

Privacy Network: Design and Implementation of a Security-Conscious, Location-Preserving Geosocial Network

Thesis submitted by

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under the guidance of

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*in partial fulfilment of the requirements
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Bachelor of Engineering in Information Technology



Department Of Information Technology

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Jadavpur University

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BONDAFIDE CERTIFICATE

This is to certify that this project titled “*Privacy Network: Design and Implementation of a Security-Conscious, Location-Preserving Geosocial Network*”, submitted to the **Department of Information Technology, Jadavpur University, Salt Lake Campus, Kolkata**, for the award of the degree of **Bachelor of Engineering**, is a bonafide record of work done by **Manas Pratim Biswas (Regn. No.: 153760 of 2020-2021)**, **Anumoy Nandy (Regn. No.: 153823 of 2020-2021)** and **Kunal Pramanick (Regn. No.: 159991 of 2021-2022)**, under my supervision from 03/07/2023 to 15/05/2024.

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JADAVPUR UNIVERSITY

Dept. of Information Technology

Vision:

To provide young undergraduate and postgraduate students a responsive research environment and quality education in Information Technology to contribute in education, industry and society at large.

Mission:

- M1:** To nurture and strengthen the professional potential of undergraduate and postgraduate students to the highest level.
- M2:** To provide international standard infrastructure for quality teaching, research and development in Information Technology.
- M3:** To undertake research challenges to explore new vistas of Information and Communication Technology for sustainable development in a value-based society.
- M4:** To encourage teamwork for undertaking real life and global challenges.

Program Educational Objectives (PEOs):

Graduates should be able to:

- PEO1:** Demonstrate recognizable expertise to solve problems in the analysis, design, implementation and evaluation of smart, distributed, and secured software systems.
- PEO2:** Engage in the engineering profession globally, by contributing to the ethical, competent, and creative practice of theoretical and practical aspects of intelligent data engineering.
- PEO3:** Exhibit sustained learning capability and ability to adapt to a constantly changing field of Information Technology through professional development, and self-learning.
- PEO4:** Show leadership qualities and initiative to ethically advance professional and organizational goals through collaboration with others of diverse interdisciplinary backgrounds.

Mission - PEO matrix:

Ms/ PEOs	M1	M2	M3	M4
PEO1	3	2	2	1
PEO2	2	3	2	1
PEO3	2	2	3	1
PEO4	1	2	2	3

(3 – Strong, 2 – Moderate and 1 – Weak)

Program Specific Outcomes (PSOs):

At the end of the program a student will be able to:

- PSO1:** Apply the principles of theoretical and practical aspects of ever evolving Programming & Software Technology in solving real life problems efficiently.
- PSO2:** Develop secure software systems considering constantly changing paradigms of communication and computation of web enabled distributed Systems.
- PSO3:** Design ethical solutions of global challenges by applying intelligent data science & management techniques on suitable modern computational platforms through interdisciplinary collaboration.

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Abstract

The recent advancements in mobile and internet technology, coupled with cheap internet data, have witnessed an exponential increase in the usage of internet and people connecting via social media networks. However, the traditional social networking sites such as *Facebook*, *Instagram* or *Twitter* have had witnessed multiple allegations of capturing and selling the user data for their corporate and business purposes. Most importantly, a breach in the user's location data can expose sensitive information regarding that user's frequent places of visit, acquaintances they meet with, food habits and political preferences.

Our project explores the applicability and implementation of a Privacy Network as a scalable Geosocial Networking website. A user-centric design for a secure location sharing is implemented into our project. The final product, *Privacy Network*, is a web application that allows the users to register into our website with their details, add or remove friends and most importantly, decide and set their visibility and other privacy parameters very precisely to ensure a secure and robust social media usage. Even more, the users can query their friends based on parameters including but not limited to *age*, *gender*, *college* and *distance*.

The user auth and data is handled by a MongoDB backend and the user location attributes are handled by a Postgres backend. PostGIS along with PostgreSQL is utilised to create custom SQL queries to fetch the user location details on-demand. Real-time location broadcasting and multi-casting is achieved by upgrading the *HTTP* protocol to *WebSocket* protocol and utilising raw *WebSockets* natively available in the client's browser. A separate WebSocket backend server handles all the WebSocket connections from the client side. Services such as *Vercel* and *Render* are utilised to host the frontend and backend servers. A complete documentation of all the backend API end-points, in compliance with the standardized OpenAPI specifications is available as a Swagger documentation.

However, scaling WebSockets is challenging. Therefore, a *distributed Redis Pub-Sub* based architecture along with a *HAProxy load balancer* is proposed. Moreover, a *change-data-capture* mechanism using *Apache Kafka* is proposed to keep the MongoDB and PostgreSQL databases consistent and in synchronization with each other.

Keywords: typescript, websockets, mern, postgresql, postgis, redis, haproxy, kafka, social-network-analysis

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