International Transactions on Artificial Intelligence (ITALIC)
Vol. 2 No. 1, November 2023, pp. 33~39
P-ISSN: 2963-6086, E-ISSN: 2963-1939, DOI: 10.33050

Application of RESTful Method with JWT Security and Haversine Algorithm on Web Service-Based Teacher Attendance System

Suryari Purnama[1], Mustofa Kamal[2], Ahmad Bayu Yadila[3]
[1] University of Esa Unggul, Tangerang, Indonesia
[2,3] University of Raharja, Tangerang, Indonesia
e-mail: suryari.purnama@esaunggul.ac.id, mustofakamal@raharja.info, ahmadbayu@raharja.info

Article Info

Article history:

Received August 18, 2023
Revised August 22, 2023
Accepted November 21, 2023

Keywords:

RESTful Method,
JWT Security,
Haversine Algorithm,
Web Service,
Teacher Attendance System

ABSTRACT

A teacher attendance system utilizing fingerprints has been implemented at Ponpes Daarul Muttaqien II. However, fingerprint recognition errors frequently occur if the scanner is unclean. Teachers fill out an attendance update form for various reasons, including forgotten attendance, damaged fingerprints, and unnoticed absences. The Human Resources Bureau receives updates from around 28 instructors within one week. Statistics reveal that 30% of instructors update due to finger injuries preventing recognition, and 70% due to forgetting. Amid the COVID-19 pandemic, organizations advise remote work. Similarly, only specific sections, like technical and security units, require attendance at Ponpes Daarul Muttaqien II. Due to the potential risks of linking fingerprints to virus transmission, this study proposes a web-based attendance system. It employs the RESTful API approach, JWT Security, and the Haversine Formula Algorithm. The system mandates employees to be within 100 meters of a designated coordinate point for attendance. The system tracks attendance status, arrival and delay times, and absence status. Future enhancements might involve facial recognition for more robust validation. In conclusion, this innovative approach addresses attendance challenges, offering adaptability, security, and potential fraud prevention.

Corresponding Author:

Suryari Purnama
University of EsaUnggul,Tangerang,Indonesia
Email: suryari.purnama@esaunggul.ac.id

1. INTRODUCTION

In recent times, Ponpes Daarul Muttaqien II has implemented a teacher attendance system utilizing fingerprint recognition technology. However, this system has encountered challenges related to accuracy due to the potential errors caused by unclean fingerprint scanners. To address this issue, teachers often resort to manually updating their

attendance records, primarily driven by reasons such as forgotten attendance, damaged fingerprints, and overlooked instances[1].

The task of managing attendance updates falls under the purview of the Human Resources Bureau, which receives attendance updates from approximately 28 instructors within a six-day working period, equivalent to one week. Notably, statistical analysis reveals that 30% of instructors update their attendance due to finger injuries that hinder accurate fingerprint recognition, while the remaining 70% do so because of occasional lapses in memory.

The prevailing circumstances, including the COVID-19 pandemic, have prompted a shift in work dynamics, urging various organizations, including Ponpes Daarul Muttaqien II, to adopt remote work policies[2],[3]. Consequently, only specific departments, such as the technical and security sectors, require physical presence at the institution. However, the use of fingerprints for attendance tracking raises concerns, as it can potentially facilitate the transmission chain of the COVID-19 virus.

This study suggests the construction of a web service-based solution to overcome these issues and produce a system for attendance recording that is more secure and effective. This system makes use of the Haversine Formula Algorithm, JWT (JSON Web Token) security, and the REST (Representational State Transfer) architectural design[4], [5]. This online attendance system guarantees that instructors may register their attendance only when they are within a predetermined proximity of 100 meters from a specific coordinate point by using a RESTful API (Application Programming Interface) approach[6].

Monitoring attendance, tracking arrival and delay times, and recording absences are some of the main features of this suggested system. Additionally, the system creates room for future development by using cutting-edge methods like facial recognition to better verify attendance records and discourage fraud[7].

Finally, a possible method to improve the precision, dependability, and security of the Ponpes Daarul Muttaqien II teacher attendance system is provided by the combination of RESTful principles, JWT security, and the Haversine Formula Algorithm[8]. This strategy uses cutting-edge web service technologies to solve current issues while also laying the groundwork for future improvements that will increase attendance management's overall efficacy.

2. LITERATURE REVIEW

At Ponpes Daarul Muttaqien II, the integration of fingerprint-based methods for tracking teacher attendance has been effectively implemented. However, a persistent issue develops when the fingerprint scanner is hacked, leading to frequent identification mistakes. To address any discrepancies, teachers frequently submit attendance update forms. These revisions are the result of three main issues: instances of absenteeism, problematic fingerprints, and instances of undiscovered fingerprints. Within a period of six working days, or one week, the Human Resources Bureau normally gets attendance updates from about 28 teachers[9]. Examining the data indicates that 70% of teachers update their attendance owing to memory gaps, whereas 30% of teachers change their attendance due to finger ailments that prevent accurate fingerprint recognition.

The ongoing global pandemic has significantly reshaped work dynamics, prompting various organizations, including Ponpes Daarul Muttaqien II, to advocate for remote work arrangements. Consequently, attendance at the institution is now primarily required for specific sectors such as technical and security departments. Given the prevailing COVID-19 pandemic, there is a heightened concern that fingerprint-based attendance systems could inadvertently contribute to the spread of the virus. Hence, this study proposes an innovative approach: an attendance system grounded in web services, incorporating the Fire REST method bolstered by Jwt security and the Haversine Formula Algorithm[10], [11].

The proposed online service attendance system follows the rules of a RESTful API (Application Programming Interface) and is strengthened by the JWT (JSON Web Token) security protocol and the Haversine Formula Algorithm. Employees must be within a 100-meter radius of the prescribed coordinate point in order to be allowed to record their attendance. With the help of this program, you can keep track of everyone's absences, tardiness, and attendance status in detail. This system might be further developed to

include attendance validation, thereby reducing the possibility for fraudulent actions within the attendance system, with the ability to include additional technologies like facial recognition[12].

In essence, this study advocates for the adoption of a modern and secure attendance system that moves beyond fingerprint-based approaches, which have demonstrated vulnerability to errors, contamination, and potential health risks amidst the ongoing pandemic. The proposed web service-based system not only ensures precise attendance recording but also opens avenues to incorporate advanced technologies for heightened validation and security[13].

3. METHOD

1. System Design and Architecture
   - Define the core objectives of the attendance system within the context of Ponpes Daarul Muttaqien II.
   - Assess the limitations of the existing fingerprint-based system, particularly in light of COVID-19 concerns.
   - Develop a comprehensive system architecture that accommodates alternative attendance methods while ensuring data security.

2. Data Collection and Analysis
   - Collect attendance data from the current fingerprint-based system, focusing on instances of attendance updates.
   - Perform a detailed analysis of the collected data to ascertain trends and factors triggering attendance modifications.
   - Categorize the reasons behind attendance updates, including instances of forgotten attendance, damaged fingerprints, and previously unnoticed absences.

3. System Development
   - Construct a dynamic web service-oriented attendance platform by adopting the RESTful API paradigm.
   - Integrate robust security measures through the implementation of JSON Web Token (JWT) protocols to guarantee secure data transmission.
   - Incorporate the Haversine Formula Algorithm to facilitate accurate distance calculations and efficient coordinate point management.
   - Create an intuitive and user-friendly online interface to facilitate attendance updates by teachers.

4. Geo-Fencing and Attendance Processing
   - Define a central coordinate point to serve as the epicenter for attendance marking.
   - Develop a geo-fencing mechanism to confine attendance recording to a defined radius of 100 meters around the designated coordinate.
   - Formulate algorithms to meticulously track arrival times, instances of delays, and the status of absences.

5. Attendance Validation and Fraud Prevention
   - Investigate the viability of integrating facial recognition technology to enhance attendance validation.
   - Explore the potential expansion of the system to encompass facial recognition functionalities.
   - Emphasize how the integration of facial recognition contributes to curbing fraudulent activities within the attendance system.

6. Testing and Implementation
- Conduct a rigorous testing phase to validate the functionality and reliability of the newly developed attendance system.
- Evaluate the performance of key features, including geo-fencing and attendance tracking, across various devices and browser platforms.
- Address any identified issues and refine the system prior to deployment.

7. User Training and Deployment
- Organize comprehensive training sessions to familiarize teachers and administrative staff with the operational aspects of the revamped attendance system.
- Execute a controlled deployment of the web service-based attendance system within Ponpes Daarul Muttaqien II.
- Solicit ongoing feedback from users to ensure a seamless transition and identify potential areas for enhancement.

8. Continuous Improvement and Future Enhancements
- Leverage user feedback to identify opportunities for system enhancement and refinement.
- Outline a roadmap for future system developments, including the exploration of advanced validation techniques.
- Maintain flexibility to adapt the system to evolving needs and emerging technologies.

4. RESULTS AND DISCUSSION

The outcomes of the implementation of the teacher attendance system at Ponpes Daarul Muttaqien II, which utilizes fingerprint recognition, offer valuable insights into the realm of attendance tracking and management. In this section, we delve into the primary findings and engage in a comprehensive discussion based on the study's objectives and data analysis[14], [15].

1. Challenges in Fingerprint Recognition:

The system's effectiveness is notably influenced by the cleanliness of the fingerprint scanner. Instances of recognition errors are observed when the scanner is contaminated, leading to inaccuracies in individual identification[16]. These challenges underscore the necessity for a robust and dependable attendance tracking mechanism.

2. Attendance Update Motivations:

The process of updating attendance entails several factors, including cases of forgotten attendance, compromised fingerprint readability, and instances of overlooked absences. Statistical analysis reveals that finger injuries, which impede accurate fingerprint recognition, contribute to about 30% of attendance updates[17]. Meanwhile, approximately 70% of updates are linked to instances of overlooked attendance. This data emphasizes the importance of introducing flexible methods for attendance correction to cater to diverse scenarios.

3. Impact of the COVID-19 Pandemic:

The prevailing COVID-19 pandemic has triggered transformative shifts within various institutions, including Ponpes Daarul Muttaqien II, prompting the adoption of remote work arrangements. Consequently, the requirement for physical presence is limited to specific sections[18]. The pandemic has also raised concerns regarding the utilization of fingerprints for attendance due to potential virus transmission, thus underscoring the need for exploring alternative attendance tracking approaches.

4. Proposed Web Service-Based Attendance System:

To address the aforementioned challenges and align with evolving requirements, we propose the implementation of a Web service-based attendance system. This system is built upon the foundation of the Fire REST Method, fortified by JWT Security, and incorporates the precision of the Haversine Formula Algorithm[19], [20]. The integration of the JSON Web Token (JWT) security protocol serves to augment data protection, while the Haversine Formula Algorithm ensures the accurate tracking of attendance based on geographical location[21].

5. Geolocation Constraints:

A pivotal facet of the suggested system involves the imposition of geolocation constraints, allowing employees to record their attendance solely when they are within a 100-meter radius of the designated coordinate point[22]. This feature not only bolsters the integrity of attendance data but also substantially curbs the potential for unauthorized and fraudulent entries.

6. Holistic Attendance Monitoring:

The proposed online service attendance system offers an all-encompassing perspective by meticulously monitoring attendance status, arrival times, instances of delays, and absence occurrences[23]. This detailed insight equips administrators with a comprehensive understanding of attendance trends, thereby facilitating informed decision-making processes.

7. Future Prospects:

An intriguing avenue for future expansion lies in the potential incorporation of facial recognition technology into the application. By exploring supplementary authentication methodologies, the system could further fortify its resilience against fraudulent activities, enhancing overall security[24].

In summary, this study underscores the paramount importance of a dynamic and adaptable attendance tracking system within educational institutions. The proposed Web service-based solution, characterized by RESTful API, JWT Security, and the Haversine Formula Algorithm, offers a promising resolution to the challenges inherent in the current fingerprint-dependent system[25]. Through meticulous geolocation-based attendance tracking and the possible integration of facial recognition, the system exhibits the potential to elevate attendance management, deter fraudulent practices, and seamlessly adapt to evolving organizational requisites.

5. CONCLUSION

To sum up, the implementation of a dependable and efficient teacher attendance system within Ponpes Daarul Muttaqien II, initially incorporating fingerprint recognition, has been thoroughly explored through this research. This system encountered challenges when the fingerprint scanner's functionality was compromised, leading to frequent inaccuracies in recognizing individuals. The attendance updating process, involving a substantial number of teachers who regularly update their attendance status, unveiled three primary motives for these updates: instances of forgotten attendance, fingerprint damage, and unnoticed absences.

Efficiently managing attendance updates for around 28 instructors within a six-day working timeframe, or a week, has been a successful practice carried out by the Human Resources Bureau. Analyzing the patterns of attendance updates revealed that approximately 30% of instructors modified their attendance records due to finger injuries that hindered proper fingerprint recognition, while the remaining 70% made revisions due to forgetfulness.

The ongoing COVID-19 pandemic has ushered in shifts in work dynamics, with remote work setups becoming the norm. Correspondingly, the specific operational needs of Ponpes Daarul Muttaqien II have necessitated the physical presence of teachers only in designated sections, such as the technical and security departments. The evident risks

associated with using fingerprint-based attendance methods in the context of COVID-19 transmission have raised the need for an alternative approach.

In response to these challenges, this study proposes an innovative web-based attendance system that leverages the RESTful API methodology, JWT (JSON Web Token) security protocol, and the Haversine Formula Algorithm. This novel system ensures that an employee's attendance is recorded only when they are within 100 meters of the specified coordinate point. The application adeptly tracks attendance statuses, arrival times, delays, and instances of absence.

Moreover, envisioning the potential expansion of this system to encompass facial recognition as an added validation technique holds promise for further enhancing the accuracy of attendance records and mitigating fraudulent activities. By embracing these advancements, the suggested attendance system offers a feasible resolution to the limitations posed by fingerprint-based methods.

In essence, this study underscores the vital importance of adaptable and secure attendance systems, particularly within the evolving landscape of remote work arrangements and health-related considerations. The integration of RESTful API, JWT security, and the Haversine Algorithm provides a robust framework that not only ensures precise attendance recording but also introduces avenues for future refinements and the prevention of fraudulent activities within the attendance tracking process.

REFERENCES

[1] Ahmad, I., Suwarni, E., Borman, R. I., Rossi, F., & Jusman, Y. (2021, October). Implementation of RESTful API Web Services Architecture in Takeaway Application Development. In 2021 1st International Conference on Electronic and Electrical Engineering and Intelligent System (ICE3IS) (pp. 132-137). IEEE.

[2] Karlsson, S., Čaušević, A., & Sundmark, D. (2020, October). QuickREST: Property-based test generation of OpenAPI-described RESTful APIs. In 2020 IEEE 13th International Conference on Software Testing, Validation and Verification (ICST) (pp. 131-141). IEEE.

[3] Maurya, R., Nambiar, K. A., Babbe, P., Kalokhe, J. P., Ingle, Y. S., & Shaikh, N. F. (2021). Application of Restful APIs in IOT: A Review. Int. J. Res. Appl. Sci. Eng. Technol, 9, 145-151.

[4] Ehsan, A., Abuhaliqa, M. A. M., Catal, C., & Mishra, D. (2022). RESTful API testing methodologies: Rationale, challenges, and solution directions. Applied Sciences, 12(9), 4369.

[5] Ozdemir, E. (2020). A general overview of RESTful web services. Applications and approaches to object-oriented software design: emerging research and opportunities, 133-165.

[6] Sabir, B. E., Youssfi, M., Bouattane, O., & Allali, H. (2020). Authentication model based on JWT and local PKI for communication security in multi-agent systems. In Innovation in Information Systems and Technologies to Support Learning Research: Proceedings of EMENA-ISTL 2019 3 (pp. 469-479). Springer International Publishing.

[7] Alkhulaifi, A., & El-Alfy, E. S. M. (2020, May). Exploring lattice-based post-quantum signature for JWT authentication: review and case study. In 2020 IEEE 91st Vehicular Technology Conference (VTC2020-Spring) (pp. 1-5). IEEE.

[8] Melton, R. (2021, March). Securing a Cloud-Native C2 Architecture Using SSO and JWT. In 2021 IEEE Aerospace Conference (50100) (pp. 1-8). IEEE.

[9] Bucko, A., Vishi, K., Krasniqi, B., & Rexha, B. (2023). Enhancing JWT Authentication and Authorization in Web Applications Based on User Behavior History. Computers, 12(4), 78.

[10] Umarjati, A., & Wibowo, A. (2020). Implementasi JWT pada Aplikasi Presensi dengan Validasi Fingerprint, Geotagging dan Device Checker. Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi), 4(6), 1085-1091.

[11] Prasetya, D. A., Nguyen, P. T., Faizullin, R., Iswanto, I., & Armay, E. F. (2020). Resolving the shortest path problem using the haversine algorithm. Journal of critical reviews, 7(1), 62-64.

[12] Ikasari, D., & Andika, R. (2021, June). Determine the Shortest Path Problem Using Haversine Algorithm, A Case Study of SMA Zoning in Depok. In 2021 3rd International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA) (pp. 1-6). IEEE.

[13] Soe, N. C., & Thein, T. L. L. (2020). Haversine formula and RPA algorithm for navigation system. International Journal of Data Science and Analysis, 6(1), 32.

[14] Soe, N. (2020). Traffic Less Navigation with Haversine Formula and RPA Algorithm. Journal of Applied Informatics and Technology, 2(1), 30-45.

[15] Sidiq, H., & Satria, D. (2022). Implementasi Algoritma Haversine Pada Absensi Kepegawaian Berbasis Android. Journal of Applied Computer Science and Technology, 3(1), 120-126.

[16] Amirulloh, I., d Iskandar, I., Apriyani, Y., Warnilah, A. I., Purnia, D. S., & Surahman, M. (2020, November). Teacher Attendance Monitoring System Teaching with QR-Code and Geo Location using Android Platform. In Journal of Physics: Conference Series (Vol. 1641, No. 1, p. 012030). IOP Publishing.

[17] El Mrabet, H., & Moussa, A. A. (2020). IoT-school attendance system using RFID technology.

[18] Fatah, A. F. A., Mohamad, R., & Rahman, F. Y. A. (2021, April). Student attendance system using an android based mobile application. In 2021 IEEE 11th IEEE Symposium on Computer Applications & Industrial Electronics (ISCAIE) (pp. 224-227). IEEE.

[19] Perez-Siguas, R., Matta-Solis, H., Matta-Solis, E., Matta-Perez, H., Cruzata-Martinez, A., & Meneses-Claudio, B. (2023). Management of an automatic system to generate reports on the attendance control of teachers in a educational center. International Journal on Recent and Innovation Trends in Computing and Communication, 20-26.

[20] Fauziah, Z., Latifah, H., Rahardja, U., Lutfiani, N., & Mardiansyah, A. (2021). Designing student attendance information systems web-based. Aptisi Transactions on Technopreneurship (ATT), 3(1), 23-31.

[21] Mariyanti, T. (2023). Development of Mobile Learning Applications for Android Based on Artificial Intelligence. International Transactions on Artificial Intelligence, 1(2), 230-235.

[22] Anwar, M. R. (2023). Analysis of Expert System Implementation in Computer Damage Diagnosis with Forward Chaining Method. International Transactions on Artificial Intelligence, 1(2), 139-155.

[23] Purnama, S., & Sejati, W. (2023). Internet of Things, Big Data, and Artificial Intelligence in The Food and Agriculture Sector. International Transactions on Artificial Intelligence, 1(2), 156-174.

[24] Prawiyogi, A. G., Purnama, S., & Meria, L. (2022). Smart Cities Using Machine Learning and Intelligent Applications. International Transactions on Artificial Intelligence, 1(1), 102-116.

[25] Sriliasta, C., & Meilinda, V. (2023). Overview of Life Cycle Assessment of Current Emerging Technologies. International Transactions on Artificial Intelligence, 1(2), 175-18