

SMILE-First Project

Concept of our newly developing Multi-Purpose Mobility (mPm)

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Summary

SMILE-Fist Project:

Symbiotic **M**obility with **I**ntelligent watching system makes everyone **L**augh every time and **E**verywhere which system can watch not only the user both directly with integrating biosensors and remotely with cloud service but also local residents by the user safely and securely.

Specifically, based on the analysis of the usage scene and the solution, we produced 3 kinds of multi-purpose mobility as prototype and we performed the test-ride event and the evaluation test to collect an opinion for society implementation.

Because all of activities make the society which overflowed with laughter = happiness = smile.

1 Introduction (Background)

1.1 Social background

In case of Japan, aiming at a low carbon society, a recycling society, and security/safe society, we mention industrial, administrative and academic sectors, and various researches and development, and investigation are conducted. For example, as a measure towards a low carbon society, vehicles with few carbon-dioxide emissions, such as an electric vehicle and a plug-in hybrid vehicle, are marketed from some automakers, and the number of cars registered is increasing gradually. Moreover, although it is little, and a super-compact electric vehicle has also come to be used for an individual's transportation or the delivery of products, by Seven-Eleven Japan Co., Ltd. in coexistence with a former type vehicle, we have produced difficulty from the size and its performance.

On the one hand, where low birthrate and longevity are progressing, the automobile accident from which elderly people become a cause is increasing. In order to realize simultaneously security/safe society and low carbon society, it is required to secure elderly people's safe movement independently and to reduce the automobile accident by elderly people.

On the other hand, in Japan which is an earthquake-ridden country, the effective transportation device and an automatic guidance system are desired also in refuge at the time of a disaster, securing the convenience in the time of usual. This is because people do not want to repeat a tragedy which huge number of people in refuge were swallowed up by TSUNAMI caused by the Great East Japan Earthquake on March 11, 2011.

Based on these situations, we are as smooth as a public transportation facility still smaller than a micro electric vehicle, we achieve seamless connection and elderly people, a physically disabled person, and

young and old of both sexes are performing and development of a new terminal transportation which can achieve movement securely/safely and comfortably.
We would like to describe about the purpose and concept here.

1.2 Current situation of terminal transportation

There are the following issues in the current terminal transportation in Japan.

- ① Also we can use a public transportation, since connection is not smooth, the high internal-combustion engine car of the environmental impact is used. For example, even if 'Access' to a public transportation is good, 'Egress' to the final destination is insufficient.
- ② There are not pleasure young and old of both sexes, convenience, and attractive mobility of low carbon that can be used security/safe.
- ③ Although the walker for an aged person (shopping trolley) is useful on a flat road surface, on an ascent hill, it is loaded heavily, and it is dragged and there is fear of a fall on a downward slope. Moreover, there is an image with the thing which the woman of advanced age uses, and it is hard to use a male.
- ④ The electric senior car (mobility scooter) has not resulted in spread for the barrier etc. of the strong consciousness of the user who does not want to be seen by elderly people and the physically handicapped person. Moreover, neither a price nor a design is also an attractive vehicle which catches a user's heart. Furthermore, the outside dimension is also large, since portability is not good, either, carrying in on a train also has restriction and especially carrying in into a bus etc. is severe.
- ⑤ Personal mobility of Stand-up type (Segway, etc) cannot move on a sidewalk or a driveway on the Road Traffic Law of Japan. And an escort runner is required on an exclusive way like a special zone for robot development and testing. Moreover, the stability of a posture is difficult and unsuitable for elderly people.
- ⑥ The stability in a low speed of the bicycle is not so good for elderly people.
Moreover, when going to the station by using a bicycle, infrastructures, such as a parking lot for bicycles, have not fully secured. Furthermore, there is restriction of being able to go into a bicycle bag in carrying in to a public transportation, and convenience is not good.
- ⑦ The mobility which realizes the transportation device (last one mile) from a public transportation to the final destination is insufficient.
- ⑧ It is very difficult for a super-compact electric vehicle (ex. COMS by TOYOTA Auto Body, Co. Ltd. etc.) to coexist with the existing passenger car because of both low safety and low performance of the vehicle.
A possibility of having negative influence on other transportation in smooth traffic rather is high.
- ⑨ The terminal transportation which both healthy person and physically-disable person can use easily or comfortably does not exist.
- ⑩ Although the traffic accident from which elderly people turn into an assailant is increasing, it is difficult to part with a car in local city or at rural areas with high dependence of automobiles.
- ⑪ We are not well-known to the terminal transportation and policy which we guide to use and the life style innovation of eco-mobility.

Table 1 Classification of current terminal transportation

Category (Item)		Speed / Power	User	Moving Area	Weight /Price (approximation)	Condition into Public Transportaion
Walker (Shopping Trolley)		≒2km/h Man-Power	Elder	Sidewalk	5kg 20,000JPY	○
Senior Car (Mobility Scooter)		~6km/h Electric Motor	Elder	Sidewalk	100kg 400,000JPY	△ (Assistance required)
Next-generation personal mobility		~10km/h Electric Motor	Young ~ Middle	Special Robot Area	20kg 250,000JPY	△ (Need to fold)
Bicycle		~20km/h Man-Power	Young ~ Elder	Roadway (Sidewalk)	10-20kg 20,000JPY~	△ (Need Carring-Bag)
ELECTRIC ASSIST BICYCLE		~20km/h Electric Assist	Young ~ Elder	Roadway (Sidewalk)	20kg 60,000JPY~	△ (Need Carring-Bag)
Super-compact electric vehicle		~60km/h Electric Motor	Young ~ Elder (Need Licence)	Roadway	約400kg 600,000JPY	×

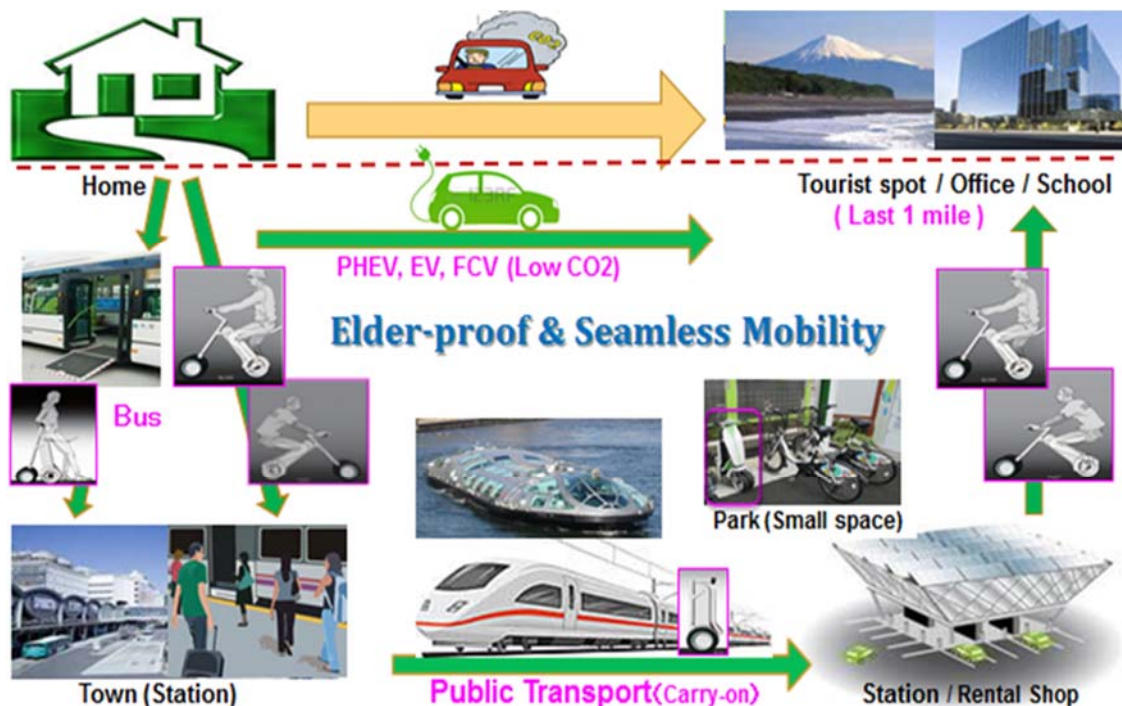


Fig. 1 Image of usage scenes of terminal transportation

2 Mobility concept

- 1) Achieve mobility which can perform seamless connection with a public transportation facility.

By developing the mobility which becomes compact by a light weight and fold-up, we make carrying in into a train, a bus, etc. easily, and achieve seamless transportation.

On the other hand, at the time of the rush hour, if carrying in of the mobility to a railroad is not special vehicles, either, it is difficult. As the alternative plan, we achieve recovery and delivery of mobility using the collection-and-delivery system of the home-delivery company who drops in at the convenience store and supermarket in front of a station.

In addition, we achieve the system which can rent mobility using a home-delivery company's Internet collection-and-delivery system to use mobility suddenly.

- 2) Transforming of mobility by one unit achieve replacement of the existing user limited current mobility.

The current short distance transportation -- a walker for an aged person (about 2 km/h) and an electric senior car (max 6 km/h) -- and the stand-up type personal mobility (max 10 km/h, such as Segway).

The transformable ultra-compact mobility replace such as current mobility by one unit. And achieving multi-functionalization by transforming also achieves low-pricing by mass production.

In addition, the sense of security which is using the mobility with same everybody wipes away the bad image of using a senior car.

- 3) Support security/safe about going-out of elderly people and disabled person by the automatic-guide system and the watching system.

There are several sensors such as such as roll sensor, GPS sensor, etc. And we also watch a passenger's health condition by a vital sensor. Also enable elderly people, a physically disable person, and still more attractive independence movement also for the family by this, and correspond to movement of a super-aged society.

Moreover, the thing for which independent movement by itself is also attained by installing an automatic guidance system -- a wheelchair user also realizes the function of a big-ticket electric wheelchair as the source of power of a general-purpose wheelchair. Furthermore, we can also desire healthy promotion creation of a going-out opportunity, or by reduction of the accident by elderly people's driving operation, and control a social cost as a result.

- 4) Achieve the assist facility in which the care worker of wheelchairs in general does a reduction of incidence.

For example, by a power assist facility, while realizing stable movement and long-distance movement in a steep hill, a wheelchair has in a train or a bus easily and we make possible.

- 5) Establish of the evacuation system corresponding to the times of as usual and a disaster.

Before communications systems such as Wi-Fi is overflowed, by installing the early earthquake prompt report system which the Shinkansen super express already adopted, we send refuge information to the ultra-compact mobility, and achieve early refuge guidance.

Furthermore, when the usual 3G communications system etc. cannot be used, we use the Wi-Sun communication technology which NICT (National Institute of Information and Communications Technology in Japan) developed. By adopting this technology to an ultra-compact mobility, the mobility will function as an imitation base station for Wi-Sun network and then build Wi-Sun communication network by a multi-hopping function, and achieves a safety check.

Table 2 Classification of Multi-Purpose Mobility

Category (Item)	Speed / Power	User	Moving Area	Weight /Price (approximation)	Condition into Public Transportaion
Walker (Shopping Trolley) 	≒2km/h Man-Power	Elder	Sidewalk	5kg 20,000JPY	○
Senior Car (Mobility Scooter) 	~6km/h Electric Motor	Elder	Sidewalk	100kg 400,000JPY	△ (Assistance required)
Multi-Purpose Mobility (Transformable, Portable, Compact) 	~2km/h Walker	Young ~ Elder & physically disabled person	Sidewalk	15kg 150,000JPY (Target)	○  (Folding Type)
	~6km/h Mobility Scooter		Special Robot Area		
	~10km/h Personal Mobility		Sidewalk		
	Wheelchair & mPm (Joint System)		Sidewalk		
Next-generation personal mobility 	~10km/h Electric Motor	Young ~ Middle	Special Robot Area	20kg 250,000JPY	△ (Need to fold)
Bicycle 	~20km/h Man-Power	Young ~ Elder	Roadway (Sidewalk)	10-20kg 20,000JPY~	△ (Need Carring-Bag)
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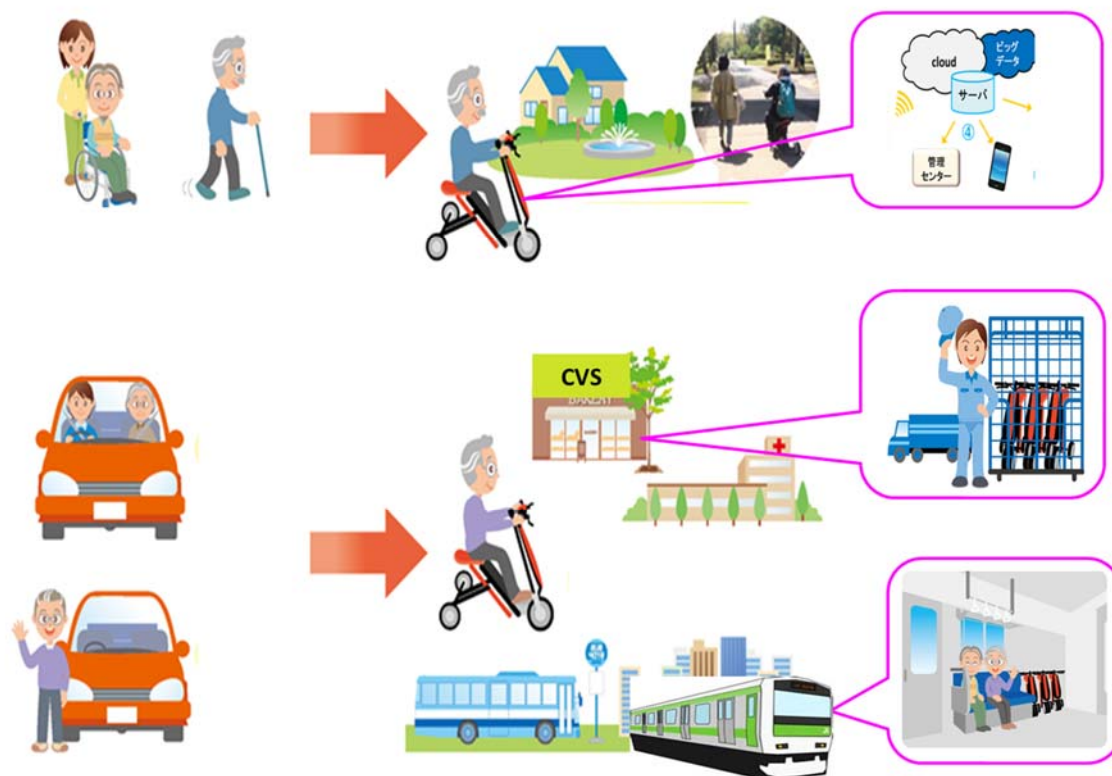


Fig. 2 Diffusion concept of multi-purpose mobility



Standing Mode



Sitting Mode



Skateboard Mode

Fig. 3 Transformable concept of multi-purpose mobility

3 Future Plan (Future Tasks)



Fig. 4 Photos of mPm

The prototype of the portable extremely-ultra-compact mobility which suited now the concept described previously is under development (Fig. 4).

The questionnaire survey to the test user has carried out, providing the prototype for the test-ride event^[1].

Aiming at the realistic introduction to society, development is still under continuation based on the analysis of the data from the survey about receptiveness, functions required, and price matter.

References

- [1] Hideki Kato, Keiichi Higuchi, Mitsutoshi Kano, Yoshinori Kondo, and Junichi Yasu, “Utilization possibility of an extremely ultra-compact electric personal mobility vehicle for active elderly people”, EVS29, 2016.

Authors



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