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CLASSIFICATION OF RED TIDE ALGAE IMAGES USING GENERALIZED FEEDFORWARD NEURAL NETWORK

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Abstract— In this paper a new classification algorithm is proposed for the Classification of Red tide algae images. In order to develop algorithm 154 red tide algae SEM images have been considered, So as to create calculation 154 red tide algae SEM image have been considered, With a view to extricate highlights from the red tide green growth SEM images after image preparing, a calculation proposes WHT changed coefficients. The Efficient classifiers dependent on Generalized feed forward neural network(GFF). A different Cross-Validation dataset is utilized for legitimate assessment of the proposed characterization calculation as for essential execution measures, for example, MSE and arrangement exactness. The Average Classification Accuracy of GFF Neural Network including one hidden layers with 20 PE's sorted out in a run of the mill topology is observed to be unrivalled (96.66 %) for Training and cross-validation. At last, ideal calculation has been created based on the best classifier execution. The calculation will give a powerful option in contrast to customary technique for Red tide algae SEM images examination for Classify the five sort of Red tide algae SEM images.

Keywords— MatLab, Neuro Solution Software, Microsoft excel, WHT Transform Techniques

I. INTRODUCTION

Red tides happen normally off coasts everywhere throughout the world. Not every single red tide have poisons or are destructive. Where red tides happen, dead fish appear on shore for as long as about fourteen days after a red tide has experienced the zone. Notwithstanding executing fish, the dangerous green growth debase shellfish. A few mollusks are not vulnerable to the poison, and store it in their greasy tissues. Shellfish devour the living beings in charge of red tide and concentrate saxitoxin (delivered from these living beings) in their tissues. Saxitoxin squares sodium channels and ingestion can cause loss of motion inside 30 minutes. Different creatures that eat the shellfish are helpless to the neurotoxin, prompting neurotoxic shellfish harming and now and again even demise. Most mollusks and shellfishes channel feed, which results in higher groupings of the poison than simply drinking the water. Scaup, for instance, are jumping ducks whose diet mostly comprises of mollusks. At the point when scaup eat the channel encouraging shellfish that are concentrated with elevated amounts of the red tide poison, their populace alongside different sorts of jumping ducks become a practical objective for harming. Notwithstanding, even fowls that don't eat mollusks can be influenced by just eating dead fish on the shoreline or drinking the water, as in the Peking duck try. The poisons discharged by the sprouts can slaughter marine creatures including dolphins, ocean turtles, winged animals, and manatees. Marine dinoflagellates produce ichthyotoxins. Fish, for example, Atlantic herring, American pollock, winter wallow, Atlantic salmon, and cod were dosed orally with these poisons in a test. Close to accepting dosages of the poison, fish began to show lost balance and started to swim in a sporadic, twitching design pursued by loss of motion and shallow, arrhythmic breathing and in the end demise after around 60 minutes. Researchers reasoned that the lethal red tide effectsly affected fish that were presented to it.

Red tide is a colloquial term used to refer to one of a variety of natural phenomena known as harmful algal blooms. The term specifically refers to blooms of a species of dinoflagellate. It is being phased out among researchers because:

1. Red tides are not necessarily red and many have no discoloration at all.
2. They are unrelated to movements of the tides.
3. The term is imprecisely used to refer to a wide variety of algal species that are known as bloom-formers.

As a technical term, it is being replaced in favour of more precise terminology, including the generic term "harmful algal bloom" for harmful species, and "algal bloom" for benign species.
Destructive algal blossoms, or HABs, happen when settlements of green growth—basic plants that live in the ocean and freshwater—develop wild while creating dangerous or hurtful consequences for individuals, fish, shellfish, marine well evolved creatures, and feathered creatures. The human sicknesses brought about by HABs, however uncommon, can be weakening or even fatal. While numerous individuals call these sprouts 'red tides,' researchers incline toward the term unsafe algal blossom. A standout amongst the best known HABs in the country happens about each mid year along Florida's Gulf Coast. This sprout, in the same way as other HABs, is brought about by tiny green growth that produce poisons that execute fish and make shellfish hazardous to eat. The poisons may likewise make the encompassing air hard to relax. As the name proposes, the blossom of green growth regularly turns the water red. HABs have been accounted

for in each U.S. beach front state, and their event might be on the ascent. HABs are a national concern since they influence not just the soundness of individuals and marine biological systems, yet in addition the 'wellbeing' of neighborhood and local economies.

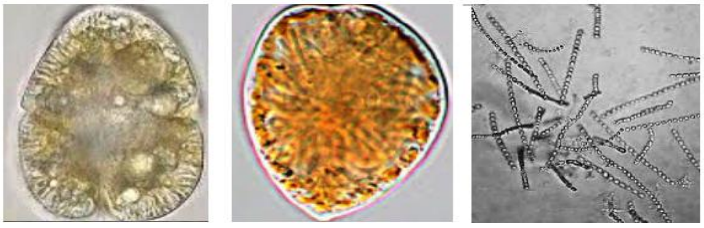
However, not every algal sprout are destructive. Most blossoms, indeed, are valuable on the grounds that the minor plants are sustenance for creatures in the sea. Truth be told, they are the significant wellspring of vitality that energizes the sea sustenance web. Scientists at the National Ocean Service have been checking and concentrating this marvel for various years to decide how to recognize and gauge the area of the sprouts. The objective is to give networks preemptive guidances so they can sufficiently get ready for and manage the antagonistic natural and wellbeing impacts related with these 'red-tide' events.Red tides are brought about by a touchy development and collection of certain tiny green growth, prevalently dinoflagellates, in beach front waters. A few types of dinoflagellates produce poisons that are among the most powerful known to man. These unsafe green growth blossoms, or HABs for short, represent a genuine and repeating danger to human wellbeing, untamed life, marine biological systems, fisheries, seaside feel and our economy. The most troublesome species in the Gulf of Mexico is Karenia brevis. Like different dinoflagellates these small, single-celled life forms photosynthesize utilizing chlorophyll like a plant yet they are versatile with the utilization of two flagella that move them through the water segment.

1.1Factors that may contribute to a bloom

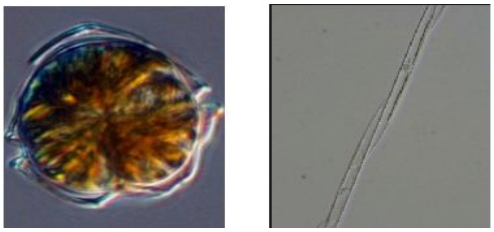
Red tides contain thick convergences of living beings and show up as stained water, frequently ruddy dark colored in shading. It is a characteristic marvel, yet the careful reason or blend of components that outcome in a red tide episode are not really known. Be that as it may, three key elements are thought to assume a critical job in a blossom - saltiness, temperature, and wind. Red tides cause monetary mischief, so flare-ups are painstakingly checked. For instance, the Florida Fish and Wildlife Conservation Commission gives a forward-thinking status report on red tides in Florida. The Texas Parks and Wildlife Department likewise gives a status report. While no specific reason for red tides has been discovered, a wide range of variables can add to their essence. These elements can incorporate water contamination, which begins from sources, for example, human sewage and rural spillover. There are different variables that have been related with the expansion in red tides, for example, climate, environmental change, and tidal examples, despite the fact that the connection isn't in every case very clear. Red tide algal sprouts will in general be increasingly visit amid the late spring due to the warm temperatures.

The event of red tides in certain areas has all the earmarks of being completely normal (algal blossoms are a regular event coming about because of waterfront upwelling, a characteristic aftereffect of the development of certain sea flows) while in others they have all the earmarks of being a consequence of expanded supplement contamination from human exercises. The development of marine phytoplankton is commonly constrained by the accessibility of nitrates and phosphates, which can be inexhaustible in rural run-off just as seaside upwelling zones. Seaside water contamination delivered by people and orderly increment in seawater temperature have additionally been involved as contributing elements in red tides. Different factors, for example, iron-rich residue flood from vast desert regions, for example, the Sahara Desert are thought to assume a noteworthy job in causing red tides. Some algal blossoms on the Pacific Coast have likewise been connected to events of substantial scale climatic motions, for example, El Niño occasions. While red tides in the Gulf of Mexico have been happening since the season of early pioneers, for example, Cabeza de Vaca, what starts these blossoms and how vast a job anthropogenic and common elements play in their improvement is hazy. Regardless of whether the evident increment in recurrence and seriousness of algal blossoms in different pieces of the world is in actuality a genuine increment or is because of expanded perception exertion and advances in species distinguishing proof strategies is additionally discussed.

While the human commitment to the long haul increment in red tides is obvious, a few scientists suggest that environmental change is likewise a factor, with more research still expected to guarantee it as a complete reason. Expanding temperature, upgraded surface stratification, modification of sea flows, increase or debilitating of nearby supplement upwelling, incitement of photosynthesis by raised CO2, decreased calcification through sea fermentation, and overwhelming precipitation and tempest occasions causing changes in land overflow and micronutrient accessibility may all create conflicting species-or even strain-explicit reactions. As far as hurtful algal sprouts (HABs), we can anticipate: (I) go development of warm-water species to the detriment of cold-water species, which are driven poleward; (ii) species-explicit changes in the plenitude and regular window of development of HAB taxa; (iii) prior planning of pinnacle generation of some phytoplankton; and (iv) optional impacts for marine sustenance networks, quite when singular zooplankton and fish nibblers are differentially affected by environmental change. Be that as it may, the potential results of these progressions for HABs have gotten generally little consideration and are not surely knew. Considerable research is expected to assess the immediate and aberrant relationship between HABs, environmental change, sea fermentation, and human wellbeing.
The algal images used in our proposed work were taken by the real-time algae imaging system from a stream of water siphoned directly from the ocean. All of the samples were labeled by biologic experts beforehand. Fig. 1 shows certain of the images.



(a) (b) (c)



(d) (e)

Figure 1 a)gymnodinium sangnineum ,b)prorocentrum micans, c)skeletonema costatum, d)alexandrium costatum, and e) pseudo-nitzschia pun gens

II.RESEARCH METHODOLOGY

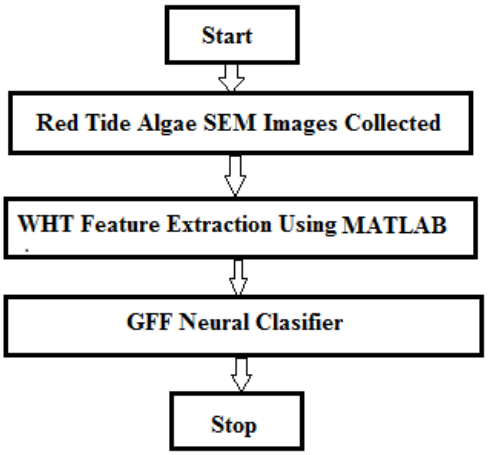


Figure2.1 Methodology of work

It is proposed to consider the gathering of five kind of Red Tide Algae SEM images Using Neural Network Approaches.Data verifying for the GFF classifier planned for the Recognition of five sort of Red Tide Algae SEM images.The most indispensable un related incorporates and what's more coefficient from the images will be removed . In order to extract features, statistical techniques, image processing techniques, WHT transformed domain will be used..

2.1Following Neural Networks are tested:

2.1Feed-Forward Neural Networks

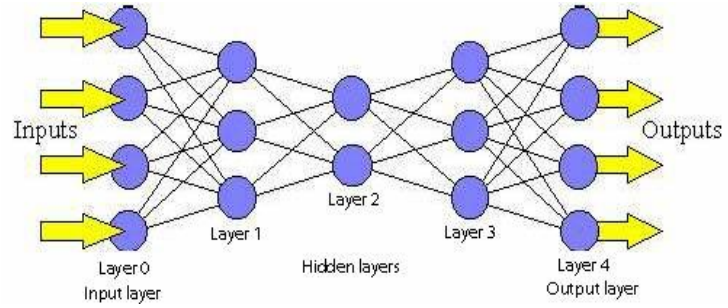


Figure 2.1. A feed-forward network.

Feed-forward networks have the following characteristics:

1. Perceptrons are arranged in layers, with the first layer taking in inputs and the last layer producing outputs. The middle layers have no connection with the external world, and hence are called hidden layers.

2. Each perceptron in one layer is connected to every perceptron on the next layer. Hence information is constantly "fed forward" from one layer to the next., and this explains why these networks are called feed-forward networks.
3. There is no connection among perceptrons in the same layer.

A single perceptron can classify points into two regions that are linearly separable. Now let us extend the discussion into the separation of points into two regions that are not linearly separable. Consider the following network:

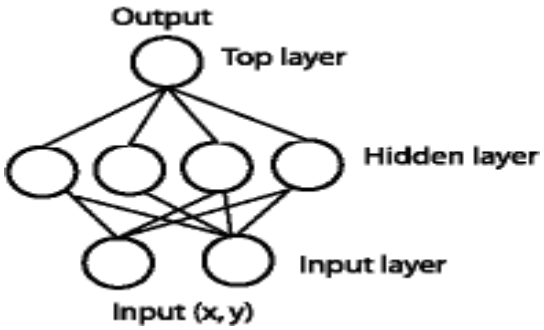


Figure 2.2. A feed-forward network with one hidden layer.

The same (x, y) is fed into the network through the perceptrons in the input layer. With four perceptrons that are independent of each other in the hidden layer, the point is classified into 4 pairs of linearly separable regions, each of which has a unique line separating the region.

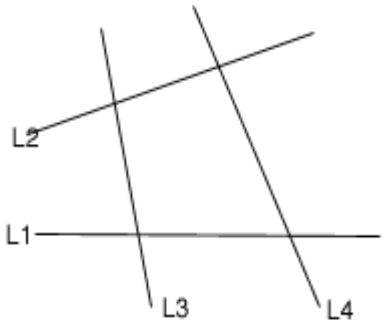


Figure.2.3 lines each dividing the plane into 2 linearly separable regions.

The top perceptron performs logical operations on the outputs of the hidden layers so that the whole network classifies input points in 2 regions that might not be linearly separable. For instance, using the AND operator on these four outputs, one gets the intersection of the 4 regions that forms the center region.

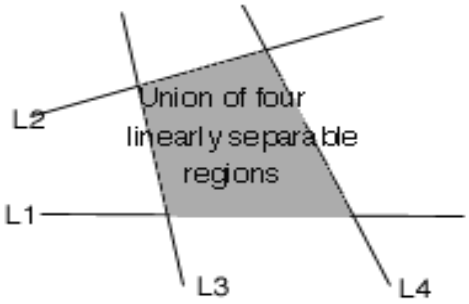


Figure .2.4 Intersection of 4 linearly separable regions forms the center region.

By varying the number of nodes in the hidden layer, the number of layers, and the number of input and output nodes, one can classification of points in arbitrary dimension into an arbitrary number of groups. Hence feed-forward networks are commonly used for classification.

❖ ***Learning Rules used****:*

➢ ***Momentum***

Momentum basically includes a division m of the past weight update to the present one. The force parameter is utilized to keep the framework from meeting to a nearby least or seat point. A high force parameter can likewise build the speed of combination of the framework. Nonetheless, setting the force parameter too high can make a danger of overshooting the base, which can make the framework become shaky. A force coefficient that is too low can't dependably keep away from nearby minima, and can likewise back off the preparation of the framework.

➢ ***Conjugate Gradient***

CG is the most mainstream iterative strategy for tackling extensive frameworks of straight conditions. CG is viable for frameworks of the structure A=xb-A (1) where x _is an obscure vector, b is a known vector, and A _is a known, square, symmetric, positive-unequivocal (or positive-uncertain) lattice. (Try not to stress on the off chance that you've overlooked what "positive-unequivocal" signifies; we will audit it.) These frameworks emerge in numerous critical settings, for example, limited distinction and limited component techniques for settling incomplete differential conditions, basic investigation, circuit examination, and math homework.

Created by Widrow and Hoff, the delta rule, additionally called the Least Mean Square (LMS) technique, is a standout amongst the most usually utilized learning rules. For a given information vector, the yield vector is contrasted with the right answer. In the event that the thing that matters is zero, no learning happens; generally, the loads are changed in accordance with lessen this distinction. The adjustment in weight from ui to uj is given by: dwij = r* ai * ej, where r is the learning rate, ai speaks to the enactment of ui and ej is the contrast between the normal yield and the genuine yield of uj. In the event that the arrangement of info designs structure a directly autonomous set, at that point self-assertive affiliations can be gotten the hang of utilizing the delta rule.

It has been appeared for systems with straight actuation capacities and with no shrouded units (concealed units are found in systems with multiple layers), the blunder squared versus the weight chart is a paraboloid in n-space. Since the proportionality steady is negative, the chart of such a capacity is sunken upward and has a base esteem. The vertex of this paraboloid speaks to the point where the blunder is limited. The weight vector relating to this point is then the perfect weight vector.

- ***Quick propagation***

Quick propagation (Quickprop) [1] is a standout amongst the best and broadly utilized versatile learning rules. There is just a single worldwide parameter making a noteworthy commitment to the outcome, the e-parameter. Brisk spread uses a lot of heuristics to enhance Back-engendering, the condition where e is utilized is the point at which the sign for the present incline and past slant for the weight is the equivalent.

- ***Delta by Delta***

reated by Widrow and Hoff, the delta rule, additionally called the Least Mean Square (LMS) strategy, is a standout amongst the most usually utilized learning rules. For a given info vector, the yield vector is contrasted with the right answer. On the off chance that the thing that matters is zero, no learning happens; generally, the loads are changed in accordance with diminish this distinction. The adjustment in weight from ui to uj is given by: dwij = r* ai * ej, where r is the learning rate, ai speaks to the enactment of ui and ej is the contrast between the normal yield and the real yield of uj. On the off chance that the arrangement of info designs structure a directly free set, at that point self-assertive affiliations can be picked up utilizing the delta rule.
It has been appeared for systems with straight actuation capacities and with no concealed units (shrouded units are found in systems with multiple layers), the blunder squared versus the weight diagram is a paraboloid in n-space. Since the proportionality consistent is negative, the chart of such a capacity is sunken upward and has a base esteem. The vertex of this paraboloid speaks to the point where the blunder is limited. The weight vector comparing to this point is then the perfect weight vector. [10].

III. Simulation Results

1) Computer Simulation

The GFF neural system has been simulated for 154 distinct images of Red tide Algae SEM images out of which 139 were utilized for training and 15 were utilized for cross validation.

The simulation of best classifier along with the confusion matrix is shown below :

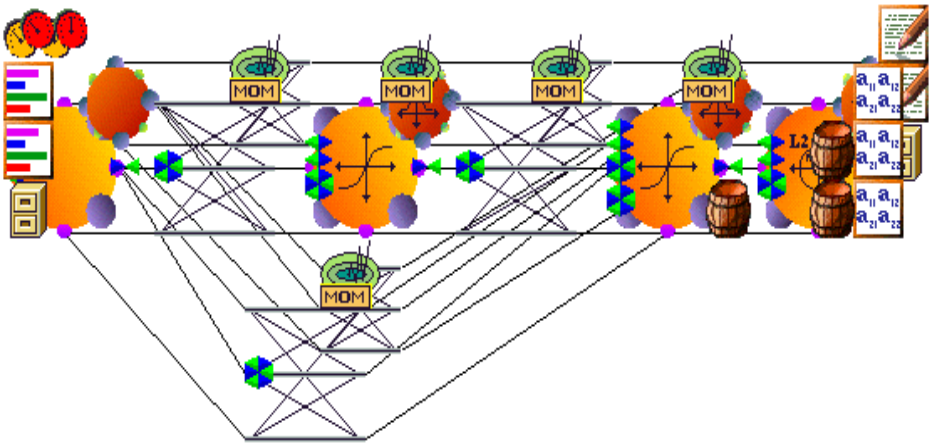


Figure.3.1 GFF neural network trained with MOM learning rule

2) Results

Output / Desired	*SKELETONEMA COSTATUM*	*PSEUDO NITZSCHIA PUN GENS*	*PROROCENTRUM MICANS*	*GYMNODINIUM SANGNINEUM*	*ALEXANDRIUM COSTATUM)*
SKELETONEMA COSTATUM	2	0	0	0	0
PSEUDO NITZSCHIA PUN GENS	0	4	0	0	1
PROROCENTRUM MICANS	0	0	5	0	0
GYMNODINIUM SANGNINEUM	0	0	0	4	0
ALEXANDRIUM COSTATUM	0	0	0	0	2

Table I. Confusion matrix on CV data set

Output / Desired	*SKELETONEMA COSTATUM*	*PSEUDO NITZSCHIA PUN GENS*	*PROROCENTRUM MICANS*	*GYMNODINIUM SANGNINEUM*	*ALEXANDRIUM COSTATUM)*
SKELETONEMA COSTATUM	10	0	0	0	0
PSEUDO NITZSCHIA PUN GENS	0	28	0	0	1
PROROCENTRUM MICANS	0	0	39	0	0
GYMNODINIUM SANGNINEUM	0	0	0	32	0
ALEXANDRIUM COSTATUM	0	0	0	0	25

Table II. Confusion matrix on Training data set

Here Table I and Table II Contend the C.V as well as Training data set.

Performance	***SKELETONEMA COSTATUM***	***PSEUDO NITZSCHIA PUN GENS***	***PROROCENTRUM MICANS***	***GYMNODINIUM SANGNINEUM***	***ALEXANDRIUM COSTATUM***
MSE	0.001979344	0.083325399	0.00293413	0.003085654	0.141409191
NMSE	0.02004086	0.482096952	0.014625509	0.017852711	1.018146174
MAE	0.037952264	0.148723215	0.04338926	0.047668	0.246318201
Min Abs Error	0.003017039	0.003036611	0.00272274	0.003435573	0.000471162
Max Abs Error	0.110176601	0.905045263	0.126091552	0.125712226	0.877402943
r	0.991879955	0.730709877	0.994037431	0.991716234	0.423774813
Percent Correct	100	100	100	100	66.66666667

TABLE III. Accuracy of the network on CV data set

Performance	*SKELETONEMA COSTATUM*	*PSEUDO NITZSCHIA PUN GENS*	*PROROCENTRUM MICANS*	*GYMNODINIUM SANGNINEUM*	*ALEXANDRIUM COSTATUM*
MSE	0.001334729	0.00115772	0.001012247	0.000949711	0.001526233
NMSE	0.019327741	0.007004048	0.004905778	0.005224573	0.010056898
MAE	0.031764622	0.029104879	0.026431924	0.025210627	0.034149849
Min Abs Error	3.86856E-05	0.000235701	0.000206251	0.000587895	0.000157612
Max Abs Error	0.05531825	0.057921334	0.055541652	0.070756784	0.060996427
r	0.994651276	0.997442995	0.998042651	0.997725143	0.99659353
Percent Correct	100	100	100	100	100

Table IV. Accuracy of the network on training data set

Here Table III and Table IV Contain the C.V and Training result and show the 100% percent accuracy.

IV. Conclusion and Future Work

From the outcomes got it reasons that the GFF Neural Network with MOM (Momentum) and hidden layer 1 with processing element 20 gives best results of 100% in Training while in Cross Validation it gives 93.33% so in total outcome is 96.66%.

V. ACKNOWLEDGMENT

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