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A Review of various Web Applications/ Apps on Health GIS

Ashutosh Mishra, Dr. Mukesh Kumar, Dr. Ashish Ratn Mishra, Dr. Ekta Pathak Mishra, Prof. (Dr.) Deepak Lal

Research Scholar, Associate Professor[2,3], Scientist, Professor

Vaugh Institute of Agriculture Engineering & Technology, Shuats, Center for Geospatial Technologies Vaugh Institute of Agriculture Engineering & Technology, Shuats, Grow Indigo Pvt. Ltd., new Delhi

1. **Introduction**:

a. **Disease**

Human disease cause major production and economic losses in global GDP. Health monitoring in human is critical for sustainable development of human resource.

The **impact of human diseases** on **human resources** (the workforce) and **Gross Domestic Product (GDP)** is profound and multifaceted. Diseases, both infectious and non-infectious, can disrupt economies by affecting individuals' health, productivity, and the overall functioning of society. This disruption can influence economic performance at local, national, and global levels.

i. Impact on Human Resources (Workforce)

Human disease can impact human resources in several key ways:

a) Reduced Labor Force Participation

b) Loss of Productivity

- Decreased Work Efficiency
- Mental Health Issues
- Loss of Skilled Laborc) Increased Healthcare Costs
- Healthcare Burden on Employers
- Workplace Health Programs

d) Labor Force Inequality

- Vulnerable Populations
- Gender Disparities

ii. Impact on Gross Domestic Product (GDP)

Human diseases have a direct and indirect impact on a country's GDP, which represents the total economic output. The effects can be short-term, long-term, and vary based on the nature and scope of the disease.

a) Direct Economic Impact

- Healthcare Expenditures
- Productivity Losses

b) Disruption of Economic Sectors

- Service and Manufacturing Sectors
- Supply Chain Disruptions

c) Increased Mortality and Life Expectancy

- Decreased Labor Supply
- Impact on Life Expectancy
- Economic Recovery and Growth
- Economic Stimulus and Recovery Costs
- Long-Term Growth Impacts

3. Pandemics and Global Economic Impact

Pandemics, by nature, have a more pronounced **global impact** on both human resources and GDP due to their widespread and unpredictable nature. The **COVID-19 pandemic** is one of the most significant examples in recent history, showing how a global health crisis can lead to the following:

Global Recession: The World Bank and other institutions predicted a **global recession** due to COVID-19, with worldwide GDP shrinking by over 4% in 2020. Economic activity slowed down due to lockdowns, supply chain disruptions, and reduced consumer demand.

Labor Migration: In many countries, migrant workers play a key role in sectors like agriculture, construction, and services. During COVID-19, restrictions on migration and the health of migrant workers significantly affected the economy, especially in lower-income countries dependent on remittances.

Global Trade Impact: Pandemics can severely affect international trade due to restrictions, closures, and interruptions in production and distribution.

1.1 Geospatial Technologies for Disease Surveillance

The importance of geospatial technology like geographic information systems (GIS) in public health, especially in infectious disease surveillance and modeling has increased for the last few years. The growing demand for mapping, analytics, and visualization in public health has led to an increase in information-age technologies for communicable disease surveillance and research. According to Winslow (1920), "public health is the science and art of avoiding disease, prolonging life, and promoting health via the coordinated efforts and educated choices of society". The American Public Health Association (APHA) defines public health as To prevent disease and promote good health using various tools like Geographical information systems (GIS), GPS, and satellite-based technologies like remote sensing (RS). (Turnock 2012). GIS is a set of computer programs that capture, manipulate, transform, analyze, query, model, and visualize all spatially referenced data. RS is an earth observation equipment that produces regional information on climate conditions and terrain aspects. Thus, while GPS and RS give regional and spatial data, GIS allows real-time geospatial data integration and analysis (Kumar et al., 2020;). The GIS provides dynamic maps to explain illness distribution, disease mapping, disease clustering, disease correlation with environmental factors, network analysis, etc. GIS technology is gaining popularity in public health due to its visual and analytical capabilities.

Health GIS: Geospatial Health is a term used to depict imaginative strategy for checking ecological danger factors on human wellbeing (Rasam, Noor, 2011). The use of GIS devices is crucial in helping health organizations, disease transmission experts, general wellbeing officials, town organizers, and important experts in creating proficient control measures and possible projects to adequately battle different human infections (Aziz, Ngui, et al., 2012).

To improve predictions of disease propagation and the likelihood of new outbreaks, health geography describes the relationship of public health officials, affected actors, and first responders. Health policy interventions for the siting of health/sanitary services and controls, mapping/tracking of human movement, formulation of appropriate scientific and political responses, and projection of spatial diffusion and temporal trends all are investigated in attempts at interdisciplinary correlation. (Pardo, Napoletano et al., 2020)

Health GIS is a powerful tool that integrates spatial data with health-related information to better understand, analyse, and address public health issues. It combines geography (maps and spatial data) with health data to provide a comprehensive view of how health patterns, behaviors, and outcomes vary across different regions or populations. Health GIS is used for disease surveillance, resource allocation, environmental health monitoring, and public health planning, among other applications.

Key Components of Health GIS

1. **Spatial Data**: Geographic data that includes the location of features (e.g., hospitals, disease outbreaks, environmental hazards). Spatial data can come from satellite imagery, GPS, or existing maps.
2. **Health Data**: This includes information about diseases, health conditions, risk factors, social determinants of health, demographics, and more. Health data might come from health records, surveys, disease surveillance systems, or environmental monitoring programs.
3. **GIS Software**: Tools and applications that process and analyze geographic data. Common GIS software includes **ArcGIS**, **QGIS**, **Google Earth Engine**, and specialized tools designed for health data analysis.
4. **Analysis Tools**: These are used to analyze patterns, trends, and correlations in spatial health data, such as:
    - Spatial analysis (e.g., hotspots, clustering)
    - Temporal analysis (e.g., tracking disease progression over time)
    - Predictive modeling (e.g., forecasting disease spread)

Applications of Health GIS

Health GIS has a broad range of applications in public health, epidemiology, healthcare delivery, and environmental health. Here are some of the main uses:

Disease Surveillance and Epidemiology	Tracking Disease Outbreaks
	Epidemiological Mapping
Environmental Health and Hazard Assessment	Air Quality and Pollution Monitoring
	Waterborne Diseases
	Vector-Borne Disease Mapping
Healthcare Access and Resource Allocation	Mapping Healthcare Facilities
	Access to Care
	Emergency Response Planning
Social Determinants of Health	Health Inequities
	Identifying Health Disparities
Health Promotion and Disease Prevention	Targeting Health Campaigns
	Behavioral Risk Factor Mapping
Healthcare Planning and Policy Development	Health System Planning
	Policy Advocacy
Clinical and Population Health Research	Mapping and Analyzing Clinical Data
	Health Surveys and Data Analysis

1.2 Public Health Informatics (PHI) is the science of using information technology and data systems to improve public health practice, research, and policy-making. It involves the collection, analysis, dissemination, and use of health-related data to support decision-making, enhance health outcomes, and manage public health programs and services. PHI integrates traditional public health practices with modern information systems, which includes the use of digital tools, health data analytics,GIS and IT infrastructure.

Key Areas of Public Health Informatics:

1. Health Data Collection and Management	2. Data Analysis and Interpretation
3. Health Information Systems	4. Decision Support
5. Data Sharing and Interoperability	6. Health Communication
7. Population Health Management	8. Public Health Surveillance
9. Emergency Preparedness and Response	

Key Components of Public Health Informatics:

1. Electronic Health Records (EHRs)	2. Health Information Exchanges (HIEs)
3. Disease Surveillance Systems	4. Data Standards and Interoperability

5. Public Health Dashboards	6. Geographic Information Systems (GIS)

1.3 Web Application:

A **web application** is a software application that runs on a web server and is accessed via a web browser over the internet or an intranet. Unlike traditional desktop applications, which are launched from a computer's operating system, web applications rely on a web browser as the interface for users to interact with them. Web applications are an essential part of the modern web and are used in a wide range of industries, from e-commerce to social media, and healthcare to banking.

Key Characteristics of a Web Application

Runs in a Web Browser:

Users interact with web applications through a web browser (such as Google Chrome, Mozilla Firefox, Safari, etc.) instead of running the application directly on their local machine.

Remote Hosting:

The application is typically hosted on a remote server, and users can access it via the internet. The server handles the processing, storage, and management of data.

Requires an Internet Connection:

Since web applications are accessed via the internet, they typically require a stable internet connection to function properly. Some web applications may offer offline capabilities via local storage (e.g., Progressive Web Apps or PWAs).

Platform Independence:

Web applications can be used across various platforms (Windows, macOS, Linux) and devices (desktops, laptops, tablets, and smartphones) as long as there is a compatible web browser. This makes them more accessible compared to desktop applications, which may be platform-dependent.

Interactive User Interface (UI):

Modern web applications are designed with rich, interactive user interfaces that offer a seamless experience. Technologies like HTML, CSS, JavaScript, and frameworks like React or Angular are used to create dynamic and responsive UI components.

Structure of a Web Application

A typical web application involves both **front-end** and **back-end** components:

1. Front-End (Client-Side)

The front-end is the user interface (UI) and includes everything the user interacts with directly. It is the **client-side** part of the application, which runs in the user's web browser. The front-end communicates with the back-end server to fetch and display data.

- **Languages and Technologies**:
    - **HTML**: The structure of the web page (e.g., headings, paragraphs, images).

  - **CSS**: The styling of the web page (e.g., layout, colors, fonts).
  - **JavaScript**: The interactive elements (e.g., form validation, dynamic content updates).
  - **Frameworks/Libraries**: React, Angular, Vue.js, Svelte, etc., are used for building dynamic and complex user interfaces.
- **User Interaction**: This involves forms, buttons, drop-down menus, and other UI components, making the application engaging for users.

2. Back-End (Server-Side)

The back-end handles the logic, database interactions, authentication, and other server-side functions. It processes requests sent from the front-end and sends back appropriate responses. The back-end is typically hosted on a remote server or cloud platform.

- **Languages and Technologies**:
  Server-Side Languages: Node.js, Python (Django, Flask), Ruby (Rails), Java (Spring), PHP, .NET, etc.
  Databases: SQL databases (e.g., MySQL, PostgreSQL) or NoSQL databases (e.g., MongoDB) for storing application data.
  Web Servers: Apache, Nginx, or Node.js for handling HTTP requests.
  API: The back-end typically exposes an **API (Application Programming Interface)**, often in the form of **RESTful** or **GraphQL** APIs, which allows the front-end to fetch or send data.

3. Communication Between Front-End and Back-End

- Web applications rely on **HTTP/HTTPS** for communication between the client and server. The client sends requests (such as loading a page or submitting a form), and the server processes those requests and returns the necessary data.
- Data exchange is often done in **JSON (JavaScript Object Notation)** format.

Types of Web Applications

1. **Static Web Applications**:

These are basic web applications that display fixed content. The content does not change dynamically based on user interaction (except for client-side JavaScript).

Example: A simple portfolio website or a personal blog.

2. **Dynamic Web Applications**:

These web applications have more complex functionality. Content changes dynamically based on user interaction or data from the server. They may also store user input or preferences.

Example: Online banking platforms, e-commerce sites, or social media platforms.

3. **Single Page Applications (SPA)**:

SPAs load a single HTML page and dynamically update content without reloading the entire page. SPAs provide a more fluid user experience by reducing page reloads and offering faster interactions.

Example: Gmail, Google Maps, Facebook.

4. **Progressive Web Apps (PWAs)**:

PWAs are web applications that offer offline capabilities, native app-like experiences, and improved performance. They can be installed on the user's device like a native app and work without an internet connection.

Example: Twitter Lite, Pinterest.

5. **Multi-Page Applications (MPA)**:

MPAs consist of multiple pages that reload when navigating between them. Each page has its own distinct URL.

Example: Traditional e-commerce websites or news websites.

Benefits of Web Applications

1. Cross-Platform Compatibility	2. Ease of Access	3. Cost-Effectiveness
4. Centralized Updates and Maintenance	5. Scalability	6. Security

Technologies Used to Build Web Applications

1. **Front-End**:
   - **HTML5**: Markup language used for structuring the content of web pages.
   - **CSS3**: Styling language used to design the layout, fonts, colors, and responsiveness of the web application.
   - **JavaScript**: Scripting language used for creating interactive elements and controlling browser behavior.
   - **Libraries/Frameworks**: React, Angular, Vue.js, Svelte, Bootstrap, etc.
2. **Back-End**:
   - **Languages**: JavaScript (Node.js), Python (Django, Flask), Ruby (Rails), PHP, Java (Spring), C# (.NET), etc.
   - **Databases**: MySQL, PostgreSQL, MongoDB, SQLite, etc.
   - **APIs**: RESTful APIs, GraphQL, WebSockets for real-time communication.
3. **DevOps and Hosting**:
   - **Web Servers**: Apache, Nginx, or Node.js.
   - **Cloud Hosting**: AWS, Google Cloud, Azure.
   - **Version Control**: Git (GitHub, GitLab).
   - **CI/CD**: Jenkins, Travis CI, CircleCI for continuous integration and deployment.

1.4 Apps for mobile devices:

An app is created for a certain operating system, such as Android or iOS, and it must be downloaded before it can be used. Mobile applications are software/sets of programs that operate on a mobile device and help the user with certain tasks.

Mobile applications are a relatively new and rapidly growing segment of the worldwide ICT industry. Mobile applications are simple, user-friendly, low-cost, downloadable, and run on most mobile phones, including low-cost and entry-level phones. The mobile application has a wide range of applications because of its extensive functionality, which includes calling, texting, browsing, chatting, social network communication, audio, video, and games, among others.

A vast number of mobile applications are pre-installed in phones, while others can be downloaded and installed via the internet. The growing number of mobile application developers, publishers, and suppliers serves this vast market of mobile applications.

From a technical standpoint, mobile applications can operate on a variety of controlled platforms, including iPhone, BlackBerry, Android, Symbian, and Windows; as well as virtual machines like Java/J2ME, BREW, Flash Light, and Silverlight.

There are various categories of mobile applications based on the application field.

1.5 Raster and Vector Maps:

Raster and vector maps are two distinct types of digital map representations, each with its own characteristics and uses.

1. Raster Maps

Raster maps are based on a grid of pixels, similar to photographs or scanned images. Each pixel has a specific color or value representing a certain geographical feature or characteristic (e.g., elevation, land cover, temperature).

Key Features of Raster Maps:

- **Pixel-based**: A raster map is made up of a grid of pixels, where each pixel stores data about the map's area.
- **Resolution**: The quality of the map is determined by its resolution (the number of pixels per unit of area). Higher resolution means more detail, but larger file sizes.
- **Data Types**: Raster maps often represent continuous data (e.g., elevation, temperature) or discrete data (e.g., land use types).
- **File Formats**: Common formats include JPEG, PNG, TIFF, GeoTIFF, and GRID.

Applications:

- Satellite imagery
- Elevation and terrain maps
- Climate data visualization
- Land use/land cover maps

2. Vector Maps

Vector maps, on the other hand, use geometric shapes such as points, lines, and polygons to represent geographical features. These shapes are defined by mathematical equations, which allows for precise representation.

Key Features of Vector Maps:

- **Geometry-based**: Vector maps use points (for locations), lines (for roads, rivers, etc.), and polygons (for areas like lakes, countries, or building footprints).
- **Scalability**: Vector data is resolution-independent. You can zoom in and out without losing quality, unlike raster maps.
- **Data Types**: Vector maps typically represent discrete data (e.g., roads, political boundaries, administrative regions).

- **File Formats**: Common formats include Shapefile (SHP), GeoJSON, KML, and DXF.

Applications:

- Road maps
- Political boundaries
- Infrastructure mapping (e.g., utilities, buildings)
- Navigation and routing
- Cartographic maps

Comparison of Raster and Vector Maps:

Feature	Raster Maps	Vector Maps
Data Representation	Pixel grid (continuous/discrete values)	Points, lines, and polygons (geometric shapes)
Resolution	Dependent on pixel count; higher = more detail	Resolution-independent (scalable without loss)
File Size	Larger for high resolution	Smaller, especially for simple geometries
Data Type	Continuous (e.g., temperature, elevation)	Discrete (e.g., roads, boundaries, buildings)
Editing	Less flexible (pixel manipulation)	Easy to edit and modify (adjust shapes, move points)
Accuracy	Limited by pixel size (blurring)	High precision, no blurring
Suitability	Ideal for imagery, satellite data, terrain	Best for maps of infrastructure, political boundaries, and geometry

- **Raster maps** are best suited for continuous data and detailed imagery, where resolution and texture are important.
- **Vector maps** excel in representing structured data with precise boundaries, making them ideal for tasks like navigation, geospatial analysis, and cartography.

1.6 Web-based applications and geographic information systems (GIS): For the past few years, GIS has been actively used in the health domain in the migration of a few GIS functions. A graphical user interface (GUI) is becoming increasingly popular as a way to make it easier for users to find information.

Users can utilize the Web Application without having any prior knowledge of GIS specialized software. To utilize the online application, users must have one of the accessible web browsers. The goal of this research is to provide a web-based GIS tool for health care facilities.

2. Objective:

To evaluate the long-term historic changes in health GIS based Web Applications/Android Apps.

3. Various Health GIS Applications for last 15 years:

EASTWeb: To assist in the development of early warning systems for mosquito-borne illnesses, an open-source, customer-based programming tool called Epidemiological Applications of Spatial Technologies was created. It's been used to predict West Nile virus outbreaks in the US and malaria epidemics in Ethiopia's highlands. (Yi Liu and colleagues, 2015).

VBD-AIR: The Vector-Borne Disease Airline Importation Risk Application (VBD-AIR) is a user-friendly Web-based GIS tool that was created to help better define the involvement of airports and airlines in the transmission and spread of vector-borne diseases.

The VBD-AIR tool was created to allow users to investigate the interrelationships between modeled global distributions of vector-borne infectious diseases (malaria, dengue, yellow fever, and chikungunya) and international air service routes to quantify seasonally changing risks of vector and vector-borne disease importation and spread by air travel, forming an evidence base to aid in mitigation strategies. Huang and colleagues (2012).

SMOKU: The administration of the Jabatan Kebajikan Masyarakat (JKM) designed SMOKU to handle all aspects of PWD management, including PWD registration requests details and information were saved in the system (2018). Rasam et al.

App Mozzify: Mozzify is a mobile health (mHealth) app that includes a real-time dengue fever case reporting and mapping system, health communication (a piece of real-time global news and chat forum/timeline, within-app educational videos, links to local and international health agency websites, and interactive signs and symptoms checker, and a hospital directions system), and behavior modification (reminders Alex) (2020).

Mawid app: It is a central appointment system supplied by Saudi Arabia's Ministry of Health. Patients can use the app to plan, change, and reschedule appointments, as well as manage referral appointments, at any of Saudi Arabia's 2400 primary care centers. The application includes a self-assessment feature for COVID-19, as well as a public consultation window. Turki is a Turkic word that means " (2021).

Tabaud App: The Tabaud app was created to help Saudi Arabia reach health and safety goals by controlling the COVID-19 outbreak and restricting the spread of novel coronaviruses, easing limitations on social and economic activities.

The app is mostly used for contact tracing, as it alerts users when they come into close contact with other infected people who are also using the app. For contact tracing, this software leverages the Google Apple API, which ensures that users' privacy and security are protected. Turki is a Turkic word that means "(2021).

Tawakkalna App: The Tawakkalna App is an official mobile application certified by Saudi Arabia's Ministry of Health. The goal of this software is to make emergency mobility of individuals easier during lockdowns and curfews. Furthermore, the application provides data about the COVID-19, such as the number of infections in various regions. In the event of an emergency during curfew, Saudi nationals can use the app to request travel permits. The software also alerts users if they are near contagious or hazardous areas. Turki is a Turkic word that means " (2021).

Sehha App: The Sehha mobile application is one of Saudi Arabia's most advanced mobile health applications. The software was created to provide users with e-consultations in audio and video formats from the comfort of their own homes.

The program makes use of artificial intelligence (AI) to provide users with secure medical information while also improving their consultation experience. During the COVID-19 outbreak, the Sehha application was found to be quite effective in easing movement limitations. Turki is a Turkic word that means " (2021).

AarogyaSetu App: AarogyaSetu is an official smartphone application developed by the Indian government to track the COVID-19 epidemic and prevent it from spreading further. For tracking, the app uses both GPS and Bluetooth technology.

This program, like Tawakkalna, employs Bluetooth technology to communicate with adjacent devices and GPS to track the user's location about other smartphone users who have been infected and are also using the same app. Additional features include self-assessment tests, test reports, e-permits for travel, COVID-19-related information, preventive approaches information, online consultations, and more. 41 More than 1.4 million users have been notified of the potential for contamination, and the app has assisted in the creation of 697 coronavirus hotspots across the country (2021).

TraceTogether App: The Singapore government launched TraceTogether, a contact-tracing mobile application. This app, like the AarogyaSetu app, employs Bluetooth technology to detect when a user is close to an infected person and sends an alarm to the user (2021). COVID Safe is a free app that allows you to stay safe online.

The Australian government has certified it as the only contact app. The app's goal is to track people's movements and determine whether they have come into close touch with infected individuals. It communicates with other devices that have installed the COVID Safe application utilizing Bluetooth technology (via a digital handshake). Date, time, and contact numbers are securely encrypted and saved on the phone for 21 days; users can erase the data after that period. Turki (2021).

Immuni App: It is a mobile app that helps you stay healthy. The Italian government launched a contact-tracing app in June 2020. This program works similarly to other contact-tracing apps in that it warns users if they come into close contact with someone who is infected and is using the same app.

The app's distinguishing characteristic is that it uses Bluetooth low energy technology, which ensures low power consumption. Furthermore, the app does not gather any personally identifiable information such as a user's name, date of birth, address, phone number, or email address. 49 When two smartphone users using the Immuni app nearby, their smartphone exchange produced codes automatically.

If one of the users is diagnosed with the virus, the application will be able to track out past encounters. The code is then entered into a centralized system by health authorities with the patients' approval, and this system is utilized to inform all other users who have come into close contact with the patient (using the code). 50 Furthermore, the application has a multi-language capability that allows people of many countries to utilize it in Italy. The application does not track user movements and simply shares contact tracking codes. By December 31, 2020, all data gathered and exchanged with the central server will be destroyed.

The COVID Symptom Study app was created by academics at King's College London's Guys and St Thomas' Hospitals, as well as Zoe Global Limited, a health technology firm. The goal of this software is to figure out how the virus spreads, identify high-risk areas in the UK, assess susceptible groups, and figure out how symptoms are linked to underlying health issues. This app does not provide any information or health advice; rather, it is designed to collect data from users to encourage COVID-19 research in the UK and better preventive measures. People can engage in the study willingly and provide two sorts of data daily. The first section is about general facts like age, health, and any underlying illnesses, while the second section is on the symptoms. More than 4 million people in the UK have volunteered to provide data to the program, which has aided in the creation of an efficient database that can be used to analyze COVID19 data.

COVID-19 NHS App:

NHS Test and Trace in the United Kingdom has released the NHS COVID-19 app. The app tracks users' movements using Bluetooth low energy technology and GPS. This app can be used for a variety of things. For starters, it notifies a user if they have had close contact with other app users who have tested positive for COVID-19. Second, it allows users to report symptoms and schedule a free COVID-19 test. Finally, when users check into a location or venue, they are informed whether there are a large number of positive cases reported there. Fourth, it allows users to keep track of their self-isolation countdown and get helpful information. The program does not save any personal data that can be used to identify a user. For track and trace purposes, however, information such as location tracking, postcode, venue check-in, and so on is collected.

App for COVID Watches: The COVID watch app (USA) was created by the University of Arizona with funding from the Arizona Department of Health Services. The program is presently being utilized within the institution, with plans to expand it out across Arizona in phases.

The app's objective is to notify users if they come into close contact with any of the app's registered infected users. The app makes use of Bluetooth technology and does not track your position. Furthermore, it does not collect any personal data that can be used to identify the user. It was one of the first programs to launch an open-source specification, and it has a unique feature in that no party or authority can trace who has been notified.

PathCheck App: Finally, the PathCheck program (USA) is a contact-tracing application developed by MIT and TripleBlind, who teamed up to form the PathCheck Foundation, a newly formed non-profit organization. The app's goal is to bring people and health departments together to share information to stop the spread of new coronaviruses. The program makes use of the Google Apple Exposure Notification API, which ensures that the data of users is kept private and secure. 57 On their phones, individuals can save their private locations and symptom diaries. The app is integrated with several health departments, and users may choose which department they want to exchange information with and receive services from. Path Check's mission is to promote the re-emergence and re-opening of economies and communities.

Comparative Study of various Web Applications/ Android Apps on Health GIS

Disease	Place	Application/ Technology used	S/W used for	Author and year
mosquito-borne diseases (WNV, malaria)	USA & Ethiopian highlands	EASTWeb	forecasting of West Nile virus outbreaks in the United States and malaria epidemics in the Ethiopian highlands.	Yi Liu et al., 2015
vector-borne diseases	-------	GIS, RS, DSS, spatial & space-time modeling	Future Prediction	Lars Eisen et al., 2010
West Nile Virus (WNV)	Greece	wild bird surveillance, GIS Spatial Analysis	Predicting Spatial Distributions of West Nile Virus in Greece	George Valiakoset al., 2014
cholera	Tawau, Sabah	MyGeoHealth	developing an introduced cholera transmission risk system in Tawau, Sabah.	Abdul Rauf Abdul Rasam et al., 2011
Dengue	Kaohsiung and Fengshan	OLS & GWR model	geographically differentiating the relationships of dengue incidence with immature mosquito and human densities.	Chia-Hsien Lin et al., 2011
Dengue	Malaysia	ANN, Spatial Analysis	distribution pattern	Aziz et al., 2011

COVID-19	------	spatiotemporal analysis, health and social geography, environmental variables, data mining, and web-based mapping	Understanding the spatiotemporal dynamics of COVID-19	Ivan Franch-Pardo et al., 2020
MBDs	-------	mapping and modeling based on SITs (e.g., GIS and its related tools)	describing the factors to control the disease	Hassan M. Khormi et al., 2011
vector-borne diseases		Web-based GIS tool: VBD-AIR	defining the roles of airports and airlines in the transmission and spread of vector-borne diseases	Zhuojie Huang et al., 2012
kala-azar	Vaishali district (Bihar), India	IDW	interpolating and predicting the pattern of VL cases	Gouri Sankar Bhunia et al., 2013
Dementia		smartwatch with the mobile phone along with messaging push technologies	alerting the patient and the caregiver	Alraddadi, Fiaidhiet al., 2017

Web Application	Country/ Place	Used for	Pros	Cons	Reference
VBD-AIR	-------	vector-borne diseases			Huang et al., 2012
SMOKU	Malaysia	PWDs			Rasamet al., 2018

Android-based (GIS)-tagged tablets (TABs)	Mangaluru city, Karnataka, India	control measures to create a digital database of each malaria case			Baliga et al., 2019
Mozzify **App**	-----	**Dengue Reporting and Mapping**			Herbuela et al., 2020
Real-time GIS-based disease surveillance	-----	**disease surveillance for leprosy control**			Wijesinghe, 2018
Mawid App	Saudi Arabia	**COVID-19**			Turki, 2021
Tabaud App	Saudi Arabia	**COVID-19**			Turki, 2021
Tawakkalna App	Saudi Arabia	**COVID-19**			Turki, 2021
Sehha App	Saudi Arabia	**COVID-19**			Turki, 2021
AarogyaSetu App	India	**COVID-19**			Turki, 2021
TraceTogether App	Singapore	**COVID-19**			Turki, 2021
COVID Safe App	Australia	**COVID-19**			Turki, 2021
Immuni App	Italy	**COVID-19**		The application does not track movements	Turki, 2021
COVID Symptom Study App	UK	**COVID-19**			Turki, 2021
NHS COVID-19 App	UK	**COVID-19**			Turki, 2021
COVID Watch App	Arizona, USA	**COVID-19**	any party or authority could not track who has been informed	does not use location tracking, it does not collect any personal information	Turki, 2021

				that can identify the user	
PathCheck App	USA	**COVID-19**			Turki, 2021
OnTAPP		Dengue			Delmelle, Zhu, et al., 2014
H.E.L.P.	Cali, Colombia	------			Delmelle et al., 2011
SNDR		Diabetes			Rubeaan, Youssef et al., 2013
GeoFog4Health	Maharashtra. India	Malaria			Barik, Dubey et al., 2018
MosquitoMap	----	Vectors of diseases (Mosquitoes)			Foley, Wilkerson et al., 2010
WebEpi	Tasmanian	Health Monitoring			Zhang, Zhang et al., 2009
DTMM	Thai-Cambodian border	malaria			Meankaew, Kaewkungwal et al., 2010
AfyaData App	Africa	-----			Karimuribo, Mutagahywa et al., 2017

4. **Result and Discussion**:

The EASTWeb software has the potential to serve as a more general solution to help bridge the gap between earth observation science and the application of geospatial technologies in the public health arena (Yi Liu et al., 2015).

GIS and spatial analysis can be used as a natural and effective means to approach a variety of program, policy, and planning issues in Health Promotion and public health. These tools offer unparalleled capabilities for describing, analyzing, Modelling, and visualizing health and place issues relevant for policy agenda in every jurisdiction (Nykiforuk et al., 2011).

GIS and spatial statistical analysis provided and new dimension to the health authorities in Malaysia specifically in the potential of using GIS applications, GPS, and other applications to develop Strategies for the implementation of prevention and control activities for DF and DHF (Aziz, NGUI et al., 2012).

Mozzify App has good user design, functionality, usability, engagement, and contains a relevant information system (Karita et al., 2020).

5. Conclusions:

This comprehensive review on geospatial technology and services for infectious diseases surveillance is to illuminate the path for decision-makers and public health officials for the implementation of a web-based health information system. Geospatial technology is having a rich set of tools for understanding spatial and temporal aspects in a wide range of disciplines, dominantly in geospatial health research for establishing the links between diseases and in its suitable environment. Also, this provides various geostatistical approaches to perform analysis in finding the interconnectedness of spatial and temporal links, outbreak detection, identifying the population at risk, movement tracing of infectious agents, investigation of environmental factors responsible for the outbreak, and hotspot and cold spot analysis of outbreak location.

Various Health GIS-based Mobile Apps and Web Applications were developed for Detecting different kinds of Human Diseases for the last few years. In recent years COVID-19 was the most vulnerable disease for human resources, and so many mobile apps and web applications are available that helped a lot in the prevention of COVID-19, and out of them, Arogyasetu was the most effective as it helped the people of India which is 2nd most populated country of the world.

This review paper concluded that geospatial applications and web-based applications could offer a well-timed solution to the all-time historic challenge of humankind in understanding the disease outbreaks, vulnerabilities to population health, and adaption of the upcoming generation.

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