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IMPLEMENTATION OF IOT-BASED SMART MEDICINE BOXES TO IMPROVE MEDICATION COMPLIANCE AND PUBLIC HEALTH LITERACY IN PALASARI VILLAGE, CIBIRU DISTRICT

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Abstract

Improving patient safety through proper drug management is particularly difficult for the elderly and people with chronic conditions. Due to low levels of health literacy and lack of access to health technology, numerous individuals in Palasari Village, Cibiru District still struggle to adhere to prescription schedules. As a technical solution to aid in appropriate medication administration, this community service research proposes an IoT-based smart medicine box. A community needs analysis, a prototype built on an ESP32 microcontroller, a dose detection sensor, and a notification system using a mobile app were all part of the implementation technique. Residents also participated in training and mentorship sessions. The trial included 27 participants who were evaluated using a Likert scale that measured their level of interest, comprehension, simplicity of use, and effectiveness with respect to the gadget. With an average score of 4.37 out of 5 (87.3%), the results demonstrated a high degree of acceptability, especially when it came to comprehending the gadget, the efficacy of medicine reminders, and the possibility of lowering the risk of medication mistakes. At the community level, this effort proves that basic technology based on the Internet of Things may enhance health literacy, patient safety, and medication adherence.

Keywords: IoT, Community Service, Health Literacy, Medication Compliance, Smart Medicine Box

INTRODUCTION

The healthcare sector has been considerably impacted by the rapid development of digital and Internet of Things (IoT)-based technologies in recent years, particularly in the areas of patient safety and medication management (Kadhim et al., 2020). Nevertheless, in numerous communities, the issue of improper medication practices persists. In particular, the elderly and patients with chronic diseases continue to experience issues such as forgetting to take medication, consuming the incorrect dosage, mixing incompatible drugs, or storing medicines in unsuitable conditions (Ghassab-Abdollahi et al., 2024; Kvarnström et al., 2021).

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These conditions exacerbate the likelihood of medication errors and diminish the efficacy of treatment.

The suburban community of Palasari village, located in Kecamatan Cibiru, is characterized by limited health awareness and restricted access to healthcare innovations. According to preliminary observations and local health reports, a substantial number of residents continue to depend on family assistance or manual reminders to regulate their medication regimens. The frequent noncompliance in drug consumption is a result of the limited comprehension of proper medication management and the absence of structured monitoring. These issues underscore the imperative necessity for a practical, technology-based solution that can help residents maintain proper medication habits and reduce the risk of adverse drug events.

This study proposes the implementation of a smart medicine box, which is an Internet of Things-based gadget that is intended to provide users with assistance in the efficient management of their prescriptions. The goal of this research is to develop a solution to these issues. The smart medication box is outfitted with a number of capabilities, some of which include real-time monitoring of usage, cloud data recording, notifications regarding dose management, and automatic reminders (Nurhakim et al., 2025). It is possible for family members or medical experts to remotely monitor pharmaceutical activities with the use of this technology, which not only helps patients adhere to their prescription regimens but also makes it possible for them to do so.

The smart medicine box is customized to the socio-technical conditions of Palasari village in this study, which is unique due to its community-centered implementation. This study differs from previous research in that it prioritizes community-level adoption to foster digital health literacy and encourage behavioral change in daily medication regimens, rather than concentrating on clinical environments or elderly care institutions.

Consequently, the objective of this investigation is to assess and implement the use of smart medicine box technology in order to mitigate medication-related hazards and enhance public health awareness in Palasari village, Kecamatan Cibiru. The project's objective is to encourage the community to adopt wise health practices and to illustrate the efficacy of straightforward technological interventions in improving the quality of life and the safety of medications through this initiative.

IMPLEMENTATION METHOD

This community service and applied research activity was implemented through a series of structured phases that were intended to guarantee the successful implementation of the smart medicine box technology in Palasari village, Kecamatan Cibiru. To resolve genuine medication administration concerns among residents, the methodology incorporates both community-based participatory approaches and technical development, as illustrated in Figure 1. A situational analysis and stakeholder consultation were conducted during the initial stage to identify the most significant medication-related issues in the community. In order to evaluate the knowledge, attitudes, and practices of residents, local healthcare professionals, and community leaders with respect to medication use, surveys and semi-structured interviews were implemented (Moecker et al., 2022; Phuyal et al., 2022). This step complies with a

participatory needs assessment that can see the current state of public health literacy. Second, a prototype of the smart medicine box was developed using an IoT-based microcontroller system (ESP32), sensors for compartment detection, and a mobile notification system, as determined by the assessment results. The system architecture implemented a modular design, which facilitates real-time monitoring and customization. The device's capabilities encompass audio-visual reminders for medication regimens, sensors in the compartments to determine whether medication has been consumed, Wi-Fi connectivity is utilized to transmit user data to a cloud-based database, and caregivers can remotely monitor adherence through a mobile application interface (Nurhakim et al., 2025).

Furthermore, a training workshop was conducted in collaboration with local health cadres (kader kesehatan) following the completion of the prototype. The training consisted of demonstrations on the use of the smart medicine box, the insertion of medication schedules, and the interpretation of indicator signals. The participatory training model employed in this study is consistent with the most effective methods of community-based technology adoption frameworks (Schaefer et al., 2021) . Subsequently, a pilot implementation was implemented among a select group of residents, predominantly elderly individuals with chronic medication requirements. The devices were distributed for a trial period of 4–6 weeks. This stage involved the collection of data on the frequency of utilization, the level of adherence, and feedback on the usability.

Fourth, during the implementation, monitoring was conducted both in-person and remotely. Field visits were scheduled on a weekly basis to gather feedback and resolve technical issues, while cloud-based recordings were analyzed to identify adherence patterns. The visit activities are shown in Figure 2. Descriptive methods were employed to analyze quantitative data, including the frequency of missed doses and qualitative feedback from users. The Technology Acceptance Model (TAM) is the reference for the evaluation framework, which evaluates the perceived utility, ease of use, and behavioral intention of community members (Wallace & Sheetz, 2014). The smart medicine box intervention's overall impact and sustainability were determined by these indicators.

The final stage consisted of the dissemination of results through community meetings, and educational posters that were disseminated by health cadres as shown in Figure 3. The device design and community engagement strategy were refined in anticipation of future scalability based on the feedback obtained from these sessions. The initiative also included a recommendation phase to explore the possibility of collaborating with local health authorities to facilitate a more widespread adoption.

Figure 1. community-based participatory approaches and technical development

Figure 2. Monitoring activities were conducted directly through meetings with residents

Figure 3. Dissemination of results through community meetings

RESULTS AND DISCUSSION

The evaluation was conducted to understand the public perception of the effectiveness and acceptance of the smart medicine box technology in Palasari Village, Cibiru District illustrates in Figure 2 and Table 2. A total of 27 respondents provided assessments for 10 questionnaire items related to aspects of understanding, usability, design, and potential use of the device. The assessment used a Likert scale (1–5) with the following criteria: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree (Kankaraš & Capecchi, 2025). The analysis results indicate that the public responded favorably to the smart medicine box's implementation and demonstration. The majority of respondents firmly agreed with the

device's benefits and effectiveness, as evidenced by the overall average score of 4.37 out of 5 (equivalent to 87.3%).

As follows are several significant discoveries from the questionnaire:

- Understanding Technology (Questions 1-2)

More than ninety percent of those who participated in the survey believed that the functioning of the medication reminder and the description of how it operates were presented in a manner that was clear and simple. As a result, this suggests that the educational approach that was utilized during the demonstration, which was successful, was effective.

- Effectiveness and Usability (Questions 3–5)

The public's firm conviction that the smart medicine box can mitigate the risk of forgetting to take medication was demonstrated by the highest score (93.4%) in item 3. This implies that this device has the potential to significantly enhance medication discipline and adherence, particularly in geriatric patients or those who are taking long-term medications.

- Security and Design Considerations (Questions 6–7)

Despite remaining in the "Good" category, the security and design aspects received slightly lower scores (84–82%) than the other aspects. Some respondents continue to express a desire for enhancements to the system's tangible appearance and reliability in order to enhance its user-friendliness.

- Comprehension of Interest and Benefits (Questions 8–10)

The demonstration caught the attention of the majority of respondents when it came to using or suggesting the gadget in the future, and they considered that the information regarding the benefits of the item was successfully presented to them. This exemplifies the positive opinion that the general public has of developments in health technology that are based on the Internet of Things.

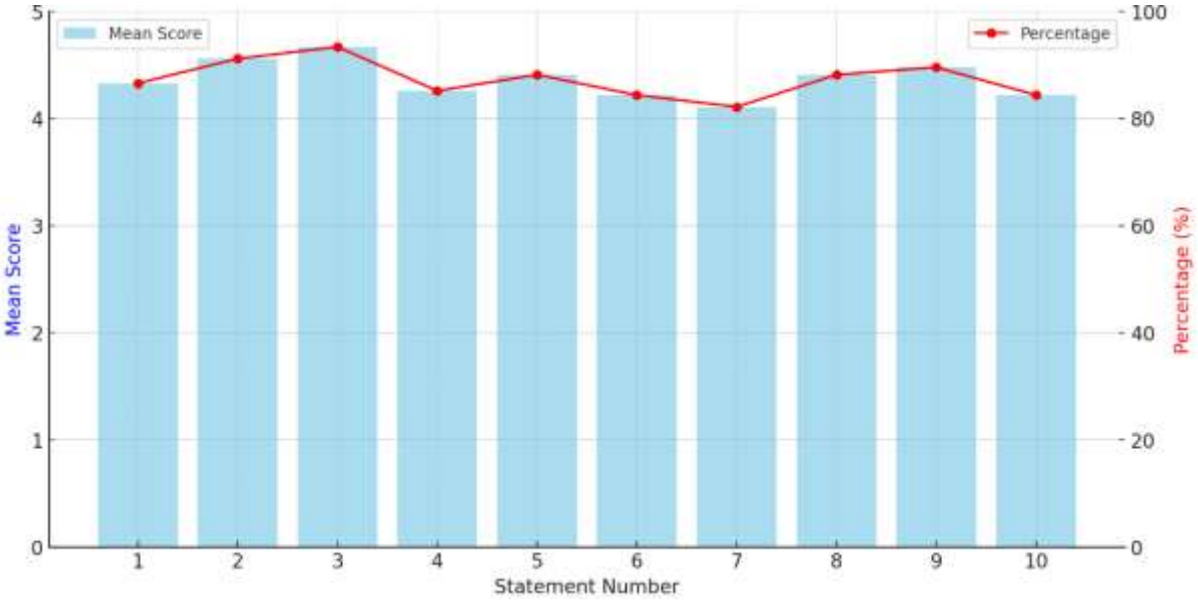

Figure 2. Evaluation of smart medicine box demonstration

Table 1. Results of respondents' statements

No	Statement	Total Score	Mean	Percentage	Category
1	The explanation of how the smart medicine box works was clear and easy to understand.	117	4.33	86.6%	Very Good
2	The alarm/reminder feature has great potential to improve medication adherence.	123	4.56	91.2%	Very Good
3	This device has the potential to be an effective solution to reduce the risk of forgetting to take medicine.	126	4.67	93.4%	Very Good
4	The demonstration of the dosage control feature was convincing in helping to prevent dosage errors.	115	4.26	85.2%	Very Good
5	After the demo, the device appeared capable of improving user compliance with medication schedules.	119	4.41	88.2%	Very Good
6	The demonstrated concept of smart medicine box gave the impression of being a safe and reliable tool.	114	4.22	84.4%	Good
7	The visual design and size of the smart medicine box seemed practical for home use.	111	4.11	82.2%	Good
8	The information about the benefits of the device in reducing medication risks was well delivered during the demo.	119	4.41	88.2%	Very Good
9	The demonstration gave a very positive impression of the device's usefulness.	121	4.48	89.6%	Very Good
10	The demo successfully generated interest in using or recommending the device in the future.	114	4.22	84.4%	Good
	Overall Average	**1179**	**4.37**	**87.3%**	**Very Good**

CONCLUSION

The implementation of the IoT-based smart medicine box in Palasari village demonstrated significant potential in improving medication adherence and enhancing community health literacy. The participatory approach, involving residents, health cadres, and local health authorities, ensured that the technology was aligned with the community's needs and capabilities. Evaluation results indicated high levels of acceptance and perceived usefulness, particularly in reducing missed doses and facilitating proper medication management. While some improvements in device design and perceived safety were suggested, the overall impact highlights that simple, technology-driven interventions can effectively support safe medication practices at the community level. This initiative provides a replicable model for promoting digital health literacy and fostering behavioral changes in medication habits, contributing to better public health outcomes.

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