

OYO i-SENSOR MONITORING SYSTEM

1. Needs for Monitoring

Nowadays, monitoring is required / demanded in various cases. Measuring ground deformation during earthworks for safety, groundwater conditions for water resource management, river flow for flood disaster prevention, etc. provides quantitative data for decision-making related to each background. Beginning with “manual monitoring”, other methods such as “mechanical automatic monitoring”, “electrical automatic monitoring” were developed, finally evolving into “remote monitoring”. This change has contributed to achieve more reliable monitoring and to reduce workload at the time of the equipment’s installation. Therefore, the stakeholders’ diverse needs are now met more smoothly, and monitoring is becoming increasingly easier for administrators to implement as its technique develops.

With the above as background, we, OYO, have released “i-SENSOR”, a user-friendly tool which facilitates easy and reasonable establishment of a remote monitoring system on site.

2. Overview of i-SENSOR

I-SENSOR consists of a data logger and transfer module, and any analog output sensor (4-20 mA output) can be connected to this equipment. It has 4 features as shown below:

- | | |
|---|--------------------------|
| (1) All-in-one design | è Compactable Monitoring |
| (2) Data transmission and alert functions | è Manageable Monitoring |
| (3) Self-judgement function | è Reasonable Monitoring |
| (4) Data transmission method | è Reliable Monitoring |

(1) All-in-one design for “Compactable Monitoring”

All-in-one-design makes it possible to use i-SENSOR immediately after installation, and to deploy it easily and flexibly in a monitoring site because of its compact body.

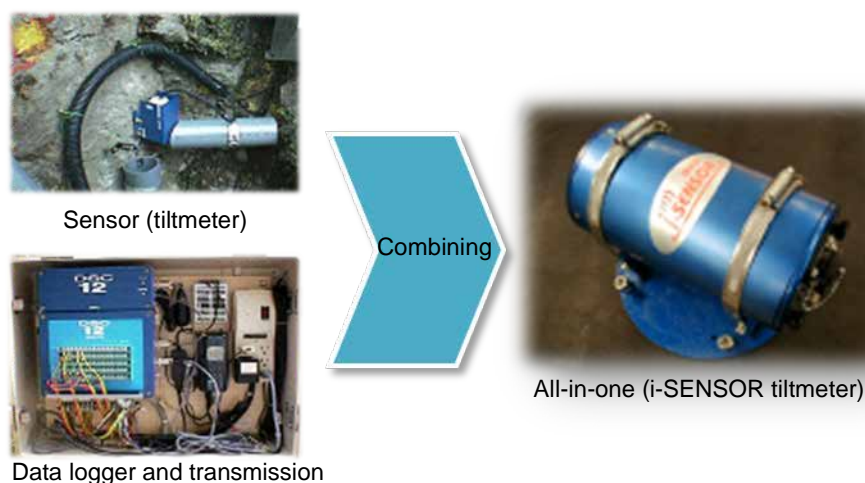


Figure-1 Example of All-in-one Package

(2) Data transmission and alert functions for “Manageable Monitoring”

A threshold value can be set to automatically change the data measurement/transmission interval and issue a warning. When a measured value exceeds the predefined threshold, the self-judgment function sends an e-mail alert to stakeholders and starts measuring at a shorter interval.

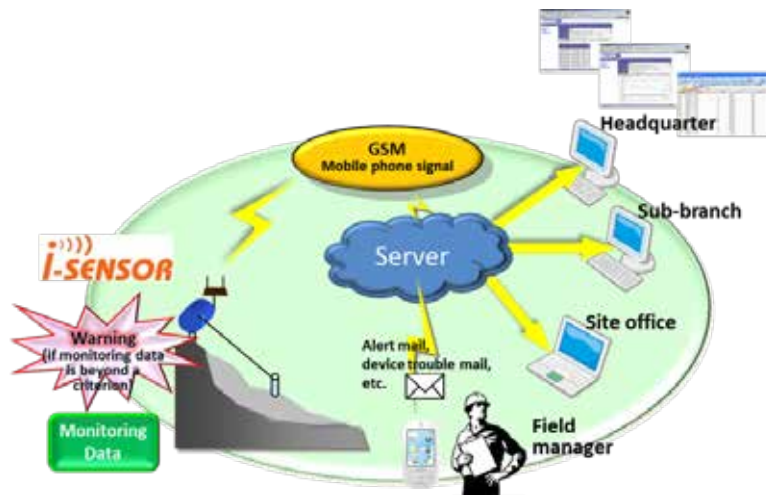


Figure-2 Image of Data Transmission and Issuing Alert

(3) Self-judgment function for “Reasonable Monitoring”

In case of exceeding a preset threshold, followings are automatically activated:

- sending an e-mail alert
- changing measurement interval
- changing data transmission interval
- changing contact output

Below thresholds can be selected by users:

- Rain gauge: hourly rainfall amount
- Extensometer: movement velocity (mm/day) and accumulated displacement
- Tiltmeter: tilting velocity (degree/day) and accumulated tilt

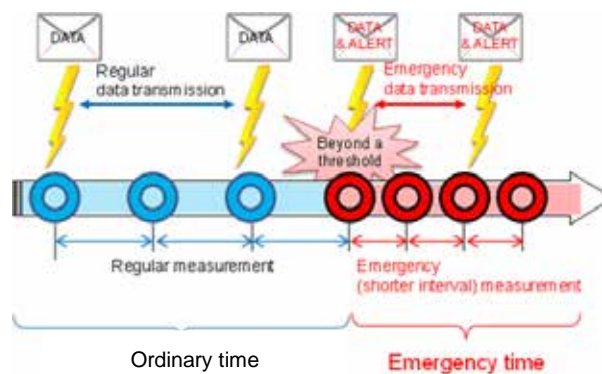


Figure-3 Image of Self-judgment Function

(4) Data transmission method for “Reliable Monitoring”

There are 2 types of data transmission for i-SENSOR: GPRS (General Packet Radio Service) on mobile phone communication; internet using TCP/IP as a protocol. The packet system provides for reliable data transmission and ensures communication efficiency, whereas the internet connection enables an interactive communication.

3. Related Products of i-SENSOR

Herein, we introduce the i-SENSOR lineup currently sold by OYO.

(1) GSM i-SENSOR 4.1ch

The “GSM i-SENSOR 4.1ch” is a data logger and transfer unit. Depending on their needs, users can choose any analog output sensors (maximum 4 pieces) plus 1 rain gauge. Application examples are as follows:

- Meteorological station: e.g. rainfall, temperature, humidity, wind force
- Flood: e.g. rainfall, river water level and quality
- Landslide: e.g. rainfall, groundwater level, extensometer, tiltmeter
- Safety control at a construction site: e.g. rainfall, tiltmeter
- Environment: e.g. rainfall, water quality, atmospheric quality



Advantageous Features

- Easy installation of remote monitoring system using GSM / GPRS packet line.
- 4 analogue sensors and 1 rain gauge can be connected to 1 i-SENSOR.
- Low power consumption and using 12V DC battery .
- Measured voltage value can be converted to physical value in every sensor.
- Criterion can be set on every sensor and alert message system by SMS / e-mail can be developed.

Figure-4 Overview of “GSM i-SENSOR 4.1ch”

(2) Rain Gauge + i-SENSOR

The “Rain Gauge + i-SENSOR” is a simple and reliable rainfall observation station. When a solar panel and battery are in use, a long life monitoring station can be set up taking minimum area. It is not only reasonable but also well suited for wide area monitoring with many observatories. Application examples are shown below:

- Meteorological station: e.g. in municipality management area
- Flood: e.g. to complement existing telemetry stations along a river
- Landslide: e.g. in watershed surrounding a target landslide
- Safety control: e.g. in a construction site
- Road management: e.g. along a managed road
- Dam management: e.g. in catchment area of a dam



Advantageous Features

- Reliable data can be recorded.
- Rain Gauge can be connected to i-SENSOR as a remote monitoring.

Specifications

- Type: Tipping bucket
- Tipping amount: 0.5 mm
- Accuracy: $\pm 4\%$
- Dimensions: $\phi 200 \times 390$ (H) mm
- Weight: 3.5 kg

Figure-5 Overview of "Rain Gauge + i-SENSOR"

(3) Integral Water Level Meter

The "Integral Water Level Meter" is a compact and reliable remote monitoring equipment, especially effective for groundwater monitoring using a drilled hole. The sensor, logger, transmission module and battery are combined in an all-in-one design. Application examples are as below:

- Groundwater management: e.g. in a water resource area
- Flood: e.g. along a river at bridge piers and/or embankments
- Landslide: e.g. in a landslide area
- Assessment: e.g. construction work impact at a site and its environment
- Environment: e.g. influence from plant and waste disposal activities



Advantageous Features

- Easy installation.
- Reasonable price.
- Included atmosphere pressure compensation.
- High durability with stainless steel (SUS 316).
- All in one consisting of SENSOR-LOGGER -TRANSMISSION-BATTERY.

Specifications

- Measurement range: 10 m, 20 m, 35 m
- Accuracy: $\pm 0.1\%$ F.S.
- Measurement interval: 1 min to 10 days
- Dimensions: $\phi 25 \times 290$ (L) mm

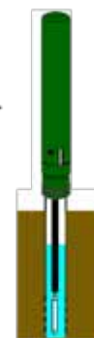


Figure-6 Overview of "Integral Water Level Meter"

(4) Stationary Inclinator + i-SENSOR

The "Stationary Inclinator + i-SENSOR" is, in contrast to conventional manual monitoring, a stand-alone monitoring instrument. The inclinometer is digital output and the lead-in cable is 1 line only from a monitoring hole to i-SENSOR. This simple layout enables quick and easy installation.

Application examples are as below:

- Landslide: e.g. in a landslide area
- Safety control: e.g. at an excavated area or foot of a slope in a construction site

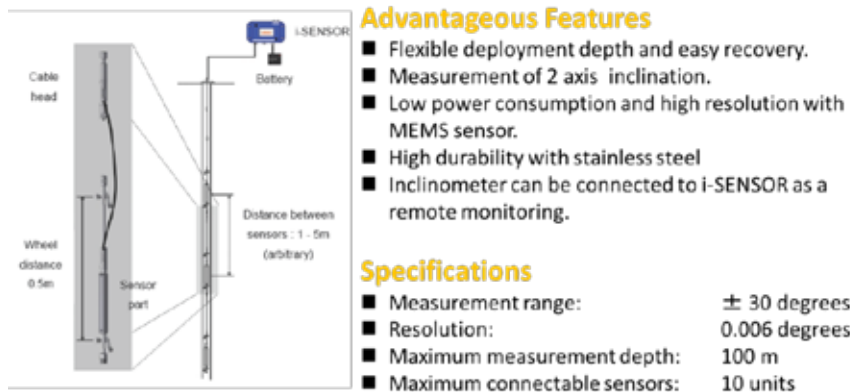


Figure-7 Overview of “Stationary Inclinometer and i-SENSOR”

(5) Slide Alarm + i-SENSOR

The “Slide Alarm + i-SENSOR” is a debris flow detection system. A wire with the Slide Alarm is set across a stream that is in a debris-flow-prone area, and if the debris comes down through the setting point and a certain stress is loaded on the wire, the sensor detects the phenomenon and issues an alert to its downstream. The alert provides the residents in the affected area some evacuation time, the length of which depending on the distance between the setting point and the affected area. Application examples are shown below:

- Debris flow: e.g. at a stream in a debris-flow-prone area
- Safety control: e.g. at a stream in the upstream of Sabo dam construction site

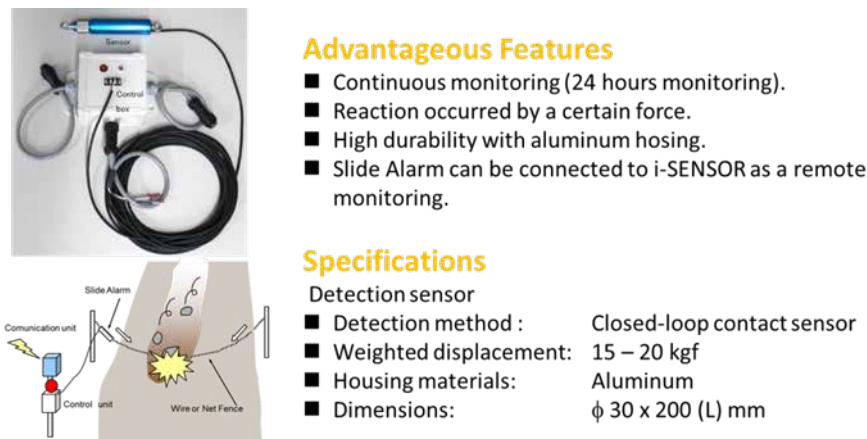


Figure-8 Overview of “Slide Alarm and i-SENSOR”

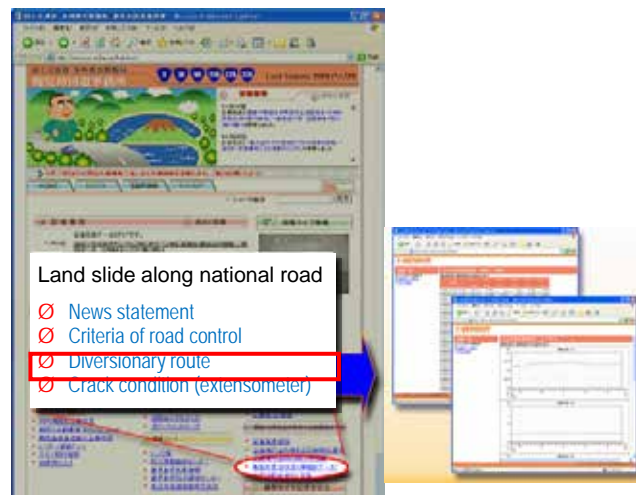
4. Application Examples of i-SENSOR

(1) Landslide monitoring

In Kagoshima prefecture, signs of a landslide had appeared along a national road. To properly carry out traffic/road control for prevention of a disaster, the road administrative office decided to install

“Extensometer + i-SENSOR”. The monitoring data was disclosed on a web site to share the information with citizens and road users.

By sharing the data on the web site, the remote monitoring data is now utilized as a good communication tool between the road administrator and users. Such collaboration can provide more open and effective disaster management.



“Website of Kagoshima Office of National Highway”

Figure-9 Dissemination of Monitoring Data

(2) Groundwater monitoring

Groundwater monitoring was being planned on an offshore artificial land in Fukuoka prefecture, and “Water Level Meter + i-SENSOR” was applied. The only access to the land at that time was via a small ship or boat, but i-SENSOR provided a system which remotely transmitted continuous monitoring data and made it unnecessary to come to the site for retrieving the data.

In such cases, the remote monitoring system “i-SENSOR” is very convenient for continued data collection and enables properly timed instrument maintenance.

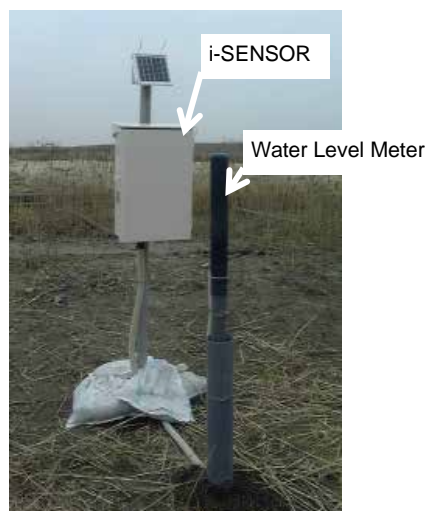


Photo: Kitakyusyu Seaport & Airport Development Office
Figure-10 Whole-view of the Monitoring Station

5. Notification and Recommendation

Taking this opportunity, we herein introduce our remote monitoring system “i-SENSOR” a little further. Although the application fields are not limited to the above described cases, the monitoring site should be covered by a mobile phone network. Also, it is noted that each country has its own communications act, and necessary permissions for i-SENSOR should be obtained before the installation. Of course, we can coordinate it with our distributors/agents which cover more than 20 countries in the world.

Depending on site conditions, there are various types of configuration for the monitoring instruments, and an appropriate deployment plan is quite important for proper monitoring. OYO has plenty of experiences and knowledge about the remote monitoring. We will be happy to provide you with our reasonable consulting services for our products.

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