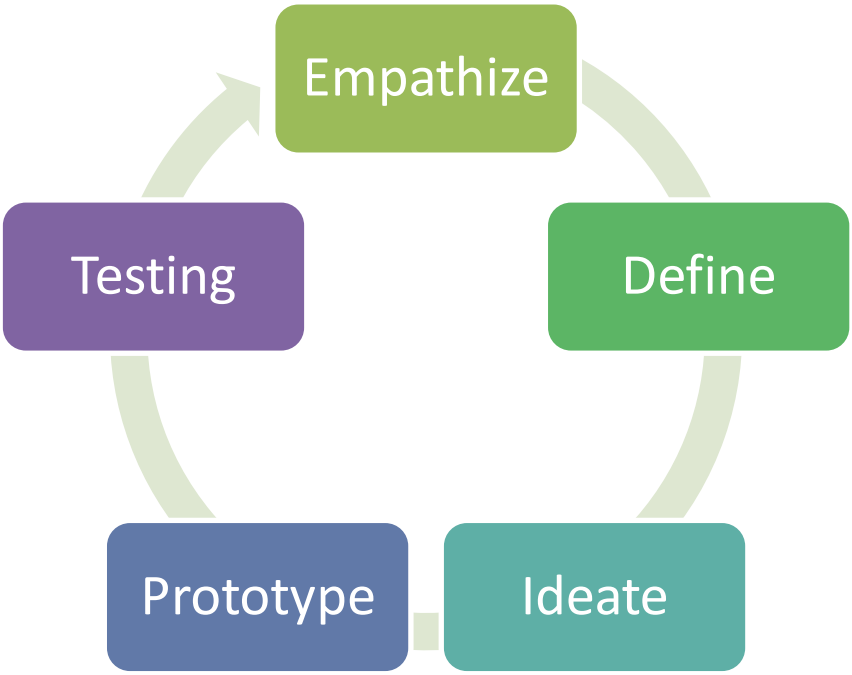
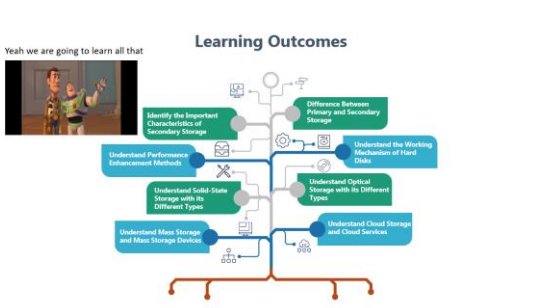
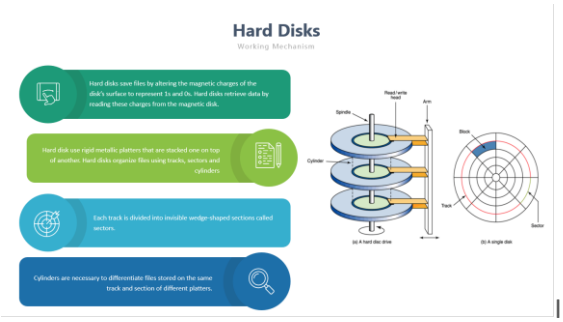
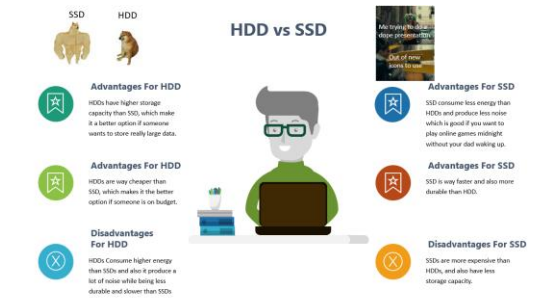
1. **Introduction**
   - **Digital thinking** consists of 5 main steps which are, **empathize, define, ideate, prototype, and testing.** In this assignment/project we had to take the whole experience which was quite interesting.



Our subject was secondary storage, first we had to do some research to get to know more about secondary storage, so everyone of us did his own research from different sources, whether it's books, articles, or YouTube videos. Then we combined everyone's summary and came up with a presentation.







Computer secondary storage was our topic so we had to study this subject and even do a presentation to our class about it.

- **Introduction to Secondary Storage**

Database is a set of structured information or data which is stored in a computer. This information or data may be images, documents, videos, programs, or any other type of data. Computer data is processed by the computer's CPU then stored on the computer storage.

There are two main types of storage, primary storage and secondary storage. Primary storage refers to the main storage of computer or which most known type is RAM (Random Access Memory). The main function of primary storage is to save data for a temporary time interval while the CPU is processing it, after the data is processed it gets erased which is why we need secondary storage if we need to save any data for long time on our computers. Secondary storage is normally used to store data on a long-term basis. One other thing to distinguish between primary storage and secondary storage is, if a computer is turned off, the data in primary storage will get lost, but that doesn't happen in secondary storage. Several examples for secondary storage are hard disk drive (HDD), solid state drive (SSD), CD, DVD and SD card.

Secondary storage is mainly used for long-term storage, but it does not mean that the data stored in secondary storage will be forever safe. Like any other technology, there are some issues that users face while using this type of storage.

2. Design Thinking Process

a) Empathize

This is the first step of digital thinking process, in this step we are required to observe, interact, and immerse our users to find their needs. Due to the covid-19 global pandemic this step was quite challenging, we had to conduct an online meeting instead of meeting our users face-to-face which made it harder to empathize but eventually we did it.

Before the interview we worked on improving our knowledge of secondary storage to be able to design the questions that helped us empathize with the interviewee. We made the questions specific to the problems often faced with secondary storage. We had a lot of interviewees to pick from but we chose Mr. Aris Arifin an expert that has been working for about 15 years as a Database Administrator (DBA) in UTM.

- **The interview**

The interview was quite challenging since we had to do the interview with other groups from other sections as well, but it was quite good and we were able to ask few questions, sample of the questions we asked:

Introduction, General issues (Time Stamp in the video: 1.50 - 4.25)
Here Mr. Aris started by stating some of the general issues he faced which was that the technology of database is always evolving at a very fast pace. And the budget of UTM when it comes to database storage and maintenance was limited.

Q1. Then we got the chance to ask our first Question (4.55 - 6.15) how do UTM store its data locally or in the cloud?

The answer to this question came as surprise for all of us, the answer to this question was that UTM uses their local premise to store and that they have their own database center. We thought like other big corporations they would be using the cloud and not a local database center.

Q2. Then we asked the following question “Do you prefer cloud storage or local storage?” (6.15 - 7.00)

Which he answered to that he would like to store data on the cloud but not confidential data. That answer made us wonder does Mr. Aris believe that cloud storage is not safe or is there another issue that’s preventing him from using the service, so we followed up with a question to investigate this more but that was later on when we had that chance to ask, he also mentioned that there is a protocol from the Malaysian government that prevents him from storing confidential data on the cloud.

Q3. For our next question we tried to find more issues to tackle the question was “What are the disadvantages of storing data locally against storing it in the cloud?” (7.00 - 8.05)

Mr. Aris answered by saying that since that the cost of storing data locally would be an issue since he would need to spend a lot of money to make sure the data is secure. Then he said that he would need a knowledgeable stuff that’s experienced to be able to handle the data.

Q4. “Is the cloud more expensive than the local storage?” (29.35 - 30.05)

Mr. Aris answered to that question by saying that storing in the cloud is more expensive on the long run.

Q5. “Would you store the data in the cloud if he had the chance?” (30.05 - 31.25)
To which Mr. Aris answered yes

Q6. “Would you store the confidential data in the cloud if there was no policy from the government that doesn't allow it?” (31.25 - 31.57)

Which Mr. Aris answered Yes.

Q7. “Do UTM use SSD or HDD?” (35.05 - 35.40)

Mr. Aris said that they use a combination of both SSD and HDD.

Q8. “Do you prefer SSD or HDD?” (35.45 - 37.29)

To which Mr. Aris answered that he prefer SSD, and that he would prefer to have SSD, even though it’s more expensive, because of the high speed of SSD.

Q9. “What are the skills needed to manage Database?” (38.55 - 40.17)

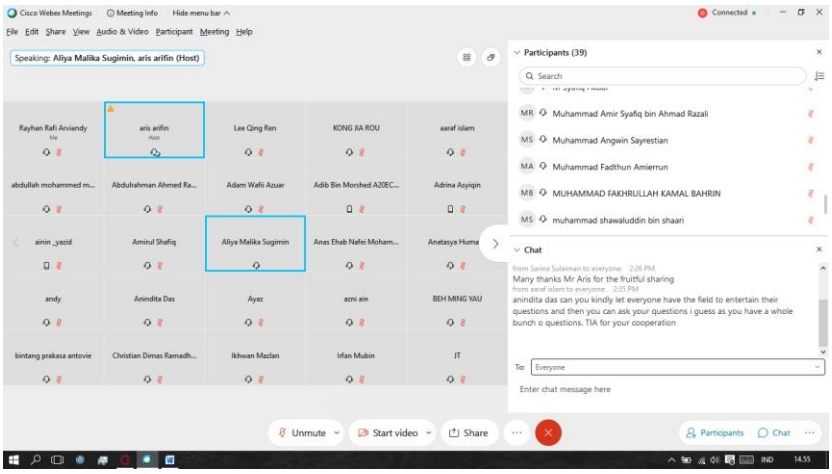
That was more of a general question. Mr. Aris said that you need to be willing to learn new things all the time, and brought the issue that the technology of database is always evolving at a very fast pace so sometimes it’s hard to follow.

Q10. “Are there other differences than the speed between HDD and SSD?” (58.05 - 60.21)
Mr. Aris answered no to this question.

Q11. “What are some issues that you face on daily basis when working with data?” (61.25 - 61.48)

Mr. Aris answered that, the data size is getting bigger as time passes which create the need for updating the hardware in UTM’s center. He also mentioned that doing maintenance and daily backups is a tiring process.

Q12. “Does taking daily backups affect your storage capacity?”
To which of course Mr. Aris answered yes.



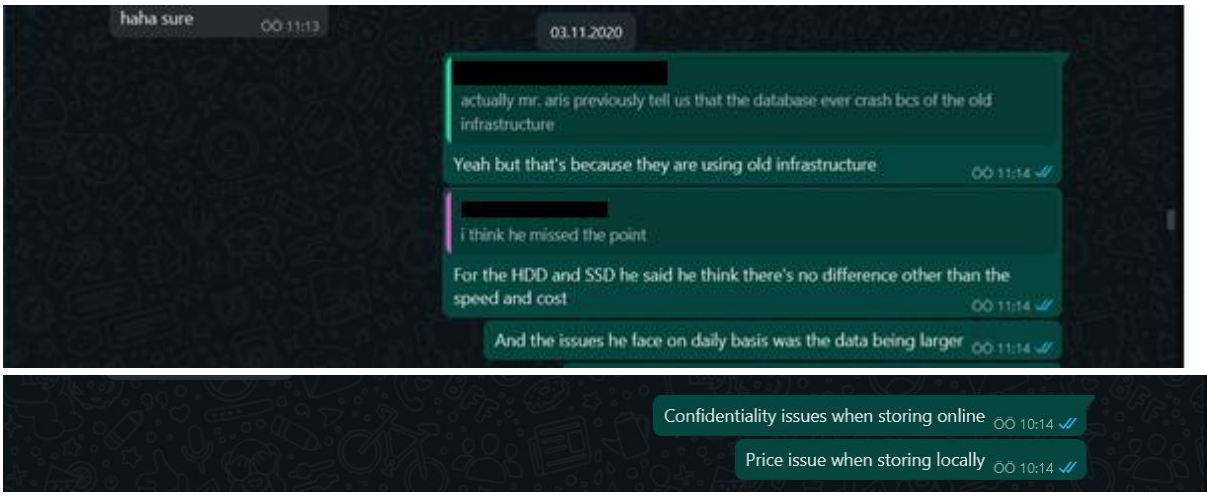
Picture of the Meeting conducted with Mr.Aris Arifin.

After the interview we were ready to move on the next step, Define.

b) Define

This step was quite hard, we tried to define the issues but it took us a while we also shared our experience after the interview with other groups from other sections with the same chapter, but sadly they didn't co-operate.

So we started discussing the answers to define the issues that we got from Mr. Aris, all of us noticed the following:



Photos from our WhatsApp group while trying to define the problem.

Mr. Aris mentioned multiple times that the budget of the university is limited.

He also seemed inclined towards cloud storage since he mentioned multiple times that monitoring data 24/7 is really a hard job, and that if he had the chance and if it wasn't for the government's protocol, he would have opted for cloud storage.

He also said that he would opt for SSD because of the speed but since it's expensive and the budget again is limited, he couldn't do it.

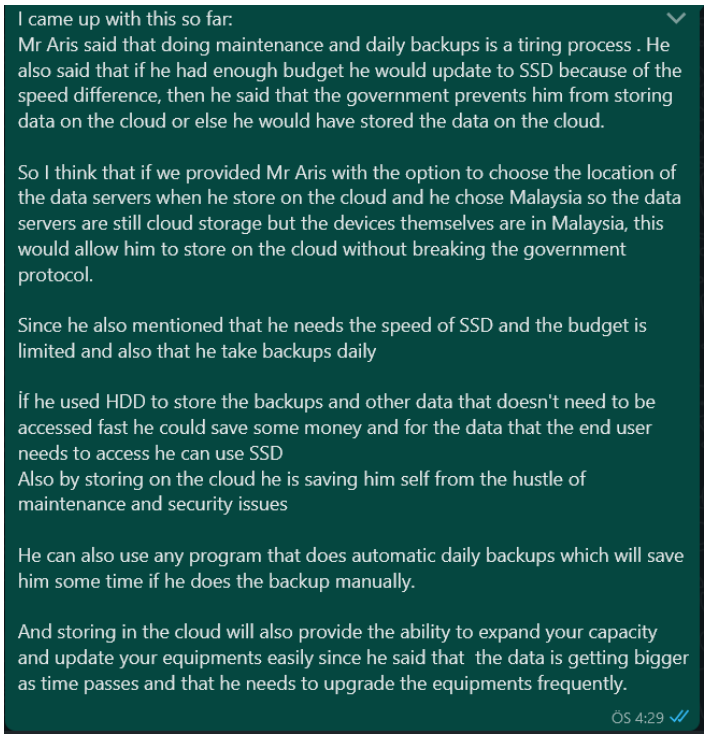
Now that we have our users' needs we were ready to move to the next step which is ideate.

c) Ideate:

This was the maybe the hardest part, since we aren't in the same country we had the brainstorming process in our WhatsApp group and not face to face. We came up with the following solutions:

- Since Mr. Aris mentioned multiple times that the budget is limited, and that he doesn't want to decrease access speed for customers, we advised that he store his backups and the data that's not accessed by end-users in HDD while storing data that needs to be accessed by end-users in SSD so that he doesn't spend a lot of money on SSD and in the same time don't lose speed.
- We also advised him to use a cloud storage which will make it easier to do automatic maintenance and automatic backups, but since he said that the Malaysian government has a protocol that prevents government organization from storing data on a cloud we came up with that new idea which is, allowing users to choose the location of the storage devices that hold the data. That way he can choose to store his data in Malaysia, avoiding issues with the government while benefiting from cloud advantages.

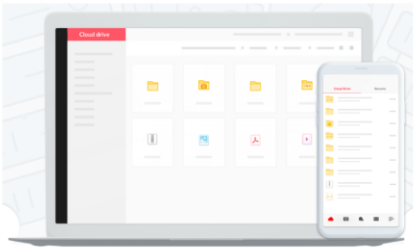
- And finally using a cloud storage that provides end-to-end encryption would make security issues less present.



d) Prototype

Making a prototype was a confusing task because we wasn't doing a new application or program, we were just giving tips based on the research that we did, and adding new features in an already existing technology, so there wasn't much creativity in the prototype but we still manage to do one.

Cloud Storage



Getting tired of doing frequent maintenance and having to take care of everything manually?

Do you have an issue keeping up with the increasing size of data?

Want to cut your expenses while maintaining the fast access speed?

You have a laws that prevent you of storing confidential data outside your country?

With our cloud storage service all your issues are solved,

We have an auto maintenance and auto backup service, which will save you from the hustle of doing all these things online.

We also have an auto monitoring feature that pings your server every certain amount of time that's chosen by you, and inform you by your preferred method either on phone or email if your server is unreachable for a certain amount of time that you choose.

We also have an auto monitoring feature that pings your server every certain amount of time that's chosen by you, and inform you by your preferred method either on phone or email if your server is unreachable for a certain amount of time that you choose.

All of the data stored in our devices are user-controlled end-to-end encrypted by the newest encryption techniques. We don't have access to the encryption key, only the user has the encryption key.

With our cloud storage you would be able to upgrade your devices and increase the capacity whenever you it's needed without any hustle.

With our cloud storage you will be able to control the type of devices that you want to use so that you can store backups in HDD and save the SSD storage devices for other data that need fast access speed, that way you don't spend a lot of money and still maintain the access speed.

Images used in the prototype are from: Mega.nz

e) Testing

Finally we were ready for our final step which was testing, unfortunately as I said communication was a bit hard since we are in different countries, and Mr. Aris isn't always free, but we managed to send him an email after we came up with our ideas, sadly we couldn't get a feedback. So we tried to contact other students in UTM and see what they think about our solutions.

3. Reflections

- **Anas' Reflection:**

a. What is your goal/dream with regard to your course/program?

I think that in the near future, really near future, automation will take over the world, robots will be doing most of the tasks with only tasks that needs creative thinking left to humans, this makes everyone realize the danger of such a thing, anyone with bad intentions and good knowledge of how computers function can use this knowledge to destroy things, that with my love to computers since I was young was what made me choose my program, Computer Network and Security, so that I'm able to help in keeping things safe and functioning probably.

b. How does this design thinking impact on your goal/dream with regard to your program?

Design thinking is really useful because you can use it in designing a solution to any issue which will help anyone in any field. In my field it will help me to design tools that I'm going to use, it will help me to make the problem-solving and solution designing more organized and simple, and also because it can be applied to any work that has to solve a problem it will help me in the business field as well, for example if I'm going to be a manager in a company in my field I can use design thinking to manage the team and make them work together and find better solutions.

c. What is the action/improvement/plan necessary for you to improve your potential in the industry?

At this moment there is a lot of things that I can improve at, first I try to develop a set of soft skills, like communication with all its different types for example body-language, negotiation, listening, and etc.. This set of skills will benefit me a lot in my field especially because in the cyber security field Social Engineering is a huge thing. Another set of skills that I'm trying to develop is critical thinking skills because no matter what field you are in critical thinking is going to benefit you. Apart from soft skills currently I need to improve my overall knowledge of my field itself because I

still have really basic knowledge that needs a lot of improvements before I'm able to persuade a career in my potential field.

- **Rafi's Reflection :**

a) What is your goal/dream regarding to your course/program?

As i know, this program is more general than the other program in school of computing, and have the main course that is Internet Security. My teacher ever told me that in my country, Indonesia, didn't have enough resource for the network security. And thats become one of my goal regarding this program.

b) How does design thinking process impact on your goal/dream regarding to your program?

I totally believe that this subject will be usefull in our future, to solve problem rationally. Or even solve a problem about network security, we have to understand about the problem first, then we conduct some research and through that we can solve thee problems.

c) What is the action/improvement/plan necessary for you to improve your potential in the industry?

I think i really have a low self-confident and bad on public speaking. Because of that i have to look experience as much as possible, so that i can control my fear. And also practice regularly, because practice makes perfect.