DESIGN THINKING

SECP1513-11 TECHNOLOGY AND INFORMATION SYSTEM

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Section: 11

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Introduction

"CICT" which refers to the Centre for Information and Communication Technology is the digital assistance authority of our university (UTM). CICT is responsible for creating, modifying, storing, and running web and mobile applications to serve UTM employees and students. E-learning is the most software application used by lecturers and students. Students consider it a backbone of teaching and learning processes. Its role increased over time because of COVID-19's pandemic hence E-learning became our design thinking topic to assist the learning process. To achieve the goal, we will interview students to observe their opinions on E-learning to conclude a definition about their main problem with the target expected from the solution to accomplish, then searching for possible ideas and compare them to find the most appropriate one. Create an object or a sample to represent the idea and testing it, to show whether it's working or not.

Empathize

Who are we? We are university students seeking for appreciable completed learning and teaching process. E-learning is a digital educational service that assists lecturers to send and receive documents from students, it became more essential under quarantine. We asked UTM students about their bad experiences with E-learning, especially international students who live overseas certainly. Firstly, a student who lives around UTM, Johor campus said, "mostly, there isn't any serious problem but sometimes I suffer from slow file transfer (upload & download), it isn't a big deal until it's related to quiz or exam submission". Secondly, an international student told us that web pages in E-learning used to freeze for a minute. Finally, to precise our observations from students, we decided to interview a CICT specialist to illustrate what's happening exactly in each case for the international student what happens with him is when UTM servers have a traffic overflow, the server will take time to respond to the farthest client. Transferring speed is slow because of the type of storage devices used in UTM servers, which couldn't handle speed with traffic overflow well.

Define

Here, we will state the main issue that the present system of E-Learning is facing. In point of fact, Slow upload & download file transfer speed and freezing E-learning web pages are two sides of the same coin because they happen at the same time, for instance when there is busy work on a week UTM students submit and download a lot of files which cause them thus our defined problem will be the slowness that happened during overflow traffic on E-learning, students need a solution to handle overflow situation with high speed.

After some discussion and research, we have come to the conclusion that the origin of the drawbacks of the current system is somewhat related to storage.

Ideate

Storage problems constitute one of the major challenges of modern technology. Indeed, one of the main focuses of IT researchers nowadays is to find some new methods of enhancing the performance of storage devices, especially when it comes to servers, as they require a broad range of capabilities to process large amounts of data as fast and efficient as possible.
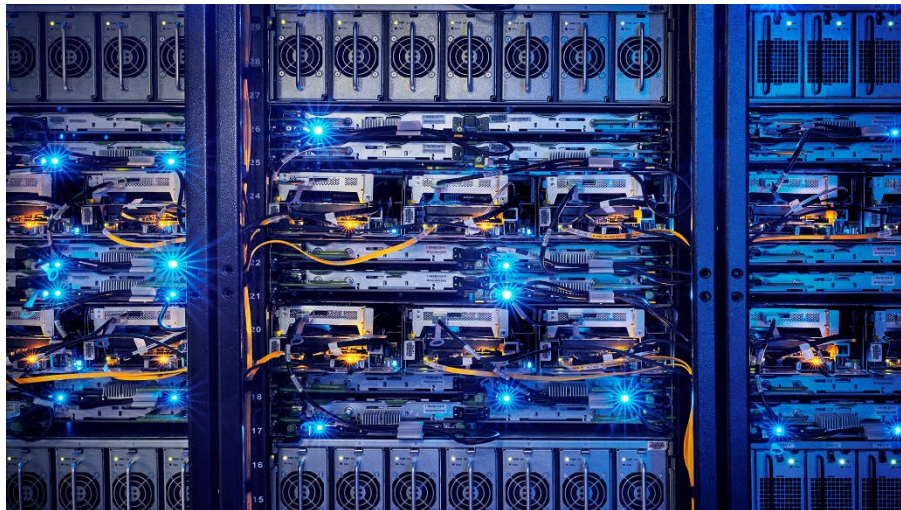
The main factor that significantly affects the speed and the quality of the servers is the type of storage device used. Actually, there are many types that are employed at present times. Here are some of them:

Hard disk drive (HDD): It is a magnetic mass memory used to store data. It consists of rotating rigid trays (formerly aluminium, now glass or ceramic) covered with a thin magnetic layer, in which the data is stored in the form of a binary code (0 and 1). Data is read from or written to the disc using the read and write heads which are located in close proximity.

When a head is crossed by a magnetic field, it can read the binary code that is contained on the surface, but also alter this magnetic field and therefore modify the binary code that is stored on the disk. A hard drive also contains a connector that provides power, as well as electronic circuits that control the mechanical movement of the platters and interpret the electrical signs from the read / write heads.

To measure the performance of an HDD hard drive, there are three things to inspect. First, there is the latency, which is the amount of time it takes to position the read / write head on the hard drive tray. The faster this time, the better the HDD is. Then comes the time spent searching for information, which is more precisely the time taken to position the read / write head of the disk on the data. Finally, it will be necessary to consider the data transfer time from the conventional hard drive to the computer.

Given all of this information, today there are tasks that an HDD can and cannot do. Among other things, this type of hard drive will not be suitable for a computer or a terminal that will serve as a server, which is the unfortunately the case in UTM. In point of fact, we think that the main cause of problems of eLearning (that occur regularly), is the use of HDD, as it is not suitable at all for the heavy processes that the server performs.

Solid state drive (SSD): It's a new type of hard drive that has appeared in recent years and does not use the same technology as a conventional hard drive at all. The SSD hard drive uses electronic components (like RAM) to store data. Except that unlike RAM, data remains written to the hard drive even if the computer is turned off; just like a USB flash drive or the memory card. The inside of an SSD hard drive has nothing to do with that of a mechanical hard drive. There are no more turntables or read heads, all of this is replaced by electronic components.

Since 2000s, the SSD has recently replaced hard drives, data centre servers and workstations due to the fact that it's fast, powerful, efficient and reliable data storage space.

Solid State Hybrid drive (SSHD): corresponds to the assembly of a conventional hard drive and a NAND type chip that is found in SSD drives, all in the same box. Thanks to its specific design, it can satisfy users who hesitate between an SSD (fast but expensive with little space), and a classic HDD hard drive (with a lot of space but slower to start or launch applications).

The main drawback of SSHD is the difficulty of being able to recover its data in case it is damaged. Moreover, even though the speed gain is notable, it remains lower than that of an SSD disk, which is the reason it's not very appropriate for our case (server), since the speed for server is extremely important.

From the available choices that we've discussed, it seems that the SSD is the most fitting to solve our problem.

Prototyping

As we stated before, UTM uses HDD in its servers, and as a result the processing of data is slow, and thus causes many issues that affect negatively the user experience (Staff and Students).

So, after doing some research, we have come to the conclusion that the transition from using HDD hard disks to SSDs, would drastically improve the current system.

SSD has a lot of benefits over HDD. First of all, there are no moving pieces. This is an essential asset, since these parts can easily be destroyed. For example, when a laptop is dropped, the HDD can be broken. This isn't the case with the SDD. As a result, they are usually more durable and effective than HDDs. Also because of the speed at which electrical patterns are traveling, SSDs can write or read data at a much faster rate than HDDs. Energy consumption is also much smaller, and also reduces heating.


After we contacted one of the experts of UTM, we realized that the transition from the old system (HDD) to the new system (SSD) won't be an easy process, as the university cannot operate properly without the eLearning system fully working 6 days per week, and therefore we're left with only one day per week to move on with the transition. It's estimated that it will take 1 to 2 years to fully adopt the new enhancements. It's true that it's a quite long period of time, but we think that it's worth waiting, as it will significantly elevate the current system.

Test

Testing the experiment will show its usability, fast-ability, and smoothness. Based on the prototype step we decided to compare two storage devices Samsung 950 EVO 1TB SSD Drive vs Western Digital 2TB RPM Hard Drive (HDD), based on the description of CrystalKiskMark program which used as a test tool. You should choose benchmarks, the number of test runs, test size, and test drive. There are four benchmarks to run, they are:
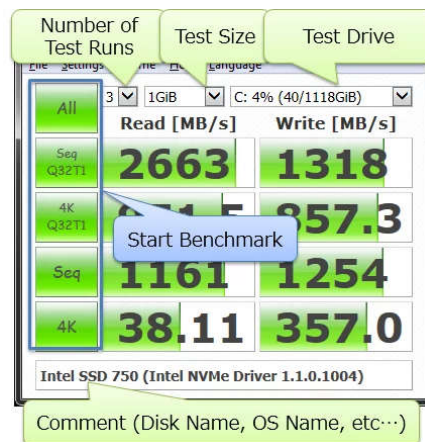
1- Seq Q32T1: Sequential (Block Size=128KiB) Read/Write with multi Queues & Threads.

2- 4K Q32T1: Random 4KiB Read/Write with multi Queues & Threads.

3- Seq: Sequential (Block Size=1MiB) Read/Write with single Thread.

4- 4K: Random 4KiB Read Write with single Queue & Thread.
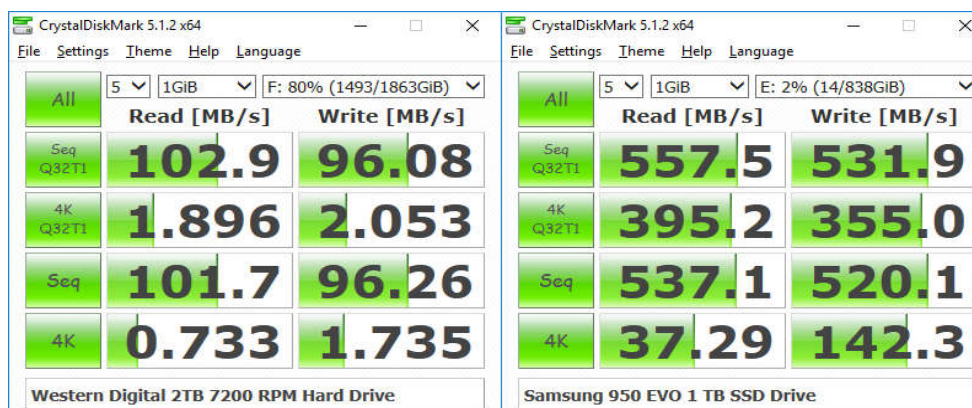
The test shows that SSD representative is five times higher than HDD representative at least.

References:

1- *Kevin Arrows, (August 7, 2019), How to Check, Analyze and Speed Test HDD or SSD Performance*, https://appuals.com/check-analyse-and-speed-test-hdd-or-ssd-performance/.

2- *PhotographyLife, (APRIL 25, 2020) NASIM MANSUROV, NVMe vs SSD vs HDD Performance,* https://photographylife.com/nvme-vs-ssd-vs-hdd-performance.

Reflections:

- **Osama Abdelhameed Reflection:**

I am a software student who had the aim to become a data scientist, big data analyst, database administrator, and software engineer, it confuses me every time I think about it because I should choose one of them to specialize in. However, their requirements are combined from time to time in different courses, one of them is the Technology and Information system (TIS) which focuses on data in information system topics.

Design thinking is not a total software method or a totally human-centered design, it's both, it combines human needs and software development planning to solve these needs in the right manner. Design thinking will help me to organize, test, and enhance any new idea or a solution to a problem.

Software and hardware technologies are still improving so to follow this competition I will select the most appropriate field for my journey then, I will keep learning, keep going and keep focusing on my recent and longtime goals.

- **Ahmedalla Hanoura Reflection:**

For me, I admired how I and my team was ready to finish this project in these circumstances. it was a bit exhausting to communicate using typing, phone calls, and online meetings, this experience developed me a great deal, once it comes to team-work and acts with my teammates. we tend to try our best to return with a clever plan and to be skilled the maximum amount as we can. I think this course will help me achieving my dream to be a remarkable Software Engineer.

Actually, this project is very important to know more about, because it was about design thinking which is something we need to use usually as a computer science student to achieve the best result in all the fields related to us. More than that, the steps of design thinking play a major role to reach what you need to implement. This group project enhanced my abilities such as dedication, leadership, planning, time management, and I am sure that I will learn and develop my skills more during this course.

Finally, I wanted to thank Dr. Goh for being very responsive and clear about what can we achieve from doing this project in a group, also I enjoyed working with my teammates they did provide a creative idea and showed a real dedication towards completing this project.

- **Abdellah Oussama Reflection:**

My experience in general has been very favorable. For some tasks I like to work
alone because it allows me to concentrate better (when I do read or write). But this time it was better to have the opportunity to collaborate with other students so that we can inspire and help each other. I must say that I have found a lot of understanding and collaboration
from my team, which I very much appreciate.

When I started this project, I honestly didn't have a clear understanding on how to apply the design thinking process in a real-life project. However, now I can proudly say that I got a decent apprehension of what it is about after finishing the project ; for me that's a good manifestation of the famous saying : << Tell me and I forget, teach me and I may remember, involve me and I learn >>, as applying the theoretical concepts I learned in the lectures in a real life situation helped me to deepen and to enforce my understanding.

I learned that design thinking is an iterative process (it works by iterations or successive loops) and non-linear (it can go back and forth between the different stages), as we were regularly switched between different stages and made changes when necessary. I also learned that this incredible process solves ill-defined or unknown problems because it reframes these problems by refocusing the solutions on the added value they bring to the users. In point of fact, it offers a way to think outside the box and dig deeper into problem solving while focusing on user priorities. It

helps designers do the right kind of research, create prototypes and test innovative products and services that use new ways to meet user needs.

I reckon that every university student should have an idea about this process, because it can help with various fields and it can be applied in different circumstances.