

Enhancing a Post-Pandemic GPS-Based Attendance System with Landmark-Assisted Selfie Verification: A Case Study at UniSIRAJ, Malaysia

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ABSTRACT

The COVID-19 pandemic accelerated the use of mobile and location-based attendance mechanism as organizations required alternative to fixed attendance terminals. At the former Kolej Universiti Islam Perlis (KUIPs), now Universiti Islam Antarabangsa Tuanku Syed Sirajuddin (UniSIRAJ), a GPS-based staff attendance application was introduced and subsequently remained in operational use after the pandemic. This study reports a post-pandemic enhancement of the established system through landmark-assisted selfie verification. The enhancement was designed as an alternative to infrastructure-less alternative to fixed facial-recognition camera assisted attendance. The system uses the employee's existing smartphone GPS and camera rather than dedicated camera infrastructure or biometric-recognition models. Rapid Application Development (RAD) guided the enhancement process, followed by functional testing and a preliminary usability evaluation. Twenty ($n=20$) actual users participated, comprising academic and administrative staff. Usability was evaluated using the ten-item System Usability Scale (SUS), supplemented by four items assessing perceptions of GPS and landmark-assisted selfie evidence. Based on the aggregated questionnaire frequencies, the enhanced system obtained an aggregate SUS score of 73.88 out of 100. Most item-level responses indicated favorable ease of use, learnability, integration and confidence, although two negatively worded SUS items showed inconsistent response patterns and are interpreted cautiously. All $n=20$ respondents agreed or strongly agreed with all four dual-evidence statements. The highest mean was recorded for confidence in the combined GPS and landmark-assisted selfie mechanism ($M=4.85/5$). The findings provide preliminary case-study evidence that an established pandemic-era GPS attendance system can be enhanced with contextual visual evidence while retaining a relatively low-complexity, smartphone-based architecture. The system is not presented as an automated GPS-spoofing detector or biometric identification system; rather, it provides supplementary, human-reviewable evidence of physical workplace presence.

Keywords: GPS mobile attendance; landmark-assisted selfie; post-pandemic digitalization; System Usability Scale; Rapid Application Development

INTRODUCTION

The COVID-19 pandemic has increased the adoption of digital technology for routine organizational activities. Restrictions on physical movement, work from home arrangements and limitations on shared facilities created an immediate need for organizations to reconsider conventional employee attendance mechanisms. Fixed attendance terminals and manual attendance register were less suitable when employees were required to perform their duties remotely. Mobile and location-based attendance systems consequently became a practical alternative for recording attendance beyond conventional office environment.

At the institutional level, a similar change occurred at the former Kolej Universiti Islam Perlis (KUIPs), now

known as Universiti Islam Antarabangsa Tuanku Syed Sirajuddin (UniSIRAJ). During the pandemic period, an Android-based GPS attendance application was developed for employees as part of the institution's human-resource information environment (Mat Bistaman et al., 2022). The application used the employee's smartphone GPS to record geographical location during attendance transactions. Although initially useful in supporting flexible working arrangements, the system continued to serve an operational purpose after employees returned to normal campus-based work.

The continued use of mobile attendance after the pandemic is not unique to UniSIRAJ. Recent studies in Malaysian higher education institutions demonstrate that location-based application remain practical mechanisms for attendance management. Che Fauzi et al. (2025), for example, developed TECH-CLASS using Google's Geofencing API, while Salleh et al. (2026) reported SmartTasjeel, which used existing institutional resources and user devices to provide GPS-based attendance for medical students. These studies suggest that location-based attendance can stay helpful in the current circumstances that originally supported its implementation.

However, continued use of GPS application under normal campus operations raised other practical concern at UniSIRAJ. The application shows the GPS record of geographical coordinates reported by the employee's device, but the attendance record itself provides limited information about the employee's physical where about. This feature becomes relevant when the management wants to examine whether a Clock-In record appropriately matches with presence within the campus area. The issue is further complicated by the availability of GPS-spoofing or other software-based location manipulation technologies from the Internet.

Jiang et al. (2022) highlighted the accessibility of GPS-spoofing tools, including Fake GPS and other software-based tools, which can generate false location information and potentially mislead monitoring systems. Similarly, Campos et al. (2020) demonstrated a mobile-based machine-learning methods for detecting fake GPS signal locations, illustrating that location information alone may require additional precautions when location integrity is important.

Automated facial recognition could provide another layer of identity verification, but this would require in technical requirements changes of the existing attendance system. Facial-recognition implementations commonly introduce additional or improvised recognition processes, biometric software, enrolment procedures, and, depending on new architecture with additional computing or camera resources (Seelam et al., 2021; Ahmad & Pratiwi, 2025; Satrianto & Sisephaputra, 2025). Such a move would involve further additional recognition technologies, and potentially new infrastructure, all of which would introduce additional implementation and maintenance costs.

UniSIRAJ present approach adopts a simpler design method. Instead of adding additional technologies such as a facial recognition, the existing GPS-based attendance workflow was enhanced with a real-time selfie captured through the employee's own smartphone. The selfie is intended to include a recognizable university building, signage or identifiable landmark context which is more practical. Thus, GPS provides reported GPS location evidence, while the landmark-assisted selfie provides supplementary visual and reporting context.

Hence, this approach is supposed to be infrastructure-light. The application does not require dedicated recognition cameras, complex biometric detection devices, or automated face-recognition models as part of the implementation workflow. Even though, it does not claim to detect Fake GPS automatically, rather it increases the amount of human-reviewable evidence associated with a Clock-In transaction.

Therefore, this study explores the establishment of the UniSIRAJ GPS attendance system that was enhanced through landmark-assisted selfie verification using Rapid Application Development (RAD). It also provides a preliminary evaluation of the usability of the enhanced system among actual employees. The study is positioned as an applied institutional case rather than the development of a new biometric or GPS-spoofing detection algorithm.

LITERATURE REVIEW

GPS and Geofencing Attendance in Higher Education

GPS-based location provides a practical basis for mobile attendance because the location associated with an attendance transaction can be obtained without requiring employees to use a fixed terminal. Mat Bistaman et al. (2022) provided an early institutional foundation for the present case through the KUIPs Android-based GPS attendance application. The system was developed for human-resource attendance and used mobile GPS to obtain staff location.

More recent Malaysian studies show that this approach remains relevant. TECH-CLASS used Android Studio, Google's Geofencing API and Firebase Realtime Database to validate attendance within defined areas. Its evaluation with 50 students reported a SUS score of 95.2 and complete correspondence between geofence-triggered detection and verified classroom presence, although indoor GPS inconsistency and connectivity dependency were identified as limitations (Che Fauzi et al., 2025). SmartTasjeel used PowerApps, SharePoint Online and Excel with GPS geofencing and was deployed to 285 medical students. It reduced per-session processing time and avoided additional attendance hardware purchase by using existing institutional licenses and user devices (Salleh et al., 2026).

Location Integrity and GPS-Only Attendance

GPS-only attendance is attractive because it can be implemented using existing mobile devices, but the application depends on the coordinates supplied by the device. Campos et al. (2020) showed that civilian GPS signals can be spoofed and developed an Android-based machine-learning mechanism using signal-to-noise and satellite information to classify spoofed signals. Location integrity may also be compromised through software-based manipulation. Jiang et al. (2022) highlighted the availability of location-spoofing tools capable of producing fabricated coordinates for location-based applications.

This issue is particularly relevant to attendance applications, as Arfianto et al. (2024) identified Fake GPS applications as a threat to the authenticity of location-based attendance data and developed a mechanism to detect location manipulation using multiple smartphone sensors. Therefore, GPS location alone may not be sufficient to verify an employee's actual physical presence, particularly when location data can potentially be manipulated using Fake GPS applications.

Automated Facial Recognition and Technical Complexity

Automated facial recognition provides biometric identity verification and is therefore more technically complex than simply capturing a photograph. A facial-recognition attendance system generally involves processes such as face detection, feature extraction, facial enrolment, and identity matching. Previous studies have proven the use of computer-vision and deep-learning techniques to automatically recognize facial verification in attendance applications (Seelam et al., 2021; Kumar et al., 2021). While such approach allows automated identification verification, it also require additional recognition processes and accompanying technologies with additional implementation and maintenance works.

There are recent mobile attendance systems have also integrated facial recognition with location verification. Ahmad and Pratiwi (2025), for example combined face recognition, liveness detection, and GPS-location, while Satrianto and Sisephaputra (2025) integrated GPS-location with a trained facial-recognition process model. These approaches can strengthen identity and location verification but involve additional biometric processing and implementation requirements. In comparison, a GPS-based system supplemented by a simple selfie can provide additional visual evidence without requiring additional processes in automated facial recognition.

Infrastructure-Light Design and Research Gap

Existing literature generally reflects two approaches in mobile attendance records. The first adopts a relatively simple and lightweight approach, relying primarily on GPS or geofencing using employees' existing mobile devices, with additional verification potentially supported through organizational procedures such as requiring a contextual Clock-in or Clock-out at the workplace. The second adopts a more technology-intensive approach by integrating automated facial recognition, which requires additional recognition software, biometric processing, and potentially dedicated devices or supporting infrastructure. The former may therefore be more practical for organizations seeking to enhance attendance verification without substantially increasing system complexity or infrastructure requirements. This infrastructure-light approach is also consistent with SmartTasjeel, which demonstrated that a GPS-based attendance system could utilize existing devices and institutional licenses without additional biometric hardware expenditure (Salleh et al., 2026).

Landmark-Assisted Selfie as Contextual Evidence

The UniSIRAJ enhancement intentionally does not perform automated biometric matching. The user's smartphone camera captures a real-time selfie, and the attendance procedure asks the user to include recognizable campus surroundings as a practicable verification. The photograph therefore has a contextual role in addition to location-based records. It can provide human-reviewable visual evidence that the physical university landmark is reasonably consistent with the attendance location.

There are two evidence sources shown as a solution to the attendance records. GPS location addresses the device reports itself to be, meanwhile the landmark-assisted selfie photo provides visual context regarding the user's existing in physical surroundings. The mechanism therefore represents a dual-evidence approach rather than a complex biometric-recognition system.

Hence, this system adopts the infrastructure-light approach by combining GPS-based attendance with a landmark-selfie requirement governed through institutional attendance procedures. The selfie serves as supplementary contextual evidence that can be reviewed when necessary, without requiring automated biometric matching.

Most previous studies have focused on GPS-based attendance or systems that incorporate automated facial recognition. For an institution such as UniSIRAJ, however, there is another practical option: retaining the existing GPS system while adding visual evidence to support attendance verification. This study examines that option through the use of a landmark-assisted selfie as an additional feature of the existing attendance system.

As summarized in Table 1, the proposed approach occupies an intermediate position between GPS-only attendance and GPS integrated with automated facial recognition by combining location evidence with contextual visual verification while maintaining relatively simple infrastructure requirements.

Table 1. Conceptual comparison of attendance approaches

Feature	GPS-only	GPS + Automated Face Recognition	UniSIRAJ GPS + Landmark-assisted Selfie
Location evidence	Yes	Yes	Yes
Image capture	Not necessary	Yes	Yes - user's smartphone
Automated biometric matching	No	Yes	No
Recognition model/enrolment	No	Generally required	Not required for automated matching
Dedicated camera/edge hardware	No	Architecture dependent	Not required
Environmental context	Limited	Not necessarily	Deliberately included
Verification Approach	Location record	Identity + location verification	Location + contextual presence evidence

Problem Statement

The GPS attendance system originally implemented at KUIPs provided a practical mechanism for flexible attendance recording and remained operationally useful after the pandemic. However, normal post-pandemic campus operations created a stronger need for reasonable evidence that a Clock-In transaction corresponded with physical presence within the university environment.

Relying exclusively on GPS leaves the attendance process dependent on device-reported location. At the same time, moving directly to automated facial recognition would introduce additional biometric-processing, model, enrolment or hardware requirements that may be disproportionate where the institution primarily requires supplementary attendance evidence rather than automated biometric identification.

The central problem addressed by this study is therefore: How can an established GPS-based employee attendance system be enhanced to provide supplementary evidence of physical workplace presence without requiring the additional infrastructure and computational complexity associated with automated facial recognition?

A second problem concerns usability. Attendance is a repetitive employees' task. Even a simple technical verification enhancement may become confusions and burdensome if it introduces excessive step for the user. Therefore, the enhanced mechanism must also be evaluated from the perspective of actual users usability.

Research Objectives and Questions

Based on the identified research gap, this study focuses on two main aspects: the practical enhancement of the existing GPS-based attendance system and the evaluation of its usability among actual users. The first objective addresses the system development aspect by integrating landmark-assisted selfie verification, while the second objective examines whether the enhanced system remains usable for repetitive staff attendance.

Accordingly, the research objectives are formulated as follows:

RO1: To enhance an existing GPS-based attendance system with landmark-assisted selfie verification using the Rapid Application Development (RAD) methodology.

RO2: To evaluate the usability of the enhanced attendance system among UniSIRAJ employees using the System Usability Scale (SUS).

Corresponding to these objectives, two research questions are formulated to lead the study:

RQ1: How can landmark-assisted selfie verification be integrated into an existing GPS-based attendance system without relying on complex infrastructure?

RQ2: What is the level of usability of the enhanced attendance system among UniSIRAJ employees?

METHODOLOGY

Research Design

This study adopts a practical Rapid Application Development (RAD) method which combining system enhancement, functional testing and preliminary usability evaluation. UniSIRAJ was selected as the case institution because the GPS attendance system was already operational and the proposed work involved improving an existing institutional process rather than developing a new attendance application.

The study therefore followed the system from its existing GPS workflow through RAD's enhancement, functional testing, live use and subsequent user evaluation, as illustrated in Figure 1.

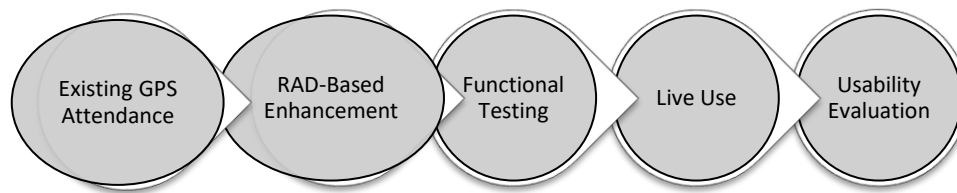


Figure 1: RAD Research Flow

Rapid Application Development (RAD)

Since the GPS attendance system was already operational, the development work focused on adding the selfie feature to the existing Clock-In process rather than building a new system. RAD provided a suitable structure for this work, which was carried out through requirements planning, user design, construction, and implementation (Martin, 1991). The process is depicted in Figure 2.

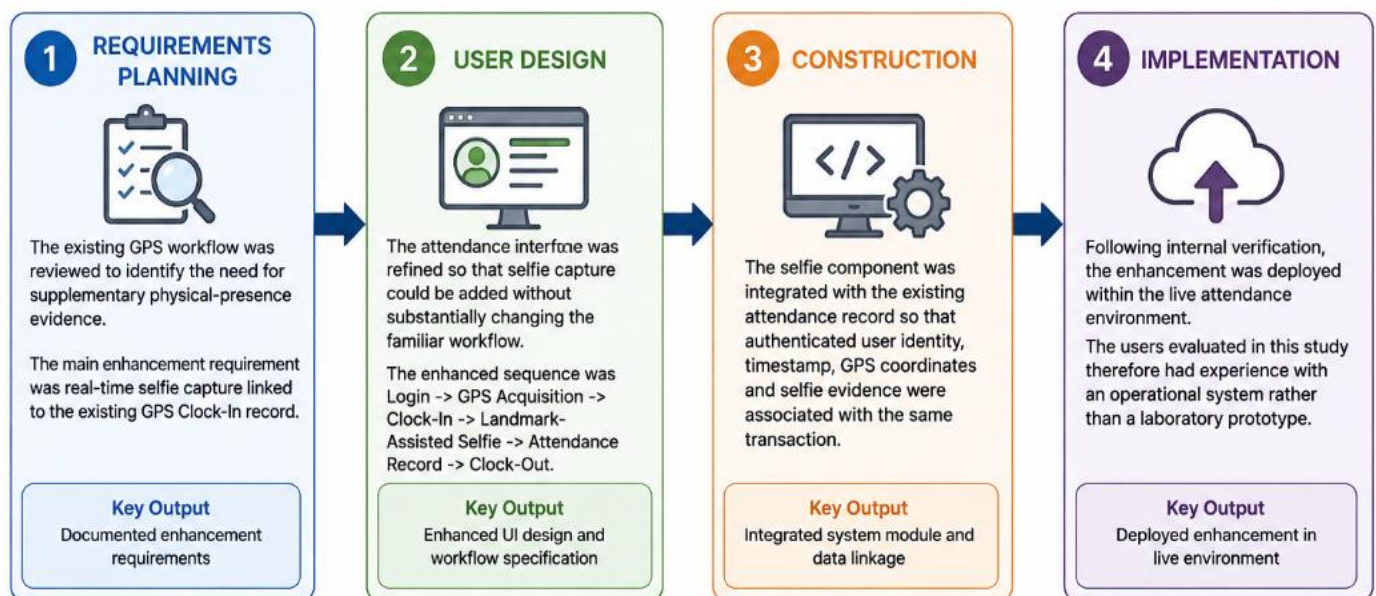


Figure 2: RAD Enhancement Framework

Functional Testing

Black-box testing was carried out before the enhanced system was brought into live. The test followed the actual attendance workflow, from user authentication and GPS acquisition to Clock-In, and landmark selfie capture. The recorded timestamp, location and selfie photo were checked to ensure that they were correctly associated with the respective users' attendance record. The function was recorded as successful when it operated as expected during testing process.

Participants and Sampling

The preliminary usability evaluation involved 20 actual users of the deployed system, which represent 10% of all UniSIRAJ employees. The sample comprised 10 academic staff and 10 administrative staff, providing equal representation of the two staff categories. Purposive sampling was used because respondents were required to have direct experience with the enhanced system.

The evaluation was intentionally positioned as a preliminary case-study assessment rather than a population survey. Accordingly, the findings are interpreted descriptively and are not intended to represent all UniSIRAJ employees or other higher-education institutions.

Research Instrument and Data Collection

The questionnaire was administered manually using printed forms after respondents had experience in using the system. Section A consists of basic respondent information. Section B contained ten-item System Usability Scale adopted from Brooke (1996), with responses from 1 (Strongly Disagree) to 5 (Strongly Agree). Section C contained four supplementary statements on the usefulness of GPS detection, landmark selfie context and confidence in the combined dual-evidence mechanism.

The completed forms were manually counted and tabulated by response frequency for each Likert category. Only aggregated frequency data were retained for the present analysis. Consequently, respondent-level measures such as the standard deviation and distribution of SUS scores are not reported.

Data Analysis

Descriptive statistics were used to analyze the questionnaire data. Respondent characteristics were summarized using frequencies and percentages, while the overall SUS score was calculated from the aggregated item responses using the standard SUS scoring procedure. The four dual-evidence verification items were analyzed using frequencies, percentages, and mean scores. As only aggregated response data were available, the SUS result is reported as an aggregate score rather than as a mean of individual respondent scores.

No inferential statistics, regression, structural equation modelling or hypothesis testing were applied because the study was designed as a preliminary operational case evaluation.

RESULTS

Respondent Profile

Twenty actual users participated: 10 academic staff (50%) and 10 administrative staff (50%). Two respondents within the administrative category were HR staff. This composition provided feedback from both routine users and staff with an administrative interest in attendance monitoring.

Table 2. Respondent composition

Staff category	Frequency	Percentage
Academic staff	10	50%
Administrative staff	10	50%
Total	20	100%

Note: Two participants in the administrative category were Human Resource staff.

System Usability Scale

The SUS response distribution showed favorable perceptions across several usability dimensions. Most respondents agreed or strongly agreed that the system was easy to use ($n = 18$, 90%), could be learned quickly by most users ($n = 19$, 95%), and inspired confidence in use ($n = 18$, 90%). For the negatively worded items, most respondents disagreed or strongly disagreed that technical support was required ($n = 15$, 75%), that the system was inconsistent ($n = 19$, 95%), or that it was cumbersome to use ($n = 17$, 85%).

Table 3. Distribution of SUS responses ($n = 20$)

Item	Statement	1	2	3	4	5
1	I would like to use this system frequently	0	0	2	2	16
2	I found the system unnecessarily complex	0	0	3	4	13
3	I thought the system was easy to use	0	0	2	4	14
4	I would need technical support to use the system	13	2	2	3	0

Item	Statement	1	2	3	4	5
5	The system functions were well integrated	0	0	2	8	10
6	There was too much inconsistency in the system	14	5	1	0	0
7	Most people would learn to use the system quickly	0	0	1	2	17
8	I found the system cumbersome to use	14	3	2	1	0
9	I felt very confident using the system	0	0	2	3	15
10	I needed to learn many things before using the system	0	0	2	6	12

Scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree.

Using the standard SUS scoring procedure on the aggregated response frequencies, the system achieved an aggregate SUS score of 73.88 out of 100, indicating generally favorable preliminary usability. However, this score should be interpreted alongside the individual item response patterns.

An unexpected response pattern was observed for two negatively worded items. Most respondents agreed or strongly agreed that the system was unnecessarily complex (SUS2; $n = 17$, 85%) and that they needed to learn many things before using the system (SUS10; $n = 18$, 90%). These responses appear inconsistent with the generally positive findings for ease of use, learnability, confidence, and perceived cumbersome. As the available aggregated data do not allow the source of this inconsistency to be determined, the responses were retained as recorded and the overall SUS result was interpreted with appropriate caution.

Perception of Dual-Evidence Attendance Verification

The supplementary dual-evidence results were consistently positive. No respondent selected Strongly Disagree, Disagree or Neutral for any of the four statements. All 20 respondents selected Agree or Strongly Agree.

Table 4. Perception of dual-evidence attendance verification ($n = 20$)

Item	Statement	Agree n (%)	Strongly Agree n (%)	Mean
C1	GPS supports verification of attendance location	7 (35%)	13 (65%)	4.65
C2	Selfie provides additional evidence of physical presence	10 (50%)	10 (50%)	4.50
C3	Recognisable university landmark strengthens verification	10 (50%)	10 (50%)	4.50
C4	GPS + landmark selfie increases confidence in record integrity	3 (15%)	17 (85%)	4.85

The highest-rated item was C4 ($M = 4.85/5$): 17 respondents (85%) strongly agreed and three (15%) agreed that combining GPS location with a landmark-assisted selfie increased confidence in the integrity of the attendance record. C1 recorded $M = 4.65$, while C2 and C3 each recorded $M = 4.50$.

Open Comments

Only three respondents provided comments in the optional open-ended section. The comments were: “Terbaik jabatan IT”, “We from HR easy to monitor the location of staff”, and “The system enhance staff integrity”. As the number of comments was small, no qualitative analysis was carried out. The comments are reported here only as additional feedback from the respondents.

DISCUSSION

Usability of the Enhanced System

The aggregate SUS score of 73.88 provides a generally favorable initial indication of usability, but the item-

level responses are more informative for understanding the operational experience. Most respondents considered the system easy to use and quick to learn, and most also reported confidence in using it. This is relevant because the enhancement introduced an additional action into a task that employees perform repeatedly. The findings suggest that adding selfie capture did not fundamentally disrupt the familiar GPS attendance workflow.

Nevertheless, SUS2 and SUS10 produced a contradictory pattern. Respondents generally described the system as easy to use and learn, yet many also agreed that it was unnecessarily complex and that substantial learning was required. The available aggregated data cannot explain this contradiction. It may reflect genuine differences in perception or difficulty interpreting the negatively worded items, but either explanation would be speculative. For this reason, the SUS score should be treated as preliminary evidence rather than a definitive usability benchmark. A future evaluation retaining respondent-level responses would allow this pattern to be examined more closely.

Value of the Dual-Evidence Mechanism

The responses to the four additional items show that respondents were generally comfortable with the use of both location and visual evidence for attendance verification. All 20 respondents selected either Agree or Strongly Agree for these items. Among them, the combination of GPS and landmark-assisted selfie received the highest mean score ($M = 4.85$). GPS evidence on its own recorded a slightly lower mean of 4.65. With only 20 respondents, the difference between these scores is treated as descriptive rather than evidence that one method is statistically better than the other.

The selfie and landmark items each recorded a mean score of 4.50. This is relevant to how the feature is used at UniSIRAJ. Staff are not simply asked to take a photograph during Clock-In. Where practicable, the photograph should also show a recognizable landmark of the university environment. The image can therefore provide information about the surroundings at the time the attendance is recorded.

It is also important to be clear about what this enhancement can and cannot do. The selfie does not confirm that the GPS coordinates are genuine, nor does it detect the use of Fake GPS. Its purpose is to give an additional record that can be referred together with the GPS information. For example, when an attendance record requires clarification, the authorized officer can view both the location recorded by the system and the photograph submitted during Clock-In. In the present system, this additional evidence is reviewed by a person rather than through automated facial recognition.

Infrastructure-Light Enhancement

The UniSIRAJ case is best understood as an evolutionary enhancement rather than a new attendance system. The original GPS approach was relevant to pandemic-era flexible attendance and continued into post-pandemic operations. The current enhancement responds to a changed requirement: stronger evidence of physical campus presence.

The design deliberately retains the employee's smartphone as the primary hardware platform. This differs from facial-recognition architectures that may use dedicated cameras, or other edge devices, recognition models, liveness detection or facial-enrolment processes (Seelam et al., 2021; Ahmad & Pratiwi, 2025). The present study does not empirically claim a specific monetary saving over facial recognition because no formal cost analysis was conducted. A more defensible conclusion is that the proposed approach reduces additional infrastructure and automated biometric-processing requirements.

This design rationale is consistent with the broader economic logic demonstrated by SmartTasjeel, where existing licenses and user devices eliminated additional biometric hardware purchase (Salleh et al., 2026). However, the UniSIRAJ case should be viewed as an infrastructure-light alternative only where human-reviewable supplementary evidence is sufficient; it is not a substitute for automated biometric authentication in high-assurance contexts.

Practical Implications

For higher-education institutions or organizations, the findings suggest that stronger attendance evidence does not always require immediate transition to automated facial recognition. Institutions that already operate GPS attendance may be able to add contextual image evidence using existing smartphones. The HR comment in this study also suggests that the enhanced record may support attendance review and location monitoring from an administrative perspective.

Nevertheless, location and photographic data are sensitive operational records. Institutions should define who may access selfies and coordinates, how long they are retained, when manual review is justified, and how staff are informed about the purpose of collection. These governance controls are important to prevent an infrastructure-light design from becoming unnecessarily intrusive.

LIMITATIONS

This study has several limitations. First, the usability evaluation involved only 20 users from a single institution and is therefore preliminary case-study evidence rather than a population-level assessment. Second, only aggregated questionnaire frequencies were retained, preventing calculation of respondent-level SUS standard deviation, confidence intervals or subgroup comparisons. Third, no formal cost-benefit analysis was performed against automated facial-recognition systems. Fourth, the landmark is reviewed contextually by humans rather than recognized automatically, so the strength of evidence depends partly on photograph quality and institutional review procedures.

CONCLUSION

This case study examined how an established GPS attendance system at UniSIRAJ was adapted to meet a post-pandemic verification requirement. Rather than replacing the existing platform with automated facial recognition, the enhancement added a landmark-assisted selfie to the GPS Clock-In transaction. This allowed the institution to retain the familiar smartphone-based workflow while adding contextual visual evidence that could be reviewed when necessary.

The preliminary evaluation suggests that this additional step remained generally usable for the participating employees. More importantly, respondents expressed strong confidence in combining GPS location with landmark-assisted selfie evidence. Although the small sample and aggregated SUS data limit the strength of generalization, the findings indicate that users recognized practical value in having two complementary forms of attendance evidence.

The contribution of the study is therefore not an automated biometric or anti-spoofing algorithm. It demonstrates how a pandemic-era GPS attendance system can evolve into a post-pandemic dual-evidence mechanism by adding contextual visual evidence without implementing automated facial-recognition infrastructure. Future work should retain respondent-level usability data, evaluate a larger user sample, conduct formal cost comparison, and examine technical safeguards such as mock-location detection or other device-integrity checks while maintaining proportionality and privacy.

Ethical Approval: This study involved a preliminary usability evaluation of an existing operational attendance system among UniSIRAJ staff. Participation was voluntary, and no personally identifiable information was reported. Formal ethical approval was not required for this study in accordance with the applicable institutional requirements.

Conflict of Interest: The authors declare that there are no conflicts of interest regarding the publication of this study.

Data Availability Statement: The data supporting the findings of this study are not publicly available due to privacy and confidentiality considerations involving staff participants. Aggregated data used in the analysis are presented within the article.

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