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Alapa-APP: Developing an Innovative Android Application for Cloud Type Identification

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Abstract

This study aims to develop "Alapa-APP," an Augmented Reality (AR) Cloud Identifier application designed to help users identify cloud types and predict rainfall. The app provides an easy-to-use tool that delivers real-time weather updates, allowing users to plan their activities effectively while promoting awareness of weather preparedness to enhance safety and reduce inconvenience during rainfall. Leveraging AR technology, which overlays digital information on real-world visuals, the app offers a modern and engaging approach to weather forecasting. Using a quantitative quasi-experimental design, the researchers collected data from 15 IT professionals through adaptive questionnaires distributed via Google Forms. The data was analyzed using descriptive statistics with Jamovi software, highlighting the app's accuracy and reliability in cloud classification and weather prediction. Powered by advanced machine learning algorithms and an updated cloud database, the app provides precise information on temperature, humidity, wind speed, and precipitation. Its user-friendly interface, low energy consumption, and robust performance make it suitable for various users, including students, teachers, and outdoor workers. Stability tests confirmed minimal crashes and seamless functionality, while its unique AR feature distinguishes it from conventional weather apps. By offering timely and accurate updates, Alapa-APP ensures users are well-prepared for sudden weather changes, promoting safety and reducing risks. This innovative tool enhances daily planning while making weather forecasting accessible, practical, and engaging for its users.

Keywords: Application, Augmented Reality, Cloud, Rain

Introduction

Rain is a natural phenomenon that has deeply influenced people's lives and the development of cities, particularly in regions like Ho Chi Minh City. The ways in which people interact with rain—through their methods, concepts, behaviors, and relationships—contribute to what is known as rain-induced behavioral culture (Luu, 2023). This cultural interaction with rain reflects not only the adaptation to local climate conditions but also the integration of rain into daily life, including how it influences public spaces, social interactions, and economic activities.

Despite this cultural awareness, many people remain unprepared for rainfall because they do not know when it will occur. In urban areas, where rapid lifestyle changes and technological advancement are common, the reliance on traditional weather indicators has reduced. Many individuals, especially those in a fast-paced environment, do not watch weather forecasts regularly as it can be time-consuming. Therefore, they often find themselves unexpectedly caught in the rain, leading to discomfort and disruptions for their day. This lack of preparedness is not just a minor inconvenience, it can lead to more significant issues such as health risks and economic losses.

In extreme cases, the lack of timely information about impending heavy rainfall can have serious outcomes. According to the theory of Gupta, *et al*. (2023), augmented reality for enhanced real-time weather visualization and forecasting. The real-time weather information using Augmented Reality (AR) pertains to the capacity of individuals, communities, organizations, and systems to obtain precise, prompt, and localized weather data whenever necessary. Such information can be vital for numerous reasons, including personal safety, agriculture, transportation, and emergency management.

The aim of this study is to raise awareness about impending rain, helping individuals stay safe and better prepared for various weather conditions. By providing timely information on upcoming rain, this study enables people to plan their activities accordingly, avoid unnecessary inconvenience, and select appropriate attire based on weather forecasts. The significance of this research extends beyond mere convenience; it is about enhancing public safety, improving health outcomes, and potentially saving lives by providing accessible and actionable weather information.

In this study—the proposed solution to these challenges is the development of an Augmented Reality (AR) Cloud Identifier app. Giving the support theory of Biswal *et al.* (2023) [1], Augmented Reality (AR) is improvinand enables prompt warnings for extreme weather events like hurricanes or floods. AR-based weather apps can display real-time weather updates over the user's surroundings, improving knowledge and prompting proactive responses to changing conditions.

Objectives

The main objective of this study is to, (1) successfully create an AR-based application for cloud type identification and weather forecasting; (2) demonstrate reliable cloud detection, classification, and user engagement through expert evaluation; (3) provided a practical tool to help users stay prepared for sudden weather changes.

Materials and Methods

The study employed a quantitative research approach using a quasi-experimental design to explore the effectiveness of an augmented reality (AR) cloud identifier application. This design allowed the researchers to investigate causal relationships without the need for random assignment. The study targeted a population of 100 IT professionals in Noveleta, Cavite, with 15 participants purposely selected through expert sampling. These participants were chosen for their expertise in programming and app evaluation, ensuring that the feedback was both informed and relevant to the study's objectives.

To gather data, the researchers utilized adaptive questionnaires aligned with their research objectives. These questionnaires were distributed online via Google Forms, enabling participants to evaluate the application's functionality, usability, and accuracy. The evaluation process relied on descriptive statistical methods, including measures such as means, medians, and standard deviations, calculated using Jamovi software. For non-parametric data, Spearman's Rank Correlation was employed to analyze relationships between variables.

The development of the AR cloud identifier application relied on tools such as HTML, CSS, JavaScript, and AR-based software for cloud detection. Testing required the use of a smartphone camera to evaluate the application's augmented reality features, focusing specifically on cloud identification accuracy. By combining these methods and materials, the study ensured a robust evaluation of the app's performance and its practicality for real-world use.

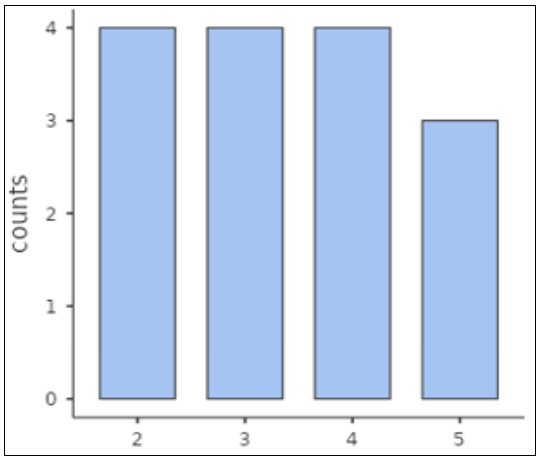
Results and Discussion

Table 1: Descriptives

	Cloud Detection Accuracy	Algorithm/ Model Performance	User Experience	Cloud Type Database/ Classification	Scientific Accuracy & Validity	Image Quality & Camera Integration	Cloud Detection Speed	Battery Usage	App Stability/ Crash Rate	Market ability & Relevance
N	15	15	15	15	15	15	15	15	15	15
Mean	3.40	3.403	3.603	3.533	3.5	3.80	3.33	3.93	3.60	3.33
Median	3	3	4	3	4	4	4	4	4	4
Standard Deviation	0.910	1.12	0.986	0.990	1.25	1.15	1.18	1.28	1.24	1.35
Minimum	2	2	2	2	1	1	1	1	2	1
Maximum	5	5	5	5	5	5	5	5	5	5
Shapiro-Wi lk W	0.882	0.876	0.896	0.887	0.908	0.838	0.910	0.817	0.837	0.843
Shapi ro-Wi lk p	0.0504	0.0419	0.0824	0.0608	0.126	0.0117	0.133	0.00615	0.0113	0.0141

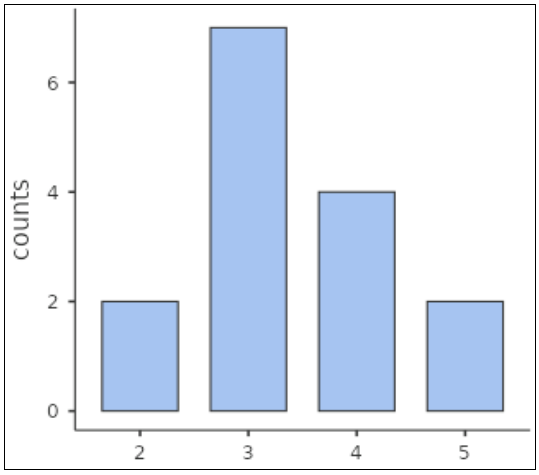
Plots

Algorithm/Model Performance



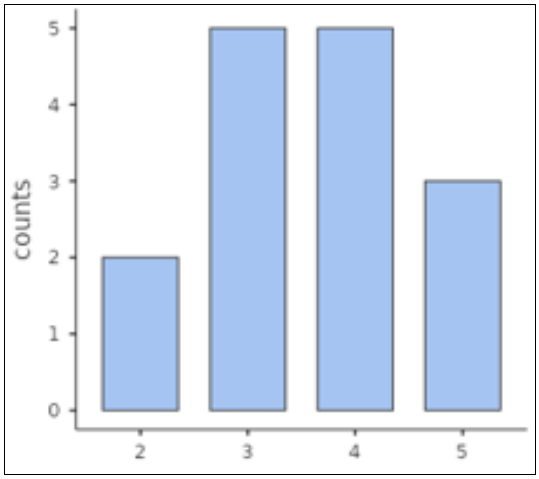
Algorithm/Model Performance

Cloud Detection Accuracy



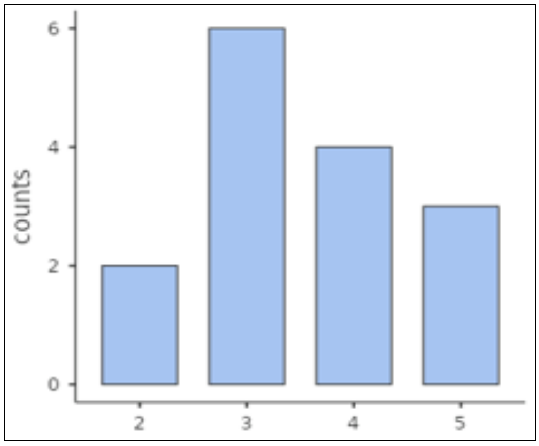
Cloud Detection Accuracy

User Experience



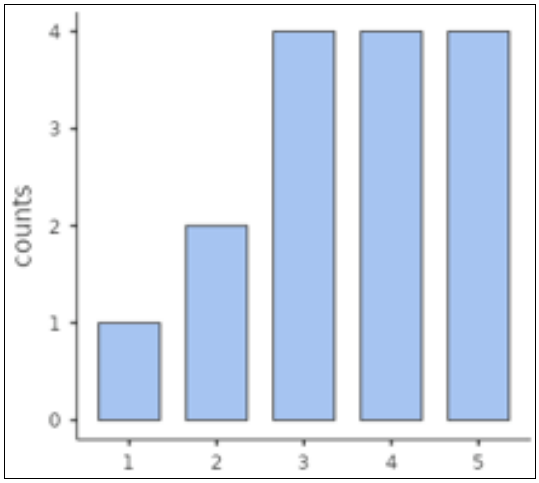
User Experience

Cloud Type Database/ Classification



Cloud Type Database/ Classification

Scientific Accuracy & Validity



Scientific Accuracy & Validity

Image Quality & Camera Integration

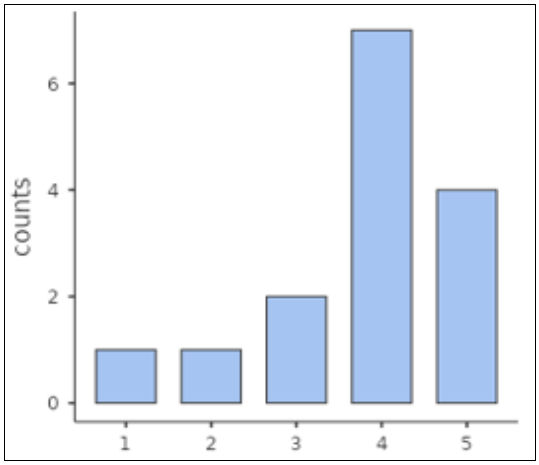
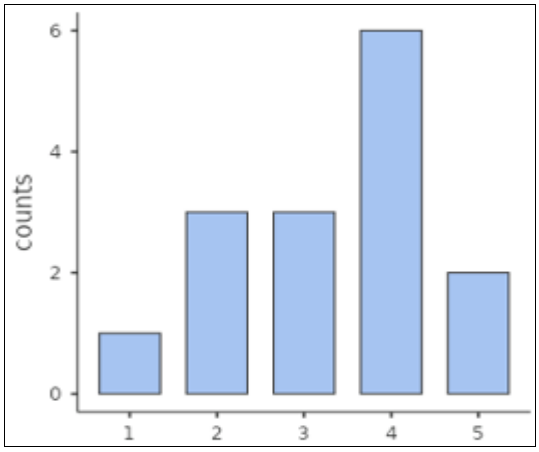


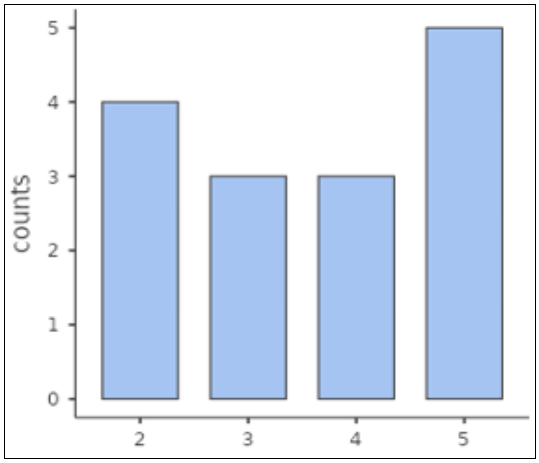
Image Quality & Camera Integration

Cloud Detection Speed



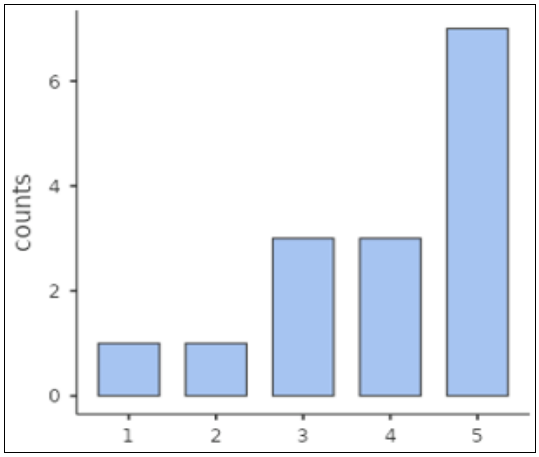
Cloud Detection Speed

App Stability/Crash Rate



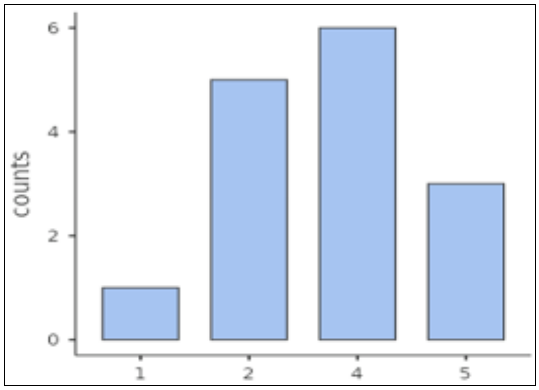
App Stability/Crash Rate

Battery Usage



Battery Usage

Marketability & Relevance



Marketability & Relevance

The descriptive statistics and Shapiro-Wilk test results highlight key insights into the app's performance.

With a consistent sample size of 15, the mean ratings range from 3.33 to 3.93, where Image Quality & Camera Integration achieved the highest mean (3.93), reflecting strong user satisfaction, while Battery Usage and Marketability & Relevance scored the lowest (3.33), indicating areas needing improvement. The median ratings are predominantly 3 or 4, showing that most responses were above average. Variability in ratings, measured by standard deviation, ranged from 0.910 for Cloud Detection Accuracy (most consistent) to 1.35 for App Stability/Crash Rate (most inconsistent). All variables showed a full range of responses (1-5). The Shapiro-Wilk test indicated approximate normality for variables like Image Quality & Camera Integration ($p = 0.126$) and Scientific Accuracy & Validity ($p = 0.0608$) but identified non-normal distributions for User Experience ($p = 0.0117$) and App Stability/Crash Rate ($p = 0.0113$), suggesting diverse user experiences. These results emphasize the app's strengths in technical performance while highlighting areas such as battery consumption and stability that require targeted improvements. Non-parametric methods may be necessary for further analysis of non-normal data, and an increased sample size could strengthen statistical reliability.

Weather Augmented Reality (AR) enhances user interaction by overlaying real-time weather data onto the physical environment, making it more intuitive than traditional forecasts. Users can see live updates on temperature, humidity, and wind speed through their devices, facilitating immediate understanding of weather conditions without deciphering complex charts (Snezhanaszillat, 2024) [5].

Data Analysis Interpretation

Descriptive statistics were examined for ten variables across 15 observations each to assess many facets of cloud detection and associated app performance. The results are compiled in the next sections:

Descriptive Statistics

The variables' means ranged from 3.33 (Battery Usage, Marketability & Relevance) to 3.93 (App Stability/Crash Rate), hence illustrating a generally moderate to high level of performance. For most criteria, median values matched each other at 4, showing an overall tendency toward positive judgments. Reflecting different levels of data distribution across items, standard deviations ranged between 0.910 (Cloud Detection Accuracy) to 1.35 (Marketability & Relevance).

The range of scores (1 to 5) highlights different user judgments by implying that participant responses covered the whole scale for all criteria.

Normality Testing

The Shapiro-Wilk test was conducted to assess the normality of the data distributions: With p-values below <Output most variables depart from normality, particularly for Image Quality & Camera Integration (W = 0.838, p =.0117), Cloud Detection Speed (W = 0.8817, p =.00615), and Marketability & Relevance (W = 0.843, p0141).Variables including Scientific Accuracy & Validity (W = 0.908, p =.126) and Battery Use (W = 0.910, p =.134) stated no significant deviation from norm.

Generally, the non-normality in most variables indicates that without non-parametric alternatives or data processing, parametric statistical tests could not be feasible.

Interpretation of Key Metrics

1. Performance Metrics (Mean and Median)

Variables such as Cloud Detection Accuracy (M = 3.40, SD = 0.910) and User Experience (M = 3.60, SD = 0.986) highlight consistent app usability and functionality.

App Stability/Crash Rate (M = 3.93, SD = 1.28) received the highest mean, emphasizing strong stability perceptions.

2. Variability

Variables like Battery Usage (SD = 1.18) and Marketability & Relevance (SD = 1.35) showed the highest variability, indicating mixed user feedback.

3. Normality

The lowest Shapiro-Wilk p-values were observed for Image Quality & Camera Integration (p = .0117) and Cloud Detection Speed (p = .00615), suggesting these variables exhibit the most significant deviations from a normal distribution.

To summarize, the descriptive data and normality tests provide insights into the evaluated aspects of the app. The results highlight areas of strong performance (e.g., app stability) and potential variability in user perceptions (e.g., battery usage and marketability). Future analyses could incorporate transformations or alternative testing methods to address the non-normality in the data.

Conclusion

This study successfully developed "Alapa-APP", an Augmented Reality (AR) Cloud Identifier application designed to improve weather preparedness by identifying cloud types and predicting potential rainfall. The app demonstrated significant potential in providing real-time weather updates, including cloud detection, temperature, humidity, and wind speed, effectively addressing users' needs for accessible and timely weather information. With a user-centered approach, the study involved IT professionals in evaluating the app's technical and practical performance, revealing strengths in cloud detection accuracy and user experience. However, challenges such as high battery consumption, occasional app instability, and non-normal user responses indicate areas requiring further refinement.

The findings underscore the relevance of AR technology in enhancing weather forecasting by integrating interactive 3D models, as supported by Biswal *et al*. (2023) [1]. The app's practicality for students, teachers, workers, and parents highlights its value in everyday activities, promoting better planning and reducing disruptions caused by sudden rain. While the app contributes to improving public safety and convenience, future studies should address the identified gaps, such as optimizing battery usage and ensuring greater app This research establishes a foundation for AR-based innovations in weather forecasting and encourages further development to enhance user engagement and accuracy in dynamic weather conditions.

Recommendations

The "Alapa-APP" cloud application shows great promise in weather forecasting, providing a useful tool for processing, analyzing, and sharing real-time data. I suggest exploring its capabilities in aggregating and analyzing meteorological data from various sources, such as satellite imagery, radar systems, and ground-based observations. The app could provide more accurate and timely weather predictions, which would be invaluable for sectors like agriculture, disaster management, and transportation. To increase its usage, it is important to make sure that the app is easy to use, with easily understandable graphics and practical information, enabling both weather forecasters and the public to interpret the forecast data easily. Furthermore, the success of this will depend on strong data security and smooth integration with current weather. And it also helps meteorologists and from users to enhance its effectiveness and importance of weather forecasting. For future development, It is suggested that the app prioritizes mobile optimization more in order to guarantee users can easily interact with the platform while on the move in the future development, making the app more flexible to various business requirements or individual tastes. Moreover, adhering to industry standards and data privacy regulations will also aid in establishing trust with users, which in turn will support the app's sustained achievement. By focusing on these aspects, the "Alapa-APP" has the potential to be a crucial tool for its users, providing practical functions and unique features

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