POLITEKNIK NEGERI BALI

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JURNAL MANAJEMEN TEKNOLOGI DAN INFORMATIKA

Vol. 12. No. 3 | Page 109-154 | November 2022 | ISSN 2580-5630

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PREFACE

We would like to present, with great pleasure, the third issue of Matrix: Jurnal Manajemen Teknologi dan Informatika in Volume 12, 2022. This journal is under the management of Scientific Publication, Research and Community Service Center, Politeknik Negeri Bali and is devoted to cover the field of technology and informatics management including managing the rapid changes in information technology, emerging advances in electrical and electronics and new applications, implications of digital convergence and growth of electronics technology, and project management in electrical, mechanical or civil engineering. The scientific articles published in this edition were written by researchers from STMIK Palangkaraya, Universitas Bumigora, Universitas Udayana, Universitas Komputer Indonesia, Universitas Amikom Yogyakarta, Universitas Singaperbangsa Karawang, Politeknik Negeri Samarinda, and Politeknik Negeri Bali. Articles in this issue cover topics in the field of Information Management and Electrical Engineering including topic modeling and sentiment analysis about Mandalika on social media using the latent Dirichlet allocation method, review methods for clock skew measurement, SITAMPAN: mobile application for planting and harvesting of horticultural crops in Garut Regency, improvement of the automatic gamma correction method in cloud image detection, and optimization of off-grid solar generating system with DC-DC converter. Finally, we would like to thank reviewers for their efforts and hard work in conducting series of review phase thoroughly based on their expertise. It is our hope that the work of the authors in this issue will be a valuable resource for other researchers and will stimulate further research into the vibrant area of technology and information management in specific, and engineering in general.

Politeknik Negeri Bali, 30 November 2022

Editor-in-chief

Gusti Nyoman Ayu Sukerti, S.S., M.Hum.

ISSN: 2580-5630

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DOI: http://dx.doi.org/10.31940/matrix.v12i3.109-116
URL: http://ojs2.pnb.ac.id/index.php/matrix

Topic modeling and sentiment analysis about Mandalika on social media using the latent Dirichlet allocation method

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Abstract: The rapid and widespread dissemination of information currently affects the tourism sector. One tourist area that is quite widely discussed is the Mandalika Circuit. Twitter is one platform that provides comments related to the Mandalika Circuit. The amount of information related to the Mandalika Circuit is currently not being utilized properly by managers (government or private). It causes many topics related to the Mandalika Circuit that are currently trending, and public sentiment regarding the Mandalika Circuit is unknown to the government or private sector. Ignorance can result in delays in decision making which can harm the manager. To overcome this problem, research on sentiment analysis and topic modeling related to the Mandalika Circuit was carried out. The sentiment analysis method used is SVM and for modeling using LDA. Based on the results of the sentiment analysis, 1500 tweets were obtained before doing the pre-processing process, thus getting a dataset of 500 tweets divided into 398 positive and 102 negative tweets. So it can be concluded that more Twitter users give positive than negative responses to the Mandalika Circuit. The test results show that the SVM algorithm can classify sentiment toward the Mandalika Circuit well, as indicated by the measurement of the performance of the SVM algorithm, namely 87% accuracy, 77% precision, 84.81% recall, and 98.52% specificity. These results also show that the F1 Score compares the average precision and recall, which is weighted at 80.72%.

Keywords: LDA, Mandalika Circuit, sentiment analysis, SVM, topic modeling

History Article: Submitted 23 October 2022 | Revised 26 October 2022 | Accepted 17 November 2022

How to Cite: V. H. Hardita, R. Hammad, and A. Z. Amrullah, "Topic modeling and sentiment analysis," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 12, no. 3, pp. 109-116, 2022.

Introduction

Tourism is one of the leading sectors in the development of the island of Lombok, especially the development of tourist areas, culture, facilities, and infrastructure. Mandalika as a super-priority tourism destination is one of the main focuses of national tourism [1]. The number of tourist destinations owned by the island of Lombok, from beach tourism to mountains, and now the construction of the MotoGP Circuit in Kuta Mandalika provides a positive trend for NTB tourism. The public showed enthusiasm by providing information and comments on social media about MotoGP [2].

In the era of rapid technological development as it is today, it provides easier access for the public to provide information [3]. It certainly affects various sectors, one of which is the tourism sector. Visitors to tourist attractions can provide comments in the form of praise, criticism, or suggestions for the attractions visited. One of the social media that is widely used to provide comments is Twitter [4]. Twitter is a social media platform that allows users to send and read 140 characters, commonly called tweets [5]. With the existence of Twitter, it is wide open for information and comments from visitors and sentiment [6] on the Mandalika Circuit.

The amount of social information on Twitter related to the Mandalika Circuit has not been utilized properly by the government or private parties who manage the Mandalika Circuit area. It causes many topics related to the Mandalika Circuit, which are currently trending unknown to the government and the private sector. Ignorance can result in decision-making delays, harming the management (government and private). From the MotoGP event to date, more than 1500 tweets related to the Mandalika Circuit have been collected. The tweets contained positive

and negative comments about the experiences and observations of visitors and the public about the Mandalika Circuit. However, the number of tweets with various topics discussed makes it difficult to identify community sentiments related to the Mandalika Circuit.

To overcome these problems, research on sentiment analysis and topic modeling related to the Mandalika Circuit was carried out. Sentiment analysis is a study used to help identify comments related to something [7]. One method used in sentiment analysis is the Support Vector Machine (SVM) [8]. SVM is a learning model which it has defined inputs and outputs. SVM proved to be the best algorithm for text categorization [9].

Topic modeling is one approach to text mining used to find data in text and find the relationship between one text and another from a corpus [10] [11]. One method that can be used in optical modeling is Latent Dirichlet Allocation (LDA) [12]. LDA is a method that can be used to group topics based on the probability of words in a topic [13].

This study proposes using the Support Vector Machine (SVM) method for sentiment analysis and the Latent Dirichlet Allocation (LDA) method for topic modeling or extraction. The result of this research is a prototype or initial model from the results of data exploration in the form of sentiment analysis and Topic Modeling. The results of this study are expected to be used as supporting data for the government and the private sector in determining policies and making decisions related to the development of the tourism sector that is relevant to the needs of tourists, such as policies for promotion, improvement of facilities, and so on.

Several previous studies support this research, such as the research conducted by Chotijah with the title "Media Relations of the Mandalika Superpriority Destination in Reporting on the Readiness of the 2021 MotoGP Event Implementation", utilizing various media through exposure and approaching through framing and agendas on the distribution of information. In addition, the organizers communicated positive messages to the public in a strategic and planned manner to create optimism for the Mandalika MotoGP event [1].

Research conducted by Siswanto, Wibawa, Gata, and Kusumawardhani in a paper published at the 2018 ICAITI conference discusses the analysis of the classification of comments related to MotoGP on Twitter using the Support Vector Machine and Naïve Bayes algorithms. The results show that the accuracy of the SVM algorithm is 95.50%, and Naïve Bayes has an accuracy of 93% [2].

Research conducted by Annisa, Surjandari, and Zulkarnain in 2019 showed opinions on Mandalika Hotel reviews using Latent Dirichlet Allocation. In their paper, they extracted eight topics from tourism keywords and reviews, where the review or public opinion relates to complaints, experiences, opinions, and hotel management responses are written on Traveloka [14]. And there are many other studies, such as research conducted by Merawati and Amrullah [15], Dwi and Adri [16], Zuriel et al. [17], and others.

Methodology

The method used in this research is SVM for sentiment analysis and LDA for topic modeling. The stages in this research can be seen in Figure 1.

Figure 1. Research flow

Figure 1 shows the stages in this research, which consist of collecting data, pre-processing data, sentiment analysis, topic modeling, and analysis and evaluation.

1. Data Collecting
   The data used in this study comes from social media Twitter, so it is necessary to carry out a data crawling process. Therefore, the data taken only contains content related to the Mandalika Circuit.
2. Pre-processing Data

Because the data comes from social media, most of the data does not have a definite structure, so the information cannot be extracted directly, so pre-processing is needed. Pre-processing aims to change the form of unstructured data into structured data. The stages of pre-processing Twitter data are [18]:

a. Case Folding aims to convert all letters in the document to lowercase.
b. Tokenization is the stage of cutting the input string based on each word that composes it. This process removes numbers, punctuation, characters, HTML tags, links, scripts, etc.
c. Filtering the stage of taking important words from the tokenization results.
d. Phrase detection aims to detect the presence of 2 or more words that are the same.
e. Stemming aims to change suffixes into base words.

3. Sentiment Analysis
The next process is sentiment analysis. The pre-processed document will be labeled positive, negative, and neutral, depending on the opinion expressed in the document. The classification method used in this study is SVM.
4. Topic Modeling
Classified data with two categories, namely positive and negative sentiment, will be modeled into topic modeling using the LDA method to conclude the topics hidden in the document. Stages in LDA [19] :
   a. The first step is to initialize parameters such as the number of documents, the number of words in a document, the number of topics, the number of iterations, and the LDA coefficient.
   b. Marks a word with a predetermined topic in a semi-random distribution based on the Dirichlet distribution.
   c. The iteration stage will produce parameters that can determine the distribution of the number of topics in the document and the distribution of words from topics.
   d. Validate the model topic by analyzing the right number of iterations to form the model, the appropriate number of topics based on the perplexity distribution, and the probability distribution of each learning document on the formed topic model.
5. Analysis and Evaluation

Topic analysis can be done by observing the entire distribution of topics, including the distribution of words in the topic. Then the topic coherence test is carried out to test the ease of the model topic being interpreted by humans.

Results and Discussions

The data used in this study is tweet data taken on Twitter of approximately 1500 tweets where this tweet was taken from the Mandalika MotoGP event until July 2022 with the keyword "Mandalika Circuit". The data that has been collected then enters the pre-processing stage. An example of this stage can be seen in Table 1.

Table 1. Pre-processing data

Step	Before	After
Case Folding	The Mandalika Circuit is stunning and beautiful	the Mandalika Circuit is stunning and beautiful
Tokenization	the Mandalika Circuit is stunning and beautiful	'the', 'Mandalika', 'Circuit', 'is', 'stunning', 'and', 'beautiful'
Filtering	the Mandalika Circuit is stunning and beautiful	'Mandalika', 'Circuit', 'stunning, 'beautiful'
Phrase detection	the Mandalika Circuit is stunning and beautiful	'Mandalika', 'Circuit', 'stunning, 'beautiful'
Stemming	the Mandalika Circuit is stunning and beautiful	'Mandalika', 'Circuit', 'amazed', 'beautiful'

Table 1 shows the pre-processing data stage on all data sets used in this study. After going through the pre-processing stage, it is known that not all tweet data collected can be used as a dataset. The amount of data that can qualify as a dataset is 500 tweets with a distribution of 398 positive sentiments and 102 negative sentiments with an inappropriate amount of data or data

imbalance for each category, both positive and negative sentiments. Therefore, under-sampling is applied to balance the data by dividing 100 positive and 100 negatives data.

The data set from the classification of positive and negative sentiments are then visualized as a word cloud. For example, the positive sentiment word cloud can be seen in Figure 2.

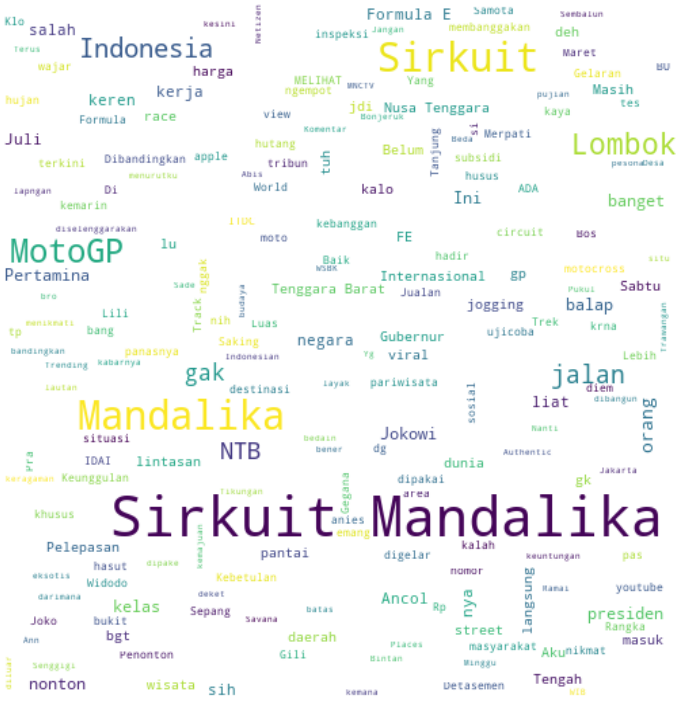

Figure 2. Positive tweet visualization

Figure 2 shows a positive sentiment word cloud where the words often appear for positive sentiment are Circuit Mandalika, Mandalika, Circuit, MotoGP, NTB, Lombok, Indonesia, and Pertamina. As for negative sentiments, words that often appear are Mandalika Circuit, Mandalika, Circuit, no, asphalt, preseason, and international. The negative sentiment word cloud can be seen in Figure 3.

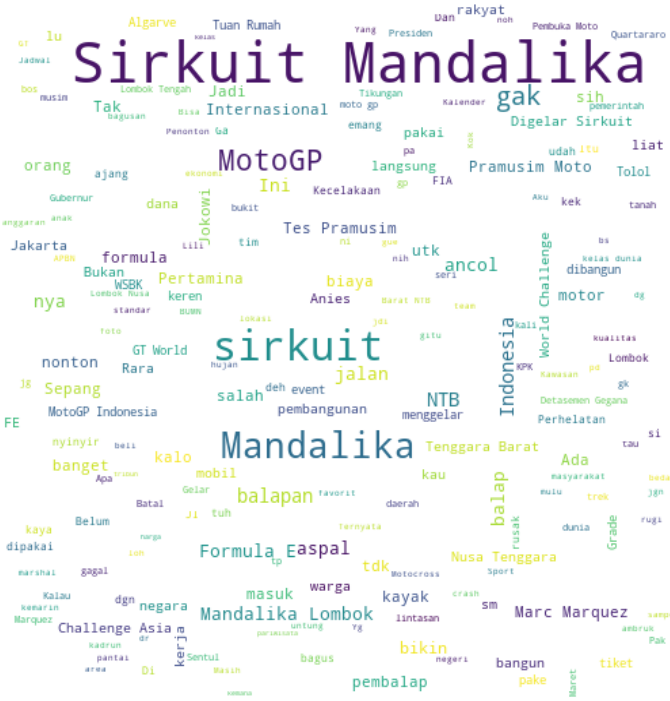

Figure 3. Negative tweet visualization

The classification method applied to the created dataset is SVM (Support Vector Machine). In doing the classification required training data and data testing. This training data consists of 200 tweets used to model the SVM algorithm. In contrast, data testing is needed to test the performance of the previously created model. The training process will mathematically determine the prior and term values of each data being trained and how likely it is to enter a certain class.

Tests in this study will use a confusion matrix where the test data can be known for accuracy, precision, recall [20], and specificity. The testing process is carried out with 100 tweets of test data. Based on the test results, the following results were obtained, 87 positive tweets and 13 negative tweets. In addition to model predictions, the results obtained were 67 True Positive, 20 True Negatives, 1 False Positive, and 12 False Negatives, as shown in Table 2 below.

Table 2. Confusion matrix

Prediction	Actual	
	Positive	Negative
Positive	67	1
Negative	20	12

Based on the calculations concerning the table above, the Accuracy Value: is 87.00, while the Precision Value is 77.01, Recall Value is 84.81, Specificity Value is 98.52, and the F1 Value is 80.72. With this, it can be said that the SVM algorithm has fairly good accuracy for classifying sentiment data.

Exploration of sentiment data using the Latent Dirichlet Allocation (LDA) method is carried out on positive and negative classes so that the topic modeling in this study is used to obtain information from the collection of opinions of tourists who have visited the Mandalika Circuit. The information will be interpreted as a collection of main topics from the tweets obtained.

This research will take ten topics to be tested to find the best group of topics. Topics resulting from topic modeling are not necessarily easy to interpret. Therefore, a topic coherence calculation is carried out to distinguish between good and bad topics. Overall, the coherence value obtained from modeling this topic is 0.473. The results of the ten topics generated are shown in the following Table 3.

Table 3. Topic

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10
Circuit	Circuit	Mandalika	Circuit	Mandalika	Circuit	Circuit	Circuit	Circuit	Circuit
Mandalika	Mandalika	Circuit	Mandalika	Circuit	Mandalika	Mandalika	Mandalika	Mandalika	Mandalika
moto	no	racer	kayak	marquez	built	lombok	no	racing	motogp
preseason	asphalt	rich	there is	marc	held	ntb	Jokowi	ticket	test
for	negara	Indonesia	Sepang	Honda	time	Street	racer	world	roll call
no	inhabitant	formula	motogp	accident	formula	kpk	cost	Asia	deposit
develop-ment	Jakarta	no	direct	race	president	interna-tional	budget	race	season
land	motogp	motor	damaged	motogp	formula	Indonesia	BUMN	not	wear
fail	Ancol	take	more	make	test	Pertamina	peeled off	challenge	no
asphalt	formula	bend	no	paved	WSBK	motogp	collapse	car	ntb

Table 3 shows ten topics in this study. Each topic has its word list. The topics that have been obtained are then visualized using pyLDAvis. The visualization can be seen in Figure 4.

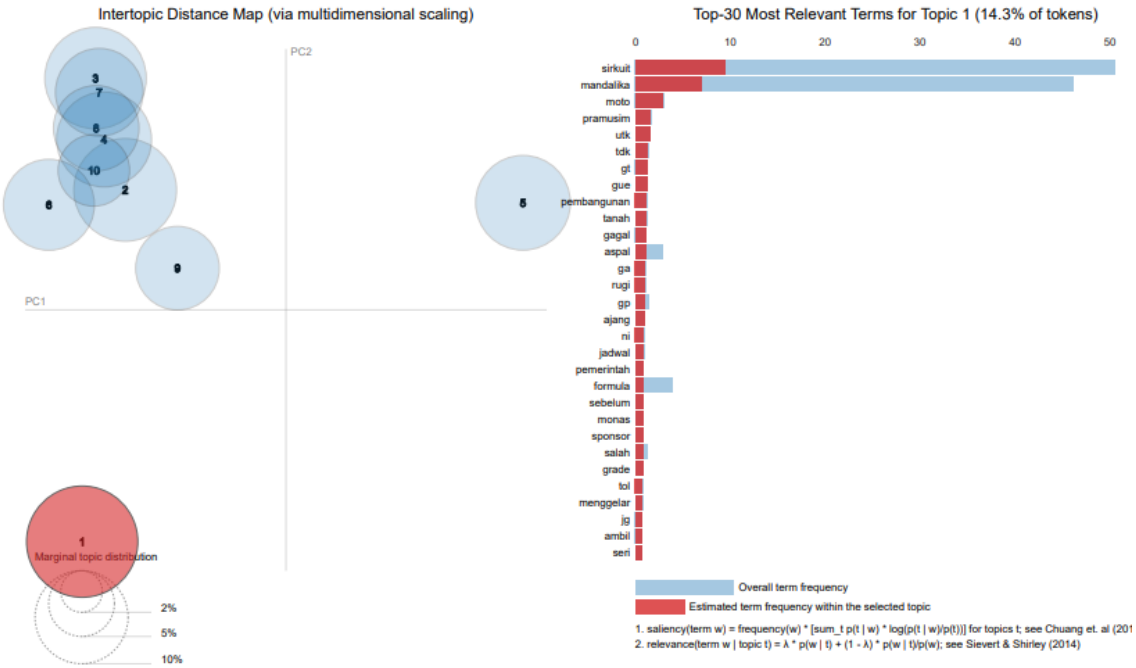

Figure 4. Topic visualization with pyLDAvis

Figure 4 shows the results of the visualization of all topics using pyLDAvis. The figure shows two different colors, namely blue and red. The blue color shows the frequency of occurrence of the word in all documents, while the red color shows the frequency of occurrence of the word in each topic. Figure 4 also shows the existence of circles (topics) that intersect and do not intersect. Intersecting topics indicate that several words are the same in each topic, while those that do not intersect indicate that there are no words in the topic that are the same as other topics. The bigger the circle, the higher the frequency of the topic. In this study, the words often appear are circuit, Mandalika, moto, and formula.

Conclusion

This study succeeded in conducting sentiment analysis using the Support Vector Machine (SVM) method and Topic modeling with the Latent Dirichlet Allocation (LDA) method for Mandalika Circuits. Based on the sentiment analysis results, 1500 tweets were obtained before the pre-processing process, thus getting a dataset of 500 tweets divided into 398 positive tweets and 102 negative tweets. So it can be concluded that more Twitter users give positive than negative responses to the Mandalika Circuit. The test results show that the SVM algorithm can classify sentiment toward the Mandalika Circuit well, as indicated by the measurement of the performance of the SVM algorithm, namely the accuracy value of 87%, the precision of 77%, recall of 84.81%, and specificity of 98.52%. These results also show that the F1 Score is a comparison of the average precision and recall, which is weighted at 80.72%. In addition, based on the research conducted, it was found that the words that most often appear are circuit, Mandalika, motto, and formula.

Acknowledgments

We thank the Ministry of Education, Culture, Research, and Technology for funding this research with a novice lecturer research grant (PDP). We also thank LLDIKTI XI and UP3M STMIK Palangka Raya for facilitating this research.

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Matrix: Jurnal Manajemen Teknologi dan Informatika
Volume 12 Issue 3 Year 2022 Pages 117-122
DOI: http://dx.doi.org/10.31940/matrix.v12i3.117-122
URL: http://ojs2.pnb.ac.id/index.php/matrix

Review methods for clock skew measurement

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Abstract: Clock skew is the deviation of the clock from the true time, which makes it an important role in time information. Clock skew is unavoidable and causes each clock to run at a different speed, so there is a very slight difference between them, but it can still be observed properly. The known properties of clock skew make it potential research for many experts, such as Paxson, Aoki, and Huang. To produce a more accurate clock skew measurement, this study uses the ant colony optimization method by adopting the behavior of an ant colony in searching for food by choosing the path with the shortest route, which will become the cluster offset as a material for measuring clock skew. Ant colony optimization method has the most potential to be adapted in clock skew measurement because the cluster offset is not affected by the upper and the bottom outliers to produce an accurate clock skew measurement.

Keywords: ant colony optimization, clock skew, cluster offset

History Article: Submitted 5 August 2022 | Revised 17 October 2022 | Accepted 17 November 2022

How to Cite: A. A. Azmir, N. M. A. E. D. Wirastuti, and K. O. Saputra, "Review methods for clock skew measurement," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 12, no. 3, pp. 117-122, 2022.

Introduction

Clock skew is the deviation of the clock against the actual time, which is the ratio between the clocking speed between two digital clocks that have the stability between one time with the other and the ability to distinguish between the two devices [1]. The known properties of clock skew make it potential research for many scientists. Such as research related to cloud computing, local area network (LAN), metropolitan area network (MAN), wide area network (WAN), and even research using a smartphone. Research related to clock skew is important because of its measurement accuracy.

Many experts research the measurement of clock skews, such as Paxson, who solves the outlier filter using the median line procedure [2]; Aoki, who uses linear regression to calculate the minimum skew offset [3]; and Huang, who uses the quick piecewise minimum algorithm (QPM) to calculate the skew from the minimum offsets based on the collected offsets at the start and the end of the segment [4] also, the linear programming algorithm (LPA) which determines the clock skew of the line gradient that lies below the entire offset. All the existing methods focused on achieving the accuracy of clock skew in the presence of outliers by utilizing offset characteristics that converged on the cluster bounded at the bottom [5].

Then, the research with hough transform, which combines the concept of clock skew for improves clock skew measurement when the lower bound is unstable due to the presence of low outliers in short time measurements and is particularly suitable for security applications such as device fingerprinting, which require high jitter wireless network connections [6].

Based on the existing research on measuring clock skew, this study will review potential methods to be used in measuring clock skews, such as genetic algorithm methods, ant colony optimization methods, particle swarm optimization methods, and bee colony optimization methods, and analyze these methods to associate with the clock skew measurement.

This study will review several methods that have the potential to be used in measuring clock skew, such as the genetic algorithm method, which determines the cluster offset by taking the results of determining the optimal solution of a problem. The ant colony optimization method determines the cluster offset based on the shortest route obtained by the ants during the food

search process. The particle swarm optimization method determines the cluster offset by narrowing the search area for the food location, and the bee colony optimization method determines the cluster offset by finding the best food location. It is hoped that this method can be used in measuring clock skew.

Methodology

This research was conducted at the Telecommunication and Multimedia Network Engineering Laboratory, Electrical Engineering, Faculty of Engineering, Udayana University, Bukit Jimbaran. This research was initiated on July 2022. The stages of the research can be seen in Figure 1.

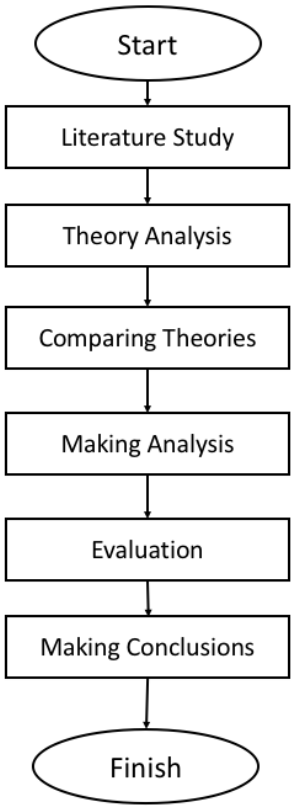

Figure 1. Research stages

Explanation of Figure 1:

Step 1. Literature study and data collecting

The first stage is carried out in the form of literature studies sourced from relevant literature, such as journals and books related to the research topic, and collecting data from previous research.

Step 2. Theory Analysis

The second stage is an analysis of the theory that has been collected. Several existing theories will be analyzed one by one.

Step 3. Comparing Theories

The third step is to compare the theories with each other. It is done to see the strengths and weaknesses of each existing theory.

Step 4. Making Analysis

The fourth stage is making an analysis. After comparing the existing theories, the advantages and disadvantages are obtained, then an analysis is carried out to get the best theoretical results.

Step 5. Evaluation

The fifth stage is evaluation, where all the methods and the best ones will be re-checked to get the best results.

Step 6. Making Conclusions

The sixth stage is making conclusions, where conclusions are drawn after going through several methods, and it is concluded that one of the best methods is obtained.

Results and Discussions

Bee Colony Optimization

Bee colony optimization is a method that adopts bee colonies when looking for natural food. The bee colony optimization method aims to optimize the habits of the bee colony by exploring to get a more optimal solution. The bee colony optimization method describes several running processes, such as the source of food, the quality of the food source, and the amount of food in the food source [7].

The process of bee colony optimization starts with determining the initial route, with the nearest neighbor followed by the foraging stage, where the bees will choose the food source to be visited next based on the value and distance between food sources. The last one performs a waggle dance where the worker bees will dance, influencing the seeker bee to follow and join in picking up food from the food source [8].

Suppose the bee colony optimization method, which aims to find food, is adapted to the clock skew measurement method. In that case, searching for food will be similar to a cluster offset where the bee colony will look for a cluster offset at random when the bees get the cluster offset location. The bees will signal the other bee groups to approach and form a cluster offset path. With the optimization support, the bees will choose the cluster to offset the path with the shortest route, which is expected to get accurate clock skew measurement results using the bee colony optimization method.

Ant Colony Optimization

Ant colony optimization is a method that adopts the behavior of ant colonies when looking for food in nature [9]. Ants will move from the anthill to the food source by passing several existing paths until the ant colony finally gets the path with the shortest route from the anthill to the food source. Figure 2 will explain the working process of the ant colony optimization method [10].

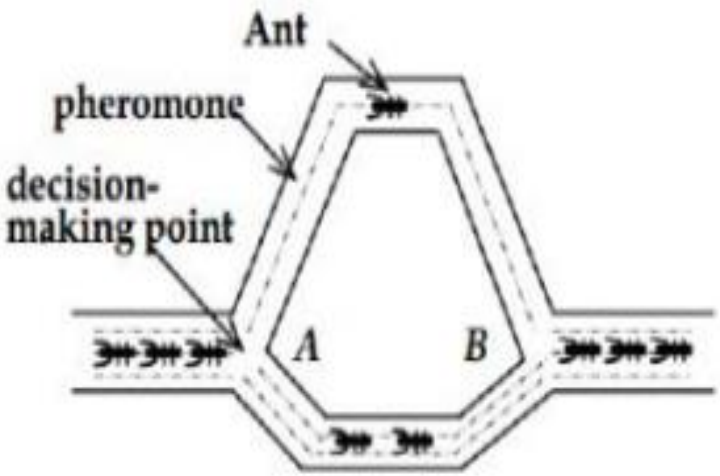

Figure 2. Ant colony optimization process

The process stage of the ant colony optimization method starts when the ant moves from the anthill to the food source, the ant will pass through several existing paths to get to the food source [11]. When passing through, the ant's path will leave a pheromone substance as a sign that the ant is passing through the path. After repeating several times from the anthill to food sources, ants will choose the path with the most accumulation of pheromone substances to pass, which means that the path is the shortest path when looking for food [12].

In the ant colony optimization method, the aim is to find the path with the shortest route. When it is adapted to the clock skew measurement method, the food search path passed by the ants will be shaped like a collection of cluster offsets used when measuring clock skew, the path for ants, which becomes the cluster offset, will be optimal with the help of optimization which is expected to be a method of measuring clock skew with ant colony optimization to get accurate results.

Particle Swarm Optimization

Particle swarm optimization is a method that adopts the behavior of a group of birds when looking for food sources randomly, with other particles that will influence each other in the flock when finding the best food position. Figure 3 describes the process of particle swarm optimization [13].

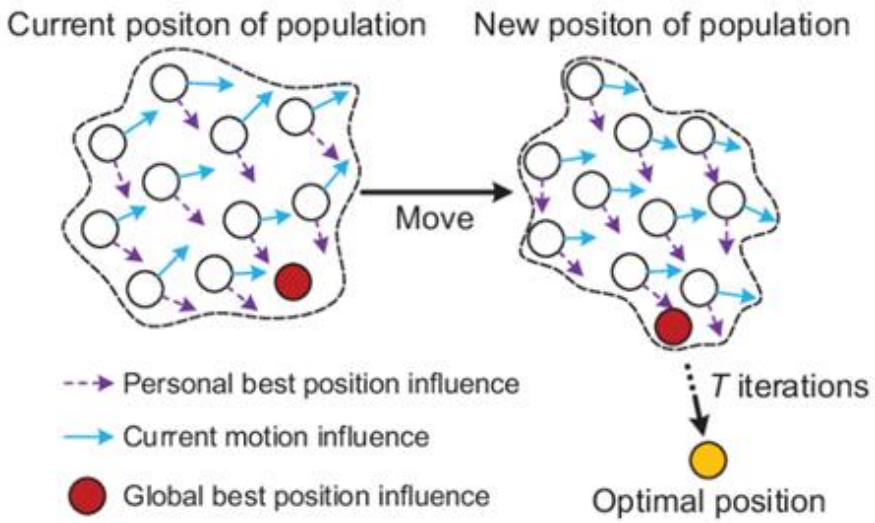

Figure 3. Particle swarm optimization process

Figure 3 shows searching for food by narrowing the foraging area. In the particle swarm optimization process, initially, a group of particles or swarms will move randomly, which aims to find a position in the repetition of the food search, followed by several variables to take the best position and as repetition to search for food as well as in the optimization process that determines the direction of a particle to move. The search for food locations in the particle swarm optimization method will be carried out repeatedly to get food locations that are getting smaller and narrower to get an optimal result.

In the particle swarm optimization method, the aim is to narrow the food search area [14]. When it is adapted to the clock skew measurement method, namely, the position of the food will resemble a cluster offset where the food search is carried out repeatedly, which aims to narrow the position of the food location with the help of optimization methods that will get the accurate results in determining the cluster to offset so it is expected to get accurate clock skew measurement results using the particle swarm optimization method.

Genetic Algorithm

A genetic algorithm is a computational algorithm that originates from an evolutionary theory and is adopted into a computational algorithm that aims to find a solution to a problem naturally, such as by getting the value of an optimal solution to a problem with several possible solutions [15].

The process stage of the genetic algorithm method starts when taking the initial population and applying operations on genetics that aims to create the next generation, where each part of a population will be considered as a chromosome that can represent one feasible solution to a problem. Individuals who have high similarity will have the opportunity to reproduce by exchanging genetic information through the crossover with other individuals. After the crossover process, the gene mutation process is carried out to change some properties of certain non-

producing genes. The resulting offspring may replace several individuals with relatively low fit functions. This reproductive cycle, crossover, mutation, and evaluation will repeatedly occur until the best solution is acquired.

The genetic algorithm method aims to obtain an optimal solution to a problem. When adapted to the clock skew measurement method, the optimal solution will be considered a cluster offset in clock skew measurement. The genetic algorithm will work by finding several solutions to the existing problem until the best result is obtained. Therefore, the genetic algorithm method is hoped to be optimal for measuring clock skew.

Potential Clock Skew Measurement Method

Based on the four methods of measuring clock skew that has been observed, by looking at the advantages and disadvantages of each method, the most potent method to be used in measuring clock skew is the ant colony optimization method. Ant colony optimization method that adopts the behavior of ants looking for food [16], where ants will move from the nest to the food source through multiple paths available. The ants will choose the path with the shortest route to search for food in nature [17]. Figure 4 explains the process of ants in search of food.

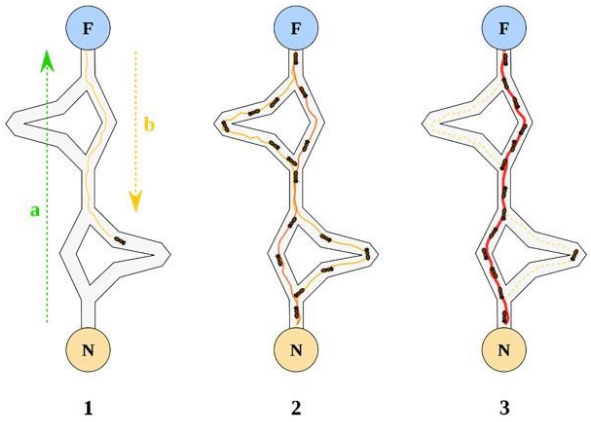

Figure 4. The process of ants in search for food

The route of ants foraging can be linked to a cluster offset in clock skew measurements. In Figure 4, path number 3 is the shortest route the ants choose, marked with the red mark, representing the cluster offset, where the ants will choose a few paths. Then with the ant colony optimization method, the ants will choose the path with the shortest route because it is more efficient where the path with the shortest route can be associated with a cluster offset. The cluster offset will not be affected by outliers at the top and the bottom because the path of the ants resembles a cluster offset, so it is expected to get accurate clock skew measurement results.

Conclusion

There are a few methods in clock skew measurements, such as genetic algorithm, ant colony optimization, particle swarm optimization, and bee colony optimization that are the potential to be a method in clock skew measurement. The ant colony optimization method has the highest potential to be adapted as the method in clock skew measurement. First, the ants will try a few paths to the food source, and eventually, the ants will choose the path with the shortest route to the food source. This shortest path for ants when looking for food sources can be linked to a cluster offset in clock skew measurements, where the path of the ants represents a cluster offset that will not be affected by the upper and the bottom outliers to produce an accurate clock skew measurement.

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Matrix: Jurnal Manajemen Teknologi dan Informatika
Volume 12 Issue 3 Year 2022 Pages 123-136
DOI: http://dx.doi.org/10.31940/matrix.v12i3.123-136
URL: http://ojs2.pnb.ac.id/index.php/matrix

SITAMPAN: Mobile application for planting and harvesting of horticultural crops in Garut Regency

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Abstract: Garut Regency's agriculture sector has the most impact on the region's GDP compared to other sectors. The Central Statistics Agency reports that the agricultural sector's contribution was 39.11% in 2014 and will be 37.97% in 2020. The farmer's inability to manage their crop goods is the primary cause of the contribution decline. The study aims to build a prototype of a mobile application information system for planting and harvesting commodities based on a geospatial information system. The research method used was field surveys, interviews, and focus group discussions (FGD) with farmers, farmer group leaders, agricultural extension workers, and officials at Garut Regency Agriculture Office. The designed application is Sitampan which stands for Sistem Informasi Tanam dan Panen (Planting and Harvesting Information System). The users of this application are farmers, farmer group leaders, agricultural extension workers, and Garut Regency Agriculture Office. Each user will have a specific role and access based on their roles. The public can only see the data contained in this application. In conclusion, this app can serve as a platform for information and communication for farmers. Farmers can use this app as a decision-making tool to manage their crops, including when to sell, plant, and harvest. Hopefully, this application will enhance the welfare of farmers, particularly those in Garut district, one of the industries that have the most impact on the Indonesian agricultural sector.

Keywords: application, harvesting, mobile, planting, prototype

History Article: Submitted 19 September 2022 | Revised 29 October 2022 | Accepted 25 November 2022

How to Cite: E. S. Soegoto, L. Warlina, S. Supatmi, A. A. Rafdhi, R. Jumansyah, and H. Saputra, "SITAMPAN: mobile application for planting and harvesting of horticultural crops in Garut Regency," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 12, no. 3, pp. 123-136, 2022.

Introduction

The agricultural sector in Garut Regency is the most significant contributor to the regional gross domestic product (GDP) compared to other sectors. Data from the Central Statistics Agency show that in 2014 the agricultural sector's contribution was 39.11%, but in 2020, it became 37.97% [1], [2] shown in Figure 1. One obstacle farmers face in managing their crop products is the marketing aspect. Even in this digital era, various applications can facilitate product marketing. In addition, the entrepreneurial aspect of agriculture is also poorly understood by farmers in rural areas.

The entrepreneurship field is considered essential to improve the economy in a region. Thus, entrepreneurship in agriculture is vital to design practical and durable mechanisms in applying the triple bottom line to develop entrepreneurial agricultural education programs. It is because many small-scale farmers have many qualities as business owners. For small-scale farmers to become entrepreneurs, they must be innovative and forward-looking. Farmers need to be able to recognize opportunities and take advantage of them. Some small-scale farmers have high quality but remain focused on preserving traditional life. Their production choices are based on what they need rather than what is possible [3], [4].

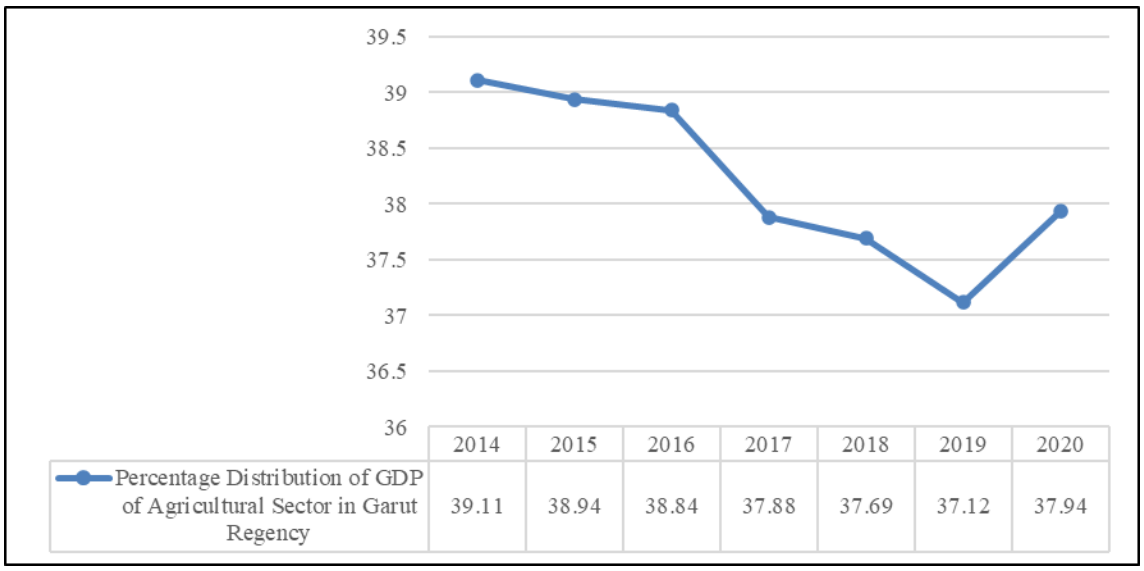

Figure 1. Percentage of distribution of the agricultural sector in Garut Regency in 2014-2020 [1,2]

Research conducted in Nigeria found that entrepreneurship in agriculture is used as a strategy to reduce unemployment and poverty by applying associative concepts and entrepreneurial ideas in agriculture. Entrepreneurship aims to increase productivity, decrease actual food prices, increase rural incomes, create jobs, and generate financial benefits from activities or activities at every stage of agricultural value. The application of entrepreneurship in agriculture that has been applied in Nigeria is vegetable farming [5], [6]. In contrast, research conducted in three different countries, namely Nigeria, India, and Bangladesh, found that entrepreneurship in agriculture aims to better connect farmers and aggregators with markets and consumers. However, applying entrepreneurship in agriculture requires government, the private sector, NGOs, and other supporting communities' participation. In addition, rural youth capacity building is needed [7]–[9].

The concept of agricultural entrepreneurship is to combine agricultural and non-agricultural activities with environmentally friendly, innovative, and educational concepts. Cases analyzed in three countries (Poland, Spain, and Romania) show that entrepreneurship in the countryside is conducted with the principle of sustainable development. The multifunctional nature shows that small farming types can survive and be aligned with sustainable development goals (SDGs). The statement supports this by saying that farming is an activity that helps farmers adjust to a free market economy. Self-employment is a significant need for farmers to survive in a volatile business environment [10], [11]. Farmers around the world are already showing incredible quality to adapt. They started looking for better ways to manage their farm. They try to grow new plants and cultivars, raise healthier animals, use alternative technologies to increase efficiency, expand production, minimize threats, and increase profits. The standard technology used in agriculture is pasture repair activities, genetics, administration, and technical procedures [12]–[14]. Based on other research, some countries already use the Internet of Things (IoT) to improve productivity and quality of agribusiness, monitoring the behavior of fruit maturity, plant and soil moisture, nutrient levels of water and soil, and environmental temperature. Instead, agriculture in Kenya uses information and Communication Technology for agricultural commodity exchange by developing a short message service in collaboration with a mobile phone provider Safaricom [15], [16]. Information and Communication Technology helps each farmer access the latest market information on commodity prices and offerings and the right Hybrid Corn seeds to be grown in their respective agroecological zones. The system is integrated with Kenya Seed Company Ltd, a major seed distributor in the East African region, using only their mobile phone [13], [17], [18].

Findings from MercyCorps & Agrifin [19], there are 55 agricultural digital technologies in Indonesia, on average, are still in the early stages. Currently, 60% of agricultural digital applications in Indonesia still target digital information such as market information or prices. While the other 40% focus on market access and almost a third on the supply chain and data management area. The rests are financial services and precision agriculture, such as satellites, sensors, and agricultural mechanization. So digital applications are still needed, especially those that can help farmers with management efficiency and entrepreneurship.

The research aims to develop a mobile application to manage agricultural business data, including planting schedule, location, planted area and harvesting schedule & volume, and market prices. In the early stages, the types of commodities in the application are oranges, shallots, and red chilies. The selection of these three commodities is based on the Agriculture Office's advice because these commodities are leading commodities in Garut Regency. The application's name is Sitampan which stands for Sistem Informasi Tanam dan Panen or Planting and Harvesting Information System. This mobile application is based on a geographic information system. The expected benefit of this research output is to provide information through maps and data in the form of tables, which will assist the Agriculture Office of Garut Regency in preparing reports and formulating strategies related to the economic development of three commodities.

Methodology

This research uses a descriptive analysis research method with a qualitative approach. The system development method used is a prototype with five stages of development (Figure 2). Android Studio will be used as an application development tool at the prototype manufacturing stage. Android Studio is an open-source application creation platform that allows users to build android-based applications with Kotlin Framework. Android Studio is an open-source application builder built with Eclipse IDE (Integrated Development Environment), the Java IDE. An application that anyone can use for Android application development. A module collects source files and builds settings that allow users to divide a project into separate functional units. Each project in Android Studio contains one or more modules with source code files and resource files as tendencies. Users can build, test, and debug each module separately. The modules include Android application modules, library modules, and Google App Engine modules. By default, android studio displays android projects organized by the module to provide quick access to the user project's main source files [20]–[23]. Emulators are used to test applications that have been created.

Throughout this prototype creation phase, we had a focus group discussion (FGD) with potential users, including farmers, farmer group leaders, agricultural extension officers, and Garut Regency Agriculture Office staff. This FGD was held at Garut Regency Agriculture Office on March 29 and September 20, 2022. In the FGD, potential users offer feedback, ideas, and requests for the application's excellence and simplicity.

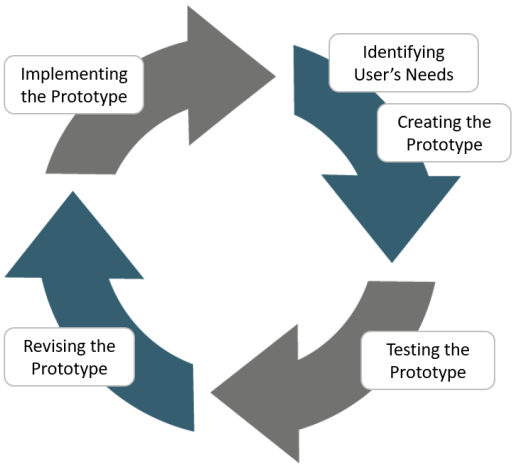

Figure 2. Prototype of development model [22].

Based on the figure above, we use the prototype method in the application development process. We chose this process to structure the application development process, starting from

identifying user needs to implement. The following is an explanation of each prototype process that we use:

1. Identifying user needs
   In this process, we conducted a group discussion forum with the Garut Regency Agriculture Office selection and the farmers. As a result, the FGD process was carried out to find the main problems in the field. This problem is what we will focus on in application development. In the FGD, we found several main problems that we can make our main focus. Garut Regency Agriculture Office needs help knowing the planting and harvesting data carried out by farmers. Hence, they need an application that can provide information related to the data. Furthermore, the problems that become our main focus are from the farmers themselves, where farmers need an application that can provide updated information regarding the selling price of plants and vegetables. The selling price needed is divided into 3: the selling price from farmers to collectors, from collectors to the local market, and from the local market to the main market. The extension workers also provided some input regarding application development. They hoped that the application could be a container that could accommodate all farmer groups and all commodities in Garut district to make it easier for them to monitor the planting and harvesting processes there.

2. Creating the prototype
   After we get the data we need, we make a prototype to provide an overview of the application's initial design. The prototype created will be the initial stage and the transformation process of the existing request.

3. Testing the prototype
   The prototype that has been made will be tested regularly to see if the application that has been built is under our main focus. Our testing process is carried out directly with Garut Regency Agriculture Office, Garut Regency Extension Officers, and farmers from various commodities in Garut Regency. It is so that we get input from all users who will use the application.

4. Revising the prototype
   Based on the testing that we have done, we found some small discrepancies in the applications that have been built. This happened because there were some differences of opinion between the agriculture office, extension workers, and farmers. Therefore, we are revising the applications that have been built under the revisions that users have given.

5. Implementing the prototype
   After we found a match between the application built and the user's wishes, we continued with the implementation of the application. With this implementation, it is expected to greatly benefit arrowroot farming, especially for farmers, so it can be one of the elements that can improve their welfare.

Results and Discussions

System Design

Before system development, the system was designed to ensure the system's suitability with the analysis of user needs to be met as expected in Unified Modeling Language (UML), which had been established as a tool for designing the proposed system [17], [24].

Use case diagram

One of the tools in UML that we used is the use case diagram. It describes the relationship between actors in a system. It can describe the interaction between one actor and another actor in the design of the system created. In addition, database design is a process that will determine the management of the data and content needed to support the design. There are two system designs in question. The first level designs the system by analyzing, while the second is the

general design to determine the user's needs. The use case diagram of Sitampan is shown in Figure 3. The use case diagram has several use cases and actors with each function. The following is the description of the use case and actor shown in Tables 1 and 2.

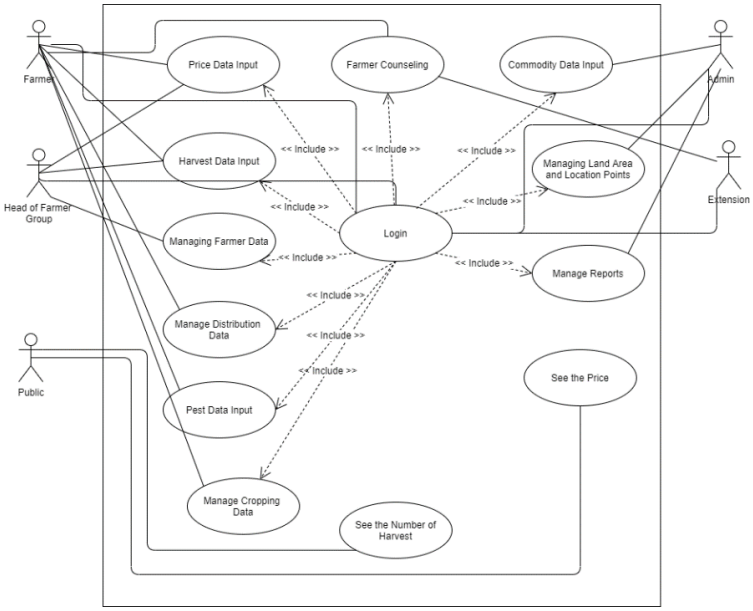

Figure 3. Use case diagram of the SITAMPAN application

Table 1. Description actor at use case diagram

No	Actor	Description
1	 Farmer	The farmer is an actor who becomes the first layer in this application system because all real-time data comes from farmers, ranging from price data, harvest data, pest data that is attacking, and planting time data.
2	 Farmer Group Leader	The head of the farmer group is responsible for managing the farmer data in the farmer's group. In addition, the farmer group leader can verify data from farmers, such as harvesting and planting time data.
3	 Admin	Admin on this system is an officer of Garut Regency Agriculture Office, who manages commodity data, report data, location, and market price data.
4	 Extension officer	The extension officer is an actor from the Agriculture Office of Garut Regency. The extension officer is responsible for managing the extension process directly to the farmer. Farmers can ask about the problems faced during the planting period until harvest.
5	 Public	The general public or anyone who uses the Sitampan application without logging in can see the location of commodities, market prices, and data on the number of harvests per commodity.

Table 2. Use case description

No	Actor	Description
1	Price Data Input	The *use case* process is an activity of inputting price data. obtained by farmers when selling crops. Then, the Admin will verify the price data before appearing on the main page of the price chart application.
2	Harvest Data Input	The process of inputting harvest data is uploaded by Farmers, who will then be validated by the farmer group leader so that the farmer's harvest number data can enter the overall harvest number.
3	Managing Farmer Data	The head of the farmer group carries out the process of adding farmer data. In this process, the farmer group leader can add, edit, or delete farmers' accounts in the farmer group.
4	Manage Distribution Data	Farmers and buyer information such as collectors, local markets, or cooperatives will input this distribution data.
6	Pest Data Input	Farmers can input in real-time to the application regarding the type of pest that is attacking.
7	Manage cropping data	Farmers can input a description of planting time so that other farmers can manage their planting period, with the goal that the harvest period does not coincide, which can finally maintain market price stability.
8	Farmer Counseling	This process can be done by Farmers and Extensionists so that Farmers can consult directly with extensionists if there are obstacles to the planting and harvesting process.
9	Commodity data in-put	Admin does this process to add the type of commodity in the system.
10	Managing Land Area and Location Points	This process is inputting land data to GIS maps conducted by admins.
11	Manage Reports	Admins can access this report for physical data output purposes, and can be filtered by time or commodity.
12	See the Price	The farmer's price input is then validated by the Admin to be displayed on the public page.
13	See The Number of Harvests	Data on the number of harvests validated by the farmer group leader will be viewable on the general page of the application to be accessed by anyone using the Sitampan application without the need for *login.*

The prototype of the Sitampan mobile application was developed to assist agricultural planting and harvesting management in Garut Regency. The data provided by this application includes the types of commodities planted, planting time, estimated harvest time, fertilizers used, and commodity yield prices. Through this application, farmers can see information on the types of plants planted in other areas and when to plant, and harvest time. In addition, the agricultural service can obtain accurate data from growing time and harvest time for each type of commodity.

Diagram Activity

At the development stage of this application, we also create activity diagrams to describe the flow of activities from farmer entities, starting from the login process to inputting data into the system [25]. This activity diagram is useful to see whether existing procedures are appropriate. The activity diagram that has been created can be seen in Figure 4.

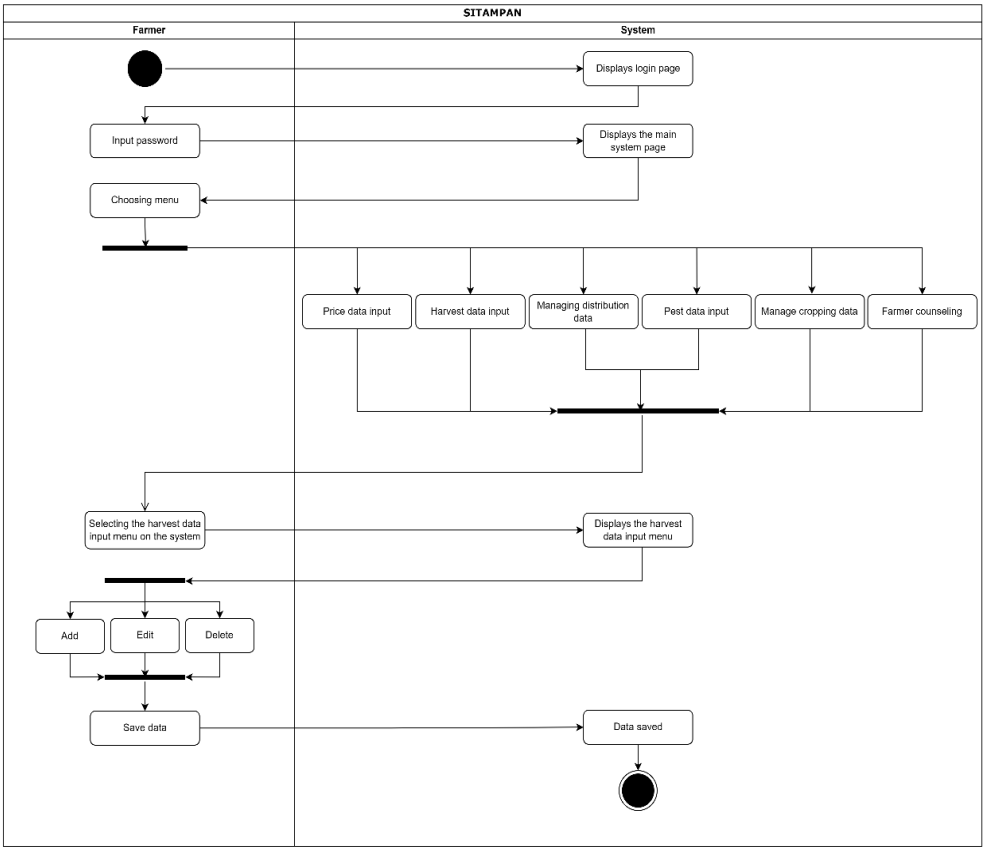

Figure 4. Activity diagram

The process contained in the storage system can be seen in the activity diagram above. According to Figure 4, there is only one actor in the system: the farmer. The farmer first logs in to access the application. Following a successful login, the system will display the main page, which includes the price data input menu, harvest data input menu, distribution menu, pest menu, crop menu, and farmer consultation menu. After the user selects a menu, the system will direct them to that menu, where they can add, change, and delete data. Once the entered data is appropriate, the user can save it, and the system will save it automatically [26].

Database

The database created is a database proposed at the Department of Agriculture which in its design has adapted to the existing and proposed system [27] (Figure 5).

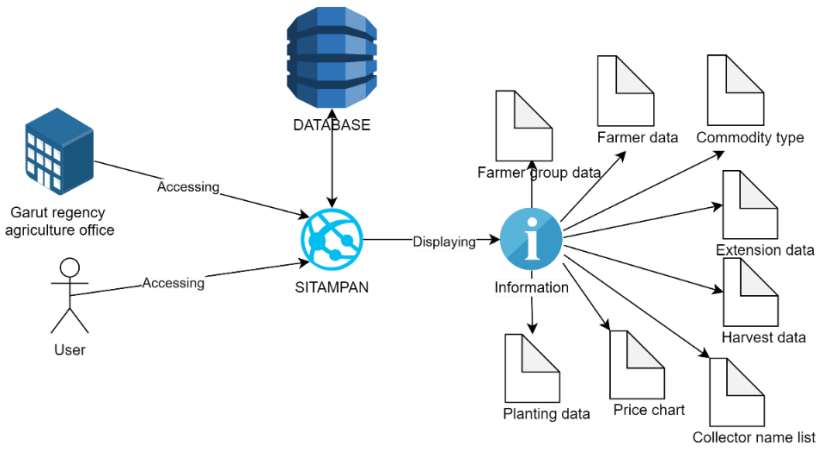

Figure 5. Proposed database

Class Diagram

Class diagrams explain the connection between classes in the food cropping information system. The class diagram is formed by entities or objects with attributes and operations [29]. From this class, a table can be formed that can be associated with other tables (Figure 6).

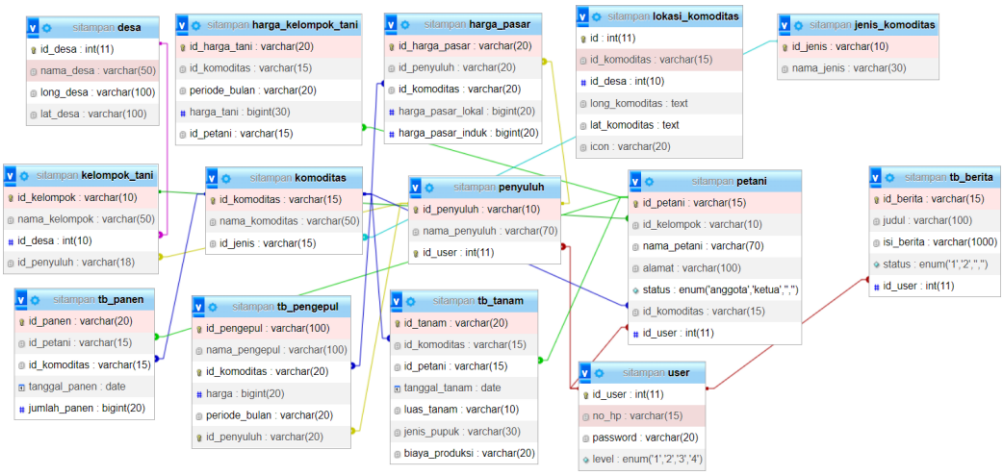

Figure 6. Class diagram

Interface Design

The interface comes with functions providing an overview of the application design. The following is the implementation of the interface under construction and the functionality and description of the display.

Homepage

The SITAMPAN application will be managed directly by the Agriculture Office of Garut Regency to record the users accurately. Therefore, the Agriculture Office provides the account that can be accessed. Before logging into the app, users must log in to Stampan's account via the Login page. The home page and login Sitampan app are shown in Figure 7.

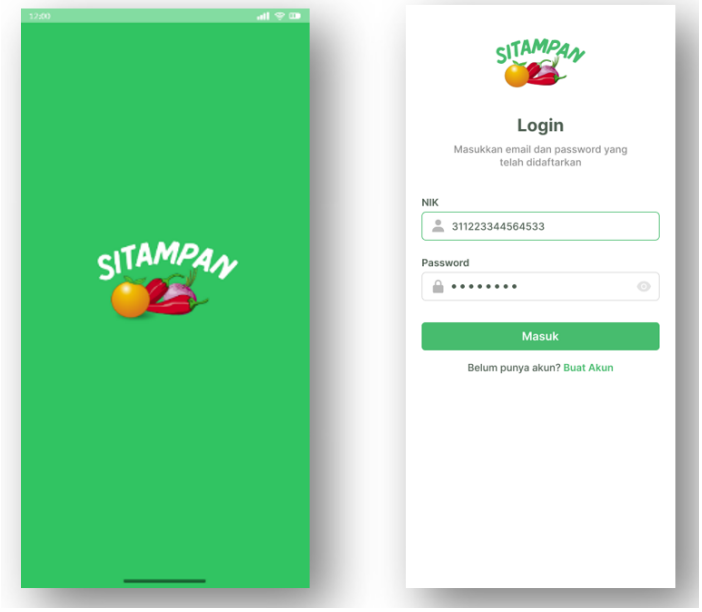

Figure 7. SITAMPAN app home and login page

SITAMPAN App Home Page

In the early stages of developing this prototype, shallots, red chilies, and oranges were the primary commodities. Once the user logs in, they will be directed to the application's main page, whose main feature is a map of the three commodities. The home page and login Stampan app are in Figure 8.

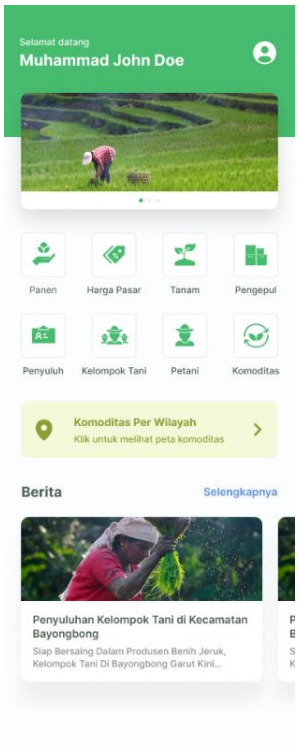

Figure 8. App home page

In the Sitampan application, a distribution map can be accessed to see the information and location points of the commodity. The map can be selected based on the subdistrict. For example, suppose the Bayongbong sub-district is clicked. In that case, the plant's location will be displayed along with information about the location point and what plants are planted at that location. Details of the map are shown in Figure 9.

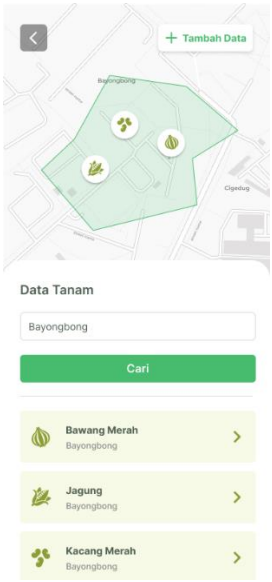

Figure 9. Map detail page

Menu Application

The SITAMPAN application has eight main menus: Crop Data, Commodity Prices, Harvest Data, Collectors Data, Extension Workers, Farmers Groups, Farmers and Commodities (see Figure 10). The menu on the application aims to make it easier for users to get information based on their needs [30], [31]. The Planting Data menu is accessed by farmers to input data when carrying out the planting process. Farmers need to fill in the planting area, type of fertilizer, and production costs for each planting commodity. Farmers carry out the harvest menu after the harvest period takes place. In the process, farmers need to fill in the date of harvest and the amount of harvest produced based on the planting data that has been previously inputted. Market price data and farmer prices can be used as benchmarks when farmers want to sell their crops. Market price management is carried out by extension workers who directly access the Department of Agriculture price data. The market price is divided into the local market price and the parent market price. Market price data is updated monthly to provide information on price fluctuations. The extension worker also inputs the data collector by providing accurate information in the form of the purchase price, the commodity purchased, and the distribution location of the collector.

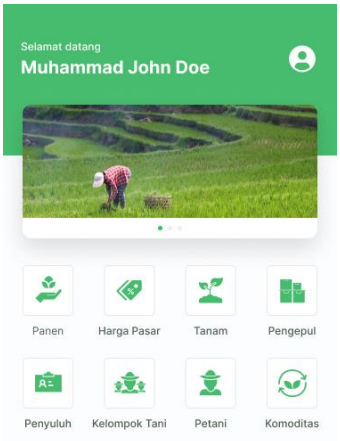

Figure 10. SITAMPAN app menu

Harvest Data Menu

Farmers, as users, can input the harvest data obtained into the application on the harvest data page, which the Admin will verify. Verified data will be displayed in graph form when the user finishes input and verification (Figure 11).

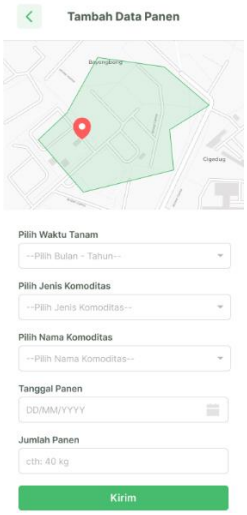

Figure 11. Harvest data page

On the Harvest Data page, farmers must fill in several data columns such as Name, Location, Commodities, Number of harvests, Harvest Area, Product Photos, Crop Age, and Harvest Time. In the commodity column, farmers can choose the commodity type from the product, where each commodity will have a different data column to fill.

Commodity Price Menu

This application also has a commodity price data menu containing real-time market price updates. Users can see price charts of each commodity, such as citrus, shallots, and chilies. On the existing chart, information can be seen about price fluctuations (Figure 12).

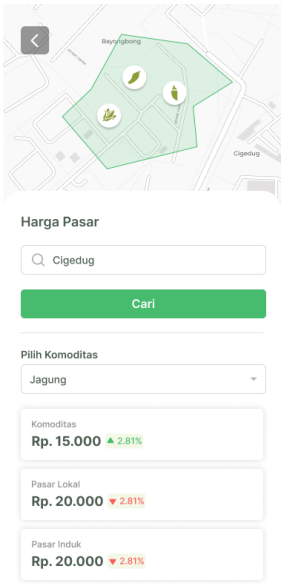

Figure 12. Commodity price menu

The commodity price page is useful to help farmers adjust the selling time of their products. With this feature, farmers are expected to know the market conditions and choose the right time to sell their products to achieve maximum selling results.

The application development team conducted a Focus Group Discussion with participants representing farmers, farmer group leaders, agricultural extension workers, and several Garut Regency Agriculture Office officials to explain and test the application prototype design. FGD participants appreciated the design of the storage application. They proposed additional features for varieties of commodities and market prices based on three locations: prices at farmers, local markets, and wholesale markets. Additional features requested are commodity price links on commodity association data and prospective buyers. In addition, there are feature adjustments according to the condition of the type of commodities, such as planting time which will only be served on red chili and shallot plants.

Based on the results of discussions with stakeholders, it can be concluded that the needs of stakeholders will be accommodated in improving the Sitampan application. Based on various countries' studies, mobile agriculture applications cannot meet all stakeholder needs. The research in India states that mobile applications range from crop information, market prices, online shopping for farmers, weather forecasts, and daily agricultural news. However, only a few can fully meet all the needs of farmers [32]. The research on mobile applications in India for disseminating agricultural information concluded that for expanding application-based information, there must be considered, such as better simple handsets, compatible smartphones, multilingual platforms, subsidized internet packages, regular training, and awareness among farmers [33]. The results of a study in Punjab, Pakistan, on mobile phones to access agricultural information show that market information and financial issues are reported to be the most widely accessed. Mobile phones show farmers' dependence on market information and financial transactions via mobile phones has connected farmers more [34]. Research on mobile

applications in India shows that mobile technology agriculture and related sectors are becoming more integrated. The use of accessible, farmer-friendly, and inexpensive mobile application devices in agriculture has dramatically changed the interface of production consumption [35].

Conclusion

Focus group discussions (FGD) were conducted as we designed the Sitampan application. The focus group discussion participants were farmers, farmer group leaders, agricultural extension workers, and Garut Regency Agriculture Office staff. The primary commodities used in creating this application were shallots and red chilies. During the FGD, the participants acknowledged their appreciation and offered ideas for improving the application. Additional features requested are commodity price and prospective buyers. In addition, there were feature adjustments according to the condition of the type of commodities, such as harvesting time on red chili that will be more than once for every planting area. These are just a few advantages this application offers to farmers: managing planting and harvesting, viewing market prices, managing the list of collectors and extension agents, and merging the list of farmer groups, commodities, and farmers. It is intended that by employing this application, the agriculture of Garut district can continue to be one of the most superior sectors, given how much Garut farming impacts the Indonesian agricultural sector. It is envisaged that farmers won't anymore be bothered by the difficulty of choosing a planting schedule that does not overlap with other farmers in the same region, which indirectly affects their well-being. Additionally, Garut Regency Agriculture Office can use this application to make it simpler to gather information on planting and harvesting agricultural products in each sub-district within Garut Regency. This application provides any data input directly from the farmer in real-time. With this application, the Department of Agriculture can obtain data directly without the need to collect data through a long bureaucracy to make reports to the Central Bureau of Statistics.

Acknowledgments

This research was granted by Direktorat Riset dan Pengabdian Masyarakat, Deputi Bidang Penguatan Riset Pengembangan, Kementerian Riset dan Teknologi, with the contract number 310/SP2H/LT/DRPM/2021 (March 18th, 2021). We thank our colleagues from Dinas Pertanian Kabupaten Garut, Bapak Ir. Beni Yoga Guna Santika, MP., and Bapak Rakhmat Jatnika, MP provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.

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Matrix: Jurnal Manajemen Teknologi dan Informatika
Volume 12 Issue 3 Year 2022 Pages 137-146
DOI: http://dx.doi.org/10.31940/matrix.v12i3.137-146
URL: http://ojs2.pnb.ac.id/index.php/matrix

Improvement of the automatic gamma correction method in cloud image detection

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Abstract: Clouds become an important part of human life and are studied in several disciplines in the form of important analyses in some applications. Examples of application of cloud analysis on solar panels or photovoltaics, accurate weather forecasts, accuracy of rainfall predictions, application in the field of meteorology, imaging of the sky in some cases, air humidity survey, and the case of turbulence on Aircraft caused by clouds cumulonimbus. The structure and shape of the clouds are continuously changing, becoming an interesting part to detect. The cloud detection process can be done by taking several samples of imagery from the cloud and the image processing process is done. Most research processes RGB cloud imagery into HSV cloud imagery, Some research using the image detection method of flying apply the channel's convolution R-B, R/B, $B–RB+R$, and chroma C = max(R, G, B)-min(R, G, B). Gamma correction has an efficient characteristic of storing and dividing imagery by small bits, thus the study proposed an image detection development using automatic gamma correction, with ground truth being Image data from SWIMSEG Nanyang Technological University Singapore. The proposed method in the proposed study obtained a precision value and better computing time with a precision value of 0.93 and a computational time of 0.71 sec.

Keywords: cloud detection, gamma correction, image processing

History Article: Submitted 7 July 2022 | Revised 18 October 2022 | Accepted 29 November 2022

How to Cite: B.N.Kusuma, and D.B Susanto, "Improvement of the automatic gamma correction method in cloud image detection," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 12, no. 3, pp. 137-146, 2022.

Introduction

Clouds are instrumental in the formation of the climate, with the clouds then excessive energy that is absorbed by the earth can be lowered. Clouds also function as mirrors and can reflect radiation from the sun.

Thus the clouds become an important part of human life and are learned in some of the important disciplines applied to some applications. For example, in the application of cloud detection analysis on solar panels or photovoltaic processes [1], the weather forecasts accurately [2], the accuracy of rainfall prediction [3], applications in the field of meteorology [4], imaging of the sky in some cases [5], [6], [7], air humidity detection [8], and the case of turbulence on aircraft caused by clouds cumulonimbus[9] [10], [11], [12].

The cloud detection process can be done by taking several samples of imagery from the cloud and the image processing process is done. Most research processes RGB cloud imagery into hue saturation value (HSV) cloud imagery, the next research uses a method for processing images by changing the RGB channel into hue saturation intensity (HSI) [13]. In its implementation, in detecting images in real-time, some researchers use a combination of RGB to HSV/ HIS/ HSL and its reverse color space model or use the image detection method of flying apply the channel's convolution R-B, R/B, (B-R)/(B+R), and chroma C = max(R, G, B)-min(R, G, B) , then there are several other ways to detect clouds by applying the edge detection method [14],[15],[16],[17] and [18].

The method proposed by the researchers used basic gamma correction in 2018 which was improved so that it has a better quality than the previous gamma correction method, the previous gamma correction method produced a precision value of 92% (0.92) compared to the color-based

segmentation method with an average precision by 91%, memory with a value of 90% (0.90), and computation time which is better than the color-based segment method. Comparison values between gamma correction and color-based segments can be seen in Table 1.

Table 1. Comparison method

Method	Precision	Recall	Time (s)
Color Based Segmentation	0.92	0.90	1.89
Gamma Correction	0.91	0.86	0.72

Thus in this study, the development of the gamma correction method was carried out to obtain a precision value that was better than the method that had been proposed. Data on the development of the proposed gamma correction method uses the same im-age data from SWIM-SEG Nanyang Technological University Singapore as ground truth.

The model of this method is expected to be able to process images with a better level of precision than previous methods and produce a lower level of computation. The expectation of this method can process images with a good level of precision compared to previous methods and produce a lower level of computation.

Methodology

This research was done according to the stage of research that involves auto-brightness contrast, split images into 3 channels red, green, and blue, automatic gamma correction, gaussian blur, and finally otsu thresholding as shown in Figure 1.

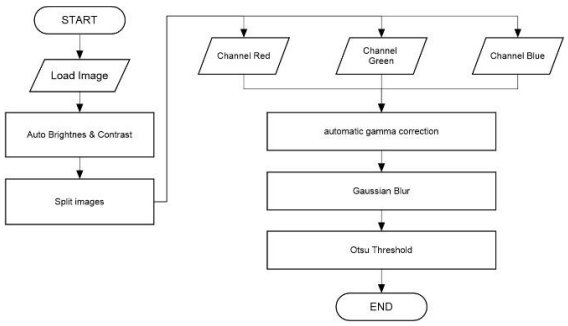

Figure 1. Flow diagram consisting of stages

Auto-Brightness and Contrast

The auto-brightness and contrast functions are also called image normalization. The process of normalizing images from ground truth has different values of light intensity. The image normalization function is done automatically by using the formula:

$$O(x,y) = \alpha * I\,(x,y) + \beta \quad (1)$$

Where the value of alpha arises from the process of division between the output range and input range.

$$input\ range = Max\,(I) - \min(I) \quad (2)$$

$$\alpha = \frac{output\ range}{input\ range} \quad (3)$$

The input range is the highest value obtained from images minus the minimum value for each image. The output range is obtained from the maximum image value with a value of 255. β value is obtained from the multiplication process of the minimum image value with alpha multiplied by -1.

$$\beta = -\min(I) * \alpha \tag{4}$$

The multiplication of the alpha value functions to adjust the brightness level of the image, and the sum of the beta value functions to adjust the level of contrast level in the image.

Figure 2 and 3, shows the results of the brightness and contrast correction process with better color results.

Figure 2. The original images

Figure 3. The results of brightness and contrast normalization

Split Images

The image extraction stage functions to separate the image into 3 main channels, specifically the red channel, green channel, and blue channel. Three-channel elements can form as many as 16,581,375 color images [19]. Figure 4 is the result of the separation of colors into 3 channels.

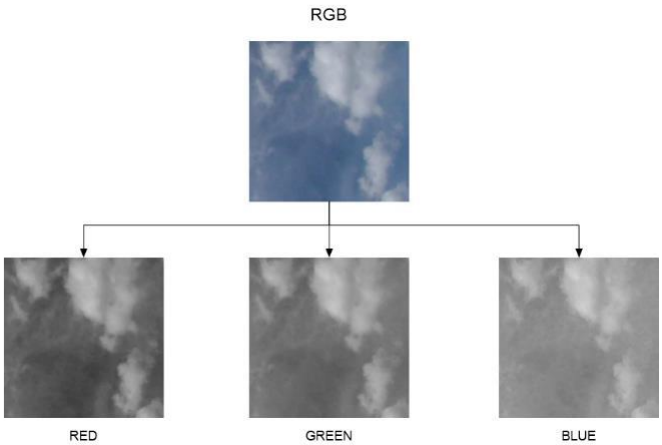

Figure 4. Cloud image extraction in 3 channels

Improvement Method Formulas Automatic Gamma

Gamma has important and rarely understood characteristics in almost some digital imaging systems. Gamma is defined as numeric pixels and luminance i.e. mapping the pixel input and received intensity as the output pixel value with the resulting intensity value, in other words, gamma is the method of adjusting the pixel value so that can be represented properly on the

output device. Without the gamma color captured by the camera will not look like the color captured by the eyes[14].

In other words, because of the lack of color capture, the gamma correction translates light sensitivity that is translated by the human eye into the digital camera or screen monitor [20]. Gamma is defined with the formula:

$$V_{out} = V_{in} Gamma \tag{5}$$

Where Vout is the output luminance value, and Vin is the actual luminance value. In the process, gamma is capable of storing and dividing image colors more efficiently as it requires a little bit to visualize the range of certain colors. Figure 5 shows a comparison of native color sensitivity, linearly encoded, and gamma.

Figure 5. (a) Original Bright tones (b), Linearly Encoded (c), Gamma

Gamma correction or also called power transformation is used in image processing in some situations that can be used also in fixing the image brightness by using a nonlinear transformation between the input and output values.

So that between input and output comparable with the inputs raised using gamma, the following example of gamma decoding is the gamma used to process the input into output with the formula:

$$V_{out} = AV_{in}^{\gamma} \tag{6}$$

$$I' = 255\ x\ \left(\frac{I}{255}\right)^{\gamma} \tag{7}$$

The basis of gamma correction is to improve the brightness of the image between input and output by determining the gamma value of γ. The gamma correction developed by INRA was modified to get the gamma value of γ. The default gamma correction function can be defined as follows:

$$\gamma = log\left(\frac{\gamma}{range}\right) / log\left(\frac{x}{range}\right) \tag{8}$$

Where the range value is the range of values of the image that starts from 0 to the maximum value of 255. The variable x is the mean value of the pixel of the image being processed and γ is half of the range value.

From the above method, automatic gamma correction is developed to produce the image needed for the detection process. The automatic gamma correction function in this study is defined as follows:

$$\gamma = log\left(\frac{\gamma}{range}\right) / log\left(\frac{\left((r-\bar{b})+(g-\bar{b})\right) - \left((r-\bar{b})+(g-\bar{b})\right)}{range}\right) \tag{9}$$

Where $\bar{b}$ is the average value of the blue channel that is part of the RGB channel. Figure 6 is the result of implementing automatic gamma correction.

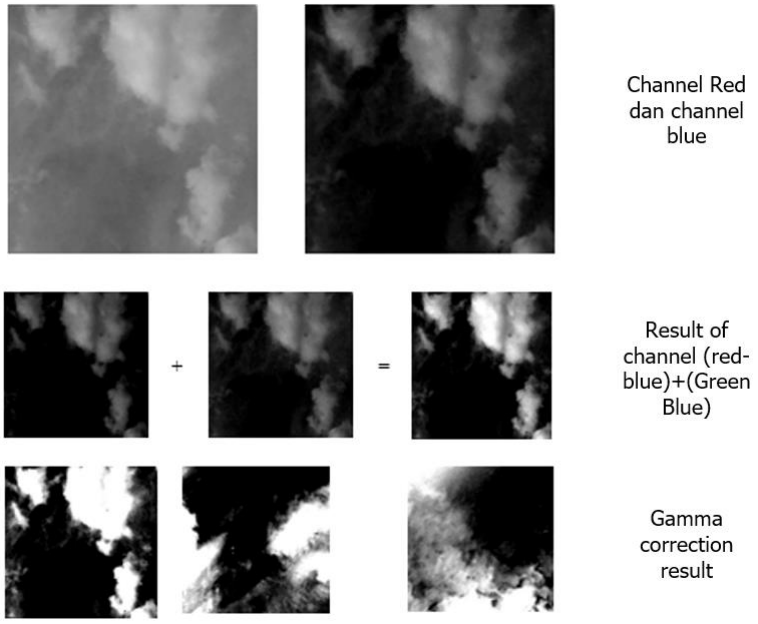

Figure 6. Implementation with gamma correction

Gaussian Blur

Gaussian blur can eliminate parts of noise that are not used in the process of cloud image detection, using the Gaussian blur noise method generated from the previous process can be ignored and does not interfere with the thresholding process [21].

Otsu Thresholding

Thresholding segmentation aims to separate objects from the background with simpler values. Thresholding functions to separate a digital image based on the characteristics of the pixels.

The result of this process is the absolute value of dark and light [22][23][24]. Otsu uses a discriminant analysis approach by distinguishing several naturally occurring blocks. Analysis of variables on otsu will maximize the separation of objects from the background. Figure 7 is the result of the implementation of the otsu method.

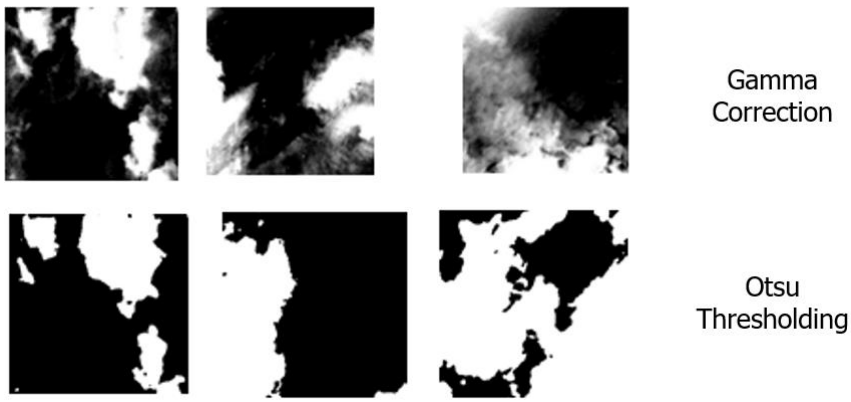

Figure 7. Implementation of multiple cloud images using otsu threshold correction

Evaluation

To find out the performance of the system that has been developed, then testing all images tested in this study. The analysis uses 3 assessments namely precision, recall, and timer.

The precision describes the accuracy between the requested data and the prediction results provided by the method, precision value is obtained from testing the image data with tp, and fp values on the processed image. The precision function can be defined as follows:

$$Precision = \frac{tp}{tp + fp} \tag{10}$$

In determining the precision value, a tp value is needed, where tp is a true positive, i.e. the number of pixels in the matrix from the results of the proposed method is detected correctly by the system compared to the pixels in the ground truth. And fp is a false positive where the pix-els in the matrix of the proposed method are correct but are detected wrong by the system based on the comparison of data on ground truth.

The recall describes the success of the method in retrieving information, recall value is ob-tained by calculating the value of tp and fn. The recall testing process can be directly carried out by the formula:

$$Recall = \frac{tp}{tp + fn} \tag{11}$$

In determining the recall value, fn is a false negative where the number of negative data but classified incorrectly by the system base on the comparison from data on ground truth. The computational timer process is calculated from the overall average value of 1013 the number of images processed.

Results and Discussions

The gamma correction testing process was conducted to determine the performance of the system that has been developed using 3 assessments, namely precision, recall, and timer. 1013 experiment of ground truth imagery, the proposed method obtained information in graphical form as follows:

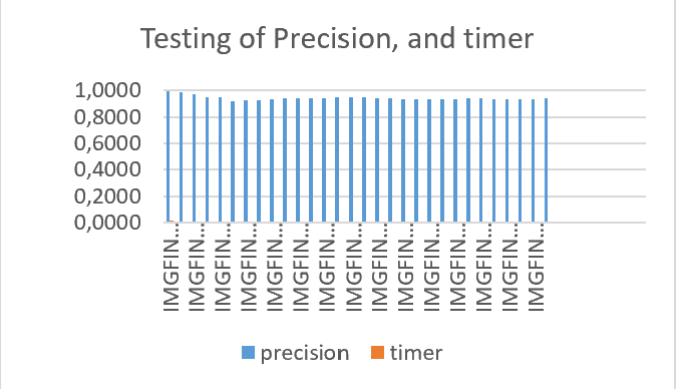

Figure 8. Precision testing, and timer of cloud image data based on ground Truth (SWIMSEG)

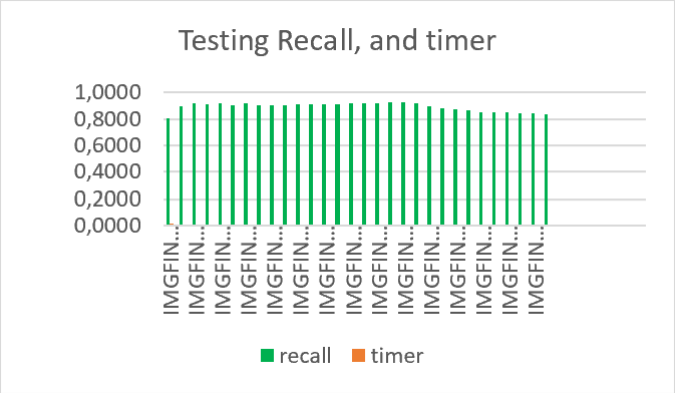

Figure 9. Recall testing and timer of cloud image data based on ground Truth (SWIMSEG)

From the above Figure 8 and Figure 9, The precision, recall, and timer test values from the 1013 image can be seen in Table 2.

Table 2. Proposed method image data

Testing	Total	Mean
precision	94248.0717	93.0386
recall	81544.6367	80.4982
Timer	720.9480	0.7117

From the average value of 1013 ground truth images obtained a precision value of 93.0386 with a recall value of 80.4982 and a timer of 0.7 117 seconds. Table 2 shows a comparison of several previous image detection methods with the proposed method. Table 3 and Figure 9 show a detailed comparison between 13 methods from previous research with the proposed method.

Table 3. Comparison of between 13 methods

Method	Precision	Recall	Time (s)
Li et al.	0.90	0.86	2.06
Souza et al.	0.95	0.76	2.04
Long et al.	0.71	0.98	1.83
Mantelli-Neto	0.70	0.97	2.16
SLIC + DBSCAN	0.72	0.79	5.29
GRAY + SVM	0.87	0.56	2.61
LBP + SVM	0.62	0.65	4.73
ColorHIST + SVM	0.81	0.64	2.63
dSIFT + BOW + SVM	0.65	0.88	5.04
Texture + BOW + SVM	0.82	0.71	2.74
Color Based Segmentation	0.92	0.90	1.89
Gamma Correction	0.91	0.86	0.72
Proposed method	0.93	0.81	0.71

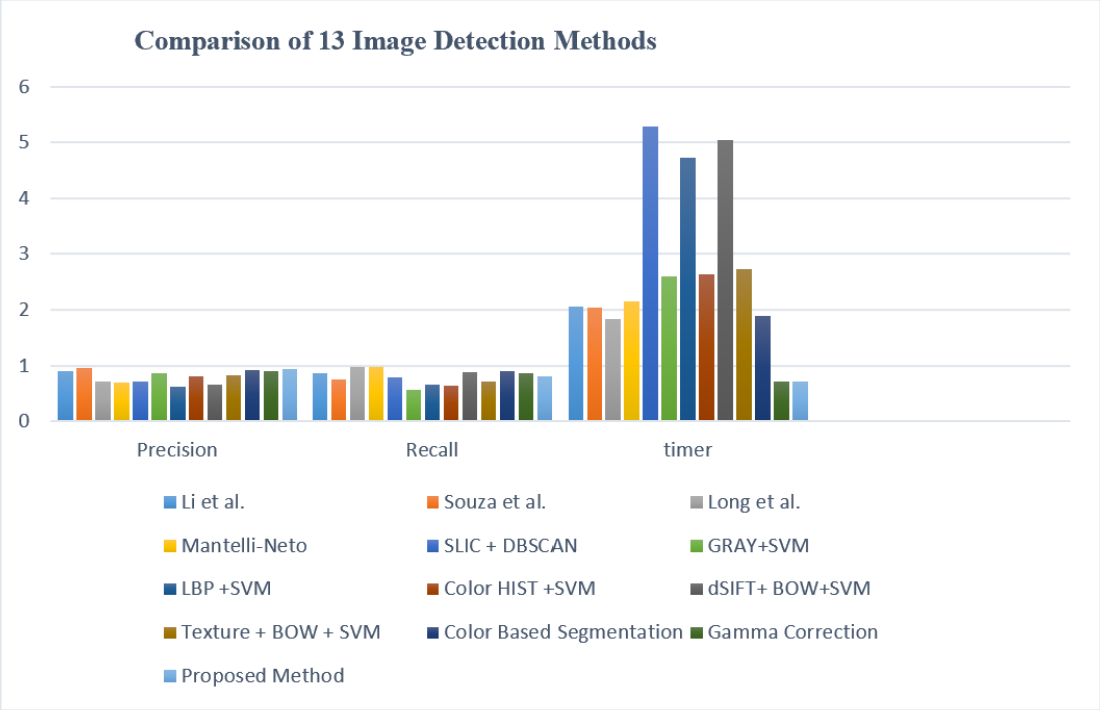

Figure 9. Comparison of 13 image detection methods

From the graph information above the highest precision value was gained in the Souza method with a percentage of 0.95, followed by a researcher's proposed method of 0.93, and the third position followed by a color-based segment of 0.92.

The highest recall result is obtained by the Long et al method with a percentage of 0.98, while the proposed method is placed to 7 with a percentage of 0.81. Comparing the computational time of imagery to the thirteen methods, the proposed gam-ma correction development method is at the lowest computing process in the first order of 0.71 seconds.

Conclusion

For the development of the gamma correction method in future research to overcome the decrease in the recall value which decreased by 0.04 points to 0.86 in the previous method which obtained a value of 0.90, additional methods are needed such as the dilation method before the advanced stage of image processing so that parts of the image that have uneven cloud areas and thin areas can still be detected as full cloud areas so that the level of precision and recall can be improved and research can be continued to develop accuracy values.

Acknowledgments

Thanks to the Faculty of Computer Science, Universitas Amikom Yogyakarta, and Universitas Singaperbangsa Karawang that helped with this research.

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Matrix: Jurnal Manajemen Teknologi dan Informatika
Volume 12 Issue 3 Year 2022 Pages 147-154
DOI: http://dx.doi.org/10.31940/matrix.v12i3.147-154
URL: http://ojs2.pnb.ac.id/index.php/matrix

Optimization of off-grid solar generating system with DC-DC converter

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Abstract: Electrical energy is a very complex problem for every country in the world, as well as in Indonesia in particular, with the rapid progress of the country's industry, of course, followed by an increase in the generation of electrical energy. While the current energy generation most often comes from fossil fuels, which are increasingly depleting, the energy supply will decrease and increase sales. Therefore, every country is competing to find other energy for electrical energy generation. Renewable energy is a green energy generator whose supply is abundant and inexhaustible. Solar power plants (PLTS) are one of the green energies developed by the Indonesian government to utilize energy derived from non-fossil fuels. To support this, it is necessary to study and research to be done using the DC-DC up/down converter is expected to obtain results that can be used as a reference in the development of solar power plants (PLTS). With a DC-DC up/down converter, the voltage stabilization produced by PLTS can be stabilized by a DC-DC converter from 9 volts DC to 11.5 volts for a minimum voltage. Above 12 volts to 18 volts, up to 12 volts can be stabilized.

Keywords: DC-DC converter, generation, stabilized, voltage

History Article: Submitted 22 September 2022 | Revised 13 October 2022 | Accepted 30 November 2022

How to Cite: I.K. Parti, Suratno and N. W. Rasmini, "Optimization of off-grid solar generating system with DC-DC converter," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 12, no. 3, pp. 147-154, 2022.

Introduction

According to several previous studies, "Design of a DC to DC Converter to Stabilize the Output Voltage of Solar Cell Panels Using Boost Converter Technology," a DC-DC converter can stabilize the output voltage of solar panels +/- 10% [1]. While research entitled "Charging System Design Battery with Solar Panel Based DC-DC Converter," DC-DC converter can regulate PV voltage up to 25V [2]. Based on the study entitled "Design of a Hybrid PLT with a Two-Way Dc-Dc Converter at the Diponegoro University ICT Building Using Matlab Simulink Software", when the power generated by the solar panels is insufficient to supply the load, the program algorithm activates boost mode on the Bidirectional DC-DC Converter, causing it to discharge the battery, which transfers power from the battery to the load [3].

Because PLTS is a less continuous power plant where the energy generation is heavily influenced by sunlight, it is necessary to have research and studies conducted to obtain maximum and continuous energy, with the application of installing Dc-DC up/down converters. The purpose of installing a DC-DC converter Up/down converter in solar power plants is to optimize the energy produced. Therefore, if the energy is low, it will be increased. Likewise, if it is too high, it will be lowered by the DC-DC converter so that the resulting voltage becomes stable [3].

The grid PLTS system is an independent generating system. The system uses electrical energy from solar panels or cells that use DC or Direct Current. Then immediately converted into AC or Alternating Current using an inverter. The AC generated by this inverter then goes directly to loads requiring electrical energy, such as TVs, lamps, irons, cabinets, etc.

PLTS Centralized Solar Power Generation System (From the Grid) [4] is a power generation system that utilizes solar radiation without being connected to the PLN network. In other words, the only source of electricity generation uses radiation with the help of solar power panels to generate the system. One of the advantages of the off-grid system compared to the on-grid

system is that it can still provide electricity in the event of a power outage from PLN. However, this system has a downside and may not be able to meet the total electricity demand, given the cost and volume of the battery can be very high. In addition, communal PV mini-grid requires more complex equipment and costs higher than communal PV mini-grid. The main components of an off-grid system are solar panels, charge controllers, inverters, and batteries [4],[5]. The inverter used in the off-grid system is different from the on-grid system. The off-grid inverter system used is an inverter with a two-way capability to charge the battery and drain electricity from the battery for use in the load.

On-grid solar panel system or PLTS Grid-Tie System is a system that works directly on solar panels. This technological system does not use batteries, and the electricity generated is used for various purposes. The electricity produced is AC, so this on-grid solar panel can be applied together with the PLN network. If there is excess power, the electric power will be sold to PLN. When at night, the power comes from PLN. This on-grid system of solar power plants is suitable for application in the field by utilizing the roof as a space to absorb solar energy. If installed with PLN, this system will reduce electricity costs [6].

An interconnected PLTS system (On-Grid) or a Grid-Connected PV System is a power generation system that utilizes solar radiation to generate electricity. As the name implies, this system will utilize the PLN network by optimizing solar energy through solar modules or photovoltaic modules that generate as much electricity as possible. This system is also considered environmentally friendly and emission-free. The interconnected PLTS system is also a green energy solution for the community, offices, and housing. It aims to reduce electricity bills from PLN and can provide added value for its owners [7]-[8].

The application of the PLTS hybrid system or working principle can run with the PLN electricity system and is regulated in the Minister of Energy and Mineral Resources Regulation of New, Renewable Energy, and Energy Conservation (EBTKE). In this system [5] [6] [9], the PLN electricity network acts as a distributor or liaison for electric current originating from solar panels that are fed to the Therefore, during the day, electricity can utilize electrical energy from sunlight. However, at night, because there is no sunlight, so there is no electricity production from solar panels, you can still use electricity from PLN [10] [12] [13].

Methodology

The materials used in this research are PLTS off-grid specifications as follows:
Specification:
1. Solar Panel150 WP
2. DC-DC up/down Converter 10A 12volt DC 30 A
3. SCC 40A/12/24volt.
4. Inverter 300 watt /12 volt
5. Battery 65 AH VRLA

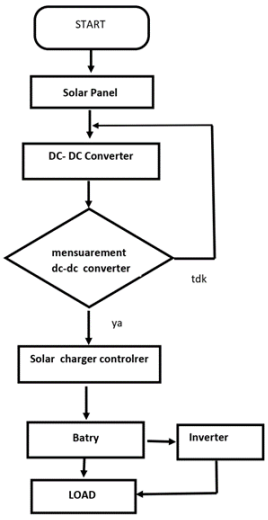

Figure 1. Flowchart on a grid modeling system

Figure 1 illustrates that the energy produced by the solar panel is directed into the up/down DC-DC converter, where the voltage will be stabilized at 12 volts DC. The voltage that results will be virtually measured. If the voltage generated by the solar panel is less than 12 volts, it will be increased to 12 volts by the DC-DC up converter. If the voltage exceeds 12 volts, then the voltage will be lowered to 12 volts DC, by energy from the battery is channeled to the DC load through the solar charger controller (SCC). If the load is AC, then the energy will flow. The voltage is 12 volts DC, and on the solar charger controller, the amount of charging current will be adjusted, as well as the voltage, so that it matches the capacity of the battery used. The amount of voltage and current is measured with a volt-ampere meter. Energy from the battery is directed to the DC load through the solar charger controller (SCC). If the load alternates current (ac), then the energy will flow to the inverter before going to the current (ac) load. If the volt meter does not match, it can be reset to SCC [13], [15], [16], as can be seen in Figure 2.

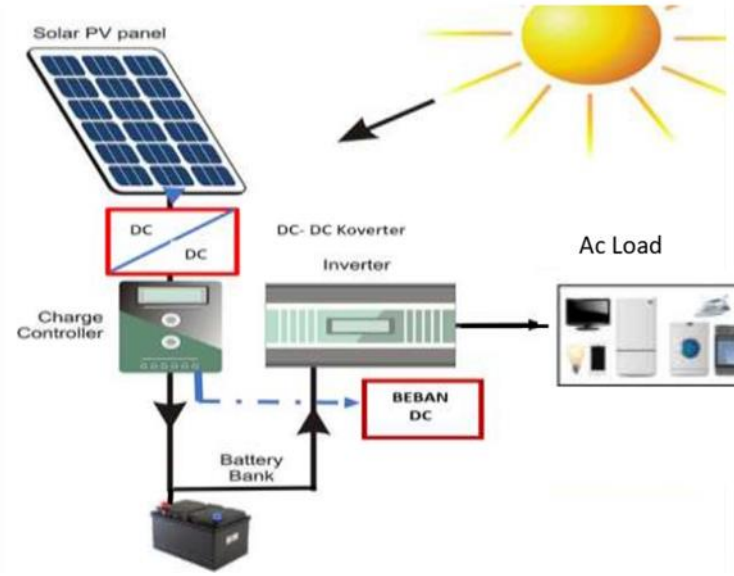

Figure 2. PLTS on grid modeling system with DC/DC converter[9]

Working diagram of the image above:

1. Sunlight falling on the solar panel will be converted into voltage and current through the control.
2. Energy from the solar panel is channeled to the DC-DC converter. The resulting voltage converter will be stabilized with a more optimal buck/boost DC-DC converter to produce a stable voltage output. The current flow is received by the solar charger controller[15],[17],[18], and [19].
3. Inside the Solar Charger Controller (SCC), the current flow will be adjusted according to the program using the voltage, current, and load. As a result, the battery charger can be programmed to last longer, as shown in Figure 2

Results and Discussions

To determine how well the DC-DC converter can stabilize the voltage generated by the solar panel, as given in Table 1, measurements are taken at the solar panel's output, and the voltage supplied to it. Table 1 shows the virtual measurement results using PV out and V out Dc-DC converter voltage magnitude.

Table 1. Measurements May 10, 2022

Hour	Vout PV (volt)	V out DC-DC converter (Volt)
10:00	16.5	12
10:10	16.5	12
10:20	16.5	12
10:30	17	12
10:40	17	12
10:50	17	12
11:00	17	12
11:10	17.5	12
11:20	17.5	12
11:30	17.5	12
11:40	17.5	12
11:40	18	12
11:50	18	12
12:00	16.5	12

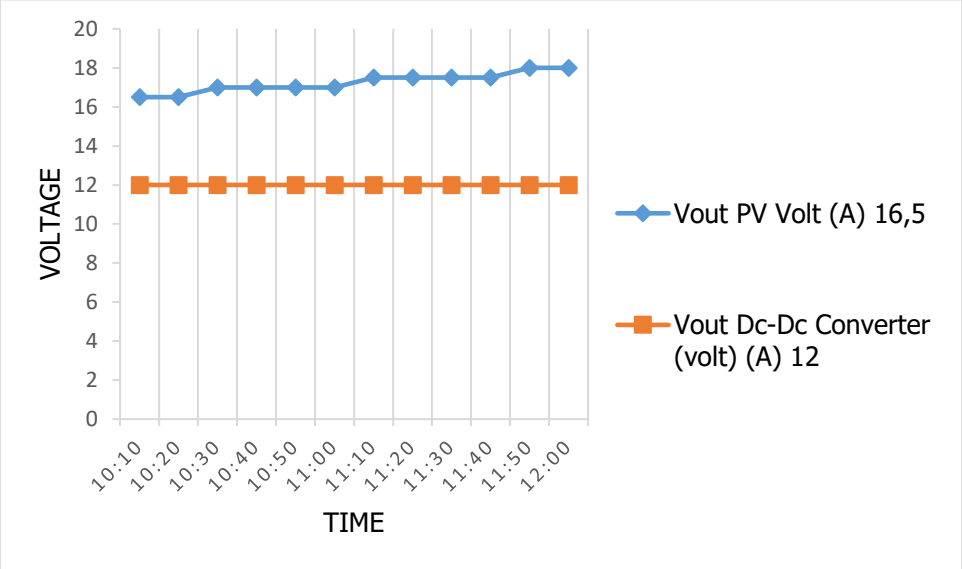

Figure 3. Characteristics of the voltage function of time

From the above characteristics, the voltage generated from the solar panel is a minimum of 16 volts DC and a maximum of 18 volts DC. After being exposed to a DC-DC voltage, the stabilized voltage becomes 12 volts DC, where the voltage will work as a voltage out of the DC-DC voltage to 12 volts DC.

Table 2. Measurements May 20, 2022

Hour	Vout PV (Volt)	V out DC-DC Converter (Volt)
13:00	17.5	12
13:10	17.5	12
13:20	17.5	12
13:30	17.5	12
13:40	17.5	12
13:50	17.5	12
14:00	17	12
14:10	17	12
14:20	16	12
14:30	12	12
14:40	9	11.5
14:50	9	11.5
15:00	10	12

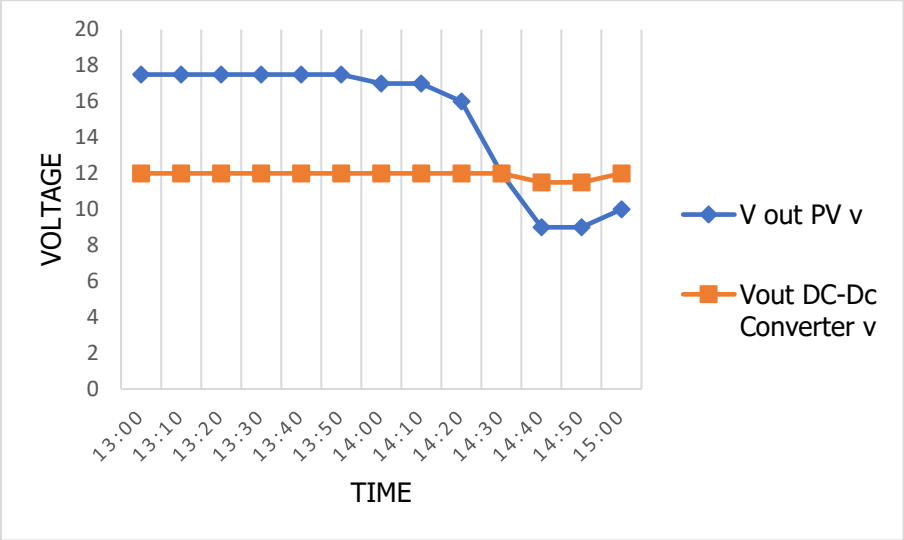

Figure 4. Characteristics of the voltage function of time

From the above characteristics, the voltage generated from the solar panel is a minimum of 9 volts DC and a maximum of 18 volts DC. Therefore, the voltage is stabilized to 12 volts DC after obtaining a DC-DC conversion. The converter work as a voltage amplifier when the voltage is 9 volts. The output voltage from the DC-DC converter to an average of 11.5 volts serves as a voltage when the solar panel voltage is 12 volts DC until the voltage reaches 18 volts DC so that the output voltage of the DC-DC converter becomes 12 volts DC.

Table 3. Measurements May 20, 2022

Hour	Vout PV (Volt)	V out DC-DC Converter (Volt)
13:00	11	12
13:10	11	12
13:20	11	12
13:30	17	12
13:40	18	12
13:50	17	12
14:00	17	12
14:10	16	12
14:20	17	12
14:30	9.5	11.5
14:40	9.5	11.5
14:50	9.5	11.5
15:00	9.2	11

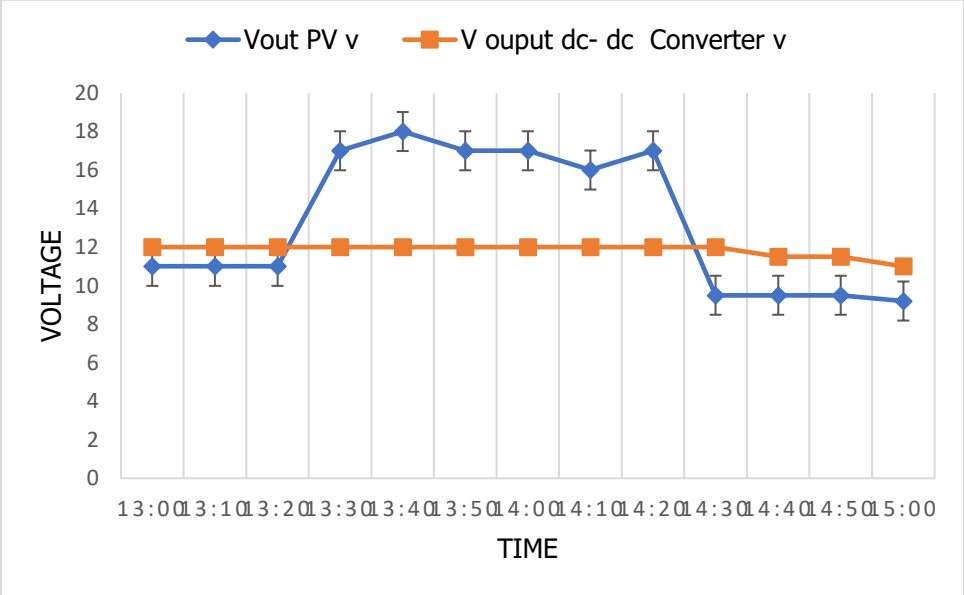

Figure 5. Characteristics of the voltage function of time

The characteristics in Figure 5 describe the magnitude of the voltage generated by the solar panel at least 9, at 2 volts DC, after switching to the DC-DC converter. First, the voltage is stabilized to 11 volts, then increased above 16 to 18 volts DC so that the output voltage of the DC-DC converter becomes 12 volts DC.

Conclusion

The solar panel voltage generation system can be optimized by following a certain procedure. The solar panel voltage can be stabilized by installing a DC-DC up/down converter. If the solar panel voltage is above the setting voltage of the DC-DC converter, then the converter will function as a down voltage so that the output is by the settings. And if the voltage (UP) of the

solar panel is below the voltage setting of the DC-DC converter, the converter will function as a voltage increaser following the settings. The voltage that can be stabilized above 16 volts will be reduced to 12 volts DC. While the stabilized voltage is below the converter setting voltage from 9 volts, it is increased to 12 volts DC.

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