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Undersafe: Monitoring safety parameters in touristic mines and caves

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Tourism is a key sector of the European economy, generating more than 5% of the EU GPD (Gross Domestic Product). Usually, underground touristic sites receive non-expert visitors; nevertheless these activities are poorly regulated or completely deregulated. Nowadays, safety is provided by underground expert professionals whom proceed to regular inspections and by basic safety infrastructures. Even with these measures, some potential personal and environmental dangers are always present and cannot be totally avoided. Therefore, there is a clear need of a new technological product for safety and environmental continuous monitoring of tourist underground attractions. So, the aim of the Undersafe project is to provide underground attractions with a novel and specifically tailored monitoring system, easy to use and maintain.

One of the goals of the Undersafe project is to develop a rock falling detection based on a set of cost limited vibration sensors. Based on the technical needs, but with cost constraints, different types of potential sensors are considered:

Underground microphone: It is placed in the surface or in the underground. It is based on the consideration that the impact of the stone generates a ground impact vibration which can be understood as a "noise" that is received by a microphone capsule.

Airborne sound sensing microphone: It similarly applies to underground use of the microphones, but now the microphone is tested as for its traditional use (I.e. air sound detection). In such case, the microphone detects the environmental noise produced by the impact of the stone falling onto the ground, which will include the impact sound of the stone.

Geophone: It is the de facto standard for ground vibrations. Although this technology was initially discarded due to its high cost, recently, low cost geophones have appeared in the market that allows its use inside the underground attractions.

Accelerometers: These, can have enough sensibility to act as vibration sensors. Although the costs of the most sensible ones are out of the limits needed for our purposes, but some non-expensive accelerometers will be tested in real environment.

All these systems have been tested and it can be concluded that results have been positive for the following technologies: piezoelectric, Electret (airborne and underground) and geophone. On the contrary, accelerometer and movement sensor provided negative results.

The most sensible sensor that we have found is Electret that, in turn, is the most sensitive one to out of ground environmental noise (relevant in order to discard surface vibrations effect). All sensors can provide detections in a range of 15m. Low cost rock falling detectors, in cercles of 30 m of diameter are feasible. Also detection for longer distances, up to 80 meters, is feasible, but not advisable for low-cost application.

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