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The Implementation of the CNN Method on Smart Image Recognition and Identification of Heritage (SIRIH) of Sundanese Traditional Tools

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Abstract

Sundanese is a regional language in West Java. Young people rarely use local languages, so they need to be preserved by using technology. Image processing technology can help the process of strengthening the Sundanese language and culture. Researchers developed Sundanese traditional tools because their existence is not only related to Sundanese language and terms, but also related to philosophy and local wisdom values. This application is called Smart Image Recognition and Identification of Heritage (SIRIH). The development of this android-based innovative application is based on image recognition technology with the CNN method. Based on the test results, the classification accuracy of pre-trained CNN is 98%, and val accuracy at 86%. Accuracy test results on the application show good and maximum results (90%-100%) if the item is in sufficient light, both indoors and outdoors, while dim light will reduce accuracy to around 60%-70%. Blurred images also affect accuracy by up to 50%.

Keywords: Image Recognition, Traditional Sundanese, Cultural Promotion Object

Abstrak

Bahasa Sunda merupakan bahasa daerah yang ada di Jawa Barat. Bahasa daerah mulai jarang digunakan oleh anak muda, sehingga perlu dilestarikan dengan cara menggunakan teknologi. Teknologi image processing mampu membantu proses penguatan Bahasa dan Budaya Sunda. Peneliti mengembangkan perkakas tradisional Sunda karena keberadaannya tidak hanya terkait dengan bahasa dan istilah Sunda saja, tetapi juga berkaitan dengan filosofi dan nilai-nilai kearifan lokal. Aplikasi ini dinamakan Smart Image Recognition and Identification of Heritage (SIRIH). Pengembangan aplikasi cerdas berbasis android ini didasarkan pada teknologi image recognition dengan metode CNN. Berdasarkan hasil pengujian, akurasi klasifikasi CNN pre-trained adalah 98% dan val akurasi pada 86%. Hasil pengujian akurasi pada aplikasi menunjukkan hasil yang baik dan maksimal (90%-100%) jika item berada pada cahaya yang cukup, baik di dalam maupun di luar ruangan, sementara cahaya redup akan mengurangi akurasi menjadi sekitar 60%-70%. Hasil gambar yang blur juga mempengaruhi akurasi sampai 50%.

***Kata-kata kunci**: Image Recognation, Bahasan Sunda, Objek Pemajuan Budaya*

1. Introduction

In the 2021 Language Statistics Report [1] published by the Ministry of Education and Culture of Indonesia, it is stated that the Sundanese language is still in the category of being safe from extinction. This category is achieved if all children and all people of that ethnicity still use the language. However, the facts specify that from the results of research by the West Java Provincial Language Center reported by Republika, only 40% of the young generation in West Java recognize and use Sundanese [2]. The same thing also emerged in the Bandung Language Center study [3] and West Java BPS data on the 2020 Census Long Form Results [4].

The factors of globalization, media, convenience, social environment, inferiority complex, and parental and environmental factors have contributed to the decline in the use of Sundanese among children and teenagers. This symptom is also influenced by technological factors, which are developing very rapidly. For example, the emergence of automatic electric rice cookers caused the loss of more than 10 Sundanese words, not to mention the cultural and philosophical activities contained in these activities, as in Table 1.

Table 1. Traditional and Modern Tools Comparison of Rice Cooking Process [5] [6] [7]

No	Name/Atribut			
	Sundanese	Indonesia	English	Technology
1	Hawu	Tungku	Furnace	Electronic Rice Cooker
2	Parako	Tempat Abu	Charcoal	
3	Songsong	Pipa bambu	Bomboo pipe	
4	Aseupan	Kukusan	Bamboo Steamer	
5	Dulang	Wadah Nasi	Rice tray	
6	Seeng	Dandang	Steamer	
7	Pangarih	Centong	Rice ladle	
8	Kekeb	Tutup	Rice cover	
9	Siwur	Gayung	Coconut shell water scoupe	
10	Hihid	Kipas	Bamboo hand fan	

From the example above, of course, it can be understood that what is missing is not only the words/terms but also the cultural actions that include them, such as *napi* (winnowing rice), *ngisik* (washing rice), *ngagigihan* (steaming), *ngarih* (stirring rice), *ngekeb* (second stage of steaming), and *ngakeul* (flipping the rice). Of course, many other things have been lost due to the emergence of technology in various fields. In the agricultural sector, the plowing system has been replaced by tractors. In the field of trade, the itinerant trading system (by feet) has been replaced by motorbikes or cars, and so on.

Generally, the government pays quite a lot of attention to the decline in the use of regional languages, as evidenced by the issuance of Republic of Indonesia Law No. 24/2009 [8] and

Government Regulation No. 57/2014 [9]. From the regional government side, the Bandung City Government also issued Regional Regulation No. 9/2012 [10] concerning the Use, Maintenance, and Development of Sundanese Literary Language and Script. Furthermore, the Department of Culture and Tourism (Disbudpar) of West Java Province also responded to this by establishing a Draft Regional Regulation for the Advancement of Culture in 2023 [11]. During the event, it was stated that there were 11 Objects for the Advancement of Culture, including manuscripts, oral traditions, customs, rites, traditional knowledge, traditional technology, art, language, folk games, traditional sports, and cultural heritage.

To support this step by the regional government and Disbudpar, the team created a media that utilizes the involvement of technology to help the process of strengthening the Sundanese language and culture. The research team took on the role of preserving traditional tools' names and functions. This domain was chosen because its existence is not only related to the Sundanese language and terms but also related to its philosophy and local wisdom values.

The development of this Android-based intelligent application is based on image recognition technology using the Convolutional Neural Network (CNN) method. This technology is expected to be able to provide a solution to the decline in the use of Sundanese terms, especially those related to traditional tools. Some traditional tools are still used daily by the Sundanese people, so that their introduction can be directly felt and applied in society.

This application is called Smart Image Recognition and Identification of Heritage, or SIRIH. The interface of this application will be as shown in **Figure 1**.

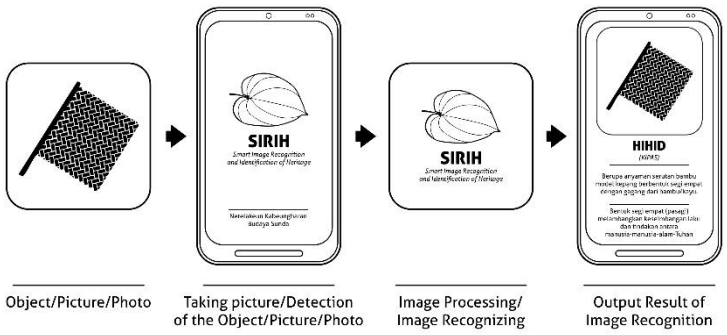

Figure 1. SIRIH Application Interface Prototype

This application supports four objects for the Advancement of Culture, namely customs, traditional knowledge, traditional technology, and language. This application is a tool for learning and maintaining language and cultural assets that are easy, inexpensive, and effective for various parties. For local governments, this application will support language preservation and revitalization programs that are currently being promoted. In the field of Education, this

application will be a tool and media for learning Sundanese as well as understanding the existing philosophical forms and meanings. From there, learning can be developed into activities related to the word or term in question. For the public, especially the older generation, this application can be a means of reminding and encouraging them to be able to transfer knowledge about local wisdom to the next generation.

Zainab **[12]** conducted research on a model based on Scalable Object Detection, using Deep Neural Networks to track people, cars, potted plants, and 16 other categories in real time. The process uses the Visual Recognition ImageNet Package 'inception5h' trained model from Google and Android studio .jar files to support Java and TensorFlow integration. The research from Kim, Hankil, et al. **[13]** extracts features from an image using CNN and then learns them with a neural network. The proposed system shows a recognition accuracy of 84%. Furthermore, Ramprasath et al. **[14]** also used CNN for image recognition and used the MNIST Digit data set as a benchmark for grayscale image classification. The result obtained has an accuracy of 98%.

Sachar S. and Kumar A. **[15]** identified plant leaves by applying transfer learning to compare the feature extraction capabilities of the VGG-16, Xception, MobileNetV2 Convolutional Neural Network (CNN), and DenseNet121 architectures. Random Forest is used as a classifier to identify leaf species. DenseNet121 achieves maximum accuracy of 100%, 99%, and 92.4% in all three datasets, respectively. Furthermore, Astawa et al. **[16]** combined CNN for face recognition and VGG for the classification process. The results show that the validation values for accuracy, loss, and loss validation are excellent. However, the best training results are images generated from digital cameras with modified classification. The Val_accuracy results are very high (99.84%), not too far from the accuracy value (94.69%).

Like all the research above, the Smart Image Recognition and Identification of Heritage (SIRIH) application was created using CNN with VGG16 for image classification. Its machine learning (ML) library uses Tensorflow Lite (tflite) to run ML models on Android. The novelty of the SIRIH application lies in its usage and targets.

The SIRIH application is devoted to preserving Sundanese cultural and language heritage and focuses on recognizing traditional tools and utensils that still exist around the Sundanese community. It is considered as an advantage because once they know the Sundanese term, the users can immediately search for its pronunciation, add new vocabulary, or learn the philosophy and values of the tool. This application was also created to support regional language

revitalization efforts by the central government and to support the creation of the West Java Cultural Advancement Regional Regulation.

2. Method

Research on the Implementation of the CNN Method on Smart Image Recognition and Identification of Heritage (SIRIH) Traditional Sundanese Tools is based on the identification of the problems mentioned above. The research team used a framework to determine the problem-forming factors, as shown in **Figure 2**.

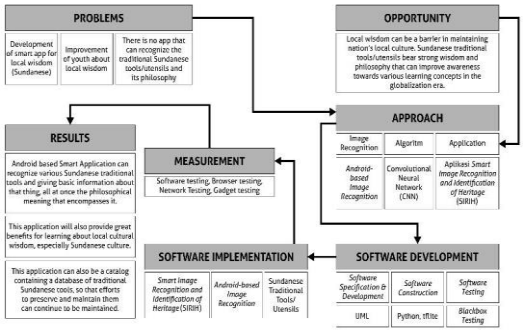

Figure 2. Research Framework

In contrast, the research was focused on designing and building Smart Image Recognition and Identification of Heritage (SIRIH) applications. The general research flow diagram is outlined in **Figure 3**.

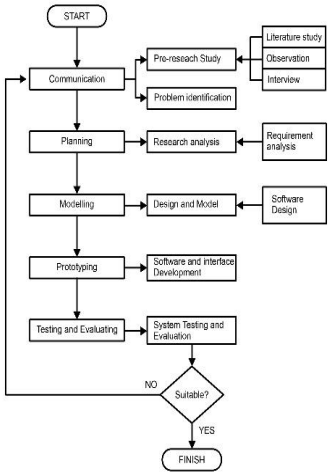

Figure 3. Research Flow Diagram

Problem identification is followed by planning in the form of research analysis, which contains needs analysis, including data collection for a dataset of Sundanese traditional tools. Then proceed with modelling in the form of a software design and model. The following step is the Prototype Formation stage, which is divided into software development and the application of the CNN model. The CNN workflow can be seen in **Figure 4**.

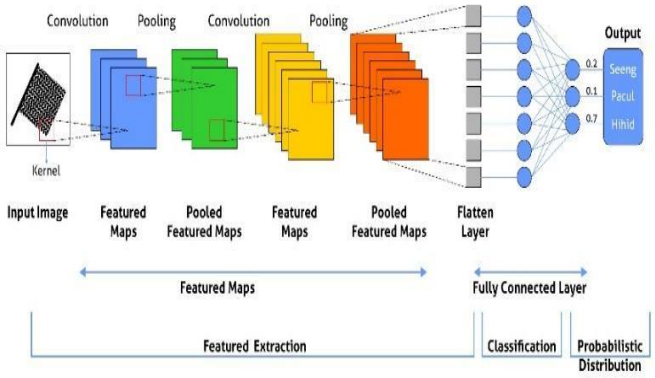

Figure 4. CNN Workflow

This process is continued at the testing and evaluation stage. This stage consists of testing using Blackbox Testing and other functionality testing. The flowchart for how the application works is divided into two parts, namely, the system workflow and the application workflow on Android is presented in **Figure 5** and **Figure 6**.

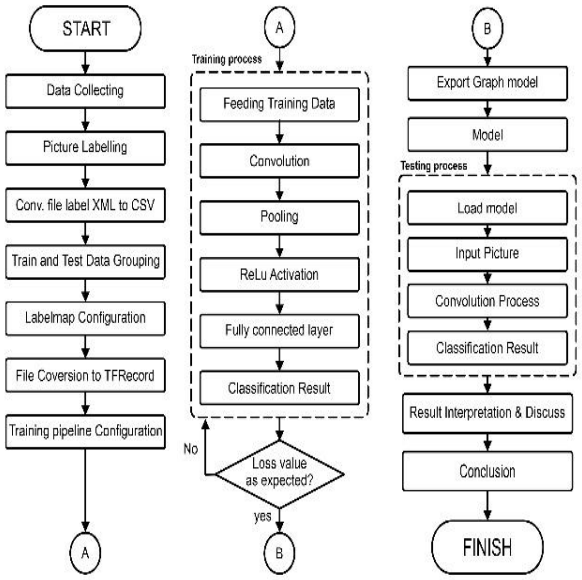

Figure 5. System's Flow Diagram

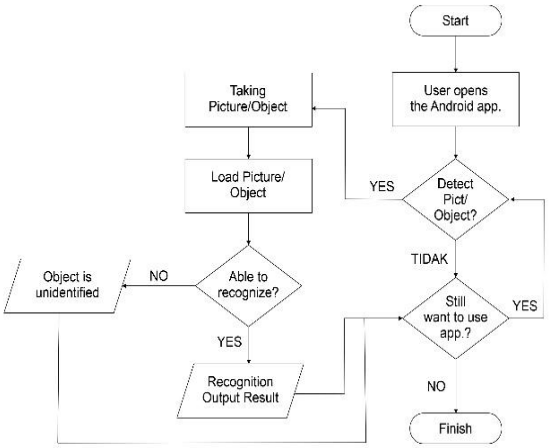

Figure 6. Android's Flow Diagram

The hardware used for this project is a laptop with CPU specifications i5–10210U 1.6Ghz (4 Core 6MB Cache), Ram: 8GB DDR4, HDD: 512GB, GPU: Nvidia GeForce MX130 2GB, with OS Windows 10 Professional 64-bit. Meanwhile, the software used is Python, Tensorflow, and Epoch. A total of 150 photos of 3 research objects (woven bamboo fan/*hihid*, woven bamboo steamer/*aseupan*, and ladle/*centong*) were used as a dataset for this research. All photos were taken by a Samsung Galaxy S8 smartphone camera (12 MP-rear cameras, f/1.7, 25mm (wide), 1/3.6", 1.22µm, AF). Example of the sundanese tools dataset is presented on **Figure 7**.

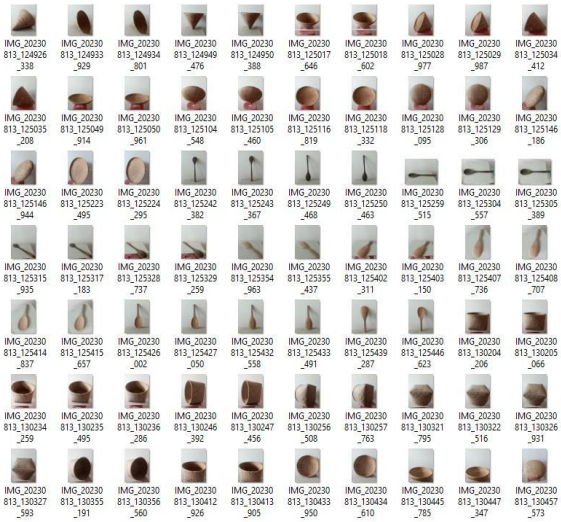

Figure 7. Example of the Sundanese Tools Dataset

All photos in the dataset are labeled using the labelImg module in Python, which makes them all have the .xml extension. For the image files to be combined into one and make it easier to take pictures from the labels that have been given, the .xml file must be converted into CSV. After the CSV dataset is ready, the next step is to separate the dataset into training data and test data with the script split_train_test.py so that the data is divided into 80% (120 images or 40 images per type) training data and 20% (30 images or 10 images per type) test data.

3. Results and Discussion

This section discusses the implementation of the interface, application testing with various conditions, and a discussion of the training data evaluation.

3.1 Interface Implementation

The implementation of the interface was tested to be able to see the ease of use from the user's side (user experience) so that it can be used even by people who are opening this application for the first time. App display in android is presented **Figure 8**.

A **B** **C** **D** **E**

Figure 8. App. Display in Android

Shades of green dominate the appearance of the 'home' interface in Figure 9A with the betel leaf logo, the word SIRIH, and the abbreviation of the word, i.e., Smart Image Recognition and Identification of Heritage. This display is also equipped with a start button and a sentence in Sundanese, "*Netelakeun Kabeungharan Budaya Sunda*," or Exposing the Wealth of Sundanese Culture. After the Start button is touched (Figure 9B), go straight to the camera with a dialog box displaying permission to use the camera to take pictures. After the 'Allow' button is touched, the camera can take pictures (Figure 9C) and be processed immediately by the application (Figure 9D). After that, the display switches to the results (Figure 9E), which displays object/image recognition with descriptions of the similarity percentage and object name.

3.2 Data Testing Using CNN

Tests were carried out in several conditions, including lighting (indoor/outdoor, sufficient light/low light), sides (front/back/side), and cropped objects. Testing was carried out on 3 objects with 5 tests, each with different but similar objects. These objects are a ladle (*pangarih*), a bamboo tray (*nyiru*), and a steamer (*aseupan*). Testing result data presented in **Table 2**.

Table 2. Testing Result Data

No	CONDITION	OBJECT'S NAME								
		Ladle			Bamboo Tray			Bamboo Steamer		
		T	*F*	*Acc.*	*T*	*F*	*Acc.*	*T*	*F*	*Acc.*
1	Outdoor with sufficient light									
	a Front side	5	0	100%	5	0	100%	5	0	100%
	b Back side	5	0	100%	5	0	100%	5	0	100%
	c Left/Right side	4	1	80%	4	1	80%	5	0	100%
	d Blurry object	3	2	60%	4	1	80%	3	2	60%
2	Outdoor with low light									
	a Front side	5	0	100%	5	0	100%	5	0	100%
	b Back side	3	2	60%	3	2	60%	3	2	60%
	c Left/Right side	1	4	20%	1	4	20%	3	2	60%
	d Blurry object	1	4	20%	1	4	20%	1	4	20%
3	Indoor with sufficient light									
	a Front side	5	0	100%	5	0	100%	5	0	100%
	b Back side	5	0	100%	5	0	100%	5	0	100%
	c Left/Right side	4	1	80%	4	1	80%	5	0	100%
	d Blurry object	3	2	60%	4	1	80%	3	2	60%
4	Indoor with low light									
	a Front side	5	0	100%	5	0	100%	5	0	100%
	b Back side	3	2	60%	3	2	60%	3	2	60%
	c Left/Right side	1	4	20%	1	4	20%	3	2	60%
	d Blurry object	1	4	20%	1	4	20%	1	4	20%

Ref.: T = True, F = False, Acc. = Accuracy

The test results for these three objects in a room with sufficient lighting reached an accuracy of 98% -100% on the front and back sides. In the side test for ladle and tray objects, accuracy only reached 45%-50% because the shape of the object tends to be thin, making it difficult to recognize, whereas for the steamer's accuracy reached 80%-90% because it has no sides (conical). Blurred objects also reduce object recognition accuracy by up to 40%-50%. CNN accuracy test for indoor objects with sufficient light – front side is presented in **Figure 9**, **Figure 10**, and **Figure 11**,

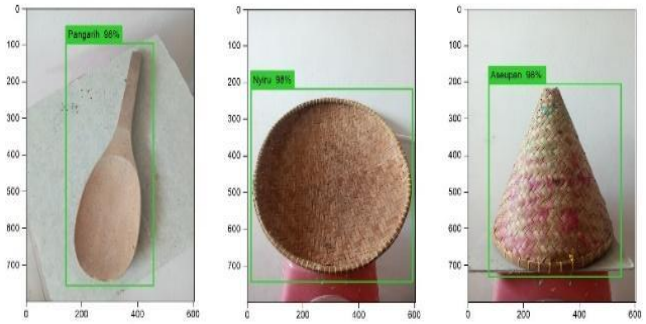

Figure 9. CNN Accuracy Test for Indoor Objects with Sufficient Light – Front Side

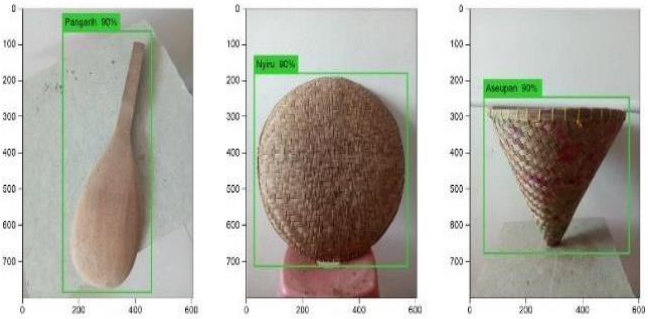

Figure 10. CNN Accuracy Test for Indoor Objects with Sufficient Light – Back Side

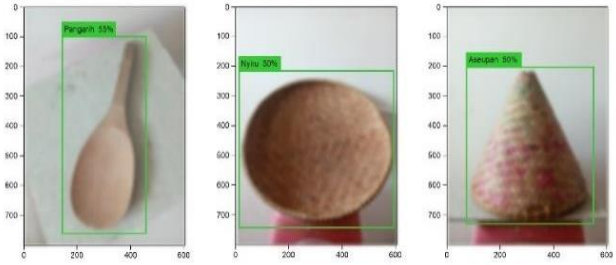

Figure 11. CNN Accuracy Test for Indoor with Sufficient Light – Blurry Objects

In tests with low-lighting room conditions, accuracy is reduced even though the system can still recognize objects. The level of accuracy reaches 70%-80% if the light is reduced to 20% of the standard limit and will decrease again to 40%-60% if the light is reduced to 40%. Items start to become difficult to recognize if the light is lowered from 60% to 100% (total darkness). Meanwhile, the lack of accuracy also has an impact on side positions and blurry objects, which only achieve Light—Back 40% -50% accuracy is presented in **Figure 12**.

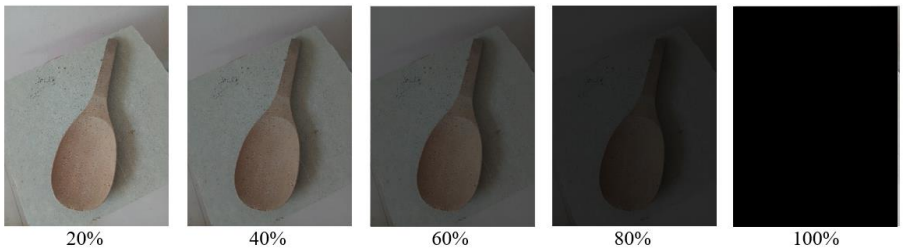

Figure 12. CNN Accuracy Test for Sufficient, Dim, and Dark Lights Indoor Object

In outdoor tests with sufficient or bright light, accuracy increased to 100% for all objects tested. The lack of precision is only found in taking pictures from side positions and/or blurry. If the outdoor light is dim, the item will still be recognizable at a dim light intensity of 50%-60% of normal light.

3.3 Training Data Evaluation

Training data evaluation is carried out to see the accuracy of the classification results carried out by the system. Good results are between 80% -100% which is determined, among other things, by the uniformity of the size and number of pixels in the image, the number of layers, convolution parameters, and others.

The sufficient amount of data and the uniformity of the layer sizes of the images taken produce the training data evaluation results, showing a value of 98% correctly classified. The test data reaches 90% with a reasonably low loss level as well, as shown in **Figure 13**.

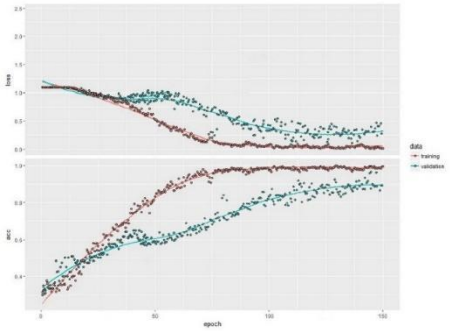

Figure 13. Dataset Testing Result

4. Conclusion

The conclusion that can be drawn from this study is that the results of the system test conducted on CNN for the Smart Image Recognition and Identification of Heritage (SIRIH) application for Sundanese tools are: 1) The accuracy of the pre-trained CNN test is 98% and the val_accuracy is 86%; 2) CNN accuracy test results show excellent and maximum results (90%-

100%) if the item is in sufficient light, both indoors and outdoors, while dim light will reduce accuracy to around 60%-70 %. Blurry image results also affect accuracy up to 50%.

5. Acknowledgements

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References

[1] Pusdatin Kemendikbud, *Statistik Kebahasaan dan Kesastraan 2021*. 2021.
[2] L. Permesti, "Bahasa Sunda Terancam Punah?," *Republika.co.id*, 2013. https://news.republika.co.id/berita/ms4nkw/bahasa-sunda-terancam-punah (accessed Mar. 23, 2023).
[3] I. Herdiana, "Pemakai bahasa Sunda tinggal 43%," *Okezone.com*, 2011. https://news.okezone.com/read/2011/11/23/447/533367/pemakai-bahasa-sunda-tinggal-43 (accessed Mar. 25, 2023).
[4] H. H. Sasongko, "Hasil Long Form Sensus Penduduk 2020 Provinsi Jawa Barat," Bandung, Jawa Barat, 2020. [Online]. Available: https://jabar.bps.go.id/publication/2023/02/10/abb859eca0277bdacbd17faa/hasil-long-form-sensus-penduduk-2020-provinsi-jawa-barat.html.
[5] Jamaludin, *Estetika Sunda*, 1st ed. Bandung: PT. Dunia Pustaka Jaya: Bandung., 2022.
[6] M. Sasmita, *Mengenal Teknologi Tradisional Orang Sunda*, 1st ed. Bandung: PT. Dunia Pustaka Jaya: Bandung., 2022.
[7] L. Herlinawati, "HAWU dalam Pandangan Masyarakat Sunda," *Kemendikbud*, 2020. https://kebudayaan.kemdikbud.go.id/bpnbjabar/hawu-dalam-pandangan-masyarakat-sunda/ (accessed Mar. 23, 2023).
[8] Pemerintah Republik Indonesia, *UU RI No. 24 Tahun 2009 tentang Bendera, Bahasa, dan Lambang Negara serta Lagu Kebangsaan*. 2009.
[9] Pemerintah Republik Indonesia, *Peraturan Pemerintah Republik Indonesia No. 57 tentang Pengembangan, Pembinaan, Dan Pelindungan Bahasa Dan Sastra, Serta Peningkatan Fungsi Bahasa Indonesia*. 2014.
[10] Pemerintah Daerah Kota Bandung, *Peraturan Daerah Kota Bandung Nomor 09 Tahun 2012 Tentang Penggunaan, Pemeliharaan Dan Pengembangan Bahasa, Sastra Dan Aksara Sunda*. 2012, pp. 1–11.
[11] D. Bandung, "Raperda Pemajuan Kebudayaan Kolaborasikan 11 OPK," *DPRD Kota Bandung*, 2022. https://dprd.bandung.go.id/warta/raperda-pemajuan-kebudayaan-kolaborasikan-11-opk (accessed Mar. 23, 2023).
[12] A. Zainab, "Realtime Object Detection on Android using Tensorflow," no. June 2019, doi 10.5339/qfarc.2018.ictpp417.
[13] H. Kim, J. Kim, and H. Jung, "Convolutional neural network based image processing system," *J. Inf. Commun. Converg. Eng.*, vol. 16, no. 3, pp. 160–165, 2018, doi:

10.6109/jicce.2018.16.3.160.

[14] M. Ramprasath, V. M. Anand, and S. Hariharan, "MNIST Image Classification Using Convolutional Neural Networks," *Smart Innov. Syst. Technol.*, vol. 292, no. January, pp. 255–266, 2022, doi: 10.1007/978-981-19-0836-1_19.

[15] S. Sachar and A. Kumar, "Automatic plant identification using transfer learning," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 1022, no. 1, 2021, doi: 10.1088/1757-899X/1022/1/012086.

[16] I. N. G. A. Astawa, M. L. Radhitya, I. W. R. Ardana, and F. A. Dwiyanto, "Face Images Classification using VGG-CNN," *Knowl. Eng. Data Sci.*, vol. 4, no. 1, p. 49, 2021, doi: 10.17977/um018v4i12021p49-54.