

Introduction to IoT and Its Industrial Applications (CS667A)
Indian Institute of Technology Kanpur
Assignment 1

QUESTION

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1. **Introduction** : First of all, it is important for us to understand what are IoT development boards. In layman language, they are simply the printed circuit boards with hardware components in order to perform input, processing and output operations to assist in IoT experiments/ projects. Formally, summarising the IoT development board, it comprises of Power circuit, Programming interface, basic input/ output in forms of buttons and LEDs respectively and I/O pins.

2. One must choose a particular IoT Development Boards based on its features. Following features may be considered while filtering out which IoT Development suits end results: -

- (a) Memory
- (b) Processing Power
- (c) Scalability
- (d) Wireless Connectivity Superiority (in terms of built in wifi, bluetooth functionality, ethernet etc)
- (e) OS Support
- (f) Library support for different hardware
- (g) Open source designs
- (h) Remote connectivity

3. **Classification of IoT Boards** : IoT Development boards are grouped in three categories: -

(a) Microcontroller based boards: They generally comprises of a small computer developed on a metal oxide semiconductor circuit chip. These are mainly in use by programming enthusiasts for DIY projects/ learning purposes.

(b) Single-board Computers (SBC): It comprises of many components like audio receiver, memory, peripherals like USB, PCI and SATA, microprocessor etc into a single Si Chip. These are prominently aimed for applications in medical field in design of nano robots.

(c) System on Chip (SOC) boards: They comprises of all the features of a functional computer such as memory, microprocessor, I/O etc

4. Study of different IoT Boards:

Parameters	Particle io ARGON	ESP8266-01 Wifi	Adafruit feather 32n4 Bluefruit LE	Arduino 101	Raspberry Pi4	TiVA-C
Processor	ARM Cortex-M4F 32 Bit processor @64 Mhz	L106 32-bit RISC microprocessor core based on the Tensilica Xtensa Diamond Standard 106 Micro running at 80 MHz	ATmega32u4 @8MHz with 3.3V logic power	Intel Curie x86 (Quark) and a 32-bit ARC architectue core	Broadcom BCM2711 Quad Core Cortex-A72 (ARM v8) 64-bit SoC @1.5 GHz	ARM Cortex-M4F, 32-Bit
Operating Voltage	3.6VDC to 5.5VDC	3.0 to 3.6 V	3.7V	3.3V (5V tolerant IO)	5V	5 V (3.3 GPIO)
Clock Speed	120 Mhz	26 MHz-52 MHz	8 MHz	32 MHz	1.5 GHz	80 MHz
RAM	256 KB	-	2 KB	24 KB	1 GB, 2 GB, 4 GB	32 KB SRAM
Flash Memory	4 MB	512 KB to 128 MB	32 KB	196 KB	-	256 KB
EEPROM	4096 bytes	-	-	1024 bytes	4 MBits/ 512 KB	2 KB
Communicati-on	IEEE 802.11 b/g/n	IEEE 802.11 b/g/n WiFi	BTLE	Bluetooth LE	2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE	Additional Module, Wifi
Programming language Support	C/C++, ARM Assembly	Micro Python, Circuit Python	Python	Python, C/C++	Python, Java, C/C++, Node JS	Energia
I/O Connectivity and GPIO	20 Mixed signal GPIO (6x Analog, 8x PWM) UART, I2C, SPI	SDIO 2.0, SPI, UART, I2C, I2S, IRDA, PWM, 16 GPIO PINS	7xPWM pins, 10xAnalog inputs, 20 GPIO Pins	14 (of which 4 provide PWM output)	Raspberry Pi standard 40 Pins, USB-2 USB 3.0 Ports, 2 USB 2.0 ports	40 GPIO Pins

5. **Summary** : As we have studied different IoT development boards, most of the boards offer huge support communities and groups to support any project. It merits attention that with the advancement in IoT field, development boards in various sizes and specifications/ functionalities are now available in the market. It depends primarily on the project demand as to which Board is suitable to get the end product. In order to have better understanding of selection process of a IoT system, here are few comparison studies of some of the development board based on their advantages and disadvantages:

(a) Arduino Uno Rev :

Advantages:

- (i) Low-cost IoT board with high standards.
- (ii) A wide range of third-party libraries and sensors are available for Arduino Uno.
- (iii) A huge community of users along with easily available resources.

Disadvantages :

- (i) Processing and task performance speed are lower when compared with other competitors.
- (ii) Arduino Uno has a big structure which requires large sized PCB, other competitors like ATmega works well for IoT development.

(b) ESP8266 :

Advantages:

- (i) ESP8266 IoT board is a cost-friendly. IoT solution in real-time implementation.
- (ii) This segment is very reliable and easily available in the market.

Disadvantages:

- (i) Most of the document is available in only Mandarin language, which makes it inaccessible to the rest of the world.

(c) Beagle Board :

Advantages:

- (i) The beagle board is very convenient and reliable in usage.
- (ii) The board is inexpensive when compared to its competitors.
- (iii) The board doesn't require additional cooling equipment and has low power consumption.

Disadvantages:

- (i) It has a basic structure suitable for beginners in electronic programming.
- (ii) Lacks audio and graphical capabilities.

(d) Raspberry Pi3 :

Advantages:

- (i) Cost friendly and the board category is largely available in the market.
- (ii) Consists of General-purpose Input-Output pins.

Disadvantages:

- (i) Raspberry Pi 3 isn't as fast when it comes to CPU processing speed and has less memory than a Mac or a laptop.
- (ii) Low fault tolerance, the board is prone to damage in case pins are inserted incorrectly.

(e) Intel Edison Board :

Advantages:

- (i) Small yet powerful board for IoT integration.

(ii) Widely used across the industry with full support provided by Microsoft.

Disadvantages:

(i) Limited potential when compared to present-day boards.

(ii) Expensive when compared to its competitors.

6. **References** :

1. Para 1-3 : <https://www.allaboutcircuits.com/news/iot-development-board-comparison>
2. Para 4 : <https://ieeexplore.ieee.org/document/9445290>
3. Para 5 : <https://www.educba.com/iot-boards>

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My solution to problem 2

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My solution to problem 3

References