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Farm Security with Fuzzy Classification- An Approach

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***Abstract*—In an agricultural country like India farmer's contribution is very vital. Though a lot of work is going on to increase the yield quality, security of the crops is also the question on the front because if the crops are destroyed or damaged due to animals or thefts the farmers are helpless. Hence we propose a system to help a farmer to identify where an animal or thief has entered the field using Fuzzy Classification. In machine learning many classifiers are there like Neural network, Convolutional neural network, Probabilistic approach, K-nearest neighbor, SVM, etc. But little literature is found on Fuzzy classifiers. Hence we introduce here an approach to classify the images of farm at fencing with and without animals using Fuzzy systems.**

***Index Terms*— Fuzzy Rules, Fuzzy classification, Animal classification.**

I. INTRODUCTION

Nearly 75 percent of the population lives in villages of India. An agricultural production depends on the latest trends in farming. A farmer to grow, must be provided with better seeds, fertilisers, manures, implements and chemicals. A lot of research is going on to cultivate the plants, to check the quality of crop yields, crops protection from different diseases, removal of weeds , check every growing stage of the yield and many. But all these methods are useless if proper protection is not provided to the farms. Animal attacks, theft attacks and due to some natural calamities all the crops which are about to give the quality yields may be destroyed. Hence protection of farms is at the most priority. We propose here a system which will identify the existence animal entering farms. All animals are not harmful. So knowledge about which animal has entered the farm is very useful to the farmers. Many of the times we come across the news about elephants entering the farms and doing rubbish damage of the crops. Proposed system will provide assistance for surveillance of the field, giving intimation to farmer to protect the crops. This work restricts the scope to computer vision and classification area and not to the installation of cameras and acquisition. To keep an eye on the condition of fields and property now a days many advanced security camera systems are available. With wireless technology and cloud computing all the information can be sent to nearest server. Received information in form of images can be processed with proposed system and farmer can be updated for animal or thief entry. It can also be extended for any abnormal activity or behaviour identification.

II. LITERATURE SURVEY

A lot of research was undertaken by us to take various parameters into consideration before practically working on the model. One paper we went through was for identifying animals based on their footprints. Other research we went through was of animal species classification, in which they have proposed a method to classify animals

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into predators and pets [3]. Y H Sharath Kumar, Manohar N and Chethan H K proposed an approach that has three stages viz., segmentation, feature extraction and classification [4]. A fusion classifier of probabilistic neural network and K-nearest neighbours was used for classification [4].
Durgesh Srivastava and Lekha Bhambu have shown how to obtain support vectors in SVM model, which are very important for classification. The classification experiments are conducted on different data like Heart data, Diabetes data, Satellite data and Shuttle data. The experiment results are encouraging .It can be seen that the choice of kernel function and best value of parameters for particular kernel is critical for a given amount of data. Also, other experiment performed a weighted Euclidean distance, the radial product kernel function and SVM algorithm are constructed to solve the problem of large data feature extraction and big data classification. The results show that the class distribution of the weighted samples is more obvious. The training time is significantly shorter. The detection effect is further improved after weighting.
Many methods for automatically generating and learning the fuzzy if-then rules from numerical data for pattern classification problems are suggested by the authors [2]. Y. L. Yang and X. Y. Bai have discussed the classification performance of fuzzy classifiers based on fuzzy set theory a new concept of fuzzy relative entropy and have proved that a pattern with high fuzziness is close to the classification boundary. Pavel and jana have classified academic staff members according to their specializationwhich can be used in HR management, so that the academic staff members could dedicate their time and effort in that area which appeals to them the most [1]. fuzzy classification can be applied to Identification and evaluation problems [1]. Fuzzy classification is also used for classifying breast cancer data. Paper published by ravi and ajith showed four rule generation method for the same. In the first approach, a single fuzzy if-then rule was generated for each class using the mean and the standard deviation of attribute values [2]. In the second approach, a single fuzzy if-then rule was generated for each class using the histogram of attribute values [2]. The third approach generated fuzzy if-then rules by homogeneously partitioning each attribute [2]. The last approach was a modified version of the simple fuzzy grid approach [2]. They also stated that The performance of fuzzy rule based systems can be further improved by feature selection and optimizing the rule selection and various rule parameters [2].
In this paper we are proposing a fuzzy classifier for classification of animals which will help farmers in keeping watch on their fields and protecting their cattle. Fuzzy classification followed by results and future scope of development of the model is discussed.
high resolution and in good quality.

III. METHODOLOGY

A. Fuzzy Logic

Fuzzy logic is a many valued logic employed to handle the concept of partial truth. Truthness of every variable can range between 0(completely false) and 1(completely true). Fuzzy logic was first studied by Lotfi Zadeh in 1965. Fuzzy models or sets are mathematical means of representing vagueness and imprecise information. These models have the capability of recognising, representing, manipulating, interpreting, and utilising data and information that are vague and lack certainty.

B. Fuzzification

Input of the system is in crisp values and is needed to be converted to fuzzy values in order to execute rules on it. Process of assigning some degree of membership to the input of the system is called fuzzification. Range for the degree of membership is between 0 and 1, where 0 represents value does not belong to the set and 1 represents value completely belongs to the set. Any value between 0 and 1 represents the degree of uncertainty that the value belongs in the set.
For example: three membership functions are represented in the figure i.e. cold warm and hot. The vertical line in the image represents a particular temperature. Red arrow points to 0 it means value does not belong to “hot” MF and can be interpreted as not hot. Similarly, it can be interpreted from yellow and blue arrow that the temperature is slightly warm and fairly cold.

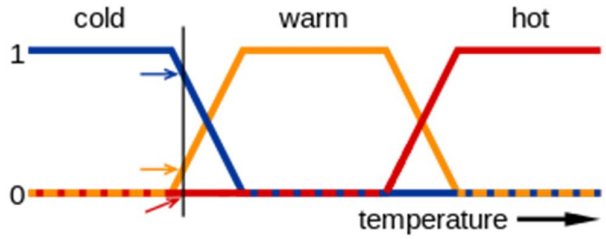

Figure 1. Fuzzy Menbership value assignment

C. Rule Base

IF-THEN rules are defined in fuzzy system. IF-THEN rules map input or computed truth values to desired output truth values.

Example: IF temperature is hot THEN fan_speed is high.
IF temperature is cold THEN fan_speed is low.

D. Defuzzification

Converting the output of fuzzy system to a continuous variable is called defuzzification. Many methods are suggested in literature for defuzzification.

E. Fuzzy Systems

Following are the well known fuzzy systems:
Mamdani:
In mamdani rule following process is involved:

- All inputs are fuzzified into fuzzy membership functions
- Rules in the rule base are executed to compute the output function
- Output is defuzzified to “crisp” values in output

F. Takagi-Sugeno-Kang

In TSK defuzzification process is included in execution of fuzzy rules. Thus, the rules are represented through a polynomial equation.

Example: IF temperature is very cold = 2
IF temperature is very cold and humidity is high = 2*temperature + 1* humidity

Output of the rule is always result of the function defined in the rule. For a rule base with 2 or more rules the total output will be weighted average between the output of each rule.

IV. Proposed Method and Results

We captured images of the farms with fence but with no animal nearby. This is considered as class1 and in class0 images of farm fence with animals present are considered. We collected minimum 50 images for both which was the training data and 10 images were considered for testing.

Fuzzy Computer Vision Toolbox (FCVT) was used to extract the features and perform classification based on it. Local binary patterns (LBP) is a type of visual descriptor used for classification in computer vision. LBP is the particular case of the Texture Spectrum model proposed in 1990. LBP was first described in 1994. It has since been found to be a powerful feature for texture classification. [3]

The LBP feature vector, in its simplest form, is created in the following manner:

- Divide the examined window into cells (e.g. 16x16 pixels for each cell).
- For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc.). Follow the pixels along a circle, i.e. clockwise or counter-clockwise.
- Where the center pixel's value is greater than the neighbor's value, write "0". Otherwise, write "1". This gives an 8-digit binary number (which is usually converted to decimal for convenience).
- Compute the histogram, over the cell, of the frequency of each "number" occurring (i.e., each combination of which pixels are smaller and which are greater than the center). This histogram can be seen as a 256-dimensional feature vector.
- Optionally normalize the histogram.

- Concatenate (normalized) histograms of all cells. This gives a feature vector for the entire window.

A. Fuzzy Classification

It is undeniable that crisp classification approach works well in many classification tasks but limited to the images or objects that are mutually exclusive. However, Ambiguity or uncertainty is a pervasive element of many real-world decision making processes. Variation in decisions is a norm in this situation when the same problem is posed to different subjects. Computer vision tasks such as scene understanding, emotion detection, and human motion analysis are fall into this category. Fuzzy approach is applied to relax the above issue [4].

Figure 2. Test image classification results

These are some of the testing images with classification results on top. As we can see for the images with animals present near fence, the first membership function value in bracket is more than second which belongs to class0. While for third image which belongs to class1 has second membership value in bracket is more which belongs to class1. The accuracy was 70 % of the classification which can further be increased by extracting different features from the image.

V. Conclusion

We did classification of farm fence images with or without presence of animals. Though the accuracy of 70% was not much satisfactory, an approach of fuzzy classification is very useful in finding behavioural changes in animals or thieves near fence. With some modifications and advanced features the fuzzy classification systems are more useful when some ambiguities are present in the information. This can be one of the best surveillance system for farmers seeking help in the security of crops giving quality yields.

Future Scope

This project can be extended further for animal detection. When field is with animal, which animal has entered, what are the chances of damage, is there any theft stealing some material can be understood and precautionary measures can be taken out.

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