FACULTY OF COMPUTING
UTM Johor Bahru

SEMESTER 1 2024/2025

DESIGN THINKING PROJECT REPORT

TECHNOLOGY AND INFORMATION SYSTEM SECP1513

SECTION : 5

GROUP : 7

GROUP MEMBER :

NAME	MATRIX NO.
CHAN SIEW CHING	A24CS0057
CHING QI YAN	A24CS0235
LOOI YU XIANG	A24CS0107
UNG YII JIA	A24CS0310
YEOH HUEY TING	A24CS0315

LECTURER : DR. HASWADI BIN HASAN

Contents

Introduction

In today’s world, people's lifestyles are increasingly inclined toward convenience. According to GlobeNewswire, there are 14.8 million vending machines worldwide. However, alongside this growth, several challenges have emerged for both users and owners. Users often encounter issues such as items getting stuck, popular products often understock, and struggle when overwhelmed by choices. Tracking stock levels and detecting customer preference can be difficult for operators.

Our design thinking project aims to address these challenges to enhance user satisfaction and operational efficiency by leveraging innovative technologies like Artificial Intelligence (AI) and the Internet of Things (IoT).

Detail Steps and Descriptions

1. Emphasize

This stage involves understanding potential users: operators and customers through research and interviews. During this stage, interviews were conducted with two operators, who are Mr. Lee and Mr. Tan, and two customers, Thung Thung and Jia Bao to investigate problems.

2. Define

During this stage, the information from the Empathy stage was discussed during group meetings (refer to Appendix A for log journal) and organized to define core problems. The operators' group struggles to understand customer preferences, restocking schedules, and accidental sale of expired products. The customers encountered problems with items getting stuck and were indecisive when buying things.

3. Ideate

During this stage, many ideas are generated and explored to develop practical solutions to the problem through brainstorming.

4. Prototype

During this stage, the design of the smart vending machine was discussed by combining the solutions. After the design draft is generated, the smart vending machine is ready to be prototyped.

5. Test

During this stage, the basic function of the smart vending machine is demoed and tested to the users. Moreover, feedback from the users is collected to be improved.

Detail Description

Problem

In terms of operators, they faced problems monitoring the stock level and restocking schedule, leading to missed sales or overstocking. Moreover, expired items being accidentally sold may result in legal issues and damage to the operator's reputation. Furthermore, it is hard for operators to accurately assess customer preferences and purchasing patterns, such as the preference for 100 Plus over cola at specific locations, leading to ineffective stock management and lost sales opportunities.

Most unsatisfactory experiences resulting in consumers come from products getting stuck in the machine. This is because the spiral rack in the vending machine causes the item to be stuck when its placement is incorrect. Furthermore, customers struggle when choosing products from vending machines. This might cause them to leave without purchasing anything.

Solution

To solve this problem, a smart vending machine named AutoTreats Vending Machine is prototyped implementing AI and IoT. It implements lockers that help to prevent items getting stuck. The screen on the top of the vending machine displays advertisements generated by AI. Besides, there is also an AI Voice Chat screen which implements AI Voice Assistant, TreatBuddy that can give recommendations according to user preferences to the customers (Christine Rzepka, Benedikt Berger, 2018). Moreover, there are also applications which have respective versions for operators and customers implementing AI and IoT.

The application can help operators monitor machine status remotely with the integration of IoT, and run routine checkups for inventory, hardware performance, and alert notification if maintenance is needed or products are about to expire (Vennan Sibanda [a], Lorraine Munetsi [b], Khumbulani Mpofu [a], Eriyeti Murena [a], John Trimble [a] , 2020). The application notifies operators of products about to expire with AI recommend advertisements for these products,

promoting sales before expiration. Then, the advertisements will be displayed in the user application and on the vending machine. Moreover, in the application, reports and charts are generated using AI for operator references on restocking (Navdeep Singh[1] , Daisy Adhikari[2] , 2023).

Besides, customers can purchase products online through the customer application or physically at the vending machine. Customers can choose their nearest pick-up location, select items and pay using online banking or e-wallets. Then, a QR code will be generated and needs to be scanned on the vending machine when collecting items to unlock the locker. Alternatively, customers can pay by QR or cash when buying physically at the vending machine too (Wahidul Alam[1], Dhiman Sarma[2], Rana Joyti Chakma[2], Mohammad Jahangir Alam[3], Sohrab Hossain[4] , 2021). After collecting the items, the new items will be automatically restocked into the empty slot.

Team Working

Firstly, we chose Siew Ching as our group leader since she can distribute tasks according to our ability. Yu Xiang and Qi Yan took charge of interviewing the operators which are Mr. Lee and Mr. Tan as well as the users of the vending machine which are Thung Thung and Jia Bao. Yii Jia and Huey Ting designed the vending machine and source for the needed materials and tools. Yu Xiang, Siew Ching and Yii Jia built the prototype according to the draft while Huey Ting did AI voice chat, user and operators APP using Canva and Figma. We worked days and nights and managed to produce a model of Auto Treats with interactive user and operator APPs.

Design Thinking Assessment

Creating a design thinking assessment for the AI in IoT-based vending machine project involved addressing challenges faced by operators and customers. Our objective was to develop an innovative solution that could streamline operations and enhance user experiences.

In the Empathy stage, our team observed the usage of vending machines and identified potential problems. We conducted interviews with two key groups: users and operators. From the interview, we get to obtain challenges they had faced and valuable insights.

In Define stage, we analysed and categorized the collected data into four core problems: for operators, the challenges of inventory management and advertising products nearing expiration; for users, issues with mechanical malfunctions (e.g., items getting stuck) and the need for personalized AI support.

Then, we proceeded to the Ideate stage, where our team brainstormed a range of solutions, from simple modifications (human-centered solutions) to advanced technologies (such as implementing AI and IoT).

In the Prototype stage, we designed a scaled-down version of our AI-powered vending machine, incorporating the key solutions identified during ideation to explore how they could work in practice.

Finally, in the Test stage, we invited both users and operators to test the prototype iteratively. In the future, we will refine the product based on their feedback and adjust to improve the vending machine.

During the project demonstration, the IoT-based vending machine was evaluated on objectives like predictive inventory management and personalized customer interaction. KPIs such as inventory accuracy, user engagement, and customer satisfaction assessed its performance. Testing included restocking predictions, online purchases, and AI-based recommendations. Over time, the machine will optimize using its database and deep learning, enhancing the system accuracy and efficiency.

Design Thinking Evidence

Sample Work

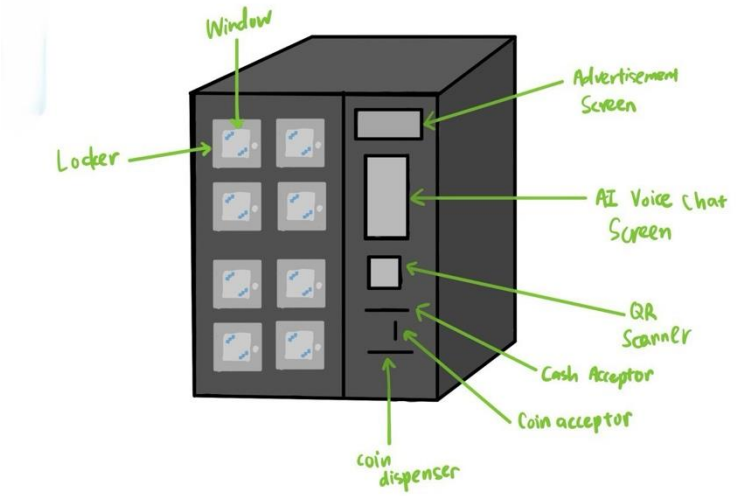

Figure 1: Drawing for the vending machine

Record For Each Phase

Empathy

We interviewed a group of individuals, and their questions and responses are summarized in the table below:

Operators A: What dissatisfaction do you face as a vending machine supplier?	I restock once a month, but best-selling products often run out quickly, even when I double their stock. Meanwhile, some items don't sell at all, making restocking inefficient and frustrating.
Operators B: What challenges do you face in managing stock?	Items sometimes expire in the machine, which is a loss and hurts my reputation. It's also hard to predict customer preferences at each location, making stock management a guessing game.

User A: What problems have you faced when using a vending machine?	Once, a cup noodle got stuck while dispensing. I couldn't get it out and had to call for a refund, which was frustrating.
Users B: What issues do you face while using vending machines?	I sometimes struggle to choose from too many options and end up not buying anything.

Define

According to interviews, operators face difficulties in managing inventory due to inaccurate stock estimations and poor planning. Expired products also result in financial loss while struggling to understand customer preferences at different locations, causing suboptimal sales.

Ideate

In this phase, we brainstormed solutions to the identified problems and ultimately decided to implement the vending machine concept.

Figure 2: First meeting

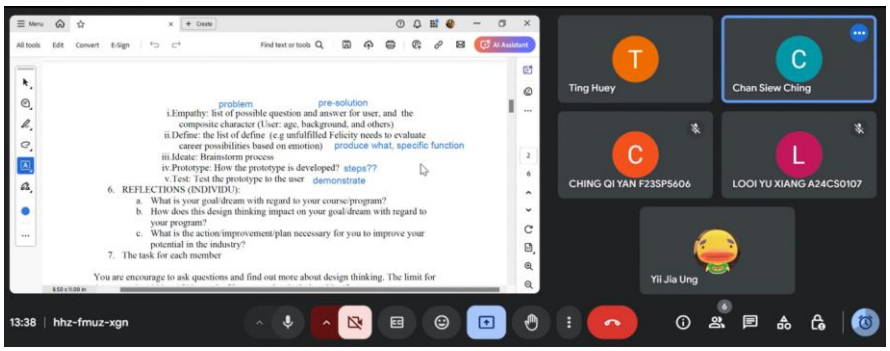

Figure 3: Online meeting

Figure 4 : Third meeting

Figure 5: Fourth meeting

Figure 6: Fifth meeting

Figure 7: Sixth Meeting

Prototype

While designing our prototype, we combined knowledge, inspiration, and information to develop solutions aimed at effectively addressing the problem.

Figure 8: Prototype

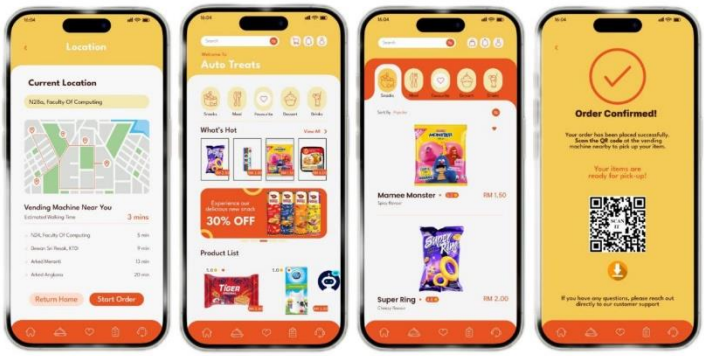

Figure 9: Application for users

Figure 10: Application for operators

Testing

During prototype testing, users praised the vending machine's innovative features. The user was amazed by the convenience offered by the application, while the seller highlighted its benefits for businesses.

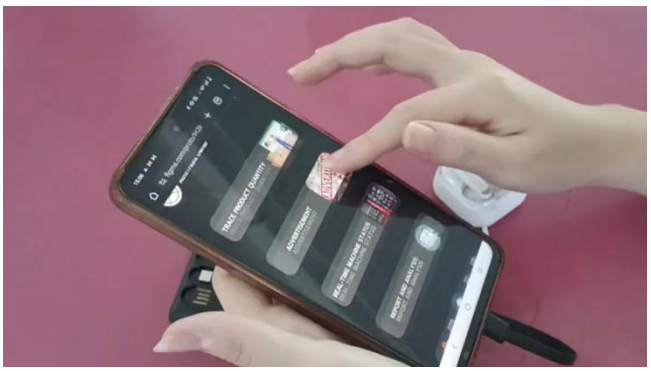

Figure 11: Testing the applications

Reflection

Qi Yan: My goal is to develop a product that can enhance happiness and transform an ordinary person's lifestyle. Design thinking allows me to collaborate with my team and share my ideas to generate a comprehensive solution. To enhance my skills, I need to deepen my understanding of the industry so I can contribute meaningfully to the industry. Additionally, seeking regular feedback is needed to advance my ability in the industry.

Siew Ching: The goal is to equip myself with the necessary skills and learn new technologies and ideas to play a key role in preventing cyberattacks. Design thinking lets me enhance my problem-solving and critical-thinking skills so that I can be aware of cyber threats and analyze complex situations effectively. I will try to keep up with the latest technology trends by participating in workshops, talks, or competitions to enhance my marketability.

Huey Ting: My goal is to turn theoretical knowledge into practical skills and help create a safer internet by defending against cyberattacks. This design thinking project inspired me to apply these principles to understanding customer needs and develop innovative solutions for real-world security challenges. To polish my skills, I will stay updated on cyber threats and continually develop my skills in Computer Network and Security to meet industry demands.

Yu Xiang: My goal is to gain technical expertise by mastering programming languages, database management, and network security. This project allows me to think about how AI can work in our daily lives while developing intelligent systems that analyze consumer behavior and optimize inventory. I plan to commit to continuous learning by enrolling in relevant courses, earning certifications, and staying updated with industry changes.

Yii Jia: My goal is to develop skills in overcoming cyberattacks and become a network security engineer in the future. This project helps to develop my problem-solving skills, and cultivate my creativity in innovation through brainstorming and cooperation with team members. I must equip myself with significant skills including problem-solving skills, learn to work in a team and get the professional certification needed for the industry.

Task Assignment

Task	Members
Interview	Yu Xiang Qi Yan Siew Ching
Report writing	Yii Jia Yu Xiang Siew Ching
Prototyping	Yii Jia Yu Xiang Siew Ching Huey Ting
Video preparation	Yii Jia Huey Ting Siew Ching
Slideshow preparation	Huey Ting Yii Jia Qi Yan

Reference

Christine Rzepka, Benedikt Berger. (2018). *User Interaction with AI-enabled Systems: A Systematic Review of IS Research.* Retrieved Dec 23, 2024, from: https://www.researchgate.net/profile/Benedikt-Berger-2/publication/329269262_User_Interaction_with_AI-enabled_Systems_A_Systematic_Review_of_IS_Research/links/5bffb55392851c63cab02730/User-Interaction-with-AI-enabled-Systems-A-Systematic-Review-of-IS-Research.pdf

GlobeNewswire. (2024). *Global surge in connected vending machines points to a high-tech future for on-the-go retail*. GlobeNewswire. Retrieved Dec 21, 2024, from: https://www.globenewswire.com/news-release/2024/10/15/2962946/28124/en/Global-Surge-in-Connected-Vending-Machines-Points-to-a-High-Tech-Future-for-On-the-Go-Retail.html

Navdeep Singh[1] , Daisy Adhikari[2] . (2023). AI in Inventory Management: Applications, Challenges, and Opportunities. *International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 11 Issue XI ,* Nov 2023, 2049-2053. Retrieved Dec 20, 2024, from: https://www.researchgate.net/profile/Daisy-Adhikari/publication/376032757_AI_in_Inventory_Management_Applications_Challenges_and_Opportunities/links/65679741b86a1d521b1b9878/AI-in-Inventory-Management-Applications-Challenges-and-Opportunities.pdf

Vennan Sibanda [a], Lorraine Munetsi [b], Khumbulani Mpofu [a], Eriyeti Murena [a], John Trimble [a] . (2020). Design of a high-tech vending machine. *Procedia CIRP 91*, 2020, 678–683. Retrieved Dec 21, 2024, from: https://www.sciencedirect.com/science/article/pii/S2212827120308829

Wahidul Alam[1], Dhiman Sarma[2], Rana Joyti Chakma[2], Mohammad Jahangir Alam[3], Sohrab Hossain[4] . (2021). Internet of Things Based Smart Vending Machine using Digital Payment System. *Indonesian Journal of Electrical Engineering and Informatics (IJEEI) Vol. 9, No. 3,* September 2021, 719-731. Retrieved Dec 20, 2024, from : https://section.iaesonline.com/index.php/IJEEI/article/view/3133/641

Appendix

Appendix A (Log Journal)

Date	In Attendance	Agenda	Activities	Due	Outcomes
Week 3 25/10/2024 (Friday) Physical	Siew Ching Qi Yan Yu Xiang Yii Jia Huey Ting	1. Understanding marking rubric. 2. Brainstorming.	1. Discuss areas to be focused on AI in IoT.	25/10/2024	Choose retail IoT to be focused for the project.
Week 8 26/11/2024 (Monday) Online	Siew Ching Qi Yan Yu Xiang Yii Jia Huey Ting	1. Task Dividing. 2. Understanding the requirements for each phase.	1. Divide tasks among group members to interview users and operators of vending machines 2. Start to prepare a report.	-	Each member is given a task to interview users and operators of vending machines.
Week 10 11/12/2024 (Wednesday) Physical	Siew Ching Qi Yan Yu Xiang Yii Jia Huey Ting	1. Preparing report. 2. Generate ideas for prototype.	1. Information from the empathy stage is discussed and organized. 2. Brainstorming idea for prototyping. 3. Sketch the draft of the vending machine.	-	The problem and solutions are generated after discussion. The draft of the desired outcome vending machine was developed.
Week 10 12/12/2024 (Thursday) Physical	Siew Ching Qi Yan Yu Xiang Yii Jia Huey Ting	Prototyping ideas.	Draw the drawing of the model.	-	The sketching for the model is generated.
Week 10 13/12/2024 (Friday) Physical	Siew Ching Qi Yan Yu Xiang Yii Jia Huey Ting	Prototyping ideas.	1. The materials needed for prototyping are prepared. 2. Start to prototype ideas.	-	The ideas are done prototyped.

Week 13 31/12/2024 (Tuesday) Physical	Siew Ching Qi Yan Yu Xiang Yii Jia Huey Ting	Testing the prototyping to users.	1. Testing the prototyping. 2. Receive feedback from the users.	-	The prototyping is tested, and we receive feedback from the users.