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MILANO 1863

Software Engineering Project
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Design Document

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1.Introduction

The aim of the design document is to guide the development and provide high level information on the structure of the software. This document describes a set of design characteristics required for the implementation of the web application.

In details this document contains a full overview of:

- Database's structure in terms of the tables utilized
- Software's structure, such as independent programs, template and python script

1.1 Purpose

The goal of this project is to develop a web-app for managing bike-sharing's service information.
Bike-sharing is a short-term bicycle rental service available in different urban locations characterized by bicycle transit.
The service is accessible through applied technology (smart cards and/or mobile phone). In particular, it offers 24h/7 service.
The development of this web application has been commissioned from Comune di Milano that will eventually release privileged permissions to obtain statistical information and other utilities. In the following a more precise description is provided.

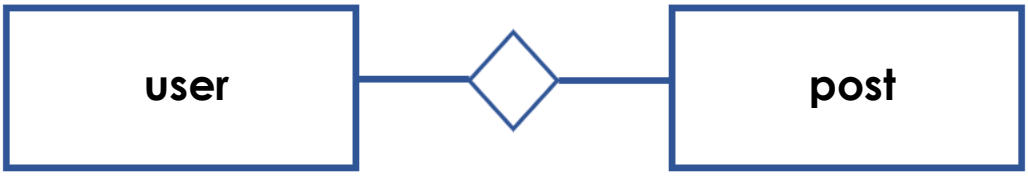
2. Structure Design

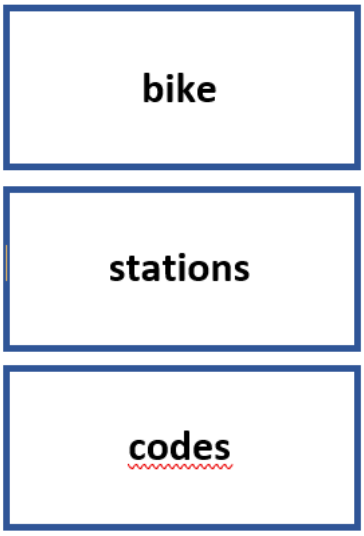
The structure of this web-application has been designed on two independent and distinct levels: a script in charge of creating the database and the Flask application.

2.2 Database Design

The design of database largely determines the usability and robustness of the system.
SQLAlchemy and **PostgreSQL** -open source object-relational database- has been chosen for managing, updating and accessing information.
Two main tables were generated following a specific structure, in particular the database schema is shown below:

Conceptual model





Physical model

User Table

CREATE TABLE User (
id INTEGER PRIMARY KEY,
username VARCHAR(20) UNIQUE NOT NULL,
email VARCHAR(120) UNIQUE NOT NULL,
password VARCHAR(60) NOT NULL
)

Post Table

CREATE TABLE Post (
id INTEGER PRIMARY KEY,
title VARCHAR(100) NOT NULL,
date_posted DATETIME NOT NULL,
content TEXT NOT NULL,
user_id INTEGER NOT NULL,
FOREIGN KEY (user_id) REFERENCES user (id)
)

Bike Table

CREATE TABLE bike (
time TEXT,
number of stations* DOUBLE,
)

*one column for each station (from 1 to 62).

Stations Table

CREATE TABLE stations (

id BIGINT PRIMARY KEY,

geom GU_POINT2D,

bike_sh VARCHAR(50),

indirizzo VARCHAR(50),

stalli BIGINT,

localiz VARCHAR(20),

lat DOUBLE,

lon DOUBLE,

)

Codes Table

CREATE TABLE codes (

PIN_codes TEXT NOT NULL,

)

2.2 Flask Application

The Flask application includes the template and Python part, both of them have their purpose, internal structure and, most important, they interact with each other.

2.2.1 Template

Dedicated templates were created depending on their function for the web-application.

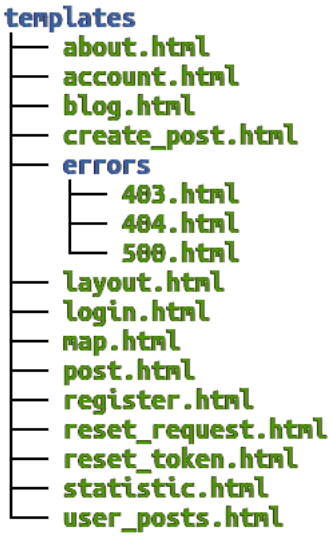


Figure 1.1: Tree structure of the templates

About

In this page users can find generic information about the service our web-app provides.

Account

Section in which the user -if registered and logged-in- can change the settings of his personal profile, such as profile picture, username and password.

Blog

Page available to every user in order to visualize already published posts.

Create_post

Section in which is possible to create and publish new posts or comments. It is available only if the user is already registered and logged-in.

Layout

This page is not addressable, but it only defines the main structure of all the templates that have been used. The navigation bar and the CSS or JavaScript libraries utilized are declared in this page.

Login

Registered users are redirected to this form in order to log-in with their credentials.

Map

Page dedicated only to the building of the GIS system in order to visualize and interact with geospatial data. We decided to use Leaflet's libraries to manage geospatial data, and a map allows the visualization and interaction with every docking station in the database. The map can be chosen by a cluster of three, the default one is the one built using OpenStreetMap.

Leaflet's plugins allowed us to build a geocoding and routing utility. A user can localize and see his position on the map and eventually ise the routing machine to navigate to a chosen docking station.

Post

Management of the posts of a user. Only the owner of a post can modify or delete it.

Register

Users are redirected to this form in oder to register themselves to the service, by providing their username, email, password and a PIN code provided by Comune di Milano.

Reset_request

Dedicated form for resetting the password.

Reset_token

Dedicated form for inserting a new password and confirming it.

Statistics

Page dedicated to the visualization and interaction of the general and specific statistic of each docking station.

User_posts

Page dedicated to the visualization of all the posts of one specific user

Errors:

- **403**
  In case of permission problem, it will be shown this kind of error

- **404**
  When the page doesn't exist, this page will be rendered
- **500**
  Generic error or problem of the application itself

2.2.2 Python

Inside the Flask web application different modules/ application packages have been distinguished, referring to: the users, the posts listed in the blog, the errors and the main pages of which the web app is composed of.
They are all placed inside the same directory in which a common constructor file ("__init__.py") is used for their management. Its role is to set up instance variables, specific for each module, to have the proper initial values when objects are created.
Each module is also provided with specific routes, used to create the association between the requested URL and the function that handles it.
The "main" module decorators refer to the web app pages: Home, About, Blog, Map.
The different "posts" decorators are set to give the user the possibility to create, update, delete their posts in the blog page.
The "users" decorators are defined to allow the user to register, login, logout, update credentials, reset the password.
The forms have been implemented using specific classes; a general form is defined to create new posts and forms to do registration, login, update of the account, reset the password are implemented for the user's interaction with the web app.
Finally, a "static" directory has been added within the above modules in order to better manage the pre-rendering of the templates of each page, that can be displayed to users before the JavaScript finishes loading.

The libraries used for the web app development are the following:

- **Flask version 1.0:**
  The Flask component is first of all imported from flask package in order to create the application instances needed.

- **WTForms version 2.1:**
  it's a form input as a handling and validation library for python applications which ties together the app framework, the database and templating engine to make validation workflow easier. It is not specific to flask.

- **Flask_wtf version 0.14.2:**
  It's a flask extension that specifically makes tying WTForms into flask.
  From it we also imported FlaskForm package in order to create python classes to be representative of our forms that are automatically converted in html forms within the templates.

- **SQLAlchemy version 1.2.7:**
  It's the Python SQL toolkit and object relational mapper (ORM). Once flask_SQLalchemy is installed it is imported in the flask application.

- **Flask-SQLAlchemy version 2.3.2:**

It's a flask extension that provides useful defaults to create and configure engine, connection and session to work with the flask application.
It was used in the bike-sharing web app to create a database where user's credentials are stored in order to register and login the web app and to let them create and store in the database their posts on the blog.

- **Flask-Bcrypt version 0.7.1:**
  It's a flask extension useful to hash passwords so that they can't be retrieved from database from external people. A hashed password can be created both in bytes or as a string.

- **Bcrypt version 3.1.4:**
  It's the flask_bcrypt library used to create an instance for this class. It allows to generate passwords each time with a different hash (even when using the same password), so that if someone steals it from the database, he/she wouldn't be able to use a hash table to crack it.

- **Flask-Login version 0.4.1:**
  It's a Flask extension used to put a validation check to verify if the new account is already existing in the database created for user's credentials.

In the paragraph below, the description of the app's structure will be defined (when the extension of the file is not expressed, we are considering the name of the foder).

- flaskblog
  - errors
    - __init__.py
      empty files initialized because we create the application packages with the blueprint.
    - handlers.py
      management of the three kinds of errors, such as 404, 403 and 500. We define the template to render when this kind of error occurs.
  - main
    - __init__.py
      empty files initialized because we create the application packages with the blueprint.
    - routes.py
      definition of the main and most general routes used for the application: root, about, blog, map and statistics. Here, it is also managed some setting of bokeh, such as the port in which it has to run.
  - posts
    - __init__.py
      empty files initialized because we create the application packages with the blueprint.
    - forms.py
      definition of the format of a new post. They have a title, a content and a submit button. Some validators are applied to each field.
    - routes.py
      initialization of all the routes connected to the management of posts (deleting, updating, creation and visualization of a single post).

- static
  - GeoJson
    Json and GeoJson file used for the map.
  - awesome-numbered-marker
    library who provides tools for managing the marker of a leaflet map.
  - css
    the css of the application.
  - js
    the JavaScript of the application.
  - leaflet-routing-machine
    library for the navigation plugin of the map.
  - profile_pics
    folder in which the default and user's customized pictures are stored.
- templates
  (see paragraph 2.2.1)
- users
  - __init__.py
    empty files initialized because we create the application packages with the blueprint.
  - forms.py
    creation and definition of the form for registration, login, updating account and resetting the password.
  - routes.py
    initialization of all the routes connected to users, such as register, login, logout, account, reset password, user's post, reset password-token.
  - utils.py
    definition of some function useful for managing user's activity (save profile picture and parameters for enable the resetting of the password).
- __init__.py
  creation of the local database and the app. Definition of the blueprinting application packages.
- config.py
  setting of some parameters used in all the application
- connection.py
  connection to PostgreSQL.
- models.py
  Building the user and post table for the database.
- multi_plot.py
  dedicated page for the statistics' implementation.
- site.db
  local database of the application with stored all the user's credentials and posts.

- run.py
  file for running the entire application.

4. Effort Spent

Marina Ranghetti: RASD, DD and web application (website and map)
Marta Rossi: RASD, DD and web application (website and code comments)
Lorenzo Amici: RASD, DD, Testing document, statistics and their implementation
Yinyao Zhang: DD, testing of use cases and code comments