# *Assignment A1*

**Title**: Study Assignment

**Problem Statement:** Study of Raspberry Pi, Arduino and Beagle Bone.

**Objectives:**

- To understand and get acquainted with above microcontrollers.
- To analyze difference between them.

**Outcomes:**

- To get basic knowledge about IoT and various microcontrollers to make it work.
- To understand history of various microcontrollers.

**S/W and H/W requirements:**

- Fedora OS 20
- Raspberry Pi
- Beagle Bone
- Arduino

**Theory**:

- **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 countries.

The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It now is widely used even in research projects, such as for weather monitoring, because of its low-cost and portability. It does not include peripherals (such as keyboards and mice) or cases.

However, some accessories have been included in several official and unofficial bundles.

The organization behind the Raspberry Pi consists of two arms. The first two models were developed by the Raspberry Pi Foundation. After the Pi Model B was released, the Foundation set up Raspberry Pi Trading, with Eben Upton as CEO, to develop the third model, the B+. Raspberry Pi Trading is responsible for developing the technology while the Foundation is an educational charity to promote the teaching of basic computer science in schools and in developing countries.

According to the Raspberry Pi Foundation, more than 5 million Raspberry Pis were sold by February 2015, making it the best-selling British_computer. By November 2016 they had sold 11 million units, and 12.5 million by March 2017, making it the third best-selling "general purpose computer". In July 2017, sales reached nearly 15 million, climbing to 19 million in March 2018. By December 2019, a total of 30 million devices had been sold.

- **Beagle Bone:**

  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.

  Beagle Bone Black ships with the Debian GNU/Linux™ in onboard FLASH to start evaluation and development. Many other Linux distributions and operating systems are also supported on Beagle Bone Black including:

  - Ubuntu
  - Android
  - Fedora

  Beagle Bone Black's capabilities can be extended using plug-in boards called "capes" that can be plugged into Beagle Bone Black's two 46-pin dual-row expansion headers. Capes are available for, VGA, LCD, motor control, prototyping, battery power and other functionality.

**Features:**

Beagle Bone

- Example Applications: Robotics, motor drivers, Twitter printer, data backup, SDR base station, USB data acquisition and more
- Board size: 3.4″ x 2.1″

- DDR memory: 512 MB
- Development environment: Fully functional terminal interface directly in the browser and the ability to run Python, Ruby and INO Sketches directly in the Cloud9 IDE, in addition to JavaScript on Node.JS and in your web browser
- Ethernet: On-chip 10/100 Ethernet
- JTAG: Optional
- Memory: 4GB eMMC memory that's pre-loaded with Debian GNU/Linux™ distribution and that frees up your microSD card slot
- Power Options: Via USB or 5V DC input
- Processor: 1GHz AM3359 Sitara ARM Cortex-A8
- USB: 1-port USB 2.0 Host, 1-port USB 2.0 Client

- **Arduino:**

  Arduino is an open-source platform used for building electronics projects. 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.

  The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable.

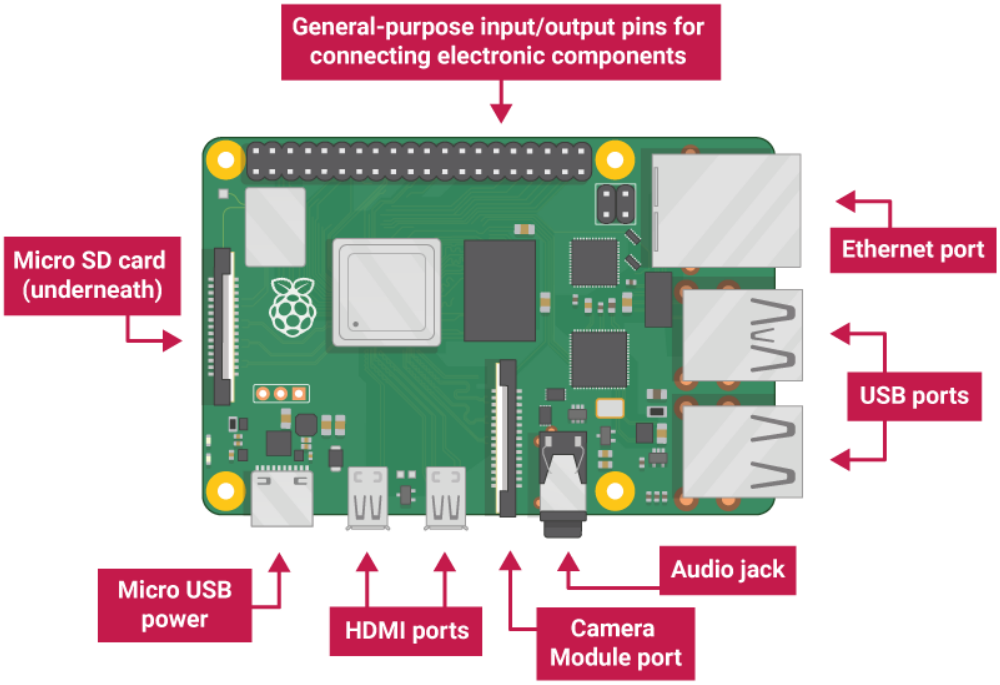
Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

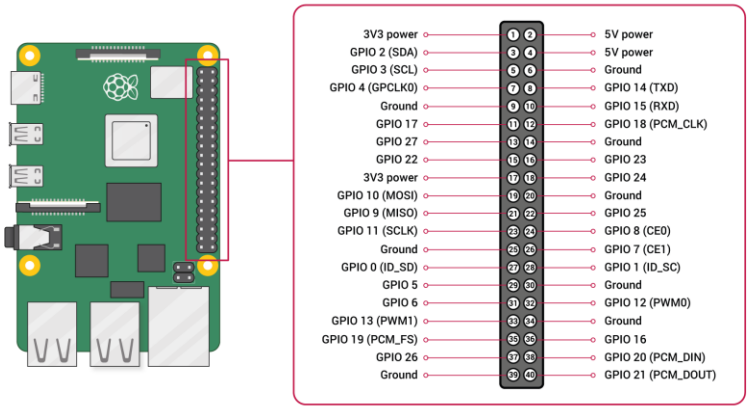
- Arduino Vs Raspberry Pi Vs BeagleBone:

| Name | Arduino Uno | Raspberry Pi | BeagleBone |
|---|---|---|---|
| Model Tested | R3 | Model B | Rev A5 |
| Price | $29.95 | $35 | $89 |
| Size | 2.95"x2.10" | 3.37"x2.125" | 3.4"x2.1" |
| Processor | ATMega 328 | ARM11 | ARM Cortex-A8 |
| Clock Speed | 16MHz | 700MHz | 700MHz |
| RAM | 2KB | 256MB | 256MB |
| Flash | 32KB | (SD Card) | 4GB(microSD) |
| EEPROM | 1KB | | |
| Input Voltage | 7-12v | 5v | 5v |
| Min Power | 42mA (.3W) | 700mA (3.5W) | 170mA (.85W) |
| Digital GPIO | 14 | 8 | 66 |
| Analog Input | 6 10-bit | N/A | 7 12-bit |
| PWM | 6 | | 8 |
| TWI/I2C | 2 | 1 | 2 |
| SPI | 1 | 1 | 1 |
| UART | 1 | 1 | 5 |
| Dev IDE | Arduino Tool | IDLE, Scratch, Squeak/Linux | Python, Scratch, Squeak, Cloud9/Linux |
| Ethernet | N/A | 10/100 | 10/100 |
| USB Master | N/A | 2 USB 2.0 | 1 USB 2.0 |
| Video Out | N/A | HDMI, Composite | N/A |
| Audio Output | N/A | HDMI, Analog | Analog |

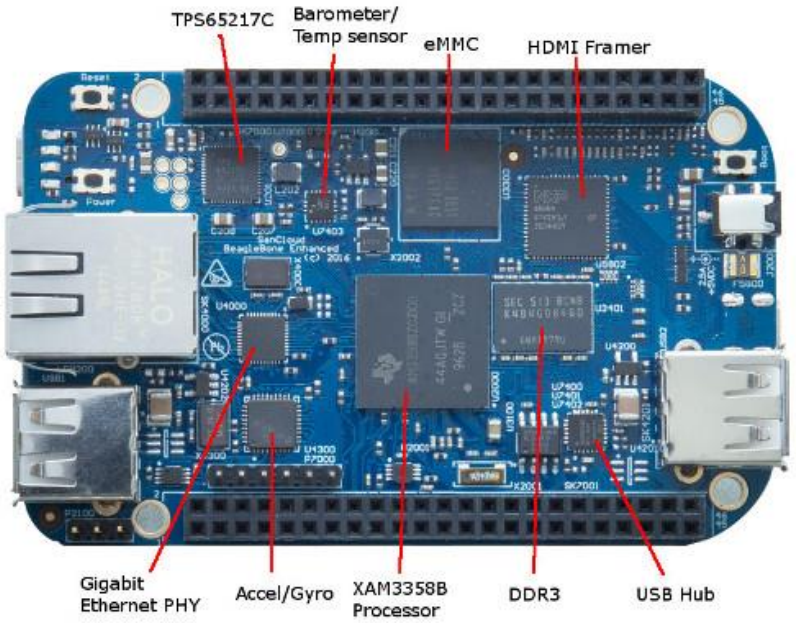
- Diagrams:

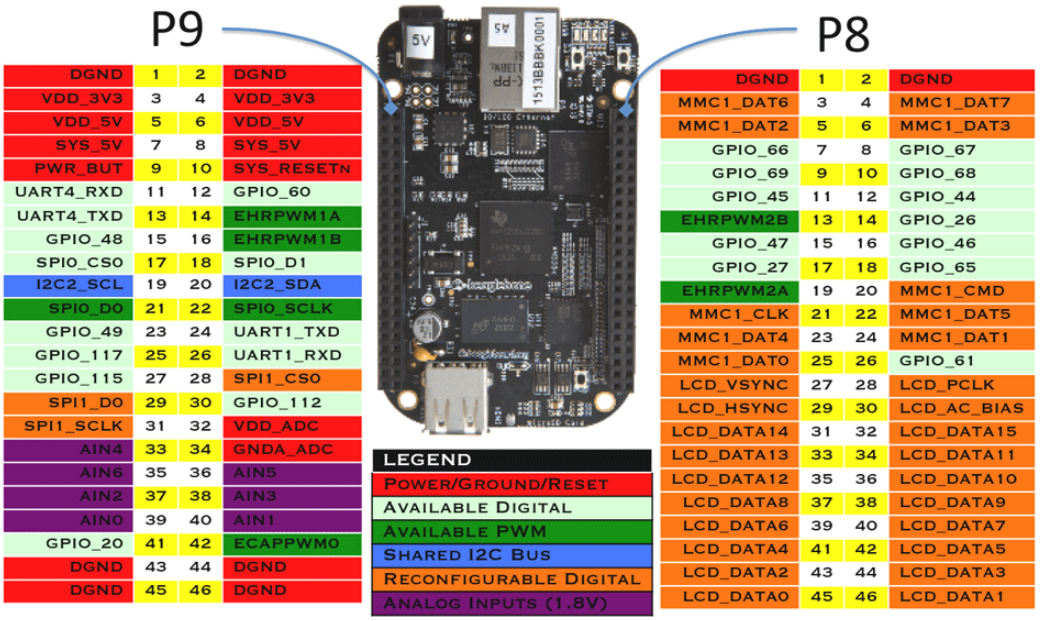
1. Raspberry Pi:


General-purpose input/output pins for connecting electronic components
Micro SD card (underneath)
Ethernet port
USB ports
Micro USB power
HDMI ports
Camera Module port
Audio jack

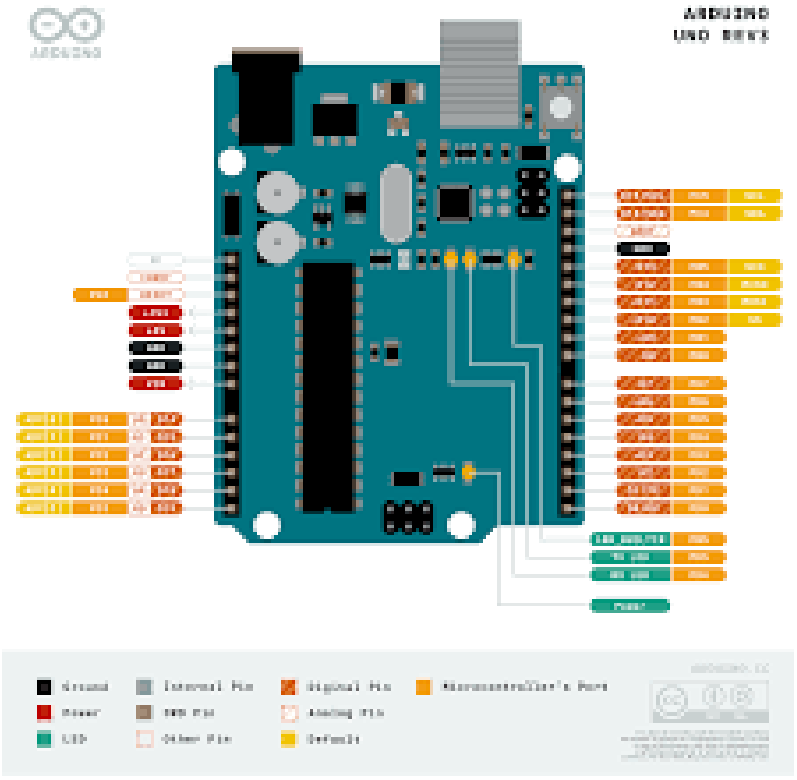

3V3 power
GPIO 2 (SDA)
GPIO 3 (SCL)
GPIO 4 (GPCLK0)
Ground
GPIO 17
GPIO 27
GPIO 22
3V3 power
GPIO 10 (MOSI)
GPIO 9 (MISO)
GPIO 11 (SCLK)
Ground
GPIO 0 (ID_SD)
GPIO 5
GPIO 6
GPIO 13 (PWM1)
GPIO 19 (PCM_FS)
GPIO 26
Ground
5V power
5V power
Ground
GPIO 14 (TXD)
GPIO 15 (RXD)
GPIO 18 (PCM_CLK)
Ground
GPIO 23
GPIO 24
Ground
GPIO 25
GPIO 8 (CE0)
GPIO 7 (CE1)
GPIO 1 (ID_SC)
Ground
GPIO 12 (PWM0)
Ground
GPIO 16
GPIO 20 (PCM_DIN)
GPIO 21 (PCM_DOUT)

## 2. Beagle Bone:



## 3. Arduino:



**Conclusion**: We studied various SBCs like Raspberry Pi, Arduino and Beagle Bone.