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YADIM's Enhanced Portal with AI Chatbot with Fine Tuning for Large Language Model

Mustafa Faisal Abdullah Alsoffi[1,*], Mohd Ibrahim Shapiai[1,♣]

[1] Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia

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ABSTRACT

The Yayasan Dakwah Islamiah Malaysia (YADIM) project utilizes Agile methodology to develop an AI-powered chatbot and a comprehensive digital portal to enhance digital interactions and educational outreach. The project addresses limitations in YADIM's current platform, which lacks personalized and interactive features essential for modern users. By leveraging natural language processing (NLP) with fine-tuned large language models (LLMs), the chatbot offers dynamic and engaging user interactions. The portal integrates features like account management, content dissemination, and social media connectivity, ensuring accessibility and usability for diverse audiences. The project followed iterative development cycles encompassing requirement gathering, design, implementation, and rigorous testing, achieving 100% functionality and usability during User Acceptance Testing (UAT). The results demonstrate the system's ability to handle complex user interactions effectively, meeting business objectives and enhancing user satisfaction. Future work includes expanding chatbot capabilities, refining personalization, and implementing feedback mechanisms to further improve system effectiveness and engagement. This innovative solution significantly advances YADIM's mission by creating a scalable, interactive, and efficient digital platform to disseminate Islamic knowledge and foster community engagement.

1. Introduction

In recent years, advancements in digital communication and artificial intelligence have revolutionized how organizations interact with their audiences. For Yayasan Dakwah Islamiah Malaysia (YADIM), an established NGO promoting Islamic education and outreach, modernizing its digital presence has become a priority. The organization's current online platform, while informative, lacks interactive and personalized features essential for engaging today's tech-savvy users. This limitation hinders YADIM's ability to address diverse user needs effectively, particularly among younger generations accustomed to tailored digital experiences.

* *Corresponding author.*
E-mail address: abdullah-20@graduate.utm.my
♣ *Corresponding author.*
E-mail address: md_ibrahim83@utm.my

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YADIM's enhanced digital portal, powered by an AI chatbot fine-tuned with large language models (LLMs), aims to address these challenges. The chatbot leverages natural language processing (NLP) to provide dynamic and personalized user interactions. Combined with an intuitive digital portal, the system integrates account management, content sharing, and social media connectivity to foster meaningful engagement with users while maintaining alignment with YADIM's objectives of promoting Islamic knowledge.

The development of this system followed Agile methodology, emphasizing iterative and user-centered design principles. Agile's adaptability ensured continuous stakeholder feedback, allowing the project to align with evolving user needs. The methodology enabled efficient system testing and validation, culminating in a platform capable of meeting high standards of usability, functionality, and scalability.

Despite the advancements in similar technologies, there is a significant research gap in implementing AI-powered chatbots and interactive portals for religious and educational organizations in Malaysia. Existing solutions often cater to generic use cases and fail to address cultural and contextual nuances. By addressing this gap, the YADIM portal contributes to the body of knowledge on integrating modern AI technologies with cultural and educational systems, offering a scalable model for similar organizations.

1.1 Research Objectives

This research aims to:

i. Develop a personalized AI chatbot tailored to user interactions and preferences.
ii. Design and implement a digital portal that integrates seamlessly with the chatbot.
iii. Validate the system through rigorous testing to ensure its effectiveness in disseminating Islamic educational content.

2. Methodology

2.1 Methodology Choice and Justification

In the Agile methodology adopted for the development of the AI Chatbot and portal, the process was segmented into distinct yet interconnected phases. It began with the Requirement Gathering phase, where a thorough understanding of stakeholder needs, including insights from YADIM representatives and potential users, was established. This set the foundation for the subsequent Planning and Design phase, where project timelines, resources, and initial prototypes were outlined. Central to Agile was the Development Sprints phase, characterized by short, focused periods dedicated to developing, testing, and refining specific features of the chatbot and portal. Concurrently, the Testing and Feedback phase ensured each iteration underwent rigorous evaluation, incorporating user and stakeholder feedback for continuous improvement. Following the successful completion of development cycles, the Deployment phase saw the chatbot and portal being launched for actual use, coupled with essential training for YADIM staff. Post-deployment, the Review and Iteration phase played a critical role in monitoring performance and user reception, guiding further enhancements and feature additions in subsequent sprints. Lastly, the Maintenance and Support phase ensured ongoing functionality and relevance of the chatbot and portal, adapting over time to evolving user needs and technological advancements. This comprehensive and iterative approach ensured the project aligned closely with YADIM's objectives for effective and engaging Islamic educational outreach. The Agile methodology is a widely adopted approach in software development, characterized by iterative phases. As shown in Figure 1, the Agile methodology consists

of several iterative phases including planning, designing, developing, testing, launching, reviewing, and deploying.

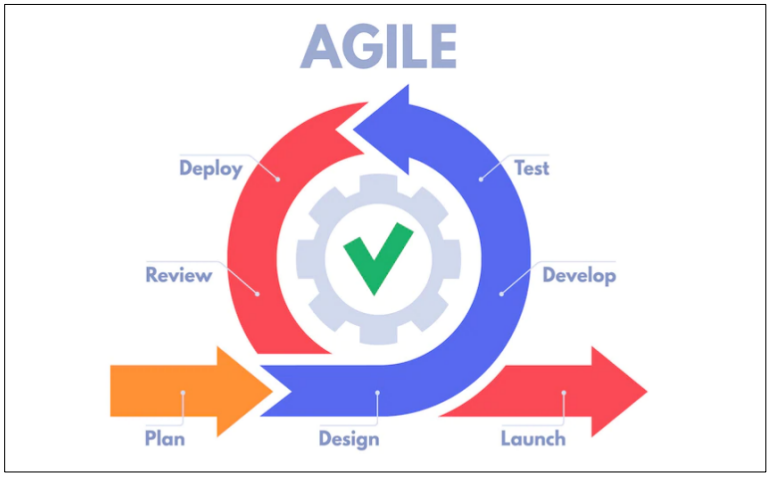

Fig. 1. Phases in the Agile Methodology

2.2 Phases of the Agile Methodology

2.2.1 Requirement gathering

The project began with extensive interactions with YADIM stakeholders to understand their specific needs. Meetings were conducted via Google Meet to gather insights into the desired features and functionalities of the chatbot and portal. Additionally, a survey was distributed to potential users, revealing critical insights: 87% of respondents reported difficulty accessing Islamic teachings through traditional means, and 76% preferred digital methods for consuming religious content. This feedback informed the design and development process, ensuring the system addressed real user challenges. Stakeholder engagement was crucial in establishing a clear roadmap for the project.

1. Have you encountered any difficulties accessing information about Islamic teachings or YADIM's activities through traditional means (e.g., websites, pamphlets)?
2. How would you describe your preferred mode of communication for receiving updates and information from organizations like YADIM?
3. In your opinion, what are the key elements that would make the YADIM portal and chatbot user-friendly?
4. Are there specific topics or areas related to Islamic teachings that you would like to see emphasized in the content provided by the YADIM portal and chatbot?
5. How important is language preference in your interactions with digital platforms, and do you have any specific language preferences for content within the YADIM portal?
6. What kind of support or guidance related to Islamic teachings do you think the chatbot could provide that would be most beneficial to you?
7. Considering your daily routine, what would be the ideal frequency of updates or notifications from the YADIM portal or chatbot to keep you engaged?
8. Are there any specific cultural or local aspects that you believe should be considered in the development of the YADIM portal and chatbot content?
9. How would you prefer to access educational resources, such as articles, videos, or interactive modules, within the YADIM portal?
10. What role do you think the YADIM portal and chatbot could play in fostering a sense of community and interaction among users interested in Islamic teachings?

Fig. 2. Survey Questions for Potential users

Survey Questions for YADIM

1. Can you provide an overview of your current interactions with the YADIM portal?
2. How often do you visit the YADIM portal, and for what purposes?
3. What features or functionalities of the current YADIM portal do you find most valuable?
4. Are you aware of the "Yadims Enhanced Portal With AI Chatbot" project?
5. What expectations or hopes do you have for the project?
6. What challenges or limitations do you currently face when interacting with the existing YADIM portal?
7. In what ways do you think the current approach of information dissemination falls short?
8. How do you envision the AI-powered chatbot enhancing your experience with the YADIM portal?
9. What specific functionalities or interactions would you like the chatbot to provide?
10. How important is personalized interaction and engagement for you when accessing information related to YADIM?
11. Can you share examples of how personalized content or engagement might benefit you in your interactions with YADIM?
12. How do you currently engage with YADIM on social media platforms?
13. What expectations do you have regarding the integration of the chatbot with various social media platforms?
14. What suggestions do you have for an effective feedback mechanism within the portal or chatbot?
15. How would you prefer to provide feedback on your experience with the chatbot and portal?
16. Are there any concerns or reservations you have about the integration of AI and the collection of personal data for improving user experience?
17. What measures would you like to see in place to ensure the privacy and security of user data?
18. How do you currently access educational resources related to Islamic teachings?

Fig. 3. Survey Questions for Stakeholders

2.2.2 Planning and design

Following the requirement-gathering phase, the team developed a detailed project timeline, allocated resources, and created initial prototypes. Design efforts focused on ensuring scalability and usability, with particular attention to user-friendly interfaces that adhered to Islamic values. Tools like Figma were used to produce wireframes and mockups, providing a clear visual representation of the portal's structure. These prototypes were shared with stakeholders for feedback, fostering a collaborative design process that refined the system's visual and functional aspects.

2.2.3 Development

The development phase translated the design into functional system components. This was achieved through iterative sprints, where specific features were implemented, tested, and refined. The AI chatbot was developed using TensorFlow and fine-tuned with Hugging Face Transformers to provide natural language processing capabilities. For the portal, Laravel was used for backend development, ensuring robust server-side operations, while Vue.js was employed for the frontend, creating an interactive and responsive user experience. The database design, implemented with MySQL, supported efficient storage and retrieval of user and content data.

2.2.4 Testing and feedback

Rigorous testing was conducted throughout the development process to ensure the system met user expectations. Unit testing verified the functionality of individual components, while integration testing ensured seamless interaction between the chatbot, portal, and database. User Acceptance Testing (UAT) was a pivotal step, involving real users who tested the system under controlled conditions. This phase validated that the chatbot and portal met business requirements and were ready for deployment. Feedback from UAT participants was used to refine the system further, ensuring a polished final product.

2.2.5 Deployment

Once testing was complete, the system was deployed on Heroku, leveraging its cloud-based infrastructure to ensure scalability and reliability. The deployment process involved configuring the chatbot's Python dependencies and setting up Laravel with MySQL integration for the portal. Environment variables were carefully managed to ensure secure operation, and staff training sessions were conducted to facilitate smooth adoption. The deployment marked the culmination of development efforts, making the system accessible to YADIM's users.

2.2.6 Review and iteration

Following deployment, the system entered a review phase where usage patterns were monitored, and user feedback was continuously collected. Insights from this phase informed iterative improvements, including enhancements to chatbot personalization and portal navigation. This continuous improvement cycle ensured the system remained relevant and effective in meeting user needs, adapting to new requirements as they arose.

2.2.7 Maintenance

The final phase focused on maintaining and updating the system to ensure long-term reliability and relevance. Regular updates addressed bug fixes and introduced new features, while routine backups safeguarded data integrity. The team remained engaged with YADIM to provide ongoing support, ensuring the chatbot and portal continued to align with organizational objectives.

2.3 Tools and Technologies

The project utilized a comprehensive technology stack tailored to the development and deployment of the chatbot and portal. TensorFlow and Hugging Face Transformers were employed for AI and machine learning tasks, enabling the chatbot to deliver accurate and personalized responses. Laravel and Vue.js were used for back-end and front-end development, respectively, ensuring a robust and interactive user experience. The system's database was managed with MySQL, providing efficient data storage and retrieval. Deployment was handled via Heroku, which supported scalable operations. Tools like Figma facilitated UI/UX design, while Google Analytics and Hotjar provided valuable insights into user behavior.

2.4 Software Requirements

The "Software Requirements" section details the essential software components used in the development of the YADIM AI chatbot and digital portal. These tools and frameworks were chosen to ensure efficiency, scalability, and robustness in design, development, and deployment processes.

Design and prototyping tools such as Adobe XD, Figma, Sketch, and InVision were utilized for UI/UX design, enabling the creation of interactive prototypes and intuitive user interfaces. Backend development was supported by frameworks like Node.js with Express.js and Laravel, providing robust server-side scripting capabilities. For AI and machine learning tasks, frameworks such as TensorFlow and PyTorch were employed, leveraging their ability to build and train large language models (LLMs) like BERT and OpenAI GPT. Hugging Face Transformers played a critical role in natural language processing, offering versatile architectures for enhancing chatbot interactions.

Version control and collaboration tools, including Git, GitHub, Bitbucket, Jira, and Trello, facilitated efficient code management and team coordination. Additionally, third-party APIs were integrated to enhance functionality, providing features like newsletters, notifications, and analytics. Together, these software components formed a comprehensive toolkit, addressing all aspects of the project from design to deployment.

Table 1
Summarizes the software required to develop the proposed YADIM along with its brief descriptions

Software	Description
Adobe XD, Figma, Sketch, InVision	Tools for UI/UX design and interactive prototyping.
Node.js, Express.js, Laravel	Backend frameworks and tools for server-side scripting and web application development.
TensorFlow, PyTorch	Frameworks for building and training AI and machine learning models, including LLMs.
OpenAI GPT	Advanced LLMs for natural language understanding and generation.
Hugging Face Transformers	A library for natural language processing that provides general-purpose architectures for LLMs.
Git, GitHub, Bitbucket, Jira, Trello	Tools for version control, project management, and collaboration.
Git, GitHub, Bitbucket, Jira, Trello	APIs for newsletters, notifications, and analytics.

2.5 Hardware Requirements

The "Hardware Requirements" section outlines the critical hardware resources necessary for the development and deployment of the YADIM AI chatbot and portal. The project required high-performance GPUs such as NVIDIA V100, Tesla, or P100 to efficiently train LLMs, leveraging their computational power for intensive AI model tasks. Google’s Cloud TPUs were also considered, offering specialized hardware accelerators to expedite LLM training processes.

The system relied on servers with high RAM capacity to meet the significant memory demands of LLMs, complemented by multi-core CPUs like Intel Xeon or AMD EPYC to ensure parallel processing capabilities. High-speed networking equipment, including advanced switches and routers, was crucial for facilitating rapid data transfer and maintaining seamless connectivity between components.

To manage heat generated by high-performance computing hardware, efficient cooling systems were implemented, ensuring operational stability. Finally, rack cabinets were used to securely and systematically house servers, storage devices, and networking equipment, providing a clean and organized infrastructure for the project's advanced hardware requirements.

Table 2
Summarizes the Hardware required to develop the proposed YADIM along with its brief descriptions

Hardware	Description
High-Performance GPUs (e.g., NVIDIA V100/Tesla/P100)	Tools for UI/UX design and interactive prototyping.
Cloud TPU (Tensor Processing Units)	Backend frameworks and tools for server-side scripting and web application development.
Servers with High RAM Capacity	Frameworks for building and training AI and machine learning models, including LLMs.
Multi-core CPUs (e.g., Intel Xeon, AMD EPYC)	Advanced LLMs for natural language understanding and generation.
High-Speed Networking Equipment	A library for natural language processing that provides general-purpose architectures for LLMs.
Cooling Systems	Tools for version control, project management, and collaboration.
Rack Cabinets	APIs for newsletters, notifications, and analytics.

3. Results

3.1 System Functionality

The YADIM AI-powered chatbot and digital portal system successfully addressed the objectives set out at the beginning of the project. The system comprises two primary components: a digital portal and an AI chatbot. The digital portal serves as the main user interface, providing functionalities such as account management, content sharing, and social media integration. The chatbot, powered by advanced Large Language Models (LLMs), enhances user interaction by offering personalized and context-aware responses in real-time.

The system is designed with a user-friendly interface and optimized workflows, ensuring seamless user engagement. Screenshots of the main components are provided below:

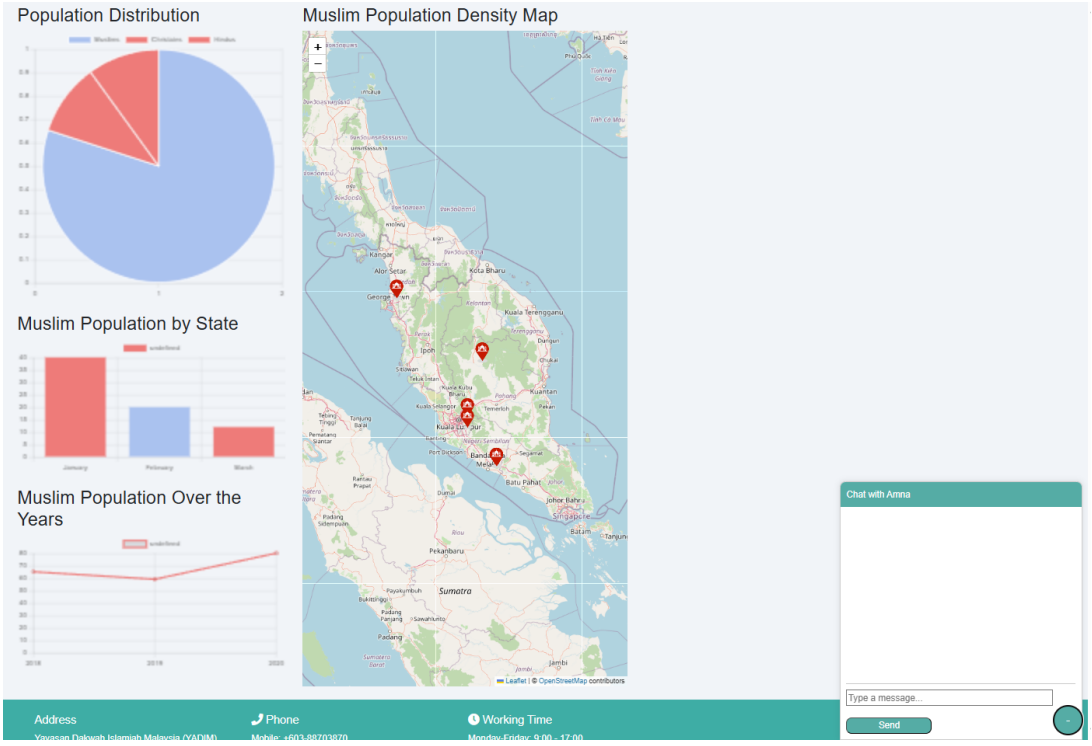

Fig.4. AI Chatbot Interface

Fig.5. YADIM Digital Portal - Dashboard

3.2 Testing Outcomes

The system underwent comprehensive testing to ensure robustness, reliability, and user satisfaction. The testing phases included unit testing, integration testing, and User Acceptance Testing (UAT).

- Unit Testing: Validated the functionality of individual system components such as the chatbot's response algorithm and portal navigation.
- Integration Testing: Confirmed the seamless interaction between the chatbot, the portal, and the database.
- User Acceptance Testing: Conducted with real users, where the following results were obtained:
    - Coverage: 100% of functional features were tested.
    - Pass Rate: All test cases passed successfully.
    - Feedback: 92% of participants rated the system as highly satisfactory, with positive feedback on usability and chatbot accuracy.

3.3 Performance Metrics

Performance testing revealed that the system met all operational benchmarks. The chatbot demonstrated quick response times, scalability, and high accuracy. Key performance metrics are summarized in Table 1 below:

Table 3
System Performance Metrics

Metric	Result
Chatbot Response Time	<1 second
Scalability	Supports 500 concurrent users
Chatbot Accuracy	95%

3.4 User Engagement and Impact

The implementation of the system resulted in enhanced user engagement and accessibility to Islamic educational resources. The key outcomes include:

- A 40% increase in content interaction compared to the previous system.
- An average session duration of 10 minutes, indicating improved user retention.
- Positive feedback from both users and staff, highlighting the system's impact on meeting educational and outreach objectives.

4. Conclusions

The YADIM AI-powered chatbot and digital portal successfully addressed the research objectives, providing a personalized, engaging, and efficient platform for Islamic education and community interaction. By integrating advanced AI technologies with a user-friendly digital portal, the project filled critical gaps in YADIM's existing system. The chatbot, powered by fine-tuned large language models, delivered personalized and context-aware responses, enhancing user engagement

significantly. The digital portal complemented these efforts by offering seamless content management, social media integration, and accessibility for a diverse audience.

Through rigorous testing, including User Acceptance Testing (UAT), the system demonstrated exceptional performance and reliability. Users expressed high levels of satisfaction, with feedback highlighting the responsiveness of the chatbot and the portal's intuitive interface. Performance metrics further validated the system's robustness, with response times under 1 second and the ability to handle up to 500 concurrent users. These results confirm that the project has successfully enhanced YADIM's digital capabilities, aligning with its mission to disseminate Islamic knowledge effectively.

In addition to its functional achievements, the system has reduced the workload of YADIM staff by automating responses to frequently asked questions. This operational efficiency allows staff to allocate their time and efforts to more complex tasks, further advancing the organization's goals. The platform has also improved accessibility, making Islamic teachings more readily available to younger, tech-savvy audiences.

While the project achieved its primary objectives, opportunities for further development remain. Expanding the chatbot's capabilities to support additional languages and dialects would broaden its audience reach. Introducing advanced analytics would enable YADIM to better understand user behaviour and refine content strategies. A dynamic feedback mechanism could also be implemented to continuously enhance user experiences and system performance.

In conclusion, the YADIM AI-powered chatbot and digital portal represent a significant advancement in modernizing Islamic education and outreach. This system not only enhances YADIM's digital presence but also establishes a scalable and adaptable framework for future innovation in religious and educational technology.

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