

A Novel Approach of Pattern Detection Using Fuzzy Logic: Implementation in MATLAB

AkhileshLatoria¹, Dr. Sarvottam Dixit², Dr. AnandSwarupSaxena³

Research Scholar¹, Professor², Asst. Prof.³

Mewar University^{1,2}, MPCT, Gwalior²

Corresponding Author: Akhileshlatoria

ABSTRACT: The pattern recognitions are arranged using different techniques and so results will be very accurate on run real time of detection of objects. These photos found red, blue and blue tones. The consequences of this understanding depend on the mastery of the image itself. A notable problem with latency is that it shows almost the estimated pixel values without taking into account the connections between them. The developing pattern detection framework offers many versatile use to enhance the existence pattern detection through proposed (Hybrid Integration Methodology-HIM). The results presented show very obvious results and you have discovered a high precision detection in MATLAB. The set of rules executed each time shows the best results and a safe output. The purpose of this paper is to apply the fuzzy method to a larger set of data identified by the model.

KEYWORD: Pattern Recognitions, Detection of Objects, Recognition for Large Data, Fuzzy Method, MATLAB, HIM (Hybrid Integration Methodology)

Date of Submission: 27-12-2018

Date of acceptance: 11-01-2019

I. INTRODUCTION

In machine learning design acknowledgment is the task of a mark to a given info esteem. In measurements, separate examination was presented for this same reason in 1936. A case of example acknowledgment is grouping, which endeavors to appoint each information incentive to one of a given arrangement of classes (for instance, decide if a given email is "spam" or "non-spam"). In any case, design acknowledgment is a more broad issue that includes different kinds of yield too. Different precedents are relapse, which allots a genuine esteemed yield to each information; succession naming, which doles out a class to every individual from a grouping of qualities (for instance, grammatical feature labeling, which allocates a grammatical form to each word in an info sentence); and parsing, which doles out a parse tree to an information sentence, depicting the syntactic structure of the sentence.

1.1 Pattern Recognition for Large Data

Fast advances in information gathering and capacity innovation have empowers, associations to aggregate huge measures of information. Be that as it may, removing helpful data has demonstrated to a great degree testing. Regularly, customary information investigation devices and strategies can't be utilized in view of the gigantic size of an informational collection. Once in a while, the non-conventional nature of the information implies that customary methodologies can't be connected regardless of whether the informational collection is moderately little. In different circumstances, the inquiries that should be addressed can't be tended to utilize existing information examination systems, and in this manner, new strategies should be created. Information mining is an innovation that mixes customary information investigation techniques with modern calculations for preparing substantial volumes of information. It has additionally opened, up leaving open doors for investigating and dissecting new sorts of information and for examining old kinds of information in new ways. Information Mining is the procedure of naturally finding valuable data in substantial information archives. Information mining procedures are conveyed to scour extensive databases keeping in mind the end goal to discover novel and helpful examples that may some way or another stay obscure. They additionally give abilities to pre. The examination of various methodologies is abridged in Table 1.1.

Table 1.1: Pattern Recognition Models

Approach	Representation	Recognition Function	Typical Criterion
Template Matching	Samples, Pixels, Curves	Correlation, Distance Measure	Classification Error
Statistical	Features	Discriminate Function	Classification Error
Syntactic or Structural	Primitives	Rules, Grammar	Acceptance Error
Neural Networks	Samples, Pixels, Features	Network Function	Mean square Error

1.2 Approaches to Pattern Recognition

There are two essential methodologies for executing an example acknowledgment framework: factual and auxiliary. Each methodology utilizes distinctive procedures to execute the portrayal and order errands. Half breed approaches, now and again alluded to as a bound together way to deal with example acknowledgment, consolidate both measurable and auxiliary strategies inside an example acknowledgment framework. Measurable example acknowledgment draws from set up ideas in factual choice hypothesis to separate among information from various gatherings in light of quantitative highlights of the information. There are a wide assortment of factual systems that can be utilized inside the portrayal assignment for highlight extraction, going from straightforward expressive measurements to complex changes. Precedents of factual element extraction methods incorporate mean and standard deviation calculations, recurrence check outlines, Karhunen-Lóeve changes, Fourier changes, wavelet changes, and Hough changes.

II. BACKGROUND

Prof. Sharvari C. Tamane, Dr. R. R. Manza [2009] accentuation on watermarking calculations have an essential necessity that the watermark adequacy ought to be as high as workable for power and at the same time the watermark ought not introduce any distinguishable antiquities. This paper proposes a versatile watermarking strategy in light of the human visual framework show and the fluffy deduction framework in wavelet area. Fluffy rationale is utilized for information combination and assembles a human visual framework (HVS) demonstrate in wavelet area. The fluffy information factors (like bend, region, unevenness, splendor, radiance, surface, edge and so on.) are registered for every wavelet coefficient in the 3D show. The yield of the fluffy framework is a solitary esteem which gives a perceptual incentive for each relating wavelet coefficient. Accordingly, the fluffy perceptual cover consolidates all these non-direct factors to assemble a basic, simple to utilize HVS demonstrate. Recreation results end up being powerful against smoothing, editing, relative activities and clamor assaults, and in the meantime accomplish an abnormal state of impalpability. Jayaram K. Udupa et.al [2014] proposed Quantitative Radiology (QR) a reality in radiological practice, mechanized far reaching Automatic Anatomy Recognition (AAR) winds up basic. With the objective of building a general AAR framework that isn't fixing to a particular organ framework, body district, or picture methodology, this paper displays an AAR system for restricting and outlining every significant organ in various body locales in view of fluffy modeling ideas and a tight incorporation of fluffy models with an Iterative Relative Fuzzy Connectedness (IRFC) depiction calculation. The procedure comprises of five fundamental advances:

- (a) Gathering picture information for both building models and testing the AAR calculations from patient picture sets existing in our wellbeing framework;
 - (b) Figuring exact meanings of each body district and organ and outlining them following these definitions;
 - (c) Building various leveled fluffy life structures models of organs for each body locale; (d) perceiving and finding organs in given pictures by utilizing the progressive models; and
 - (e) Depicting the organs following the order.
- (c) They expressly encode question measure and positional connections into the chain of importance and in this way abuse this data in protest acknowledgment in Step (d) and outline in Step (e). Methodology free and ward angles are precisely isolated in model encoding. At the model building stage, a learning procedure is completed for practicing an ideal limit-based protest acknowledgment strategy. The acknowledgment procedure in Step (d)

begins from expansive, very much characterized questions and continues down the progression in a worldwide to nearby way. A fluffy model-based form of the IRFC calculation is made by normally incorporating the fluffy model requirements into the depiction algorithm. **Fevrier Valdez, Oscar Castillo and Patricia Melin [2016]** depict in this paper the design of modular neural system (MNN) for example acknowledgment. All the more as of late, the investigation of measured neural system strategies hypothesis has been getting critical consideration. The outline of an acknowledgment framework likewise requires cautious consideration. The paper means to utilize the Ant Colony worldview to streamline the design of this Modular Neural Network for example acknowledgment with a specific end goal to get a decent level of picture recognizable proof and in the most limited time conceivable. **Jinling Wang et al. [2015]** presents a novel RBF-like quick progressively Evolving Spiking Neural classifier (ESNC). The prepared feed-forward SNN comprises of three layers of spiking neurons: an encoding layer which transiently encodes genuine esteemed highlights into spatio-worldly spike designs, a shrouded layer of progressively developed and pruned neurons which perform spatiotemporal grouping, and an advancing yield layer for characterization. Both the structure and weights of the SNN are adapted progressively through a mix of unsupervised and managed learning ideal models. An unsupervised grouping strategy is executed by the concealed layer for altering the synaptic weights of the shrouded neuron's afferent associations. The focal point of each concealed RBF neuron is spoken to by a vector of fleeting separations between the principal spike of the shrouded neuron and the presynaptic spikes. In addition, methodologies are proposed to alter the structure of the hidden and yield layers as information sources are introduced to the SNN, and order at the yield layer is accomplished through directed realizing where a learning window is utilized to change the weights of the yield neurons afferent associations. **Yan Xu et.al [2012]** recommended that the Quantification of coronary blood vessel stenoses is valuable for the conclusion of a few coronary heart ailments. Being noninvasive, conservative and instructive, figured tomographic angiography (CTA) has turned into a typical methodology for observing illness status and treatment impacts. Here, they present another strategy for recognizing and evaluating coronary blood vessel stenosis in CTA utilizing fluffy separation change (FDT) approach and another rationality examination of watched information for figuring expected neighborhood distance across.

- (1) Fluffy division of coronary corridor in CTA,
- (2) FDT calculation of coronary conduits,
- (3) Average pivot calculation,
- (4) Estimation of observed and expected breadths along veins and

(5) Identification of stenoses and measurement of blood vessel blockage. The execution of this technique has been quantitatively assessed on a practical coronary supply route ghost dataset with haphazardly recreated stenoses and the outcomes have been contrasted and a double separation change based and a customary paired calculation. The strategy has additionally been connected on a clinical CTA dataset from thirteen heart patients and the outcomes have been contrasted and a specialist's quantitative appraisal of stenoses. Aftereffects of the ghost try demonstrating that the new technique (mistake: 0.53%) is essentially more precise when contrasted with both twofold separation change based (blunder 2.11%) and regular paired (mistake 3.71%) strategies. Likewise, the consequences of the clinical investigation indicatethat the new FDT-based technique (kappa coefficient = 87.9%) is very in concurrence with the master's appraisals and, in this regard, outflanks the other two strategies (kappa coefficients = 75.2% and 69.5%). **Chen Yanda, BaoSusu, PengFengping[2008]** recommended that Image division is a fundamental and critical part in medicinal picture handling. Traditional strategies commonly request noteworthy measures of time and don't loan to a characteristic connection plot with 3D volume. In this paper they present a novel intuitive strategy for fluffy connectedness division. In our methodology, the client unreservedly determines a seed point 3D area at districts of intrigue specifically over the 3D volume. At that point the 3D seed focuses will be mapped into seed pixels in somewhere in the range of 2D cuts of picture groupings. From that point onward, the proposed calculation is utilized to division of different articles from complex foundation and bunch division of picture groupings. That can be accomplished by seeds picked from protest and foundation in 3D volume. The exploratory outcomes with a serial of stomach CT pictures demonstrate that the proposed strategy can enhance the exactness of division adequately with almost no communication. **Yuxiang Yang et.al [2016]** presents a strong vision in area framework for distinguishing the surface deformities of film capacitors. Specifically, they utilize a novel Non-sampled Contourlet Transform (NSCT) based calculation to identify the surface imperfections. At that point, the location results are sent to the mechanical se parathion framework through serial port. The imperfect capacitors are peeled off from the creation line by engine. The proposed framework can enhance the location proficiency. It hence can enhance the item quality and lessen generation costs. Trial results have exhibited that the framework accomplishes prevalent play out a cover other best in class arrangements. In addition, with the framework, substantial scale vision information of capacitor surfaces can be gathered and used to direct capacitors fabricating process. **M. EminYukselempphasis on a novelneuro-fluffy (NF) [2007]** administrator for edge recognition in advanced

pictures debased by motivation commotion is introduced. The proposed administrator is built by consolidating a coveted number of NF sub finders with a postprocessor. Each NF sub-detector in the structure assesses an alternate pixel neighborhood connection. Subsequently, the quantity of NF sub-detectors in the structure may be shifted to acquire the coveted edge location execution. Inward parameters of the NF sub-detectors are adaptively advanced via preparing by utilizing basic fake preparing pictures. The execution of the proposed edge indicator is assessed on various test pictures and contrasted and famous edge finders from the writing. Recreation results show that the proposed NF administrator beats contending edge locators and offers unrivaled execution in edge recognition in advanced pictures undermined by drive commotion. **Yufei Yuan[1995]** a recommended that most choice tree acceptance techniques utilized for removing learning in order issues don't manage psychological vulnerabilities, for example, dubiousness and uncertainty related with human reasoning and recognition. In this paper intellectual vulnerabilities engaged with characterization issues are expressly spoken to, estimated, and joined into the information acceptance process. A fluffy choice tree acceptance technique, which depends on the decrease of characterization equivocalness with fluffy proof, is produced. Fluffy choice trees speak to arrangement learning more normally to the method for human reasoning and are more powerful in enduring uncertain, clash, and missing data.

III. COLOR AND SHAPE ALGORITHM PROCESS

- Step 1: Read an Input Image.
- Step 2: Creating Red, green and blue Color bands of the Image.
- Step 3: Compute and plot the Red, Green, Blue Color band Histogram.
- Step 4: Convert Input Image to gray-scale image.
- Step 5: Track BLUE entity in real-time, we have to subtract the BLUE segment from the gray scale picture to remove the red segments in the picture.
- Step 6: Apply Median-filter to remove noise.
- Step 7: Transform the gray-scale picture into a black and white Picture.
- Step 8: Extract every pixel less than 300px.
- Step 9: Select all the associated segments in the picture.
- Step 10: Find Centroid, Area, and Bounding Box using Region props.
- Step 10.1: Apply rectangular box for each Blue color in Image.
- Step 11: Stop

IV. GEOMETRICAL SHAPE ALGORITHM

We have integrate the various algorithm to detect the shape and size of pattern with fuzzy logic. This proposed method is called as the hybrid integration methodology (**HIM**) for fuzzy implementation to detection of various patterns.

4.1 Smooth the image with a Gaussian filter to reduce noise and unwanted details and textures.

$$g(m, n) = G_{\sigma}(m, n) * f(m, n)$$

Where,

$$G_{\sigma} = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{m^2 + n^2}{2\sigma^2}\right)$$

4.2 Compute gradient of $g(m,n)$ using any of the gradient operators (Roberts, Sobel, Prewitt, etc.) to get

$$M(m, n) = \sqrt{g_m^2(m, n) + g_n^2(m, n)}$$

And

$$\theta(m, n) = \tan^{-1}[g_n(m, n)/g_m(m, n)]$$

4.3 Threshold M:

$$M_T(m, n) = \begin{cases} M(m, n) & \text{if } M(m, n) > T \\ 0 & \text{otherwise} \end{cases}$$

Where, T is so chosen that all edge elements are kept while most of the noise is suppressed.

A survey of the basics of fuzzy sets, fuzzy tenets and fuzzy surmising frameworks is given in this part. Starting with fresh or established sets and their tasks, we inferred fuzzy sets and their activities. Traditional set participation capacities and fuzzy enrollment capacities are talked about in detail following set hypothesis. Fuzzy guidelines are depicted utilizing a climate control system control model. The distinctive de-fuzzification methods and their procedures are talked about with a similar precedent well ordered. At last, some other fuzzy strategies are examined, for example, disconnected and on-line fuzzy control frameworks and additionally a

fuzzy shut circle control framework including different query tables. In light of room restrictions, the creator can't cover all unique fuzzy frameworks and their applications, for example, sliding mode fuzzy, connector fuzzy and neural fuzzy control frameworks in a single part. With the improvement of new fuzzy strategies, fuzzy control will play a more essential job in our general public.

V. RESULT AND DISCUSSION

An arrangement of various goals arrangements and analyses was utilized for testing for this calculation and the outcomes were exceptionally exact. Red, blue, and blue hues were effectively found in these photos. The aftereffect of this identification relies upon the edge esteem that have been set for the pictures. A noteworthy issue with postponements is that it looks pretty much the estimation of the pixels and does not think about the connection between them. In some cases, additional pixels are recognized which are not the piece of the covered area, and with increment in clamor these blunders increment. The calculation, in any case, is a viable method to break down the shapes and shades of articles. The idea of configuration depends on the straightforward accessible measurements that are utilized to us in our exploration, the calculation is utilized to perceive the geometrical shape.

Another versatile recursive plan for the fluffy rationale-based movement location and video de-noising was proposed called as **HIM** (Hybrid Integration Methodology). The **HIM** is powerful against clamor and gradually differing enlightenment changes. The telecom framework for gushing has incidentally empowered numerous channels, which enhances the presence of moving highlights in the updated proposed framework. Later on, we expect to examine the utilization of shading components and neighborhood pictures to locate the best accessible travel encounter that can confront quick light changes and quick and simple route.

Table 5.1: RGB Colour Detection

Name Of Images	Colour Detected (Yes Or No)		
	Red	Green	Blue
Colour_Detect1.Jpg	Yes	Yes	Yes
Colour_Detect2.Jpg	Yes	Yes	Yes

Table 5.2: Shape Detection

Name Of Images	Shape Detected (Detected/Not Detected)		
	Square	Rectangle	Circle
SHAPE_DETECT_1.Bmp	1/0	4/1	3/0
SHAPE_DETECT_2.Bmp	1/0	4/1	3/0
SHAPE_DETECT_3.Png	1/0	1/0	1/0
SHAPES.Png	1/0	1/0	0/1

Table 5.3: GIS

Name Of Images	Number Of Features			
	3	4	5	6
Salellite_Imgate1.Jpg	Recovered	Recovered	Recovered	Recovered
Salellite_Imgate2.Png	Recovered	Recovered	Recovered	Recovered
Salellite_Imgate3.Jpg	Recovered	Recovered	Recovered	Recovered

Table 5.4:3D MODELLING

3d Modelling Ball	3d Modelling Triangle	3d Modelling Square	3d Modelling Rectangle
Yes	Yes	Yes	Yes

Table 5.5: TRACK MOVING OBJECT

Video Input	Detected
V1.avi	Track Ball Detected
V2.avi	Track Ball Detected

As the above result shows that very appreciable result and find high accuracy of detection on performing on the MATLAB. The set of rule that has been used for the each execution (each button) has shown the best outcome and reliable output. The objective of our thesis has been to apply the fuzzy approach for larger set of data for pattern recognition achieved.

VI. CONCLUSION

The calculations were tested using different planning and analysis arrangements, and the results were very accurate. These photos actually found red, blue and blue tones. The consequences of this recognition depend on the mastery of the image itself. A notable problem with latency is that it shows almost an estimate of the pixels and does not take into account the connections between them. In some cases, the additional pixels identified are not part of the coveted area and, with increasing increment, these errors increase. In any case, calculations are a viable way to break down the shape and shadow of an element. The configuration idea depends on the directly accessible measurements we use in the exploration, and the calculations are used to perceive the geometry. It is modified another versatile recursive plan for motion based on theory and for video demonization. The proposed theoretical movement found a strong opposition to embarrassment and gradual differences in illumination. The recent development of pattern detection framework offers many versatile use to enhance the existing pattern detection through proposed (Hybrid Integration Methodology-HIM). Further, we want to check the use detection with more accurate and effective use in day to day life. Since the result show very obvious results in each modules, and it found high-precision detection in MATLAB. The rule set (per button) for each execution shows the best results and safe output. The purpose of our paper is to apply fuzzy methods to larger data sets identified by models.

REFERENCES:

- [1]. Ferdous Hossain, Mina Asaduzzaman, Mohammad Abu Yousuf, Md. Armanur Rahman, "Dynamic Thresholding based Adaptive Canny Edge Detection" International Journal of Computer Applications (0975 – 8887), 135(4), pp. 37-41, 2016.
- [2]. Ranita Biswas, Jaya Sil, "An Improved Canny Edge Detection Algorithm Based on Type-2 Fuzzy Sets" Procedia Technology, pp.820 – 824, 2012.
- [3]. Dhiraj Kumar Patel, Prof. Sagar A., "Edge Detection Technique by Fuzzy Logic and Cellular Learning Automata using Fuzzy Image Processing" International Conference on Computer Communication and Informatics, 2013.
- [4]. Jayaram K. Udupa, SupunSamarasekera, "Fuzzy Connectedness and Object Definition: Theory, Algorithms, and Applications in Image Segmentation", Graphical Models and Image Processing, pp. 246–261, 1996.
- [5]. S. Lakshmi, Dr.V. Sankaranarayanan, "A study of Edge Detection Techniques for Segmentation Computing Approaches" IJCA Special Issue on Computer Aided Soft Computing Techniques for Imaging and Biomedical Applications, 2010.
- [6]. Mr. Salem Saleh Al-amri, Dr. N.V. Kalyankar and Dr. Khamitkar S.D, Yeshwant College, Nanded" Image Segmentation By Using Edge Detection", International Journal on Computer Science and Engineering, 02, pp. 804-807, 2010.
- [7]. U. Rajendra Acharya, P. SubbannaBhat, S.S. Iyengar, Ashok Rao, SumeetDua "Classification of heart rate data using artificial neural network and fuzzy equivalence relation" Pattern Recognition 36, pp. 61 – 68, 2003.
- [8]. Xiaomei Wang, James M. Keller, "Human-based spatial relationship generalization through neural/fuzzy approaches" Fuzzy Sets and Systems, pp. 5- 20, 1999.
- [9]. Tao Yang and Lin-Bao Yang, "The Global Stability of Fuzzy Cellular Neural Network", IEEE Transactions on Circuits and Systems, 43, 1996.
- [10]. W. Burger, B. Bhanu, "On Computing a 'Fuzzy' Focus of Expansion for Autonomous Navigation", Honeywell Systems & Research Center, 563-568, 1989.
- [11]. RaffaellaMattone, GiuseppinaCampagiomi, Andreas Wolf, "Fuzzy-based processing of 3D information for items localization in the automated sorting of recyclable packaging", IEEE, 1998.
- [12]. E. Montseny, P. Sobrevilla, S. Romani, "A Fuzzy Approach to White Blood Cells Segmentation in Color Bone Marrow Images" IEEE, pp. 173-178, 2004.
- [13]. Liu HuaJun, Yang Jingyu, Zhao Chunxia" A Generic Approach to Rugged Terrain Analysis Based on Fuzzy Inference" IEEE pp-1108-1113, 2004.
- [14]. King NgNgan, Sing Bing Kang, "Fuzzy Quatemion Approach to Object Recognition Incorporating Zemike Moment Invariants", IEEE pp. 288-290,1990.
- [15]. Fabrizio Russo, "Edge Detection in Noisy Images Using Fuzzy Reasoning" IEEE, pp. 369-372, 1998.
- [16]. Zbigniew Was& and Alessandro Saffiotti" A Fuzzy Behavior-Based Control System for Manipulation" IEEE, pp. 1596-1602, 2002.
- [17]. Klaus Bogenberger, Khaled El-Araby and Hartmut Keller" Design of a Genetic Fuzzy Approach for Ramp Metering" IEEE, pp. 470-475,2000.
- [18]. FatihaKarbou, fatimakarbou, "An Interval Approach to Fuzzy surroundedness and fuzzy spatial relations" IEEE, pp 100-104, 2000.

- [19]. Prof. Sharvari C. Tamane, Dr. R. R. Manza, "3 D Models Watermarking Using FuzzyLogic", 2009 International Conference on Advances in Computing, Control, and Telecommunication Technologies, IEEE, 2009.
- [20]. Jayaram K. Udupa et al., "Body-wide hierarchical fuzzy modeling, recognition, and delineation of anatomy in medical images" *Medical Image Analysis* 18 (2014) 752–771.
- [21]. Fevrier Valdez, Oscar Castillo and Patricia Melin, "Ant Colony Optimization for the Design of Modular Neural Networks in Pattern Recognition" IEEE, 2016.
- [22]. Jinling Wang et al. "Dynamically Evolving Spiking Neural Network for Pattern Recognition" IEEE, 2015.
- [23]. Yan Xu et al. "Quantification of coronary arterial stenoses in CTA using fuzzy distance transform", *Computerized Medical Imaging and Graphics* 36 (2012) 11– 24.
- [24]. Chen Yanda, BaoSusu, PengFengping, "A Fuzzy Connectedness Segmentation of Image Sequences Based on 3D Seed Points Selection", 2008 International Symposium on Computer Science and Computational Technology, IEEE, 2008.
- [25]. Yuxiang Yang et al. "A robust vision in section system for detecting surface defects of film capacitors", *Signal Processing* 124(2016)54–62.
- [26]. M. EminYuksel, "Edge detection in noisy images by neuro-fuzzy processing", *Int. J. Electron. Commun. (AEU)* 61 (2007) 82 – 89.
- [27]. Yufei Yuan a, "Induction of fuzzy decision trees" *Michael J. Shaw Fuzzy Sets and Systems* 69 (1995) 125-139.
- [28]. BaharehBafandehMayvan, Abbas Rasoolzadegan, "Design pattern detection based on the graph theory," *Knowledge-Based Systems*, PP.1-31, January 6, 2017.
- [29]. ShadiAlzu bi, Mohammed Shehab, Mahmoud Al-Ayyoub, YaserJararweh, Brij Gupta, "Parallel Implementation for 3D Medical Volume Fuzzy Segmentation," *Pattern Recognition Letters*, 2018.
- [30]. FranziskaBocklisch, Steffen F. Bocklisch, Matthias Beggiato, Josef F. Krems, "Adaptive fuzzy pattern classification for the online detection of driver lane change intention" *Neurocomputing* 262 (2017) 148–158.
- [31]. FranziskaBocklisch, Daniel Hausmann, "Multidimensional Fuzzy Pattern Classifier Sequencesfor Medical Diagnostic Reasoning," *Applied Soft Computing*, PP. 1-43, 2018.
- [32]. Tiantian He, and Keith C. C. Chan, "Discovering Fuzzy Structural Patterns for Graph Analytics," *IEEE Transactions on Fuzzy Systems*, PP. 1-12, 2017.
- [33]. Yi-Hsuan Lin, Jacob P Brady, Julie DForman-Kay and Hue Sun Chan, "Charge pattern matching as a 'fuzzy' mode of molecular recognition for the functional phase separations of intrinsically disordered proteins," *New J. Phys.* 19 (2017) 115003.
- [34]. VangipuramRadhakrishna, Shadi A. Aljawarneh, P.V. Kumar, V. Janaki, "A novel fuzzy similarity measure and prevalence estimation approach for similarity profiled temporal association pattern mining," *Future Generation Computer Systems*, pp.1-33, 2017.

Akhileshlatria" A Novel Approach of Pattern Detection Using Fuzzy Logic: Implementation in MATLAB" *International Journal of Computational Engineering Research (IJCER)*, vol. 08, no. 11, 2018, pp 81-87