# Chapter 8.6
# Archiving Nature's Heartbeat Using Smartphones

**Jinglan Zhang**
*Queensland University of Technology, Australia*

**Paul Roe**
*Queensland University of Technology, Australia*

**Binh Pham**
*Queensland University of Technology, Australia*

**Richard Mason**
*Queensland University of Technology, Australia*

**Michael Towsey**
*Queensland University of Technology, Australia*

**Jiro Sumitomo**
*Queensland University of Technology, Australia*

## ABSTRACT

*The impact of urban development and climate change has created the impetus to monitor changes in the environment, particularly, the behaviour, habitat and movement of fauna species. The aim of this chapter is to present the design and development of a sensor network based on Smartphones to automatically collect and analyse acoustic and visual data for environmental monitoring purposes. Due to the communication and sophisticated programming facilities offered by Smartphones, software tools can be developed to allow data to be collected, partially processed and sent to a remote server over the network for storage and further processing. This sensor network which employs a client-server architecture has been deployed in three applications: monitoring a rare bird species near Brisbane Airport, study of koalas behaviour at St Bees Island, and detection of fruit flies. The users of this system include scientists (e.g. ecologists, ornithologists, computer scientists) and community groups participating in data collection or reporting on the environment (e.g. students, bird watchers). The chapter focuses on the following aspects of our research: issues involved in using Smartphones as sensors; the overall framework for data acquisition, data quality control, data management and analysis; current and future applications of the Smartphone-based sensor network, and our future research directions.*

DOI: 10.4018/978-1-61350-456-7.ch8.6

## INTRODUCTION

Increasing urban development and climate change have exerted adverse effects on our environment, especially on the conditions of flora and the behaviour, habitat and movement of fauna species. The key to understanding this problem and its management lies in the ability to monitor, record and detect changes so that evidence-based strategies can be developed. Currently, most ecological sampling and monitoring involve stepping out into the environment to measure physical variables and to manually monitor, count and observe plants and animals. As this process is very time-consuming and labour intensive, it is impractical to carry out large scale studies. Another drawback of this approach is that the presence of the observer affects the behaviour and detection of the subject animals.

Sensor networks provide a viable technology for monitoring the environment. Once deployed, they can monitor their environment automatically with minimal human intervention. A number of sites can be monitored at the same time. Many different environmental characteristics can be monitored, traditionally these include: temperature, humidity, water, pressure, and many other scalar quantities. Other characteristics such as acoustic and visual data provide richer information on flora and fauna monitoring.

Mobile phones have become one of the most important communication tools. They are also pervasive in other sectors and drive market demand. For example, engineers, plumbers, or insurance company staff uses mobile phones to record site images as evidence for approving/rejecting repair or insurance claim. People on the move can use mobile phones to identify their current location and time, or to report on the environment. Mobile phones have also been used as sensors for personal medical sensing or for social networking (Kansel, Goraczko, & Zhao, 2007; Oliver & Flores-Mangas, 2006) and for capturing bird calls (http://owlproject.media.mit.edu/).

This chapter reports an innovative application of mobile phones in the monitoring of environmental changes. We present the design and development of a sensor network which is based on Smartphones for monitoring and archiving the impacts of human and animal movement on the environment as well as the impacts of environmental changes on the behaviour of animals. We choose to use Smartphones because they offer powerful processors and sophisticated programming facilities. Although micro-servers have similar hardware and capabilities, Smartphones are cheaper due to commoditization. The networks have been deployed at a few selected sites in Queensland, Australia. In particular, it is targeted at monitoring a rare bird species, the Lewin's Rail near Brisbane Airport and enhancing koala research at St Bees Island. Frog and fruit-fly population studies are also under experiment at a central city area and a farm for ecological research. To date, the Smartphones communicate with the remote servers only, but we plan to extend the communication capability further, allowing them to communicate with each other at the next stage of development.

This chapter is organised as follows. It presents firstly related work on environmental observatories, the use of different types of sensors and their drawbacks. These drawbacks lead to our approach of using Smartphones as sensors. Issues involved in using Smartphones as sensors are then analysed. This is followed by a detailed description of our system architecture, and the process of data collection and management of data quality. Data analysis and pattern recognition also form an important aspect of our work. However, due to page limitation, we can only briefly describe it here and provide references to other papers which report this aspect of our work in more detail. The chapter then discusses current and future applications of our sensor networks, followed by our future research directions.