Management Of Traditional Business Into Modern: From Microsoft Excel To Deep Learning For Prototyping Classification Swiftlet's Nests

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Abstract.

In this article, the transformation of traditional management of Swiftlet's nests into modern business is proposed. Traditional business means that data management of Swiftlet's nests is done manually, sorted by recording in Microsoft Excel. This is done by PT Waleta Asia Jaya, a company engaged in processing Swiftlet's nests. This sorting is done because the number of feathers in the Swiftlet's nests determines the price and cost of workers in processing feather cleaning. In addition, the shape of the Swiftlet's nests needs attention. However, because it is complex, sorting is done simpler. Originally, Swiftlet's nests were sorted into 50 categories. To facilitate sorting, deep learning is used with the SSD Mobile Net V2 algorithm as an algorithm to classify into 7 categories based on feather intensity. The device is still a prototype that shows an 85% accuracy rate but has been quite helpful in the process of purchasing Swiftlet's nests before processing.

Keywords: *Swiftlet's nests; Microsoft Excel; deep learning and SSD Mobile Net V2.*

I. INTRODUCTION

Today's industry requires automation for many of the tasks performed. Therefore, the use of digital technology today covers all fields [1]. The complexity of doing management occurs because of digital data collection that must be integrated for various purposes [2] [3]. One of them is an industry with Swiftlet's nest that is not many in Indonesia or in the world but is always needed, especially for food and cosmetic needs. One of Swiftlet's nests processing companies, PT. Waleta Asian Jaya is in Salatiga City, Central Java. Indonesia, which is one of the largest exporters in this business in Asia, This company manages Swiftlet's nest from several islands in Indonesia. The traditional management consists of cleaning the Swiftlet's nest from dirt and adhering feathers before finally being packaged for export abroad. Some typical Swiftlet's nests are shown in Figure 1 with different feather intensities.

Fig 1. Illustration of Swiftlet's nests in 4 different feather intensities (source: private documents from PT Waleta Asia Jaya).

In a production company processing Swiftlet’s nest, it is necessary to control the quality of the final products. The chemical components in it have become a study where the Swiftlet's nest is one of the favorite specialties in China[4][5] . However, the desired initial control is the number of raw materials produced that needs to be considered. Furthermore, we have a Process Loss i.e., the process in that materials are falling or friction during preparing the raw material into the final material with the needed shapes as shown in Figure 2. Controlling production results does not only reach that stage, but it is also necessary to redo the grading results of the final product to see the quality. Therefore, it is necessary to have a management strategy to process data from the results of the assessment of final products to determine the quality of the products produced by the company.

Fig 2. Examples of the final production of Swiftlet’s nest
(Source photo: private documents from PT Waleta Asia Jaya)

Based on the background above, the problem arises, i.e., how to manage raw materials into final products with clear reports that are easy to read and understand. The results are related to the salary workers who are working with different difficulties in removing the feathers from Swiftlet’s nests. The research has been done since 2018 together with the company to develope an objective system of recording data on the complexities of Swiftlet’s nests in different intensities of feathers, shapes, and colors, leading to more than 100 classifications. In this article, the manual of modeling is exposed by manual procedures to have data management using Microsoft Excel because employees can only read and process with Microsoft Excel to report and reward employee performance. This method is considered traditional management because the buying and selling processes are carried out manually at most.Until 2020-2022, classification was carried out again, which will be easier and more objective by using deep learning in conducting the initial sorting of Swiftlet’s nests based on feather intensity up to 7 classes because it also affects the purchase price of middlemen who send raw materials for processing. The novelty of this research is shown when this sorting activity has just been carried out at PT Asia Jaya and there is no industry engaged in this field of sorting with deep learning even though it is still in the form of a prototype application on Android.

II. RESULT AND DISCUSSION

The complexity of Swiftlet’s nest means that the automation process using existing algorithms in data science cannot be used immediately. PT Waleta Asia Jaya is a company that processes Swiftlet nests.

2.1 The process of traditional management Swiftlet’s nest

The process of traditional management Swiftlet’s nest in general is as follows:

Unloading of Raw Products

In this process, Swiftlet’s nest (raw materials) are moved from the company's Swiftlet’s nest house to the Swiftlet’s nest processing site, which is a company in Salatiga. In addition, Swiftlet’s nest are also obtained by purchasing from collectors.

Raw Material Receiving and Checking

In this process, the receipt of raw materials is carried out, and the raw materials are checked directly and manually.

Raw Material Grading

Raw materials are separated by shape, numerous feathers and color which are mostly done manually.

Reverse Osmosis Washing

The process of cleaning raw materials is carried out using running water to remove all dirt and particles attached to the Swiftlet's nest.

Feather Picking

In this process, feather removal is carried out manually using tweezers and a cup shaped like a Swiftlet's nest. Employees working on this process are trained in advance for several weeks to master feather plucking skills with minimal damage to the shape of the Swiftlet's nest, so that the Swiftlet's nest can be reshaped to its original shape.

Laboratory Checking

The lab inspection process is carried out to ensure the product is of good quality. In addition, nitrite checks related to nitrite requirements by the Chinese government (less than 30ppm) were carried out. China is one of the export destinations for Swiftlet's nest products from PT Waleta Asia Jaya.

Heat Treatment

Heat Treatment is carried out for Swiftlet nests that are ready to be packaged. The purpose of this process is to make the product free from bacteria and viruses.

Packing

In this process, the packaging of goods is carried out according to the buyer's request.

The most complicated initial process is doing the classification manually to be able to compile the correct training data, test data, and validation data to build applications that are targeted for classification. Therefore, the first part shows the manual way of classification modeling using Microsoft Excel. Henceforth, the results of the data collection that has been obtained become data collection for algorithms in data science that are used where we use deep learning, which is considerably more modern than using Microsoft Excel.

2.2 Manual Processing Data Using Microsoft Excel

Microsoft Excel is still in demand by the industry for data processing, especially in the initial process of data modeling manually. For example, thereis research on doing factor analysis [6] without using programming skills. One may also combine coding in R integrated with Microsoft Excel to explain Markov models as well as compare analysis results in R and Microsoft Exce l[7]. The used data in this research were collected from a company that has been working to store big data of images of Swiftlet’s nests. The Swiftlet’s nests are initially simplified into 4 classifications based on feathers intensities, i.e. heavy feathers (BB), medium feathers (BS), light feathers (BR), and very light feathers (BRS). The more feathers there are, the more difficult it is to clean (right to left in Figure 1).

The Swiftlet’s nests are differentiated based on this category because it determines the value of the salary given to workers. Figure 2 shows some examples of Swiftlet’s nests that have been produced by PT. Waleta Asia Jaya by considering the shapes, which are distinguished into six shapes.After the Swiftlet’s nests are processed manually for different types of feather intensities by about 800 workers at the factory every day, the Swiftlet’s nests still must be sorted based on their shape, as stated in Figure 2. However, the shape may have different shapes in the final product due to the process of cleaning feathers. Due to these complexities, the initial process must be studied properly to get a good training set of data before using deep learning. The data are taken from data on all grades of final products and data on the results of grading of finished materials in April and May 2018 for developing the model. Hence, the modeling data for preprocessing data in this study case are managed as follows:

1. Data collection

   In this process, data is obtained with various characteristics such as feather intensity, shape, clean, dirty, and so on which are categorized as completely as possible to be able to provide fair salary rewards for workers who will pluck feathers from the Swiftlet’s nests. At the beginning of learning, up to 50 categories are used as shown in Table 1. Some of them contain names in Indonesian

2. Collect data on various grades of finished materials and data on the results of grading of finished materials in May and April 2018. In this section, old data is used as an initial exercise for the team in processing with Microsoft Excel.
3. Classification of finished material grade data
4. Grouping the grade of finished materials to be calculated according to the grade of raw materials.
5. Creating a data management program with Microsoft Excel.
6. Prepare cells for input and cells for calculating data on the results of grading finished materials.
7. Implementation of data management programs
8. Implementing a program to process grading results data for April and May 2018 to produce a report on the quality of finished goods.

Due to the complexities above, the initial preprocessing is done by identifying each piece by grading manually for each raw material as stated in Table I.

Table 1. Data on all grades of finished materials (some words are written in Indonesian)

No	*Grade*	No	*Grade*	No	*Grade*	No	*Grade*
1	GNS JMB	14	GNS OVAL1	27	GNS OVAL2R	40	GNS SRBT
2	GNS SUPER	15	GNS OVAL2	28	GNS JMBR	41	GNS *SUWIR*
3	GNS PREMIUM	16	GNS SGTG1	29	GNS MKABNORMAL	42	GNS ZT
4	GNS STANDARD	17	GNS SGTG2	30	GNS SUPERG	43	GNS SRBTKTKKCL
5	GNS SUPER R	18	GNS SGTGGBINTG	31	GNS PREMIUMG	44	GNS YT KTKSTR
6	GNS PREMIUM R	19	GNS SGTGLEM	32	GNS STANDARDG	45	GNS *PATAHAN*
7	GNS KKKNG	20	GNS *DWIWARNA*	33	GNS YT SRTKCL	46	GNS ZT *BINTANG*
8	GNS JMB *BINTANG*	21	GNS LAB	34	GNS SRBTKTK	47	GNS MKPCH
9	GNS SGTGKKKNSG	22	GNS SAMPLE	35	GNS YT KCL	48	GNS SGTGPCH
10	GNS STRJMR	23	GNS MKCUPB	36	GNS YT *SEDANG*	49	GNS YT KTKPCH
11	GNS *GRADE* 2	24	GNS OVAL	37	GNS YT BSR	50	GNS RONT GRD
12	GNS *GRADE* 3	25	GNS SGTG	38	GNS YT KTKBSR		
13	GNS MKLEM	26	GNS OVAL1R	39	GNS SRBTKTKBSR		

Not all grades of raw materials issued by the raw materials department produce all grades of finished goods, so trades of finished goods need to be grouped/classified into simpler groups according to the shape and fur of the raw materials. This grouping is intended to make it easier to control the grading results of finished goods. Finished goods grade classification data according to raw material grade is provided and listed in the Appendix in Table II-V.

2.3 Deep Learning Classification

In the years 2020-2022, the progress of research in the classification of Swiftlet's nest was going on, where object detection was the most studied algorithm to be employed [8]. Some results have been tested for the company through the developed application, which was still a prototype. The used method here is object detection. Several algorithms are available, we employ MobileNet SSD which is one of the deep learning architectures that involves the SSD (Single Shot Multibox Detector) [9]. MobileNet SSD is an object detection model that uses a MobileNet-based feature extractor and Single Shot Detector (SSD) framework for detecting objects in images [10]. Here are the general procedures for using MobileNet SSD:

a. Preprocessing: Before passing an image to the model, it needs to be preprocessed. The image is resized to a fixed size, and the pixel values are normalized to the range [-1, 1].
b. Feature Extraction: MobileNet SSD uses a MobileNet-based feature extractor to generate a feature map from the input image. The MobileNet architecture is optimized for mobile devices and can be trained efficiently on small datasets [11].
c. Multiscale Feature Maps: The feature extractor generates feature maps at multiple scales, which are then used to detect objects of different sizes. Each scale feature map is fed into a set of convolutional filters to generate predictions [12].
d. Anchor Boxes: MobileNet SSD uses anchor boxes to detect objects. These boxes are pre-defined bounding boxes of different sizes and aspect ratios that are placed at various locations on the feature map [13].

e. Prediction: The model generates a set of predictions for each anchor box. The predictions include the class of the object, the offset of the bounding box from the anchor box, and the confidence score that the object is present in the bounding box.
f. Non-Maximum Suppression: To eliminate duplicate detections, MobileNet SSD uses non-maximum suppression. This algorithm selects the bounding box with the highest confidence score and removes any other bounding boxes that overlap with it by more than a certain threshold [14].
g. Post-processing: Finally, the remaining bounding boxes are converted back to the original image coordinates and returned as the output of the model.

The SSD MobileNet V2 architecture is better than the MobileNet V1 SSD in detecting 20 types of objects in the house [15]. Therefore ,we chose SSD MobileNet V2 to classify the Swiftlet's nest data in our prototype. The SSD MobileNet V2 is a popular object detection model that combines the MobileNet V2 architecture and the Single Shot Detector (SSD) algorithm [16]. The MobileNet V2 architecture is a lightweight neural network architecture that is designed to run efficiently on mobile devices. The SSD algorithm is an object detection algorithm that performs detection in a single forward pass of the network.

Here are the main steps involved in the SSD MobileNet V2 architecture:

a. Input image: The input to the model is an image of size 300 x 300 pixels.
b. Base network: The base network of the model is a modified version of the MobileNet V2 architecture. The MobileNet V2 architecture consists of depthwise separable convolutions, which are designed to reduce the number of parameters and computations required by the network. The modified version of the MobileNet V2 architecture used in the SSD MobileNet V2 model has been optimized for object detection.
c. Convolutional feature maps: The base network generates a set of convolutional feature maps of different spatial resolutions. These feature maps are used for detecting objects at different scales.
d. Multiscale feature maps: The feature maps are passed through a set of additional convolutional layers to generate multiscale feature maps. These multiscale feature maps are used for detecting objects at different aspect ratios.
e. Detection: The multiscale feature maps are then used to predict the locations and classes of objects in the input image. The SSD algorithm performs detection at multiple locations and scales by applying a set of convolutional filters to each location on each feature map.
f. Output: The final output of the model is a set of bounding boxes and their associated class probabilities.

2.4 Classification Data Grade of Finished Material

Finished materials have at least 50 types of grades, each of which has different forms and criteria, as shown in Table I. As shown in Tables I and II above and in Tables III-V in the Appendix, the initial process of data collection begins with naming the grading manually. This means that Swiftlet's nest data needs to be studied one by one to be able to examine it in detail. In the further process, this classification data will be processed using artificial intelligence, which is not shown in this article. Next, a process is carried out with Microsoft Excel to make data management according to the categories that have been made.

2.4.1 Setting Up Input Cells in Microsoft Excel

Production of input cells is based on the shape and type of fur (grade) of the raw material. Each raw material grade has its own worksheet. Each sheet is divided into 3 work sections for data management according to the type of fur from the raw material, namely BRS/BR, BS, and BB. Figure 4 shows the next step, in which some words are written in Indonesian by the workers. The red sentence states that one must guarantee that the written weights are not in decimals. Excel here is used as the direct report for workers to proceed with the further process. After dividing the worksheet, prepare a place to put or input data on the results of the grading of finished materials. There are 2 types of input cell tables prepared, namely copy, and paste input cell tables of grading results of finished materials taken from the Swiftlet system and manual input cell tables for additional information on the results of grading on F2. These input cells are marked with green cells, as shown in Figures 3 and 4.

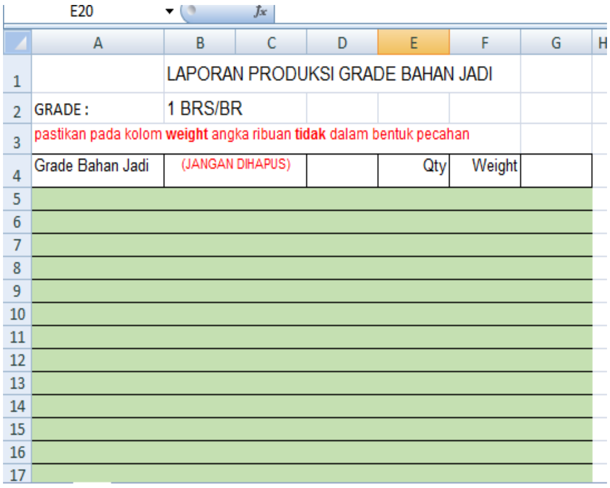


Fig 3. Table of input cells grading results of finished materials (in Indonesian).

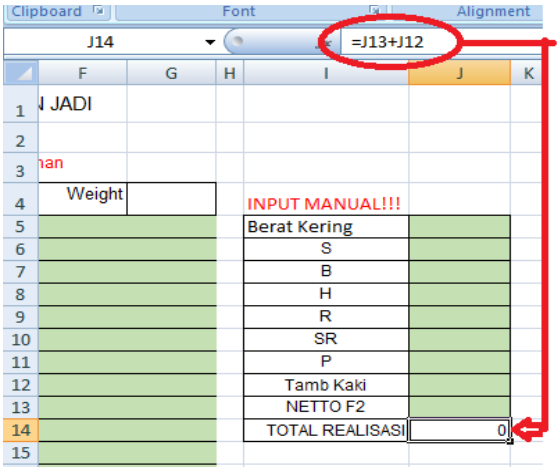


Fig 4. Table of manual input cells for the results of F2 (in Indonesian)

Counting cells are prepared according to the number of grade groups of each raw material grade and the number of members in the grade group. The empty cell in each group of finished material grades is intended so that if a new grade is added (an addition to the number of members), there is no need to recalculate or change the formula on the Microsoft Excel worksheet. In each grade group (Jumbo, Oval, Triangle, MK, YT, etc.), the number of pieces, weight (grams), and percentage of finished material grading results that have been inputted using the combined IFERROR and VLOOKUP functions will be searched. IFERROR is a function used to check if an error occurs. If an error occurs in the formula, Ms. Excel will then display an error message such as #DIV/0, #VALUE, #N/A, etc. To remove or replace the error message, use the IFERROR function. Syntax IFERROR is as follows:

=IFERROR(value;value_if_error)

Meanwhile, the VLOOKUP function is used to read data or values from a reference table (an array table), then retrieve the desired value from that table based on a certain key. So, the used formula for counting quantity (Qty), weight (weight), and percentage of each group member in a group of finished material grades is:

=IFERROR(VLOOKUP(lookup_value;table_array;col_index_num;[range_lookup]); value_if_error)

where:

lookup_value: reference cell that refers to the name of the finished material grade, for example, L5, Q5, etc.

Table_array: refers to the data input table of finished material grading results. For BRS/BR raw materials, the array table is $A$4:$G$50, BS is $A$61:$G$105, and BB is $A$115:$G$155.

Col_index_num: to find the number of pieces (qty), the index number is 4, the weight is 6, and the percentage is 7.

Range_lookup: false

Value_if_error: 0

The total cell contains the sum of the Qty and weight values of each grade group. Similar calculations are made for all grade groups of finished goods. Next, a table is made that contains a summary of each group of grades of finished goods that have previously been calculated.The Qty cell refers to the total value in each table for the finished material grade group, as well as the weight value. Example: Qty from Jumbo+Super means referring to the sum of the total Qty values in the Jumbo and Super tables, namely =M15+R15, Qty Premium, namely =W15.

Finding the weight value is the same as finding the Qty value, but there are several groups of finished material grades whose weight value must be added to the additional value of the feet. Additional legs are materials that are added to pieces of a Swiftlet’s nests whose shape is not perfect to perfect the shape of the nest. The total added value of the feet is obtained from the manual input cell. To get the added value of the feet per piece, the total added value of the feet must be divided by the number of pieces of material added with the added feet. It is assumed that the materials with additional legs are in the Jumbo, Premium, Super, Triangle, Oval, MK, and other grade groups. Besides that, they do not require additional legs. To calculate the weight value in the Jumbo, Premium, Super, Triangle, Oval, MK, and others grade groups, an additional leg value must be added. For example, the calculation of the premium weight value involves referring to the total weight value in the calculation table for the premium grade group (W15) and then adding the multiplication result of the Qty premium value and the additional value of feet or chips.Particularly for Qty for SP and SH, the value is 0, while the weight for SP is the sum of S, B, H, R, SR, and P from manual input data, and SH is the reduction of the dry weight (manual input data) minus the SP and SH values. The percentage value is based on the weight of each grade compared to the total weight of the grading results (make sure the total weight equals the dry weight). In the grading of finished materials, a cell is made for calculating RD, SP, and SH. Furthermore, the information from the results of the summary table for all grade groups of finished materials is formed into a pie chart. After the procedures above are done, we finally obtain complete data management. Some examples are depicted in Figures 5-7 as the results of data management using Microsoft Excel.

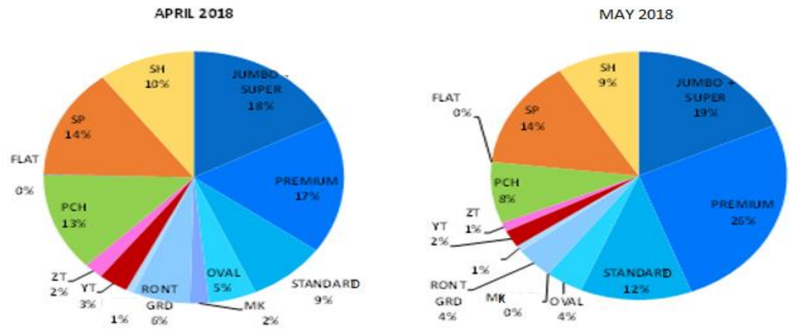


Fig 5. Percentage distribution of types finished goods 1 BRS/BR April 2018 and May 2018

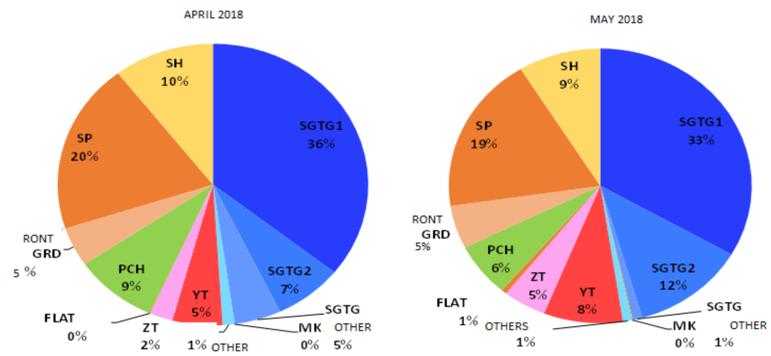


Fig 6. Percentage distribution of types of Triangles (denoted as SGTG), BRS and BR in April 2018 and May 2018.

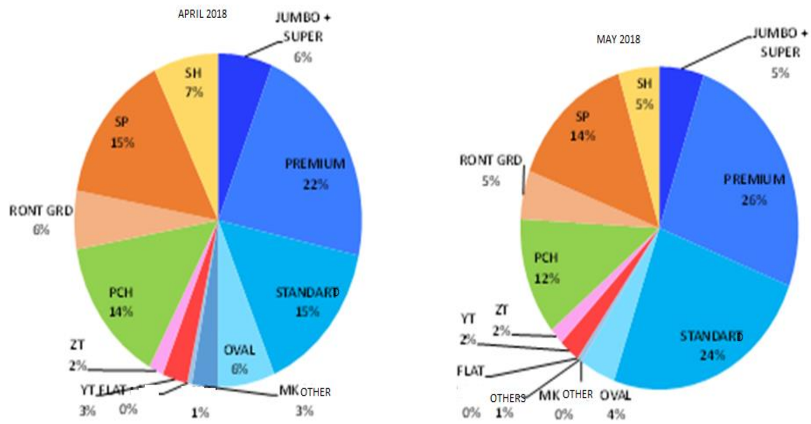
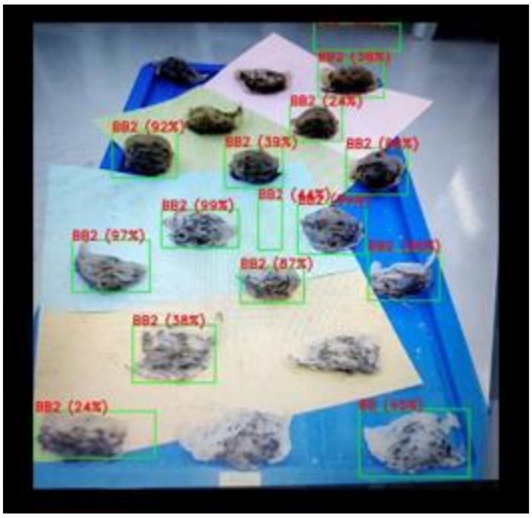


Fig 7. Percentage distribution of types of finished goods 2 BRS or BR April 2018 and May 2018.

By knowing the data grouped by category, we can predict the price of Swiftlet's nest for each type because each category is different. With the percentage of each type that exists, we can calculate the price of each category that has been set. In addition, the processing process of each category determines the performance of employees against each category, considering that Swiftlet's nests with heavy feathers will be more difficult and take a longer time to clean than Swiftlet's nests with less feather intensity.

2.4.2 Results of Deep Learning Classification

Based on the explanation above, we observed that 50 categories are too big. We simplified the classification into seven classes to employ deep learning for our initial research using artificial intelligence to develop the prototype. In making applications that can detect objects, the MobileNet V2 SSD architecture will be used, and in the first development, this technology focuses on detecting Swiftlet's nests, which are divided into 7 categories to help with the process of calculating the percentage of BRS, BR, BST, BS, BBT, BB, and BB2 in an image or several images of Swiftlet's nest. Currently, the application is designed to detect Swiftlet nests, which are then classified based on feather intensity (7 categories). The application is also packaged simply so that it is easy to use. Users can detect Swiftlet nests and get real-time calculation results, as shown in Figure 8.



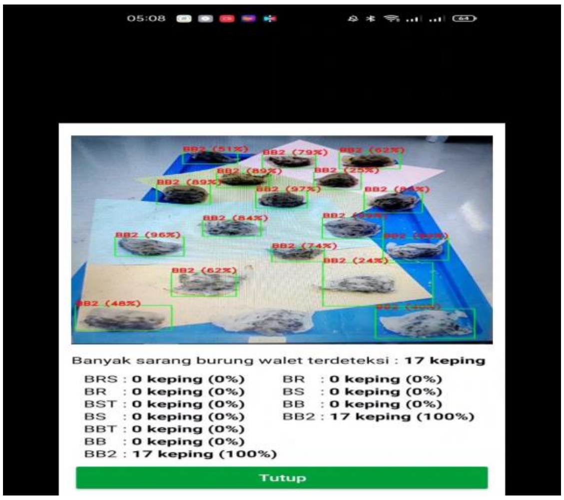


Fig 8. (left). Examples of classification are due to the intensity of feathers on Swiftlet's nest. Each piece is denoted by its percentage of feathers to indicate its category.

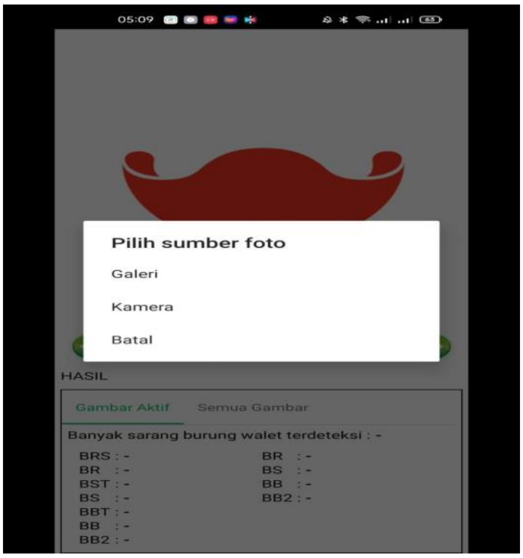
Fig 9. (right). Examples of classification due to the intensity of feathers on Swiftlet's nest: BB2 has 17 pieces, and others are none (written in Indonesian).

The prototype of the application finally shows the result of classification. There are 17 pieces containing only the BB2 class, whereas other classes are none. This is shown in Figure 9, which is shown in the Indonesian since it is used for Indonesian workers.

2.5 DISCUSSION

As explained, in the business process of buying and selling Swiftlet's nests, there are difficulties in setting the price of the goods purchased because of the complexity of the nests, which is influenced by feather intensity, shape, and size. In this business process so far from various countries, it is known that this is still a traditional business. Businesspeople only suspect how much heavy hair intensity or light hair there is the classification that has been made above. This provides inaccuracy and non-uniformity in pricing for the same Swiftlet's nest weight. Therefore, PT Waleta Asia Jaya in Salatiga City, Indonesia, is trying to build this traditional business by conducting data analysis from existing Swiftlet's nest data. With manual sorting, it can be arranged up to 50 categories so that it can be arranged more carefully for the economic value of Swiftlet's nests. With the help of Microsoft Excel and data in 2018 as a learning process for buying and selling data management Swiftlet's nests, a percentage was obtained for each class. Of course, this takes a very long time.

With the development of data analytics and data science using computing, the next stage is the transformation of the Swiftlet's nests business, which was originally manual (traditional) used by applications on mobile phones using deep learning algorithms, namely the MobileNet V2 SSD architecture. The created application starts by performing an image data collection that contains various types of Swiftlet's Nest image data for all possible types and is labeled according to the classification created manually. So, the preparation of training data is very important to be able to train the coding created. The use of applications on a mobile phone is very helpful for businesspeople in managing data on goods bought and sold. Initially, recording using Excel became very long. With the application, we can take photos of samples of goods traded to predict prices more quickly. Users can also detect and count Swiftlet's nests in the photos on their smartphones. In addition, object calculations can also be performed on several photos at once. There is also a feature to delete and add photos that will detect the object of the Swiftlet's nest. Figure 10 shows the performance of the related menu. One may use all images to classify from the gallery to see the performance of the algorithm as depicted in Figure 11.



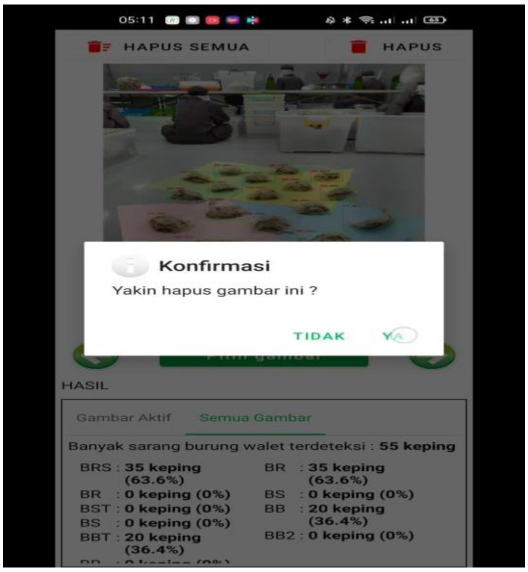


Fig 10. (left) : The visualization of a prototype of an application for choosing images to classify in Indonesian ("Pilih sumber foto" means choose photo sources either gallery, camera or cancel). Below in shadow show the result percentage for each class.

Fig 11. (right): Illustration (in Indonesian) of application performance for classification of all recorded images. There are 55 pieces of images detected containing BRS 35 pieces, BR 35 pieces, BBT 20 pieces, BB 20 pieces, and none for the other 3 classes.

The results above have shown the running of the algorithm as an application that can be used by workers so that it can help carry out classifications faster than the manual method, where the classification reporting process becomes faster. However, this process is certainly obtained after carrying out observations and classifications manually to build training data, test data, and validation data on the used algorithms to build applications. In analysis, this classification is still 85% successful, but it has provided progress in this research which will be carried out in 2022. In 2023, this application will be developed on an industrial scale, where it will be implemented on sorting machines that are being built so that the initial process for classification can be carried out. In addition, this application will be introduced to all Swiftlet's businesspeople so that there are the same standards for classifying. This would also provide a more objective price for the raw Swiftlet's nests being sold. Additionally, the results of this research have shown the novelty of this article since there is no research or article written on the special topic such as the classification of Swiftlet's nests with this method.

III. CONCLUSION

This article explains business efforts that were originally traditional switched to the modern way, which was marked by manual sorting of Swiftlet's nest assisted by Microsoft Excel to use deep learning which is implemented using a mobile phone. The procedure for modeling the classification of Swiftlet's nest raw materials manually with the help of Microsoft Excel. The use of Microsoft Excel to conduct research can provide evidence with categories of up to 50 classes. Because there are too many of these classes, simplifications are made. The prototype of the application has been made successfully using Deep Learning MobileNet V2. The mathematical analysis of the prototype results has not been carried out because the industry has urgent need from the classification obtained results. Therefore, the used algorithm does not receive further attention in this article, even though the prototype only gets 85% of the classification results. However, the sorting machine has not been developed, leading to further research on a topic where the prototype will be developed to adjust to the resulting sorting machine.

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