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Ms. TROMM: An Intelligent Styler Recommendation System Integrating Weather, Schedule, and Personalization for Enhanced Daily Wear Management

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***Abstract*—This paper introduces Ms. TROMM, a sophisticated application designed to enhance clothing management and utilization through intelligent recommendations. Ms. TROMM leverages a combination of real-time weather data, user schedules, and personal preferences to offer tailored clothing suggestions. The application provides various types of notifications including daily recommendations based on current weather and user schedules, control recommendations for styler functions, general reminders, and post-schedule learning notifications to refine future suggestions. Users interact with the system through pop-ups and notifications, with options to manage and control their styler directly. The My Closet feature allows users to manage their wardrobe efficiently, ensuring that clothes needing stylizing are highlighted and new items can be easily registered. The system aims to alleviate the daily stress of clothing decisions and optimize the use of home appliances, such as stylers, in a smart home ecosystem. With the vision of becoming an integral part of users' smart home setups, Ms. TROMM represents a significant advancement in personalized and automated home appliance management, promising enhanced convenience and efficiency for modern lifestyles.**

TABLE I: Roles and Descriptions

Roles	*Name*	*Description*
User/Customer	*EO JIN LEE*	User/Customer contemplates what functions should be added from their perspective. For example, the 'LG TROMM Styler' not only manages clothes neatly but also adds scent. Consumers may want to use these functions remotely via the 'LG ThinQ' app. The app could also identify weather or schedules to manage clothing needs appropriately.

I. Introduction

A. Overall Introduction

We are going to create this application with an emphasis on enhancing the value of LG TROMM Styler. Clothing functions as my second skin as one of the three basic elements of life, food, clothing, and shelter. I wear clothes every day and look at what the other person wears. In particular, it constitutes my egos through the process of choosing clothes and the habit of wearing clothes. Clothing is not only a basic purpose of protecting the body, but also a means of representing the value and status of the person wearing the clothes. Likewise, clothes are tools to complete humans, which are social animals.

However, it takes a lot of time and effort to manage the clothes to wear every day. Especially, in Korea, difficulties in managing clothing at home have increased due to air pollution such as fine dust. Due to this situation, the demand for clothing management devices at home increased, and in May 2011, LG launched the 'LG TROMM Styler' (hereinafter referred to as 'Styler'). Styler is loved by allowing clothes to be managed at home for dry cleaning and shows high growth in sales rates. Furthermore, stylers are developing into comprehensive home appliances including indoor dehumidification functions as well as clothing management.

In addition to this, LG increased device accessibility by linking its app called 'LG ThinQ' with a styler.' LG ThinQ' is a representative home appliance management app that provides smart home services based on AI. With this application, you can control not only home appliances, but also all parts of the house, as well as check product status and malfunctions anytime, anywhere. In a situation in which the market environment is rapidly changing from 'supplier-centered' to 'consumer-centered, LG is providing these services, believing that the role of AI technology has grown.

However, I found that most users always worry in front of the Styler, "What should I wear tomorrow?" This is because they put clothes in the Styler to take full care of them for tomorrow schedule. In this situation, I have introduced an AI-based recommendation system(hereinafter referred to as 'Ms.TROMM') to Styler to reduce this time of concern and promote consumer-centered value.

Ms.TROMM recommends modes that can be operated by the Styler, styling, and scent. First, Ms.TROMM makes recommendations based on the user's calendar. By linking the calendar, Styler mode is recommended according to the user's schedule, and user can select the Styler operation by their preference. Second, Ms.TROMM uses the weather API to recommend suitable for the weather or a Styler mode that suits with weather. Third, Ms.TROMM identifies the clothes and the material of the clothes in the Styler and recommends the appropriate Styler mode and styling information for the clothes. Finally, data is accumulated through the process of receiving

Product Designer	*YU JIN HER*	A product designer is a person with user-centered thinking ability to sympathize with and understand the user's experiences and plays a role in creating an overall framework for product and services. It performs smooth collaboration with other team members with excellent communication skills. It focuses on the usability of products and services and performs designs to provide better results.
Software Developer	*GA HEE HAN*	A software developer refers to a person who makes software. This includes discovering a meaningful service and accurately grasping the needs of a user who wants to use the service. In addition, there is a need for the ability to design and code these services and user needs in software. Furthermore, the software developer tests the created program.
Development Manager	*JIN HO KIM*	Development Manager manages the overall part of the project, such as the schedule/planning of the project and the quality of products and services. It also manages/supervises the entire software engineering process of designing, developing, and testing software from accurately grasping user requirements. In addition, in this process, Development Manager helps project participants communicate smoothly.

TABLE 2: Roles of Members

user feedback after all recommendations, and Ms.TROMM provides more sophisticated personalized recommendations. Through this, people can reduce their time of concern in front of the styler every evening or morning, and the need for a styler in my lives will also increase. Also, it is expected that users will be able to receive positive values for LG and styler if Ms.TROMM is installed in the 'LG ThinQ' application. I plan to create this application with an emphasis on increasing the satisfaction of styler users through Ms.TROMM, a system that allows users to use stylers and experience better.

B. Problem Statement

- There is an application called 'LG ThinQ' as a mobile application that can be used in conjunction with LG home appliances. I thought that it would be better if a recommendation function was included in this application
- It is very useful to use a styler to manage clothes, but since it takes a lot of time to manage clothes, there is a time constraint to take care of clothes to wear right away in the morning.
- Therefore, I thought that the styler could be used more effectively if there was software that knew the user's schedule and weather and sent a message to manage clothes in advance.
- The software recommends clothes that users will like in the future based on feedback on past users' tastes and recommendations. In other words, it helps you to use the styler efficiently by controlling the past and the future at once.

II. REQUIREMENT

A. Entry

If the user downloads and runs the application, the splash screen is required. The splash screen is a screen that appears for 1 to 2 seconds not to show the empty screen during loading of the app's data when running the application and will utilize the way to access the app screen naturally using the service's logo as the background. And if the user doesn't have a login history on your phone, the onboarding page will be displayed to the user explaining why the main functions and functions of Ms. TROMM are useful. The onboarding page consists of a description of the overall application, the sign-up button and the login button.

B. Login

On the login page, a form screen appears where users can enter e-mails and passwords. Ms. TROMM authenticates whether you are a user registered in the DB with two elements: an e-mail and a password. At the bottom of the login button, there is a button to sign up for membership and go to the password change screen.

1) Fail to Login: The re-input request pop-up has occurred.

2) Sign up: Go to the member registration page.

3) Find password: Go to the password search page.

4) If the user log in for the first time: Go to Survey

5) If the user has a log-in record: Go to Main Page

C. Sign up

Ms. TROMM requires four types of information when signing up for membership. This is the email and password used to check DB registration and the gender and year of birth required to configure the initial recommendation. And there is a password verification field to reduce password-related errors. When the membership registration is completed, go to the login page.

1) Invalid: If an invalid value is entered in each field, a remark requesting re-entry occurs under the field.

2) Pass: If a valid value is entered in each field, a statement that it has been confirmed occurs under the field.

3) Fail to Sign-up: If you do not fill out each field or press the membership button while entering an invalid value, a pop-up occurs that requires re-entry.

4) Complete: A message congratulating membership and a button to go to the login page is exposed.

D. Survey

When the user first logs in to Ms. TROMM, the survey page is exposed. The survey consists of contents that help set up the initial recommendation system. The survey consists of a total of three chapters (a style you usually wear often, a favorite color, and a favorite scent). Among them, the style you usually wear often offers different options depending on the gender value you entered when signing up for membership.

1) Survey Guide Page: There is a brief description of the survey and a button to go to the survey page.

2) Questionnaire page: It consists of a total of three chapters. Up to three options can be selected, and you can pass them without selecting them.

3) If the user doesn't select an option: If you don't select it, a pop-up appears stating that the accuracy of the recommendation may decrease.

4) Warning: When clicking on the bottom nav during the survey, a pop-up will occur indicating that the user cannot go to another page.

5) Complete: When the user complete the survey, press the button on the exposed screen to go to the main page.

E. Main Page

Users can check the functions in the app at once on the main page.

1) Date and weather widget: The user can check today's date and weather.

2) Today's recommendation widget: The user can check today's recommendation.

3) Styler Control Widget: Styler Control Possible

4) Current my house widget: The user can check the temperature and humidity of your house.

F. Pop-up notification

Recommendations and styler-related information from Ms. TROMM are displayed through pop-ups.

1) Today's Recommendation Pop-up: consists of buttons that receive content and user responses.

2) Control Recommendation Pop-up: consists of content and confirmation buttons.

3) General pop-up: consists of content and confirmation buttons.

G. Notification

It is a menu in which all pop-ups are displayed within Ms. TROMM. Everything the user has seen is recorded.

H. Recommendation

It is a menu where recommendations are exposed. In this menu, users can check two tabs: today's recommendation based on schedule and weather, and control recommendation using clothing information in the styler. When the user first enters the recommendation menu, a page with a description of each element in the recommendation menu is exposed.

If the user wants to see the recommendation and run the fragrance control system inside the styler, the user can click on the fragrance recommendation list to run it.

1) Menu description screen: Exposed when entering for the first time.

2) Move the recommended menu: Check and move the two recommended tabs with the menu button at the top.

3) Apply Scent: You can apply the recommended scent within the styler with a pop-up that appears by pressing the Scent button.

I. My Closet

My closet is a menu that can be accessed anywhere in Ms. TROMM with floating action buttons. You can see the registered clothes in my closet, and you can check the information you entered when registering clothes. And each outfit tells you how many stylers you need in a comment.

1) Information Check: The information you wrote when you registered your clothes, the registration date of your clothes, and the date you last put your clothes in the styler are exposed.

2) Register new clothes: Ms. You can register new clothes in TROMM DB. This information is linked to a smart mirror. When registering new clothes, a form screen appears to enter the information on the clothes.

J. Styler

This menu is linked to the styler so that the user can control the styler in this app. It provides a button to operate all the operating functions in the styler. The button placement was adjusted by referring to another remote control application.

1) Styler on/off

2) Choose a styler course

K. All

This is a menu that allows users to check the basic application information. You can check the application version information in this menu. In addition, you need a function that allows users to check and modify what they wrote when signing up. And you can check the terms and conditions of personal information used within the application.

III. DEVELOPMENT ENVIRONMENT

A. Choice of software development platform

Our main development environment is Windows and MacOS. In the case of Windows, terminals that can be used even in windows such as Powershell were used to create a linux environment, and in the case of MacOS, built-in linux environment and terminals were used. Ms.TROMM in order for consumers to receive recommendations faster and immediately control devices such as stylers and smart mirror. Ms.TROMM was manufactured based on mobile applications. In addition, Ms.TROMM so that more users can use it in various mobile operating systems. The frontend framework of Ms.TROMM selected 'Flutter', a representative cross-platform framework. Currently, Google's Android accounts for the majority of global mobile platforms, and Apple's iPhone accounts for about 15%, but Apple's iPhone users' consumption patterns and loyalty to electronics are quite different from Android users, and iPad, which accounts for a large portion of the tablet market, so the actual usage rate is very high. In fact, looking at the mobile operating system market share, including the tablet market, it can be seen that the proportion of iOS (including iPadOS) has increased by about 30%. Therefore, I have adopted Flutter, a mobile/web/desktop cross-platform framework launched by Google based on the Dart Programming language, as a frontend framework, satisfying all of these demands and further considering future desktop applications. In the case of backend server, Python-based Flask, which implements artificial intelligence-based services and has well-established statistical and analysis packages, was adopted. Flask has the advantage of being easy to create API servers and very light. In addition, since Flask has a high degree of freedom, such as being able to change and respond immediately according to the purpose of development when there is not much time left, It was adopted because it was considered the most suitable web framework for Ms.TROMM development.

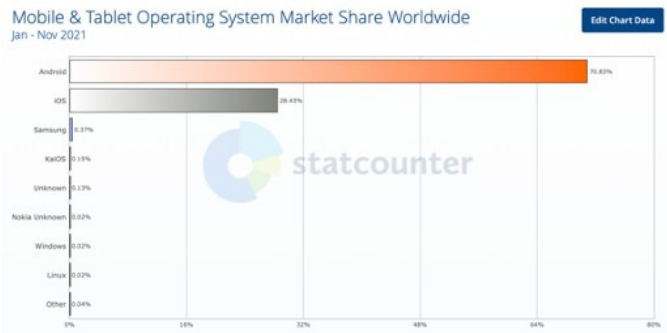


Fig. 1: Mobile & Tablet OS Market Share Rate

B. Cost estimation

To implement Ms.TROMM, it was necessary to obtain data from the database or to obtain real-time information from the server while communicating with the server in real-time.

TABLE III: Development Environment

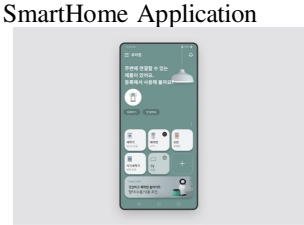
Name	*Development Environment*
JIN HO KIM	MacOS, Python 3.8.5
EO JIN LEE	Windows, Python 3.9.0
GA HEE HAN	Windows, Python 3.9.2
YU JIN HER	Windows, Python 3.7.1

Fig. 2: Cross-platform framework 'Flutter'

Therefore, real-time servers were hosted or several APIs were needed. However, in the process of development, I tried to develop open APIs, free modules, and free servers first. Therefore, the server also implemented a real-time server through the Heroku service, which is a server that provides free hosting up to certain traffic. In addition, the process of bringing up weather and calendar information used open APIs that were released free of charge to Google and others. However, JetBrain's Datagrip was used in the process of controlling data, and this application is provided free of charge only to students. Later, Ms.If the TROMM service is expanded, traffic on the server may increase and various copyright problems may occur, so it would be desirable to use paid services when expanding the service.

C. Software in use

1) LG ThinQ, LG SmartHome Application

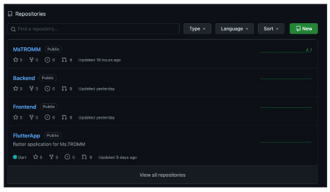


LG Electronics uses the 'LG ThinQ', an application to control its smart home appliances. In addition, in the case of smart mirror, it can be controlled through the 'LG Smart Home' as a key home appliance for the smart home ecosystem that will be built as soon as possible. Through these two apps, LG Electronics will bridge users and smart devices so that users can monitor and control their homes anytime, anywhere. My application is also an app to build a better ecosystem between users and smart devices. my app is a smart assistant-like application that integrates the environment in which users use smart devices, checks minor things in advance that users may miss, and recommends the best way.

2) VSCode(Visual Studio Code)

VSCode is an open source-based text editor published by Microsoft. VSCode is a text editor, not an IDE, but has the advantage of being able to install various expansion packs. In addition, it has its own terminal function. Supporting various languages, The development environment for data and artificial intelligence technologies used by Ms.TROMM is excellent. In addition, VSCode was adopted as a text editor because of its excellent interworking with Git, a version control system.

3) GitHub



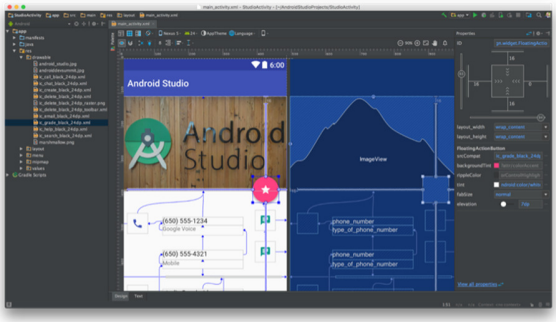
GitHub serves as a repository for Git, a distributed version control system. During development, several people go through a collaborative process of adding and deleting various functions, which can lead to confusion in this process without a version control system. Github is a web-based service that allows you to intuitively understand the team members' version control process. In addition, simple processes such as simply uploading and downloading files can be easily controlled using GUI tools such as Github Desktop.

4) Android Studio

In the case of Ms.TROMM, since it is basically a mobile app, an integrated development environment (IDE) for mobile apps was needed, and Android Studio, which team members were relatively familiar with, was adopted as IDE. Both Flutter and Android Studio, which I adopted as the Frontend Framework, are platforms announced by Google, so they are highly interconnected,

TABLE IV: Tools and Programming Languages Used for Development

Tools and Language	***Reason***
Python	Python is one of the most widely used programming languages. The TIOBE Index, which ranks programming languages monthly, listed Python as the No. 1 language as of November 2021. Python is also used as the base language for Flask (a web server framework) and offers modules like Pandas and Numpy, which are essential for data analysis and processing collected data.
MySQL	MySQL is selected to manage a database that stores user data from Ms.TROMM members, including schedules for recommendations and user responses. This supports tailored service recommendations, so MySQL was chosen to handle these core databases.
Flutter (Dart)	Flutter, launched by Google, is a cross-platform framework based on the Dart language. For future expandability to web and desktop apps, Ms.TROMM is developed with Flutter, which provides near-native performance, a wide range of extensions, easy UI testing in virtual environments, and compatibility with IDEs and code editors, making it ideal for frontend development.



so there was no big problem in developing them. The advantage of being able to develop while checking the progress of the app through the UI is also the reason for adopting Android Studio.

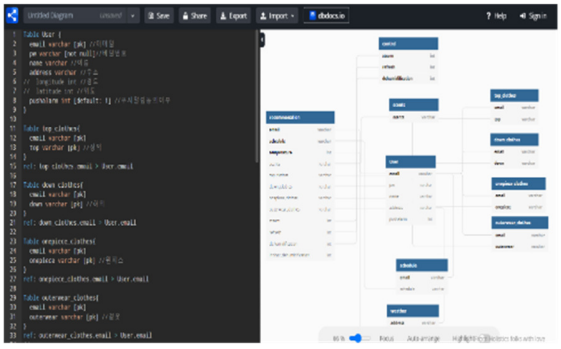
5) Heroku

Heroku is a service that allows free hosting of websites through git. It is a cloud platform as a service (PaaS) that supports multiple programming languages. In general, when developing or implementing an app, it provides a platform that enables applications to be developed, executed, and managed without the complexity of creating and maintaining related infrastructure.

6) Firebase

Firebase is a backend as a service (BaaS) that provides the necessary functions for web and mobile development. In other words, it is a service that helps you focus on front-end development without designing or implementing servers separately through back-end development. Features include real-time databases, easy user authentication, cloud storage, hosting, app testing, and profit generation.

7) DBdiagram



It is a free, simple tool to draw ER diagrams by just writing code. So, the user can draw entity-relationship diagrams, painlessly. ERD is a very important development product because it can be used to see the model at a glance when implementing functions. Using this site, ERD can be configured through a code similar to SQL. If related codes such as tables and indexes are inserted without drawing ERD separately, ERD is automatically generated. It is also very useful because it can be modified based on code even when modifying.

8) MySQL

MySQL is the most widely used open-source database worldwide. It is an open-source relational database management system (RDBMS) that uses the standard database query language SQL (Structured Query Language) and features very fast, flexible, and easy to use. It supports multi-user, multi-threads, and provides an application interface (API) for C, C++, Eiffel, Java, Pearl, PHP, Python scripts, and the like. It can be

used in Unix, Linux, and Windows operating systems. The Linux operating system, Apache server program, MySQL, and PHP script language composition are free programs that are developed as open-source despite good interworking, so MySQL was also adopted in the development of Ms. TROMM.

9) SQLAlchemy

SQLAlchemy is an open-source SQL toolkit and object-relational mapper (ORM) for the Python programming language. The advantage is that it is possible to focus on business logic with object-oriented code. It also increases reuse and maintenance convenience and reduces dependence on DBMS. Because of these advantages, I decided to use SQLAlchemy with Ms. TROMM's recommendation system.

10) Datagrip

A DBA tool which is aimed at developers who work with SQL databases. In other words, it is a GUI development tool that facilitates DB development and management. A lite version of DataGrip is embedded within the Ultimate edition of some of JetBrains' IDEs.

11) flask

Flask is a micro web framework written in Python. It is classified as a microframework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that can add application features as if they were implemented in Flask itself. Extensions exist for object-relational mappers, form validation, upload handling, various open authentication technologies and several common framework related tools.

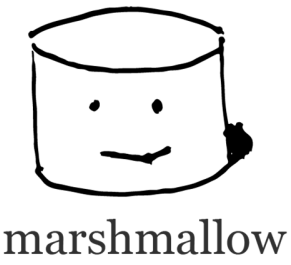
12) numpy

NumPy is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays.The ancestor of NumPy, Numeric, was originally created by Jim Hugunin with contributions from several other developers. In 2005, Travis Oliphant created NumPy by incorporating features of the competing Numarray into Numeric, with extensive modifications. NumPy is open-source software and has many contributors. NumPy is a NumFOCUS fiscally sponsored project.

13) pandas

Pandas is a software library for analyzing and manipulating data written in Python language. Pandas provide data for manipulating and operating numerical tables and time-series data, which can be used free of charge under Article 3 BSD license conditions. Pandas is named after the first letter of "PANel DATA," a term used in econometrics. Pandas use a structure called DataFrame modeled after the data. Frame structure used in R, many of the functions used in data. The frame of R can be used without difficulty. Moreover, because Python operates on a language-based basis with good accessibility, it has become an essential library for those who enter Python for data analysis.

14) Marshmallow Marshmallow is an



ORM/ODM/framework-agnostic library for converting complex datatypes, such as objects, to and from native Python datatypes. Marshmallow schemas can be used to validate input data. And it can be used to deserialize input data to app-level objects. Also it can be used to serialize app-level objects to primitive Python types. The serialized objects can then be rendered to standard formats such as JSON for use in an HTTP API

15) Swagger

Swagger is a framework for Open API Specification (OAS). Swagger is used together with a set of open-source software tools to design, build, document, and use RESTful web services. Swagger includes automated documentation, code generation (into many programming languages), and test-case generation. Simply put, Swagger is an API Spec document. The method of managing APIs through Excel or guide documents requires periodic updates, so it is not easy to manage and takes a long time. So, I can easily manage and test API documents by automating API Spec documents using Swagger.

16) XCode Xcode consists of a suite of tools that developers

use to build apps for Apple platforms. Use Xcode to manage your entire development workflow — from creating your app to testing, optimizing, and submitting it to the App Store.

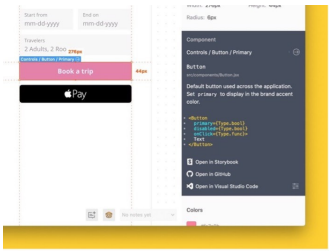
17) Google API API is an application programming interface that allows users to exchange requests and responses from different programs such as clients and servers. API allows products/services to communicate with each other without knowing how to implement them and saves time

and money by simplifying the application development process. It is divided into an open API and a private API according to the method and purpose of use. Open APIs can be easily accessed and shared by anyone, and private APIs provide information only to some authorized users. (Google API is an open API.)

18) Adobe XD Adobe XD is an application for prototyping

PCs, mobile Internet pages, and mobile apps released by Adobe. Since Ms.TROMM is a mobile app-based service, it was necessary to think about how users could feel the best experience when providing the app. Therefore, it is possible to intuitively prototype the operation of an Internet page or app operating in a corresponding environment through Adobe XD. In addition, the app development can be made easier by linking the prototype made in this way with Zeplin.

19) Zeplin



Zeplin is a software that helps designers and developers collaborate, and through Zeplin, you can convert design elements into development information (e.g., font, size, size, etc.). While developing apps through Zeplin, you can solve problems that may not be faithful to functional implementation while calculating design elements too deeply.

D. Task distribution

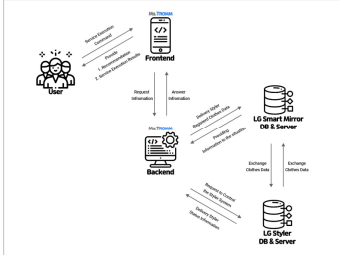
As shown in *Table V.*

TABLE V: Task Distribution of Members

Tasks	***Name***	***Description***
Frontend Developer	*GA HEE HAN*	The frontend developer configures business logic and the user interface by exchanging data with the backend API. This includes developing all components the user interacts with, as it provides the first impression of Ms. TROMM. The role serves as a bridge between backend functionality and user experience, ensuring seamless interaction.
Backend Developer	*EO JIN LEE* *JIN HO KIM*	Backend developers implement the service logic for Ms. TROMM, including cloud management, hosting, and API development for client requests. They design tables to organize application data for database management and use cloud platforms for server setup.
Product Designer	*YU JIN HER*	The product designer defines required functions for Ms. TROMM, based on user and service benchmarks. This role involves analyzing requirements, deriving insights, and designing screens and service policies that align with user needs and application goals.

IV. ARCHITECTURE DESIGN AND IMPLEMENTATION

A. Overall Architecture



We have three parts of my application, Ms. TROMM'. The first part is 'Flutter', which is for my front end. It mainly reacts with the client(user) part. This will help us with my overall application, containing several functions and designs. For my backend, which mainly reacts with the server, I use Flask and SQL Alchemy. Flask adopted it because it can build and develop back-and-server light and fast. In addition, through SQL Alchemy, the database can be object-oriented and SQL can be handled with Python. Last part is MySQL and Heroku which is for server. MySQL is used to remotely manage databases, and MySQL is connected to Heroku Service Part, a server that provides free hosting up to certain traffic.

B. Directory organization

(We will add the picture of out UML) This is the table which shows directory, file name and part name. (We will add the directory of last part)

C. Part 1: Flutter (Frontend)

1) Purpose
   To develop Ms.TROMM, a cross-platform that can be developed in both Android and iOS environments, I used Flutter, a web/app cross-platform framework developed by Google based on the Dart language. In the case of Ms.TROMM developed with Flutter, it can be used in both web and app environments. The advantage of developing Ms.TROMM is that it can be developed in a familiar environment among the existing iOS or Android development environments, such as Android Studio or Xcode. In the case of Ms.TROMM, it is an artificial intelligence software that provides better recommendations while accumulating data through learning, so it is important to provide an environment that can be used by more users. Therefore, Flutter was adopted as a front-end development environment to provide a better experience for both developers and users.
2) Functionality
   Ms.TROMM's front-end made with Flutter requests JSON-type data processed by the back-end itself (or processed from the database) from the back-end and serves to show Ms.TROMM users to use it easily. In addition, the information received from the user is delivered to the back-end server and stored (updated) in the database, or data is provided for the back-end server to process. In other words, users can communicate with the backend server of Ms.TROMM through the frontend of Ms.TROMM as well as with the systems of LG Styler and LG Smart Mirror. Users can get a better experience for Ms.TROMM and LG Electronics from the user-friendly front-end of Ms.TROMM.
3) Location of source code
4) Class component
5) Where it is taken from
   Install the Flutter SDK first. Environmental variables must be set to use the plotter command. If you type environmental variables in the window search box, you will see "Edit System Environment Pile" and click it. Find and correct the variable 'PATH' in the user variable and put the Flutter SDK in the BIN path. Run the flutter console and enter the flutter doctor command to verify that the conditions for executing the flutter are satisfied. After installing Android Studio, install the Flutter plug-in to complete it.
6) How and why I use it
   Flutter is a web/app cross-platform framework developed by Google based on the Dart language. When developing, it is a burden for developers to create a separate native app that runs in both iOS and Android environments. However, this problem can be solved by using a flutter. In addition, the community is active because it is created and supported by Google, and unlike other frameworks and Android studios, modules

TABLE VI: Directory of Ms. TROMM

Directory	*File Name*	*Part Name*
document/ Ms.TROMM -Project -document	*Ms.TROMM-document.pdf Ms.TROMM-document.tex*	*documentation*

or libraries must be imported, it is developed using various functions provided on the basis, so the speed of development is relatively short. So, Ms.TROMM had to be developed in an agile development environment, so it was developed by adopting Flutter and focusing on selection.

D. Part 2: Flask+ SQLAlchemy (Backend)

1) Purpose
It was decided to use Python-based Flask to build Ms.TROMM's backend server. In the case of Flask, since it is possible to build and develop backend servers light and fast, it was judged to be the most suitable framework due to the nature of the development that requires delivering Restful API to the frontend. Due to the nature of the agile development environment, choosing a secure framework certified by many developers was an important issue for us, and when blocked by various errors and bugs, it had to be easy to find a way to solve it. Therefore, flask served my purpose as a stable framework loved by many developers as a web framework. In addition, through SqlAlchemy (ORM), the database can be object-oriented and SQL can be handled with Python.
2) Functionality
As a result of weaving the ERD model at the design stage, the ERD model was not simple. Therefore, it was determined that it was better to deal with the database through ORM. As a utility to utilize ORM, Python-based SqlAlchemy was used. Through this, database control, management, maintenance, and maintenance were easily established. In addition, Marshall, a great module from Python that processes data in the database into restful API (JSON), was used to selectively respond to the desired data.
3) Location of source code
4) Class component
5) Where it is taken from
Python is released free of charge, so anyone can easily download it, and it is being updated continuously. In addition, modules developed with Python are continuously being updated and can be easily installed through anaconda, a virtual environment, or pip, an installation module. Various integrated development environments (IDE) and text editors are also supporting python. Ms. flask, SQL Alchemy, etc. Several modules used in Ms. TROMM can also be easily used by installing and importing them through pip or the like in a python environment. (https://www.python.org/downloads/)
6) How and why I use it
In the case of Flask, since it is Python-based, object-oriented programming and excellent open-source modules, which are advantages of Python, can be used. There is a lot of work to process various and large amounts of data with the back-and-framework, Ms.In the case of TROMM, since it is artificial intelligence-based software, it is very helpful to have many modules in various fields. In addition, the community has the advantage of being solid as it is a programming language used by experts in various fields. In the case of the environment developing Ms.TROMM, Agile development was not long, and the development of Front and Back had to communicate closely. In addition, there were many processes of updating information in the database and importing updated information in real-time, and the main function was to check it in real-time and inform the most optimal recommendation through push notification. In addition, the linkage (connection status) and control between LG Styler and LG Smart Mirror were also considered, so many variables were often considered. In this volatile environment, front and back-and-developers were able to communicate with Restful API and work simply by checking Restful API through Swagger Tool.

E. Part3: MySQL + Heroku (Database)

1) Purpose
In the case of Ms.TROMM, it was difficult to utilize a database or server on a local basis because it had to receive information in real-time, update, and learn. Therefore, MySQL, which can remotely manage the database, is used, and MySQL is connected to the Heroku service part, a server that provides free hosting up to certain traffic so that data in the database can be read and updated in real-time.
2) Functionality
MySQL is an application that helps create and manage tables that can manage databases. To deal with MySQL (SQL), I need to be familiar with SQL language, but I were able to deal with SQL through Python code through SQL Alchemy's ORM. By connecting MySQL to the clearDB of the Heroku server, I was able to check in real-time whether the data was properly updated through JetBrain's Datagrip. In addition, through Heroku, real-time communication between the front and back end (database) was possible. Heroku, a free hosting server,

allows users to receive Restful APIs from back-and-server or use Ms.TROMM services even in remote environments, not local to certain traffic.

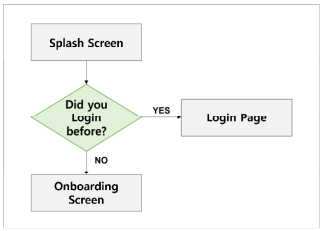
3) Location of source code
4) Class component
5) Where it is taken from
   MySQL is an open-source DBMS announced in 1995. Many of the world's largest and fastest-growing organizations, including various SNS such as Facebook and Twitter, rely on MySQL. This is to save the operating time and cost of large websites and package software. To implement an efficient database solution, I use MySQL. MySQL can be installed simply on Windows 10 and you can easily download it by entering the website link.
   Heroku is a cloud computing platform that supports multiple programming languages. The origin of the name comes from Hero and Haiku. It supports a variety of things, including Git and GitHub, and many services are supported by add-on and API. Heroku's most representative advantage is that it has very good elasticity. To use Heroku, you need to install the CLI, and if you proceed with the tutorial, you can install Heroku's program.
   DataGrip is a GUI development tool that facilitates database development and management. DataGrip is widely used because data extraction is fast and simple. Compared to the web, the web has a lot of restrictions on data extraction. However, regardless of the size of the Datagrip bank, it can be extracted with a single click. Datagrip corresponds to SQL and operates in conjunction with other DBMS. You can enter JetBrains and install it easily.
6) How and why I use it
   When I select a database, which service to choose between SQL and NoSQL was an important issue. Due to the nature of Ms.TROMM's service, there is no service to be provided other than the existing database service, and SQL was adopted because it was judged that the service could be provided to users only by queries of the existing SQL service. In addition, it was decided to use MySQL, which was judged to be the most stable and popular among several SQLs. In addition, I judged that MySQL is a good choice because it is one of the SQLs that can easily and visually handle databases in conjunction with JetBrain's Datagrip. Several server hosting services were considered as servers that help manage these databases in real-time, but Heroku's clearDB service, which can be used free of charge, was linked to MySQL to conduct prototype tests using Heroku.

V. USE CASES

A. Installation

When the user goes to 'App Store' or 'Google Play Store' and searches the words 'Styler', 'Smart closet', or 'home application control', my application will be recommended. When the user downloads my application, 'Ms. TROMM' will becreated on their mobile phone.

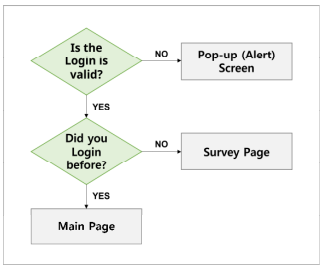
B. Turn on the application



When the user clicks the 'Ms. TROMM' application icon, the splash page of my application will be shown. If there is no history of logging in to my application on the user's mobile phone, the onboarding page will be displayed. The user can read the description of why the main functions on the onboarding screen. At the end of the onboarding screen, the user can go to the login or membership screen. If the user has a history of logging in to my application from the user's mobile phone, the login screen appears immediately instead of the onboarding screen.

C. Login

1) Enter ID(e-mail) and password
   The user must enter their ID(e-mail) and password in the ID and password fields for Login, respectively.



1) Login Button

- If the user's ID and password are established: Approved
- If the user's ID and password are not established: Pop-up screen indicating that login failed
- If the login is successful(if the user is first time to Ms.TROMM): the survey page is displayed
- If the login is successful(if the user logged to Ms.TROMM in before): the main page is displayed

2) Sign-up Button
   When clicking the password change button, it goes to the password change screen. The user can change the password after entering the ID information and receiving confirmation that the ID is in the DB.
3) Changing Password Button When the user clicks the membership registration button, it goes to the Sign-up form page.

D. Sign-up

When the user presses the membership registration button, the membership form page is displayed. The membership form page requires five types of information. Users must agree to the terms and conditions of personal information utilization.

1) Name
   The user enters the name to be used within the app. This information is notified that it is used as a nickname for the user in the app. The name is accepted as a letter value of 8 characters or less. If it exceeds 8 characters, the phrase ”Please enter your name less than 8 characters” will be displayed at the bottom of the field. If the user follows the format, the phrase ”confirmed” will be displayed in green at the bottom of the field.
2) ID(e-mail)
   This e-mail information is used when logging in. If the user enters content that does not comply with the email format, the phrase ”Please follow the email format and enter it” will be displayed at the bottom of the field. If the user follows the format, the phrase ”confirmed” will be displayed in green at the bottom of the field.
3) Password
   This password information is used when logging in. The password has a rule of combining English and numbers of less than 8 digits. If the user does not follow the password format, the phrase ”Please configure the password in a combination of English and numbers of 8 digits or less” will be displayed in red at the bottom of the field. If the user follows the format, the phrase ”confirmed” will be displayed in green at the bottom of the field.
4) Check Password
   To reduce password errors, the user is asked to enter the password one more time. If the user does not enter the same password, the comment ”Please check the password again” will be displayed in red at the bottom of the field. When the format is followed, the phrase ”confirmed” is displayed in green at the bottom of the field.
5) Gender
   I receive the user’s gender value for the initial recommendation system configuration. Gender values consist of two, male and female.
6) Birth year
   The initial recommendation for system configuration, the dates of birth of the user input. The user clicks the scroll box and selects the dates of birth.
7) Complete Sign-up When the user creates all the items and completes verification of the items, membership registration is approved. After approval of membership registration, go to the page where membership registration is completed. Users can return to the login screen by pressing the login button on the Completion page.

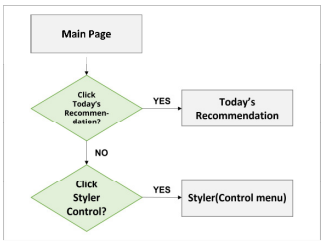
E. Survey

Users who are new to log-in will go to the survey page. The first page of the survey consists of informing users that it is a survey to recommend better. You can proceed with the survey by clicking the ’Go to survey button’ on the page. You can’t move on to another menu before the survey.

1) Favorite style
   This page allows users to choose a style that they wear often. Users are given six options, and different options are given depending on the gender they created when signing up for membership. Pop-up occurs that it may be difficult to apply the recommended information customized service when selecting ”Not Here.”
2) Favorite color
   This page allows users to select their favorite colors. Users will be given a total of nine options. Pop-up occurs that it may be difficult to apply the recommended information customized service when selecting ”Not Here.”
3) Favorite scent
   This page allows users to select their favorite scent. The user will be given a total of 6 options. Pop-up occurs that it may be difficult to apply the recommended information customized service when selecting ”Not Here.”

F. Main Page

This is the main page of Ms. TROMM. Here, the user can check and manipulate approximate information on the application.



1) Basic item
   This is a widget that allows users to check today’s date and today’s temperature. It’s a widget that can’t be clicked.
2) Today’s Recommendation
   In today’s recommendation items, users provide today’s recommendations based on schedules and weather information in the form of previews. When the user clicks on this item, it goes to today’s recommendation menu.
3) Styler Control
   In the Styler control item, the user can check the connection and connection status with the Styler/Smart Mirror. It supports the pause/react button when the styler is operated. It also displays the remaining time until the styler operation stage and shutdown. When the app is initially running, it says it’s before the connection. After the connection, you can check the basic operation of the

styler. In order for the user to manipulate more details, it is necessary to go to the Styler Control Menu.

4) Styler Control
Users can check the temperature and humidity of their homes in this menu. And you can operate buttons that can control indoor dehumidification and automatic drying functions.

G. Pop-up

All recommendations occurring within this application are displayed once in the form of pop-ups. If you haven't checked the pop-up notification, you can check it in the notification item. If you turn on the push alarm, you can check the pop-up alarm without turning on the application.

1) Today's Recommendation
Based on the weather and schedule information, today's recommendation results using the recommendation system are displayed as a pop-up. Users can see the recommendations and check if they liked the recommendations. The check results are recorded in the DB, and the recommendation system learns based on the check results.
2) Control Recommendation
Based on the information value of the styler, today's recommendation results using the recommendation system are displayed as pop-ups. For functions such as drying, users can view recommendations and issue execution commands directly. When an execution command is issued, the command is executed, and a pop-up notifying the user that it has been executed is displayed again.
3) General Recommendation
Based on the weather value, content about what the user needs is displayed in a pop-up. For example, if it rains on that day, the user will be asked to take an umbrella that morning. Or if the daily temperature difference is more than 10 degrees Celsius, a comment is displayed asking you to be careful of the daily temperature difference. Users can get approximate information about the weather based on this notification.
4) Reminding
Based on the schedule information, it is displayed when a certain schedule is on the day of the user's schedule. Users can receive alarms that fit the schedule and check the schedule again or take care of the trivial things that can be forgotten. For example, on the day of the user's interview, a comment cheering for the interview is displayed.

H. Notification

All pop-up notifications that have occurred within this application can be found in the notification menu accessible on the main page. If there is a pop-up that you haven't checked, the pop-up will be displayed in blue, and you can check what was displayed in the pop-up when you click. In particular, in the case of today's recommendation, you can go to today's recommendation menu by clicking "Go to Today's Recommendation" at the bottom as soon as you check it. Pop-ups that have already been read are displayed in white. Like the pop-up that you haven't checked, you can check the details by clicking.

I. Recommendation

In the recommendation menu, more details of the recommendations that were printed as pop-ups are exposed. This menu is divided into two categories: today's recommendation and control recommendation. When you first enter this menu, a screen indicating the description of each menu is displayed. Based on this screen, the user can know what role each button plays in this recommended menu. In today's recommendation, users can check recommendations using calendars and weather APIs. In particular, when you click on the scent recommendation part, a pop-up asking if you want to apply the scent is exposed. In the case of control recommendations, recommendations related to the clothing and home environment in the styler are exposed. In the case of indoor drying, pop-ups asking if indoor drying will be performed are exposed.

J. My Closet

My closet is a floating action button displayed in the bottom right corner of this application that can be accessed anywhere. When the user clicks the button, he or she can go to the My Closet. If the styler is working, the user can determine what clothes are in the styler in a bookmark state. The clothes in the styler are bookmarked and displayed at the top of the clothing list. And divide the degree to which the styler is needed into three stages and display it on the clothes list together. Except for the costumes in the styler, the rest of the clothes are arranged in the order in which the styler is required. This makes it easy for users to figure out which clothes need a styler. For example, if the wedding is scheduled in three days, it will be marked "This Closes need Styler!" above the suit clothing item that can be worn for the wedding. And if you click the arrow at the bottom of each clothing item, the user can check the registration date, the last styler working day, and the registration of the clothes.
If the user clicks the "Register New Clothes" button in the upper right corner of the menu, a form page will be displayed to register new clothes. On this form page, users can enter pictures, names, colors, and materials of clothes. Pop-up information will reveal that learning recommended content may become difficult if the category is designated as not selected. And when you finish the new clothes registration process, a guide pop-up will occur to notify you of the completion of the new clothes registration process, and you will know that the user has completed this process.

K. Styler

In this menu, the user can control the interlocked styler. First of all, you can check the interlocking status between the styler and the smart mirror at the top of the menu, and if it is not interlocked, you can proceed with the interlocking. If it is not interlocked, the styler cannot be controlled. Assuming

interlocked, the user can control the styler with power on, power off, start operation, stop operation buttons, and reservation buttons. In addition, if the styler is working, it shows which function is working, and you can check the current status of the styler. At the bottom, there are a total of six menu buttons that can be operated by the styler. When the user clicks these buttons, detailed courses that can be executed in each menu are exposed in the form of modals. If the user clicks here, the detailed course is executed. If the user presses another run button during the styler trial, a pop-up will be displayed saying, "The styler is currently operating." If the user wants to do another run, the styler must be stopped first with the top button.

L. All

The user can check Ms. TROMM's general information in the All menu. You can check the application version information at the top of this menu. By clicking on the My Information menu below, you can check the information you created when signing up for this application. You can also modify the information. If the user wants to modify it, click the 'Modify' button at the bottom of the My Information menu. When the user clicks the button, the form page that was displayed at the time of membership registration is displayed. Each field contains values that the user originally entered. By clicking on each field, you can modify the content you have entered. When the correction is completed, the correction is reflected by pressing the button at the bottom. Changes are saved in the DB. Finally, when you click on the Personal Information Terms menu, you can check the terms and conditions you agreed to when you signed up for this application.

VI. Conclusion

In conclusion, the integration of artificial intelligence (AI) into home appliances represents a significant advancement in technology, transforming the way consumers interact with their everyday devices. This research highlights the profound impact of AI on user experience, emphasizing the benefits of enhanced functionality, energy efficiency, and convenience. As consumers increasingly seek smart solutions for their homes, it is imperative for manufacturers to focus on user-centered design and continuous innovation.

Moreover, the findings indicate that user perceptions play a crucial role in the adoption of AI-powered appliances. Companies must prioritize understanding consumer needs and preferences to create products that not only meet expectations but also enhance the overall quality of life. The future of home appliances lies in the seamless integration of AI technology, fostering a smarter and more sustainable living environment. Further research is needed to explore the long-term effects of AI on consumer behavior and the potential for new applications in clothing management systems and beyond. By addressing these areas, stakeholders can drive the development of cutting-edge solutions that cater to the evolving demands of the market.

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