Case Study

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Landslide warning detection system

Isahaya City

A system for monitoring landslide disaster risks and ensuring that "nobody becomes a victim of a disaster"

Challenges

- Protecting citizens from any disaster
- Making a disaster prevention system with simple architecture for easy operation and management
- Integration of disaster prevention information for rapid decision making

Solution

- When a precipitation warning is published, the system awakes the sensors to collect soil moisture data. Those data are sent to NEC data analysis server through a LTE network and analyzed by NEC's original algorithm. After that, those data are sent to the city office and shown in graph form on a large display in a conference room. One of the major advantages of this system is its ability to detect signs of a landslide several hours earlier than the actual one.
- The system requires only a set of two sensors to be installed in three locations at each slope. Each equipment runs on a large-capacity battery which can supply power to operate the system for approximately two years, and communicates through independent radio communication.

Results

- Real-time monitoring of landslide risks enables early warning to mitigate landslide disaster
- The simple system architecture requires almost zero maintenance.
- Integration of the landslide warning detection system with a system which supports the decision-making process in publishing official announcements facilitates rapid decision making and announcements regarding disaster measures.

Introduction

Isahaya City is located at the center of Nagasaki prefecture, with Nagasaki peninsula on the west side and Shimabara peninsula on the east side. Isahaya Plain which is built on reclaimed coastal land, is one of the biggest granaries in Nagasaki prefecture, and vegetables, mandarin oranges and other local specialties are produced in its hilly terrain. Isahaya also ships the second largest amount of industrial products in the prefecture.

Isahaya, known for its flourishing agriculture and industry sectors, suffered severe damage in July 1957 due to record-breaking heavy rainfall. After occurrence of the Great Flood of Isahaya, the city focused further on disaster prevention.

Due to its geographical characteristics, Isahaya City has frequently suffered from localized downpours, so they've adopted measures to mitigate disasters caused by heavy rainfall. However, recently the city has been experiencing frequent localized downpours triggering a need for the city to create a system that enables sharing of disaster prevention information between related departments at times of disasters to facilitate rapid decision making.

Challenges

Due to recent frequent sudden downpours they need to build a disaster prevention system

Against this backdrop, Isahaya City has built a centralized system for communicating disaster prevention information. The system includes afunction to determine the risk levels oflandslides. However, there remains some problems. That is: low accuracy of information and lateness of the information. "In the past, landslide risk assessments were made using landslide risk assessment mesh data (possibility of a landslide in each 5-km grid mesh from level 1 to 5) and rainfall data. In an

Toshinori Matsufuji
Chief Director,
General Affairs Section,
Isahaya City Office
Disaster PreventionSystem

effort to obtain more highly accurate data, our city worked together with local companies to conduct experiments using wire sensors, but all the sensors detected signs just only at the onset of a landslide. We were struggling to find ways to make highly accurate early sign detection possible," says Mr. Toshinori Matsufuji in the General Affairs Section of Isahaya City, who is in charge of the disaster prevention management.

Solution

The system's ability to detect signs prior to a disaster and simple architecture of the system prompted the decision to install the system

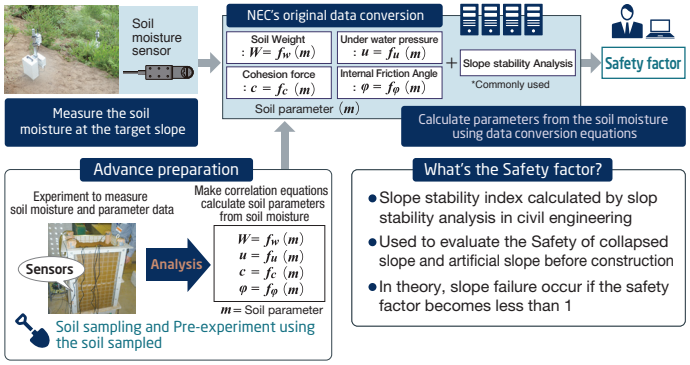
Around that time, Mr. Matsufuji luckily found an article about algorithm development of landslide sign detection by NEC in a newspaper. So he contacted NEC straight away.

"After a meeting with NEC, I couldn't believe a system with such a simple architecture and which doesn't require AC power supply and communication cables was feasible," recalls Mr. Matsufuji. This is the description that was provided: The system monitors shallow and deep soil moisture of a target slope with possibility of landslide occurrence. Its large-capacity battery enables operation of each equipment for approximately two years, and communication is established via specified low-power radio that is independent from external systems.

After considering the above, Isahaya City decided to install the system and set sensors on a hillside behind a junior high school in the city on a trial basis.

When the system receives precipitation warnings from Japan Meteorological Agency, the system awakes the sensors to collect soil moisture data. Those data are sent to servers at NEC headquarters through LTE network via two relay stations. At the servers, the system analyzes the obtained data based on NEC's original algorithm, and the analyzed data are sent to the Isahaya City Office and shown in graph form on a large display in a conference room. One of the major advantages of this system is its ability to detect signs of a landslide several hours before it actually occurs. Prior to installation of the system, NEC undertook a thorough survey of the soil at the target slope where sensors were to be installed. Those data are turned into important parameters by which to detect signs of an impending disaster. "I felt NEC's sincere passion to face our challenge together from their effort of not only installing sensors, but testing the soil"

Another factor in deciding to install the system was NEC's proposal of collecting weather information, water level and other data provided by Japan Meteorological Agency and combining them into a map-based system to support our decision-making process in publishing official announcements. "Our main purpose for the system was not only to detect landslides, but also to allow data to be centrally managed and facilitate decision making. To make it possible, we needed a system which can combine a wide variety of data and display the information in an effective and pertinent manner. We came to the conclusion that NEC was the best partner we could rely on to provide us expertise not only in terms of sensors but also regarding ICT in general," explains Mr. Matsufuji.



Data analysis mechanism
A set of two sensors are installed in three areas at a target slope, with a total of six sensors used to obtain soil moisture content. Those collected data are sent to NEC's servers via two relay stations. The level of safety of the hillside is calculated based on obtained data regarding the weight of the soil, pore water pressure, cohesion force, and internal friction angle. The results are sent by LTE network to Isahaya City Office, where it is displayed in graph form on a large-scale display. This process has made it possible to achieve almost real-time assessment of landslide disaster risks.

Results

Rapid decision making at the time of a disaster ensures the safety and security of citizens

It is not easy for municipalities in Japan to announce official evacuations to the public. There is a lot of things to do before publishing announcements, such as assessing disaster risks, setting up evacuation sites and routes, preparing emergency supplies, and so on. "The system provides quantitative data related to landslide disaster risks which we can share with relevant personnel and enables us to make decisions earlier. The system has been operated several times as tests and worked exactly as we had hoped," says Mr. Matsufuji with a satisfied look on his face.

Hereafter, the system will continue to be operated on a trial basis to verify accuracy under intensive rainfall. "I hope this system will be successively installed in other municipalities too. If the number of places the sensors installed are increased, the more data can be collected for analysis, which will improve the accuracy of the sign detection algorithm. What we need to do is ensure that nobody becomes a victim of a disaster. With this end as our primary mission, we hope to work together with NEC to advance the disaster prevention system."

Corporate Headquarters (Japan)
NEC Corporation
www.nec.com

North America (USA)
NEC Corporation of America
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