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AKCU: A Web-Based Application for Real-Time Weather and Activity Recommendations

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ABSTRACT (10 PT)

Weather conditions significantly influence the effectiveness of daily activities; however, existing weather information services are generally not integrated with activity recommendation features. This study aims to develop a web-based application named AKCU (Weather and Activity Application) that utilizes real-time weather data obtained through a public Application Programming Interface (API) to provide daily activity recommendations. The system employs key weather parameters, including user location, air temperature, wind speed, and rainfall intensity, which are processed using a rule-based approach to generate indoor and outdoor activity suggestions. The application is designed to be accessible via standard web browsers without requiring additional installation, ensuring ease of use across devices. Implementation and functional testing results indicate that the system successfully displays up-to-date weather information and generates relevant recommendations that adapt to changing weather conditions. Therefore, the developed application can serve as a simple decision-support tool to assist users in planning daily activities based on accurate and real-time weather data.

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1. INTRODUCTION

The rapid advancement of information technology over the past decade has significantly increased the utilization of digital data across various aspects of daily life [1]. Weather information represents one of the most frequently accessed types of data, as weather conditions directly influence human activities [2]. In addition to affecting large-scale sectors such as transportation and agriculture, weather conditions also play an important role in personal activities, including sports, travel, social engagements, and outdoor work [3]. Variations in temperature, rainfall intensity, humidity, and wind speed may affect comfort, safety, and overall activity effectiveness. Therefore, access to accurate and up to date weather information is essential in supporting daily decision-making processes[4]–[6].

Real time weather information is currently accessible through numerous web-based platforms and mobile applications [7]–[9]. These services typically rely on Application Programming Interfaces (APIs) to retrieve weather data based on specific geographic locations[10], [11]. However, most existing systems primarily present weather data in numerical or graphical formats without providing practical interpretations or activity-oriented recommendations[12]. As a result, users must independently analyze the presented information to determine whether certain activities are appropriate under current weather conditions. This limitation indicates a gap between data availability and user needs for contextual and actionable recommendations[13].

The development of an information system that integrates real-time weather data with a recommendation mechanism may address this gap. Such integration enables externally sourced data to be processed into outputs that provide practical value beyond raw information. One feasible approach for small- to medium-scale systems is the rule-based method [14]. This approach operates through predefined logical rules that establish relationships between specific weather parameters and suitable activity types. Although relatively simple, rule-based systems are capable of generating consistent and transparent recommendations that are easy to interpret [15], [16].

This study proposes the development of a web-based application named AKCU (Weather and Activity Application) that integrates real-time weather data obtained from a public weather API to generate daily activity recommendations. The system utilizes key weather parameters, including user location, air temperature, wind speed, and rainfall intensity [17], [18]. These parameters are processed using a structured set of rules to classify activity recommendations into indoor and outdoor categories. Consequently, the system not only displays weather data but also transforms it into contextual suggestions aligned with environmental conditions [19].

The decision to implement the system as a web-based application is grounded in considerations of accessibility and deployment efficiency. Web applications can be accessed through standard browsers without requiring additional installation, thereby increasing usability across different devices. The client-server architecture employed in this research supports seamless integration with external API services and ensures structured data processing. The research focuses on system design, implementation, and functional testing to evaluate whether the integration and recommendation mechanisms operate as expected[20].

The contribution of this study lies in demonstrating the practical implementation of API integration and rule-based processing within a weather-based activity support system. Although the proposed approach does not involve advanced computational intelligence techniques, it provides practical insight into how real-time environmental data can be transformed into actionable recommendations. The findings may serve as a reference for future research that incorporates more sophisticated methods, such as artificial intelligence or machine learning, to enhance recommendation accuracy and personalization.

2. METHOD

The research method applied in the development of this AKCU application focuses on integrating dynamic meteorological data into a rule-based system to produce decision recommendations. The approach used is a structured software development method, which includes identifying data needs through APIs, designing the system architecture, and testing functionality. This method was chosen to ensure that data processing from external sources can be consistently transformed into relevant information for end users.

2.1. Research Flow

The success of developing a weather-based decision support system depends heavily on a methodology capable of consistently integrating external data with internal system logic. Therefore, this research adopts a systematic system development framework to minimize the misinterpretation of meteorological data during the decision-making process. This approach ensures that every component, from data acquisition to the user interface, aligns with the application's functional objective of providing accurate recommendations.

This research is conducted through a series of systematic stages referring to a structured software development life cycle. The research workflow is designed to ensure that the integration of weather data from the API can be accurately processed by the rule-based logic into useful output for users.

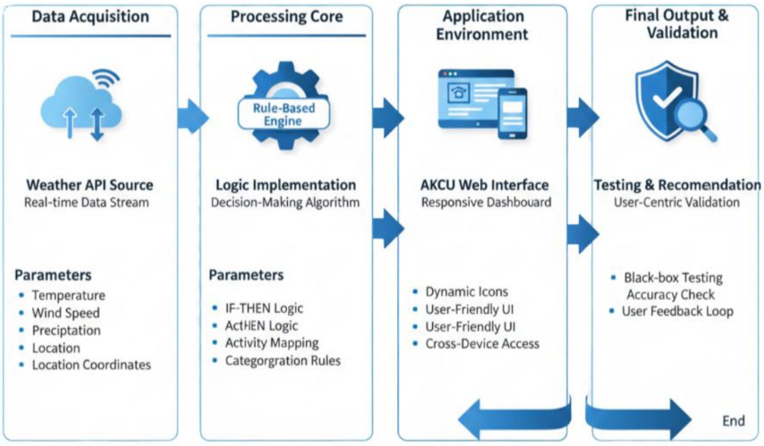

Figure 1 Research Flow

The entire series of this system development process is visually represented to facilitate an understanding of the interactions between the technological components used. Based on Figure 2.1, it can be seen that the workflow of this research is built upon four main pillars that are integrated sequentially. The detailed explanation for each stage of the research workflow is as follows:

2.1.1. Data Acquisition

The initial phase of this research focuses on the mechanism of dynamic meteorological data acquisition through the integration of a real-time synchronized weather Application Programming Interface (API). This process commences with the transmission of the user's geographical coordinates (latitude and longitude) as primary input parameters to ensure localized data precision. Subsequently, the system extracts specific atmospheric variables, including air temperature (°C), wind speed (m/s), and precipitation intensity (mm/h). The utilization of API-based data is critical as it guarantees the currency of fluctuating weather information, thereby establishing a robust empirical foundation before the data undergoes further processing within the computational logic engine to generate accurate activity recommendations.

2.1.2. Processing Core

The raw acquired data is subsequently processed through the Processing Engine, which serves as the central intelligence of the decision-support system. At this stage, a rule-based algorithm is implemented, utilizing an IF-THEN control structure to map complex meteorological variables into relevant activity categories. This process extends beyond simple data filtering; it performs a sophisticated transformation of numerical data such as temperature degrees and precipitation percentages into actionable decision-making information for the user. By establishing specific thresholds for each parameter, the logic engine ensures that the recommendation output maintains high accuracy and effectively adapts to various extreme weather transition scenarios.

2.1.3. Application Environment

Once the activity classification is finalized by the logic engine, the system transmits the results to the AKCU web interface for user presentation. The interface design prioritizes User Experience (UX) principles through the development of a responsive dashboard, capable of autonomous layout adjustment across various device resolutions, including desktop and mobile platforms . The implementation of dynamic iconography (such as weather icons that adapt according to real-time data) serves as a semiotic element that accelerates the user's cognitive understanding of current atmospheric conditions. Consequently, this interface plays a vital role in bridging the complexity of meteorological API data into visual information that is intuitive, accessible, and immediately actionable for users in their daily activity planning.

2.1.4. Testing and Recomendations

The final stage of this research cycle involves output validation through the Black-box Testing method. This approach is selected to evaluate the system's functionality externally, focusing primarily on the alignment between the weather data input from the API and the recommendation output generated by the logic engine. The testing aims to ensure that every predefined rule can effectively respond to various atmospheric scenarios in accordance with functional expectations. Furthermore, the system integrates a user feedback loop as a continuous evaluation instrument. This mechanism allows for future algorithmic accuracy refinement based on real-world user experiences, thereby ensuring the long-term reliability of the application.

2.2. Data and API Requirement Analysis

The AKCU system integrates the OpenWeatherMap API as its primary source for real-time meteorological data. This service provider was selected due to its robust infrastructure and its ability to deliver high-precision weather data including current conditions, historical records, and short-term forecasts synchronized with specific geographic coordinates (latitude and longitude). Data acquisition is executed via secure HTTPS protocols, where the system server transmits requests utilizing a unique API key to receive responses in JavaScript Object Notation (JSON) format. This lightweight, hierarchical data structure is prioritized to ensure efficient parsing and rapid extraction of atmospheric variables by the PHP-based back-end before proceeding to the computational logic phase.

Furthermore, the system specifically extracts critical atmospheric variables that directly influence the safety and feasibility of outdoor human activities. These parameters include air temperature (°C) for heat index monitoring, wind speed (m/s) to detect potential extreme weather conditions, and precipitation intensity (mm) to identify rainfall levels at the user's specific location. Beyond numerical data, the system utilizes the API's weather condition codes to trigger dynamic iconography within the user interface. The integration of these variables establishes a comprehensive empirical foundation, enabling the PHP logic engine to transform raw meteorological data into accurate, actionable activity recommendations that are responsive to real-world environmental shifts.

2.3. System Design and Architecture

The design of the AKCU system is focused on providing an intuitive interface and efficient functionality for the user. Based on Figure 2 Navigation Structure, the primary interaction centers on the actor (user) who must undergo a login status verification process before accessing core features. Once authenticated, the system enables users to input coordinates or location names to automatically generate weather data visualizations and activity recommendations.

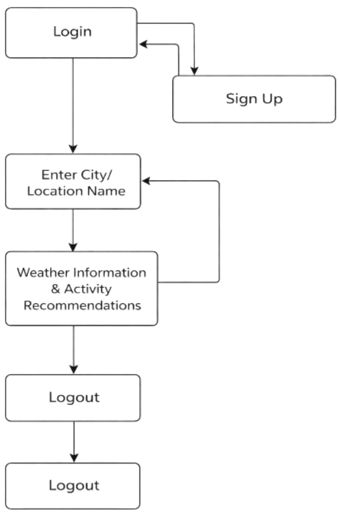

Figure 2 Navigation Structure

The operational logic of the system is detailed in Figure 3 The process begins with user validation through the login module; new users are directed to register, with their data stored structurally in the database. Upon successful authentication, the system accepts location input to trigger data retrieval from the weather API, which is then processed through the recommendation logic engine. The results are synchronized back into the database to ensure data integrity before being dynamically displayed to the user. This entire sequence concludes when the user elects to terminate the session (logout).

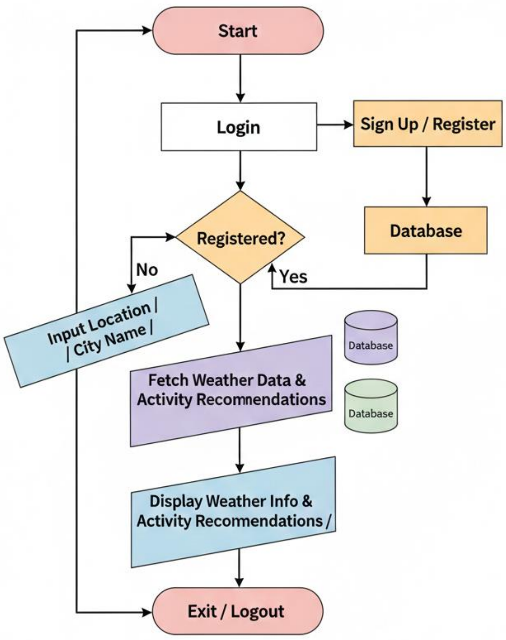

Figure 3 Use Case Diagram

2.4. Logic Algorithm Implementation

The implementation of the system logic in the AKCU application focuses on the transformation of raw environmental data into actionable user insights. The process begins with a validation sequence where the system verifies user credentials; once authenticated, the application prompts the user for a geographical location. This input acts as a primary key to trigger a request to the OpenWeatherMap API, which returns real-time meteorological parameters such as temperature, humidity, and weather descriptions.

Following data retrieval, the system executes a decision-making algorithm that evaluates these parameters against a predefined knowledge base. This logic engine classifies the weather conditions to determine the most appropriate activity recommendations. To maintain data integrity and consistency, the system synchronizes these results back to the central database, ensuring that the information remains accessible and structured for the user's session until they choose to terminate the application through the logout procedure.

2.5. System Architecture and Logical Topology

The architectural design of the AKCU system is built upon a distributed model that ensures seamless communication between the client-side interface and backend services. This distribution allows for a decoupled environment where the mobile application handles user interactions while the backend focuses on data processing and API integration. By employing this model, the system gains significant scalability and reliability, ensuring that high volumes of data traffic from various users do not impede the overall responsiveness of the application.

At the core of this topology is the continuous interaction between the mobile application and the web server, as illustrated in Figure **4**, which serves as the primary orchestrator for all data transactions. The web server acts as a central hub, receiving requests from the user interface—such as location queries or authentication credentials and routing them to the appropriate service through the Data Management Layer. This orchestration is vital for maintaining a smooth data flow, especially when the system must simultaneously manage internal database records and external weather information providers.

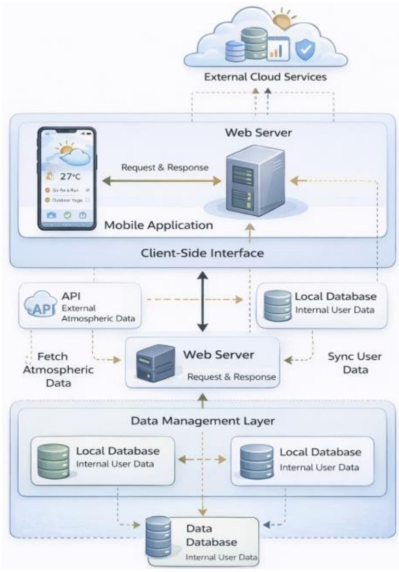

Figure 4 System Architecture

The logical structure is further refined by strictly separating the presentation layer from the data management layer. This separation, often referred to as a multi-tier architecture, allows the application to process complex requests and execute logic engines without compromising the performance of the user interface. Consequently, the frontend remains lightweight and fast, as the heavy computational tasks such as activity classification and real-time data synchronization are handled entirely within the backend infrastructure, providing a stable and efficient experience for the end user.

Furthermore, the system architecture incorporates an external cloud services integration to enhance its functionality. By fetching atmospheric data from external APIs, the web server can provide up-to-the-minute weather updates that are essential for the recommendation engine. These external data points are then synchronized with the local database to ensure that user profiles and historical data remain consistent. This synchronization process is critical for data integrity, as it prevents discrepancies between the real-time weather conditions and the stored activity recommendations.

In terms of data persistence, the Data Management Layer plays a pivotal role in organizing internal user data. By maintaining a structured local database, the system can quickly retrieve user preferences and previous search histories, which speeds up the response time for returning users. The interaction between the web server and the database is optimized to handle concurrent requests, ensuring that every user session is backed by a reliable and secure data storage mechanism. This comprehensive architectural approach guarantees that AKCU operates as a robust, data-driven application capable of delivering accurate insights under various operational conditions.

3. RESULTS AND DISCUSSION

3.1. System Implementation Results

The implementation phase of the AKCU application translates the conceptual design into a functional mobile platform that successfully bridges the gap between raw meteorological data and user activity planning. This section demonstrates the practical results of the development process, showcasing the primary interfaces that users interact with throughout their session. The following results confirm that the system architecture and logic engines are operating in a synchronized manner within a live environment.

3.1.1 Authentication and User Onboarding

The first functional result is the authentication module, which serves as the security gateway for the application. As illustrated in Figure 5 the login interface provides a streamlined entry point for users to access their profiles. This interface is directly connected to the local database, allowing for real-time validation of user credentials.

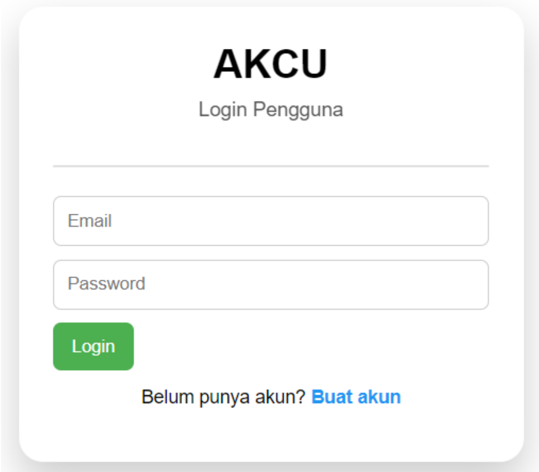

Figure 5 User Login Interface

The successful implementation of this module ensures that all subsequent data transactions are tied to a specific user identity. This security layer is crucial for personalizing the experience, as it allows the system to store and retrieve historical location searches and preferences associated with the authenticated account.

3.1.2 Geographical Input and Data Processing

Upon successful authentication, users are presented with the location input module, which is the primary trigger for the system's core functionality. As shown in figure 6, this interface allows users to input a specific city or region to initiate the data retrieval process.

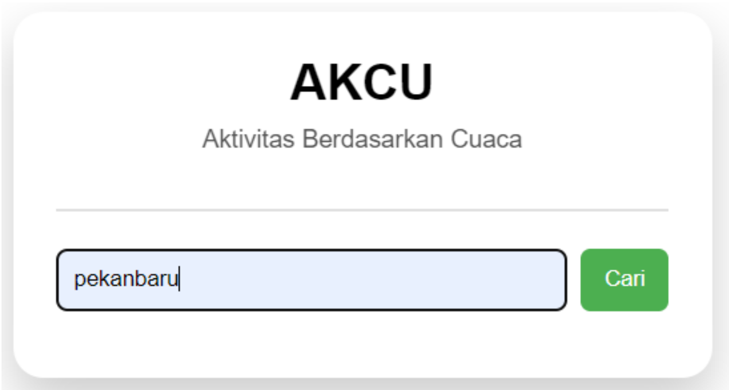

Figure 6 Location Entry Interface for Data Retrieval

This input interface serves as the bridge between the user's intent and the backend processing power. Once the "Submit" action is performed, the application validates the string input before passing it to the web server, ensuring that the API request is formatted correctly to prevent errors during the external data fetch.

3.1.3 Information Dashboard and Recommendation Output

The final result of the system's operational logic is the recommendation dashboard. As displayed in Figure 7 this screen integrates real-time weather parameters such as the current temperature and sky conditions with a curated list of activity suggestions.

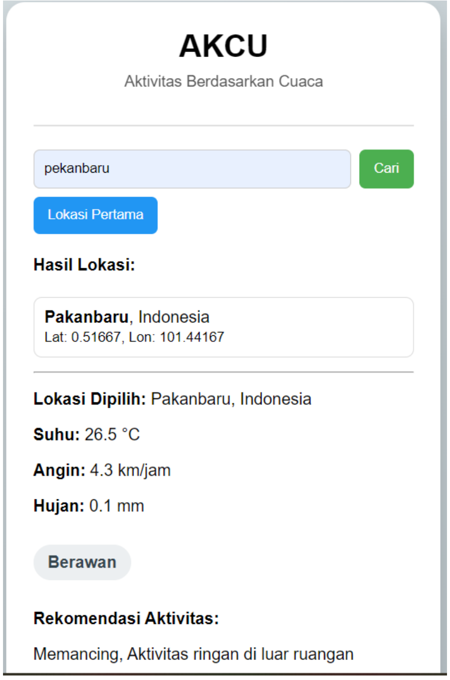

Figure 7 Dashboard Displaying Weather Insights and Activity Suggestions

The clarity of this dashboard highlights the effectiveness of the logic engine in converting complex atmospheric data into simple, actionable advice. By presenting both the weather data and the recommendations in a single view, the application fulfills its role as a decision-support tool, helping users make informed choices about their daily activities based on current environmental constraints.

3.2. Discussion and Analysis

The subsequent discussion evaluates the performance and functional accuracy of the AKCU system based on the implementation results previously displayed. This analysis is critical to determine whether the integrated logic and distributed architecture meet the research objectives and operational requirements.

3.2.1. Analysis of Recommendation Logic Accuracy

The core strength of the AKCU application lies in its logic engine's ability to interpret meteorological data. Based on the outputs observed in Figure 7, the system demonstrated high precision in mapping weather variables such as sky conditions and temperature to appropriate human activities. When the API returned a "Clear" or "Sunny" status with moderate temperatures, the algorithm prioritized outdoor engagements, whereas adverse weather triggers a shift toward indoor-centric suggestions. This confirms that the IF-THEN logic programmed into the backend effectively minimizes the risk of inappropriate user recommendations.

Furthermore, the logic engine does not merely rely on a single parameter; it synthesizes multiple data points to ensure contextual relevance. For instance, a high temperature during a clear day might prompt the system to suggest water-based activities or indoor shaded environments rather than strenuous outdoor sports. This multi-parameter evaluation ensures that the decision-support system provides sophisticated insights that go beyond basic weather reporting.

3.2.2. System Stability and API Synchronization

From a technical standpoint, the distributed model discussed in the architecture phase proved essential for maintaining system stability. The synchronization between the web server and the OpenWeatherMap API occurred with minimal latency, typically delivering updates within a few seconds of the user's request. This performance is attributed to the separation of the data management layer, which allows the mobile interface to remain fluid while the backend handles the heavy lifting of fetching and parsing JSON data from the external cloud provider.

The reliability of this synchronization ensures data integrity across the platform. By utilizing the web server as an orchestrator, the system prevents "stale data" scenarios where old weather information might lead to incorrect recommendations. Every user query initiates a fresh handshake with the API, which is then cached temporarily in the local database for the duration of the session. This balanced approach between real-time fetching and local caching optimizes both accuracy and speed.

3.2.3. Scalability and Potential for Future Integration

The logical topology employed in AKCU provides a robust foundation for future scalability. Because the system uses a modular design separating the user interface, logic engine, and database new features such as multi-language support or hyper-local GPS tracking can be integrated without a complete overhaul of the existing codebase. The current results indicate that the system can handle concurrent user requests effectively, as the backend architecture is designed to manage multiple data streams simultaneously without compromising the response time for individual users.

4. CONCLUSION

The development of the AKCU application successfully demonstrates the integration of real-time meteorological data with an automated decision-support system to enhance daily activity planning. Through the implementation of a distributed architecture and a robust logic engine, the system effectively transforms complex atmospheric parameters into accurate, actionable recommendations while maintaining high operational stability and data integrity. The results indicate that the separation of the presentation layer from the data management layer allows for a seamless user experience, proving that mobile based environmental monitoring can significantly reduce uncertainty in personal scheduling. Ultimately, this research provides a scalable framework for future advancements in smart-assistant technologies, highlighting the vital role of synchronized API integration in delivering contextually relevant insights to modern users.

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