

**Press Release**

**“Distance-Free Mask” for General Citizen**

**Proposal of New Social Infrastructure that Eliminates Lockdown**

Gunma University  
NPO e-JIKEI Network Promotion Institute

※Please refrain from reporting on this until the press release time.

Latest file (PDF file) is available here:  
[http://www.e-jikei.org/site/Press\\_Distance-Free\\_Mask.htm](http://www.e-jikei.org/site/Press_Distance-Free_Mask.htm)



**【Time and Place】**

Time: 14:00~15:00, Tuesday, 28th July 2020  
Place: Room-303, Soken-Bldg, Gunma University, Kiryu 376-8515, Japan

**【Overview】**

As a social infrastructure of the very-near future that guarantees reliable implementation of various events (such as *Tokyo Olympics*, festivals, ceremonial occasions, sports games, music concerts, etc.), we have invented a lightweight full-face helmet-type mask that completely shields the invasion of viruses from the outside and almost completely shields the discharge of viruses to the outside (Japanese Patent Application 2020-113097). This mask simultaneously achieves the four items, (1) complete screening of viruses, (2) lightweight body, (3) easy breathing, and (4) inexpensive manufacturing costs, at a high level by precise control of pressure and flow rate inside the helmet. The wearer of this mask, just like the antibody carrier, cannot be infected itself with the virus, nor infect others with the virus. If every general citizen keeps the mask on hand and wears it when going out when the risk of spreading virus infection arises, the convergence of the infection can be surely and easily realized. By this very effective infrastructure, lockdown, restraint on going out, restraint on business, etc. are completely unnecessary anymore. In the press release, we will explain the outline of the mask "Distance-Free Mask", "Social infrastructure using the mask that eliminates the lockdown", and demonstrate the function of the prototype. We believe that "Distance-Free Mask" and its peripheral systems (provision of service air supply/exhaust ports in vehicles and facilities, home airlock systems, etc.) will become an indispensable social infrastructure in the corona era.

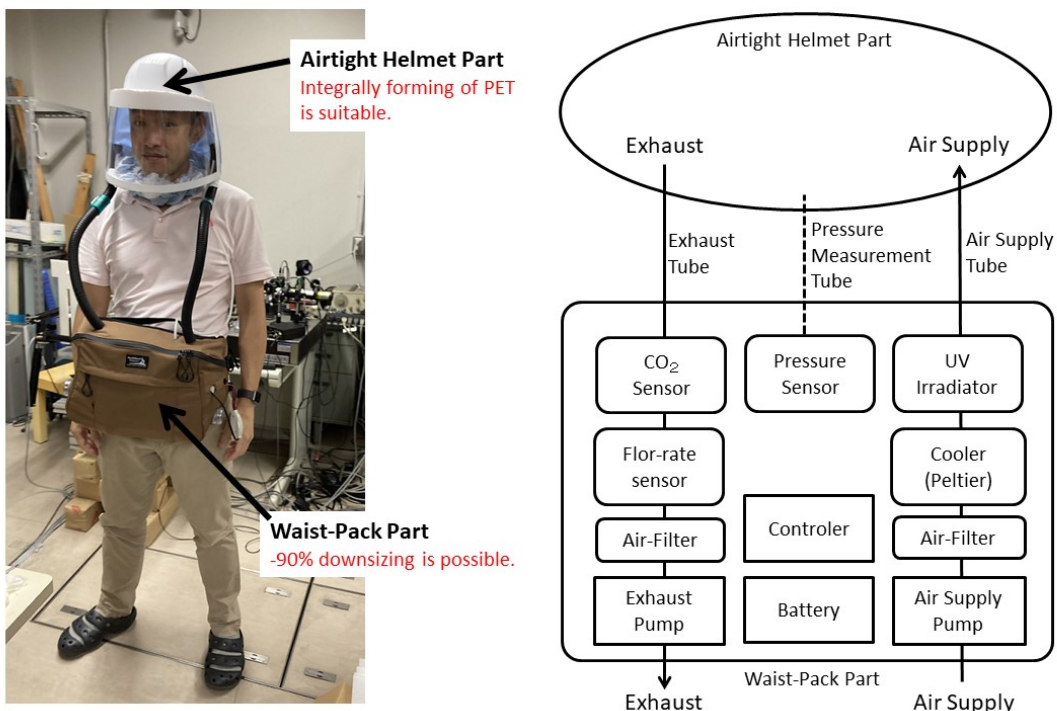


Figure 1. Prototype of “Distance-Free Mask” for General Citizen

## **【Features of the Developed "Mask"】**

Figure 1 shows a photograph of the prototype (helmet part and waist pack part) of the "Distance-Free Mask" and the mechanism of supply and exhaust of purified air. The prototype of the present invention has the following three features.

- [1] **By controlling the inside of the helmet to a slight positive pressure**, it is possible to **completely block the entry of outside air** from the seal part of the neck. In addition, the helmet dome can be made of a lightweight transparent resin material by keeping the internal pressure high to some extent. Invasion of virus can be blocked 100%. The virus emission depends on the air tightness of the neck seal, but it can be reduced to a minimum.
- [2] **A constant flow of air** is taken in and out to keep a fresh air flow in the helmet. This allows fresh air to be breathed without adding extra load to the lungs.
- [3] **A high-performance filter** with extremely large flow resistance can be inserted by forced air supply and exhaust by a pump, pressure buffer, and electromagnetic control valve housed in a backpack. It is also possible to equip the air supply side and the exhaust side with virus killing devices (UV irradiator, plasma cluster generator, etc.) and an air-conditioning unit.

The prototype is large because it is made by simply combining commercially available parts. By designing and manufacturing dedicated parts, it is possible to make the size and weight significantly smaller. The same material and construction method as the plastic/PET bottle is suitable for the helmet part. The waist pack can be downsized to about 1/10 and even can be integrated with the helmet.

## **【Recommendations to Governments in the World】**

I would like to make the following recommendations to the national governments in the world.

The mask, "Distance-Free Mask", is distributed to each citizen as a social infrastructure that makes lockdown unnecessary in an emergency. With this, the following can be achieved.

**[1] No need for lockdown: It is no longer necessary to restrict people's economic activities such as lockdowns, requests to refrain from going out, and requests to refrain from business.** => If there is concern about the spread of a virulent virus, it is sufficient to obligate all people to wear "Distance-Free Mask".

**[2] Guaranteeing implementation of various events:** It is possible to guarantee the reliable implementation and holding of important events such as the Tokyo Olympics, festivals, ceremonial occasions, sports games/events, music concerts/events. People can join any event without any problem.

**[3] Liberalization of overseas travel and international exchange:** If the infection of immigrant is suspicious, all they have to do is oblige immigrants to wear "Distance-Free Mask" instead of "isolate".

We propose the following procedure as a method of distributing and operating "Distance-Free Mask" as the social infrastructure.

**[A] The government will hold a competition for private companies under the following conditions.**

- [a] Meet basic specifications (pressure and flow rate control, medical filter, if possible with evaporative cooling, waist pack type or integrated type).
- [b] For example (in Japan): Price: 20 USD/unit, order quantity: 13 million pieces/company, delivery date: December 2020 (the earlier the better), ordering company number: 10 companies (total order quantity: 130 million pieces = total population of Japan)

**[B] By the end of this year 2020, the mask (basic specification version) will be distributed to each and every citizen.**

=> No need to lock down as the virus protection!

**[C] In an emergency, the government issues a state of emergency.**

- => All people are required to wear "Distance-Free Mask" when going out.
- => The infection is quickly resolved.
- => The emergency declaration is canceled.
- => People can return to a life without restrictions.

**[D] Even if a vicious virus emerges due to mutation, the infection can be promptly converged at any**

time.

- => By knowing this, the public does not need to be afraid of the virus.
- => Knowing this, the government can take drastic measures.

[E] **“Distance-Free Mask” is established as an indispensable (literally, “air”-like) social infrastructure.**

- => The pursuit will start for a better “Distance-Free Mask” in the various viewpoints, such as comfortable to wear, good-looking appearance, clean air supply/exhaust, convenient functions, forms suitable for exercise/sleep/meal, forms suitable for hospitals/evacuations, etc.

## **[Variations of the Invention]**

The following are variations of the "mask" based on the present invention.

- [a] A **temperature/humidity adjusting device** and an **air composition adjusting device** (increasing oxygen concentration, decreasing carbon dioxide concentration, etc.) can be freely installed on the air supply side.
- [b] Various products can be created by **replacing the airtight helmet part with any airtight space**. As an example, a stroller with an airtight structure (Figure 2), a bed with an airtight structure, clothes with an airtight structure, etc. can be used.
- [c] We propose a **system that allows the airtight helmet part to be connected to an external intake/exhaust service port** (Figure 3). Each seat of vehicles (cars, buses, trains, airplanes, etc.) and facilities (offices, conference rooms, theaters, cinemas, etc.) is provided with a service air supply/exhaust port connected to the air supply/exhaust tube of the mask. In addition, clean air with controlled temperature and humidity and composition (composition) is supplied to provide a more comfortable, cleaner and quieter mask environment.
- [d] By incorporating a virtual reality display, a smartphone function, a noise canceling function, etc., the helmet part can be made a **user-friendly information terminal**.
- [e] Like a glove box, **gloves and various feed-throughs** can be built in so that the wearer can squeeze his/her face or blow his/her nose. The waist pack part and the helmet part can be combined as one.

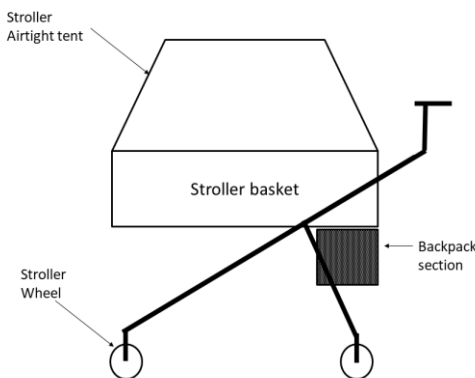


Figure 2. Stroller type

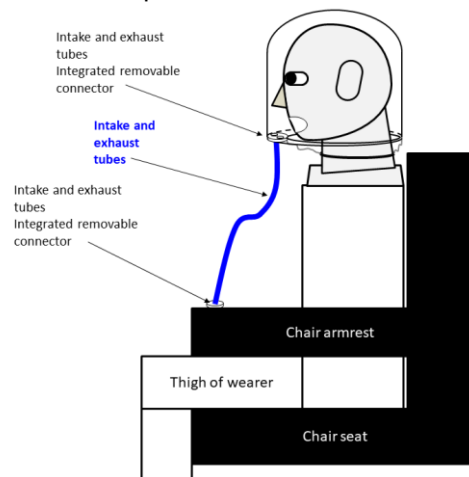


Figure 3. Service air supply and exhaust from seats

## **[Scenario for Exiting from the Lockdown Intermittent State]**

The new coronavirus is expected to continue mutations and remain on the earth. The greatest threat is that the virus might be more virulent and more infectious due to mutation than the current virus threat, and it is not known when such more virulent and more infectious virus will emerge. Society in the future will always be required to be prepared for the emergence of vicious viruses due to such mutations. In the future society, it is expected that the social aspect will be changed on the premise of keeping a social distance. Telework, online classes, etc. will become popular as standard. However, people need/want to participate in various events (Tokyo Olympics, ceremonial occasions, festivals, concerts, sports games, theaters, etc.), face-to-face meetings at companies and government offices, experiments and practical training at schools and universities, etc. It is expected that the demands for the physical movement and assembly of the will definitely remain.

Currently, Japan and other parts of the world are experiencing intermittent lockdown as a countermeasure against new coronavirus (SARS CoV 2) infection. There are **4 possible scenarios to get out of the locked-down intermittent state**. ("Lockdown" here is defined as "a state in which the government requests or

orders some kind of going-out regulation, business regulation, or behavior regulation as a countermeasure against infection." Japan is now under a weak lockdown.)

**[A] Most of the people have become infected and have acquired immunity, and acquired collective immunity.**

Collective immunity is acquired when most of the people have become infected and have been cured and acquired immunity. Here, the important point is that the "mask wearer" cannot be infected by the virus nor infect the virus to others, so from the viewpoint of collective immunity, it is equivalent to the "immunity acquirer".

**[B] A "prophylaxis (vaccine)" has been developed, and vaccination will obtain collective immunity.**

If a "prophylaxis (vaccine)" is developed, as with influenza, the majority of non-infected persons will be vaccinated to obtain collective immunity.

**[C] An "effective therapeutic agent" is developed.**

Once "effective remedies" have been developed, made available, and are able to heal infected individuals easily, there is no need to fear the spread of infection.

**[D] A "simple and reliable test method" is developed.**

If there is a "simple and reliable test method/tester" just like a thermometer or a blood pressure monitor, it is enough to promptly detect the infected person, isolate and treat it. Others (=confirmed to be non-infected people) do not need to keep staying at home at all. Since there is no "easy and reliable test method" available now, the whole society will be placed in the darkness where no one knows who is infected, and everyone can only respond uniformly.

Among the above-mentioned escape scenarios, **[A] Collective immunity acquisition** is difficult to adopt in Japan because of the large cost. In addition, if any of **[B] preventive method (vaccine)**, **[C] therapeutic agent**, and **[D] simple and reliable test method** are developed, the problem will be solved, but any of them is expected to be developed immediately. (It is expected that it will take at least one year at the shortest.) In other words, until this current invention/proposal is made, it has been "occlusion in all directions".

Since the "percentage of people wearing this mask" is equivalent to the "percentage of people who have immunity (antibody) in the population," increasing the proportion of people wearing this mask will lead to the same effect as the acquisition of collective immunity!

**Building a social infrastructure using "Distance-Free Mask" is the only way to immediately eliminate the need for lockdown and to overcome corona crisis.**

## **【Acquisition of Collective Immunity by "Distance-Free Mask"】**

The collective immunity rate **P<sub>c</sub>** required to obtain the collective immunity can be expressed by the following equation using the basic reproduction number **R<sub>0</sub>**.

$$P_c = 1 - 1/R_0$$

Example: When **R<sub>0</sub>**=5, the infection ratio **P<sub>c</sub>**=1-1/5=0.8 (80%) required for collective immunity acquisition. (It should be noted that the above formula is a little unreasonable because it is assumed that the mode of movement and contact of individuals does not change even if the infection rate spreads and the population immunity increases. It should be considered as a reference level.)

The basic reproduction number **R<sub>0</sub>** can be expressed by the following equation.

$$R_0 = \beta \times k \times D$$

**β**: Probability of infection per contact

**k**: The average number of times one person contacts another person (=uninfected person) in the group per unit time

**D**: Average infection period

The basic reproduction number **R<sub>0</sub>** is defined as the average number of people who are infected by an infectious disease and are directly infected during the infection period when they join a group (society) in which no one is immune. From the definition, in the "state where there are almost no infected people", if **R<sub>0</sub>**=1 for the group (society), it is a steady state, if **R<sub>0</sub>**<1, it converges, and if **R<sub>0</sub>**>1, it expands. **R<sub>0</sub>** depends not only on the nature of the virus, but also on the nature of the population (racial constitution, condition, public health condition, individual health condition, etc.). It is thought that **R<sub>0</sub>** can be reduced against all viruses by improving public health.

That is, the following is valid.

**Reduction of  $\beta$ :** Immunity increased, mask worn, hand washing encouraged.

**Reduction of  $k$ :** Working from home, introducing home-based learning, and ensuring social distance.

By creating a social state in which  $\beta$  and  $k$  are reduced,  $R_0$  is reduced and  $P_c$  is reduced.

It can be said that the lockdown state is a state in which  $\beta$  and  $k$  are extremely reduced.

**If all the people wear "masks that completely shield viruses" when going out, a society with the number of basic reproductions ( $R_0$ ) of zero for all viruses can be realized. No lockdown is required.**

At the stage when the risk of spread of the virus is predicted, a sufficient number of people will wear "masks that can completely shield the virus", and the basic reproduction number ( $R_0$ ) in the society concerned is reduced to a sufficiently small value less than 1, and infection can be stopped.

An uninfected person wearing a "mask that can completely shield the virus" he does not infect the virus or infect others with the virus, as does a cured immune carrier. In other words, if the proportion of uninfected persons who wear a "mask that can completely shield the virus" increases,  $k$  will be reduced by that proportion.

**The "wearer of Distance-Free Mask" has an "infinite social distance" to the people around it.** (It takes an infinite social distance regardless of the physical distance.) A nation (society), in which **all the people have one "Distance-Free Mask" and wear it** when they go out, is **extremely resistant to viruses**.

## **【Social States of the Corona Era】**

We predict the social aspects/states of the corona era to be as follows.

**[1] All people have one "Distance-Free Mask".**

**[2]** If there is a risk of spreading the virus, the government will declare an emergency and oblige the people to wear "mask" when going out.

=> If a person wears "mask", he/she can go out freely without any restrictions.

=> For example, if **80% of people wear "mask"** when going out, it is equivalent to achieving **80% of the collective immunity**.

**[3]** When it is confirmed that the virus infection has been resolved, the government lifts the declaration of emergency and ceases to be obligated to wear a "mask" when going out.

Unlike primitive people, modern people drink "purified water" rather than "water from rivers and puddles." "Air" contains various pollutants such as viruses, PM2.5, pollen and dust. Therefore, in the near future, it is expected that there will be a strong demand for breathing "purified air" instead of "natural air". In the near future, many people will wear **"Distance-Free Mask"** when going out, regardless of the spread of virus infection and whether or not there is a request from the government to wear it.

People wear "shoes" when they go out. Similarly, in the near future, people will wear "mask" when going out. Then, it is expected that people will own various types of "masks" in the same way as they own various types of "shoes".

**We believe that the "mask" based on the present invention and its peripheral systems (provision of service air supply/exhaust ports in vehicles and facilities, home airlock systems, etc.) will become an indispensable social foundation in the corona era.**

## **【Contact points】**

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## [Appendix-1: Control/Electronic Circuits]

Figure A1-1 shows a block diagram of the basic configuration of the control system related to the helmet type mask which completely shields viruses. The flow rate and pressure in the helmet are measured by a flow sensor and a pressure sensor. Feedback control is performed by two pumps for air supply and exhaust. As a result, the pressure and flow rate inside the helmet are controlled at high response and with high accuracy.

The rotation speed of the exhaust side pump is controlled so that the output of the flow sensor installed in front of the exhaust side pressure buffer quickly follows the reference value.

Here, the flow rate is controlled as a sufficiently large value (100 L/min), considering that human respiration is about 10 L/min. Its responsiveness is fast enough within 1 s.

Similarly, the rotation speed of the air supply side pump is controlled so that the pressure in the helmet measured by the pressure sensor follows the reference value.

Here, the pressure inside the helmet is set to a value slightly higher than the external atmospheric pressure (fine positive pressure: +40 Pa, about 0.04% of 1 atmospheric pressure) to completely prevent the entry of outside air. The pressure response is also within 1 s, which is a sufficiently quick response.

In this way, air supply and exhaust in helmet are completely controlled by the two pumps. As a result, even if a mask filter or HEPA filter with a large pressure loss (air pressure loss due to air resistance) is used on the inside (helmet side), a sufficient flow rate can be held. This makes it possible to completely block the virus without breathiness of conventional masks.

For safety, a CO<sub>2</sub> sensor is installed and monitored in the helmet, and the carbon dioxide concentration of the situation inside the helmet is constantly monitored. When it exceeds a certain value (set to 2000ppm: 2000-5000ppm equivalent in a room with poor arousal), the flow rate is immediately increased and an alarm is set to sound.

The demo model has two pumps installed for clarity, but this function can also be realized with one pump and one valve. In addition, the sensor, pump, and control unit are all driven by a portable battery (12V lithium-ion type).

The first model used a backpack because a large pump was used for easy recognition in the demonstration. On the other hand, in consideration of portability and convenience, the second model developed this time is manufactured with dimensions such that all devices other than the helmet, such as pumps, control devices, and various sensors, can be accommodated in the waist pouch. Furthermore, in the subsequent model, a helmet-integrated structure will be developed in consideration of practicality.

### [Verification of high-performance control effect]

- Pinch the tube on the exhaust side to reduce the flow rate → Increase the rotation speed of the pump to increase the flow rate
- Push in the bulge under the helmet to raise the internal pressure → The rotation speed of the air supply side pump is reduced to lower the internal pressure to the set value
- Repeat rapid breathing in the helmet to increase carbon dioxide concentration → Increased flow rate + alarm sound generation

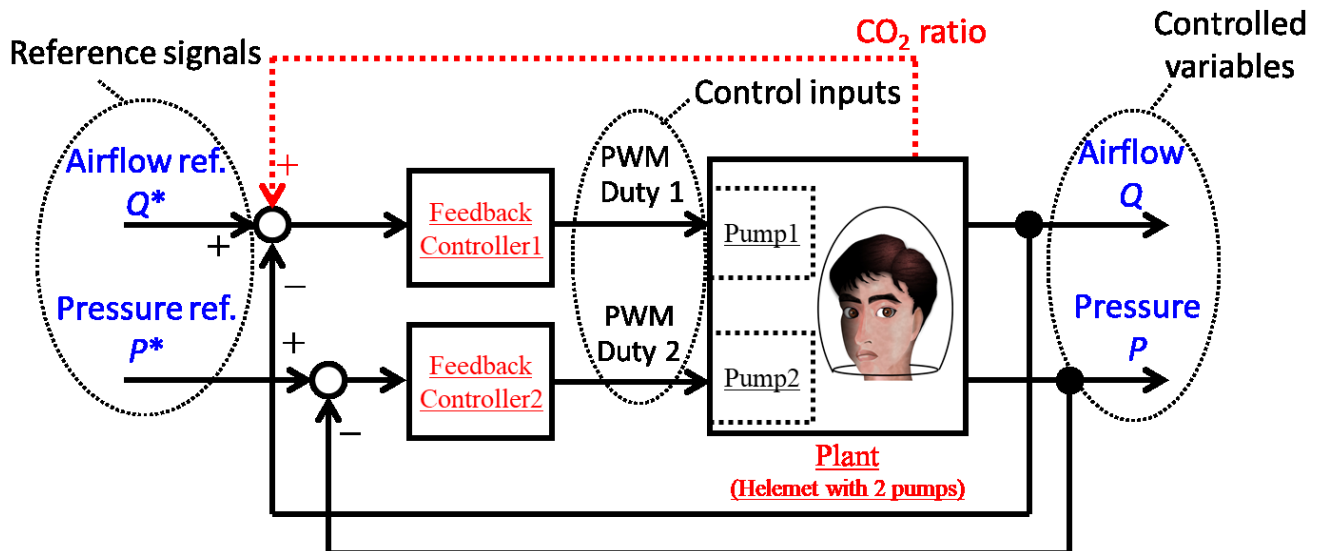


Figure A1-1. Block diagram of helmet type mask with intake and exhaust control function.

## [Appendix-3: Comfort Amenities, Information and Communication, AR]

### [Comfort Amenities]

To wear the mask long time period, it is important that user can be comfortable with the mask. The following comfort amenities have been proposed.

#### (1) Inner glove (Figure A2-1)

- A thin glove is integrated at under part of a mask (Flange part).
- User can insert their hands from under part and touch their face.
- User can also wipe seat and scratch itchy spots.
- The gloves can be folded and stored when not in use.

#### (2) Inner pocket

- A pocket is placed inside the mask (Flange part).
- Small foods and medicine can be stocked in the pocket.
- Those goods can be taken out and used with inner glove mentioned above.
- User can blow their nose with a tissue or wipe sweat off with a handkerchief.

### [Information and Communication, AR]

Because our helmet mask should be worn long time in a day, it is important to perform various tasks with wearing the mask. In particular, the integration of information and communication technologies such as smartphones and XR (a general term of VR, AR and MR) technologies such as augmented reality will be important to extend the comfort and convenience of masks.

#### (1) Integrating a microphone and speaker

- Hands-free call
- Voice control (AI assistant)

#### (2) Integrating a head-mounted display

- Watching a movie or playing a game

#### (3) Integrating XR devices (Figure A2-2)

- VR experience

User can experience a virtual reality (VR) world created on a computer.

- AR,MR experience

User can experience an augmented reality (AR) experience that combines external view and CG, mixed reality (MR) world in which CG images are superimposed on the real world.

CG-generated images and information are superimposed on external view, and are used to navigation and working support.

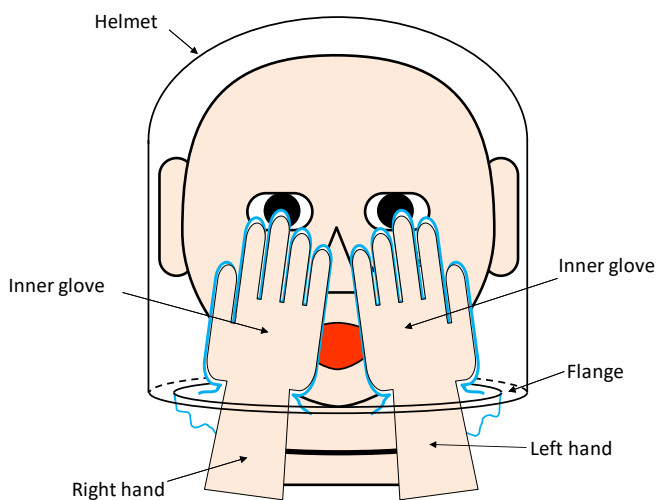


Figure A2-1. Sample of inner glove.

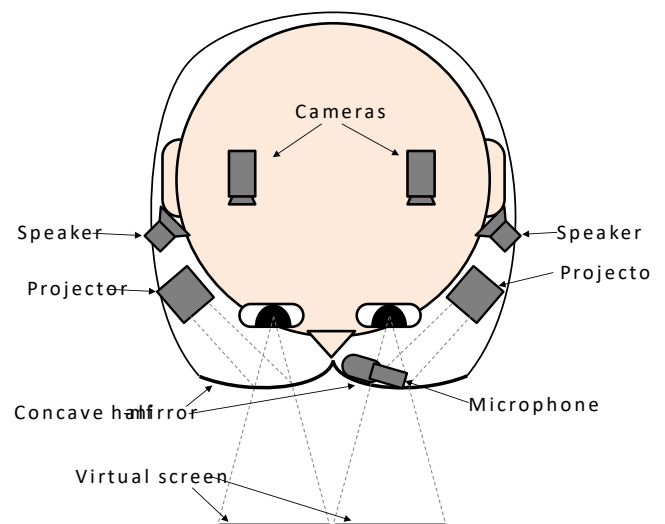


Figure A2-2. Sample of VR system integration.