Early detection of fires to protect cultural sites

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Fires can have a devastating impact on invaluable archaeological and cultural sites. These areas are often at greater risk of fires because they are commonly surrounded by vegetation or situated close to forest regions. Early detection, however, can significantly reduce the potential damage fires cause.

Detection systems to date have failed to overcome the problem of false alarms and can thus be unreliable. The European Union (EU)-funded FIRESENSE project created a new monitoring system, which integrates different types of sensors (video cameras, infrared cameras, temperature and humidity wireless sensor networks and meteorological stations) to detect smoke and fire. The system increases fire detection rates, reduces the number of false alarms and improves the quality of information that fire services receive.

The novel system was devised by the Information Technologies Institute of the Centre for Research and Technology Hellas (in Thessaloniki, Greece) in cooperation with Bilkent University in Ankara (Turkey) and other partners including Xenics, a Belgian manufacturer of high-quality infrared cameras.

The project team also drew on the expertise of CWI, a Dutch research centre with experience in multimodal data fusion, the Higher School of Communications of Tunis (Sup'Com, Tunisia), the Bogazici University (Turkey) with experience on Wireless

Sensor Networks and TITAN, a Turkish company that provides safety and security services for buildings, as well as the National Research Council of Italy, which has know-how in fuel model estimation, and the IX Ephorate for Prehistoric and Classical Antiquities of the Hellenic Ministry of Culture and Sports in Greece.

"We already had experts in wireless sensor networks as well as video/infrared-based fire detection, so the emphasis was put on integrating the different technologies. We also developed additional software for fire propagation estimation and visualisation," says project coordinator Dr Nikos Grammalidis of the Centre for Research and Technology Hellas, Greece.

The system detects fire and estimates how the fire will spread based on the amount and type of 'fuel' for the fire in the area and other important parameters such as local weather conditions and ground morphology. Additionally, a 3D Geographic Information System (GIS) environment provides a visual image of the likely spread of the fire.

False alarms occur due to the reflection of the sun or temperature variations in the environment which may trick sensors. Moving objects with similar colours to fire also present a challenge. The FIRESENSE system overcomes most of these difficulties by using advanced signal and image processing algorithms and by combining information from different sensors.

Furthermore, in case of an alarm, the manual operator can always set the system to a 'manual mode' in order to zoom in on the picture and examine the situation in real-time in further detail. *"However, although significant progress was made, some more work and fine-tuning is needed to further reduce false alarms and create a fire detection product ready for market,"* explains Dr Grammalidis.

The system was tested in five sites of archaeological and cultural interest in Greece, Turkey, Italy and Tunisia – each site having different types of buildings/monuments, vegetation and terrains. The project team worked with forestry experts and local authorities in order to produce improved vegetation maps and apply advanced fire propagation models, taking into account various local constraints in the setup of the system.

The FIRESENSE system is still operational in the archaeological site of ancient Rhodiapolis, near Antalya, Turkey. In fact, the Turkish Bilkent University owns some patents on the system. Moreover, the General Directorate of Forestry of Turkey is also using the new system.