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FACE RECOGNITION MODEL FOR ATTENDANCE SYSTEMS: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Technological developments are currently very rapid in all industries. Technology has also entered our daily lives, for example when taking attendance, both at school and at work, we already use a sophisticated attendance system. Most of the existing attendance systems use fingerprints and RFID cards, which of course will cause many errors and system failures, as well as fraud in attendance. To overcome this, an attendance system was developed using facial recognition technology. FR technology itself is a science that comes from artificial intelligence which of course plays with the algorithm model in the system. This makes attendance systems developers confused to choose which algorithm model is good to implement on attendance systems. Therefore, this paper aims to find trends in the development of attendance systems using face recognition, the best algorithm for face detection and face recognition, and the best algorithm for face liveness detection. This can be answered by using a Systematic Literature Review with the PRISMA model approach, where data on papers were published in 2007-2023. From a review of the literature, it was found that there were the most trends in the development of attendance systems for face recognition in the education industry for student attendance, the best algorithm for face detection was MTCNN , the best algorithm for face recognition in attendance systems was CNN with an accuracy rate of 98.87 % Based on a literature review, and the best algorithm for face liveness detection is the ECT algorithm, because it is the most stable for liveness detection.

Keywords: *Face Recognition Algorithm, Face Detection Algorithm, Face Liveness Detection Algorithm, Attendance Systems, Systematic Literature Review*

1. INTRODUCTION

A method of tracking attendance at workplaces, universities, and educational institutions is present attendance. Due to the ability to track everyone's progress who is involved with the firm, attendance is crucial for the business [1]. As a result, data collection shouldn't be inaccurate or deceptive. There are two ways to record attendance: manually with a paper signature and automatically using a card. The process that is frequently utilized for the manual approach entails the teacher or note-taker handing out a piece of paper with a list of names on it, after which the paper is signed to record each employee's attendance [1]. In addition to signatures, another common manual technique is to report attendance using forms that Human Resources Management has issued for employee absences [2].

Along with the manual methods already mentioned, there are also non-manual procedures, where human resources management makes use of instruments to help with the attendance process. For instance, many businesses currently employ a card (RFID) for non-manual attendance [1].

The following data describes the number of companies implementing employee attendance divided into four attendance methods, namely manual, finger print, card (RFID), and application.

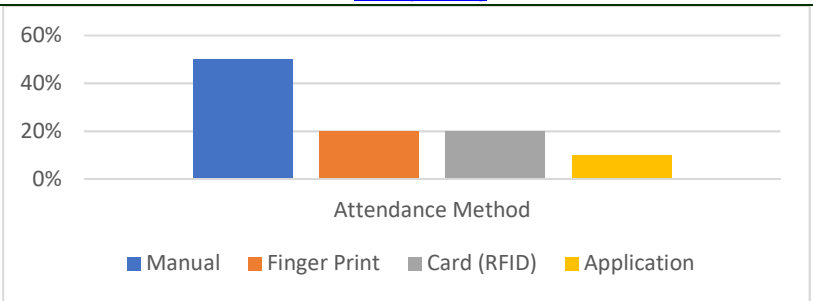

Figure 1. Attendance Method in Organization [1]

From the Figure 1. it can be seen, there are still many companies that use manual attendance systems to record employee attendance, and there are still a few companies that use application systems for attendance. The application system in question is clock-in and clock-out through the application by capturing the time, place, and circumstances where employees are absent, so that it can be tracked by Human Resources Management [2].

However, there are other strategies to increase attendance effectiveness in tandem with technological advancement. One of these is biometric identification, more especially facial recognition. Facial recognition technology can recognize a person's face from video recordings by using a facial database. Typically, this technique is used to identify people using ID verification services. Software for facial recognition can be created using a variety of deep learning methods, including the LBPH (Local Binary Pattern Histogram) algorithm and the CNN (Convolutional Neural Network) algorithm. The LBPH method combines Local Binary Patterns (LBP) and Histogram Oriented Gradients (HOG) to enhance the performance of facial recognition results [3].

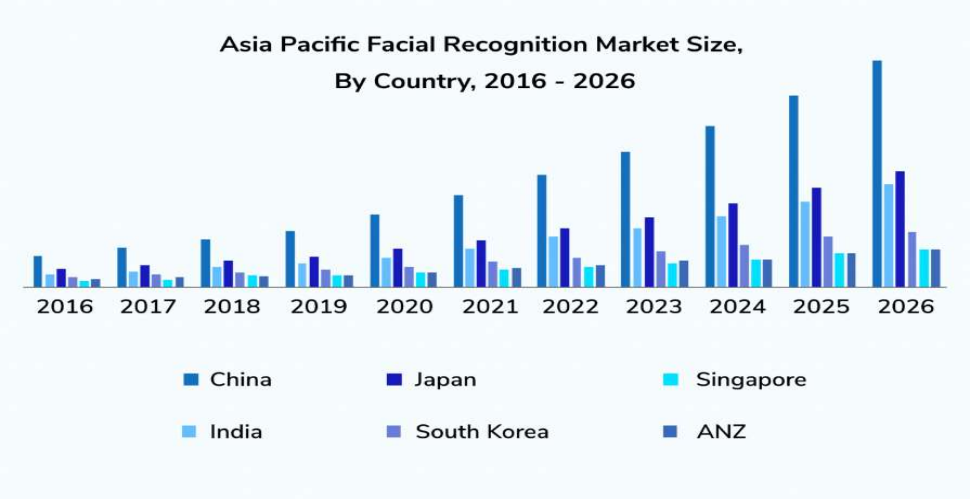

Figure 2. Asia Pacific Facial Recognition Market Size by Country, 2016-2026 [4]

It is well known for its performance and accuracy because LBPH can recognize a person's face from both the front and the side. Using high-level abstractions on the data and nonlinear transformation functions grouped in layers and depth, deep learning is a method or subset of machine learning. You might think of it as artificial intelligence that mimics how nerve cells in the human brain work. Deep learning employs convolutional neural networks (CNN), deep neural networks (DNN), and artificial neural networks (ANN) as its building blocks or algorithms. For instance, while developing facial recognition using deep learning, CNN will be the algorithm [5].

A subset of deep learning techniques called convolutional neural networks (CNN) may examine input photos to determine which features or objects can be used by machine learning to recognize and distinguish one image from another. The CNN design is similar to the neuronal or nerve cell connections found in the human brain. The Visual Cortex, a part of the brain that processes and remembers visual information, served as CNN's inspiration [6].

In the study entitled "Face Recognition: A Survey" and written by Sharif, M., et al, conclusions can be drawn based on the survey results that have been conducted on studies regarding Face Recognition, 100% accuracy has not been found. Therefore, researchers should try to improve the accuracy of the system by using a single method or hybrid methods [7].

In a study entitled "Implementation of the Viola Jones Method written by M., Mahmudi et al, for Detecting Human Faces" it was concluded that this method can detect faces with an accuracy of 88.7% from 20 test images taken randomly from the internet. From a series of tests, several facial images were not detected, including because; The position of the face is not facing straight ahead; Obstructed by other objects, such as hands, glasses, hair [8].

In this day of rapid technological growth, we must make the best use of technology. One of these, facial recognition technology, can be used to monitor staff attendance. The likelihood of attendance fraud, such as attendance transferred to other employees and human error, can be decreased with face recognition. The facial recognition technology that will be utilized is therefore the most suited for the company, both in terms of the technology used and the proper design to use it. The use of facial recognition will reduce the likelihood that the facial recognition system will make mistakes, and the use of technology will be appropriate [9]. Facial recognition will be accurate and error-free when the proper algorithm is used to create it. In this study, the literature review technique was used in which the researcher made details and comparisons of all similar studies and drew conclusions from these results. This Systematic Literature Review needs to be carried out to find out the benefits that exist in research, find out how existing research trends are from other similar studies, find out the limitations of previous research, and find gaps from previous studies which can become new research to be researched in the future. By completing a literature review and summarizing how researchers have attempted to reduce errors when applying face recognition for use in businesses, this article assesses the best face recognition algorithms.

The research questions for this SLR are:

1. What are the current trends in the development of attendance systems using face recognition technology?
2. What is the most effective face recognition algorithm for attendance systems?
3. What is the best algorithm face liveness detection for attendance systems?

2. LITERATURE REVIEW

2.1 Attendance Systems

Attendance system is a system created with the aim of verifying employee attendance records in an organization. This attendance system is very closely related to the human resources department in an organization, because with a good attendance system it can help human resources staff in the organization to properly record the attendance of employees in the company, and can help the HR staff to see consistency of employees in an organization, as well as help make decisions regarding the attendance of employees and payroll in an organization. The existing attendance system is divided into two, namely manually and automatically using the system. Manual Attendance System is the process of verifying employees in an organization manually, usually using attendance paper. This manual attendance can make it difficult for HR staff to re-verify and store the attendance sheet as long as the organization still exists. Attendance automatically is an attendance system that records the attendance of employees in the organization with the help of the latest technology, and the data can be synchronized to the employee attendance database, and has good and clear records. This automatic attendance can make it easier for HR staff to verify the attendance of employees, so that it can speed up work time for HR staff and can help make decisions very well in the future [1].

There are also many types of automatic attendance and when implemented in an organization, errors often occur in the automatic attendance system. One example of an automatic attendance system is a fingerprint attendance system which was found, that the system has an error rate of 5 percent attendance, starting from an unresponsive fingerprint attendance system, fingerprint errors of people who make

attendance, and forgery of fingerprints. someone using a candle that copies the fingerprints of colleagues in an organization. This can affect the level of employee attendance in an organization. Then, another example of an automatic attendance system is an attendance system that uses employee cards to record employee attendance. The attendance system using this card can experience errors, such as damage to the RFID card, damage to the card scanner machine, and the occurrence of fraud in employees of an organization, by entrusting their attendance cards to other colleagues, which can lead to fraud in employee attendance. According to [10], the best automatic attendance system is an attendance system using face recognition technology which verifies attendance by validating the faces of employees in the company. This attendance system has a very good level of accuracy, compared to attendance systems with fingerprint and RFID cards [11].

2.2 Face Recognition

Face recognition is an artificial intelligence technology that is widely used in the world today, and is of great concern to organizations today. Face recognition technology is an application of artificial intelligence that can analyze images and recognize patterns from a person's face which is simplified by the system, so that the system can verify a person's face whether it is valid or not. Nowadays, face recognition technology has become a trend in everyday life, because this technology can be supported by other existing technologies (for example, mobile phones, laptops, cameras, etc.), as well as digital technology. it is widely used in various fields of life in the world, such as for commercial, financial, and so on [12].

One of the artificial intelligence techniques used for biometric recognition is face recognition. Face recognition is an artificial intelligence technology that uses a system algorithm to give systems or computers vision as similar to humans as possible. The system can analyze data from a person's face's contours, authenticity, and other factors in order to determine that person's identity and identify them so that the system can do the same. Face recognition software receives input in the form of a facial image or video of a person's face, and it might be based on the shape and contour of the person's face that the camera wishes to detect. Face detection and face recognition matching are the two steps of face recognition technology that are used to process an image. In order to establish if the system can recognize a human face or not, it is necessary to first determine the general shape and location of the human face as well as its primary dimensions. The measurements of the human face can be generated from these binary points by determining the human face's determination of the organs on the human face as a whole. The primary goal of the face detection stage is to gather as much information as possible about a person's face in order to conduct a thorough evaluation of whether a human face image can be found in the image that was captured by the camera, as well as to determine the size and position of the image and categorize the detected human facial images. the adult facial region [13].

Face extraction will take place after this stage, which produces information comprising a person's identity attributes from the results of face detection. In this stage, the facial information gleaned through face detection is extracted, the findings are compared to various categories of human faces already present in the database, and each discovered face is then identified and further verified to ensure its identity. Face recognition technology combines biometric media with artificial intelligence to recognize faces. It has four main stages: collecting facial images, preprocessing facial images, extracting facial image features, matching and combining hard recognition, and combining it with hardware cameras, network paths, and computing devices. [8].

2.3 Systematic Literature Review

One exploratory research approach that seeks to gather as much data as possible in this study in order to gain an overall picture of Face Recognition Technology research on system attendance in businesses is the systematic literature review. In information systems research, the SLR technique is frequently employed to identify crucial elements, unresolved issues, advantages, and difficulties. The SLR method is used in this study as the best artificial intelligence model for implementing face recognition technology, and the problems that will arise when doing so in businesses for attendance systems and what are the most crucial factors for doing so are also covered. [14].

3. METHODOLOGY

The systematic literature review (SLR) method or strategy will be used in this investigation of face recognition for attendance systems. The systematic literature review approach is frequently used in research to find, assess, and analyze all prior relevant research with the goal of responding to research questions, phenomena, and related subject areas. The systematic literature review approach involves

various steps, such as the search procedure, inclusion and exclusion standards, data extraction, and interpretation of findings to address research objectives. Additionally, this study makes use of the programs Vosviewer and Publish or Perish..

3.1 Search Process

The data that will be processed in this Systematic Literature Review is existing research paper data obtained from the Scopus database. The data used are similar research data, and research on similar topics from 2007 - 2023, with the search conditions in the Scopus database as follows:.

Table 1. Search Process Sytematic Review Literature in Scopus

Search terms in Scopus		
Field Tag	Tittle, Abstract and Keywords	TITLE-ABS-KEY (attendance AND systems AND face AND recognition)
Document Type	Conference Paper, Article, Conference Review	
Language	Limit to English	
Subject Area	Limit to Computer Science	
Full Search Boolean	TITLE-ABS-KEY (attendance AND systems AND face AND recognition) AND (LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , 2008) OR LIMIT-TO (PUBYEAR , 2007)) AND (LIMIT-TO (OA , "all")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "ENGI"))	

The search technique is filtered on the keywords “Face Recognition AND Attendance Systems” and “Face Recognition AND Attendance” which are searched for in the title of the publication of the paper. Research topics collected from 239 papers found 86 selected papers in this study. Details of the papers are shown in Table 1. The year of publication was taken from 2012-2023, because the first publication year discussing the Face Recognition Model was found in 2012 and the study of applying Face Recognition technology to Attendance Systems in new companies started in 2017.

3.2 Method Systematic Literature Review

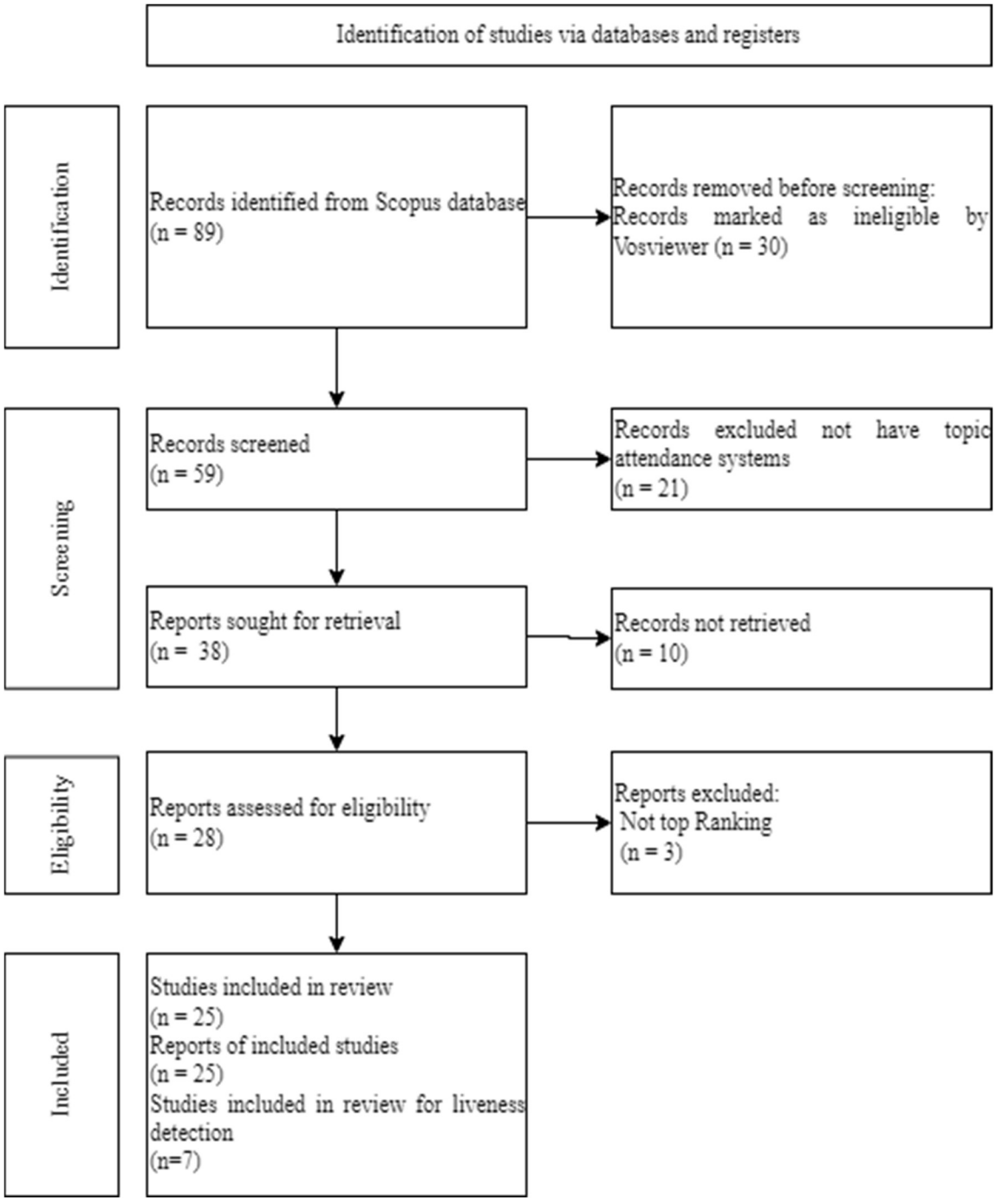

Figure 4. PRISMA Systematic Literature Review

The PRISMA diagram, which is shown in the image below, shows the SLR approach that will be employed in this investigation. PRISMA, which is a diagram outlining the steps and criteria that must be met when gathering literature sources, is a useful tool in systematic literature reviews, or SLRs. Observe the PRISMA diagram in Figure 4 [3].

3.3 Publish or Perish

Publish or Perish is software used for bibliometric research and looking for quality papers related to the

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topic you want to search for. Publish or Perish can also help to find the validity of a journal, look for the year when the journal was published, and find out who the publisher of the journal is. Publish or Perish also functions to conduct reviews related to literature that will be discussed quickly, by looking at the ranking of the papers available at Publish or Perish and seeing how many of these papers have been cited by other journals.

In this study, Publish or Perish was used to see which research journals of a similar quality were of high quality, judging from the ranking of journals based on the number of citations from other journals. The following is a picture of the results of data processing in Publish or Perish.

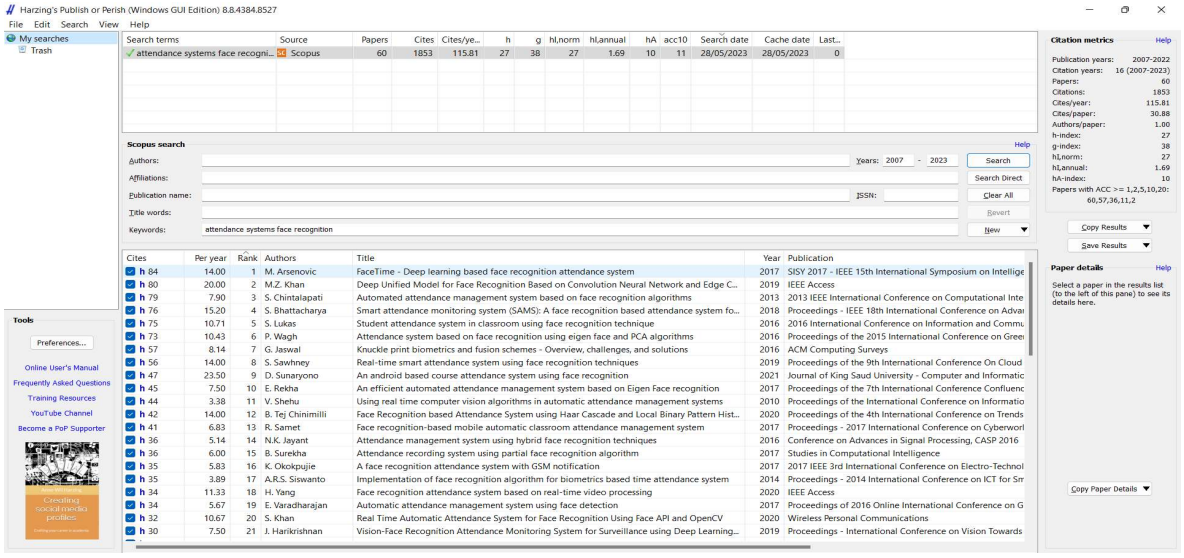

Figure 3. Publish or Perish

3.4 Vosviewer

VOSviewer is a tool that can help bibliometric research which can be used to create a data map based on data extracted into the Vosviewer software with various types of data available. Making a data map in Vosviewer using the VosMapping technique.

VOSviewer is widely used to analyze existing data networks in bibliometric research. Vosviewer can be used to create various types of data maps, for example co-occurrence, co-authorship, citations, authors, bibliometric coupling, and so on. In this study, Vosviewer was used to look at the map data network on the trend of developing attendance systems using face recognition, by creating the data network, we can identify clusters that are related to data in similar journals.

Figure 5. Vosviewer

4. RESULT AND DISCUSSION

In this study, it is expected to be able to get answers from research questions that have been formulated beforehand at the beginning of the study. This research focuses on finding trends in the development of attendance systems using face recognition technology that currently exists in various industries in the world. Then, this study also focuses on identifying the best face recognition and face liveness detection algorithm models to be applied to mobile and dashboard-based attendance systems (for maintenance). This study also explains the demographics of the data journals that have been obtained in this study, by looking at the title of the journal, the year of publication of the journal, the publisher of the journal, the attention systems application development industry, and the disciplines of the journal authors.

4.1 Demographic and Trend Characteristics

4.1.1 Publish Outlet

In this study, the data found were articles or writings from previous research related to the development of attendance systems using face recognition technology. Sources of articles and writings from previous research, published in international journals (Journal), are 7 papers, and for papers published through international conferences (Conferences) are 16 papers. Then, there are also papers from writing a thesis, namely 1 paper that discusses attendance systems with face recognition technology. An explanation of the details of the paper can be seen in Table (2).

Table 2. Publication Year

No	Title of Paper	Type	Year
1	FaceTime … [15]	Conference	2017
2	Deep Unified … [16]	Journal	2019
3	Design of … [17]	Conference	2023
4	Smart attendance … [18]	Conference	2018
5	University Classroom … [19]	Conference	2017
6	Face Recognition … [20]	Conference	2019
7	Face Recognition … [1]	Conference	2017
8	Real-time … [21]	Conference	2019
9	An android … [22]	Journal	2021
10	An efficient … [23]	Conference	2017
11	Using real … [9]	Conference	2010
12	Face Recognition … [3]	Conference	2023
13	Face recognition … [24]	Conference	2017
14	Attendance management … [25]	Conference	2016
15	Attendance recording … [26]	Journal	2017
16	A face recognition … [27]	Conference	2017
17	Implementation of … [28]	Conference	2021
18	Face recognition … [10]	Journal	2020
19	Automatic attendance … [29]	Conference	2017
20	A Conceptual Model … [30]	Journal	2014
21	Vision-Face … [31]	Conference	2019
22	Face recognition … [32]	Journal	2019
23	Face Recognition … [11]	Journal	2018
24	Class Attendance … [33]	Conference	2018
25	Improving the … [34]	Conference	2022

From the data that has been found, it can provide information regarding research on attendance systems using face recognition technology, there are still many developments in the world for now, which are mostly carried out by activity actors in schools and in organizations to facilitate recording of attendance from students or employee. From Table (2), it can be seen that the published papers are still close to the current years, which indicates that the topic is still being researched and developed by many people. The number of papers discussing this topic is also very diverse and unstable from year to year, as can be seen in 2010 there was only 1 paper, in 2011-2013 there were no papers that entered the best ranking based on Publish or Perish, then in In 2014 there was only 1 paper. In 2015 there were no papers with the best ranking again, and from 2016-2021 there were 21 papers discussing this topic. And in 2022, there is 1 paper discussing a related topic,

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and in 2023 there is currently 1 paper discussing attendance systems using face recognition technology.

Table 3. Source of Paper

No	Journal/ Conference Name	#	%
1	IEEE 15th International Symposium	4	16%
2	2013 IEEE International Confluence Research	1	4%
3	2018 IEEE 18th International Conference on Advanced Learning Technologies	1	4%
4	ACM Computing Surveys	1	4%
5	9th International Conference on Confluence	1	4%
6	Journal of King Saud University – Computer and Information Sciences	1	4%
7	2017 7th International Conference on Confluence	1	4%
8	ITI 2010 32nd Int. Conf. on Information Technology Interfaces	1	4%
9	Fourth International Conference ICOEI	1	4%
10	2017 International Conference on Cyberworlds	1	4%
11	2016 Conference on CASP	1	4%
12	Springer International Publishing Switzerland 2017 Journal	2	8%
13	2017 IEEE 3rd International Conference on NIGERCON	1	4%
14	IEEE Journal	2	8%
15	2016 Online International Conference on IC-GET	1	4%
16	International Journal of Innovative Science and Research Technology	2	8%
17	2019 International Conference on ViTECoN	1	4%
18	Bulletin of Electrical Engineering and Informatics	1	4%
19	2018 7th International Conference on ICCCE	1	4%
20	2020 4th International Conference on ELTICOM	1	4%
21	2020 6th International Conference on ICIDM	1	4%
22	2019 IEEE International Conference on I2CACIS	1	4%
23	2017 10th International Conference on ICTA	1	4%
	Total	25	100%

The journal data obtained for further processing in this study mostly came from journals published by a conference, as can be seen in the table above. The data in this study range from 68% of papers originating from a conference, 28% of papers originating from a journal, and 4% of papers written in the form of a thesis/dissertation. For publishers that published the most papers for processing data for this research were the IEEE 15th International Symposium on Intelligent Systems and Informatics, which was around 16% (4 papers), then Springer International Publishing Switzerland 2017 Journal and IEEE Journal each around 8% (2 papers), and

the rest are around 4% each (1 paper). The IEEE Conference is the conference that has published the most papers which will become the data for this research.

4.1.2 Most Profilic Authors

Research related to the development of attendance systems using face recognition technology has occurred in various countries around the world. Based on the journal data processed in this study, the authors of the paper mostly come from India, Malaysia, Indonesia, Nigeria and the United Arab Emirates. These countries became the countries that contributed the most authors for the papers that became the data in this study. This study reviews and considers the country of origin of the papers that become the research data which can be seen in the figure below.

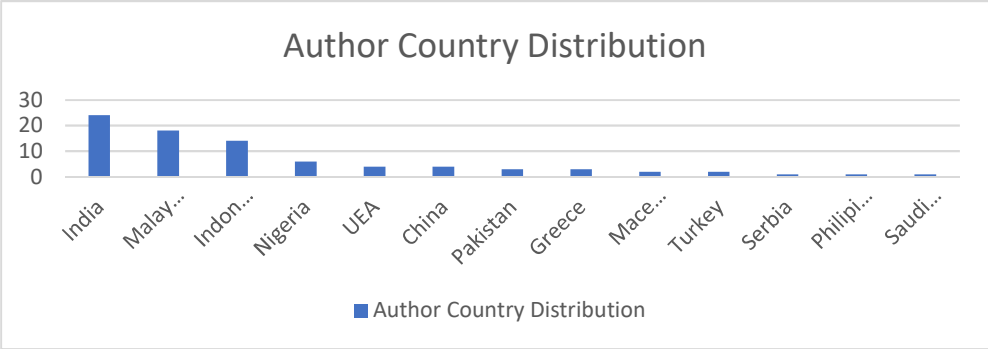

Figure 6. Author Country Distribution

Apart from the background of the author's country, this research also looks at the scientific background or what is commonly referred to as the scientific discipline of the authors of the papers that become the research data. In the table below, the disciplinary backgrounds of previous researchers are only divided into four scientific disciplines that are daily related to computers and systems, namely Computer Science, Information Systems, Electronic Engineering, and Mathematics. Computer Science discipline has 33 authors (64.73%), then Information System discipline has 9 authors (17.63%), then for the Electronics Engineering discipline there are 6 authors (11.76%), and finally the discipline Mathematics there are 3 authors (5.88%).

Table 4. Research Discipline Field

No	Background Author	#	%
1	Computer Science	33	64,73%
2	Information Systems	9	17,63%
3	Electronics Engineering	6	11,76%
4	Mathematics	3	5,88%
	Total	51	100%

4.2 RQ1: What are the current trends in the development of attendance systems using face recognition technology?

This research will answer the first question that was formulated in the early stages of the research, namely regarding the development trend of attendance systems using face recognition technology. The figure below shows the development of research trends for the development of attendance systems and face recognition.

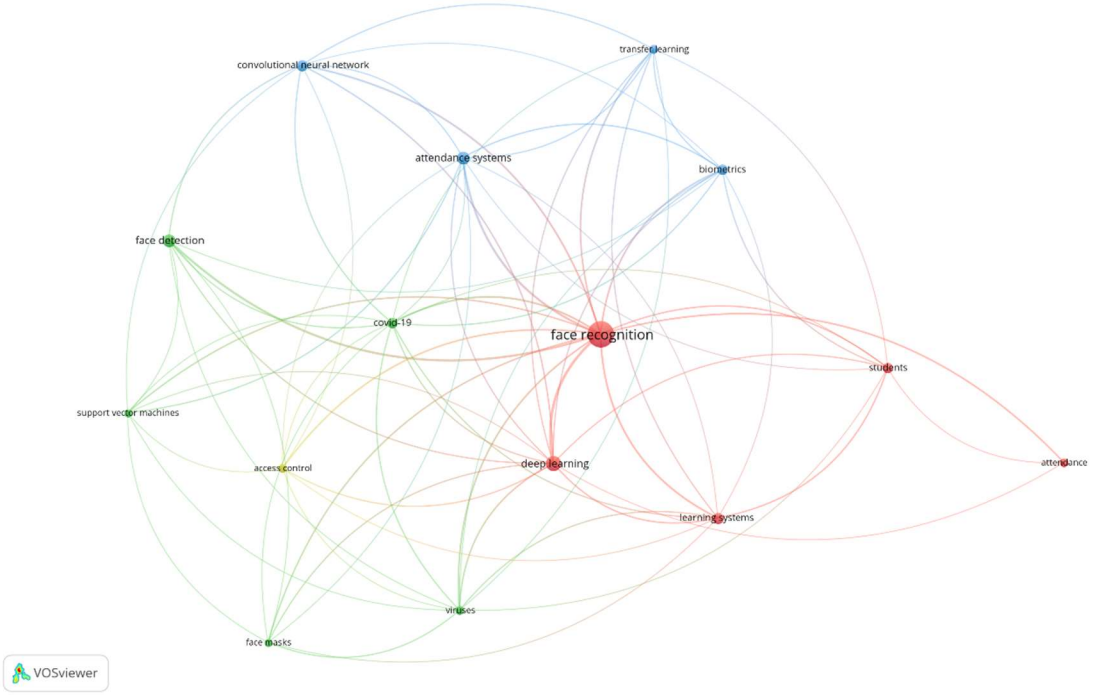

Figure 7. Trend of Development Attendance Systems with Face Recognition

The earliest development of an attendance system using face recognition occurred in 2007, where an attendance system was implemented using the Support Vector Machine (SVM) algorithm and capturing images using a camera from a laptop or webcam in a school. This initial research also used the Face Landmark and Deep Learning methods for learning the attendance system by using a dataset of students at school, so that the attendance system at school can recognize human faces [35].

Table 5. Item Occurance

No	Items	Occurance	Cluster
1	Face Recognition	31	1
2	Deep Learning	11	1
3	Face Detection	8	2
4	Attendance Systems	8	3
5	Learning Systems	6	1
6	Convolutional Neural Network	6	3
7	Students	5	1
8	Covid-19	5	2
9	Biometrics	5	3
10	Attendance	4	1
11	Viruses	4	2
12	Transfer Learning	4	3
13	Access Control	4	4
14	Face Masks	3	2
15	Support Vector Machine	3	2

Then from the co-occurrence data that has been processed using the Vosviewer software, clusters will emerge from the relationship of the data that exist with each other. In the cluster, there are colors, items from keywords, and the number of these keywords is in the journal data which is the research data. For more details, it can be described in the table above.

From the table above it can be explained with the various clusters that have been separated. The first cluster consists of five items, namely face recognition, deep learning, learning systems, students, and attendance. This first cluster can show that the development of attendance systems uses a

lot of face recognition technology for biometric recognition of a person against attendance systems, then uses the Deep Learning method on these attendance systems to study the shape of the human face. This deep learning is supported by data on the faces of students in schools, because most of the use cases for attendance systems are applied to schools [36].

The second cluster consists of five items, namely face detection, covid-19, viruses, face masks, and support vector machines. This second cluster can show that the development trend of attendance systems using face recognition technology has resulted in many new studies emerging during the Covid-19 virus outbreak in the world. The Covid-19 outbreak requires people to do activities at home, to maintain social distancing from one another, and to wear masks for self-protection. Due to the use of masks in everyday life, attendance systems must be able to detect someone's face when not wearing a mask or wearing a mask. This makes attendance systems have to implement a new face detection algorithm that is supported by a support vector machine (SVM) algorithm. The way this algorithm works is by making a landmark on the top of a person's face and comparing it with the person's full face data in the database [37].

Then there is a third cluster, which consists of four items, namely attendance systems, convolutional neural networks, biometrics, and transfer learning. This third cluster shows that the trend of developing attendance systems using face recognition technology uses a lot of convolutional neural network algorithm models, because this algorithm displays an accuracy rate above 99%, which is very good for validating and verifying someone's facial data with facial data exist in the database, whether there is a match or not. This algorithmic model is also suitable for the introduction of biometrics, because the model can be built with the help of landmarks and data training can be carried out with various data. Transfer learning here is also related to CNN, namely CNN can support the performance of deep learning on attendance systems, so that the system can study faces independently [33].

Then, for the last cluster in the trend of developing attendance systems using face recognition is access control, which can be interpreted as attendance systems, most of these use cases are used for access control in a field. An example is access control to enter a school's LMS, then access control to open a door in the school and is equipped with IoT technology [38].

In the previous research, the development of face recognition for the attendance system has not yet discussed the trends that occurred when developing this face recognition technology for the attendance system. Research discusses more about the face recognition algorithm for the attendance system [3]. This study found that there was a trend of developing face recognition for attendance systems that had been implemented with the help of face detection, then applied to existing learning systems at schools or universities, and many schools or universities used face recognition technology for attendance due to the Covid-19.

4.3 RQ2: What is the most effective face recognition algorithm for attendance systems?

Attendance Face recognition algorithms themselves will undoubtedly be needed by systems using this technology. Before face recognition is carried out, face detection is first carried out to determine whether the image captured by the camera is a human face or not. Face recognition technology is a technology for verifying a person's face input data with existing data in a database related to that person's face. [20]. The goal of this study is to identify the face detection and identification model with the greatest accuracy value or model with the best accuracy. The examination of the face detection and face recognition algorithm models produced the table below.

Table 6. Model Algorithm Face Detection and Face Recognition

No	Title of Paper	Method/ Algorithm	Face Detection Accuracy	Face Recognition Accuracy
1	FaceTime … [15]	• CNN Cascade • FaceNet CNN • SVM Classifier	94,60%	95.02%
2	Deep Unified … [16]	• CNN Face Detection • Convolution Neural Networks (CNN)	95,34%	97,90%
3	Design of … [17]	• Support Vector Machine (SVM)	92,34%	61,00%

4	Smart attendance … [18]	• Convolution Neural Network (CNN) Deep Learning	95,23%	99,63%
5	University Classroom … [19]	• MTCNN face detection • Center-Face face recognition	98,87%	98,87%
6	Face Recognition … [20]	• Eigenface algorithm	93,30%	95,66%
7	Face Recognition … [1]	• Viola-Jones • CNN	95,18%	97,87%
8	Real-time … [21]	• Eigenface • PCA • CNN	95,12%	95,82%
9	An android … [22]	• Linear Discriminant Analysis	96,55%	97,29%
10	An efficient … [23]	• Eigenface algorithm • Principle Component Analysis	95,24%	95,92%
11	Using real … [9]	• HAAR Clasifier • Python (Pyfaces)	95,34%	56,00%
12	Face Recognition … [3]	• Haar Cascade • Local Binary Pattern Histogram Algorithm	95,34%	77,00%
13	Face recognition … [24]	• Eigenfaces algorithm • Fisherfaces algorithm • LBP	92,11%	84,81%
14	Attendance management … [25]	• Viola-Jones • PCA	98,56%	95,00%
15	Attendance recording … [26]	• Viola-Jones algorithm • Partial Face Recognition Algorithm	92,34%	80,60%
16	A face recognition … [27]	• Viola Jones Algorithm • Fisherfaces	95,34%	54,17%
17	Implementation of … [28]	• PCA AND LDA AS FACE RECOGNITION ALGORITHM • Eigenface • Fisher/ace	89,15%	90,00%
18	Face recognition … [10]	• Geometric • Subspace • ANN • SVM	97,10%	96,00%
19	Automatic attendance … [29]	• Eigen Faces • Local Binary Pattern Histogram (LBPH)	95,89%	96,00%
20	A Conceptual Model … [30]	• PCA • LDA • LBA	92,84%	90,00%
21	Vision-Face … [31]	• Haar Cascade Method • Local Binary Pattern Histogram (LBPH)	89,22%	74,00%

22	Face recognition … [32]	• Local Binary Pattern (LBP)	92,20%	92,35%
23	Face Recognition … [11]	• SVM • LBP • GAP	98,80%	98,70%
24	Class Attendance … [33]	• Haar Feature-based Cascade algorithm • Eigenface • PCA • Local Binary Pattern	82,00%	95,00%
25	Improving the … [34]	• Haar-cascade • Triplet loss FaceNet	85,30%	82,20%

The table above shows that for an attendance system built with face recognition technology, it cannot stand with just one algorithm model, because there are differences in the data logic algorithms for face detection and face recognition. Besides that, the algorithms for both face detection and face recognition can achieve maximum accuracy and are very good with the help of other artificial intelligence technologies or modifications of existing algorithms, so that they can achieve very high accuracy scores. The best algorithm for face detection is MTCNN face detection, where this algorithm is an algorithm that has a CNN basis modified by its data processing algorithm, so as to obtain a high accuracy value. Then, the next best face detection algorithm is a support vector machine (SVM), followed by Viola-Jones's HAAR Cascade.

4.3.1 MTCNN

The Multi Task Cascade Convolutional Neural Network is an algorithmic model for face detection that combines methods for detecting a person's face using face landmarks that have been created in the algorithm model and a combination of the FaceCenter algorithm model combined with using deep learning methods, so that it can detect faces from people people very well and high accuracy. The MTCNN model is applied to universities where the camera in the class center can detect the faces of people present in class in real time and can instantly synchronize attendance lists with the existing attendance system [19].

MTCNN can automatically detect the faces of students who have just entered class, detect the location of which students are in class, and can immediately capture existing student faces and save them in the database. MTCNN can also extract the face of a student quickly after performing face detection. The face extraction was carried out at five points on the face that have been marked by this algorithm, namely two points in the center of the eyes, one point at the tip of the nose and two points at the corners of the mouth. Then, the systems use specially designed deep learning with a combination of the MTCNN and FaceCenter models. The MTCNN facial recognition model has an accuracy rate of 98.87%, which can be characterized by detecting faces, quickly (with the help of a supporting camera, the algorithm will be better), can detect faces that are very far from the camera, and the wide range of algorithms that can detects the faces of all students in the class [39].

4.3.2 Support Vector Machine

The support vector machine is an algorithm for face detection that is widely used in current research, because this support vector machine can perform very deep classifications. Support Vector machine has the main principle, that is, the sample used to identify an object is formed into a side in the feature space that you want to detect, then selects the sample point used for the main supporting vector of the two existing sample point types, then uses the supporting vector to create decision on the face or object it detects. This SVM ultimately aims for classification and identification [35].

SVM is a face detection algorithm model that performs projections onto facial contours or parts of the face that choose a high enough dimension and cannot be solved by linear classification on that part of the face. SVM can perform general classification, so that the projection can be used for all images or objects that are detected. The drawback of SVM is that the efficiency of modeling this algorithm is greatly reduced, because there are two class classifications [40]. Then, to implement this model, it is necessary to make a kernel which can cause problems in the future. SVM has the second highest accuracy in this study, which is 98.80%.

4.3.3 Viola-Jones HAAR Cascade

Viola-Jones is a face detection algorithm model that is widely used for similar research, because of its high accuracy and low false detection. The Viola-Jones algorithm works by receiving input facial images from people taken from cameras, either cellphone cameras or central cameras in school classrooms. The input images taken are taken at intervals of time, then the input images that have been taken are processed to the next stage, namely making the input image a gray image. After that, from the gray image of the person's face, the facial landmarks in the Viola-Jones model are detected. The Viola-Jones algorithm uses an input image from a person's face and transcribes it into a mathematical integral form to calculate features or parts, so that the image can be classified, then uses the algorithm from Adaboost deep learning to determine the important parts of the object that can be calculated with the Viola model -Jones this. Viola-Jones is also closely related to Cascade calculations or what is commonly called the HAAR Cascade Classifier model [32]. Viola-Jones has the third highest accuracy in this study, which is 98.56%.

The advantages of the Viola-Jones algorithm are [25]:

- High end accuracy
- Low false detection rate
- Fast extraction
- Location and scale invariant feature detectors
- Scalable
- Very fast computing feature
- Efficient feature selection

The best algorithm for face recognition is CNN face recognition. Then, the next best face recognition algorithm is LBPH, followed by Eigenface.

4.3.4 CNN Face Recognition (ANN)

CNN is the most popular and most widely used face recognition algorithm model for the needs of all use cases in face recognition, especially in attendance systems. CNN is an algorithm that is made as closely as possible to ANN which has the ability to classify images very well and correctly, group images based on similarities and similarities between one image and another, and can recognize faces or objects when they are moving or dynamic. CNN is also not limited to use cases for face recognition, this algorithm model is also very accurate for identifying objects around it, such as animals, fruits, vehicles, plants, and others. The way CNN works is by identifying existing images by creating many layers of learning in them by being trained continuously to match one image to another, until the algorithmic model can draw conclusions for which class the input image is in [21]. CNN accuracy is 98.87%.

4.3.5 LBPH

Local Binnary Pattern (LBP) is a face recognition algorithm model that is widely used to take facial data processing to a further level by transcribing facial shapes and parts from input facial images into binary patterns. The Local Binnary Pattern is closely related to the histogram of the data. The integration between LBP and Histogram is called LBPH [3].

Local Binnary Pattern Histogram (LBPH) is an algorithmic model based on local binary which is the scoring operator, in which the operator allocates labels to the input image and transcribes each pixel value from each image, then performs a comparison of the pixel values of the pixels. the like. This comparison is done by comparing the central pixel and other small pixels, if you get a value of 1, then the pixel will be accepted, and if you get a value of 0, then the pixel will be returned. In the final part the results of this pixel comparison will be recorded in decimal form, and a histogram is created, then the histogram results are matched with the input image. LBPH accuracy for face recognition is 96,00%

4.3.6 Eigenface

Eigenface is an algorithm for face recognition that applies Principle Component Analysis (PCA). Eigenface is designed to perform recognition by reducing the variables in the object to recognize a person's face. The main benefits of using Eigenface are that it is easy to implement into an attendance system, fast in performing human face recognition, because it can perform statistical assessments

of faces from the same human, so it can match a lot of data in the database [41]. Eigenface accuracy is 95%.

In previous research, it only discussed certain algorithms, namely LBPH and CNN, then compared using SLRs [5]. In this study, it was explained that the Attendance system using face detection and face recognition technology is very good using five face detection and face recognition algorithms, with the best being MTCNN, which is the base of the algorithm model is CNN.

4.4 RQ3: What is the best algorithm face liveness detection for attendance systems?

Face liveness detection is an algorithm model used to detect whether objects or faces are spoofing or not. In Table 7, there are various kinds of face liveness detection algorithms with their level of accuracy.

Table 7. Model Algorithm Face Liveness Detection

No	Title of Paper	Year	Method/ Algorithm	Face Liveness Detection Accuracy
1	Attendance System … [39]	2020	• ERT (Ensemble of Regression Tree) algorithm	99,75%
2	An Identity … [42]	2021	• Multimodal feature fusion	99,60%
3	A Face Antispoofing … [43]	2012	• DoG and LTV (Algorithm extract high frequency information (texture))	98,32%
4	Eyeblink-based … [44]	2007	• Adaboost • HMM	95,70%
5	Face Liveness … [45]	2010	• Sparse Low Rank Bilinear Discriminative Model	76,70%
6	A Liveness Detection … [46]	2009	• Optical flow algorithm	92,00%
7	Real-Time Face … [35]	2007	• OFL algorithm • Mouth detection	93,00%

4.4.1 ERT Algorithm

The Ensemble of Regression Tree is an algorithm model used for face liveness detection, which is built based on the TensorFlow framework. Liveness detection is intended to detect faces with the camera, whether the face is included in spoofing or not. The ERT algorithm used is the Gradient Boosting Decision Tree algorithm model. GBDT is done by making liveness landmarks on human faces as many as 68 points, from which liveness landmarks can form human faces which become a standard in face detection, so that it will quickly detect a face including spoof or not, in just 4ms [39].

From the landmarks that have been made and form human faces, the liveness detection in this algorithm model is combined with active liveness detection, namely by making a command to people who want to detect their faces by blinking, nodding, look left, look right, look up, look down, open mouth, and other similar commands. That way, landmarks that are already in the facial organs, such as the eyes, when the eyes blink, the landmarks in the eyes can detect whether the object is moving or not [39]. ERT algorithm accuracy is 99,75%.

4.4.2 Multimodal Feature Fusion Algorithm

Lip reading recognition model is an algorithmic model of face liveness detection that uses a classifier technique, by combining facial image detection with voice detection of the person. When someone detects a face using a camera, there will be instructions from the screen of the device to speak with Chinese accents, after speaking, the system will return a response whether it is detected as spoofing or not spoofing. This algorithm will also store the person's voice in the database, as data for future voice verification. Then from the data that has been obtained, deep learning is implemented with the AdaBoost model [47]. Multimodal feature fusion algorithm accuracy is 99,60%.

In previous research, the attendance system that uses face recognition technology currently does not use the algorithm model of face liveness detection [42]. In this study, it is stated that the existing attendance system needs to be added to the face liveness detection algorithm, in order to monitor attendance by humans, so that it can overcome the level of fraud or spoof detection.

The face detection, face recognition, and face liveness detection algorithms in the attendance

system aim to verify the face of someone using the attendance system. This research provides the development trend of the existing attendance system, provides the most suitable facial algorithm applied in the attendance system. It is hoped that when creating an attendance system in the future, the algorithm for face liveness detection will always be included in the attendance system, in order to monitor fraud in making attendance with the face recognition attendance system. For further research, you can carry out further analysis of the face liveness detection algorithm using only passive liveness, because this research suggests using active liveness with facial movements on the camera, and analyzing face recognition models with various attributes used by humans.

5. CONCLUSION

This research focuses on seeing the development trend of attendance systems with face recognition technology, finding the best algorithm for face recognition, and finding the best algorithm for face liveness detection. The method used in this research is Systematic Literature Review with the PRISMA method. From the data search that has been carried out with this method, 25 articles + 7 articles were obtained which became the research data this time. The paper obtained from the Scopus database discusses the development of attendance systems with face recognition technology in various fields.

RQ1, which is related to the development trend of attendance systems with face recognition technology which can be answered by explaining the four clusters processed at Vosviewer. The trend in the first cluster is the trend of developing attendance systems with face recognition technology and also using the Deep Learning method for data training, which is used in the education industry or schools. The trend in the second cluster is the trend of developing an attendance system with face recognition technology where it is hoped that face recognition can identify and verify the use of masks on people due to the Covid-19 virus outbreak. So, people don't need to take off their masks when they want to use face recognition technology. The trend in the third cluster is the trend of developing attendance systems with face recognition technology that uses the Convolutional Neural Network (CNN) algorithm model, where this algorithm is most suitable for the introduction of biometrics and transfer learning in deep learning methods. The trend in the last cluster is the development of attendance systems with face recognition technology to control access to another system or to open class doors, and so on.

RQ2, which is related to the best facial recognition algorithm model to be applied to attendance systems. Of the 25 articles that have been processed and analyzed, many of these papers discuss various face recognition algorithms. The best algorithm for face detection is MTCNN with an accuracy rate of 98.87% and stability when detecting people in the class using a supported camera. The best algorithm for face recognition is CNN (ANN) with an accuracy rate of 99.63%. Both of these algorithms can be applied to attendance systems, due to their high accuracy and stability in detecting and processing a face image.

RQ3, which is related to the best algorithm model for face liveness detection to be applied to attendance systems. Face Liveness detection is intended to detect human faces whether spoofing or not. For the best algorithm model is the ERT Algortihm with an accuracy of 99.75%. This model algorithm combines the existing landmarks in the model with active liveness commands from the camera display screen for face liveness detection.

6. LIMITATION AND FUTURE RESEARCH

This research has limitations, namely for paper data that is processed based on only one source, namely the Scopus database. Then, this research has not yet discussed models for detecting attributes from a person's face, such as masks, glasses, hijabs, and so on. This research also has not explained about the variables that can affect the algorithm model.

For future research, it is hoped that it will be able to enlarge existing paper sources, find the most suitable algorithmic model for face recognition attributes from a person's face (if you look at the development trend it can combine CNN and SVM), find out what variables can affect the face recognition model, face liveness detection, and find out face liveness detection algorithm using only passive liveness.

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