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A MOBILE-BASED ALUMNI RELATIONSHIP MANAGEMENT SYSTEM USING EXTREME PROGRAMMING: ENHANCING DIGITAL ENGAGEMENT IN ISLAMIC BOARDING SCHOOL EDUCATION

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ABSTRACT
Alumni management plays an important role in strengthening institutional sustainability and engagement in educational environments. However, many educational institutions still manage alumni data manually, resulting in inefficient communication, data fragmentation, and limited interaction between alumni and institutions. This study aims to design and implement a mobile-based alumni relationship management system using the Extreme Programming method to enhance digital engagement in Islamic boarding school education. The research applies a qualitative approach with data collected through observation, interviews, and literature study to identify system requirements. The system is developed using Flutter for mobile applications, React JS for the web-based admin panel, and Firebase as the backend infrastructure. The development process follows Extreme Programming stages, including planning, design, coding, and testing. System evaluation is conducted through Black Box Testing and User Acceptance Testing involving 16 alumni respondents. The results show that the system functions effectively and achieves a user acceptance score of 92.5%, categorized as very good. The study concludes that the proposed system successfully improves alumni data management, strengthens communication, and supports digital transformation in educational institutions.
Keywords : *Agile Development; Alumni Management; Extreme Programming; Mobile Application; Relationship Management.*

1. Introduction

Alumni play a strategic role in strengthening the sustainability and competitiveness of educational institutions(Jumasseitova et al., 2024; Nisar et al., 2025). They contribute to institutional development through knowledge sharing, networking, promotion, and financial support. Effective alumni relationship management enables institutions to maintain long-term engagement, track alumni development, and utilize alumni potential as strategic partners. In the era of digital transformation, managing alumni through integrated digital systems has become essential to support institutional growth and collaboration. However, many educational institutions, particularly Islamic boarding schools, still rely on conventional and manual approaches in managing alumni data and communication.

In Islamic boarding school environments, alumni management is commonly conducted through handwritten records, spreadsheets, or informal communication channels such as social media and messaging applications. These methods are inefficient for managing large amounts of alumni data and maintaining structured engagement. The absence of a centralized system often leads to difficulties in updating alumni information, limited interaction between alumni and institutions, and challenges in organizing alumni-related programs. As a result, the potential of alumni as strategic contributors to institutional development has not been optimally utilized. These challenges highlight the need for an integrated digital platform that can manage alumni data and facilitate sustainable communication effectively.

The rapid advancement of mobile technology provides significant opportunities to transform traditional alumni management into a more dynamic and accessible digital system(Aithal & Alnfiai, 2025). Mobile-based applications enable real-time communication, efficient data management, and wider accessibility across geographical boundaries. The widespread use of smartphones among alumni makes mobile platforms an effective solution for improving engagement and information dissemination. A mobile-based alumni relationship management system can serve as a centralized platform for data management, information sharing, networking, and collaboration, thereby enhancing institutional connectivity with its graduates.

To ensure that the developed system is adaptive and user-oriented, agile software development methodologies are increasingly adopted in modern system design. One of the most widely used agile methods is Extreme Programming (XP)(Abrar et al., 2025), which emphasizes iterative development, continuous feedback, rapid delivery, and close collaboration between developers and users. XP supports flexibility in responding to changing user requirements and ensures high-quality software through continuous testing and refinement. Previous studies have shown that XP is effective in developing educational information systems due to its user-centered approach and ability to produce reliable and functional applications in a relatively short development cycle.

Several related studies have explored alumni management systems and agile development approaches. Research on alumni roles in institutional development indicates that alumni significantly contribute to institutional reputation and sustainability. Other studies have developed mobile-based alumni information systems and demonstrated improvements in data accessibility and communication efficiency. Additionally, research on agile methods, particularly Extreme Programming, highlights its effectiveness in producing flexible and user-friendly educational applications. However, limited research integrates mobile-based alumni relationship management systems with agile development methods specifically in Islamic boarding school education, which has unique organizational and cultural characteristics. This gap indicates the need for further research that combines mobile technology and agile methodology to create an effective alumni management platform.

To strengthen the research background and demonstrate the research gap, several previous studies are summarized in Table 1.

Table 1. Summary of Related Studies on Alumni Management Systems and Agile Development

No	Author(s) & Year	Research Focus	Method/Technology	Key Findings	Research Gap
1	Nisar et al (2025)	Role of alumni in institutional development	Conceptual & survey study	Alumni significantly contribute to institutional reputation and development	Does not provide a digital system for managing alumni
2	Prasetyo & Eviyanti (2024)	Mobile-based alumni information system	Mobile application development	Mobile systems improve alumni data accessibility and communication	Limited integration with agile software development
3	D. Prasetyo et al.(2024)	Application of Extreme Programming in education systems	Extreme Programming (XP)	XP improves flexibility and software quality in educational systems	Not specifically applied to alumni management
4	Rathor et al.(2025)	Agile development for information systems	XP-based development	Agile methods accelerate development and user satisfaction	Focused on POS systems, not alumni engagement
5	Wiratama & Santoso (2023)	Educational application development using XP	Agile mobile development	XP enhances user-centered system design	No focus on alumni relationship management

6	Diansyah & Syafrinal (2025)	Mobile application development using Flutter	Mobile programming framework	Flutter enables cross-platform and efficient mobile development	Not applied to alumni networking systems

Table 1 shows that previous research has explored alumni management systems, mobile application development, and agile methodologies in educational contexts. Nevertheless, the integration of mobile-based alumni relationship management systems using Extreme Programming within Islamic boarding school environments remains limited. Therefore, this study addresses the gap by integrating mobile technology and agile development to build an effective alumni management system that enhances digital engagement and institutional networking.

Based on these considerations, this study aims to design and implement a mobile-based alumni relationship management system using the Extreme Programming method to enhance digital engagement in Islamic boarding school education. The objectives of this research are to develop an integrated platform for managing alumni data, facilitating communication between alumni and institutions, and strengthening alumni networks through mobile technology. In addition, this research contributes to the development of agile-driven digital solutions in educational institutions by demonstrating the effectiveness of Extreme Programming in producing a flexible, user-centered, and sustainable alumni management system.

2. Literature Review

Alumni relationship management has become an essential component in strengthening institutional sustainability and competitiveness in the digital era(Nisar et al., 2025). Educational institutions increasingly recognize alumni as strategic stakeholders who contribute to institutional reputation, collaboration opportunities, and long-term development. Effective alumni management enables institutions to maintain engagement, monitor alumni progress, and facilitate communication between graduates and their alma mater. According to alumni management theory, structured alumni engagement improves institutional branding, student recruitment, and partnership development. Therefore, integrating digital technology into alumni management systems is considered a strategic step in modern educational governance.

Digital transformation in education has significantly influenced how institutions manage information and communication systems(Harini et al., 2024). The adoption of mobile technology has enabled institutions to provide real-time access to information and interactive services for users. Mobile-based information systems are widely used due to their accessibility, flexibility, and ability to support continuous interaction regardless of geographical limitations. Studies have shown that mobile applications improve data management efficiency, user engagement, and service accessibility in educational environments. Consequently, mobile-based alumni management platforms can serve as effective tools to enhance communication and networking between institutions and alumni.

In software development, agile methodologies have become increasingly popular due to their adaptability and user-centered approach(Szabo & Hercegfi, 2023). Agile methods emphasize iterative development, collaboration, and rapid response to changes in user requirements. One of the most widely adopted agile approaches is Extreme Programming (XP). XP focuses on continuous improvement, short development cycles, and frequent user feedback to ensure that software meets user needs effectively. The XP approach consists of several key stages, including planning, design, coding, and testing, which are carried out iteratively to produce high-quality software. Previous research indicates that XP enhances software quality, accelerates development time, and improves user satisfaction due to its flexible and collaborative nature.

Several studies have explored the implementation of alumni information systems and agile methodologies in educational contexts. Research on alumni information systems indicates that digital platforms improve data accessibility and communication efficiency between alumni and institutions. Other studies demonstrate that mobile-based systems enable institutions to manage alumni data more effectively and support networking activities. Furthermore, research on agile

software development in education shows that the XP method improves system usability, reliability, and development efficiency. Despite these advancements, limited studies have integrated mobile-based alumni relationship management systems with agile development approaches in Islamic boarding school environments, which have unique organizational structures and communication patterns.

The literature also highlights the importance of integrated platforms that combine data management, communication, and networking features. An effective alumni relationship management system should provide functionalities such as user registration, profile management, information dissemination, and communication forums. The integration of cloud-based backend services, such as Firebase, further enhances system scalability, data security, and real-time synchronization. Combining mobile technology, cloud computing, and agile development methods can produce a comprehensive and sustainable digital solution for alumni management.

To provide a clearer overview of previous scholarly works related to this research, several relevant studies are summarized in Table 2.

Table 2. Summary of Literature on Alumni Management Systems and Agile Development

No	Author(s) & Year	Source Type	Focus of Study	Method/Approach	Key Findings
1	Nisar et al. (2025)	Journal article	Alumni role in institutional development	Survey and conceptual analysis	Alumni contribute significantly to institutional reputation and sustainability
2	Prasetyo & Eviyanti (2024)	Conference paper	Mobile-based alumni information system	Mobile system development	Mobile platforms improve alumni data accessibility and communication
3	D. Prasetyo et al.(2024)	Journal article	Extreme Programming in educational systems	Agile XP method	XP improves flexibility, collaboration, and software quality
4	Rathor et al.(2025)	Journal article	Agile development in information systems	XP methodology	Agile methods accelerate development and enhance user satisfaction
5	Wiratama & Santoso (2023)	Journal article	Educational mobile application development	Extreme Programming	XP produces user-centered and reliable applications
6	Diansyah & Syafrinal (2025)	Journal article	Flutter for mobile applications	Mobile programming framework	Flutter supports efficient cross-platform mobile development

The literature summarized in Table 2 demonstrates that digital alumni management systems and agile software development methods have been widely studied. However, the integration of mobile-based alumni relationship management systems using Extreme Programming within

Islamic boarding school education remains limited. Most previous studies focus on general educational institutions or standalone mobile applications without emphasizing alumni relationship management and digital engagement simultaneously.

Based on the reviewed literature, this research positions itself by integrating mobile technology and Extreme Programming to develop a comprehensive alumni relationship management system that enhances digital engagement in Islamic boarding school education. This study contributes to the advancement of digital transformation in education by proposing an agile-driven mobile platform that supports sustainable alumni networking, efficient data management, and continuous institutional engagement.

3. Research Methods

This study employs a qualitative and system development approach to design and implement a mobile-based alumni relationship management system using the Extreme Programming (XP) method(Wiratama & Santoso, 2023). The research focuses on developing an integrated digital platform that enhances alumni engagement and improves data management efficiency within Islamic boarding school education. The research stages include problem identification, requirement analysis, system design, development, and evaluation. Each stage is conducted systematically to ensure that the developed system meets user needs and achieves research objectives.

Research Design

This research adopts an agile-based system development methodology using Extreme Programming (XP). XP is selected due to its flexibility, iterative development process, and emphasis on user involvement(Szabo & Hercegfi, 2023). The method supports continuous feedback and rapid adaptation to user requirements, ensuring that the system developed aligns with user expectations. The XP model consists of four main phases: planning, design, coding, and testing, which are carried out iteratively until the system meets the desired quality and functionality.

Data Collection Techniques

Data collection is conducted to understand user needs and system requirements. Several techniques are used, including:

1. **Observation**

Direct observation is conducted at the educational institution to examine existing alumni management processes. This stage aims to identify problems, workflow inefficiencies, and opportunities for system improvement.

2. **Interviews**

Semi-structured interviews are conducted with administrators and alumni representatives to gather detailed information about system requirements, user expectations, and functional needs.

3. **Literature Study**

A literature review is conducted to analyze theories, models, and previous studies related to alumni management systems, mobile applications, and agile software development methods. This stage supports theoretical grounding and identifies research gaps.

System Development Method: Extreme Programming (XP)

The development of the alumni relationship management system follows the Extreme Programming framework. The stages are described as follows:

a. Planning

The planning phase identifies system requirements and defines user stories based on data collected from observations and interviews. Functional and non-functional requirements are determined to guide system development. Two main user roles are defined: admin and alumni. Each role has specific system functionalities such as registration, profile management, information sharing, and communication features.

b. Design

The design phase translates user requirements into system architecture and interface design. System modeling is carried out using Unified Modeling Language (UML), including use case diagrams, activity diagrams, sequence diagrams, and class diagrams. The design phase also includes user interface (UI) and user experience (UX) design to ensure usability and accessibility.

Database design is developed using Firebase Cloud Firestore to manage real-time data storage and synchronization.

c. Coding

The coding phase implements the system based on the designed architecture. The mobile application for alumni is developed using Flutter with Dart programming language to ensure cross-platform compatibility. The admin panel is developed using React JS for web-based system management. Firebase services are integrated as backend infrastructure, including Firebase Authentication for user authentication, Cloud Firestore for database management, and Cloud Functions for notification automation.

d. Testing

Testing is conducted to ensure system functionality, reliability, and user satisfaction. Two types of testing are applied:

a. **Black Box Testing**: Conducted to verify system functionality without examining internal code structure. Each feature is tested to ensure it operates according to specified requirements.
b. **User Acceptance Testing (UAT)**: Conducted to evaluate user satisfaction and system usability. Alumni users are involved as respondents to assess system performance and effectiveness using questionnaire-based evaluation.

System Modeling and Framework

The system is designed as an integrated platform consisting of a mobile application for alumni and a web-based admin panel. The system architecture includes frontend, backend, and database components connected through cloud-based services. Firebase is used as a real-time database and authentication service, enabling secure and scalable system performance. The modeling process includes defining system entities, relationships, and workflows to ensure structured system operation.

Research Flowchart

The research process is conducted systematically as illustrated in the following framework.

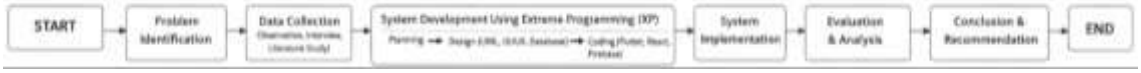

Figure 1. Extreme Programming–Based System Development Framework

Evaluation Method

The evaluation of the developed system focuses on functionality, usability, and user acceptance. Black Box Testing ensures that each feature functions correctly, while User Acceptance Testing measures user satisfaction and system feasibility. The results of the evaluation are analyzed to determine whether the system effectively enhances alumni data management and digital engagement.

Through these stages, the research provides a comprehensive framework for developing a mobile-based alumni relationship management system using Extreme Programming, contributing to digital transformation and sustainable alumni engagement in educational institutions.

4. Results and Discussions

Results

This study produced a mobile-based alumni relationship management system developed using the Extreme Programming (XP) method. The system consists of two main components: a mobile application for alumni and a web-based admin panel for institutional administrators. The results presented in this section describe the factual outcomes obtained from system development, implementation, and testing.

System Implementation Results

The developed system successfully digitizes alumni data management and provides a centralized communication platform between alumni and the institution. The mobile application enables alumni to register, update profiles, access institutional information, and interact with other alumni. Meanwhile, the admin panel allows administrators to manage alumni data, verify registrations, publish announcements, and monitor system activity.

The system architecture integrates Flutter for mobile development, React JS for the web-based admin panel, and Firebase as the backend infrastructure. Firebase services include Authentication for user verification, Cloud Firestore for real-time database management, and Cloud Functions for automated notifications. This integration ensures secure data management, scalability, and real-time synchronization.

Functional Features of the System

The implemented system includes several main features for both alumni users and administrators. These features are summarized in Table 3.

Table 3. Main Features of the Alumni Relationship Management System

No	Feature	User Role	Description
1	User Registration and Login	Alumni	Allows alumni to create accounts and securely log in
2	Profile Management	Alumni	Enables users to update personal and professional data
3	Information Sharing	Admin & Alumni	Provides institutional news, events, and job vacancies
4	Alumni Mapping	Alumni	Displays geographical distribution of alumni
5	Group Communication	Alumni	Facilitates interaction among alumni through chat features
6	Data Verification	Admin	Enables administrators to verify alumni registration
7	Dashboard Analytics	Admin	Displays statistics of alumni and system usage

Table 3 shows that the system provides integrated features that support alumni data management and digital engagement. The system facilitates both administrative control and user interaction through a centralized platform.

System Testing Results

System testing was conducted to evaluate functionality and user acceptance. Two testing methods were applied: Black Box Testing and User Acceptance Testing (UAT).

Black Box Testing was performed to verify system functionality. Each feature was tested to ensure that it operated according to predefined requirements. The testing results indicated that all system functions operated successfully without significant errors.

User Acceptance Testing (UAT) was conducted to measure user satisfaction and system feasibility. A total of 16 alumni participated as respondents. Data were collected using a questionnaire based on a Likert scale with four response options. The UAT results are summarized in Table 4.

Table 4. User Acceptance Testing Results

No	Evaluation Aspect	Score Obtained	Ideal Score	Percentage
1	Ease of Use	60	64	93.75%
2	System Functionality	58	64	90.63%
3	Interface Design	59	64	92.19%
4	Information Accessibility	60	64	93.75%
5	Overall Satisfaction	59	64	92.19%
Total		**296**	**320**	**92.5%**

The total score obtained from respondents was 296 out of an ideal score of 320, resulting in a feasibility percentage of 92.5%. Based on the feasibility interpretation scale, this result falls into the “Very Good” category, indicating that the system is highly acceptable and useful for users.

Discussion

The results of this study demonstrate that the implementation of a mobile-based alumni relationship management system using Extreme Programming effectively improves alumni data management and communication. The high functionality and usability scores indicate that the system meets user needs and expectations. The agile development approach enabled continuous user involvement during development, ensuring that the system features aligned with user requirements.

The integration of mobile technology significantly enhances digital engagement between alumni and the institution. The availability of real-time information, interactive communication features, and accessible data management allows alumni to remain connected regardless of geographical distance. This finding supports previous studies stating that mobile-based systems improve communication efficiency and data accessibility in educational environments.

The application of Extreme Programming contributes to the success of the system development process. XP emphasizes iterative development and continuous feedback, enabling developers to quickly adapt to user requirements and improve system quality. The results of this study confirm previous research indicating that XP enhances software flexibility, usability, and development efficiency in educational information systems.

Furthermore, the high user acceptance score (92.5%) indicates that the system provides practical benefits for users. This finding aligns with earlier studies on agile-based system development, which report increased user satisfaction and system effectiveness. The integration of Firebase as a cloud-based backend also ensures system scalability, data security, and real-time synchronization, supporting sustainable system operation.

Compared to previous studies that primarily focus on web-based alumni systems or general educational applications, this study offers a more comprehensive approach by integrating mobile technology, agile development, and real-time cloud services into a unified alumni relationship management platform. This integration represents an advancement in digital alumni management systems and contributes to the development of smart educational ecosystems.

Scientifically, this research contributes to the field of information systems and educational technology by demonstrating how agile-driven mobile platforms can enhance alumni engagement and institutional connectivity. Practically, the developed system provides an effective solution for educational institutions seeking to digitalize alumni management and strengthen alumni networks in the era of digital transformation.

5. Conclusion

This study successfully designed and implemented a mobile-based alumni relationship management system using the Extreme Programming method to enhance digital engagement in Islamic boarding school education. The developed system effectively digitizes alumni data management, improves communication between alumni and institutions, and provides an integrated platform accessible through mobile technology. The application demonstrated high feasibility and user acceptance, with a User Acceptance Test score of 92.5%, indicating that the system is highly effective, user-friendly, and beneficial for institutional use. The main advantages of the system include real-time data management, flexible communication features, and agile-based development that ensures adaptability to user needs, while its limitations include the current absence of advanced features such as financial contribution management and private messaging. Therefore, future research is recommended to enhance system scalability by integrating additional features such as donation modules, intelligent data analytics, and broader institutional implementation to improve efficiency and sustainability of digital alumni management systems.

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