



Application “halal path” with learning features, assistance for MSMEs in halal certification process with the use of IoT systems

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ABSTRACT

Muslim population in Indonesia is approximately 229.62 million, accounting for 87.2% of the country's total population. With this large Muslim demographic, there is a growing need for Halal-certified food sources that are safe for consumption. However, many MSMEs (Micro, Small, and Medium Enterprises) in the country face significant challenges in obtaining Halal certification due to various factors. These include geographical barriers, expensive certification processes, limited understanding of online services, and public perceptions that Halal certification is unnecessary for MSMEs. To address the challenges, changes have been made to Indonesian Halal Certification System, particularly the introduction of regular and self declare programs. Therefore, this study aims to develop Halal Path application to support the self declare program for eligible MSMEs and enhance the economy, reputation, and cultural globalization of Indonesia. This initiative seeks to create safe and comfortable conditions for Muslims and improve food safety and quality. The study procedures were carried out using an academic literature review focusing on legal frameworks and Halal certification processes, which integrate Internet of Things (IoT) to streamline Halal supply chain management in industrial and agricultural contexts. The proposed Halal Path comprised 6 stages, namely educational videos on Halal system in Indonesia, video tutorials for obtaining business identification numbers (NIB), instructions for applying for Halal certification under both regular and self declare programs, Halal Assurance System (HAS) training, internal audits, and monitoring. In addition, the application “Halal Path” included a supplier information feature using IoT to help MSMEs obtain safe and Halal raw materials effectively.

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1 Introduction

Food is an essential component for living organisms, which provides the nutrients required for growth (Farid *et al.* 2018). With the rapidly growing global population, meeting food demands has become a significant challenge, particularly in the agricultural sector. According to Food and Agriculture Organization (FAO), food production will need to sustain approximately 9.6 billion people worldwide by 2050. However, various external factors, including climate change and global warming, threaten agricultural productivity. These issues can be addressed through Internet of Things (IoT)-enabled solutions for monitoring and managing agricultural resources, including Halal-certified supply chains. By leveraging technology, the systems support industrial growth and also enhance national economic development (Setyawan *et al.* 2022).

In recent years, technology has become integral to daily life, including agriculture and industry, offering improvements in efficiency and productivity (Waluyo 2023). Food safety regulations, when combined with quality management systems, such as Total Quality Management (TQM), can further enhance these benefits. Quality management systems provide tools to meet customer needs, desires, and expectations through continuous improvement. These systems also positively impact internal and external company functions, including standardized procedures, job efficiency, and improved product quality (Winarto & Madja 2021). High-quality food products improve consumer loyalty and trust, which is specifically crucial in a global market where compliance with food safety and Halal standards can open new opportunities (Nainggolan & Batubara 2023).

Several studies have shown that Halal certification plays a significant role in ensuring that product quality is in line with Islamic Sharia law. Halal is not only a religious obligation for Muslims but also represents cleanliness and safety, making it relevant to all consumers (Waharini & Purwantini 2018; Izzudin & Adinugraha 2021). With Indonesia being home

to the world's largest Muslim population, the importance of a robust Halal certification system cannot be overstated. Recent updates to Indonesian Halal certification process, including the regular and self declare programs, aim to address the specific needs of businesses, particularly MSMEs. These programs are in line with food safety and quality management principles, assuring consumers that products are safe, clean, and compliant with both religious and quality standards.

Indonesian Halal certification framework operates under a comprehensive legal foundation, including Government Regulation No. 31 of 2019 as the implementation regulation for Law No. 33 of 2014 on Halal Product Assurance (Silalahi *et al.* 2024). Minister of Religious Affairs Decree No. 982 of 2019 and Government Regulation No. 39 of 2021 further define the authority, responsibilities, and obligations of stakeholders in the certification process. Recent updates have also streamlined the system, introducing 2 main certification pathways, namely the regular program for medium and large-scale businesses and the self declare program for MSMEs, which simplifies the process and addresses economic and logistical barriers.

Key stakeholders in the process include Halal Product Assurance Agency (BPJPH), the Fatwa Commission of Indonesian Ulama Council (MUI), Halal Examining Institutions (LPH), and the newly introduced LP3H and Fatwa Committee. BPJPH oversees policy formulation and coordinates certification efforts, while MUI focuses on issuing fatwas and accrediting LPHs. In addition, LP3H supports capacity building and policy development in the country. These stakeholders work together to ensure the certification system is inclusive, particularly through initiatives, such as self declare program, which targets the unique challenges faced by MSMEs.

Despite these advancements, MSMEs face persistent challenges in obtaining Halal certification, such as difficulties in meeting hygiene and sanitation standards, lack of access to reliable supplier information, and economic constraints, particularly in the aftermath of the pandemic. Cultural

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and psychological barriers, such as the perception that small businesses do not require Halal certification, further complicate the process. Addressing the challenges is essential for the success of Indonesian Halal certification system and the broader goal of supporting MSMEs in Halal economy. Therefore, this study proposes Halal Path, a digital platform designed to guide MSMEs through the certification process and provide access to reliable Halal suppliers. The platform integrates IoT technology for traceability and offers structured educational content, including distinctions between the regular and self declare programs. By addressing critical barriers, such as lack of awareness, geographical challenges, and economic constraints, Halal Path aims to strengthen Indonesian Halal ecosystem. This initiative seeks to empower MSMEs to meet both Islamic principles and global quality standards, enhancing their competitiveness in local and international markets.

2 Methodology

This study used a qualitative method to analyze the challenges faced by MSMEs in obtaining Halal certification in Indonesia. Data were collected by reviewing academic literature in the legal frameworks, including recent updates to Indonesian Halal certification system, particularly the regular and self declare programs, as well as by using case studies related to the certification process. This study also explored digital platforms, such as Halal Path, which provided training content, step-by-step guidance, and overall support to MSMEs regarding Halal certification, addressing the specific requirements and challenges of both the regular and self declare programs. Halal Path tailored its assistance to the diverse needs of MSMEs by ensuring clarity and direction in the certification process. In addition, the study discussed the application of IoT in maintaining food quality and safety, demonstrating its role in aiding MSMEs with tracking Halal status of their products. Through this comprehensive method, the key issues were identified and potential solutions were proposed to enhance MSMEs compliance with Halal certification requirements. Specifically, it addressed challenges related to the self declare program, such as ensuring proper hygiene as well as sanitation practices, simplifying the documentation process, and improving MSMEs operators' understanding of Halal standards. Based on these results, this study presented practical solutions to make Halal certification more accessible, with platforms like Halal Path offering seamless assistance, continuous education, and support through digital and IoT integration. These solutions aimed to bridge important gaps, helping MSMEs meet Halal requirements. The following section further discussed the implementation of educational content through digital training modules and their role in enhancing MSMEs' understanding of Halal system, ensuring compliance, and improving food safety.

3 Halal Path Application Process

In the first phase, several educational videos were presented on the fundamental aspects of Halal system in Indonesia, including updates to the latest Halal Certification System, which involved both the regular and self declare programs. These videos covered an introduction to Halal Assurance System (HAS), details of Halal certification process, hygiene and sanitation practices in food production, and the implementation of policies set by MUI for Halal products. In addition, it was important to note that MUI now referred to the Fatwa Commission, and there were additional actors such as LP3H and the Fatwa Committee involved in the certification process. After completing all the educational content, users were tested to measure their understanding of the material learned. When the user completed this test, a certificate was obtained and proceeded to the next stage.

The second phase of Halal Path application presented video tutorials on the procedure for applying for Business Identification Number (NIB). After watching the tutorial video, users were directed to Online Single Submission (OSS) website of Indonesia to create NIB for their business. After successfully obtaining NIB, users were asked to enter it into Halal Path application. When NIB entered was correct, the user proceeded to the next stage of learning process.

In this study, the third stage of Halal Path application focused on Halal certification. Users could watch a guided video on applying for Halal certification, which included instructions on how to fill out the required forms, prepare supporting documents, and fulfill several requirements to obtain Halal certification. MSMEs were encouraged to use the self declare option when applying for Halal certification, which simplified the process compared to the regular program. Once businesses filled out the forms and collected the required documents, it was uploaded to Halal Path application for verification by the team before official submission.

The next stage was HAS training. At this stage, users learned to create and implement HAS in their business operations. Halal Path team provided educational videos covering the preparation of HAS manual, the implementation of Halal policies and procedures, and continuous monitoring and evaluation of the production process. After completing HAS training, users were asked to compile HAS manual and submit it through the application. The team collaborated with Halal auditors to review and provide feedback on the submitted HAS.

In the fifth stage, users were guided to conduct an internal audit process to ensure that all Halal procedures had been carried out properly. Halal Path application provided material on how to conduct an internal audit of Halal standards. In this study, users were asked to complete an internal audit report and upload it to the application. The team reviewed the report to ensure that the business was ready for an official audit. In addition, businesses inputted the scheduled date for their official audit ensuring that Halal Path team could coordinate and provide dedicated support during the audit process.

The sixth and final stage in this study focused on monitoring. After completing all the previous stages and applying for Halal certification, Halal Path team continued to monitor compliance to ensure that Halal status of the product was maintained. Businesses were required to submit periodic reports through the application to demonstrate their compliance with Halal standards. Halal Path application included a customer service feature to help users navigate all planned stages. This feature allowed users to engage in real-time communication with Halal Path team, addressing their challenges and reporting difficulties encountered during learning process or Halal certification application process.

4 Integration of IoT in Halal Path

Halal Path application integrated IoT features to ensure the safety and halalness of food products in the production process. Such a feature included the ability to detect farms in tables from each production site, making it easier to monitor food quality and Halal status. In agriculture, IoT devices could ensure that food was grown with the best quality by monitoring factors such as pH levels and moisture content using sensors, relays, and water pumps (Morchid *et al.* 2024). The data obtained from these sensors were sent over the Internet, allowing access from users through mobile phones or laptops. pH and soil moisture sensors were connected to a microcontroller, and when the readings did not meet the required standards, the relay activated the water pump to adjust moisture levels. The microcontroller was connected to a Raspberry Pi, which served as the communication bridge to the internet. Raspberry Pi could also function as a camera to monitor the condition of the crops. When connected to the internet or cloud, the data from the sensors, including pH and moisture content, were accessed through various devices, such as mobile phones or laptops (Dwiyatno *et al.* 2022). IoT not only ensured optimal food quality but also played a significant role in tracking Halal compliance in food production, ensuring that the products met safety and Halal standards (Dwiyatno *et al.* 2022). In addition, IoT devices were equipped with sensors, processors, and communication technology that enhanced efficiency and productivity, while also reducing environmental impact through effective pest control systems (Waluyo 2023).

IoT also played a crucial role in manufacturing processes by managing supply chains, smart factories, and overall production operations (Taj *et al.* 2023). In manufacturing, key elements such as monitoring, human-machine interaction, asset management, planning, performance optimization, and end-to-end transparency were essential for improving production efficiency. Asset management, maintenance, and tracking were integral throughout the production stages. Finally, field services, which involved the installation and repair of manufacturing equipment, were vital for ensuring the sustainability of the manufacturing process.

5 Opportunities for MSMEs

For MSMEs, IoT offered valuable opportunities to prove the quality and safety of food products, making it an effective tool for Halal certification. With the help of Halal Path application, MSMEs could optimize crop conditions on farms, improving both efficiency and food quality (Sandi & Fatma 2023). The application also allowed MSMEs to identify suppliers who were tested for halalness and food safety, further ensuring product integrity.

Through Halal Path application, MSMEs could expand their reach in international markets and contribute to economic diversification. By maintaining local wisdom and upholding Halal certification standards, MSMEs represented Indonesian products and culture on a global scale. Increased consumer trust in Halal-certified products improved accessibility, boosted regional incomes, and supported Indonesian economic growth (Saputri & Astutik 2024).

As the number of Halal-certified MSMEs grew, the increasing demand for Halal products presented a significant opportunity for Indonesia. Previous studies showed that factors such as the rising Muslim population and greater awareness of health, hygiene, and food quality trends were driving this demand, contributing to the growth of Islamic economy (Utari *et al.* 2022). MSMEs had the potential to create new jobs and improve the reputation of Indonesia globally.

With Halal certification, the Muslim community could confidently consume the product, as it met Halal standards and ensured safety (Saputri & Astutik 2024). Halal Path application exemplified a commitment to improving food quality, facilitating Halal certification process through video-based learning, and providing easy access to safe, quality suppliers. In addition, it promoted healthier, quality lifestyles for consumers.

6 Challenges in Halal Certification for MSMEs

MSMEs in Indonesia encountered several challenges when applying for Halal certification, including difficulties related to the meat slaughter process, food matrix complexity, as well as hygiene and sanitation standards. Others included laboratory inspections, HAS training, inadequate facilities, mindset barriers, economic constraints, limited socialization efforts, and a lack of access to relevant literature. To address these challenges, Halal Path application was developed to guide MSMEs through Halal certification process using a tiered method.

The first stage of the application introduced HAS, the certification process, best practices for hygiene and sanitation in food production, and the policies set by MUI for Halal products. In the second stage, instructional videos guided users on how to apply for NIB and were directed to the official Online Single Submission (OSS) platform. For the third stage, users were provided with video tutorials on how to apply for Halal certification. The fourth stage involved HAS training, while the fifth stage focused on conducting internal audits. The final stage of the process monitored Halal certification journey.

Halal Path application offered MSMEs a comprehensive and structured method to navigating Halal certification process, facilitating easier access to Halal quality and safety communication. By integrating IoT technology, the application helped MSMEs track and monitor processing systems, quality, agricultural conditions, and other key factors to ensure compliance with Halal standards as well as improve product safety.

7 Conclusion

In conclusion, Halal Path application provided a comprehensive and structured solution for facilitating Halal certification for MSMEs in Indonesia. This platform simplified the complexities of obtaining Halal certification and ensured ongoing compliance with Halal standards by offering a range of educational videos, step-by-step guidance, and integrated features such as IoT technology. Through its tiered system, the application equipped MSMEs with essential knowledge, tools, and support, guiding every stage of their certification process, from obtaining NIB to monitoring Halal product compliance.

The integration of IoT further enhanced the ability to track and monitor the quality, safety, and Halal compliance of products from farm to table, promoting transparency and ensuring that Halal standards were met at each stage of production. In addition, as the global Halal market continued to expand, Halal Path application offered MSMEs the opportunity to enhance product quality, build consumer trust, and tap into the growing demand for

Halal-certified goods. By empowering MSMEs with the necessary tools and resources, this application not only supported Indonesian economic diversification but also preserved local cultural values and fostered a healthier, more sustainable food industry. This holistic method had the potential to increase the growth of Islamic economy and elevate Indonesian position in the global Halal market.

Conflict of Interest

The authors declare no conflict of interest.

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