# Lovebirds type identification designing based on color using automaton theory

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**Abstract -** *Lovebirds are a unique and legendary bird species that can attract most bird lovers in Indonesia. The colors and types are also varied, ranging from valves, non-valves, colorful feathers starting from the lungs, eyes, chest, tail wings, and so forth. In addition to a variety of colors, the birds singing is also another attraction for bird lovers. But for the general public as well as beginner Lovebirds hobbyists, it is difficult to know the type of each Lovebirds they meet or have. This is due to the lack of knowledge they have about Lovebirds, so we need a system that can help them in solving problems to find out the name of the species on a specific basis.*
*Expert systems are computer programs that simulate the reasoning of an expert with expertise in a particular area of knowledge. Expert systems work based on theory, rules, and knowledge base. The theory is the necessary foundation in making an expert system as a substitute for an expert's logic mindset. Automaton theory of intelligent abstract modeling recognition machine is one theory that can work on a system to resolve uncertainty according to predetermined rules, especially reading the input of words or context-free language, and then can conclude whether the writing is following the state of the regulation set in the programming language. The results of this study resulted in an expert system application to identify Lovebirds based on the color of feathers found in the body of the lovebird using finite-state Automata.*
***Key Words**: Expert System, Lovebirds, Automaton Theory.*

## 1. INTRODUCTION

Lovebirds are one of the birds that are unique in the field of chirping and color that can captivate most bird lovers in Indonesia. For the general public as well as beginner Lovebirds hobbyists, it is difficult to know the type of each Lovebirds they encounter or have. This is due to the lack of knowledge they have about Lovebirds, so we need a system that can help them in solving problems to find out the name of the species on a limited basis.
Expert systems are computer programs that mimic the reasoning of an expert with expertise in a particular area of knowledge. Expert systems work based on theory, rules, and knowledge base.

Automaton Theory is the study of abstract computing devices, or "machine recognition." The theory was initially proposed to model brain function, turned out to be very useful, and can help various other problems associated with intelligent computer systems (John E. Hopcrof, Rajeef Motwani, Jeffry D. Ulman in his book Introduction to Computer Theory). Automaton theory also can work on system logic and can be understood to resolve uncertainties according to established rules.

Lovebirds are one of the birds that are unique in the field of chirping and color that can captivate most bird lovers in Indonesia. For the general public as well as beginner Lovebirds hobbyists, it is difficult to know the type of each Lovebirds they encounter or have. This is due to the lack of knowledge they have about Lovebirds, so that it needs a system that can help them in solving problems to find out the name of the species on a limited basis.

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## 2. THEORY BASIS

**Lovebirds**

Lovebirds are a bird of nine species of genus Agapornis (from the Greek "agape," which means "love" and "ornis," which means "bird"). They are small birds, ranging from 13 to 17 cm, weighing 40 to 60 grams, and are social in nature. Eight of these species originated in Africa, while the "gray head love bird" species originated in Madagascar. Their name comes from the commonly observed behavior that a pair of love birds will sit close together and love each other. The nature of the love bird pair is monogamy in the wild.

Table 1. Kinds and features of Lovebirds

| Names | Characteristic features |
|---|---|
| Green standard | Appearance feathers bright green, especially in the back, wings, to the chest and abdomen. While from the neck to the head is orange and red with a blackish tinge on the top. Lovebird is the presence of white eye circles or what is called glasses/valves. |
| Green Dakocan | Lovebirds have a color combination between clean green, yellow, and blackhead, feet slightly to blue-blue and generally beak red |
| Green Red Head | The appearance is predominantly bright green feathers, redhead, yellow neck |
| Green Head Black Pastel Eyes | Lovebird has a color combination of yellow and green dirty / faded, there is a sharp orange head and some people are less sharp, feet slightly blue-blue and generally the beak is red |
| Green Pastel Red Eyes | Just like Lovebird Pastel Green Black Eyes, this lovebird has a color combination of yellow and dirty green/faded, there is a sharp orange head and some people are less sharp, feet slightly to blue-blue and generally, The beak is red. The difference in his eyes are red |
| Darkgreen | he dominant coat color is dark green. The beak is red, the eyes are black, the head is reddish black, the neck is yellow and most are orange. The wings are dark green, the tail is brownish-green |
| Olive/Double Darkgreen/DDG | The dominant coat color is dark green. Red beak, black eyes, reddish black head, yellow neck. Brownish wing and tail |
| Yellow Pastel | Lovebird has a faded yellow color, the head is slightly orange, the feet are somewhat blue-blue, and the beak is generally red |
| Lutino Red Eyes | The bill is dark red, dominant feathers bright yellow with red eyes |
| Lutino Black Eyes | The beak is dark red; the dominant feathers are bright yellow with black eyes. |
| Blue Mangsi | Lovebird blue color is dominated by light blue and dark blue, with a white neck. |
| Cobalt | Lovebirds cobalt dominated by turquoise, with a blackhead, with black eyes, white valves |
| Blue Pastel | The head is gray, neck is white Chest and back are bluish, the lower part of the body is blue. Lovebirds are similar to White Pastels but there are still differences due to the content of eumelanin in the chest hair, wings and back. Blue Pastels inherit autosomal recessive and can be combined with one or two dark factors. If Blue Pastel is mated with Cobalt Blue which has one dark |

| | factor so that two dark factors are created, then a bird with mauve color will be born. |
|---|---|
| Black Head Blue Pastel | lovebird has a color combination of clean blue, white, and blackhead, slightly to blue-blue feet and generally its beak is white |
| Violet | Masked head, Beak light orange to the old, dark blue purplish body, black strait. |
| Albino Black Eyes | Lovebird has the color of pure white fur all over his body. The characteristic is that the entire body is pure white, the feet are also slightly white and the eyes are black |
| Albino Red Eyes | Lovebird has a clean white coat color all over its body. Its characteristic is that the entire body is pure white, its feet are also slightly white, and its eyes are red |
| Batman | Characteristic of the blackhead and brownish-white neck, brownish-black wings |
| Mocca | Lovebirds type of Mocca is dominated by brown mocca in combination with white. |

*Sumber. Didit, 2016*

Previous research by Tedy Gumilang Sejati[1], Achmad Rizal[2], Alfian Akbar Gozali[3], with the title "Lovebirds Sound Classification with Fuzzy Logic Algorithm" is a classification study of Lovebirds based on sounds divided into three classes. The method used is the Fuzzy Logic method. Current research is the design of color-based Lovebirds species identification using Automaton theory. This first and second study both examined Lovebirds, but what distinguishes it from the current research is both the aspects studied and the methods used in their resolution.

**Expert system**

In general, the Expert System (expert system) is one of the fields of computer science that utilizes computers so that they can behave intelligently like humans. This system seeks to adopt human knowledge into computers so that computers can solve problems as can be done by experts. Expert Systems, made in order to solve problems that are complicated enough that actually can only be solved with the help of experts. For experts

**Automaton Theory**

An automata engine is an abstract machine or a word or language recognition engine where receiving input is processed to produce output "(accepted or rejected)", the concept of automata is described as a working protocol application machine "(known or unknown)", for example the relationship between stores, customers and banks by analogy with a graph protocol, as payment, a customer gives a credit card to the store service, when the purchase process is done, the store service instructs the system to transfer the balance from the account customers to the store account in accordance with the price of goods purchased, then the bank transfers from the customer's account to the store account and so on. (*John E. Hopcrof, Rajeef Motwani, Jeffry D. Ulman*, 2001: 39), as well as other examples, and automata machine as a transducer that converts input sequences into output sequences, in this case seeing machines as identifiers that classify an input string into two states, both accepted and rejected. A set consisting of all lines received by the machine is said to be recognized by the machine. (*switching and automata* theory, 2010: 570-573)
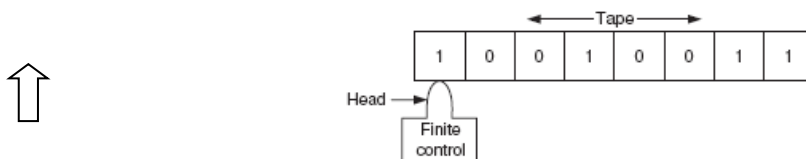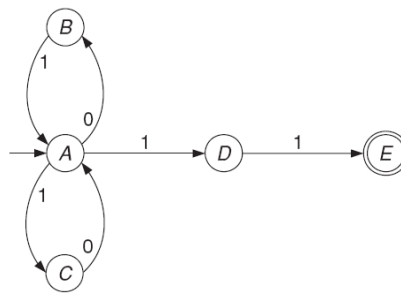


Figure 1a.  How do machines read strings?

Figure 1b. State Automata

Machine: { Q(A, B, C, D, E),õ, ∑(0,1),S(A),(F)}
Dimana Q: himpunan state
    ∑ : input Alphabet
    Õ : transition fanctions  Q X ∑ → Q
    S : initial State
    F :  final State

The automata machine in the picture. 1b Can be explained by a state diagram where the initial status is marked with a short entry arrow and the recipient's status is marked with a double circle. For example, the state diagram describes a machine that accepts a string if and only if the string starts 01.10 and even the set is empty and ends with alphabet 11, the machine consists of three states, where A is the initial state and E is the state receiver. Note that in general, the initial state in state A and must end in state E, if we want the word or string to be accepted or known. In such cases, the machine is said to accept or recognize after reading the state of the input word/string. This machine accepts the words if and only if the input string reads the alphabetical sequence in sequence from the initial state (S) to stop at the receiving state (F)

**Rules or grammar rules**

    Rules or grammar rules in Figure 1b. we define grammar as follows,
A → 1C | 0B | 1D
 B → 1A,
 C → 0A,
 D → 1E
 E → ε

**Programming Theory**

    Web programming consists of two syllables namely programming and the web. Programming is the process, or way, of making. Many people know the web with the term WWW (world wide web), WWW are web pages that can be connected to one another. Web pages are pure text files that contain HTML syntax that can be opened, translated with an Internet browser (Raharjo, 2011).

    HTML is a script where we can display information and our creative power through the internet. HTLM is a flexible programming language. The browser will not display a 'syntax error' dialog box if there is incorrect writing of code in the HTML script as long as the code we write is HTML code without the addition of external codes such as Java. PHP is a collection of scripts that are used to process form data from the web.

here are several ways to write
script PHP, are

   1.    *<?php*
    *Script PHP*
  *?>*
   2.    *<?*
    *Script PHP*
  *?>*
   3.    *<script language = "php">*
    *Script PHP*
  *?>*

4.      <%
    Script PHP
%>

MySQL is a database management system. MySQL is open-source software. MySQL MySQL is often used in creating websites, namely: Create, Use, Show, Drop, Alter, Select, Insert, Update, Delete.  XAMPP is an Apache webserver software that is embedded in a MySQL server that is supported by the PHP programming language to create dynamic websites. XAMPP itself supports two operating systems namely Windows and Linux.

**The Design System**
The design of knowledge-based information systems. The lovebird species identification system consists of two kinds of sources of knowledge, the first from facts, the second of the rules. Knowledge facts are facts sourced from bird enthusiasts, expert knowledge is bird species data stored in a database (table 2,3, and 4 and table), and the rule is a logical concept that can be written with a computer programming language and the results are used to link the characteristics/symptoms and facts.

Table 2. Lovebird species

| Kode | Nama Jenis Lovebirds |
|---|---|
| JL-01 | Green Standard |
| JL-02 | Green Dakocan |
| JL-03 | Green Red Head |
| JL-04 | Black Eye Green Pastel |
| JL-05 | Green Eyes Red Pastels |
| JL-06 | Darkgreen |
| JL-07 | Olive |
| JL-08 | Yellow Pastel |
| JL-09 | Lutino Red Eyes |
| JL-10 | Lutino Black Eyes |
| JL-11 | Ink |
| JL-12 | Ink Cobalt |
| JL-13 | Blue Pastel |
| JL-14 | Black Head Blue Pastel |
| JL-15 | Violet |
| JL-16 | Albino Black Eyes |
| JL-17 | Albino Red Eyes |
| JL-18 | Batman |
| JL-19 | Mocca |

Color information knowledge of lovebird consisting of birds

Table 3. Knowledge Base Identification

| Code | Fur color | | | | | | |
|---|---|---|---|---|---|---|---|
| | Lungs | Eyes | Head | Neck | Chest | Wings | Tails |
| Jl-01 | Read | Black | orange | orange | Yellow | Dark green | Dark green |
| Jl-02 | Read | Black | Black | orange | Dark green | Dark green | Dark green |
| Jl-03 | Read | Black | Read | Yellow | Dark green | Dark green | Dark green |
| Jl-04 | Read | Black | orange | orange | Dark green | green white strait | Dark green |
| Jl-05 | Read | Read | orange | orange | Dark green | green white strait | Dark green |
| Jl-06 | Read | Black | Reddish black | orange | Dark green | Dark green | brownish green |

**RESEARCH PARKS**

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| Jl-07 | Read | Black | Reddish black | orange | Dark green | Brownish green | yellow, red strait |
| Jl-08 | Read | Black | light orange | orange | Yellow | Yellow | Yellow |
| Jl-09 | Read | Read | Read | orange | Yellow | Yellow | yellow red strait |

Table 4. Knowledge Base Identification

| Code | Fur color | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | Lungs | Eyes | Head | Neck | Chest | Wings | Tails |
| JL-10 | Dark red | Black | red | orange | yellow | yellow | yellow red strait |
| JL-11 | Ligh red | Black | Grey | White | Ligh blue | Darkblue | Darkblue |
| JL-12 | Ligh red | Black | Grey | White | Ligh blue | greenish blue | greenish blue |
| JL-13 | Ligh red | Black | Grey | White | Light blue | Light blue | Light blue |
| JL-14 | Ligh red | Black | Black | White | Light blue | Light blue | Light blue |
| JL-15 | Ligh red | Black | Grey | White | Purple | purple black strait | Purple |
| JL-16 | Ligh red | Black | White | White | white | white | White |
| JL-17 | Ligh red | Red | White | White | white | white | white |
| JL-18 | Ligh red | Black | Black | White | Black | Black | Black |
| JL-19 | Ligh red | Black | Grey | white | white | Bluish white | Bluish white |

**Finite State Automata**

Finite State Automata is an abstract engine that recognizes or recognizes language, where the engine reads word input (word/string), and produces output of two statements namely "known or unknown" (accepted or rejected), while the concept The automata engine for the lovebird bird recognition system can be described as follows, which consists of eight States, Lung states, Eyes states, Head states, Neck states, Chest states, Wing states, Tail states, and final states, while the color is the alphabet input.

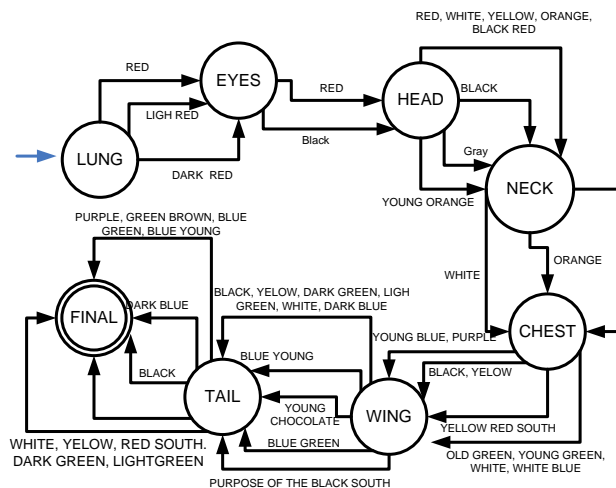Machine:{Q(S,P,M,L,D,SY,E),õ, (Color),S,(E)}



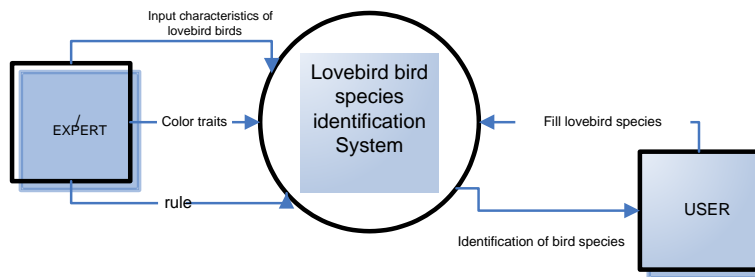Figure 2. Lovebirds State Diagram

Figure 3. Context diagram

**Flowchart**

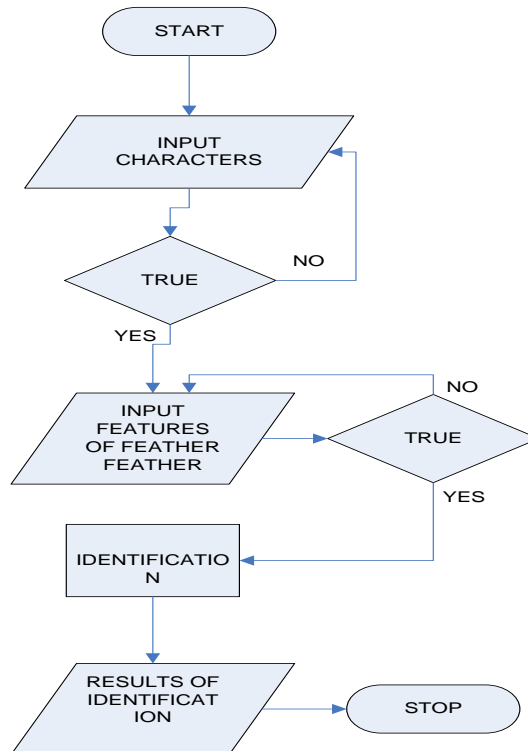Flowchart system application identification of lovebird birds.



Figure 4. Flowchart system application identification of lovebird birds.

**Research result**

This consultation page is a page that is used in running computer-based system applications to obtain information on the intended bird species, so that users get answers from the system, a variety of which can be seen in Figure 5 and the results seen in Figure 6. as the first search page on the user
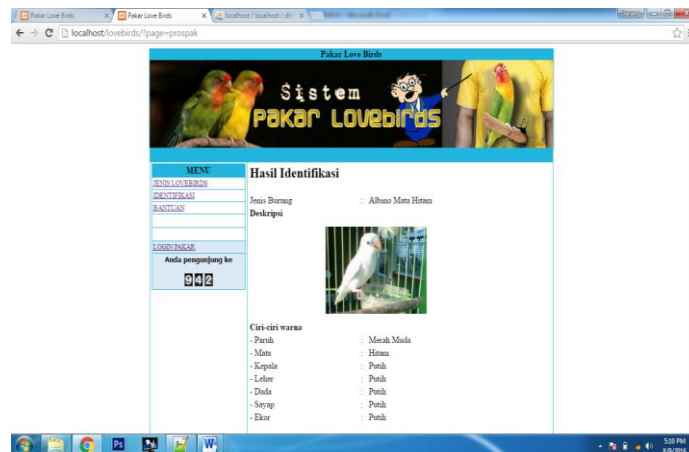


Figure 5. Bird species search.

Figure 6.  Type identification

**Discussion of Application Programs**

The computer-based Expert System application program "*IDENTIFICATION OF TYPE OF LOVEBIRDS BASED ON COLOR USING AUTOMATON THEORY*" runs using word recognition machine rules, reading then we define using a knowledge base. This method is applied to the identification process. A user who identifies Lovebirds by entering data in the form of color features in the seven columns on the form identification page (figure 6). After all the columns have been filled according to the color characteristics of the object, the user presses the identification button to start the export process.

In (figure 2), an automaton machine as a basis for the identification of Lovebirds birds. then translated with the PHP programming language script as follows.

Script php

```php
<?
include ('koneksi.php');
$tparuh = $_POST['paruh'];
$tmata = $_POST['mata'];
$tkepala = $_POST['kepala'];
$tleher = $_POST['leher'];
$tdada = $_POST['dada'];
$tsayap = $_POST['sayap'];
$tekor = $_POST['ekor'];
//kosongkan Table temp_proses
$sqldel = "DELETE * FROM temp_proses";
$prosesdel = mysql_query($sqldel);
//proses
$resulp = mysql_query("select * from rule where paruh like '%$tparuh%'");
if(mysql_num_rows($resulp) >0){
while($lp = mysql_fetch_array($resulp)){
$sql1 = mysql_query("insert into temp_proses (nama,paruh,mata,kepala,leher,dada,sayap,ekor)
values('$lp[nama]','$lp[paruh]','$lp[mata]','$lp[kepala]','$lp[leher]','$lp[dada]','$lp[sayap]','$lp[ekor]')");
}}
$resulm = mysql_query("select * from temp_proses where mata like '%$tmata%'");
if(mysql_num_rows($resulm) >0){
while($lm = mysql_fetch_array($resulm)){
$sql2 = mysql_query("delete from temp_proses where mata not like '%$tmata%'");
}}
$resulk = mysql_query("select * from temp_proses where kepala like '%$tkepala%'");
if(mysql_num_rows($resulk) >0){
while($lk = mysql_fetch_array($resulk)){
```

```
$sql3 = mysql_query("delete from temp_proses where kepala not like '%$tkepala%'");
}}
$resull = mysql_query("select * from temp_proses where leher like '%$tleher%'");
if(mysql_num_rows($resull) >0){
while($ll = mysql_fetch_array($resull)){
$sql4 = mysql_query("delete from temp_proses where leher not like '%$tleher%'");
}}
$resuld = mysql_query("select * from temp_proses where dada like '%$tdada%'");
if(mysql_num_rows($resuld) >0){
while($ld = mysql_fetch_array($resuld)){
$sql5 = mysql_query("delete from temp_proses where dada not like '%$tdada%'");
}}
$resuls = mysql_query("select * from temp_proses where sayap like '%$tsayap%'");
if(mysql_num_rows($resuls) >0){
while($ls = mysql_fetch_array($resuls)){
$sql6 = mysql_query("delete from temp_proses where sayap not like '%$tsayap%'");
}}
$resule = mysql_query("select * from temp_proses where ekor like '%$tekor%'");
if(mysql_num_rows($resule) >0){
while($le = mysql_fetch_array($resule)){
$sql6 = mysql_query("delete from temp_proses where ekor not like '%$tekor%'");
//tampilkan hasil
?>
<table border="0">
<tr><td colspan="3"><h2>Hasil Identifikasi </h2></td></tr>
<tr><td>Jenis Burung</td><td>:</td><td><?php echo $le['nama'];?></td></tr>
<tr><td><b>Deskripsi</b></td></tr>
<tr><td colspan="5" align="center" ><?php
$foto = mysql_query("select * from jenis where nama like '%$le[nama]%'");?>
<?php
while($data = mysql_fetch_array($foto)){?>
<img src="pakar/gambar/<?php echo $data['foto']; ?>" style="width: 200px; height: auto; border='1';
align:center; margin: 10px 150px 10px 150px; display: inline; float: left">
<?php }?>
</td></tr>
<tr><td><b>Ciri-ciri warna</b></td></tr>
<tr><td>- Paruh</td><td>:</td><td><?php echo $le['paruh'];?></td></tr>
<tr><td>- Mata</td><td>:</td><td><?php echo $le['mata'];?></td></tr>
<tr><td>- Kepala</td><td>:</td><td><?php echo $le['kepala'];?></td></tr>
<tr><td>- Leher</td><td>:</td><td><?php echo $le['leher'];?></td></tr>
<tr><td>- Dada</td><td>:</td><td><?php echo $le['dada'];?></td></tr>
<tr><td>- Sayap</td><td>:</td><td><?php echo $le['sayap'];?></td></tr>
<tr><td>- Ekor</td><td>:</td><td><?php echo $le['ekor'];?></td></tr>
</table>
<?php
}}
else{
echo 'Jenis burung Lovebirds tidak Terdaftar!';
}
?>
```

Application Testing

When the Automaton Machine reads the word (Lovebird lungs are red, eyes are black, head is orange, neck is yellow, chest is dark green, wings are dark green, tail is dark green) and then Machine percept and producing green lovebird standard species, can be seen Computer program application in Figure 5,6,and Automaton machine concept and rule in figure 7, search logic in Figure 8
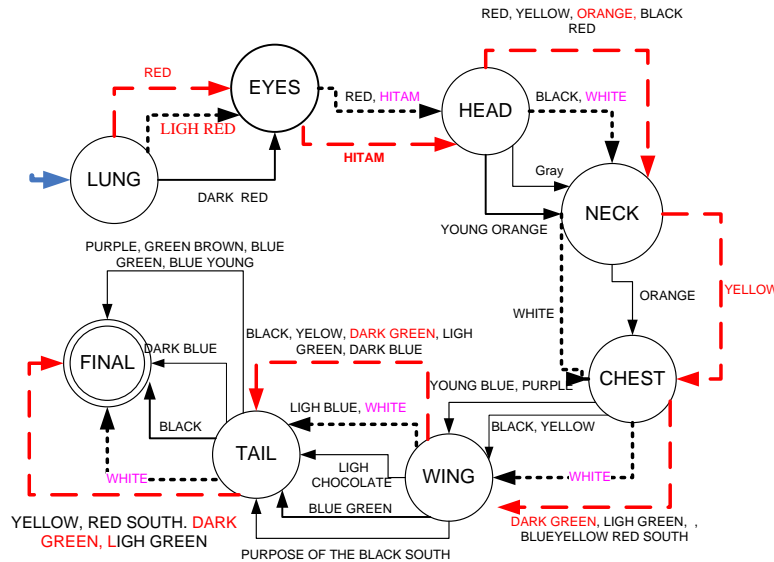
The Automaton Machine Read are:



Figure 7. Transition diagram Machine to define Green Lovebirds standard and Lovebirds Albino Lovebirds Black Eyes

If translated in the machine recognizing words that are generated from the input are:
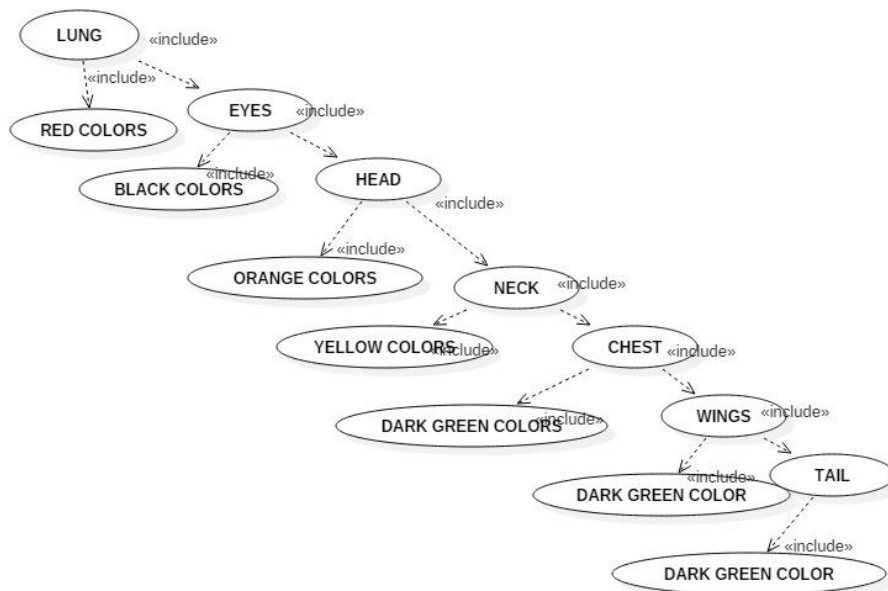


Figure 8. Decision tree kind of green Lovebirds standard

In developing this expert system, an expert can add logical rules to the knowledge base into the system's input process output (HIPO) hierarchy (figure 9)

Figure 9. Expert menu (additional types)

In table 5. It is the result of trials of nineteen kinds of Lovebird (table 2), and the results reached 100% correctness.

Table 5. Test results

| N0 | Fur color | | | | | | | MANUAL | SISTEM |
|----|------|------|------|------|-------|-------|------|--------|--------|
|    | Lung | Eyes | Head | Neck | Chest | Wings | Tail | | |
| 1 | RED | BLACK | ORANGE | YELOW | DARK GREEN | DARK GREEN | DARK GREEN | GREEN STANDARD | GREEN STANDARD |
| 2 | RED | BLACK | Black | ORANGE | DARK GREEN | DARK GREEN | DARK GREEN | DAKOCAN GREEN | DAKOCAN GREEN |
| 3 | LIGH RED | BLACK | WHITE | LIGHT BLUE | LIGHT BLUE | LIGHT BLUE | PURPLE BLUE | ALBINO BLACK EYES | ALBINO BLACK EYES |
| 4 | LIGH RED | BLACK | WHITE | WHITE | WHITE | WHITE | WHITE | ALBINO BLACK EYES | ALBINO BLACK EYES |
| 5 | LIGH RED | RED | WHITE | WHITE | WHITE | WHITE | WHITE | ALBINO RED EYES | ALBINO RED EYES |
| 6 | RED | RED | BLACK | ORANGE | DARK GREEN | DARK GREEN | DARK GREEN | NO LOVEBIRD | NO LOVEBIRD |
| 7 | RED | BLACK | ORANGE | YELLOW | DARK GREEN | DARK GREEN | LIGHT GREEN | NO LOVEBIRD | NO LOVEBIRD |
| 8 | LIGH RED | BLACK | WHITE | WHITE | WHITE | LIGHT BLUE | LIGHT BLUE | NO LOVEBIRD | NO LOVEBIRD |
| 9 | RED | YELLOW | BLACK BRIGHT NESS | ORANGE | DARK GREEN | DARK GREEN | BROWN ISH GREEN | NO LOVEBIRD | NO LOVEBIRD |
| 10 | LIGHT BLUE | ORANGE | DARK GREEN | DARK GREEN | RED | RED | RED | NO LOVEBIRD | NO LOVEBIRD |

## 3. CONCLUSION

Based on the results of the study it can be concluded as follows:

1. The application of Lovebird species identification by color can help the Lovebird loving community.
2. The color features of this application are still nineteen lovebird species that can be easily recognized.
3. If there is a new Lovebird type, the system provides facilities to include bird type rules and feather color characteristics.

This application still has many shortcomings, especially in the knowledge of the introduction of lovebird species.

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