New Precautions for an Earthquake from the View of Engineering Students

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A: First, we would like to express our sincere condolences to the victims of the earthquake on January first.
B: We were deeply shocked when it happened.
C: For today, our presentation covers the earthquake that occurred in May, but what happened on January first will never be forgotten.

B: Hello, everyone. I'm Ruka from Ishikawa Kosen.
C: I'm Mao.
A: I'm Kokoro.
B: This is sudden, but do you know what you should do first in case of a major earthquake?
C: I think many people would answer, "Hide under the desk."
A: Of course, that's right, but it's not enough to survive.
B: New precautions are necessary to reduce the number of victims.

A: You might ask, "Why did you decide to present on this topic?" The answer is, "It was triggered by the severe damage to Ishikawa from the Okunoto earthquake that happened in May of last year."
B: It was the largest earthquake in Ishikawa and was registered in the upper 6 on the Japanese earthquake scale. What were you doing then, Kokoro?
A: I was walking in Kanazawa. I was worried because I was outside. How about you, Mao?
C: I was shopping in Nakanoto town. Some store items fell off the shelves.
B: Really? I was in Kagawa. I watched the news of the earthquake on TV.
C: Once again, I thought we should take the proper precautions.
B: So, we wanted to explore how we can apply what we are learning at Kosen to reduce damage.

A: Now we will introduce three new precautions we have come up with.
First, we came up with the "Evacuation Eye," a device that uses light to indicate the seismic intensity of an earthquake. When an earthquake is detected by a seismograph, this device glows to visually convey earthquake information. Changing the color of the light for each seismic intensity is effective in providing information easily. This device is placed near streetlights and a screen is set up nearby. By projecting nearby evacuation sites and earthquake information from the Japan Meteorological Agency on the screen, people who have no access to information, such as small children, and people who are out of the house can quickly evacuate, thereby reducing the number of victims.

C: Wow, the device will be very useful for people with hearing disabilities because the information is displayed visually.
B: However, doesn't it need a lot of power and circuitry to operate the system?
A: Actually, using a computer called Raspberry Pi, it's possible to share and display real-time data from the Japan Meteorological Agency on a screen, and to display maps to evacuation centers in various areas. The Raspberry Pi is power efficient and can communicate wirelessly, so this device can be active 24 hours a day, 7 days a week, no matter when an earthquake happens.
B: How do you predict that an earthquake is coming?
A: We will link this device to the seismographs used in the earthquake early warning system we have now. Then it will be feasible for everyone to evacuate before the shaking starts, just as with the earthquake early warning system. However, during heavy rain or typhoons, the screen may break, so measures to prevent breakage are necessary such as making it waterproof.

C: Our second idea is the Communication application Surasura, which specializes in communication during times of disasters. Currently, there is a "Disaster Message Dial". This service allows users to leave 30-second phone messages during disasters. However, few people know about this service, and it's complicated to use.
A: I see. However, isn't it difficult to make ordinary phone calls during an earthquake?
C: That's why we came up with this application. One of the main reasons for busy lines on ordinary phones is the concentration of access. To improve this, we plan to narrow the range of servers in each region and expand the network. By narrowing the servers, the people accessing them would be spread out, allowing calls and communication to run much more smoothly.
B: But if people who use different servers try to contact each other, won't the networks between the servers become congested?
C: To solve this problem, you can use a Starlink Satellite network. Starlink is an internet communication service that connects almost all areas of the earth via space. Starlink is a stable communication system that allows constant transmission and reception. This can be achieved simply by installing software.
A: One challenge, however, is the cost of launching and maintaining the satellite, as well as high Internet fees.

B: Finally, I have thought of a "disaster battery". When a major earthquake happens, the electricity in a building is cut off. This is to prevent fires caused by earthquakes, but it's said that it takes 72 hours for electricity to be fully restored.
However, some people, like those living with ventilators or pacemakers, have trouble without electricity almost immediately.
C: Also, nowadays, some people are recuperating at home as well as in hospitals, right?
B: These medical devices are equipped with a battery-like device called UPS. Thanks to this, it continues to operate for 10 to 15 minutes without power. But evacuating takes longer than 10 to 15 minutes so you need more power to keep them running for three days.
C: It would be nice if we could share the electricity from our electronics and other

devices of the people around us.
B: I agree. But unfortunately, it's not possible with the current technology.
A: Why is that?
B: Simply put, because there is not enough electricity. Lithium-ion batteries don't have enough power to charge medical devices.
However, development is underway for a compact, high-capacity battery, one that may be able to do just that. It's called the all-solid-state fuel cell.
A: What is the difference from the conventional lithium-ion batteries?
B: Lithium-ion batteries use electrolytes, which are very sensitive to temperature changes. On the other hand, all-solid-state fuel cells are made entirely of solids, making them resistant to environmental changes such as earthquakes. In addition, they have more than twice the capacity of lithium-ion batteries.
A: That's wonderful!
B: However, under severe evacuation conditions, it's difficult for the cells to last for 72 hours. That's why we came up with a disaster battery that can be used and charged at the same time.
C: How do you charge the batteries when the power is out?
B: We generate electricity by attaching solar panels or by a hand-cranked generator to the cell. The energy obtained is converted and sent to the cell to keep it charged for a longer time.
C: However, there are some challenges, such as weather conditions and labor requirements, so it would be nice to discover renewable energy sources that can produce electricity more easily.

B: If developed in Japan, an earthquake-prone country, they must be high-performance and easy to use. Our country's invention will improve evacuation life around the world and save more people.
A: We cannot prevent earthquakes themselves, but we can minimize the damage by being prepared. Let's prepare for earthquakes by adopting new precautions.
Although our ideas are still in the developmental stage, we hope to continue to research and develop these ideas throughout our education at Kosen.