1.

Good morning, everyone.

I' d like to thank you for giving me the chance to present here today.

My name is Shunsuke Onuki. I'm going to start my presentation.

My study's title is The Development of WiFi-Based Indoor Navigation System Using Augmented Reality.

2.

I' m going to proceed with the presentation in this order

3.

I'd like to start by talking about Introduction.

4.

Recently, some navigation applications using AR have been released. The most of these applications are designed for outdoors, so they cannot be used indoors where GPS is not available. AR is an abbreviation for Augmented Reality, a technology that visualizes the real world by adding digital information such as voice, images, text and so on.

5.

Therefore, the objective of this research is developing a WiFi-based navigation application that can be used indoors.

We also aim to use AR technology to provide visual, intuitive, and easy-to-understand guidance.

6.

In this section, we describe position tracking, which is the most important part of this application

7.

Our approach is using WiFi APs that are placed in the building. And, The RSSI values received from them are used to estimate the user's location.

AP stands for access point, which acts as a repeater for the router.

RSSI means the strength of the signal received from the AP, and the distance is estimated by the weakness of this values.

The method for estimating the user's position consists of two steps: RSSI distance calculation and Trilateration.

8.
First, the distance between the WiFi AP and the smartphone is calculated using the following equation to identify the user's location. The distance is obtained by the unique frequency and RSSI of the detectable WiFi APs.

9.
After the distance is determined, the user's position is calculated using Trilateration.
Solving a system of equations consisting of a circle whose radius is the distance from each of three or more WiFi APs, we can find some coordinates.

10.
Depending on the number of WiFi APs detected, the vertices of the polygon will change. The figure shows a case of 4 WiFi APs detected.
A polygon is created from them.
And, divided by triangles.
The your position is estimated by the average of their centers of gravity.

11.
Next, I' d like to talk about the actual application we developed.
7.
We have developed an indoor navigation application for smartphones that can be used in the research building at the University of Aizu.
This application guides you through the various rooms in the building, allowing you to get to user’s desired room without getting lost.

8.
The environment for development is as follows：
We used Unity to develop this application.
AR Core can be installed on Unity to enable AR content development for android.
And we used the Galaxy s9 to test the actual device.

9.
The main functions of this application are as follows.
Position tracking as explained before, selecting the desired room from the room list, guiding the user to the desired room using AR technology, and checking the current location and trajectory on the map.

15.
I' d like to describe the second function, selecting a destination.
By selecting a destination from the room list, a route will be calculated from the user's current location to the destination room selected on this screen.

16.
Next is AR Navigation.
The AR function of this application displays the route to the desired room on the screen, and along with it, signs for going straight and turning right or left are displayed on the user's smartphone.

17.
This application also allows users to check their trajectory on a map.

18.
This is the flow of this system. The application works like this.

19.
I'd like to start the demo from the front of the ALO to the soundless room on the first floor of the research building.
On this page, you can see the information of the detectable WiFi APs.
Then, select the desired room here.
Touch the AR button to start the AR navigation.
And now we will see the user's trajectory.
And resume the AR navigation.
Follow the lines and signs displayed on the screen of your smartphone to get to your destination.
That's the end of the demo.

20.
Next is comparison.
We could not find any indoor navigation application like our application, so we compared the application with "Google Map". We can see that our application can only be used in a very limited number of locations. However, by expanding the target buildings, it can be used in more places.

21.
Next is conclusion
22.
The RSSI received from the WiFi APs was used to identify the user's current location on the first floor of the research building, and successfully navigate the user to the destination from there. In addition, AR technology is used to create applications that are visual, intuitive, and easy to understand

24.
However, there is an error in position tracking, and this research could not eliminate the error, but only identify the cause.
There are three issues that need to be solved.
Drift and lost due to position tracking error. And the narrowness of this application.

26.
Thank you for listening my presentation.