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New Evacuation Guidance Using Augmented Reality for Emergency Rescue Evacuation Support System (ERESS)

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1. Background

In recent years, sudden disasters such as fires and terrorism have occurred in buildings.

Fire

Terrorism

It is difficult to obtain real-time disaster information.

ERESS

(Emergency Rescue Evacuation Support System)

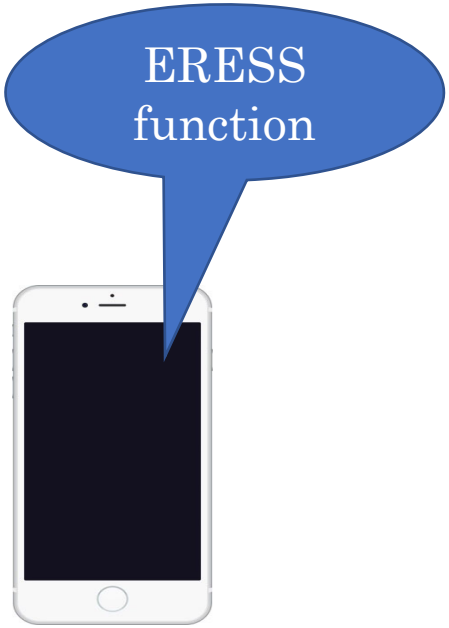
2. ERESS

Purpose

Reduction of casualties by notifying real-time disaster information to evacuees

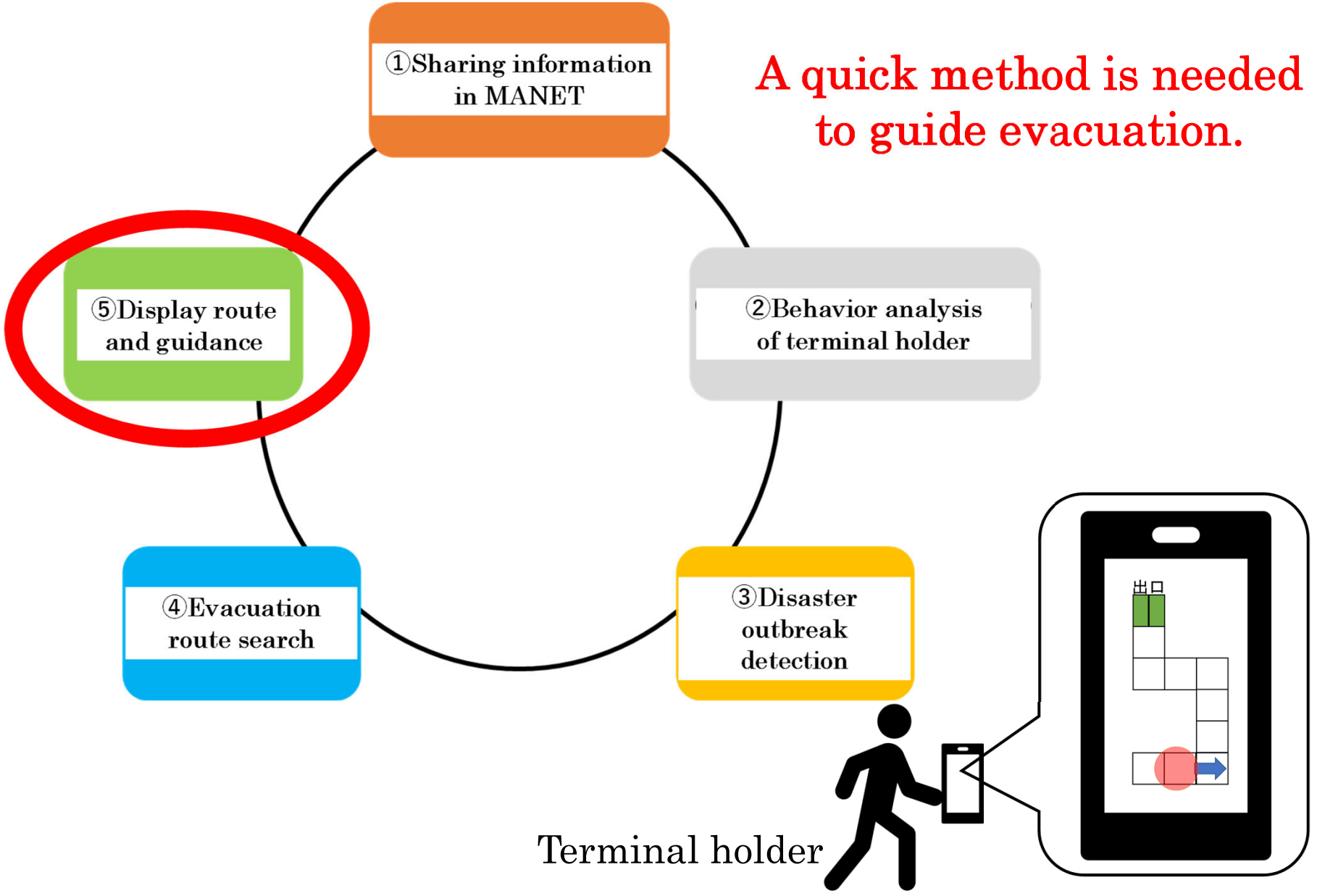
Feature

- Disaster detection and evacuation guidance are possible in real time.
- Each terminal communicates with each other and exchanges and shares information.
- ERESS can operate in any environment without depending on communication infrastructure.



ERESS terminal

2. ERESS



A quick method is needed to guide evacuation.

3. Conventional method

Evacuation guidance by using iBeacon

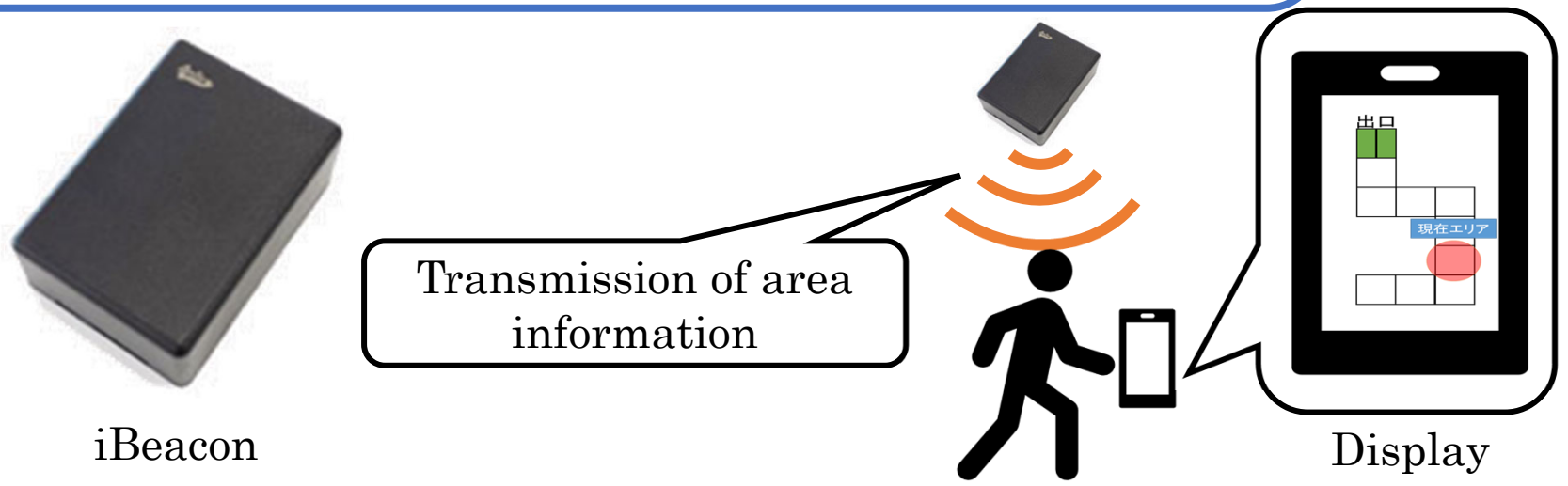
Purpose

Guidance for evacuees to evacuate safely and quickly

Feature

・Use of iBeacon's area information

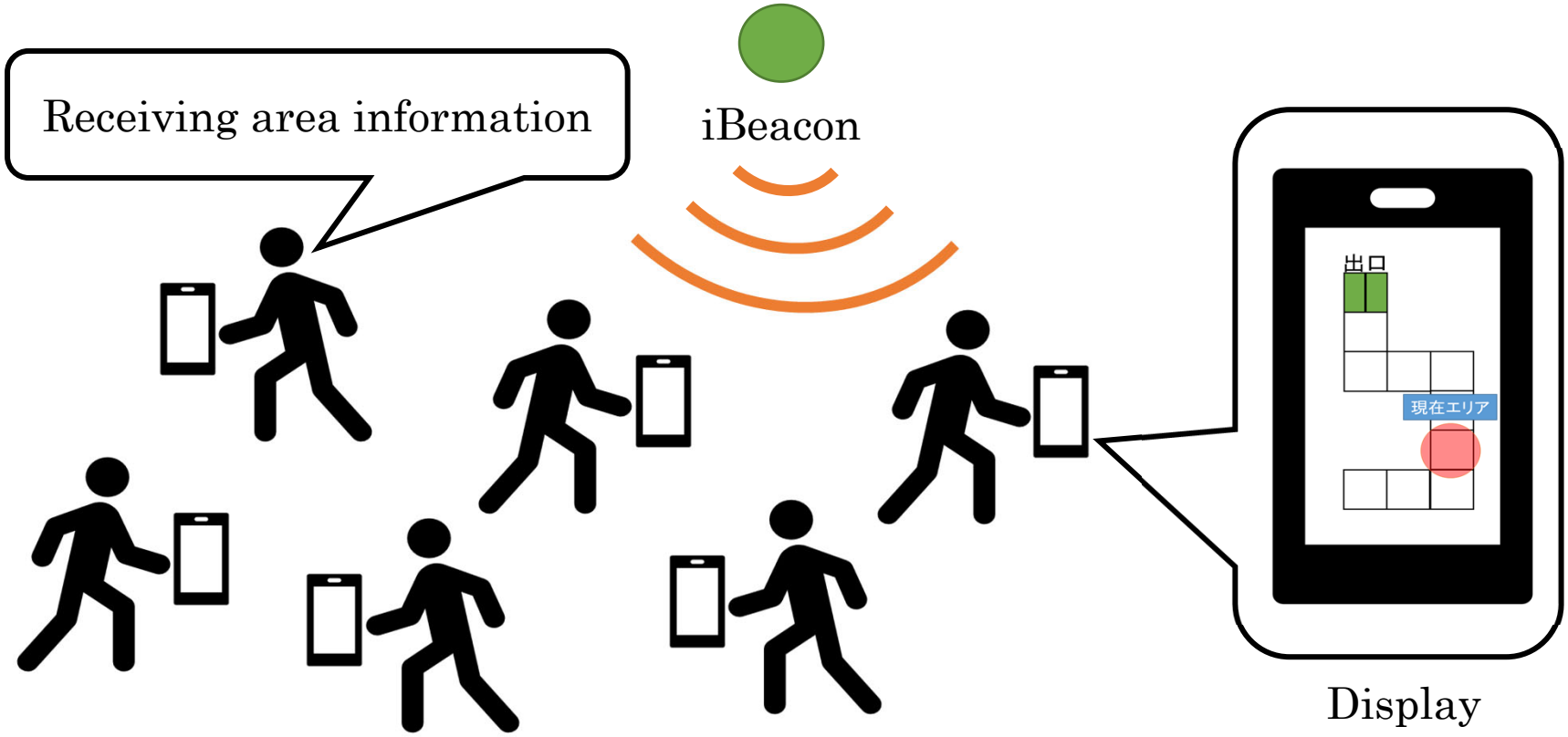
・Multiple iBeacons attached on the ceiling so that they do not interfere with each other



3.1 Process

Step 1 : Each ERESS terminal obtains iBeacon's area information

Step 2 : Start evacuation guidance based on received iBeacon area information



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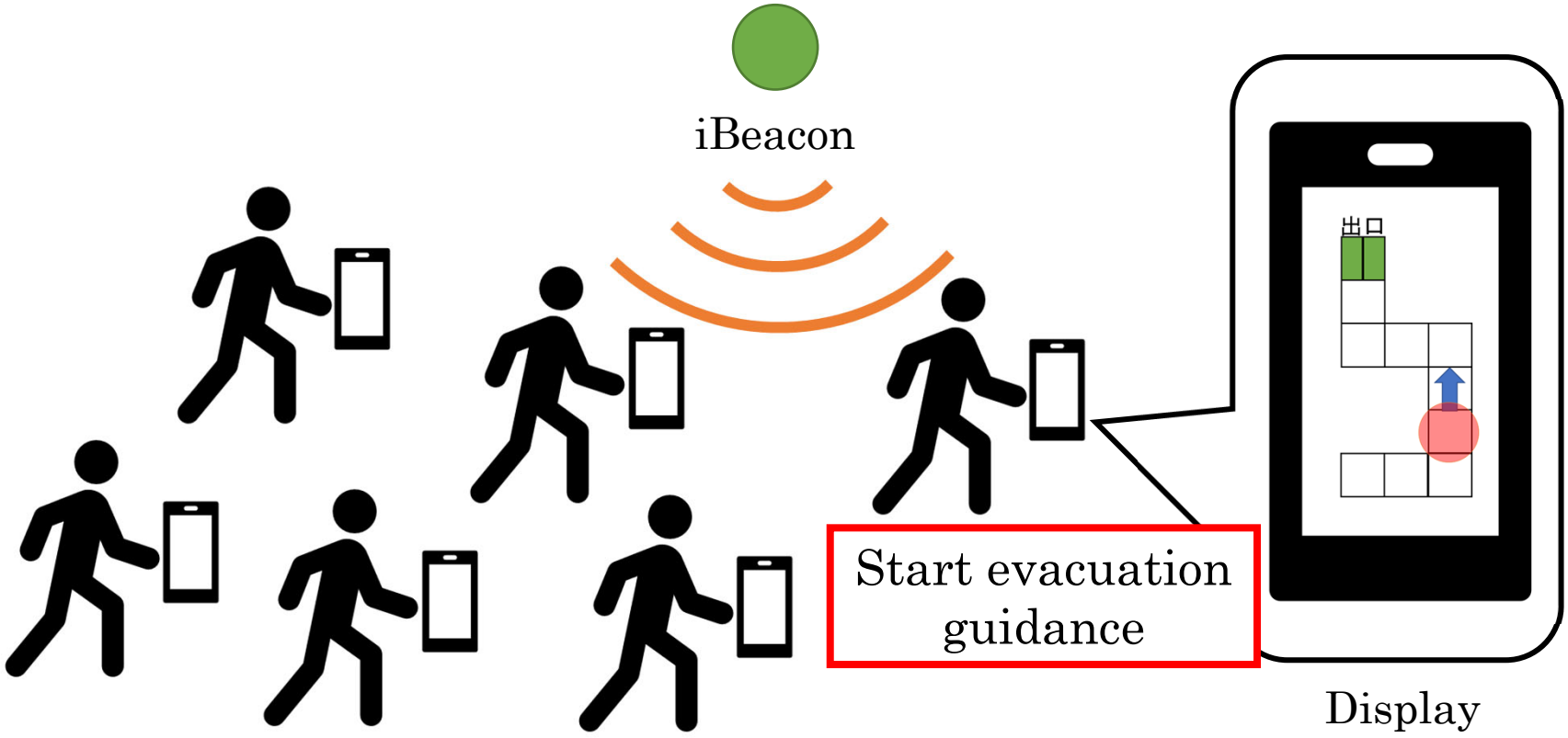
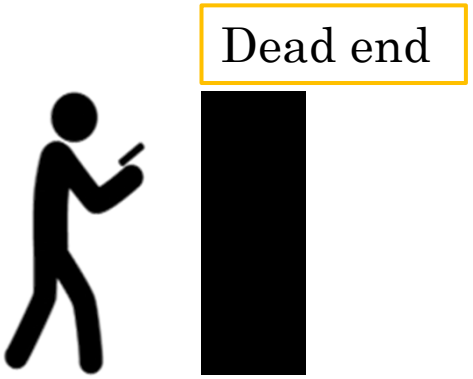


3.2 Problem of the conventional method

① Poor visibility makes it difficult to know the direction to go.



② Not everyone can read the map correctly.

There is a need for a quick evacuation guidance method even in situations with poor visibility or in places where there is no sense of land.

We propose AR evacuation guidance using augmented reality technology.

4. Proposed method

AR (Augmented Reality) evacuation guidance

Purpose

- Reduced evacuation time even with poor visibility
- Even tourists who do not know the land or people who cannot read the map can evacuate in an easy-to-understand and accurate manner.

Feature

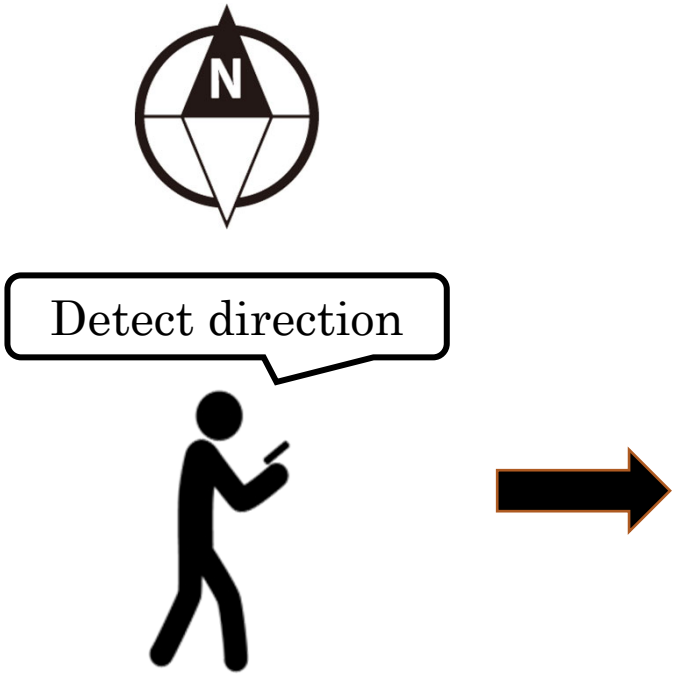
- Get directions from magnetic and accelerometers
- Use iBeacon to acquire indoor position

Process

Step 1 : Direction is detected by magnetic sensor and accelerometer.

Step 2 : Each ERESS terminal obtains near iBeacon's area information.

Step 3 : Start evacuation guidance by displaying a 3D model suitable for each area.



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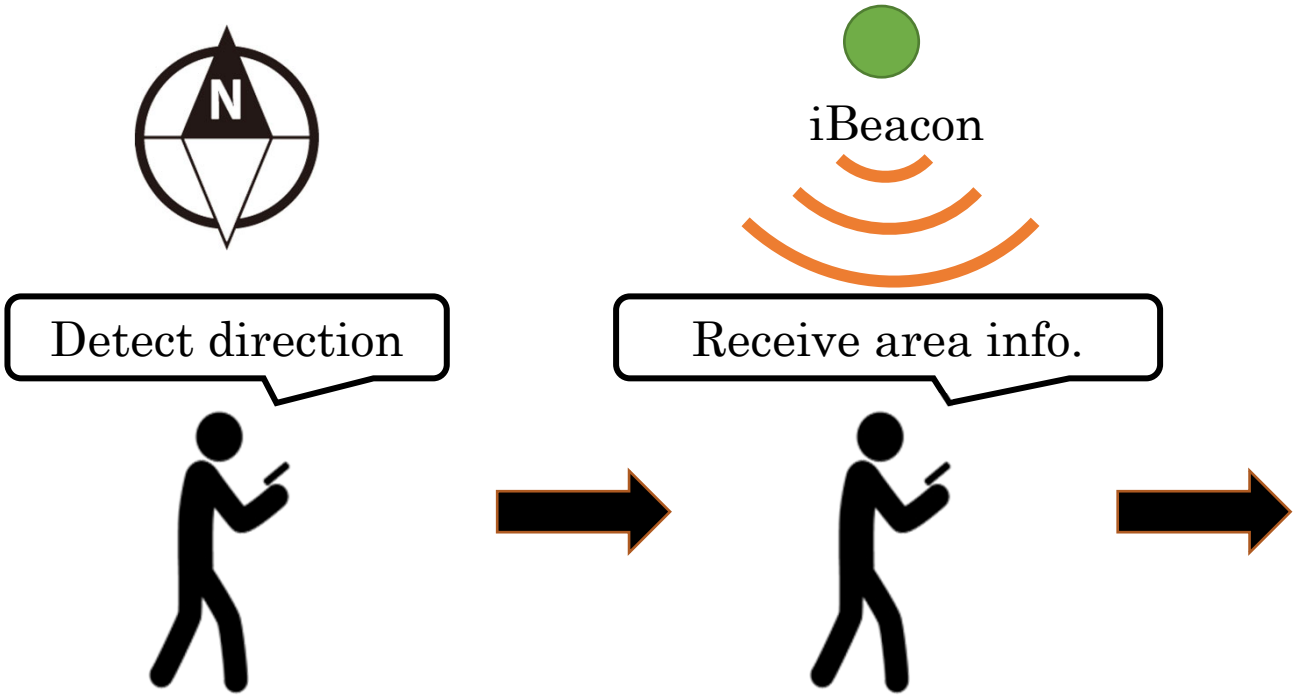

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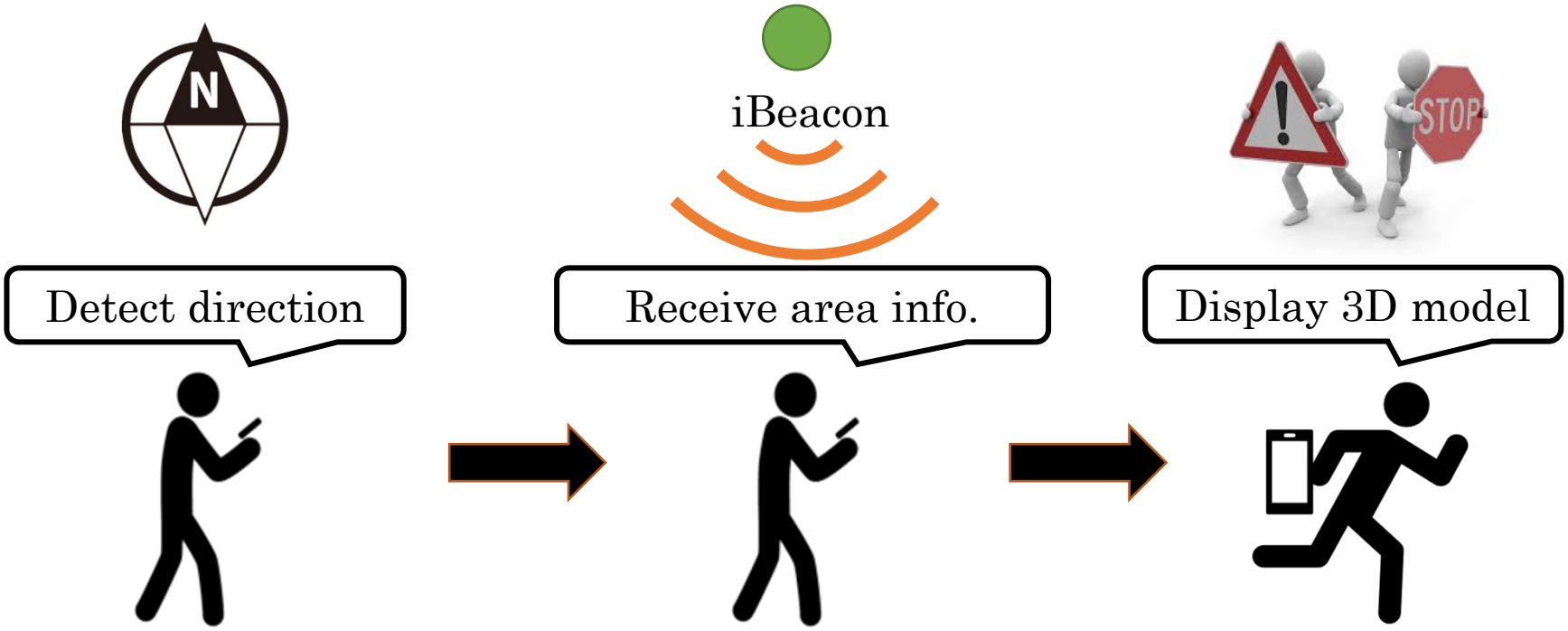
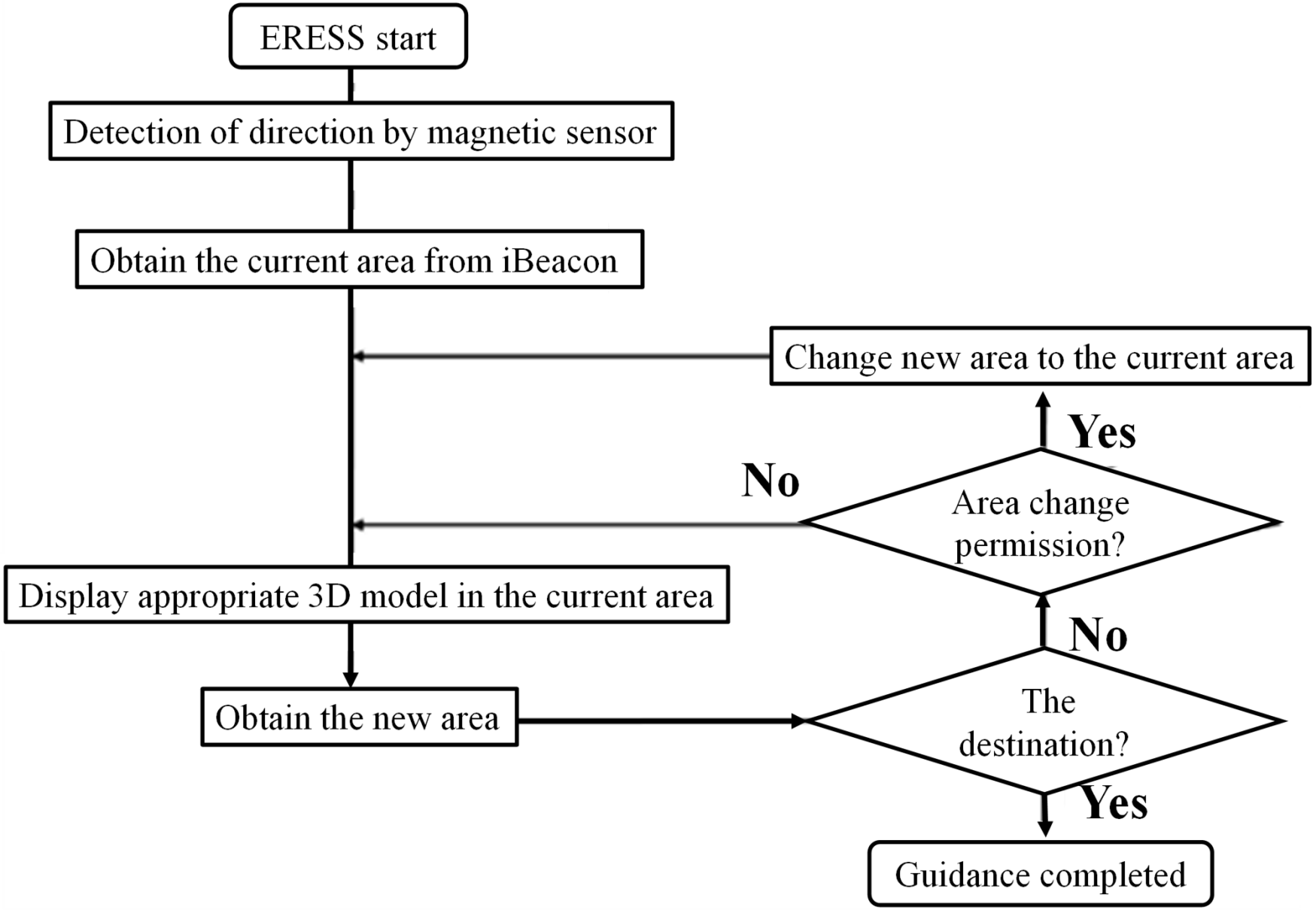


Flowchart


ERESS start
Detection of direction by magnetic sensor
Obtain the current area from iBeacon
Change new area to the current area
Yes
No
Area change permission?
Display appropriate 3D model in the current area
No
Obtain the new area
The destination?
Yes
Guidance completed

5. Performance evaluation

Experiment

Guidance to the destination by AR

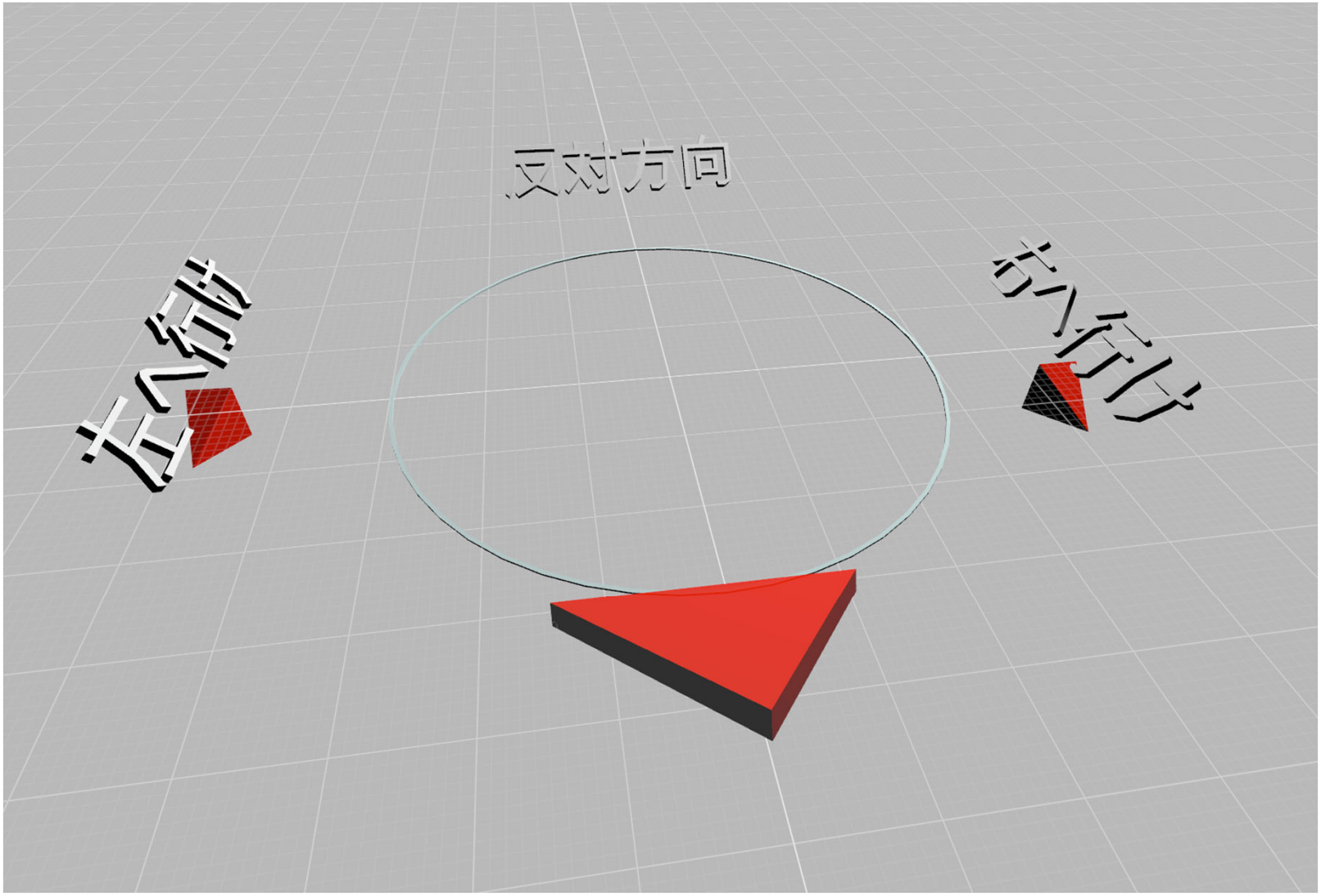
Purpose

Verify the possibility of evacuation intuitively and accurately with AR guidance

Experimental environment

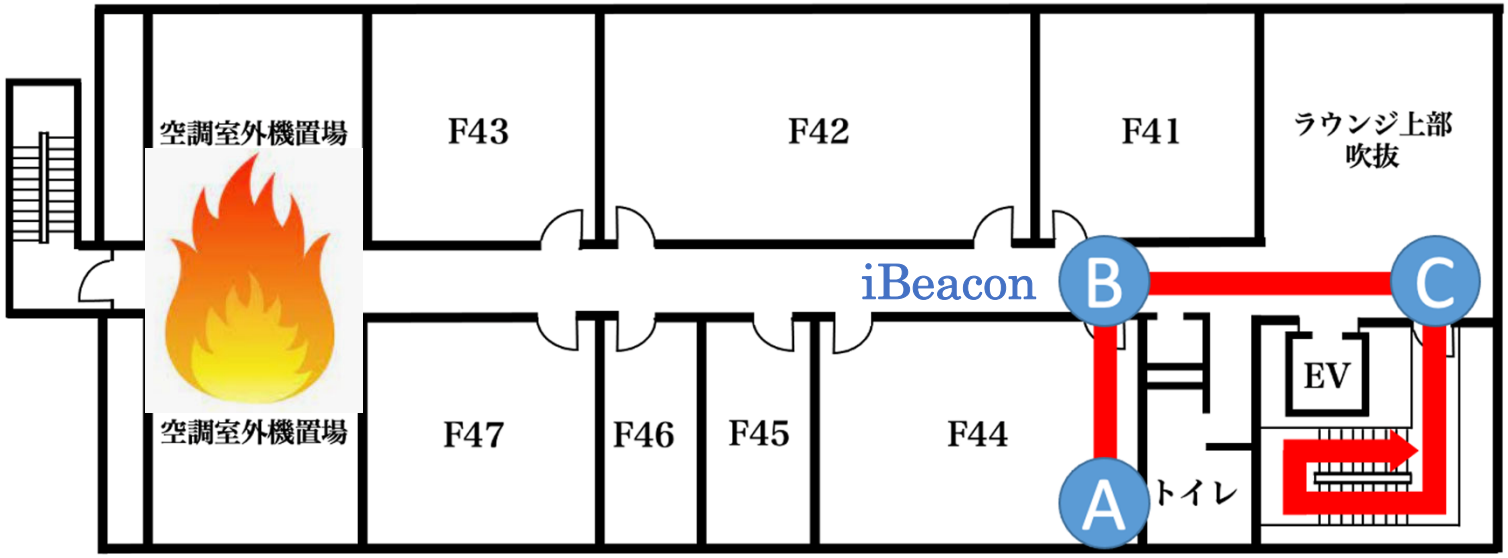
Experiment day	27 and 28 Jan. 2021
Experiment place	3F and 4F in the building
Number of subjects	6
Number of Beacon / Terminal	6 (iBeacon) / 1 (iPhone6s)
Terminal holding method	Texting while walking

Display 3D model

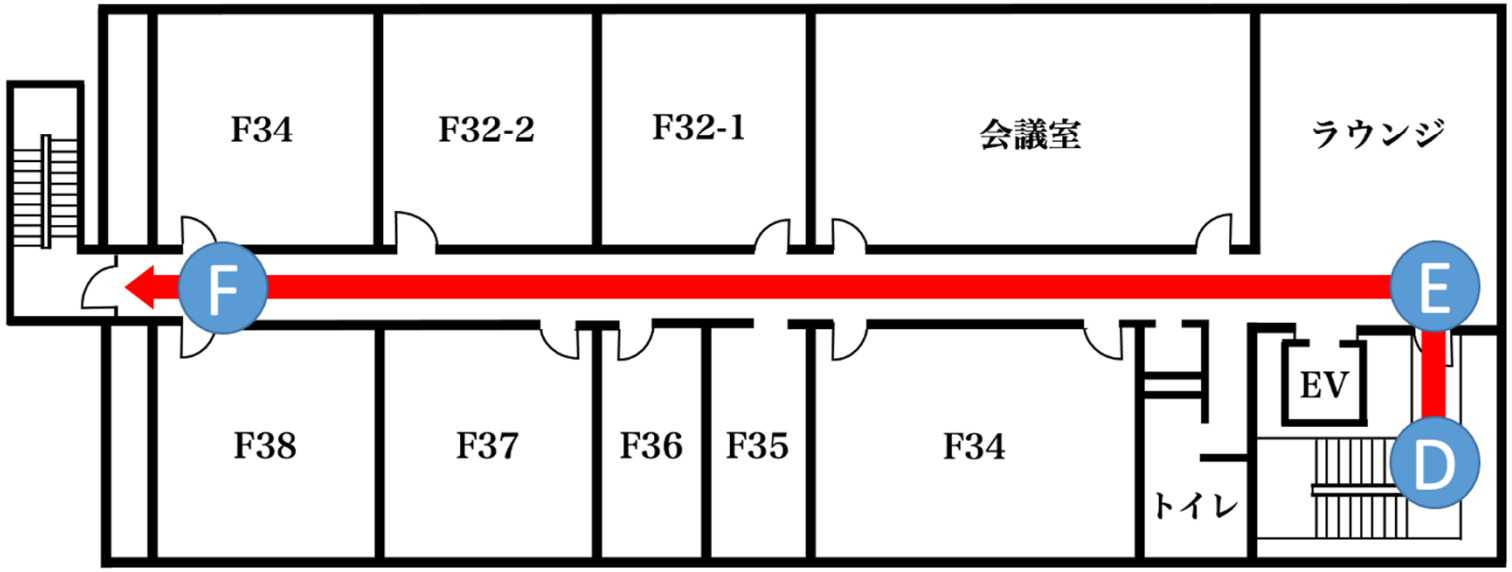


Experiment

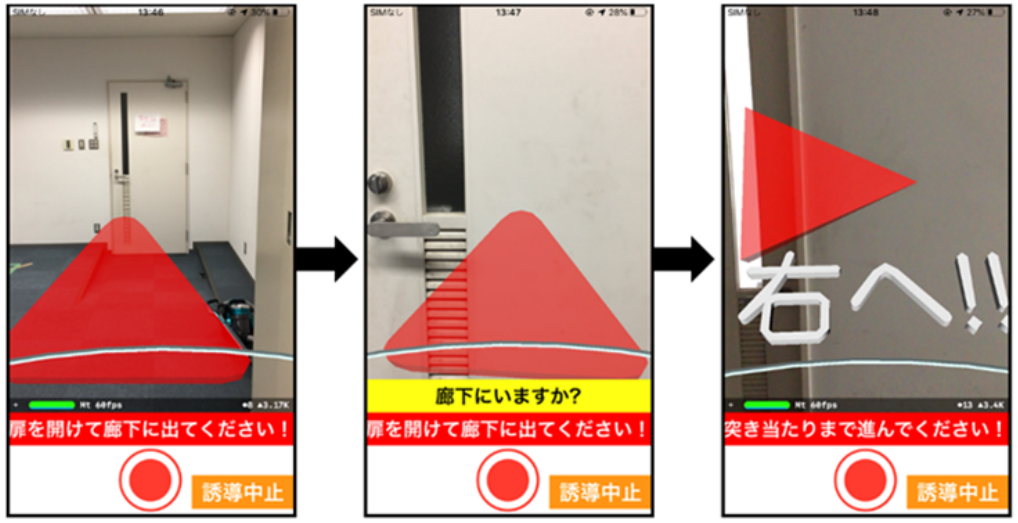
4F



3F

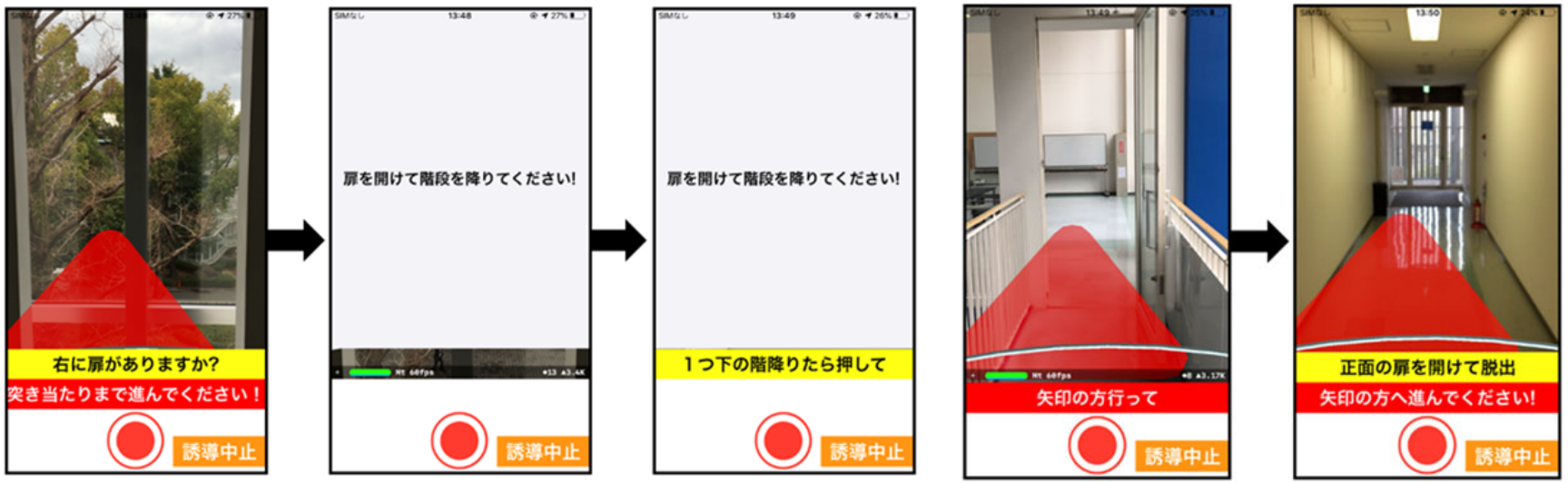


Example of displays in application



(a) (b) (c)

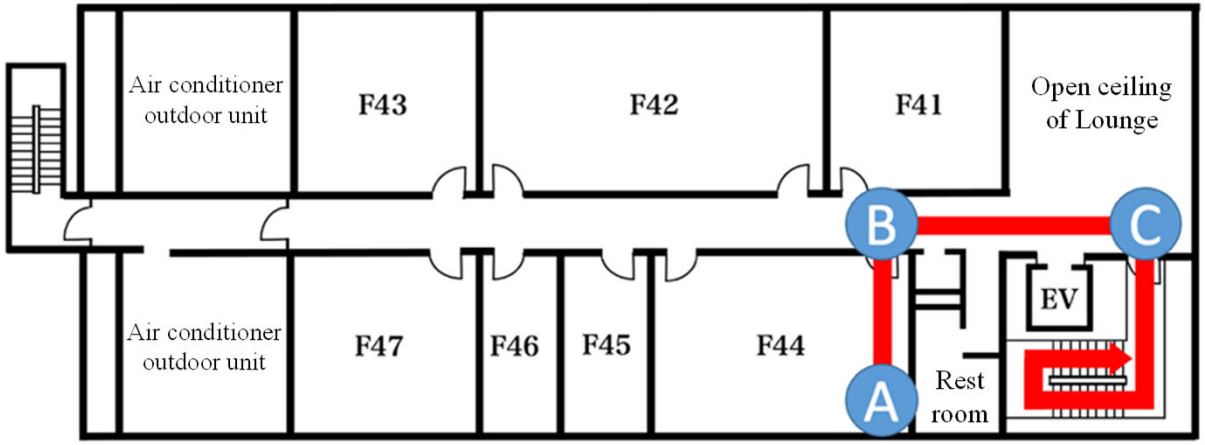
When the red circle button is pressed, switch to the next display.
(a)～(h) Warning sound when switching the display
(e), (f) The camera display is stopped because he is on the stairs.



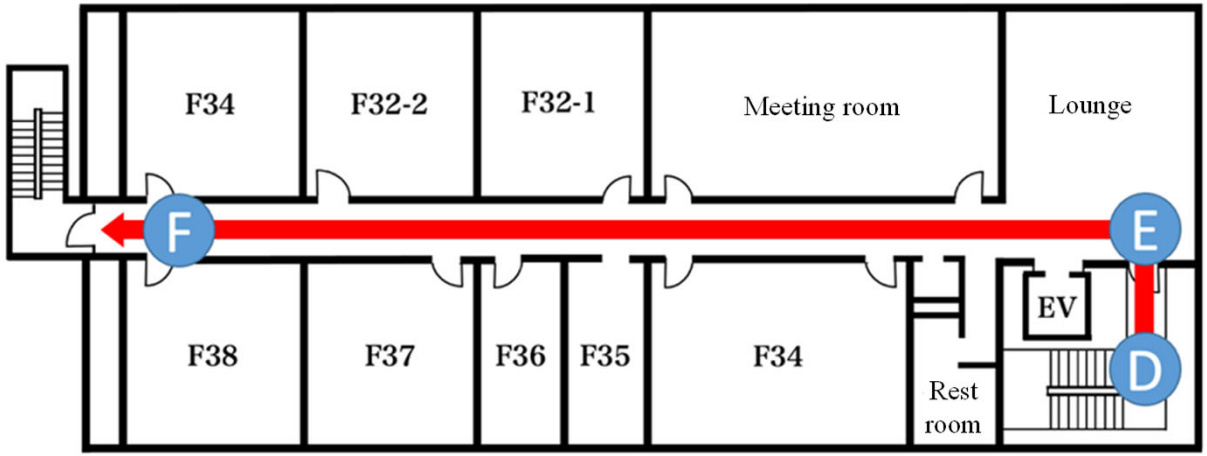
(d) (e) (f) (g) (h)

Experiment

4F

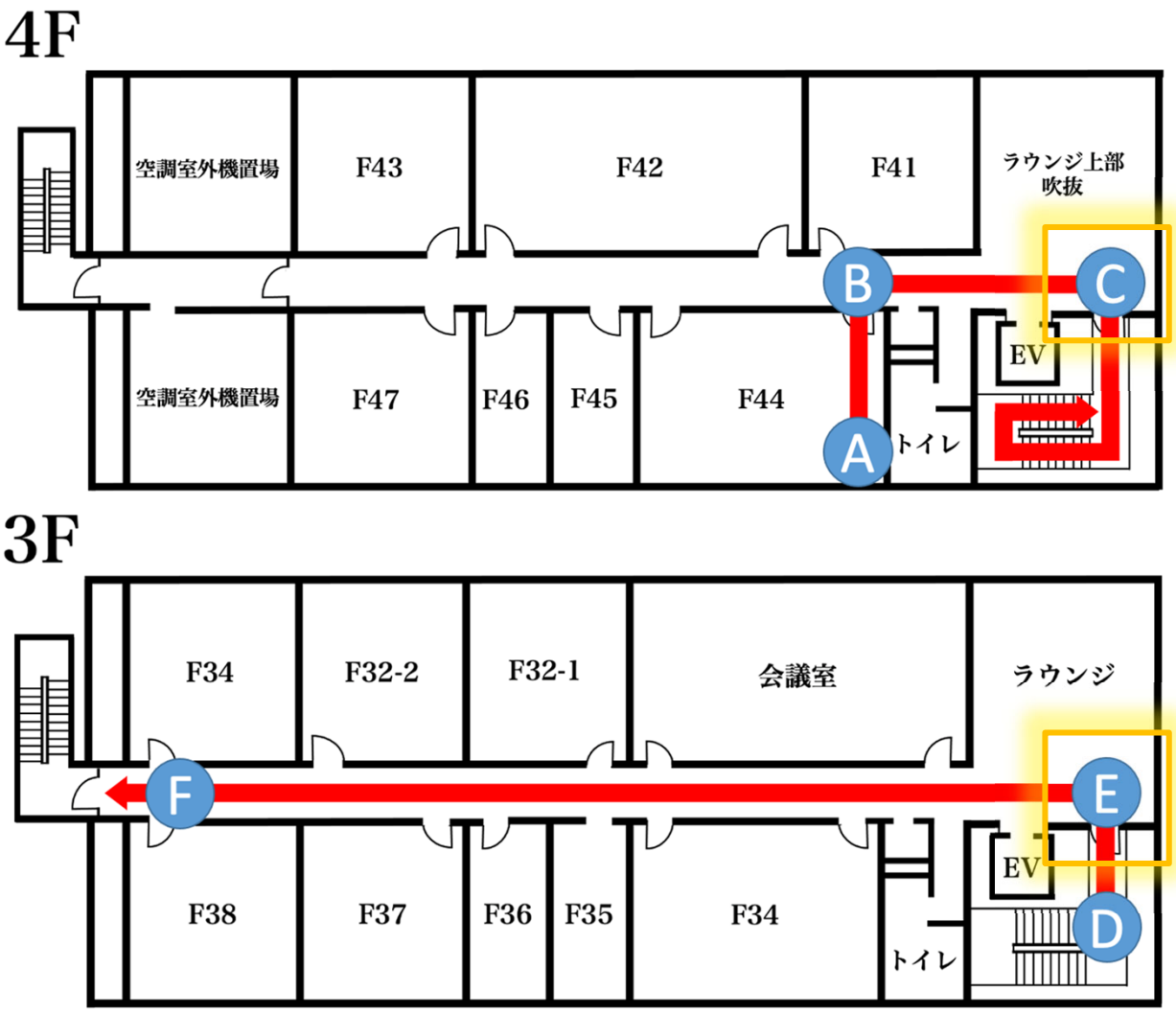


3F



Percentage of problems	
Place	Ratio
Point A	0%
Point B	0%
Point C	17%
Point D	0%
Point E	23%
Point F	0%

Experiment



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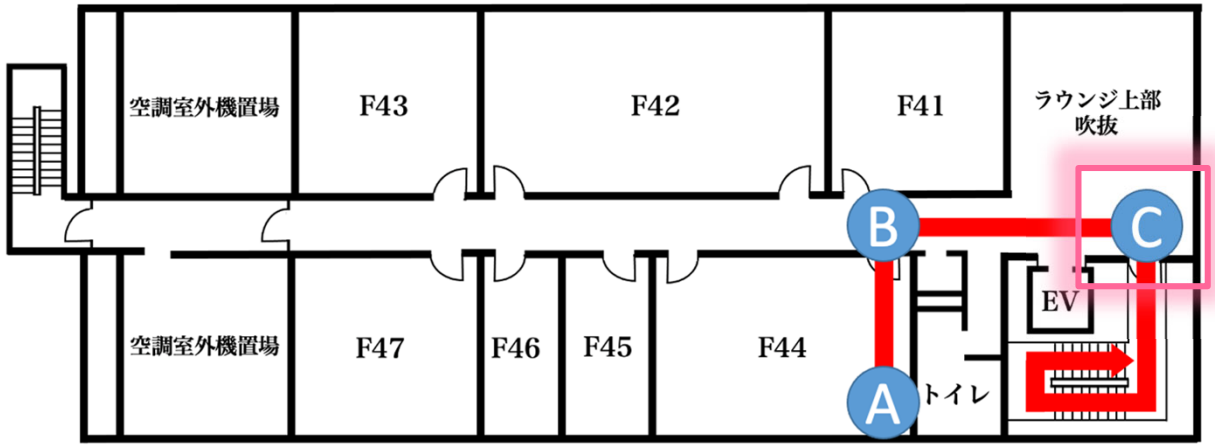
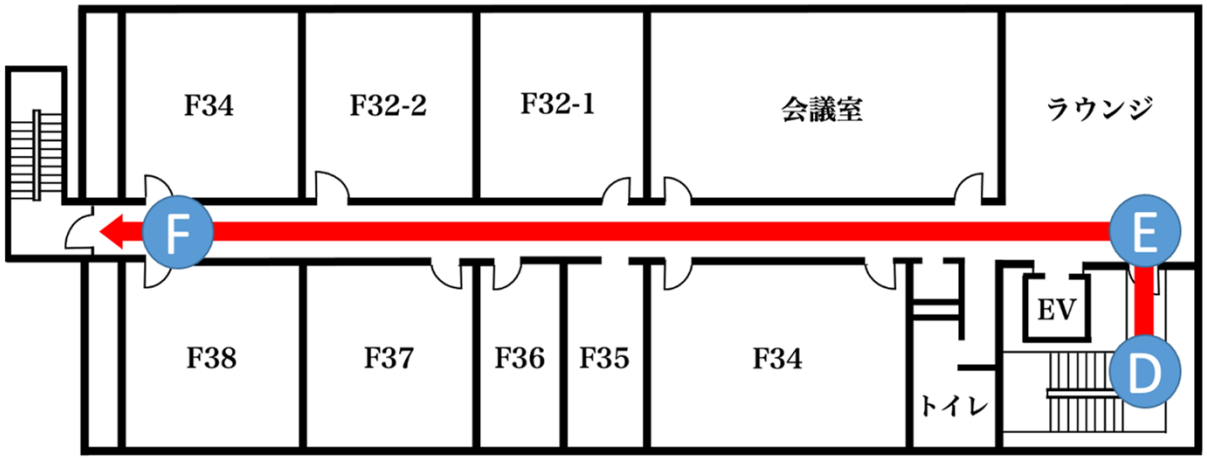


3F



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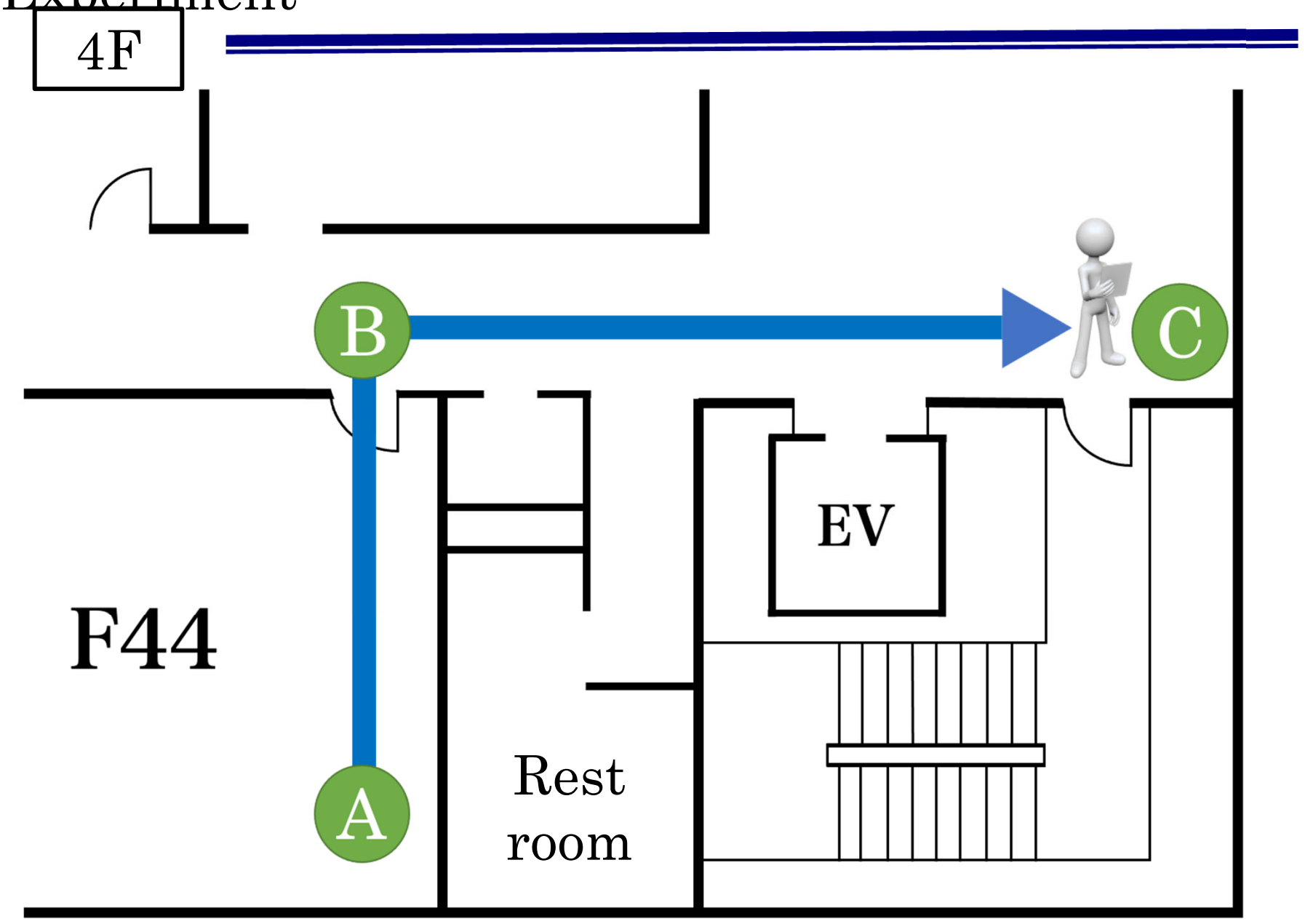
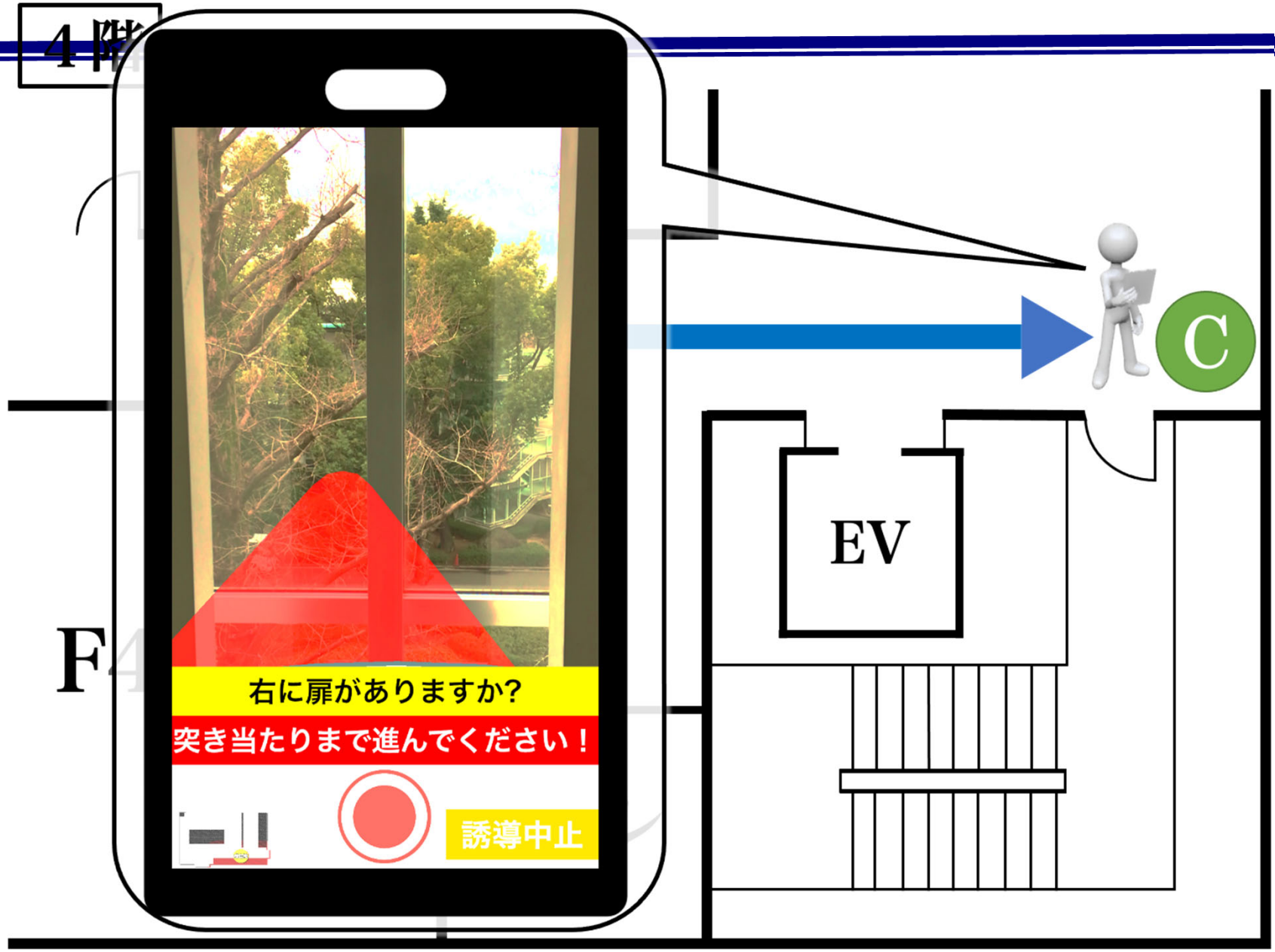
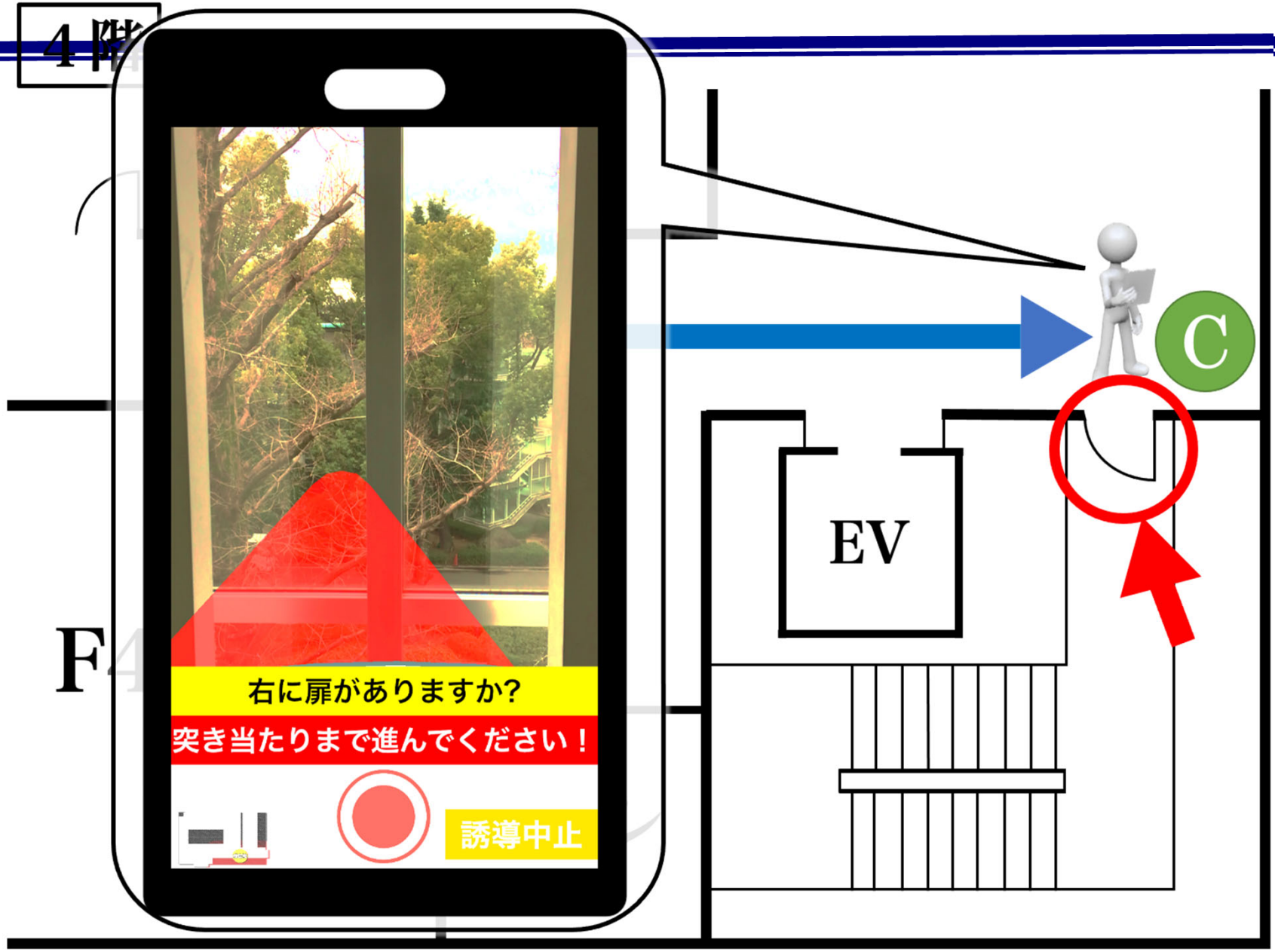
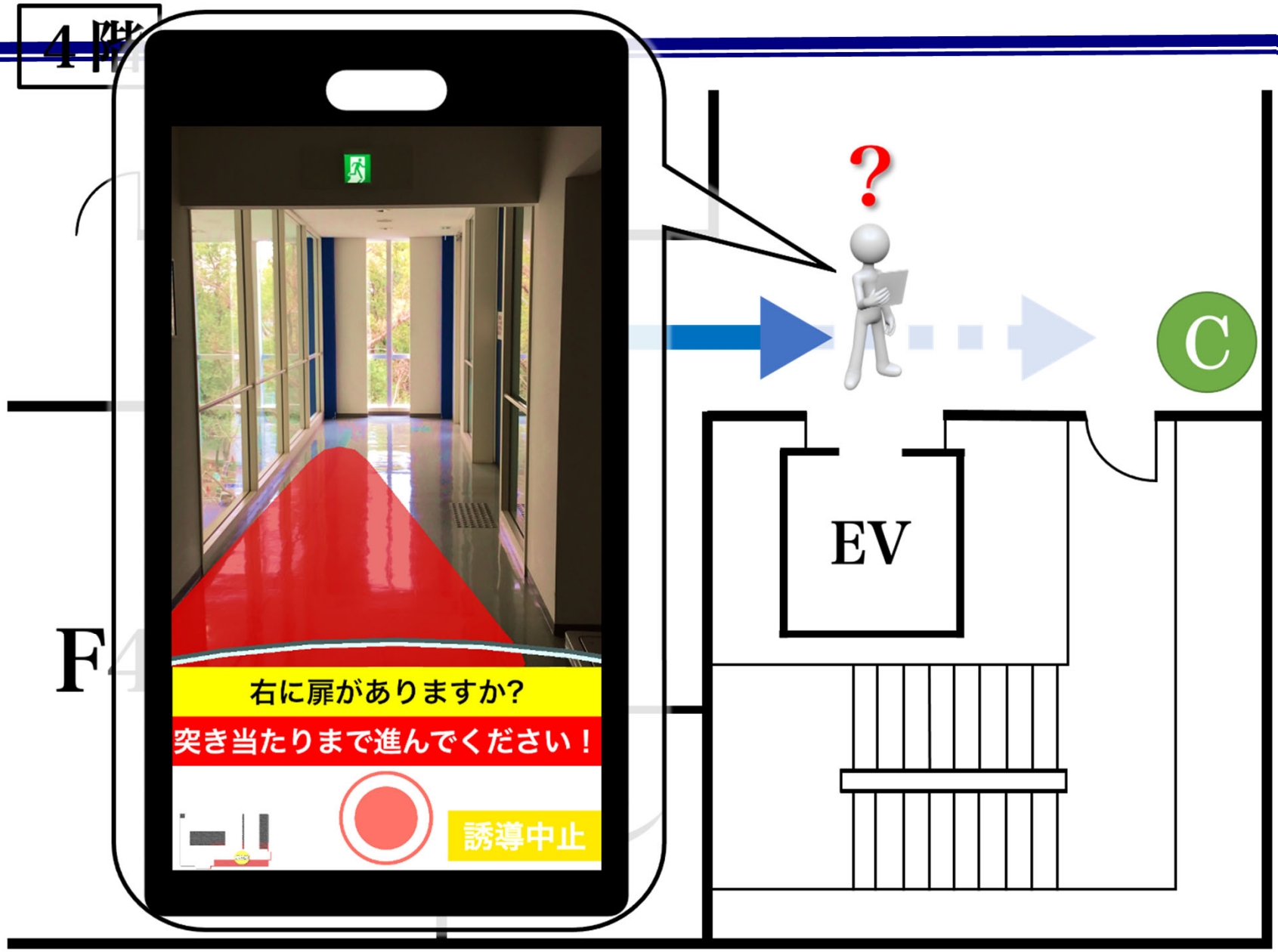
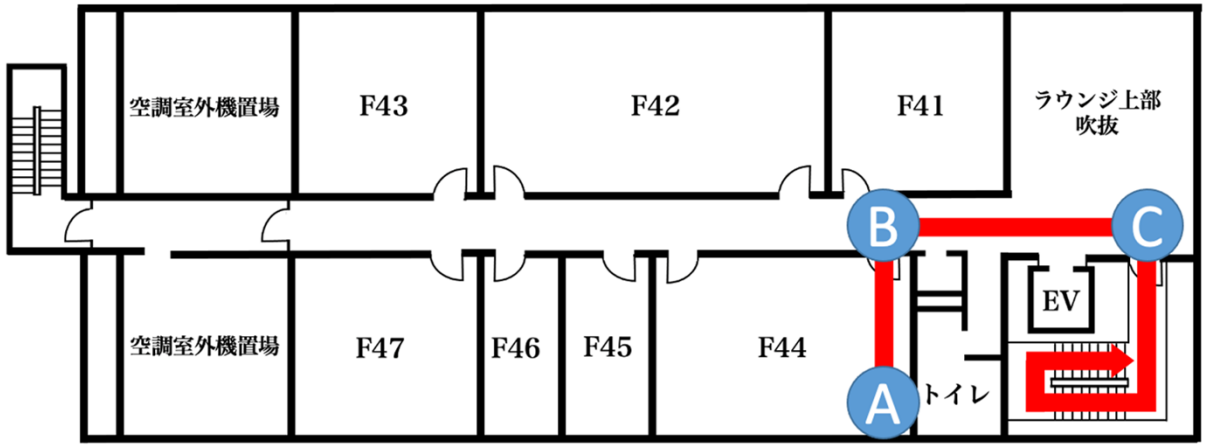



4階
右に扉がありますか?
突き当たりまで進んでください！
誘導中止
EV
C

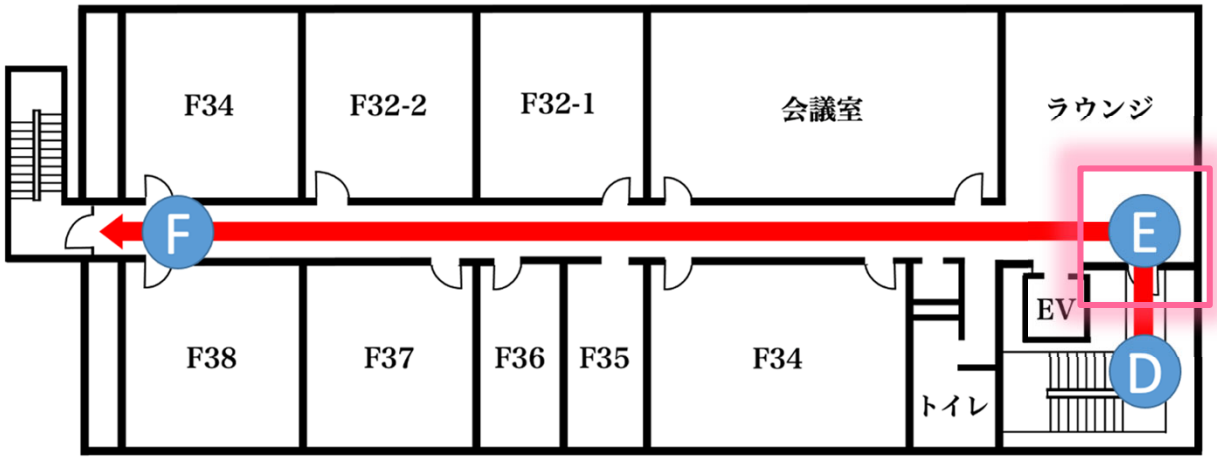

4階
右に扉がありますか?
突き当たりまで進んでください！
誘導中止
EV
C


4階
右に扉がありますか?
突き当たりまで進んでください！
誘導中止
?
C
EV

4F



3F



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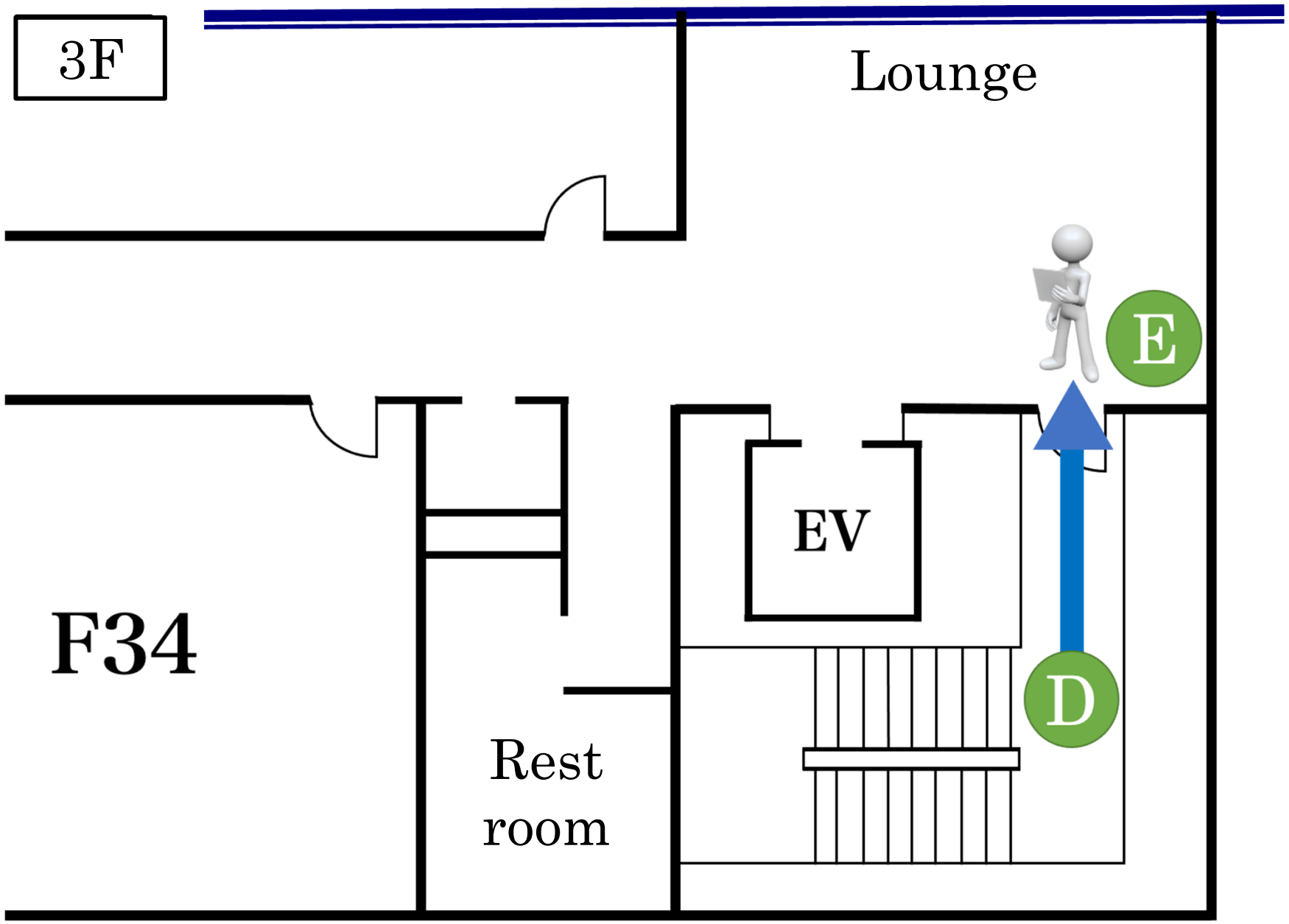
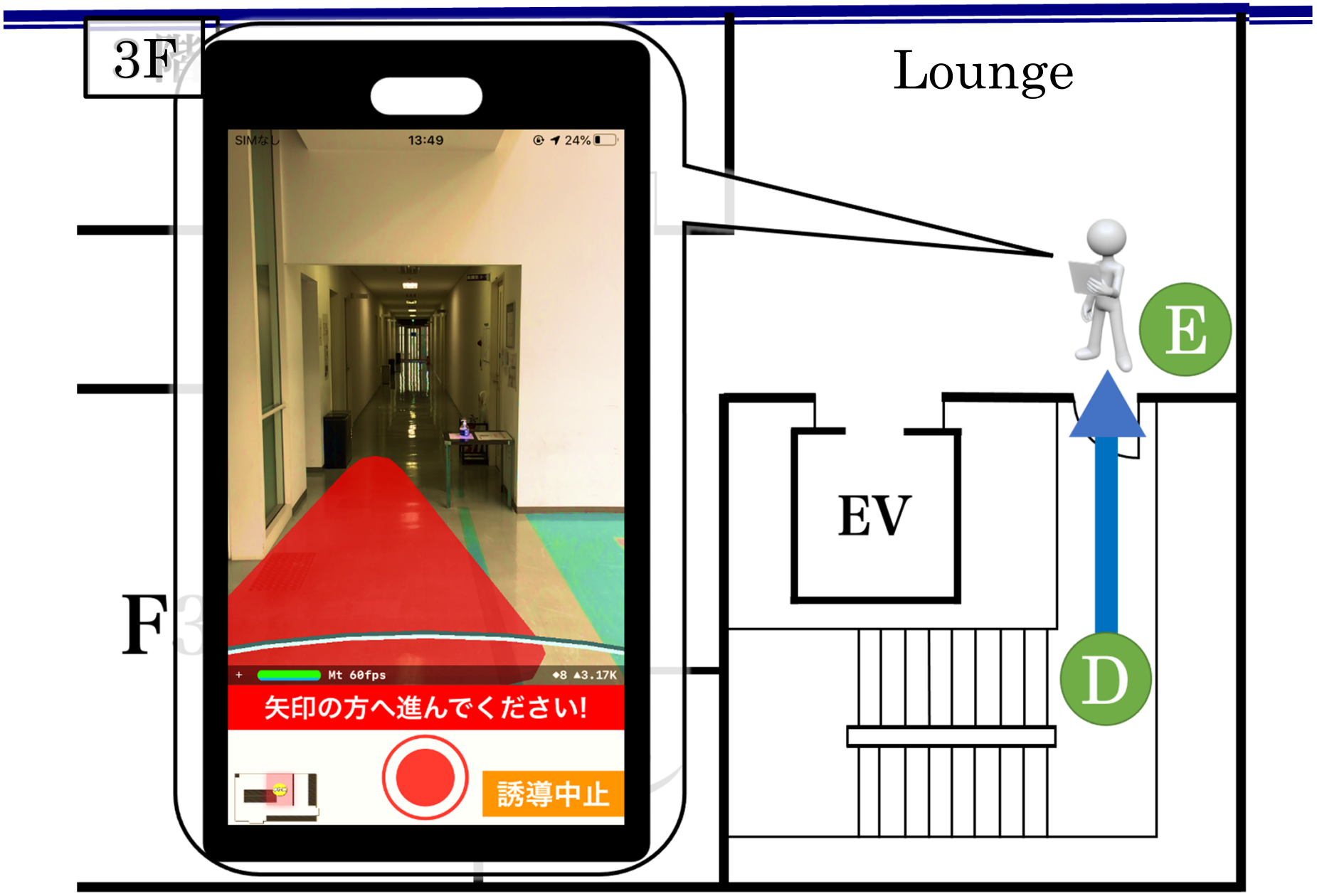
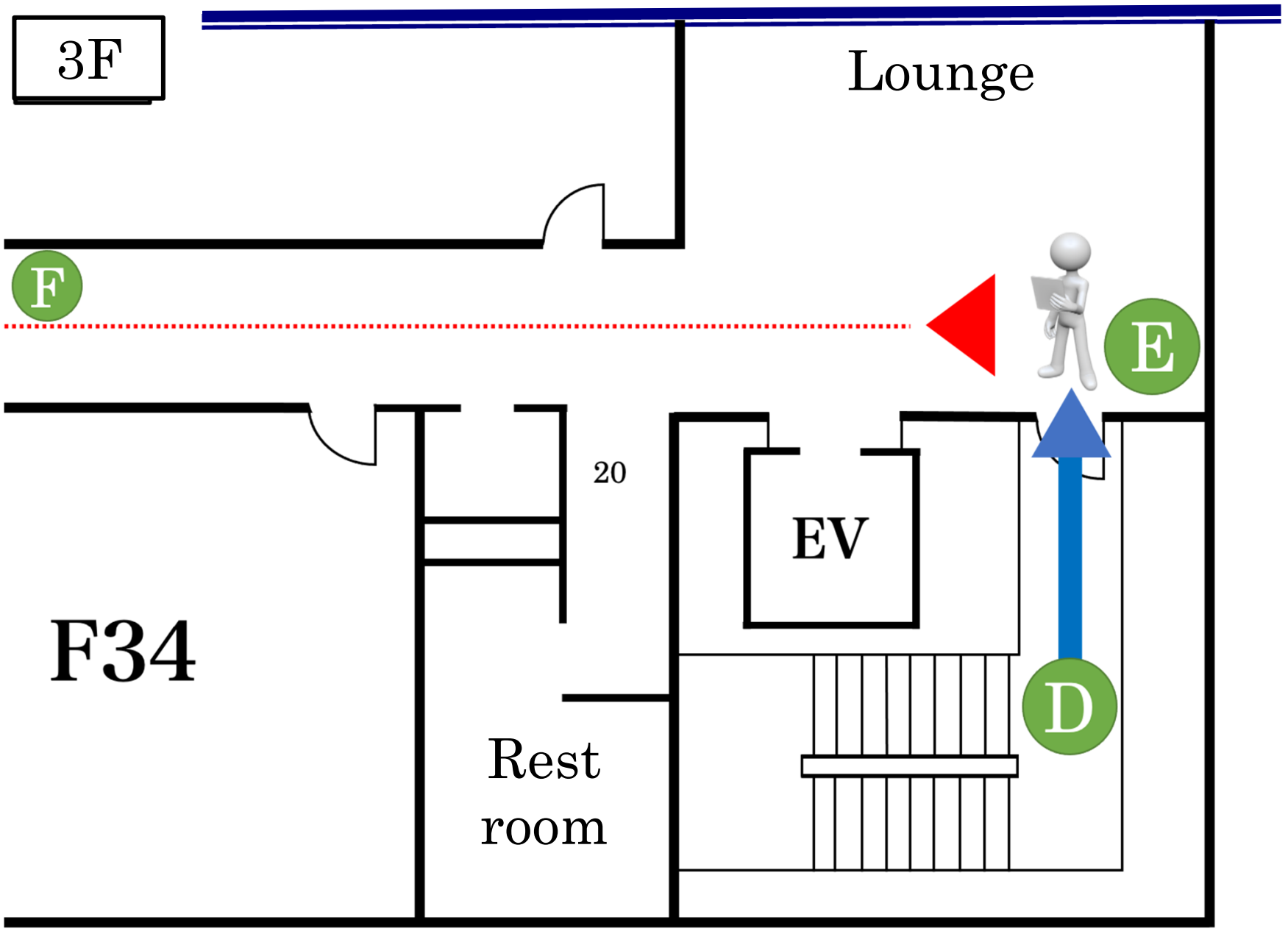
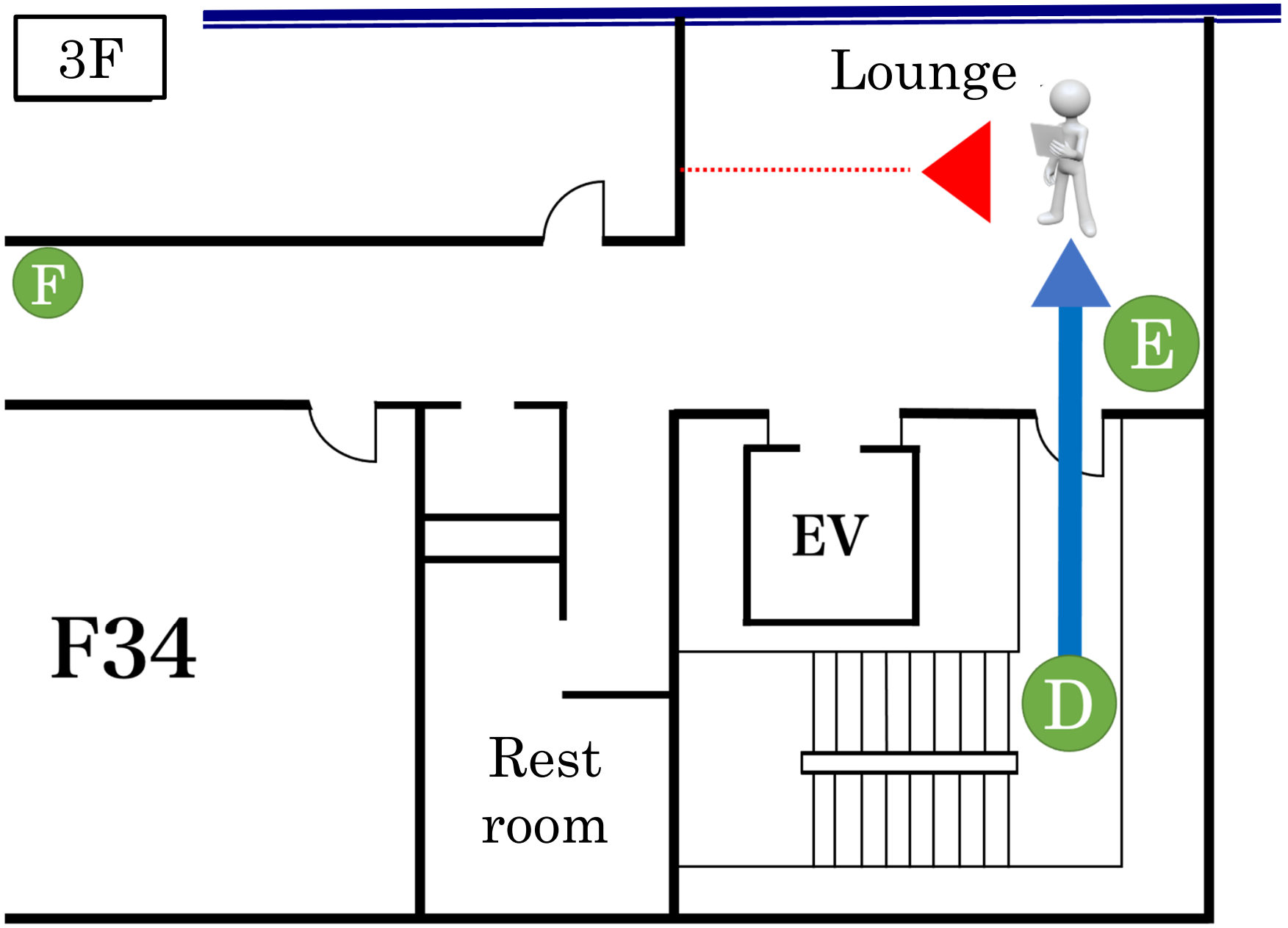

3F
Lounge
E
EV
F34
D
Rest
room


3F
Lounge
EV
E
D
SIMなし
13:49
24%
Mt 60fps
◆8 ▲3.17K
矢印の方へ進んでください!
誘導中止


3F
Lounge
F
E
20
EV
F34
D
Rest
room


3F
Lounge
F
E
EV
F34
D
Rest
room

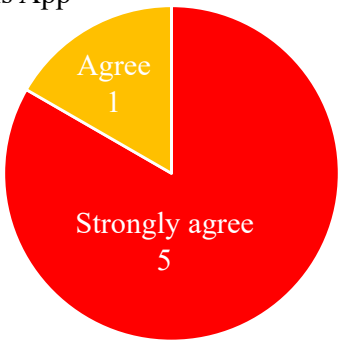
Stopping and evacuation time

Subject	Stop 1	Stop 2	Stop 3	Stop 4	Stop 5	Stop 6	Evacuation time [s]
1	3.15	1.25	5.14	3.07			91
2	2.28	3.21	3.29	5.12	5.11		109
3	2.28	1.28	6.05	1.02	4.20	4.12	99
4	3.28	3.25	3.06	3.12			94
5	3.02	3.05	9.15	3.05			83
6	1.18	2.03	2.23	2.19			66

Results of questionnaire

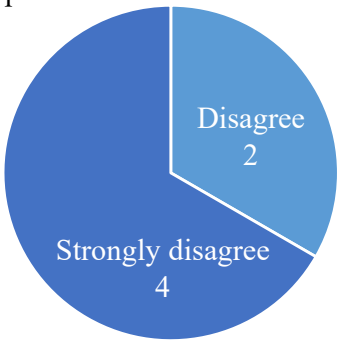
1. You could feel relieved if you have this App indoors without knowing the building.

- Strongly agree
- Agree
- Disagree
- Strongly disagree



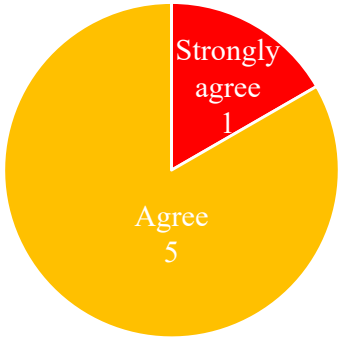
3. You sometimes felt this App difficult to operate.

- Strongly agree
- Agree
- Disagree
- Strongly disagree



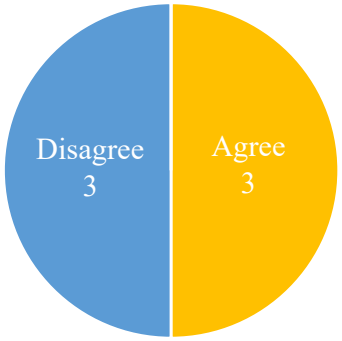
2. You could get to the goal without thinking by only following the displayed guidance.

- Strongly agree
- Agree
- Disagree
- Strongly disagree



4. There were some points where you were confused.

- Agree
- Disagree



5. Conclusion

(1) We have explained the need for an evacuation support system as a research background.

(2) We have clarified the outline of ERESS and the need for evacuation guidance.

(3) We have explained conventional evacuation guidance and clarified problems.

(4) We have proposed AR evacuation guidance using augmented reality technology.

(5) We have confirmed the effectiveness of the proposed method based on the results of the experiments.