step 2: Connect the Power supply adaptor and power on the circuit.

Step 3: Open Arduino IDE and create a new sketch (program) using the above pins.

Step 4: In the Arduino IDE go to tools→Port and select the appropriate COM port.

Step 5: In the Arduino IDE click on the upload button ( ) to compile and download the code into the Arduino UNO. When successfully downloaded the code will start running.

Step 6: Tap on the piezo element and hear the tune.

Conclusion: You can use the Piezo element for both input sensing and output tone generation**.** In this experiment the user will tap the sensor and read the input values and once a certain threshold is passed can start generating a tone from the Piezo Element.

Lab Assignment No.	14
Title	Understanding the connectivity of Raspberry-Pi /Beagle board circuit / Arduino with IR sensor. Write an application to detect obstacle and notify user using LEDs
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 14

Title: Understanding the connectivity of Raspberry-Pi /Beagle board circuit / Arduino with IR sensor. Write an application to detect obstacle and notify user using LEDs

Problem Statement: Detect obstacle using a IR receiver and indicate using a LED, using Arduino.

Objective:

- Understanding the connectivity of Raspberry-Pi /Beagle board circuit / Arduino with IR sensor.
- An application to detect obstacle and notify user using LEDs

Theory:

Apparatus: Arduino Uno board, Micro-IoT sensor actuator board, Power adaptor.
Interface:

Peripheral	Arduino Pin
IR Receiver	9
LED 4	4

Procedure:
Step 1: Connect the Arduino board to the Micro-IoT Sensor board using the FRC cable provided with the board.
Step 2: Connect the Power supply adaptor and power on the circuit.
Step 3: Open Arduino IDE and create a new sketch (program) using the above pins.
Step 4: In the Arduino IDE go to tools→Port and select the appropriate COM port.
Step 5: In the Arduino IDE click on the upload button () to compile and download the code into the Arduino UNO. When successfully downloaded the code will start running.
Step 6: Put an obstacle (paper, finger) between the IR transmitter and receiver and observe LED 4.

Conclusion: When an obstacle is inserted in between the IR transmitter and Receiver the state of the LED is changed.

Lab Assignment No.	15
Title	Study of ThingSpeak – an API and Web Service for the Internet of Things (Mini Project: Same can be done parallel with PBL).
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 15

Title: Study of ThingSpeak – an API and Web Service for the Internet of Things

Problem Statement: Study of ThingSpeak – an API and Web Service for the Internet of Things.

Objective:

Select random number

Theory:

Apparatus: Raspberry Pi, Micro-IoT sensor actuator Board, Power adaptor.

Procedure:

Step 1: Connect the RaspberryPi board to the Micro-IoT Sensor board using the FRC cable provided with the board.

Step 2: Connect the Power supply adaptor and power on the circuit.

Step 3: Open a terminal and create a new python program .

Step 4: Run the program python program.

Step 5: check the simulation.

Conclusion: Study of ThingSpeak – an API and Web Service for the Internet of Things.

Lab Assignment No.	16
Title	Develop a Real time application like smart home with following requirements: When the user enters into the house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is that students should construct complete Smart applications in groups
Roll No.	
Class	SE
Date of Completion	
Subject	Internet of Things Laboratory
Assessment Marks	
Assessor's Sign	

ASSIGNMENT No: 16

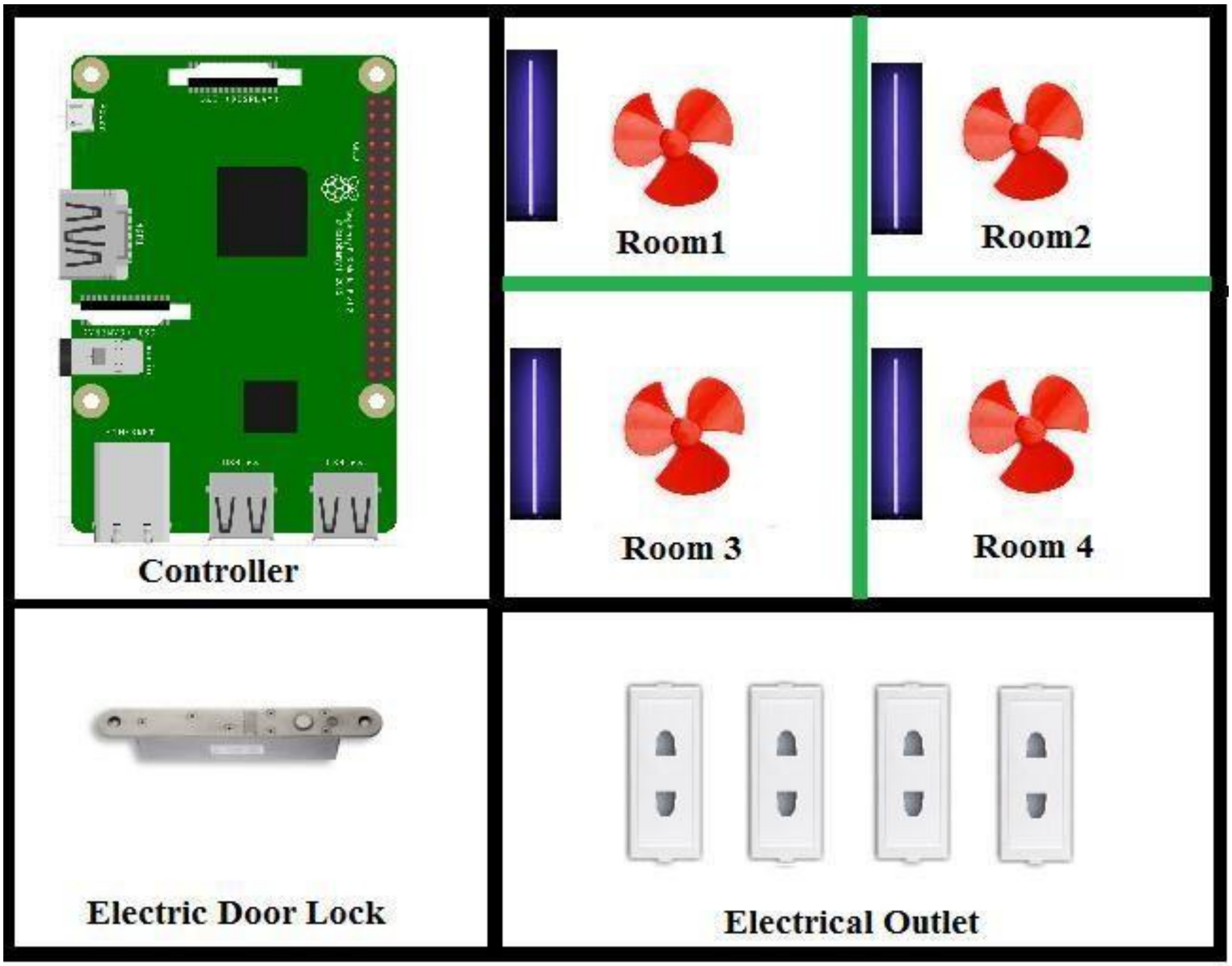
Title: Develop a Real time application like smart home with following requirements: When the user enters into the house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is that students should construct complete Smart applications in groups

Problem Statement: To control the Home Appliances using a webpage.

Objective:

- Controlling home appliances

Theory:



Apparatus: RaspberryPi, relays, power supply.
Procedure:
Step 1: Connect the RaspberryPi board to the Micro-IoT Sensor board.

Step 2: Understand the connections for the Micro-IoT Sensor board and RaspberryPi board.
Step 3: Connect the Raspberry Pi setup and write the program for interfacing relays.
Step 4: Send the files to the **/var/www/html/HomeAutomation** directory.
Step 5: open the browser on any other PC and connect to the IP address of Raspberry Pi : **e.g. //http:192.168.1.100/ HomeAutomation.**
The webpage will take instructions from the user and pass it on to the PHP page which will in-turn run shell commands to switch the Home Appliances.

Interfacing Details:

Peripherals	**RaspberryPi Pin**
Buzzer (Alarm)	GPIO 6
Relay 1- Door Latch	GPIO 7
Relay 2- Light	GPIO 12
Relay 3- Fan	GPIO 16

Conclusion: Thus you can control the Home Appliances using a webpage.