

## Smart Barrier System

**Key Message :** The Geotechnical Engineering Office (GEO) has pioneered the novel development of the Smart Barrier System. This aims to detect the occurrence of landslides by means of all-weather and non-stop monitoring of landslide debris-resisting barriers, facilitated by the use of state-of-the-art internet-of-things (IoT) technologies. The system will provide immediate alerts to relevant government officers via a mobile application when the barriers are hit by landslide debris, enabling timely arrangement of inspections and follow-up actions to enhance public safety. The performance and reliability of the system are being tested and optimised.

### Introduction

The Government has been constructing landslide debris-resisting barriers to mitigate landslide risks arising from natural hillsides. These barriers are designed to intercept landslide debris, thus to reduce the chance of debris impacting on downhill developments and facilities and causing casualties. Many barriers are located at natural stream courses or hillsides, where accumulation of landslide debris behind the barriers may easily go unnoticed. The GEO has developed the Smart Barrier System. This aims to detect the occurrence of landslides by means of all-weather and non-stop monitoring of the barriers, facilitated by the application of state-of-the-art IoT technologies. The system will provide immediate alerts to relevant government officers via a mobile application when the barriers are hit by landslide debris, enabling timely arrangement of inspections and follow-up actions to enhance public safety. The performance and reliability of the system are being tested and optimised.

### System Features

The Smart Barrier System contains IoT devices installed on debris-resisting barriers. The devices include impact switches for detecting debris impacts, depth gauges for measuring thickness of debris accumulated behind the barriers, and cameras for watching over field conditions and screening out false alarms. Under normal circumstances, depth gauge measurements and camera images are taken at regular intervals and transmitted to a cloud server via mobile networks. These measurements and images are subsequently forwarded to a dedicated mobile application via the internet to facilitate online monitoring of the barriers.

In the event of debris flow, when landslide debris hits the impact switches, the system will immediately send impact alert signals, depth gauge measurements and camera images to the monitoring officers. Further depth gauge measurements and camera images will be sent at shorter intervals to keep the monitoring officers updated on the latest field conditions. The officers can also command through the mobile application to take additional instant depth gauge measurements and camera images.

The harsh outdoor environment of natural terrains necessitates the use of more robust IoT

devices for the Smart Barrier System, e.g. devices with higher waterproofing capability. It aims to ensure the functioning of the system in such harsh environment, as well as to reduce the required maintenance efforts in the future. Moreover, the cameras in the system are equipped with infrared cut-off filters and infrared floodlights to enhance image quality during both day and night respectively. This is to ensure that the system would be fit for purpose round-the-clock.

As some of the debris-resisting barriers are located on remote hillsides out of reach of any power supply networks or mobile networks, the system utilises IoT devices with low power consumption, accompanied by self-contained power supplies, e.g. solar power. In addition, low-power wide-area networks are deployed for data communication between the IoT devices and the cloud server in case the devices are not covered by any mobile networks.

### **Responses to Alerts**

The GEO is testing and optimising the performance and reliability of the Smart Barrier System. Upon receipt of alerts from the system, the GEO would assess the field conditions through the system, and arrange geotechnical engineers promptly for field inspection and follow-up actions if necessary.

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**Civil Engineering and Development Department**  
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