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Wi-GIM system: a new wireless sensor network (WSN) for accurate ground instability monitoring

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Landslides are among the most serious and common geologic hazards around the world. Their impact on human life is expected to increase in the next future as a consequence of human-induced climate change as well as the population growth in proximity of unstable slopes. Therefore, developing better performing technologies for monitoring landslides and providing local authorities with new instruments able to help them in the decision making process, is becoming more and more important. The recent progresses in Information and Communication Technologies (ICT) allow us to extend the use of wireless technologies in landslide monitoring. In particular, the developments in electronics components have permitted to lower the price of the sensors and, at the same time, to actuate more efficient wireless communications.

In this work we present a new wireless sensor network (WSN) system, designed and developed for landslide monitoring in the framework of EU Wireless Sensor Network for Ground Instability Monitoring - Wi-GIM project (LIFE12 ENV/IT/001033). We show the preliminary performance of the Wi-GIM system after the first period of monitoring on the active Roncovetro Landslide and on a large subsiding area in the neighbourhood of Sallent village. The Roncovetro landslide is located in the province of Reggio Emilia (Italy) and moved an inferred volume of about 3 million cubic meters. Sallent village is located at the centre of the Catalan evaporitic basin in Spain.

The Wi-GIM WSN monitoring system consists of three levels: 1) Master/Gateway level coordinates the WSN and performs data aggregation and local storage; 2) Master/Server level takes care of acquiring and storing data on a remote server; 3) Nodes level that is based on a mesh of peripheral nodes, each consisting in a sensor board equipped with sensors and wireless module. The nodes are located in the landslide ground perimeter and are able to create an ad-hoc WSN. The location of each sensor on the ground is determined by integrating an ultra wideband technology with a radar technology; this integration allows to push the accuracy towards the cm. An extended Kalman filter is also used to reduce the noise and enhance the accuracy of the measures. The sensor nodes are organized as a hierarchical cluster, composed by one master and several slave nodes. The landslide movement is detected by comparing day by day the x, y and z coordinates of each nodes. The 3D movements of each sensor during the monitoring period are represented as vector and displayed on a Web-GIS which is accessible at the following link: www.life-wigim.eu.