

DESIGN OF AUTOMATION INSPECTION SYSTEM USING CLUSTER IDENTIFICATION METHOD BASED ON LEATHER SHOES COLOUR AT VENAMON CORPORATION

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Abstract

Visual identification using the human eye as the primary senses has limitations. The limitations of the eye as a visual identification are the factor of fatigue and lack of endurance. This drawback occurs when done a visual identification of products on the production line or for other identification process. Therefore, man developed a visual identification automation system which is called vision system. Indonesia is growing rapidly in the textile industry. Especially the textile industry uses a wide variety of basic materials of leather. Therefore, we need a system utilizing automated vision system for identifying the type and quality of the leather.

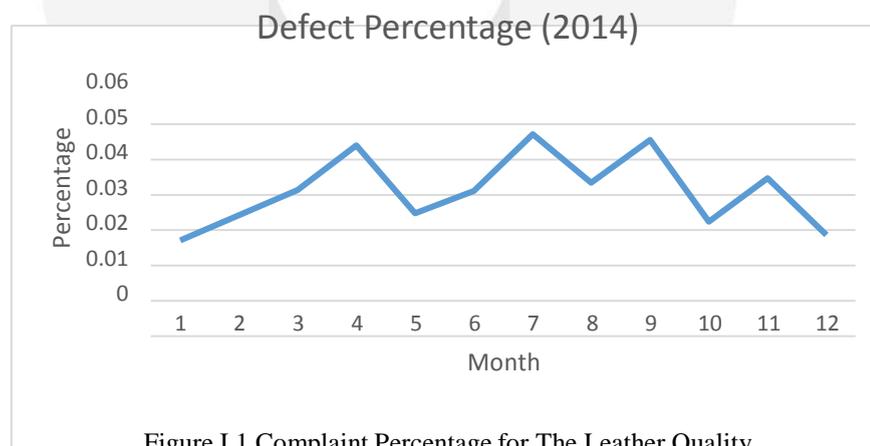
Vision System using MATLAB language can be applied in a variety of automated systems, which one of them is for processing of basic materials in various products such as leather shoes, handbags, and wallets. Textile industry nowadays, identified clusters leather still using manual methods, which causes much human error on its application.

Vision System work begins with the user input the samples to the conveyor, then the camera will capture the leathers material through a graphical user interface in MATLAB assisted with stable lighting. Then the sampling results will be processed by MATLAB that the result will be stored in the database which is actuated by pneumatic system controlled by a programmable logic controller.

Keywords— *Vision System, Industrial Automation, Cluster Identification, Programmable Logic controller, RGB.*

I. Introduction

Venamon Corporation is an individual-owned enterprises engaged in the production of leather shoes in Indonesia, based on Figure I.3 Companies should be able to produce according to existing demand in order to compete in the market. There are so many complaint from their reseller about their leathers shoes quality, as shown in Figure below.



Quality standards that still does not fullfill yet can be caused by many factors. Figure 1.5 shows the causes that can lead to the achievement of quality standards are still not being met, including:

1. Human

Force automation designed will minimize the role of human / operator in the process of operation so that human error factor can be avoided, such as forgetting to monitor the quality of the leather.

2. Materials

Raw materials obtained from the supplier does not meet the standards of the company.

3. Method

Production Operational Standards are often violated by the operator

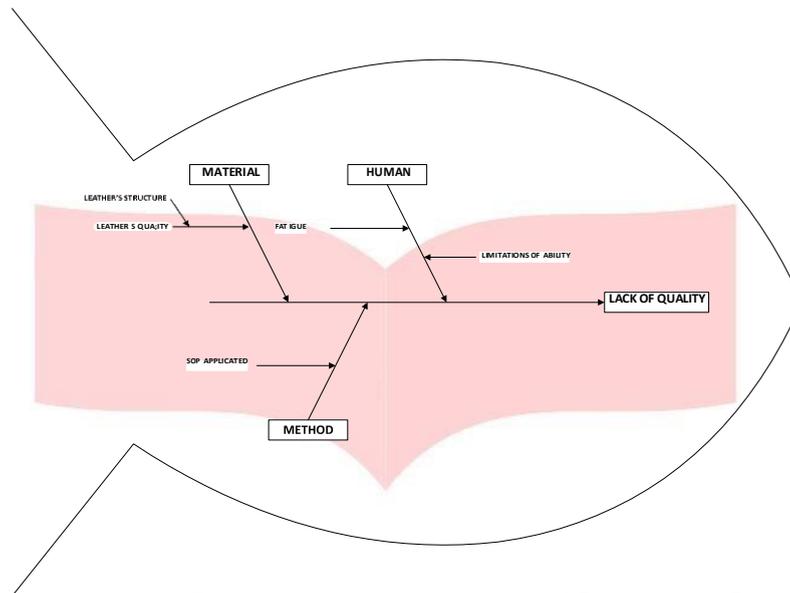


Figure I.2 Fish bone in this paper

In this paper will be built an image clustering application to identify the quality of the shoes by color. In the initialization clustering should normally be desired number of clusters in advance, whereas in some cases clustering, users do not even know how many clusters can be built. Therefore, in this study applied a method Valley Tracing capable of solving the problem. This method can perform clustering automatically (Automatic Clustering) to the color feature in the form of R, G, B of the shoe's leather by utilizing the Single Linkage Hierarchical Method (SLHM), which detects the movement of variants at each stage of the formation to find the global optimum cluster so that it can be built cluster automatically (automatic clustering). Value centroid of each clustering result then be used to identify the type of fruit and ripeness.

In order to decrease the processing time and minimize the error value, this system will use automation. Automation is a group of interconnected elements, working together, and merge into a single unit to achieve certain goals. From Latin and Greek, the term "system" is defined as combining to facilitate the flow of information, materials or energy. The term is often used to describe a set of entities that interact, in which a mathematical model can often be made.

There are three kinds of automation system in manufacur, such as :

1. Fixed Automation
Fixed Automation is a system that has an unflexibles operation process with using a fixed machine. A system that is used Automation System usually a simple system.
2. Programmable Automation
Programmable Automation is commonly used for a dynamic system, with a controller that control those process. Arrangement of the production process had been arranged by a program in a program code, which readable and understandable by the system next day.
3. Flexible Automation
Flexible Automation is a development of a Programmable Automation System. Flexible Automation is a flexible system with an ability to make all kinds of part or products that has a different shape, without lost much time.

Automation is a technology which deals with the application of mechanical systems, electronics, and computer-based systems to operate and control the production (IBM, 1979). Automation consists of three basic elements, actuator, controller, and sensor. The actuator which does the work, and controlled by the controller. The actuator in an automated process may in fact be several actuatos, each of which provides an output that drives another in the series of actuator. The controller which tells the actuator to do work may be a simple digital system or an analog system. The sensor is provides feedback to the controller so that it knows the actuator is doing work which. These three elements have been integrated into a mechanical system either electronic, and computer-based systems to operate and

control the production. Thus the automation system is a collection of elements consisting of sensors, controller, and actuators which aims to operate and control the production. (Kharagpur, 2010) The following image depicting three main components in an automation system:

The identifier in this system will use MATLAB as the main program. MATLAB is a programming language that combines computing, visualization, and programming in a single unit that is easy to use where problems and solutions are expressed in familiar mathematical notation. MATLAB (matrix laboratory) is also a multi-paradigm numerical computing environment. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, Fortran and Python (Marchand, 2003).

The concept of 4GL was developed from the 1970s through the 1990s, overlapping most of the development of 3GL. While 3GLs like C, C++, C#, Java, and JavaScript remain popular for a wide variety of uses, 4GLs as originally defined found narrower uses. Some advanced 3GLs like Python, Ruby, and Perl combine some 4GL abilities within a general-purpose 3GL environment. Also, libraries with 4GL-like features have been developed as add-ons for most popular 3GLs. This has blurred the distinction of 4GL and 3GL (Marchand, 2003).

The automation system will need database to make the user easy to see the result of this system. A database is a collection of information that is organized so that it can easily be accessed, managed, and updated. In one view, databases can be classified according to types of content: bibliographic, full-text, numeric, and images.

Three databases could be connected to Wonderware Intouch 10.1 Program, such as: SQL Database, Access Database, CSV Database.

There are two software that could provide SQL Database properly, which are:

1. MySQL

MySQL is a relational database management system (RDBMS), and ships with no GUI tools to administer MySQL databases or manage data contained within the databases. Users may use the included command line tools or use MySQL "front-ends", desktop software and web applications that create and manage MySQL databases, build database structures, back up data, inspect status, and work with data records. The official set of MySQL front-end tools, MySQL Workbench is actively developed by Oracle, and is freely available for use. In this study, MYSQL didn't chose because it used a lot of memory space.

2. SQL Server

Microsoft SQL (Structured Query Language) Server is a relational database management system developed by Microsoft. As a database server, it is a software product whose primary function is to store and retrieve data as requested by other software applications, it is on the same computer or those running on another computer across a network (including the Internet). There is at least a dozen different editions of Microsoft SQL Server aimed at different audiences and for workloads ranging from small single-machine applications to large Internet-facing applications with many concurrent users. Its primary query languages are T-SQL and ANSI SQL.

To make the system easy classify the leather type, will used a cluster method called KNN. KNN is a cluster method that uses supervised algorithm which the output of a training sample will be classified based on the majority and category of KNN. Purpose of this algorithm is classifying new object based on nearest distance with the training sample. (Kristanti, 2011)

Classifier doesn't use any model to matching process, classifier only use memory. KNN algorithm use neighbor classifying method as a prediction score from a new training sample.

KNN algorithm is very simple, works based on the nearest distance from an experiment image to the training sample to define the KNN score. After collecting the KNN score, then Majority of the KNN gathered to be a prediction of an image experiment.

KNN have some excess which is:

1. KNN clustering process is very fast.
2. KNN clustering is very sensitive to the initial centroids randomly generating.
3. Allows a cluster does not have a member.
4. The results of the KNN clustering are not unique (always changing).
5. sometimes good, sometimes bad.
6. KNN is very difficult to achieve the global optimum.

This system will identify the leather types based on its RGB Average value. Color in digital image could be classify as shown by the figure below :

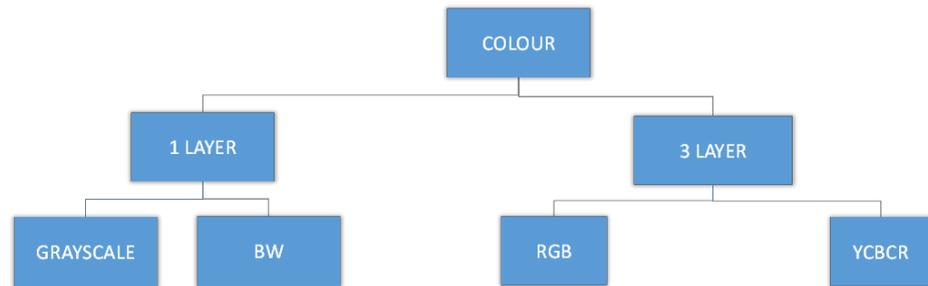


Figure I.3 Colour Taxonomy

II. System Desugn

To build a vision system that integrated with all automation concept, we have to gather data that needed by the vision system that we will make. Which is the data could be gathered from existing system identification.

2.1 Existing System Identification

Existing system analysis done to identify the systems that works now, so we can decide the needed by the existing system for a new system design. Differentiation process for the leathers types are done by quality control department. Quality control department use a manual methods which they look on a table and a lamp for differentiate the leather types. Existing system identification flow chart:

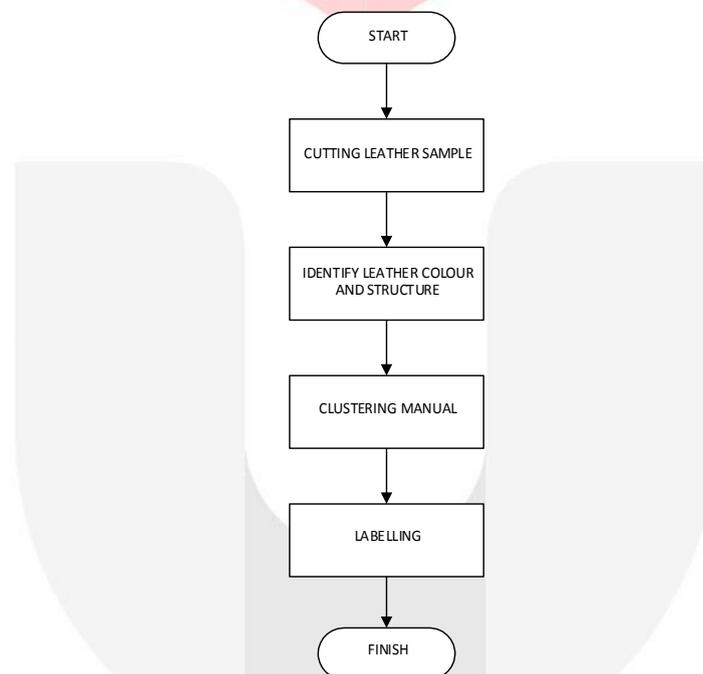


Figure II.1 Existing leather types identification system

2.2 Problem Identification

There are some problem found by using manual quality control system in Venamon Corporation, such as:

1. Sometimes they did human error in quality control processing.
2. There are no record for the incoming leathers
3. Each worker has a different standard based on their idea.
4. Not capable for an advance manufacturing system.

2.3 Improvement System

After identifying the existing system done, we could make the improvement system based on the weakness and problem that found from the existing system. These are improvement system component that we built:

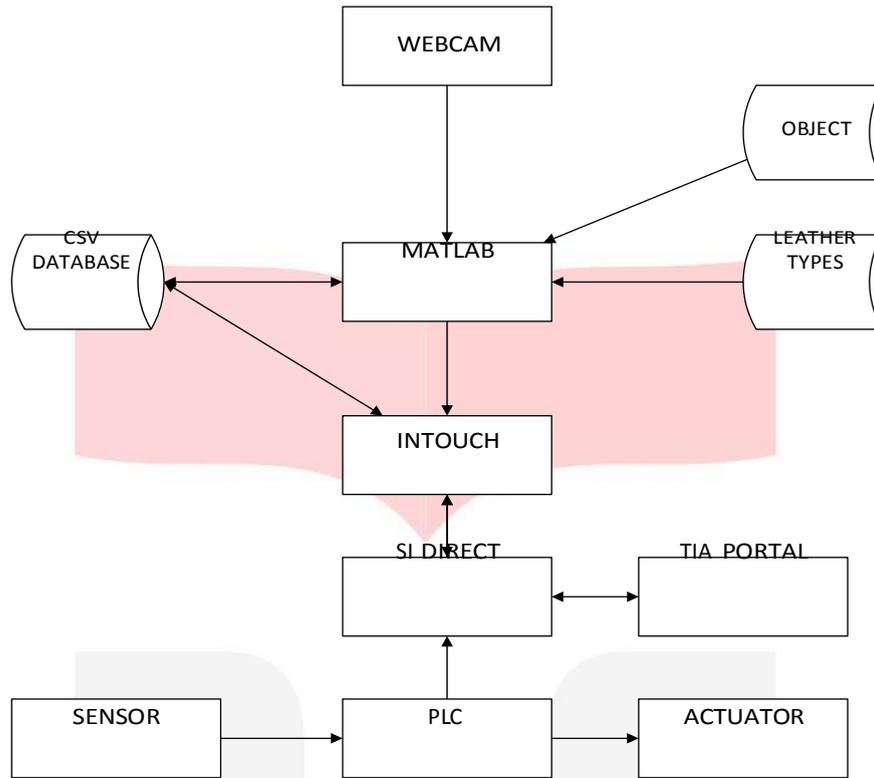


Figure II.2 Vision System component

III. Discussion

Identification program using cluster identification algorithm and RGB method has been successfully made. This statement came out from the identification program test which done before, which the result is 90% leather identified perfectly. The vision system could integrated with any webcam brands, as long as the resolution is equal or higher than the minimum specification which has been explained previously. Integration between MATLAB 2013A, Intouch Wonderware, and CX Programmer successfully done. The connection between MATLAB 2013A and Intouch Wonderware is using CSV Database. There are some result that could be retrieved from this paper :

3.1 DOE Result

There are some parameter which will make the output of the vision system optimal. Such as : Camera distance, Light lux, and Camera resolution. The result of the experiment are :

- a. Camera distance :

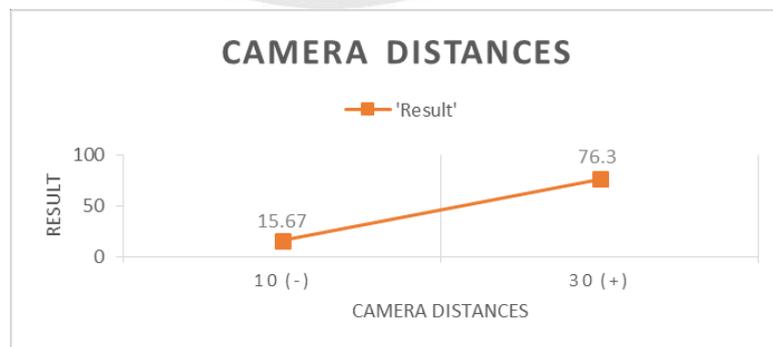


Figure III.1 Camera Distance Scatter Diagram Result.

From the scatter diagram above, shown from the low condition and high condition there are much differences. So, we can conclude camera distances is an important parameter for the system. For an advance analysis, We also can conclude that camera distances parameter is depends on the object that we'll identify. The camera distance equal with the object width.

b. Camera Resolution :

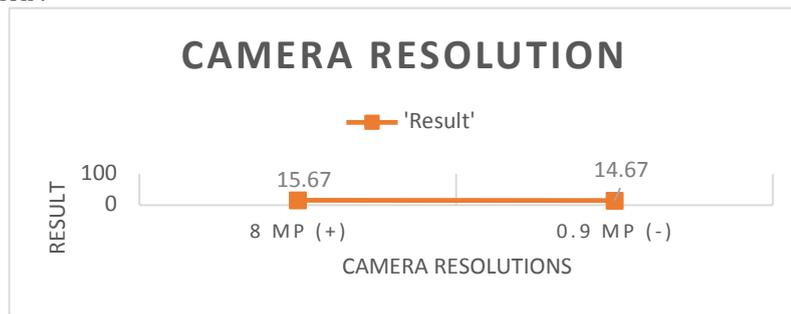


Figure III.2 Camera Resolution Scatter Diagram Result.

From the scatter diagram above, shown from the low condition and high condition there is only little differences. So, we can conclude camera distances is not an important parameter for the system. The camera resolution is not a significant parameter because in this vision system we only identify the object based on the object colours. So, in fact the camera resolution is depend on the identification types.

c. Lux Density :

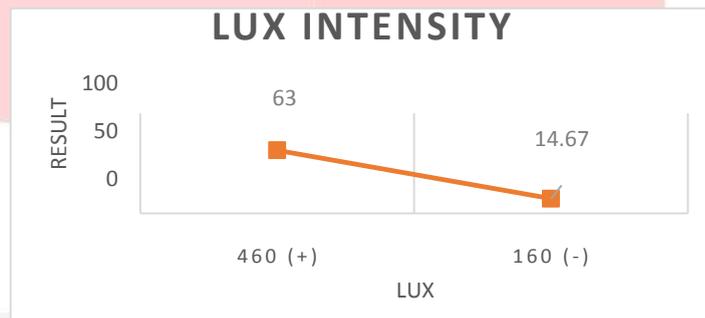


Figure III.3 Lux Intensity Scatter Diagram Result

From the scatter diagram above, shown from the low condition and high condition there are some differences. So, we can conclude lux intensity is an important parameter for the system. Lux intensity will be optimized if the system using 160 until 460 lux.

3.2 MATLAB identifier result

The identifier which is MATLAB has been tested 8 times for each leather types.

Table III.1 Identifier test result

No.	Expected Result	Result	No.	Expected Result	Result
1	Leather Type 1	match	31	Leather Type 4	match
2	Leather Type 1	match	32	Leather Type 4	match
3	Leather Type 1	match	33	Leather Type 4	match
4	Leather Type 1	match	34	Leather Type 4	match
5	Leather Type 1	match	35	Leather Type 4	match
6	Leather Type 1	didn't match	36	Leather Type 4	match
7	Leather Type 1	didn't match	37	Leather Type 4	match
8	Leather Type 1	match	38	Leather Type 4	match
9	Leather Type 1	didn't match	39	Leather Type 4	match
10	Leather Type 1	match	40	Leather Type 4	match
11	Leather Type 2	match	41	Leather Type 5	match
12	Leather Type 2	match	42	Leather Type 5	match
13	Leather Type 2	match	43	Leather Type 5	match
14	Leather Type 2	match	44	Leather Type 5	match
15	Leather Type 2	match	45	Leather Type 5	match
16	Leather Type 2	match	46	Leather Type 5	match
17	Leather Type 2	didn't match	47	Leather Type 5	match

No.	Expected Result	Result	No.	Expected Result	Result
18	Leather Type 2	didn't match	48	Leather Type 5	match
19	Leather Type 2	didn't match	49	Leather Type 5	match
20	Leather Type 2	match	50	Leather Type 5	match
21	Leather Type 3	match	51	Leather Type 6	match
22	Leather Type 3	match	52	Leather Type 6	match
23	Leather Type 3	match	53	Leather Type 6	match
24	Leather Type 3	match	54	Leather Type 6	match
25	Leather Type 3	match	55	Leather Type 6	match
26	Leather Type 3	match	56	Leather Type 6	match
27	Leather Type 3	match	57	Leather Type 6	match
28	Leather Type 3	match	58	Leather Type 6	match
29	Leather Type 3	match	59	Leather Type 6	match
30	Leather Type 3	match	60	Leather Type 6	match
		match		Result	90%

From the test, conclude that for leather types 1 there are 3 missed match leather. For leather type 2 there are 3 missed match leather. For leather type 3,4,5 and 6 all leather completely identified.

Overall from the test has been done before. There are 90% identification result correct. It means this identification program works as well as what expected before. The test result could be increased by identify the leather types using another parameter, such as : structure.

3.3 HMI result

After user pass the login windows, user will be brought to the process windows, where user can operate the system through this windows. User will able to start the conveyor and see the result number of the identified leathers.



Figure III.4 Process windows in Intouch wonderware

IV. Conclusion

Based on the design and analysis that has been made, we can conclude that :

1. The existing system has identified, which the system needs an improvement on the clustering process which take 50 seconds to identified,
2. Identification program using cluster identification algorithm and RGB method has been successfully made. This statement came out from the identification program test which done before, which the result are 90% leather identified perfectly, and the processing time are minimized to 3 seconds.
3. The system has been integrated with a flexible hardware and software which can make the users easier to maintain the system.

4. Parameter of the system could be conclude which this system needs 3 MP camera, 150-600 lux, and more than 10 cm for camera distance to be optimized.
5. Integration between matlab 2013A, intouch wonderware, and CX Programmer successfully done. The connection between matlab 2013A and intouch wonderware are using CSV database.

Based on the design and analyzes, there are some suggestion to make the next research will be better, which are :

1. The object must be tested with large number of sample to decrease the errors from the identification program.
2. Use the larger conveyor or larger plant simulation to make the web camera easier to do autofocus to the object.
3. Use the other variable to cluster the object in order to decrease the error level.

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