Identification of Canaries Bird's Chirp Quality Using Statistic Analysis, Sound Analysis and Fuzzy Mamdani Method

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Abstract

Research about sound processing by computer using fuzzy logic has been known since 1970. One of approach logic fuzzy method is fuzzy mamdani method. Fuzzy mamdani method is the method to give conclusion from groupof rules of fuzzy. There have to be minimum of two rules, input rule and output rule. Sound processing in canaries bierd's chirp quality can be explained as measurement standar for canary's bird's chirp to the point of song variant and volume. The background of this research is to create a sound identification system that uses dynamic data, the pattern of canary's bird's chirp obtained from dynamic data.Dynamic data is difficult to approach with certain formulas. The purpose of this research is to create indentification system to measure Canaries bird's chirp quality pre-contest. The method used in this research was statistic analysis, sound analysis and fuzzy Mamdani method. Statistic analysis was used to look for important features from Canarie's chirp sample. This analysis results Max amplitude variable, Min amplitude variable, Root-mean square. Then sound analysis results Autocorrelation time, Zero cross and Energy. Then those values were used as the input in fuzzy Mamdani method process. As for the output variables were the judges score result about the quality of bird' chirp. The results from identification system of bird's chirp quality from 6 samples are (1). Accuration level 81,67%. (2) Error sytemrate 18,33%. (3). Based on system performance and error rate that have been known can be concluded that the system can indentifyCanarie's chirp quality well.

Keywords: quality, Canaries bird's chirp, statistic analysis, sound analisys, fuzzy Mamdani

1. Introduction

Artivicialintelegencehas been sucsessfuly implemented in many fields, including sound processing field and computer vision [1]. One ofartificial intelligenceapproach fuzzy Mamdani method.The method is to map room of input to room of output. [2]. Fuzzy Mamdani Logic and also can be used to indetify dynamic system. [3]. Beside, that method can explain the relation of input/output in non-linear condition [4].

Fuzzy Mamdani method is a method based on fuzzy logic. Fuzzy logic first used was to manage uncertainty [5]. While uncertainty is a problem contains doubt and unfit. The appearance of fuzzy logic doesn't mean replacing probability theory that has existed previously, but with fuzzy logic, we have found another alternative that can be used to solve problems of uncertainty.The past research about mamdani fuzzy model was to choose eligible studententry [6].

Fuzzy logic concept is present in a set of fuzzy theory. Set of fuzzy theory is the expnasion of clasic set of binary theory that only recognize number 0 or 1. Every element has 2 (two) probabilities, that is part of the set or not part of the set. The limitation of set of binary clasic is inability to handle uncertainty.

In this research fuzzy Mamdani method realizing between Canaries bird's chirp and score of bird's chirp quality from the judges. Where, fuzzy method can give solution related to complex system and to give identification output for non-linear system. Canaries bird is one of animal that not only phisically beautiful but also have adorable sound. Even the contest of Canarie's chirp is exist [7-8]. The beauty of Canaries bird's chirp has its own attractiveness [9]. Classification method is based on the voice of birds using records and spectogram analysis that have been implemented [10].

In the contest of canaries bird, the birds must have basic criterion in assessment. Based on a website in social media was explained that the criterion are, rhythm and song, volume, and physic and style. In the contest of bird chirp in Indonesia, there are three standarts of assessment wether in local bird's chirp competition or in national level. Those are, Indonesian bird conservationistor Pelestari Burung Indonesia (PBI), Boy & Roots(BnR) and Indepentent Assessment or Independent. From literatures study that obtained based on assessment system bird's chirp in Singapore and Indonesia, there are form of three standarts that have been implemented.

Based on judging criterion on the assessment standar of canaries bird' chirp contest on the above table, the quality of canaries' bird can be determined from rhythm, volume, and physical of canaries bird. To determine the quality of bird's chirp based on rhythm and volume, in this research, the author used statistic analysis and sound analysis from records of canarie's bird chirp that have been given assessment by the judgers.

Formulation of problems in this research is judging system in bird's chirp competition. Normaly judges prepare 2 criterias that have to be fulfilled to be the winner. Those criterias are still in the form of description and not in the standardized measurement. Therefore, this research can explain judging criteias that can be measured. Criterias that can be measured are from two basic criterias in judging system, those are amplitude and rhythm. Beside that, this research can be reference for creating judging system of bird's chirping in simplier and measured manner.

To know the parameters on Canarie's bird chirp, the sound analysis was used [11]. The past research about sound analysis thathas been measured was to investigate amplitude from various measurement points at various depths [12]. The sound analysis can be used to detect the presence of sea turtles [13]. Sound analysis is the analysis of signal based on time, where the bird's sound can be divided into amplitude aspect and frequency aspect [14]. In the sound analysis process, parameters obtained were, autocorrelation, zero cross and energy. This research also used statistic analysis. In statistic analysis also used time domain to extract feature of canary's bird's chirp. The purpose of additional statistic analysis is the extraction of features of bird's chirp can be more accurate in getting parameters about Canaries bird's chirp. Max amplitude value, min amplitude value, root mean-square value, and mean value were obtained in statistic analysis.

Therefor, in this research was explained how to create quality of canaries bird's chirpidentification system using statistic analysis, sound analysis and fuzzy mamdani method. The result obtained can identify the quality of Canaries bird's chirp in more sensitive fashion and the analysis can be more adaptable toward the changes of records variant.

2. Research Method

For data processing and computing were performed in Network Laboratorium at BJ Habibie building, faculty of science and technology State Islamic University Maulana Malik Ibrahim, Malang. The data of bird's voices that were assessed by judges were obtained from recording process of some bird's competition in Malang, East Java, Indonesia and http://www.budidayakenari.com/2015/04/suara-kenari-juara-nasional.html. This research used 54 training data. For bird's voice with first winner quality were 18 samples. With second winner quality was 18 samples and third winner qualities were 18 samples. Recording process of Canaries bird's chirp was performed with handphone. The recordings were being performed during the contest for 10 minutes. The chosen records were chosen among the records that has no stops or minimum stops. The recording design of the canarycan be seen in Figure 1. Then digital audio data of Canaries bird's records were transformed into WAV format. (Microsoft Wave form Audio Files) with the help of Microsoft sound recording software [8]. This research was performed in few stages. Generally, can be seen in Figure 2.
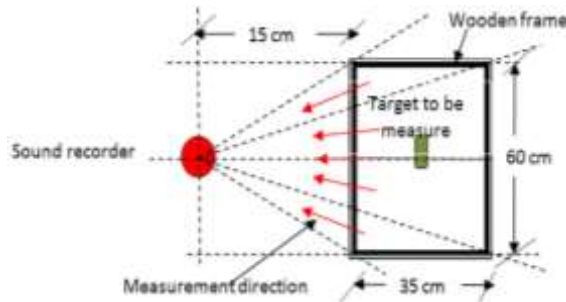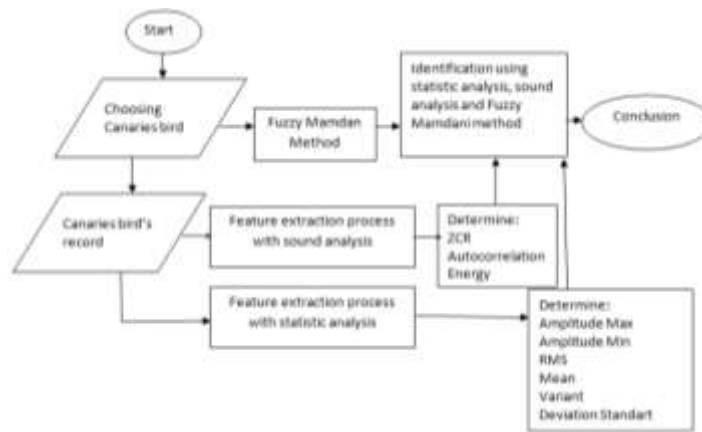
Figure 1. The recording design of the Canary

Figure 2. Research stages

3. Results and Analysis

In Figure 1 explained the stages that must be performed in order to create quality indentification sytem for Canaries bird's chirp.

a. Perform cutting process of voice records from 10 minutes into 21 seconds. The choosen record was chosen the one without stops or with minimum stops. The cutting of records was performed using software wave editor version 3.6. The process of cutting can be seen in Figure 3.
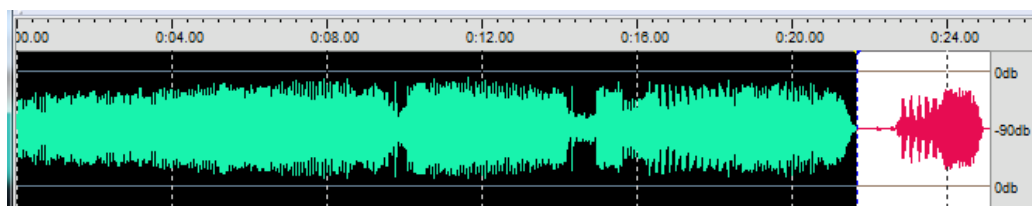

Figure 3. The cutting records of Canarie Bird using software wave editor from 25 second to 21 second

b. Perform Feature Extraction process.This stage is performed afer obtaining sample date from cutting process, there for, data samples have the same time, and then perform feature extraction process from the records of Canaries bird in order to get the characteristic in every bird's records. Features obtained from extraction process are signal length, time

vector and data samples, can be seen in Figure 4. Program code for Feature Extractionprocess in matlab, can be seen in Figure 5.
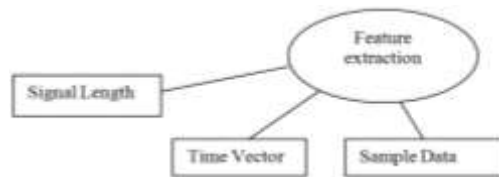

Figure 4. Block diagram of feature extraction method

```
[x, fs]=wavread('101_Canaries.wav');        %- to read the sound file
x=x(:,1);                                    %-- to read data samples
N=length(x);                                 %-- to read signal length
t=(0:N-1)/fs;                                %-- to readtime vector
```

Figure 5. Program codes forfeature extractionprocess in matlab

c. Perform pre-emphasis process. This process is to dismiss the DC components. Dismissing DC components by counting the average of voice data samples, then deduct by every data sample. This process uses mathematic Equation (1).

$$x_i = x_i - \frac{1}{N}\sum_{i=1}^{N} x_i, i = 1,2,3, \dots, N \tag{1}$$

Where: x_i=Value x number-i
         N=Total samples
Program code for pre-emphasis process can be seen on Figure 6.

```
u=mean(x);   %-- obtainin average value/mean
x=x-u;                    %-- dismissing component
DC %-----------------------------------------------
```

Figure 6. Program Codes for Pre-Emphasis Process in Matlab

d. Normalisation. Normalisation process is the process that can be used to normalize degraded sample value that caused by distance of canaries bird and microphone recorder. In every record, the bird's chirp has different shape and also different amplitude level. Therefor, to level the highest amplitude value from every record, normalisation process was performed. Normalisation amplitude process was performed by dividing all value digital signals with absolute highest value of data sample. Generaly, normalisation process program code with matlab can be seen on Figure 7.

```
%----------obtaining normalisation process
Kn=255/maxval;
x=Kn*x;
```

Figure 7. Program code for normalization process in matlab

e. Statistic Analysis
        Statistic is the science that studies how to plan, collect, analyzes, interpret and present data. Statistic is science that related to data. And statistical data is data,

information, or the result of statistic algorithm implementation on specific data. From data collection, statistic can be used to conclude or describe data.

Statistic analysis is a method that can be used to calculate statistic value form heartbeat pulse based on signal, amplitude, frequency and duration in few limited parameters. Various parameters that can be used as follows:

1) Varian (VAR). Variant is measurement that states variants or diversities. Variant can be used to measure/count the variants from sample data. The implementation of counting variance process in data sample of bird's chirp was performed using application in Matlab in Figure 8.

```
% compute and display the variance values
rav=var(x);
disp(['Variance value=' num2str(rav)])
```

Figure 8. Program code for variance process in matlab

2) Deviation Standart. The process to get deviation standart value was used to,measure how big the difference sample value toward average, this process used mathematic Equation (2).

$$\sigma = \frac{\sqrt{\sum_{x_i}^{N}(x_i - \mu)2}}{N-1} \qquad (2)$$

Where:

σ=Deviation Standart
x_i=Value of x number-i
μ=Average
N=Number of samples

3) Mean. Mean process is for counting average value from collective sample data. This process used mathematic Equation (3).

$$\vec{x} = \sum_{i=1}^{n} \frac{x_i}{N} \qquad (3)$$

where: $\vec{x}$= Mean
x_i=Value of x number-i
N=Number of samples

4) Root Mean Square (RMS). Root Mean Square (RMS) is average square.RMSwas used to measure voice volume level in voice sample data. RMS process is the process of squaring data sample, then the average from those data was taken, and the last step is to get square root out of it. Program code of Matlab to calculate RMS can be seen in Figure 9.

```
% compute and display the RMS values
s=rms(x);
disp(['Root-mean-square value=' num2str(s)])
```

Figure 9**.** Program codes for root-mean-squareprocess in matlab

f. Sound analysis sound analysis can be used to count basic frequency from a sound signal. Pitch from sound signal. Pitch from sound signal defined as perseptual feature that related to how human interpret that particular sound signal.

1) Zero Crossing Rate (ZCR). Zero Crossing Rate (ZCR) is one of the method that works in time domain.In the context timer of discrete signal, zero crossing takes place when sample has previous algebra sign that different with the current sample.Example if x is a signal sample, then zero crossing happens when$x_i$is positiveand$x_{i-1}$is negative, and so vice versa.

Zero Crossing Rate (ZCR) method in this research using mathematic Equation (4) [15].

$$Z_n = \sum_{m=-\infty}^{+\infty} |sgn[x(m)] - sgn[x(m-1)]| \, w(n-m). \tag{4}$$

where,

$$sgn[x(m)] = \begin{cases} 1, x(n) \geq 0 \\ -1, x(n) < 0 \end{cases} \tag{5}$$

And

$$w(n) = \begin{cases} \frac{1}{2N}, 0 \leq n \leq N-1 \\ \quad 0, \ otherwise \end{cases} \tag{6}$$

Where: x(m)   = data sample on m
        sgnx(m)= sign of x(m)
        N   = Total sample from the record of Canaries bird's voice.

Where sgnx(m) is the sign on x(m) and will become 1, if x(m) is positive and -1 if x(m) is negative. To see 1 sound sample, deducted with previous sample. If the sample now positive, the value is 1. Then, if negative, the value is -1.

        Previously, input signal to matlab, was transformed into envelope using Hilbert transformation. This transformation result then will be smoothening using average moving filter. Window size for n was10, where the bigger value the smoother the envelope will be produced. Implementation of ZCR method was performed by counting the zero crossing when x1and x2where they have different algebra sign. F0is basic frequency that counted based on occurance of zero crossing (zc).

        Can be shown that every window that have the result of diagonally addition will be processed by zero crossing rate formula. The result of the first frame is [0.194, 0.816, 1.136, 0.658, 0.042, -4.866, 4.894, -6.525, -5.671, -3.83]. Then, those calculations were performed from the first frame until the fourth frame, and the results of the calculation are as follows: Frame 1=1.540 Frame 2=1.426 Frame 3=1.621 Frame 4=1.660. Every value above will be normalized with mathematical Equation (7).

$$z = \frac{1.540 + 1.426 + 1.621 + 1.660}{4} = 1.561 \tag{7}$$

So, the result of every stage that mentioned above produced frequenzy value 1.561Hz.Program code for matlab can be seen on Figure 10.

```
%--------counting value of Zero Cross rate
y=abs(hilbert(x));  n=10;b=[];a=[1];
for k=1:n
b= [b 1/n];
end;
for k=2:n
a= [a 0];
end;
x1=filter(b,a,y); x1=x1-mean(x1);
x2=zeros(length(x1),1);
x2(1:length(x)-1)=x1(2:length(x));
zc=length( find((x1>0 & x2<0) | (x1<0 & x2>0)) );
F0=0.5*fs*zc/length(x);
disp(['Zero Cross rate=' num2str(F0)])
%------------------------------------------------
```

Figure 10. Program code for zero cross rateon matlab

2) Autocorrelation.Autocorrelation method is a method that normally used to calculate pitch (basic frequency) based on the highest value from autocorrelation function toward certain range value. Autocorrelation refers to connection from series of time value and future value. Someone's preception towards sound signal pitch is close related to wave period on the shape of wave in the time domain. Statistically, autocorrelation from a random sinusoidal process is like mathematic Equation (8):

$$x[n] = \cos(\omega_0 n + \varphi) \tag{8}$$

Given by mathematic formula (9).

$$R[m] = E\{X^*[n]X[n + m]\} = \frac{1}{2}\cos(\omega_0 m) \; ..... \tag{9}$$

Where maximum value of $m = lT_0$ that is period and harmonization from tone. So, period of tone can be found by counting the highest value of autocorrelation results. Practically, can be done the calculation $\widehat{R}[m]$ from N sample that owned. The autocorrelation function can be given as mathematic Equation (10).

$$\widehat{R}[m] = \frac{1}{N}\sum_{n=0}^{N-1-|m|}(\,\omega[n]x[n]\omega[n + |m|]x[n + |m|]) \; .... \tag{10}$$

Implemetation of autocorrelation function based on [16] that performed in Matlab using command line: r=xcorr (wave, maxlag, 'coeff'). Command line is the call function of autocorrelation in matlab where wave is matrix sample of sound signal with Nx1 size, and maxlag is range of lagthat given includes –maxlag to maxlag. Maxlag was counted to get bigger F_0 than 20Hz. Program code in matlab can be seen on Figure 11.

```
%------ counting autocorrelation value
maxlag=fs/20;
% search for maximum  between 1ms (=1000Hz) and 50ms (=20Hz)
ms2=floor(fs/1000); % 1ms
ms20=floor(fs/20); % 50ms
% half is just mirror for real signal
r=xcorr(wave, maxlag, 'coeff');r=r(floor(length(r)/2):end);
[maxi,idx]=max(r(ms2:ms20));  f0=fs/(ms2+idx-1);
disp([' Autocorrelation=' num2str(f0)])
%----------------------------------------------------
```

Figure 11. Program code for autocorrelati on process in matlab

Value of r that counted using xcorr function, then maximum value was counted on the period of 1 mili second (1000Hz) until 50mili second (20Hz).
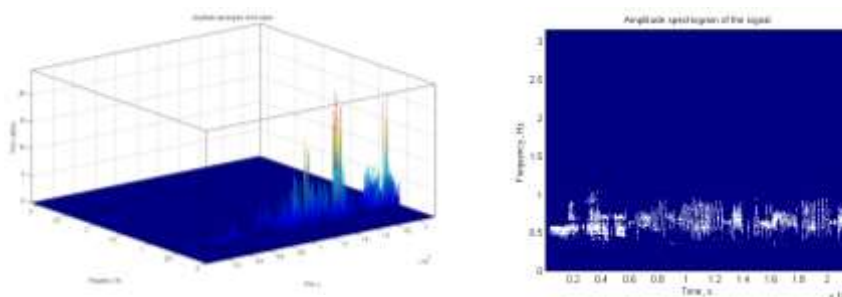

Figure 12. Regionof 1 mili second (1000Hz) until 50 mili second (20Hz)

3) Energy. Energy defined as the size ofenergyper frequency interval, in the mathematic form [17]. Energy is the process measuring thepowerfrom a sound signal determined periodically. The type of continuous signal in time domain, but producing discrete power spectrum.As for the size of power from data sample of bird's chirp can be stated from mathematic Equation (11).

$$P(i) = \frac{x_i^2}{R} \text{.......}$$ (11)

Where: $P(i)$=Value of power number-i

　　　x_i=Value of x number-i

　　　R=Field restriction

R is the parameter of sound travelling restriction fields. In this research the value of Rstated as 1 Ω. And this parameter often written, so, mathematic equation (11) becomes simplier mathematic formula (12).

$$P(i) = x_i^2 \text{.....}$$ (12)

Where: $P(i)$=Value of power number-i

　　　x_i=Value of x number-i

In the other hand, the sizeenergy from a signal known as total powerin certain period of time. With refers to Equation (2) that has been modified, and then can be state as mathematic fomula (13).

$$E = \sum_{i=1}^{n} x_i^2 \text{.....}$$ (13)

Where: E=Value of Total Energy

　　　x_i=Value of x number-i

　　　n=Total sample

g. Fuzzy Mamdani Method. Fuzzy Mamdani Method often known as Metode Max-Min. This method introduced by Ebrahim Mamdani in 1975. Identification process using fuzzy Mamdani method can be seen on Figure 13.
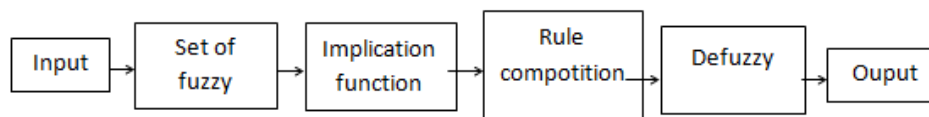

Figure 13. Stages on fuzzy mamdani method implementation

On the Figure 13 was explained that there are 5 stages. Those are:
1) Creation of fuzzy set. The result of sound analysis, were obtained, Max amplitude, Min amplitude value, Root mean square calue, Mean value, Dynamic range value, Crest factor Q value, Autocorrelation time value, Zero cross value and Energy value. Those are input variables on fuzzy Mamdani method. Output variables were obtained from observation about bird'schirp quality inline with the achievement; those are First Winner, Second Winner and Third Winner. Value of input and output that can be maped to be crips value (numerical) into a set of fuzzy and determined degree of membership in the fuzzy set. All data, input and output were processed based on set of fuzzy theory. Set of inout variables for Amplitude Maximum can be seen in Table 1.

Table 1.Set of Input Variables Fuzzy for Amplitude Maximum

| No | Set of input variables fuzzy Amplitude Maximum | | Domain |
	Nama	Notation	
1	Low	r	[0, 3]
2	Medium	s	[2, 3, 4]
3	High	t	[3,6]

On Table 1 the function of membership degree linearly decreases used to represent set of low fuzzyand the function of membership degree leearlyincreses used to represent set of high fuzzy. The function of triangle membership used to represent set of medium fuzzy. While the function of membership degree from Maximum Amplitude input variable, for low, defined as mathematic formula (14), as for medium define as mathematic formula (15), and as for high defined as mathematic formula (16).

$$\mu_{r(x)} = \begin{cases} (3-x)/(3-0) \; ; \; 0 \le x \le 3 \\ 0 \qquad\qquad ; \; x \ge 3 \end{cases} \dots \qquad (14)$$

$$\mu_{s(x)} = \begin{cases} 0 \qquad\qquad ; \; x \le 0 \text{ or } x \ge 6 \\ (x-0)/(3-0) \; ; \; 0 \le x \le 3 \dots \\ (6-x)/(6-3) \; ; \; 3 \le x \le 6 \end{cases} \qquad . (15)$$

$$\mu_{t(x)} = \begin{cases} 0 \qquad\qquad ; \; 3 \le x \\ (x-3)/(6-3) \; ; \; 3 \le x \le 6 \dots \\ 1 \qquad\qquad ; \; x \ge 6 \end{cases} \qquad (16)$$

Program code for fuzzy Mamdani method started by creating FIS variables and added with input variables, for MAXIMUM _AMPLITUDE variable, the creation of set of fuzzy in Matlab can be seen on Figure 14.

```
%-----Create FIS variabels
a=newfis('quality_of_canaries_chirp');
%---------add input MAXIMUM _AMPLITUDE
a=addvar(a,'input','MaximumAmplitude',[0 6]);
% add membership functionMAXIMUM _AMPLITUDE: Low, Medium, High
a=addmf(a,'input',1,'Low','trimf',[0 3]);
a=addmf(a,'input',1,'Medium','trimf',[234]);
a=addmf(a,'input',1,'High','trimf',[2 6]);
% plot input qualityto see the result
plotmf(a,'input',1)
%--------------------------------------------------
```

Figure 14. Program code for membership function process in matlab

2) Application of implication fucntion. Ofter obtained the set of fuzzy for input and output, then implication function process was performed to get the output in the form of IF-THEN rule. On the input part is degree of truth, part ofantesenden and fuzzy set on the consequenses part. Implication function that used was mimimum. For one implication function with matlab can be seen in Figure 15.

```
% Rule1: IF Max_Amplitude LOW AND Min_Amplitude HIGH AND
Mean_Amplitude    HIGH    AND    Value_RMS    LOW    AND
Dynamic_Range   HIGH   AND   Crest_Factor_Q   LOW   AND
Autocorrelation LOW AND Zero_Cross_time  LOW AND Energy
LOW THEN Quality_chirp LOW;
 rule1=[1 1 1 2];
```

Figure15. Program codes for implication function process in matlab

3) Rule's Compotition.Developed system contains 54 rules, then inference was obtained from set and correlation from 54 rules.In this research, inference method fuzzy system used was max.Then set of fuzzy solution was obtaine by taking maximum value of rule, then use it to modify fuzzy area, and implementate it to output using operator OR (union). If all propositionshave been evaluated, then output will be filled by set of fuzzy that reflects contributin of every proposition. Generaly can be written in the mathematic formula 16:

$$\mu sf[xi] \qquad max(\mu sf[xi],\ \mu kf[xi]) \ \dots \qquad\qquad (16)$$

Where: μsf [xi]=value of membership fuzzy solution until rule number-i;
        μkf [xi]=Value of membership fuzzy consequencies rule number-i;
If there are 3 rules (proposition) as follow use program code forcreating rulesin matlab can be seen in Figure 16.

```
% ---------Create rules
% Rule1: IF Max_AmplitudeLOW AND Min_AmplitudeHIGH AND Mean_AmplitudeHIGH AND
Value_RMS LOW AND Varian_ValueHIGH AND Standart_DeviasiLOW AND Autocorrelation LOW
AND Zero_Cross LOW AND Energy LOW THEN Quality_chirpLOW;
rule1=[033 0 0 0 0 0];
% Aturan2:
rule2=[03 3 0 30 0 3];
% Aturan3:
rule3=[0 3 303 00 0];
```

Figure 16. Program code for creating rules process in matlab

4) Inference process. Inference process using method of Max in performing rules compositioncan be seen Figure 17.
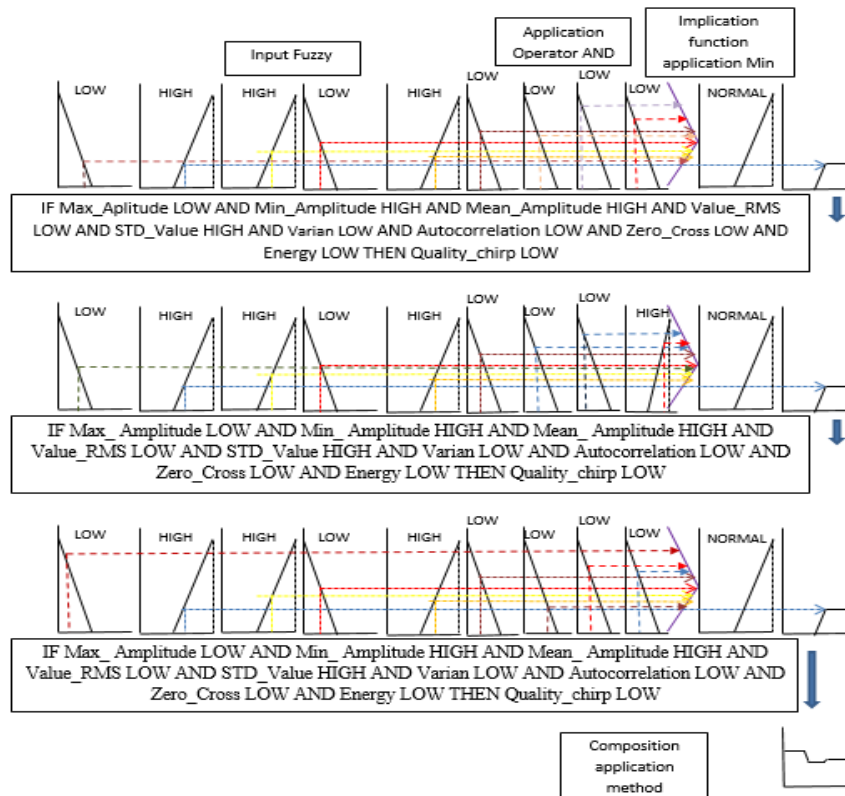

Figure17.Composition of fuzzy rules: MAX method

Program code for rules composition process in matlab can be seen in Figure. 18

```
%---------Entering rules
listofRules=[rule1;rule2;rule3];
a=addrule(a,listofRules);
```

Figure 18. Program code for rules composition process in matlab

5) Affirmation (defuzzy). Input from the process of defuzzification is a set of fuzzy that obtained from rules composition of fuzzy. While output that produced is a number on that set of fuzzy domains. So, if given a set of fuzzy in certain range, have to be taken a certain script value like can be seen on Figure 19.
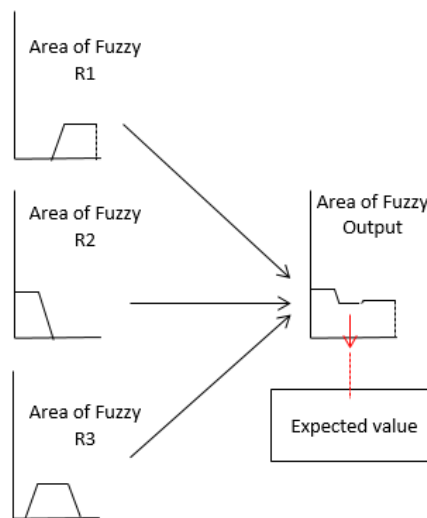

Figure 19. Defuzzification process

Defuzzification method in rules composition fuzzy Mamdani method in this research was Centroid Method (Composite Moment). In this method, crisp solution was obtained by taking center point (z*)area of fuzzy. Generaly can be formulated with mathematic Equation (17).

$$z^* = \frac{\int_{z1} z\mu(z)dz}{\int_z \mu(z)dz} \dots \qquad . (17)$$

To get evaluation from indentification system of Canaries Bird's chirp, program code can be seen on Figure 20.

```
%       ---------Perform   evaluation   forMax_Amplitude=7and
Min_Amplitude=8andMean_Amplitude=9andValue_RMS=10And
Varian_Value= 11andStandart_Deviasi= 12  andAutocorrelation=13and
Zero_Cross=14and Energy=15
evalfis([7 8 9 10 11 12 13 14 15], a)
```

Figure 20. Program codes for defuzzy process in matlab

Evaluation process was performed toward Table 2. The quality of bird's chirp from Table 2 will be compared with quality of canaries bird's chirp produced by fuzzy mamdani method. That process was made for error rate, like can be seen in Table 2

Table 2.Errorratefor Quality of Canaries Bird's Chirp

Code of sound	Errorratefor quality of canaries bird's chirp Fuzzy Mamdani Method			Description
	Statistical analysis	Sound analysis	Statistical and sound analysis	
1	17,66	15,27	13,34	First Winner
2	15,17	12,92	10,21	Second Winner
3	12,36	15,33	12,21	Third Winner
4	16,22	17,99	12,71	Second Winner
5	18,99	20,01	11,44	First Winner
6	16,66	20,11	12,11	Third Winner
Mean	16,17	16.93	12,00	

The accuracy of calculation results of fuzzy mamdanimethod can be determined by counting error rate, by comparing result of measurement with result data of fuzzy Mamdani calculation.To counterror rate, in this research using Mean Absolute Percentage Error (MAPE) method, with mathematic Equation (18).

$$\text{MAPE} = \frac{\sum \frac{(x_i - y_i)}{x_i} x\ 100\%}{n} \ ....$$ (18)

With Xiis actual data number-i, data from records and Fiis forcast data number-i, data from fuzzy Mamdani calculation results. From Table 2 was obtained average level of error presentage is under 12,00 %. From the result ofinferensifuzzy mamdaniin identify quality of Canaries bird's chirp value. Level of error rate (MAPE)less than 40% can be said as good and dependable [18].

4. Conclusion

In this research can be concluded as follow : (1). In the system of quality identification of Canries bird's chirp succeeded to extract features birds voice samples by using sound analysis and statistic analysis (2). In statistic analysis, using Amplitude Max value, Amplitude Min value, Root-mean-square value, mean value (3). In sound analysis, using Autocorrelation time value, Zero Cross value and Energy value (4). The result of identification system that have been done, was obtained, introduction presentage quality of Canaries bird's chirp is 82, 00 %.

References

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