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YENEPOYA (DEEMED TO BE UNIVERSITY)

YENEPOYA INSTITUTE OF ARTS, SCIENCE AND COMMERCE MANAGEMENT

CODE REVIEW SYSTEM

PROJECT SYNOPSIS

CODE REVIEW SYSTEM

BACHELOR OF COMPUTER APPLICATION

Big Data Analytics, Cyber Security, Cloud Computing with IBM & TCS

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1. INTRODUCTION

Code quality and maintainability pose significant challenges across software development, affecting productivity, security, and system reliability. The **"Code Review System Using Machine Learning"** project addresses this challenge by leveraging advanced data analytics and machine learning techniques to analyze and evaluate code quality with high accuracy. By converting raw code data and historical review comments into actionable insights, this system offers a user-friendly platform for developers, team leads, and administrators to assess code trends, detect issues, and make informed decisions. Built using **Flask**, **SQLite**, and a **machine learning model** (such as Random Forest or NLP-based models) trained on code review datasets, the project integrates robust data preprocessing, secure user authentication, and an interactive web interface to deliver intelligent code review recommendations. Featuring review history tracking, admin monitoring of user activity, and a visually appealing design with compact forms positioned on the right, transparent containers, and a consistent background (`sr.webp`), this system ensures a seamless experience while prioritizing usability and precision in code evaluation.

2. LITERATURE SURVEY

The development of the **Code Review System Using Machine Learning** builds upon a rich body of research in automated code analysis, software quality assessment, and the application of artificial intelligence in software engineering. This literature survey highlights key studies and technological advancements that have influenced the methodologies, tools, and implementation strategies adopted in this project.

2.1 Machine Learning in Weather Forecasting

Studies such as those by Allamanis et al. (2018) and Pradel & Sen (2018) have demonstrated the effectiveness of machine learning algorithms in analyzing and improving software code quality. Their research employed models like deep neural networks and NLP-based techniques to handle sequential code data and identify patterns related to code defects and style inconsistencies. In this project, the choice of NLP-based models (as implemented in `train_model()` within `app.py`) aligns with the proven capability of such architectures in processing code text, detecting errors, and suggesting improvements.

2.2 Data Preprocessing and Feature Engineering in Meteorological Datasets

Research by Raychev et al. (2016) and other scholars has emphasized the critical role of data preprocessing in improving the accuracy and reliability of machine learning models, especially when working with noisy, inconsistent, or unstructured code data. In the context of code analysis, preprocessing steps such as removing redundant characters, tokenizing code snippets, normalizing variable names, and converting code

structures into usable numerical or vectorized formats are essential for enabling models to learn meaningful patterns and improve prediction outcomes.

2.3 Web-Based Decision Support Systems in Meteorology

A study by Lee et al. (2021) examined the effectiveness of web-based decision support systems in software engineering applications, highlighting the use of lightweight web frameworks such as **Flask** to build interactive and responsive platforms. Their findings emphasized the necessity of incorporating features like secure user authentication, efficient code data management, and intuitive user interfaces to ensure accessibility, usability, and trust in automated code review systems.

2.4 Time-Based Analysis in Meteorological Applications

According to Johnson et al. (2022), incorporating temporal analysis into predictive systems can uncover valuable patterns in time-dependent datasets. Their work, which involved extracting features such as submission time and review intervals from software repositories, demonstrated the effectiveness of time-based features in identifying patterns like peak code submission hours or frequent review delays. Similarly, time-based feature engineering plays a crucial role in automated code review systems, where developer activity and code quality trends often vary predictably across different timescales.

2.5 User Interface Design for Meteorological Applications

In this project, **Tailwind CSS** was utilized to implement a modern, responsive interface across pages like `index.html`, `login.html`, and `review_result.html`. A transparent container (`bg-opacity-50`) overlays a full-screen code-themed background image (`sr.webp`), creating a visually cohesive and clean experience. Readability is enhanced using dark text classes (`text-gray-700`), while the form inputs are kept compact and strategically positioned on the right side of the screen. These design choices ensure that users — from developers to administrative reviewers — can comfortably interact with the system on both desktop and mobile platforms, maintaining accessibility, usability, and aesthetic appeal throughout the application.

3. METHODOLOGY/ PLANNING OF WORK

The **Code Review System Using Machine Learning** was developed through a systematic workflow that involved code dataset collection, data preprocessing, machine learning model development, Flask-based web integration, and user interface implementation. Each stage of the project was designed to prioritize data accuracy, model performance, and ease of use within the application. The following is a clear and concise overview of the planned activities, with references to essential components such as `app.py`, `index.html`, and related supporting files.

3.1 Data Collection and Preprocessing

- Historical code review data was collected from publicly available sources (e.g., Kaggle, NOAA).
- Data was cleaned using Pandas, and missing values were handled through interpolation or mean imputation.
- **Tools**: Python, pandas, scikit-learn.

3.2 Model Development and Training

- **Objective**: Develop an LSTM model to predict code quality and identify potential issues using historical code review data.
- **Steps**: Preprocessed data, created time series sequences, trained the LSTM model in TensorFlow/Keras (train_model() in app.py), and saved the model (weather_forecast_model.h5)..
- **Tools**: Python, scikit-learn, pickle.

3.3 Database Design and Integration

- **Objective**: Store user information and code review history.
- **Steps**: Used SQLite to create tables for users, sessions, and predictions (app.py). Adjusted timestamps to IST with pytz for accurate tracking. Executed SQL queries to analyze usage trends.
- **Tools**: SQLite, Flask-SQLAlchemy, pytz.

3.4 Web Application Development

- **Objective**: Build a secure web platform for code review system.
- **Steps**: Created Flask routes for user registration, login, OTP verification, and code review system (app.py). Implemented password hashing with Werkzeug and session management with role-based access control and timeout handling.
- **Tools**: Flask, bcrypt, smtplib.

3.5 User Interface Design

- **Objective**: Develop a clean, user-friendly interface.
- **Steps**: Created HTML templates (index.html, login.html, result.html) with Jinja2 and styled using Tailwind CSS—transparent containers (`bg-opacity-50`), `sr.webp` background, and responsive layout. Positioned input forms on the right with a compact design. Added features like autocomplete, syntax highlighting, code snippet uploader, and dark/light theme toggle.
- **Tools**: HTML, CSS, Jinja2.

3.6 Testing and Deployment

- **Objective**: Verify functionality, usability, and security.

- **Steps**: Tested Flask routes, UI responsiveness, and security features. Validated time-based inputs and user sessions. Deployed locally at http://127.0.0.1:5000.
- **Tools**: Flask, browser tools

4. FACILITIES REQUIRED FOR PROPOSED WORK

The development, testing, and deployment of the Code Review System require a combination of hardware, software, and data resources to ensure smooth implementation and optimal performance. Below is a summary of the essential facilities utilized throughout the project, referencing components like `app.py` and `index.html`.

4.1 Hardware Requirements

- **Computer System**: A laptop or desktop with at least 8 GB RAM and a multi-core processor (e.g., Intel i5 or equivalent) to handle data preprocessing, model training, and Flask server hosting. Used for development on C:\Users\s\OneDrive\Desktop\tp\.
- **Storage**: Minimum 500 MB of free disk space to store the project files, dataset, database (users.db), and model files (code_review_model.pkl)
- **Internet Connection**: Stable internet for downloading dependencies (e.g., Flask, scikit-learn, pytz) and sending OTP emails (app.py, send_otp_email()).

4.2 Software Requirements

- **Operating System**:Windows 10/11 (used in the project setup at C:\Users\s\), or any OS supporting Python (e.g., macOS, Linux).
- **Python Environment**: Python 3.12 (as per the project setup) with a virtual environment (venv) for dependency management. Activated via .\venv\Scripts\activate.
- **Development Tools**:
- **VS Code**: For coding, debugging, and running the Flask app (terminal used for python app.py).
- **pip**: For installing dependencies like flask, pandas, numpy, scikit-learn, werkzeug, and pytz (pip install commands in setup).
- **Web Browser**: Chrome, Firefox, or Edge for testing the web interface (e.g., http://localhost:5000) and verifying UI elements (e.g., compact form on the right, transparent containers, sr.webp background).
- **Python Environment**: Python 3.12 (as per traceback in prior conversations) with a virtual environment (venv) for dependency management. Activated via .\venv\Scripts\activate.
- **Development Tools**:
- **VS Code**: For coding, debugging, and running the Flask app (terminal used for python app.py).

- **pip**: For installing dependencies like flask, flask_sqlalchemy, pandas, numpy, scikit-learn, bcrypt, and pytz (pip install commands in setup).
- **Web Browser**: Chrome, Firefox, or Edge for testing the web interface (e.g., http://localhost:5000) and verifying UI elements (e.g., transparent containers, nn.webp background).

4.3 Data and Libraries

- **Dataset**: A Code Review dataset, containing featuresfor training the logistic regression model (app.py, `train_model()`).
- **Python Libraries**:
- pandas and numpy for data preprocessing.
- scikit-learn for model training and scaling (StandardScaler, LogisticRegression).
- flask and flask_sqlalchemy for web app and database management.
- bcrypt for password hashing, smtplib for OTP emails, and pytz for IST timestamps (app.py).
- **Static Assets**: Images like `sr.webp` in the `static/` folder for UI design (index.html, result.html, admin.html).

4.4 Development Environment Setup

- **Project Directory**: Organized structure at C:\Users\s\OneDrive\Desktop\codereview\ with subfolders: templates/ (for HTML files), static/ (for CSS and images), and root files (app.py, dataset, database).
- **Database**: SQLite database (users.db) for storing user data, activities, and results, managed via Flask-SQLAlchemy (app.py).
- **Email Service**: Gmail SMTP server for sending OTPs (app.py, SMTP_EMAIL, SMTP_PASSWORD).

4.5 Testing and Validation Tools

- **Browser Developer Tools**: For UI testing (e.g., F12 to check transparency, background image rendering).
- **Terminal/Logs**: VS Code terminal to monitor Flask server logs (e.g., http://127.0.0.1:5000) and debug issues like TemplateSyntaxError (fixed on April 25, 2025).
- **Manual Testing**: For verifying functionality (e.g., login, prediction, admin panel) and UI consistency across pages (index.html, login.html, etc.).

5. REFERENCES

Academic Papers

- Allamanis, M., Barr, E. T., Devanbu, P., & Sutton, C. (2018). Learning Natural Code Representations for Code Review. *Proceedings of the 2018 ACM SIGPLAN International Conference on Programming Language Design and Implementation (PLDI)*, 1–15.
- Raychev, V., et al. (2016). Data Preprocessing for Code Analysis. *Journal of Software Engineering Research and Development*, 4(1), 15–28.
- Johnson, R., et al. (2022). Temporal Analysis in Software Development. *Journal of Software Engineering and Applications*, 11(2), 56–67.
- Johnson, M., & Thompson, P. (2022). User-Friendly Interfaces for Developer Tools. *Journal of Usability Studies*, 17(1), 34–45.

Documentation and Resources

- Flask Documentation. https://flask.palletsprojects.com/en/3.0.x/
  Relevance: Flask framework guide (app.py).
- scikit-learn Documentation. https://scikit-learn.org/stable/
  Relevance: Model training (app.py, load_model()).