Sentiment Analysis Using Convolutional Neural Network Method to Classify Reviews on Zoom Cloud Meetings Application Based on Reviews on Google Playstore

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Abstract

Zoom Cloud Meetings is an application that is used to conduct video conferencing. On the Google Play Store, the Zoom Cloud Meeting application received a rating of 3.8, with 500 million more downloads as of March 2021. The application has many advantages, such as not being disturbed by pauses in conversation and having good video and audio quality. The advantages possessed by these applications require development so that application services are getting better. For this reason, user reviews are needed to see user satisfaction with the application so that they can determine services that can be developed in the future. Based on this, this research was created to create a web-based application that can classify user reviews of the Zoom Cloud Meetings application using the Convolutional Neural Network (CNN) method and calculate the accuracy value. This application is built using the Flask framework and the Python programming language. Model training is carried out using the TensorFlow library. Applications that have been made are then tested using two stages of testing, namely system testing with black box and data testing. Based on system testing, it was found that the website can run well, and for data testing using test data, the accuracy result is 91.5%.

Keywords: *Classification, Sentiment Analysis, Convolutional Neural Network, Deep Learning.*

1. Introduction

Indonesia has now entered the era of the industrial revolution 4.0. In the era of the industrial revolution 4.0, technology is increasingly sophisticated and emphasizes digitization by utilizing information technology in its implementation. This increasingly sophisticated information technology is used in carrying out daily activities. Utilization of this technology is used for communication, information dissemination, data retrieval, data management, and others. As a result, information technology has become very important and much needed in human life. The need for information technology is getting bigger so that it requires people to be technology literate. The information technology used is laptops, computers, and mobile phones. In addition, supporting applications are also needed for face-to-face communication. One application that can be used is Zoom Cloud Meetings. This application can be used as a means for students, workers, and the public to hold meetings or meetings online.

Zoom Cloud Meetings is an application that is used to conduct video conferences. This application is compatible on laptops, computers, and mobile phones. In addition, this application is popular because it is easy to use and easy to install. Installation can be done by downloading the application on the Google Play Store, App Store, or Zoom's official website. On the Google Play Store, the Zoom Cloud Meetings application received a rating of 3.8 with over 500 million downloads as of March 2021. According to information compiled by KompasTekno from CNBC, Zoom CFO Kelly Stackelberg said that Zoom's usability and reliability were the reasons behind its adoption rate. very high. This application produces low latency so that it is relatively undisturbed by pauses in conversation and can maintain video and audio quality even if the internet connection is unstable. This application has two methods of use, which can be used for free and paid. These two usage methods have a difference, namely if they use it for free, participants are limited to only 100 people and the meeting duration is 40 minutes. On the other hand, the paid version provides the advantages of an unlimited number of participants and a longer meeting duration of up to 24 hours.

The advantages possessed by Zoom Cloud Meetings require continuous development so that application services are getting better. For this reason, user reviews are needed to see user satisfaction with the application so that they can determine services that can be developed in the future according to the wishes and needs of users. One platform that provides user reviews of applications is the Google Play Store. User reviews contained in this Google Play Store have a variety of positive and negative comments. In addition, user reviews are overwhelming and often contain spelling errors that are difficult to decipher. Based on this, a system is needed to conduct sentiment analysis in classifying these reviews quickly and automatically.

Sentiment analysis is a method used to extract opinion data, understand, and process textual data automatically to see the sentiments contained in an opinion [11, 2, 4, 6–8]. This sentiment analysis can be done using machine learning or deep learning techniques. Deep learning is a learning method for data that aims to create a multilevel representation (abstract) of data using several data processing layers. This deep learning has several neural network-based algorithms, one of which is Convolutional Neural Network (CNN). Convolutional Neural Network (CNN) is a neural network using perceptron for supervised learning and for analyzing data [3, 5, 9].

Based on the description described above, research about analysis of sentiment to classify reviews on the zoom cloud meetings application based on reviews on Google Play Store was conducted using the Convolutional Neural Network (CNN) Method. This research is expected to be useful and become a benchmark for companies in improving the service quality of the Zoom Cloud Meetings application.

2. Method

In this research, there are several stages with the flow of work carried out, planning, analyzing data, making application designs, implementation, and testing. The following figure 1 shows the stages of the research method.
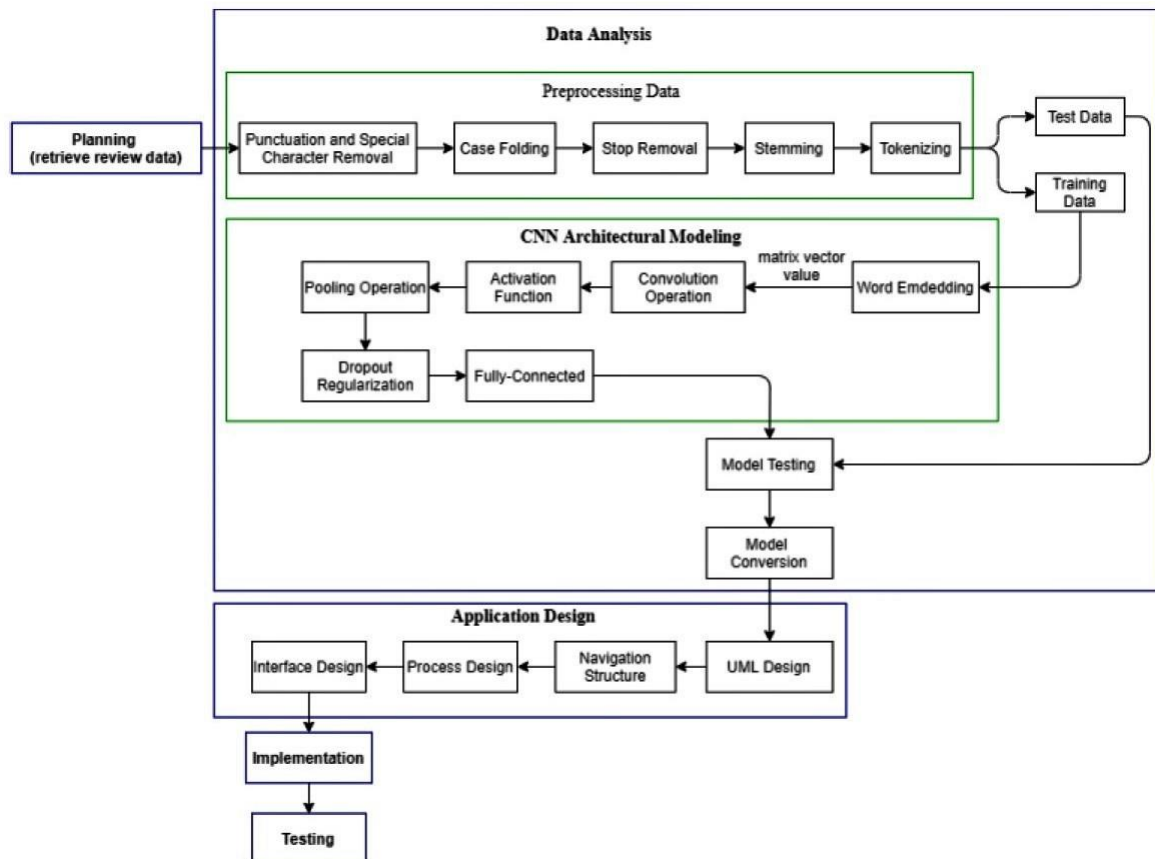

Fig 1. Research methods

2.1. Planning

This research was conducted to create a web-based application that can classify user review sentiments on the Zoom Cloud Meetings application. The web-based application will show the classification results sentiment of positive and negative user reviews. In this research, the review data used were 1000 data up to March 2021 which were written in Indonesian. The review data was obtained from the Google Play Store using a web scraper.

2.2. Data Analysis

At this stage of data analysis, review data that has been obtained from the Google Play Store is collected in Microsoft Excel. After that, manually assign negative and positive labels to the review data that has been collected. The negative label is symbolized by the number 0 (zero) given to negative reviews. Meanwhile, the positive label is symbolized by a number (one) given to positive reviews. This review data is divided into two types, training data and test data. The distribution of this data is 80% training data and 20% test data. Furthermore, the review data in Microsoft Excel is saved in Comma Separated Values (CSV) format. The data in this CSV formatted file will be used for the data preprocessing stage.

A. **Preprocessing**: The review data that has been collected is data that still has noise. At this stage the process carried out is eliminating noise in the data. This stage aims to make the sentiment recognition process more accurate. The process at this stage is carried out using Python's Natural Language Toolkit.

   a. Punctuation and Special Character Removal: The process at this stage is to remove punctuation marks and characters that are not needed.

   b. Case Folding: At this stage the process carried out is to make case uniformity on the review data. This case uniformity is changing words that have uppercase letters into lowercase letters (lowercase).

    c. Stopwords Removal: At this stage the process carried out is to remove words that are not needed by using the Sastrawi module from Python. This Sastrawi module provides various stopword words in Indonesian.

    d. Stemming: The process at this stage is to change a word into the basic form of the word. This process is done by removing the affixes attached to the word.

    e. Tokenizing: At this stage the process carried out is to separate the text into parts called tokens. This text separation is done using Python's tokenizer module.

B. CNN Architectural Modeling: Next, doing the CNN architectural modeling stage, the Convolutional Neural Network (CNN) has an architecture that can recognize predictive information on an object such as images, text, sound snippets, and others. This CNN has a similar way of working with Multi-Layer Perceptron (MLP). This research uses a simple architectural model by using not too many layers. The layers that are passed to carry out this sentiment are word embedding, convolution operations, Rectified Linear Unit (ReLu) activation functions, pooling operations, dropout regularization, and fully connected layers [1, 10].

    a. Word Embedding: In this word embedding process, GloVe is used with dimensions of 100. GloVe is an algorithm used to obtain a vector representation of data in the form of text. This word embedding process produces a matrix vector value that will be used in the convolution stage. In the convolution stage, the vector value of this matrix is the input used in the convolution operation.

    b. Convolution Operation: The way this convolution operation works is to shift the convolution kernel (filter) which has a certain size. The kernel shifts from the left corner to the bottom right. When a shift occurs, a "dot" operation is performed between the input and the value of the filter. In this research, the kernel used is 5x5 in size. This convolution operation produces an output known as an activation or feature map.

    c. ReLU Activation Function: The matrix that has been obtained in the form of an activation map from convolution will be normalized using the Rectified Linear Unit (ReLu) function. In this layer, the process carried out is to change all pixel values that have values less than zero to zero.

    d. Pooling Operation: This layer is a layer that consists of a filter with a certain size to reduce the dimensions of each feature map. This pooling operation can control overfitting, in this research the pooling operation used is max pooling. The output generated at this layer is then forwarded to the dropout regularization process.

    e. Dropout Regularization: Dropout regularization is a neural network regularization technique by selecting several neurons at random that will not be used in the training process. The dropout size used in this research is 20%.

    f. Fully Connected Layer: The last layer is fully-connected. This layer is a layer where all activity neurons from the previous layer are connected to neurons in the next layer. This layer has a purpose to process data so that data can be classified. In this layer the filter used is 5x5 in size. In addition, this research uses 200 batch parameters and 20 epochs. These parameters are defined using the dense method available in TensorFlow.

C. Model Testing: After the classification results are obtained, the model is tested to measure the accuracy of the classification results. Testing this model is done by using a confusion matrix. This confusion matrix aims to provide comparative information on the classification results. Measurement of accuracy is done to find out how well the model performs data classification. Testing this model is done by using the following formula.

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \tag{1}$$

$$Precision = \frac{TP}{TP+FP} \tag{2}$$

$$F1Score = 2 * \frac{Recall*Precision}{Recall+Precision} \tag{3}$$

Where TP means positive data detected are positive. FP means positive data detected is negative. FN means negative data detected is positive. TN means negative data detected is negative.

D. Model Conversion: The next stage is to convert the model. This model conversion is the step taken to change the model that has been made into a JavaScript Object Notation (JSON) form. Changing the shape of this model has resulted in the form of a model that has been made into a JavaScript Object Notation (JSON) form. Changing the shape of this model has resulted in the form of a .json file a .json file.

2.3. Application Design

This stage is the stage for designing the application. The application made is a web-based application. The design of the application system is made using Unified Modeling Language (UML) diagrams. The design with UML is described by using a use case diagram [14]. A use case diagram is a diagram that describes a series of activities carried out by a system with one or more users (actors). This use case diagram shows who is involved in the system. In addition, this diagram shows the activities of actors or users who get a response from the system. The following figure 2 is a use case diagram for a web-based sentiment classification application.

In designing this web-based application, the navigation structure is used to describe the flow of access relationships between web pages. The type of navigation structure used in designing this web-based application is a mixed type of structure. This mixed structure is a combination of navigational and non-linear navigation structures, figure 3.
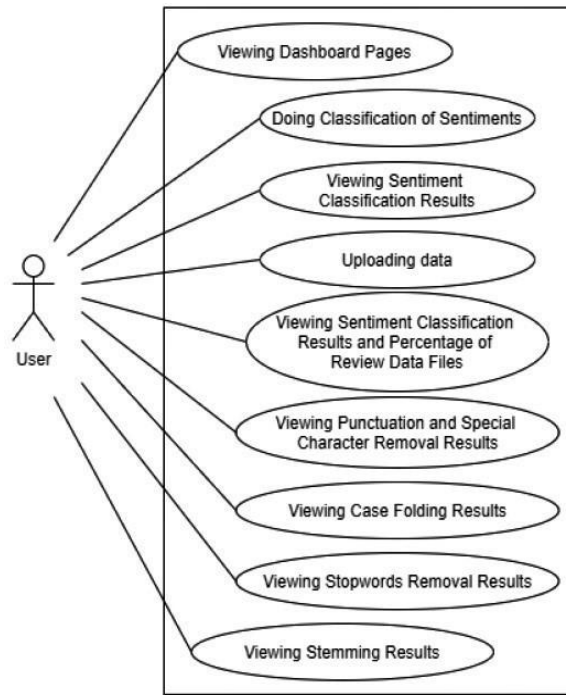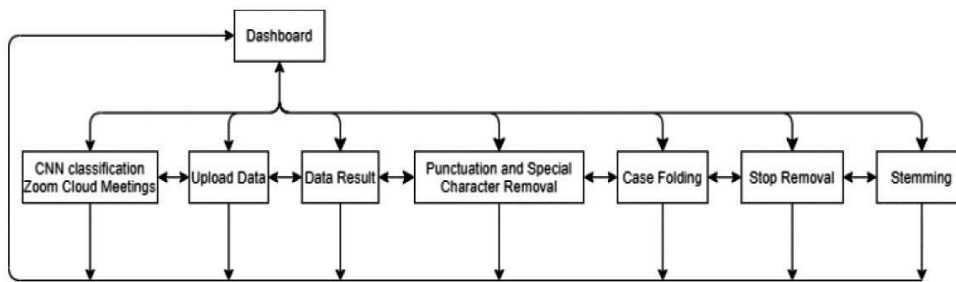
Fig 2. Use-Case Diagram

Fig 3. Navigation Structure

The process design is made using a flowchart, figure 4. This flowchart describes an arrangement of flows in a program. The flowchart made in this research describes the flow of sentiment classification of user reviews of the Zoom Cloud Meetings application using the Convolutional Neural Network (CNN) method. The next stage is designing the web interface. The design of this interface is based on the navigation structure that has been made previously. This interface design has eight pages that can be accessed by the user. The pages are dashboard, CNN classification Zoom Cloud Meetings, upload data, data result, punctuation and special character removal, case folding, stopwords removal, and stemming.
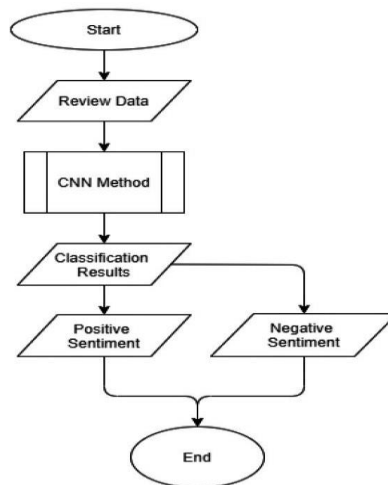

Fig 4. Flowchart

3. Results and Discussion

3.1. Implementation of the Convolutional Neural Network (CNN) Model

In this research, several stages were carried out to implement the Convolutional Neural Network (CNN) model, namely im- porting data, preprocessing, dividing the data into two, namely test and training data, and word embedding. After carrying out these stages, the model training is carried out. This model training process is a process for conducting training on the model used. The model used in this research is a Convolutional Neural Network (CNN) model. This training process is carried out using 200 batches and 20 epochs. In this process the filter used is a 5x5 filter. In addition, this process uses 4 convolution layers, 3 dropout layers, and 4 pooling layers. In the training process of this model, the SoftMax function is used so that the resulting output can represent a sentiment category or a class. The following is the accuracy and loss resulting from the model training process.

Table 1. Model Training Results

Epoch	Training Data	
	Loss	Accuracy
1	0.5677	0.2476
2	0.6797	0.2100
3	0.1677	0.7488
4	0.1291	0.8230
5	0.1064	0.8710
6	0.0842	0.8913
7	0.0751	0.9068
8	0.0754	0.9088
9	0.0525	0.9387
10	0.0359	0.9555
11	0.0392	0.9522
12	0.0306	0.9633
13	0.0322	0.9575
14	0.0235	0.9713
15	0.0268	0.9655
16	0.0254	0.9693
17	0.0269	0.9668
18	0.0286	0.9657
19	0.0243	0.0240
20	0.0244	0.9685

Based on the table above, the model training process at the 20th epoch resulted in an accuracy value of 0.9685 or 96.85%. These results were obtained by taking 12 minutes 23 seconds. In addition to the level of accuracy, the model training process produces a loss value of 0.0244 or 2.44%. The level of accuracy and loss generated by the training of this model is represented in following figure 5 and figure 6
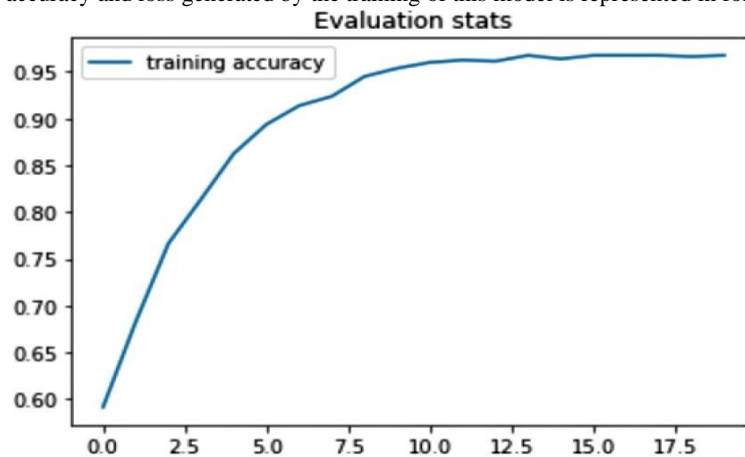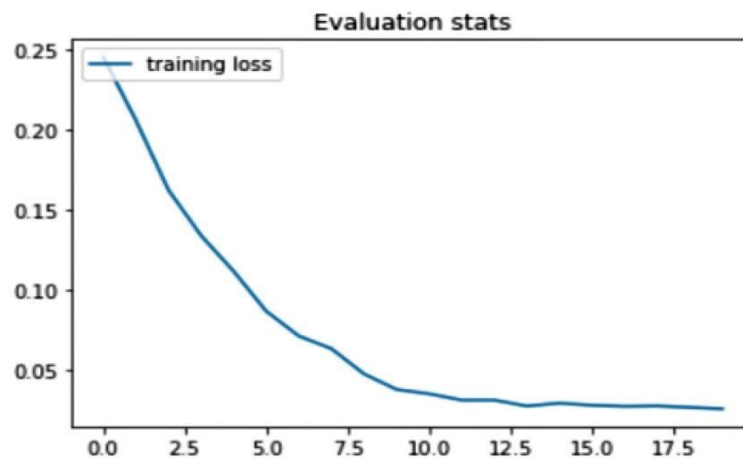

Fig 5. Accuracy Model

Fig 6. Loss Model

3.2. Creating Application

At this stage the application is built using the Flask framework [12, 13]. The first step to build this web application is to installFlask. This Flask is installed through the command prompt on the laptop. The following is the code used to install Flask. After that,create a file with the name web.py. The file is the main file for writing various program codes used to build web applications. Writtenprogram code such as importing modules, app packages with xxx-name-xxx-program code, writing routing to access every page onthe web, and various other program codes. The next step is to make the interface. Making this interface is done using Hypertext Markup Language (HTML).

A. **Dashboard page:** The dashboard page is the initial view of the website. This page shows an explanation of the Zoom Cloud Meetings application and sentiment analysis.
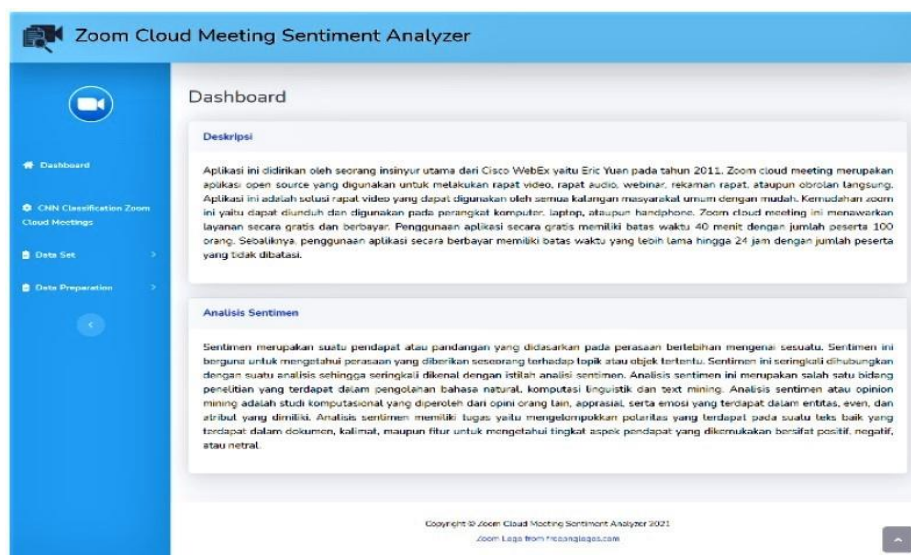

Fig 7. Dashboard Page

B. **CNN classification Zoom Cloud Meetings page:** The CNN classification Zoom Cloud Meetings page is a page that users can useto classify sentiments. This sentiment classification can be done by entering a review in the available text area column then clickingthe process button to process the classification.
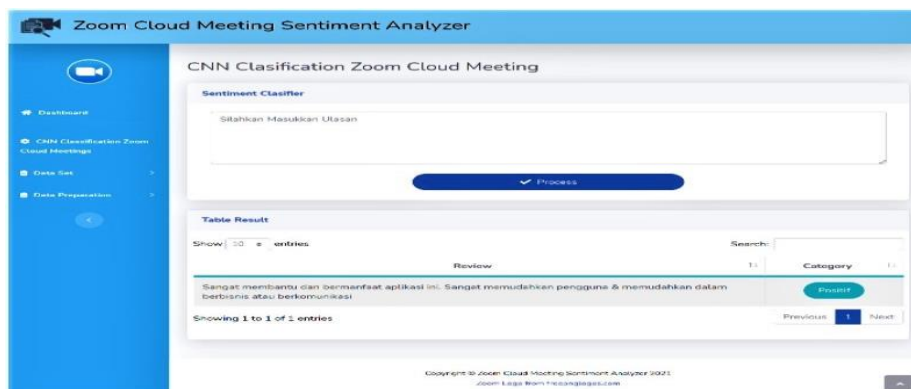

Fig 8. CNN Classification Zoom Cloud Meetings Page

C. **Upload data page:** The data upload page is a page that users can use to upload files for sentiment classification. File upload can be done by clicking select file, then selecting the file to be classified. Next, click the submit button to upload files to the system. Process button used to process uploaded files.
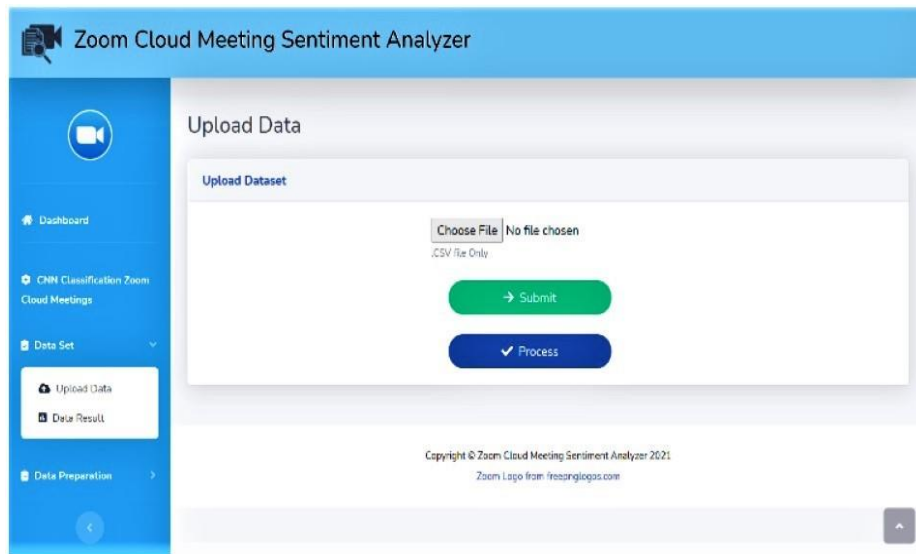

Fig 9. Upload Data Page

D. **Result data page**: The data result page is a page that users can use to view the results of classifying sentiments against previously uploaded datasets. The results of this classification are presented in tabular form with the results of the classification, namely positive and negative. In addition, the results of this classification are presented in the form of a pie chart.
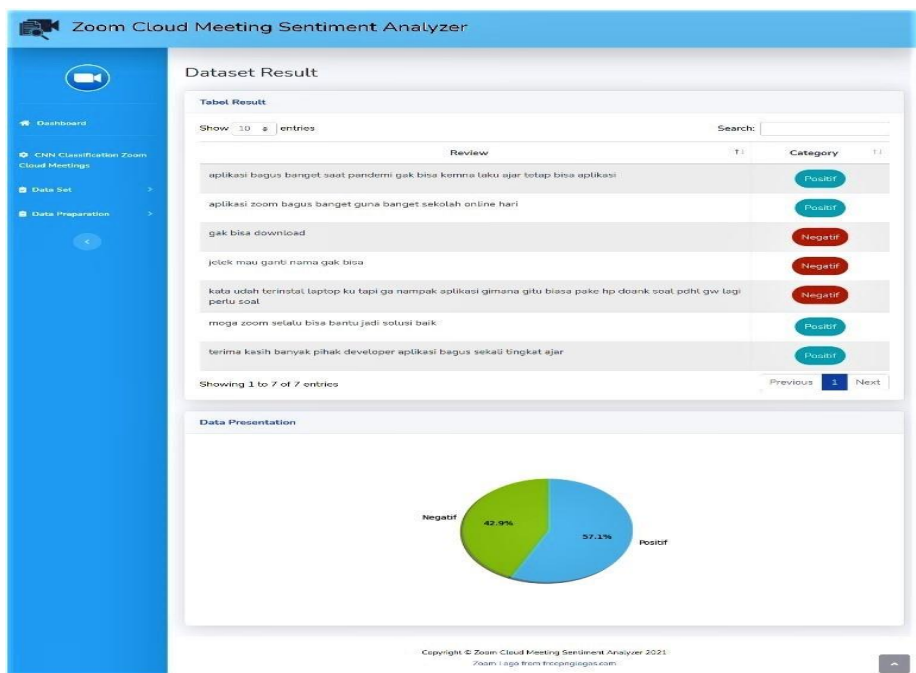

Fig 10. Result Data Page

E. **Punctuation and special character removal page**: This page is a page that users can use to view the results of punctuation and special character removal. The displayed results are datasets that have gone through the process of removing punctuation and special characters. Users can see the results of punctuation and special character removal in the table provided.

Fig 11. Punctuation And Special Character Removal Page

F. **Case folding page**: Punctuation and special character removal page: This page is a page that users can use to view the results of punctuation and special character removal. The displayed results are datasets that have gone through the process of removing punctuation and special characters. Users can see the results of punctuation and special character removal in the table provided.
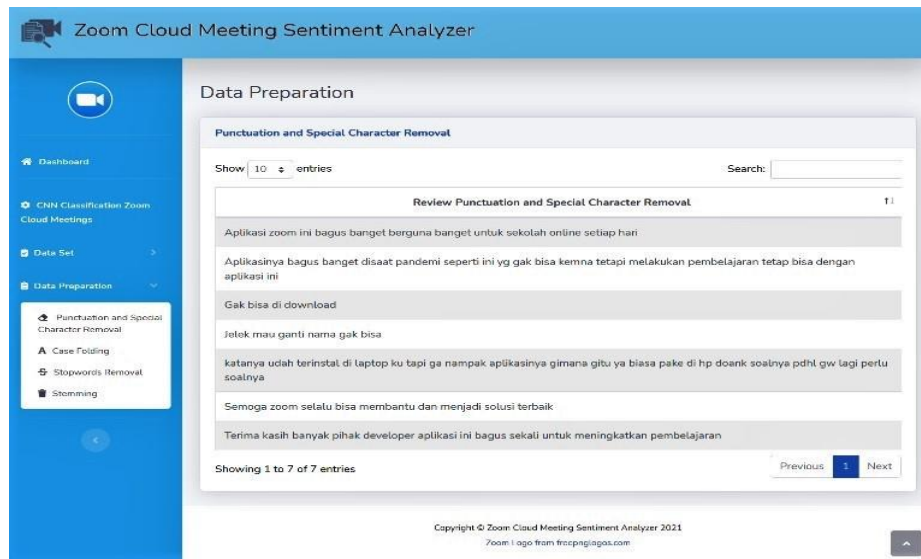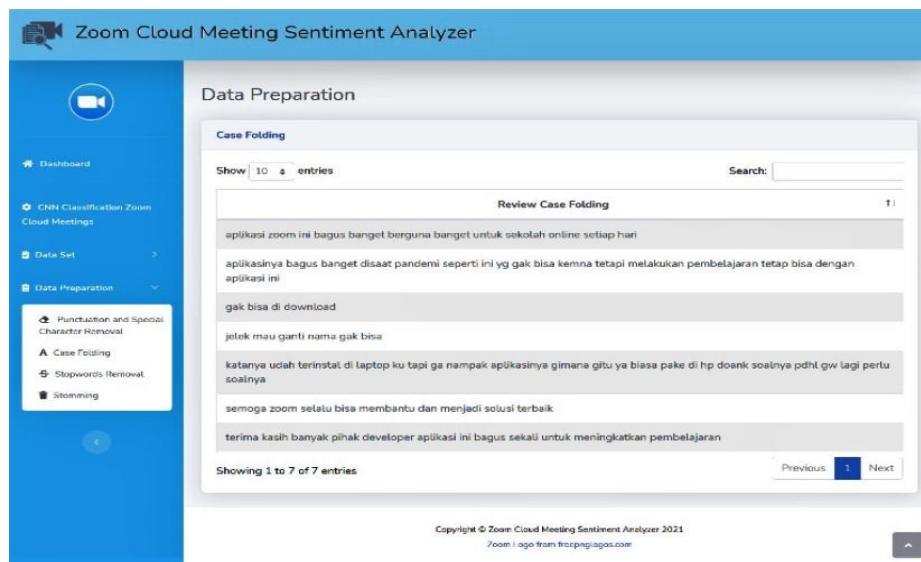

Fig 12. Case Folding Page

G. **Stopwords removal page**: This page is a page that users can use to view the stopwords removal results. The displayed results are datasets that have gone through the process of deleting words that are not included in the stopword. Users can see the results of stopwords removal in the table provided.
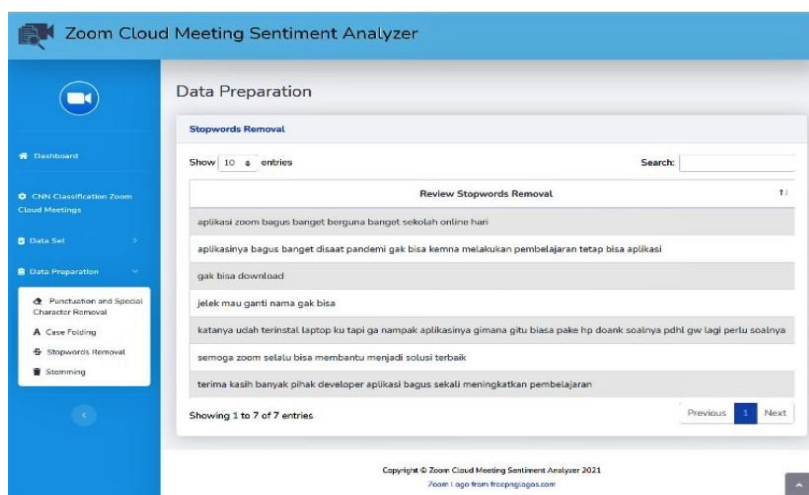

Fig13. Stopwords Removal Page

H. **Stemming page**: This page is a page that users can use to view stemming results. The results displayed are datasets that have gone through the process of converting words into the basic form of the word. Users can see the results of stemming in the table provided.
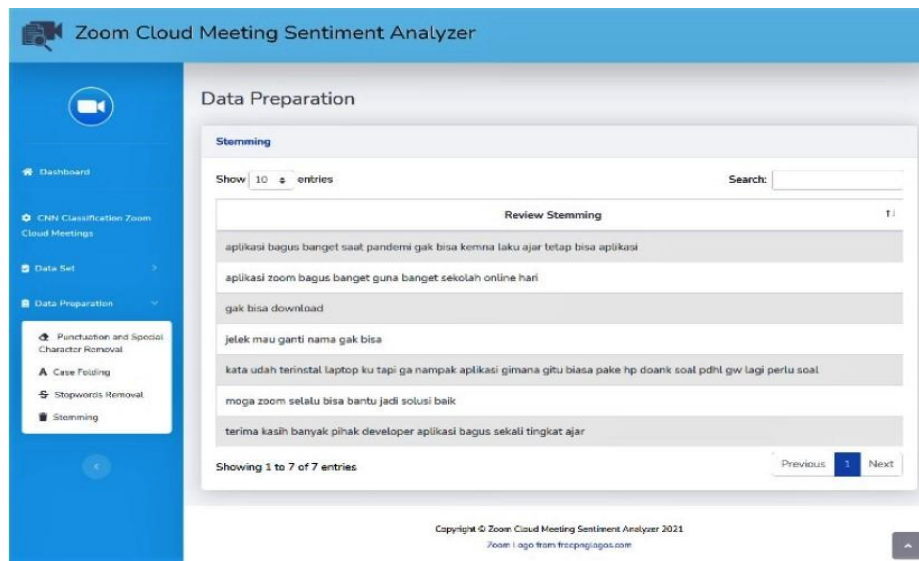

Fig 14. Stemming page

3.3. Embedding Model

Embedding the model on the website is by calling the model and network weights of the Convolutional Neural Network (CNN) method that has been built previously. The model used is the model that is stored with the JSON and h5 extensions. The model with h5 format is a model that stores the weights and configuration of the model that has been trained. Furthermore, so that the model can be used, it is necessary to compile the model. The compilation process is carried out using variables, namely, optimizer, loss, and metrics.

3.4. Testing

After the website is successful, the testing phase is then carried out. The testing carried out is testing the system and data. System testing is carried out using the black box method to observe the results of the execution carried out through test data. Based on the results of the system test, it was found that the system was running well as expected. Meanwhile, for data testing, it is carried out to measure the level of accuracy by using a confusion matrix. The dataset used is 200 review data taken from 1000 user review data for the Zoom Cloud Meetings application. The classification results obtained by the system will be compared with the results of the classification performed manually.

Table 2. Data Testing

No.	Review	Data Testing Results		
		Manual Classification	System Classification	Results
1	Min kenapa saya setiap mau ikut zoom tidak bisa mulu padahal saya sudah sign in A ke akun goggle, Facebook tapi tetap tidak bisa dan selalu keluar tulisan "You are not eligi- ble to sign in to Zoom at this time" Tolong di per- baiki lagi min	Negatif	Negatif	Benar
2	Sangat bermanfaat dan Tambah ilmu	Positif	Positif	Benar
3	Aplikasi yg sangat berguna. pokonya mantap jiwa	Positif	Positif	Benar
. . .				
198	Saya tidak bisa login aneh nih aplikasi udah coba pake akun fb,goggle tetep aja gk bisa	Negatif	Negatif	Benar
199	sangat bagus ... mudah digunakan teri-makasih	Positif	Positif	Benar
200	Gak bagus massa pas lagi ngezoom keluar mulu	Negatif	Negatif	Benar

Based on the data testing, the results were that the system classified correctly on 183 test data and incorrect classification on 17 test data. System errors in classifying can be caused because the model does not recognize the words contained in the test words. Unrecognized words such as slang, abbreviations, and incorrect writing. Furthermore, the level of accuracy based on the experiments carried out was obtained using a confusion matrix table.

Table 3. Confusion Matrix

Number of review data: 200	Positive Classification by System	Negative Classification by System
Manual Positive Classification	True Positive: 116	False Negative: 9
Manual Negative Classification	False Positive: 8	True Negative: 67

After creating a confusion matrix table, the next step is to calculate accuracy using the following equation.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

$$= \frac{116+67}{116+67+8+9} = 0.915$$

Based on the calculations that have been done, the results obtained have the accuracy value of 0.915 or 91.5%. In classifying sentiment on test data, the system can classify as many as 116 positive reviews and 67 negative reviews.

4. Conclusion

A website for classifying user reviews of the Zoom Cloud Meetings application has been successfully created. This website was success- fully created by applying the Convolutional Neural Network (CNN) method. This website was created using the Flask framework and the Python programming language and TensorFlow as a module for model training. The classification of sentiment on the website is divided into two categories, namely positive and negative. This website has a menu to classify the sentiments of the entered review sentences. In addition, there is a menu for uploading data and viewing the results of sentiment classification and data preparation.

After the website is successfully created, two stages of testing are carried out by the author. This test is conducted to test the system and data. System testing is done using the black box method. Based on the results of the system testing, it was found that the website could run well and was able to respond as expected. For data testing, it is done by comparing the classification results obtained from the system and manually. The results of these comparisons are used to calculate accuracy. Based on the calculations on the test data, the results of the accuracy value achieved using the CNN method are 91.5% for the test data. Meanwhile, the accuracy value achieved in the model training process using the CNN method is 96.85

The author realizes that there are still many shortcomings in this research. Based on this, the author hopes for future developments. Devel- opments that can be made are such as increasing the amount of training data used to increase the accuracy value. In addition, improving the Sastrawi Dictionary which still has many shortcomings that affect the stopword removal and stemming process as well as adding other functions on the website.

Acknowledgement

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