Information System design in support of Albanian biodiversity conservation.

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Abstract

The conservation of biodiversity is one of the challenges of ecologists. The collection and monitoring of biodiversity knowledge is the first step in the conservation of biodiversity. Technological developments and their implementation in the field of biodiversity are thought to turn the WWW into a giant global information system on biodiversity. Biodiversity data in Albania are distributed. It would be very helpful for students and researchers to integrate these data as it would facilitate teaching and research. The aim of this paper is to model and implement the database for Albanian biodiversity knowledge in ODONATA species and to design and an information system that will facilitate access to biodiversity data. The system is implemented for ODONATA species and their habitats in Albania.

Keywords: Information System, Biodiversity Data Management, Biodiversity Conservation

1. Introduction

Existing knowledge about species, habitats, ecosystems and their trends in Albania are distributed. Actually, it is difficult to use this knowledge from students and scholars. Moreover, the collected data are in different formats and in some cases incomplete. Species, habitats and ecosystems provide irreplaceable services and resources that support human life. Society is becoming increasingly aware about the importance of conserving them, the importance of biodiversity conservation.

There are many international initiatives that have been undertaken to biodiversity conservation. In 2003, the Earth Observations Group was established. In 2004, the group agreed to create a Global Earth Observation System (GEOSS). One of GEOSS's main goals is to link existing systems and networks to the Earth Observation System achieve comprehensive, coordinated and sustainable observations of the Earth system [Cra, Goo, Ann, Cam, Gou, Kuh, Mar, Mas, Mag, Lia, Par 2008]. Biodiversity is one of the subordinates of Earth Observations infrastructure. To develop global biodiversity integration, GEO BON Group was created on Earth Observation Biodiversity Observation Network. This group aims to create a global network of local, national and international activities that they have created to record different species and ecosystems. GEO BON connects and supports these activities within a scientifically robust framework.

Maintaining all the knowledge on their species and habitats in our country would help in accessing data, monitoring biodiversity and as a result would help decision-making on actions to be taken to biodiversity conservation. It would be very helpful for students and researchers to integrate biodiversity data as it would facilitate teaching and research. The integration of the Albanian biodiversity data also supports the “Strategic Policies for the Protection of Biodiversity in Albania”

in its target objective: “Growing and dissemination of scientific knowledge on biodiversity and ecosystem services”.[1] The design and implementation of an information system for biodiversity data in Albania is presented in the following sections.

2. Related Works

Society day by day is becoming more aware of how species, habitats and ecosystems offer indispensable services and resources that keep human life. The conservation of these so-called "goods and services" requires quick access to as much data as possible in the space and the temporary distribution of species and their habitats within an environment. The most efficient way to provide this information is to keep in standardized online databases.

The field of Biodiversity Informatics was born when researchers began to exploit databases and the Internet as a tool to manage and publish data [Cos, Van, Ber, Bro06]. The early work to design a Global Plant Species Information System presented a vision for full interconnection and access to species knowledge through digital systems [Pan, Rus, Bis93]. This vison, which is still unfulfilled, presented a lot of challenges. A huge work is made in subsequent decades by researcher communities. Global organizations, like Global Biodiversity Information Facility (GBIF) and Ocean Biogeographic Information System (OBIS), collaborate with each other to manage the publication and integration of biodiversity data to the benefit of the research community.

The work is still ongoing. Different conferences are organized, like Global Biodiversity Informatics Conference in Copenhagen in 2012 with the objective to make an overview of the actual situation in biodiversity informatics and define the major areas where biodiversity informatics needed to advance[Hob, Apo, Arn, Bell, Can, Dub, Fie, Alo, Hard, Harr, Hei, Kri, Mat, Pag, Parr, Pri, Will12] and Biodiversity Informatics Horizons which aimed at offering recommendations for advancing the field. [Har, Rob13] GBIC2: the 2nd Global Biodiversity Informatics Conference was also organized on July 2018.[2] The vision for GBIC2 [3] was to 1) provide a framework for international parties to work together efficiently and 2) enable a global network of institutions and organizations to be able to take responsibility for components that fit together to create a fully interconnected whole.

3. Materials and Methods

The first step in biodiversity conservation is the storage and monitoring of biodiversity knowledge. An information system will be necessary to store Albanian biodiversity knowledge. The system will facilitate the integration of the Albanian biodiversity knowledge, with other data sources for biodiversity data all over the world. It will support not only Albanian researchers but also foreigner ones. The foreign researchers will get from the system, knowledge about Albanian biodiversity.

A prototype of the system is created with the knowledge gathered about ODONATA species and their habitats in Albania. Model View Controller software architecture is chosen for the system.

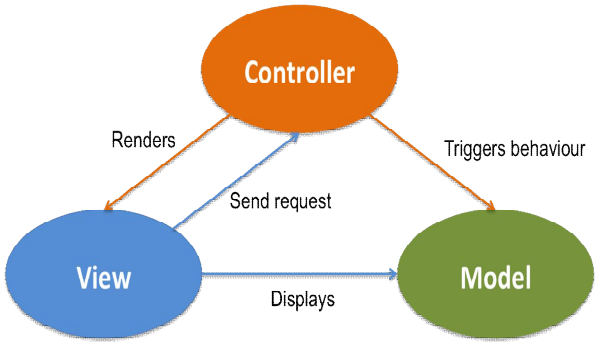

Figure 1: MVC Software Architecture

MVC, a software architecture that organizes the application into three parts according to their responsibilities: data, presentation, and control logic is an appropriate architecture for the system.

[1] Document Of Strategic Policies For Protection Of Biodiversity: https://www.cbd.int/doc/world/al/al-nbsap-v2-en.pdf

2 https://www.biodiversityinformatics.org/en/#

[3] https://www.biodiversityinformatics.org/en/background/

4. Results

Traditionally used for graphical user interface (GUI), MVC architecture has become known for designing web, desktop, and other applications.

Every section of the code being implemented has a goal, and those goals are different. A code section keeps application data; another section makes the app look beautiful and the last section controls application performance.

The MVC Architecture separates data and business logic from the display. Model represents data and rules to access and update this data.

View provides the rendering of the model's content. Controller translates the user-view interaction into actions that will be performed by the model.

4.1 Physical Architecture

Client Server technology, that enables easier communication between the client and the server, is used in the system. [Vas09] This technology consists of two main parts, server part (sever), and part of the user (client). Figure 2 shows the implementation of MVC in a Client Server setting for our system.

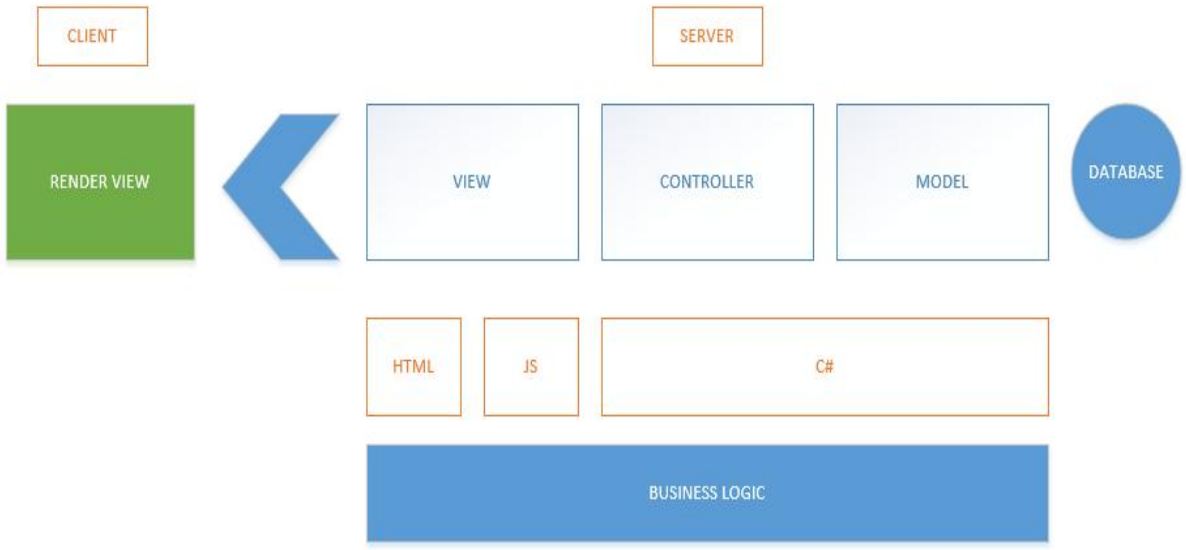

Figure 2: MVC implementation in Client Server Architecture

4.2 Requirements

The services the system is expected to provide are as following:

- Display of data for each species
- Geographic distribution of species
- Add, delete and update data to databases
- Collection of relevant information in a single Dashboard interface
- Information about recently collected species

Other services the system is expected to provide:

- Setup different User Roles
- User Creation
- Password Modification
- Being a website that has a clear and simple User Interface.
- Being a website that can be viewed on mobile devices.

4.3 Data Model

Data logic is implemented in the model of MVC software architecture. The main function of the system is the data management for the Albanian Biodiversity. A prototype of the system is created with the data for ODONATA species, for which we have the following hierarchy: Domain, Kingdom, Phylum, Class, Order, Suborder, Family and Genus.

Figure 3 shows the Entity Relationship diagram created for the prototype of the system.

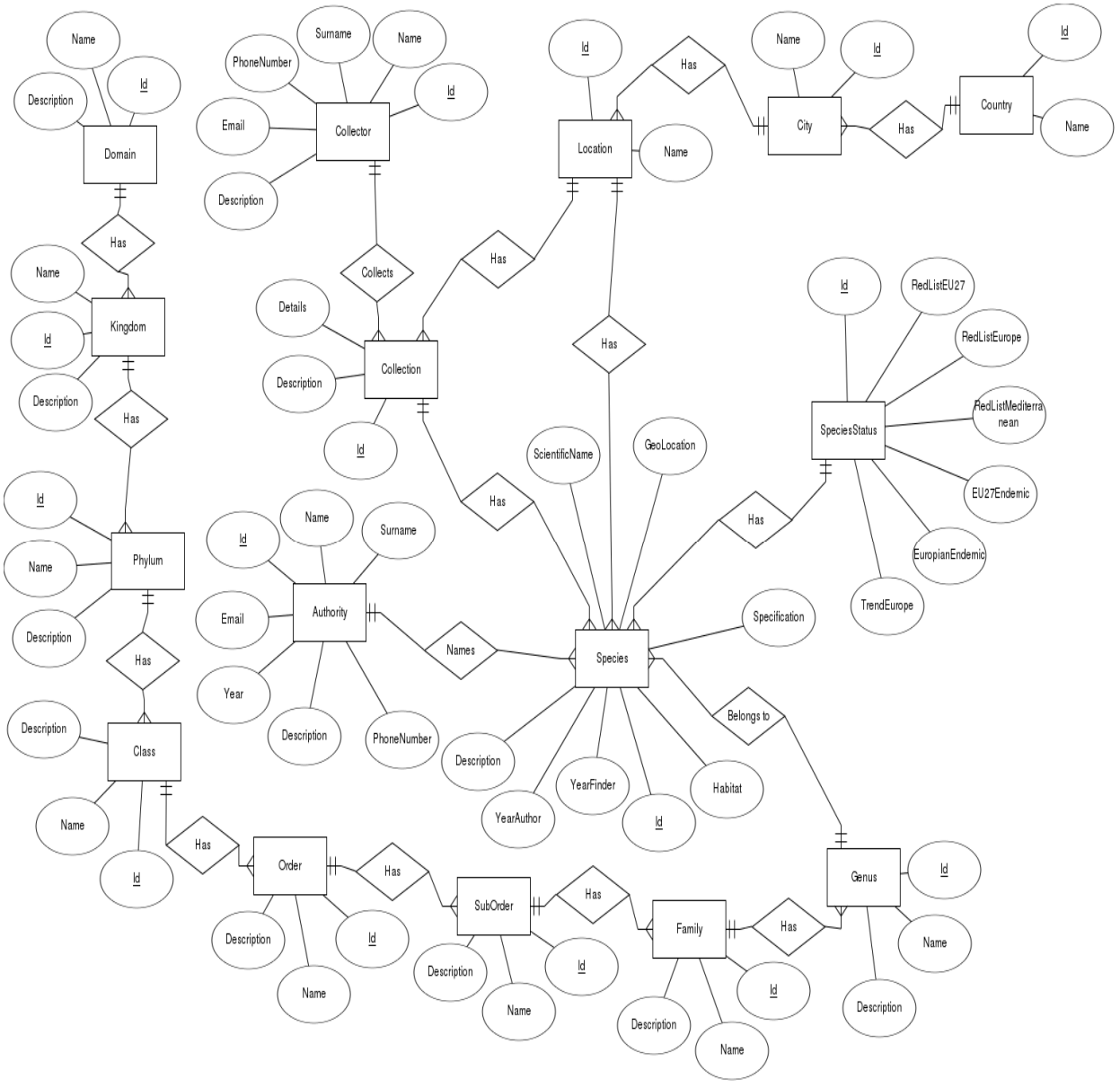

Figure 3: Entity-Relationship diagram

4.4 Controller module

The main interaction with the system is the storage data of data in database and the main operations are Create - Read - Update – Delete.

These actions are set it up as methods in the Controller module**.** The figure 4 shows all the classes that are set it up in the controller module.

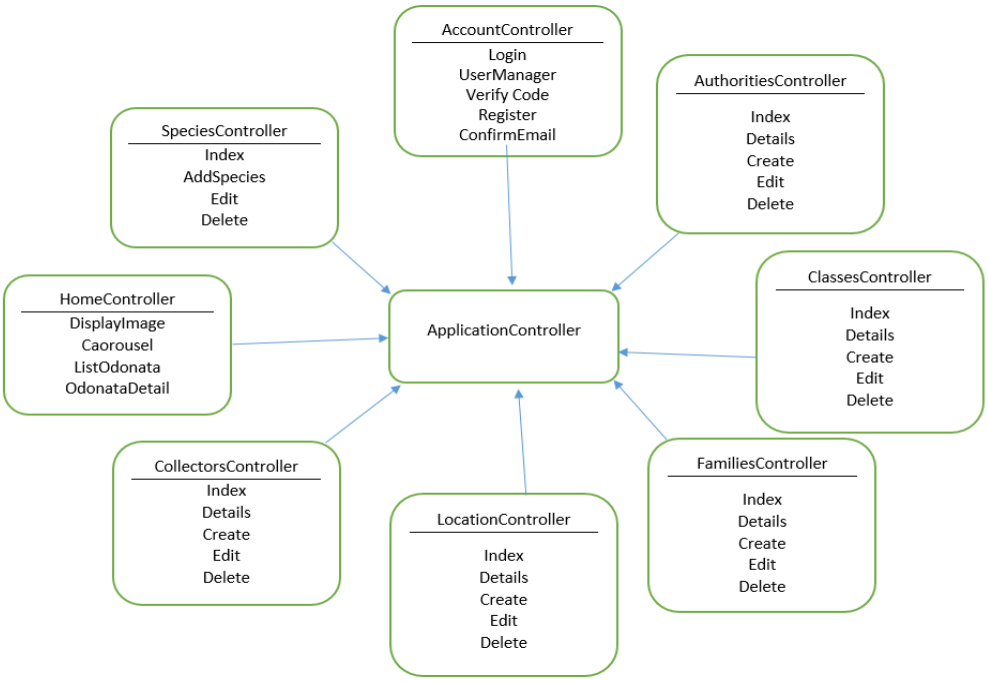

Figure 4: Controller Module.

4.5 View module

Views are taking care for the displays of the application, User Interfaces. Each controller class has its own view files.

Figure 5 shows a sample from view files of controller class Species.

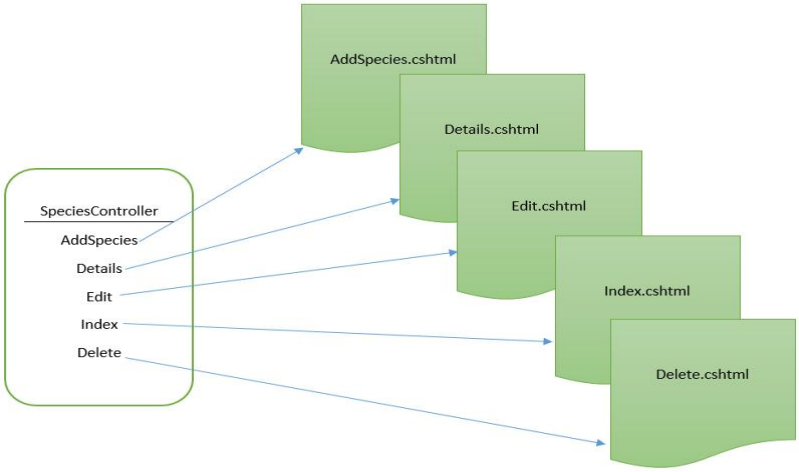

Figure 5: View Files of Species controller class.

4.6 User Requests

The three modules of this architecture cooperate with each other to handle user requests.

Figure 6 shows an example of handling user request: delete an entity

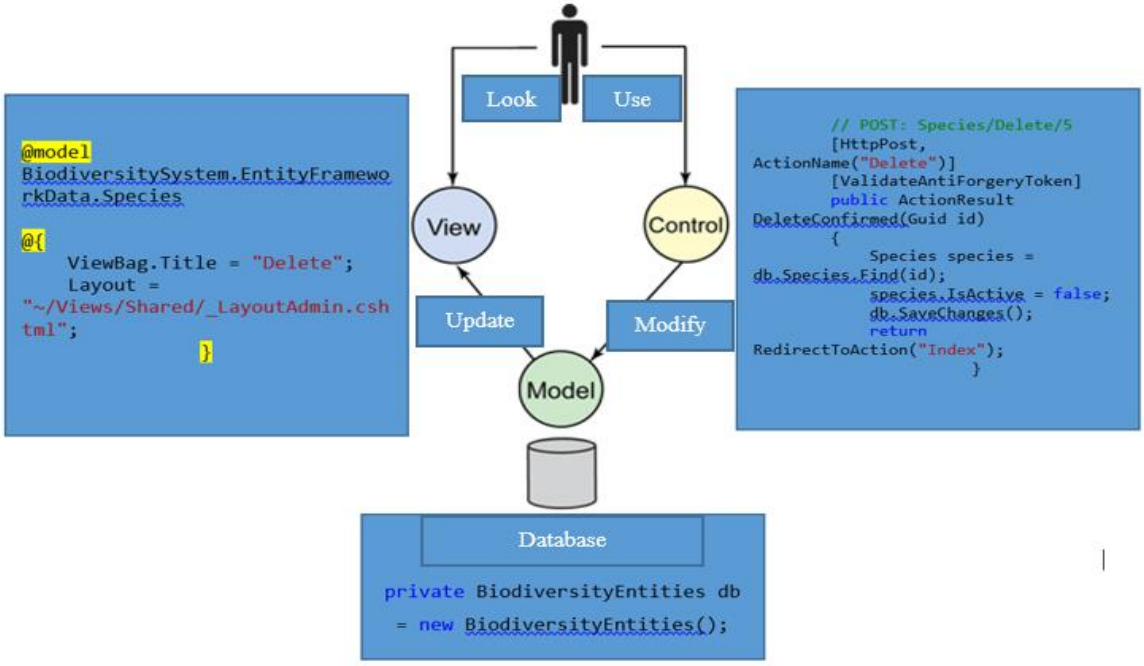

Figure 6: User Request: Delete an Entity

5. Conclusion

Biodiversity, the diversity of the living world determined by the number of different species in a given area, contributes to a healthy biosphere and provides direct and indirect benefits to people. Conserving biodiversity has economic, aesthetic and scientific value for people. The prototype, created to store and monitor the biodiversity knowledge that Albanian Biologists have about ODONATA could be expanded and used for all the data about Albanian biodiversity The designed system could help ecologists and researchers of flora and fauna in Albania to publish their data, support the "Strategic Policies for the Protection of Biodiversity in Albania" in its target objective: "Growing and dissemination of scientific knowledge on biodiversity and ecosystem services" and inform students, researchers and the interested community about the Albanian Biodiversity.

6. Future Work

The main task that this system has for the future is data expandability about new species and their habitats. The data source of the system could be integrated in a big data system with other sources of information from devices such as drones, sensors, cameras etc.

The application of Machine Learning algorithms will be needed to get useful information. This information

could be used to identify species in risk or to automatically detect what kind of species is it.

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