Methods to Evaluate Or Identify Suitable Storage for AI/IoT Application

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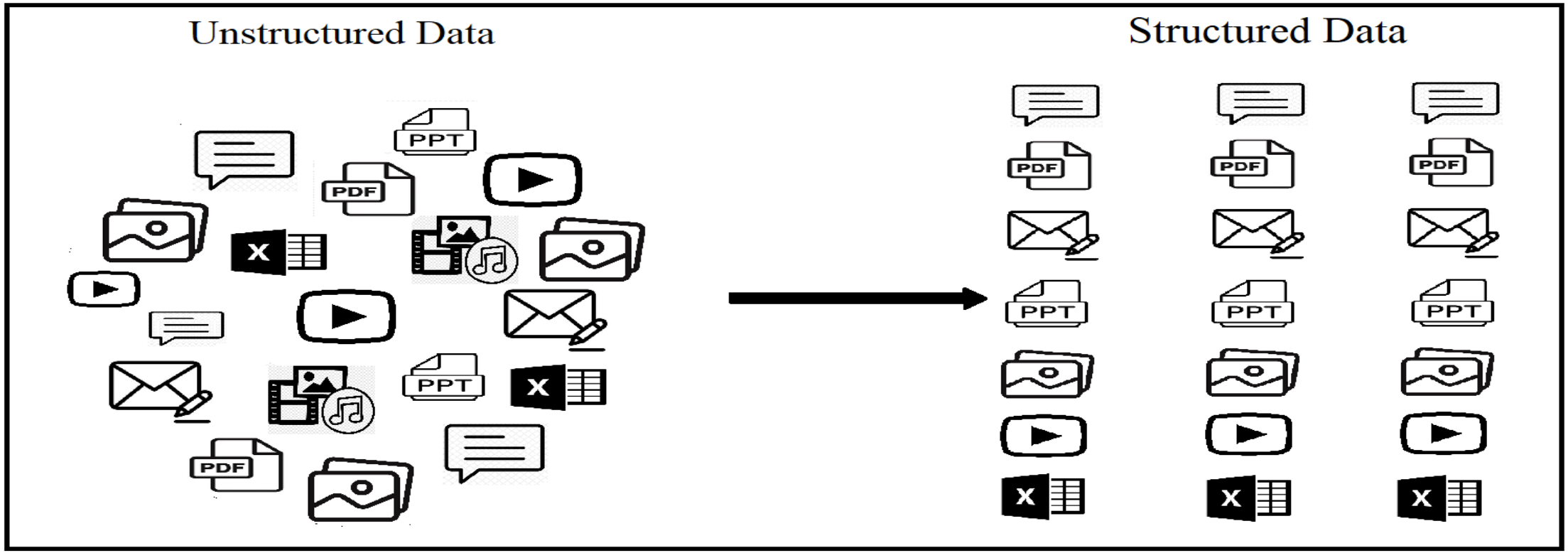
Unstructured Data & AI/IoT Applications

- On Average, every human created at least 1.7 MB of data per second in 2020.

- Mostly User data generated using Smart Phones and other Portable devices are Unstructured data.

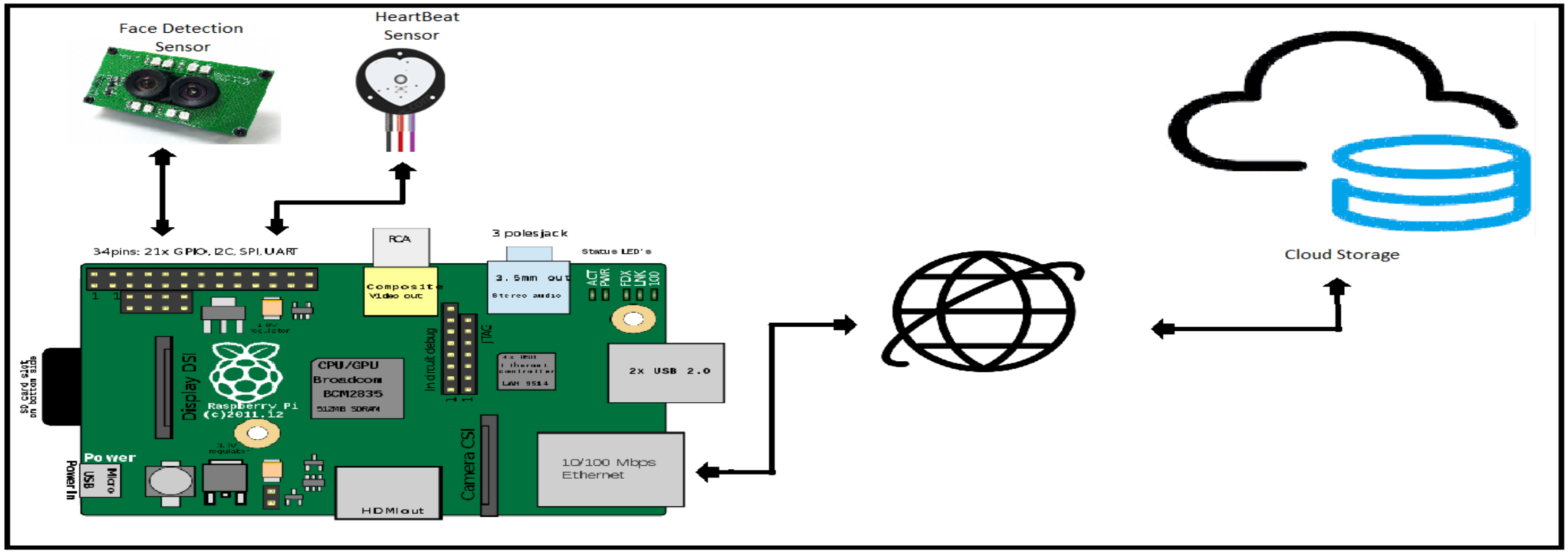


- Intense investment in AI/IoT are result of huge data generated everyday.
- By 2025, there would be 75 billion Internet-of-Things (IoT) devices in the world.
- Legacy AI/IoT Application uses Cloud to save Structured/Unstructured data.
- Cloud storage has higher latency to fetch data from cloud and higher consumption of power.
- Also users have Privacy concerns to save their Personal data in cloud and hence people are more comfortable with having data on Edge devices.
- Off-Chip Memory of Smart Phones and other Portable devices are being used to address these problems and also to keep up consistent performance with data being secured.

Raspberry Pi Boards

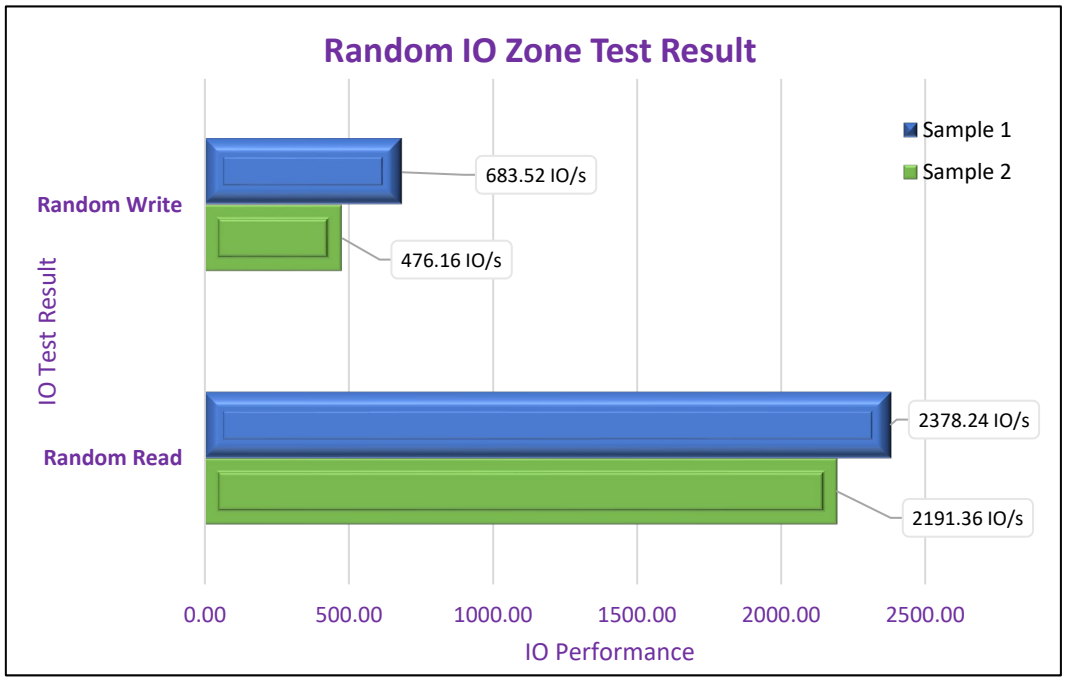
- Professionals and Companies uses small inexpensive Development Boards that can support plethora of Applications to perform various Experiments.

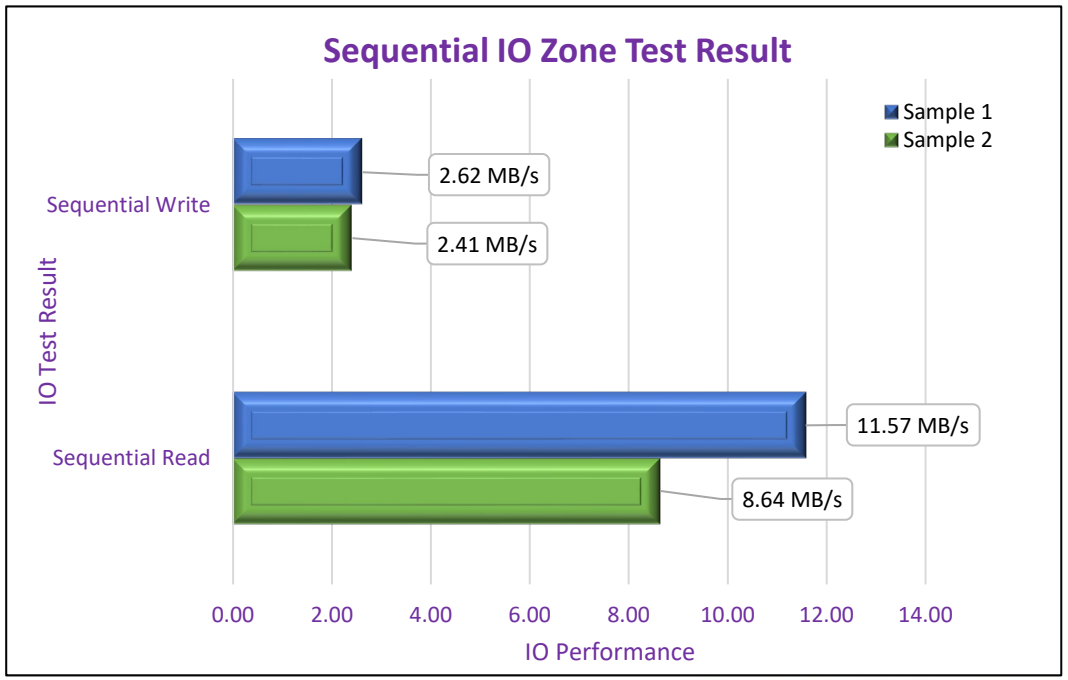
- 36 Million units of Raspberry Boards have been sold till date since its launch in 2012.



IOZone Results

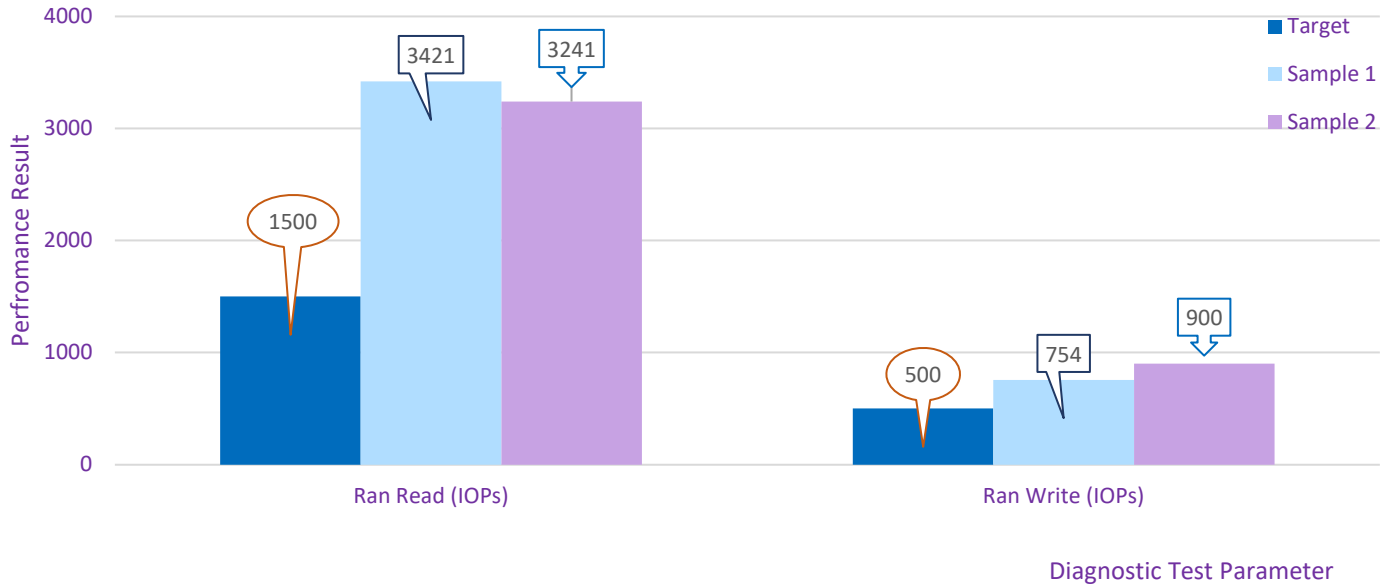
- IOZone is Benchmarking tool generates and measures a variety of file operations, it runs Under many Operating System.
- The Results obtained for 1GB,4K chunk size on two different manufacturer 64GB microSD cards when used in Raspberry Pi 4 board
  - Sequential Write Performance is 2.62MB/s & 2.41MB/s.
  - Sequential Read Performance is 11.57MB/s & 8.64MB/s.
  - Random Write Performance is 683.52 IO/s & 476.16 IO/s.
  - Random Read Performance is 2378.24 IO/s & 2191.36 IO/s.

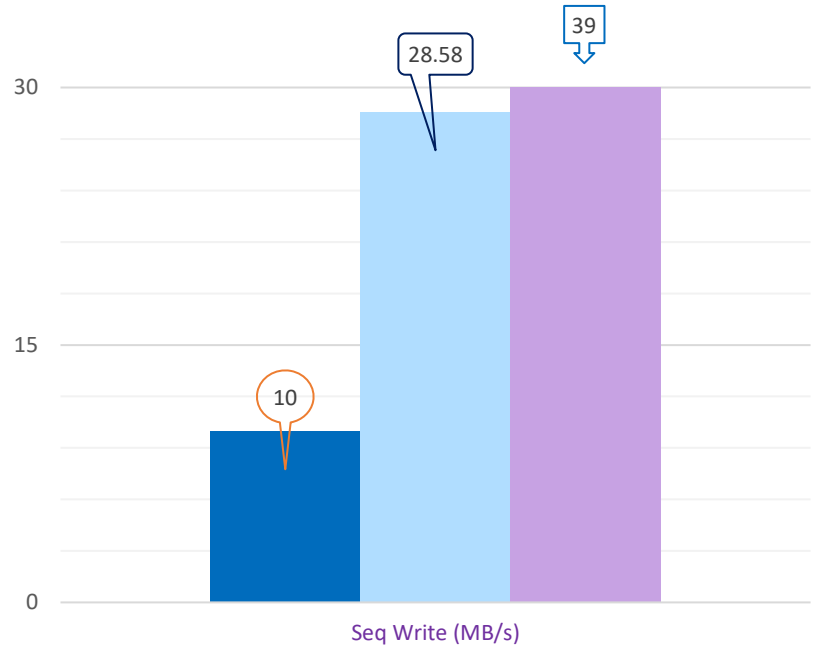




Raspberry Diagnostic tool Results

Raspberry Diagnostic Parameter Tool Test Result



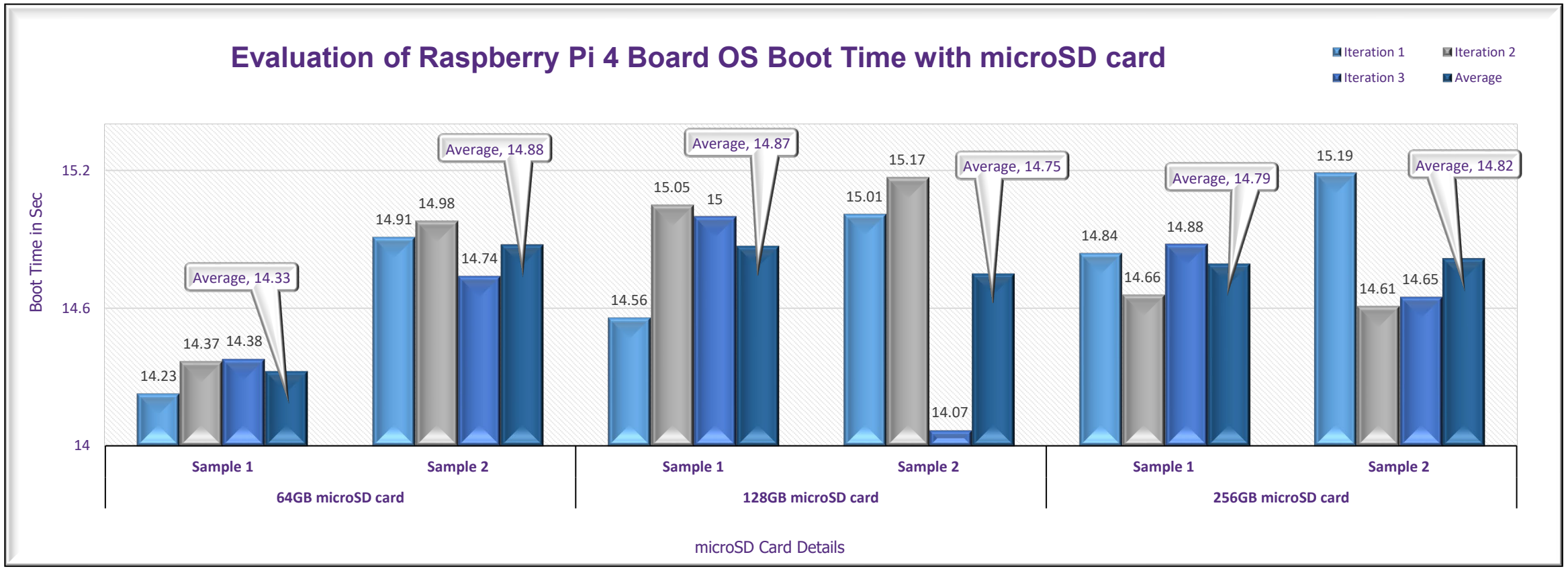


- Rasberry board is having its in-house speed test tool which measures & provide the performance of microSD card.
- Performance measurement includes Random Read, Random Write and Sequential Write test of microSD card in 1GB area with 4K chunk size.
- Measured Rasberry Speed Test with two different manufacturer microSD card and observed both card performance values are above the target value defined by Raspberry team as shown in above graph.

Boot Time

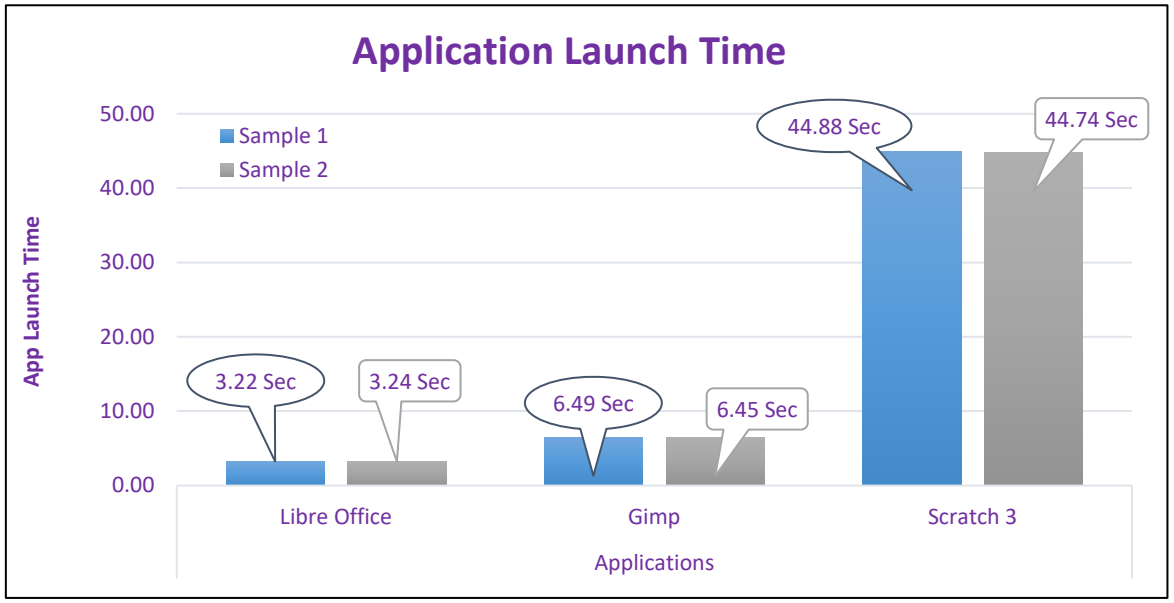
- Boot time is the time taken to OS to come up after Power Button is pressed.

- This is an important parameter and depends on microSD card performance, on Fresh card Boot time remains same in multiple iteration irrespective of card Density.

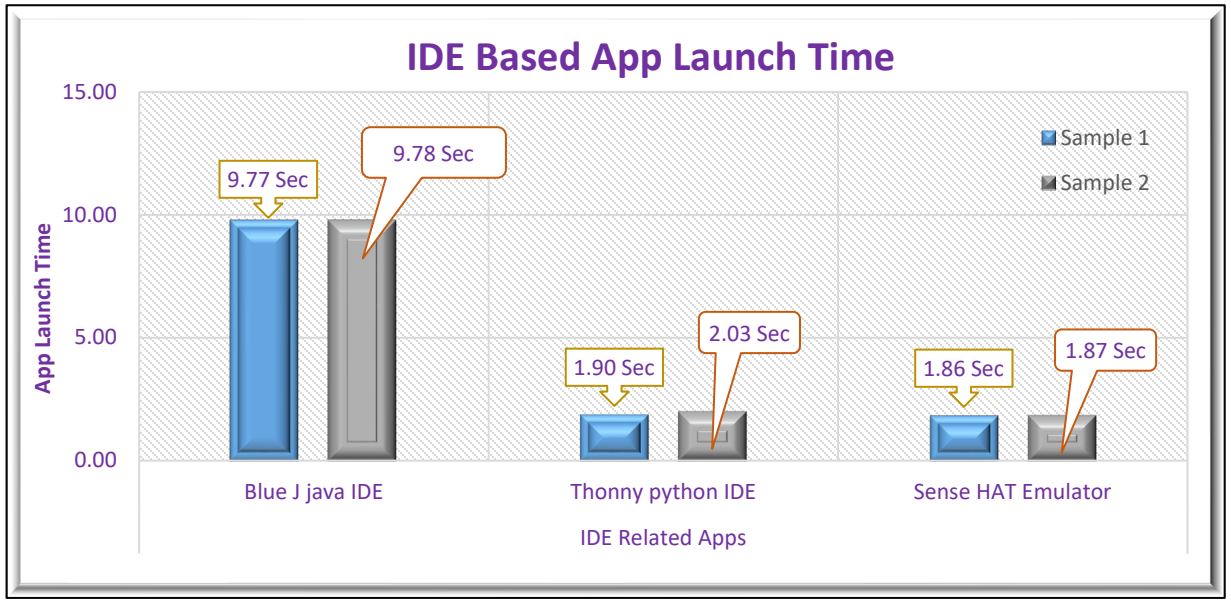


Application Launch Time

- Application Launch Time is the another important Parameter considered to Evaluate suitable storage.
- Application Launch time of some of the famous Application like Libre Office, Gimp & Scratch 3 in Raspberry Pi OS are measured as shown in Graph A.
- Also Measured the launch time of popular IDE based application in Raspberry OS as shown in Graph B.
- These Applications are used often in Raspberry to prepare structured data out of Unstructured data.



Graph A

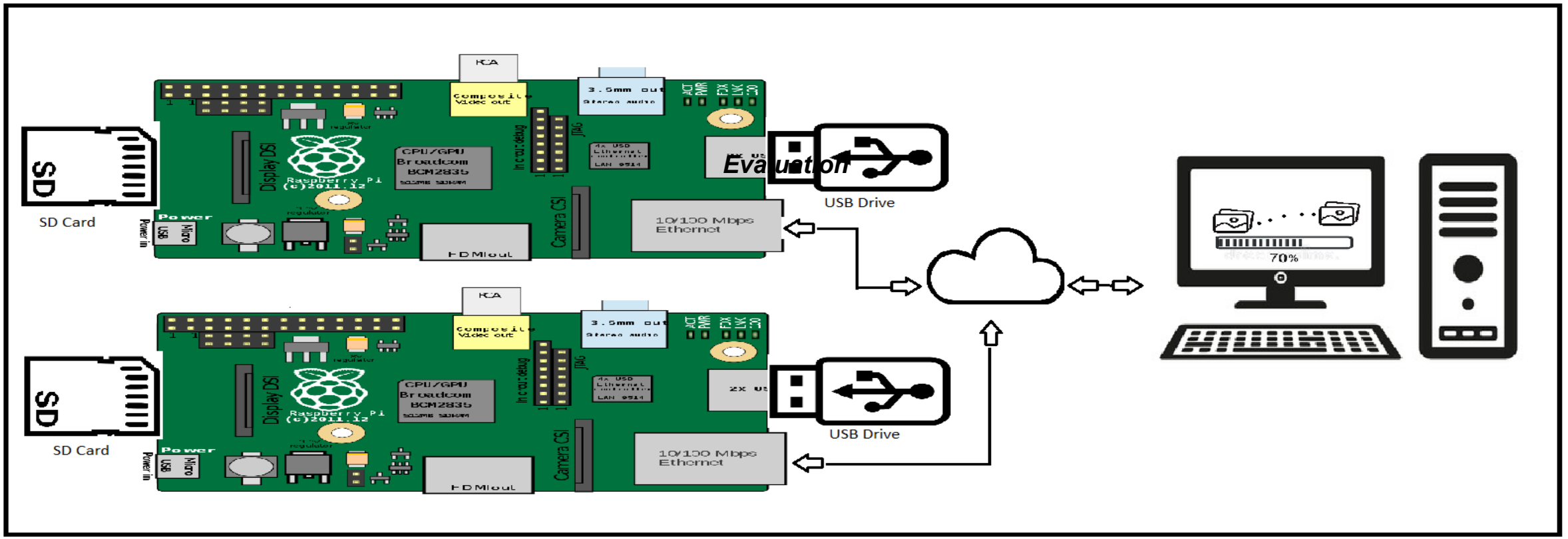


Graph B

Method to Emulate AI/IoT Application Setup and Results

- This method is used to Emulate AI/IoT Applications where various sensor are connected and Image/Video are copied to storage connected to Raspberry board.

- In this Method, parameters like Boot time are measured that are impacting Performance of Raspberry Board after Predefined data transfer.



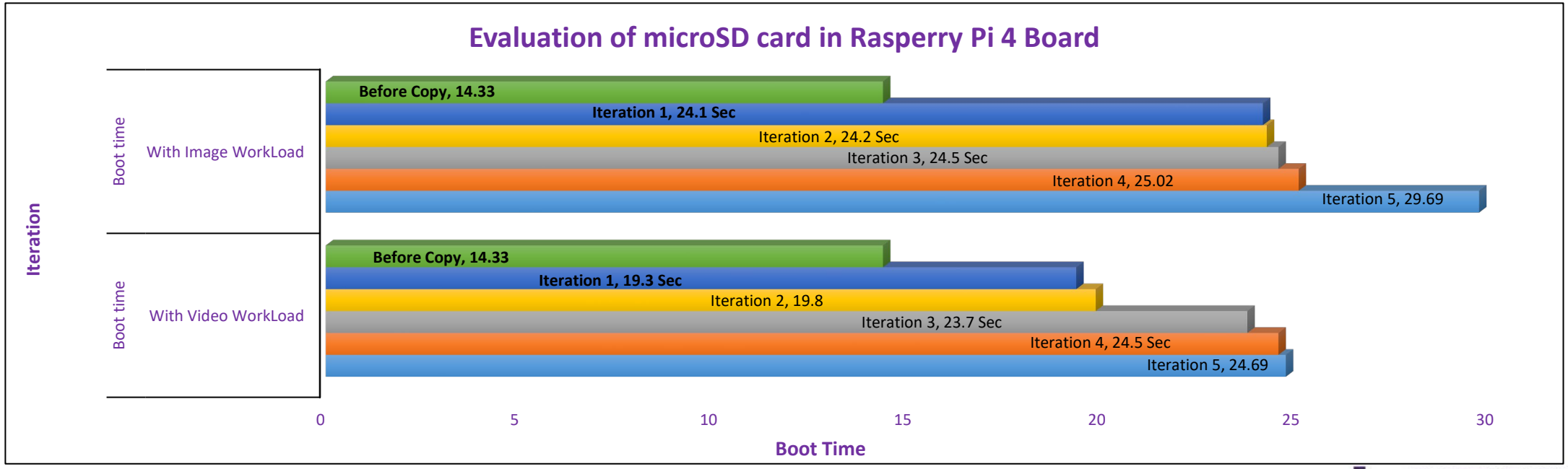
Evaluation

- MicroSD card performance in Raspberry Board is evaluated by measuring boot time after Predefined data transfer like Images & Videos.

- Observed, Boot time is increased from
  - 14.33 sec to **24.1** sec after copying predefined size of Images in 1st Iteration.
  - 14.33 sec to **19.3** Sec after copying predefined size of Video files in 1st Iteration.

- As we are stressing the microSD card with predefined data of images and videos, Boot time of Raspberry board is increasing as shown in below graph.

- With this method, evaluation of microSD card performance over a period of time when various application are being used can be determined.



Conclusion

- This study and Test Results provided in this paper, presents Parameters that needs to be considered while choosing storage for Development Boards like Raspberry Board.
- Irrespective of any density of card, Boot time will vary based on Raspberry Pi board version.
- Boot time and Application launch time are important Parameters to check how Storage is performing when microSD card being used continuously.
- When USB Port is used as storage for Raspberry Boards , it can perform better.
- Latest Raspberry Boards allow user to boot from NVMe device but cost of solution will go up and also Power Consumed by device are at higher side
- Boards can also implement SD express solution with necessary modification which is easy to implement to meet the needs of Memory hungry and higher performance Applications.

Q & A

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