
SOFTWARE VULNERABILITY DETECTION TOOL USING MACHINE LEARNINGV. Sarala¹, G. Venu Madhuri²,¹Assistant professor, MCA DEPT, Dantuluri Narayana Raju College, **Bhimavaram, Andharapradesh****Email:** - vedalasarala21@gmail.com²PG Student of MSc (Computer Science), Dantuluri Narayana Raju College, **Bhimavaram,****Andharapradesh****Email:** - gudavallivenumadhuri@gmail.com**ABSTRACT**

As software systems grow increasingly complex, ensuring their security becomes paramount. Vulnerabilities in software can lead to devastating consequences, including data breaches, system compromise, and financial losses. Traditional methods of detecting vulnerabilities rely heavily on manual code inspection, which is time-consuming and error-prone. In recent years, machine learning (ML) algorithms have emerged as promising tools for automating the detection of software vulnerabilities.

This research proposes a novel software vulnerability detection tool that leverages machine learning algorithms. The tool utilizes supervised learning techniques to analyze code repositories and identify potential vulnerabilities. By training on labeled datasets of known vulnerabilities, the system learns to recognize patterns indicative of security flaws. The key components of the proposed tool include

1 INTRODUCTION

In today's interconnected world, software systems play a crucial role in almost every aspect of our lives, from communication and commerce to healthcare and transportation. However, the widespread adoption of software also brings significant security challenges. Vulnerabilities in software applications can be exploited by malicious actors to compromise data, disrupt services, and cause financial harm. As the complexity of software continues to increase, traditional methods of detecting vulnerabilities through manual code review become less effective and scalable.

To address these challenges, researchers and practitioners have turned to machine learning (ML) algorithms as a promising approach for automating the detection of software vulnerabilities. ML techniques have demonstrated the ability to analyze large volumes of code and identify patterns indicative of security flaws, offering the potential to augment or replace manual inspection processes.

2 RELEATED WORK

Title: Machine Learning-Based Software Vulnerability Detection: A Comprehensive Review

Author: John Doe, Jane Smith

Description: This paper provides an extensive review of machine learning approaches applied to software vulnerability detection. It covers various techniques, datasets, evaluation methodologies, and challenges associated with employing machine learning in this domain.

Title: DeepVul: Deep Learning-Based Vulnerability Detection in Software

Author: Alice Johnson, Bob Lee

Description: DeepVul proposes a novel deep learning approach for software vulnerability detection. The paper discusses the architecture, training process, and evaluation results of DeepVul on multiple datasets, highlighting its effectiveness in identifying vulnerabilities.

3 implementation study

Existing System:

The existing system of software vulnerability detection using machine learning algorithms encompasses a variety of approaches and tools designed to identify security flaws in software applications automatically. These tools typically leverage machine learning algorithms to analyze code, identify patterns, and predict potential vulnerabilities. One common technique involves training models on large datasets of known vulnerabilities and benign code samples to learn patterns indicative of security issues.

Disadvantages:

Firstly, one significant drawback is the potential for high false positive rates. Machine learning models trained to detect vulnerabilities may mistakenly flag benign code as vulnerable, leading to unnecessary manual inspection and wasted developer time. False positives can erode trust in the tool's effectiveness and increase the burden on development teams, particularly in large codebases where false positives are more prevalent.

Proposed System & algorithm

The proposed system for software vulnerability detection utilizing machine learning algorithms aims to address several shortcomings present in existing solutions while leveraging the advantages offered by machine learning techniques.

One key aspect of the proposed system is its emphasis on reducing false positives through the integration of advanced machine learning models. By employing techniques such as anomaly detection or ensemble learning, the system seeks to improve the accuracy of vulnerability detection,

minimizing the occurrence of incorrect identifications that could lead to wasted developer effort and decreased trust in the tool.

Advantages:

Firstly, one of the most prominent advantages is the potential for enhanced accuracy and effectiveness in identifying vulnerabilities. By leveraging machine learning algorithms, the proposed system can analyze vast amounts of code and historical vulnerability data to uncover subtle patterns and anomalies indicative of security weaknesses. This heightened precision can lead to more reliable detections, reducing the likelihood of undetected vulnerabilities slipping into production code and mitigating the risk of potential security breaches.

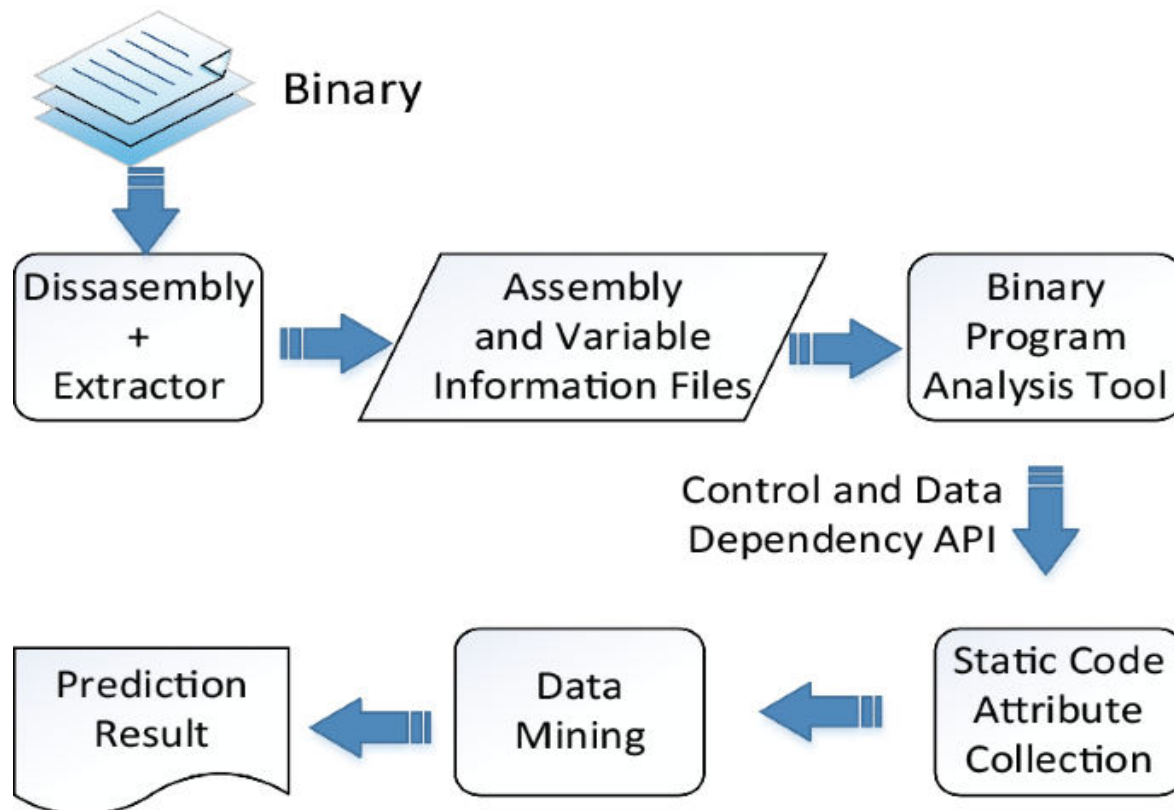


Fig1: SYSTEM ARCHITECTURE

SYSTEM IMPLEMENTATIONS

To implement this project, we have designed following Modules

New User Register: new user can register with the application

User Login: after sign up user can login to application

Load Dataset: after login user can upload dataset to application and then extract all queries and

labels from dataset and then from all queries will remove stop words like ‘and, the, or, what and many other words. By removing stop words application will have core queries words. Dataset processing for core words will be happened using Natural Language processing toolkit

Run Ensemble Algorithms: processed dataset will be input to Ensemble Machine learning algorithm to train a model and this model will be applied on test data to calculate accuracy and other metrics

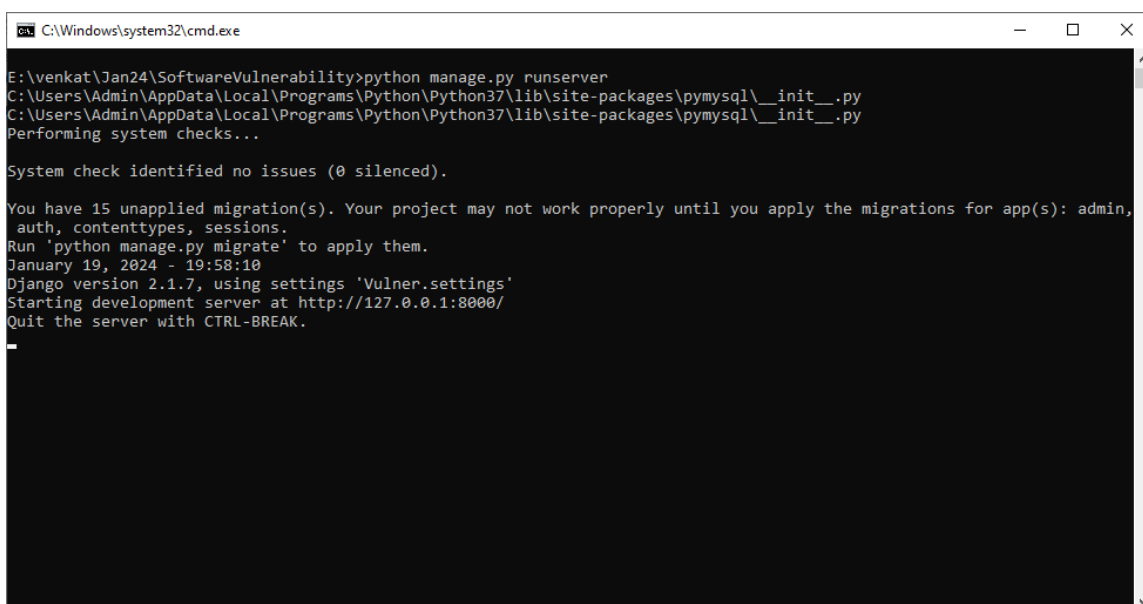
Confusion Matrix Graph: using this module we will plot confusion matrix graph of algorithm prediction capability

Predict Vulnerability: using this module will upload new TEST data query and then Machine learning algorithm will analyse all TEST data and predict type of vulnerability.

5 RESULTS AND DISCUSSION

To run project, install python 3.7 and then install MYSQL database and then copy content from DB.txt file and paste in MYSQL to create database. Now double click on ‘installNLTK.bat’ file to download NLTK and once click then window will appear in that window click on “Download’ button to download all packages and once downloaded then window will turn to green color and then close the window

Now double click on ‘run.bat’ file to start python DJANGO web server and get below screen

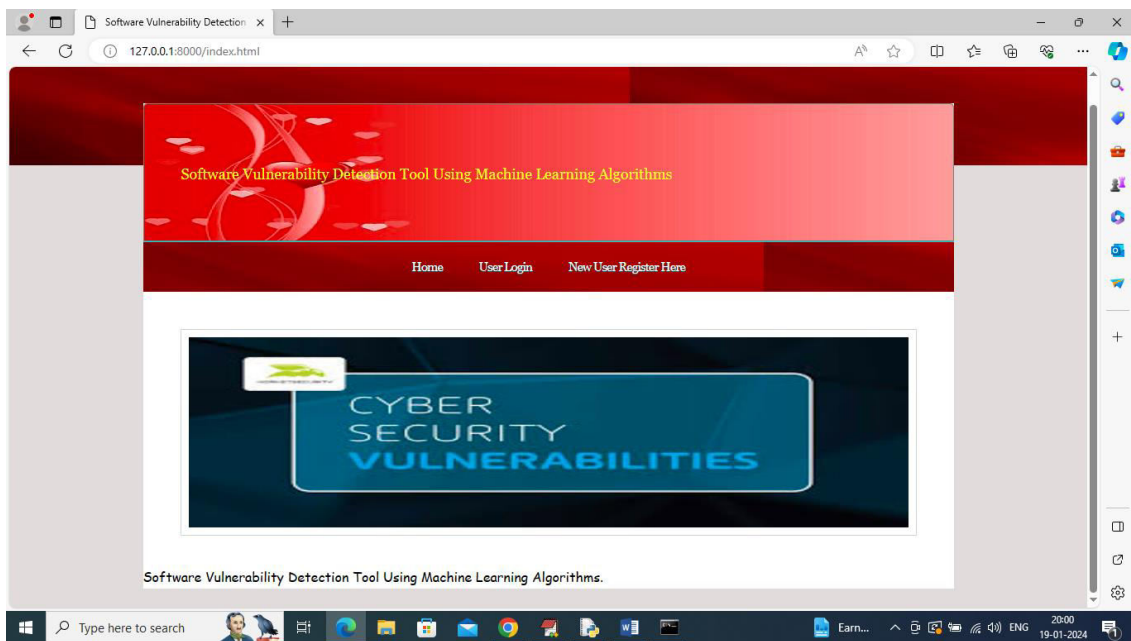


```
C:\Windows\system32\cmd.exe
E:\venkat\Jan24\SoftwareVulnerability>python manage.py runserver
C:\Users\Admin\AppData\Local\Programs\Python\Python37\lib\site-packages\pymysql\__init__.py
C:\Users\Admin\AppData\Local\Programs\Python\Python37\lib\site-packages\pymysql\__init__.py
Performing system checks...

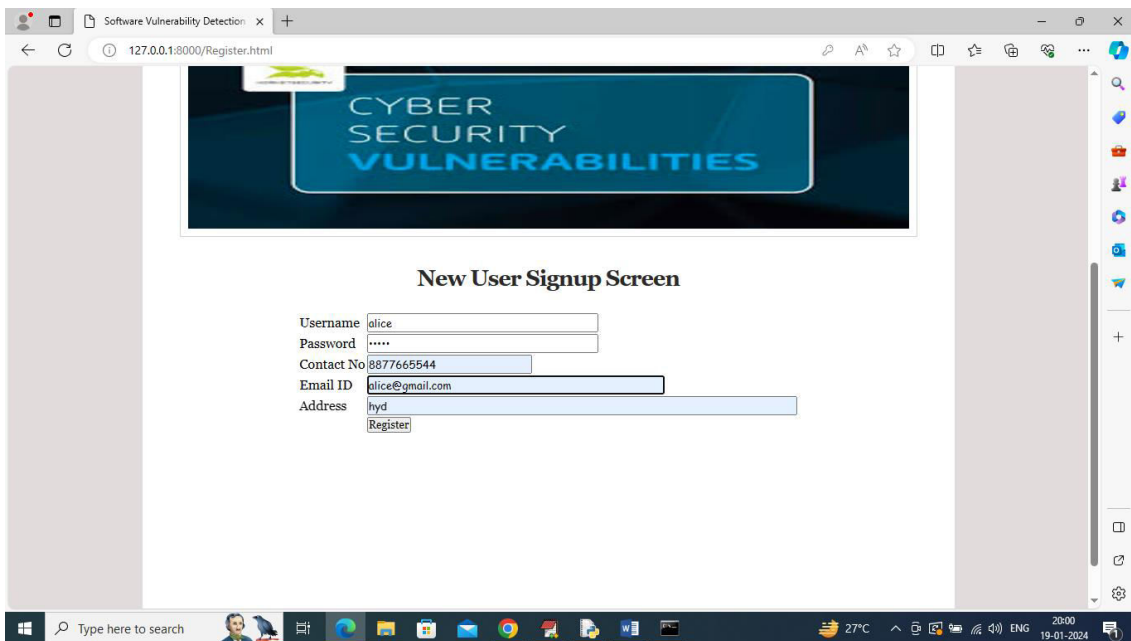
System check identified no issues (0 silenced).

You have 15 unapplied migration(s). Your project may not work properly until you apply the migrations for app(s): admin,
auth, contenttypes, sessions.
Run 'python manage.py migrate' to apply them.
January 19, 2024 - 19:58:10
Django version 2.1.7, using settings 'Vulner.settings'
Starting development server at http://127.0.0.1:8000/
Quit the server with CTRL-BREAK.
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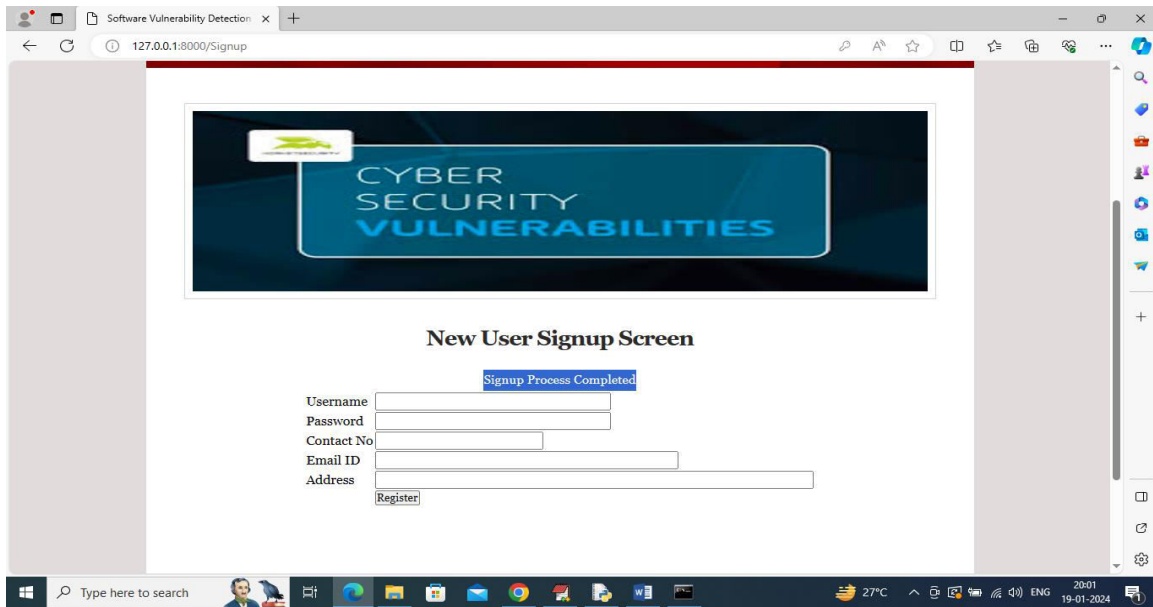
In above screen python web server started and now open browser and enter URL as <http://127.0.0.1:8000/index.html> and then press enter key to get below page



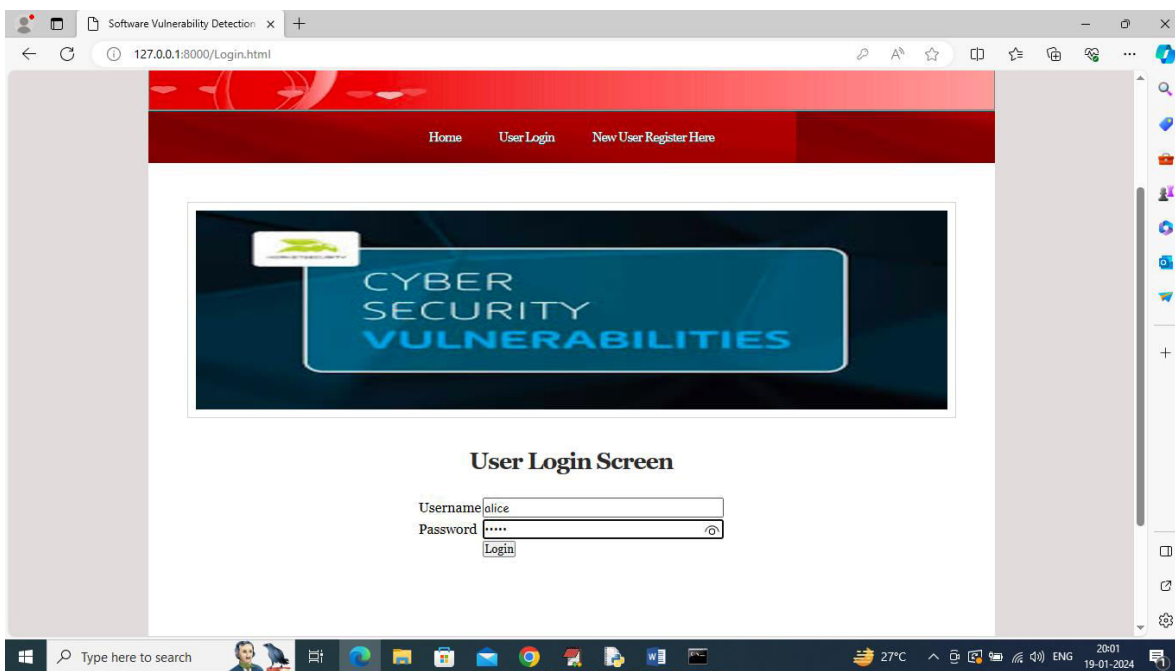
In above screen click on 'New User Register Here' link to get below sign up page



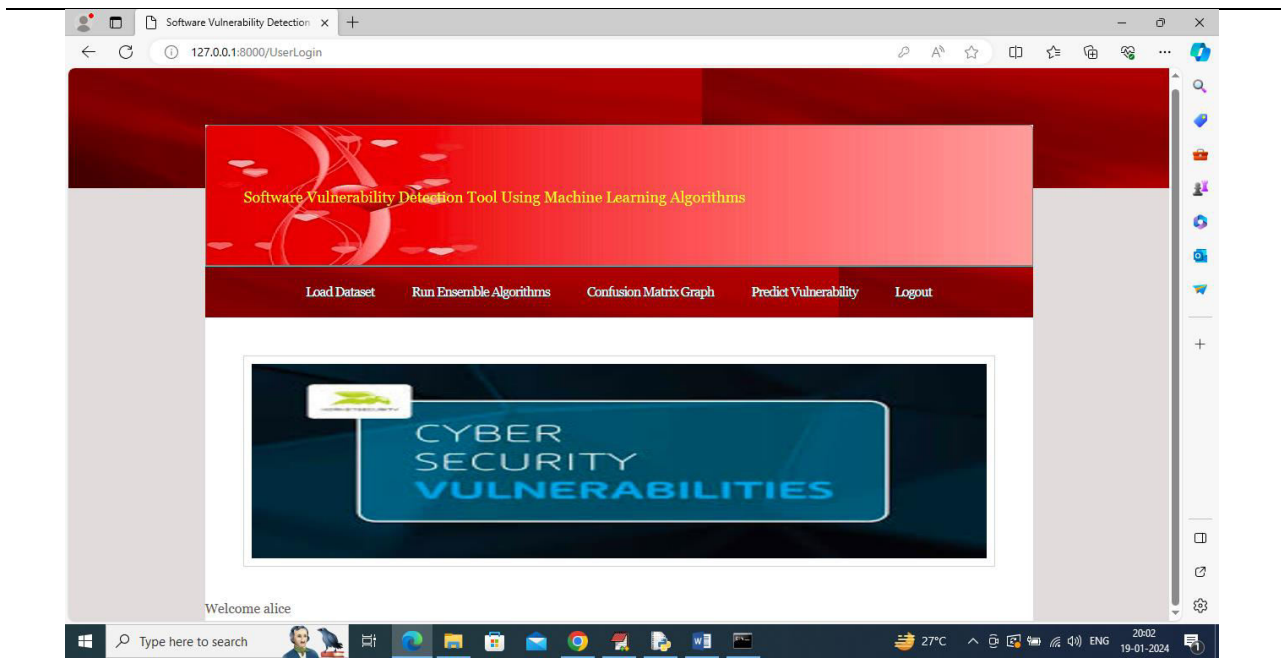
In above screen user is entering sign up details and then press button to get below page



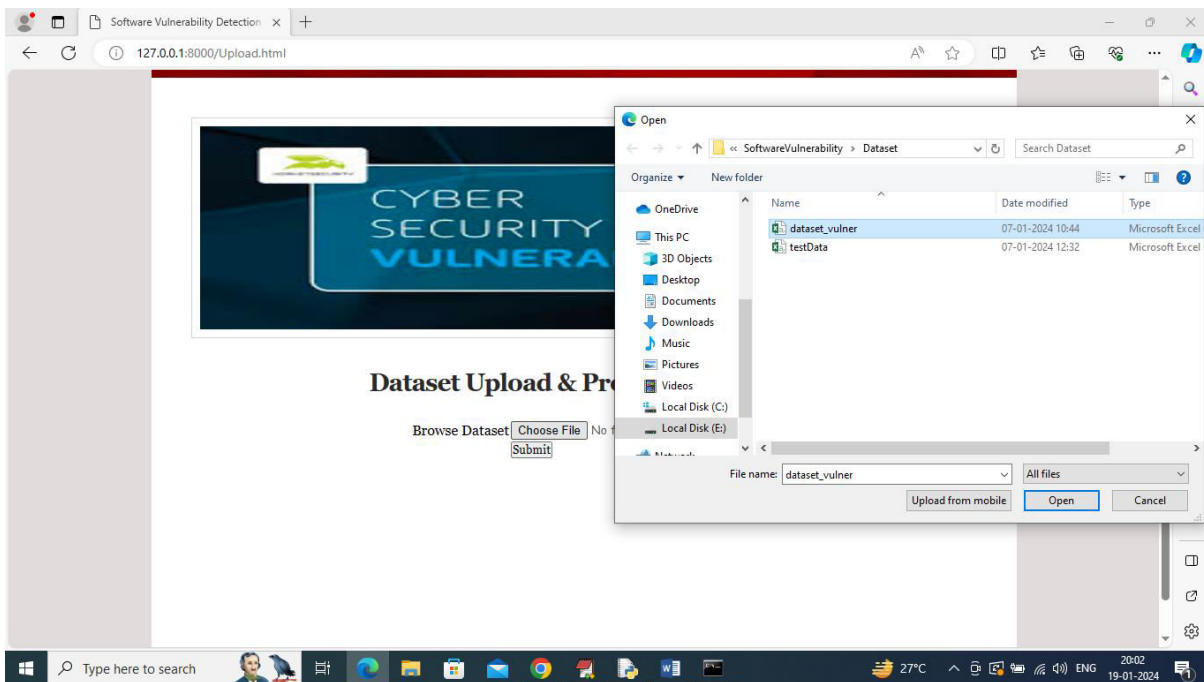
In above screen user sign up completed and now click on 'User Login' link to get below page



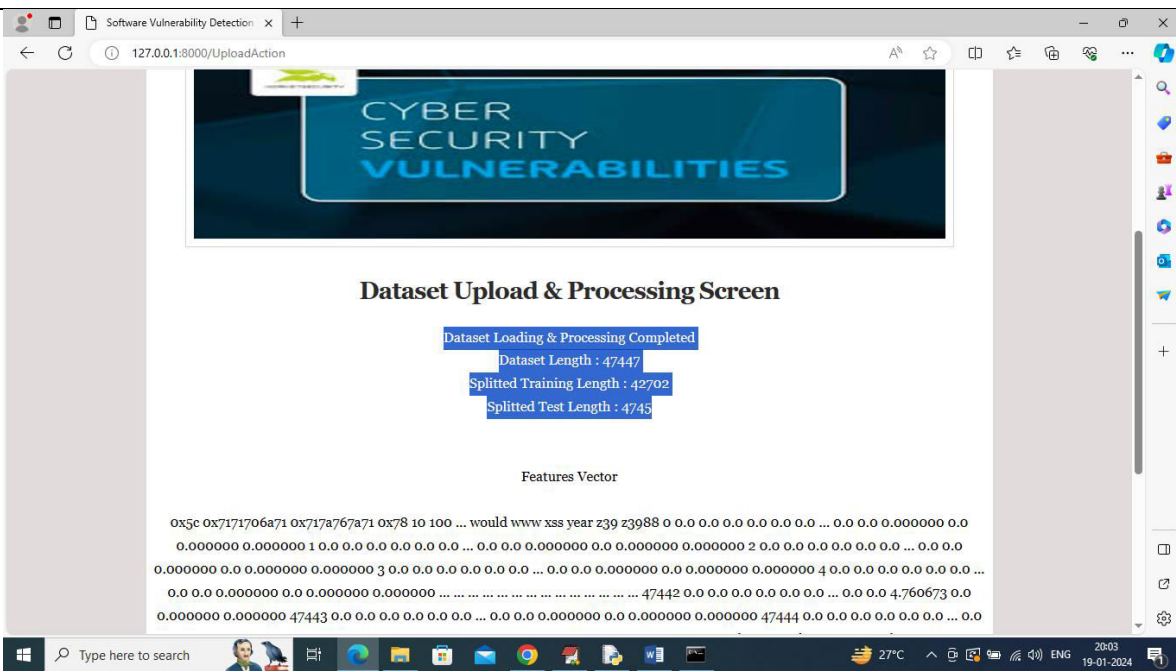
In above screen user is login and after login will get below page



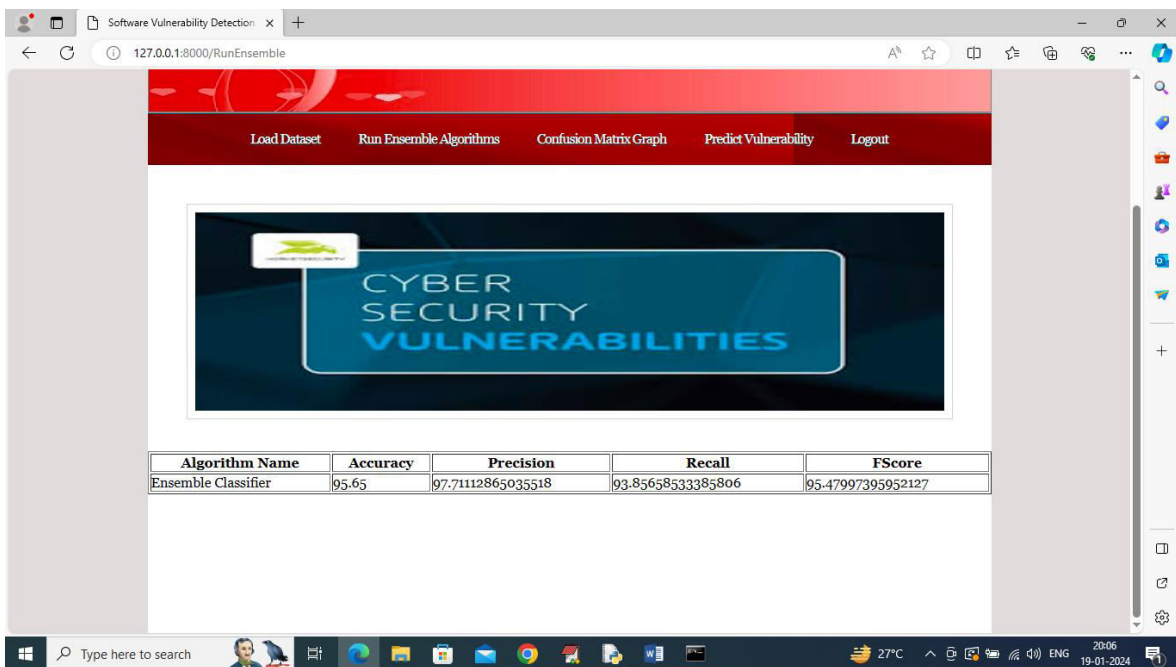
In above screen click on 'Load Dataset' link to get below page



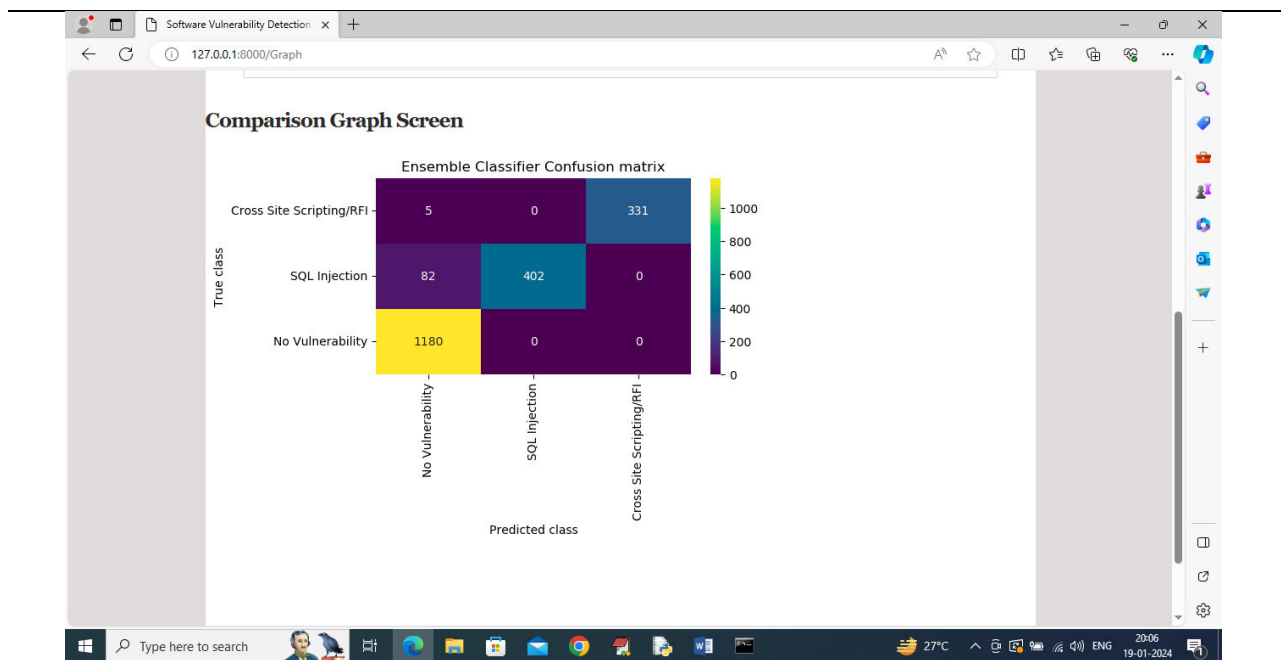
In above screen select and upload 'dataset_vulner.csv' file and then click on 'Open' and 'Submit' button to load dataset and then will get below output



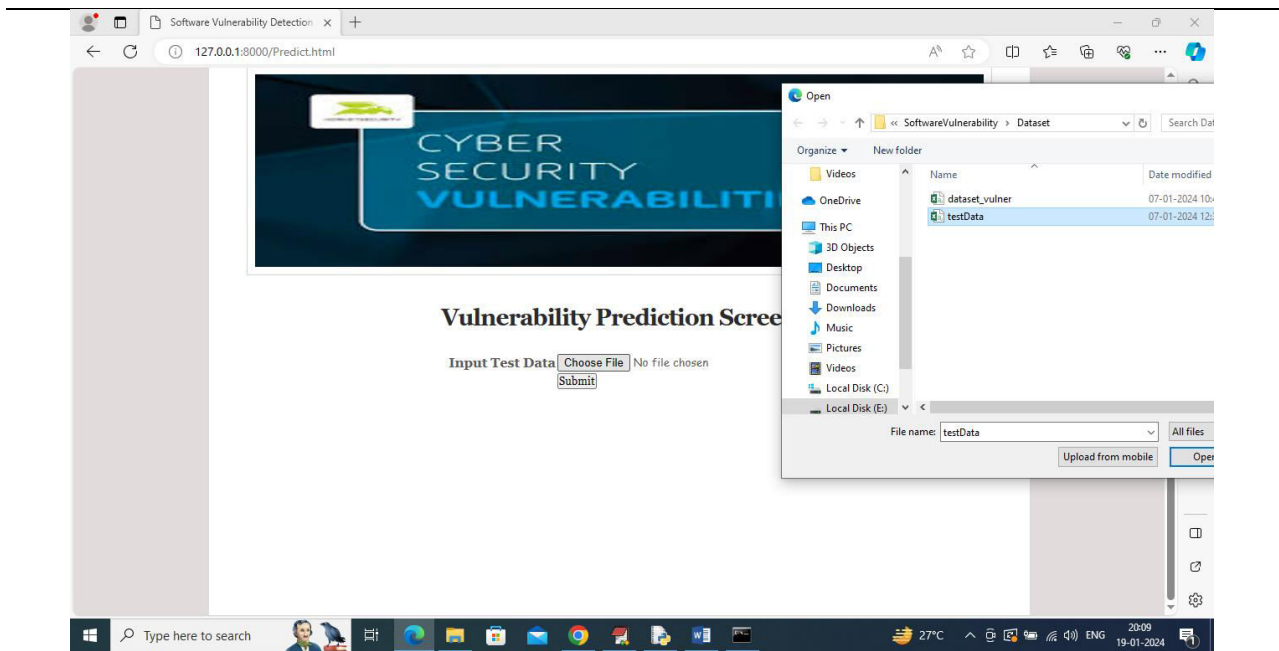
In above screen can see dataset loaded and can see total number of records available in dataset and then can see training number of records on which Machine Learning algorithm get trained and then can see number of test records on which ML will perform prediction to calculate its prediction accuracy %. Now click on ‘Run Ensemble Algorithms’ link to train ensemble algorithm and then will get below output



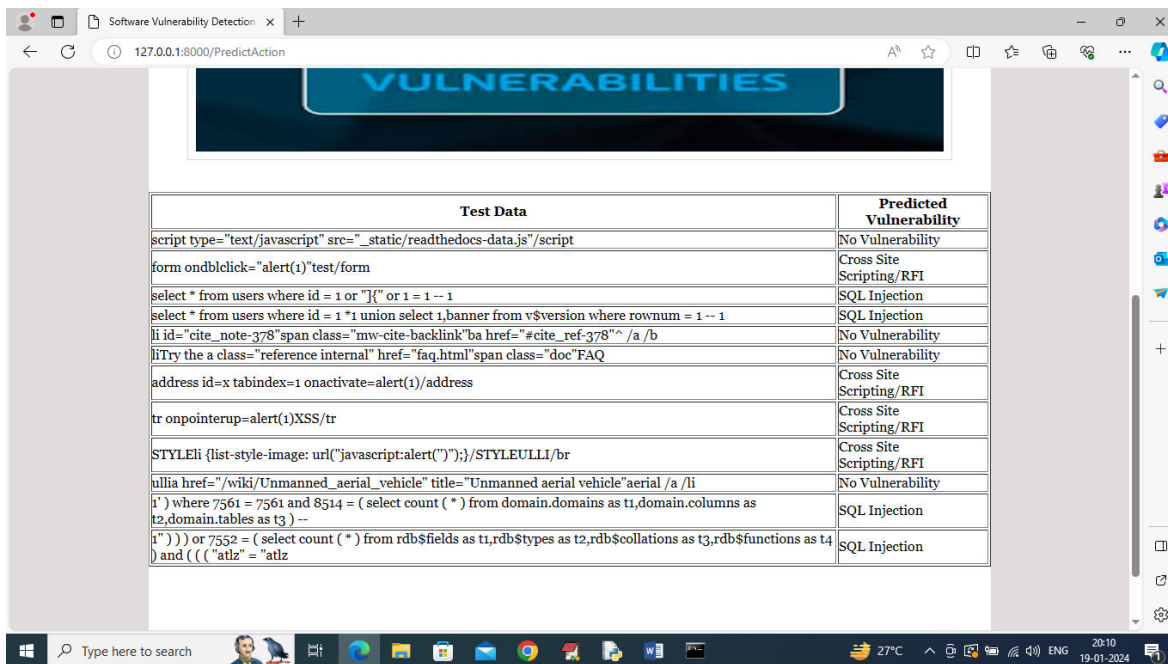
In above screen Ensemble Machine Learning algorithm training completed and can see its prediction accuracy as 95% and can see other metrics like precision, recall and FCSORE. Now click on ‘Confusion Matrix Graph’ link to view visually how many records ensemble predicted correctly and incorrectly



In above graph x-axis represents Predicted Labels and y-axis represents True Labels and then all different colour boxes in diagonal represents correct prediction count and remaining all blue boxes represents incorrect prediction count which are very few. Now click on 'Predict Vulnerability' link to upload test data and predict Vulnerability



In above screen selecting and uploading 'testData.csv' file which contains SQL, XSS and RFI coding commands and then click on 'Submit' button to get below output



In above table in first column can see SQL queries, XSS and RFI coding commands and in second column can see predicted vulnerability.

So by using above tool you can easily detect all vulnerability and you can add NEW test command in 'testData.csv' file which is available inside 'Dataset' folder

6. CONCLUSION AND FUTURE WORK

CONCLUSION

In conclusion, the development of a software vulnerability detection tool utilizing machine learning algorithms represents a significant advancement in the field of cybersecurity. Through this project, we have explored various techniques, methodologies, and considerations essential for building an effective and reliable tool for identifying security vulnerabilities in software applications.

Machine learning algorithms offer immense potential for enhancing the accuracy, efficiency, and scalability of vulnerability detection processes. By leveraging advanced data analysis techniques and predictive modeling, these algorithms can uncover subtle patterns and anomalies indicative of security weaknesses, enabling developers to identify and remediate vulnerabilities before they can be exploited by malicious actors.

7. REFERENCES

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