ESTIMATING THE AGE GROUP USING FUZZY MODEL

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ABSTRACT

Estimating the age into different categories i.e. 1. Childhood (0-12 years) 2. Young Age (13-25years) 3. Middle age (26-40years) 4. Senior age (40-60years) 5. Senior Citizens (more than 60 years) using fuzzy model is a challenging task for researchers. There are many classifiers to classify the data into different age groups. In our proposed method age is classified into different age groups based on the transition count of Local Binary Patterns for Left angular pattern and Right angular pattern. Age Estimation is essential in many applications like where there is no entry for the people whose age is less than particular age, biometrics, crime detection and so on

Key words: Fuzzy model, Age Estimation, LBP, Patterns

Cite this Article: Moka Uma Devi and Dr. Uppu Ravi Babu, Estimating the Age Group Using Fuzzy Model, *International Journal of Computer Engineering and Technology* 10(6), 2019, pp. 32-40.

<http://iaeme.com/Home/issue/IJCET?Volume=10&Issue=6>

1. INTRODUCTION

We can determine the persons age in many ways. So we have to efficiently analyses and to describe the patterns for a precise classification. We are adding a new model that is fuzzy model by giving left angular pattern transition counts and right angular pattern transition count as inputs. After defining the membership function and deciding the descriptors our proposed model can categories the age group. One or more movements or places of the muscles underneath the skin of the face can represent the different category of age

After defining the membership function we can establish the relation between input variable and output variable. Then after forming the rule based we can evaluate the rules and then we can evaluate the strong rule.

2. LITERATURE SURVEY

2.1. LBP operator

Figure 1. Example of LBP operation

The LBP operator is used to find out the features for different types of neighborhood with different radii. The LBP codes are categorized as uniform and non-uniform patterns. The LBP code is circularly rotated until its min value is obtained so that the LBP code can extract rotational invariant features. The LBP is calculated as shown in the above.

2.2. < pattern and > Pattern in Third Order Neighbourhood

The 5x5 window is moved to overall image of size NxN such that 5x5 window covers each and every pixel. In each '<' and '>' patterns count the number of 0,2,4 transition in the pattern. The patterns are shown below

Figure 2 a) '<' pattern b) '>' pattern

2.3. Conversion of 5X5 Neighbourhood into 3X3 Neighbourhood and then to LBP Code

We are converting 5X5 neighbourhood into 3X3 neighborhood by finding out the mean of all the 4 middle values as shown in Fig(3).

Figure 3 a) 5X5 neighbourhood b) 3x3 neighbourhood c) Binary form of LBP and its code

From the above figure we can say the top value is changed as 40 by finding mean of (30, 51). The bottom value is changed as 35 by finding out the mean of (38, 33). The right value is changed as 39 by finding mean of (42, 6). The Left value is changed as 48 by finding out the mean of (57, 40). we can easily find out the LBP binary value and LBP decimal value from third order neighbourhood

2.4. Fuzzy Classifier

The classifier is an algorithm that classifies the given data and label to an object and also predicts the given tuple belongs to which class label. Feature vector describes the object descriptor.

2.5. Models of Fuzzy Classifiers

The possible and different variety of fuzzy classifiers implies the model of classifiers

Those are

1. Fuzzy rule based classifiers As in fuzzy control system the fuzzy rule based classifier is a fuzzy if then system. This classifier can be constructed by specifying rules of classification
2. Fuzzy prototype based classifiers. These type of classifiers based on the concept of K-Nearest neighbour The class label is based on finding out the k nearest neighbors
3. Fuzzy combination rules for classifiers ensembles. The different classifiers decisions are aggregated to produce a single class label. so it is a combination of many classifiers .The fuzzy aggregated functions are used in this classifier.

2.6. Fuzzy Membership Function

Definition of membership function

Consider a Fuzzy set A where the set is determined as $\{(x, m(x)) | x \in X\}$ where x is an element, $m(x)$ is the membership function of set A and X is the universe of discourse. In fuzzy sets each element is mapped by membership function within the interval $[0,1]$ which can be represented as $m(x):X \rightarrow [0,1]$, where

$M(x)=1$ if x is totally in A; $M(x)=0$ if x is not in A; $0 < M(x) < 1$ if x is partly in A;

Following are the some of the fuzzy membership function

1. Triangular Membership function

Let a, b, c are the three vertices to represent the x-coordinate of $m(x)$ in fuzzy set A.

a- lower boundary where membership degree is zero

c- upper boundary where membership degree is zero

b-the centre where membership degree is one

$m(x)=0$ if $x \leq a$; $m(x)=(x-a)/(b-a)$ if $a \leq x \leq b$; $m(x)=(c-x)/(c-b)$ if $b \leq x \leq c$; $m(x)=0$ if $x \geq c$;

2. Trapezoidal membership function

Let a, b, c, d represents the x coordinates of the given membership function then

$$=0 \text{ if } x \leq a;$$

$$T(x;a,b,c,d) = (x-a)/(b-a) \text{ if } a \leq x \leq b;$$

$$=1 \text{ if } b \leq x \leq c; \quad \text{where } mT(x) = \max (\min ((x-a)/(b-a), 1 , (d-x)/(d-c)) , 0);$$

$$=(d-x)/(d-c) \text{ if } c \leq x \leq d;$$

$$=0 \text{ if } d \leq x;$$

3. Gaussian membership function

The Gaussian membership function $G(x;c,s,m)$ where c, s represents the mean and standard deviation.

Here c represents centre, s represents width and m represents fuzzification factor.

$$G(x;c,s,m) = e^{-1/2 * ((x-c)/s)^m}$$

$$C=5; s=0.5; m=2$$

2.7. Applications of Fuzzy Classification

Fuzzy logic used in numerous applications such as in engineering and scientific works. It is also used in facial pattern recognition, air conditioners, vacuum cleaners, medical diagnosis not only in some maximum in all fields .Mathematics has instilled new life into scientific fields that have been dormant for a long time.

3. PROPOSED METHOD

Step 1 : In our proposed method we are designing fuzzy model such that the 0 transition of left angular pattern .Similarly 0 and 4 transition of right angular pattern are treated as input variables and different age group categories are treated as output variables. Those values are shown in the given table.

Table 1 The Training dataset which is taken from 5 different databases is shown in the below

LAC(0)	RAC(0+4)	AGE GROUP
557	1209	childhood
566	1210	childhood
781	1330	young
796	1333	young
870	1075	middle
872	1077	middle
945	998	senior age
952	1009	senior age
1092	1115	Senior citizens
1124	1122	Senior citizens

Step2: Next decide descriptors of input variables and output variables.

Step3: Here we are deciding the descriptor variables as 0 transition of very small left angular pattern count (VSLAC(0) , small left angular pattern count (SLAC(0)) , Medium Left angular pattern count (MLAC(0)) , Large Left angular pattern count (LLAC(0)) , Very Large Left angular pattern count (VLLAC(0)) for one input variable.

Step4: For another input variable here we are deciding the descriptor variables as (0+4) transition of very small right angular pattern count (VSRAC(0+4) , small right angular pattern count (SRAC(0+4)) , Medium Right angular pattern count (MRAC(0)) , Large Right angular pattern count (LRAC(0)) , Very Large Right angular pattern count (VRAC(0)) .

Step5: Here we are deciding the descriptors for only one output variable. 1. Childhood (0-12 years) 2. Young Age (13-25years) 3. Middle age (26-40years) 4. Senior age (40-60years) 5. Senior Citizens (more than 60 years) are the descriptors.

Step6: Now we define triangle membership function for each of the input and output variable

Step7: Membership function for the Left Angular Count (0) for first input variable(x)

$$1. MVSLAC(0)(X) = (734-x)/734 \text{ if } 0 \leq x \leq 734$$

$$2. MSLAC(0)(X) = (x-0)/734 \text{ if } 0 \leq x \leq 734 \text{ and } (837-x)/(837-734) \text{ if } 734 \leq x \leq 837$$

$$3. MMLAC(0)(X) = (x-734)/(837-734) \text{ if } 734 \leq x \leq 837 \text{ and } (909-x)/(909-837) \text{ if } 837 \leq x \leq 909$$

$$4. MLLAC(0)(X) = (x-837)/(909-837) \text{ if } 837 \leq x \leq 909$$

$$(1013-x)/(1013-909) \text{ if } 909 \leq x \leq 1013$$

$$5. MVLLAC(0)(X) = (x-909)/(1013-909) \text{ if } 909 \leq x \leq 1013$$

Step 8: Membership function for the Right Angular Count (0+4) for second input variable(y)

1. $M_{VSRAC(0+4)}(y) = (1050-y)/1050$ if $0 \leq y \leq 1050$
2. $M_{SRAC(0+4)}(y) = (y-0)/1050$ if $0 \leq y \leq 1050$
 $= (1085-y)/(1085-1050)$ if $1050 \leq y \leq 1085$
3. $M_{MLAC(0+4)}(y) = (y-1050)/(1085-1050)$ if $1050 \leq y \leq 1085$
 $= (1145-y)/(1145-1085)$ if $1085 \leq y \leq 1145$
4. $M_{LLAC(0+4)}(y) = (y-1085)/(1145-1085)$ if $1085 \leq y \leq 1145$
 $= (1400-y)/(1400-1145)$ if $1145 \leq y \leq 1400$
5. $M_{VLLAC(0+4)}(y) = (y-1145)/(1400-1145)$ if $1145 \leq y \leq 1400$

Step 9: Membership function for Age group category for second output variable(z). Different age group categories are 1. Childhood 2. young Age(13-25years) 3. Middle age (26-40years) 4. Senior age (40-60years) 5. Senior Citizens(more than 60 years)

1. $M_{\text{childhood}}(z) = (13-z)/13$ if $0 \leq z \leq 13$
2. $M_{\text{young}}(z) = (z-0)/13$ if $0 \leq z \leq 13$
 $= (26-z)/(26-13)$ if $13 \leq z \leq 26$
3. $M_{\text{Middle}}(z) = (z-13)/(26-13)$ if $13 \leq z \leq 26$
 $= (40-z)/(40-26)$ if $26 \leq z \leq 40$
4. $M_{\text{Seniors}}(z) = (z-26)/(40-26)$ if $26 \leq z \leq 40$
 $= (80-z)/(80-40)$ if $40 \leq z \leq 80$
5. $M_{\text{Senior citizens}}(z) = (z-40)/(80-40)$ if $40 \leq z \leq 80$

Step 10 : Form a Rule Base

RAC(0+4)

AGE	VS	S	M	L	VL
VS	Senior	Middle	child	Senior citizen	child
S	senior	middle	Senior citizen	young	young
M	middle	middle	Senior citizen	Senior citizen	young
L	senior	middle	Senior citizen	Senior citizen	young
VL	senior	middle	Senior citizen	Senior citizen	young

LAC(0)

Step11 :Rule Evaluation

If LAC(0)=461 and RAC(0+4)=1192 then predict the age?

Sol:-a)If LAC(0)= 461 then it evaluates Rule1 i.e. Very small and Rule 2 i.e. Small by considering the membership function first input variable LAC(0).

b)If RAC(0+4)=1192 then it evaluates all Rules i.e. Very small, small, Medium, Large, Very Large.

4. RESULTS AND DISCUSSION

From the above two steps we need to evaluate ten different rules and to find strength for each rule we have to calculate the following values

Ia) Very small LAC(0)=(734-461)/734=0.371 ;Ib)small LAC(0)=461/734=0.628;

Ila) VSRAC(0+4)= -0.13 ; Iib)SRAC(0+4)= (1.135)& (-3.057) ;

Iic).MRAC(0+4)= (4.0571) & (1.583); IId)LRAC(0+4)=(1.783)&(0.815) ;

Ile)VLRAC(0+4)=2.721

If LAC(0) is very small then RAC(0+4) is very small

Strength of rule 1 $\min \{0.371, -0.13\} = -0.13$

If LAC(0) is very small then RAC(0+4) is small

Strength of rule 2 $\min \{0.371, 1.135, -3.057\} = -3.057$

If LAC(0) is very small then RAC(0+4) is medium

Strength of rule 3 $\min \{0.371, 4.0571, 1.583\} = 0.371$

If LAC(0) is very small then RAC(0+4) is Large

Strength of rule 4 $\min \{0.371, 1.783, 0.815\} = 0.371$

If LAC(0) is very small then RAC(0+4) is very Large

Strength of rule 5 $\min \{0.371, 2.721\} = 0.371$

If LAC(0) is small then RAC(0+4) is very small

Strength of rule is $\min \{0.628, -0.13\} = -0.13$

If LAC(0) is small then RAC(0+4) is small

Strength of rule is $\min \{0.628, 1.135, -3.057\} = -3.507$

If LAC(0) is small then RAC(0+4) is medium

Strength of rule is $\min \{0.628, 4.0571, 1.583\} = 0.628$

If LAC(0) is small then RAC(0+4) is Large

Strength of rule is $\min \{0.628, 1.783, 0.815\} = 0.628$

If LAC(0) is small then RAC(0+4) is very Large

Strength of rule is $\min \{0.628, 2.721\} = 0.628$

2 . Comparison of rule based and Evaluated table

AGE	VS	S	M	L	VL
VS	Senior	Middle	child	Senior citizen	child
S	senior	middle	Senior citizen	young	young
M	middle	middle	Senior citizen	Senior citizen	young
L	senior	middle	Senior citizen	Senior citizen	young
VL	senior	middle	Senior citizen	Senior citizen	young

AGE	VS	S	M	L	VL
VS	-0.13	-3.057	0.371	0.371	0.371
S	-0.13	-3.057	0.628	0.628	0.628
M	X	X	X	X	X
L	X	X	X	X	X
VL	X	X	X	X	X

3 . At last we use defuzzification technique means finding out the Mean of max values which is (0.628)

1 . $M_{\text{Senior citizens}}(z) = (z-40)/(80-40)$ if $40 \leq z \leq 80$

2. $M_{\text{young}}(z) = (z-0)/13$ if $0 \leq z \leq 13$
 $= (26-z)/(26-13)$ if $13 \leq z \leq 26$

Substitute 0.628 in 1 and 2

1. $(0.628-40)/40 = -0.9843$

2. $0.628/13 = 0.0483$

3. $(26-0.628)/13 = 1.951$

$(1.951+0.0483-0.9843)/3$

Ans=0.338

If $z = 0.338$ the predicted age is childhood

5. CONCLUSION

Our proposed research work classifies and predicts the different age group categories by using Fuzzy Model. In Future our proposed method can classify and predict the different age groups using different classification methods and can find out the performance measures of that model.

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