



CMR ENGINEERING COLLEGE

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Department of Computer Science & Engineering

A Major Project Stage1 Presenatation
On

CITY HOTSPOT IDENTIFICATION USING SMART CYBER PHYSICAL SOCIAL SYSTEM

Internal Guide
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BATCH NO – D10

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Abstract

The rapid development of smart cities relies heavily on Information and Communication Technologies (ICT) to enhance urban living through intelligent data-driven services. One of the key challenges in this domain is the efficient handling and analysis of massive telecommunication data generated by Call Detail Records (CDRs). These datasets are vital for understanding user behavior and improving network performance. To address these challenges, this research proposes a smart Cyber-Physical-Social System (CPSS) model for telecom big data analytics. The proposed model integrates cyber, physical, and social layers to efficiently process, analyze, and identify hotspots or high-traffic communication areas within a smart city. Unlike traditional approaches that rely solely on centrality measures, our model introduces social network similarity and behavioral metrics to quantify node importance and identify the Top-10 influential nodes in a network. This enhances both accuracy and robustness in hotspot detection. The proposed CPSS framework combines graph theory and big data analytics to support telecom operators in improving service quality and decision-making. Experimental results demonstrate that the model effectively handles large-scale telecom data, providing valuable insights for real-time network optimization and smart city management.

Introduction

- ❖ Smart cities use Information and Communication Technologies (ICT) to improve citizens' lives by enabling intelligent services, data exchange, and efficient infrastructure management.
- ❖ Graph theory is essential for modeling interconnected systems like telecom networks, while Call Detail Records (CDRs) act as valuable big data sources for analyzing user behavior and communication patterns.
- ❖ Cyber-Physical-Social Systems (CPSS) integrate cyber, physical, and social components connecting sensors, networks, and people to provide intelligent, data-driven services in smart cities.
- ❖ This research proposes a smart CPSS model that processes telecom big data to identify hotspots or high-traffic communication areas using social network similarity and behavioral measures, ensuring higher accuracy and robustness in telecom service analysis.

Existing System

- Existing research on telecom data mainly uses traditional centrality measures such as degree, closeness, and Eigenvector to identify hotspots and influential nodes in networks.
- Studies like those by Nattapon et al., Ahmad et al., and Mededovic et al. focused on data cleaning, churn prediction, and hotspot detection, but they lacked advanced social or behavioral analysis.
- These models perform well only on small or medium-scale networks, and their accuracy and robustness decrease when applied to large-scale telecom datasets.
- The existing systems do not incorporate social network similarity or behavioral measures, making them less effective in detecting complex communication patterns and high-traffic areas in smart cities.

Existing System with Limitations

- Most existing telecom analysis models rely on traditional centrality measures such as *Degree*, *Closeness*, and *Eigenvector* to identify influential nodes and hotspots.
- Researchers like Nattapon et al., Ahmad et al., and Mededovic et al. proposed models for data cleaning, churn prediction, and hotspot detection, but these lacked advanced behavioral insights.
- Existing methods perform well only on small or medium-scale networks and fail to maintain accuracy and robustness on large-scale telecom datasets.
- The current systems do not implement social network similarity or social behavioral measures, limiting their ability to detect complex communication patterns in smart city environments.

Proposed System

- The proposed smart CPSS model efficiently processes large-scale telecom data to identify hotspots or high-traffic communication areas in smart cities.
- It consists of three functional layers, each performing different tasks such as data extraction, social network analysis, and behavioral analysis.
- The model introduces social network similarity and behavioral measures to find the Top-10 influential nodes, improving accuracy and robustness.
- This system helps telecom operators make real-time decisions, enhance service quality, and focus on high-density areas for better network performance.

Proposed System & Advantages

- Provides big data analysis using telecom data, helping telecom operators identify hotspots or high-communication areas in smart cities.
- Enables telecom companies to focus on target areas, improving service quality and customer experience.
- The proposed CPSS model is intelligent and capable of accurately identifying high-traffic communication zones.
- Combines two powerful research fields Graph Theory and Communication for efficient and intelligent data analysis.

Literature Survey

SL.NO	Journal /Venue (IEEE)	Year	Paper title	Paper Abstract & Overview	Methodology	Purpose
1	R. Sharma et al.	2020	Big Data Analytics for Smart City Communication Networks	The paper explores how big data frameworks can process telecom communication data in smart cities for traffic monitoring and network optimization.	Telecom data collection, big data analytics, clustering, and visualization.	To improve communication network efficiency and optimize traffic management.
2	R. Lavelle-Hill et al.	2022	Using Mobile Money Data and Call Detail Records to Explore Migration and Mobility	The study integrates CDRs with mobile money data to analyze human mobility and population movement across urban regions.	Spatio-temporal analysis of large telecom datasets combined with demographic data.	To investigate migration and urban mobility using real-time CDRs.
3	G. Maji et al.	2023	Identification of City Hotspots by Analyzing Telecom Call Detail Records Using Complex Network Modeling	This research models CDR-based telecom data as complex networks to identify communication hotspots and social influence nodes.	Telecom CDR dataset converted to a complex network graph; hotspot nodes identified using centrality.	To detect high-traffic communication zones in smart cities.

SL.NO	Journal/Venue (IEEE)	Year	Paper title	Paper Abstract & Overview	Methodology	Purpose
4	Z. Aziz & P. Bestak.	2024	Insight into Anomaly Detection and Prediction and Mobile Network Security Enhancement Leveraging K-Means Clustering on Call Detail Records.	This paper proposes a clustering-based approach to detect anomalies in mobile network data using CDRs to improve reliability and prevent cyber threats.	Analysis of 14 million CDRs using clustering for anomaly detection and predictive modeling.	To identify and predict network anomalies to strengthen telecom security.
5	K. Kavya Sri & N.Srinivasa Rao.	2025	City Hotspot Identification Using Smart Cyber-Physical-Social System.	The paper presents a smart CPSS framework integrating graph theory, big data analytics, and behavioral measures for telecom hotspot detection in smart cities.	Multi-layer CPSS model with graph construction, SNA, and behavioral similarity computation.	To identify top-ten high-traffic communication areas in a smart city.

Software Requirements

- Operating System - Windows XP
- Coding Language - Java/J2EE(JSP,Servlet)
- Front End - J2EE
- Back End - MySQL

Hardware Requirements

- Processor
 - Pentium –IV
- RAM
 - 4 GB (min)
- Hard Disk
 - 20 GB
- Key Board
 - Standard Windows Keyboard
- Mouse
 - Two or Three Button Mouse
- Monitor
 - SVGA

Modules

Server

In this module, the Admin has to login by using valid user name and password. After login successful he can do some operations such as View All Users and Authorize, View All Datasets, View All Datasets by Chain using CPSS model, View City Hotspot Identification Status Results, View Cyber Physical Social System Results.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like Register and Login, View Profile, Upload Datasets, Find City Hotspot Identification Status Type, Find City Hotspot Identification Status Type By CPSS model.

Libraries Used in the Project

Frontend Technologies

HTML, CSS, JavaScript, and JSP: Are used to design dynamic and interactive user interfaces for our project.

Backend Web Technologies

Java (J2EE), Servlets, JSTL, and Apache Tomcat: Are used to handle server-side processing and manage client requests.

Data Handling

MySQL with JDBC: Is used to store, retrieve, and process uploaded datasets efficiently in the system.

Security:

Logging & Monitoring: Log4j tracks system activities, errors, and access attempts for security auditing.

• **Data Protection:** Sensitive user data and datasets are stored with restricted access and protected server-side controls.

Techniques and algorithms used

- **Graph Theory:**

Used to model and represent telecom networks where nodes represent users and edges represent communication links. Helps in hotspot identification and network structure analysis.

- **Social Network Analysis (SNA):**

Applied to understand user interactions, network influence, and relationships between nodes using measures such as similarity and behavior.

- **Social Network Similarity Measure:**

Used to calculate the similarity between nodes based on their communication patterns and connections, identifying strong relationships and influential users.

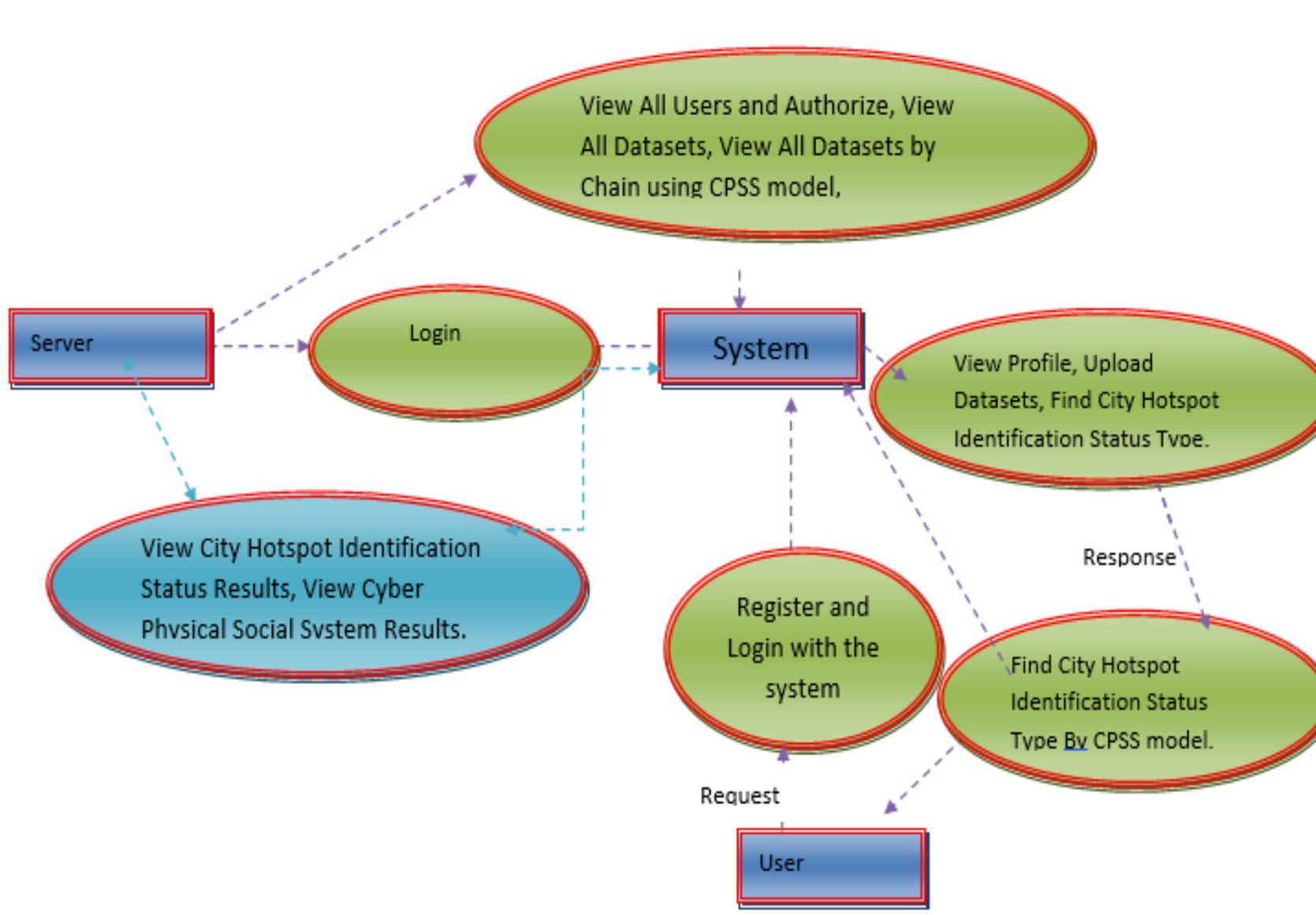
- **Behavioral Measure:**

Evaluates user behavior and activity patterns to determine the **Top-10 influential nodes** and high-traffic communication areas.

- **Big Data Analytics Techniques:**

Implemented to handle, store, and process large-scale telecom data efficiently, ensuring real-time performance and scalability in smart city environments.

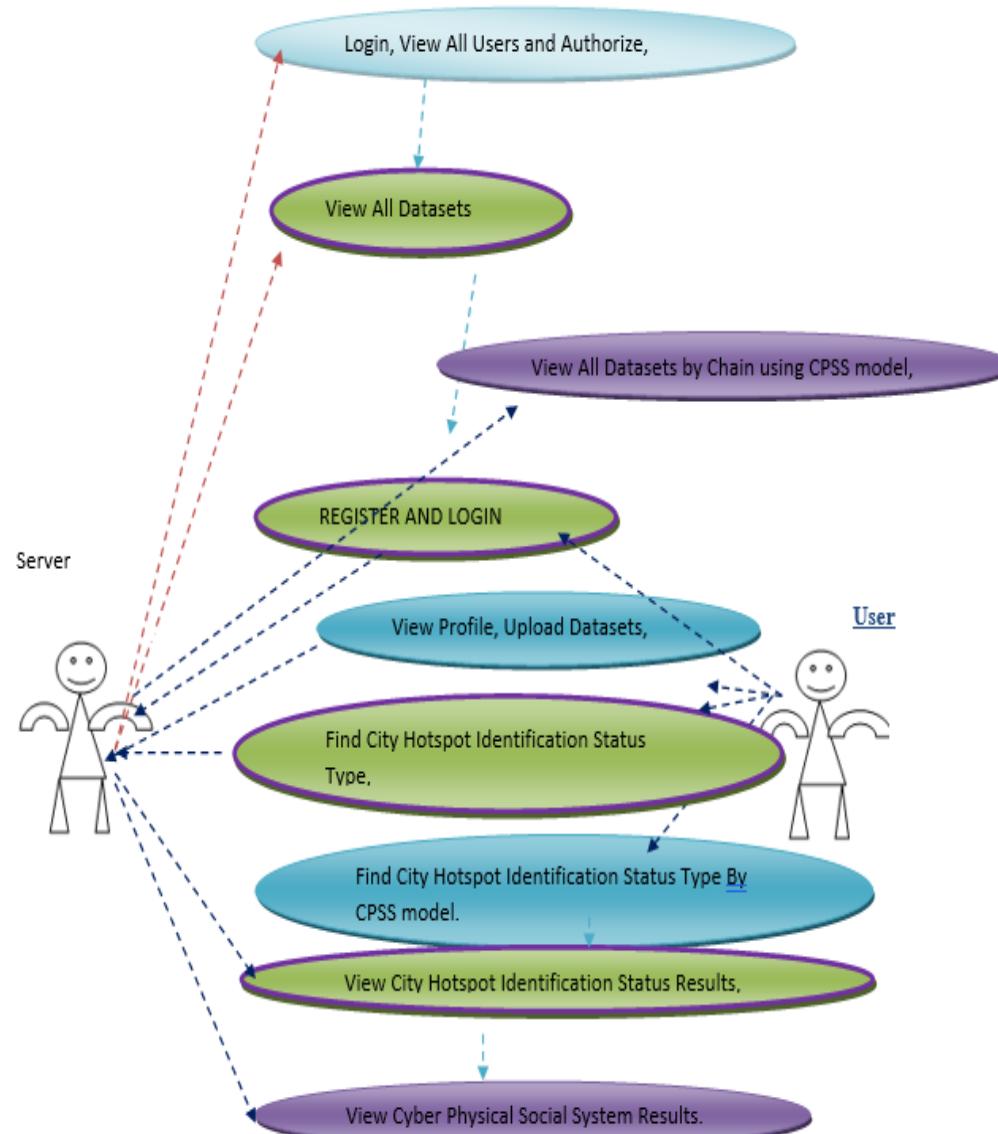
Data Flow Diagram



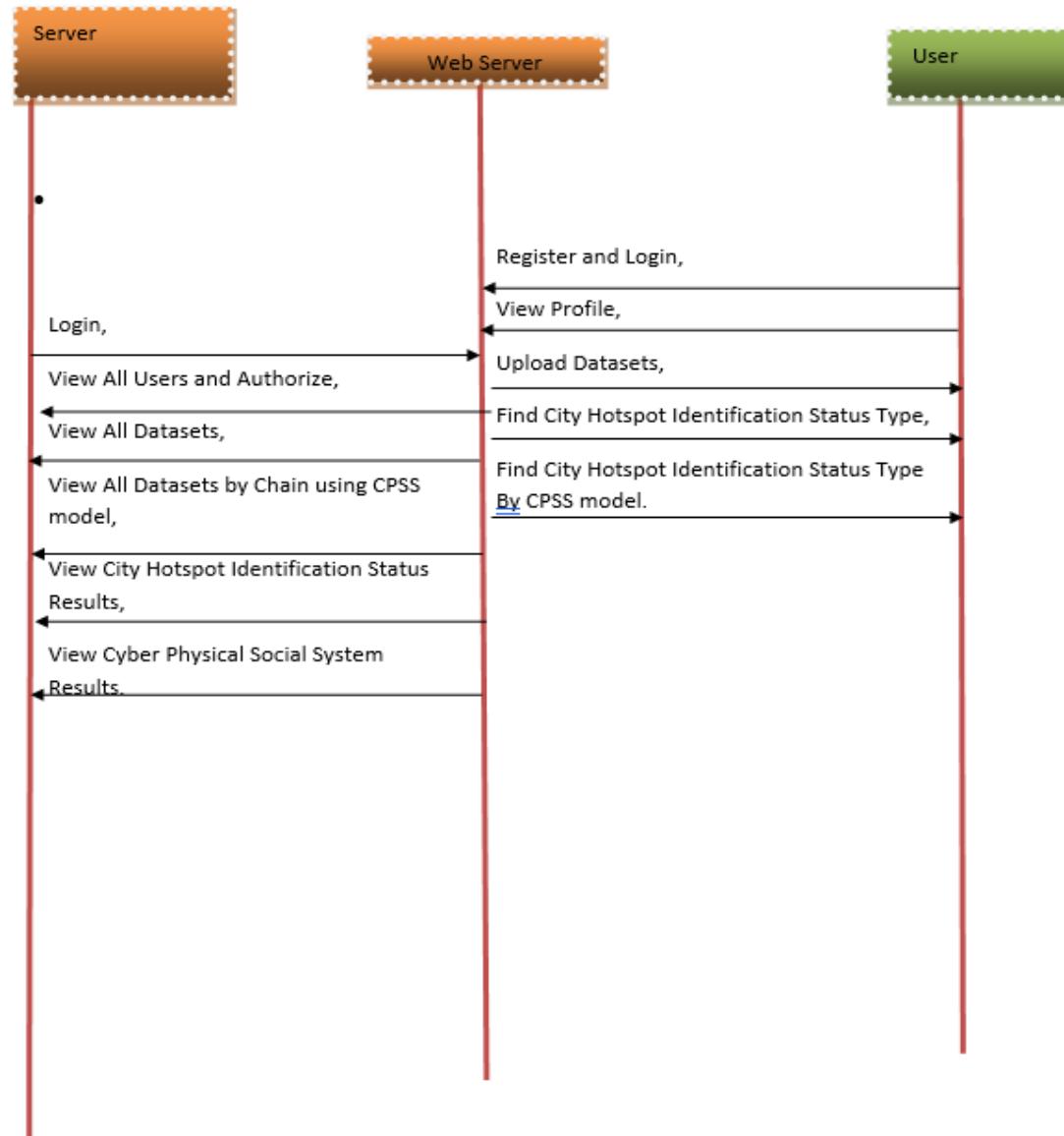
UML Diagrams

- UML is an acronym that stands for Unified Modeling Language. Simply put, UML is a modern approach to modeling and documenting software.
- In fact, it's one of the most popular business process modeling techniques.
- It is based on diagrammatic representations of software components.
- As the old proverb says: “a picture is worth a thousand words”. By using visual representations, we are able to better understand possible flaws or errors in software or business processes.
- UML was created as a result of the chaos revolving around software development and documentation.

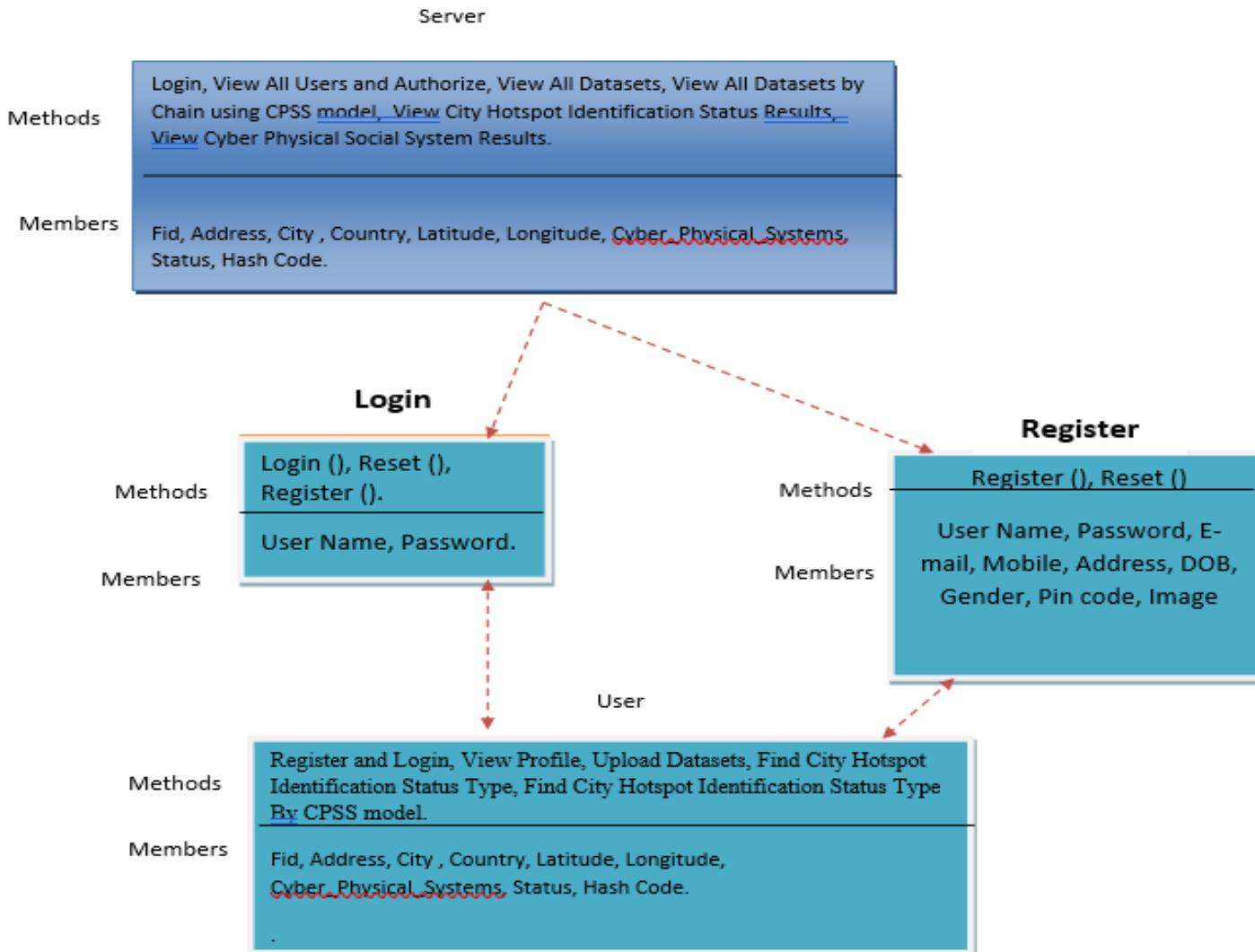
Use Case Diagram



Sequence Diagram

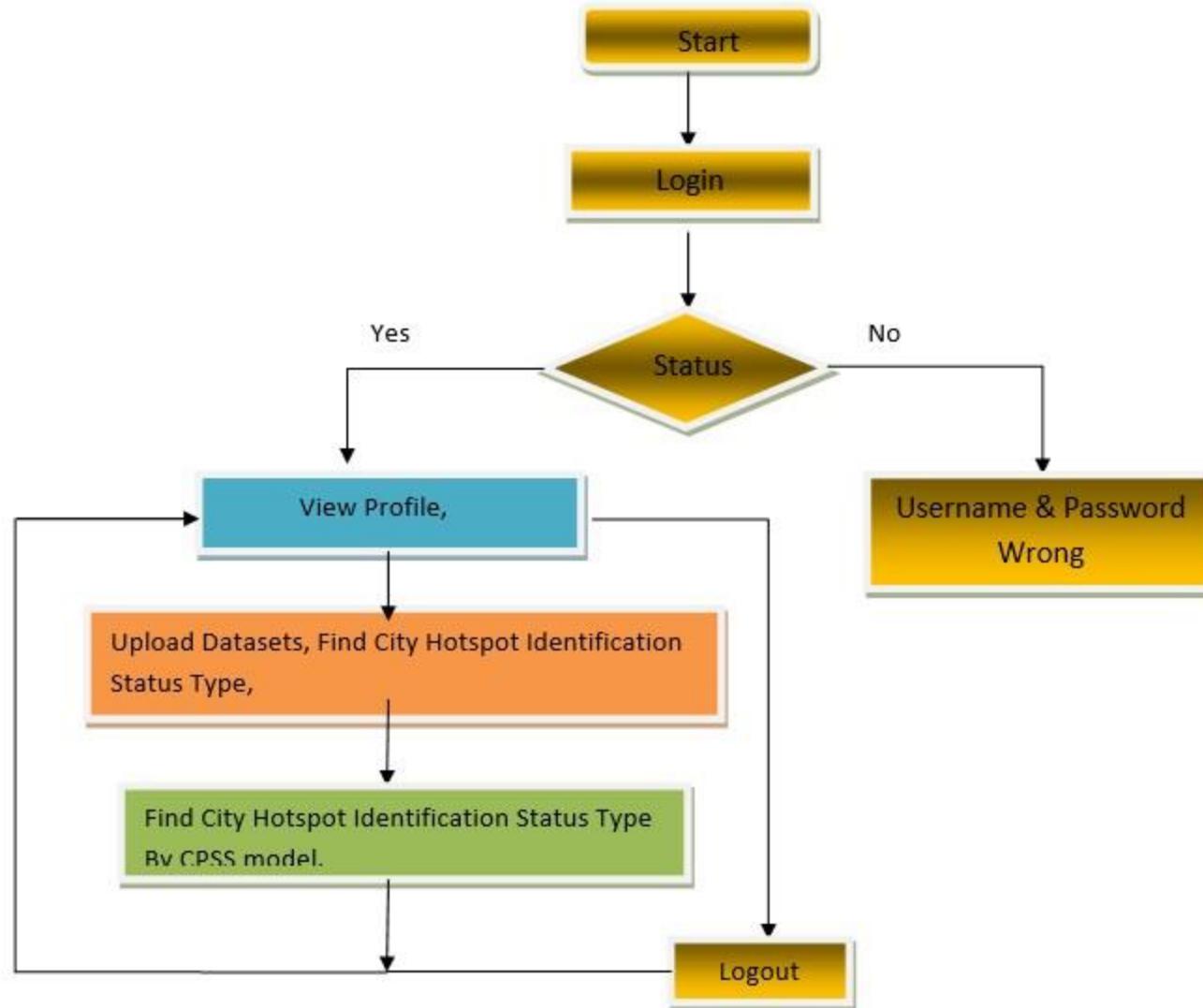


Class Diagram

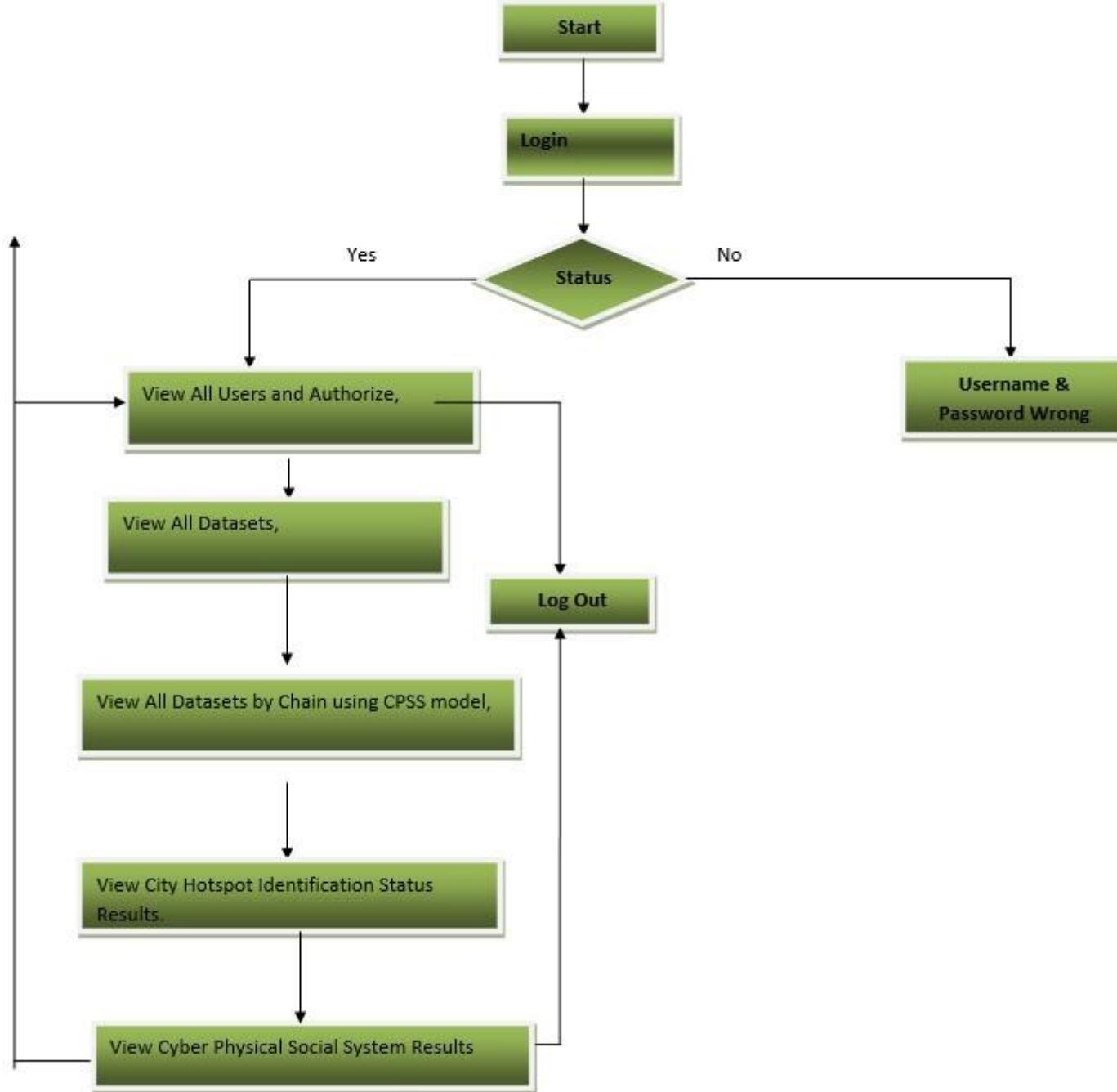


Flow Diagram

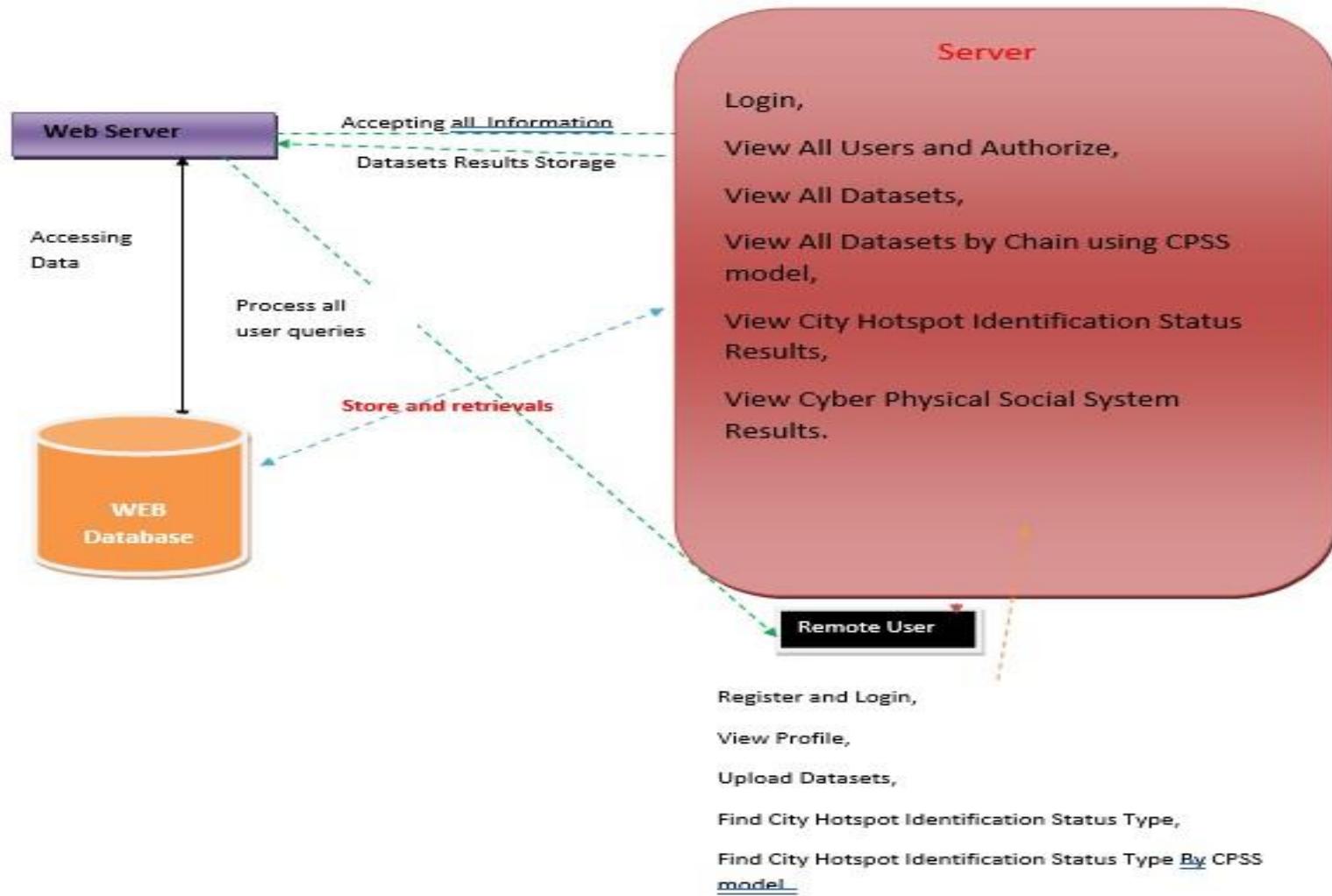
User:



Server:



System Architecture



Conclusion

- A smart Cyber-Physical-Social System (CPSS) model has been proposed using telecom big data to identify high-communication areas in smart cities.
- The model is structured into multiple layers data collection, processing, and analysis each with distinct functionalities.
- The data collection layer gathers raw telecom data, while the data processing layer handles storage, cleaning, and transformation.
- A graph is constructed from processed data, and Social Network Analysis (SNA) is performed to detect Top-10 hotspots using social network similarity and behavioral measures.
- The results confirm that the proposed approach provides accurate and consistent hotspot detection with minimal variance across datasets.
- The system also contributes to telecom service optimization and traffic forecasting in smart cities.
- In future work, the model will be extended to perform detailed weekly analyses on the full dataset from Trento, enhancing long-term network insights.

THANK YOU.....