CS486C – Senior Capstone Design in Computer Science

Project Description

Project Title: CRAB CAKES – Colorado River Area Biologists Computer Aided Knowledge Entry System	
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Project Overview:

The Colorado River in the Grand Canyon is home to a variety of endemic fishes. Since Glen Canyon Dam was completed, the river has been considerably altered. There is less variation in water flow and temperature, and most sediment is now contained behind Glen Canyon Dam. As a result of these changes there is extensive monitoring and conservation activities centered on the fishes of the Grand Canyon. This work is carried out by a variety of agencies: US Fish and Wildlife Service (USFWS), Grand Canyon and Monitoring Research Center (GCMRC) - US Geological Survey, Arizona Game and Fish Department, as well as the National Park Service, and private contractors (i.e. the cooperators). All the data generated from monitoring and research activities is maintained in a database maintained by GCMRC.

Fig. 1. Entering data into a field computer

Having a computer program for in field data entry for fish monitoring projects has increased our efficiency and productivity (Fig1.) Each year we capture about 150,000 - 200,000 fish (Fig. 2.). Many of these fish receive a passive integrated transponder (PIT) tag. Most of us no longer manually enter tag data (13 characters) for each fish, but use a scanner with a Bluetooth connection to a field computer to automatically record the PIT tag ID. This reduces transcription errors, and controls can be placed on data entry fields to minimize data entry mistakes. At the end of a monitoring trip data can be easily summarized for trip reports and more easily checked for QA/QC before importing into a database.

Fig. 2. Bluehead Sucker

To facilitate field data entry, a computer program called "Shoals" based on Visual Basic was developed by GCMRC about 10 years ago for use on field laptops and tablets. The developer of Shoals has been retired for over six years. The program is being used, but it has not been updated or modified for quite some time. We are concerned that this program will no longer be usable at some point in the future. All

fish monitoring and research projects rely on field computers for data entry. At some point we fear Shoals will no longer be supported by Windows, and we currently do not have a replacement for the program.

Solution overview

We are looking for a desktop applications/program to replace Shoals. This is a program for entering site data and specimen (fish) data. We would like a program that will connect via Bluetooth to PIT tag scanners. If a fish is recaptured with a PIT tag, the program provides information on the history of that fish (e.g. species, length, weight, river mile it was last caught at, etc.), and provides a warning if any of that information differs with the current information being entered.

The Shoals program is set up with a menu of project specific forms (Fig. 3). All projects have the same organizational structure but have fields specific to the project or sampling gear. For an electrofishing project there are fields such as volts, and amps, which are not relevant for hoop nets, and thus are not present in a hoop net project. All projects have a sample site menu with information on the sample site (e.g.: trip_id, location, river mile, date, time, gear type, sample type, etc.), and specimen data with information on the individual fish we capture such as species, length, weight, sex, PIT tag, etc. (Fig. 4). The program can then export the data with sample and specimen information linked (or separately).

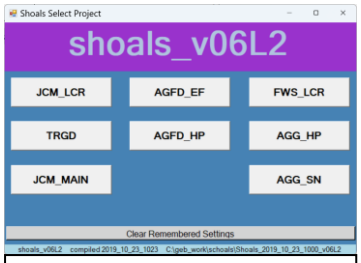

Fig. 3. Shoals project menu

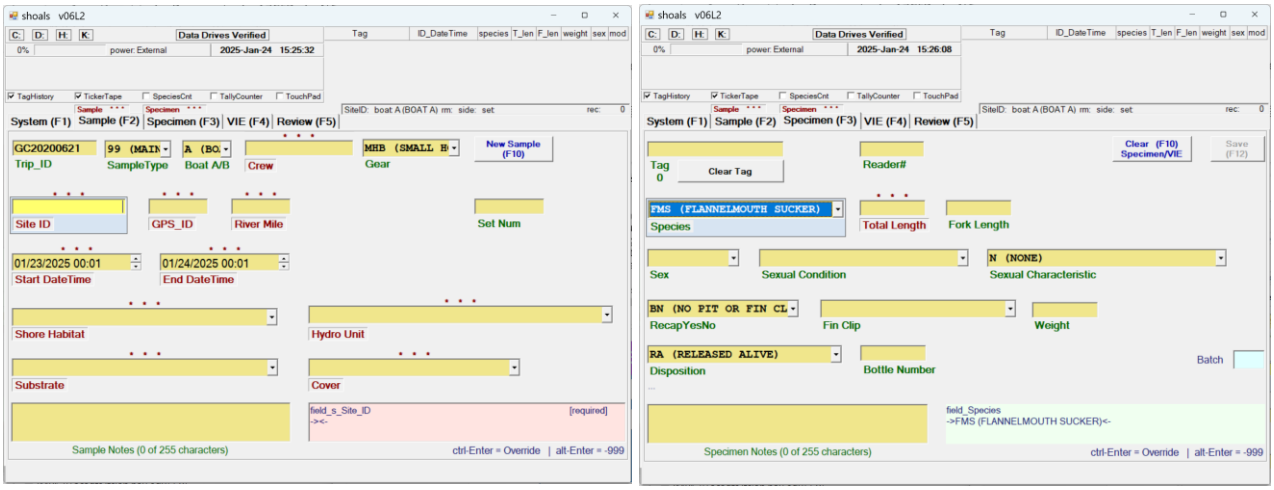

Figure 4. Main menu for A) sample and B) specimen information for an AZGFD hoop net monitoring project.

Key features

- Bluetooth connectivity with passive integrated transponder (PIT) tag scanners
- Recognize a (PIT) tag identified by the scanner and provide history on that tag

- Create a binary file from a tab delimited text file of PIT tag data for use in tag lookup
- Ability to link site data with specimen (fish) data
- Ability to be customized for various projects with relevant data fields
- Ability to add controls to data fields (e.g. control file)
- Ability to review and make corrections on data entries in the field
- Ability to backup (automatically) and sync data with external hard drives (usb thumb drives or sd cards)
- Ability to synchronize upload/backup data on the cloud as some projects now have Starlink access
- Ability to perform some simple summaries and graphics to use as a data QA/QC check in the field. For example, a summary of the number of fish captured by species, and plots of length vs weight by species.

Knowledge, skills, and expertise required for this project:

- Effective implementation of user-friendly and engaging GUI to make operation as easy and expedient as possible
- Bluetooth communication
- Data manipulation and database management

Equipment Requirements:

- There should be no equipment or software required other than a development platform and software/tools freely available online.
- A passive integrated transponder scanner (PIT) and some test PIT tags will be provided
- We will provide a copy of the Shoals program

Software and other Deliverables:

- A strong as-built report detailing the design and implementation of the product in a complete, clear and professional manner. This document should provide a strong basis for future development of the product.
- Complete professionally documented codebase, delivered both as a repository in GitHub, BitBucket, or some other version control repository; and as a physical archive on a USB drive.

Impact of a successful solution

The development of a program would help all biologists (AZGFD, NPS, USFWS, USGS) who conduct fish research and monitoring within the Grand Canyon. This program could also be used by other agencies, academics, and contractors that conduct monitoring programs anywhere, as there has been a recognized need for a similar program with Bluetooth capability for PIT tag entry.