

Introduction to Engineering Design

**Making Communication Happen Again for Patients in NPUs**



Group 4

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## **Abstract**

When our group was first introduced to NPU rooms, we all had little to no knowledge of such a subject. However, before we started on this project, our group created charts and a set of lists on what we need to do in order to make our project successful. First, we created the Team Charter to set goals and boundaries within our group to maximize our efficiency and set a straight path for our project. We also created work breakdown structure charts to organize the important things we need to do to prevent confusion and stress in our group. After organizing our group, we then decided to individually research about NPU'S to overcome our lack of knowledge to start the project. We brainstormed and listed some of the common yet serious problems patients could face during their time in the NPU rooms. We were able to create a presentation that would show and describe some of the things we have researched and discovered. However, after our presentation, we found out that we were not satisfied with the results. We came to the conclusion that we could spend more time and effort to increase the quality of our work. Therefore, our group spent time and effort and carefully chose one of the problems out of our list to finish the rest of the project. The problem we chose was the anxiety and loneliness patients could feel during their time in the NPU rooms. Our group all agreed that this is a serious problem that should be dealt with because it is hard for patients to have face-to-face communication with others outside the room. Although it was no simple feat, our group stressed the little details and studied some of the situations that could potentially distress the patient and cause them to feel isolated. We created a list of objectives and constraints of the problem to help our group create the final design. After putting much thought and effort, our group came up with three designs that could potentially meet the criteria of objectives and constraints we have listed. However, to complete the next assignment, our group wrote down the advantages and disadvantages of each design to select the best design. After filling in multiple data, it was clear for our group to choose the design that had more pros than cons compared to the other two. The design we chose was to add a visiting room to the NPU room to allow patients to have face-to-face communication with visitors. To overcome the disadvantages of our chosen design, our group researched some ways to minimize the disadvantages. The research assisted us to create the specifics in our design which was to create a reinforced glass wall between the patient's room and visitors' room while adding interphones for them to communicate with. We sent out a survey to multiple people to see if they like our design specifications more, or if they preferred the current design. When the results came in, we got our expected results, which was that people would prefer our design more. Moreover, we also discovered a design by the Kolon Group that minimizes the spread of disease, as well as take the best safety precautions for those who leave the NPU rooms. Our group believed that this was the best way to solve the problem of isolation because one of our group members found excellent information from a professor at a university. He educated us that talking about loved ones or a familiar past with patients is a great treatment for them. Furthermore, we were able to come up with ideas that would also benefit the medical staff and visitors, so that they would not be contaminated by the disease. We made an effort to reduce the work stress the medical staff must undergo before they enter the NPU rooms for the current design to spare time and increase work productivity. With the help of every member in group 4, we were able to find solutions to the problem we have discovered.

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## **1. About NPU**

### **1-1 Definition of NPU**

An NPU is a type of hospital room that keeps patients with infectious illnesses or patients who are susceptible to infections from others, away from other patients, visitors, and healthcare staff.

### **1-2 NPU principle**

They are called NPU because the air pressure inside the room is lower than the air pressure outside the room. This means that when the door is opened, potentially contaminated air or other dangerous particles from inside the room will not flow outside into non-contaminated areas.

## **2. Problem of NPU**

### **2.1 Invasion of Privacy**

Inside the NPU rooms, there are surveillance cameras that monitor the patients daily. Although it may be used to persistently check the patient's condition, it can also be seen as an invasion of privacy. Patients who know they are being watched may feel pressured and uncomfortable causing distress.

### **2.2 Noise**

Inside each NPU room, there is a sound pressure machine that has the purpose of regulating the air inside the room. It is used to prevent the spread of the contaminated air outside of the room. However, the loud noises of these machines can cause stress and other negative effects on the patient's health.<sup>2-3</sup>. Claustrophobia

### **2.3 Claustrophobia**

NPU have enclosed structures with no windows to prevent the virus from leaking out. This structure can sometimes cause claustrophobia in patients.

### **2.4 Loneliness**

The purpose of the NPU is to isolate patients in an enclosed room to prevent the spread of the contagious virus. However, because of the isolation, it is common for patients to experience loneliness and anxiety.

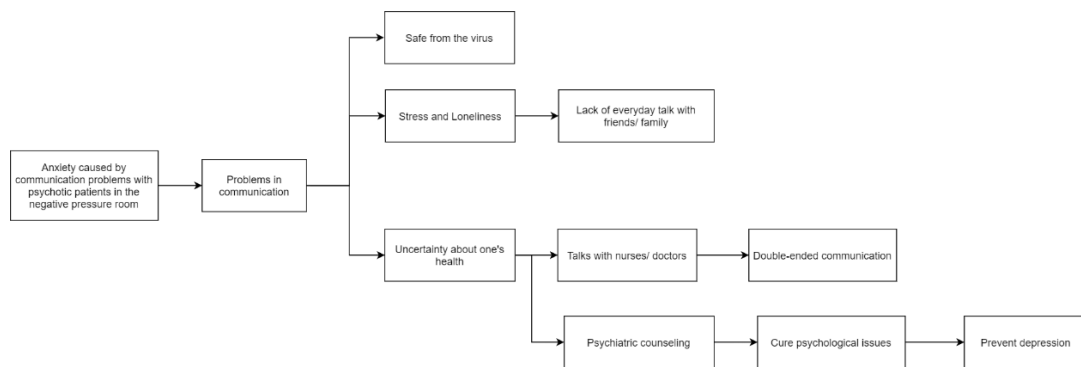
### 3. How to solve about NPU's problem.

#### 3.1 The NPU's problem we are going to solve.

After discussing with our group members, we have come to the conclusion that the biggest problem with the NPU is loneliness caused by lack of communication. When there is little to no communication, it is difficult for people to express their emotions as they did in the past. Therefore, our group came up with multiple potential solutions that could aid those who experience this problem.

#### 3.2 Problem Solving Process

##### 3.2.1 Investigating the objectives of stakeholders



##### 3.2.2 Constraints of the design

Constraint #1. Only one meeting a day to prevent spread of viruses

Constraint #2. Patients should have psychiatric counseling at least once a week

Constraint #3. Maintain the differential air pressure between rooms in the order of: nonnegative pressure isolation area > Corridor front room > Negative pressure corridor > NPR front room = Visitor room > NPR > Toilet about 2.5 Pa or more.

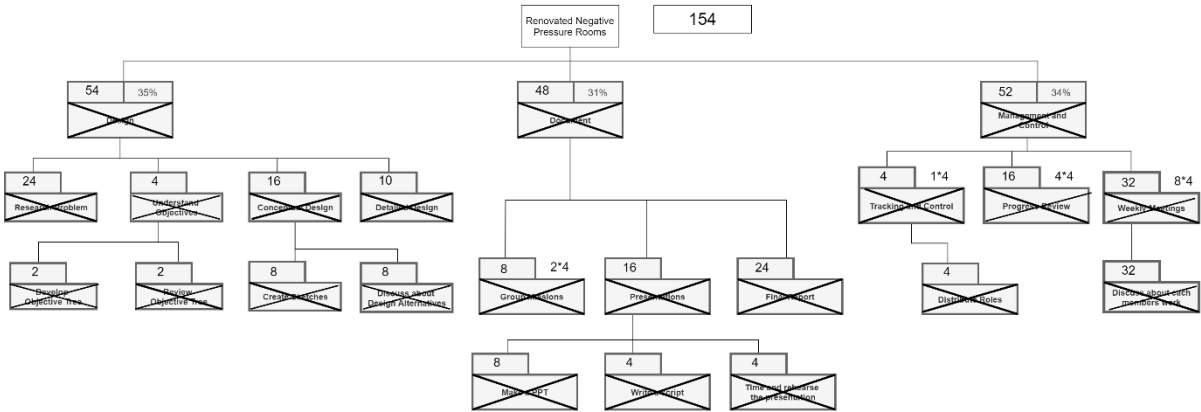
Constraint #4. The size of the patient's room should be at least 15m<sup>2</sup> excluding NPR front rooms, toilets and walls in order to make patients feel comfortable and not trapped.

##### 3.2.3 Principal Functions

Principal Function #1: The patient and the medical staff should be able to communicate freely.

Principal Function #2: The patient should be able to have a screened meeting.

3.2.4 Percent Complex Matrix



3.2.5 Gant Chart

Description	Rem Dur	Week 11			Week 12			Week 13			Week 14			Week 15		
		Monday	Wednesday	Friday	Monday	Wednesday	Friday	Monday	Wednesday	Friday	Monday	Wednesday	Friday	Monday	Wednesday	Friday
Start Project	0	O														
Clarify Problem Statement	1															
Conduct Research	5															
Develop Objectives Tree	1															
Analyze Function Requirements	1															
Generate Design Alternatives	3															
Evaluate Design Alternatives	1															
Create Sketches for Design Alternatives	3															
Final Report	6															
Presentation	3															
End Project	0															O

3.2.6 Metrics for Objectives

Objective	Not suitable at all	Inappropriate	Average	Suitable	Very Suitable
Does the virus stay inside even after communication takes place?					
Can the patient communicate with the medical staff freely?					
Can communications take place when the patients want?					
Can the patient get psychiatric counseling?					

### 3.2.7 Morphological Chart

Function/Mean	1	2	3	4
Meeting with patients	Online meeting	Meeting between rooms	Standard phone calls	Meeting inside the room with protective clothing on
Prevent spread of virus	Negative pressure rooms	Protective clothing	Reduce meeting to the minimum	washing hands/body
Check health condition	Communication with medical staff	Psychiatric counseling	A two-way communication device to use	CCTV

### 3.2.8 Research

A. NPU Definition

B. NPU Principles - Principles of Air Leak Prevention

C. Configuration of NPU

D.NPU Management Law and Management Staffing

E.NPU Patient Behavior Guidelines

F. Status of NPU

### 3.2.9 Description and Evaluation of Three design alternatives

1<sup>st</sup> Design: Our first design was to reconstruct the NPU rooms by adding in a visitor room for people to visit the patient. The visiting room and the patient room is separated by a glass wall for face-to-face communication

2<sup>nd</sup> Design: The second design we have thought of was to give patients a doll that had a speaker built into it for counselors outside the NPU rooms to use to communicate with the patients.

3<sup>rd</sup> Design: The final design was to implement a way for patients to use videophones to freely have a two-way conversation with the medical staff.

#### 3.2.10 Pros and Cons of Each Design

##### 1st Design.

Pros: Real-Time conversation between the patients, can communicate face to face reducing the feeling of being lonely, can form bonds for patients are in similar situations, can reduce the amount of materials that need to be used for safety precautions.

Cons: Might be difficult to build depending on building structure (Because the rooms have to be right next to each other), may affect the structure that keeps contaminated air inside the room, patients cannot have a conversation whenever they want.

##### 2nd Design

Pros: Can have a conversation between patient and counselor, no risk of using materials to enter the room

Cons: Counselor is talking through a doll so the patient may feel uncomfortable, the patient may find it difficult to talk to a doll, the doll is contaminated because it is inside the room, can be difficult to fix if the doll if it is malfunctioning because it is contaminated

##### 3rd Design

Pros: No risk of the medical staff entering the room, the patient can hold conversations to feel less lonely, the patient can send an alert to the medical staff whenever they want to have a conversation.

Cons: it may be expensive for many patients may feel the need to have one, medical staff cannot always hold a conversation with the patient, can be difficult to replace if broken, not all patients know how to access/use videophones



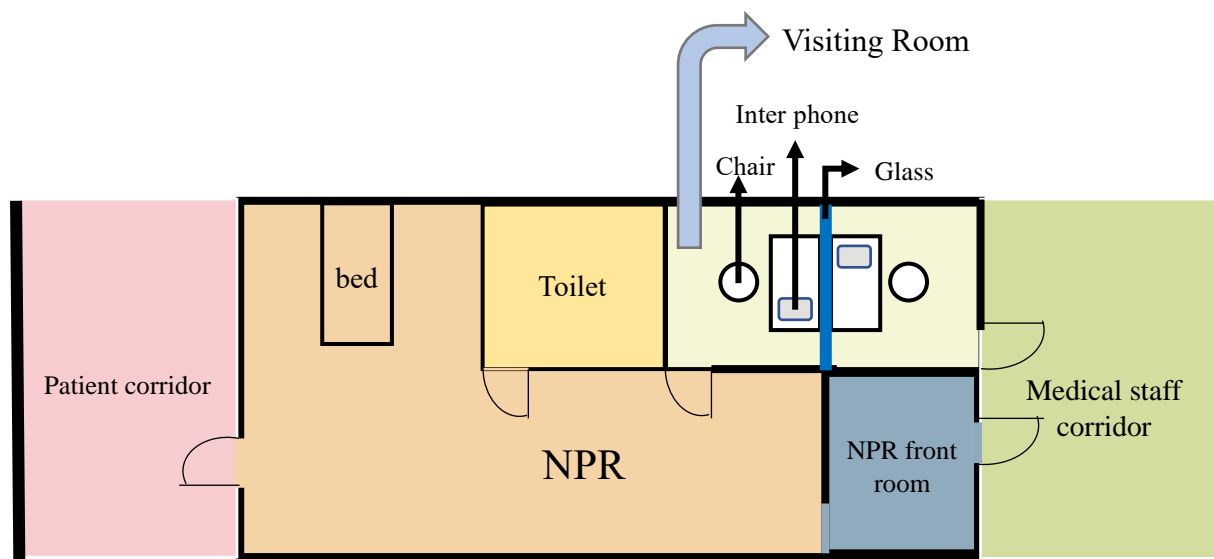
### 3.2.11 Selecting the final design

After discussions and evaluation within our group we decided to have our 1<sup>st</sup> Design plan as our final design.

1<sup>st</sup> Design - Changing NPR design to create a meeting room so that people can talk with the patients face-to-face with a glass in between

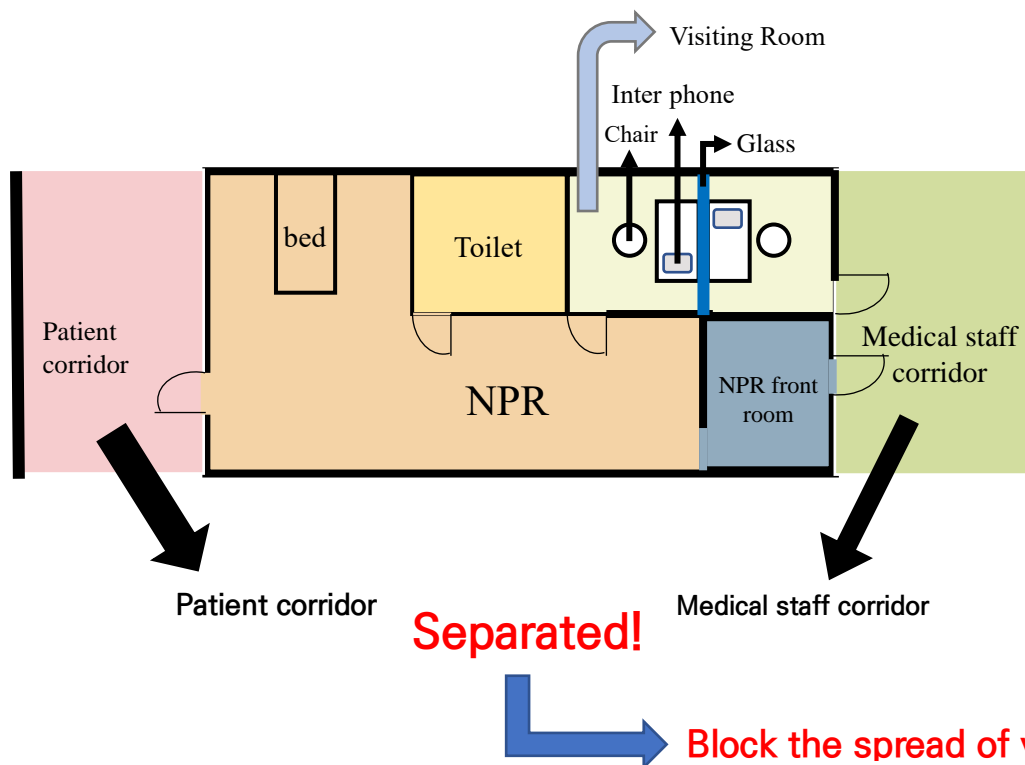
## 4. New design of NPU

### 4.1 Design Floor plan



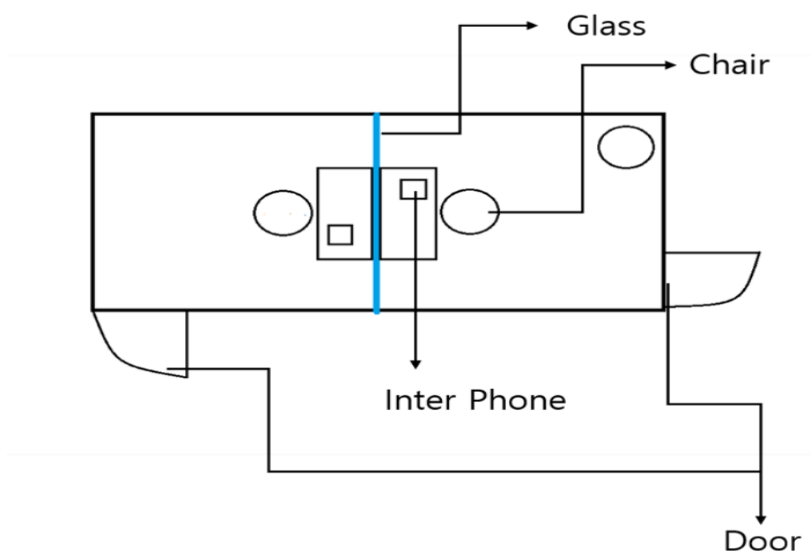
The new design we propose is the same as the outline of the picture above. As you can see above, it is to create a visiting room in a negative pressure ward.

#### 4.2 Raising design issues

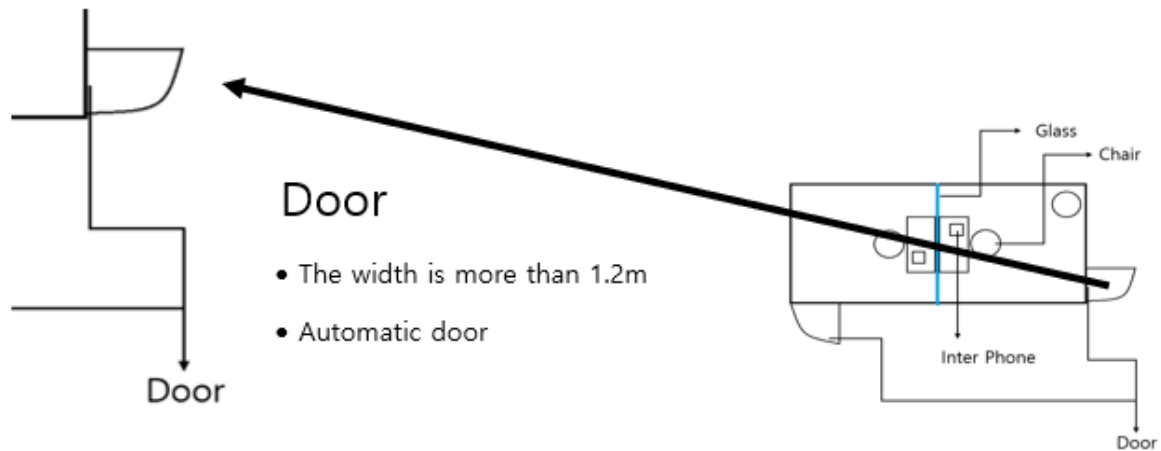


However, as we were working on our first design, we identified a new problem. For the current design of NPUs, wearing PPE was mandatory for visitors and medical staff to prevent the spread of the virus. We thought one problem the patients had to face was that they only saw visitors wearing full PPE. Therefore, to solve this problem, we discovered that Kolon Group's modular sound pressure life treatment center established a system to prevent the spread of the virus by separating the central corridor into the medical staff's movement and the path on.

#### 4.3 Structure of the visiting room

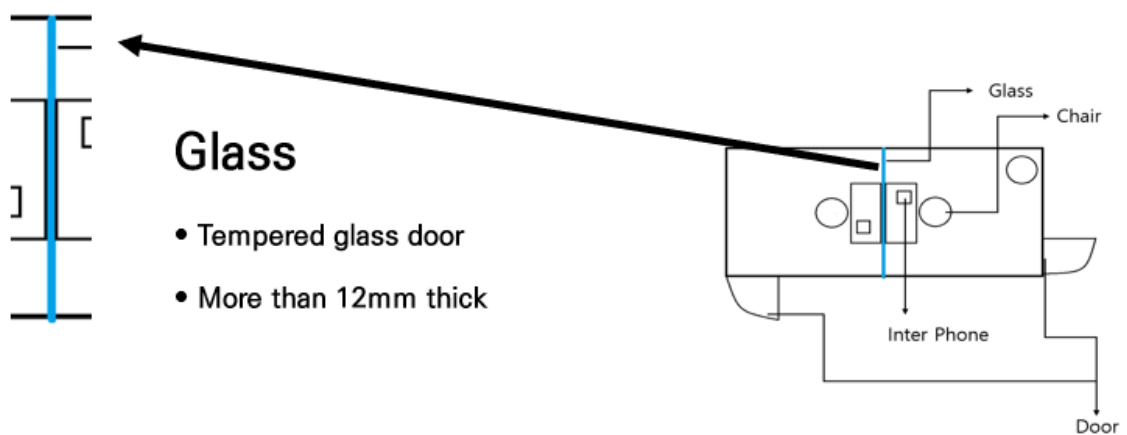


#### 4.3.1 Door



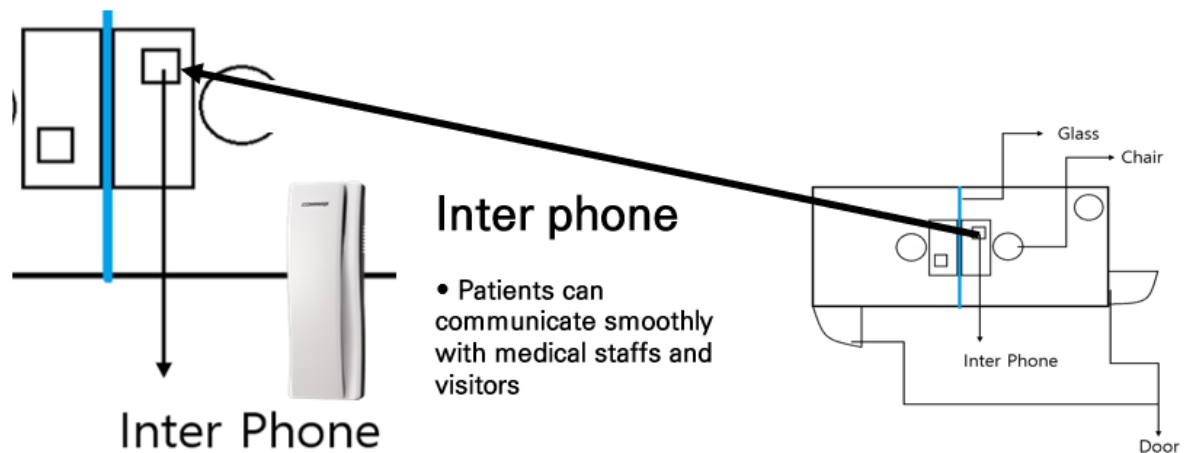
We decided that the door for the NPR should be at least 1.2m in width to maximize the convenience of movement. It should also be an automatic door in case of certain circumstances where the person who is entering cannot access the door handle.

#### 4.3.2 Glass



The glass in the visiting room is designed to be at least 12mm thick made from reinforced glass. This is in accordance with the design plan for existing NPU.

#### 4.3.3 Inter Phone



Interphones are installed in the visiting room so that patients, medical staff and visitors can communicate smoothly. This method is the most effective way for face to face communication without the risk of spreading the virus.

### 5. Conclusion

In conclusion, it is important for people to have regular conversations with people to reduce anxiety and depression. We expect positive results on the patients' mental health because our design provides the patients an opportunity to have conversations with anybody, including friends and family. Not only that, but our design also includes counseling sessions for patients, similar to therapy, to help patients develop emotional skills and reduce symptoms of mental illness. Furthermore, our design is advantageous towards medical staff. We designed it so that they do not need to waste time and energy putting on full protective equipment. This will lessen the burden of medical staff, which can increase the work productivity because the medical staff will have more time and energy.

### 6. Participation by Members

21700227 노은호 : Lead and participate in the team missions as a team leader, organize all team meetings, data investigation and overall arrangement, outline the final presentation, make the final presentation slide, create and complement the final design, draft the final announcement script, final report modification.

22000072 김민기 : Created the PPT for the first presentation, worked on the final report

22000255 박동건 : Took care and updated the team website, recorded final presentation, worked on the final report, contributed throughout the whole project and participated in every mission given in and out of class, main English translator, participated in every class and every meetings our group had outside of class time.

22000456 유승준 : Recorded final presentation. And translated, wrote down the information, and edited information on the final report, contributed throughout most of the project and participated in every mission given in and out of class, participated in every class and most meetings our group had outside of class time.

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