

# Robot-Assisted Group Tours for Blind People

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This is ISS, go ahead









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This is ISS, go ahead





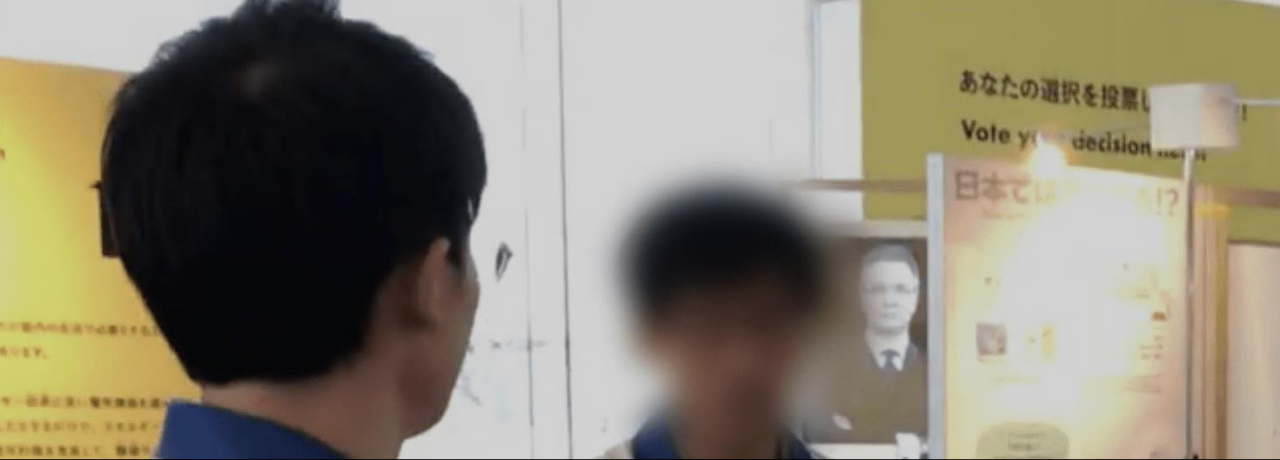
Blind Visitors



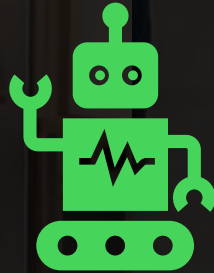
Sighted Visitors

Tour Guide





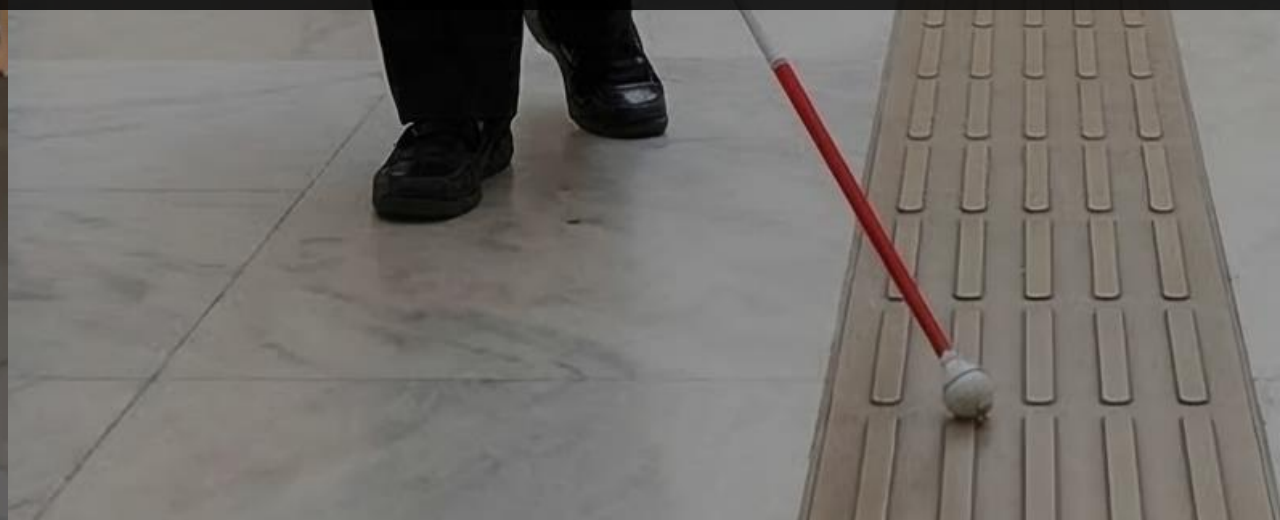
Blind Visitors



Sighted Visitors



Tour Guide



# Method | Overview

*Phase I*

Interview Studies

*Phase II*

System Design &  
Implementation

*Phase III*

Field Study

# Phase I: Interview Studies | Method

*Phase I*

Interview Studies



Interview with blind people (n=5)



Interview with tour guides (n=5)

# Phase I: Interview Studies | Findings



with blind people (n=5)

## *General Tour Challenges*

- Communication challenges with the tour guide
- Difficulties in following the tour
- Lack of personalized tour pace



with tour guides (n=5)

## *Blind Tour Design*

- Focus on the touch experience
- Explaining visual information
- Group tour management

## *Robot Design Insights*

### **Provide explanation**

- Describe visual information
- Explain exhibits
- Point out new things

### **Support group interactions**

- Find the guide
- Describe group members
- Indicate turn taking

### **Support Navigation**

- Maintain appropriate proxemics within the group
- Enhance safety and give alerts

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with blind people (n=5)

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with tour guides (n=5)

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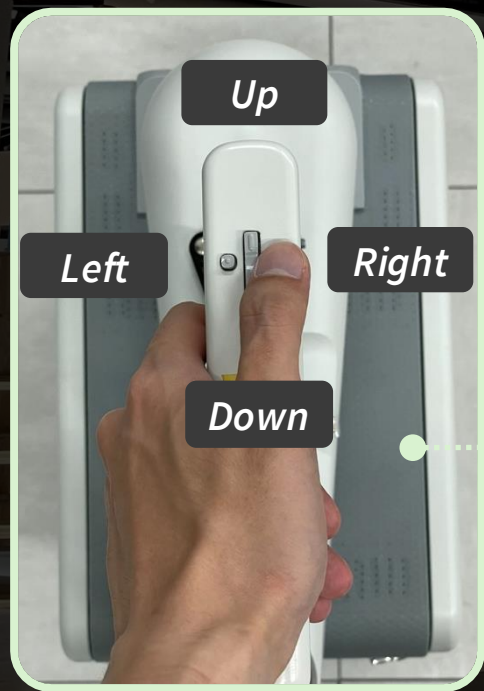
### Support Navigation

- **Maintain appropriate proxemics within the group**
- Enhance safety and give alerts

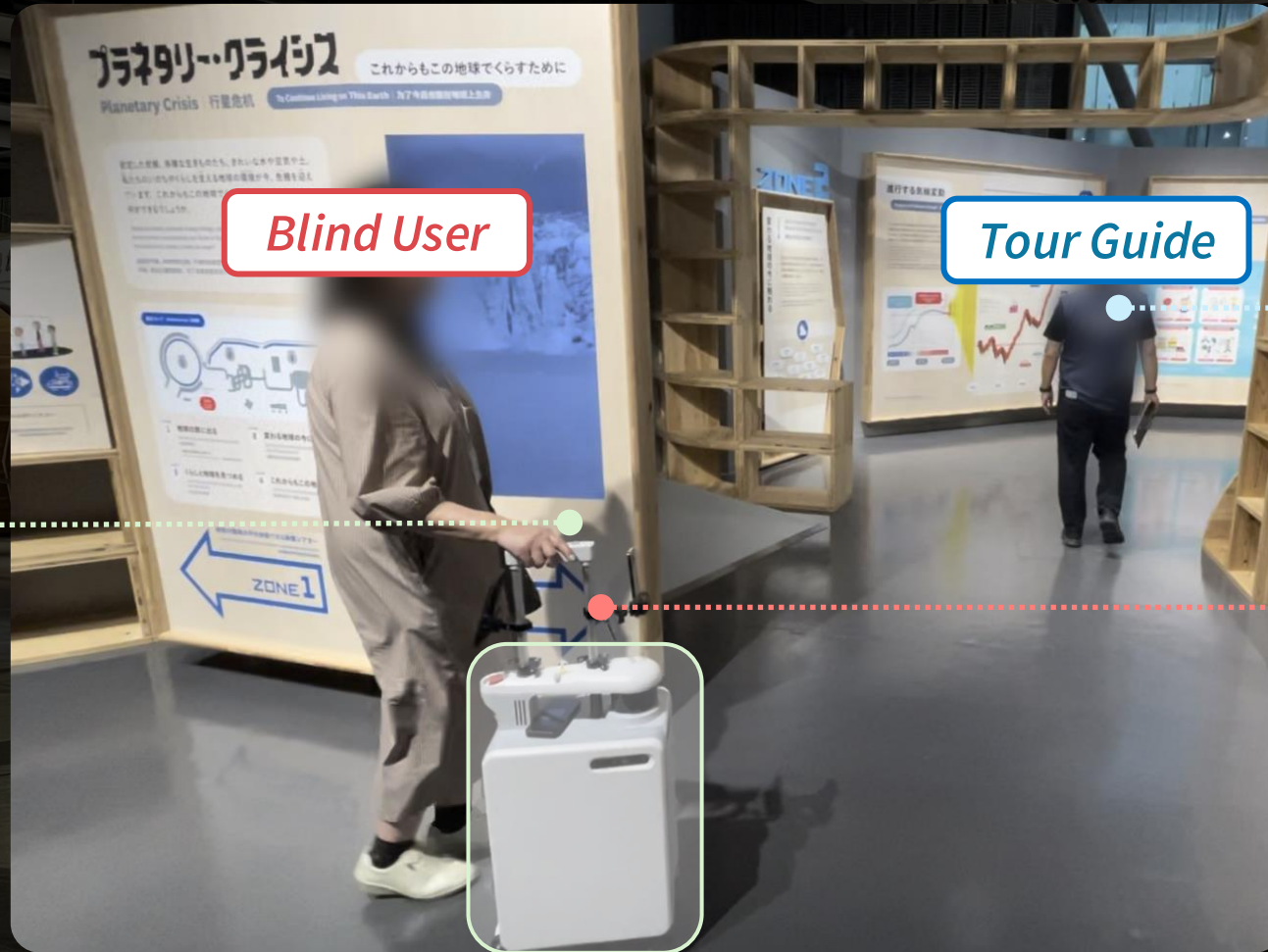
Phase II

System Design & Implementation

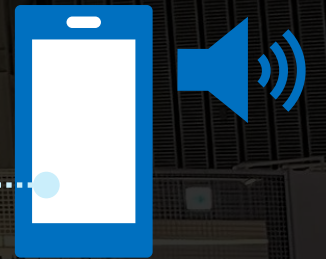
# Phase II: System | Overview



Suitcase Robot



Guide App

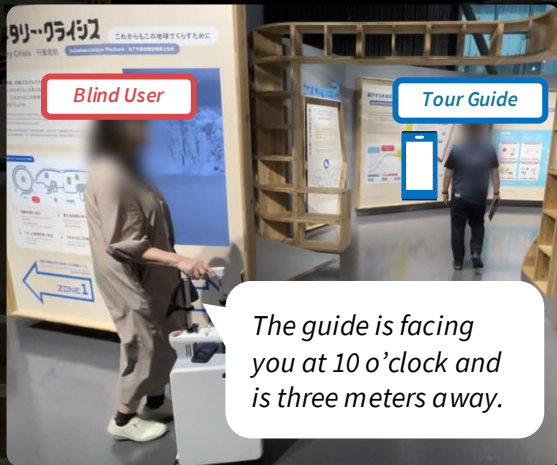


User App



# Phase II: System | Robot Features

## 1. Guide Description



世界の今に触れる

NONOZ

Get to Know the State of the World  
接触正在

私たちの暮らしに急激な変化が起きている。地球の環境は、その原因は何で...

Rapid changes are being seen from the foundation of the global environment. These are the reasons for them...

- 気候変動
- 海面上昇
- 水不足
- 生態系崩壊
- 人口増加

### 進行する気候変動

Progress of Climate Change | 正在进行的气候变化

今、世界の平均気温は過去10万年で最も高くなっています。地球の歴史の中で繰り返されてきた氷期と間氷期のあいだの気温変化と比較すると、その変化の急激さが目立ちます。この気温上昇は人間の活動によって排出される温室効果ガスが主な原因です。

The global average temperature is currently the highest it has ever been in 100,000 years. Compared with the temperature change from the glacial period to the interglacial period that has occurred repeatedly, the speed of the temperature change is striking. The main reason for this temperature rise is the greenhouse effect gas emitted by human activities.



気温の上昇を1.5°C以内におさえることが世界目標です

1.5°C

気候変動のリスク

気候変動によるリスクは、自然災害の増加、農業・漁業への影響、健康被害、生態系への影響、社会不安の増加などです。

- 自然災害の増加
- 農業・漁業への影響
- 健康被害
- 生態系への影響
- 社会不安の増加



Describe Guide Location

### 今が将来への分岐点

The World is at a Crossroads

気候変動のリスクは、自然災害の増加、農業・漁業への影響、健康被害、生態系への影響、社会不安の増加などです。

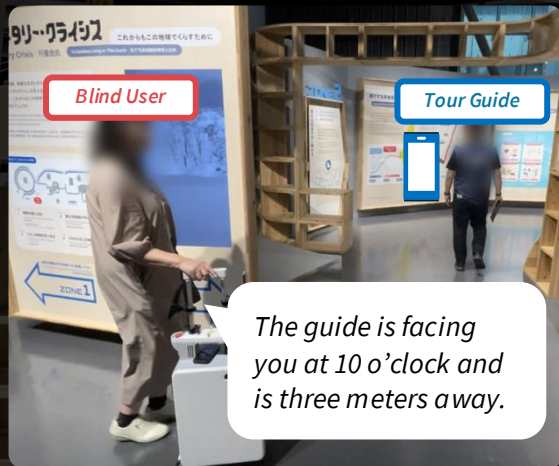
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- 自然災害の増加
- 農業・漁業への影響
- 健康被害
- 生態系への影響
- 社会不安の増加

# Phase II: System | Robot Features

## 1. Guide Description



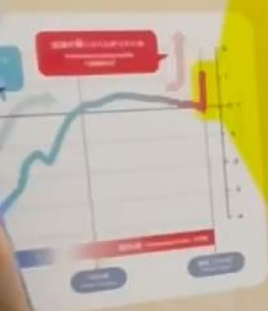
## 2. Notify the Guide



# 気候変動

Climate Change | 正在進行の気候変化

近年で最も早く見られています。地球の平均気温は過去100年間で約1.1℃上昇しています。この急激な上昇は人間の活動が主な原因です。



# 今が将来への分かれ道

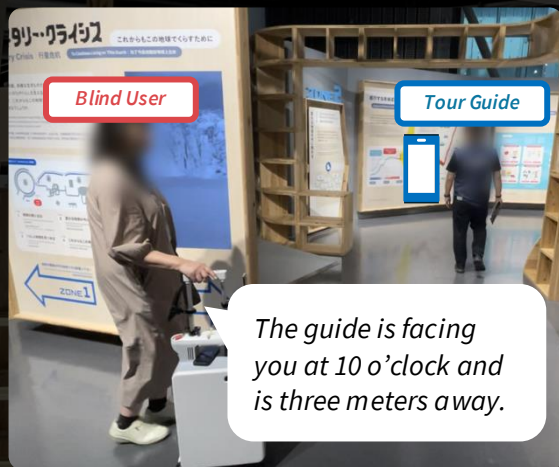
We Are Community as a Community | 共に未来を創る

- Energy: 再生可能エネルギー (Renewable Energy)
- Water: 持続可能な水資源 (Sustainable Water Resources)
- Food: 持続可能な食料 (Sustainable Food)
- Waste: 持続可能な廃棄物管理 (Sustainable Waste Management)

Notify the Guide

# Phase II: System | Robot Features

## 1. Guide Description



## 2. Notify the Guide



## 3. Surrounding Description



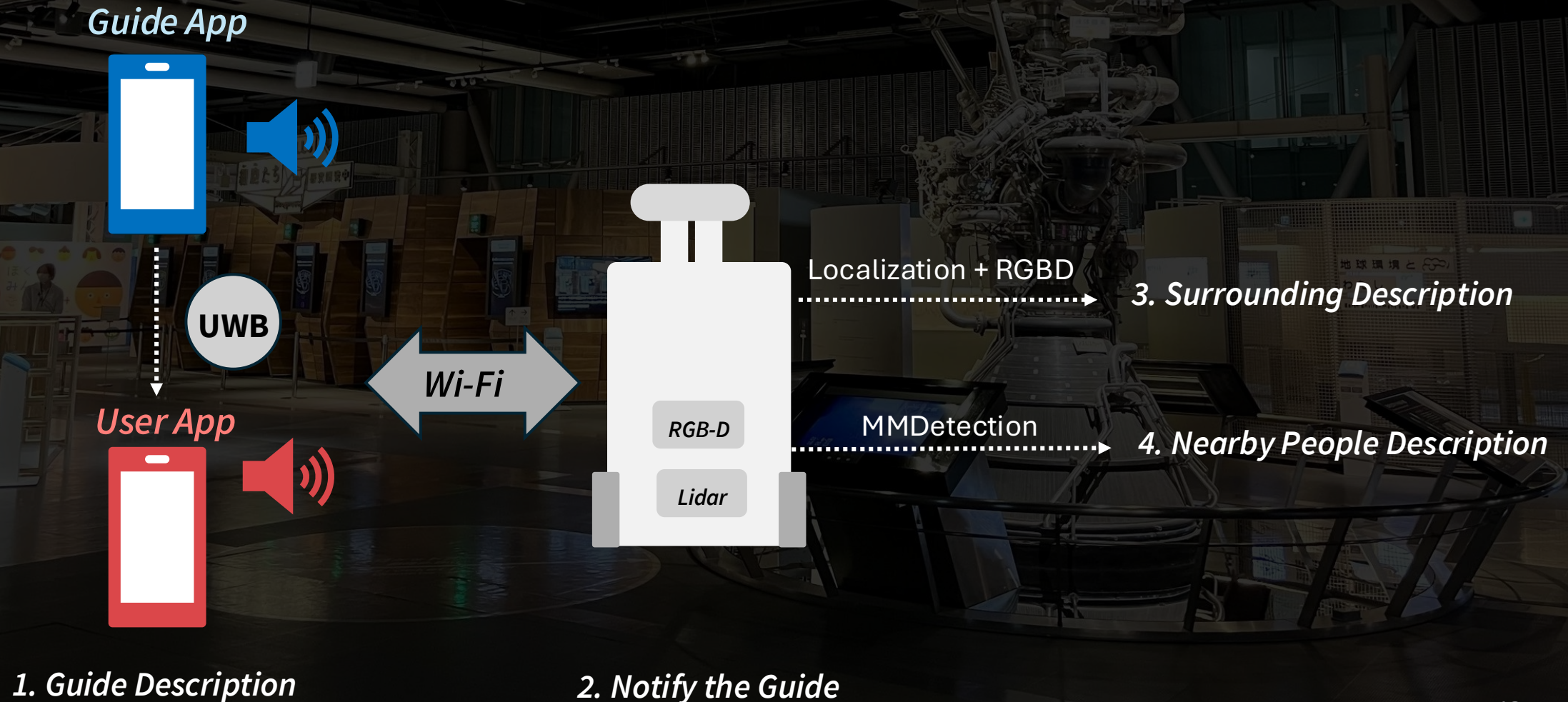
## 4. Nearby People Description



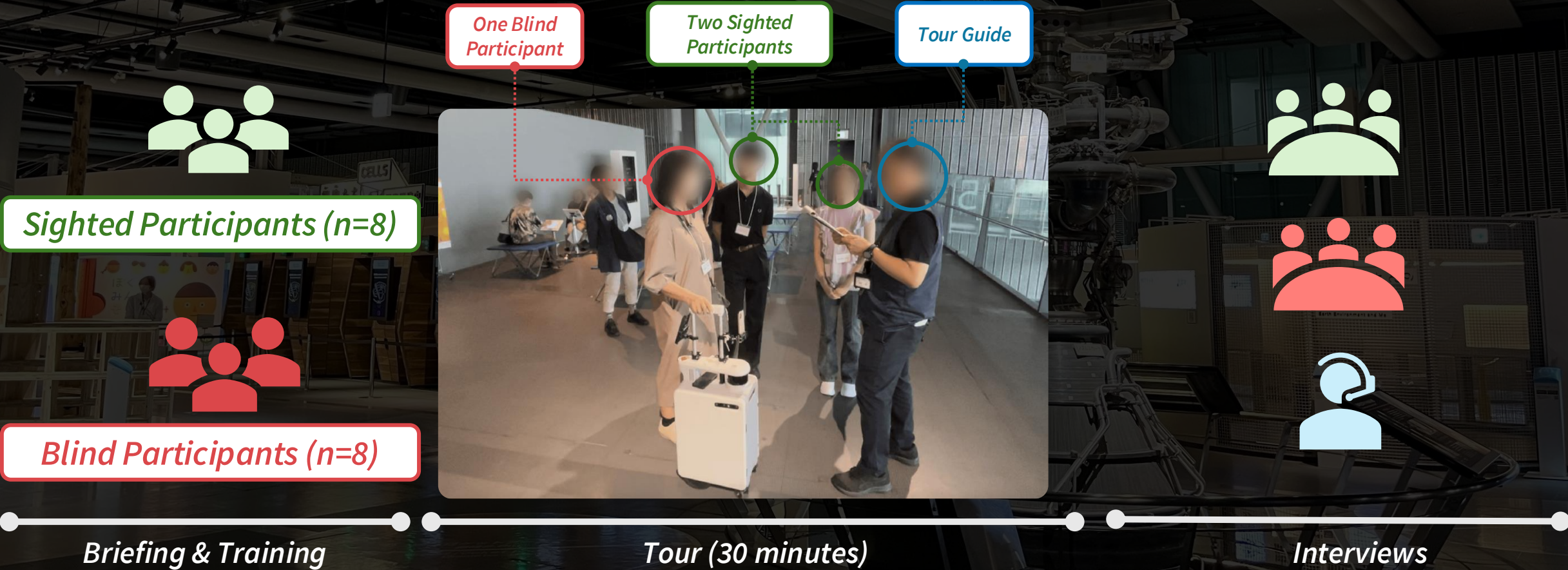
## 5. Navigational Support

The blind user follows the robot to join the tour (Robot Tele-operation)

# Phase II: System | Implementation

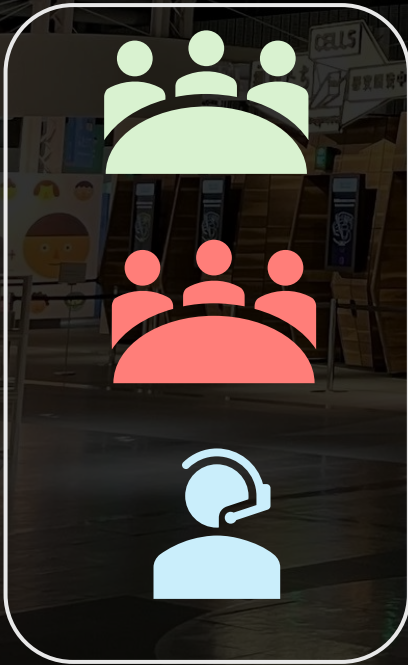


# Phase III: Field Study | Method



# Phase III: Field Study | Data Analysis

*Interview Data*



*System Log*

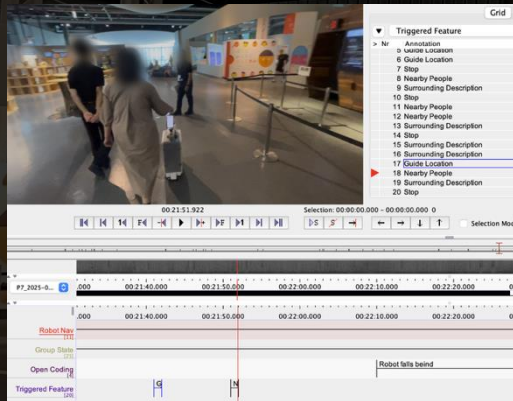


*Tour Video Analysis*

A screenshot of a video analysis software interface. The top part shows a video player with a timeline and playback controls. Below the video player is a list of triggered features. The list includes: 5 Guide Location, 6 Guide Location, 7 Stop, 8 Nearby People, 9 Surrounding Description, 10 Stop, 11 Nearby People, 12 Nearby People, 13 Surrounding Description, 14 Stop, 15 Surrounding Description, 16 Surrounding Description, 17 Guide Location, 18 Nearby People, 19 Surrounding Description, and 20 Stop. The interface also shows a selection mode and a grid view.

# Phase III: Field Study | Data Analysis

## System Log & Tour Video Analysis



Triggered Feature

Timeline



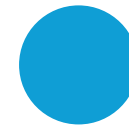
Guide Location



Call Guide



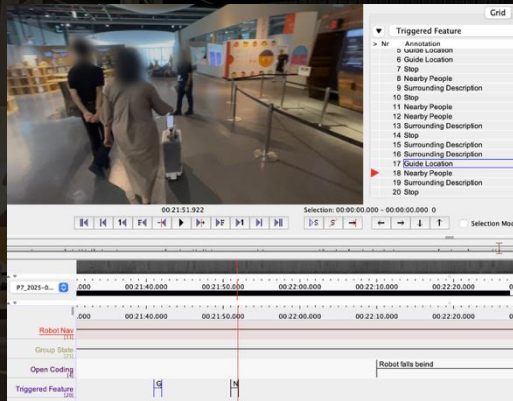
Surrounding  
description



Describe nearby  
people

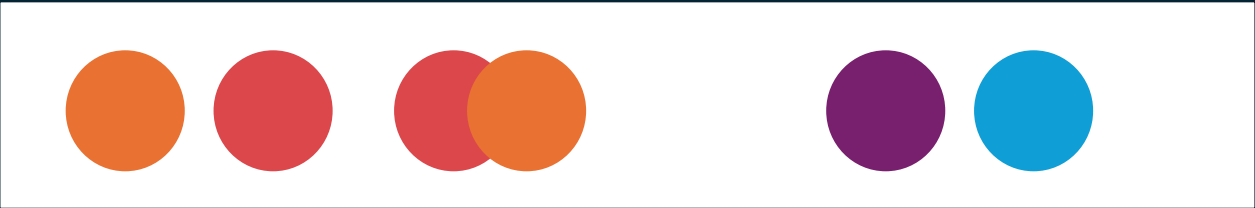
# Phase III: Field Study | Data Analysis

## System Log & Tour Video Analysis



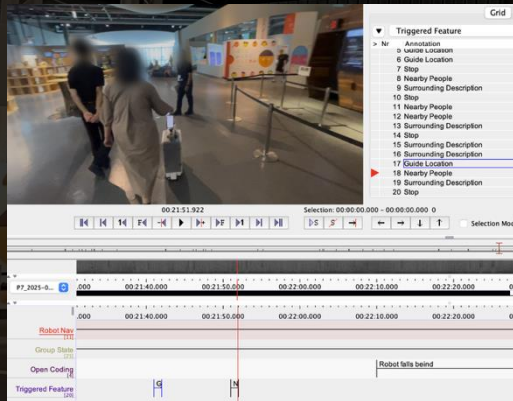
Triggered Feature

Timeline



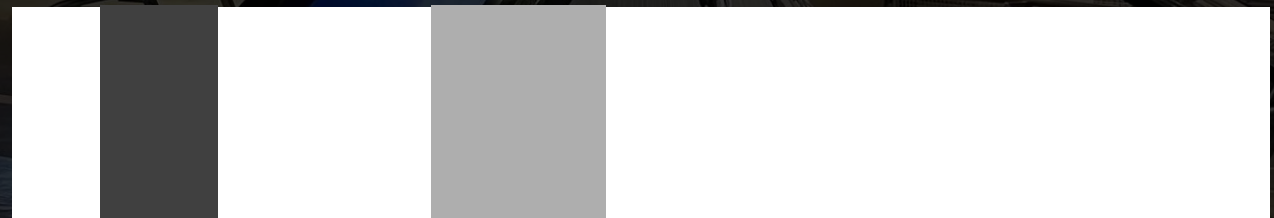
# Phase III: Field Study | Data Analysis

## System Log & Tour Video Analysis



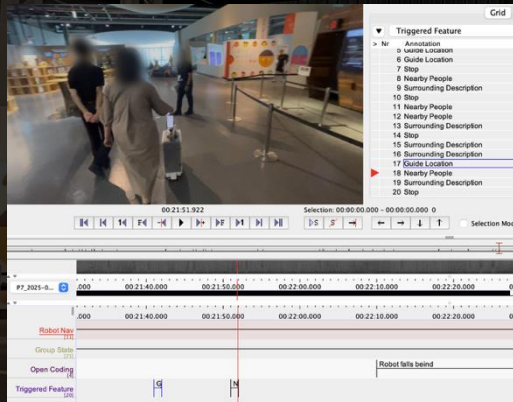
*Robot Nav State*

*Timeline*



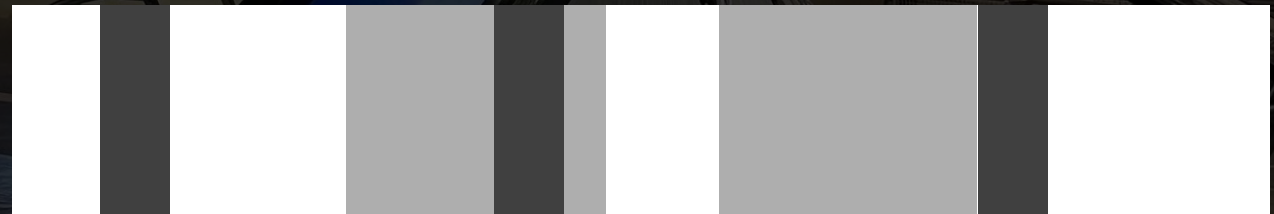
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## System Log & Tour Video Analysis



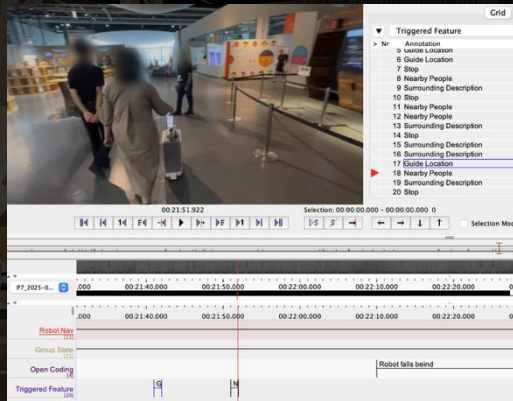
*Robot Nav State*

*Timeline*



# Phase III: Field Study | Data Analysis

## System Log & Tour Video Analysis



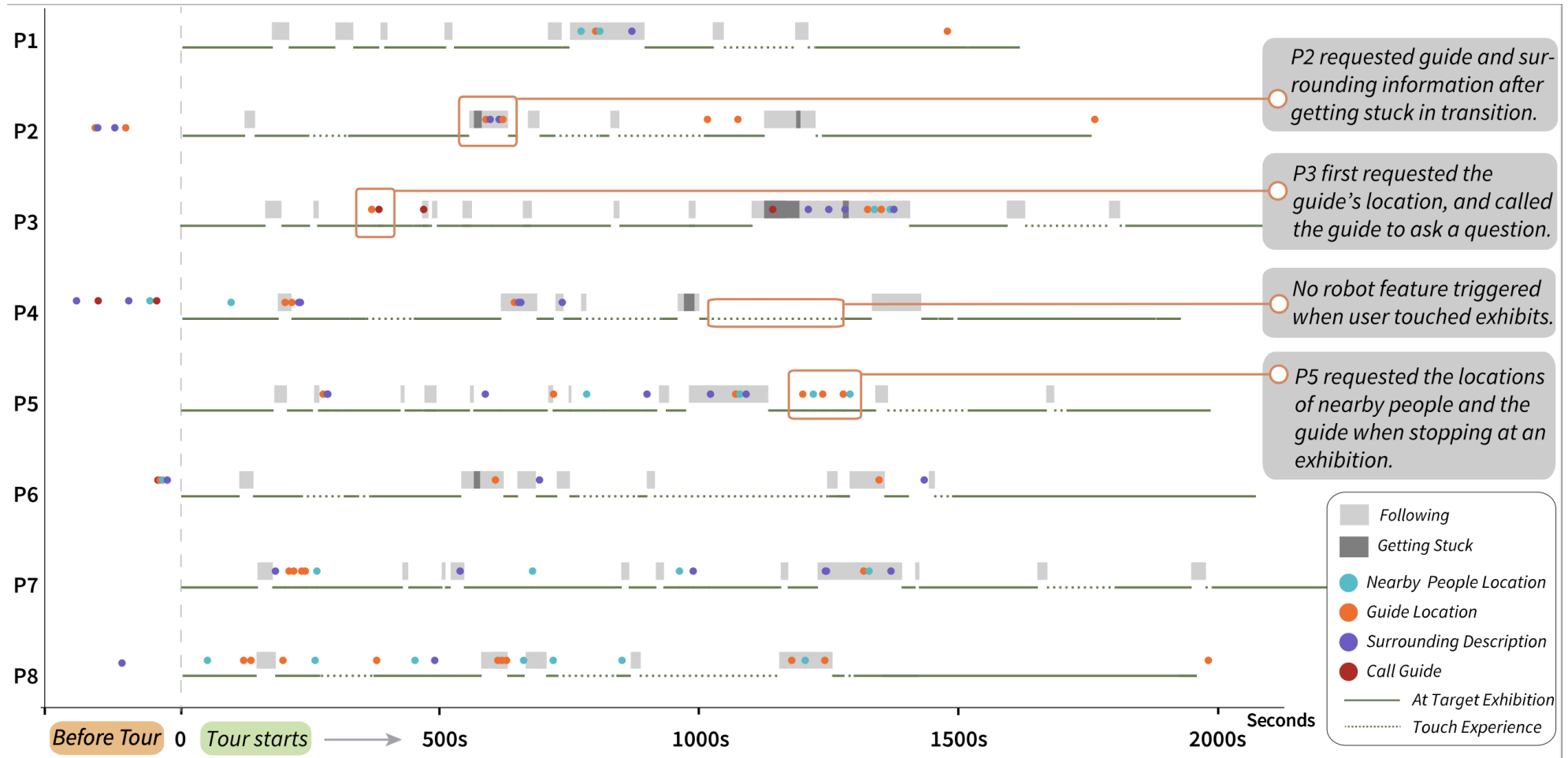
*Group Member State*

*Timeline*

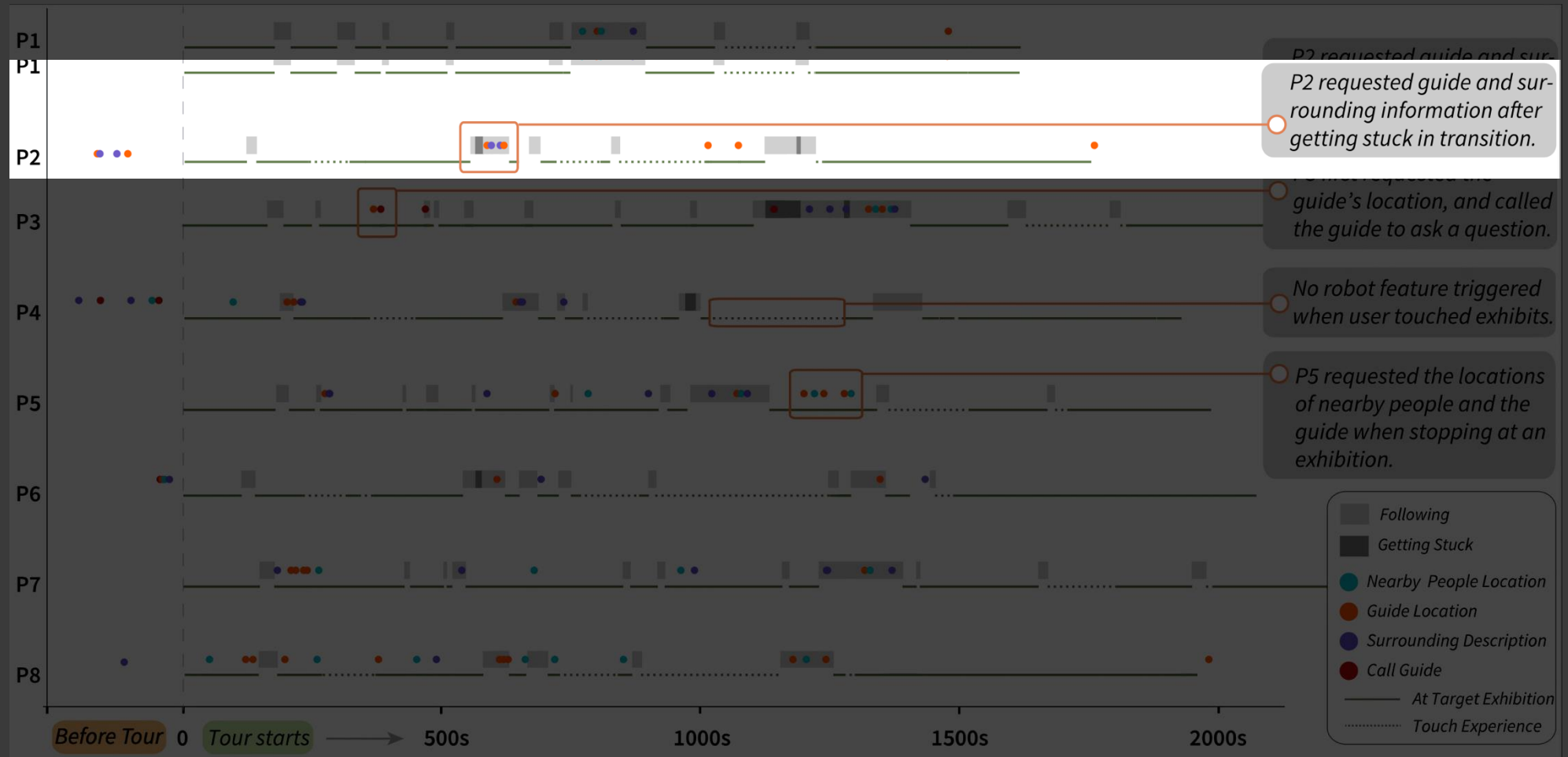
*At the exhibit*

*Touch the exhibit*

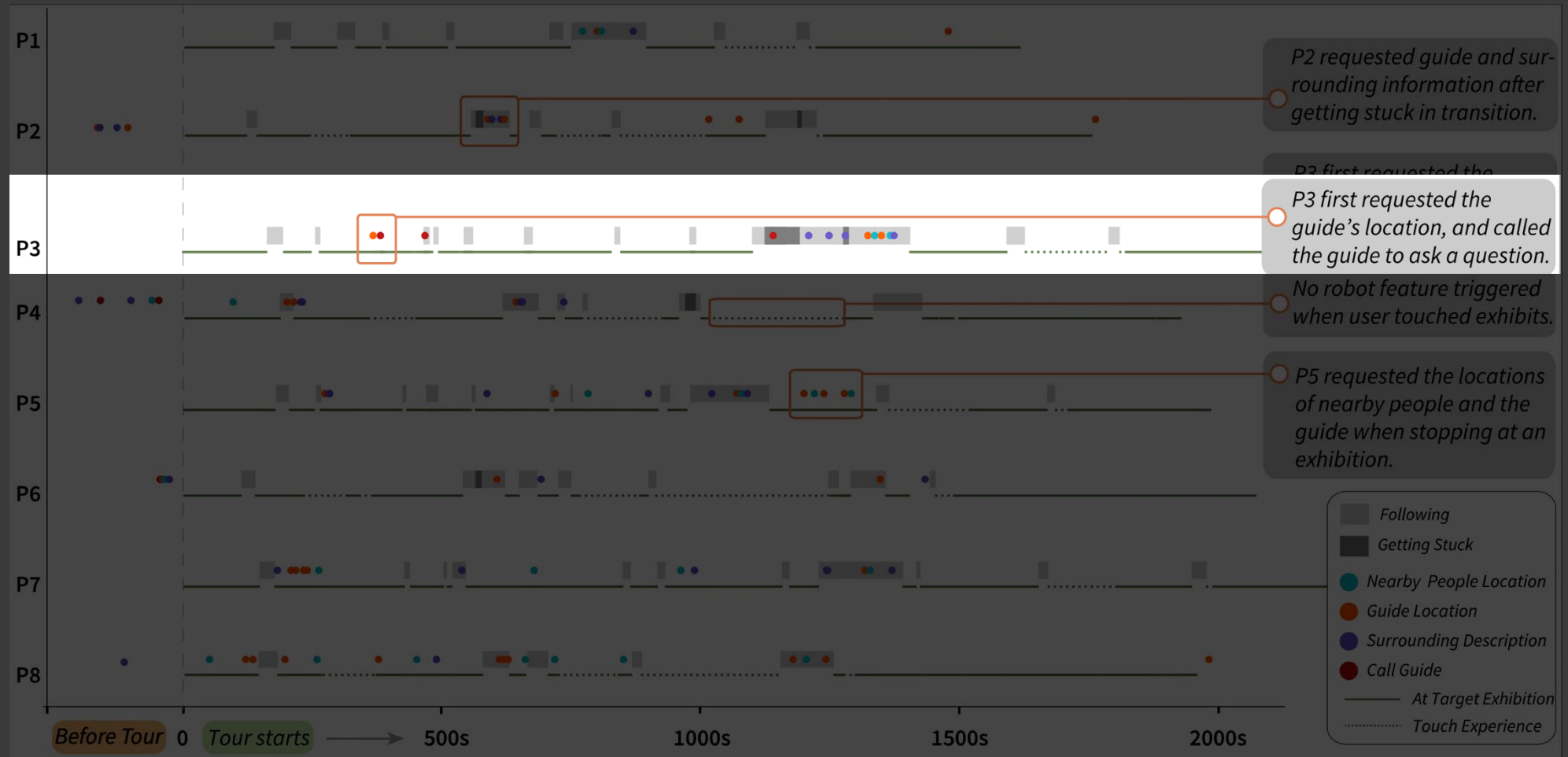
# Phase II: Field Study | Interaction Patterns



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# Phase II: Field Study | Interaction Patterns



# Phase III: Field Study | Qualitative Findings

## *Robot-Assisted Group Following*

- Sense of safety in following
- Robot adjustment by the user

## *Robot-Assisted Group Interaction*

- Engagement with the tour guide
- Maintain connections with the guide
- Interaction with other visitors
- Heighted self-consciousness

## *Sighted Stakeholder Feedback*

- Touch experience for sighted visitors
- Slowed tour pace
- Need of “call guide” and monitoring the robot location



# Thank you for listening!

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Paper Link

