Developing Website-Based Information System Applications to Map PT. XYZ's Properties Using Next.JS Framework with Haversine Method

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Abstract. The presence of technology in society fosters rapid innovation in the industrial sector. Information Systems in the property industry is necessary for the development of marketing and sales. The customer's attitude towards the Website Application is determined by the perceived benefits, trust and customer satisfaction with the Website which helps users to obtain information about the current property of the XYZ company and trust PT. XYZ to make predictions using location calculations with the Haversine Calculation method. Through this prediction, it is hoped that we discover the University's closest location to the PT. XYZ property. Application specially designed to make it easier for PT. XYZ customers in server-side rendering is very useful when loading single page applications because it results in a better user experience with Next Js. This application utilizes the Geographic Information System feature supported by Google Maps equipped with a geolocation feature that can pinpoint a location based on latitude and longitude, as well as using the Haversine Formula technique in a web application which is useful for users.
Keywords: property, Haversine Calculation, React, website application

INTRODUCTION

The Website Application is a service designed for users who have an Internet connection that is accessed by a browser equipped with multimedia documents such as text, images, sound, animation, and video using the Hypertext Transfer Protocol [1]. Estate property management identifies the complexity of a management process related to a broad and inherently spatial location/geographical area. Traditionally, the function of spatial data is to assist joint plantation management activities through a Management Information System. However, Geographic Information Systems have demonstrated their efficacy in many plantation property management applications in recent days. [2].

Many studies have identified that the visual identity of the company's brand web design reflected in the company's website design, so the company design guidelines should be considered. Color has a strong effect on the design of a web that affects individual perception. If the company's website design is favored, the company's brand can be perceived in a more positive way which leads to a more modern perception of the company's brand. The clearer the structure of the website, the company's brand become more transparent and reliable for customer [3]. GIS technology allows increasing property productivity by providing information with higher accuracy and precision that was previously unavailable. GIS, developed using maps, fulfills the spatial visualization of properties in a concise and user-friendly manner.

METHOD AND MATERIALS

RAD (Rapid Application Development) method

This application uses the Rapid Application Development Method. According to previous research [4], Rapid Application Development is used as an information developer because this method focuses on program development. The RAD method also includes an approach by developing applications consisting of analysis, design and implementation in testing system development in a short time to develop a system that is in accordance with the wishes

of the user. According to Coronel [5], System Development Life Cycle RAD is a framework process that functions in developing applications consisting of planning, analysis, design and implementation.

GIS (Geographic Information System) method

The application uses the Geographic Information System (GIS) method, a geospatial web service paradigm that captures, stores, analyzes, and visualizes data describing parts of the earth's surface, technical and administrative entities, as an information system with an observable database of objects, activities, or events, which can be described by points, lines, or surfaces in a complete manner for capturing, storing, retrieval, transformation, and visualization of real-world spatial data containing all spatial data of the atmosphere, Earth's surface, and lithosphere, enabling systematic capture, updating, manipulating, and analyzing data [6] [7]. The method used to predict the closest university to the property of PT. XYZ is a Haversine Calculation Prediction Calculation method. A method for determining the distance between two points by observing that the earth is a plane that has degrees of curvature which is the Haversine Formula. At trial stage, a review of the calculation with manual results is carried to minimize errors in the application [8]. Method defined on Figure 1.

```
const getDistance = (x1, y1, x2, y2) => {
  const R = 6371e3;
  const φ1 = (x1 * Math.PI) / 180; // φ, λ in radians
  const φ2 = (x2 * Math.PI) / 180;
  const Δφ = ((x2 - x1) * Math.PI) / 180;
  const Δλ = ((y2 - y1) * Math.PI) / 180;

  const a =
    Math.sin(Δφ / 2) * Math.sin(Δφ / 2) +
    Math.cos(φ1) * Math.cos(φ2) * Math.sin(Δλ / 2) * Math.sin(Δλ / 2);
  const c = 2 * Math.atan2(Math.sqrt(a), Math.sqrt(1 - a));

  const d = R * c; // in metres
  return d;
};
```

FIGURE 1. The Haversine Formula Method in Programming [Image Source: Personal Documentation]

With the hypothesis that the earth with a radius of R 6367, 45 km, and location of the second point on the coordinate sphere, respectively lon1, lat1, and lon2, lat2, the formula can be written in an equation. Latitude and longitude angles must be converted from degrees to radians before trigonometric functions be used. The Haversine formula is defined in Formula 1.

$$\Delta lat = lat2 - lat1 \quad \Delta long = long2 - long1 \quad a = sin^2\left(\frac{\Delta lat}{2}\right) + cos(lat1) * cos \, cos \, (lat2) * sin^2\left(\frac{\Delta long}{2}\right) \quad (1)$$
$$c = 2 * atan^2(\sqrt{a}, \sqrt{1-a})$$
$$d = R * c$$

FORMULA 1. The Haversine Formula [8]

Description:

R	=	Earth's radius is 6371 (km)
Δlat	=	amount of change in latitude
$\Delta long$	=	amount of change in longitude
c	=	Trend coefficient value in period t
d	=	*distance (km)*
1 *degree*	=	0.0174532925 *radians*

60

This method was chosen because the Haversine Calculation is suitable for determining the closest distance and comparing the results with calculations for finding the closest location and designing a GIS.

Materials

The data is used through the creation and processing of primary and secondary data, while the measurement of accuracy using the Haversine formula. GIS was built after the calculation results were obtained [9]. The calculation of the distance from the starting point of the property to the reference university can be generated using the Haversine formula.

LITERATURE REVIEW

Google Maps is a Geographic Information System application provided by Google which used to find locations or regions in the world, accessible via an internet browser, and can pinpoint a specific location based on latitude and longitude [10]. A way of determining the distance between two points noting that the earth having degrees of curvature is the Haversine Formula, a method in spherical geometry for calculating the distance between two points on a curved surface such as the Earth, based on their longitude and latitude.

These coordinates define a unique large circle that is divided into two arcs [11]. Research on the application of the Haversine Formula method has been used previously in several studies such as: Locating the nearest Nugraha Ekakurir (JNE) Line [12], Information System for Searching for Higher Education Locations in Makassar [13], Application of the Haversine Formula Method in Geographic Information Systems for Land Area Measurement [14] in finding the shortest distance of a straight line to the system, and grouping geotagged photos in calculate longitude and latitude [15].

RESULT AND DISCUSSION

Personnel are required in managing and operating a Website-Based Information System Application for mapping the property of PT. XYZ using the Next.JS Framework with the Haversine Method. The personnel are divided into 2, namely admin and user. The following are the roles of each personnel: First, the Admin who is the developer is in charge of managing all data on the website starting from input, updating and deleting property data and university data into the database in the Content Management System. Second, users who are customers of PT. XYZ can view various property information of PT. XYZ and discover the location of the nearest university that is predicted by the Haversine method for making the desired decision by using the application. The development of this Website Application uses the JAM (JavaScript, APIs and Markup) Stack, the React Library with the Next Js Framework solves React's client-side rendering problem which is rendered and then requested to the server which is then responded to by the HTML page very quickly [16] , Sanity Studio as a Content Management System that stores data and as a mature technology stack architecture involves Core Technologies such as PostgreSQL, ElasticSearch, JavaScript, and React which are very fast without the possibility of being hacked. The Sanity platform data store resides in the cloud and can be accessed via the Sanity API either using the Sanity client library or via the HTTP API directly making it possible for a collaboration using Sanity Studio to create data-driven content applications that are efficient, and real-time connected services [17].

The Google Maps API that helps in application development can be used to provide simple map services to the public [18] and perform the Haversine Calculation method. The design made on this Website Application program uses the Unified Modeling Language (UML) model. Entity-Relationship Diagram (ERD) design is chosen, which describes how the data of a system is stored at a high level of detail [19]. The program design can be seen at Figure 2.
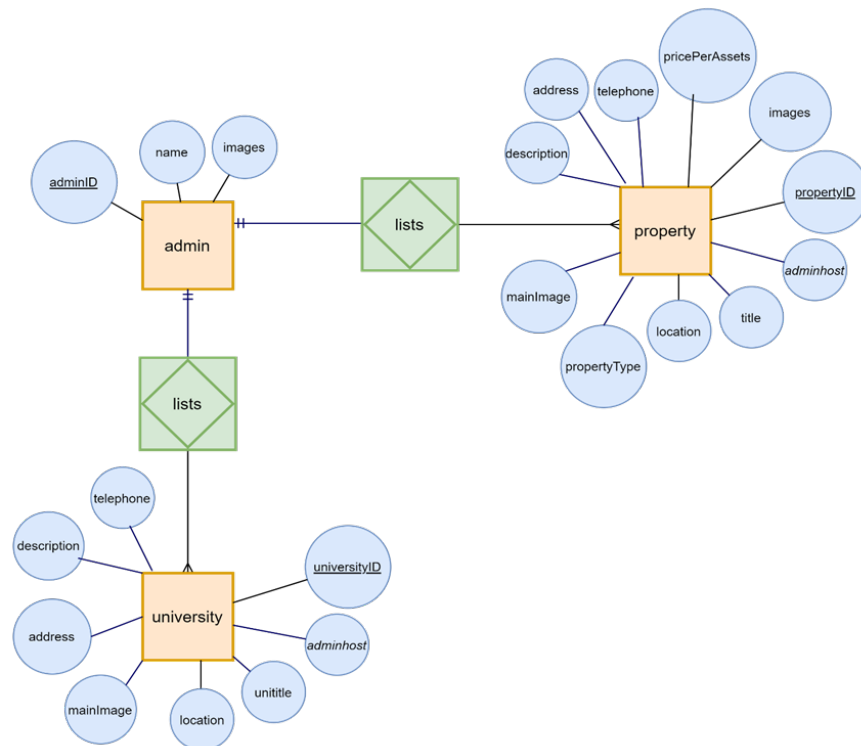
FIGURE 2. Entity-Relationship Diagram (ERD) [Image Source: Personal Documentation]

From the prediction calculation process using the Haversine Calculation, the prediction results are obtained from the nearest Property and University data. After getting the prediction results, the data will be displayed in the form of a Website Application with the Next Js Framework, adjusting to the inputted data, updating it, and then displaying it in visual form. The visuals displayed in the Website Application are the closest universities with properties which are sorted from closest to furthest and then limited by the filters provided by the application, namely from 10KM (>10000), 50KM (>500000), 100KM (>10000) according to the managed data. Developers. The use of this filter aims to help users find out property information of PT. XYZ. The program design can be seen at Figure 3.
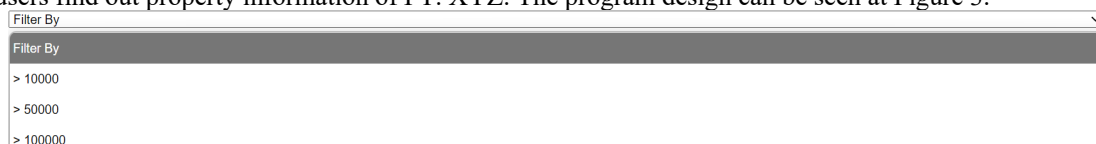
FIGURE 3. Haversine Website Application Filter Interface [Image Source: Personal Documentation]

FIGURE 4. Haversine Website Application Result Interface [Image Source: Personal Documentation]

CONCLUSION

Based on the explanation, it can be concluded that the Website Application Development in the property sector aims to provide convenience for PT. XYZ in searching for existing properties and yields significant results in management efficiency with the power of technology that ensures the speed and security. PT. XYZ website is supported by a feature that shows the closest property to various universities by prediction using the Haversine Calculation method.

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