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Identification of Inpari HDB 32 Superior Rice Seeds based on Android in Realtime with Artificial Neural Network

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ABSTRACT

Rice is a staple food for humans living in East Asia. Rice is a crystal fruit. The Latin name for rice is Oryza Sativa. Rice plants are 110-120 days old. The selection of quality rice seeds by farmers is seen from the bright yellow color of the rice without black/brown spots, its large size and rounder. Rice seeds that are not of good quality are dark brown in color, have black/brown spots, and are flat in shape. The absence of superior rice recognition technology that is not Android-based in real time is the main reason for this research. The focus of this research is to identify superior and non-superior rice in Inpari HDB 32 rice with a high recognition accuracy rate of more than 70 percent with a viewing angle of 0-180 degrees using the real-time ANN method. The training data used in this research was 1000 datasets consisting of 350 superior rice datasets and 650 non-superior datasets. The smart model for classifying rice seeds that has been built in this research is generally able to run well where the classification accuracy obtained is quite good. The classification accuracy of the ANN model during training of the neural network model was able to classify rice seeds with an accuracy of 70-100% with the confidence value of the real-time classification results ranging from 65-98%. Real-time classification of rice grains with maximum accuracy of 96% and many grains 73%.

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1. INTRODUCTION

Rice is the staple food for humans who settled in East Asia. Rice is a crystalline fruit. The Latin name for rice is Oryza Sativa. Rice plants are 110-120 days old [4]. This plant needs special care in order to produce abundant and superior-quality rice. In addition to care, the selection of quality seeds is the first and most important effort in an effort to produce an abundant and quality rice harvest that has high taste and selling value. The selection of quality rice seeds by farmers is seen from the color of the rice which is bright yellow without black/dark brown spots, large in size and rounder. Apart from the characteristics of superior rice seeds, there are also rice seeds that are less qualified to be used as seeds because they will produce unhealthy rice plants and produce rice fruit below quality standards and not abundant. Rice that is not of good quality for consumption and is used as seeds is dark brown in color, has black/brown spots and has a flat shape [9]. Selection of superior rice seeds can also be done with today's advanced and latest technology. The process is identification with an image processing system based on Neural Network. Artificial Neural Network (NN) is a technique in ML that imitates human nerves which are a fundamental part of the brain [1]. The latest research conducted by Adnan et al [1] with the title "Identification of Rice Varieties Using Digital Image Processing and Discriminant Analysis" on Inpari 10 and Inpari 13 rice types, respectively, had 52.8% and 76.0% recognition accuracy, and not done in real time.

This research also applies the convolutional Neural Network method. Research conducted by Prasetyo, M.L [10] discusses face recognition-based biometric authentication for a barrier gate system simulation using a convolutional neural network algorithm based on an artificial neural network to classify images in real-time with 100 data and an average error rate of 0, 3205, the system success rate is 94%, and the average response time required by the microcontroller is 0.56217634 ms and the results of evaluating system accuracy in the confusion matrix model are 93.3%. These results become a reference for researchers to apply the convolutional Neural Network in this study. Identification of the introduction of superior rice can not be done in real-time with an Android-based smartphone. Smartphone cameras will recognize superior and non-superior seeds through the extraction of shape features and RGB (Red, Green, Blue) images. Existing research on the identification of rice seeds is still not real-time and is still based on image input to be recognized. Researchers feel there is a need to develop this identification application in real-time and based on Android that can detect many rice seeds in real-time and can be used for free by Android smartphone users. This research consists of stages of rice sample analysis, image processing stages, pattern recognition stages, and research conclusions. The rice used in this study was Inpari HDB 32 type.

2. METHOD

The research method of the research took place in seven stages, starting from the analysis of the problem to the conclusion. More clearly can be seen in Figure 1 and the explanation below the picture.

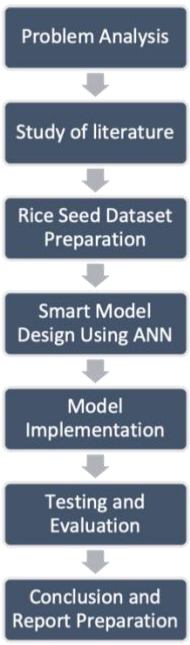

Figure 1. Flow of research method

Details of the explanation of the research method carried out are as follows:
1. **Problem Analysis**, at this stage a problem analysis is carried out from the emergence of the need for the development of a smart system that can identify superior rice seeds in real time which can help both farmers, suppliers, and researchers to easily identify superior rice seeds.
2. **Literature study**, at this stage a study of the theory of rice seeds available in the market today, the agricultural extension service office, and those of farmers in the city of Langsa, Aceh is carried out. Knowledge of types of superior and not superior is then compiled for the needs of compiling datasets. At this stage, a study is also conducted on the ANN model that will be used in the intelligent model to be built.
3. **Preparation of the Rice Seed Dataset**, at this stage the collection of superior and non superior rice seeds is carried out. The rice seeds are then captured using a digital camera device to obtain digital

images of the collected rice seeds. The dataset is then formed by dividing the image of rice seeds into two categories, namely superior and non-superior categories. Pre-processing using image processing techniques will then be applied to the dataset that will be used for ANN training.
4. **Smart Model Design Using The ANN Method**, at this stage the ANN model design using EfficientNet-Lite 0 is carried out. The prepared dataset will be divided into three parts, namely training data, validation data and test data. After the model and data are prepared, the next step is to conduct training and testing of the designed model
5. **Model Implementation**, at this stage the implementation of the designed model by implementing it in the form of a mobile-based application on the Android framework will be carried out. The model that has been built using python and tensorflow is integrated into an application that can be used on android-based devices.
6. **Testing and Evaluation**, at this stage testing is carried out on applications that have been built to test the performance of applications and intelligent models in real-time. The accuracy results will then be observed and evaluated to be used as a basis for the development of future research.

2.1. Research Stages

2.1.1. Dataset

This study uses a dataset of rice seeds captured using a digital camera. Each rice seed, both superior and non-superior, from various types is collected into a data library that contains digital images of rice seeds. The dataset used consists of 1000 datasets consisting of 350 superior seed images and 650 non superior seed images. The superior rice seeds have a bright yellow color pattern without black/brown spots, are large in size and are more rounded. Then the rice seeds that are not superior have a dark brown color, have blackish/brown spots, and are flat in shape. The example dataset for superior rice is taken from superior rice seeds as in Figure 2 and not as superior as in Figure 3.

Figure 2. Example of rice as a superior rice dataset

Figure 3. Rice seeds are not superior

From the data on superior and unrefined rice that has been collected, a dataset of rice seeds is made. This is also called the image cropping process. Making intelligent models based on neural networks is then trained using cropped superior and non-superior rice seed datasets (training data). An example of a cropping result called a dataset is shown in Figure 4. “Unggul” means superior (high quality), while “NonUnggul” means non-superior (low quality).

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Figure 4. Rice dataset

The rice dataset is formed with complete horizontal, vertical, and sloped images from various angles. The formation of a dataset with a complete slope can later support the segmentation process from various viewing angles. The superior rice dataset has full light brown RGB residents with an average value of rgb(179,135,66), rgb(136,78,19), rgb(220,177,98). Meanwhile, the non-superior rice dataset has a value of rgb rgb(131,100,50)-rgb(72,45,29). In the non-superior rice dataset there are brown color spots with rgb values (72,45,29). Each dataset is then resized to 600x600 using interpolation scaling. The results of the scaling will then be cropped to obtain the center area of the image in order to obtain the rice grain area of the image dataset. The results of the cropping operation can be seen in Figure 4.

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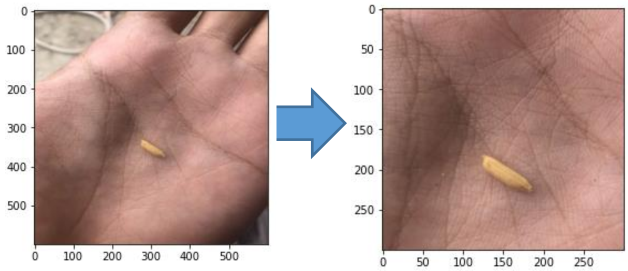

Figure 5. Cropping Center Operation

After the image is cropped, the image is then segmented based on the color of the rice seeds in general to get the candidate area of the object from the rice seeds. Image segmentation serves to separate one object from another. Separation is carried out based on regional boundaries that have the same shape or composition [15]. The results of the segmentation are as shown in Figure 6.

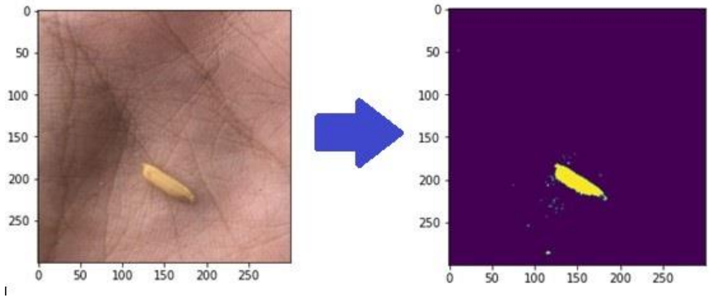

Figure 6. Segmentation Results

The purpose of this segmentation is to find a number of areas that are not truncated and areas that have adjacent properties with clear differences. The segmentation process is very important in computer vision research. In addition, it can also recognize an object [11]. After the image is cropped, the image is then segmented based on the color of the rice seeds in general to get the candidate area of the object from the rice seeds. The results of the segmentation are as shown in Figure 7.

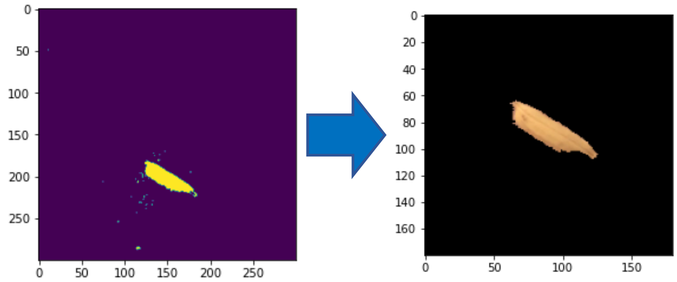

Figure 7. Morphology and Contouring

After the area of the rice seed object is obtained, then a masking operation will be carried out to obtain an image with the original color of the rice seed as an input to the depth of the ANN model used. The result is as in Figure 8.

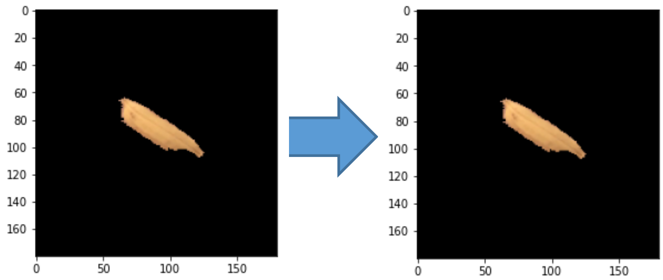

Figure 8. Final results of pre-processing dataset

2.1.2. Model Artificial Neural Network (ANN)

ANN or neural network-based learning neural network that processes information that is inspired by biological neural cell systems, just like the human brain in recognizing and identifying something, both in the form of images and sounds. The ANN model used in this study is the EfficientNet-Lite 0 model which uses a convolutional Neural Network where the layer architecture of the neural network used can be seen in Figure 9.

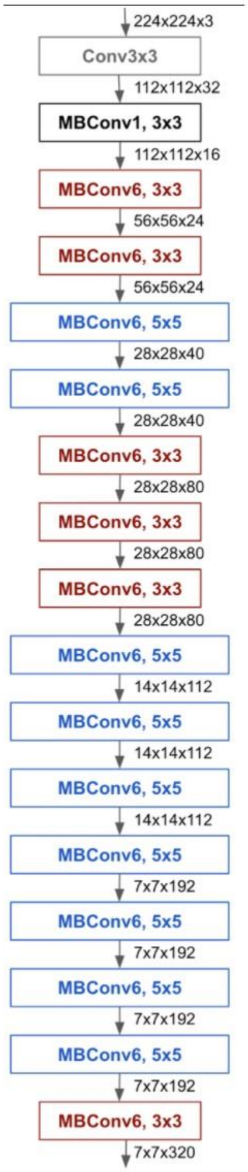

Figure 9. EfficientNet Architecture

The tabular information can be seen in Table 1 below:

Table 1. Tabular Information Table

Stage i	Operator $\hat{\mathcal{F}}_i$	Resolution $\hat{H}_i \times \hat{W}_i$	#Channels $\hat{C}_i$	#Layers $\hat{L}_i$
1	Conv3x3	224×224	32	1
2	MBConv1, k3x3	112×112	16	1
3	MBConv6, k3x3	112×112	24	2
4	MBConv6, k5x5	56×56	40	2
5	MBConv6, k3x3	28×28	80	3
6	MBConv6, k5x5	14×14	112	3
7	MBConv6, k5x5	14×14	192	4
8	MBConv6, k3x3	7×7	320	1
9	Conv1x1 & Pooling & FC	7×7	1280	1

The designed network is then trained using a dataset that has been prepared where the graph of the training results in terms of loss and accuracy can be seen in Figure 10.

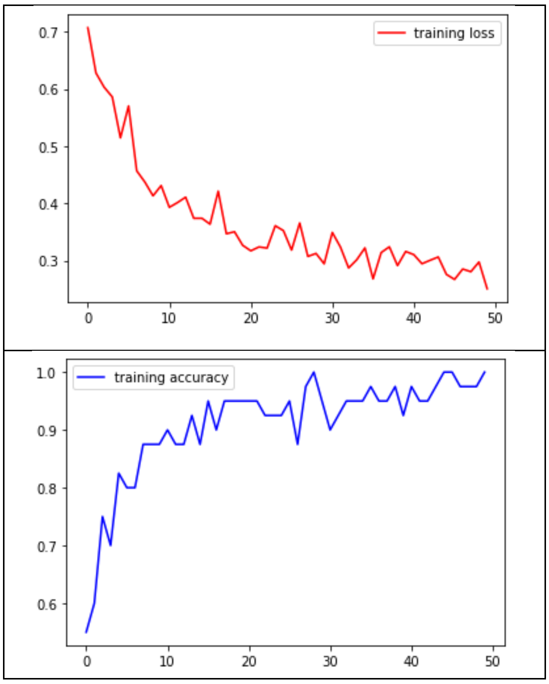

Figure 10. EfficientNet-Lite 0 . network training results

The graph above (red) shows the results of the training loss accuracy which decreases with the number of trainings up to 50 times. The bottom graph (blue) shows the training accuracy which increases with increasing trials up to 50 times. the conclusion is training accuracy is the greater the identification success up to 90-100 percent.

2.2. Software Used

The development of this application uses the arctic fox android studio software. Screenshot of this application development can be seen in Figure 11.

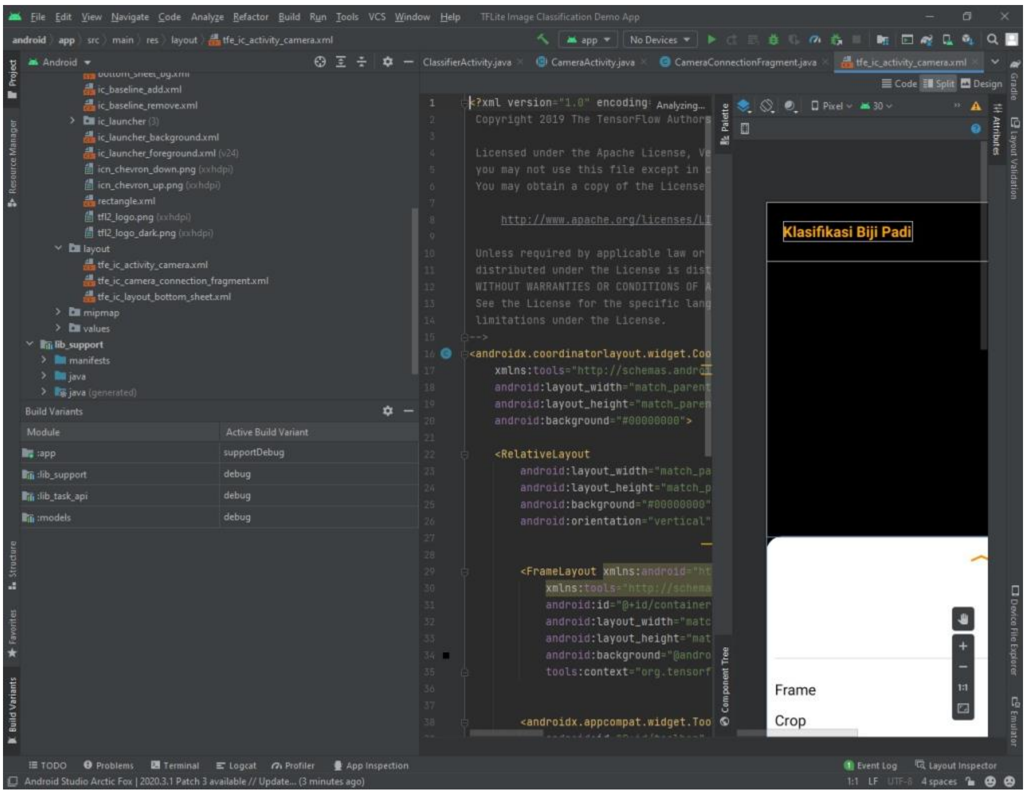

Figure 11. Screenshot of application development

3. RESULTS AND DISCUSSION

The display of the application and the results can be seen in Figures 12 and 13. Realtime detection process via smartphone. This application is built with android studio programming.

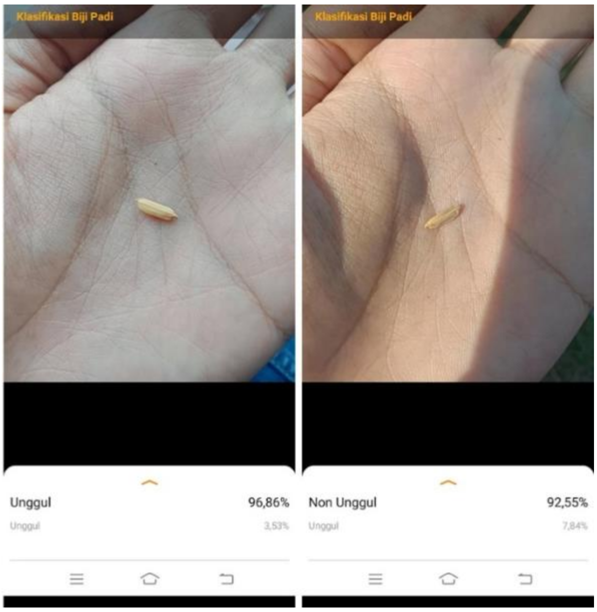

Figure 12. Rice grain detection results

Figure 12 shows the results of the detection of a smartphone with the Android operating system on one grain of rice. The results of this study indicate that the introduction of one grain can achieve an accuracy of up to 96.86% for superior rice and 92.55% for non-high-yielding rice. This means that the level of recognition is very high for a single grain of rice.

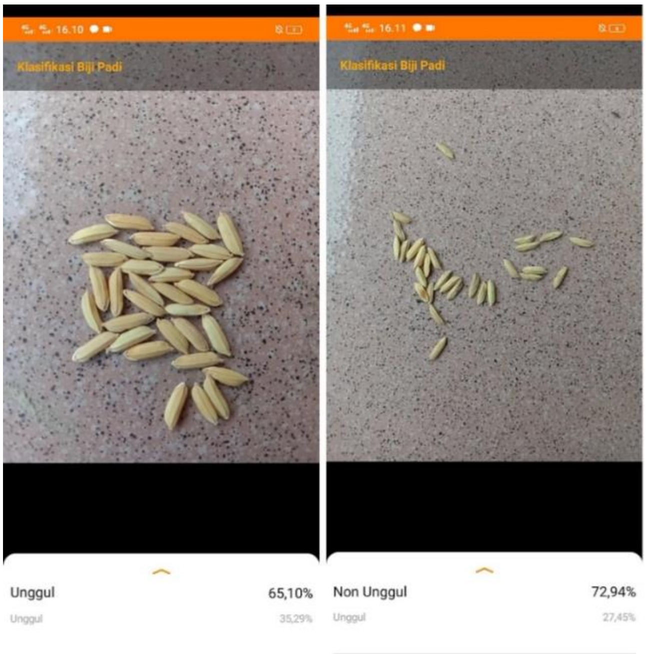

Figure 13. Detection results of many grains of rice

Figure 13 shows the results of the detection of many grains of rice, the results are different from the identification of one grain. The results of the identification of many grains reached an accuracy of up to 65.10% percent for superior rice and 72.94% for non-high-yielding rice. The recognition rate of many rice grains with different types has a lower recognition accuracy. In general, the application is able to classify rice seeds 65-98% for one grain of rice and many grains of rice.

3.1. Testing and Evaluation

Testing the model and application developed in this study uses two types of testing, namely testing the model separately and testing the integration of the model into an Android-based application. The results of testing the model separately can be seen in Figure 14.

Figure 14. Model Test Results

From the results of model testing, it can be seen that the model is able to detect superior and non-superior seeds well where all test data can be predicted correctly. Confusion matrix test results can be seen in Figure 15.

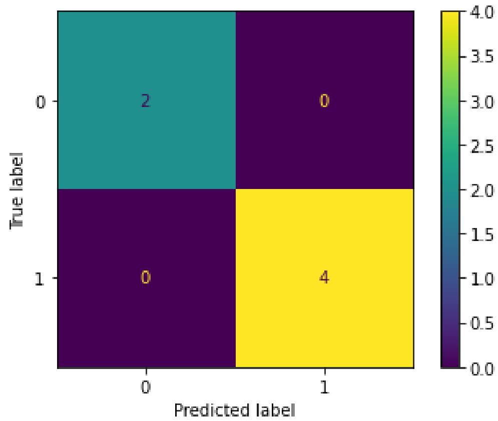

Figure 15. Conffusion Matrix model test results

4. CONCLUSION

The smart model for the classification of rice seeds that was built in this study is generally able to run well where the classification accuracy obtained is quite good. The dataset used is 1000 consisting of 350 superior seeds and 650 non-superior seeds. The classification accuracy of the model during training of the neural network model and ability to classify rice grains with an accuracy of 70-100% with the confidence value of the classification results in real-time ranges from 65-98%. Classification of rice grains in real-time with a maximum accuracy of 96% and 73% of grains. External factors such as lighting, and device camera focus are the determining factors in the accuracy of rice grain classification in real time. In the training dataset, several obstacles were also found, such as the very significant similarity between superior and non-superior rice seeds, so in future studies a more in-depth study of the features of rice seeds is needed so that the accuracy obtained can be better and can identify the type of rice seeds

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