

Development of a Digital Camera-Based Attendance System for University Students

Suwit Somsuphaphrunyos, Rajamangala University of Technology Suvarnabhumi, Thailand
Anek Putthidech, Rajamangala University of Technology Suvarnabhumi, Thailand
Amnaj Sookjam, Rajamangala University of Technology Suvarnabhumi, Thailand
Sangtong Boonying, Rajamangala University of Technology Suvarnabhumi, Thailand
Nutthawat Mudpetch, Rajamangala University of Technology Suvarnabhumi, Thailand

The Asian Conference on Education 2024
Official Conference Proceedings

Abstract

This research aimed to 1) develop a process for counting class time and screening for diseases using digital camera technology, 2) develop an application for managing class time and screening for diseases, and 3) evaluate and monitor the performance of the developed system. This study involved designing a process for counting class time and screening for diseases. The study population was students from the Faculty of Business Administration and Information Technology. The sample group was students from the Digital Business Technology program at Rajamangala University of Technology Suvarnabhumi. The prototype was tested using facial recognition technology and temperature measurement to screen and record data in a cloud database. The system has a notification mechanism via the Line application for risk groups to inform those involved to prepare and respond appropriately. The research results indicated that the developed process for counting class time and screening for diseases can effectively assess those at risk of COVID-19 with high efficiency (mean=4.85, standard deviation=0.47). The accuracy testing group consisted of 30 Digital Business Technology program students. Each person was tested three times. The test results showed that the facial recognition and temperature measurement programs had an accuracy of ± 0.3 degrees Celsius. Expert evaluations of the system performance also indicated high overall performance (mean=4.81, standard deviation=0.52).

Keywords: Detection Face, Digital Camera, Counting Students, Screening For Diseases

iafor

The International Academic Forum

www.iafor.org

Introduction

Higher education institutions such as universities are places where the following people, such as students, lecturers, and educational personnel, gather to perform activities such as teaching, research, registration, seminars, sports, recreation, and leisure. The variety of services depends on the nature of each activity, such as registration services, library services, meeting room reservations, appointments with academic advisors, and convenient and energy-saving services. Universities and university management development involve organizing and allocating resources and facilities to support educational services and related activities. It should keep pace with the times and adopt new technologies such as artificial intelligence, cloud computing, virtualization, and the Internet of Things as the future direction for building smart campuses. This development aims to improve teaching, management, and services to a higher level to achieve the status of "smart" educational institutions. Colleges and universities can also become smart campuses like cities, innovative businesses, and buildings.

The Faculty of Business Administration and Information Technology, Rajamangala University of Technology Suvarnabhumi, offers doctoral, master's, bachelor's, and advanced diploma programs in various fields of study. Teaching and learning management also requires the collection of class attendance scores to motivate students to gain effective scores. Currently, the system for recording class attendance and student activity participation still uses the method of calling names from a list printed on paper from the student registration system, which is slow in reading the names of students one by one, in order from the first to the last person in the class, which wastes much time.

Therefore, the researcher has the idea of applying digital camera technology to record class attendance, activity participation, and screening for COVID-19. The system will collect data on class attendance participation and participation in other activities and identify students with abnormal body temperatures, indicating they may be infected with COVID-19. The system will then send a report to relevant personnel for further action.

Review of Literature

This literature review encompasses three main areas: digital cameras, the Study of Class Attendance Behavior, Screening, and Temperature Measurement Technology. It explores the existing literature and empirical evidence surrounding these topics and identifies the potential benefits and concerns of using digital cameras in educational settings.

A Digital Camera

A digital camera, also called a digicam, is a camera that captures photographs in digital memory. Most cameras produced today are digital (Musgrove, 2006), essentially replacing those that capture images on photographic film or film stock. Digital cameras are now widely incorporated into mobile devices like smartphones with the same or more capabilities and features of dedicated cameras (Cooke, 2017). High-end, high-definition dedicated cameras are still commonly used by professionals and those who desire to take higher-quality photographs (Tarrant, 2006, pp. 8-31).

Digital and digital movie cameras share an optical system, typically using a lens with a variable diaphragm to focus light onto an image-pickup device. The diaphragm and shutter

admit a controlled amount of light to the image, just as with film, but the image pickup device is electronic rather than chemical. However, unlike film cameras, digital cameras can display images on a screen immediately after being recorded and store and delete images from memory. Many digital cameras can also record moving videos with sound. Some digital cameras can crop and stitch pictures and perform other kinds of image editing (White, 2019; Zhang, 2011).

Study of Class Attendance Behavior

Study of class attendance behavior is conducted by classroom research process in which teachers are the ones who carry out the work to solve problems that occur in the classroom and use the results to improve teaching and learning or promote the development of students' learning to be better to maximize the benefits to the students. Studying classroom attendance behavior, such as being late and absent, is a guideline that helps to know the learning behavior of students that affects learning achievement. The researcher teacher can choose to use data sources from both school data collection and data collection by the researcher teacher himself, such as school statistics, class attendance, grades, subjects registered, etc. Regarding research related to studying classroom attendance behavior, behavior adjustment, not attending class, and being late to class, students found that in collecting data on student attendance, the researcher used the student responsibility observation form and the attendance record book as data collection tools. These methods are suitable for a small sample group. Therefore, if you want to collect data from a large sample group, you must use tools to collect data more easily and quickly than the behavior observation method and the attendance record book. Conduct participatory action research using activities emphasizing integrated learning to study students' learning achievement. It used observation, assignment of work, project evaluation form, self-evaluation form, critique record, and mid-term test. It was found that the trainees had knowledge and understanding. They could write an integrated learning management plan comprising various teaching methods, activities integrating content and life skills knowledge, and various evaluation tools through the specified criteria. In addition, it was found that most students had scores that passed the quantitative knowledge criteria of 70 percent in terms of learning achievement, systematic thinking process skills, and analytical thinking. In terms of awareness and learning behavior, it was found that students were interested in teaching and learning activities, could answer questions, and participated in the classroom. From the above research on classroom attendance behavior, it can be concluded that regular classroom attendance affects their academic achievement. The tool used to collect classroom attendance data is in the form of notes, which is inconvenient for data collection.

Screening and Temperature Measurement Technology

Amid the outbreak of the Coronavirus Disease 2019 (COVID-19), both public and private sectors have developed technologies to assist in screening patients at risk of contracting the virus. Some of the interesting new technologies include the following:

Thermal Cameras.

Government and private organizations use thermal cameras to help scan and check employees or customers who may have a fever. These thermal cameras are the latest in thermal imaging technology using artificial intelligence, designed to detect body temperature accurately. Scanning people with high body temperatures can help identify early symptoms

of the virus. The cameras can accurately detect body temperature even when people walk and wear masks, hats, or helmets. The cameras help speed the screening process and provide audible and visual alerts when temperatures exceed normal ranges.

Body Temperature Screening System.

The body temperature measurement system screens people quickly and accurately. Its Application Programming Interface (API) is integrated with the organization's software system, making it suitable for large organizations that link employee or user data with body temperature data. This system is also suitable for patient screening services in public areas such as hospitals, train stations, bus stations, shopping malls, and large office buildings.

Thermal Camera Solution for COVID-19.

The thermal camera has high-precision body temperature detection technology and can detect up to 15 people per second from up to 3 meters. It has a built-in sensor and speaker that will immediately notify when the body temperature exceeds the specified criteria with an error value of only 0.3°C (+/-). The camera also works with other security systems, such as CCTV cameras, recording still images and videos, recording temperatures, and tracking people entering or leaving the area in real-time. This solution reduces the risk of employees contacting people infected with the disease.

µTherm FaceSense Smart Temperature Measurement Device.

Developed by the Photonics Technology Research Team of the National Electronics and Computer Technology Center (NECTEC), this device measures body temperature without contact. It can detect temperature from a person's face up to 1.5 meters away in just 0.1 seconds, displaying the temperature as a number on the screen. If the temperature exceeds the set value, the number changes from green to red, triggering an alarm. This technology, which compensates for variables like temperature, humidity, and distance, ensures highly accurate measurements, even when individuals are wearing masks.

Methodology

The attendance recording system and screening are operated to separate groups of people at risk of infection with the new coronavirus strain 2019 (COVID-19) before entering the classroom. When a group of people enters the area, they must go through the automatic screening process using a camera to detect it by checking the information of the group of people along with the body temperature of that group. When the detection finds that the body temperature of the group of people is higher than the standard criteria for infection with the COVID-19 virus, the system will notify the information and specify the location to the relevant officers, which will consist of Security officers must separate the group of people who are at risk and notify the nurses and administrators. However, if the group of people who have passed the automatic screening system and are not found to have a body temperature exceeding the specified standard, the information will be recorded in the system that they have entered the classroom.

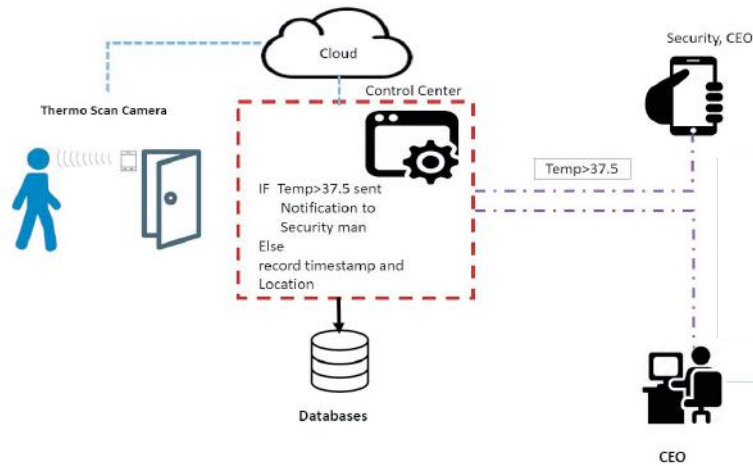


Figure 1: System Architecture

Setup

Design of screening process, module development, and equipment installation the research team designed the screening process by studying and analyzing documents and asking the needs of those involved. System requirements were designed by considering the possible and appropriate context.

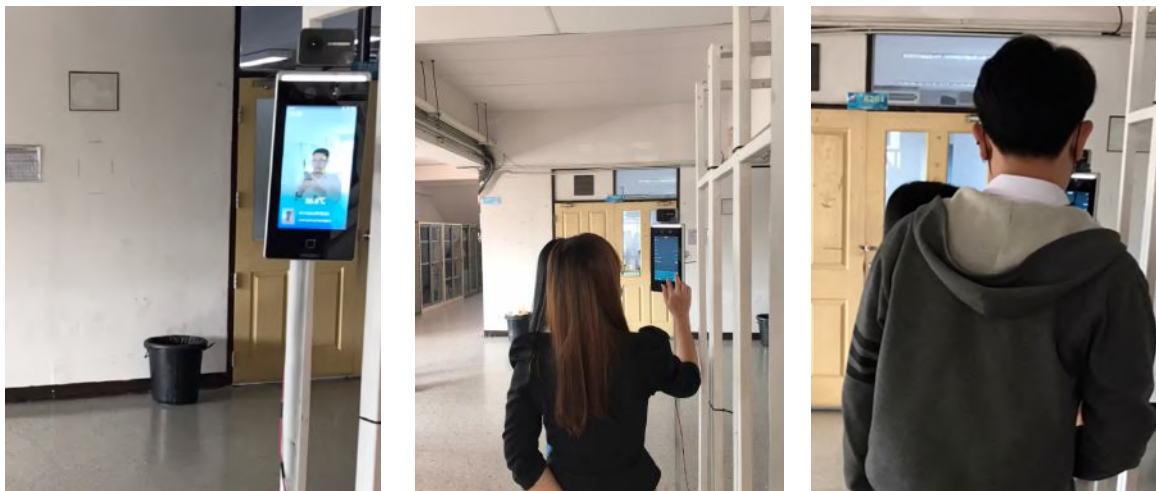


Figure 2: Setting Up a Digital Camera for Detection

From Figure 2, the camera can capture the facial structure when there is movement in front of the camera. The facial structure check data will be sent from the camera's memory database. If a person's face data is in the memory, the camera will read the person's data along with the temperature detection. The system database will be saved to the learning stage if the temperature is expected according to the conditions. The alarm system will start the process if the temperature exceeds the conditions. If the data from memory is checked and no data is found, the camera will display the message N/A (person data not found), but the temperature is still detected. If the temperature is expected according to the conditions, the data will be recorded as a person with no name details (N/A), but the temperature and time are recorded. If the temperature exceeds the conditions, the alarm system will follow the process, and the history will be recorded later.

Design and develop applications. The application is capable of reporting temperature information, risk group information, and coordinates of risk groups from the location of the face and temperature detection camera to risk groups and related persons. It is developed according to the information system development life cycle (SDLC). In developing the system application, the capabilities of the face and temperature detection camera can be used to send data to the cloud and develop a web application as a system management part, which consists of a system administrator and a report display part via the web application page. The development tools are PHP language, MySQL database, and data management, and the system performance is evaluated by information technology experts who graduated in information technology or other related fields with no lower than a master's degree or hold an academic position of no lower than an assistant professor, totaling three people.

Results

Accuracy Test Results

The test was conducted to check the accuracy of the temperature measurement system and the recognition system. The experimental group used to check the system's accuracy consisted of 30 students in the Information Systems and Business Computer Program at the Faculty of Business Administration and Information Technology, Rajamangala University of Technology Suvarnabhumi. Each participant in the test was tested three times. The temperature measurement program yielded test results with an error margin of ± 0.3 degrees Celsius. The analysis results for the accuracy of temperature measurement and face recognition are presented in Table 1. The test results are acceptable in medical applications and can be used in real-world scenarios. The developed face recognition program has an average accuracy of 90%. Based on the test results, it can be concluded that the face recognition program is suitable for real-world applications. Various factors, including one influence the margin of error) The actual lighting conditions during the test did not match those when the database images were collected, 2) The camera's resolution used to develop the face recognition program, and 3) Insufficient number of databases for training purposes.

Table 1: The Analysis Results for the Accuracy of Temperature Measurement and Face Recognition

Number of testers	Temperature measured by infrared sensor (°C)			Temperature measured by mercury sensor (°C)			Discrepancy (°C)		
	Test-1	Test-2	Test-3	Test-1	Test-2	Test-3	Test-1	Test-2	Test-3
1	36.5	36.4	36.7	36.5	36.7	36.5	0.0	-0.3	0.2
2	36.4	36.5	36.5	36.2	36.5	36.5	0.2	0.0	0.0
3	36.5	36.6	36.7	36.5	36.7	36.7	0.0	-0.1	0.0
4	36.7	36.6	36.5	36.6	36.4	36.3	0.1	0.2	0.2
5	36.5	36.5	36.7	36.3	36.5	36.6	0.2	0.0	0.1
6	36.7	36.5	36.4	36.5	36.6	36.2	0.2	-0.1	0.2
7	36.4	36.6	36.5	36.5	36.9	36.5	-0.1	-0.3	0.0
8	36.5	36.7	36.6	36.7	36.5	36.5	-0.2	0.2	0.1
9	36.6	36.5	36.9	36.3	36.5	36.7	0.3	0.0	0.2
10	36.9	36.2	36.5	36.6	36.5	36.7	0.3	-0.3	-0.2
11	36.5	36.5	36.5	36.2	36.7	36.5	0.3	-0.2	0.0
12	36.5	36.6	36.5	36.5	36.5	36.6	0.0	0.1	-0.1

13	36.5	36.3	36.7	36.5	36.6	36.8	0.0	-0.3	-0.1
14	36.7	36.7	36.5	36.5	36.5	36.7	0.2	0.2	-0.2
15	36.5	36.5	36.7	36.7	36.2	36.5	-0.2	0.3	0.2
16	36.2	36.7	36.5	36.5	36.5	36.7	-0.3	0.2	-0.2
17	36.5	36.4	36.2	36.2	36.5	36.4	0.3	-0.1	-0.2
18	36.6	36.5	36.5	36.5	36.7	36.5	0.1	-0.2	0.0
19	36.3	36.6	36.6	36.6	36.5	36.6	-0.3	0.1	0.0
20	36.5	36.9	36.3	36.3	36.7	36.5	0.2	0.2	-0.2
21	36.5	36.5	36.7	36.7	36.5	36.5	-0.2	0.0	0.2
22	36.7	36.5	36.5	36.5	36.6	36.5	0.2	-0.1	0.0
23	36.6	36.5	36.7	36.7	36.3	36.5	-0.1	0.2	0.2
24	36.6	36.5	36.4	36.6	36.5	36.5	0.0	0.0	-0.1
25	36.2	36.5	36.5	36.3	36.5	36.7	-0.1	0.0	-0.2
26	36.6	36.7	36.6	36.7	36.5	36.3	-0.1	0.2	0.3
27	36.3	36.4	36.9	36.5	36.7	36.7	-0.2	-0.3	0.2
28	36.6	36.6	36.5	36.8	36.4	36.3	-0.2	0.2	0.2
29	36.4	36.2	36.5	36.2	36.5	36.6	0.2	-0.3	-0.1
30	36.2	36.6	36.7	36.5	36.6	36.4	-0.3	0.0	0.3

Table 2: The Efficiency of the System

Detail	Mean	S.D.
1. Functional Requirement Test	4.82	0.53
2. Functional Test	4.82	0.52
3. Usability Test	4.82	0.52
4. Security Test	4.80	0.51
Total	4.81	0.52

Conclusion

The research focuses on developing a system for recording class attendance and participation in other activities, including screening for COVID-19, using digital camera technology, and developing an application for managing class attendance and screening. The performance of the developed system was also evaluated. The system helps teachers reduce the time spent recording class times, thus saving time on calling names before starting the lesson. It also helps track and prevent the spread of the disease.

Accuracy Testing of the Digital Camera Equipment

The system was tested with 30 Digital Innovation Business students from the Faculty of Business Administration and Information Technology, Rajamangala University of Technology Suvarnabhumi, by testing, analyzing, and improving the temperature measurement program and facial recognition software.

In the experiment, each of the 30 students was tested 3 times, and the results were analyzed and summarized, identifying and fixing problems that caused inaccuracies in each round of testing to achieve the desired objectives. The temperature measurement program for the test subjects was inaccurate, with the temperature measured by the infrared sensor (°C) compared to the mercury sensor (°C) having an error of $\pm 3^{\circ}\text{C}$, indicating that the temperature measurement and facial recognition program is effective and accurate, able to record class

attendance and participation in other activities, including screening people at risk of COVID-19 infection.

Application Development for Attendance Recording, Screening, and Risk Assessment. The facial recognition and temperature measurement data record attendance and screen at-risk individuals. The system records information such as when the face was detected, the measured temperature, and the risk status of viral infection. This data includes internal and external individuals who have not verified their identity. The data is then stored on the cloud system for further use in reporting and system development. The application for recording attendance and screening consists of several screens: an attendance recording screen, a display showing data upon entering a location, a screen displaying the recorded temperature when it reaches the screening threshold of 37.5°C, and a display of the date and time of entry.

Experts and users conducted tests to evaluate the system's efficiency. They were asked to use the system and complete a questionnaire assessing its performance. The evaluation focused on four aspects: functionality (Functional Requirement Test), system performance (Functional Test), usability (Usability Test), and security (Security Test).

Results of the System Evaluation

Based on expert analysis, the system's overall performance was highly effective. The top three performance areas met the system's functional requirements, performance, and usability. Security and verification were rated slightly lower. The user analysis also rated the system as highly effective overall. The highest-rated area was usability, followed by meeting the system's functional requirements and performance. Security and verification were rated lowest.

References

- Cooke, A. (2017, October 30). Nikon closed China's camera factory, citing smartphones as the cause. *Fstoppers*. <https://www.fstoppers.com/archived/2019-10-23>
- Lin, J.-W., & Other Authors. (2019). A thermal camera-based continuous body temperature measurement system. In *Proceedings of the ICCV Workshops*. Retrieved from https://openaccess.thecvf.com/content_ICCVW_2019/html/CVPM/Lin_A_Thermal_Camera_Based_Continuous_Body_Temperature_Measurement_System_ICCVW_2019_paper.html
- Ling, T. H. Y., & Other Authors. (2015). Non-intrusive human body temperature acquisition and monitoring system. *IEEE Xplore*. <https://ieeexplore.ieee.org/document/7311202>
- Mansor, H., & Other Authors. (2013). Body temperature measurement for remote health monitoring system. *IEEE Xplore*. <https://ieeexplore.ieee.org/abstract/document/6717956>
- Musgrove, M. (2006, January 12). Nikon says it is leaving the film camera business. *The Washington Post*. <https://www.washingtonpost.com/archive/business/2006/01/12/nikon-says-it-is-leaving-the-film-camera-business>
- Nareumol, F. (2004). Improving students' punctuality by using a learning contract with vocational students. In *Proceedings of the Conference on the Development of Vocational Education Academic Work* (pp. 81-90). Bangkok: Kasetsart University.
- Sun, Sun, G., & Other Authors. (2013). Developing an infection screening system for entry inspection at airport quarantine stations using ear temperature, heart, and respiration rates. *IEEE Xplore*. <https://ieeexplore.ieee.org/document/6611097>
- Tarrant, J. (2006). Basic features. In J. Tarrant (Ed.), *Understanding digital cameras* (pp. 8–31). Oxford: Focal Press.
- Thipwan, A. (2010). Students are developed through integrative learning activities in general psychology courses at Northeastern University. *Journal of Behavioral Science*, 16(2), 83–95.
- White, A. (2019, February 26). *Photographer's guide to the Panasonic Lumix DC-LX100 II*. White Knight Press.
- World Health Organization. (2020). Coronavirus. https://www.who.int/health-topics/coronavirus#tab=tab_3
- Zhang, M. (2011, March 2). Panasonic Lumix FX77 can whiten teeth and apply makeup to faces. *PetaPixel*. <https://www.petapixel.com/2011/03/02/panasonic-lumix-fx77-can-whiten-teeth-and-apply-makeup-to-faces/>

Contact email: suwit.s@rmutsb.ac.th