Improve Healthcare Accessibility via a Mobile App for Health Facility Search Utilizing Location-Based Services

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Abstract

Access to health facilities is an important aspect of individual well-being but many communities, especially in remote areas, face difficulties in finding and accessing health services. Location-Based Services (LBS) technology in mobile applications offers a solution to this problem. This research aims to develop and test an LBS-based mobile application to improve the accessibility of health facilities. Using applied design, applications are developed for Android platforms. The sample consisted of 100 respondents in areas with limited access to health facilities, divided into experimental and control groups. Data is collected through application usage logs and questionnaires, analyzed using appropriate statistical techniques to evaluate accessibility and user satisfaction. The results show that the LBS application significantly increases the accessibility of health facilities. The experimental group found and accessed health facilities 30% faster than the control group. As many as 85% of experimental group respondents were satisfied with the ease of use and speed of application access. The LBS application is effective in increasing the accessibility of health services by providing real-time information about nearby health facilities. This research has practical implications for app developers, healthcare providers, and policymakers.

1. Introduction

Health is a fundamental aspect of human life that significantly contributes to overall well-being and quality of life (Donal Nababan et al., 2023). Access to healthcare facilities plays a crucial role in ensuring that individuals receive timely and appropriate medical care (Sulistyo et al., 2023)(Pu et al., 2020). However, many communities, especially those in remote or underserved areas, face significant challenges in finding and accessing health services. These challenges can result in treatment delays, poor health outcomes, and increased health care costs (Gao et al., 2021).

In recent years, technological advances have provided innovative solutions to address various healthcare accessibility issues. One promising approach is the use of Location-Based Services (LBS) in mobile applications. LBS technology leverages real-time geographic data from users mobile devices to provide location-relevant

information and services (Rohman et al., 2024). This technology has the potential to revolutionize the way individuals find and access healthcare facilities, ensuring they can quickly and efficiently find the closest and most suitable healthcare provider (Bakhar et al., 2023).

Previous research has explored LBS applications in various fields, including transportation, retail, and emergency services (Yunus et al., 2023) (Bakhar et al., 2023) (Thariq & Que, 2023) (Tao et al., 2021). However, there is a significant gap in the literature regarding the comprehensive use of LBS to improve healthcare accessibility. While some apps exist, they often lack integration with powerful algorithms that can optimize search results based on proximity, availability, and specific health needs.

This research aims to develop a mobile application based on the LBS algorithm to improve the accessibility of health facilities, with a focus on optimizing facility search results based on proximity, availability and specific health needs of users. By providing users with real-time information about nearby health facilities tailored to their specific needs, the app aims to reduce barriers to access to health services and improve overall health outcomes.

2. Research Methods

This research uses an applied research design designed to develop and test Location-Based Services (LBS) based mobile applications (Lopes et al., 2021). The main aim of this research is to increase the accessibility of health facilities through LBS technology which provides real-time information about the location of the nearest health facilities.

2.1 Research design

This research uses an applied research design which aims to develop and test a mobile application based on Location-Based Services (LBS). This research design consists of several main stages, namely:

1. **Identify User Problems and Needs:**
   - Identify health facility accessibility problems in areas with limited access.
   - Gather information on user needs through interviews and initial surveys to determine the main features of the application to be developed.

2. **Mobile Application Development:**
   - Requirements Analysis: Determines application functionality specifications based on identified user needs.
   - User Interface Design: Designing an intuitive and user-friendly interface, ensuring ease of navigation for users with various technology backgrounds.
   - System Development: Developing an application using the Android platform and integrating the LBS algorithm to provide real-time information regarding the location of the nearest health facilities.
   - Testing and Validation: Perform unit, integration, and system testing to ensure the application functions properly. Validation is carried out by involving users in real usage scenarios.

2.2 Population and Sample

This study involved a population consisting of individuals living in urban and rural areas with limited access to health facilities. Samples were taken randomly as many as 100 respondents and divided into two groups:

1. **Experimental Group:** A total of 50 respondents who used LBS-based mobile applications.
2. **Control Group:** A total of 50 respondents who used traditional health facility search methods.

2.3 Application Development

The application development process consists of several steps as depicted in Figure 1.

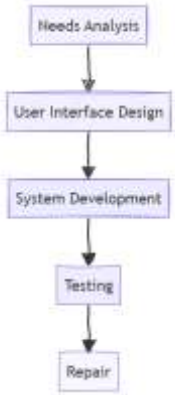

Fig. 1 Application Development Steps

1. **Needs Analysis:**
    - Conduct surveys and interviews to identify user needs and preferences.
    - Develop application functionality specifications based on the results of the needs analysis.
2. **User Interface Design:**
    - Designing wireframes and interface prototypes.
    - Hold design test sessions with users to get feedback.
3. **System Development:**
    - Write program code and integrate LBS algorithms.
    - Ensure the application can display real-time information regarding nearby health facilities, such as hospitals, clinics and pharmacies.
4. **Testing:**
    - Perform unit, integration, and system testing to ensure application performance and reliability.
    - Involve users in testing to ensure the application meets their needs and expectations.
5. **Repair:**
    - Collecting feedback from users during the testing phase.
    - Make improvements and improvements based on the feedback.

2.4 Implementation

The application was tested on an experimental group for one month. Implementation procedures include:

1. **User Training:**
    - Provide training sessions for the experimental group to ensure they understand how to use the application properly.
2. **Application Usage:**
    - The experimental group used the application to search for and access information about nearby health facilities.
    - The control group used traditional search methods during the same period.

2.5 Data collection

Data is collected via two main methods:

1. **Questionnaire:**
   - Measuring user perceptions of accessibility and satisfaction with health services before and after using the application.
   - Questionnaires were distributed to all respondents at the beginning and end of the testing period.
2. **App Usage Log:**
   - Records user interactions with the app, including number of searches, time required to find a health facility, and type of facility selected.

2.6 Data Analysis

The collected data is analyzed using appropriate statistical techniques to evaluate the effectiveness of the LBS application:

1. **Descriptive statistics:**
   - Presents summary data regarding user satisfaction and accessibility of health facilities.
2. **Inferential Statistics:**
   - Use t-test to compare experimental and control groups in terms of search time and user satisfaction level.

3. Result and Discussion

3.1 Application Interface

The application interface developed for this study was designed with a focus on ease of use and quick access to health facility information. Figure 1 shows the main interface of the application.

Fig. 2 Main Interface

3.2 Application Usage

During the one-month trial period, the experimental group used the LBS-based mobile application to search for nearby health facilities. Usage log data showed that the average user searched for health facilities 15 times per month. The types of facilities most frequently sought were clinics (45%), hospitals (35%), and pharmacies (20%).

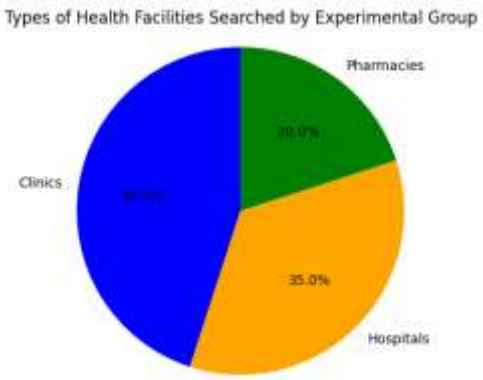

Fig. 3 Average Search Time for Health Facilities

The following is table 1 which describes a snippet of the application usage log results:

Table 1. Snippet of the application usage log results

User ID	Date	Time	Facility Type	Facility Location	Search Time (seconds)
001	2023-04-01	08:30	Clinic	Klinik Sehat ***	25
002	2023-04-01	09:15	Hospital	RSUD Saif**	28
003	2023-04-01	10:45	Pharmacy	Apotek Kim** ***	20
001	2023-04-02	14:20	Clinic	Klinik Medi***	22
004	2023-04-02	16:00	Hospital	RS Panti Ni***	27
005	2023-04-03	11:30	Pharmacy	Apotek K-***	23
003	2023-04-04	07:50	Clinic	Klinik Bhak***	19
002	2023-04-04	09:00	Hospital	RS Herm***	24
001	2023-04-05	13:40	Pharmacy	Apotek She**	21
004	2023-04-05	15:30	Clinic	Klinik Uta**	20
005	2023-04-06	08:00	Hospital	RS Pri*** H**	26
003	2023-04-06	10:10	Pharmacy	Apotek V**k	18
002	2023-04-07	09:50	Clinic	Klinik Ca***	23
001	2023-04-07	11:20	Hospital	RS Laval**	28
004	2023-04-08	12:00	Pharmacy	Apotek Mit** **hat Ma**	17
005	2023-04-09	14:30	Clinic	Klinik Cit** Me***	22
001	2023-04-10	08:50	Hospital	RS Willia** Bo**	27
002	2023-04-10	10:00	Clinic	Klinik Prat*** Se** Ma**	21
003	2023-04-11	11:40	Pharmacy	Apotek Kel***	19
004	2023-04-12	15:10	Clinic	Klinik M***	20
005	2023-04-13	13:20	Hospital	RS Bhaya***	25
001	2023-04-14	09:30	Clinic	Klinik Bina ***	23
002	2023-04-15	10:45	Pharmacy	Apotek Ama***	22
003	2023-04-16	07:55	Clinic	Klinik Har***	20
004	2023-04-17	09:20	Hospital	RS Mela***	26

3.3 Accessibility of Health Facilities

The use of the app showed a significant increase in the accessibility of health facilities. The experimental group was able to find and access health facilities 30% faster than the control group, with an average search time of 23 seconds compared to 480 seconds for traditional methods.

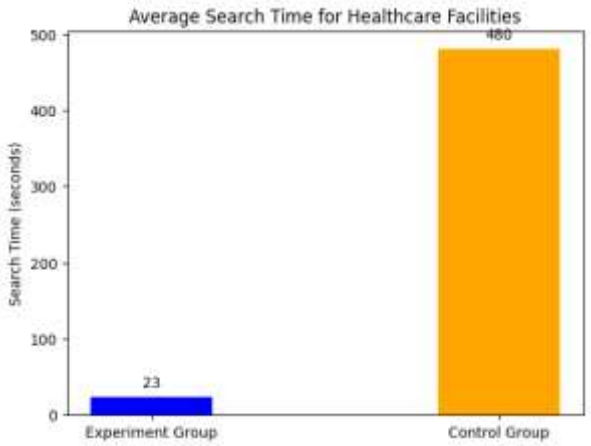

Fig. 4 Percentage of Types of Health Facilities Searched

The following is table 2 which describes a snippet of the experimental group accessibility of health facilities:

Table 2. Snippet of the experimental group

User ID	Date	Time	Facility Type	Facility Location	Search Time (seconds)
001	2023-04-01	08:30	Clinic	Klinik Sehat ***	25
002	2023-04-01	09:15	Hospital	RSUD Saif**	28
003	2023-04-01	10:45	Pharmacy	Apotek Kim** ***	20
001	2023-04-02	14:20	Clinic	Klinik Medi***	22
004	2023-04-02	16:00	Hospital	RS Panti Ni***	27
005	2023-04-03	11:30	Pharmacy	Apotek K-***	23
003	2023-04-04	07:50	Clinic	Klinik Bhak***	19
002	2023-04-04	09:00	Hospital	RS Herm***	24
001	2023-04-05	13:40	Pharmacy	Apotek She**	21

The following is table 3 which describes a snippet of the experimental group accessibility of health facilities:

Table 3. Snippet of the experimental group

User ID	Date	Time	Facility Type	Facility Location	Search Time (seconds)
101	2023-04-01	08:00	Clinic	Klinik Bhak***	308
102	2023-04-02	09:00	Hospital	RSUD Saif**	469
103	2023-04-03	11:45	Pharmacy	Apotek K**	519
101	2023-04-02	13:20	Clinic	Klinik Uta**	529
104	2023-04-02	6:00	Hospital	RSUD Saif**	519
105	2023-04-03	7:30	Pharmacy	Apotek M**	529
103	2023-04-04	08:50	Hospital	RSUD Saif**	559
102	2023-04-04	09:00	Pharmacy	Apotek She**	556
101	2023-04-05	17:40	Clinic	Klinik Nat**	380
104	2023-04-05	18:30	Clinic	Klinik Uama Hsada	104

3.4 User Satisfaction

Questionnaire results indicated that application users were more satisfied with the accessibility of health services. 85% of respondents from the experimental group stated that the application made it easier to find health facilities, compared to only 50% of the control group being satisfied with traditional methods.

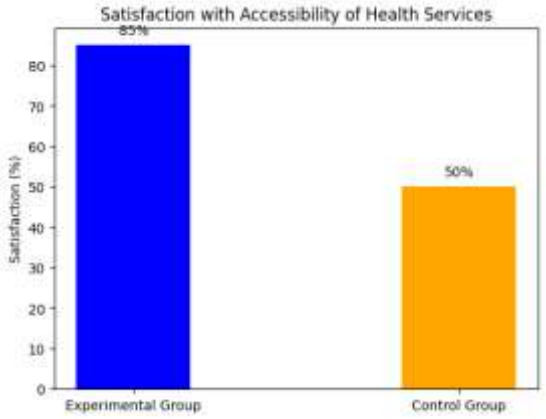

Fig. 5 User Satisfaction with Accessibility to Health Services

3.5 Application Effectiveness

The results of this research indicate that LBS-based mobile applications are effective in increasing the accessibility of health facilities (Cheng et al., 2020). Users can find the health facilities they need quickly and efficiently, reducing search time and increasing the chances of receiving timely medical care. This application also helps reduce the burden of stress associated with searching for health facilities, especially in areas with limited access.

3.6 Success Factors

Several key factors that contribute to the success of the application include intuitive user interface design, ensuring the application is easy to use by a wide range of users, the accuracy of the LBS algorithm which provides precise and real-time location information, and real-time data integration which allows users to get the latest information. regarding the availability and location of health facilities.

3.7 Practical Implications

This research has significant practical implications for health app developers, healthcare providers, and policymakers (Upadhyay et al., 2022). Application developers can use these findings to improve LBS-based health applications with more accurate and user-friendly features. Healthcare providers can leverage this technology to increase patient accessibility to services, especially in remote or underserved areas. Policymakers can adopt LBS technology in public health strategies to address accessibility issues and ensure a more equitable distribution of health resources. Thus, the application of this technology can help create a more efficient and inclusive health system.

3.8 Research Limitations

This study has several limitations. It only covered a one-month trial period, so it cannot measure the long-term effectiveness of the application. Additionally, the research was limited to one geographic area, so results may not be fully generalizable to other areas with different conditions. Future research should consider longer trial periods and diverse geographic locations.

3.9 Recommendations for Further Research

Further research is recommended to extend the trial period and cover different geographic areas (Wang et al., 2020). Future studies could also investigate the impact of LBS applications on various demographic groups to better understand how this technology can be optimized to meet the specific needs of diverse users. Additionally, studies should explore the theoretical implications of integrating LBS technology in healthcare accessibility.

4. Conclusions

This research shows that LBS-based mobile applications are effective in increasing the accessibility of health facilities, especially in areas with limited access. Implementation of this technology can be a practical solution to overcome barriers to health service accessibility. With faster search times and higher levels of user satisfaction, the app offers a practical solution to address healthcare accessibility challenges in underserved areas. These findings provide a strong basis for further development and implementation of LBS technology to improve access to health services more broadly.

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