

Mediger - A medication alarm manager on NUGU speaker

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Abstract—As our society enters an aging society, social problems related to the elderly are getting serious. We focused on the problem about them and we got to know older people often suffer from improper medication. Because of chronic diseases, the elderly usually take many medicines. In the case, they could confuse the medicines and take them in inappropriate ways. Therefore, we will develop 'Mediger' by using NUGU speaker, an AI speaker, and provide patients with a service to receive information about proper medication and alarm when to take a medicine.

Index Terms—Medication, Alarm, NUGU speaker, Application

I. INTRODUCTION

A. Motivation

As our society enters an aging society, we started with the idea that services for the elderly would be practical. While searching for problems of elderly, we noticed that there are many elderly who take more than 10 medicines due to chronic diseases, and that they can be hospitalized for inappropriate use of drugs, or even die in severe cases. In order to solve this problem, expert emphasized that there has to be the way to figure out which specific medicine the elderly take hour to hour, which was difficult in reality. Based on this, our team came up with the idea of 'Mediger' as a software that could solve the problem. We abbreviated 'A medication alarm manager'. At every time they have to take medicine, NUGU alerts and tells them how and what to take, like a secretary. And NUGU checks whether they took the right medication and records the result. By providing day-routine medicine information to the NUGU speaker and mobile application, we suggest a way to solve improper medicine taking problem.

It is also likely that SK Telecom, the client, will assess its effectiveness positively. Currently, SK Telecom sets importance on artificial intelligence welfare services for senior citizens. To be specific, in April 2019, SK Telecom launched an artificial intelligence care service to take care of elderly people living alone. In their point of view, the software that we developed is also fancy in that it can enrich their currently in place artificial intelligence care services.

B. Problem statement (client's needs)

We regarded that the client is in need of the development of user-friendly service and the expansion of NUGU speaker service. Thus, we decided to develop a software that can be used in the daily lives of older people who take medicine and that can utilize the NUGU service.

Even though it is daily routine for the elderly to take medicine due to chronic diseases, it is difficult to memorize all of them properly. It is because since many medications are taken with different dosages, the medication is often not taken in the right amount at the right time. If the improper medicine intake lasts longer, it can lead to the severe side effect.

Therefore, to meet the client's requirement and solve the social issue, we figured out our software.

C. Research on any related software

Currently, Korea University Medical Center cooperated with SK Telecom is developing an AI-based voice recognition medical treatment system. The goal is to allowing medical staff to simply enter the cure chart in voice directly and automatically by using AI speaker 'NUGU', which relieves the current medical staff from the cumbersome typing into the chart. However, the point is that this research is on the physician's perspective, not the patient's. Therefore, our team developed a service focused on the patients' daily lives.

As we researched for the background, there were already medicine alarms on the mobile application market. For example, the 'Medicine Time' application is alarmed when the time, medicine type, medicine usage is set, and checked whether the user took it or not. However, we differentiated ourselves as follows: Firstly, our service can identify the name and the usage of the medicine in voice. Secondly, our service can instruct how and what to take in voice. These two can be done by utilizing the 'NUGU' AI speaker.

In addition, we plan to apply artificial intelligence algorithm to our software, firstly, in suggesting a customized alarm time by analyzing personal intaking data, and secondly, in predicting the rest of word when typing the new medicine name by adopting 'autocomplete'. Whenever the user registers

a new medicine to the application, it is cumbersome to decide the every time to take medicine. To decrease this discomfort, our service recommends the personalized alarmic time, based on the user's data for which user recorded. By referencing the recommended alarm time, user could feel much easier to set alarm times. Also, typing complicated medicine name in Korean could be the hard job whenever user enrolls the new medicine. To solve this problem, we added a mechanism to predict the rest of the word that a user is typing, which is called as 'auto complete' or 'word completion', like Google or Naver. Every time user's typing goes by, our application shows the list of medicines including the specific character so that user can enter the medicine name by choosing the one of list.

TABLE I
ROLE ASSIGNMENTS

Role	Name	Task description and etc.
User	Myeongji Son	Assumes which specific services would be popular and needed in the user's point of view. Also searches for the background of the actual services.
Customer	Jiwon Yang	Predicts which requirements could be needed to raise purchasing desire in the customer's point of view. Also when the software development is done, checks if the requirements are sufficient or not.
Software Developer	Seungeun Lee	Draws out a list of software features to satisfy the customer's requirements and works on the actual software development. Tries best to reflect the customer's and user's needs.
Development Manager	Yewon Chung	Totally manages the project schedule and checks the deadline of each role. Helps other roles to communicate with each other smoothly and evaluates the software features.

II. REQUIREMENTS

A. Functional Requirement

A-1. Mobile application

The application serves to visually show the input and output of data. In addition, it is connected to an external server and passes various data to the speakers via proxy server.

- 1) The mobile application will be powered by Android and iOS.
- 2) The application must be able to receive information on medication from the user.

- The application should be able to process information about the user-inputted 'medicine name', 'dosage', and 'time to take medicine'.
- The application should be able to execute if the user wants to enter drug information through the photograph. Applications should be able to extract and process medicine information from photographs.

- 3) The application should be developed for user's convenience.
 - The application should have the text prediction service while typing the medication name.
 - The application should suggest the personal optimized time for taking the medication according to the accumulated personal data.
- 4) The application will have a simple and intuitive UI for older people to use.
- 5) The application will use a medication API that contains additional information such as the medicine's effects/side effects.
- 6) The application must be able to store the information received from the user in the database. The database will have information about user, medication name and medication time (e.g. - 30 minutes after meals)

A-2. NUGU Speaker

- 1) NUGU speaker should be able to start 'Mediger' play.
- 2) NUGU speaker should be able to recognize the voice and read the medicine information from the user's various speeches.
- 3) The request entered through NUGU speaker should be reflected in 'Mediger' application.
- 4) NUGU speaker will allow users to check the medication information by voice through 'Mediger' play.
- 5) NUGU speaker should be able to end 'Mediger' play.
- 6) NUGU speaker will inform the user that it is time to take certain medicine.
- 7) NUGU speaker must be able to automatically terminates the alarm when the medication period is over

A-3. Backend Proxy Server

- 1) The Backend Proxy Server is connected to the NUGU speaker. It receives the user's voice request through the speaker and forwards it to the application server.
- 2) The Backend Proxy Server is connected to the application server. The Backend Proxy Server receives a response to the request from application server and forwards it to the NUGU speaker.

B. User Management

- 1) Create a user account
- 2) Register the information of medication that the user is taking
 - Enter the information through voice via NUGU speakers
 - Type the information in the application
 - Register a photograph about the medication

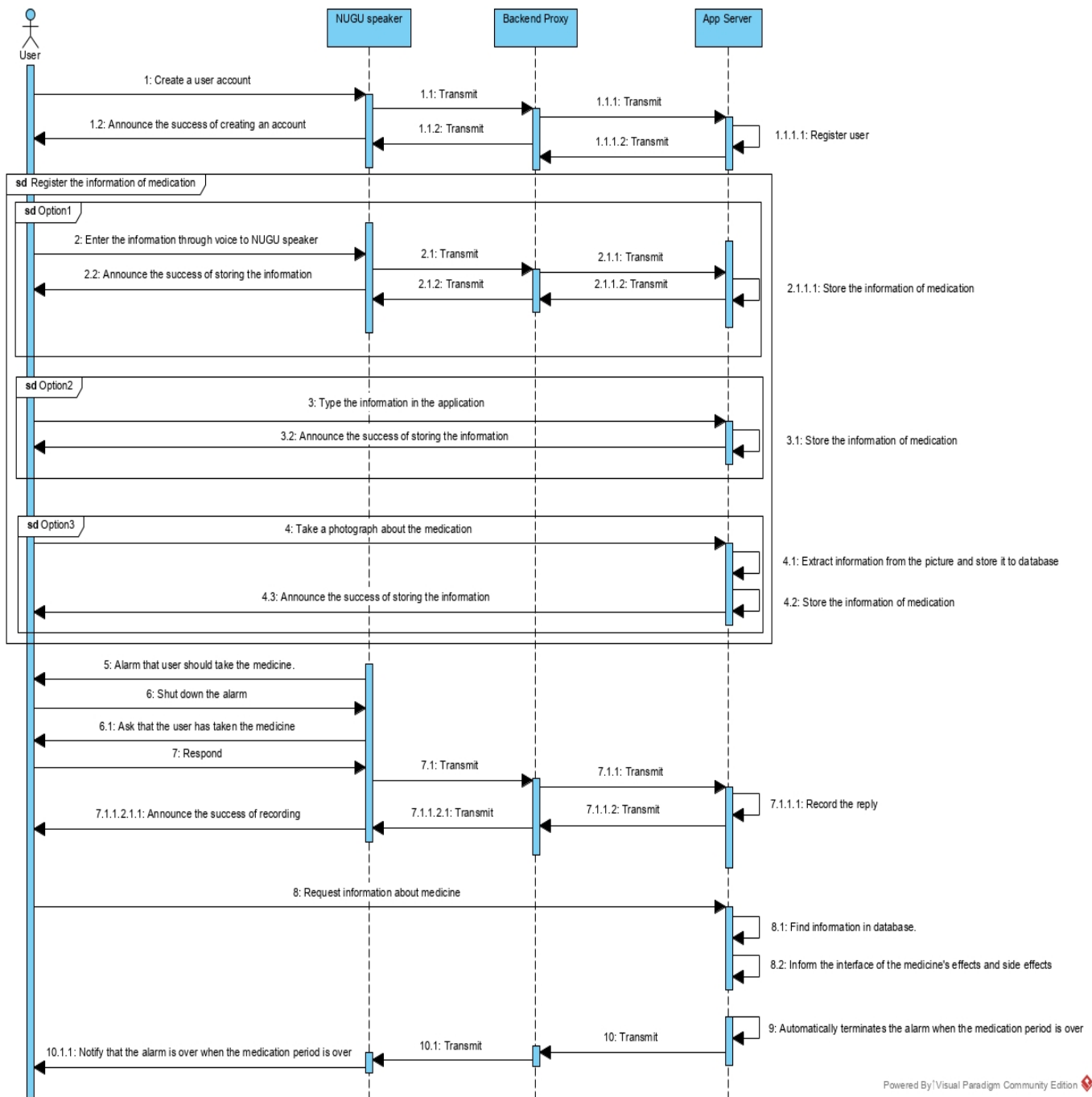


Fig. 1. fig:diagram

3) Store information in Database

- Store the information received through NUGU speaker
- Store the information entered from users via application
- If entered as a picture, extract information from the picture and store it to database

4) Notification of medication

- Alarm that user should take the medication.

- Notify that the alarm is over when the medication period is over
- Visually delivers effects/side-effects of medicine through application

5) Confirmation of medication

- Consider the termination of the alarm as taking medicine well
- User can check through app whether he/she has taken the medicine or not

- 6) Saving information about whether to take medicine or not

III. DEVELOPMENT ENVIRONMENT

A. Choice of software development platform

1) Platform used form

We will go to use Windows 10 and macOS. Windows 10 is a series of personal computer operating systems produced by Microsoft. According to the data onto 'Usage share of operating systems', In the area of desktop and laptop computers, Microsoft Windows is generally above 70% in most markets and at 77% globally. Then, it could be familiar to both of users and developers and decided to use. On the other hand, macOS is a Unix-based operating system and is a popular choice since lots of people prefer using Mac so we also choose it for developing.

2) Programming language

- Javascript : We program using JavaScript because it enables interactive web pages and is an essential part of web applications. The vast majority of websites use it, and major web browsers have a dedicated JavaScript engine to execute it. As a multi-paradigm language, JavaScript supports event-driven, functional, and imperative (including object-oriented and prototype-based) programming styles. It has APIs for working with text, arrays, dates, regular expressions, and the DOM, but the language itself does not include any I/O, such as networking, storage, or graphics facilities. To be more specific, we use react for front-end and use Node.js for back-end. React is a Javascript library for building user interfaces. It is optimal for fetching rapidly changing data that needs to be recorded such as information about medication. Node.js is an open-source, JavaScript runtime environment that executes JavaScript code outside of a browser. Node.js lets we use JavaScript to write command line tools and produce dynamic mobile app.
- HTML& CSS : We use HTML (Hypertext Markup Language) for front-end of our mobile app. It is the standard markup language for documents designed to be displayed. We also use CSS (Cascading Style Sheets) to describe the presentation of a document.
- SQL : We use SQL(Structured Query Language) for managing data. It is a domain-specific language used in programming and designed for managing data held in a relational database management system. It is particularly useful in handling structured data so this makes it possible to process user accounts and medicine-related information.

3) Cost estimation

4) Information of development environment

- Visual Studio Code : We choose Visual Studio Code as source code editor which could run on desktop

TABLE II
COST ESTIMATION

Software	Task Description	Cost
Visual Studio Code	source code editor	0
Github	Remote repository	0
MySQL	Data management	0
Overleaf	Document typesetting program	\$8/month
Adobe XD	UI design tool	0
Visual Paradigm	UML tool	0
Passport	authentication middleware	0

and is available for Windows and macOS. Also, it comes with built-in support for JavaScript and Node.js that we would use for programming.

- Github : We decided to use Github because it provides the necessary management functions for software development including the basic functions of the Git such as bug tracking, functional requests, task management and etc. Also, we can easily share and develop program sources together with our team members.
- MySQL : We would use MySQL for data management. It is an open-source relational database management system which is using SQL language to add, view or modify data in database. It is used to store account information and information about medicine.
- Overleaf : We decided to use Overleaf for writing the document. It is an online collaborative writing and publishing tool with real-time collaboration and the fully compiled output produced automatically.
- Adobe XD(UI design) : We use Adobe XD for user interface design. Adobe XD is a vector-based user experience design tool for web apps and mobile apps, developed and published by Adobe Inc. It is available for Windows and macOS, although there are versions for iOS and Android to help preview the result of work directly on mobile devices. We decided to use it because it reflects all the platforms we plan to use.
- Visual paradigm(diagram tool) : We use Visual Paradigm for modeling UML diagram(Unified Modeling Language diagram). This helps us envision simple and easy to understand the software we want to develop.
- Passport : Passport is authentication middleware for Node.js. Extremely flexible and modular, Passport can be unobtrusively dropped in to any Express-based web application. A comprehensive set of strategies support authentication using a username and password or authentication by single sign-on using an OAuth provider such as Facebook or Twitter and more.

B. Software In Use

- 1) Existing Software Medication alarm services(ex. Medisafe, MyTherapy, ROUNDhealth and etc) that can be operated on mobile apps already exist in many markets. It alerts a user when the user should take medicine. However, it is difficult for the elderly, who are information-weak, to use it. This is mainly because the way it is used is by hand to type information and set alarms. That is why we would utilize NUGU speaker to make medication-related services available to users through voice.
- 2) API For Applying Google cloud vision api : Google cloud vision api will provide us texts from the picture. This would help users enter drug information more easily.

C. Task Distribution

TABLE III
TASK DISTRIBUTION

Name	Task Description
Son Myeongji	App Backend, App Frontend
Yang Jiwon	App Backend, App Frontend
Lee Seungeun	Frontend, Playbuilder
Chung Yewon	Frontend, Playbuilder

IV. SPECIFICATIONS

A. Mobile Application

1) Sign up



The sign-up page for the Mediger app features a blue header with the 'Mediger' logo. Below the header, there are three input fields: '이름' (Name) with the placeholder '홍길동', '생년월일' (Date of Birth) with the placeholder '2000-01-01', and '성별' (Gender) with radio buttons for '남자' (Male) and '여자' (Female). At the bottom, there is a blue button labeled '가입 완료' (Sign up complete).

Fig. 2. Sign up

Sign-up page is a page after seeing logo when users enter to our 'Mediger' app. They can sign up our app by entering their name, the date of their birth and gender. By doing this, we make their accounts and store it to database for identification. By storing the user's session id, once they sign up, they don't have to log in again.

2) Main Page

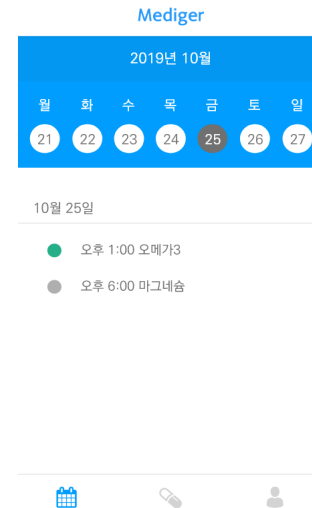


Fig. 3. Main page

Users can check their medication schedule on the main page after sign up.

a) Horizontal scroll calendar

The calendar is divided into two main parts: At the top, the horizontal scrolling calendar displays only the weekly unit, which can be flipped horizontally to increase user convenience. At the bottom, it tells you the medication schedule for the day you selected on the calendar above. In particular, it is easy to distinguish between medicine taken (green) and those not taken (gray) by color. Clicking on the medicine takes users to the Alarm function.

b) Alarm

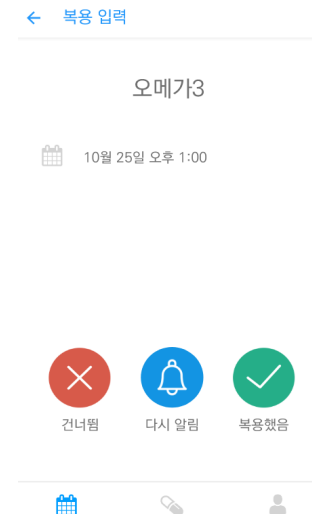


Fig. 4. alarm

When the alarm sounds that you need to take the medicine, the following page pops up. The user can

respond 3 ways. You can tell them that you have taken it, ask for a re-alarm, or skip not to take it. The user can easily send his request with the intuitive button design.

3) Medicine List

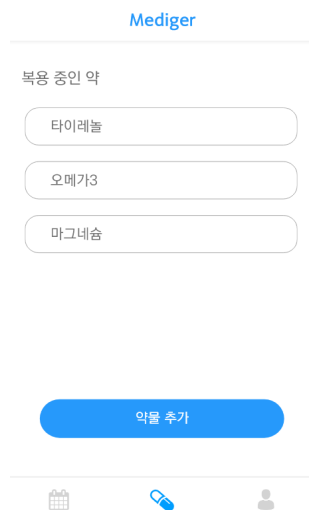


Fig. 5. Medicine list

The user are served a series of services to register the medications, to view a list of medicines, and to view detailed information about individual medicines.

a) Add medicine

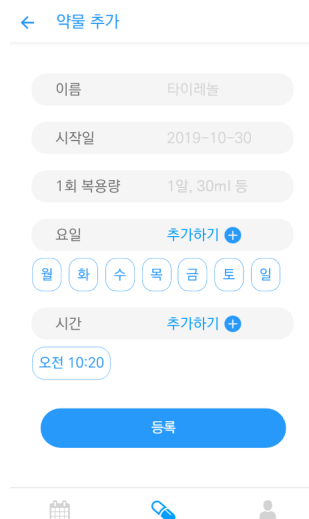


Fig. 6. Add medicine

The users can add medicine by touching the 'Add medicine' button. Six types of information about medication is required.

i) Text prediction

In the name of the medicine, a 'text prediction' service is provided. Autocomplete is a technical

term used for the search suggestions you see when searching. This feature increases text input speed. To ease users write complicated medicine name, our software is going to have text prediction, which is autocomplete, when registering medicine.

ii) Convenient data input

For the elderly, who will be the major users of our service, we add another convenient functions for entering data. By writing an example description in each input field in advance, users will not have to worry about what to write. Days and times are more convenient to select via popup. The selected day and time will appear on the screen immediately and can be deleted by clicking it again.

b) Read medicine detail



Fig. 7. Medicine detail

i) Analyze user data

Other medication applications that exist today simply function as alarms on time. However, Mediger offers a variety of services that analyze your data. It analyzes the user's medication data from the start date to the present to inform about the total number of doses.

ii) Recommendations medication time

If a user clicks on the red circle notification, he/she can receive a 'Recommendations medication time' service. Medication needs to consider the time having breakfast, lunch, dinner and the life cycle patterns. However, the people in daily life do not know which specific hour and minute is the optimal personal time to take medicine. To solve this problem, our software suggests the best time to take based on the past personal records by 'K-means clustering', a machine learning method.

c) Update/Delete medicine

The user can change or delete the information of

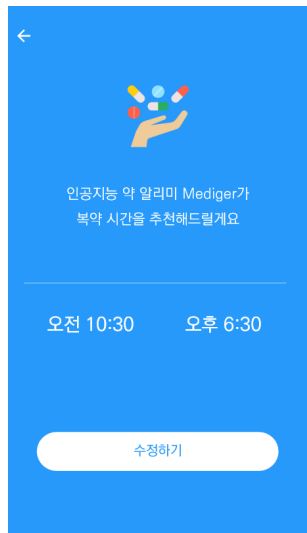


Fig. 8. Recommendations medication time



Fig. 10. Delete medicine

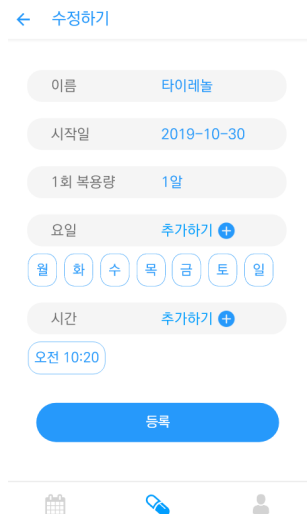


Fig. 9. Update medicine

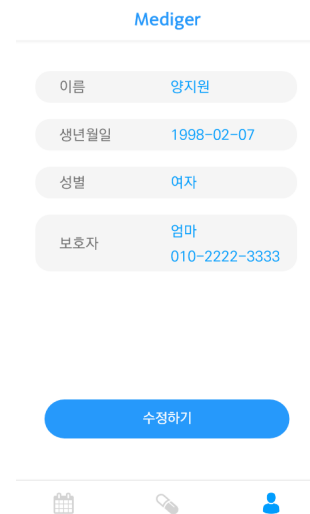


Fig. 11. Profile

medication on the 'medicine detail' page whenever he needs it.

4) Profile

The users can see his personal information in your profile. In particular, you can edit the information by touching the Edit Profile button. In addition to user's own information, he can add the protector's information by saving the his name and phone number.

B. NUGU Speaker

1) Mediger PLAY

Mediger Play shows the structure of "PLAY" of NUGU speaker to carry out "Mediger" service. It consists of intents and actions. The intent means the user's speech to invoke a specific function of service. The actions answer

specific intent and accomplish the user's order in intent. They can be divided into small units per precondition.

2) Action Trees

a) Action A Tree

Action A defines the response to the intent to enter the medication. it repeats the step to verifying the entities essential to providing the service. Action A Tree describes user intent and action A to response to Intent A.

b) Action B Tree

Action B is divided into Branch actions according to various preconditions. Each branch action provides information that meets the user's needs. Diagram below describes intent B and action B in a tree format. Also, it has branch actions of action B and responses written in Korean.

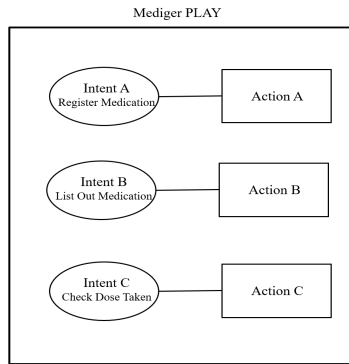


Fig. 12. PLAY Diagram

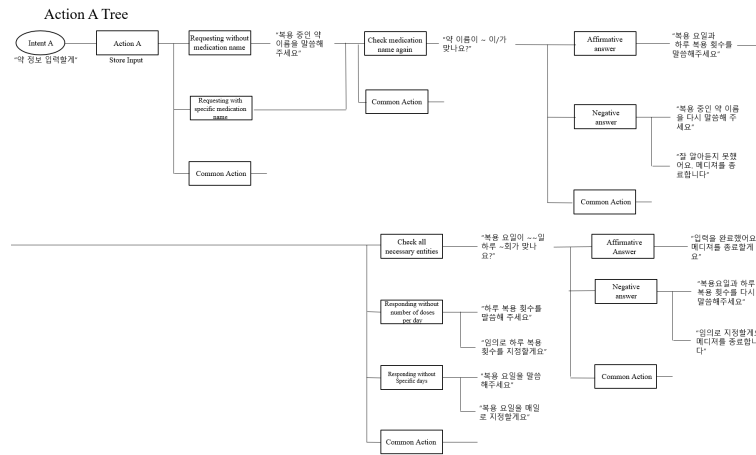


Fig. 13. Action A Tree Diagram

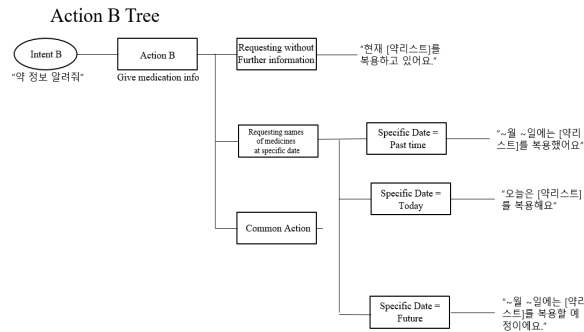


Fig. 14. Action B Tree Diagram

c) Action C Tree

It is a tree diagram for Action C. it shows a number of situations in which a user terminates an alarm. The first situation is when the user took medicine. The second is when a user has not taken medicine. The last scenario is when the user asks an alarm to be delayed. In the Action C Tree Diagram, Each situation is treated by branch actions of action C.

d) Common Action

Common Action is used to describe action shared by main actions. In the three diagrams showed above, the common action part has the response described in the common action diagram. Common action can help iterations to be reduced and simply configure entire play to easily understand.

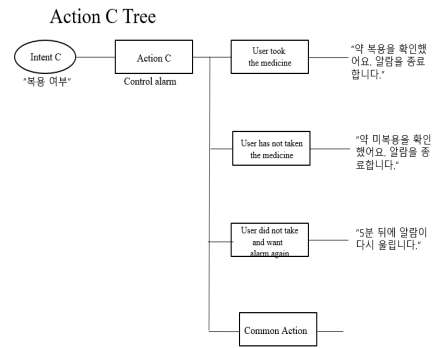


Fig. 15. Action C Tree Diagram

Common Action

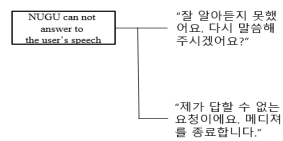


Fig. 16. Common Action Diagram