UTM
UNIVERSITI TEKNOLOGI MALAYSIA

SCHOOL OF COMPUTING
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Section 08

Technology and Information System
Design Thinking
Chapter 4: System Software

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Abstraction

Our group noticed that due to the recent COVID-19 pandemic occurring worldwide, online services like UTM's e-learning are more vulnerable to having their services disrupted, delayed or even crashed. After several interviews, we found out that the main reason for this issue is mainly due to sudden spikes in network traffic to the webserver. Some web servers, unprepared for the sudden increase in network traffic, will suffer from the issue of server overload. After realising the problem, our group decided to tackle the problem by improving the features of the System Software currently implemented in the web servers. Using the methodology of Design Thinking, which consists of Emphasize, Define, Ideate, Prototype and Testing, we were able to come up with a plausible solution and produce a workable prototype. In the end, our proposed solution, *"Scout Activity Monitor"*, which is an improved version of Activity Monitor, had received recognition from the user who originally had the problem, stating that the solution did help in alleviating the server overloading problem.

INTRODUCTION

Design thinking

Design thinking is a process or list of processes that an inventor, content creator or anyone who wants to create or improve a solution can take. One that utilizes design thinking as their methodology essentially has to understand the user completely, challenge the assumptions, and identify the problems to discover alternative strategies against the problem faced. To achieve this, one has to be equipped with critical thinking and analytical skills to come up with an innovative and creative idea, along with excellent intercommunication skills to be able to convey and interpret ideas from and to the users easily. Design Thinking involves certain processes like questioning, which undoubtedly is one of the best ways to acquire the needs and problems faced by the users, and other experimental steps like sketching, prototyping and lastly, testing. With Design Thinking, inventors aim to be able to come up with a workable solution and fulfil the user's requirements.

Five stages for design thinking

- Empathize (Questioning and understand user's needs and problems)
- Define (Identifying, extracting user's needs, problems and insights)
- Ideate (challenging assumptions and creating innovative ideas to solve it)
- Prototype (Create a working instance of the solution proposed)
- Test (Ensuring the working instance is at least functional)

System software

System software is a type of computer program whose function is to handle the technical details of computer hardware and application programs. It is designed to ensure the correct operation of the computer, and act as a middleman between the end-users, application software and computer hardware. System software makes the operation of a computer faster, effective, secure and more user friendly through the idea of abstraction.

Example of system software: -

1. Operating system
2. Utility software
3. BIOS (Basic Input / Output System)
4. Boot program
5. Language Translators
6. Device driver
7. System servers

Details of design thinking

DATE	DESCRIPTION
2 November 2020	**Meeting between group members for discussion** 1. Understand the concept and idea of the topic – System Software 2. Put a strategy 3. Coordination of tasks to each of the members 4. Plan who will take the interview with Mr Ruzhan Islam 5. Plan who is going to edit the video
3 November 2020	**Interview with an ICT expert: Mr Mohd Farid** Asking about recent unresponsiveness and crashing of e-learning webpage and if there is a possibility that system software can be improved to better address the issue
4 November 2020	**Meet up a group for Define and Ideate** Put a plan for making prototype and report 1. Record meeting to support the video that we develop Searching for more idea for prototype and report
11 November 2020	**Start making prototype and report**
	Ready for submission

Detailed Step and Descriptions of 5 Phases

Empathy

Empathy is the first step of design thinking where the design teams conduct research, survey and interviews to get a thorough understanding of the user needs and problems. During the COVID-19 pandemic period, e-learning has become the key component in facilitating learning activities between the lecturers and students. However, due to the risk of heavy traffic on the server, they cannot access the e-learning.

In this phase, we interviewed Mr Ruzhan Islam, a startup owner to know his problems and also interviewed an ICT expert, Mr Mohd Farid, working in UTM digital department to get a deeper understanding of the problems.

Define

Define is one of the stages of Design Thinking where we collect and group the information obtained at the Empathy phase. This information will be analyzed and interpreted carefully to synthesize new information from it. Also, we will redefine those problems in more clear and precise problem statements.

Ideate

Ideate is the stage of design thinking where individuals and groups think creatively and innovatively to develop and discover the possibilities to solve the problem. It is a step towards identifying a specific question or problem that generates various possible answers and solutions through sessions such as Brainstorms and Worst Possible Idea.

In this stage, we give our best to come up with our own opinions, and essentially filter and combine the ideas to determine the best workable solution to the problems.

Prototype

Prototyping is a general experimental model of a proposed solution that is used to test or validate an idea, design assumptions and other aspects of its concept without having to break the bank so that designers involved can accurately correct or make possible changes to the direction before making an actual product.

After finding the original solution, we start to prototype. We used "**Figma",** a user interface designing tool to build our prototypes.

Test

The test is the fifth and last stage of design thinking where the proposed solution is tested by the user and user feedback is obtained. After finishing the prototype, end users will need to test our prototype, and we have to collect their feedback to understand how they feel and think about the prototype. Note we must also pay attention on user interaction.

Testing is a repetitive process where we let the users test the prototype, obtain their feedback and reviews, and make an improvement based on them which leads to a better prototype for them to test

Detailed Description

Problem

Due to the recent ongoing Covid-19 pandemic, a lot of people are forced to switch their activities to be conducted online. This shift had caused websites and applications to be used more often, and thus the requests to the server will certainly increase. The sudden increase in network traffic to the unprepared servers, like those in a start-up company, may suffer from issues like high latency, being unresponsive or at its worst, crashing the server. This is observed when UTM's e-learning site had become unresponsive or even crashed a few weeks ago. As we all knew, this will pose certain problems to the ones using the service and those hosting the service.

Solution

After some discussions, our group decided that we should improve the activity monitor to have more functionalities specialized in dealing and reducing implications of performance spikes. Our proposed improvised activity monitor, "*Scout Activity Monitor*" will have 3 focus functionalities:

- Emergency data backup
- Performance History Analysis and Visualization
- Automatic Admin Notifying System

Team Working

To ensure a smooth workflow, each of the group members is assigned to have their role. Soh Jun Wei mainly focuses on task coordination to each member and report writing with Mir Tamzid Hasan having his focus on shooting, compiling and editing the video. Md Samiul Hasan Sayad and Youssef Hesham Khairat focus on prototype and also the report writing.

Although we faced certain difficulties, like the lack of idea for the solution, having to hold a group discussion and collaborate on prototype remotely due to restriction of Covid-19, and conflicting ideas, we always manage to resolve the problems and came up with a workable prototype.

Phase 1: Empathy

Initially, our group noticed that UTM's e-learning site had suffered some issues earlier. This certainly had brought some inconveniences to the students as well as the lecturers. Therefore, our group was interested in finding out the cause of the problem and perhaps contribute to what we can to help the situation.

First of all, we had figured that interviewing with the person responsible for managing and keeping the UTM's digital system is the best option, and therefore we interviewed Mr Mohd Farid, an ICT Expert working for UTM digital. The following are some problems that we raised, and corresponding answers that we obtained from Mr Mohd Farid.

Problem	Answer
Recently we noticed that students had problems accessing the UTM e-learning platform. During high traffic times, the e-learning cannot be accessed. Why does that occur?	• In the beginning, there is not much problems or challenges or that occurred on the e-learning • Since the pandemic happened, most of our class, maybe 100% of them, must be performed online, and the usage/performance suddenly spiked due to the high volume of users using the service. • During the pandemic, all 25k students at the same time have to access the e-learning • At the beginning of the semester where every single course must be performed online, all the students essentially had to access the e-learning • Between 11'o clock to 12'o clock, there is a very high volume of users accessing the e-learning
Regarding the activity monitor, is there any weakness or some ways to improve it so that it responds to the performance spikes better?	• If you are asking about whether the activity monitor itself can be improved to have better functionality to respond to the performance spike, yes it can be done.

Having realized that the problem originates from the increase in network traffic due to ongoing Covid-19 pandemic, we notice that similar problems might occur to local businesses as well. Therefore, we have interviewed Mr Ruzhan Islam, the founder of a ride-sharing app, MYgo.com, to ask if he had also faced problems due to the increasing network traffic.

Problem	Answer
Could you tell us about yourself?	• I am Ruzhan Islam, and I am the founder of the new ride-sharing app MYgo.com
What problems have you been facing lately while providing services through your app	• Recently my app gained huge popularity so it has a lot of users wanting to access the server. • This results in high network traffic to the server. Sometimes this causes the server to go down • It may take a long time to fix the servers sometimes because we are not well-notified about the problem that the server is havings

From both the interviews, we noticed a very common pattern. The disruption of service provided by their servers is mainly due to high network traffic accessing the server, therefore causing a spike in server's performance. With that information in mind, we proceeded into the Define phase.

Phase 2: Define

After the Empathy phase, our group reorganized and rearranged the information that we had obtained. We can verify that the problem of server overloading did affect many people. For example, the crashing of the UTM's e-learning site had caused students unable to submit their assignments on time, and lecturers unable to deliver their teaching materials to the students.

We observed that this problem occurred more frequent recently, and suggested that this is mainly due to the currently ongoing Covid-19 pandemic where everyone essentially has to rely more on online services. This fact is said to be true by Mr Mohd Farid, an ICT expert currently working on UTM's digital team which we had interviewed. The sudden increase in network traffic to the web servers may not create much impact on a large-scale company, but it definitely will greatly affect those servers which were unprepared to handle such tremendous amount of network traffic. Tamzid's friend, a startup company owner, also faced problems with his company server overloading due to the increasing popularity in his company's product.

With our problem statement clearly stated, we continue into phase 3, Ideate to begin seeking for a plausible solution to alleviate the server overloading problem.

List of Problems and Information identified in Define Phase:

Information and Problems	Description
Network traffic to web servers had increased significantly	More people are accessing web services like e-learning or a company's website due to them having to carry out their activities remotely or online. This is mainly due to the ongoing Covid-19 pandemic which people are unable to do their tasks physically (like going to school)
Web servers begin to become unresponsive, high latency or even crash	Unprepared web servers, which does not have the adequate hardware requirements to handle such a tremendous amount of network traffic, will suffer issues like being unresponsive, high latency or even crashing in whole.
Web server issues would bring problems to both parties	When a web service had gone down or was having issues, it will create a great deal of impact on both server and client alike. Clients will be unable to complete their task, while on the server-side, businesses will lose out on many great opportunities.

Phase 3: IDEATE

Ideate is a process where designers have their creativeness and innovativeness challenged. The designers essentially have to generate ideas in the session. It is the third stage in the Design Thinking process. Ideate is the phase for brainstorming where we attempt to generate all possible solutions for the problem statement.

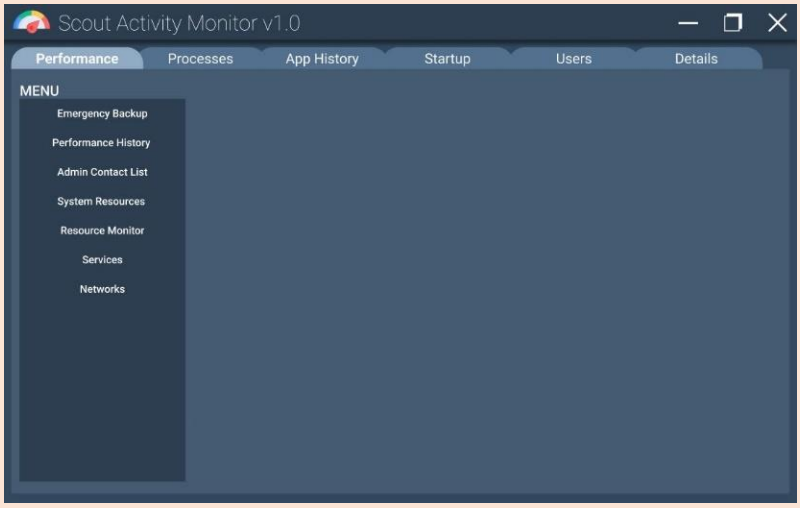
After we identified the problems and reorganized the pieces of information that we needed in the Define phase, we continued onto the Ideate phase. After a short brainstorming period, we all had come up with our unique ideas, ready to be presented and discussed.

Focusing on System Software, we all had the same idea to improve the Activity Monitor currently implemented on the servers. The proposed ideas are listed as follows:

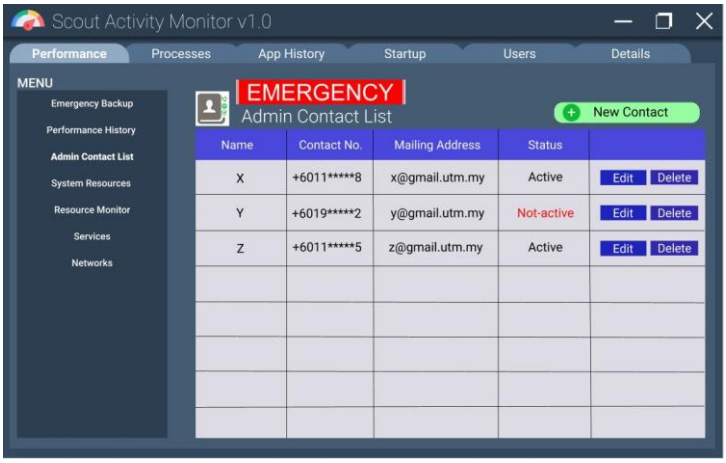
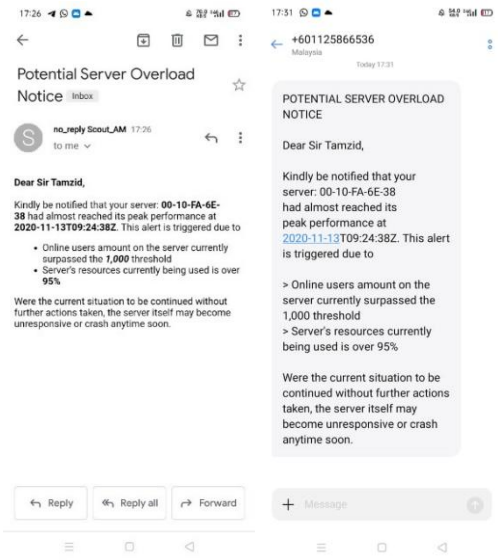
Solution	Description
Ability to perform an emergency backup	When the Activity Monitor senses the server is about to hit the threshold or limit of the available server resources, it will immediately force itself to save a backup. This way if the server crashes, no data is lost. This would also shorten the maintenance or restoration time during the event of a server crash. The activity monitor will possess the flexibility to allow the system admin to tweak the threshold or limit in which the Activity Monitor will automatically trigger the backup process.
Detailed server performance analysis and visualization	The activity monitor would keep track of past server's performance, and able to immediately analyse and generate a user-friendly data representation of the server's performance, through the aid of clear visualizations like charts and graphs. For example, when invoked, the activity monitor will be able to show precisely which time of the day in the past months that the server suffered a spike in network traffic. This way the system admin will be able to gain a better insight on the server resources and thus better determine the server's hardware needs
Automatic alerting and warning capability	The activity monitor will possess the ability to automatically notify the staff when it senses an unusual amount of high traffic accessing the system resources. This can be done through sending an SMS or email to the related ICT staff registered in the Activity Monitor's "Contact List" The threshold or limit can be set manually so that the activity monitor will only notify those in the "Contact List" when the server reaches it.

Phase 4: Prototype

Based on the ideas of improvement generated from the Ideate phase, we were ready to make our ideas come true. Below showcase the useful specifications which our prototype, "Scout Activity Monitor", will possess.

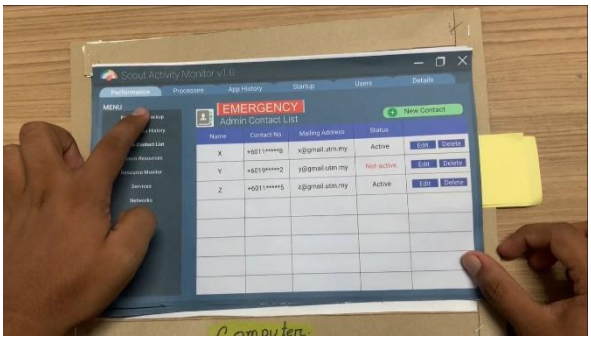
	Description
Clean and modern looking UI	Using **Figma**, we attempted to show how our improvised Activity Monitor would look like. Emphasizing on the clean and modern design, the colour palette for the GUI is carefully selected. We choose so that our prototype, "*Scout Activity Monitor*" to be dark themed and easy to be navigated through tabs and menu lists. 
Emergency data backup	The activity monitor will be able to automatically sense when the server is about to hit the limit for its available resources and therefore, forces the server to immediately perform a data backup to prevent data loss in an event of a server crash.] The "Scout Activity Monitor" is made to provide flexibility to the users. Through easy-to-use interface, the system admin can adjust the backup drive to be used, as well as the threshold for the backup to be triggered, like the number of online users active or processor workload.

	
Detailed server performance analysis and visualization	The activity monitor would keep track of past server's performance, and able to immediately analyse and generate a user-friendly data representation of the server's performance, through the aid of clear visualizations like charts and graphs. With the data of past server's performance stored, our "Scout Activity Monitor" would be able to quickly perform analysis and synthesize a user-friendly overview of the server's performance. By just catching a glimpse of the graphs and charts, the users can immediately grasp an insight on how the server is performing currently and in the past. Past issues with the server were also precisely logged in a table, with detailed information like the date and time, the staff that fixed the issue and duration of the issue. 

Automatic alerting and warning capability	When the activity monitor senses a spike in the network traffic and exceeds the threshold set by the user, it will automatically send an SMS as well as e-mail to the admins registered in the “Contact List”. This way the admin can be notified and be prepared for an upcoming server issue like crashing before the event happening itself. As the saying goes “Prevention is better than cure”. System admins can register themselves in the “Contact List” easily through the interfaces provided. The messages and e-mail sent are also clearly understandable, stating the exact server that is having the problem and the time of occurrence.   **Email received (Left), SMS received (Right)**

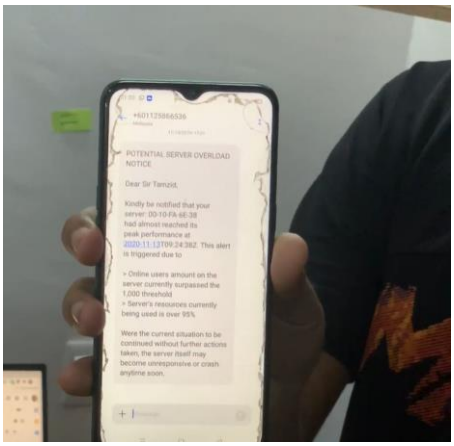
Phase 5: Testing

After the prototype is successfully built, we first tested our product, “Scout Activity Monitor” ourselves. Every functionality is ensured to be running correctly and smoothly before we show it to our actual clients.

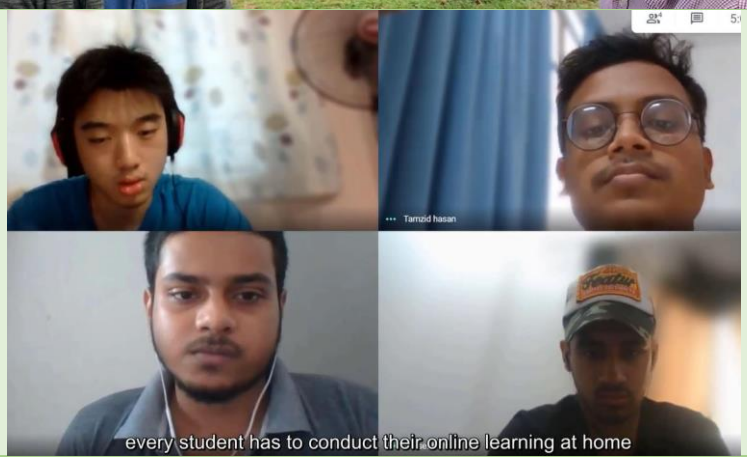


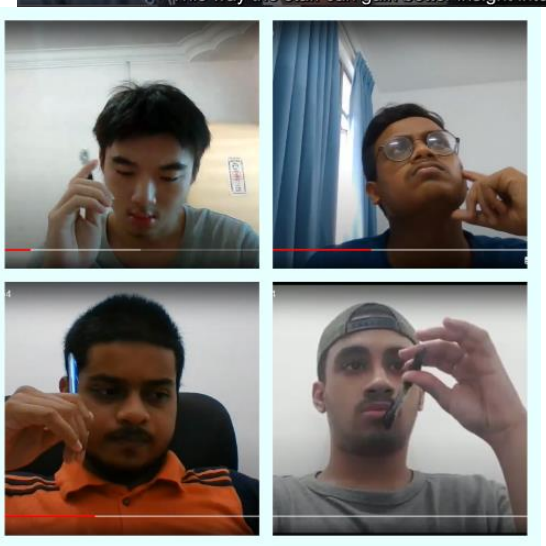
Our first client to have the prototype tested is Mr Ruzhan Islam, Tamzid’s friend who is a startup owner that we have interviewed in Empathy phase. We installed our “Scout Activity Monitor” on his server, and have him use our improvised system software for 1 week.

After 1 week, we interviewed Mr Ruzhan Islam again to obtain his feedback. Satisfied with our prototype, Mr Ruzhan Islam responded positively about it and even showed us the SMS alert message that he received during one occurrence that his server almost crashed. It can be said that the testing turned out to be a great success.

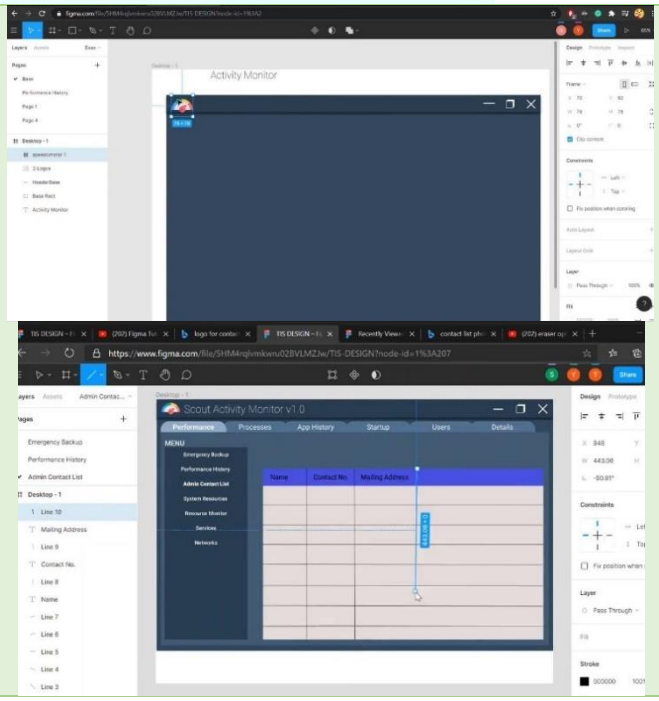


Design Thinking Evidence

Photo	Description
	Empathy Phase: Interview session with Mr Mohd Farid, an ICT Expert
	Empathy Phase: Interview with Mr Ruzhan Islam, Tamzid's friend who is also a startup owner
	Define phase: Group meeting



Ideate phase:
Group meeting and brainstorming process

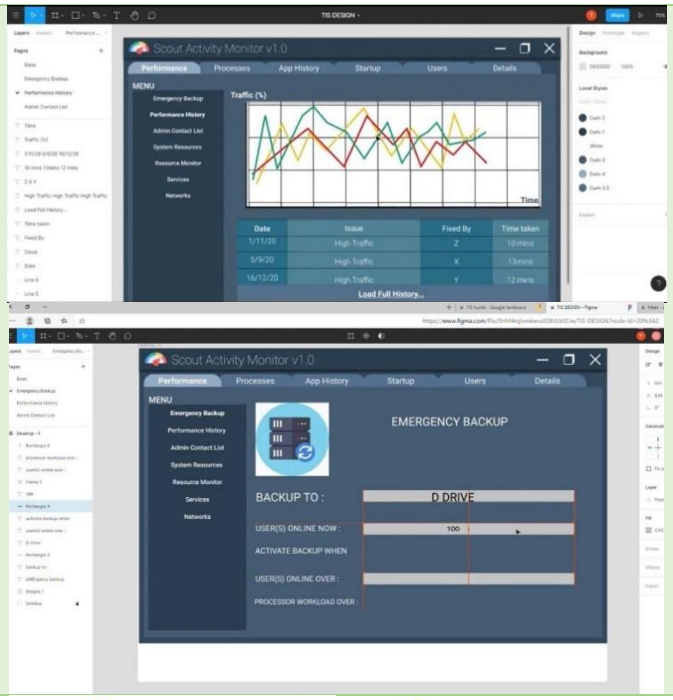


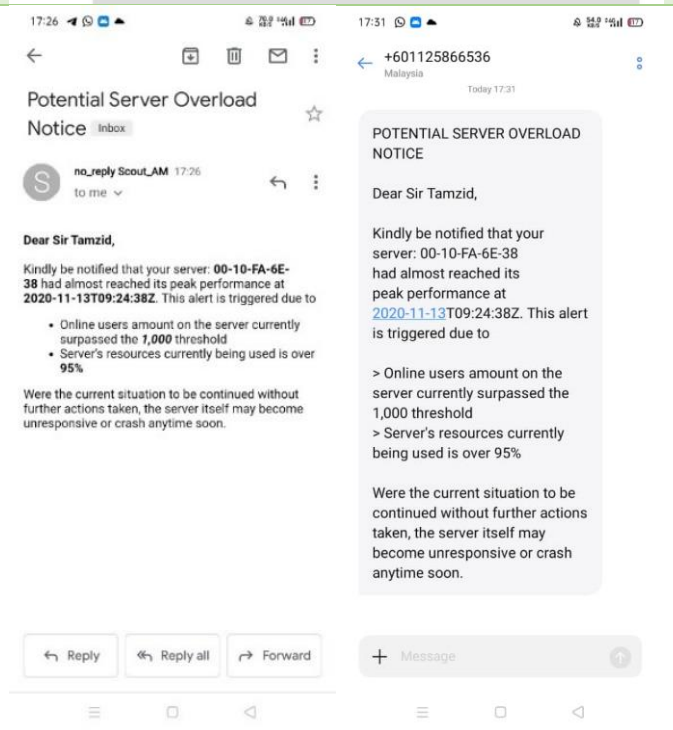
Prototype Phase:
Each group member collaborating on **Figma** to create the prototype of "Scout Activity Monitor"

Soh – Base of the window
Samuel – Admin Contact List
Tamzid – Performance History
Youssef – Admin Contact List

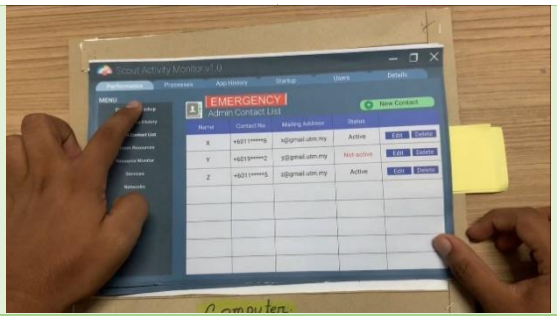
Raw Sketch

Figma

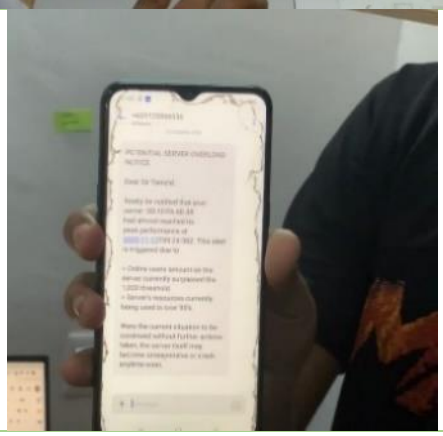




Prototype Phase:
The screenshot of the SMS and e-mail received from the Scout Activity Monitor



Testing Phase:
Testing the software ourselves before testing on the client's device

	Testing Phase: Initial installation on the client's device
	Testing Phase: Software installed on the client's device
	Testing Phase: Client showing the SMS message received from the Scout Activity Monitor

Reflection

Member	Reflection
Soh Jun Wei	Since the moment I first enrolled myself into Software Engineer Course, I have set my goal precisely: work hard to climb up the ladder in becoming a useful engineer in the future which could potentially contribute a lot to the society. Throughout the Design Thinking project, I've learned a lot about both System Software and the methodology of design thinking itself. I have truly realized how important system software is to the normal functioning of a computer. Also, I learnt that design thinking is one of the best ways to come up with a solution to a problem, as the processes, although seemingly simple, had proven to be very effective and efficient from the start of identifying the nature of problem until the testing phase. It also had taught me about critical thinking and ways to think creatively and innovatively in coming up with a solution to a problem. Every day, technology is evolving rapidly and one can easily fall behind if not actively learning. Therefore, to become successful in the field of IT, I must shape myself to be a lifelong learner, always be passionate and active in digesting new information and knowledge.
Youssef Hesham KHAIRAT	Since I finished high school, I decided then that I wanted to learn more and more about the computer and know how it works in terms of software and how to improve its work and innovation of new designs and works and how to solve the problems that exist in it. Design thinking was my beginning in it, from which I learned about software better and about how to plan to solve problems better as it helped me think more (Thinking Outside The Box) to create new and effective ways to solve problems. Day after day, science improves, man must be familiar with it, especially the software part of it. To be successful in the field of information technology, it is necessary to be constantly informed of technology and all modern innovations, and always be passionate about discovering and searching
Md Samiul Hasan Sayad	I chose software engineering as my career because this field is so wide and involves a variety of roles in both computer applications and software. And I am very interested in the computer and their software. Also, I need to work hard to be a successful engineer in future. From the design thinking project, I got a lot of information about system software and how it works. Design thinking is a powerful tool for problem-solving because the methodology is simple and easy to implement, in addition to being a new and creative way to solve a problem. Design thinking certainly tries to share the ideas I have learned and how I can apply them to improve the problem-solving processes. Although we are already thinking of creative solutions to the problems,

	empathy finding techniques, making a problem statement, concept building and making prototypes will help my team to come up with better solutions. With design thinking, daily problems can be seen from a new perspective and fixed in a few repetitive cycles.
Mir Tamzid Hasan	I took this course of software engineering to become an effective developer and serve in a tech giant company. From my very childhood I have been interested in computers, video games and gradually grew up as a software and technology enthusiast. Since then I have cherished an intense desire of becoming a software engineer and work in a tech giant company and eventually build my applications someday. The concept of Design thinking is new to me. Understanding the customer's problems and creating an application or a program as a solution to it rather than selling a specific idea or creation is undoubtedly a modern move. I believe I can be a successful software engineer once I can develop programs that help or solve people's problems. Design Thinking will impact specifically on how I will be able to satisfy my customers by understanding their needs and help me figure out solutions for them. The world is evolving. It is witnessing changes now and then. Especially when it comes to the Information Technology sector, evolution is prevalent every second. To become successful in this field I believe staying updated and focused to cope up with all these changes is the only improvement necessary for me to let my potential reach the peak.

Task Coordination

Member	Task
Soh Jun Wei 	• Coordination of tasks and activities to group members • Interview with Mr Mohd Farid • Proposal for the general idea of the solution • Recording of discussion • Subtitling of discussion and interview • Prototype – Base creation • Report writing and compiling
Youssef Hesham Khairat 	• Complete task and activities as a group member • Participate in a discussion about the problem and the solution • Giving some solution for solving the problem • Prototype- Emergency Backup • Report writer
Md Samiul Hasan Sayad 	• Complete task and activities as a group member • Discuss the problem and solution • Give opinion to get a better solution • Prototype – Contact List • Report writing
Mir Tamzid Hasan 	• Interview with Mr Ruzhan Islam. • Discussing with group members for a solution. • Designing of the Performance History of the Prototype. • Making the whole Prototype physically. • Presenting the prototype in the video. • Taking customer feedback. • Subtitling of an interview with Ruzhan Islam and feedback.

	• Compiling and editing the Design Thinking video. • Report writing.

Video Link:

https://youtu.be/vt3x8z5cbk8

Thank You