การพัฒนาและการยอมรับเว็บแอปพลิเคชันการลงเวลาโดยใช้การระบุตัวตนด้วยภาพและตำแหน่งของบุคลากรมหาวิทยาลัยเอกชน

Development and Acceptance of Time Attendance Web Application Using Identity Verification with Picture and Location of Personnel in Private Universities

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บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อพัฒนาเว็บแอปพลิเคชันบันทึกเวลา (TAW) โดยใช้การยืนยันตัวตนพร้อมรูปภาพและตำแหน่งในมหาวิทยาลัยเอกชน และเพื่อศึกษาการยอมรับของบุคลากรต่อ TAW ประชากรเป็นหัวหน้าแผนกทรัพยากรมนุษย์และอาจารย์ 94 คนในมหาวิทยาลัยพิษณุโลก การเก็บรวบรวมข้อมูลใช้การสัมภาษณ์เชิงลึกและแบบสอบถาม ข้อมูลถูกวิเคราะห์ทางสถิติโดยการวิเคราะห์เนื้อหา สถิติเชิงพรรณนา และสถิติเปรียบเทียบ เว็บแอปพลิเคชันที่พัฒนาแล้วจะอยู่ในรูปแบบของเว็บที่ตอบสนองการแสดงผลบนคอมพิวเตอร์และอุปกรณ์พกพา โดยใช้ภาษาโปรแกรมแบบรหัสเปิดในการพัฒนา ได้แก่ พีเอชพี จาวาสคริปต์ และเจคิวรี ประกอบด้วย 3 ฟังก์ชัน ได้แก่ การยืนยันตัวตนด้วยภาพถ่าย และตำแหน่งของพิกัดทางภูมิศาสตร์ บันทึกการทำงาน และรายงานสรุปการลงชื่อเข้าทำงานรายเดือน โดยภาพรวมบุคลากรมีความพึงพอใจต่อ TAW ในระดับสูง ($\bar{x}$ = 4.46, SD=0.68) บุคลากรตอบรับ TAW ในระดับสูง ($\bar{x}$ = 4.08, SD=0.63) บุคลากรที่มีเพศ อายุ และตำแหน่งต่างกันมีระดับการยอมรับที่แตกต่างกันของ TAW ในปัจจัยภายในและปัจจัยเสริมที่มีนัยสำคัญทางสถิติ .05

คำสำคัญ: การยอมรับ, เว็บแอปพลิเคชัน, การลงเวลา, มหาวิทยาลัยเอกชน

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ABSTRACT

This research aims to develop a time attendance web application (TAW) by using identity verification with picture and location in private universities, as well as to study personnel's acceptance of the TAW. The population consisted of the Head of the Human Resource department and 94 instructors in Phitsanulok University. Data were collected through in-depth interviews and questionnaires, and were statistically analyzed using content analysis, descriptive statistics, and comparable statistics. The developed web application took the form of a responsive web, accessible on both computer and portable devices which was developed with open-source web programing languages: PHP, Java script, and JQuery. It consisted of 3 main functions: identity verification through personnel pictures and geographical location for sign-in and sign-out work attendance points, work-in record, and monthly work attendance summary reports. Overall, the personnel showed a high level of satisfaction with the TAW ($\bar{x}$=4.46, SD=0.68) and also accepted it at a high level ($\bar{x}$=4.08, SD=0.63). Personnel of different sexes, ages, and position levels showed varying levels of acceptance of the TAW in both the internal and supplemented factors, with statistical significance at .05.

Key words: acceptance, web application, time attendance, private university

INTRODUCTION

The changes in smart organization and the effects of the pandemic Covid-19 situation have changed personnel's ways of working, shifting from traditional document-based methods to the use of modern technologies and touchless methods in various public environments (Wibirama *et al.*, 2020). Specifically, in the routine duty of personnel in most organizations, they have to sign their names for daily attendance. In the traditional process of the Human Resource Department Phitsanulok Uiversity, names are signed on documents. Therefore, it is difficult to compile a monthly report with useful information that can be used to consider personnel's salaries and monitor their responsibilities within the organization (Human Resource Department, 2022). This is because most private universities focus on hiring personnel who can work to justify their salary. Implementing modern technology for personnel signing will improve the document process and enable effective summarization into monthly work reports. It can also immediately calculate and notify the number of personal leave days for both personnel and human resource officers.

Web application is an effective tool that can widely support many services for personnel in an organization. The web application also delivers information and services to users in other organizations in order to build socialization and collaboration (Yusufu *et al.*, 2022). A The Time Attendance Web application (Taw) is a form of web application integrated with identity verification using picture and location technique to service time attendance for personnel staying around the university area. Personnel no longer need to queue up to sign their names on a document.

On the contrary, they can sign their names faster via this developed web application. Moreover, in implementing new technology in all organization, it often suffers from the problem of narrow technology usage among aged personnel who may often encounter biophysical and psychosocial changes that affect how they interact and react to the adopted technologies (Kaufman and Elder Jr, 2002; Moschis, 1992). This is an important cause of failure for technologies in private universities. Therefore, developing an effective web application should be simultaneously performed along with studying and building personnel's acceptance of the web application. The Technology Acceptance Model theory (TAM) was used to study the personnel's perception and attitude towards the developed time attendance software in external, internal, and supplemented factors.

TAM posits that users will directly decide to use technology by themselves based on their individual intentions and behaviors after perceiving technology's usefulness, ease of use, and user-friendliness (Natasia *et al.*, 2022). It is expected that this research and innovation development will achieve the goal of changing the university to a smart university in the near future. It also creates an effective innovation product that will be widely used and accepted by personnel of all ages.

MATERIALS AND METHODS

This research used the following effective methodology and related resources to achieve the research objectives.

1. Population

The population consisted of the head of the Human Resource department and 94 instructors the Phitsanulok University.

2. Research method

The research methods were defined according to the research objectives into 2 main parts as follows:

2.1 Developing the TAW

This stage was divided into 3 parts.

2.1.1 Surveying system requirement from the head of Human Resource department

An in-depth interview was used with the head of Human Resource department at Phitsanulok University to study the problems of the traditional sign-on-document system and to gather requirements for the work signing system from officers. Basic data were collected to be used for designing and developing a better system with web-based technology.

2.2.2 Developing and implementing the TAW in a real working process at Phitsanulok university

The developed web application architecture was designed to integrate with the main personal database to access each personnel's profile and permission in the work signing process. The open-source software - PHP, Java script, JQuey – was chosen for developing this web application and building the web user interfaces that support adaptive display on devices with different sizes, such as computers, laptops, smartphones, and other portable devices, using the responsive web techniques. After the web application was completed, the web application service was continuously implemented and promoted to the 94 Phitsanulok university's instructors and officers via electronic media and training.

TAW's processing functions can be explained by using a case diagram as follows.
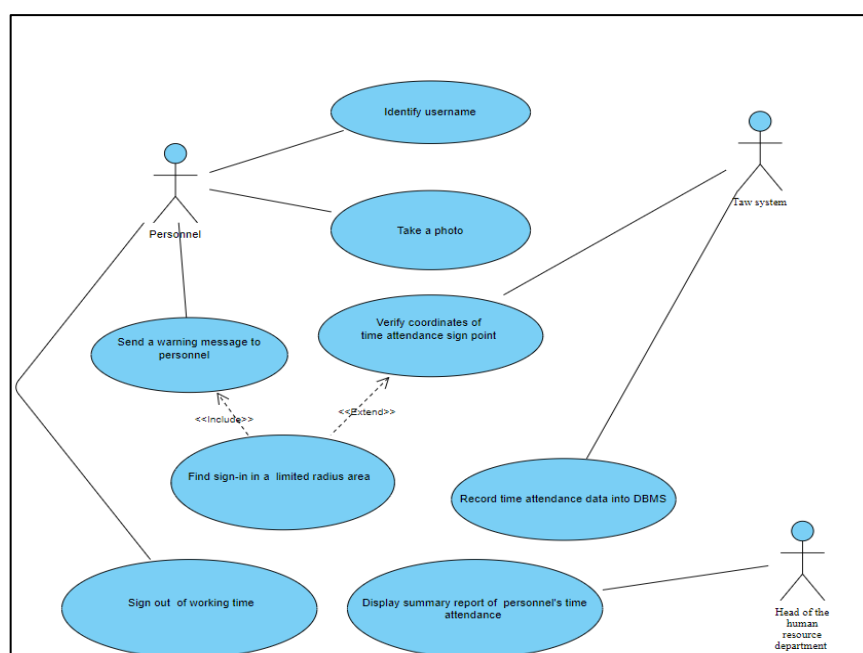

Figure 1 Case diagram of TAW's processing functions

From Figure 1, TAW consists of 4 sub-processing functions: 1) identifying personnel's username and take a photo; 2) verifying coordinates of time attendance sign-in point; 3) recording sign-in and sign-out of time attendance data into the database management system (DBMS); and 4) displaying summary report of personnel's time attendance. when verifying the coordinates and distance from the university to the personnel's sign-in point, TAW will calculate the latitudes and longitudes of the university and personnel's points to determine the distance in kilometers. If some personnel's distance is more than one kilometer from the university's coordinates on Google map, the TAW system will setup a point on the computer desktop or personnel's mobile devices. Then it will send a warning message about incorrect sign-in or sign-out of time attendance via the web user interface.

The TAW's system architecture was designed to connect with personnel's account database via API service of the Human Resource Management (HRM) department operating on the university's network infrastructure for effective management of personnel's work attendance information as follows:
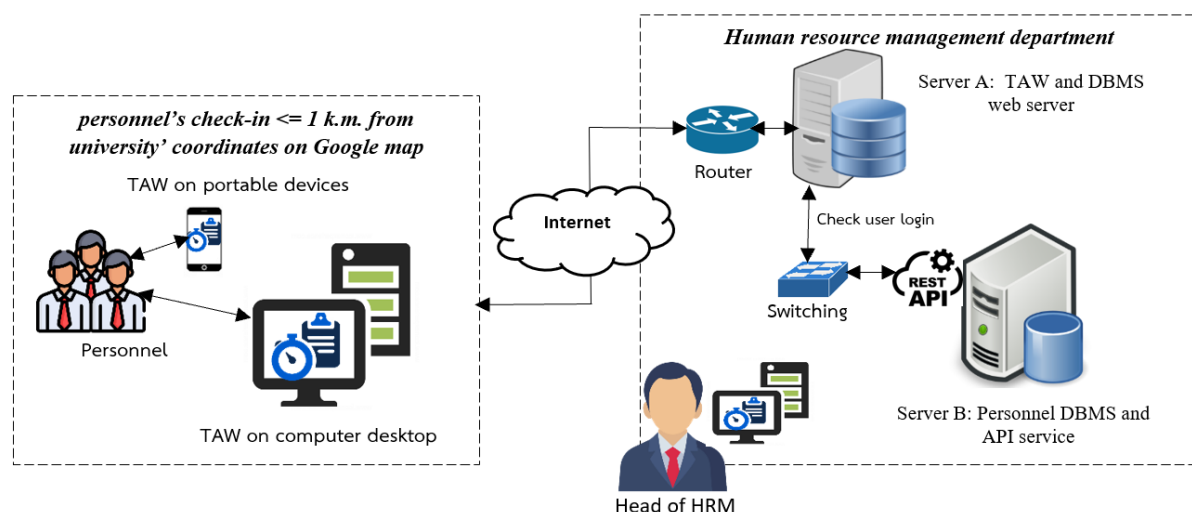

Figure 2 TAW's system architecture

From Figure 2, Server A of TAW and DBMS receives requesting services from personnel who signs in to work attendance via their computer desktop or mobile device within a limited radius area on the internetwork. Then, the Server A sends the personnel's user login to Server B of the API service to identify their authentication. The Server B sends a response indicating correct or incorrect user authentication to approve and record personnel's time attendance data into TAW's DBMS. The head of HRM can access TAW on Server A via the Internet working as WAN (wide area network) to summarize monthly reports and update personnel's profiles on the DBMS on Server B through a local area network (LAN).

The TAW's DBMS was designed based on relational database concept and presented by the entity relationship diagram (E-R diagram) as follows.
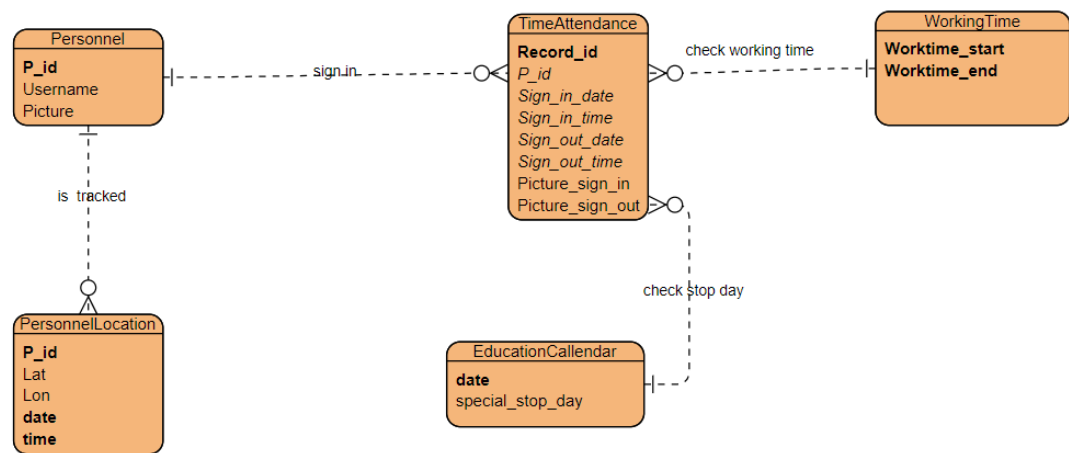
Figure 3 E-R diagram of TAW's DBMS

From Figure 3, TAW's DBMS consists of 5 entities or data tables that track personnel through their geographical location (Personnellocation) for sign-in time attendance in a limited radius area. The personnel's sign-in and sign-out date and time data are checked in EducationalCallendar and WorkingTime table to correctly store data into TimeAttendance table. If the system finds that the personnel signs in on a holiday or before working hours, it will send a warning message to them via a web user interface.

To calculate the distance between the personnel's sign-in coordinates point (mk1) and the university coordinates point (mk2), a function was developed using Javascript language to track both coordinates and convert to units of kilometers (return d) as follows:

```
function haversine_distance(mk1, mk2) {
    var R = 6371.0710; // Radius of the Earth in miles
    var rlat1 = mk1.position.lat() * (Math.PI/180); // Convert degrees to radians
    var rlat2 = mk2.position.lat() * (Math.PI/180); // Convert degrees to radians
    var difflat = rlat2-rlat1; // Radian difference (latitudes)
    var difflon = (mk2.position.lng()-mk1.position.lng()) * (Math.PI/180); // Radian difference (longitudes)
    var         d         =         2         *         R         *
Math.asin(Math.sqrt(Math.sin(difflat/2)*Math.sin(difflat/2)+Math.cos(rlat1)*Math.cos(rlat2)*Math.sin(difflon/2)*Math.sin(d
ifflon/2)));
    return d;
    }
```

Figure 4 Source code for converting coordinates to kilometers

2.2.3   Assessing   users' satisfaction with the web application's form and performance

In the user training process, the web application performance was assessed with a questionnaire to gather users' feedback for use in editing and developing a more effective system.

2.2 Studying personnel's acceptance of the web application

When the web application was used in the period of 2 weeks, questionnaires were used for studying the personnel's acceptance of the web application. Results of this process will be a guideline to adjust the servicing process and the web application's function form to specially support the users' needs, based on different personal factors.

3. Research instruments

The research instruments were in-depth interviews and questionnaires for collecting data that can be explained in details according to the research objectives as follows:

3.1 Developing the Taw

This step used the following 2 instruments for collecting data.

3.1.1 An in-depth interview for studying problems of the traditional sign-on-document and an officer's requirements for the work signing system.

It collected data in 2 parts: 1) personal data of the sample, and 2) users' opinions about the work signing processes, based on 3 questions relating to work signing regularities and documents, problems of the traditional work signing system, and new requirements for improving and developing the web application to replace the document method.

3.1.2 A questionnaire for assessing users' satisfaction of the web application performance.

It collected data in 2 parts: 1) personal data of the sample, and 2) users' satisfaction with the web application based on 3 aspects: function's performance, user-friendliness, and security.

3.2 Studying personnel's acceptance of the web application

A questionnaire was used to collect data in 2 parts: 1) personal data of the sample, and 2) personnel's acceptance of the web application for work signing in the following 3 factors.

3.2.1 External factors, including quality of the software, information service, and building users' motivation in using the software (Chen and Tseng, 2012; Motaghian *et al.*, 2013; Sánchez and Hueros, 2010)

3.2.2 Internal factors, including user's anxiety, self-efficacy, perceived usefulness and perceived ease of use, intention to use, and learning styles

3.2.3 Supplemented factors, including personal knowledge and skills, speed of internet signal, and comfortable internet assessing (Bhrommalee, 2011).

The preciseness of both questionnaires (in topic 3.1.2 and 3.2) was assessed with IOC values by three information management specialists. It was found that all questions in both questionnaires have IOC values between 0.60 – 1.00, which meet the standard quality criteria and can be used for collecting data with samples in the next step.

4. Data collection

This research gathered data with in-depth interviews to study the state of work signing operations and problems from the head of Human Resource department, and questionnaires were used to study thelevel of satisfaction and acceptance of the web application from 94 instructors and officers at Phitsanulok university.

5. Data analysis

5.1 The data from the in-depth interview, which aimed to study the problems of the traditional sign-on-document and the requirements of officers for the work signing system, were analyzed with the content analysis method.

5.2 The data from the questionnaire for studying satisfaction and acceptance of the web application were analyzed using descriptive statistics for frequency, percentage, mean, standard deviation, as well as inferential statistics such as t-tests and f-tests for comparison.

RESULTS AND DISCUSSION

Results of this research can be showed as follows:

1. Results of developing and implementing the TAW

1.1 Results of surveying system requirement from the head of Human Resource department.

The new web-based signing system supported distancing in the Covid 19 pandemic situation. It could manage queues in daily work and reduce the risk of spreading the Covid 19 infection (Sun *et al.*, 2020). It could also summarize reports necessary for effectively considering personnel's salaries and disciplined penalties.The TAW applied a responsive web technique design and selected to use open-source web programing languages.

It could support flexible access on both computers and portable devices, such as smartphones, iPads, and tablets (Jiang *et al*., 2014) for signing in within the limited area zone. It also reduced excessive and continuous budget (Chigwada, 2022).

Table 1 Results from survey of system requirement from the head of human resource department

Question	Results from interviewing
1. Problem states of the traditional sign-on-document system	- It was difficult to summarize the monthly signing report. - Most personnel often forget to sign out from work time. - The traditional document system could not immediately notify personnel of their remaining number of leave days. - Too much time was spent queuing to sign in, with a possible risk of the Covid-19 infection from touching the document.
2. User's requirements of the work signing system.	- The system can print out summary reports for administrators' decisions. - The system can warn the personnel who forget to sign-in and sign-out of work each day. - The system can notify personnel of their leave day data. - The system will allow personnel to sign name within a radius of 1 kilometer in the university area.
3. Related documents and rules of signing process needed in developing the system.	- The system must record ersonnel who come to work late after 09.00 a.m. or do not sign their name for work, marking them as absentees. - Personnel who are absent from work three times or more in a month will receive a warning document from the Human Resource department. - Results of signing in for work will be used to consider personnel rewards for adjusting their salary and position each year.

1.2 Results of developing and implementing the TAW's user interfaces and functions.

The web application was provided on a public server at https://ojs.plu.ac.th/workio.

It consisted of many functions that supported the collection of users' requirements, as shown in Table 1.
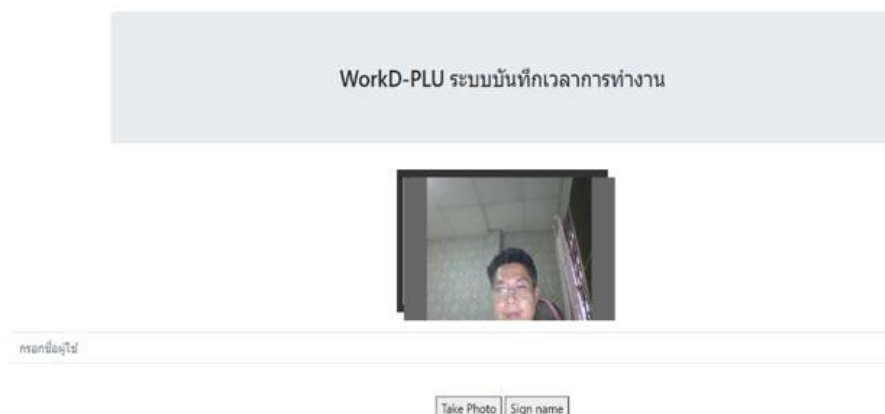

Figure 5 Enter the personnel's username and take the photo

From Figure 5, the personnel within the radius of university area enter their official usernames assigned by the university, then take their photos for signing in and validation by the system. In this process, the system also verifies the coordinates of each personnel as latitude and longitude of each personnel for validating เป็น to validate their sign-in points.

When the system detects an incorrect sign-in point, it will immediately warn the personnel and not allow them to sign-in for work attendance, as shown in Figure 6.
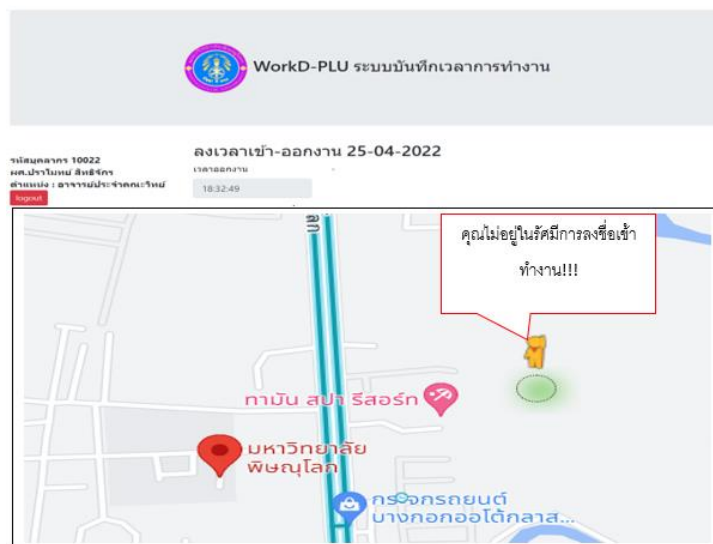

Figure 6 Verify and warn about out-of-radius signing

From Figure 6, the system detects the personnel's check-in distance between the university location and the personnel location. If it finds that they are over a radius of 1 kilometer (personnel's check-in > 1 k.m.), it will send a warning to them via the web user interface and record their incorrect work attendance sign-in.
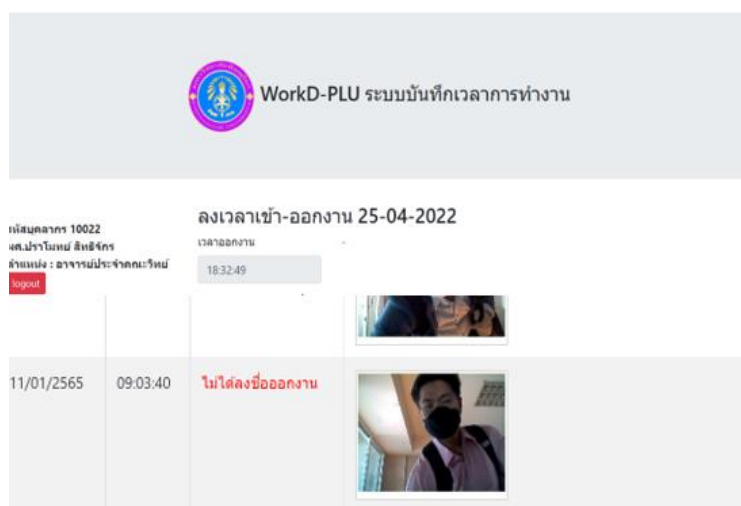

Figure 7 Show private signing records

From Figure 7, the personnel can access their private time attendance report and search by day, week, and month and they can also sign out from this function.

The TAW's user interfaces can use responsive web techniques to display on mobile devices as follows:
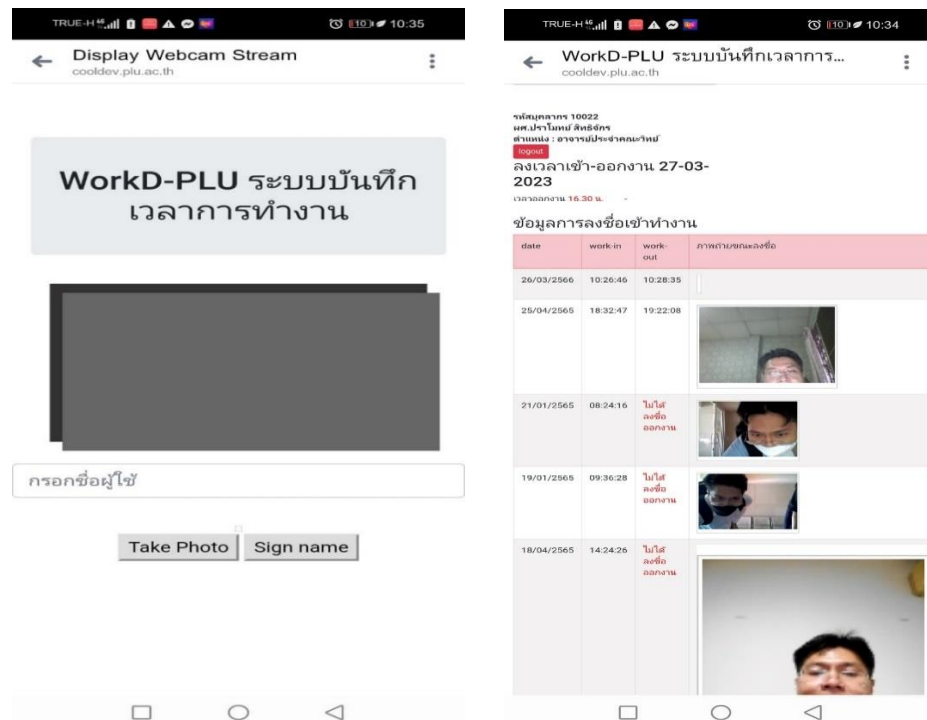

Figure 8 Display TAW's user interfaces on mobile devices

From Figure 8, TAW's user interfaces support both computer desktops and mobile devices, such as smartphones, tablets, and iPads. They will build responsive frames with HTML and CSS language.

Figure 9 TAW's Report function

From Figure 9, the TAW's report function serves to identify search criteria lists and print reports according to day, month, personnel identity number, first name, last name, and personnel's department.

It supports printing on A4-size paper in both vertical and horizontal orientations.

1.3 The results of assessing 94 users' satisfaction of TAW's performance are resented in Table 2.

Table 2 Results of assessing users' satisfaction with the web application

Assessment topic	Satisfaction level		Interpretation	Ranking
	$\bar{x}$	SD		
Function' s performance aspect				
1. The recording of the sign-in and sign-out times is accurate according to the real clock.	4.82	0.65	Very high	1*
2. The daily reporting name list of personnel who are present or absent from work is correct, aiding in the decision-making of the university's executive administrators.	4.75	0.78	Very high	2
3. The private signing statistics data of each personnel are correctly reported to support future leave day plans.	4.20	0.74	High	3
Average of Function' s performance aspect	**4.59**	**0.72**	**Very high**	**1**
User-friendliness aspect				
4. Proper categorization of the menu to access the application's functions	4.32	0.58	High	1*
5. Insertion of data into the application's input form	4.15	0.61	High	3
6. Displaying and printing of summary reports	4.25	0.81	High	2
Average of User-friendliness	**4.24**	**0.67**	**High**	**3**
Security aspect				
7. Login to the personnel's private functions	4.52	0.54	Very high	2
8. Safe keeping of private personal information, such as username, password, and telephone number	4.72	0.74	Very high	1*
9. Accurate assignment of roles for accessing private report data to the correct users.	4.41	0.65	High	3
Average of Security	**4.55**	**0.64**	Very high	**2**
Overall average	**4.46**	**0.68**	High	

From Table 2, the overall satisfaction level of personnel with the TAW is high ($\bar{x}$=4.46, SD=0.68). The level of users' satisfaction can be ranked in descending order according to the average satisfaction score as follows: 1) Performance aspect is at a very high level ($\bar{x}$=4.59, SD=0.72). The highest average is for recording the sign-in and sign-out time is accurate เป็น accurately according to real clock. 2) User-friendliness aspect is also at a very high level ($\bar{x}$=4.55, SD=0.64). The highest average is for the proper categorization of the menu to access the application's functions. 3) security aspect is at a high level ($\bar{x}$=4.24, SD=0.67). The highest average is for the safekeeping of private personal information, such as username, password, and telephone number.

  2. Results from studying personnel's acceptance of TAW can be presented in Table 3.

Table 3 Level of personnel's acceptance of the web application

Acceptance factors	Acceptance level		Interpretation	Ranking
	$\bar{x}$	SD		
External factors				
1. Quality of the signing web application	4.02	.455	High	1*
2. Quality of problem-solving service about the signing web application by the administrator team	3.95	.564	High	2
3. Motivation building in using the signing web application in replace of the traditional documentary signing system	3.75	.955	High	3
Average of External factors	**3.91**	**0.66**	**High**	**3**
Internal factors				
4. Elimination of user's anxiety to use the signing web application	3.78	.666	High	3
5. Personal knowledge and skills in using the signing web application	3.54	.666	High	4
6. Perceived usefulness and ease of use for the signing web application	4.24	.766	High	2
7. Intention to use the signing web application	4.35	.654	High	1*
Average of Internal factors	**3.98**	**0.69**	**High**	**2**
Supplemented factors				
8. Speed of internet signal in the university area for accessing the signing web application	4.45	.654	High	2
9. Suitability of setting the signing system's point where personnel can access comfortably	4.52	.456	Very high	1*

Table 3 (Continuous)

Acceptance factors	Acceptance level		Interpretation	Ranking
	x̄	SD		
10. Training personnel for use of the signing system before using it in the real work process	4.07	.554	High	3
Average of Supplemented factors	**4.35**	**0.55**	**High**	**1**
Overall average	**4.08**	**0.63**	**High**	

From Table 3, the overall acceptance level of personnel toward TAW is high (x̄=4.08, SD=0.63). The level of personnel's acceptance of the web application in all aspects is high and can be sorted in descending order according to the acceptance average as follows: 1) Supplemented factors (x̄=4.35, SD=0.55) have the highest average for accepting the quality of the signing web application. 2) Internal factors (x̄=3.98, SD=0.69) have the highest average for the intention to use the signing web application.

3) External factors (x̄=3.91, SD=0.66) have the highest average for the suitability of setting the signing system's point where personnel can access comfortably.

The personnel's acceptance of the web application was also analyzed with comparable statistics using t-tests and f-tests to test the research hypothesis that personnel with different basic data also have different levels of acceptance of the web application. Results of the analysis are shown in Table 4.

Table 4 Comparing personnel's acceptance of the web application according to gender with t-test

Gender	N	x̄	SD	t	df	sig
Male	94	4.12	0.61	3.67	9	0.01*
Female	94	3.91	0.85			

* Statistically significant at .05

From Table 4, personnel of different genders have different levels of acceptance of the TAW (sig = 0.01) with statistical significance. Male personnel have a higher acceptance of the web application than female personnel (x̄ = 4.12 > x̄ =3.91).

When considering each acceptance list, it was found that both male and female personnel were different in the internal factor aspect of eliminating user anxiety to use the TAW (sig=0.04).

Table 5 Comparing personnel's acceptance of the web application according to other personal factors with f-test

personal factors	N	x̄	SD	f	sig
Age					
Lower 30 years	94	4.15	0.58		
30 – 39 years	94	4.12	0.51		
40 – 49 years	94	4.09	0.74		
50 – 59 years	94	3.75	0.84	**3.12**	0.03*
Equal to or more than 60 years	94	3.52	0.79		
Education level					
Bachelor degree	94	4.08	0.81		
Master degree	94	4.15	0.75		
Doctoral degree	94	4.05	0.76	2.54	0.15

Table 5 (Continuous)

personal factors	N	x̄	SD	f	sig
Position					
Administrator	94	3.85	0.89		
Teacher	94	4.01	0.68	3.25	0.03*
Officer	94	4.19	0.64		
Number of experience years					
Lower 5 years	94	4.15	0.65	2.65	0.06
5 – 10 years	94	4.08	0.52		
More 10 years	94	4.02	0.74		

* Statistically significant at .05

From Table 5, personnel who are different in age and position have different levels of acceptance of the web application with statistical significance at .05. Younger personnel have higher acceptance of the web application than older personnel (lower age's x̄ = 4.15 to higher age's x̄ = 3.52). When considering each acceptance factor, it was found that younger and older personnel were different in the internal factors of eliminating user anxiety to use the signing web application and personal knowledge and skills in using the signing web application (sig=0.03). The personnel who hold different positions have different levels of acceptance of the web application in the supplemented factor of training personnel for use of the signing system before using it in the real work process (Aministrator's x̄ = 3.85, Teacher's x̄ = 4.01, and Officer's x̄ = 4.19, sig =0.03).

The developed web application received high satisfaction in all aspects from users because it was designed and developed based on users' requirements, documentary reviews, and related technology surveys. After the development was completed, users' technology skills were enhanced through training that provided web application knowledge in the form of a brief infographic manual. These methods led to high overall users' acceptance of the web application. When comparing personnel's acceptance of the web application according to personal factors, it was found that personnel who differ in gender, age, and position have varying levels of acceptance of the web application in both the internal and supplemented factors, with statistical significance. This is because most female users often experience more anxiety when starting to use the new signing system than male users, as mentioned in the research by Somporn Rungreangkulkij and Phunnapa Kittirattanapaiboon (Rungreangkulkij and Kittirattanapaiboon, 2021), which states that most women suffer from depression and anxiety more than men. Therefore, the developer team should continuously provide recommendations and monitor users with different requirements and skills in order to reduce their anxiety when transitioning to the new technology.

CONCLUSION

The TAW developed with responsive web application development consists of 3 main functions: identity verification by picture and location, work-in record, and monthly summary report. The proposed TAW can reduce time spent managing work attendance queues and support personnel in checking their leave days. After the web application was finished, the related TAW usage knowledge was provided to the personnel in the form of a brief infographic manual and training to improve the personnel's technology skills and acceptance of the TAW. To enhance the performance of time attendance technological innovation in the near future, image processing abilities and deep learning techniques should be applied to detect personnel's faces instead of typing usernames. Moreover, Internet-of-things (IoT) technology and medical sensors can also be integrated into this software to

measure personnel's vital health signs and assess their health states related to working competency in future research.

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