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Attendance System Face Recognition Using Convolutional Neural Network (CNN)

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ABSTRACT

This article discusses the development of technology in various fields, with a focus on the implementation of digital technology and machine learning. Digitalization has influenced various aspects of life, including education and tourism. Machine learning, particularly convolutional neural networks (CNNs) and deep learning play an important role in these advancements, with applications extending from biology to healthcare. Face recognition technology, as part of biometrics, is highlighted in this article, used in various contexts such as security and enterprise management. This research implements CNN and Haar Cascade Classifier methods to build a face recognition system in the context of library attendance. With the tests conducted, the system achieved 95% accuracy, showing a good ability to detect faces in various conditions. In conclusion, the CNN algorithm can produce an effective face recognition system for use in library attendance systems, with reliable performance and high accuracy.

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1. INTRODUCTION

Many things have changed and developed, for example in the field of education, which has implemented a lot of technology in education such as online attendance using a website [2]- [4]. Of course, this developmentdoes not only occur in the field of education but also in the fields of tourism, banking, and others [5]- [7]. Fromthis progress, changes will occur. Changes will occur if information is made, and with information, a new discovery will be developed again. Currently, the world is experiencing a revolution in the application of computer technology called digitization [8].

The development of technology certainly does not stop there, there is the latest technology that is developing and is currently trending, namely machine learning [9]. Many fields have applied machine learning such as in the fields of biology, physics, and mathematics [10]-[12]. Even the health sector is greatly helped by this breakthrough such as the utilization in detecting diseases that make patients able to prevent these diseases and help doctors in identifying and treating these diseases [13]-[16]. There is also the name deep learning, which is an extension of machine learning where the structure is more complicated and produces better accuracy [17]. One of them is Face Recognition technology, which is a biometric technique that allows computers or authentic machines to recognize human faces [18]. Face recognition technology has begun to be applied in everyday life to facilitate human activities, such as at certain airports that use face recognition technology to facilitate passenger data validation to replace boarding passes [19]. Face recognition can also help in recognizing the faces of employeesin a company so that it can be implemented for face-based attendance systems [20].

The issue of data collection of library members and library access managers is the basis for using biometric systems in these service facilities. In contrast to conventional methods that often use manual data

collection, such as writing attendance lists manually, writing names and signatures takes longer, especially if many guests come at the same time. Digitalization of this system is expected to make the access system used sofar faster and more efficient and reduce the occurrence of human error. Conversely, for library managers, thissystem can also replace the manual time recording system so that it can minimize delays in the manager's work[18].In this application, the use of system recognition uses a convolutional neural network (CNN) and Haar Cascade algorithms. The use of convolutional neural network algorithms is used because it has high accuracy [21].

2. METHOD

In this study, data analysis was conducted using the CRISP-DM (Cross Industry Standard Process for Data Mining) method, which is a data mining process model consisting of six life cycle phases. These phasesinclude business understanding, data understanding, data processing, modeling, and evaluation, as shown in the following figure:

Figure 1. CRISP -DM

2.1 Convolutional Neural Network

The method using Convolutional Neutral Network (CNN) is one of the machine learning methods which is a development of Multi-Layer Perceptron (MLP) which is designed to process or generate data from two afternoons. CNN is also a type of deep neural network method because it has a network level and many applications that are realized in images. The CNN method includes two methods, namely classification using feedback and the learning phase using backpropagation. The principle of operation of this method has similarities with the MLP method, but in the CNN method, each neuron is presented in two dimensions, unlikethe MLP method where each neuron is only one dimension [22].

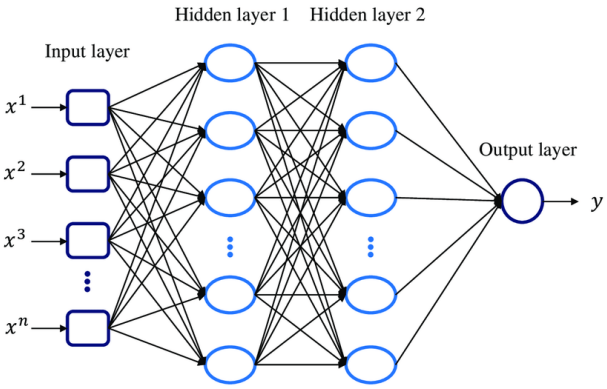

Figure 2. Architecture of the Multilayer Perceptron (MLP) Method

The CNN method is a further development of the MLP method as it uses a similar method with more dimensions. In the CNN method, the input layer used before is not a one-dimensional image but a two-dimensional image. If it is similar to the characteristics of a human face, the first layer is a representation of lines in different directions while in the second layer characteristics such as the shape of the eyes, nose, and mouth capture the head that appears, this process is caused by the combination of the first layer which is left in

the form of lines, in the third layer a combination of eye, nose and mouth characteristics will be formed which can later be concluded as a person's face and may even be recognized in this way.

Similar to the neural network method in general, the CNN method has several hidden layers from an input that has a single vector. In the input which is a digital image that is made into a single vector. In the hidden layer, there are several neurons that are like having four mapping features, namely C11 in the image. The neurons in C1 are connected to the neurons in S1, and so on. The last layer that is connected to the previously hidden layer is called the output layer and presents the final result in a class classification.

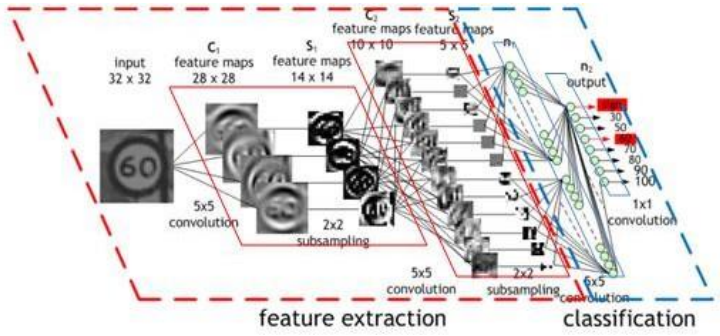

Figure 3. CNN Network Architecture

2.2 Haar Cascade Classifier

Proposed by Viola and Jones, the Haar Cascade Classifier method trains machine learning to find objects in an image, which can also help find faces[23]. In rectangular form, feature extraction andclassification are haar features that present certain characteristic special features in an image, where these features are used for simple object recognition and do not take into account the value of the object's pixel value.

2.2.1 Haar-like feature

Haar-Like Features [24] is a feature extraction method for recognizing faces. Each Haar-Like Feature is a combination of several features for training positive and negative image data. The types of features can be seen in Figure 1.

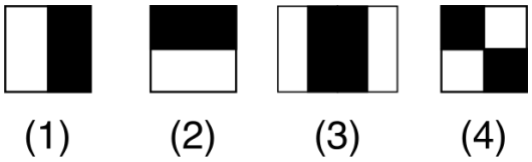

Figure 4. Haar-like feature

The Haar rectangle feature formula is as follows:

$$F_{haar} = \sum R_{black} - \sum R_{white} \text{ .....}$$

The feature value of the rectangular hair in the above equation is calculated by subtracting the pixel value in the darker area compared to the pixel value in the lighter area. This difference value indicates that facial features exist if the difference value exceeds a predefined threshold[25].

3. RESULTS AND DISCUSSION

3.1. Discussion result

Data cleaning is done to make it easier for the model to analyze the data and increase accuracy, which originally only had one photo of the data will rotate the photo to change the color of the photo andothers.

Figure 5. Data Preparation

Modeling for CNN uses several required layers such as Conv2D, MaxPooling 2D, Flatten, and dense, these layers have their own functions such as one example Pooling layer, the function of this poolingis to reduce the input spatially (reduce the number of parameters) by down-sampling operations.

```
model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(50, 50, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Flatten())
model.add(layers.Dense(128, activation='relu'))
model.add(layers.Dense(len(set(LABELS)), activation='softmax'))
```

Figure 6. CNN Layers

After creating a layer for the CNN model, the accuracy test will be carried out in face recognitionhere researchers use 80% training data and 20% testing data and get the accuracy model results as in Figure 6.

```
5/5 [==============================] - 2s 199ms/step - loss: 0.1260 - accuracy: 0.9500
```

Figure 7. Accuracy

The model has a fairly high accuracy of 0.95 or 95% which is where the model can recognize faces quite well and can help recognize faces in the absent system.

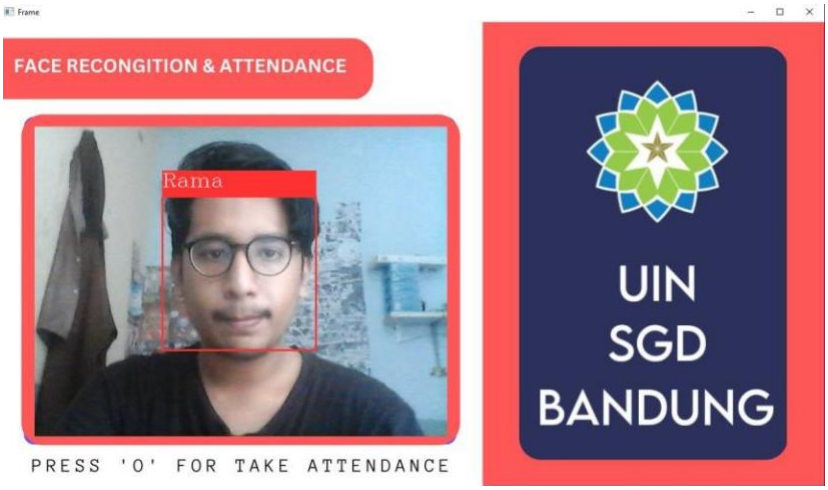

Figure 8. App View

The application successfully recognizes the face captured through the camera and recognizes the labelof the face well and library visitors can just press the o key on the keyboard to record their attendance into thelibrary data.

3.2 Application Testing

To test whether face detection works well, the researcher conducted several experiments with a face-to-camera distance of 50 cm and 80 cm with an upright face position, 30^0 rotations to the right and left, bowing the head and raising the head 15^0 degrees and getting results.

Tabel 1. Trial Results

Face Position	Detection Result
Perpendicular	Successful
30^0 rotation to the right	Successful
30^0 rotation to the left	Successful
Head down 15^0	Successful
Appointing the Head 15^0	Successful

From the trial, the application successfully detects faces in various positions and several distances that have been tried.

4. CONCLUSION

After doing research related to face recognition in the library attendance system using the Convolutional neural network algorithm. The Convolutional Neural Network algorithm applied to the systemwas successfully created with good performance and can recognize faces well and get good accuracy, namely 0.95 or 95%.

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