

# Prototype of Augmented Avatar with Mobile Smart Device Operation

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**Abstract**— Avatar technology is expected to solve the social problem of uneven population distribution by enabling everyone to live and work where and with whom they want to live. In this paper, we, the team LAST MILE, introduce the proposed “Augmented Avatar” which consists of non-humanoid Avatar and non-HMD (Head Mounted Display) in XPRIZE/AVATAR, and describe the next evolution which makes operation by a mobile smart device possible.

## I. INTRODUCTION

The world population exceeded 8 billion by 2020. On the other hand, there are concerns about shortage of labor population in many developed countries due to the declining population with declining birthrate and an aging population. AVATAR technology is expected to solve the social problem of uneven population distribution by enabling everyone to live and work where and with whom they want to live. There are a lot of functional Avatar in the world. Because of the same body structure, humanoid avatars are suitable for replacing human tasks, especially when they are remotely controlled by wearing HMDs to perform a variety of tasks[1](Fig.1). However, humanoid robots are currently too complex and expensive and wearing HMDs may disturb the spread of tele-operation services.



Figure 1. Humanoid Avatar with HMD Interface

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We at LAST MILE aim to realize a tele-operation service that realize anyone to live and work where they want and with whom they want (Fig. 2). In order to popularize the service, it is important to develop flexible design technology that enables low cost and interface technology that can be operated by mobile smart devices. In this paper, we introduce two main strategies developed to make this service begin true.

- i. The first is the proposed Augmented Avatar technology, which can be flexibly designed for each service by separating the "mind" and the "body" of the avatar. By a selection of modularly designed communication avatars and manipulation avatars in accordance with the service, the combined avatar which we named “Augmented Avatar” can communicate and manipulate with people in the surrounding area at a distance.
- ii. The second is a mobile smart device interface technology which operate our new prototyped Augmented Avatar. It makes an operator communicate and manipulate remotely only by a smart phone.

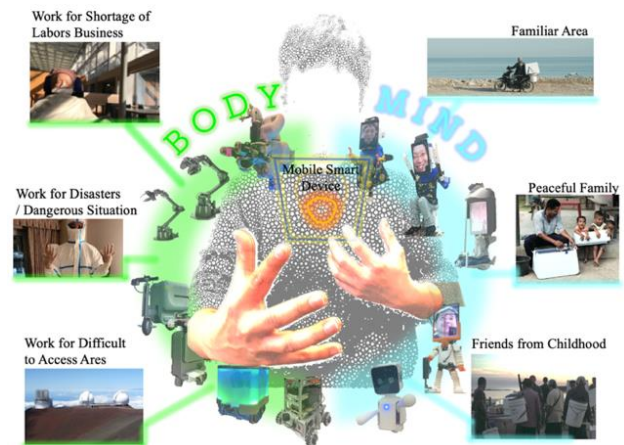


Figure 2. VISION of Team LAST MILE  
Remote Work Service with Mobile Smart Device Operation

## II. PROPOSAL AND PROTOTYPES OF AUGMENTED AVATAR

We propose an "Augmented Avatar", which is a tele-operation system that reconstructs human functions by combining each Avatar after independently designing two functions, "body" and "mind," of human manipulation and communication. The advantage of the proposed "Augmented Avatar" is that a potentially low-cost avatar system can be

realized through a minimalistic design and simple specifications for each function. The function-specific Avatar designed for each function can be reused in multiple applications, thus improving design efficiency. In addition, when the system is operated in an environment where people are nearby, it is possible to operate the teleoperation system with the Communication Avatar while ensuring safety by turning off the power of the Manipulation Avatar with high-power motors.

We joined the competition XPRIZE/AVATAR[2] using three types of Augmented Avatar as shown in Fig.3 to ensure our concept and the proposal Augmented Avatar. As a result, our team LAST MILE got 12<sup>th</sup> among 820 teams and fruitful lesson and learned[3].

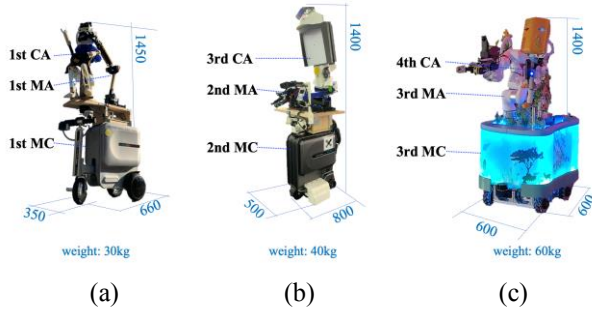


Figure 3. The 1st to 3rd Prototypes of Augmented Avatar for each phase of XPRIZE/AVATAR

(a) video test (b) semifinal test (c) final test where CA means Communication Avatar, MA means Manipulation Avatar, and MC means Moving Cart

### III. MOBILE SMART DEVICE OPERATION

The remaining problems after XPRIZE/AVATAR competition were weight reduction and implementation of the operation interface on a mobile smart device. By downsizing the communication avatar by the omitting of eye contact function and the reducing the drive joints, the cart structure was simplified, and the overall weight was successfully reduced by about 50%. In addition, we have succeeded in partially implementing the MC maneuver and the MA manipulation functions on a smartphone. On the smartphone monitor, the view mounted camera is projected, and the view is changed according to the attitude of the operator interface device. This function contributes to the operator to recognize the environment around the avatar intuitively. The “touch and drag” operation for the moving cart maneuver and arm tip motion was newly implemented, which has been used for one-click operation[3]. The results of the mobile smart device operation experiments were demonstrated in Kansai Robot World[4] successfully. In the future work, enough subject evaluation will be planned.

### IV. CONCLUSION AND FUTURE OF AVATAR

We, Team LAST MILE, are developing an Augmented Avatar that can be operated with mobile smart devices, aiming to realize a remote working environment where anyone can live and work where and with whom they want to live. The third prototype for XPRIZE/AVATAR final has been improved to be 50% lighter and to enable partial operation. In the near future, we aim for early commercialization by

promoting our technologies brush-up both in the viewpoint of hardware and software to enable various tasks[5].

Finally, the authors expect that the future of AVATAR technology will not only connect people and avatars, but also connect people to people, people to animals, and people to the earth, leading to the realization of a future where we can understand each other. We dream that if we can visualize the impact of our actions on the earth, we will be able to feel that the earth is a part of our body, just as we can feel a sense of physical possession and a sense of movement in AVATAR.

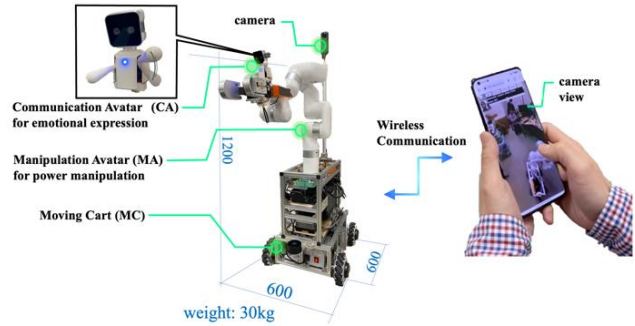


Figure 4. The 4th Prototype with Mobile Smart Device Interface



Figure 5. Future VISION of author's AVATAR technology

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