

EXPERIMENT NO. 1 (Group A)

- **Aim:** Study of Raspberry-Pi/ Beaglebone/ Arduino and other microcontroller (History & Elevation)
- **Outcome:** At end of this experiment, student will be able to study of different microcontrollers like Raspberry-Pi/ Beaglebone/ Arduino
- **Hardware Requirement:** Arduino
- **Software Requirement:** Arduino IDE

➤ **Theory:**

Internet of Things: - IoT is short for Internet of Things. The Internet of Things refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. The Internet of Things (IoT) refers to the use of intelligently connected devices and systems to leverage data gathered by embedded sensors and actuators in machines and other physical objects. In other words, the IoT (Internet of Things) can be called to any of the physical objects connected with network.

Examples of IoT: -

- 1) Apple Watch and Home Kit.
- 2) Smart Refrigerator.
- 3) Smart Refrigerator.
- 4) Smart cars.
- 5) Google Glass.
- 6) Smart thermostats.

A) 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.



Fig.A.1: - Raspberry-Pi

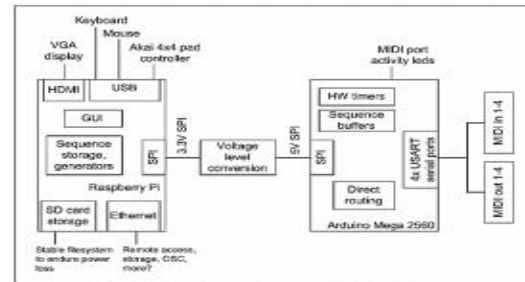


Fig. A.2: -Raspberry-Pi Architecture

Here are the various components on the Raspberry Pi board:

1. **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.
2. **GPIO** -- These are exposed general-purpose input/output connection points that will allow the real hardware hobbyists the opportunity to tinker.
3. **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.
4. **LEDs** -- Light-emitting diodes, for your entire indicator light needs.
5. **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.
6. **HDMI** -- This connector allows you to hook up a high-definition television or other compatible device using an HDMI cable.
7. **Power** -- This is a 5v Micro USB power connector into which you can plug your compatible power supply.
8. **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.
9. **Ethernet** -- This connector allows for wired network access and is only available on the Model B.

B) 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.

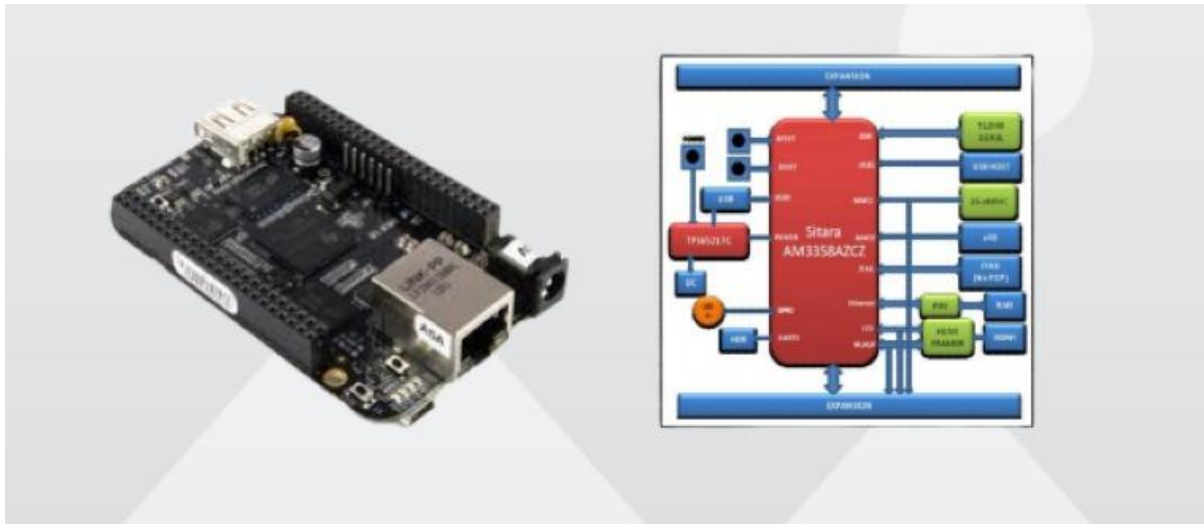


Fig.B.1:-Beagle Board Black

Fig.B.1:- 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

C) 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.

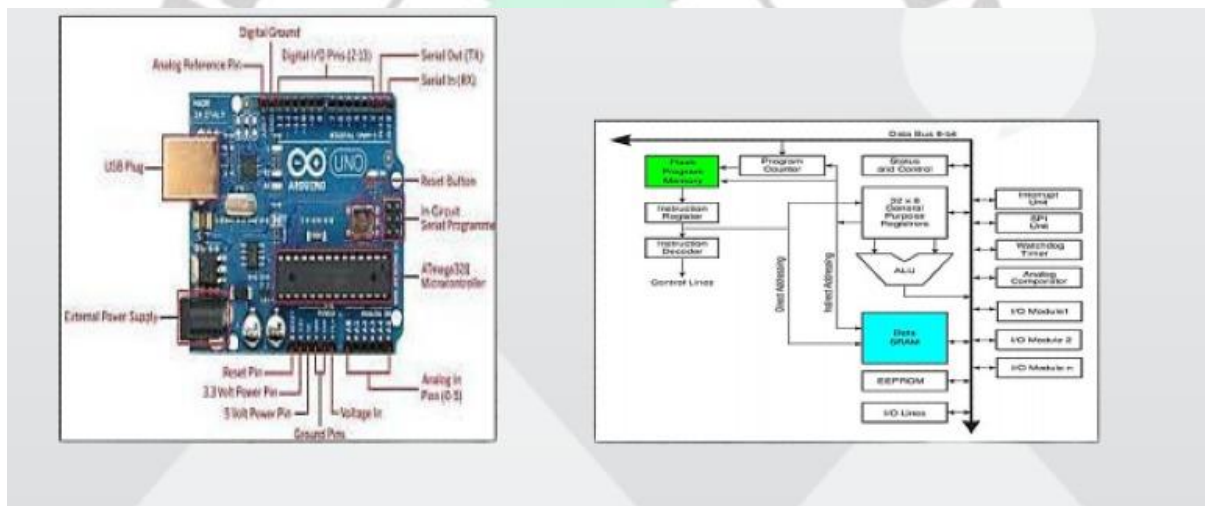


Fig.C.1:- Arduino Board

Fig.C.1:- Arduino Board Architecture

Here are the various components on the Arduino board:
Microcontrollers

1. ATmega328P (used on most recent boards)
2. ATmega168 (used on most Arduino Diecimila and early Duemilanove)
3. 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

1. AREF. Reference voltage for the analog inputs. Used with analogReference().
2. 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)
3. Digital Pins 2-13 (green)
4. 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).
5. Reset Button - S1 (dark blue)
6. In-circuit Serial Programmer (blue-green)
7. Analog In Pins 0-5 (light blue)
8. Power and Ground Pins (power: orange, grounds: light orange)
9. External Power Supply In (9-12VDC) - X1 (pink)
10. Toggles External Power and USB Power (place jumper on two pins closest to desired supply) - SV1 (purple)
11. 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)

Conclusion: -

Questions:

- Q1. Enlist and Explain different types of Arduino board ?
- Q2. What's the difference between digitalWrite() and analogWrite() in Arduino?
- Q3. Can you give me some examples of real-world applications of Arduino?
- Q4. What is the purpose of PWM in Arduino?
- Q5. What are the different components of a Raspberry pi board?
- Q6. How is Raspberry Pi different from Arduino?
- Q7. What are the generations of Raspberry Pi available?
- Q8. What is the maximum screen resolution output of Raspberry Pi?

