



e-ISSN 2460-0040
p-ISSN 2407-7658



Vol. 11, No. 1, February 2024

Scientific Journal of Informatics



Vol 11, No 1 (2024)

February 2024

DOI: <https://doi.org/10.15294/sji.v11i1>

Table of Contents

Articles

Applying Structural Equational Model (SEM) to Analysis of Perceived Social Media Influence on Intention to Buy Online Store by Consumer Trust and Hedonic Brand Image	DOI 10.15294/sji.v11i1.47859	Abstract 213 times	PDF 1-10	 	 
Wisnalmawati Wisnalmawati ⁽¹⁾ , Ahmed Mohamed Annegrat ⁽²⁾ , Marjam Desma Rahadini ⁽³⁾ , Abadi Sanosra ⁽⁴⁾ , Agus Suryono ⁽⁵⁾ ,					
(1) Department of Management, Faculty of Economics and Business, Universitas Pembangunan Nasional "Veteran" Yogyakarta, Indonesia					
(2) Faculty of Economics, University of Bani Waleed, Libya					
(3) Study Program of Management, Faculty of Economics, Universitas Slamet Riyadi Surakarta, Indonesia					
(4) Faculty of Economics, Universitas Muhammadiyah Jember, Indonesia					
(5) Department of Management, Faculty of Economics and Business, Universitas Pembangunan Nasional "Veteran" Yogyakarta, Indonesia					
Damerau-Levenshtein Distance Algorithm Based on Abstract Syntax Tree to Detect Code Plagiarism					
DOI 10.15294/sji.v11i1.48064					
Abstract 174 times					
PDF 11-20					
 					
 					
Ahlijati Nuraminah ⁽¹⁾ , Abdullah Ammar ⁽²⁾ ,					
(1) Department of Computer Science, Sekolah Tinggi Ilmu Manajemen dan Ilmu Komputer ESQ, Indonesia					
(2) Department of Computer Science, Sekolah Tinggi Ilmu Manajemen dan Ilmu Komputer ESQ, Indonesia					
Indonesian Hate Speech Text Classification Using Improved K-Nearest Neighbor with TF-IDF-ICSpF					
DOI 10.15294/sji.v11i1.48085					
Abstract 15 times					
PDF 21-30					
 					
 					
Nova Adi Saputra ⁽¹⁾ , Khurotul Aeni ⁽²⁾ , Nurul Mega Saraswati ⁽³⁾ ,					
(1) Department of Informatics, Faculty of Science and Technology, Universitas Peradaban, Indonesia					
(2) Department of Informatics, Faculty of Science and Technology, Universitas Peradaban, Indonesia					
(3) Department of Informatics, Faculty of Science and Technology, Universitas Peradaban, Indonesia					
A Comparative Study of Javanese Script Classification with GoogleNet, DenseNet, ResNet, VGG16 and VGG19					
DOI 10.15294/sji.v11i1.47305					
Abstract 91 times					
PDF 31-40					
 					
 					
Ajib Susanto ⁽¹⁾ , Christy Atika Sari ⁽²⁾ , Eko Hari Rachmawanto ⁽³⁾ , Ibnu Utomo Wahyu Mulyono ⁽⁴⁾ , Noorayisahbe Mohd Yaacob ⁽⁵⁾ ,					
(1) Faculty of Computer Science, Universitas Dian Nuswantoro, Indonesia					
(2) Faculty of Computer Science, Universitas Dian Nuswantoro, Indonesia					
(3) Faculty of Computer Science, Universitas Dian Nuswantoro, Indonesia					
(4) Faculty of Computer Science, Universitas Dian Nuswantoro, Indonesia					



ABOUT THE JOURNAL

- [Focus and Scope](#)
- [Author Guidelines](#)
- [Template Article](#)
- [Online Submissions](#)
- [Editorial Team](#)
- [Reviewer Team](#)
- [Ethics Statement](#)
- [Indexing & Abstracting](#)
- [Scopus Citation](#)
- [Visitor Statistics](#)
- [Contact](#)

Readers

 ID	207,522	 SG	1,397
 US	12,702	 GB	775
 CN	9,337	 JP	674
 IN	2,370	 PK	602
 PH	2,313	 CA	586
 MY	2,246	 TR	524

Pageviews: 837,432



00610239 View My Stats

USER

Username	<input type="text"/>
Password	<input type="password"/>
<input type="checkbox"/> Remember me	<input type="button" value="Login"/>

JOURNAL CONTENT

Search	<input type="text"/>
Search Scope	<input type="button" value="All"/>
<input type="button" value="Search"/>	
Browse	
<ul style="list-style-type: none"> By Issue By Author By Title Other Journals 	

[E-Dharmagita Learning Model Innovation with Mobile and Multimedia Technology](#)



?

DOI 10.15294/sji.v11i1.46653 Abstract 14 times PDF 4 times

PDF

41-52

Oka Sudana⁽¹⁾, Kd. Vigyan Melati Sukma⁽²⁾, Ayu Wirdiani⁽³⁾, Gusti Agung Ayu Putri⁽⁴⁾,
(1) Department of Technology Information, Universitas Udayana, Indonesia
(2) Department of Technology Information, Universitas Udayana, Indonesia
(3) Department of Technology Information, Universitas Udayana, Indonesia
(4) Department of Technology Information, Universitas Udayana, Indonesia



[Smart System on Two-dimensional Shapes Recognition Application for Kindergarten Students](#)



?

DOI 10.15294/sji.v11i1.47494 Abstract 12 times PDF 14 times

PDF

53-60



Teja Endra Eng Tju⁽¹⁾, Elizabeth Nurmiyati Tamatjita⁽²⁾,
(1) Faculty of Information Technology, Universitas Budi Luhur, Indonesia
(2) Department of Informatics, PTK - STMIK Widuri, Indonesia

[Optimization Selection on Deep Learning Algorithm for Stock Price Prediction in Indonesia Companies](#)



?

DOI 10.15294/sji.v11i1.47935 Abstract 30 times PDF 15 times

PDF

61-

68



Gunawan Gunawan⁽¹⁾, Wresti Andriani⁽²⁾, Sawaviyya Anandianskha⁽³⁾, Aang Alim Murtopo⁽⁴⁾,
Bangkit Indarmawan Nugroho⁽⁵⁾, Naella Nabila Putri Wahyuning Naja⁽⁶⁾,
(1) Department of Informatic Engineering, STMIK YMI Tegal, Indonesia
(2) Department of Informatic Engineering, STMIK YMI Tegal, Indonesia
(3) Department of Informatic Engineering, STMIK YMI Tegal, Indonesia
(4) Department of Informatic Engineering, STMIK YMI Tegal, Indonesia
(5) Department of Information System, STMIK YMI Tegal, Indonesia
(6) Department of Management, Universitas Negeri Semarang, Indonesia

[Real-Time Web-Based Monitoring System for Temperature, Humidity, and Solar Panels in Ramie Drying Facilities](#)



?

DOI 10.15294/sji.v11i1.47234 Abstract 3 times PDF 2 times

PDF

69-

80



Sidiq Syamsul Hidayat⁽¹⁾, Kiara Izzatus Shabuya⁽²⁾, Sri Anggraeni Kadiran⁽³⁾, Irfan Mujahidin⁽⁴⁾,
M. Cahyo Ardi Prabowo⁽⁵⁾, Arif Nursyahid⁽⁶⁾, Endro Wasito⁽⁷⁾, Helmy Helmy⁽⁸⁾,
(1) Department of Electrical Engineering, Politeknik Negeri Semarang, Indonesia
(2) Department of Electrical Engineering, Politeknik Negeri Semarang, Indonesia
(3) Department of Electrical Engineering, Politeknik Negeri Semarang, Indonesia
(4) Department of Electrical Engineering, Politeknik Negeri Semarang, Indonesia
(5) Department of Electrical Engineering, Politeknik Negeri Semarang, Indonesia
(6) Department of Electrical Engineering, Politeknik Negeri Semarang, Indonesia
(7) Department of Electrical Engineering, Politeknik Negeri Semarang, Indonesia
(8) Department of Electrical Engineering, Politeknik Negeri Semarang, Indonesia

[Analysis Impact of Rapid Application Development Method on Development Cycle and User Satisfaction: A Case Study on Web-Based Registration Service](#)



?

DOI 10.15294/sji.v11i1.49590 Abstract 11 times PDF 4 times

PDF

81-

94



Imam Riadi⁽¹⁾, Anton Yudhana⁽²⁾, Ade Elvina⁽³⁾,
(1) Department of Information System, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
(2) Department of Electrical Engineering, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
(3) Master Program of Informatics, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

[Community Satisfaction with Online Services in East Lombok Regency: \(Case Study: BAKSO Application\)](#)



?

DOI 10.15294/sji.v11i1.48083 Abstract 46 times PDF 17 times

PDF

95-

106



Yujitia Ahdarrijal⁽¹⁾, Ulung Pribadi⁽²⁾,
(1) Master of Government Affairs and Administration, Universitas Muhammadiyah Yogyakarta, Indonesia
(2) Master of Government Affairs and Administration, Universitas Muhammadiyah Yogyakarta, Indonesia

[Examination of the Factors Impacting the Interest of Residents in Semarang City in Mobile Health Applications: An UTAUT Analysis](#)



?

DOI 10.15294/sji.v11i1.48130 Abstract 5 times PDF 1 times

PDF

107-

118



Muhamad Putra Perdana⁽¹⁾, Zaenal Abidin⁽²⁾,
(1) Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia
(2) Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia

Readers

	ID 207,522		SG 1,397
	US 12,702		GB 775
	CN 9,337		JP 674
	IN 2,370		PK 602
	PH 2,313		CA 586
	MY 2,246		TR 524

Pageviews: 837,432



Analysis of Attack Detection on Log Access Servers Using Machine Learning Classification: Integrating Expert Labeling and Optimal Model Selection	PDF
 DOI 10.15294/sji.v11i1.49424 Abstract 21 times PDF 3 times	119-126
Mohammad Ridwan ⁽¹⁾ , Irwan Sembiring ⁽²⁾ , Adi Setiawan ⁽³⁾ , Iwan Setyawan ⁽⁴⁾ , (1) Faculty of Engineering, Universitas Islam Syekh Yusuf Tangerang, Indonesia (2) Faculty of Science and Mathematics, Universitas Kristen Satya Wacana Salatiga, Indonesia (3) Faculty of Science and Mathematics, Universitas Kristen Satya Wacana Salatiga, Indonesia (4) Faculty of Science and Mathematics, Universitas Kristen Satya Wacana Salatiga, Indonesia	✖
YOLOv8 Analysis for Vehicle Classification Under Various Image Conditions	PDF
 DOI 10.15294/sji.v11i1.49038 Abstract 9 times PDF 28 times	127-138
Eben Panja ⁽¹⁾ , Hendry Hendry ⁽²⁾ , Christine Dewi ⁽³⁾ , (1) Department of Information Technology, Universitas Kristen Satya Wacana, Indonesia (2) Department of Information Technology, Universitas Kristen Satya Wacana, Indonesia (3) Department of Information Technology, Universitas Kristen Satya Wacana, Indonesia	✖
YOLO vs. CNN Algorithms: A Comparative Study in Masked Face Recognition	PDF
 DOI 10.15294/sji.v11i1.48723 Abstract 18 times PDF 5 times	139-
Muhammad Ridho Dewanto ⁽¹⁾ , Mifta Nur Farid ⁽²⁾ , Muhammad Abby Rafdi Syah ⁽³⁾ , Aji Akbar Firdaus ⁽⁴⁾ , Hamzah Arof ⁽⁵⁾ , (1) Department of Electrical Engineering, Institut Teknologi Kalimantan, Balikpapan, Indonesia (2) Department of Electrical Engineering, Institut Teknologi Kalimantan, Balikpapan, Indonesia (3) Department of Electrical Engineering, Institut Teknologi Kalimantan, Balikpapan, Indonesia (4) Department of Engineering, Universitas Airlangga, Surabaya, Indonesia (5) Department of Electrical Engineering, University of Malaya, Malaysia	146 ✖
Performance Comparison Between LeNet And MobileNet In Convolutional Neural Network for Lampung Batik Image Identification	PDF
 DOI 10.15294/sji.v11i1.49451 Abstract 9 times PDF 5 times	147-154
Rico Andrian ⁽¹⁾ , Hans Christian Herwanto ⁽²⁾ , Rahman Taufik ⁽³⁾ , Didik Kurniawan ⁽⁴⁾ , (1) Computer Science Study Program, Universitas Lampung, Indonesia (2) Computer Science Study Program, Universitas Lampung, Indonesia (3) Computer Science Study Program, Universitas Lampung, Indonesia (4) Computer Science Study Program, Universitas Lampung, Indonesia	✖
Indonesian News Text Summarization Using MBART Algorithm	PDF
 DOI 10.15294/sji.v11i1.49224 Abstract 28 times PDF 18 times	155-164
Rahma Hayuning Astuti ⁽¹⁾ , Muljono Muljono ⁽²⁾ , Sutriawan Sutriawan ⁽³⁾ , (1) Department of Computer Science, Universitas Dian Nuswantoro, Indonesia (2) Department of Computer Science, Universitas Dian Nuswantoro, Indonesia (3) Department of Computer Science, Universitas Muhammadiyah Bima, Indonesia	✖
Comparison of Discriminant Analysis and Support Vector Machine on Mixed Categorical and Continuous Independent Variables for COVID-19 Patients Data	PDF
 DOI 10.15294/sji.v11i1.48565 Abstract 6 times PDF 3 times	165-176
Husnul Aris Haikal ⁽¹⁾ , Aji Hamim Wigena ⁽²⁾ , Kusman Sadik ⁽³⁾ , Efrivati Efrivati ⁽⁴⁾ , (1) Faculty of Mathematics and Natural Sciences, Institut Pertanian Bogor, Indonesia (2) Faculty of Mathematics and Natural Sciences, Institut Pertanian Bogor, Indonesia (3) Faculty of Mathematics and Natural Sciences, Institut Pertanian Bogor, Indonesia (4) National Research and Innovation Agency, Indonesia	✖
Comparative Study of Machine Learning Algorithms for Performing Ham or Spam Classification in SMS	PDF
 DOI 10.15294/sji.v11i1.47364 Abstract 7 times PDF 1 times	177-186
Erna Zuni Astuti ⁽¹⁾ , Christy Atika Sari ⁽²⁾ , Eko Hari Rachmawanto ⁽³⁾ , Rabei Raad Ali ⁽⁴⁾ , (1) Departmen of Informatics Engineering, Universitas Dian Nuswantoro, Indonesia (2) Departmen of Informatics Engineering, Universitas Dian Nuswantoro, Indonesia (3) Departmen of Informatics Engineering, Universitas Dian Nuswantoro, Indonesia (4) Department of Computer Engineering, Northern Technical University, Iraq	✖
Implementation of Feature Selection Strategies to Enhance Classification Using XGBoost and Decision Tree	PDF
 DOI 10.15294/sji.v11i1.48145 Abstract 10 times PDF 9 times	18-
Phara Elvina Pingky Nadya ⁽¹⁾ , M.Firdaus Ibadi Ferdiansyah ⁽²⁾ , Vinna Rahmayanti Setyaning Nastiti ⁽³⁾ , Christian Sri Kusuma Aditya ⁽⁴⁾ , (1) Faculty of Engineering, Universitas Muhammadiyah Malang, Indonesia	194 ✖

- (2) Faculty of Engineering, Universitas Muhammadiyah Malang, Indonesia
- (3) Faculty of Engineering, Universitas Muhammadiyah Malang, Indonesia
- (4) Faculty of Engineering, Universitas Muhammadiyah Malang, Indonesia

Comparative Analysis of LSTM Neural Network and SVM for USD Exchange Rate Prediction: A Study on Different Training Data Scenarios	PDF
 DOI 10.15294/sji.v11i1.49975	195-
Abstract 7 times	206
Yesy Diah Rosita ⁽¹⁾ , Lady Silk Moonlight ⁽²⁾ ,	*
(1) Faculty of Informatics, Institut Teknologi Telkom Purwokerto, Indonesia	
(2) Aeronautical Communication, Politeknik Penerbangan Surabaya, Indonesia	

A Comparative Study of Random Forest and Double Random Forest Models from View Points of Their Interpretability	PDF
 DOI 10.15294/sji.v11i1.48721	207-
Abstract 5 times	218
Adlina Khairunnisa ⁽¹⁾ , Khairil Anwar Notodiputro ⁽²⁾ , Bagus Sartono ⁽³⁾ ,	*
(1) Faculty of Mathematics and Natural Sciences, Institut Pertanian Bogor, Indonesia	
(2) Faculty of Mathematics and Natural Sciences, Institut Pertanian Bogor, Indonesia	
(3) Faculty of Mathematics and Natural Sciences, Institut Pertanian Bogor, Indonesia	

Forensic Analysis of Drones Attacker Detection Using Deep Learning	PDF
 DOI 10.15294/sji.v11i1.48183	219-
Abstract 21 times	226
Arda Surya Editya ⁽¹⁾ , Neny Kurniati ⁽²⁾ , Mochammad Machlul Alamin ⁽³⁾ , Anggay Luri Pramana ⁽⁴⁾ , Angga Lisdiyanto ⁽⁵⁾ ,	*
(1) Faculty of Computer Science, Universitas Nahdlatul Ulama Sidoarjo, Indonesia	
(2) Faculty of Computer Science, Universitas Nahdlatul Ulama Sidoarjo, Indonesia	
(3) Faculty of Computer Science, Universitas Nahdlatul Ulama Sidoarjo, Indonesia	
(4) Faculty of Computer Science, Universitas Nahdlatul Ulama Sidoarjo, Indonesia	
(5) Faculty of Computer Science, Universitas Nahdlatul Ulama Sidoarjo, Indonesia	

Knowledge Discovery from Confusion Matrix of Pruned CART in Imbalanced Microarray Data Ovarian Cancer Classification	PDF
 DOI 10.15294/sji.v11i1.50077	227-
Abstract 20 times	236
Ni Kadek Emik Sapitri ⁽¹⁾ , Umu Sa'adah ⁽²⁾ , Nur Shofianah ⁽³⁾ ,	*
(1) Department of Mathematics, Universitas Brawijaya, Indonesia	
(2) Department of Mathematics, Universitas Brawijaya, Indonesia	
(3) Department of Mathematics, Universitas Brawijaya, Indonesia	

The Comparison of K-Nearest Neighbors and Random Forest Algorithm to Recognize Indonesian Sign Language in a Real-Time	PDF
 DOI 10.15294/sji.v11i1.48475	237-
Abstract 10 times	244
Aaqila Dhiyaanisafa Goenawan ⁽¹⁾ , Sri Hartati ⁽²⁾ ,	*
(1) Department of Computer Science, STMIK ESQ, Indonesia	
(2) Department of Computer Science, STMIK ESQ, Indonesia	

Comparative Study of Imbalanced Data Oversampling Techniques for Peer-to-Peer Lending Loan Prediction	PDF
 DOI 10.15294/sji.v11i1.50274	245-
Abstract 7 times	254
Rini Muzayanah ⁽¹⁾ , Apri Dwi Lestari ⁽²⁾ , Jumanto Jumanto ⁽³⁾ , Budi Prasetyo ⁽⁴⁾ , Dwika Ananda Agustina Pertiwi ⁽⁵⁾ , Much Aziz Muslim ⁽⁶⁾ ,	*
(1) Department of Computer Science, Universitas Negeri Semarang, Indonesia	
(2) Department of Computer Science, Universitas Negeri Semarang, Indonesia	
(3) Department of Computer Science, Universitas Negeri Semarang, Indonesia	
(4) Department of Computer Science, Universitas Negeri Semarang, Indonesia	
(5) Faculty of Technology Management, Universiti Tun Hussein Onn Malaysia, Malaysia	
(6) Department of Computer Science, Universitas Negeri Semarang, Indonesia	

Scientific Journal of Informatics (SJI)

p-ISSN 2407-7658 | e-ISSN 2460-0040

Published By Department of Computer Science Universitas Negeri Semarang

Website: <https://journal.unnes.ac.id/nju/index.php/sji>

Email: sji@mail.unnes.ac.id



This work is licensed under a [Creative Commons Attribution 4.0 International License](#).



Editorial Team

Editor-in-Chief

1. [Much Aziz Muslim](#), Universitas Negeri Semarang, Indonesia, Indonesia

Editorial Boards

1. [Anam Saeed](#), (SCOPUS ID=57216788243) Sichuan University, China, China
2. [Sangeeta Gupta](#), (SCOPUS ID=56959624000) Chaitanya Bharathi Institute of Technology, India
3. [Mohamad Fauzan Noordin](#), (SCOPUS ID=53264598500) Department of Information System, International Islamic University Malaysia
4. [Jin Peng](#), (SCOPUS ID=9734635400) Institute of Uncertain Systems, College of Mathematics & Computer Science, Huanggang Normal University
5. [Shahrul Na'im Sidek](#), (SCOPUS ID=55605554800) Department of Mechatronics Engineering International Islamic University Malaysia
6. [Budi Prasetyo](#), (SCOPUS ID=56997557000) Computer Science Department, Universitas Negeri Semarang
7. [Dewi Handayani](#), (SCOPUS ID= 57196061784), Information and Technology Department, Universitas Stikubank, Indonesia
8. [Dwi Ely Kurniawan](#), (SCOPUS ID= 57200983756), Department of Informatics, Batam State Polytechnic, Batam, Indonesia
9. [Dwika Ananda Agustina Pertiwi](#), (SCOPUS ID: 58102707400) Department of Computer Science, Universitas Negeri Semarang, Indonesia
10. [Rini Muzayannah](#), Universitas Negeri Semarang, Indonesia
11. [April Dwi Lestari](#), Universitas Negeri Semarang, Indonesia

Editorial Advisory

1. [Dr. Anggun Fitrian Isnawati](#), Institut Teknologi Telkom Purwokerto, Indonesia
2. [Asaad F. Qasim](#), (SCOPUS ID=57200728532) School of Computing, Science and Engineering, University of Salford, Greater Manchester, M5 4WT, United Kingdom
3. [Nuryake Fajaryati](#), (SCOPUS ID=57205293785) Universitas Negeri Yogyakarta, Indonesia
4. [Nerfita Nikentari](#), (SCOPUS ID=57202789964) Universitas Maritim Raja Ali Haji, Indonesia
5. [Hanny Haryanto](#), (SCOPUS ID=55844919300) Universitas Dian Nuswantoro, Indonesia
6. [Faried Effendy](#), (SCOPUS ID=84921445030) Universitas Airlangga, Indonesia
7. [Irawan Afrianto](#), (SCOPUS ID=57204188766) Universitas Komputer Indonesia
8. [Hadi Santoso](#), (SCOPUS ID=57216851575) Institut Sains Dan Bisnis Atma Luhur, Indonesia
9. [Sadiyah Jantan](#), (SCOPUS ID=37261587300) University of Kuala Lumpur, Malaysia
10. [Yosza Dasril](#), (SCOPUS ID=6505715619) Universiti Tun Hussein Onn Malaysia, Malaysia
11. [Rabiya Khalid](#), (SCOPUS ID=57194326674) Computer Science Department, COMSATS University Islamabad, Pakistan
12. [Zuherman Rustam](#), (SCOPUS ID=26422482100) University Indonesia, Indonesia
13. [Hesmeralda Rojas](#), (SCOPUS ID=57203159362) Universidad Nacional Micaela Bastidas de ApurÁmac, Abancay, PerÁ
14. [Sibghat Bazai](#), (SCOPUS ID=57194788948) Massey University Auckland disabled, Albany, New Zealand, New Zealand
15. [Dr Arny Yuniarti](#), (SCOPUS ID=55701533100) Institut Teknologi Sepuluh Nopember, Indonesia
16. [Heri Nurdyianto](#), (SCOPUS ID=57200089726) STMIK Dharma Wacana, Indonesia, Indonesia
17. [Junbo Ma](#), (SCOPUS ID=55363737100) National University of Defense Technology, School of Computer Science, Changsha, China, China
18. [Oman Somantri](#), (SCOPUS ID: 57208898676), Politeknik Negeri Cilacap, Indonesia
19. [Jati Sasongko Wibowo](#), Information and Technology Department, Universitas Stikubank, Semarang, Indonesia

Technical Editor

1. [Jumanto Unjung](#), (SCOPUS ID=58102068400) Department of Computer Science, Universitas Negeri Semarang, Indonesia

Scientific Journal of Informatics (SJI)

p-ISSN 2407-7658 | e-ISSN 2460-0040

Published By Department of Computer Science Universitas Negeri Semarang

Website: <https://journal.unnes.ac.id/nju/index.php/sji>

Email: sji@mail.unnes.ac.id



This work is licensed under a [Creative Commons Attribution 4.0 International License](#).



ABOUT THE JOURNAL

- [Focus and Scope](#)
- [Author Guidelines](#)
- [Template Article](#)
- [Online Submissions](#)
- [Editorial Team](#)
- [Reviewer Team](#)
- [Ethics Statement](#)
- [Indexing & Abstracting](#)
- [Scopus Citation](#)
- [Visitor Statistics](#)
- [Contact](#)

Readers

	207,526		1,397
	12,702		775
	9,337		674
	2,370		602
	2,313		586
	2,246		524

Pageviews: 837,448



[00610246](#) [View My Stats](#)

USER

Username	<input type="text"/>
Password	<input type="password"/>
<input type="checkbox"/> Remember me	<input type="button" value="Login"/>

JOURNAL CONTENT

Search

Search Scope

Browse

- [By Issue](#)
- [By Author](#)
- [By Title](#)
- [Other Journals](#)

Readers

	207,526		1,397
	12,702		775
	9,337		674
	2,370		602
	2,313		586
	2,246		524

Pageviews: 837,448





Peer Reviewer

Peer Reviewer

Country	Name	Scopus ID	Affiliation
1. China	Junbo Ma	55363737100	National University of Defense Technology, School of Computer Science, Changsha, China
2. United Kingdom	Asaad F. Qasim	57200728532	School of Computing, Science and Engineering, University of Salford
3. India	Shanmugam Sundaramurthy	57213699624	Department of CSE, Kongunadu College of Engineering and Technology
4. Malaysia	Assoc Prof Dr Jamaiah Yahaya	57190117387	Research Centre for Software Technology and Management, Faculty of Information Science and Technology, UKM, Bangi, Selangor, Malaysia
5. Malaysia	Sadiyah Jantan	0	Electrical and Electronics Section, Universiti Kuala Lumpur Malaysia France Institute, Sect. 14, Jalan Teras Jernang, 43650 Bandar Baru Bangi, Selangor, Malaysia
6. Albany, New Zealand	Sibghat Bazai	57194788948	Massey University Aucklanddisabled
7. Peru, Amerika Selatan	Hesmeralda Rojas	57203159362	Universidad Nacional Micaela Bastidas de Apurímac
8. Indonesia	Hanny Haryanto, S.Kom, MT	0	Department of Informatics, Universitas Dian Nuswantoro
9. Indonesia	Assoc. Prof. Leon A. Abdillah	57200984011	Universitas Bina Darma
10. Indonesia	Hudan Studiawan	36005028500	Department of Informatics, Institut Teknologi Sepuluh Nopember, Surabaya.
11. Indonesia	Irawan Afrianto	57204188766	Teknik Informatika/Teknik dan Ilmu Komputer/Universitas Komputer Indonesia (UNIKOM)
12. Indonesia	Faried Effendy, S.Si., M.Kom.	56592788400	Universitas Airlangga
13. Indonesia	Adhatus Solichah Ahmadiyah, S.Kom., M.Sc.	56624485800	Department of Informatics, Institut Teknologi Sepuluh Nopember
14. Indonesia	Max Deadline	57202789964	Teknik Informatika/Teknik/Universitas Maritim Raja Ali Haji
15. Indonesia	Nuryake Fajaryati, M.Pd.	57205293785	Electronic Engineering Education / Electronic Engineering and Informatics Education /Faculty of Engineering/Universitas negeri Yogyakarta
16. Indonesia	Jaenal Arifin S.T., M.Eng.	0	S1 Teknik Elektro/Fakultas Teknik Telekomunikasi dan Elektro/Institut Teknologi Telkom Purwokerto
17. Indonesia	Dr.Heri Nurdiyanto, S.Kom., M.Ti	57200089726	Department of Informatics Engineering, STMIK Dharmawacana, Indonesia
18. Indonesia	I Made Sukarsa	56009093600	Information Technology Departement, Udayana University
19. Indonesia	A.A. Kompiang Oka Sudana	56009489100	Udayana University
20. Indonesia	Dwi Ely Kurniawan	57200983756	Department of Informatics, Batam State Polytechnic, Batam
21. Indonesia	Dewi Handayani	57196061784	Information and Technology Department, Universitas Stikubank
22. Indonesia	Jati Sasongko Wibowo	0	Information and Technology Department, Universitas Stikubank, Semarang
23. Indonesia	Oman Somantri	57208898676	Politeknik Negeri Cilacap
24. Indonesia	Kartika Imam Santoso	55995374100	STMIK Bina Patria
25. Indonesia	Suharyanto Suharyanto	24460821300	Department of Electrical Engineering and Information Technology, Universitas Gadjah Mada
26. Indonesia	Nurul Hidayat	57210463399	Informatics & Computer Science Department, Universitas Jenderal Soedirman, Purwokerto
27. Indonesia	Hadi Santoso	57216851575	Information Technology/Institut Sains Dan Bisnis Atma Luhur
28. Indonesia	Anny Yuniarti, S.Kom, M.Comp.Sc	55701533100	ITS - Informatics Department
29. Indonesia	Alfin Hikmaturohman, ST, MT	57194239039	Institut Teknologi Telkom Purwokerto/Fakultas Teknik Telekomunikasi dan Elektro/S1 Teknik Telekomunikasi
30. Indonesia	Heru Agus Santoso, Ph.D	36142038000	Faculty of Computer Science - Dian Nuswantoro University
31. Indonesia	Dr. Ir. Rini Nur Hasanah, S.T., M.Sc., I.PM.	56879143000	Electrical Engineering Department, Faculty of Engineering, Universitas Brawijaya
32. Indonesia	Purwanto, S.Si, M.Kom, Ph.D	35339931800	Doctor of Computer Science/ Faculty of Computer Science/ Universitas Dian Nuswantoro
33. Indonesia	Wina Witanti, S.T., M.T.	0	Informatics/ Science and Informatics Faculty / Jenderal Achmad Yani University
34. Indonesia	Dhanar Intan Surya Saputra, M.Kom.	57193156799	Department of Informatics, Faculty of Computer Science, Universitas Amikom Purwokerto
35. Indonesia	Assoc Prof Dr, ZuhermanRustam, DEA	26422482100	University of Indonesia
36. Indonesia	Syah Alam, S.Pd, MT	57191903622	Electrical Engineering



ABOUT THE JOURNAL

[Focus and Scope](#)
[Author Guidelines](#)
[Template Article](#)
[Online Submissions](#)
[Editorial Team](#)
[Reviewer Team](#)
[Ethics Statement](#)
[Indexing & Abstracting](#)
[Scopus Citation](#)
[Visitor Statistics](#)
[Contact](#)

Readers

	206,650		1,383
	12,660		770
	9,306		672
	2,334		602
	2,240		579
	2,179		522

Pageviews: 830,772


[00606977](#) [View My Stats](#)

USER

You are logged in as...

teja

- [My Journals](#)
- [My Profile](#)
- [Log Out](#)

JOURNAL CONTENT

[Search](#)

[Search Scope](#)

All

[Search](#)
[Browse](#)

- [By Issue](#)
- [By Author](#)
- [By Title](#)

37. Indonesia	Dr. Anggun Fitrian Isnawati, ST., M.Eng.	55014500800	Institut Teknologi Telkom Purwokerto
38. Indonesia	Nurul Fajrin Ariyani, S.Kom., M.Sc.	57189234962	Department of Informatics, Institut Teknologi Sepuluh Nopember
39. Indonesia	Danny Kurnianto, S.T, M.Eng	0	Institut Teknologi Telkom Purwokerto
40. Indonesia	Endang Sugiharti, S.Si., M.Kom	56771330700	Computer Science Department, Universitas Negeri Semarang
41. Indonesia	Anggyi Trisnawan Putra	57201672825	Computer Science Department, Universitas Negeri Semarang
42. Indonesia	Dr. Alamsyah, S.Si., M.Kom	56997537400	Computer Science Department, Universitas Negeri Semarang
43. Indonesia	Yahya Nur Ifriza	0	Computer Science Department, Universitas Negeri Semarang
44. Iran	Mona Tahmasebi	0	Agricultural Engineering Research Department, Markazi Agricultural and Natural Resources Research and Education Center
45. Indonesia	Dr. Rifki Kosasih, S.Si., M.Si.	56422259300	Departement of Informatics, Universitas Gunadarma
46. Kuwait	Mohammad H Alshayeqi, Ph.D.	6508005996	Departement of Computer Engineering, Kuwait University
47. Indonesia	Nerfita Nikentari, ST., M.Cs.	57202789964	Departement of Informatics, Universitas Maritim Raja Ali Haji
48. Indonesia	Dr. Diana Purwitasari, S.Kom., M.Sc.	23493277700	Departement of Informatics, Institut Teknologi Sepuluh Nopember Surabaya

- Other Journals

Readers

	ID 206,650		SG 1,383
	US 12,660		GB 770
	CN 9,306		JP 672
	IN 2,334		PK 602
	MY 2,240		CA 579
	PH 2,179		TR 522

Pageviews: 830,772



Scientific Journal of Informatics (SJI)

p-ISSN 2407-7658 | e-ISSN 2460-0040

Published By Department of Computer Science Universitas Negeri Semarang

Website: <https://journal.unnes.ac.id/nju/index.php/sji>

Email: sji@mail.unnes.ac.id



This work is licensed under a [Creative Commons Attribution 4.0 International License](#).

Smart System on Two-dimensional Shapes Recognition Application for Kindergarten Students

Teja Endra Eng Tju^{1*}, Elizabeth Nurmiyati Tamatjita²

¹Faculty of Information Technology, Universitas Budi Luhur, Indonesia

²Department of Informatics, PTK - STMIK Widuri, Indonesia

Abstract. Kindergarten-aged children are going through an important period of cognitive development, such as the ability to think concretely, including recognizing simple geometric shapes such as circles, triangles, and squares. However, many children find it difficult to understand the basic concepts of two-dimensional shapes.

Purpose: It is necessary to develop prototype learning aids in the form of intelligent systems in two-dimensional shapes applications for kindergarten students, which utilize information technology and object visualization directly through cameras on smartphones. This is expected to increase children's learning motivation and help strengthen their understanding of two-dimensional shapes.

Methods: The research combines Waterfall and Agile methodologies, tailoring them to four stages: plan and discovery, analysis and design, application development, and testing. Testing gathers accuracy with 120 smartphone-collected data points for square, triangle, circle, and pentagon shapes. Also, usability testing based on learnability, efficiency, memorability, error handling, and satisfaction, was obtained from six kindergarten teacher questionnaires and quantitatively processed.

Results: The application achieves an accuracy rate of approximately 79%. Notably, accuracy decreases with fewer corners, mainly due to low resolution or lack of focus, resulting in simplified detected shapes. Regarding usability, it is evident that the application has received positive feedback from users, particularly kindergarten teachers, who have given it an average score of 78.83.

Novelty: Distinguished from previous research, the novelty of this study resides in its ability to capture objects through a camera, eliminating the need for predefined shapes within the application, and innovating by creating an educational tool aligned with the kindergarten curriculum to recognize two-dimensional shapes. The research contribution is the creation of an innovative learning tool for kindergarteners, merging smartphone technology with real-world objects to teach two-dimensional shapes, thus integrating technology into early childhood education effectively, which has urgency in efforts to improve the quality of learning.

Keywords: Early childhood, Geometric objects, Artificial systems

Received September 2023 / **Revised** November 2023 / **Accepted** February 2024

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).



INTRODUCTION

At the beginning of the kindergarten phase, the child experiences an important in cognitive development [1]–[3]. At this stage, children begin to develop the ability to think concretely and recognize the concept of simple geometric shapes such as circles, triangles, and squares. They learn to compare different shapes and understand each shape's basic features, such as the number of sides and angles. Learning basic concepts of two-dimensional shapes in kindergarten children generally involves playing, drawing, and manipulating simple geometric objects. Teachers and parents play a role in providing direct experience to children through play and exploration of geometric shapes [4]. However, from observations, many cases show that the concept of two-dimensional shapes is still difficult for children to understand. They have difficulty distinguishing basic shapes such as triangles, squares, pentagons, and circles, thus requiring special guidance in understanding the concept. In addition, teachers and parents need to understand the stages of cognitive development of kindergarten students to choose the right learning method and provide clear guidance in understanding the concept of two-dimensional shapes.

*Corresponding author.

Email addresses: teja.endraengtju@budiluhur.ac.id (Tju)

DOI: [10.15294/sji.v11i1.47494](https://doi.org/10.15294/sji.v11i1.47494)

In addressing the challenges of teaching two-dimensional shapes to kindergarten students, teachers and parents are currently implementing various creative and interactive teaching strategies. They utilize teaching aids such as geometric blocks, puzzles, and drawing materials to help children understand the shapes and spatial orientation of objects in two-dimensional space. Educational games are designed to reinforce their understanding of basic shapes and concepts in two-dimensional geometry. Furthermore, parents engage children in everyday activities that involve recognizing and utilizing fundamental shapes in flat structures, such as constructing structures with blocks and cutting paper. Learning from the methods employed by teachers and parents to facilitate the introduction of two-dimensional shape concepts to kindergarten children, it is evident that engaging and captivating teaching methods are essential. Incorporating games, drawings, and visually oriented activities is crucial. In today's context, where kindergarten children are already interacting with smartphones, interactive learning facilitated by information technology holds particular appeal. Therefore, this research aims to develop a learning tool in the form of an intelligent system within an application for recognizing two-dimensional shapes, tailored for kindergarten students. Utilizing the smartphone's camera, objects are captured and transformed into corresponding two-dimensional shapes. This approach enables kindergarten students to easily and swiftly grasp fundamental concepts in geometry, including two-dimensional shapes, through an innovative and enjoyable method.

Academics have conducted research related to educational aids utilizing information technology through mobile devices or smartphones. Applications involving geometric shapes have been developed for junior high school students [5], for elementary school students [6] using both two-dimensional and three-dimensional shapes; using three-dimensional shapes for college students [7], [8], for junior high school students [9], for elementary school students [10], [11]; and using two-dimensional shapes for elementary school students [12]. All studies involving these geometric applications utilize predefined shapes provided within the application. However, in the case of kindergarten students, research diverges from geometric shapes to other objects, including letters [13], [14], numbers [15], human body parts [16], colors [17], and various objects [18]. Distinct from prior research, this study's innovation lies in capturing objects through a camera, thereby eliminating reliance on predefined shapes within the application. Furthermore, the novelty also lies in the development of an educational aid for recognizing two-dimensional shapes aligned with the kindergarten curriculum.

The research contribution introduces an innovative learning tool tailored for kindergarten students, utilizing smartphone technology to translate real-world objects into two-dimensional shapes, and it effectively integrates technology into early childhood education, addressing a crucial gap in educational aids while enhancing the understanding of geometric concepts at a foundational level. This research is urgently needed as it directly addresses the pervasive struggles faced by kindergarten children in comprehending fundamental geometric concepts. By swiftly developing an innovative learning tool employing smartphone camera technology, it aims to bridge this critical gap, laying the groundwork for an enhanced educational experience at the kindergarten level and igniting a strong motivation among children to grasp these essential concepts more effectively and enthusiastically.

METHODS

The research involves four steps or stages, adopting a methodology that combines the Waterfall and Agile software development methodologies [19]–[21], tailored to specific needs. Combining Agile and Waterfall methodologies creates a hybrid approach that harnesses the strengths of both methods. It typically begins with a structured planning phase similar to Waterfall, where project scope and initial requirements are defined. However, as the project progresses, Agile principles are integrated to introduce iterative development cycles, continuous testing, and feedback loops. In this hybrid model, the structured phases of Waterfall, such as planning, analysis, and design, are adapted to accommodate flexibility and iterations. Agile's incremental development approach allows for ongoing adjustments based on evolving requirements and stakeholder feedback. This means that while the project maintains a structured framework, it also incorporates Agile's adaptability and responsiveness to change. The integration of Agile principles within the Waterfall structure enables a more flexible and adaptive project management style. It encourages regular reviews, collaboration, and the ability to incorporate modifications throughout the development process [22]–[25].

This hybrid model aims to balance the benefits of structured planning and documentation with the agility to respond to changing project needs efficiently. It utilizes and merges into four phases: plan and discovery, analysis and design, application development, and testing and evaluation, as illustrated in Figure 1.

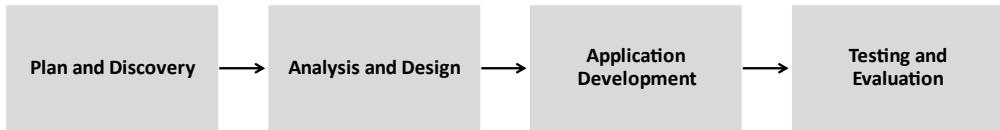


Figure 1. Stages of research

In the initial stage, which is the planning and discovery phase, activities involve observing and analyzing the needs within the kindergarten curriculum and cognitive learning processes, followed by a literature review and planning related to this research topic and its implementation. The outcomes of the analysis phase are presented using Data Flow Diagrams (DFD) [26], [27], while in the design phase, the results are depicted through flowcharts, incorporating the method of two-dimensional shape detection with the Harris Corner Detector algorithm [28]–[32]. Development of applications using the Kotlin programming language [33], [34] that produces an Android-based application. In the final stage, testing is conducted on the application to obtain accuracy values in flat shape recognition and usability scores from users.

The data for accuracy calculations are collected using an Android-based application installed on smartphones, totaling 120 data points, with 30 data points each for triangle, square, pentagon, and circle shapes. Additionally, usability scores are obtained through questionnaires filled out by six teachers at a kindergarten. The questionnaire is related to the use of the application with usability testing [35] consisting of five points, namely learnability, efficiency, memorability, error handling, and satisfaction. The questionnaire data is processed quantitatively by calculating the average results.

RESULTS AND DISCUSSIONS

The first-level DFD [36] modeling depicts the entire system. Figure 2 illustrates the Context DFD for the Smart System on Two-dimensional Shapes Recognition Application. It involves a single external-entity/sink/source, the User, which provides two data flows, two-dimensional shape data and testing input, into the system. From the system, two data flows, two-dimensional shapes formed and recognized, are provided to the User.

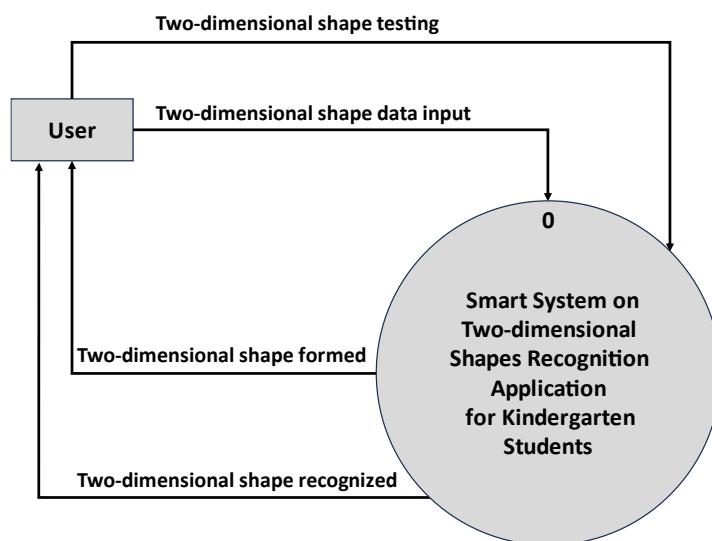


Figure 2. Context DFD for the two-dimensional shapes recognition application

The workflow of two-dimensional shape detection, a crucial component of the application design, is illustrated in Figure 3, utilizing the Harris method to detect corners or corner points on an object. The Harris method comprises five processes: image acquisition, segmentation, corner detection, center of mass and aspect ratio calculation, identification and highlighting.

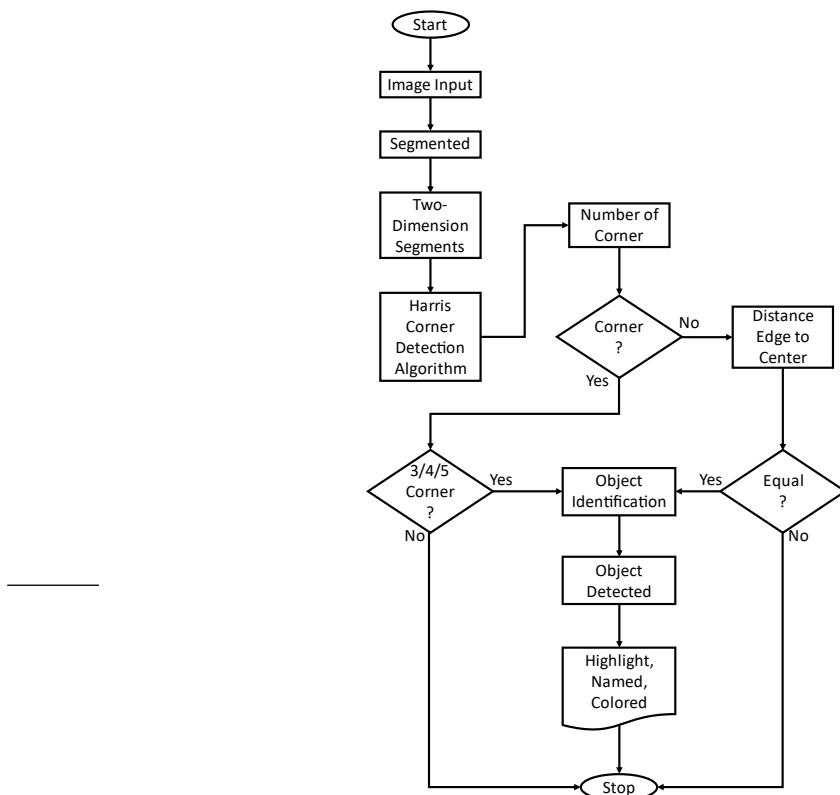


Figure 3. Two-dimensional shapes recognition application design

After the application is created and run on the smartphone, it appears as shown in Figure 4. On the left side of Figure 4 is the initial display, equipped with an explanation of flat shape recognition, including triangles or ‘segi tiga’, squares or ‘segi empat’, pentagons or ‘segi lima’, and circles or ‘lingkaran’. There are also buttons for Camera or ‘Kamera’ and Exit or ‘Keluar’. Selecting the ‘Kamera’ button activates the smartphone’s camera to capture the desired object, resulting in an image like the one in the center of Figure 4. Next, press the confirmation button to perform the testing, as shown on the right side of Figure 4. It can be seen that triangles, squares, pentagons, and circles have been successfully detected and are highlighted in green, red, yellow, and blue, respectively. Objects detected elsewhere are outlined.

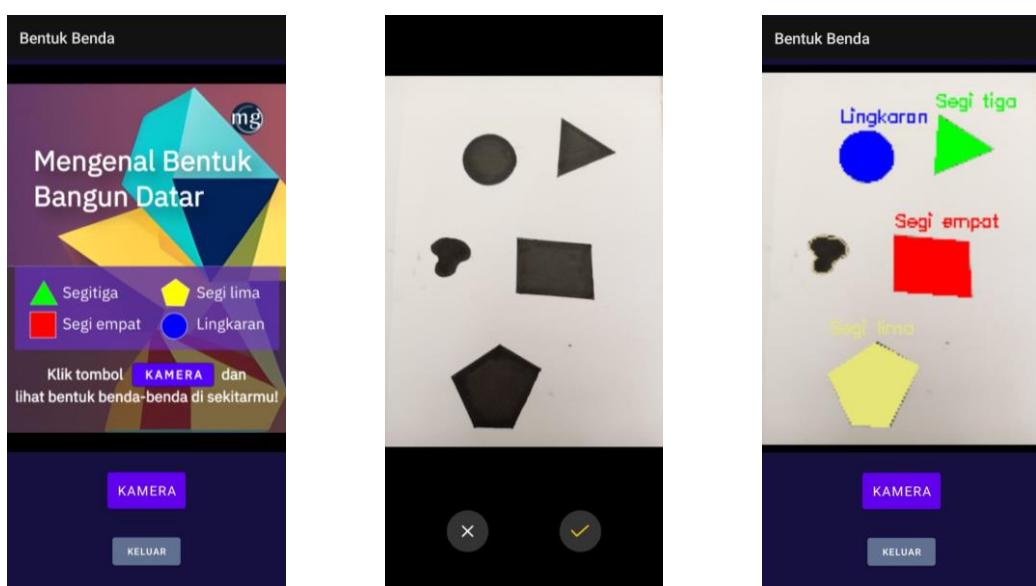


Figure 4. Application’s user interface

A summary of the data collection results and accuracy is presented in Table 1, with an accuracy value of 95/120 or approximately 79%. It is observed that the lower number of corners inversely correlates with accuracy, primarily due to low resolution or lack of focus, leading to simplified detected shapes.

Table 1. The recapitulation of data collection and accuracy

Two-dimensional Object	Number of Data	Accurate	Not Accurate
Triangles	30	27	3
Squares	30	25	5
Pentagons	30	23	7
Circles	30	20	10
Total	120	95	25

Image processing steps, which necessitate preprocessing with greyscale and binarization, lead to the loss of color information in the photo, causing the boundaries between objects in the image to become biased. Consequently, the application program can accurately detect objects with darker colors against a brighter background (closer to white) but struggles to detect objects placed on patterned or slightly darker backgrounds. The application also faces difficulties in detecting objects that do not contrast sharply with their backgrounds once they have been converted to greyscale, such as a green circle on a red paper. The quality of the smartphone camera sensor plays a significant role in its success, as an inaccurate sensor in capturing the true colors of objects can result in the same issues. This is why field tests with various makes and models of mobile phones yield highly variable results.

Regarding installation compatibility, there are no issues, and it is supported by mobile phones running Android [37] versions 9.0 to 12.0. The OpenCV [38]–[40] 4.6.0 library used is sufficiently compatible with the various Android versions used during testing. However, a drawback of using the OpenCV library is that it increases the size of the application and the application package (.APK) to a large size of 131 MB. The rotational-invariant nature of contour detection means that the detected shapes do not have to be in an upright position. Triangular, square, and pentagonal areas that undergo rotation or other transformations can still be detected.

Table 2. Assessment of usability testing

Assessment	Teacher1	Teacher2	Teacher3	Teacher4	Teacher5	Teacher6	Average
Learnability	80	77	90	75	80	70	78,67
Efficiency	80	75	90	75	80	65	77,50
Memorability	75	76	90	85	80	75	80,17
Error Handling	70	72	90	90	80	60	77,00
Satisfaction	85	80	90	80	80	70	80,83
Average	78	76	90	81	80	68	78,83

From Table 2, it is apparent that the application has been well-received by its users, particularly kindergarten teachers, who have given it a favorable score of 78.83. This score indicates a positive reception and suggests that the application meets the usability and functionality expectations of the teachers.

Based on the results, this research has made a significant impact in two crucial areas. Firstly, it has introduced an innovative learning tool specifically designed for kindergarten students, utilizing smartphone technology to convert real-world objects into two-dimensional shapes. This tool fills a critical gap in educational resources for early childhood education, offering a unique approach to enhancing children's understanding of fundamental geometric principles. Secondly, the research contributes significantly to integrating technology into early childhood education. By recognizing the need for effective educational aids, particularly in helping kindergarten children grasp basic geometric concepts, this study provides a practical solution. Through the use of smartphone camera technology, it seamlessly merges modern technology with educational objectives, creating a more engaging and impactful learning experience for young learners. Overall, this research directly addresses challenges faced by kindergarten children in comprehending basic geometric concepts. Its rapid development of an innovative learning tool aims to

bridge this critical gap in early education, paving the way for an improved educational journey and igniting children's motivation to grasp these essential concepts more effectively and enthusiastically.

CONCLUSION

This intelligent two-dimensional shape recognition system, tailored to the kindergarten curriculum, offers several advantages for both teachers and young learners. For educators, it provides a tech-savvy teaching aid that aligns with the ICT-based learning approach, enhancing their ability to engage students and make learning more interactive and engaging. Additionally, it streamlines the assessment of students' understanding of basic geometric shapes. On the other hand, for kindergarten students, the system fosters a fun and interactive learning environment, allowing them to visually explore and grasp fundamental shapes while promoting digital literacy from an early age. This technology not only aids in improving shape recognition skills but also encourages independent exploration, making learning an enjoyable and memorable experience. Overall, the system's integration into kindergarten education offers a promising avenue for enhancing both teaching and learning outcomes.

Despite its significant contributions, this research does have certain limitations that need acknowledgment. Firstly, the reliance on smartphone technology for object recognition might pose challenges in terms of accuracy and reliability, especially when dealing with diverse real-world environments. Variations in lighting conditions, object sizes, or occlusions might affect the system's effectiveness in accurately translating objects into two-dimensional shapes. Secondly, the study's focus on kindergarten students might limit the generalizability of the findings to other age groups or educational settings. Additionally, the evaluation of the learning tool's effectiveness could be further enhanced by incorporating a larger and more diverse sample of kindergarten students to ensure the tool's applicability across various learning contexts.

Looking ahead, future research endeavors could address the identified limitations and further advance the field. One potential avenue is to refine the smartphone-based object recognition system by integrating advanced algorithms or machine learning techniques to improve accuracy and adaptability to different environmental conditions. Moreover, expanding the scope of the study to include a wider range of age groups or educational levels could provide insights into the tool's effectiveness across diverse learners. Additionally, conducting longitudinal studies to assess the long-term impact of the learning tool on children's geometric understanding and academic performance could provide valuable insights into its sustained effectiveness. Exploring collaborative approaches between educators, technologists, and child psychologists to tailor the learning tool to diverse learning styles and cognitive abilities could also be a promising direction for future research endeavors. Overall, future research efforts should aim to address the identified limitations while exploring innovative ways to optimize the learning tool's effectiveness and applicability in enhancing geometric understanding among young learners.

ACKNOWLEDGMENT

We would like to extend our heartfelt appreciation to the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) Indonesia for their generous funding and support for the New Lecturer Research, as outlined in Decree Number 0536/E5/PG.02.00/2023 and Agreement/Contract Number 179/E5/PG.02.00/PL/2023; 1404/LL3.AL.04/2023. This funding has played a pivotal role in enabling the successful execution of our research endeavors.

REFERENCES

- [1] Susan Abdulla Mohamed and Jameela Raheem Abd, "Cognitive Motive of the Kindergarten Child," *Journal of the College of Education for Women*, vol. 33, no. 2, 2022, doi: 10.36231/coedw.v33i2.1599.
- [2] B. H. Ali and H. T. A. Rahman, "Cognitive independence of kindergarten students," *Int J Health Sci (Qassim)*, 2022, doi: 10.53730/ijhs.v6ns4.10355.
- [3] A. K. Sulyandari, *Cognitive and Language Development in Early Childhood*. GUEPEDIA, 2021. [Online]. Available: <https://books.google.co.id/books?id=jiNLEAAAQBAJ>
- [4] K. Khadijah and N. Amelia, *Cognitive Development in Early Childhood: Theory and Practice*. Prenada Media, 2021. [Online]. Available: <https://books.google.co.id/books?id=wfIsEAAAQBAJ>
- [5] A. Wahyudi, R. Dwi Agustin, M. Ambarawati, and I. B. Utomo, "Development of Geotri Application for Geometry Material Based on Mobile Learning," *Jurnal Ilmiah Matematika Realistik (JI-MR)*, vol. 3, no. 2, pp. 62–70, 2022, doi: 10.33365/ji-mr.v3i2.2288.
- [6] S. D. Putra, D. Aryani, H. Syofyan, and V. Yasin, "Elementary School Geometric Augmented

Reality Application for Plane and Spatial Shapes Using Marker-Based Tracking Method," *Jurnal Media Informatika Budidarma*, vol. 7, no. 1, pp. 250–259, 2023, doi: 10.30865/mib.v7i1.5281.

[7] Z. Amrina, S. G. Sari, J. Alfino, and M. Mahdiansyah, "Development of Mathematics Learning Media Based on Augmented Reality to Enhance Student Competence," *Jurnal Cendekia : Jurnal Pendidikan Matematika*, vol. 7, no. 1, pp. 380–391, Jan. 2023, doi: 10.31004/cendekia.v7i1.1932.

[8] K. Anam, G. Wiradharma, and M. A. Prasetyo, "Development of Augmented Reality-Based Mobile Learning Application for Spatial Shapes," *Journal of Elementary School (JOES)*, vol. 5, no. 2, pp. 234–246, 2022, doi: 10.31539/joes.v5i2.4426.

[9] S. Sungkono, V. Apiati, and S. Santika, "Augmented Reality-Based Learning Media," *Mosharafa: Jurnal Pendidikan Matematika*, vol. 11, no. 3, pp. 459–470, Sep. 2022, doi: 10.31980/mosharafa.v11i3.1534.

[10] I. P. Sari, I. H. Batubara, A. H. Hazidar, and M. Basri, "Introducing Spatial Shapes Using Augmented Reality as a Learning Media," *Hello World Jurnal Ilmu Komputer*, vol. 1, no. 4, pp. 209–215, Dec. 2022, doi: 10.56211/helloworld.v1i4.142.

[11] D. Mursyidah and E. Rahayu Saputra, "Augmented Reality-Based Application for Introducing Spatial Shapes to Elementary School Students," *Jurnal Tunas Nusantara*, vol. 4, no. 1, pp. 427–433, 2022, doi: 10.34001/jtn.v4i1.2941.

[12] S. Adinda Putri and T. Pamungkas Alamsyah, "Development of Interactive Multimedia Android-Based 'Sipembada' Application for Elementary School Fourth Grade Students to Learn Plane Geometry," *Jurnal Pengembangan Pendidikan Dasar*, vol. 7, no. 2, pp. 96–107, 2023, doi: 10.36379/autentik.v7i1.281.

[13] S. Romlah and Z. Zarnelly, "Design and Development of Hijaiyah Letter Articulation Learning Application Based on Android for Az-Zahra Tambusai Utara Kindergarten," *Jurnal Ilmiah Rekayasa dan Manajemen Sistem Informasi*, vol. 7, no. 1, pp. 11–18, 2021, doi: 10.24014/rmsi.v7i1.10440.

[14] M. Bakhar and A. Yusni, "Design and Development of an English Alphabet Learning Application for Early Childhood Education Based on Android Using Eclipse," *Power Elektronik: Jurnal Orang Elektro*, vol. 6, no. 1, pp. 1–6, Jan. 2019, doi: 10.30591/polektro.v6i1.1190.

[15] K. Fahmi, S. Gumilang, and U. Albab, "Design and Development of an English Number Recognition Application Using Eclipse for Kindergarten Level Based on Android," *Power Elektronik: Jurnal Orang Elektro*, vol. 6, no. 2, pp. 33–37, Jan. 2019, doi: 10.30591/polektro.v6i2.1194.

[16] A. Latifah, E. Gunadhi, and A. Faroqi, "Design and Development of Learning Media for Recognizing Human Body Parts Using Augmented Reality Technology for Kindergarten/Early Childhood Education Based on Android," *Jurnal Algoritma*, vol. 17, no. 2, pp. 378–385, 2020, [Online]. Available: <http://jurnal.sttgarut.ac.id/>

[17] M. Y. B. Nugraha, R. Susanto, and A. I. Pradana, "Design and Development of a Color Combination Learning Media Based on Microcontroller with Desktop Visualization," *Prosiding SNFA (Seminar Nasional Fisika dan Aplikasinya)*, vol. 5, Dec. 2020, doi: 10.20961/prosidingsnfa.v5i0.46606.

[18] M. Syahrudin and G. Kencanawaty, "Learning Application for Syauqi Islamic Kindergarten Based on Android," *Jurnal Riset dan Aplikasi Mahasiswa Informatika (JRAMI)*, vol. 2, no. 03, Jul. 2021, doi: 10.30998/jrami.v2i03.1134.

[19] M. McCormick, "Waterfall and Agile Methodology," *MPCS Inc*, no. 8/9/2012, 2012.

[20] L. Ahmed and R. Chukwu Ogbu, "A Comparative Analysis of Agile and Waterfall Software Development Methodologies," *Bakolori Journal of General Studies*, vol. 11, no. 2, 2021.

[21] "The Best Software Development Methodologies for Small Team - fram^." Accessed: Sep. 06, 2023. [Online]. Available: <https://wearefram.com/blog/software-development-methodologies/>

[22] N. Yahya and S. S. Maidin, "The Waterfall Model with Agile Scrum as the Hybrid Agile Model for the Software Engineering Team," in *2022 10th International Conference on Cyber and IT Service Management, CITSM 2022*, 2022. doi: 10.1109/CITSM56380.2022.9936036.

[23] A. Baird and F. J. Riggins, "Planning and sprinting: Use of a hybrid project use of a hybrid project use of a hybrid project management methodology within a CIS capstone course," *Journal of Information Systems Education*, vol. 23, no. 3, 2012.

[24] N. El-Sokkary, W. H. El-Masry, and N. R. Darwish, "A Proposed Hybrid Approach for Developing Healthcare Information Systems," *Int J Comput Appl*, vol. 183, no. 28, 2021, doi: 10.5120/ijca2021921664.

[25] R. R. Raval and H. M. Rathod, "Improvements in Agile Model using Hybrid Theory for Software

Development in Software Engineering," *Int J Comput Appl*, vol. 90, no. 16, 2014, doi: 10.5120/15806-4677.

[26] W. S. Davis, "Data flow diagrams," in *The Information System Consultant's Handbook*, CRC Press, 2019, pp. 175–188. doi: 10.1201/9781420049107-24.

[27] A. Y. Aleryani, "Comparative Study between Data Flow Diagram and Use Case Diagram," *International Journal of Scientific and Research Publications*, vol. 6, no. 3, 2016.

[28] Baeldung, "Harris Corner Detection Explained | Baeldung on Computer Science." Accessed: Apr. 05, 2023. [Online]. Available: <https://www.baeldung.com/cs/harris-corner-detection>

[29] T. P. Patel and S. R. Panchal, "Corner Detection Techniques: An Introductory Survey," *International Journal of Engineering Development and Research*, vol. 2, no. 4, 2014.

[30] Z. Jiang, Y. Wu, J. Wang, J. Lu, and L. Zhang, "The Improved Harris Operator based on Steerable Filter," in *ISME 2016 - Information Science and Management Engineering IV*, SCITEPRESS - Science and and Technology Publications, 2016, pp. 305–311. doi: 10.5220/0006449503050311.

[31] H. A. Kadhim and W. A. Araheemah, "A method to improve corner detectors (Harris, Shi-Tomasi & FAST) using adaptive contrast enhancement filter," *Periodicals of Engineering and Natural Sciences*, vol. 8, no. 1, 2020, doi: 10.21533/pen.v8i1.1158.g532.

[32] "DataTechNotes: Harris Corner Detection Example with OpenCV." Accessed: Nov. 24, 2023. [Online]. Available: <https://www.datatechnotes.com/2023/07/harris-corner-detection-example-with.html>

[33] "Developing Android Apps with Kotlin | Free Courses | Udacity." Accessed: Sep. 07, 2023. [Online]. Available: <https://www.udacity.com/course/developing-android-apps-with-kotlin--ud9012>

[34] "Kotlin Programming Language." Accessed: Sep. 07, 2023. [Online]. Available: <https://kotlinlang.org/>

[35] R. A. Setyawan and W. F. Atapukan, "Measurement of E-Commerce Website Usability for Sambal Nyoss Using the Likert Scale Method," *Compiler*, vol. 7, no. 1, May 2018, doi: 10.28989/compiler.v7i1.254.

[36] A. Purwinarko and Y. Sukestiyarno, "Expertise Management System Model at Universitas Negeri Semarang," *Scientific Journal of Informatics*, vol. 1, no. 2, pp. 177–184, Oct. 2015, doi: 10.15294/sji.v1i2.4024.

[37] "Android | Do More With Google on Android Phones & Devices." Accessed: Nov. 24, 2023. [Online]. Available: <https://www.android.com/>

[38] "OpenCV - Open Computer Vision Library." Accessed: Nov. 24, 2023. [Online]. Available: <https://opencv.org/>

[39] A. Zelinsky, "Learning OpenCV—Computer Vision with the OpenCV Library," *IEEE Robotics and Automation Magazine*, vol. 16, no. 3. 2009. doi: 10.1109/MRA.2009.933612.

[40] G. Bradski, "The OpenCV Library," *Dr. Dobb's Journal of Software Tools*, 2000.