

EFFICIENT SYSTEM FOR CPU METRIC VISUALIZATION

Kuldeep Vayadande

Professor, Department of Artificial Intelligence & Data Science, Vishwakarma Institute of Technology, Pune, (India).

Ankur Raut

Student, Department of Artificial Intelligence & Data Science, Vishwakarma Institute of Technology, Pune, (India).

Roshita Bhonsle

Student, Department of Artificial Intelligence & Data Science, Vishwakarma Institute of Technology, Pune, (India).

Vithika Pungliya

Student, Department of Artificial Intelligence & Data Science, Vishwakarma Institute of Technology, Pune, (India).

Atharva Purohit

Student, Department of Artificial Intelligence & Data Science, Vishwakarma Institute of Technology, Pune, (India).

Samruddhi Pate

Student, Department of Artificial Intelligence & Data Science, Vishwakarma Institute of Technology, Pune, (India).

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ABSTRACT

There are multiple metrics associated with the smooth and efficient working of a computer system. Some of the crucial parts are like the CPU, memory usage and GPUs. For different Operating Systems, they have their own System Software for managing and analysing their sessions. Like Task Manager in Windows, Nmon in Linux and Activity Monitor in Mac. In addition to it, there are few applications software's which perform similar tasks with slight modifications. In this paper, a web application is proposed that will fetch these performance metrics from the user's system and display them using dynamic charts. The proposed application is a system independent tool and can be useful for all operating system. The application also can be used to determine whether or not a game is compatible with the user's system based on the system requirements.

KEYWORDS

CPU Metrics Visualization, Operating Systems, Resource Utilization, System Monitoring, Performance measures.

1. INTRODUCTION

Computer Systems have evolved by leaps and bounds in the last few decades stemming from the introduction of technology trends and improvements. This has paved the way for new architectures and systems with higher and better performance to evolve. It is always a good idea to keep an eye on how much of your resources are being used when working on various chores and projects while having a lot of files, folders, and tabs open on your local system to make sure they don't go over their allotment. Although higher-end computers or workstations rarely have these problems, it may be argued that most typical laptop and PC users must confirm the best use of their resources. The advances in new technology comes with proper analysis and evaluation of the performance metric of the processor. Understanding the performance measure is essential to comprehend the underlying computer organization and bring about modifications based on the different dependent factors. So, there are even various Hardware metrics which are essential and its detailed description helps in getting the insights of our system. Given are few metrics in accordance with Windows Task Manager. Few of them are:

- CPU: CPU's name and model number, speed, number of cores, and accessibility to hardware virtualization features. Additionally, it displays the amount of "uptime" the time since your system's last boot which is another useful statistic.
- Memory: How much RAM you have, how fast it is, and how many of the motherboard's RAM slots are occupied. You can also view the amount of cached material that is currently using your memory. For Windows, this is "standby." Although Windows will instantly clear the cached data and make room if your system requires more RAM for another job, this data will be available and waiting if your system needs it.
- Disc: Your disc driver's name, model number, size, and current read and write speeds.
- Wi-Fi: It displays the name of a network adapter along with its IP addresses (IPv4 and IPv6 addresses).
- GPU: The GPU pane displays different graphs for various activities, such as 3D vs. video encoding or decoding. Due to the GPU's own internal memory, it also displays GPU memory utilization. Here, you may also see the name, model number, and graphics driver version of your GPU.

There are various factors that may affect the system's performance. The instructions used, the memory hierarchy, handling of the input/output all contribute to the computer's performance. The most important parameter is time and is crucial to evaluate the performance of a computer. There are several time-based parameters such as the response time which can be defined as the time taken by the processor to respond after the execution of a particular task, or the throughput which is the total work done for a given time. One such parameter is CPU utilization which is commonly used to understand and evaluate the system performance. It describes the CPU usage for a given time interval as a percentage. It is also an excellent indicator of whether the system has been attacked by a virus or if the system does not have sufficient CPU power. This can be observed in a case when CPU utilization is high (indicating a heavy load) despite there being not many programs running in the background. A computer's RAM is extremely important when it comes to handling tasks and applications. The computer or device is observed to slow down in case there isn't sufficient RAM available. To get the maximum use out of a system, a tool for monitoring these performance parameters to generate logs and allow visualization in the form of graphs is absolutely necessary. Such an application provides other insights about the amount of memory used by a particular program, the availability of the computer's hardware resources and can also be used to force a frozen program. In this paper, another such application is proposed that will help the user view the system information of his device and view certain performance parameters such as CPU Utilization and availability of the RAM. While using applications such as games, the CPU usage (utilization for a given process) can go up as high as 50 or

60 % which may result in overheating of the system, decrease frame rates and even cause system crashes.

Thus, the player must be made aware if the game has system requirements not compatible with his system. A good RAM specification is needed for a smooth experience while playing games. This ensures that there are fewer lags and allows for higher frame rates. RAM usage also depends on the kind of software or game that is being run on the user's device. Hence, this paper also proposes an additional feature that will help determine if the user can run a particular game on his or her device based on his system requirements.

The paper has the following structure, the 'Literature Survey' Section provides a concise overview of the existing literature and tools available for the analysis of CPU metrics, the next section – 'Comparison Table' illustrates the different tables and diagrams used to support the ideas presented in this paper, 'Proposed Work' section discusses the methodology of implementation in detail while the results and outputs are presented in the 'Results and Discussions' section. Finally the paper discusses some aspects of improvement in the future and provides a conclusion outlining the key points of the entire paper.

2.1. LITERATURE SURVEY

Stefanov and Gradskov (2016) monitored and analysed some properties of CPU usage data provided by Linux Kernel. This work analysed CPU usage data provided by the Linux kernel and how CPU load level is calculated based on these data. For every active CPU in the system, the kernel gives the amount of time, measured in 1/100th of a second, that the system spent in different modes of execution since boot. These different modes are 'user mode' (running user processes), 'user mode with low priority' (nice), 'system mode' (running kernel), 'idle', 'iowait' (idle while waiting for IO request to complete), 'irq' (processing interrupts), 'softirq' (processing software interrupts).

Formula for calculating Load Level (L): If ' T_m ' is the time spent in ' m -th' mode at time moment ' i ' then, the CPU load level ' L_m ' for the mode m is represented below using Equation (1):

$$L_m = \frac{T_m^i - T_m^{i-1}}{\sum_m (T_m^i - T_m^{i-1})} \quad (1)$$

Urriza and Clariño (2021) used Python to web scrape reviews written on 'Steam' website and classifies them into either Audio, Gameplay or Graphics. Further it also categorizes them into Positive, Negative and Neutral sentiments.

Gomes and Correia (2020) Cryptojacking infects the browsers and does CPU intensive computation to mine cryptocurrencies on behalf of cyber criminals. The paper introduces a new Cryptojacking detection mechanism based on monitoring CPU usage of visited web pages. They use machine learning along with monitoring and monitoring the precision and recall values to make a decision. In this Study they used CPU utilization for decking if certain games can be run or not on the computer, similarly here we are utilizing the CPU for detecting cryptojacking. It uses 'mpstat', a command line tool to monitor the CPU. It gives us several metrics such as CPU Utilization at every level, CPU Utilization at user level, CPU Utilization at system level, time that the CPU or CPUs were idle during which the system had an outstanding disk I/O request, time spent by the CPU or CPUs servicing hardware interrupts, time spent by the CPU or CPUs servicing software interrupts, time spent in involuntary wait by the virtual CPU or CPUs while the hypervisor was servicing another virtual processor, time spent by the CPU or CPUs running a virtual processor; time that the CPU or CPUs were idle and the system did not have an outstanding disk I/O request.

"Windows Task Manager" can optimize performance by terminating programmes and processes, changing processing priorities, and setting processor affinity as necessary. Task Manager shows

fundamental performance information and visual representations of CPU, swap file, and memory utilization as a monitoring tool. Disk and network information are also included in later versions of Task Manager.

“Glances - an eye on your system” Glance-Glances is a system monitoring tool for Linux computers, it is used to monitor system resources. Views can show more system information than any other conventional monitor. This comprises disc and network I/O, temperature information—which can reveal the temperatures of the CPU and other hardware—as well as fan speeds and disc utilization by logical volume and hardware device.

“What is system explorer?,System Explorer - Keep Your System Under Control.” System Explorer is not only a replacement for task manager, but it is more than that. Additionally, to aiding in process management, it has a number of characteristics that can boost system security and avert disasters. Even a portable version is available for it. It provides great features like calculating the CPU metrics history, taking snapshots and more.

“Can you Run it?” System Requirements Lab is an online platform which provides information about different games and the minimum hardware and software requirements to run them in any local system. The platform also helps you to determine whether the games can run on your current system by comparing the minimum requirements and the local systems information.

2.2. COMPARISON TABLE

Various System Software’s and Application Software’s with the task of evaluating metrics of a system are discussed in Table 1 below:

Table 1. Comparison of various system monitoring tools.

Sr No	System Monitoring Tool	Operating System	Type	Performance Metrics Monitored
1	Task Manager	Windows	System Software	CPU, Memory, Disk, Network
2	Glances	Linux	Application Software	CPU, Memory
3	Process Explorer	Windows	Application Software	Real Time – CPU, GPU, Memory, Disk, Network
4	System Explorer	Windows	Application Software	CPU, Memory

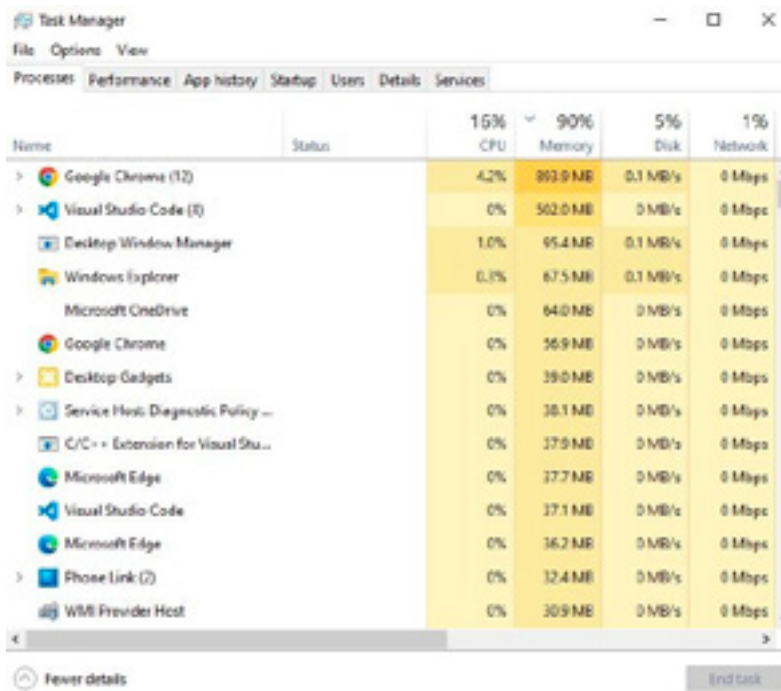


Fig. 1. Task Manager Interface.

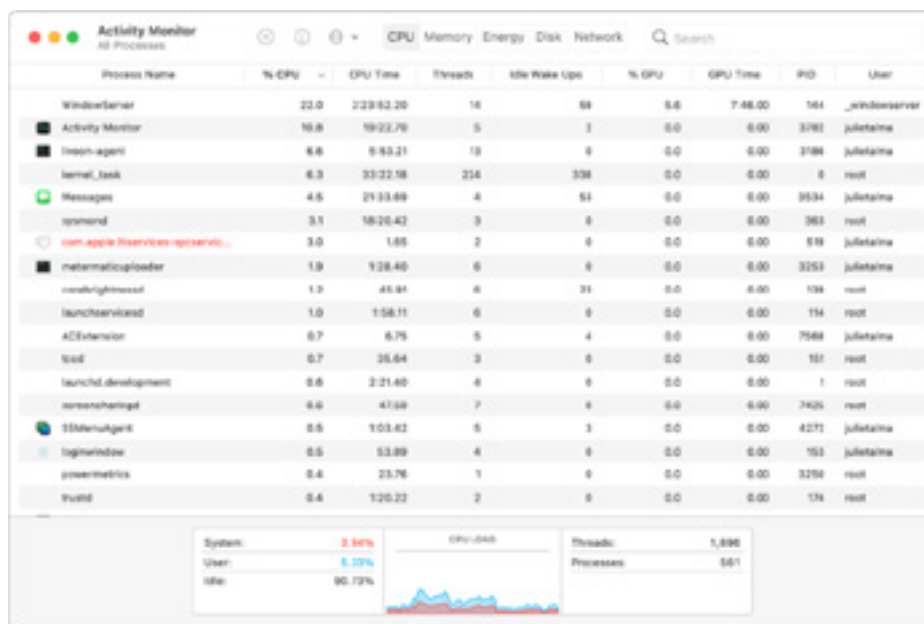


Fig. 2. Activity Monitor Interface.

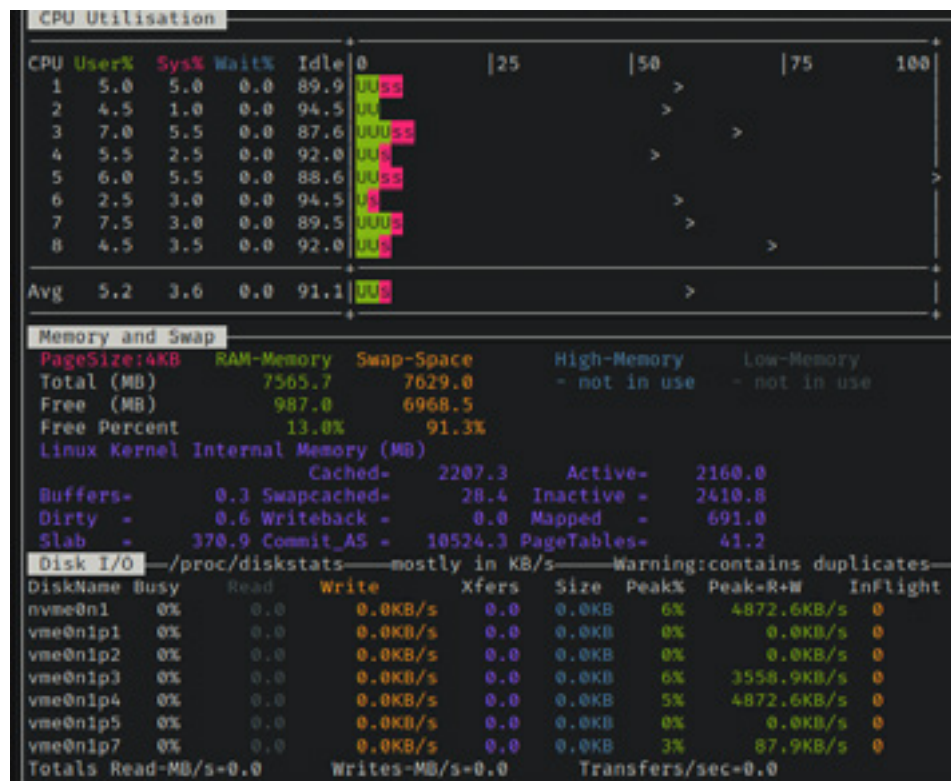


Fig. 3. Nmon Interface.

3. PROPOSED WORK

The need for maintaining and tracking different CPU Metrics is mentioned in this paper. Along with it, various tools which are used to monitor these metrics are described. Similarly, a web-based system for fetching system information and displaying it, has been developed which will be able to provide graphical insights to the performance parameters such as CPU usage, Memory, and GPU. It will be an effective light-weight data visualization tool, so that the history of the parameters can also be recorded.

The website fetches useful system information from the local system with the help of a '.exe' file which the user needs to download and run on the local system. The website displays different static system metrics and visualizes the dynamic information in the form of graphs. There is an additional feature added to the system where the user can check whether a particular application can work on their system or not by comparing the minimum requirements with the local systems information.

Figure 4. below illustrates the process flow diagram of the proposed system and describes the end to end working of the system.

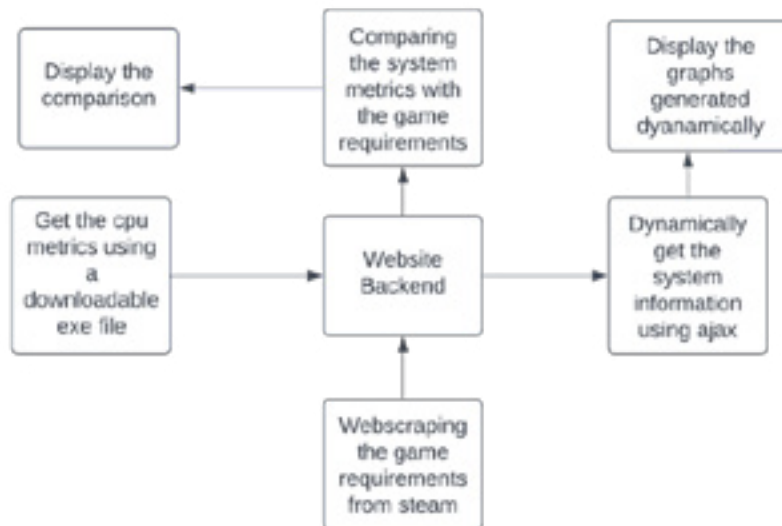


Fig. 4. Flowchart illustrating proposed work.

3.1. METRIC

There are various parameters to monitor the system performance and system resources in a computer system. Some of the most important metrics that affect the system performance are CPU utilization, Used RAM, GPU specifications, System information, etc. The website focuses on fetching the useful system information, displaying it and visualizing dynamic information that updates after every second. The metrics are fetched from the system using the ‘psutil’, ‘wmi’ and ‘platform’ Python libraries. The ‘platform’ Python library is used to fetch the operating system, node name, operating system release version and processor details. The ‘psutil’ library is used to retrieve the number of physical and logical cores, CPU utilization and RAM availability of the system. The ‘wmi’ module fetches the GPU and video RAM details. In order to get the metric from the local system, a ‘.exe’ file is used which sends it to the web server.

3.2. VISUALIZATION

The CPU utilization and RAM availability are dynamic metrics that update after every second, so these metrics are visualized graphically as a line and pie chart. This visualization helps the user to track the systems performance and know how exactly the metrics perform. The graphs are created using the ‘Chart.js’ library in JavaScript and Ajax to update the graphs in real time.

3.2. SYSTEM REQUIREMENTS SATISFIED OR NOT

‘Steam’ is used to web-scrape minimum requirements to run games entered by the user. We compare the minimum requirements with the system metrics and warn the user if the requirements are not met by the user’s system.

4. RESULTS AND DISCUSSION

Figure 5. shown below is the home page of the website of the proposed idea. It contains a navigation bar with the options – System information, Graphs and the ‘Can you Run this game?’ feature. The main section of the website contains the button “Download Link”. A ‘.exe’ file is downloaded on clicking the button which when executed on the user’s device/computer will fetch and display the exact system information of the user’s computer/laptop.

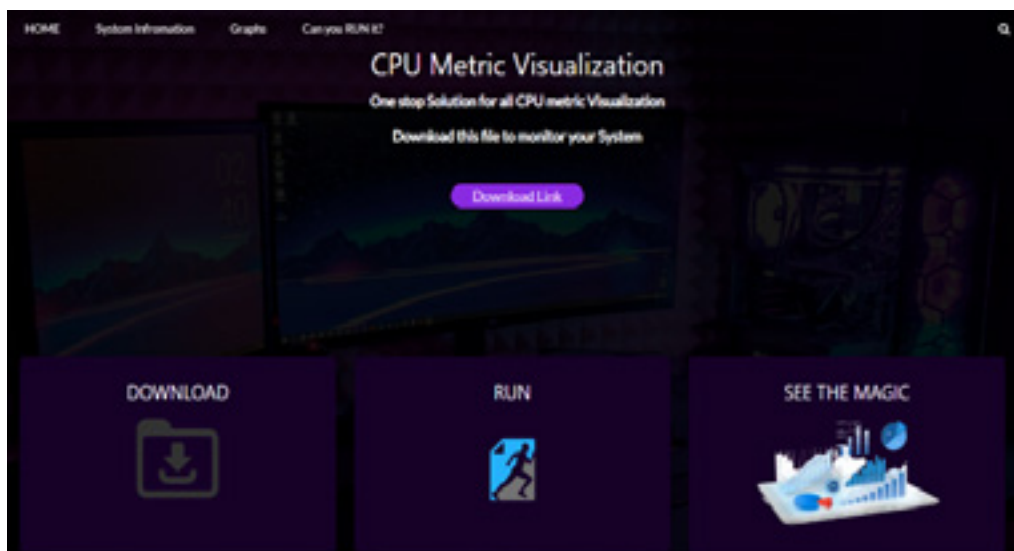


Fig. 5. Home page of the website.

Figure 6. displays the information that is fetched from the user’s computer or laptop device and is displayed in a new window. The system information contains the following – NodeName, Version, Machine, Processor, LogicalCore, PhysicalCore, Operating System, Operating System Release and Version, RAM available and lastly the Total Disk Storage Space.

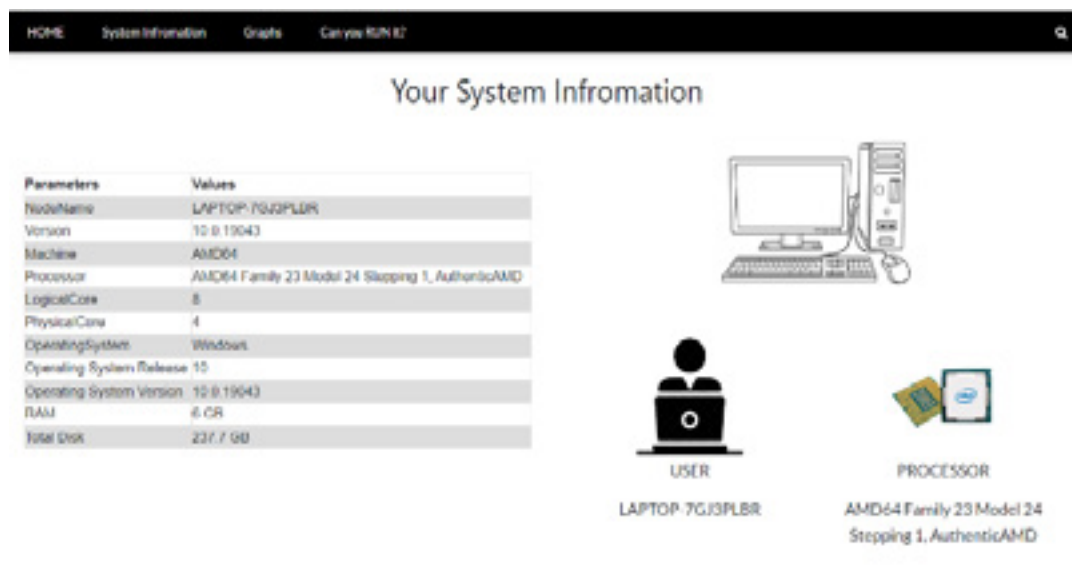


Fig. 6. System information of the user’s device.

Table 2. illustrates the actual data fetched from local system in regular intervals. The table contains the CPU Utilization percentage which will be further visualized as a line chart and the RAM usage and availability which are very important in any operating system to perform well.

Table 2. CPU Metrics.

Sr No	Time (in seconds)	CPU Utilization	RAM Used	RAM Available
1	2	31.8	5.96	0.40
2	4	9.4	5.98	0.38
3	6	17.4	5.89	0.51
4	8	12.3	5.84	0.51

Figure 7 (a). and Fig 7 (b). illustrate the CPU Utilization metric and the available RAM dynamically using a line chart and a pie chart respectively. The charts are dynamic in nature and the proposed application fetches real time information about the metrics from the user's system and updates the charts with the new values every second.

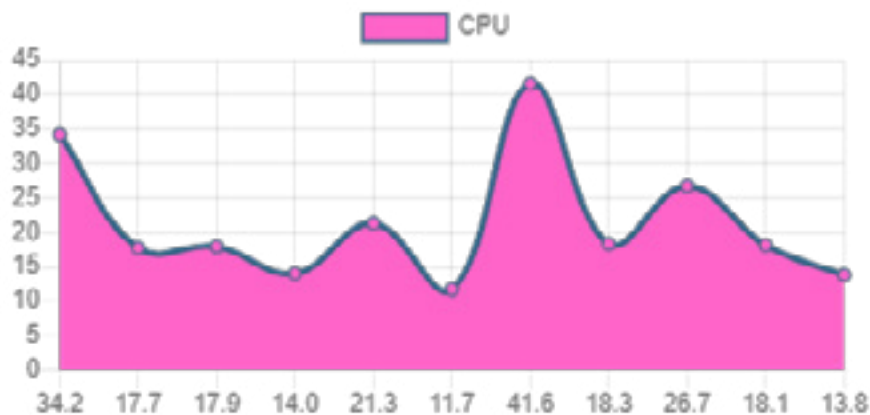


Fig. 7. (a) CPU Utilization visualized graphically.

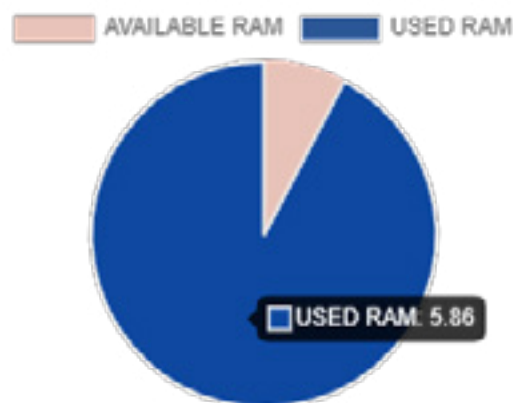


Fig. 7. (b) RAM availability visualized graphically.

Another essential feature of the proposed application allows the user to check if a game is compatible with his own system. This feature requires the user to enter the name of the game in the search bar and then displays the required system specification for the same. It also displays the user's system specification and based on the comparison between the two, it displays whether the game will be able to run on the user's system successfully or not.

Figure 8. Shows an example of the game "Watch Dogs" being entered by the user. Based on the comparison between the user's system specifications and the required system specifications for the game, a message "Yes you can run it!" specifies that the game is compatible with the user's system.

Can You Run IT?

What game you want to run?

Submit

Counter-Strike: Global Offensive

Required Specification		Your Specification	
Parameters	Values	Parameters	Values
OS	Windows 7/Vista/XP	Processor	AMD64 Family 23 Model 24 Stepping 1, AuthenticAMD
Processor	Intel® Core™ 2 Duo E6600 or AMD Phenom™ X3 8750 processor or better	Total	6
Memory	2 GB RAM	TotalDisk	237.7
Graphics	Video card must be 256 MB or more and should be a DirectX 9-compatible with support for Pixel Shader 3.0	Operating System	Windows
DirectX	Version 9.0c		
Storage	15 GB available space		

Yes you can Run IT!

Fig. 8. Example of a game that can be run on the user's system.

Figure 9. Shows an example of the game “Red Dead Redemption 2” being entered by the user. Based on the comparison between the user's system specifications and the required system specifications for the game, a message “No you can't run it!” specifies that the game is not compatible with the user's system

Can You Run IT?

What game you want to run?

Submit

Red Dead Redemption 2

Required Specification		Your Specification	
Parameters	Values	Parameters	Values
addition	Requires a 64-bit processor and operating system	Processor	AMD64 Family 23 Model 24 Stepping 1, AuthenticAMD
OS	Windows 10 - April 2018 Update (1803)	Total	6
Processor	Intel® Core™ i7-4770K / AMD Ryzen 5 1500K	TotalDisk	237.7
Memory	12 GB RAM	Operating System	Windows
Graphics	Nvidia GeForce GTX 1060 6GB / AMD Radeon RX 480 4GB		
Network	Broadband internet connection		
Storage	150 GB available space		
Sound Card	Direct X Compatible		

No you can't Run IT!

Fig. 9. Example of a game that cannot be run on the user's system.

5. FUTURE SCOPE

The proposed system provides information about whether the application will run on users' local system or not, so a recommendation system can be developed in future which will recommend necessary hardware and software to the user for better performance by analysing the system information.

6. CONCLUSION

The CPU metrics measurements are essential because they guide one's decision-making around the computer equipment which one intends to buy. It enables one to cut through the marketing spin that surrounds computer systems; without a basic understanding of how they operate, one won't be able to handle this and won't be able to make an informed decision when buying systems. Understanding performance measurements is essential for comprehending the underlying organizational motivation, or the reasons why people try to make these changes in order to increase performance for future development.

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