Bird Watching and Ecotourism: An Innovative Monitoring System to Project the Species of Lesvos Island to Potential Ecotourists

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Abstract. Ecotourists have high potentials to spread ecological awareness, while they maintain quality tourism and learn how to respect and preserve the natural environment. Knowledge is an important prerequisite to predict future attitudes and connect tourists with nature. Ecotourism focuses on areas with rare flora and fauna. Lesvos Island hosts rare species which attract numbers of bird watchers yearly. The current paper presents an innovative system that may record the movements of the birds and transmit the data to a mobile application available to potential tourists.

Keywords: birdwatching, ecotourism, innovation, Lesvos.

1 Introduction

Lesvos Island has been known to birdwatchers for the presence of two rare species: Sitta Krueperi and Emberiza Cineracea. The great variety of wetlands as well as its location in Eastern Meditteranean make Lesvos Island a unique destination for birds. Thus, Lesvos has the richest bird fauna of all the Aegean islands. Greece in general hosts around 449 bird species, more than 300 of which have been observed on Lesvos Island (Dudley, 2015).

Ecotourism can improve and disseminate the nature and culture of an area while it can be divided into active and passive ecotourism. Active ecotourism is when people try to improve or save the environment and make it healthier, but passive is considered when person wants to relax and seeks to minimize to damage the area. In short, ecotourism contributes in the interaction between humans and nature and help to acquire much awareness and understanding of the area, plus it helps to improve peoples' attitudes and behaviors towards natural environment (Cini et al., 2015).

Moreover the bio-cultural information should be provided to all people who take part in it. Within this framework, an innovative system is proposed to monitor the

Proceedings of the 7th International Conference on Information and Communication Technologies in Agriculture, Food and Environment (HAICTA 2015), Kavala, Greece, 17-20 September, 2015.

activity of the birds on the protected area. A network of wireless cameras is set to capture the usual or the migrating movements of the birds and simultaneously upload the data on an application allowing the registered users to comment on the picture. Furthermore, the users will be allowed to upload their own pictures from birds they watch so as to either be approved as a rare bird after the review of the Lesvos Bird Records Committee (Hellenic Rarities Committee, 2009) or accept the comments of the other users.

2 State of the Art

2.1 SCADA Systems

The suggested platform consists of a Supervisory Control and Data Acquisition (SCADA) system for the collection of the required information. SCADA systems collect data from sensors, communicate the acquired data, present them and finally use them mainly on the supervisory level (Daneels & Salter, 1999). Wireless sensors are used in numerous scientific fields like agriculture, nursing, medicine etc (Rehmann et al., 2014; Huang et al., 2014; Zhang et al., 2014).

Should the collection of data, in order to assess the performance of a system, is not an option, SCADA systems become useful and while, in the beginning, they were considered as a technical engineering tool, they eventually evolved to a key tool for decision makers within organizations. Among SCADA capabilities, the one that stands out is that they control complex processes without the need for specialist human resources (Asgarkhani & Sitnikova, 2014).

In technologically advanced countries, particularly the USA and countries of Western Europe, the need for monitoring parameters associated with environmental quality characteristics and especially the quality of water has been extensively recognized. For this purpose, several programs of automatic measurement of qualitative characteristics and analyses of results have been installed, which help in the development of agriculture (Gross Kopf William, 2001).

Supervisory Control and Data Acquisition (SCADA) systems are being widely used in agricultural applications and specifically in irrigation management systems, where an intelligent use of the water is required. Molina et al (2014) propose an application developed with LabVIEW graphical programming language, complex mathematical models for irrigation, data sampling. The use of a data acquisition card for collecting data from transducers and for the activation of the actuators makes it possible to apply the implemented platform both to a real irrigation system and to the developed scale model, supplying the students with a more practical application of the learned concepts. At the same time an educational platform for the design of SCADA applications for irrigation programming combined with a scale model of a trickle irrigation system is proposed from the researchers.

Vera-Repullo et al (2015) provide a SCADA system to optimize irrigation using weighing lysimeters in a potted crop. The software was programmed in a compact

embedded controller using the LabVIEW graphical programming language with the Real-Time module. This controller receives data from the lysimeters throughout a Modbus/RS-485 communication network, processes them and realizes the calculations to control the irrigation valves in real time.

Tsagaris and Hatzikos (2014) propose an innovative system that monitors and controls the water quality, both surface as well as groundwater and sea. Developed using the PLC and SCADA technologies, it is a sophisticated way to provide timely and reliable information and it is a necessary tool for public services, local authorities, scientific institutions and private companies that manage, control and / or use any form of water resources such as lakes and watersheds, rivers or streams, sea and groundwater. The system monitors the environmental, hydrological and meteorological conditions in real time with a wireless communication system for instant information and timely anticipation. It consists of a local control station located in the field of interest, which hosts various sensors for measuring water quality and meteorological parameters and a data collection central station which collects sensor readings, stores them persistently, it allows users to visualize, and finally regulate and receive alerts when certain metrics exceed some predefined limits.

2.2 Ecotourism - Bird Watching

Ecotourism has not yet been clearly defined. A number of studies were conducted in order to come up with a definition widely accepted. It is an alternative form of tourism (Fennell, 2008) focusing on the need for "clean"environment, alternative form of holidays linked to nature, that respects the local hosting community's needs.

The typology of hardcore ecotourists frames tourists with special interests oriented to nature and ecology (Fennell, 2008). The most common form of ecotourism is the observation of flora and fauna (birdwatching is part of this observation), visiting national forests etc (Chatzigeorgiou, 2009).

Ecotourism develops in areas of spectacular beauty and wealthy natural resources. It is directly linked to sustainability since the preservation of the environment, the culture and the community of every area are the pillars of ecotourism development (Hall & Boyde, 2005).

The island of Lesvos is the 3rd biggest island of Greece located on the NorthEastern Aegean Sea. The Gulf of Kalloni is one of the two main gulfs of the island where there are many wetlands and a "house" of rare birds. Alykes wetlands, when flooded, are a real magnet for birds and birders. 332 species have been recorded from the island as at 31 December 2014 while there are species of dragonflies and butterflies, rare reptiles and amphibians, and mammals. Finally, Lesvos is an island with explicit flora and rare orchids (Dudley, 2015).

Like other bird populations worldwide, there are birds on Lesvos island that are at risk of extinction and their conservation relies heavily on protected area networks. Ecotourism to these areas generates revenue to contribute to the species' conservation (Steven et al., 2013). Limited research has been carried out on the impact of tourism on bird populations, whereas extensive discussion has been devoted on sustainable development (Collins-Kreiner et al., 2013).

To sum up, the typology of bird watchers according to Vayanni et al., (2005), is people of middle age, well educated, individual tourists who spend more money than an average tourist and whose main concern is the preservation of the environment.

3 Proposed System

The paper proposes the implementation of an environmental monitoring network, which will monitor the environment of the target area, capture the movements of the birds, update the records of rare birds and simultaneously upload the pictures captured to a database available to any potential visitor of the area. At the same time, visitors will also be able to upload their own pictures to the database so as to submit them for approval by the LBRC.

The proposed system includes the installation of a network of wireless cameras in combination with meteorological stations. The cameras' objective will be the recording of the birds' activities in the protected area while the stations in combination with the hydrological stations will gather data concerning the environmental conditions of the area. In addition to the aforementioned elements, an elearning platform will contribute to informing the potential tourists on the climate, environmental conditions applied at the time in combination with the presence of the species in the area. The ultimate goal of the system is to gather data on the presence of the birds, upload them on the system so as to provide immediate information to potential tourists. Furthermore, given the lack of information to bird watchers, the immediate availability to a mobile application will allow the tourists to be constantly updated on species' movements, whereas the Lesvos Bird Records Committee will immediately be updated so as to approve or reject the record.

The network consists of (a) several Local Monitoring Stations (LMSs) which record and transmit data to the main station and (b), the Main station (MS), which initiates the communication process with all LMSs and stores the data in the database for future processing.

The Main Station (MS) includes a) all the necessary electronic telemetry hardware that enables the central system to communicate wirelessly with all the LSMs, either automatically or on user’s command. b) the software for the safe recording, storage, presentation and management of measurements and monitoring for excessive environmental parameter values (alarms). c) Necessary hardware and software for remotely accessing and managing the MS.

The local stations collect all hydrologic and air indices like water ph, water temperature, dissolved oxygen, conductivity, turbidity, chloride, nitrate and ammonium ions, chlorophyll, direction and air speed, air temperature and humidity, sunlight, rainfall e.t.c. The sensors come from various international vendors with RS232 and analogue output ports (Fig. 5).

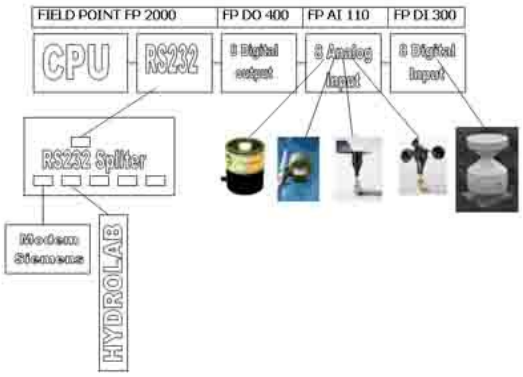

Fig. 1. Connecting sensors with the central unit of the local station (Tsagaris & Hatzikos, 2014).

An important point is that the system is connected to the batteries that are installed in the LSM that cover the complete and continuous operation of telemetry system. The port-to-port response time of the system is negligible. The communication of the LSMs with the MS is performed through mobile telephony (GSM technology).

3.1 Network Topology

The cameras will be placed to spots indicated by the Hellenic Ornithological Society whose contribution is of utmost importance. The conjunction of image capturing with central gathering points will be accomplished with the use of wireless links. A wireless link will also be used for the connection of any intermediate spot with the central station. All the points of image capturing will communicate with the use of directional antennas to guarantee the required communication speeds and the protocol used will be Ethernet TCP/IP.

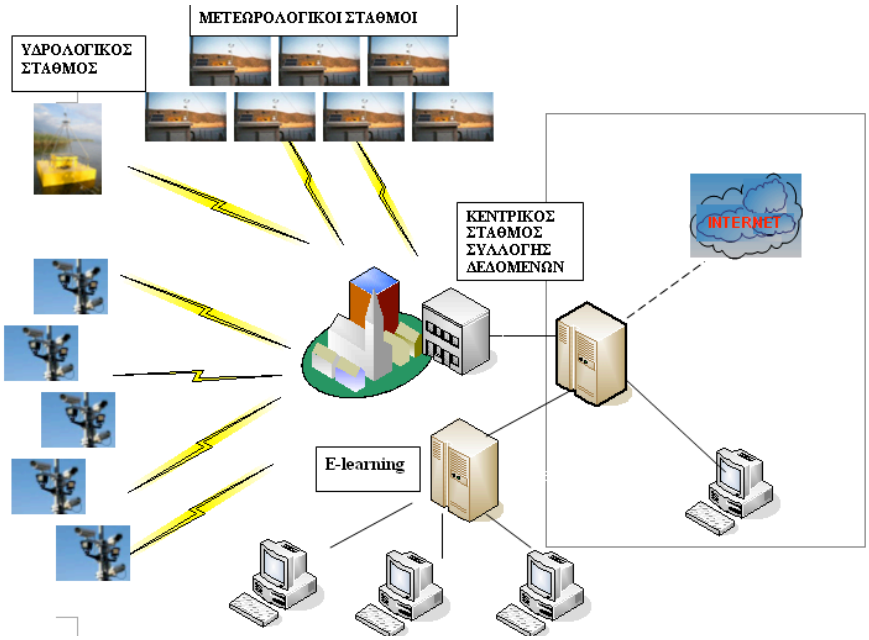

Fig. 2. Network topology.

3.2 E-learning Platform

Nowadays, users not only do they seek the information but rather participate in its creation (wikis), comment (forum, blogs, micro blogs), create networks with common interests (social networking), cooperate (collaborative networks), they are trained (e-learning) in combination with traditional learning (blended learning), they entertain with videos (youtube) and pictures (flikr). This is the new face of the evolving network (Web 2.0)

The e-learning platform will include learning objects, which will be compatible to SCORM standard and communicate user data and performance data i.e. user id, pictures uploaded by the user, user's records accepted by LBRC etc. Users will be trained to interpret the data collected by the stations like wind speed, waterfall, bird movements, threats etc.

The educational material will be accessible to all users and it will record statistical info on its use by visitors in order to evaluate and upgrade the platform.

4 Discussion

Ecotourism is an alternative form of tourism, which focuses on the preservation of the environment and the sustainable development of an area. Lesvos island is a well-known island for the development of alternative forms of tourism and the rare flora and fauna present on the area. Bird watchers flood the area in springtime looking to record views of rare species.

On the other hand, records aren't approved or rejected on time. It needs to be highlighted that there are records that haven't yet been examined since 2013.

Thus, there is a need for online information and education on the area's exceptional natural environment and provide instant update on the presence of rare birds.

Technology can contribute to satisfy the above-mentioned needs of all interested parties.

The system described in the current paper benefits scientists - ornithologists who visit the area to observe the birds, environmental associations, students, potential tourists, ecotourists and visitors in general, local authorities. Their benefits can be grouped in:

- understanding the unbreakable relationship between the human and nature and their interaction
- sensitizing the public in environmental education
- documentation of rare species
- creation of a pillar of environmental education and research
- educating people on the rare flora and fauna of Lesvos island

Managerial implications

Such a system can contribute to decision making on a local or regional level regarding the development of an area with environmental concerns. Through the elaboration of the data gathered, important decisions can be made regarding the impact of the visitors on the area, the endangered species as well as the satisfaction of the visitors' needs. Lastly, the proposed system can heavily contribute to the environmental education in Greece and abroad via the online learning platform, which gives remote access to everybody interested in the area or ornithology.

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