

# A Mobile Computing Crowd Sourcing Application for Reporting Ecological Disasters

## Abstract

The 2010 Deepwater Horizon oil spill in the Gulf of Mexico is one of the largest ecological disasters ever. A multitude of species, many of them endangered, are being impacted by the oil spill. Many ordinary citizens are involved in the clean-up and restoration effort.

With the proliferation of smart phones, not only can ordinary citizens access knowledge on their mobile devices, but they can also contribute to the scientific knowledge base. Crowd sourcing mobile applications are effectively turning concerned citizens into "citizen scientists." This application enables the citizen to report an endangered species found on the Gulf. A picture of the endangered species, the preliminary identification of the species, GPS coordinates and the date/ time of the discovery are all included in the report. The preliminary identification is accomplished through a series of questions built into the reporting application. This information will then be shared with researchers, allowing them to study the effect of the oil spill on the animals of the Gulf.

The species identification program was built using the Decision Tree Code Generator (DTCG), an extensible decision tree based code generator. The DTCG is generic enough to be used to report on future ecological disasters. Biologists can use the DTCG to build binary decision trees to identify animals or plants through a series of true/false questions. With the use of the DTCG, and the existing application framework, new mobile applications can be rapidly deployed to gather information about future environmental disasters through crowd sourcing.

## Purpose

The purpose of this project is to create a mobile computing application that can utilize the contributions of ordinary citizens to gather data on the effect of ecological disasters on animals in a specific region. Specifically, this project focuses on endangered species affected by the Gulf Oil Spill of 2010. More generally, it provides a code generating capability to allow the existing mobile computing application to be used for other disasters.

## Objectives

Specific goals for this project were as follows:

- Create a user-friendly Android application that can be used to help researchers study the effect of the Gulf Oil Spill on endangered species
- Construct a series of yes/no questions that could be used to identify selected endangered species in the Gulf of Mexico
- Create a binary decision tree based animal identification program
- Generalize the animal identification program so that it could be rapidly modified and used in other environmental disasters
- Create a Java code generator for binary decision trees



Oil spill



Animals in peril



Citizen scientist



Data reporting



Research

When the user starts the Disaster Reporting Application for Citizen Scientists (DRACS) they are presented with a screen that allows them to either take a photograph and report an animal affected by the oil spill or invoke the animal identification process in stand-alone mode. Choosing to report an animal will lead the user through taking a photograph, invoking the animal identification process and sending the incident report via email.

- Android camera application is invoked
- Global Positioning System (GPS) coordinates are obtained
- Animal identification process is invoked
- Photograph, GPS coordinates and preliminary identification are recorded and included in email
- Email is sent to collection point



Animals Harmed by the Deepwater Horizon Oil Spill



Android Application Developed to Report Animals Harmed by Oil

## Mobile Computing

- Mobile computing is defined as any form of computing that is intended to be used while moving. In recent years, with the advent and proliferation of smart phones, mobile computing has become accessible to much of the world's population.
- A natural application of mobile computing is for crowd sourcing, which is the process of using the public at large to complete some task. Using ordinary citizens for collecting data to be used in scientific research is a common application of crowd sourcing.
- Crowd sourcing applications on mobile computing devices are enabling concerned citizens to actively participate in the scientific research by gathering valuable data. Citizens at the site of an ecological disaster will be able to quickly gather and disseminate data, effectively turning citizens into "Citizen Scientists."
- The Disaster Reporting Application for Computer Scientists (DRACS) mobile computing crowd sourcing application was built for the generic, open source Android platform that is used on many smart phones.
- Android-specific Java was used as the programming language for this project.
- The Java SE Software Development Kit (SDK), 6u20 with JRE 6 was used as the primary development platform.
- The Eclipse Interactive Development Environment was chosen for its robust Android development environment.
- Android Eclipse plug-in platform 2.2 API level 8 revision 1 was used as the primary Android development platform.
- The Android SDK Tools revision 6 and Android Virtual Device (AVD) Manager were also used.
- The AVD Manager was used to emulate the Android hardware on the development computer.
- Using this framework, 2X application classes were implemented:
  - AdapterActivityBird, AdapterActivityCoral, AdapterActivityFish,
  - AdapterActivityMammal, AdapterActivityTurtle, BasicQuestionScreen,
  - CameraSurfacePreview, CameraWork, EndangeredSpeciesBird,
  - EndangeredSpeciesCoral, EndangeredSpeciesFish, EndangeredSpeciesMammal,
  - EndangeredSpeciesTurtle, FilteringQuestionScreen, Question,
  - QuestionList, SeniorProject, SpeciesAdapterBird, SpeciesAdapterCoral,
  - SpeciesAdapterFish, SpeciesAdapterMammal, SpeciesAdapterTurtle

## Methodology

The Disaster Reporting Application for Citizen Scientists (DRACS) consists of Mobile Computing and the Decision Tree Code Generator.

```
Code generated by DTCG --- DO NOT MODIFY DIRECTLY
package com.seniorproject.androidscreen;
import java.util.ArrayList;
import android.content.Context;
import android.os.Bundle;
import android.view.View;
import android.widget.Button;
import android.widget.TextView;
import android.app.Activity;
import android.os.Bundle;
public class QuestionList extends Activity
{
private static ArrayList<Question> questionList;
private int numQuestions;
private Question current;
public QuestionList()
{
questionList = new ArrayList<Question>();
numQuestions = 0;
current = new Question();
public void fillList()
{
questionList.add(new Question("mammal", "Is your animal a mammal?", "fur", "fish", true, "", ""));
questionList.add(new Question("fur", "Does your animal have fur?", "carribbean monk seal", "spere whale", true, "", ""));
questionList.add(new Question("spere whale", "", "", true, "", "carribbean monk seal");
questionList.add(new Question("carribbean monk seal", "", "", true, "", "carribbean monk seal");
questionList.add(new Question("fish", "Is your animal a fish?", "red", "bird", true, "", ""));
questionList.add(new Question("red", "Is it red?", "polric head", "serrated nose", true, "", ""));
questionList.add(new Question("polric head", "Does the fishes head come to a point", "red porgy", "red porgy", true, "", ""));
questionList.add(new Question("red grouper", "", "", true, "", "red grouper");
questionList.add(new Question("red porgy", "red porgy", "", true, "", ""));
questionList.add(new Question("serrated nose", "Does your animal have a long serrated nose", "saifish", "dark", true, "", ""));
}
}
}
```

Code Generated by DTCG used in DRACS Application

## Decision Tree Code Generator

Extensive internet research was conducted to identify the selected affected endangered species and the best way to identify each. Once this research was complete and the sequence of true/false questions to identify each animal was determined, the Java code was written to input the sequence of questions. At this point it was realized that a code generator could be written to automate this portion of the coding process. The Decision Tree Code Generator (DTCG) was written in Java to generate the Android-style Java code necessary to identify the animals in the mobile application. This generated code was then compiled and linked with the rest of the application. With the animal identification portion of the Java code generated by the DTCG, this application can be modified quickly and used to gather and report information about any environmental disaster.



Screenshot of User-Friendly Decision Tree Code Generator Interface



Screenshot of Generated Code as Implemented in Android Application

