Indonesian Digital Wallet Sentiment Analysis Using CNN And LSTM Method

Ananda Affan Fattahila[1], **Fendi Irfan Amorokhman**[2],
Kaenova Mahendra Auditama[3], [4]**Kurniadi Ahmad Wijaya**
Telkom University
Informatics Engineering, School of Computing
Bandung, West Java, Indonesia
[1]affanfattahila@student.tekomuniversity.ac.id
[2]fendiirfan@student.tekomuniversity.ac.id
[3]kaenova@student.tekomuniversity.ac.id
[4]kurniadiwijaya@student.tekomuniversity.ac.id

***Abstract*— An approach combination of deep learning and natural language processing is applied to analyze the sentiment of the text for a particular sentence. The digital era makes many things adapt because it is fast and easy for information to be obtained and disseminated. Many financial transactions have been carried out with technology which is often called a digital wallet. Digital wallet technology is also supported by the culture of people who are starting to like cashless payments, so that many companies provide these services, such as DANA, OVO, Link Aja, and Sakuku. Consumer reviews judge the quality of a digital wallet company, and other people want to understand from one person's review. These consumer opinions are organized in a structured way to understand consumer reviews and reactions. We get consumer review data through reviews on the Google Play Store. Then create a data set that we have crawled and perform data processing by using the combined CNN LSTM architecture used in our dataset and get training accuracy of 87% and validation accuracy of 83%.**

Keywords— Digital Wallet, OVO, DANA, LinkAja, Sakuku, Reviews, Consumer, CNN, LSTM

I. Introduction

A. Background

The Digital Era is a time when information is quick to scale, easy to obtain, and disseminate using digital technology or a technology that uses a computerized system connected to the internet [1]. The COVID-19 pandemic has impacted many sectors such as industry, economy, government, education, etc. This also makes system changes that cause some activities to use quota restrictions until they are done online. The impact of the COVID-19 pandemic also demands that many things can be done digitally or electronically. As a result, technology has become very popular because it can help human needs and facilitate human work [2].

The increasingly developing technology provides many conveniences in the economic sector, transportation, information, education, to the comfort of digital transactions, as we can see in the current development of digital wallets that can be done quickly with smartphones. The increasing use of e-commerce today affects consumer habits in making payments [3].

The development of digital wallets as digital wallets used by people to facilitate online and offline transactions are increasingly popular. In 2018, Bank Indonesia recorded that the number of transactions made using digital wallets in Indonesia reached Rp 23.3 trillion. This value is expected to grow with the popularity of cashless payment methods to Rp 355.7 trillion in 2023 [4]. In February 2019, Go-Pay still ranked first, followed by OVO, DANA, LinkAja, and Sakuku [4]. Digital wallet technology is indeed easy to use because. Thanks to this technology, humans do not need to be in direct contact to make payments. However, behind the ease of using digital wallet technology, it can be seen from several cases, such as in the Go-Pay application, sometimes there are still problems such as the balance not increasing after transfer from a bank [5]. In fact, there are still several other cases that occur, of course can be harmful to the company if not resolved.

In today's highly competitive market, the step towards success for any company, including digital wallet-based companies is normal. Several digital wallet companies have widespread reviews, starting from Twitter, Facebook, google play store, and many others. One way to do sentiment analysis is to collect existing reviews, where the data can be a form of feedback from real users. By analyzing the sentiments in consumer reviews, it can be classified whether the consumer's perception of the product is positive or negative.

Thus, the sentiment analysis approach is considered one of the best ways to track or know consumers' feelings. This research is expected to give an advantage to a company over its competitors in the market. The information obtained from the analysis can assist companies in answering their questions, such as how someone reacts or feels after using an existing feature.

This will allow digital wallet companies to gain new insights regarding the needs of consumers or users. Currently on several papers in almost the same fields as product reviews, film reviews, economics and politics. Sentiment analysis is also used to explore public emotional information that is expressed related to the problem.

Digital wallets still have a lot of criticism from the public because this technology is still new, so improvements need to be made. This is also supported by ratings on several digital wallet applications such as Go-Pay, OVO, LinkAja, Sakuku, which still vary, and not all of them receive a 5-star rating. Several processes will be carried out to solve this problem, such as collecting digital wallet consumer data that will be processed first to be appropriately predicted using the CNN-LSTM deep learning method. Prediction results from the deep learning method are used as sentiment analysis material that we can analyze to provide new insights into digital wallet companies.

B. Research Problem

The formulation of the problem is described as follows:

1. What is the method used in sentiment digital wallet applications?
2. How is the accuracy of the model in the sentiment of the digital wallet application?
3. How is the public review of the digital wallet application?

C. Objectives and benefits

This research has several objectives and benefits as follows:

1. Describe the methods used in sentiment digital wallet applications.
2. Describe the accuracy of the method in the sentiment of a digital wallet application.
3. Describe public reviews of digital wallet applications.

II. LITERATURE REVIEW

The emergence of new technology that everyone can use makes consumers communicate more often with service providers or products to make high use of services that can be used online in daily activities [10]. Purchasing online by using a service, the quality of the service itself is something that consumers will consider. Consumers expect that the service of an application product can provide good quality and satisfaction.

This is also related to digital wallet products between consumers and digital wallet companies to communicate transactions. When a transaction occurs at a digital wallet company, evaluating the consumer experience in using the service will feel satisfied and build a sense of trust, commitment, and loyalty of consumers using a digital wallet application [11].

In some cases, the decisions we make are influenced by the opinions or opinions of others [9]. Before internet awareness was widespread and easy to access, many people asked other people about a product before buying it. But now, with the development of the digital era, information resources are very high where public opinion can be found easily, such as on Twitter, Facebook, google play store reviews, review sites, and many others. From this, it can be easy to collect data that will be used to understand other people's opinions.

Sentiment Classification is a public work with the rapid development of information technology to deal with public sentiment. Public sentiment is essential data in the research domain to analyze the emotional point of view and the author's opinion on various issues [6]. From this, it can be seen where public sentiment is precious for correcting an error or deficiency contained in digital wallet products for the convenience of consumers.

Machine learning and deep learning approaches are used to classify public emotions. In a deep learning study, it is much better than machine learning algorithms to conduct public sentiment. Indicated by the accuracy of machine learning testing and training 81% to 90%, while deep learning got 85% to 97% [7].

Sentiment analysis is a fundamental technique for exploring public emotions and is a multidisciplinary research area in developing social media interactions and dealing with big data [8]. Sentiment analysis from comments on google play store is used to extract user opinions on various views such as application system, design, performance, and other issues. This paper uses the CNN-LSTM approach. Convolutional Neural Network (CNN) is one type of neural network that is very good when faced with spatial data.

The Convolutional layer is only used for current connections from the previous layer, local neurons are connected to neurons in the next layer. This method helps increase knowledge at the layer to understand more generally the incoming input. In LSTM, there are several steps: define network, compile network, fit network, evaluate network, and make a prediction. Using LSTM can determine a value that will be used as output relevant to the given input.

Long Short Term Memory (LSTM) is a neural network development that can be used for time-series data modeling [12]. LSTM can also be interpreted as a neural network with an adaptable architecture, so that its shape can be adjusted, depending on the application that is made. In LSTM, there are several steps: define network, compile network, fit network, evaluate network, and make a prediction. Using LSTM can determine a value that will be used as output relevant to the given input.

III. METHOD

Tensorflow was used to train and evaluate our model. Before training, we need some pre-processing for our data set. Then we will introduce our proposed model. Figure-1 shows the workflow, and others are described below.

A. Dataset

Dataset collection is done by merging from the first data used is data that has been developed by IndoLEM[1][13]. The second data is data developed by indo SMSA[2][14]. The review data collection is taken from the Play Store at the data crawling stage. The reviews of digital wallet sentiment data that will be taken are reviews of digital wallet applications from large companies such as OVO, Dana, LinkAja, and Sakuku digital wallet applications.

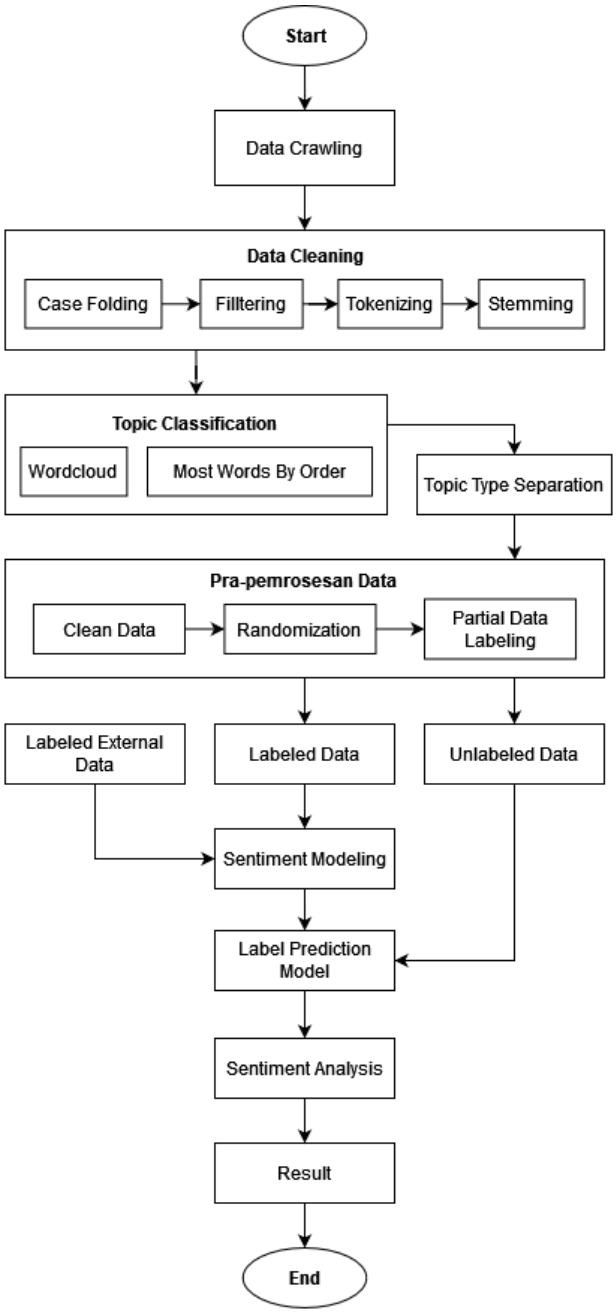


Figure 1: Workflow

We use the *google-play-scraper* library to retrieve reviews on the top digital wallet applications on the play store with parameters only reviews in Indonesian. Some of our review data is labeled, after that, the data we get we combine with a balanced composition between negative and positive labels. The implementation examples are as follows:

Digital Wallet	Crawling Review Sample
Link Aja	Aplikasi yang sangat simple, memudahkan kita untuk melakukan transaksi. Aplikasi ini sangat memudahkan kita untuk pembayaran pinjaman online, token listrik, bayar gojek, bayar grab food & bayar di Bukalapak. Benar-benar aplikasi yg sangat lengkap & ga bikin ribet buat bayar ini itu.
Dana	Kenapa si dana skrng menurun amat system nya, saya biasa bayar tagihan wifi, pulsa listrik, beli paket data pakai dana suka ilang fitur² pembayaran nya aneh skrng
OVO	Semenjak di update salah kode security terus, padahal uda benar kode security-nya, Error ini Aplikasi OVO nya min. Jdi ngk nyaman dalam bertransaksi lewat OVO ini.
Sakuku	sakuku sangat membantu, hanya saja limit lnya terlalu kecil. harapan saya ada tambahan lagi fitur fitur menarik untuk pengalaman yang lebih maksimal

Table 1: Crawling Data Samples

B. Data Preprocessing

Data preparation, or it can also be called data preprocessing is a process or step taken to make raw data into quality data for further processing in data mining. The preprocessing process carried out in this sentiment analysis is as follows:

- Case folding is a form of text preprocessing that converts all letters in a document into lowercase letters. Only letters 'a' to 'z' are accepted. Characters other than letters are omitted and are considered delimiters. The case folding is done using the python function, lower().
- Tokenizing is a method for separating words in a sentence for further text analysis. Before tokenizing, they usually carry out a case-folding process, including removing unnecessary numbers, punctuation marks, and whitespace.

[1]https://github.com/indolem/indolem/tree/main/sentiment/data

[2]https://github.com/indobenchmark/indonlu/tree/master/dataset/smsa_doc-sentiment-prosa

As for the tokenizing process, this sentiment analysis uses several rules, including:

- Deleting Links With http/https pattern
- Removing HTML Characters
- Remove Punctuation (.,;:'"()?!%)
- Deleting Characters Other the Letters a-z and A-Z
- Replacing Newlines With Spaces
- Removing Repeating Characters
- Deleting 1 Separate Character
- Removing Multiple Spaces

- Filtering is the stage of taking important words from the token results by using a stoplist algorithm (discarding less important words) or wordlist (saving important words). Stopwords are common words that usually appear in large numbers and are considered meaningless. Examples of stopwords in Indonesian are "yang", "dan", "di", "dari", etc. For filtering in the sentiment analysis of this project, several types of filtering are used, namely:

  - Deleting words in the Alay dictionary in the Alay Dictionary dataset and indonesian lexicon
  - Deleting Indonesian stopwords using the stopwords indonesia dataset

- Stemming is the process of removing the inflection of a word to its basic form (there is no affix to the word). For example, the words "mendengarkan", "dengarkan", "didengarkan" will be transformed into the word "hear". In this sentiment analysis, we use the Python Sastrawi library to carry out the stemming process for each word.

C. Topic Classification

Topic Classification is a determination technique to determine a topic from a text. To classify data that has been preprocessed, a method is used, namely Word Cloud. Word Cloud is commonly called a tag cloud which is usually used to highlight popular words and phrases. Each digital wallet application has its own Word Cloud as follows.



Figure 2: Dana Word Cloud



Figure 3: OVO Word Cloud



Figure 4: LinkAja Word Cloud



Figure 5: Sakuku Word Cloud

In determining the selection of classification topics, we use words with the highest number of occurrences from the data crawled results and word results from the word cloud. Based on this, several classification topics and sub-topics are obtained and described in the following table.

Topic	Sub Topic
Accessibility	*Login, Register, OTP, Kode, Pin*
Transaction	*Transfer, Pembelian, Pembayaran, Saldo, Topup, Top, Up, Beli, Listrik, Transaksi, Biaya, Potongan, Uang, Beli*
Account	*Upgrade, Verifikasi, KTP, Premium, Akun*
Service	*Email, WA, Whatsapp, Telpon, CS, Telfon, Respon, pelayanan*
Performance	*Lambat, Lag, Cepat, Performa*

Table 2: Classification Topic

Some examples of classifying topics and sub-topics from several reviews on the dataset are described as follows.

Reviews	Topic Classification
kemarin benar berhasil konfirmasi upgrade premiumnya berubah gagal konfirmasi kak kemarin senang topup terus cape kak komplain terakhir kali berhasil lebih baik pakai aplikasi terimakasih	Transaction: *Topup*, Account: *Upgrade*
aduh jadi min tiba login sandi salah benar loh coba bekukan jam maksudnya ya perbaiki akun mengirim uang ribu	Accessibility: *Login*, Transaction: *Uang*, Account: *Akun*
maaf ubah akun dana tiba tiba dibekukan suruh chat gak respon awal suka aplikasi akhir akhir mengeluh dana semoga dana mengembalikan uang	Service: *Respon,* Transaction: *Uang, Akun: Akun*
parah majin berat lag terus crash force close perbaiki cepat transaksi lag bikin sabar bikin salah input melulu jdnya hape kucoba update masalah handphone masalah jaringan aplikasi mu ngadat asam	Performance: *Lag*, Transaction: *Transaksi*

Table 3: Topic Classification Sample

Parameter	Value
Batch Size	60
Epoch	20
Conv Filter 1D	filters=32, kernel_size=2, padding='same', activation='relu'
Max Pooling 1D	pool_size=2
LSTM Size	128, dropout=0.2, recurrent_dropout=0.2
Layer Dense (1)	64
Layer Dense (2)	16
Dropout	0.5

Table 4: CNN-LSTM Model Parameters

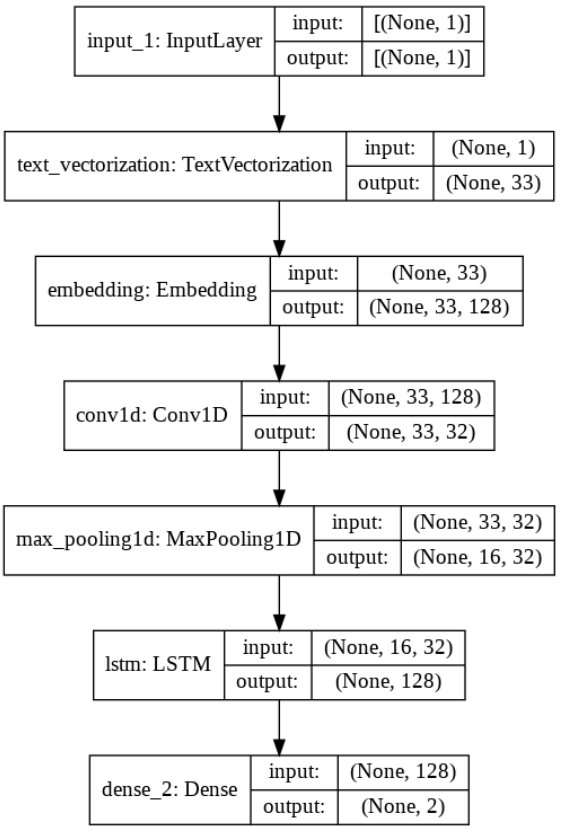


Figure 6: CNN-LSTM Model Architecture

D. Model Evaluation

In the training process, parameter rules are applied, as shown in Table 3. Using the dataset, parameters, and CNN-LSTM architecture created, code implementation can be carried out using the Google Colab Environment and the CPU. The training process is time-consuming, and the results are as follows.

Data	Accuration	Loss	Precision	Recall	F1
Traning	0.87	0.4	0.89	0.89	0.89
Validation	0.83	0.27	0.82	0.82	0.83
Testing	0.81	0.44	0.81	0.81	0.77

Table 5: CNN-LSTM Training Process Result

The results of the model obtained measurement results which can be seen in Table 4. The data that we use has gone through the preprocessing process from imbalanced to balance. We can see the primary matrix, namely the accuracy that gets training results 0.87, validation accuracy 0.83, and testing accuracy 0.81.

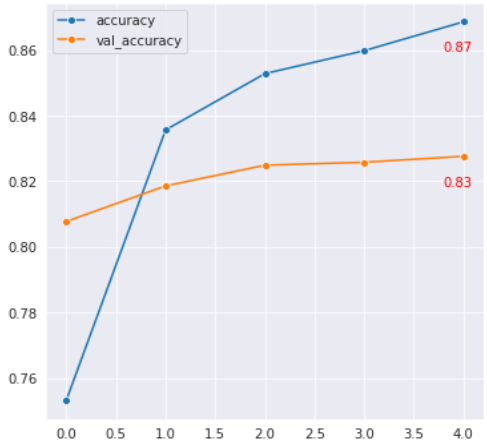


Figure 7: Accuracy and validation accuracy for each epoch

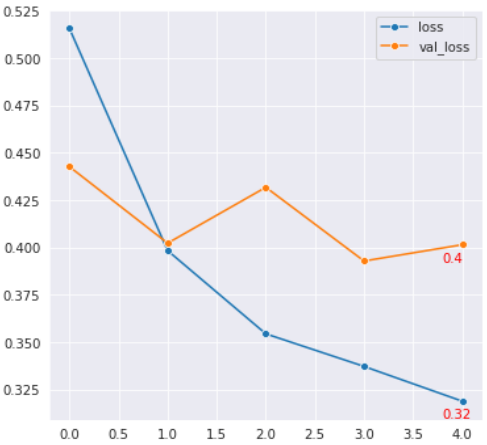


Figure 8: Loss and validation accuracy for each epoch

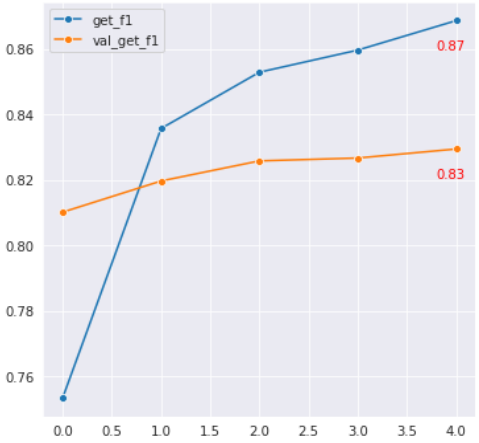


Figure 9: F1 and F1 validation score for each epoch

We set 20 epochs and use early stopping, which sees this condition where if the loss validation does not decrease to the 2nd epoch after the lowest loss validation, it will be dismissed for the next epoch and get an epoch of 6.

Loss validation is used as a benchmark because this matrix describes the model's error rate in predicting data outside the data that the model studied, which means the model is increasingly trained with higher epochs, the model is worse at predicting new data.

E. Website Product

We made a website to make it easier for digital wallet companies and consumers to access the results of this research. The features that can be used are as follows:

- Main page
- Data Crawl
- Data Preprocessing
- Topic Classification
- Sentiment Analysis Model
- Sentiment Analysis Results
- Sentiment Analysis Demo

The website can be accessed via the following link https://yaduhlah-sentiment.herokuapp.com/.

IV. Data and Analysis

The analysis is carried out by calculating the semantic pen of the digital wallet application. The data collected as analysis material comes from reviews on the google play store obtained using the google-play-scraper library. By using the CNN-LSTM prediction model, the following results are obtained :

Sentence	**Prediction Results**
bukanya mempermudah jadi mempersulit top up langsung masuk cepat transfer prosesnya gagal lambat	-1
bintang satu perbaiki masala transfer masa gagal perlu uang transfer masala gagal perlu transfer cepat	-1
terima ovo aplikasi membantu transaksi apapun jadi mudah praktis pelayanan tanggap cepat menangani keluhan mantul pokoknya	1
puas aplikasi dana mendapat keluhan mulai transferan beli pulsa bayar tagihan listrik cepat tepat pokoknya dana is the best semoga kedepannya berikan terbaik.	1

Table 5: Example of Model Prediction Results

V. Conclusion

Our research uses the combined CNN-LSTM architecture to predict the sentiment analysis of reviews or reviews of digital wallet applications consisting of DANA, OVO, Link Aja, and Sakuku. The designed CNN-LSTM model produces 81% accuracy. Based on the review dataset that has been collected, predictions will be made to provide an overview of the digital wallet company.

Based on the data visualization and analysis results of the four digital wallet applications, namely DANA, OVO, Link Aja, and Sakuku, the sentiments tend to be negative towards the categories we have created, including transactions and access, services, accounts, and performance. However, of the four digital wallet applications, most reviews are in the transaction category, which includes word cloud as follows: transfer, pembelian, pembayaran, saldo, topup, top, up, beli, listrik, transaksi, biaya, potongan, uang, beli. This needs to be an illustration for digital wallet companies to continue to grow to serve consumers well. This can be done by optimizing the primary transaction because it has the most reviews, followed by application accounts, access, service, and application performance for the trust and business progress of the related digital wallet company.

Although we didn't achieve one hundred percent accuracy through this model, we could still provide near satisfactory accuracy in digital wallet app reviews. In our approach, we find a new diversity of reviews of the Indonesian Baha'ah text. This model can also be reused for other Indonesian text perspectives. Since this is our first approach, there are too many opportunities to improvise to achieve the best accuracy

References

[1] Admin GLN (2019). Mendidik Anak di Era Digital | Gerakan Literasi Nasional. Kemdikbud.go.id. Available at: https://gln.kemdikbud.go.id/glnsite/mendidik-anak-di-era-digital/.

[2] A. Josi, L. A. Abdillah and Suryayusra (2014). Penerapan Teknik Web Scraping Pada Mesin Pencari Artikel Ilmiah. Jurnal Sistem Informasi, Volume 5,Nomor 2, September 2014, hlm 159-164.

[3] A. Safarudin, L. Kusdibyo and W. Senalasari (2020). Faktor-Faktor Pembentuk Loyalitas Generasi Z dalam Menggunakan Financial Technology E-Wallet, Prosiding The 11th Industrial Research Workshop and National Seminar Bandung, 26-27 Agustus 2020.

[4] Anggraeni, L. (2019). Go-Pay Jadi E-Walletl Paling Populer di Indonesia - Medcom.id. Available at: https://www.medcom.id/teknologi/news-teknologi/0Kv9o5pk-go-pay-jadi-dompet-digital-paling-populer-di-indonesia.

[5] CNN Indonesia (2019). Konsumen Gopay Keluhkan Saldo Tak Bertambah Usai Top Up. teknologi. Available at: https://www.cnnindonesia.com/teknologi/20191026152757-185-443111/konsumen-gopay-keluhkan-saldo-tak-bertambah-usai-top-up.

[6] T. T. Mengistie and D. Kumar, (2021). "Deep Learning Based Sentiment Analysis On COVID-19 Public Reviews," 2021 International Conference on Artificial Intelligence in Information and Communication (ICAIIC), 2021, pp. 444-449, doi: 10.1109/ICAIIC51459.2021.9415191.

[7] M. Khan and A. Malviya, (2020). “Big data approach for sentiment analysis of twitter data using hadoop framework and deep learning,” in 2020 International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE). IEEE, 2020, pp. 1-5.

[8] I. Kandasamy, W. Vasantha, J. M. Obbineni, and F. Smarandache (2020), “Sentiment analysis of tweets using refined neutrosophic sets,” Computers in Industry, vol. 115, p. 103180, 2020.

[9] D. A. Muthia (2017), ‘Analisis Sentimen pada Review Restoran dengan Teks Bahasa Indonesia Menggunakan Algoritma Naive Bayes’ VOL. 2. NO. 2 FEBRUARI 2017, E-ISSN: 2527-4864.

[10] K. B. Yap, D. H. Wong, C. Loh, and R. Bak, (2010) "Offline and Online Banking-Where to Draw The Line When Building Trust in E-Banking," The International Journal of Bank, pp. 27-46, 2010

[11] R. P. J. Kingshotta, P. Sharmaa, and H. F. L. Chungb, (2018), "The Impact of Relational Versus Technological Resources on E-Loyalty: A Comparative Study Between Local, National, and Foreign Banks," Industrial Marketing Management, 2018.

[12]] D. I. Komputer, F. Matematika, D. A. N. Ilmu, and P. Alam, (2018) “Prediksi temporal untuk kemunculan titik panas di kabupaten rokan hilir riau menggunakan long short term memory rnn hafshah luthfiah,” 2018.

[13] Fajri Koto, Afshin, Rahimi, Jey Han Lau, and Timothy Baldwin, (2020). IndoLEM and IndoBERT: A Benchmark Dataset and Pre-trained Language Model for Indonesian NLP. In Proceedings of the 28th COLING, December 2020.

[14] Purwarianti, A. and I. A. P. A. Crisdayanti, (2020), ‘Improving Bi-LSTM Performance for Indonesian Sentiment Analysis Using Paragraph Vector’, Proceedings of the 2019 International Conference of Advanced Informatics: Concepts, Theory and Applications (ICAICTA), pages 1-5, IEEE 2019.