PROJECT TITLE : REAL TIME MAPPING OF EPIDEMIC SPREAD

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Introduction

- In the face of emerging infectious diseases and recurrent epidemics, there is a critical need for real-time data to understand the spread of these diseases, facilitate timely interventions, and inform public health strategies.

- Current epidemic tracking systems often lack integration of real-time , crowd-sourced data and predictive analytics, leading to gaps in situational awareness and delayed responses.

- This project aims to develop a portal that provides a comprehensive, real-time mapping of epidemic spread by leveraging both official data sources and crowd-sourced information. The goal is to offer actionable insights into how an epidemic evolves, thereby supporting public health efforts and enhancing community awareness.

Literature Review

Epidemiological models & surveillance data:

- **Traditional models (SIR)**: effective but lag in early outbreak detection.
- **Spatial dynamics**: GIS enhances predictions by mapping disease spread with environmental factors.

Real-time forecasting:

- **Bayesian methods**: estimate reproductive number (R) for outbreak dynamics.
- **Unconventional data**: google trends and phone logs provide early signals.

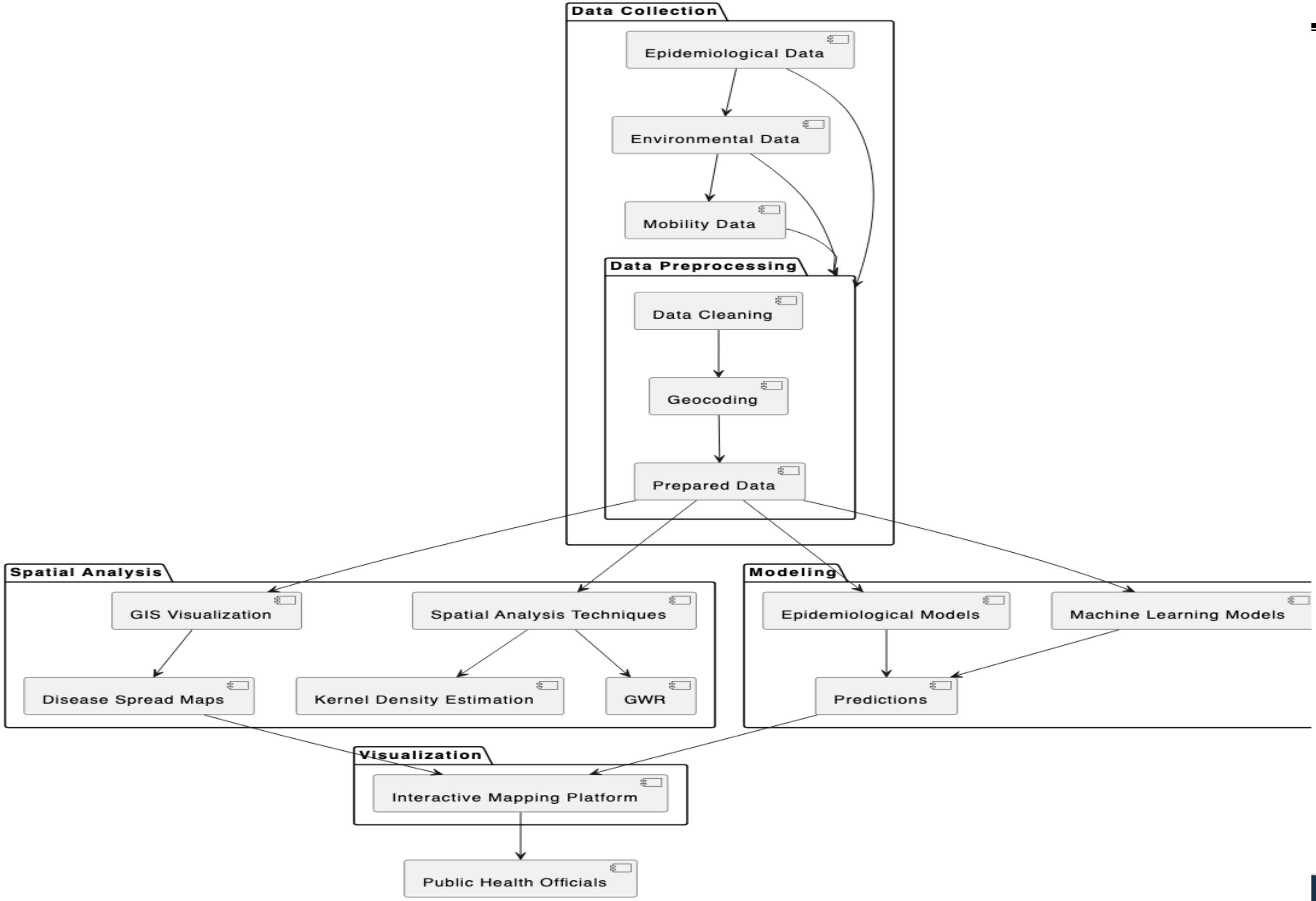
Methods overview:

1. **GIS**:
   1. *Advantage*: spatial analysis.
   2. *Limitation*: data quality issues.
2. **Mobile health apps**:
   1. *Advantage*: real-time reporting.
   2. *Limitation*: digital divide.
3. **Epidemiological modelling**:
   1. *Advantage*: predictive analytics.
   2. *Limitation*: data dependency.
4. **Social media monitoring**:
   1. *Advantage*: rapid insights.
   2. *Limitation*: noise and privacy concerns.

Literature Review (contd..)

5. **Remote sensing**:
    1. *Advantage*: wide-area monitoring.
    2. *Limitation*: high cost.
6. **Wearable devices**:
    1. *Advantage*: continuous monitoring.
    2. *Limitation*: privacy issues.
7. **Public health dashboards**:
    1. *Advantage*: centralized data.
    2. *Limitation*: data lag.
8. **Crowdsourcing**:
    1. *Advantage*: community engagement.
    2. *Limitation*: data reliability.
9. **Contact tracing apps**:
    1. *Advantage*: immediate alerts.
    2. *Limitation*: privacy concerns.
10. **Traditional systems**:
    1. *Advantage*: established protocols.
    2. *Limitation*: slow response.

Proposed Method



Objectives

- **Develop a Real-Time Mapping System:** The project aims to build a robust, real-time mapping system that visualizes the geographical spread of an epidemic as it unfolds. This system will leverage GIS technology to create dynamic maps that can be updated with real-time epidemiological data.

- **Identify High-Risk Areas:** By analysing both spatial and temporal data, the project seeks to identify high-risk areas where outbreaks are likely to intensify. These areas will be flagged for public health officials, enabling targeted interventions to prevent further spread.

- **Provide Timely Insights:** The project will focus on providing timely insights to guide public health interventions. This includes predicting the future trajectory of the epidemic, highlighting regions that require immediate attention, and informing resource allocation decisions.

- **Integrate Real-Time Data:** The mapping system will incorporate various real-time data sources, including confirmed cases, environmental conditions, and mobility patterns. This integration will enhance the predictive power of the model and allow for dynamic updates as new data becomes available.

Methodology

1. Data Collection

- Gather epidemiological data: confirmed/suspected cases, mortality from health agencies and hospitals.
- Collect environmental data: temperature, humidity, rainfall.
- Incorporate mobility data: public transport and mobile phone patterns.

2. Data Preprocessing

- Clean and standardize data: address missing values and inconsistencies.
- Geocode locations for spatial analysis.

3. Spatial Analysis

- Use GIS to visualize case distribution and identify spatial clusters.
- Apply techniques: kernel density estimation, Geographically Weighted Regression (GWR), and Local Index of Spatial Autocorrelation (LISA) to analyse correlations with environmental and socioeconomic factors.

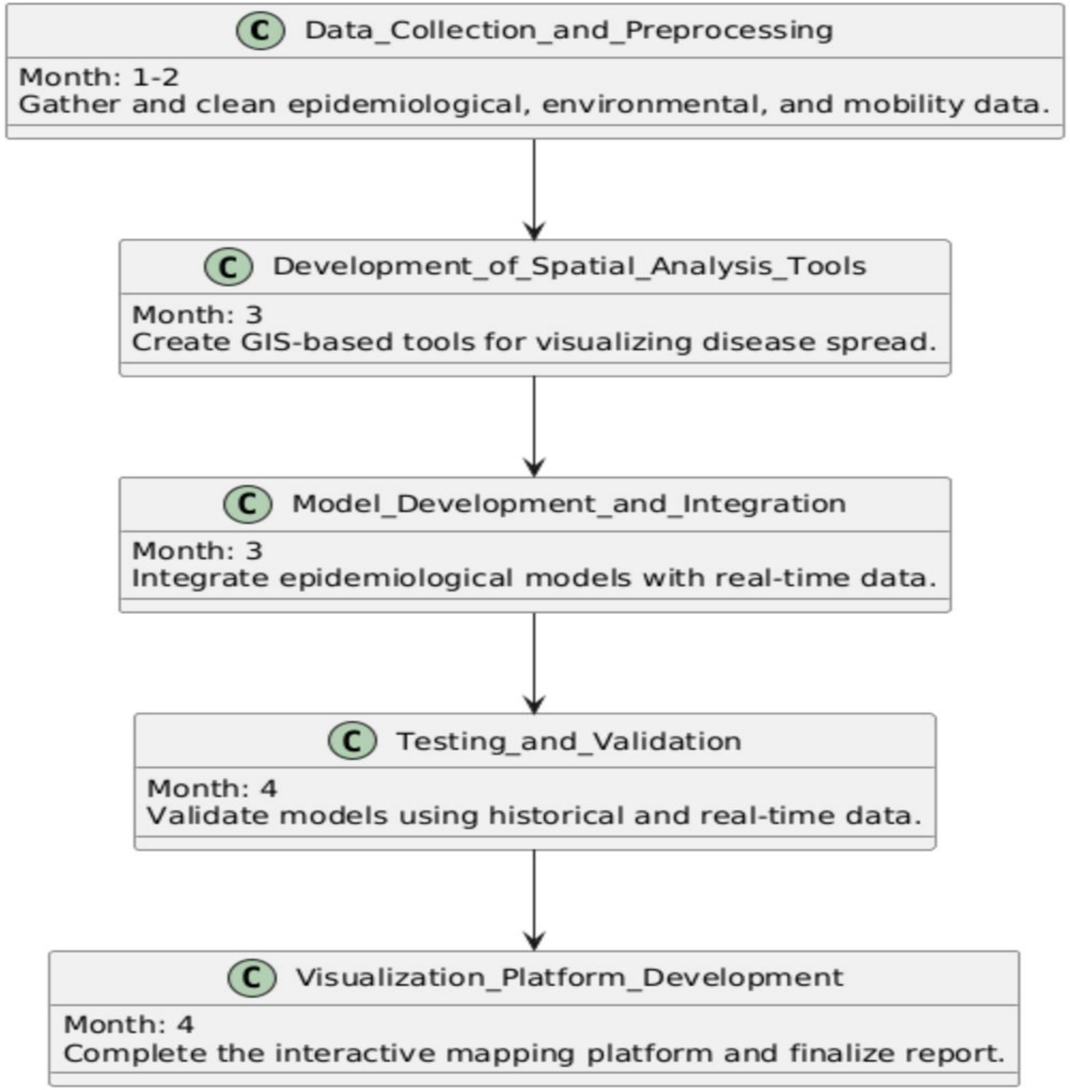
4. Modelling

- Develop dynamic epidemiological models (SIR/SEIR) enhanced with agent-based techniques.
- Utilize Graph Attention Networks (GAT) for spatial and temporal predictions of outbreaks.

5. Visualization

- Create an interactive web platform for real-time epidemic mapping.
- Features: display case distribution, highlight high-risk areas, and provide future predictions.
- User-friendly design for public health officials to assess situations and prioritize interventions.

Timeline of Project



Expected Outcomes

- **A Real-Time Mapping System:** A fully operational, real-time mapping system that visualizes the spread of the epidemic, offering up-to-date data on the distribution of cases and predicted outbreak trajectories.

- **Identification of High-Risk Areas:** The system will highlight regions where disease transmission is likely to escalate, allowing public health officials to allocate resources effectively and target interventions in areas with the greatest need.

- **Improved Understanding of Disease Transmission:** By incorporating spatial and temporal data, the project will provide new insights into the factors that influence disease spread, including the impact of environmental conditions and human mobility patterns.

- **Enhanced Public Health Preparedness:** The system will help authorities respond more rapidly to emerging outbreaks, ensuring that interventions are implemented in a timely and efficient manner.

- **Scalability:** The system will be designed to be flexible and scalable, allowing it to be applied to different diseases and geographical contexts, making it a valuable tool for future epidemics.

Conclusion

- Real-time mapping of epidemic spread is an essential tool in the modern fight against infectious diseases. By integrating epidemiological data with spatial analysis and advanced modelling techniques, health authorities can gain a clearer understanding of how diseases spread and implement timely, targeted interventions. The proposed system will contribute to improved public health management by offering real-time insights into epidemic dynamics and guiding efficient resource allocation. This proactive approach will not only enhance the ability to control current outbreaks but also improve preparedness for future epidemics.

- Real-time mapping of epidemic spread is a vital component of modern public health efforts. By leveraging advanced technologies and data analytics, stakeholders can enhance their ability to monitor, respond to, and ultimately mitigate the impact of infectious diseases. As the world continues to face emerging health threats, the importance of effective mapping and response strategies will only grow, making this domain a critical area for research and innovation.

References

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Thank You!