VISUALIZATION OF BROILER CHICKEN DATA AT PT. MUSTIKA SUKSES NIAGATAMA

Muhammad Imammulloh[1], Adam Mukharil Bachtiar[2]

Universitas Komputer Indonesia
Jl. Dipatiukur No. 112-116, Coblong, Bandung 40132
E-mail : frauhoujiro@email.unikom.ac.id[1], adam@email.unikom.ac.id[2]

ABSTRACT

Cage and the environment are an important factor in supporting the success of broiler farming business. Cage maintenance and environmental factors such as air temperature, humidity and ammonia can affect the development process of broiler.. Visualization is a way to present information in a visual form to make it easier to read and understand. The method that is used in this study refers to the process of data visualization. This study uses environmental conditions and data condition of broiler chickens that have different information needs. To meet the information needs, data is mapped with or without certain methods and algorithms. This research uses statistical methods and DBSCAN algorithm to get the information that is needed. The information that has been obtained will be processed into the appropriate visual form. The result from visualizing is diagrams, texts and symbols that can represent data. The visualization results then tested to the cage officer. Usability testing is used to determine whether the data visualization system that is created can fulfill the goals of the research.

Keywords : Data Visualization, Cage, Environment, Broiler.

1. INTRODUCTION

In the broiler farming business, cage and the environment are an important factor in supporting the success of business [1]. If the cage condition is not well maintained, then failure in maintenance may occur. Failure of a broiler farm can start from an officer error in cage maintenance, temperature regulation and others [1]. Failure in cage impacts on reduced revenues.

The condition of the cage that is influenced by several factors such as temperature, humidity and ammonia content can't be observed directly by the cage officer. The large number of broiler chickens in each cycle period also makes the officers have difficulty in case of chicken death.

The need for monitoring is also due to anomalies in the enclosure. The anomaly occurs because there are differences in the condition of one or several broilers with other broilers. This phenomenon is called an outlier. Outliers are hard to know, while often outliers contain very useful information [2]. Outliers need to know because it can show broiler information that condition is not normal. Conditions such as under-standard broiler weight, high levels of ammonia, temperature and humidity can cause problems in the development of broiler.

One of the best ways to understand great data is with visualization. Visualization presents detailed data into easily-accepted information by converting a series of numbers into visual elements to make data easier to read and understand [3]. With visualization, the data pattern will be found rather than just using the usual statistical methods.

The objective of this research is to assist the officer in monitoring the cage and environmental conditions, assisting officers in knowing the condition and development of broiler in real-time and to facilitate the officer in knowing the existence of outlier in broiler maintenance.

2. RESEARCH

2.1 Methodology

The steps taken during the study refers to the process of The Seven Stages of Visualizing Data from Ben Fry in his book entitled "*Visualizing Data*" [4]. The process of visualizing the data can be seen on Figure 1.

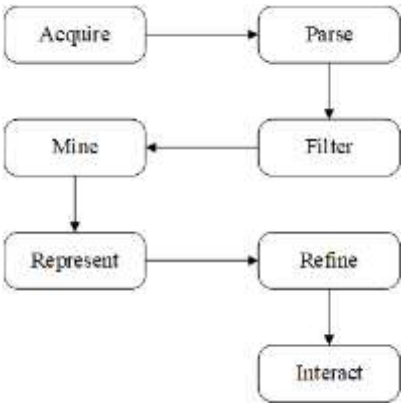


Figure 1. Data Visualization Process

Then adjusted to this research to produce the following steps:

Data Sources Analysis (*Acquire*)

Stage analysis of data sources is the stage in which data are collected from various data sources. The data collected is then transferred into the database for visualization.

Data Filter (*Parse* & *Filter*)

In the data selection phase, grouping of data is based on information needs. Information needs related to the problem to be solved. Then mapping data based on information needs to be used in the next process.

Method Ana Algorithm Analysis (*Mine*)

At this stage problem solving is done using certain methods and algorithms. Algorithm that will be used adjusted based on information to be searched is to look for existence of outliers.

Visualization (*Represent* & *Refine*)

At this stage we determine the type of visualization of the information obtained after the results of the algorithm processing or statistics that have been done. Focuses on visualization as per data requirements (graphs, lines, and more) and their attributes (color, size, position).

Implementation dan Testing (*Interact*)

At this stage is done visualization implementation on software that has been built. Visualization displays information that can be understood by the user and can be a solution to an existing problem. The last stage was tested by the cage officer. Testing is done to determine whether the results of the visualization can help solve existing problems.

2.2 Result and Discussion

A. Data Source Analysis

The broiler data used comes from two sources, namely Firebase and Microsoft Excel documents stored in the Dropbox cloud service. The data available in the Firebase database is data retrieved by sensors and other data such as feed and chicken death data and broiler quality data. While the data available in Microsoft Excel documents are broiler data entered manually by the officer, as well as other supporting data. The data used in this study can be seen on Table 1.

Table 1. Data yang Digunakan

Data	**Name**
Data 1	Mobile Sensor
Data 2	Fixed Sensor
Data 3	Outdoor Sensor
Data 4	Feed and Mortality
Data 5	Quality of broiler

B. Data Filter

Data selection includes two stages: parse and filter. The first stage is parse is the process of classifying data that has been collected based on information needs to solve existing problems. While the filter is the process of mapping data based on information needs to be used in the next stage. The mapping of information needs based on the required data can be seen on Table 2.

Table 2. Data Mapping

Information Needs	**Data**
How broiler conditions and the environment every day	1,2,3
Is there a broiler grid that is different from other broiler grids	1
How is the development trend of broiler every day	1,4,5
How big the success of broiler maintenance	5

C. Method Ana Algorithm Analysis

Analysis of methods and algorithms (mine) is a process in which problem solving is done using statistical calculations or certain algorithms. Mapping methods and algorithms based on information needs can be seen on Table 3.

Table 3. Method and Algorithm Mapping

Information Needs	**Method**
How broiler conditions and the environment every day	Statistics
Is there a broiler grid that is different from other broiler grids	DBSCAN

Statistics are used in Data 1 and Data 2 to find the average of each attribute.

DBSCAN is a clustering method that builds clusters based on density between data points. Every object of a radius area must contain at least a minimum amount of data to create a cluster. All objects that are not included in the cluster are considered as noise. DBSCAN is used in Data 2.

The steps in the DBSCAN algorithm are as follows:

1. Initialize parameters of eps and minPts. Value of eps and minPts
2. Determine the starting point as the center point
3. Calculate p or all density-reachable point spacing toward the center point (p <eps). Distance between points refers to the distance matrix of Euclidean Distance
4. If the point that meets the eps is more than minpts then the center point is the core point and the cluster is formed.

The data sample used is mobile sensor data in cage 1 on January 8, 2017. The sample data can be seen on Table 4.

Table 4. Data Sample

No	Ammonia	Weight	Humidity	Temperature
1	9.98	1860.5	74.75	27.15
2	14.77	956.5	72.3	27.2
3	11.37	1879	76.4	26.6
4	13.38	1809	74.4	26.2
5	5.50	1808.5	77.6	27
6	7.51	1927	76.9	27.2
7	5.96	1884	76.8	27.1
8	10.91	1950	76.2	26.6
9	6.89	1820.5	76.9	26.9
10	8.74	923.5	76.6	26.75
11	9.98	1857	75.2	26.6
12	7.82	1862.5	74.5	27.1

To determine the optimal eps value is to measure the distance between the center of the cluster with each data point used Euclidean Distance, then get the distance matrix. The formula from Euclidian Distance is as follows:

$$d(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$$

The Euclidian Distance distance matrix calculation results are then used to calculate the minimum distance for the distance of a number of nearest neighbes k. In this example the number of nearest neighbors (k) is 3 (3-Distance).

Based on the k-distance results can be determined the optimal estimation of eps value for each data. The eps value search is done by calculating the slope of the line from each point and searched for the point pair having the largest slope of the line. The biggest slope of the line lies at the 71.00 point. It is this point that becomes the optimal eps value. Results of plots that have been sorted ascending are described by k-distance Graph on Figure 2.

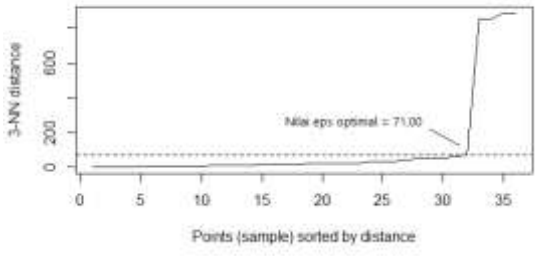


Figure 2. K-Distance Graph

It can be seen that the optimal value of eps is in the range of number 71 with minPts worth 3. After the data is done the implementation of cluster results obtained. Results plot clusters can be seen on Figure 3.

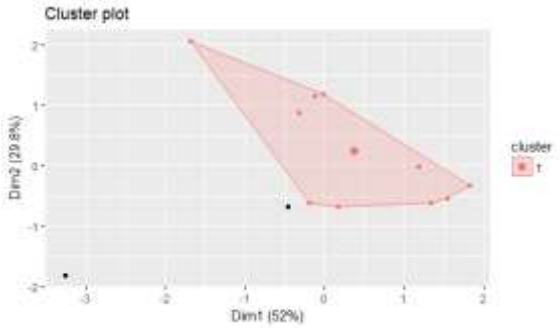


Figure 3. Cluster Plot

Here are the knowledges obtained from the cluster:

1. Data that includes clusters describes the condition of normal broiler.
2. Data that does not include clusters (Data 2 and Data 10) detected noise describes abnormal conditions.

D. Visualization

The visualization stage is the stage in which the data that has been selected will be presented in several forms. Visualization aims to make data easy to read and understand. In general, the presentation of data can be grouped into three parts: presentation in the form of text, presentation in the form of tables and presentation in the form of graphs or diagrams [5]. At this stage of visualization the data will be presented in the form of diagrams. The diagram is used because it is easier to get the picture data as a visual tool for the layman [6].

Stage mapping visualization (represent) is a process of mapping the information needs with the type of diagram that will be used to represent data [7]. Mapping of data visualization can be seen on Table 5.

Table 5. Data Visualization Mapping

Information Needs	Chart
How broiler conditions and the environment every day	Symbol
Is there a broiler grid that is different from other broiler grids	Heatmap
How is the development trend of broiler every day	Line Chart
How big the success of broiler maintenance	Symbol

In the data presentation stage (refine) is the process of adding attributes such as colors, sizes and symbols used in visualization.

Symbol

The need for this information is to show the condition of broiler and its environment from each grid. The conditions of broilers and the environment are described by symbols that represent the condition. Explanation of symbols used for information needs number 1 can be seen on Table 6.

Table 6. Symbol Explanation

Symbol	Information
	Weight
	Ammonia
	Humidity
	Temperature

Results Visualization of data for information needs No. 1 can be seen on Figure 4.



Figure 4. Visualization of Data No. 1

Symbols are also used to display broiler quality data with up and down conditions compared with previous values. Visualization results for information needs no. 1 can be seen on Figure 5.



Figure 5. Visualization of Data No. 5

The symbol above shows that the FCR value has increased compared to the previous FCR value, while the IP value has decreased.

Heatmap

The need for this information is to find out whether there is a broiler grid that is different from other broiler grids. This information is obtained from the calculation of DBSCAN clustering algorithm that has been done before. The results of cluster visualization on information needs number 2 can be seen on Figure 6.



Figure 6. Visualization of Data No. 1

Line Chart

The need for this information is to see the development of environmental conditions, broiler conditions and the quality of broiler in one period. Here is the information requirement visualized with line chart:

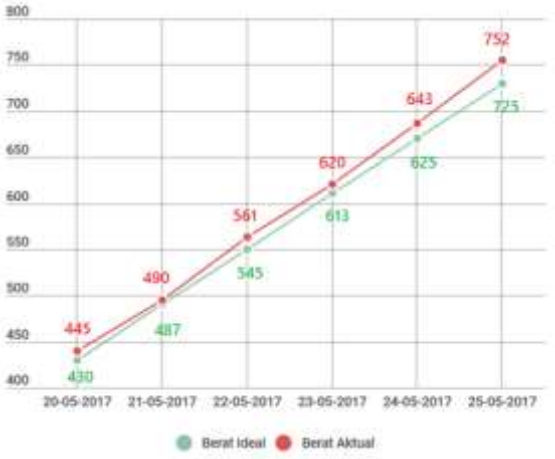


Figure 7. Line Chart Growth of Weight

The development of broiler weight shows the trend of chicken weight increase and its value exceeds the standard weight of chicken that has been determined.

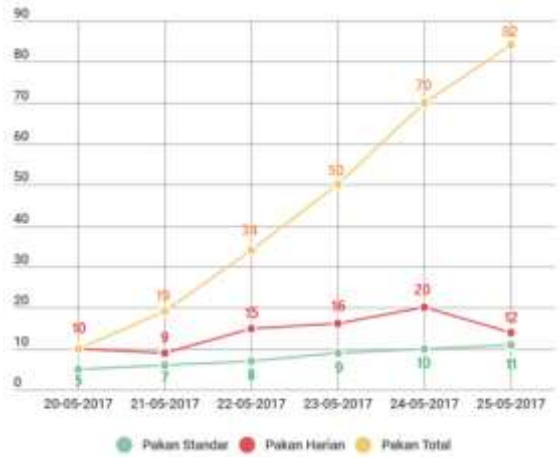


Figure 8. Line Chart of Daily Feed

Visualization results show the trend of the amount of broiler feed every day exceeds the standard chicken feed that has been determined. Total chicken feed from May 20-25 is 82 sacks.

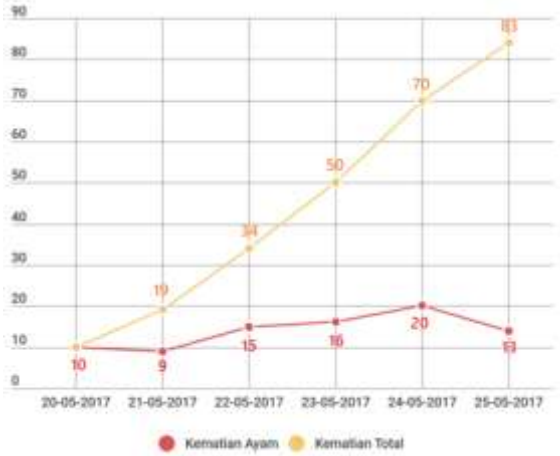


Figure 9. Line Chart of Mortality

Visualization results show the trend of the number of deaths of broiler every day and show the total broiler that died from May 20 to 25 as much as 82 tails.



Figure 10. Line Chart of FCR

The visualization results show the trend of FCR values from May 20 to 23 below the predetermined value standard, meaning that feeding on that date is more efficient. While on May 24th and 25th the value of FCR exceeded the standard, meaning that feeding was no more efficient.



Figure 11. Line Chart of IP

The visualization results show the trend of IP value from May 20 to 23 exceeded the standard value, meaning that the broiler maintenance went well. While on the 24th and 25th of May IP value decreased, meaning that the broiler maintenance is not running well.

E. Implementation and Testing

In the implementation and testing stage of broiler data visualization system, there are functional and non-functional requirements analysis, interface design and testing using usability testing.

Functional Requirement

Functional requirements describe the interaction between the user and the system. In this research modeling is attached is use case diagram. Use case can be seen on Figure 12.

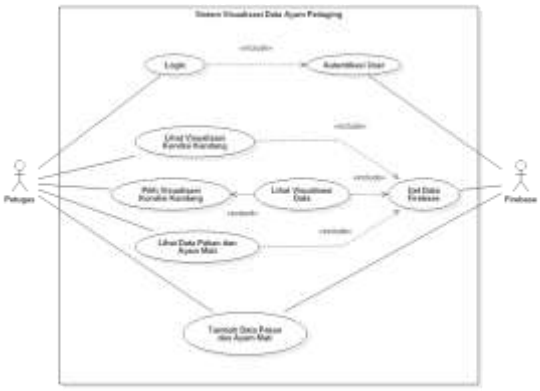


Figure 12. Use Case Diagram

Description of each use case can be seen on **Table 7**.

Table 7. Use Case Description

Use Case	Description
Login	The process to enter into the broiler data visualization system
User Authentication	Username and password validation process entered by the user
View Feed Ana Mortality	Displays data of feed and dead chickens
Input Feed Ana Mortality Data	The process of entering data feed and chicken dead by the user
View Visualization of Environment	Displays the visualization of the information needs of the average value of the sensors in the whole enclosure
Select Visualization of Environment	Select visualization of information needs from each cage
View Data Visualization	Displays visualization of indoor sensor data and outdoor sensors
Get Data Firebase	The process of collecting data in a collection grid in the database

Non-Functional Requirement

Non-functional requirements describe the specification of the software and hardware requirements used in the construction of data visualization systems.

The software requirement used can be seen on **Tabel 8**.

Tabel 8. Software Requirement

Software	Spesification
Operating System	Windows 10
Programming Language	Javascript
Framework	Angular.js
Library	Chart.js and AngularFire
IDE	Visual Studio Code
Database	Firebase
Version Controlling System	Github
Services	Microsoft Azure

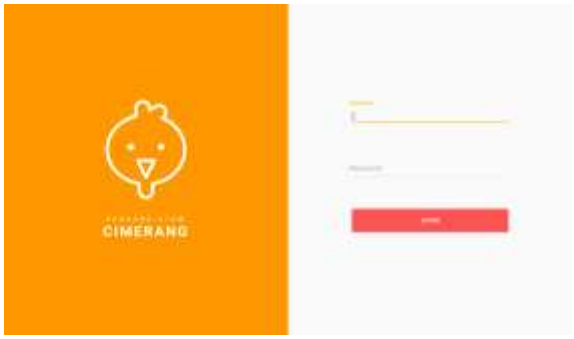
The hardware requirement can be seen on **Table 9**.

Table 9. Hardware Requirement

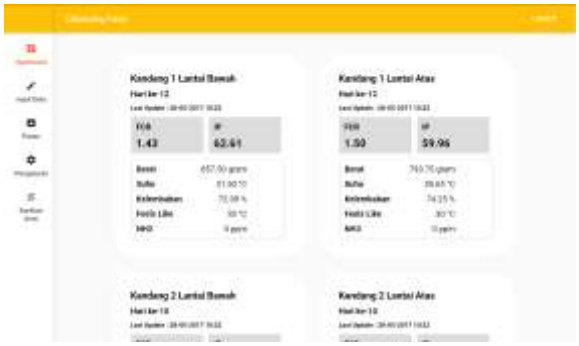
Hardware	Spesification
Processor	Intel Celeron Processor N2840
RAM	2 GB DDR3
Harddisk	500 GB
Monitor	1366 x 768 pixel
Modem	Modem USB
Internet of Things	Arduino UNO, Modul DHT11, Modul TGS 2602

Interface Design

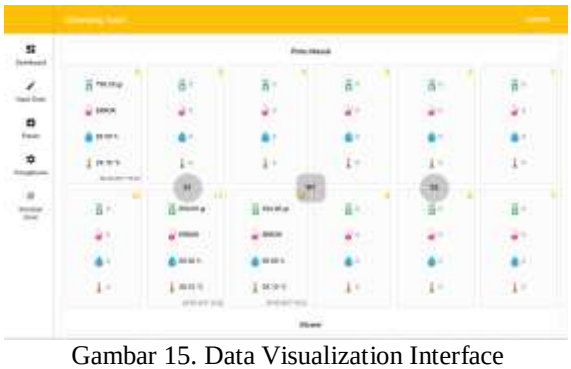
Here is a design at the pages on the broiler data visualization system:



Gambar 13. Login Interface



Gambar 14. Dashboard Interface



Gambar 15. Data Visualization Interface



Gambar 16. Input Form Interface

Usability Testing

Usability testing is done to ensure that the built system meets the research objectives to be achieved. Scenario testing usability testing by defining the tasks that will be ordered to system testers, namely the cage officer. A defined task consists of two types: poor task and better task. Test scenarios can be seen on Table 10.

Table 10. Usability Testing Scenario

Poor Task	Better Task
See the average air temperature in the enclosure 1 floor below	What about the environmental conditions in the cages 1 floor below?
See broiler weight on the cage 1 floor below on 20 May 2017	How is the development of broiler weight seen from the graph?
See the number of feeds at the top 1st floor on May 21, 2017	How is feeding seen from the graph?
See number of dead chickens in cages 1st floor on May 21, 2017	How is the number of chicken deaths seen from the graph?
See the FCR rating at the bottom 2 storey on May 22, 2017	How is the development of FCR values seen from the graph?
Check out the IP values at the bottom 2 storey on May 22, 2017	How is the development of IP values seen from graphs?
See the condition of broiler in the cage 2 floors above, any number of grids that indicate the condition of broiler that is not normal?	How broiler conditions are shown on the grid?

The result of the test is that if the officer can complete the task is given a value of 1, whereas if officers can not complete the work will be given a value of 0. The results of the ability of officers in testing can be seen on

Table 11. Usability Testing Result

User Goals	Result
Know the environmental conditions of the cage	1
Know the weight of broiler development	1
Know the amount of daily feed	1
Know the number of chicken deaths	1
Know the development of FCR value	1
Know the development of IP value	1
Knowing the existence of outliers	1

From the results of usability testing, obtained the results of the effectiveness level of 100%. From these results can be concluded that the testing of broiler data visualization system has met the expected goals. The cage officer can do the job well provided and understand the knowledge of each displayed data.

3. PENUTUP

Based on the results of implementation and testing that has been done on broiler data visualization system at PT. Mustika Sukses Niagatama, it can be concluded as follows:

1. The built system can help the cage officer in monitoring the environmental conditions of the cage and the development of broiler.

2. Visualization allows officers to see and understand the data of each sensor read.

3. Visualization helps officers in knowing the condition of broiler. The officer can then do the handling in case of environmental condition or broiler that is not normal.

Data visualization can solve the problems that occur and can meet the objectives of this study. However, there are still constraints faced in visualizing data in real-time.

A constraint if the data captured by the sensor can not be stored into the database or the constraint due to error reading the data from the sensor. Therefore, for the development of a data visualization system in the future ie the data provider periodically checks the data read by the sensor or data entered manually into the system for real-time data, in order to keep the data available and valid to be visualized.

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