Image Based Leaf Area Measurement Method Using Artificial Neural Network

Joko Siswantoro
Department of Informatics Engineering Universitas Surabaya
Surabaya, Indonesia
joko_siswantoro@staff.ubaya.ac.id

Ida Bagus Made Artadana
Department of Biology Universitas Surabaya
Surabaya, Indonesia
arta@staff.ubaya.ac.id

***Abstract*—Leaf area is an important parameter in plant monitoring. An automatic method for measuring leaf area is needed to obtain accurate result. In this paper, a method for automatic leaf area measurement from image is proposed. The method captured the image of leaf without object reference. Four features were extracted from the image and used as input to artificial neural network for estimating leaf area. The experiment results show that the proposed method can measure leaf area with mean absolute relative error less than 1% and less computational time.**

Keywords*—*leaf area measurement, automatic, artificial neural network, image processing

I. Introduction

Leaf area plays an important role in plant monitoring, including monitoring plant growth, plant competition, and plant yield [1]. Moreover, leaf area can be used to measure the performance of mechanism occurred in a plant [2]. Traditionally, leaf area measurement can be performed manually using grid counting method [3-5] or paper weighing method [1]. These methods are simple in practice but time consuming. Furthermore, the measurement accuracy for these methods depends on the expertise of the operator.

To overcome the problems occurred in traditional leaf area measurement method, several alternative methods for leaf area measurement have been proposed. Córcoles, et al. [6] and Amiri and Shabani [7] have proposed semi-automatic methods for measuring leaf area. They manually measured the length and width of leaf and inputted the results to a computer program for estimating leaf area using general linear regression model (GLM) [6] and adaptive neural-based fuzzy inference system (ANFIS) [7]. The methods have been validated using several types of leaves and produced high coefficient of determination. However, the accuracy of the methods is very dependent on the expertise of the operator in measuring length and width manually.

Gong, et al. [2], Lü, et al. [3], Patil and Bodhe [4], and Radzali, et al. [5] have been proposed automatic methods to measure leaf area by utilizing image processing technique. To measure leaf area, the proposed methods captured the image of measured leaf and an object reference with known area together using a camera. The image was then processed to obtain a binary image. Leaf area was calculated by comparing the number of leaf pixels and the number of object reference pixels in the binary image and then multiplying the result with actual object reference area. The proposed methods have been validated and produced low error. However, the using of object reference could lead a problem during segmentation process and finally could decrease measurement accuracy. In addition, the method proposed by Gong, et al. [2] was not fully automatic; the user intervention was still needed during segmentation process.

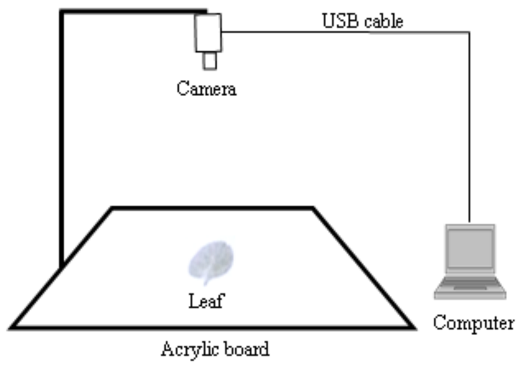
Therefore, an automatic leaf area measurement method which does not need object reference and user intervention need to be developed. A synergy between image processing technique and artificial neural network (ANN) can be considered for solving the problems. ANN is a nonlinear model that imitates human nervous system and has simple computation [8]. ANN has been applied to solve classification and prediction problems in several areas, such as natural produce recognition using computer vision [9], egg volume measurement using computer vision [10], biodiesel production optimization [11], and gas concentration estimation for electronic nose [12].

This paper proposes an image based leaf area measurement method using ANN. The proposed method uses length, width, area, and perimeter of leaf extracted from the image of measured leaf and used the features as input to ANN for predicting leaf area. Therefore the proposed method can be used to measure leaf area without object reference and user intervention. The rest of the paper is arranged as follow. Section 2 explains the material and the detail of all steps used in the proposed method. Section 3 describes the experimental setup for validating the proposed method. Section 4 presents experimental results and discussion. Finally, conclusion is drawn in Section 5.

II. Materials and Method

A. Materials

Hardware used in the proposed method consisted of a camera, two flat acrylic boards, an USB cable, and a computer, as shown in Fig. 1. A Logitech® HD Webcam c270h was used to capture the image of measured leaf. The camera was located on the above of measured leaf at a distance of 50 cm with an orientation such that the image plane is parallel to leaf surface and connected to the computer using the USB cable.



978-1-5386-8448-1/19/$31.00 ©2019 IEEE

Fig. 1. Hardware used in the proposed leaf area measurement method.

To flatten the measured leaf, the leaf was placed between two flat acrylic boards. The lower board was white painted and used as background during image acquisition. The proposed system employed a 2.20GHz Intel Core 2 portable computer with RAM 4GB and Windows 7 operating system to control the camera, process the acquired image, and measure leaf area.

To validate the proposed method, 30 samples of leaf were chosen randomly from an area around Universitas Surabaya. The samples consisted of 10 kailan (Brassica oleracea Alboglabra Group) leaves, 10 ipecac (Cephaelis ipecacuanha) leaves, and 10 wild betel (Piper sarmentosum Roxb. Ex Hunter) leaves. The exact area of all samples were measured manually using paper weighing method [1].

B. Method

The proposed leaf area measurement method consisted of a series steps starting from image acquisition followed by preprocessing, segmentation, features extraction, and leaf area estimation. The details for every step are explained in the following subsections.

1) Image Acquisition

The measured leaf was located between two flat acrylic boards during image acquisition. The image of measured leaf was captured using the camera with a white background. The white background was chosen since in general the color of leaf is different from white. Therefore leaf pixels could be easily separated from background pixels during segmentation step. The image was captured in RGB color space and was then saved in PNG file for further process. Every leaf sample was captured twice in vertical and horizontal directions. The examples of captured image are shown in Fig. 2.

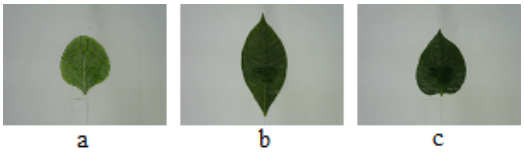


Fig. 2. The exaples of captured image: (a) kailan, (b) ipecac, (c) wild betel.

2) Preprocessing

In preprocessing step, the captured image was converted from image in RGB color space to gray scale image by calculating the weighted average of R, G, and B values for every pixel in the captured image. To reduce noises produced by the camera, a 5×5 Gaussian filter [13] was applied to the gray scale image. Fig. 3 shows the example of preprocessing result.

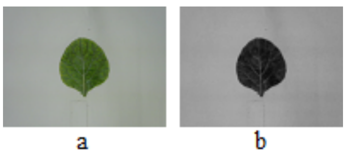


Fig. 3. The example of preprocessing result: (a) captured image, (b) gray scale image.

3) Segmentation

Segmentation step was used to separate leaf pixels from background pixels in the gray scale image. The proposed method employed thresholding method [13] in this step. The threshold value T was automatically determined using Otsu method [14]. As can be seen in Fig. 3 (b), the intensity of leaf pixel in the gray scale image was less than the intensity of background pixel; therefore a pixel in the gray scale image with intensity less than T was categorized as leaf pixel with binary value 1 (white pixel), otherwise as background pixel with binary value 0 (black pixel). The result of segmentation step was a binary image, as shown in Fig. 4.

Fig. 4. The example of segmentation result: (a) captured image, (b) binary image.

4) Features Extraction

In this step, four features were extracted from leaf pixels in the binary image. The extracted features were used to estimate the area of measured leaf in the next step. The features were length, width, area, and perimeter.

- Length (*L*) was defined as the length (in pixels) of major axis of measured leaf. The major axis was defined as line connecting between two pixels on the leaf boundary that have the longest distance in the binary image, as shown in Fig. 5 (a).
- Width (*W*) was defined as the length (in pixels) of minor axis of measured leaf. The minor axis was defined as line connecting between two pixels on the leaf boundary that perpendicular to the major axis in the binary image, as shown in Fig. 5 (b).
- Area (*A*) was defined as the number of leaf pixels (white pixels) in the binary image, as shown in Fig. 5 (c).
- Perimeter (*P*) was defined as the number of pixels on the leaf boundary in the binary image, as shown in Fig. 5 (d).

Fig. 5. The extracted features: (a) length, (b) width, (c) area, (d) perimeter

5) Leaf Area Estimation

To estimate the area of measured leaf, the proposed method used an artificial neural network based on the features extracted in the previous step. The architecture of ANN consisted of three layers, which are an input layer, a hidden layer, and an output layer. The output layer had one neuron that corresponds to leaf area. The number of neurons in the input layer depended on the number of features used to estimate the area of measured leaf. To obtain high leaf area estimation accuracy, a feature selection was performed by inputting all possible combination of features to ANN. Therefore, there were 15 ANNs with different input. The number of neurons in the hidden layer was heuristically determined in the range of 2 and 5 in an experiment such that the ANN produces high leaf area estimation accuracy.

The ANN used hyperbolic tangent sigmoid, as in (1), and linear functions, as in (2), as transfer functions from the input layer to the hidden layer and from the hidden layer to the output layer, respectively. The ANN was trained using back propagation algorithm [15] with mean square error (MSE) used as performance function. All features were scaled to $\left[-1,1\right]$ before training process to avoid the domination of a feature against the others and to speed up training process [9].

$$f\left(x\right)=\frac{1-e^{-2x}}{1+e^{-2x}} \quad (1)$$

$$f\left(x\right)=x \quad (2)$$

III. Experimental Setup

To validate the proposed method, an experiment has been conducted in laboratory. In the experiment every leaf sample was captured twice in vertical and horizontal direction. Therefore, there were 20 leaf images from every type of leaf or there were 60 images data in total.

Five-fold cross validation was used to develop training and testing data from 60 leaf images [16]. All images data were randomly divided into five mutually exclusive sub data with equal size. One of sub data was used as testing data and 4 remaining sub data were used as training data. This process was repeated 5 times such that every sub data is used as testing data once.

In every training process, ANN was trained with 15 different input combinations and the different number of nodes in hidden layer. MSE between the exact area and its estimation was calculated for testing data to measure the accuracy of ANN in every training process. ANN with the lowest MSE was then used in the proposed method. In addition the training time was also considered in determining the best ANN.

Furthermore, the proposed method was used to measure the leaf area of all samples. Absolute relative error (ARE) between the exact area and the area measured using the proposed method was calculated for all samples to measure the accuracy of the proposed method. ARE was calculated using (3),

$$ARE=\frac{\left|A_E-A_P\right|}{A_E}\times 100\% \quad (3)$$

where A_E and A_P are the exact area and the area measured using the proposed method, respectively.

IV. Result and Discussion

The proposed method was implemented in a software using Visual C++ 2010 with open source computer vision library OpenCV 231 [17]. The software was used in the experiment to measure the leaf area of all samples. The experiment results are explained in the following sub sections.

A. The Architecture of ANN

The results of feature selection and determining the number of hidden nodes in the hidden layer experiments are summarized in TABLE I. As can be seen in TABLE I. The higher accuracy with average MSE of 0.249 was achieved if ANN used *W*, *A*, and *P* as input features and three nodes in the hidden layer, shown in TABLE I. The training time for such ANN architecture was 2.983 s. From TABLE I, it can also be seen that the second higher estimation accuracy with average MSE of 0.251 was obtained if ANN used L and A as input features and four nodes in the hidden layer. However, by using this architecture, there was an increase in training time of 1.504 s.

TABLE I. THE RESULTS OF FEATURE SELECTION AND DETERMINING THE NUMBER OF HIDDEN NODES IN THE HIDDEN LAYER EXPERIMENTS

	Average MSE			
The Number of Nodes in Hidden Layer	*2*	*3*	*4*	*5*
Input Features				
L	34.562	35.786	30.901	**25.443**
W	148.050	**117.069**	121.946	122.131
A	0.536	0.398	**0.355**	1.160
P	**11.224**	15.888	13.500	12.737
L, W	1.386	1.293	1.063	**0.956**
L, A	0.345	0.340	**0.251**	0.279
L, P	11.186	19.587	**10.649**	10.768
W, A	0.347	0.669	0.352	**0.271**
W, P	2.632	**2.170**	3.295	2.667
A, P	0.554	**0.255**	0.349	0.299
L, W, A	0.357	0.380	0.510	**0.344**
L, W,P	1.251	1.384	1.311	**1.173**
L, A, P	0.476	0.337	**0.274**	0.449
W, A, P	0.401	**0.249**	0.341	0.384
L, W, A, P	0.471	0.341	0.308	**0.277**

Based on these results, the proposed method employed two ANN architectures to estimate leaf area. The first architecture consisted of an input layer with two input nodes corespond to *L* and *A* features, a hidden layer with four nodes and an output layer with one node correspond to leaf area, as shown in Fig. 6. The second architecture consisted of an input layer with three input nodes corespond to *W*, *A*, and *P* features, a hidden layer with three nodes and an output layer with one node correspond to leaf area, as shown in Fig. 7.

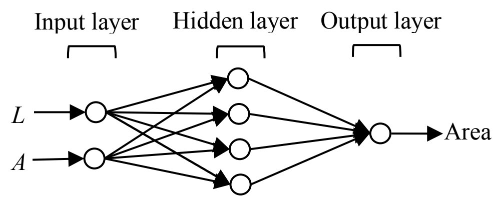


Fig. 6. The first ANN architecture used in the proposed method

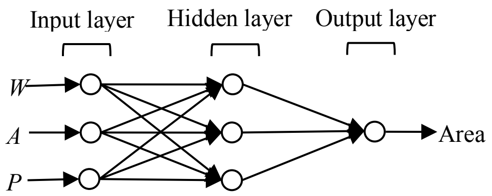


Fig. 7. The second ANN architecture used in the proposed method

B. Leaf Area Measurement

The results of leaf area measurement experiment for all samples using the proposed method with the first and the second ANN architectures are summarized in TABLE II and TABLE III, respectively. As can be seen in TABLE II and TABLE III, on average leaf area measured using the proposed method with the first and the second ANN architectures closed to exact leaf with mean ARE less than 1%. This results show that the proposed method has high measurement accuracy in measuring leaf area of all samples.

TABLE II. THE MEASUREMENT RESULTS USING THE PROPOSED METHOD WITH THE FIRST ANN ARCHITECTURE

Leaf Sample	Average Area(cm^2)		Mean ARE (%)
	Exact	*Proposed method*	
Kailan	29.996	30.060	0.783
Ipecac	52.809	52.939	0.586
Wild betel	36.896	36.869	0.939
All samples	39.900	39.956	0.769

TABLE III. THE MEASUREMENT RESULTS USING THE PROPOSED METHOD WITH THE SECOND ANN ARCHITECTURE

Leaf sample	Average Area(cm^2)		Mean ARE (%)
	Exact	*Proposed method*	
Kailan	29.996	29.912	0.635
Ipecac	52.809	52.802	0.301
Wild betel	36.896	37.000	0.871
All samples	39.900	39.905	0.602

For both ANN architectures, the lowest and highest mean ARE were achieved by the proposed method in measuring ipecac and wild betel leaves, respectively. The proposed method with the first ANN architecture produced mean ARE of 0.7796%. On the other hand, with the second ANN architecture the proposed method produced lower mean ARE, which is 0.602%. Based on this condition, it can be inferred that by employing the second ANN architecture the proposed method produce more accurate leaf area measurement result.

For further analysis, the linear relationship between leaf area measured using the proposed method and exact leaf area was also investigated. Fig. 8 and Fig. 9 show this linear relationship for the first and the second ANN architectures, respectively. It can be seen in Fig. 8 and Fig. 9, leaf area measured using the proposed method and exact leaf area had high linear relationship with coefficient of determination (R^2) greater than 0.99 for both ANN architectures. It means that more that 99% variation in the exact leaf area can be explained by a linear relationship with leaf area measured using the proposed method. From computational time point of view, the proposed method only needed less than 0.1 s for measuring area of a leaf.

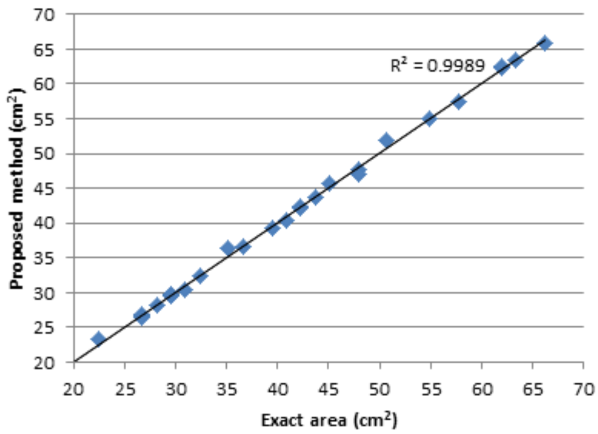


Fig. 8. The linear relationship between exact area and area measured using the proposed method with the first ANN architecture

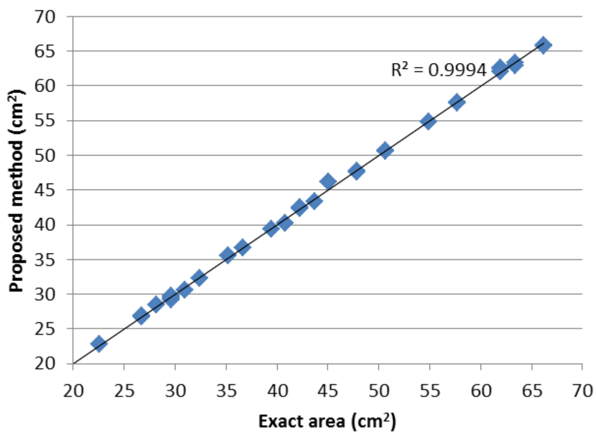


Fig. 9. The linear relationship between exact area and area measured using the proposed method with the second ANN architecture

V. CONCLUSION

An image based method for measuring leaf area using artificial neural network (ANN) is proposed in this paper. The method used a camera to capture the image of measured leaf from the distance of 50 cm. The image was processed to produce a binary image. From the binary image, four features were extracted and used as input to ANN for estimating leaf area. The proposed method has been tested using three types of leaf, including kailan, ipecac, and wild betel in an experiment. The experiment results show that the proposed method has high measurement accuracy compared to exact area with mean absolute relative error less than 1%. In addition, leaf area measured using the proposed method has high linear relationship with exact leaf area. Therefore the proposed method can be considered as alternative for manual measurement method in measuring leaf area. For future study, the application of the proposed method in plant growth monitoring needs to be investigated.

ACKNOWLEDGMENT

The authors would like to thank Universitas Surabaya for providing facilities and financial support under Competitive Research Grant No. 033/Lit/LPPM-01/FT/V/2018.

REFERENCES

[1] S. K. Pandey and H. Singh, "A Simple, Cost-Effective Method for Leaf Area Estimation," Journal of Botany, vol. 2011, p. 6, 2011.

[2] A. Gong, X. Wu, Z. Qiu, and Y. He, "A handheld device for leaf area measurement," Computers and Electronics in Agriculture, vol. 98, pp. 74-80, 2013/10/01/ 2013.

[3] C. Lü, H. Ren, Y. Zhang, and Y. Shen, "Leaf Area Measurement Based on Image Processing," in 2010 International Conference on Measuring Technology and Mechatronics Automation, 2010, pp. 580-582.

[4] S. B. Patil and S. K. Bodhe, "Betel leaf area measurement using image processing," International Journal on Computer Science and Engineering, vol. 3, pp. 2656-2660, 2011.

[5] M. H. Radzali, N. A. M. Kamal, and N. M. Diah, "Measuring Leaf Area using Otsu Segmentation Method (LAMOS)," Indian Journal of Science and Technology, vol. 9, pp. 1-6, 2016.

[6] J. I. Córcoles, A. Domínguez, M. A. Moreno, J. F. Ortega, and J. A. de Juan, "A non-destructive method for estimating onion leaf area," in Irish Journal of Agricultural and Food Research vol. 54, ed, 2015, p. 17.

[7] M. J. Amiri and A. Shabani, "Application of an Adaptive Neural-Based Fuzzy Inference System Model for Predicting Leaf Area," Communications in Soil Science and Plant Analysis, vol. 48, pp. 1669-1683, 2017.

[8] J. Siswantoro, A. S. Prabuwono, A. Abdullah, and B. Idrus, "A linear model based on Kalman filter for improving neural network classification performance," Expert Systems with Applications, vol. 49, pp. 112-122, 2016.

[9] J. Siswantoro, A. S. Prabuwono, A. Abdullah, and B. Indrus, "Hybrid Neural Network and Linear Model for Natural Produce Recognition Using Computer Vision," Journal of ICT Research and Applications, vol. 11, pp. 185-199, 2017.

[10] J. Siswantoro, M. Hilman, and M. Widiasri, "Computer vision system for egg volume prediction using backpropagation neural network," in IOP Conference Series: Materials Science and Engineering, 2017, p. 012002.

[11] F. Kusumo, A. Silitonga, H. Masjuki, H. C. Ong, J. Siswantoro, and T. Mahlia, "Optimization of transesterification process for Ceiba pentandra oil: A comparative study between kernel-based extreme learning machine and artificial neural networks," Energy, vol. 134, pp. 24-34, 2017.

[12] S. I. Sabilla, R. Sarno, and J. Siswantoro, "Estimating gas concentration using artificial neural network for electronic nose," Procedia Computer Science, vol. 124, pp. 181-188, 2017.

[13] R. C. Gonzalez and R. E. Woods, Digital Image Processing, 2nd ed.: Prentice Hall, 2002.

[14] N. Otsu, "A Threshold Selection Method from Gray-Level Histograms," Systems, Man and Cybernetics, IEEE Transactions on, vol. 9, pp. 62-66, 1979.

[15] D. E. Rumelhart, G. E. Hinton, and R. J. Williams, "Learning internal representations by error propagation," in Parallel Data Processing. vol. 1, D. Rumelhart and J. McClelland, Eds., ed Cambridge: MIT Press, 1986, pp. 318–362.

[16] E. Alpaydin, Introduction to machine learning, ke-2 ed. Cambridge, Massachusetts: MIT Press, 2010.

[17] G. Bradski, "The OpenCV Library," Dr. Dobb's Journal: Software Tools for the Professional Programmer, vol. 25, pp. 120-123, 2000.

UNIVERSITAS ATMA JAYA YOGYAKARTA
KALBIS Institute
Science • Technology • Business
IEEE INDONESIA SECTION
IEEE The Indonesia Section Computer Society Chapter

PROCEEDING

2019 INTERNATIONAL CONFERENCE OF ARTIFICIAL INTELLIGENCE AND INFORMATION TECHNOLOGY (ICAIIT 2019)

IEEE Conference Number #45307

IEEE Catalog Number : CFP19JVE-ART
ISBN : 978-1-5386-8448-1

13 - 15 March 2019
Platinum Adisucipto Hotel & Conference Center
Yogyakarta

supported by:
Universitas Pancasila

Proceeding - 2019 International Conference of Artificial Intelligence and Information Technology, ICAIIT 2019

COUNTRY

United States

Universities and research institutions in United States

SUBJECT AREA AND CATEGORY

Computer Science
- Artificial Intelligence
- Computer Networks and Communications
- Computer Science Applications
- Information Systems
- Signal Processing

Mathematics
- Control and Optimization

PUBLISHER

H-INDEX

4

PUBLICATION TYPE

Conferences and Proceedings

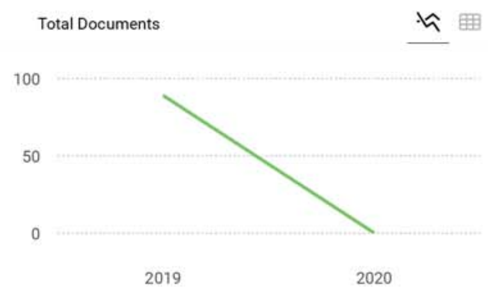
ISSN

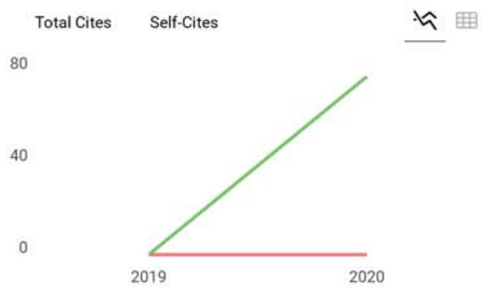
-

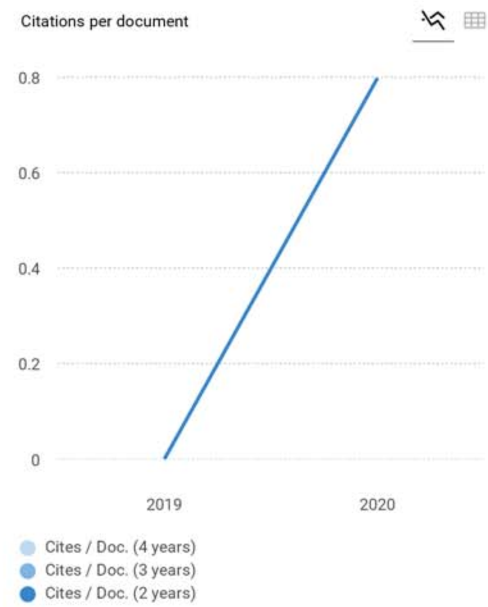
COVERAGE

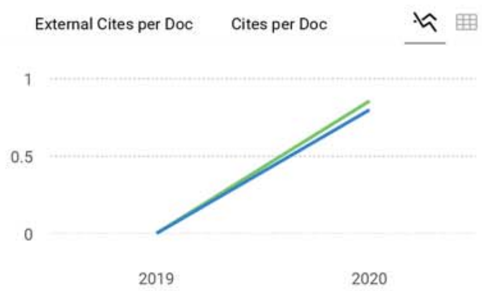
2019

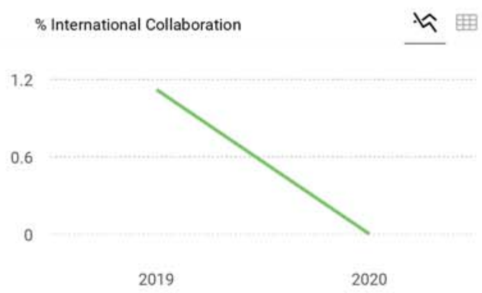
Join the conversation about this journal

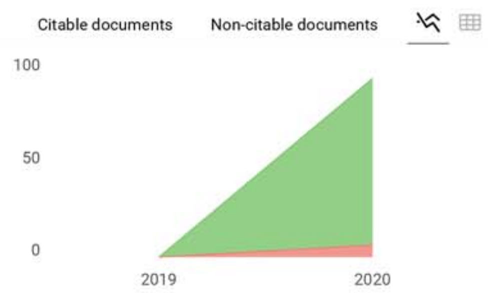


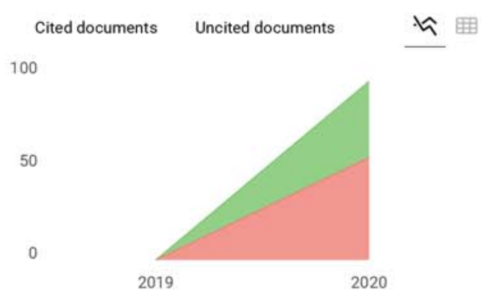












← Show this widget in your own website

Just copy the code below and paste within your html code:

<a href="https://www.scim

Metrics based on Scopus® data as of April 2021

Leave a comment

Name

Email
(will not be published)

I'm not a robot
reCAPTCHA
Privacy - Terms

Submit

The users of Scimago Journal & Country Rank have the possibility to dialogue through comments linked to a specific journal. The purpose is to have a forum in which general doubts about the processes of publication in the journal, experiences and other issues derived from the publication of papers are resolved. For topics on particular articles, maintain the dialogue through the usual channels with your editor.

UNIVERSITAS ATMA JAYA YOGYAKARTA

KALBIS Institute
Science • Technology • Business

IEEE INDONESIA SECTION

IEEE The Indonesia Section Computer Society Chapter

ICAIIT
INTERNATIONAL CONFERENCE OF ARTIFICIAL INTELLIGENCE AND INFORMATION TECHNOLOGY

2019 INTERNATIONAL CONFERENCE OF ARTIFICIAL INTELLIGENCE AND INFORMATION TECHNOLOGY (ICAIIT 2019)

13 - 15 March 2019

Platinum Adisutjipto Yogyakarta
Hotel & Conference Center

IEEE Conference Number #45307

IEEE Catalog Number : CFP19JVE-ART
ISBN : 978-1-5386-8448-1

supported by:
Universitas Pancasila

COPYRIGHTS

2019 International Conference of Artificial Intelligence and Information Technology

IEEE Conference Number #45307

IEEE Catalog Number : CFP19JVE-ART

ISBN : 978-1-5386-8448-1

Additional copies of this publication is available from

IEEE Conference Operations
445 Hoes Lane
Piscataway, NJ 08854 USA
Fax: +1 732 981 1769
Email: conference-ops@ieee.org
Availability: Monday-Friday 08:00 - 16:30 Eastern Standard Time
IEEE: Advancing Technology for Humanity

supported by:
Universitas Pancasila

International Conference of Artificial Intelligence and Information Technology 2019 (ICAIIT)

Organizing Committees

(IEEE International Conference #45307)

Honorary Chair:

- Dr. Gregorius Sri Nurhartanto, S.H., LL.M. (Universitas Atma Jaya Yogyakarta)
- Dr. A. Teguh Siswantoro, M.Sc (Universitas Atma Jaya Yogyakarta)
- Dr. Hadi Sutopo (Institut Teknologi dan Bisnis Kalbis)
- Prof. Andrea Corradini (Copenhagen School of Design and Technology, Denmark)
- Associate Professor Wladyslaw Homenda (Warsaw University of Technology, Poland)
- Dr. Suryadiputra Liawatimena (The Indonesia Section Computer Society Chapter, Indonesia)
- Wu Hai Yong, Ph.D.(Nanjing Xiaozhuang University, China)

General Chair:

- Martinus Maslim (Universitas Atma Jaya Yogyakarta)
- Yulius Denny Prabowo (Institut Teknologi dan Bisnis Kalbis)

Co-Chair:

- Stephanie Pamela Adithama (Universitas Atma Jaya Yogyakarta)
- Jullend Gatc (Institut Teknologi dan Bisnis Kalbis)

Liaison Chair:

- Vinindita Citrayasa (Universitas Atma Jaya Yogyakarta)
- Anjar Dwi Astono (Institut Teknologi dan Bisnis Kalbis)

Media and Information Chair:

- Thomas Adi Purnomo Sidhi (Universitas Atma Jaya Yogyakarta)
- Andreas Hemawan Tri N. (Universitas Atma Jaya Yogyakarta)

Program Chair:

- B. Yudi Dwiandiyanta (Universitas Atma Jaya Yogyakarta)
- Eduard Rusdianto (Universitas Atma Jaya Yogyakarta)

Publication Chair:

- Yulius Harjoseputro (Universitas Atma Jaya Yogyakarta)
- Findra Kartika Sari Dewi (Universitas Atma Jaya Yogyakarta)

Program Committee:

- Agustinus Kris Handoyo (Universitas Atma Jaya Yogyakarta)
- Lucia Misa Indrawati (Universitas Atma Jaya Yogyakarta)

978-1-5386-8448-1/19/$31.00 ©2019 IEEE
2019 International Conference of Artificial Intelligence and Information Technology
supported by: Universitas Pancasila

Technical Committee (reviewers) :

- Dr. Alb. Joko Santoso (Universitas Atma Jaya Yogyakarta, Indonesia)
- Prof. Suyoto (Universitas Atma Jaya Yogyakarta, Indonesia)
- Dr. Pranowo (Universitas Atma Jaya Yogyakarta, Indonesia)
- Dr. Andi Wahju Rahardjo Emanuel (Universitas Atma Jaya Yogyakarta, Indonesia)
- The Jin Ai, S.T., M.T., Dr.Eng. (Universitas Atma Jaya Yogyakarta, Indonesia)
- Paulus Mudjihartono, S.T., M.T. (Universitas Atma Jaya Yogyakarta, Indonesia)
- Kusworo Anindito, S.T., M.T. (Universitas Atma Jaya Yogyakarta, Indonesia)
- Y. Sigit Purnomo WP., S.T., M.Kom. (Universitas Atma Jaya Yogyakarta, Indonesia)
- Harya Bima Dirgantara S.Kom., M.T.I. (Kalbis Institute, Indonesia)
- Alfa Ryano Yohannis S.T., M.T. (Kalbis Institute, Indonesia)
- Asst. Prof. Thitipong Tanprasert, Ph.D (Assumption University, Thailand)
- Dr. Benjawan Srisura (Assumption University, Thailand)
- Prof. Nanna Suryana Herman (Universiti Teknikal Malaysia Melaka, Malaysia)
- Dr. Jaziar Radianti (University of Agder, Norway)
- I Putu Edy Suardiyana Putra (Macquarie University, Australia)
- Thomas Suselo, S.T., M.T. (University of Auckland, Australia)
- Ahmed Hussein (University of Mustansiriyah, Iraq)
- Shir Mohammad Tavangari (University of Zurich, Switzerland)
- Dr. Inggriani Liem (Institut Teknologi Bandung, Indonesia)
- Dr. Ridi Ferdiana (Universitas Gadjah Mada Yogyakarta, Indonesia)
- Prof. Eko Sediyono (Universitas Kristen Satya Wacana Salatiga, Indonesia)
- Dr. Adhi Dharma Wibawa (Institute Teknologi Sepuluh Nopember, Indonesia)
- Prof. Dr. Adi Wijaya (Telkom University, Indonesia)
- Dr. Mujiono Sadikin (Universitas Mercu Buana, Indonesia)
- Ionia Veritawati, S.Si., M.T. (Universitas Pancasila, Indonesia)
- Febri Maspiyanti, S.Kom., M.Kom (Universitas Pancasila, Indonesia)
- Diah Harnoni Apriyanti, S.T, M.Kom. (Indonesian Institute of Sciences)
- Firman Anindra, S.T., MTI (Universitas Nasional, Indonesia)
- Erick Fernando, S.Kom., MSI (Bina Nusantara University, Indonesia)
- Surjandy, S.Kom., M.M. (Bina Nusantara University, Indonesia)
- Dr. Sudi Mungkasi (Sanata Dharma University, Indonesia)
- Iwan Binanto, S.Si., M.Cs. (Sanata Dharma University, Indonesia)
- Teny Handhayani, S.Kom, M.Kom (Tarumanagara University, Indonesia)

Table of Contents

978-1-5386-8448-1/19/$31.00 ©2019 IEEE
2019 International Conference of Artificial Intelligence and Information Technology
supported by: Universitas Pancasila

International Conference of Artificial Intelligence and Information Technology 2019 had been listed at IEEE Conference number 45307 (https://conferences.ieee.org/conferences_events/conferences/conferencedetails/45307).

Papers in International Conference of Artificial Intelligence and Information Technology 2019 for media communication only which is spread among the authors, Keynote speakers, and other academic colleagues in the International Conference of Artificial Intelligence and Information Technology 2019, at 13-14 March 2019 at Platinum Adisucipto Hotel & Conference Center, Yogyakarta, Indonesia.

Each paper which is shown in this International Conference of Artificial Intelligence and Information Technology 2019 can be appeared at proceeding of International Conference of Artificial Intelligence and Information Technology 2019 where the authors of each paper should :

1. Present their paper
2. Submit the paper's revision to icaiit.reg@uajy.ac.id

Failing to do the requirement will be subjected to eliminated from proceeding of International Conference of Artificial Intelligence and Information Technology 2019.

International Conference of Artificial Intelligence and Information Technology 2019
Conference Schedule

Wednesday, 13 March 2019

Time	Activity		
08.00 - 09.00	Participants Registration & Materials Collection		
09.00 - 10.00	Welcome Speech & Opening Ceremony - General Chair of ICAIIT 2019 - Rector Kalbis Institute - Rector Universitas Atma Jaya Yogyakarta		
10.00 - 10.30	Coffee Break		
10.30 - 11.15	Keynote Speech 1 Professor Andrea Corradini (Copenhagen School of Design and Technology, Denmark) Speech Title: Multimodal Data Analysis		
11.15 - 12.00	Keynote Speech 2 HAIYONG WU, Ph. D (School of Information Engineering, Nanjing Xiaozhuang University) Speech Title: Deep Learning in Tractography		
12.00 - 13.00	Lunch		
13.00 - 15.00 (15 Minutes presentation per paper) ***Session 1:*** 1:13.00-13.15 2:13.15-13.30 3:13.30-13.45 4:13.45-14.00	**Titanium 1** 1.1570508359 2.1570526507 3.1570526480 4.1570526013 5.1570518440 6.1570519077 7.1570518796	**Titanium 2** 1. 1570512443 2. 1570512569 3. 1570514049 4. 1570507038 5. 1570512457 6. 1570526214 7. 1570513290	**Titanium 3** 1. 1570512696 2. 1570512578 3. 1570512583 4. 1570512614 5. 1570512722 6. 1570512735 7. 1570518672

5:14.00-14.15 6:14.15-14.30 7:14.30-14.45				
15.00 - 15.30	Coffee Break			
15.30 - 17.00 (15 Minutes presentation per paper) ***Session 2:*** 1:15.30-15.45 2:15.45-16.00 3:16.00-16.15 4:16.15-16.30 5:16.30-16.45 6:16.45-17.00	**Titanium 1** 1.1570515432 2.1570526222 3.1570526304 4.1570526319 5.1570526544 6.1570526452	**Titanium 2** 1.1570513614 2.1570497900 3.1570497821 4.1570512658 5.1570523975 6.1570525893	**Titanium 3** 1.1570526455 2.1570526552 3.1570516699 4.1570513732 5.1570509093 6.1570526401	**Ballroom 1** 1. 1570521650 2. 1570526538 3. 1570526466 4. 1570526453 5. 1570524081 6. 1570513593
18.00 - 20.00	Gala Dinner at Rama Shinta Resto Prambanan Temple			

Thursday, 14 March 2019

Time	**Activity**			
08.00 - 09.00	Registration & Coffee Break			
09.00 - 09.45	Keynote Speech 3 Dr. Suryadiputra Liawatimena, S.Kom., PgDip.App.Sci (Universitas Bina Nusantara, Indonesia) Speech Title: Artifical Intelligence in Agriculture & Fishery			
09.45 - 10.30	Keynote Speech 4: Associate Professor Władysław Homenda (Warsaw University of Technology, Poland) Speech Title: Cognitive Maps for Time Series Modeling			
10.30 - 11.30 (15 Minutes presentation per paper) ***Session 3:*** 1:10.30-10.45 2:10.45-11.00 3:11.00-11.15 4:11.15-11.30	**Titanium 1** 1.1570526412 2.1570526525 3.1570516332 4.1570526533	**Titanium 2** 1. 1570526555 2. 1570526750 3. 1570508178 4. 1570526557	**Ballroom 1** 1. 1570526547 2. 1570526500 3. 1570511011 4. 1570522671	**Ballroom 2** 1. 1570526541 2. 1570512562 3. 1570513741 4. 1570513710
11.30 - 12.30	Lunch			
12.30 - 15.00 (15 Minutes presentation per paper) ***Session 4:*** 1:12.30-12.45 2:12.45-13.00 3:13.00-13.15 4:13.15-13.30 5:13.30-13.45 6:13.45-14.00 7:14.00-14.15 8:14.15-14.30 9:14.30-14.45 10:14.45-15.00	**Titanium 1** 1.1570526563 2.1570516556 3.1570523658 4.1570524898 5.1570524566 6.1570526512 7.1570484576 8.1570511144 9.1570520869	**Titanium 2** 1. 1570512995 2. 1570510797 3. 1570510791 4. 1570526499 5. 1570526192 6. 1570526423 7. 1570523474 8. 1570526180 9. 1570514074	**Ballroom 1** 1. 1570512694 2. 1570497875 3. 1570512201 4. 1570513608 5. 1570513712 6. 1570513896 7. 1570513597 8. 1570526714 9. 1570526573	**Ballroom 2** 1. 1570515288 2. 1570523931 3. 1570526385 4. 1570526502 5. 1570526281 6. 1570526529 7. 1570521672 8. 1570526218 9. 1570526456 10. 1570526549
15.00 - 15.30	Coffee Break			

978-1-5386-8448-1/19/$31.00 ©2019 IEEE
2019 International Conference of Artificial Intelligence and Information Technology

15.30 - 16.30	Closing Ceremony

Friday, 15 March 2019

Time	Activity
07.00 - 20.00	Excursion (for Full Package only)

978-1-5386-8448-1/19/$31.00 ©2019 IEEE
2019 International Conference of Artificial Intelligence and Information Technology

International Conference of Artificial Intelligence and Information Technology 2019

List of Papers

	(BALTRA AGUSTI PRAMAJURI, Erni Widarti, Suyoto)		
1570512614	IOT: Improved Home Energy Control System Based on Consumer Behavior (Melky Radja, Gilbert Gutabaga Hungilo, Gahizi Emmanuel, Suyoto)	Titanium 3 (1), 13.45-14.00	104
1570512658	A classification approach of emotional reactions while driving a vehicle (Andrea Corradini, Alexander Efa)	Titanium 2 (2), 16.15-16.30	109
1570512694	Determining the Neural Network Topology from the Viewpoint of Kuhn's Philosophy and Popper's Philosophy (MUHAMMAD IBNU CHOLDUN RACHMATULLAH, Kridanto Surendro, Judhi Santoso, Dimitri Mahayana)	Ballroom 1 (4), 12.30-12.45	115
1570512696	IoT-Based Smart And Healthy Wardrobe System (Fedelis Brian Putra Prakasa, Jaouja Maiga, Suyoto)	Titanium 3 (1), 13.00-13.15	119
1570512722	IoT Based: Hydroponic Using Drip Non-Circulation System for Paprika (Dhana Sudana, Dadang Eman, Suyoto)	Titanium 3 (1), 14.00-14.15	124
1570512735	Smart hydroponic farming with IoT-based climate and nutrient manipulation system (Rangga Perwiratama, Yosef Kelly Setiadi, Suyoto)	Titanium 3 (1), 14.15-14.30	129
1570512995	Audio Steganography Using Lifting Wavelet Transform and Dynamic Key (Mohamad Anwar, Moechammad Sarosa, Erfan Rohadi)	Titanium 2 (4), 12.30-12.45	133
1570513290	Automated Test Suite for Regression Testing Based on Serenity Framework: A Case Study (Fransiskus Anindita Kristiawan Pramana Gentur Sutapa, Sri Suning Kusumawardani, Adhistya Erna Permanasari)	Titanium 2 (1), 14.30-14.45	138
1570513593	Clutter Mitigation Technique on OFDM MIMO Radar (Risdilah Mimma Untsa, Gamantyo Hendrantoro, Puji Handayani)	Ballroom 1 (2), 16.45-17.00	145
1570513597	Switching Formation and Topology in Cooperative Multi-Agent Source Seeking Using Gradient Estimation (MOCHAMMAD SAHAL, Trihastuti Agustinah, Achmad Jazidie)	Ballroom 1 (4), 14.00-14.15	151
1570513608	Forming Formation of Particle Swarm using Artificial Neural Network Self Organizing Map (ANN-SOM) with 2-leveled Strategy (Bayu Fandidarma, Achmad Jazidie, Rusdhianto Efendi Abdul Kadir)	Ballroom 1 (4), 13.15-13.30	157
1570513614	Complexity Reduction for Multiview HEVC Codec Using FPGA (M. Suhairi, Wirawan, Endroyono, Astria Nur Irfansyah)	Titanium 2 (2), 15.30-15.45	163
1570513710	Trajectory Tracking Automated Guided Vehicle Using Fuzzy Controller (Mamat Septyan, Trihastuti Agustinah)	Ballroom 2 (3), 11.15-11.30	169
1570513712	Modified Ant Colony Algorithm For Swarm Multi Agent Exploration on Target Searching in Unknown Environment (Yoan Purbolingga, Achmad Jazidie, Rusdhianto Efendi Abdul Kadir)	Ballroom 1 (4), 13.30-13.45	175
1570513732	EEG-based Mental Fatigue Detection Using Cognitive Tests and RVM Classification (Andi Setiawan, Adhi Dharma Wibawa, Evi Septiana Pane, Mauridhi Hery Purnomo)	Titanium 3 (2), 16.15-16.30	180
1570513741	REINFORCEMENT POINT AND FUZZY INPUT DESIGN OF FUZZY Q-LEARNING FOR MOBILE ROBOT NAVIGATION SYSTEM (Arga Dwi Pambudi, Trihastuti Agustinah, Rusdhianto Efendi Abdul Kadir)	Ballroom 2 (3), 11.00-11.15	186
1570513896	Parameter Identifiability of Phased-MIMO Radar (Muttaqin Hardiwansyah, Syahfrizal Tahcfulloh , Gamantyo Hendrantoro)	Ballroom 1 (4), 13.45-14.00	192
1570514049	Review of Benefit Using Gamification Element for Countryside Tourism (Fedelis Brian Putra Prakasa, Andi Wahju Rahardjo Emanuel)	Titanium 2 (1), 13.30-13.45	196
1570514074	The Classification of the Movie Genre based on Synopsis of the Indonesian Film (Antonius Christiyanto Saputra, Pius Guiseppe Sarto Aji Tetuko, Giovani Christian Nugroho, Anjelina Br Sitepu, Stanley, Yohanes Sigit Purnomo WP)	Titanium 2 (4), 14.30-14.45	201
1570515288	A Study of Text Classification for Indonesian News Article (Grelly Lucia Yovellia Londo, Dwiky Hutomo Kartawijaya, Muhammad Rafi Aryasuta P, Hesti Tri Ivariyani, Dipo Ariyandi, Yohanes Sigit Purnomo WP)	Ballroom 2 (4), 12.30-12.45	205
1570515432	Big Data Analytics: Estimation of Destination for Users of Bus Rapid Transit (BRT) Public Transportation in Jakarta (MUHAMMAD SYARIF, Widyawan, Teguh Bharata Adji)	Titanium 1 (2), 15.30-15.45	209
1570516332	Gamification of Mobile-based Japanese Language Shadowing (Hans Christian Kurniawan, Benhard Sitohang, Satrio Adi Rukmono)	Titanium 1 (3), 11.00-11.15	215

978-1-5386-8448-1/19/$31.00 ©2019 IEEE
2019 International Conference of Artificial Intelligence and Information Technology
supported by: Universitas Pancasila

	Activities Around Campus (Rohmat Tulloh, Ridha Muldina Negara, Yayan Eka Yudha Prasetya, Sendy Saputra)	13.30	
1570526512	Backpropagation Implementation To Classify Dysgraphia In Children (Pratama Wisnu Samodro, Sari Widya Sihwi, Winarno)	Titanium 1 (4), 13.45-14.00	437
1570526525	The Repercussions of Game Multiplayer Online Battle Arena (Sasmoko, Senly Halim, Yasinta Indrianti, Yogi Udjaja, Jurike Moniaga, Brilly Andro Makalew)	Titanium 1 (3), 10.45-11.00	443
1570526529	A Review of Sentiment Analysis for Non-English Language (Fahim Djatmiko, Ridi Ferdiana, Muhammad Faris)	Ballroom 2 (4), 13.45-14.00	448
1570526533	The Influence of User Experience Playerunknown's Battlegrounds *Game* Toward Adaptive Learning (Jurike Moniaga, Bonavensius Yosua Aprilianus Tansil, Sasmoko, Yasinta Indrianti, Noerlina)	Titanium 1 (3), 11.15-11.30	452
1570526538	Implementation of Depth-HOG based Human Upper Body Detection On A Mini PC Using A Low Cost Stereo Camera (Bima Sena Bayu Dewantara, Fernando Ardilla, Ardiansyah At Thoriqy)	Ballroom 1 (2), 15.45-16.00	458
1570526541	Thermal Optimization on Incubator using Fuzzy Inference System based IoT (Renny Rakhmawati, Irianto, Farid Dwi Murdianto, Atabik Luthfi, Aviv Yuniar Rahman)	Ballroom 2 (3), 10.30-10.45	464
1570526544	A Neural Network based Approach for Predicting Indonesian Teacher Engagement Index (ITEI) (Sucianna Ghadati Rabiha, Sasmoko, Emny Harna Yossy, Yasinta Indrianti)	Titanium 1 (2), 16.30-16.45	469
1570526547	Incorporating Information Technology Concept to Sustainable Enterprise (Erda Guslinar Perdana, Husni S. Sastramihardja, Iping Supriana Suwardi)	Ballroom 1 (3), 10.30-10.45	475
1570526549	Auto-Encoding Progressive Generative Adversarial Networks for 3D Multi Object Scenes (Vedant Singh, Manan Oza, Himanshu Vaghela, Pratik Kanani)	Ballroom 2 (4), 14.45-15.00	481
1570526552	Pneumonia Detection with Deep Convolutional Architecture (Abdullah Faqih Al Mubarok, Ahmad Habbie Thias, Dominique Jeffrey Alamaro Maximilianus)	Titanium 3 (2), 15.45-16.00	486
1570526555	Audio Signal Transmission over Vehicular Channel with Moving Scatterer (Jans Hendry, Wahyu Pamungkas, Anggun Fitrian Isnawati, Eka Setia Nugraha)	Titanium 2 (3), 10.30-10.45	490
1570526557	Machine Learning for Data Processing in Vessel Telemetry System: Initial Study (Herry Susanto, Gunawan Wibisono)	Titanium 2 (3), 11.15-11.30	496
1570526563	Indonesian Sign Language (BISINDO) Translation System with ORB for Bilingual Language (Rahmatullah Arrizal Pranatadesta, Iping Supriana Suwardi)	Titanium 1 (4), 12.30-12.45	502
1570526573	An Efficient Resource Allocation Mechanism for Time-Sensitive Data in Dew Computing (M Saddam Hossain Khan, Puloma Roy, Fatema Khanam, Farzana Hannan Hera, Amit Kumar Das)	Ballroom 1 (4), 14.30-14.45	506
1570526714	Comparison Road Safety Education with and without IoT to Develop Perceptual Motor Skills in Early Childhood Children Aged 4-5 (Mario Nugroho Willyarto, Anggraeni S. Reksodipuro, Ulani Yunus, Suryadiputra Liawatimena)	Ballroom 1 (4), 14.15-14.30	511
1570526750	A Simple RBAC And SSO Architecture for ISONER Framework (I Made Sukarsa, I Ketut Gede Darma Putra, Nyoman Putra Sastra, Lie Jasa)	Titanium 2 (3), 10.45-11.00	517

978-1-5386-8448-1/19/$31.00 ©2019 IEEE
2019 International Conference of Artificial Intelligence and Information Technology
supported by: Universitas Pancasila

International Conference of Artificial Intelligence and Information Technology 2019
List of Papers Per Room

Titanium 1

Session	Time	Paper Code	Title
1	13.00-13.15	1570508359	Design of Manufacture Professional Training and Assessment Information System in The Implementation of PBET (Production Based Education and Training) Learning Activity Model
1	13.15-13.30	1570526507	HERO: Maximizing Student Potential to Mobilize Community Empowerment Activities Around Campus
1	13.30-13.45	1570526480	Predicting Candidates For Fit And Proper Test Using K-Nearest Neighbor
1	13.45-14.00	1570526013	Adapted Flower Pollination Algorithm for Lecturer-Class Assignment
1	14.00-14.15	1570518440	Predictive Analytics for Predicting Customer Behavior
1	14.15-14.30	1570519077	Fluid Simulation Based on Material Point Method with Neural Network
1	14.30-14.45	1570518796	Decision Support Systems to Determining Programme for Students Using DBSCAN And Naive Bayes
2	15.30-15.45	1570515432	Big Data Analytics: Estimation of Destination for Users of Bus Rapid Transit (BRT) Public Transportation in Jakarta
2	15.45-16.00	1570526222	Deep Learning-Based Patient Visits Forecasting Using Long Short Term Memory
2	16.00-16.15	1570526304	Customizable Dynamic Hand Gesture recognition System for Motor Impaired people using Siamese neural network
2	16.15-16.30	1570526319	Use of ARIMA Method To Predict The Number of Train Passenger In Malang City
2	16.30-16.45	1570526544	A Neural Network based Approach for Predicting Indonesian Teacher Engagement Index (ITEI)
2	16.45-17.00	1570526452	Study on a Train- and Bus-based Delay-Tolerant Networks: Scheduled Mobility and Impact on Routing
3	10.30-10.45	1570526412	The Effect of Game Experience from Counter-Strike: Global Offensive
3	10.45-11.00	1570526525	The Repercussions of Game Multiplayer Online Battle Arena
3	11.00-11.15	1570516332	Gamification of Mobile-based Japanese Language Shadowing
3	11.15-11.30	1570526533	The Influence of User Experience Playerunknown's Battlegrounds Game Toward Adaptive Learning
4	12.30-12.45	1570526563	Indonesian Sign Language (BISINDO) Translation System with ORB for Bilingual Language
4	12.45-13.00	1570516556	A Preliminary Performance Evaluation of Population-Based Algorithms in VANET
4	13.00-13.15	1570523658	Rough-Regression for Categorical Data Prediction based on Case Study
4	13.15-13.30	1570524898	FHC-Optimization Model for Deciding the Objective Hajj Pilgrims to Restricted Quota (Case Study: Hajj Pilgrimage Procedure in Indonesia)
4	13.30-13.45	1570524566	Improved Particle Swarm Optimization By Fast Simulated Annealing Algorithm
4	13.45-14.00	1570526512	Backpropagation Implementation To Classify Dysgraphia In Children
4	14.00-14.15	1570484576	A comparative study on variational autoencoders and generative adversarial network
4	14.15-14.30	1570511144	Design and Development Meeting Schedule Management Application using

978-1-5386-8448-1/19/$31.00 ©2019 IEEE
2019 International Conference of Artificial Intelligence and Information Technology

			the RAD Method
4	14.30-14.45	1570520869	Designing IT-based Skills and Competency Learning System

Titanium 2

Session	Time	Paper Code	Title
1	13.00-13.15	1570512443	The Priority of Tourism Destinations Development using 6AsTD Framework and TOPSIS
1	13.15-13.30	1570512569	Improve Smart Waste Management to Preserve Tourist Attractions Yogyakarta in IoT Environment
1	13.30-13.45	1570514049	Review of Benefit Using Gamification Element for Countryside Tourism
1	13.45-14.00	1570507038	Social Media Prototyping for Web-based Property Business
1	14.00-14.15	1570512457	Systematic Literature Review of Profiling Analysis Based on Social Media
1	14.15-14.30	1570526214	Harmonics Reduction for Four-Leg Distribution Network-Connected Single Phase Transformerless PV Inverter System Using Diagonal Recurrent Neural Network
1	14.30-14.45	1570513290	Automated Test Suite for Regression Testing Based On Serenity Framework: A Case Study
2	15.30-15.45	1570513614	Complexity Reduction for Multiview HEVC Codec Using FPGA
2	15.45-16.00	1570497900	Semi-Supervised Image-to-Image Translation
2	16.00-16.15	1570497821	Face Detection using Haar Cascades to Filter Selfie Face Image on Instagram
2	16.15-16.30	1570512658	A classification approach of emotional reactions while driving a vehicle
2	16.30-16.45	1570523975	Image Based Leaf Area Measurement Method Using Artificial Neural Network
2	16.45-17.00	1570525893	Detection of Anomalies in Citrus Leaves Using Digital Image Processing and T^2 Hotelling Multivariate Control Chart
3	10.30-10.45	1570526555	Audio Signal Transmission over Vehicular Channel with Moving Scatterer
3	10.45-11.00	1570526750	A Simple RBAC And SSO Architecture for ISONER Framework
3	11.00-11.15	1570508178	Simple Implementation of Fuzzy Controller for Low Cost Microcontroller
3	11.15-11.30	1570526557	Machine Learning for Data Processing in Vessel Telemetry System: Initial Study
4	12.30-12.45	1570512995	Audio Steganography Using Lifting Wavelet Transform and Dynamic Key
4	12.45-13.00	1570510797	Visual Servoing using Mixed Sensitivity $H\infty$ Control for Yaw-Pitch Camera Platform
4	13.00-13.15	1570510791	Real-time Moving Object Video Tracking using Support Vector Machines for Visual Servo Application
4	13.15-13.30	1570526499	Face Recognition of Low-Resolution Video Using Gabor Filter & Adaptive Histogram Equalization
4	13.30-13.45	1570526192	Digital Overcurrent Relay Implementation With Non-Standard Inverse Curve Modelling Using Adaptive Neuro Fuzzy Inference System
4	13.45-14.00	1570526423	Dynamic Background Video Forgery Detection using Gaussian Mixture Model
4	14.00-14.15	1570523474	Comparison Of Distance Methods In K-Means Algorithm For Determining Village Status In Bekasi District
4	14.15-14.30	1570526180	Fuzzy Coordinator based AI for Dynamic Difficulty Adjustment in Starcraft 2

4	14.30-14.45	1570514074	The Classification of the Movie Genre's based on Synopsis of the Indonesian Film

Titanium 3

Session	Time	Paper Code	Title
1	13.00-13.15	1570512696	IoT-Based Smart and Healthy Wardrobe System
1	13.15-13.30	1570512578	Smart Kost: Ubiquitous Boarding House Controlling and Monitoring System in Industry 4.0
1	13.30-13.45	1570512583	IoT Based: Improving Control System For High-Quality Beef in Supermarkets
1	13.45-14.00	1570512614	IOT: Improved Home Energy Control System Based on Consumer Behavior
1	14.00-14.15	1570512722	IoT Based: Hydroponic Using Drip Non-Circulation System for Paprika
1	14.15-14.30	1570512735	Smart hydroponic farming with IoT-based climate and nutrient manipulation system
1	14.30-14.45	1570518672	Internet of Things: Roboboat for Water Area Monitoring using 4G network and Google Firebase
2	15.30-15.45	1570526455	Automated Segmentation of Breast Tissue and Pectoral Muscle in Digital Mammography
2	15.45-16.00	1570526552	Pneumonia Detection with Deep Convolutional Architecture
2	16.00-16.15	1570516699	Classification of Premature Ventricular Contraction based on ECG Signal using Multiorder Rényi Entropy
2	16.15-16.30	1570513732	EEG-based Mental Fatigue Detection Using Cognitive Tests and RVM Classification
2	16.30-16.45	1570509093	Extraction of Skull and Face Surfaces from CT Images
2	16.45-17.00	1570526401	Heart Rate Estimation from Wrist-Type Photoplethysmographic Signals Corrupted by Intense Motion Artifacts using NLMS Adaptive Filter and Spectral Peak Tracking

Ballroom 1

Session	Time	Paper Code	Title
2	15.30-15.45	1570521650	Determining The Threshold Value for Identification of The Goblet Cells in Chicken Small Intestine
2	15.45-16.00	1570526538	Implementation of Depth-HOG based Human Upper Body Detection On A Mini PC Using A Low Cost Stereo Camera
2	16.00-16.15	1570526466	Determining Banana Types and Ripeness from Image using Machine Learning Methods
2	16.15-16.30	1570526453	A Study on Part Affinity Fields Implementation for Human Pose Estimation with Deep Neural Network
2	16.30-16.45	1570524081	Contrast-enhanced Based on Abdominal Kernels for CT Image Noise Reduction
2	16.45-17.00	1570513593	Clutter Mitigation Technique on OFDM MIMO Radar
3	10.30-10.45	1570526547	Incorporating Information Technology Concept to Sustainable Enterprise
3	10.45-11.00	1570526500	Improved Ranking Based Collaborative Filtering Using SVD and Borda Algorithm
3	11.00-11.15	1570511011	Automatic Lecture Video Content Summarization with Attention-based Recurrent Neural Network
3	11.15-11.30	1570522671	Traffic Sign Image Recognition Using Gabor Wavelet and Principle Component Analysis
4	12.30-12.45	1570512694	Determining the Neural Network Topology from the Viewpoint of Kuhn's Philosophy and Popper's Philosophy

978-1-5386-8448-1/19/$31.00 ©2019 IEEE
2019 International Conference of Artificial Intelligence and Information Technology

4	12.45-13.00	1570497875	MREAK: Morphological Retina Keypoint Descriptor
4	13.00-13.15	1570512201	The Influence of Sampling Frequency on Guitar Chord Recognition using DST Based Segment Averaging
4	13.15-13.30	1570513608	Forming Formation of Particle Swarm using Artificial Neural Network Self Organizing Map (ANN-SOM) with 2-leveled Strategy
4	13.30-13.45	1570513712	Modified Ant Colony Algorithm For Swarm Multi Agent Exploration on Target Searching in Unknown Environment
4	13.45-14.00	1570513896	Parameter Identifiability of Phased-MIMO Radar
4	14.00-14.15	1570513597	Switching Formation and Topology in Cooperative Multi-Agent Source Seeking Using Gradient Estimation
4	14.15-14.30	1570526714	Comparison Road Safety Education with and without IoT to Develop Perceptual Motor Skills in Early Childhood Children Aged 4-5
4	14.30-14.45	1570526573	An Efficient Resource Allocation Mechanism for Time-Sensitive Data in Dew Computing

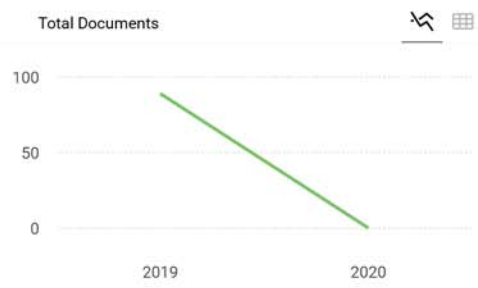
Ballroom 2

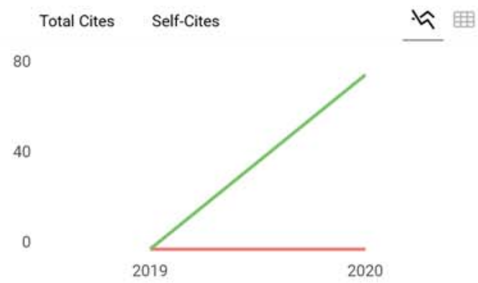
Session	Time	Paper Code	Title
3	10.30-10.45	1570526541	Thermal Optimization on Incubator using Fuzzy Inference System based IoT
3	10.45-11.00	1570512562	NDNization of IP Network Based On Communication Flow Model
3	11.00-11.15	1570513741	Reinforcement Point and Fuzzy Input Design of Fuzzy Q-Learning for Mobile Robot Navigation System
3	11.15-11.30	1570513710	Trajectory Tracking Automated Guided Vehicle using Fuzzy Controller
4	12.30-12.45	1570515288	A Study of Text Classification for Indonesian News Article
4	12.45-13.00	1570523931	A Comparison of the Use of Several Different Resources on Lexicon Based Indonesian Sentiment Analysis on App Review Dataset
4	13.00-13.15	1570526385	Sentiment Analysis In Twitter Using Lexicon Based and Polarity Multiplication
4	13.15-13.30	1570526502	Word Embedding Comparison for Indonesian Language Sentiment Analysis
4	13.30-13.45	1570526281	Offensive Language Detection using Artificial Neural Network
4	13.45-14.00	1570526529	A Review of Sentiment Analysis for Non-English Language
4	14.00-14.15	1570521672	Information Retrieval System for Searching JSON Files with Vector Space Model Method
4	14.15-14.30	1570526218	Melanoma Classification Using Texture and Wavelet Analysis
4	14.30-14.45	1570526456	Proportional-Derivative Control for Quadrotor Stabilization under Inertia Perturbation
4	14.45-15.00	1570526549	Auto-Encoding Progressive Generative Adversarial Networks For 3D Multi Object Scenes

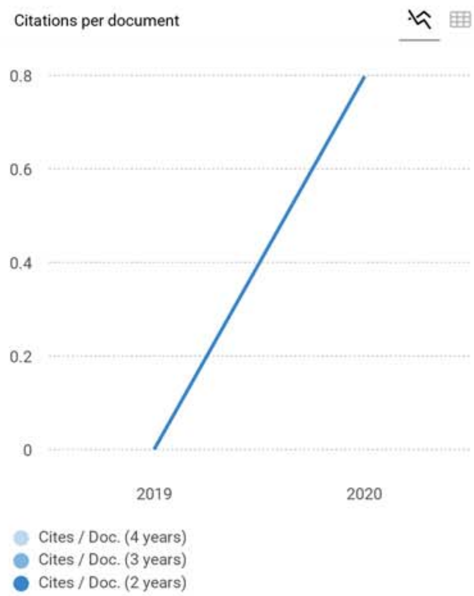
Proceeding - 2019 International Conference of Artificial Intelligence and Information Technology, ICAIIT 2019

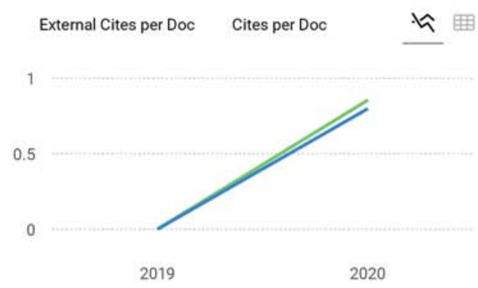
COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
United States Universities and research institutions in United States	Computer Science Artificial Intelligence Computer Networks and Communications Computer Science Applications Information Systems Signal Processing Mathematics Control and Optimization		4

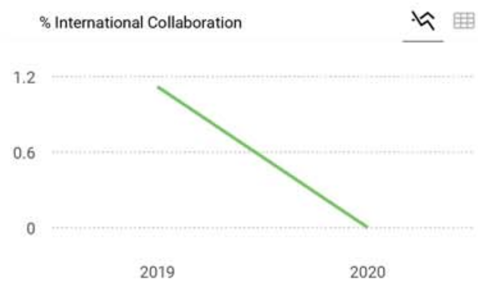
PUBLICATION TYPE	ISSN	COVERAGE
Conferences and Proceedings	-	2019

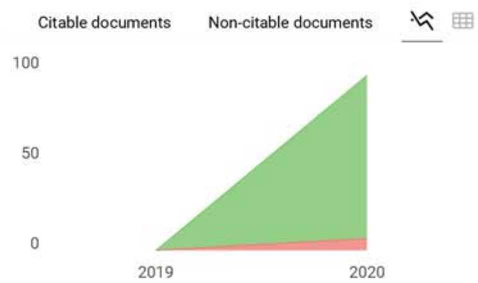


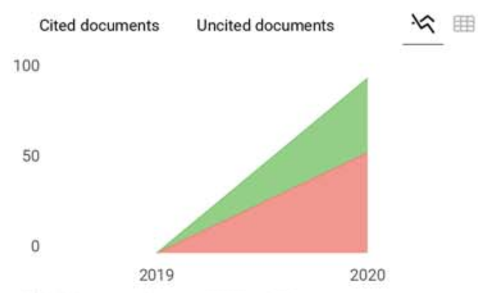












← Show this widget in your own website

Just copy the code below and paste within your html code:

<a href="https://www.scim

Metrics based on Scopus® data as of April 2021

Leave a comment

Name

Email
(will not be published)

Submit

The users of Scimago Journal & Country Rank have the possibility to dialogue through comments linked to a specific journal. The purpose is to have a forum in which general doubts about the processes of publication in the journal, experiences and other issues derived from the publication of papers are resolved. For topics on particular articles, maintain the dialogue through the usual channels with your editor.

Document details - Image based leaf area measurement method using artificial neural network

Export Download More...

Proceeding - 2019 International Conference of Artificial Intelligence and Information Technology, ICAIIT 2019

March 2019, Article number 8834500, Pages 288-292

1st International Conference of Artificial Intelligence and Information Technology, ICAIIT 2019; Platinum Adisucipto Hotel and Conference CenterYogyakarta; Indonesia; 13 March 2019 through 15 March 2019; Category numberCFP19JVE-ART; Code 151944

Image based leaf area measurement method using artificial neural network(Conference Paper)(Open Access)

Siswantoro, J., Artadana, I.B.M.

[a]Department of Informatics Engineering Universitas Surabaya, Surabaya, Indonesia
[b]Department of Biology Universitas Surabaya, Surabaya, Indonesia

Abstract

Leaf area is an important parameter in plant monitoring. An automatic method for measuring leaf area is needed to obtain accurate result. In this paper, a method for automatic leaf area measurement from image is proposed. The method captured the image of leaf without object reference. Four features were extracted from the image and used as input to artificial neural network for estimating leaf area. The experiment results show that the proposed method can measure leaf area with mean absolute relative error less than 1% and less computational time. © 2019 IEEE.

SciVal Topic Prominence

Topic: Leaf Area | Sum of Squares | Coefficient of Determination

Prominence percentile: 77.205

Author keywords

Artificial neural network | Automatic | Image processing | leaf area measurement

Indexed keywords

Engineering controlled terms: Geodesy | Neural networks | Surveying

Engineering uncontrolled terms: Automatic | Automatic method | Computational time | Image-based | Leaf area measurements | Object reference | Plant monitoring | Relative errors

Engineering main heading: Image processing

Funding details

Funding sponsor	Funding number	Acronym
Universitas Surabaya	033/Lit/LPPM-01/FT/V/2018	

Funding text

ACKNOWLEDGMENT The authors would like to thank Universitas Surabaya for providing facilities and financial support under Competitive Research Grant No. 033/Lit/LPPM-01/FT/V/2018.

Cited by 2 documents

Sabouri, H. , Sajadi, S.J. , Jafarzadeh, M.R.

Image processing and prediction of leaf area in cereals: A comparison of artificial neural networks, an adaptive neuro-fuzzy inference system, and regression methods

(2021) Crop Science

Tu, L.-F. , Peng, Q. , Li, C.-S.

2D in Situ Method for Measuring Plant Leaf Area with Camera Correction and Background Color Calibration

(2021) Scientific Programming

View details of all 2 citations

Inform me when this document is cited in Scopus:

Set citation alert > Set citation feed >

Related documents

Find more related documents in Scopus based on:

Authors > Keywords >

ISBN: 978-153868448-1
Source Type: Conference Proceeding
Original language: English

DOI: 10.1109/ICAIIT.2019.8834500
Document Type: Conference Paper
Publisher: Institute of Electrical and Electronics Engineers Inc.