「Strategic Innovation Promotion Program (SIP) Phase Two / Automated Driving (Expansion of Systems and Services) Visual Field Defects

~FY2018-FY2020_FY2019 Annual Report~

Summary

RIKEN
Nagoya university
University of tsukuba

【Agenda】

1. Overall plan
2. Progress list for each task (time schedule)
3. Task a
    - 3-1. Overview
    - 3-2. Schematic image of data analysis
    - 3-3. Result-1
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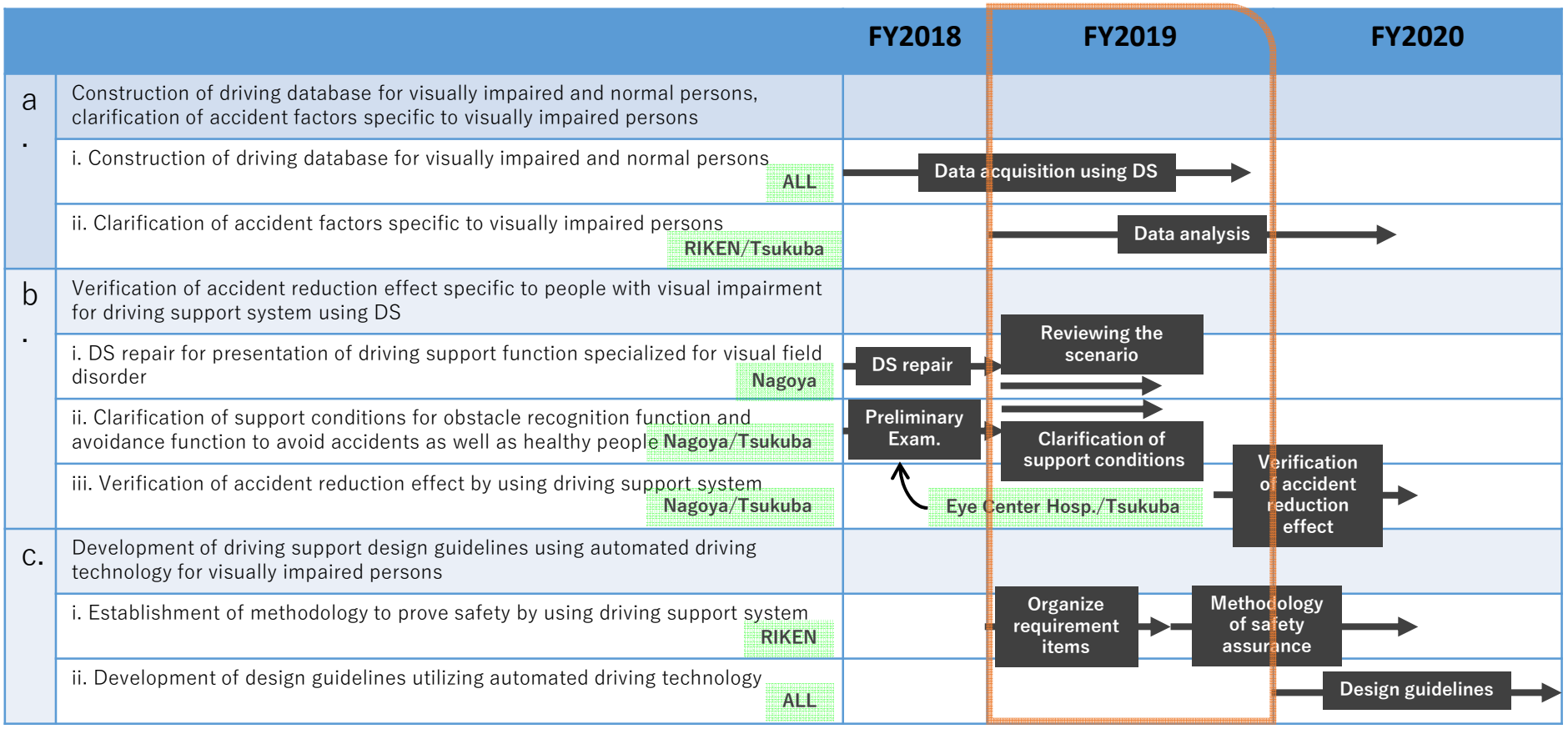
    - 3-5. Result-3
4. Task b
    - 4-1. Overview
    - 4-2. Detailed method of simulation
    - 4-3. Result
5. Task c
    - 5-1. Driving outpatient
    - 5-2. Draft of design guideline

1. Overall plan

▷Research agenda of FY2019(□) in the overall plan



2. Progress list for each task (time schedule)

▶Task a.

Construction of driving database for visually impaired and normal persons, clarification of accident factors specific to visually impaired persons

【o/g】 Collection of DS data at medical institutions(2019.2~Present~2020.9)
【Fin】 Analysis of previous research DS data(2019.10~2020.1)
【o/g】 Analysis of original research DS data(2020.1~Present~2020.4)
【Plan】 Clarification of accident factors specific to visually impaired persons(2020.4~2020.12)
【Plan】 Construction of driving database(2020.4~2020.12)
【Fin】 Preparation for HMD-DS data collection*(2019.10~2019.12)
【o/g】 Comparative analysis of DS data (Snai vs HMD-DS)*(2020.1~Present~2020.3)
【Plan】 Comparative analysis of DS data (each device)*(2020.4~2020.10)

▶Task b.

Verification of accident reduction effect specific to people with visual impairment for driving support system using DS

【Fin】 High precision DS scenario modification(2019.1~2020.1)
【Plan】 Gaze behavior analysis using DS data(2020.3~2020.5)
【Fin】 Accident analysis simulation using JARI system(2019.8~2020.1)
【Plan】 Accident analysis simulation that reflects gaze behavior analysis(2020.4~2020.9)

▶Task c.

Development of driving support design guidelines using automated driving technology for visually impaired persons

【o/g】 Installation & pre-operation of driving outpatient (2019.7~present~2021.3)
【o/g】 Design of connection with medical examination and enlightment*(2019.10~present~2021.3)
【o/g】 Discussion about design guideline*(2020.1~present~2021.3)

*Cooperation with other projects

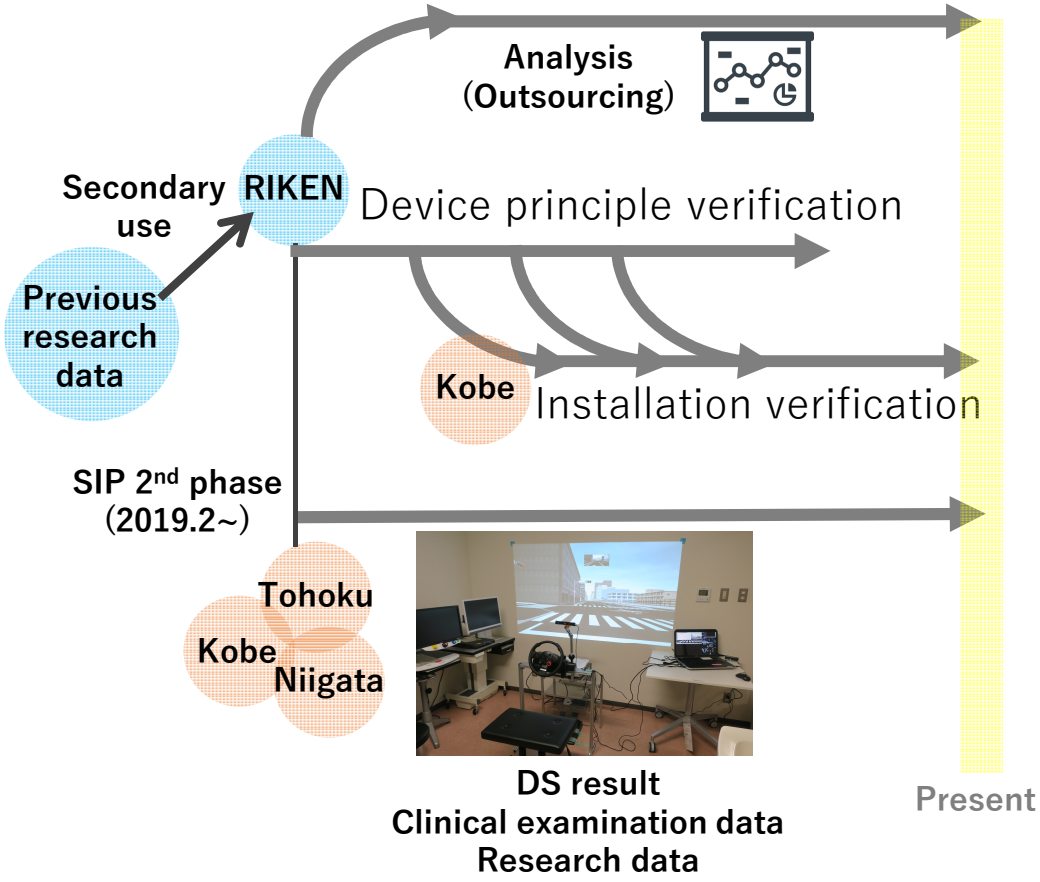
3-1. Overview

▷Task a,_Overview

▷Schematic image of task a: Data collection environment and analysis

【o/g】Data collection by medical institutions is accumulating on schedule

【Fin】HMD-DS devices have begun to be implemented in medical institutions



↑
HMD-DS(VR)

Gaze behavior→

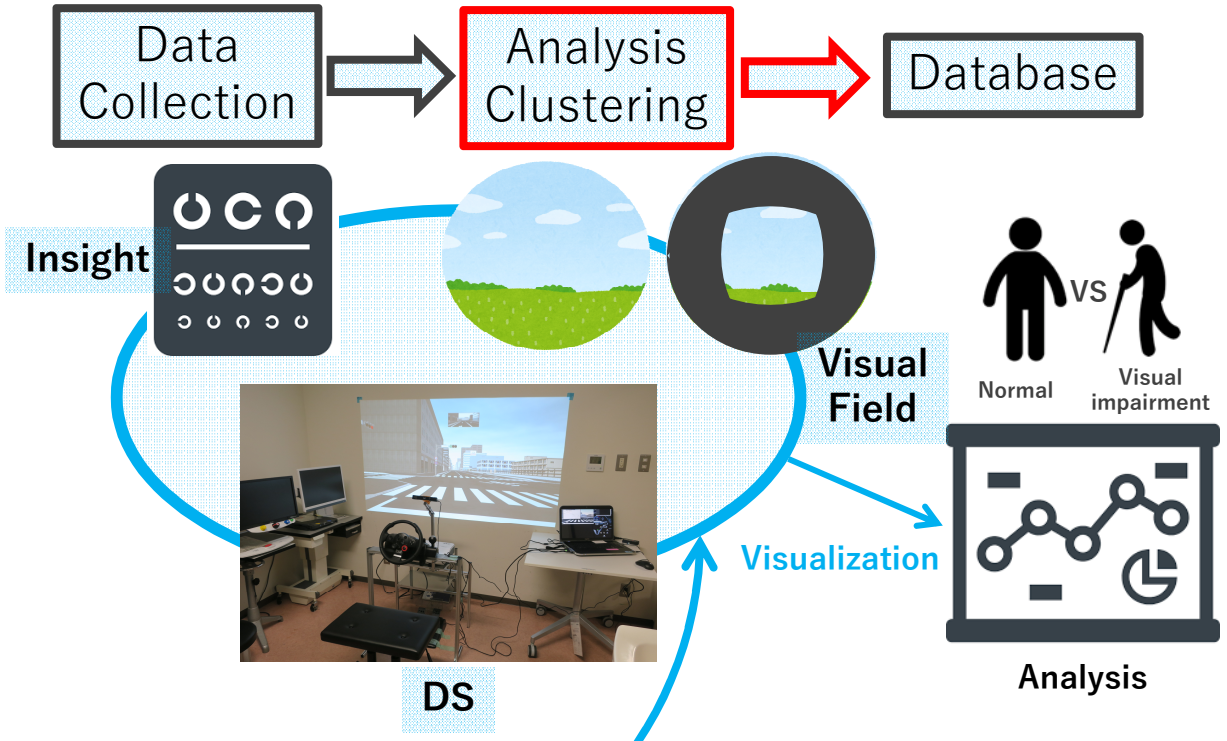
RIKEN Device principle verification

Kobe Tohoku Niigata

Result of data collection (2019.1~2020.2)	
Medical institute	Case (RP)
Kobe Eye Center Hos	34(18)
Tohoku Unv	20(8)
Niigata Univ	48
Nishi-kasai Inoue clinic	24(1)

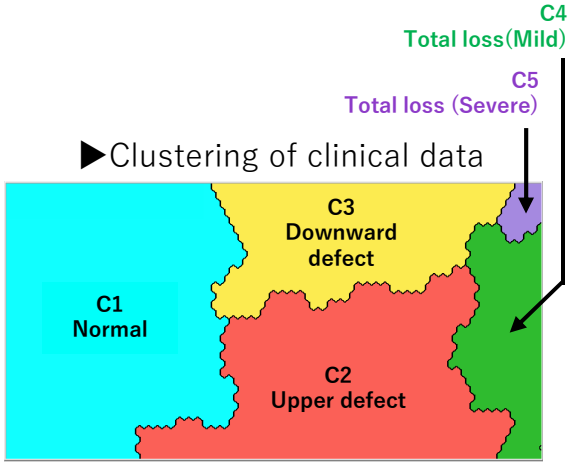
3-2. Schematic image of data analysis

▷Clarification of accident factors specific to visually impaired persons
【Fin & o/g】We performed a data analysis of previous studies to achieve visualization of ocular findings and driving risk.



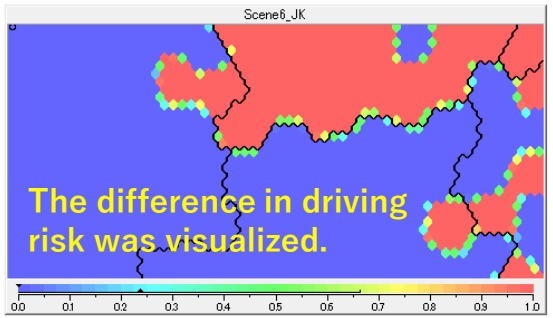
-[Fin] Principle verification
-[Fin] Setting
-[Fin] Pre-operation
-[o/g] Pre-operation at driving outpatient
-[plan] Data collection

▶Clustering of clinical data



▶DS scenario

▶Analysis using DS result



3-3. Result-1

▷Analysis

e.g. The scene with the car coming out of the left side

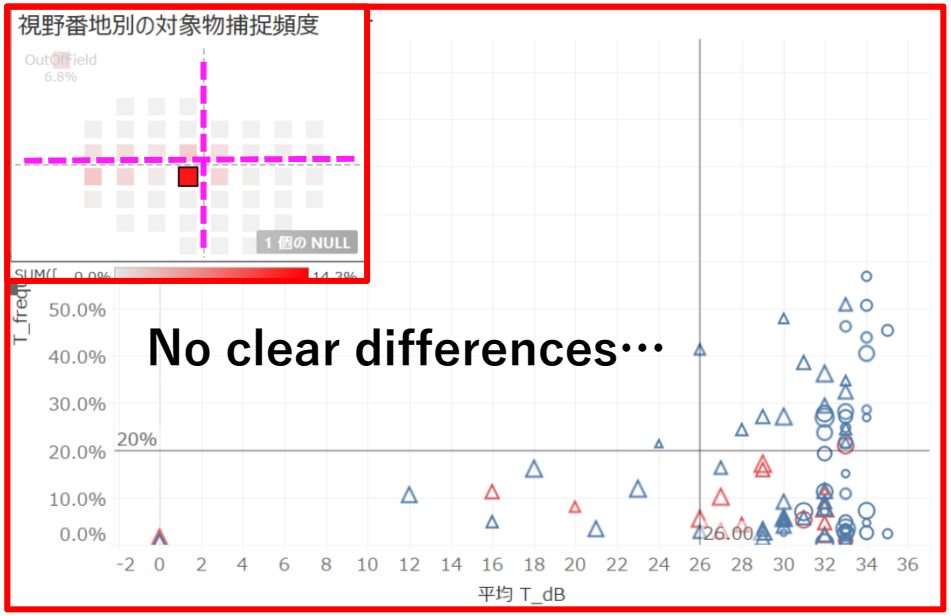
-There were scattered differences between the presence/absence of accidents and visual field abnormalities in the risk area.

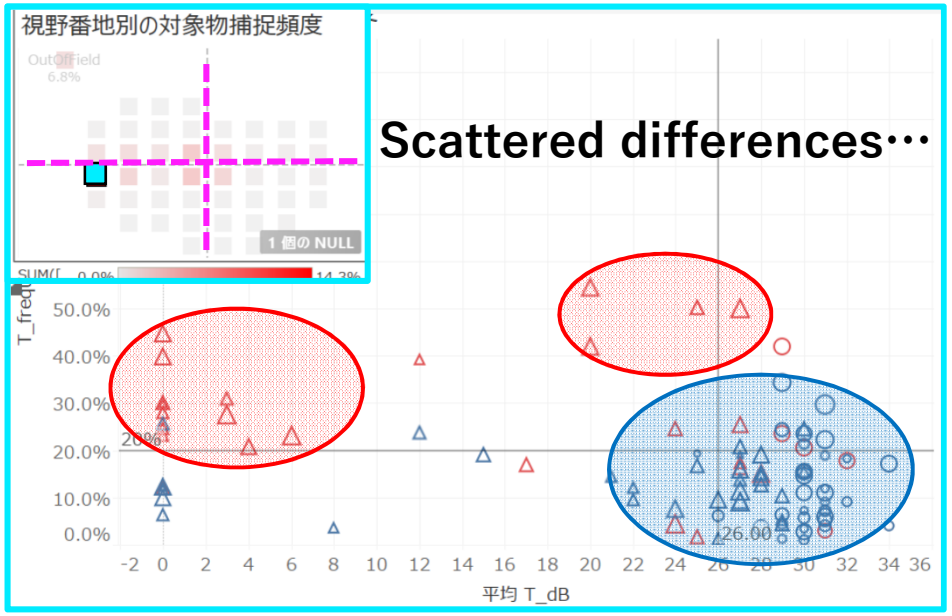
-No clear differences were found in areas unrelated to risk.

Clash | VisFld	Normal	Impairment
No clash	○	△
Clashed	○	△

Frequency

Degree

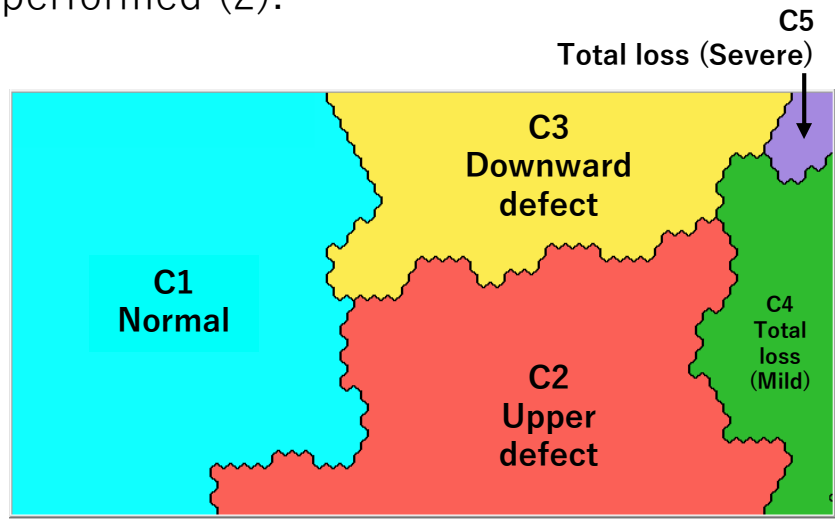




3-4. Result-2

▷SOM analysis

Clustering of the examination findings by SOM analysis (1) and overlaid with the results of the presence/absence of crash for each DS scene, visualization of visual impairment and driving risk was performed (2).



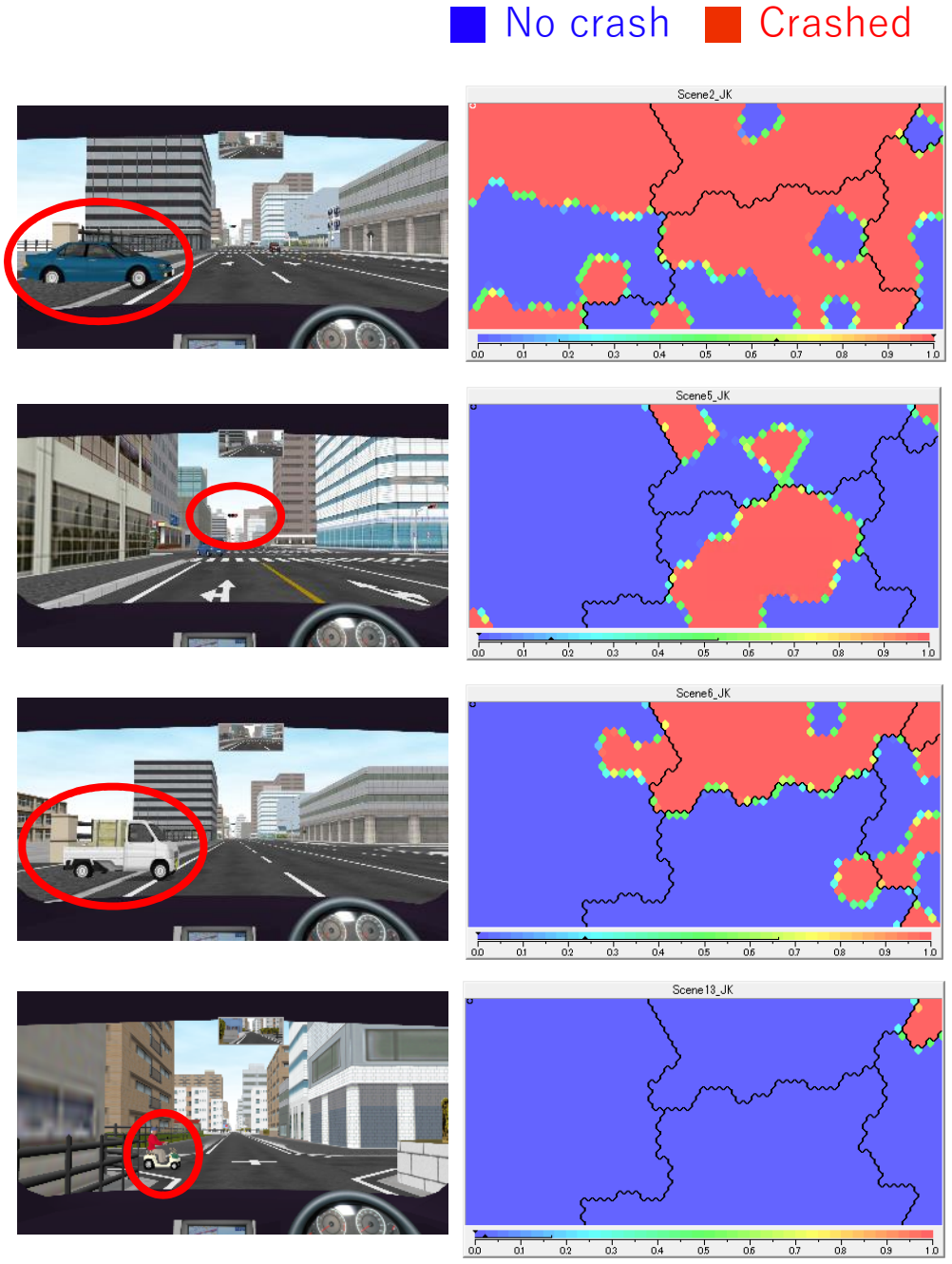
↑

Clustering of clinical examination findings by SOM analysis (1)

→

Left, DS scenes

Right, Overlaid with DS results(2)



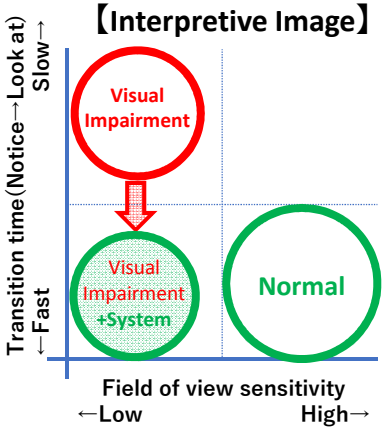
3-5. Result-3

▷Comparative analysis (S-navi vs HMD-DS)

The accuracy and trend of DS results across devices were compared and analyzed.
It was suggested that the HMD-DS is also useful as a data collection device because it is long and portable.

- Normal/No crash
- Normal/Crashed
- Vis Imp/No crash
- Vis Imp/Crashed
- Risks

【Interpretive Image】



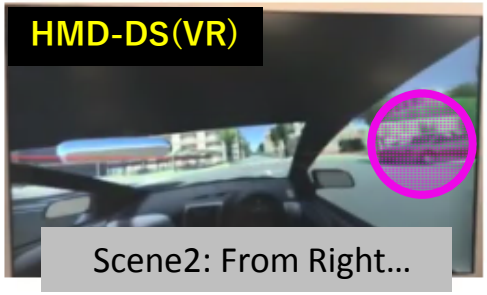
Selective area

Out							
		06	07	08	09		
	12	13	14	15	16	17	
20	21	22	23	24	25	26	27
30	31	32	33	34	35	36	37
40	41	42	43	44	45	46	47
50	51	52	53	54	55	56	57
	60	61	62	63	64	65	
		68	69	70	71		

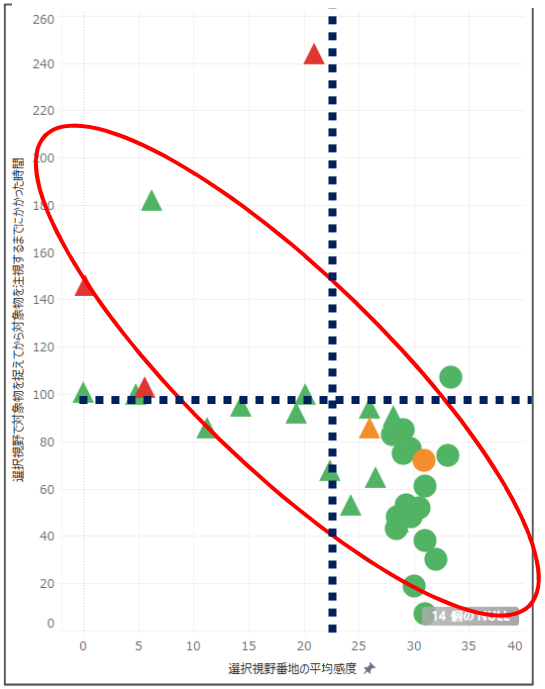
Selective area (Looking at)

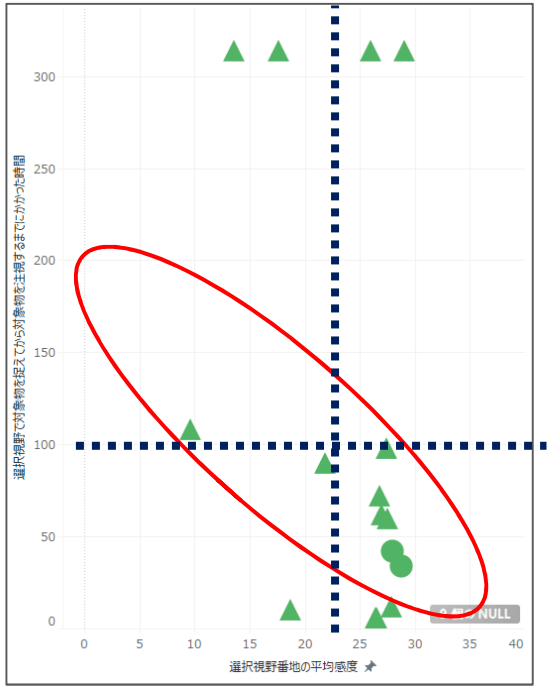
Out							
		06	07	08	09		
	12	13	14	15	16	17	
20	21	22	23	24	25	26	27
30	31	32	33	34	35	36	37
40	41	42	43	44	45	46	47
50	51	52	53	54	55	56	57
	60	61	62	63	64	65	
		68	69	70	71		

Scene10: From Right…



Scene2: From Right…





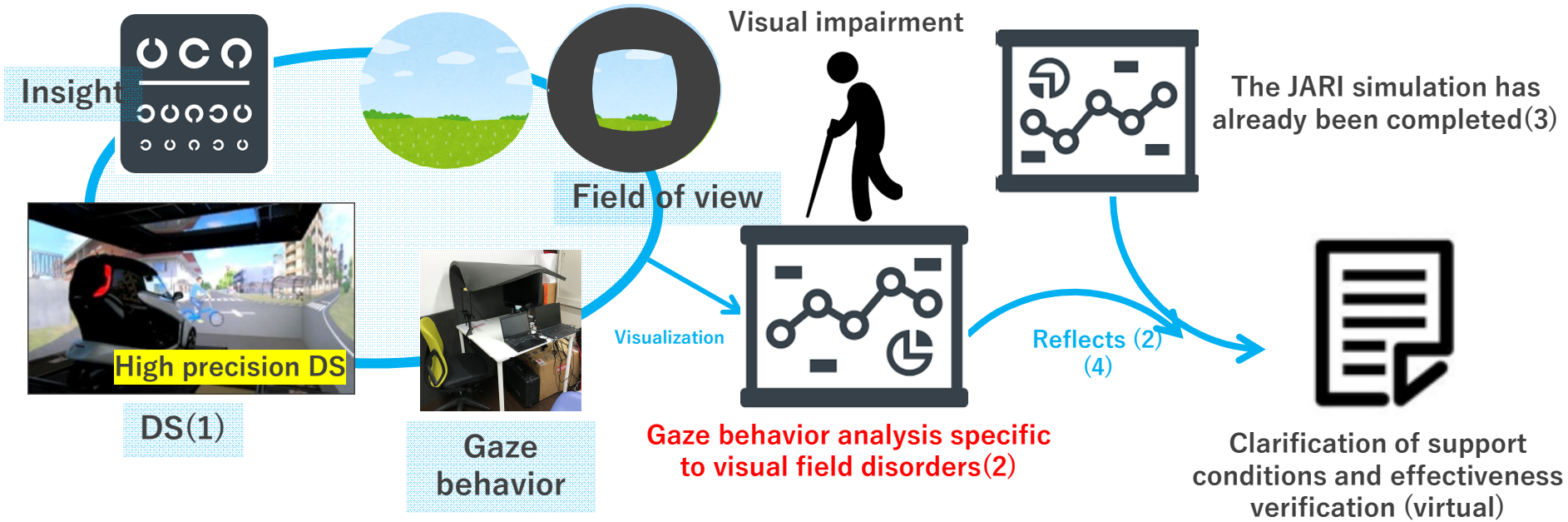
The HMD-DS showed generally the same trend, although some conditions were different and the number of cases was small.

4-1. Overview

▷Task b overview

▷Verification of accident reduction effect specific to people with visual impairment for driving support system using DS

1【Fin】 High precision DS scenario modification
Completed data collection for 15 subjects.
2【Plan】 Gaze behavior analysis using DS data
3【Fin】 Analysis simulation using JARI system
4【Plan】 Analysis simulation that reflects gaze behavior analysis



4-2. Detailed method of simulation

▷Simulation about effect of ADAS

Numerical simulation of accident avoidance and collision damage reduction effect with and without ADAS

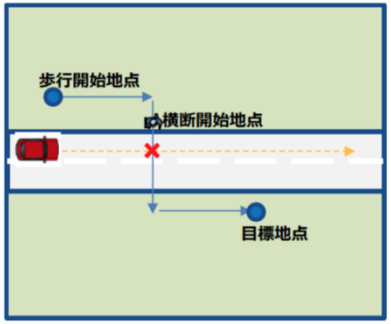
Utilize the results of the first phase of the SIP (JARI)

→Multi-agent Traffic Environment Reproduction Simulation Technology

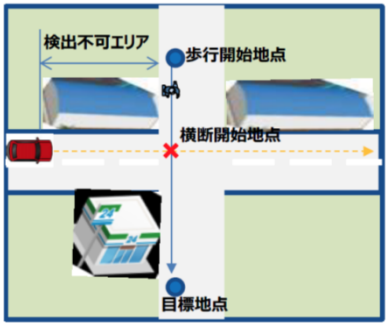
【Issue】

- Modeling the gaze behavior of healthy people and people with visual impairments
- Estimating the quantitative accident reduction effect of the presence or absence of a driver assistance system

On the straight road



Crossing street without traffic signal



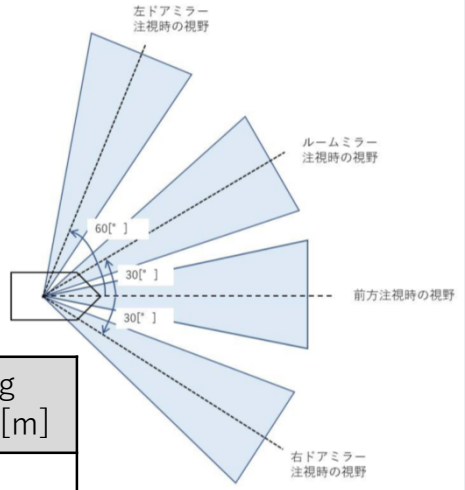
Simulated accidents with crossing pedestrians

<Simulation setting>

- **AEB（Alarm＋Brake）**
- Alarm：TTC1.8[s] →AEB：TTC0.6[s]

Camera sensor specification

Type	Range [m]	Horizontal FOV [deg]
Regular	45	40
Advanced		140



Visual behavior

Each speed

- Straight ahead vehicle：30[km/h], 50[km/h]
- Intersecting vehicle：40[km/h]
- Pedestrian：as below

Pedestrian	Walking speed [m/s]	SD [m/s]
Child (6-12 years old)	1.339	0.107
Adult (13-64 years old)	1.358	0.093
Senior (Over 64 years old)	1.337	0.104

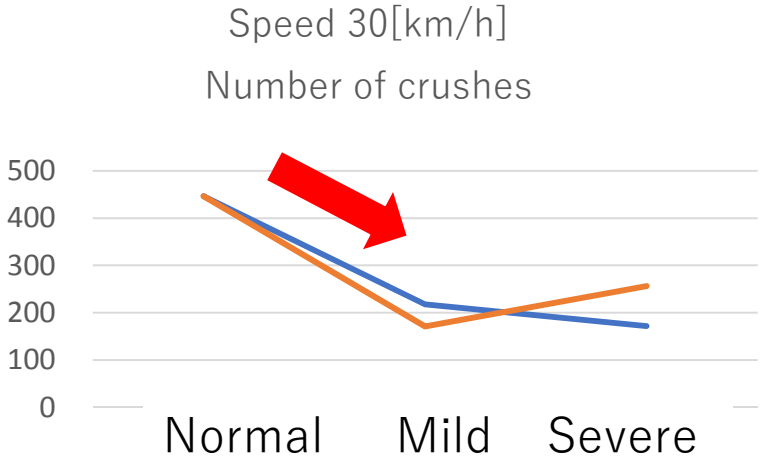
Impairment	Viewing angle [°]	Viewing distance [m]
Normal	140	100
Mild	40	100
Severe	20	100

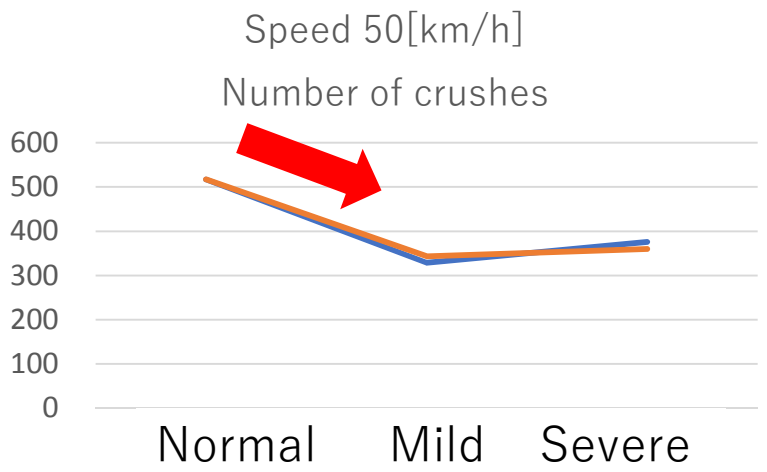
4-3. Result

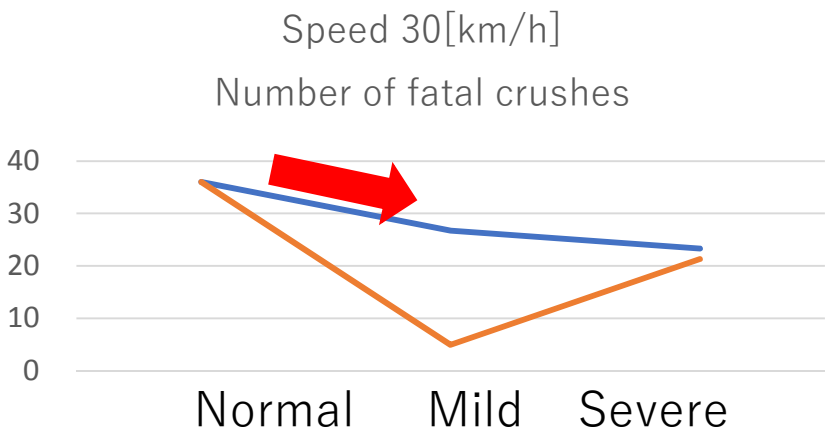
▷Result of simulation

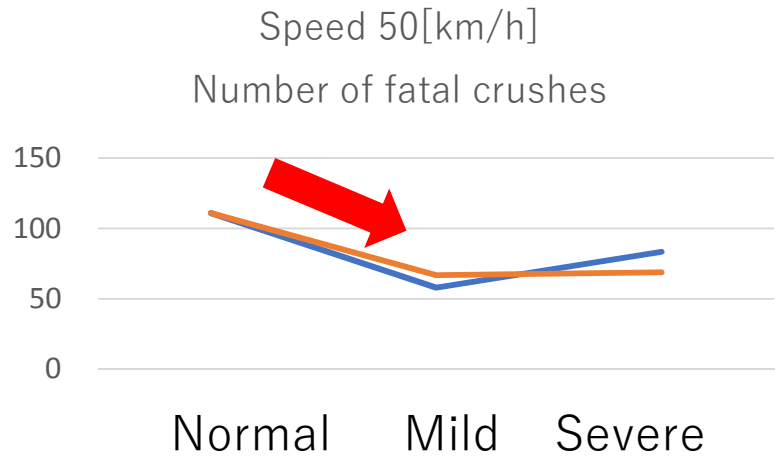
Multi-agent Traffic Environment Reproduction Simulation Technology

ADAS system
— Regular (lower price)
— Advanced (higher price)









- The number of crushes and fatalities were lower in the case of those with visual field deficits/with systems than in the case of healthy subjects/without systems.
- Widespread automatic braking systems are expected to have some effect

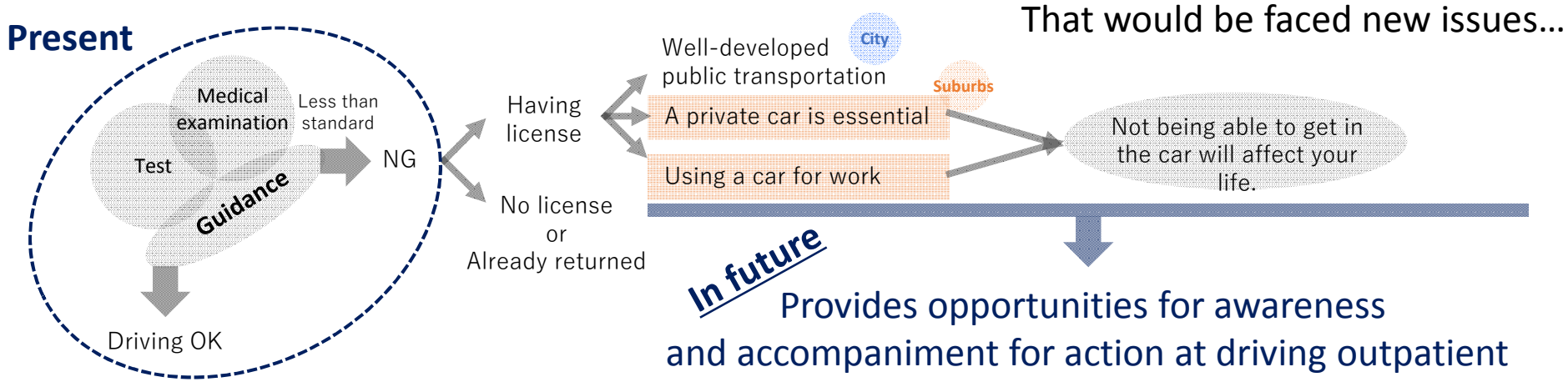
5-1. Driving outpatient

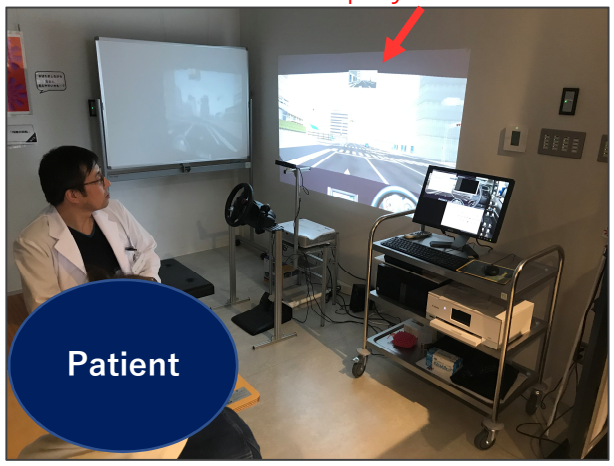
▷ Installation & pre-operation of driving outpatient

【Fin】 Installation of driving outpatient

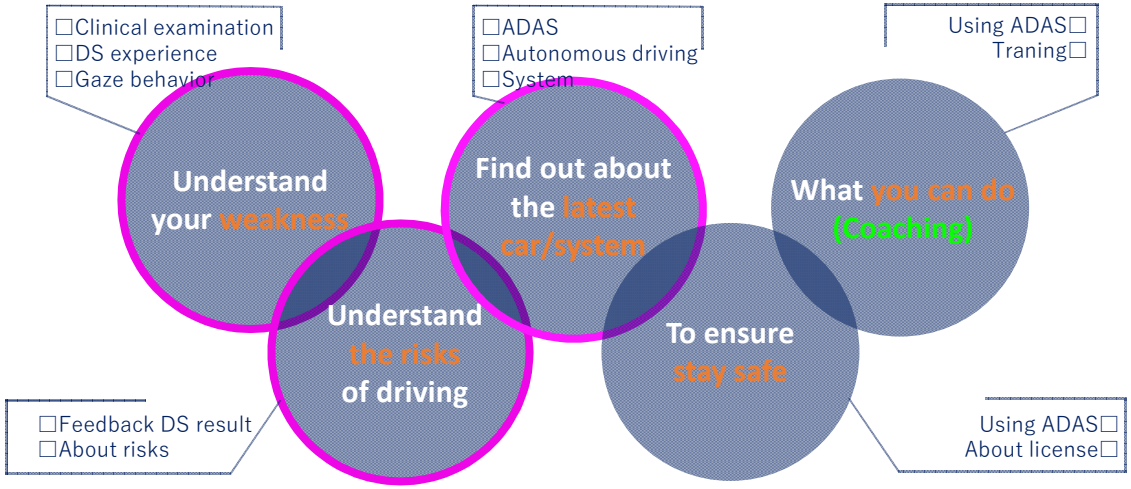
【o/g】 Pre-operation @Kobe eye center hospital

【o/g】 Brush up the contents of driving outpatient





Driving outpatient (191218@Kobe)



5-2. Draft of design guideline

▷Draft of design guideline

①Before (Connect to driving outpatient) ②Driving outpatient (Hospital/Clinic) ③Follow up (External cooperation)

【To C】
- Health checkup
- Self medication
- For the unconscious group

【To B/C】
- Promoting driver safety
- Make the most of corporate checkup opportunities
- Institutional design of merit

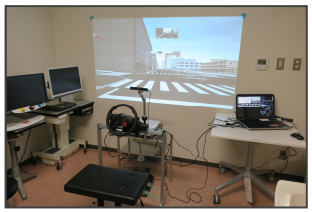
Transportation, Bus, Taxi etc.

Driving outpatient (Hospital/Clinic)

Insight

View of field

DS/Gaze behavior



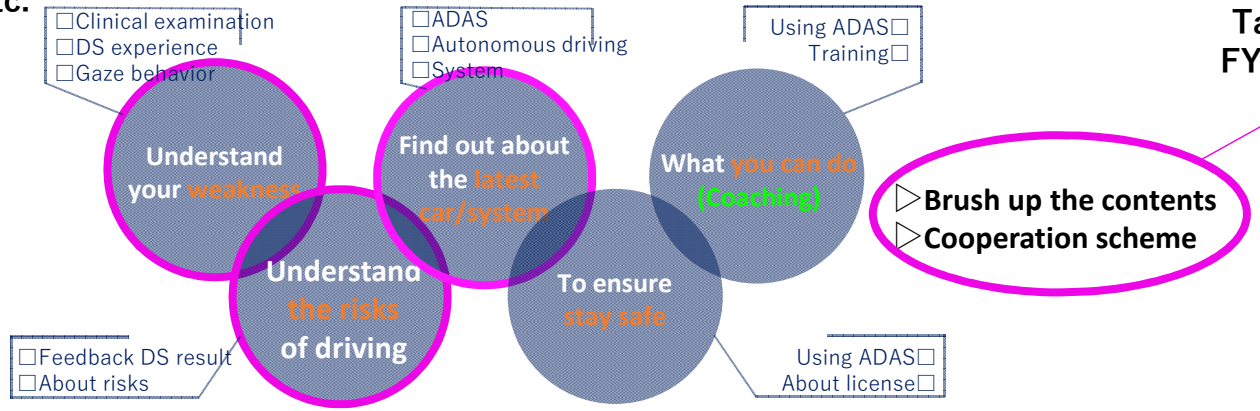
【Installation/Using】
- Retrofit alarm system
- Purchase support

【Learning/Training】
- Driving schools and dealerships
- Gaze behavior

【Institutional design】
- Cooperation with
  >Administration
  >Local government
  >Insurance industry

【Medical institution】
- Cognitive function
- Medications and preexisting medical conditions

Cooperation with clinic/hospital and being authorized by medical associations



Tasks FY2020

▷Brush up the contents
▷Cooperation scheme