Design Analysis Of School Bell Simulation System At High School N 1 Percut With Iot Technology

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Abstract: The automatic school bell system is a technological innovation that aims to optimize the time management of activities at school, such as entering, resting, and returning home. This research aims to design and analyze an Internet of Things (IoT)-based school bell simulation system at SMA Negeri 1 Percut. This system uses IoT technology to automate and control the bell schedule in a structured manner through internet-connected devices, allowing flexibility in setting and monitoring remotely. This research method includes hardware and software design, simulation testing, and system performance evaluation. The results of the research show that this IoT-based automatic bell system is able to run well according to the specified schedule, provides efficiency in timing school activities, and allows more accurate control and minimal errors. With the implementation of this system, it is expected to improve time discipline in the school environment and support technological advances in the field of education.

INTRODUCTION

In the modern educational environment, time management is essential to maintaining the smooth flow of daily activities and ensuring that both students and teachers adhere to structured schedules. One of the pivotal tools for enforcing this schedule is the school bell system, which marks important time intervals such as the beginning and end of class periods, breaks, and dismissal. However, conventional school bell systems often require manual operation or preset programming, which lacks flexibility and may result in occasional errors or scheduling conflicts (Novelan et al., 2020). To address these limitations, an automated school bell system based on Internet of Things (IoT) technology presents a promising solution, as it enables remote access, easy schedule adjustments, and real-time control(Herdianto et al., 2021).

This study focuses on designing and analyzing an IoT-based school bell simulation system for High School N 1 Percut, with the goal of automating time

management while reducing human intervention(Amin, 2020). By leveraging IoT technology, the proposed system can be controlled via an internet-connected interface, allowing school administrators to set, monitor, and adjust bell schedules effortlessly from a smartphone or computer(Fahmi et al., 2020). This technological shift not only streamlines daily school operations but also aligns with the digital transformation goals of educational institutions aiming to incorporate advanced technologies into their infrastructure (Syahdi Nasution et al., 2023).

The design and development process of this IoT-based school bell system involves both hardware and software components(Zamora-Izquierdo et al., 2019). The hardware setup includes a microcontroller to control the bell sound and connectivity modules to link with the IoT platform(Yoon et al., 2018). Meanwhile, the software allows for scheduling configurations and remote access, ensuring that the system can be adjusted in real time to accommodate changes such as special events or sudden alterations to the (Mudhoffar et al., 2022)schedule. Through this study, it is expected that the automated bell system will enhance time efficiency, increase accuracy, and contribute to a more disciplined learning environment.

RESEARCH METHODS

The research methodology in this study involves a combination of design, implementation, and evaluation phases to create an automated IoT-based school bell system suitable for High School N 1 Percut. This approach includes both hardware and software development, simulation testing, and system performance analysis. The study follows a prototype-based design method, which allows for iterative testing and refinement, ensuring the system meets operational requirements and functions accurately according to predefined schedules (Firliana & Rhohman, 2019).

1. System Design and Hardware Selection

In the design phase, we identified the necessary hardware components to achieve an effective IoT-based system. This includes a microcontroller (such as the ESP8266 or Arduino) to control bell activation, as well as a Wi-Fi module for internet connectivity, enabling remote scheduling and control(Wadly et al., 2023). Additional components, such as relays and speakers, were selected to ensure the bell rings at adequate volume and timing intervals (Rombekila, 2021). Circuit diagrams were created to map

connections between components, and prototypes were assembled for preliminary testing(Sokibi & Nugraha, 2020).

2. Software Development and IoT Integration

For the software, we developed an interface to configure the bell schedules and manage the system through a web-based or mobile application, allowing remote access. The software was programmed to communicate with the microcontroller and trigger bell sounds based on the scheduled times. An IoT platform, such as Blynk or Firebase, was integrated to manage data exchange between the user interface and the hardware, ensuring that schedule changes are seamlessly updated in real time. The programming logic was tested iteratively, refining it to account for specific scheduling needs, error handling, and user accessibility(Tan & Sidhu, 2022).

3. Simulation and Testing

To evaluate the system's effectiveness, we conducted simulation tests to ensure it operates as intended. The tests were performed in two stages: first, a laboratory-based simulation was conducted to verify system responsiveness, schedule accuracy, and connectivity. Second, a pilot test was carried out at High School N 1 Percut to assess performance in a real environment. Performance metrics included response time, reliability, and ease of use, while feedback from school administrators was collected to gauge user satisfaction and suggest further improvements (Fahmi et al., 2020).

4. Evaluation and Analysis

Following testing, we analyzed the results to measure the system's effectiveness in automating the bell schedule and reducing manual interventions. This involved comparing the automated system's performance with that of the traditional bell system in terms of scheduling accuracy, ease of control, and the frequency of timing errors. The data collected was used to fine-tune both the hardware and software, ensuring that the final design provides a reliable, efficient, and user-friendly solution for the school's time management needs (Irfan et al., 2023).

This study employs a prototype-based design approach to develop an IoT-powered automated school bell system for High School N 1 Percut. The methodology consists of four main stages: system design, software development, simulation, and evaluation. The design phase involves selecting suitable hardware, such as microcontrollers and Wi-Fi modules, to enable remote control and connectivity.

Software development follows, focusing on creating an accessible interface for scheduling and managing bell functions via an IoT platform. After assembling the prototype, simulation tests are conducted both in a lab and on-site to ensure schedule accuracy, connectivity, and user responsiveness. The final phase involves evaluating system performance against the traditional bell setup, analyzing metrics such as reliability and ease of use, and refining the system based on user feedback for optimal functionality in a school environment.

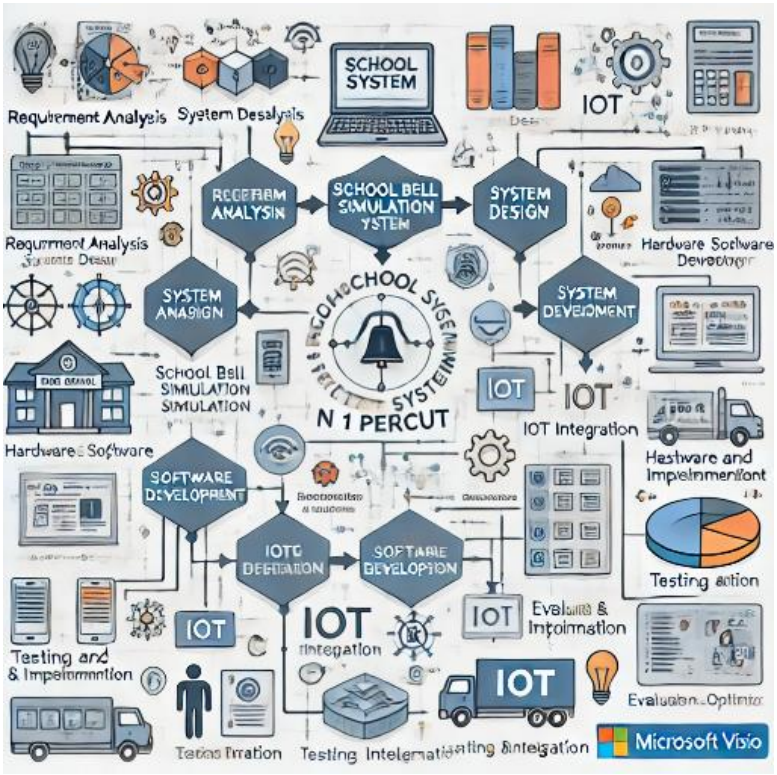

Figure 1. System Design Stages Model

RESULTS AND DISCUSSION

The results of implementing the IoT-based school bell simulation system demonstrated significant improvements in both functionality and reliability compared to traditional bell systems. Initial tests in a controlled lab environment confirmed that the system successfully activated bells according to scheduled times with a high degree of accuracy, responding promptly to schedule changes made through the interface. During pilot testing at High School N 1 Percut, the system operated smoothly under real conditions, consistently triggering the bell at designated times without manual intervention. School administrators found the web-based interface easy to navigate, and

they reported that schedule adjustments were intuitive and could be implemented immediately. However, certain challenges emerged, particularly regarding the dependency on internet connectivity for remote control and schedule adjustments. Although the system continued to operate on preset times during brief network downtimes, longer outages could hinder administrative control. This could be mitigated by incorporating a local backup interface or offline scheduling options to ensure continuous management capabilities. Despite this limitation, the system proved to be a reliable and efficient tool for school time management, paving the way for broader IoT applications in educational settings.

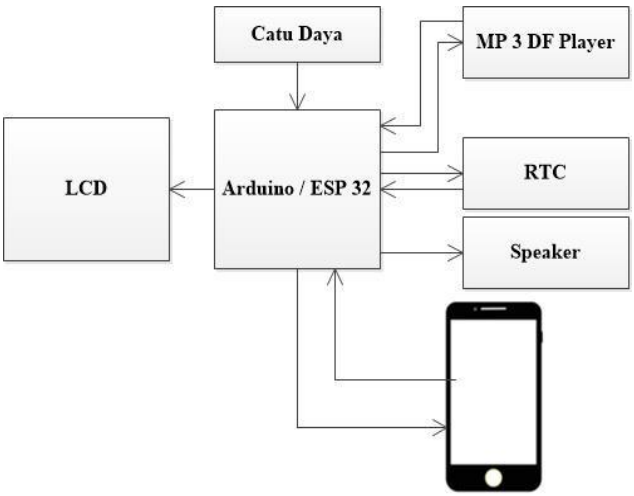

Figure 2. School Bell Design

CONCLUSION

The development and implementation of an IoT-based school bell system at High School N 1 Percut successfully demonstrated the advantages of automated time management in educational settings. By utilizing IoT technology, the system allows for precise scheduling, remote access, and easy adaptability to changes, effectively minimizing manual intervention and potential errors associated with traditional bell systems. Testing results confirmed that the system is reliable, with stable connectivity and responsiveness, ensuring uninterrupted school operations even during minor network interruptions.

REFERENCE

Amin, M. (2020). Sistem Cerdas Kontrol Kran Air Menggunakan Mikrokontroler Arduino dan Sensor Ultrasonic. *Jurnal Nasional Informatika Dan Teknologi Jaringan*, *2*.

Fahmi, M., Santoso, B., Maisyaroh, M., Sunandar, A., & Wahyudi, I. (2020). Prototipe Alat Simulasi Taman Pintar Dengan Pengontrol Bluetooth HC-05 Berbasis Mikrokontroller. *BINA INSANI ICT JOURNAL*, *7*(2). https://doi.org/10.51211/biict.v7i2.1427

Firliana, R., & Rhohman, F. (2019). Aplikasi Sistem Informasi Absensi Mahasiswa dan Dosen. *DoubleClick: Journal of Computer and Information Technology*, *2*(2).

Herdianto, H., Mursyidah, M., & Rusli, R. (2021). Perancangan Washtafel Otomatis Menggunakan Mikrokontroler ATMEGA16. *Jurnal Infomedia*, *6*(1). https://doi.org/10.30811/jim.v6i1.2330

Irfan, M., Rosid, M. A. G. N., & Lutfiyani, A. (2023). Perancangan Sistem Absensi Berbasis Website dengan Metode Waterfall di BAPPEDA Kebumen. *JURNAL KRIDATAMA SAINS DAN TEKNOLOGI*, *5*(01). https://doi.org/10.53863/kst.v5i01.702

Mudhoffar, G. R., Partono, P., & Prihandono, E. (2022). PENGEMBANGAN PERANGKAT BEL SEKOLAH OTOMATIS DENGAN MICROCONTROLLER ARDUINO UNO BERBASIS INTERNET of THING (IoT). *JURNAL FIRNAS*, *3*(1). https://doi.org/10.24127/firnas.v3i1.3412

Novelan, S. M., Syahputra, Z., & Putra, P. H. (2020). Sistem Kendali Lampu Menggunakan NodeMCU dan Mysql Berbasis IOT (Internet Of Things). *Jurnal Nasional Informatika Dan Teknologi Jaringan*, *5*(1).

Rombekila, A.-. (2021). RANCANG BANGUN SISTEM KENDALI KIPAS OTOMATIS BERBASIS ARDUINO UNO PADA LABORATORIUM POLITEKNIK AMAMAPARE TIMIKA. *DINAMIS*, *18*(1). https://doi.org/10.58839/jd.v18i1.906

Sokibi, P., & Nugraha, R. A. (2020). PERANCANGAN PROTOTYPE SISTEM PERINGATAN INDIKASI KEBAKARAN DI DAPUR RUMAH TANGGA BERBASIS ARDUINO UNO. *Jurnal Digit*, *10*(1). https://doi.org/10.51920/jd.v10i1.152

Syahdi Nasution, M., Muhammad Amin, & Wirda Fitriani. (2023). Smart Sistem Iot Pemberi Pakan Ikan Dengan Menggunakan Metode Time Schedulling Berbasis Mikrokontroller. *JOURNAL ZETROEM*, *5*(2). https://doi.org/10.36526/ztr.v5i2.3082

Tan, W. C., & Sidhu, M. S. (2022). Review of RFID and IoT integration in supply chain

management. *Operations Research Perspectives*, *9*. https://doi.org/10.1016/j.orp.2022.100229

Wadly, F., Muslim, & Fitriani, W. (2023). PERANCANGAN SISTEM RADIUS PADA MIKROTIK ROUTEROS DI PT.PUAN BALEO RAHMADSYAH. *Jurnal Nasional Teknologi Komputer*, *3*(1). https://doi.org/10.61306/jnastek.v3i1.68

Yoon, C., Huh, M., Kang, S. G., Park, J., & Lee, C. (2018). Implement smart farm with IoT technology. *International Conference on Advanced Communication Technology, ICACT*, *2018-February*. https://doi.org/10.23919/ICACT.2018.8323908

Zamora-Izquierdo, M. A., Santa, J., Martínez, J. A., Martínez, V., & Skarmeta, A. F. (2019). Smart farming IoT platform based on edge and cloud computing. *Biosystems Engineering*, *177*. https://doi.org/10.1016/j.biosystemseng.2018.10.014

Supiyandi, C.Rizal, M.Iqbal. (2023). Perancangan Website Promosi Kursus LKP Karyaprima Berbasis Web. Prosiding Nasional ESCAF (Economic, Social Science, Computer, Agriculture and Fisheries. 989-995.

C. Rizal, Supriyandi, M. Amin. "Perancangan Aplikasi Pengelolaan Keuangan Desa MelaluiE-Village Budgeting," *Bull. Comput. Sci. Res.*, vol. 3, no. 1, pp. 7–13, 2022, doi: 10.47065/bulletincsr.v3i1.181.