

Image Dataset Evaluation by Boltzmann Machine under Deep Neural Networks

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Abstract- It presents the concept of image dataset evaluation using deep learning methods. These methods are used for evaluating large databases at a time. It uses the bacteria dataset for evaluation purpose. The scope of this work is defined by several machine learning tasks. The first one is analysed to see how much the unsupervised pre-training technique introduced with the Deep Belief Network (DBN) model improves the training of neural networks. The second is evaluating the efficiency of DBN. The idea behind this greedy layer-wise pre-training algorithm is that each model in the sequence of layers is learning from a different representation of the input. Each model performs a non-linear transformation and produces the input of the next layer. The performance is measured in terms of accuracy value. The proposed mechanism is implemented with MATLAB.

Keywords- Image Processing, DNN, Boltzmann Machine etc.

I. INTRODUCTION

In ongoing decades, innovation has accepted an inexorably significant function in everyday life. The scaling of electronic parts has made it conceivable to utilize equipment foundations that give complex outcomes rapidly and at moderate expenses. New performing frameworks have been presented available, in light of AI and profound learning for picture preparing, that have had the option to draw from a develop and multidisciplinary explained condition, for example, PC vision. Having the option to relate to a couple of words the primary spaces of AI and PC vision is confounded on the grounds that the fields of intrigue are numerous and in consistent development. Specifically, they extend from unadulterated amusement to mechanical technology and Endeavor frameworks investigating issues in security, medication, engineering, craftsmanship and training. Additionally, what astonishes each time is the way that each development definitely influences at any rate one other order. So, it occurs, for instance, that innovative work bunches make such complex calculations to give new life to the universe of retail or Endeavor the executive's frameworks. This could thus re-establish the standards of video reconnaissance, or make new creative procedures for clinical pictures examination through a totally unique and sudden cycle. This happens in light of the fact that every strategy is progressively interconnected and development resounds over adjoining business regions. The advantages getting from such trend setting innovations are clear. The consistency, dependability and objectivity of the mechanical structures encourage human mediation in measures that require numerous monotonous control tasks.

Specifically, computerized retail frameworks have as of late arrived at exceptionally elevated levels of exactness and common sense, figuring out how to control a developing number of data. This consistent improvement has permitted to investigate ever more extensive fields, moderating the issues of adaptability and innovative effectiveness every now and then. In the most recent decades, the field of Machine Learning (ML) has been going through emotional changes. It

has seen the ascent of Deep Learning (DL) and Artificial Neural Network (ANN) specifically. A few ideas that can be ascribed to DL have been known since the finish of XX century, however for different reasons they didn't get a lot of increase by the ML people group. It has changed with the reception of Convolutional Neural Networks (CNNs) in picture handling issues. CNN is a learning framework that comprises of different computational layers that utilize convolution activity.

Continuous uses of convolution change the contribution of the framework into its most enlightening portrayal with regards to issue being comprehended. Advancement of CNNs and their productive Graphics Processing Unit (GPU) usage made a few issues that were viewed as illogical to fathom with ANNs computationally practical. Simultaneously, arrangement of picture acknowledgment challenges in 2011-2012 years were won by groups that were utilizing CNNs. This focused on a ton of the territory of DL. One of the most known outcomes from this period is the CNN that won enormous scope object acknowledgment Image Net rivalry, outflanking different techniques by a noteworthy edge.

A. Machine Learning Systems

The zone of ML is making a framework that can play out a particular assignment without being expressly customized as appeared in Figure 1. Rather, it ought to be adequate to give such framework experimental information of the cycle which conduct is being considered. This can be expressed officially: "A PC program is said to gain as a matter of fact E regarding some class of assignments T and execution measure P, if its exhibition at errands in T, as estimated by P, improves with experience E." This definition catches exceedingly significant parts of a ML issue.

1. T, the undertaking – the issue a ML framework is planned to understand. The most well-known assignments relapse and characterization. Relapse models are prepared to gauge obscure ceaseless variable dependent on given information sources. In arrangement a ML model figures out how to indicate which of k classifications some article has a place with.

2. P, the Performance Measure is a quantitative proportion of how well the model performs. Advancing the exhibition measure is one of the fundamental objectives of AI. Generally, the decision of the measurement relies upon the sort of the undertaking that AI framework is managing. A typical practice is to utilize a few measurements that give alternate points of view on the model exhibition.

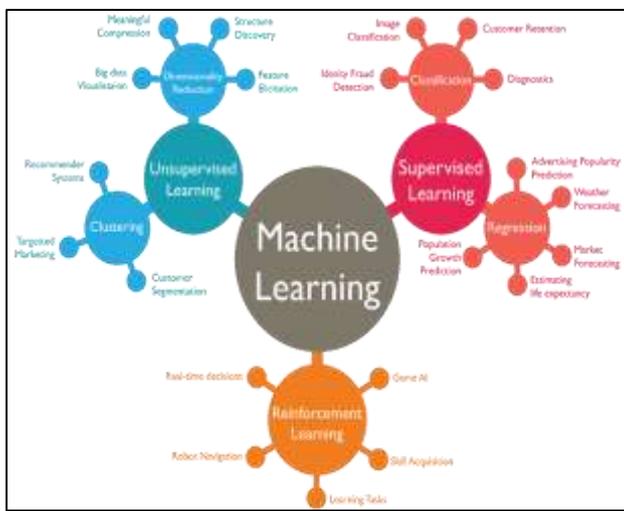


Figure 1: Machine Learning System [1]

3. E, the Experience: In most ML calculations experience is spoken to by a dataset – an assortment of information focuses, that are spoken to by genuine esteemed vectors $x \in R^m$. By and large, ML issues require gathering experimental proof and changing it into the qualities that can be acknowledged by the learning calculation. This cycle is normally alluded to as highlight designing. Albeit a few parts of AI, similar to profound learning, go amiss from this methodology and utilize however much data as could be expected. For example, a dark scale picture could be spoken to by a component equivalent to the total of its left-part pixel esteems deducted from the entirety of its right-part pixel esteems. Profound learning framework would utilize the entire picture as an information.

B. Neural Networks to Deep Learning

Presently profound learning has got incredible enthusiasm for every single field and particularly in clinical picture examination and it is normal that it will hold \$300 million clinical imaging market by 2021. Consequently, by 2021, only it will get more venture for clinical imaging than the whole examination industry spent in 2016. It is the best and administered AI approach. This methodology use models of profound neural organization which is variety of Neural Network yet with enormous estimation to human cerebrum utilizing advance component as contrast with basic neural organization. The term profound learning suggests the utilization of a profound neural organization model. The fundamental computational unit in a neural organization is the neuron, an idea roused by the investigation of the human cerebrum, which accepts different signs as sources of info, consolidates them straight utilizing loads, and afterward passes the joined signs through nonlinear tasks to create yield signals.

C. Advantages of Deep Learning

The human mind doesn't decipher a picture by pixel however it decays an issue into sub-issues through numerous degrees of translations. As appeared in [1], the human minds measure visual signs through a structure of different layers, very much spoke to by Neural Networks. One of the guarantees of profound learning is supplanting high quality highlights with solo or semi-managed include learning and various levelled include extraction. Examination here endeavours to improve portrayals and make models to take in these portrayals from enormous scope information. One of

the most striking realities about neural organizations is that they can process any capacity whatsoever. Regardless of what the capacity, it is ensured there is a neural organization so that for each conceivable information x , the worth $f(x)$ or some nearby estimate is yield from the organization. Hypothetical outcomes show that an engineering with a lacking profundity can require a lot more computational components and the development in the quantity of these is exponential concerning input size. This additionally causes a slower learning. Models with various levels encourage the sharing and re-utilization of parts. It implies that all the neurons in the principal shrouded layer recognize various highlights at various areas in the information picture.

The paper is ordered as follows. In section II, it presents the model of deep learning. In Section III, It defines proposed work. Results are presented in Section IV. Finally, conclusion is explained in Section V.

II. MODELS OF DEEP LEARNING

1. Convolutional Neural Network (CNN)

CNN is one of the neural organization models for profound realizing, which can be depicted by three explicit attributes, in particular privately associated neurons, common loads and spatial or fleeting sub-examining. The engineering of a CNN is intended to exploit the 2D structure of an information picture (or other 2D information, for example, a discourse signal). This is accomplished with neighbourhood associations and tied loads followed by some type of pooling which brings about interpretation invariant highlights. An advantage of CNNs is that they are simpler to prepare and have numerous less boundaries than completely associated networks with similar number of concealed units. To give a diagram on the engineering qualities, CNNs are made out of convolutional and sub inspecting layers alternatively followed by completely associated layers. The contribution to a convolutional layer is a $m \times m \times r$ picture where m is the tallness and width of the picture and r is the quantity of channels, e.g. an RGB picture has $r = 3$. The convolutional layer will have k channels of size $n \times n \times q$ where n is littler than the component of the picture and q can either be equivalent to the quantity of channels or littler and may change for every bit. The size of the channels offers ascend to the privately associated structure where every component is convolved with the picture to create k include guides of size $mn + 1$.

2. Remaining Neural Network

A variety of standard CNNs are Deep Residual Neural Networks. A portrayal and a model for ResNets can be found. ResNets take a standard feed-forward ConvNet and include skip associations that sidestep (or easy route) a couple of convolution layers one after another. Each sidestep offers ascend to a remaining square wherein the convolution layers foresee a leftover that is added to coming up next square's info. It demonstrates that these organizations can pick up exactness from impressively expanded profundity. Remaining layers address an issue of corruption that happens as the profundity increments and this issue isn't expected to over fitting. The exactness soaks first and afterward corrupt quickly. At the point when extra-layers end up being superfluous or even reason for corruption, a personality planning between layers is the best arrangement. A lingering association permits to push the remaining to zero and proliferate along the stack a character planning, in this manner "covering up" the presence of extra (superfluous) layers. To the extraordinary, if a personality planning were

ideal to a particular preparing spread, it is simpler to push the leftover to zero than to fit a character planning by a heap of nonlinear layers. Alongside the profundity corruption, the inside covariate move issue has been considered with ResNets. A careful clarification is given. The interior covariate move is brought about by the way that the appropriation of each layer's information sources changes during preparing alongside the adjustment in the organization boundary's qualities.

3. Repetitive Neural Network

The thought behind RNNs is to utilize consecutive data. In a conventional neural organization, we accept that all information sources (and yields) are autonomous of one another. However, for some assignments that might be a poorly conceived notion. To foresee the following word in a sentence it is smarter to realize which words preceded it. RNNs are called intermittent in light of the fact that they play out a similar undertaking for each component of an arrangement, with the yield made reliant on the past calculations. Another approach to consider RNNs is that they have a "memory" which catches data about what has been determined up until now.

4. Long Short-Term Memory

In a conventional repetitive neural organization, during angle back spread advance, the inclination esteems can wind up being duplicated countless occasions by the weight grid related with the associations between the neurons of the intermittent concealed layer. This implies the greatness of loads in the progress network can strongly affect the learning cycle. On the off chance that the loads in this grid are little (or, all the more officially, if the main eigen estimation of the weight framework is littler than 1.0), it can prompt a circumstance called evaporating angles where the slope signal turns out to be little to such an extent that adapting either turns out to be moderate or quits working through and through. It can likewise make more troublesome the assignment of learning long haul conditions in the information. Then again, if the loads in this framework are huge (or the main eigen estimation of the weight grid is bigger than 1.0), this can prompt a circumstance where the angle signal is huge to such an extent that it can make learning veer. This occasion is regularly alluded to as detonating angles.

A. Challenges For Deep Learning

Profound learning innovation applied to clinical imaging may turn into the most troublesome innovation radiology has seen since the approach of computerized imaging. Most scientists accept that inside next 15 years, profound learning-based applications will assume control over human and not just a large portion of the finding will be performed by shrewd machines yet will likewise assist with foreseeing sickness, endorse medication and guide in therapy. The thought of applying profound learning-based calculations to clinical imaging information is a captivating and developing examination territory nonetheless, there are a few obstructions that hinder its encouraging. These difficulties are:

1. Dataset

Profound learning requires huge measure of preparing dataset as arrangement exactness of profound learning classifier is to a great extent reliant on the quality and size of the dataset, be that as it may, inaccessibility of dataset is one the greatest hindrance in the accomplishment of profound

learning in clinical imaging. Then again, advancement of enormous clinical imaging information is very testing as comment requires broad time from clinical specialists particularly it requires different master conclusion to defeat the human blunder.

2. Security and Legal Issue

It is substantially more muddled and harder to share the clinical information when contrasted with true pictures. Information protection is adequately both sociological just as specialized issue, which must be tended to together from the two points of view. HIPAA strikes a chord when protection is examined in wellbeing part. It gives legitimate rights to patients with respect to their actually recognizable data and build up commitments for medical services suppliers to ensure and limit its utilization or exposure. One significant issue to deliver that how to share delicate information of information while restricting exposure and restricting its sharing by guaranteeing the adequate information utility for example Year of birth, 3-digit Zip code, sexual orientation is novel for 0.04% of US populace while Date of birth, 5-digit Zip code and sex is interesting for 87% of US populace The restricted limitation information access, shockingly lessen data content too that may be significant.

III. PROPOSED WORK

1. Problem Formulation & Methodology

In the previous years, administered convolutional models have everlastingly changed the PC vision and AI scene. Because of the ongoing presentation of huge administered datasets and quickened preparing models utilizing Graphic Processing Units, the customary blending of handmade low-level vision highlights with complimentary classifiers has been given by Convolutional Neural Networks. CNNs are profound feed forward organizations dependent on a pecking order of dynamic layers which all the while gain proficiency with the low-level highlights and classifier. These organizations have been appeared to rise to the exhibition of neurons in the primate substandard worldly cortex, much under troublesome conditions, for example, posture, scale, and impediments. The Boltzmann models with mix of DNN tackled the angle issue by supplanting the conventional fake neuron with a memory cell containing long and transient nonlinear abilities.

2. Research Methodology

AI is utilized to dissect increasingly more information and the accessible information is turning out to be increasingly perplexing. In the most recent decade, the approach of Deep Learning helped in making more productive learning models. Many Machine Learning errands are focusing on arrangement issues. Such frameworks work in a manner like what is appeared on Figure 2. To begin with, highlights are removed from the information. This can be viewed as making another portrayal of the information explicitly for the current assignment. An arrangement framework is then learned on head of these highlights to accomplish the undertaking. When prepared, the framework should now have the option to be utilized on information that have not yet been seen during the preparation stage and precisely foresee its reaction, for this situation, the class mark. Regularly, and particularly until ongoing years, the highlights separated from the info were handmade highlights. This capability implies that such highlights are planned particularly for the information and the main job. They are commonly tied not exclusively to the sort of information, for example pictures of transcribed words, however to a particular subset, for example, pictures of English transcribed words composed with ink on material. A large

portion of these highlights are commonly not powerful to change.

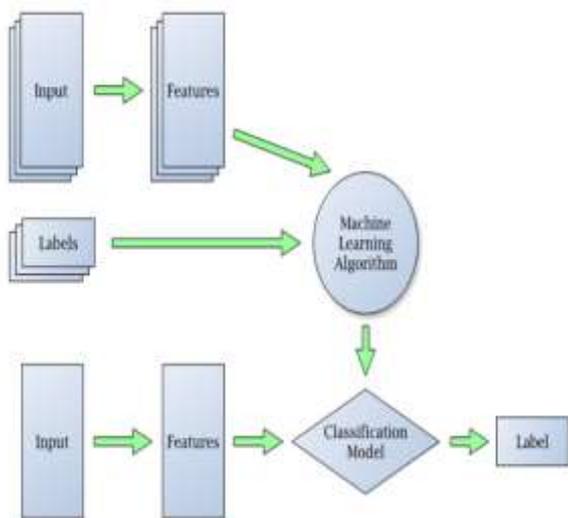


Figure 2: A Supervised Machine Learning Model for Classification

Another way to deal with extricate highlights from the information is to gain proficiency with an element extractor utilizing Machine Learning. Rather than building a framework to arrange a few pictures, a learning framework is worked to remove highlights from the information. On account of pictures, this implies the organization is gaining more elevated level highlights legitimately from the info pixels. We accept that this methodology is better than utilizing handmade highlights, for a few reasons. Via preparing a model on every informational collection, the prepared model can be adjusted to numerous kinds of information sources while carefully assembled highlights may require hand-tuning for every informational index. Besides, this methodology ought not require a specialist information on the pictures being examined. The primary thought behind this theory is the top to bottom investigation of procedures for highlight extraction from information. The target of regulated learning can be summed up as learning a decent guess of an obscure capacity $y = f(x)$, where x means an information vector and y the normal yield. The learning cycle expect the accessibility of delegate preparing models (x_n, y_n) . The objective is to gain proficiency with a planning capacity y , through the learning cycle, that approximates $f(x)$:

$$y = f(x)$$

The learning objective is to make \hat{y} as close as conceivable to the genuine y , a property known as combination. The picked-up planning capacity utilizes a few boundaries, or loads. The arrangement of boundaries is by and large indicated as θ , along these lines the planning capacity is here and there characterized as $f_{\theta}(x)$.

3. Proposed System Model

This work presents examination of bacterial picture information base utilizing Alex Net and blunder minimization by BM-DNN network framework. The utilization of DNN gives better blunder lessening capacity in network when contrasted with other regular organizations. A Restricted Boltzmann Machine (RBM) is a generative stochastic ANN. It is a model particularly made to become familiar with a likelihood appropriation over the sources of info. Figure 3.2 outlines a RBM design. It is made of two layers, an obvious layer and a shrouded layer. The two layers contain a specific number of units (orneurons). In a RBM, the "limited" implies that neurons structure a bipartite

diagram, for example there are no associations between units of a similar gathering. This extraordinary limitation makes for more productive calculations to prepare the model, as opposed to the overall class of Boltzmann Machines. Generally, a RBM is a straightforward ANN with a solitary obvious layer and a yield layer and no shrouded layers in the middle. It can likewise be seen as an unfurled neural organization with three layers, the yield layer having similar number of neurons as the information layer, and utilizing a typical arrangement of loads for the two layers. The fundamental contrast is the manner by which the model is prepared and, in its capacity, to remake its contribution from its yield.

A RBM model can be spoken to with a vector v of M obvious units, a vector h of N shrouded units, a network W of loads associating the noticeable and the concealed units ($[M \times N]$ lattice), a vector b of M obvious inclinations and a vector c of N concealed predispositions. As a standard neural organization, the loads are straightforwardly associated, implying that a yield neuron is associated with each info neuron. This implies the planning capacity utilizes the framework augmentation activity to associate the two layers. In opposition to standard neural organizations, a unit has a likelihood and a state and both are utilized during preparing. The actuation likelihood is the likelihood of a unit to be enacted while the state is the aftereffect of inspecting the likelihood. At the point when a RBM is utilized as a component extractor, the separated highlights are the initiation probabilities of the yield (covered up) layer. The cycle of RBM is appeared in Fig 3.

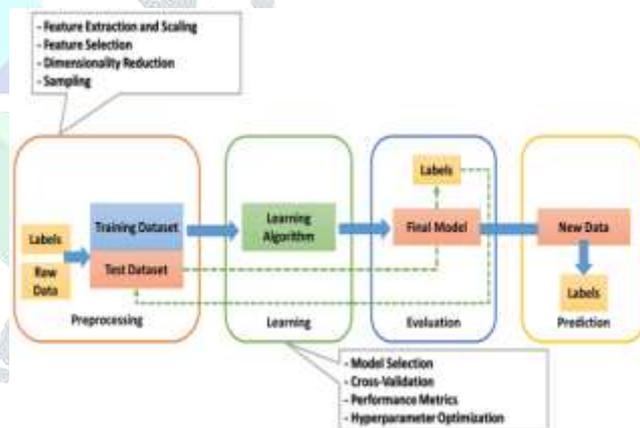


Figure 3: Proposed System Model

The objective of preparing a RBM is to make it model the info conveyance as well as could be expected. For this, the information tests must be made more probable and different examples more uncertain during preparing. As such, the probabilities of the information tests $p(x)$ must be expanded. To limit this cost work, stochastic angle drop can be utilized, inferring the subordinate of the capacity for one example as for the boundaries of the framework. The two pieces of the slopes are commonly alluded as the positive and negative stages. The inclinations of the positive eliminate can be conveyed since it is adapted on the estimation of a preparation test. In any case, the slopes of the negative stage are obstinate. Along these lines, it is important to inexact this negative term so as to productively perform slope plummet. The utilization of Alex Net in framework assists with improving precision as it is a pretrained model that can deal with enormous picture dataset at once and furthermore gives better order results.

The pretrained association can assemble pictures into 1000 article arrangements, for instance, support, mouse, pencil, and various animals. The association acknowledges an image as information and yields a name for the article in the image alongside the probabilities for all of the thing groupings. The image Datastore thus denotes the photos reliant on envelope names and stores the data as an Image Datastore object. An image datastore engages you to store colossal picture data, including data that doesn't fit in memory, and beneficently read gatherings of pictures during getting ready of a convolutional neural association.

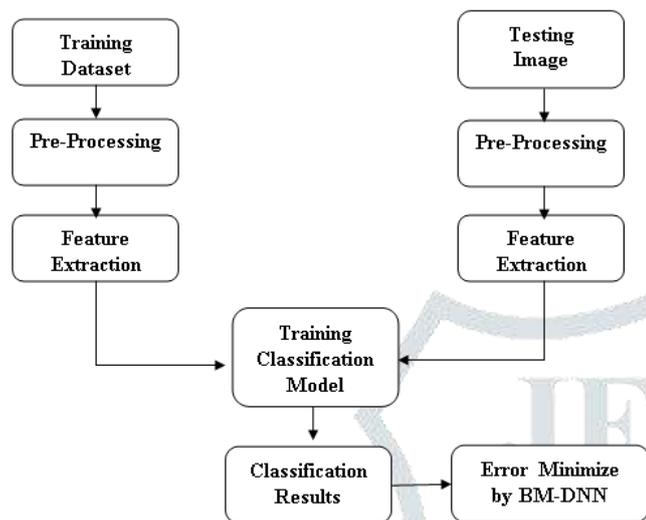


Fig 4: Proposed Model using BM-DNN

Use an extended picture datastore to normally resize the readiness pictures. Different Convolutional Kernels separate captivating features with respect to an image. In proposed framework model, it utilizes a bacterial picture dataset for investigation of execution of profound neural organizations. It utilizes preparing and test dataset at first then pre-handling is applied on the equivalent. The component extraction is applied on pictures and afterward prepared utilizing pre-prepared profound neural organizations for improving exactness of framework. Yet, it causes some RMSE esteem that is decreased by DNN framework. The last arranged yield is appeared at conclusive objective.

IV. RESULTS & DISCUSSION

This work gives the idea of microorganism's picture grouping and investigation utilizing progressed profound neural organizations. The utilization of profound learning gives the better exactness when contrasted with existing AI procedures. This work is concentrated on Bacteria dataset in which three kinds of datasets with 20 pictures are utilized for usage. The info pictures from each dataset is appeared in Fig 5. It is utilized for additional handling.

A. Results using ResNet

While CNN has just 2 convolutional layers and AlexNet has 5 convolutional layers in framework, Resnet has hundreds of convolutional layers in network. This profound neural engineering is going further and turns out to be increasingly more unpredictable exceptionally for picture information bases. The expansion inside and out can cause an issue for preparing more information bases together because of increment in stacking layers. For this, its presentation gets marginally diminished when contrasted with different organizations. This Resnet network has greater

multifaceted nature when contrasted with different organizations. The outcomes are appeared in Fig 2 and 3 underneath. The characterized yield utilizing network is appeared in Fig 4. It furnishes single anticipated yield with exactness of 96%.

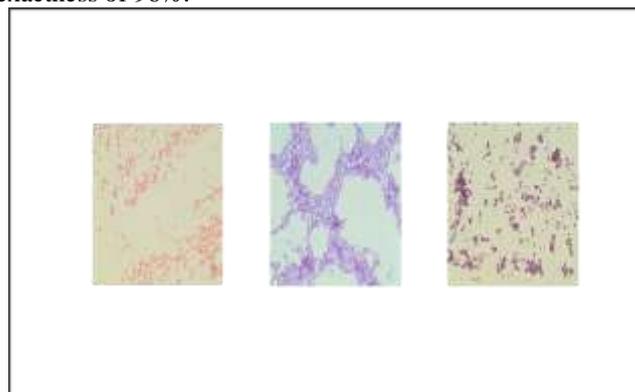


Fig 5: Input Images from Database

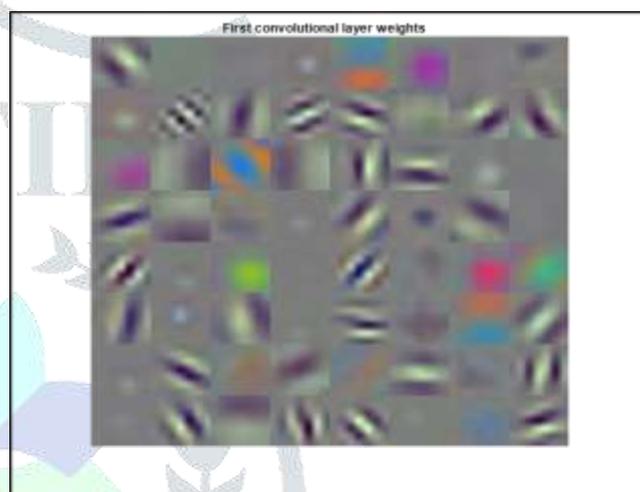


Fig 6: Convolutional Output of Database of Res Net

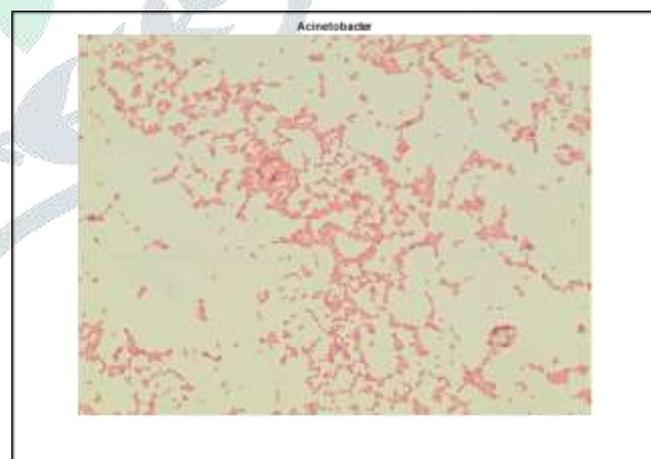


Fig 7: Classified Bacteria Image Output using Res Net

2. Proposed System Output

The CNN structure objects to accuracy, by then proposed method is used for improving the system. This work depicts the execution of two more significant varieties, specifically with 2 and 5 convolutional layers. The 2-layer configuration has two consecutive layers, after this a covered layer and sensitive max action is performed. The 3-layer configuration has an extra convolutional + pooling layer before the concealed and fragile max ones. This organization likewise takes a shot at same information base with same

info pictures and gives better exactness when contrasted with others. The outcomes are demonstrated as follows.

V. CONCLUSION

This work presents the idea of microscopic organism’s picture dataset investigation utilizing progressed profound learning technique. The traditional CNN framework disapproves of precision, at that point proposed strategy is utilized for improving the framework. The utilization of ResNet network in existing framework works just for huge datasets in framework yet once in a while it can mess up angle esteem thus lessening precision. It is a direct result of enormous number of convolutional layer networks that expansion multifaceted nature of framework. Because of this, it requires better profound learning strategy for improving exactness of framework. The CNN technique utilizes just 2 convolutional layers for highlight planning. Be that as it may, the proposed technique utilizes 5 convolutional layers and 3 covering layers. Because of this, it assists with improving exactness of framework when contrasted with other existing techniques. Additionally, it utilizes BM-DNN framework to deal with rmse estimation of organization. The utilization of DNN gives better execution rate when contrasted with other traditional blunder minimization techniques.

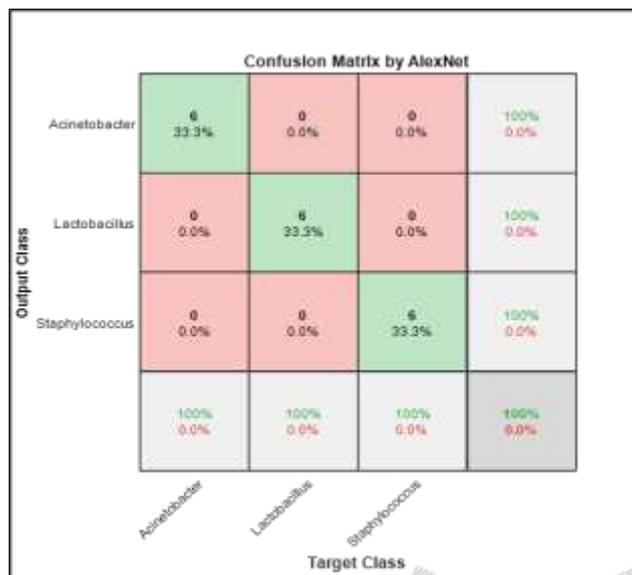


Fig 8: Confusion Matrix using Proposed Method

The final classified output is shown in Fig 9 and provides exact identification with proper labelling on image that shows the identity of particular image. So, it helps to provide results with almost better accuracy in system.

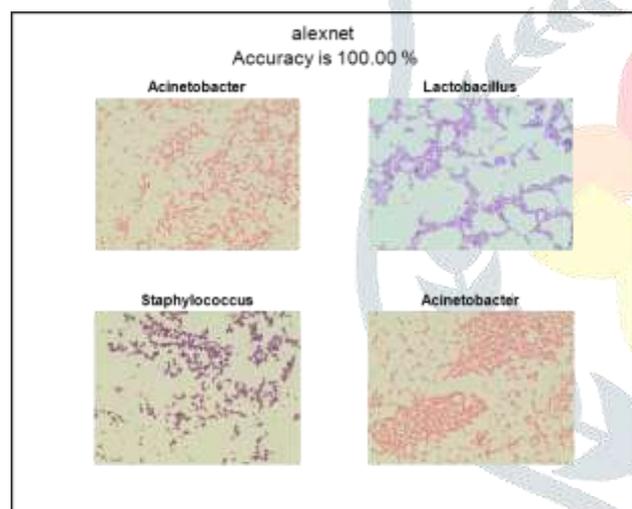


Fig 9: Classified Bacteria Output using Proposed Method

The final thresholder output using Otsu in DNN network provides better segmentation results for analysis and showing only bacteria separately. Table 1 shows the performance comparison of proposed system with existing methods and shows proposed results are better in terms of accuracy.

Table 1: Performance Comparison of System

| Parameters | RESNET [22] | Proposed (AlexNet+ BM-DNN) |
|------------|-------------|----------------------------|
| Accuracy | 96% | 99% |
| RMSE | 0.07 | 0.01 |

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