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DETECTION OF RETINOPATHY OF PREMATURITY USING CONVOLUTION NEURAL NETWORK

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ABSTRACT

Retinopathy of Prematurity (ROP) is an eye disease which leads to childhood blindness, it is most commonly found in premature babies, which is one of the largest preventable cause. The other name of ROP is retrolental fibroplasias (RLF), was first described in the mid-1900s. The use of Oxygen therapy in newborn babies is one of the major reason for cause of ROP. Due to this effect the role of supplemental oxygen in ROP has not been approved. Though there are many work has been undergone to detect ROP but the accurate method has not been identified. In ureti there will not be a normal development in blood vessels until the baby reach 40 weeks. The retina has not fully developed in premature babies. The retinal vessels may stop growing, or they may grow abnormally if retinal vascularization detached outside the uterus[1]. Due to abnormal development of blood vessels ROP occurs.ROP affects the new born babies' vision. To detect this at earlier stage this work is proposed. In this project dataset of ROP and normal images are trained by using CNN algorithm and the test image is compared with available dataset and the result is provided as the test images is of normal or with ROP.

Keywords*: *Convolution Neural Network, Database, Mini-batch loss, Retinopathy of prematurity, Time Elapsed.

I. INTRODUCTION

Retinopathy of Prematurity (ROP) is a proliferative retinal vascular disease that occurs when abnormal blood vessels grow and spread throughout the retina. Premature infants separate themselves from the maternal environment too early, so the edges of the retina may not get enough oxygen and nutrients. Doctors believe that the periphery of the retina then sends out signals to other areas of the retina for nourishment. As a result, new abnormal vessels begin to grow. These new blood vessels are fragile, weak and can bleed, leading to retinal scarring. When these scars shrink, they pull on the retina, causing it to detach from the back of the eyes. Nowadays, ROP has become a potentially blinding eye disorder that primarily affects premature infants weighing about 2.75 pounds (1250 grams) or less and being born before 31 weeks of gestation. The shorter gestation of baby, the more likely that baby is to develop ROP. According to ROP classification guideline[6] , 5 stages are used to describe the severity degree of ROP. Stage 1 has a thin but definite structure demarcation line, with recognisable abnormal branching or arcading of [4]vessels. The appearance of Stage 2 is that the ridges arise from the demarcation line and have height and width. Stage 3 demonstrates that neovascularization extends from the ridge into the vitreous. Stage 4 occurs partial retinal detachment. And Stage 5 occurs total Retinal

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detachment. The diagnosis of ROP is based on the retinal fundus images from premature infants. A simple screening test and timely treatment by an ophthalmologist can prevent from blindness . The early diagnose of ROP helps to reduce the vision loss of premature infants. However, ROP screening is facing two challenges. Firstly, clinical assessment and grading is difficult, the reason is that the quality of images such as type of lens, focus of image, size of optic nerve, pigmentation and other disease characteristics may influence final clinical assessment badly.

1.1 CONVOLUTION NEURAL NETWORK

Artificial Neural Networks are employed in varied classification[5] task like image, audio, words. different kinds of Neural Networks are used for various functions, AN performs well when machine leaning is involve example for predicting the sequence of words we have a tendency to use perennial Neural Networks additional exactly an LSTM, equally for image classification [2] we have a tendency to use Convolution Neural Network. Convolution neural network is divided into three layers. They are input layer, hidden layer and output layer.

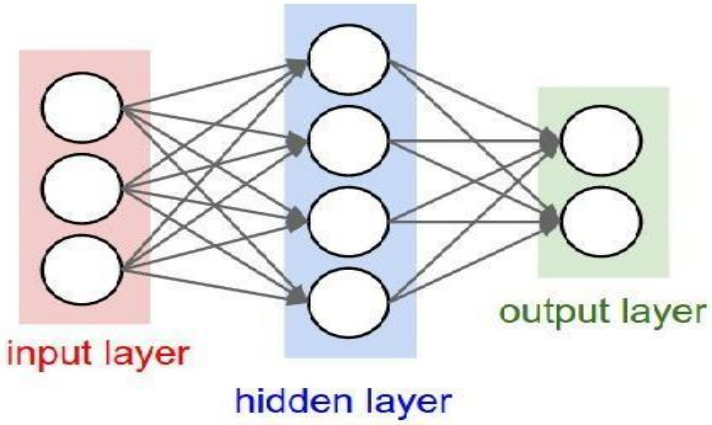

Fig 1. Convolution Neural Network

- INPUT LAYER

For the model the data is given by the input layer**.** The total number of features in the data is equal to the number of neurons present in that layer**. .**

- HIDDEN LAYER:
  - The information from Input layer is then feed to the shrouded layer. There are a few shrouded layers depending upon the model dependent on data size.
  - Every shrouded layer will have totally various quantities of neurons that territory unit normally bigger than the amount of alternatives.

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- The yield from each layer is processed by framework activity of yield of the past layer with learnable loads of that layer then by expansion of learnable predispositions pursued by initiation work that makes the system nonlinear.

- The hidden layers contains the following layers

1. CONVOLUTION LAYER:

   Convolution layer is a mainly used to extract features from the input image. The inputs of convolution layer are image matix and filter[2].

2. RECTIFIED LINEAR UNIT:

   Rectified linear unit (Relu) permits for quicker and easy training of a data. It is a activation function.It will change the negative value in image matrix to zero and maintain the positive values.

3. POOLING LAYER:

   At the point when the picture is too enormous pooling layer is utilized to diminish the quantity of parameters in the picture network where as the sorts of pooling layers are max pooling, min pooling, average pooling.

- OUTPUT LAYER

  The yield from the concealed layer is then encouraged into a strategic capacity like Sigmoid or Soft Max that changes over the yield of each class into likelihood of each class.

1.2 STAGES OF ROP

Stage I Mildly strange vein development. The infection is often associated with transient visual impairment.

Stage II Moderately unusual vein development ,again often transient ,which eventually resolves spontaneously.

Stage III Severely irregular vein development[3]. The unusual veins grow towards the centre of the eye instead of normal growth pattern. There is no treatment for the children who suffer in stage three. The threatened outcome with the plus diseases in stage –III is retinal detachment. Some infants in this stage escape with regular vision.

Stage IV Retina is disengaged from unique position[2]. Balance from the scar conveyed by biting the dust, surprising vessels pulls the retina away from the mass of the eye.

Stage V Fully disconnected retina results the infant to have serious visual disability and even visual deficiency.

1.3 CAUSES OF ROP

- ROP happens when odd veins create and spread all through the retina, the tissue that lines the back of the eye.
- These atypical veins are sensitive and can spill, scarring the retina and pulling it out of position.

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- This causes a retinal detachment. Retinal partition is the central driver of visual impedance and visual weakness in ROP.
- A couple of complex components may be accountable for the headway of ROP.
- The eye starts to make at around four months of pregnancy, when the veins of the retina begin to shape at the optic nerve in the back of the eye.
- The veins grow relentlessly toward the edges of the making retina, giving oxygen[7] and enhancements. During the latest 12 weeks of a pregnancy, the eye develops rapidly.
- At the moment that a youngster is brought into the world full-term, the retinal vein advancement is commonly completed (the retina usually wraps up a large portion of a month to a month after birth).
- In any case, if a kid is imagined impulsively, before these veins have landed at the edges of the retina, regular vessel improvement may stop.
- The edges of the retina the edges may not get enough oxygen and enhancements.

1.4 PROPOSED METHOD

Load and Survey Image Data

- Digit test information is loaded as a image dataset consequently names the pictures dependent on envelope names and stores the information as an Image dataset object.
- A picture dataset permit you to store enormous picture information, including information which is not present in the memory, and productively read groups the pictures during preparing of convolution system.

Specify Training and Validation Sets

- Partition of information into preparing and evaluating datasets, with the goal that every classification in the preparation dataset includes numerous pictures, and the approval dataset includes the rest of thepictures from every name.
- Each label is divided and stored in the data store digit Data into two novel data stores for prepaing and evaluating the Digitdata.

Image Input Layer

- An picture Input Layer is the place you determine the picture dimension, for this situation, 375-516-3.
- Width and channel dimension of the stature is compared with numerical values.
- The channel dimension is 1 for a gray scale picture and the channel dimension is 3 for color pictures.
- since training Network, itself, rearranges the information toward the start of training.
- Train Network can likewise naturally rearrange the information toward the start of each epoch during training.

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Convolution Layer

- In the convolution layer, the primary argument is filter Size, which is the tallness and width of the channels the preparation capacity utilizes while examining size is 3-by-3. You can indicate various sizes for the tallness and width of the channel.
- The subsequent argument is the quantity of channels, numFilters, which is the quantity of neurons that interface with a similar area of the information.
- This parameter decides the quantity of highlight maps. You would be able to characterize the stride and learning rates for this layer utilizing name-esteem pair contentions of convolution2dLayer, along the pictures. In this model, the number 3 shows that the channel[2].

Relu Layer

- The rectified linear unit (Relu) is the most common activation function
- Rectified Linear Unit which neglects the negative value and convert it into positive value.

Max Pooling Layer

Convolution layers (with actuation capacities) are now and then pursued by a down-testing activity that decreases the spatial size of the element guide and expels excess spatial data.

- Down-testing makes it conceivable to expand the quantity of channels in more profound convolution layers without expanding the necessary measure of calculation per layer.
- One method for down-inspecting is utilizing a maximum pooling, which you make usingmaxPooling2dLayer.
- The maximum pooling layer restores the most extreme estimations of rectangular districts of data sources, indicated by the principal contention, pool Size.
- In this model, the size of the rectangular area is [2,2]. The 'stride' name-values pair argument determines the progression size that the training function takes as it examines along the input

Fully Connected Layer

- The convolution and down-examining layers are trailed by pursued by in any event one completely associated layers.
- Fully associated layer is the place the neurons interface with the majority of the neurons in the past layer.
- This layer joins the majority of the highlights learned by the past layers over the picture to perceive the more noteworthy models.
- The last completely associated layer joins the highlights to portray the pictures.
- Consequently, the Output Size parameter in the last completely associated layer is indistinguishable from the quantity of classes in the objective information[2].

Softmax Layer

- Output of the fully connected layer is used to standardize the softmax activation function .

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- The summed output of the softmaxlayer can be used to classify the probabilities obtained by the classification layer.
- After the last fully connected layer make a softmax layer for utilizing softmax function.

Classification Layer

- The characterization layer is the last layer in the neural system.
- To relegate the info this layer utilizes the probabilities acquired by the softmax initiation work for processing the misfortune in one of the commonly irrelevant classes.

Label the Preparation Option

- Using preparing options and data the network characterized by the layers are trained.
- The training graph demonstrates accuracy ,mini-batch loss and validation loss.
- CPU cannot be used to train large dataset.
- The cross-entropy loss is a type of loss.
- The precision level of pictures characterizes the system effectively.

Evaluation of Images and Calculating Accuracy

- The labels in the evaluated data is predicted and the final evaluation of the trained network is calculated. Precision is the portion of marks that the system predicts effectively.
- The original data in the evaluation set is matched with the predicted output.

II. EXPERIMENTAL RESULTS

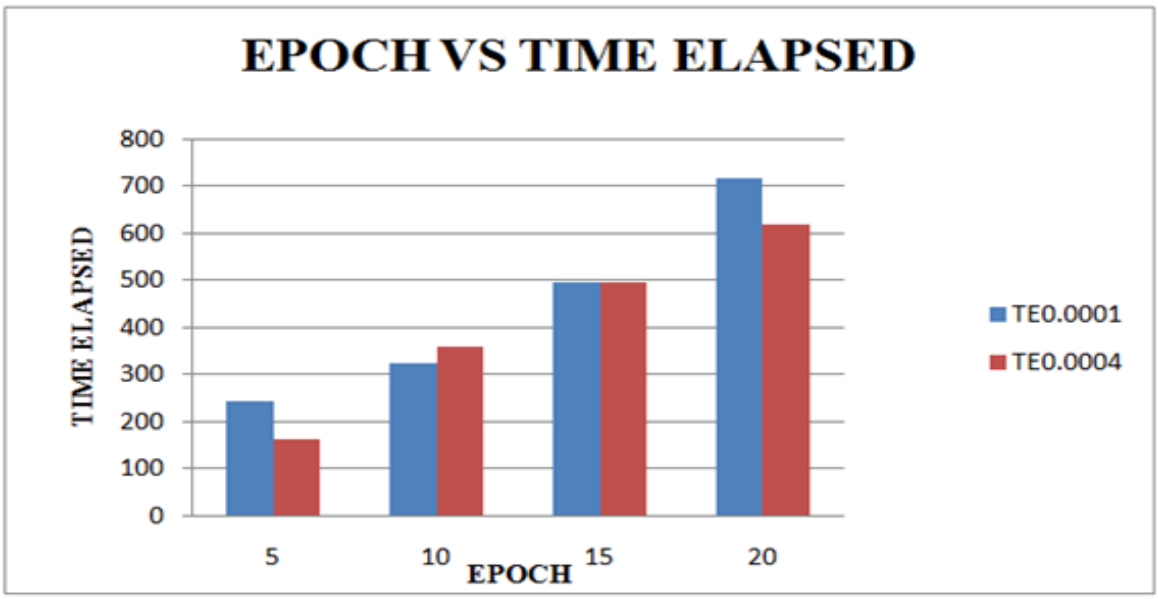

Fig 2 Epoch Vs Time elapsed for 5*5 convolution layer with Learning rate 0.0001 and 0.0004

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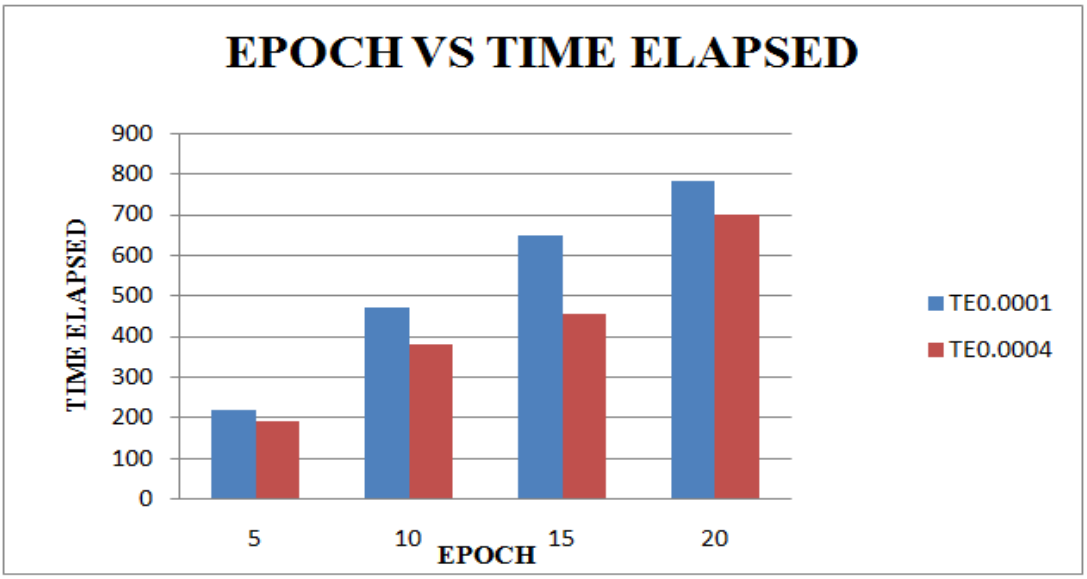

Fig 3.Epoch Vs Time elapsed for 6*6 convolution layer with learning rate 0.0001 and 0.0004

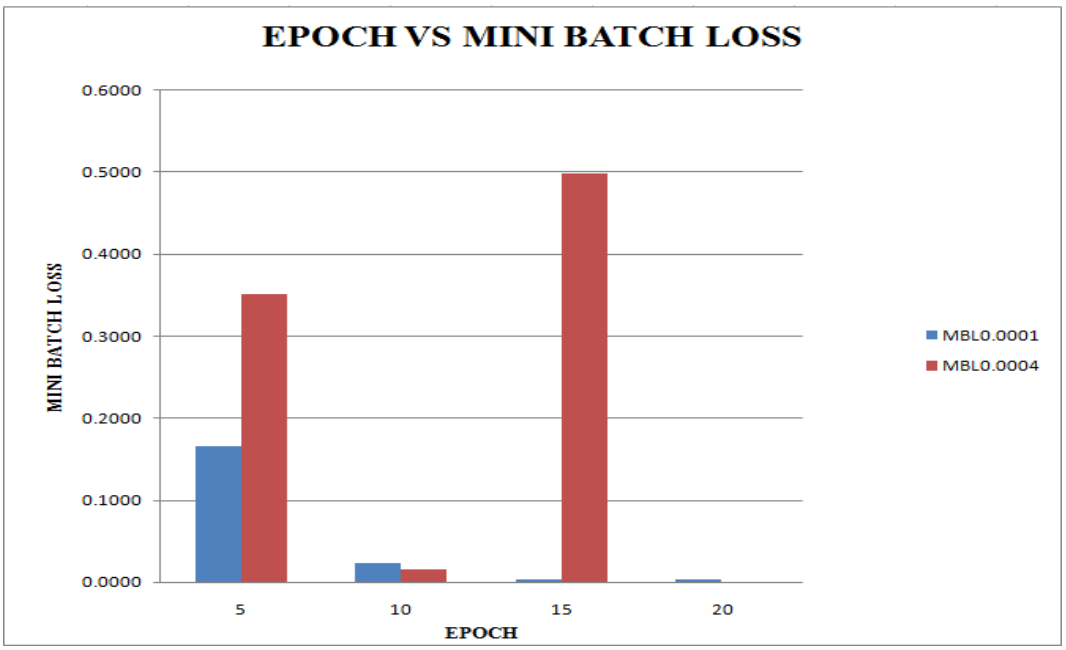

Fig 4. Epoch Vs MiniBatch Loss for 5*5 convolution layer with Learning rate 0.0001 and 0.0004

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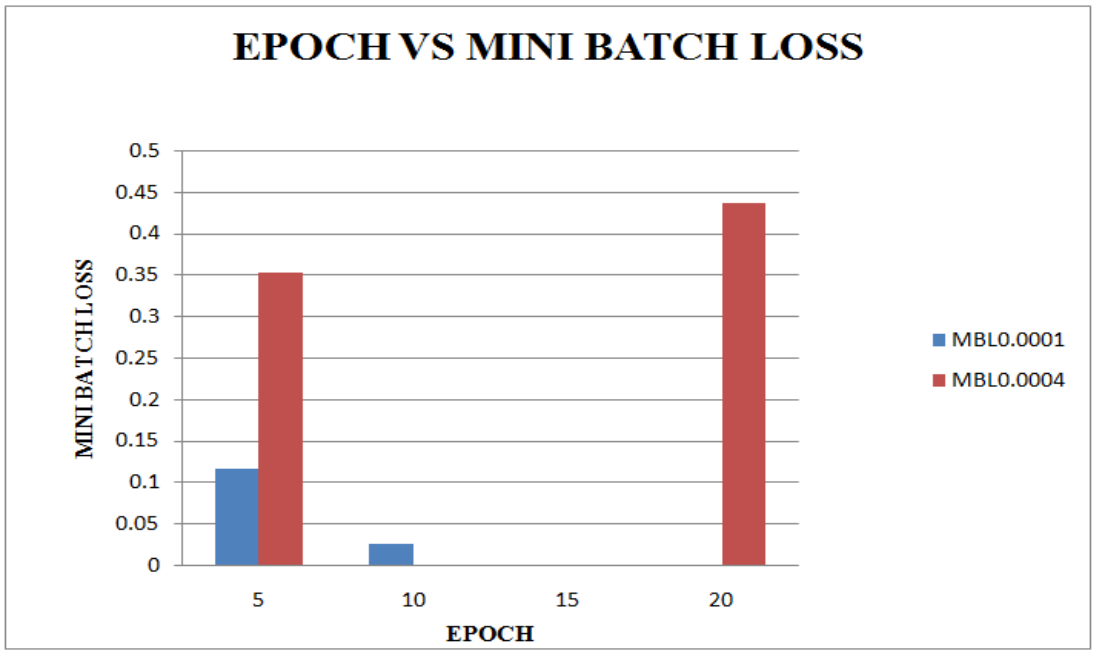

Fig 5.Epoch Vs MiniBatch Loss for 6*6 convolution layer with Learning rate 0.0001 and 0.0004

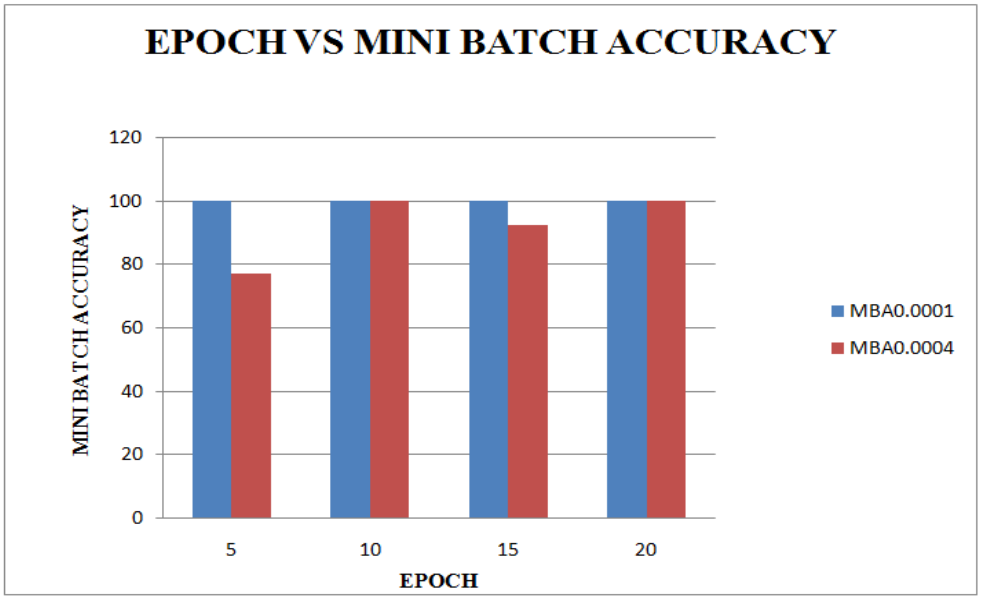

Fig 6. Epoch Vs MiniBatch Accuracy for 5*5 convolution layer with Learning rate 0.0001 and 0.0004

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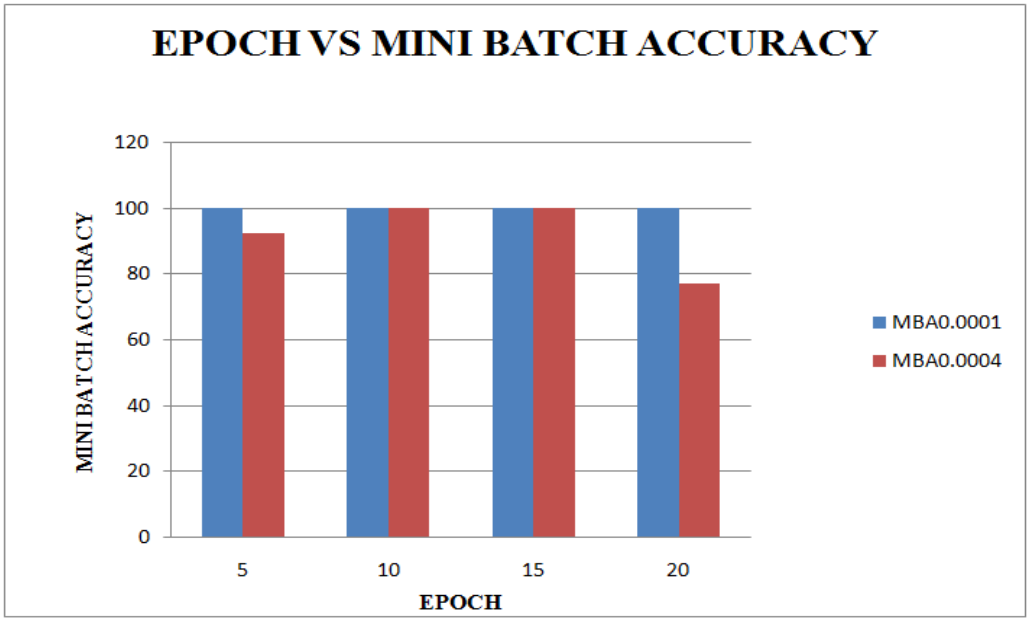

Fig 7.Epoch Vs MiniBatch Accuracy for 6*6 convolution layer with Learning rate 0.0001 and 0.0004

CONVOLUTION LAYER	EPOCH	TIME ELAPSED	MINI BATCH LOSS	MINI BATCH ACCURACY (%)	LEARNING RATE
5*5	1-5	66.47-245.67	0.8289-0.1661	61.542-100.00	0.0001
	1-10	31.72-326.17	0.8474-0.0227	53.85-100.00	0.0001
	1-15	33.89-494.55	0.9664-0.0037	61.54-100.00	0.0001
	1-20	43.14-715.00	0.8289-0.0036	61.54-100.00	0.0001
	1-5	32.52-164.69	0.8365-0.3571	38.46-76.92	0.0004
	1-10	36.67-360.71	0.5999-0.0152	84.62-100.00	0.0004
	1-15	36.39-496.82	1.5596-0.4981	46.15-92.31	0.0004
	1-20	31.95-617.92	0.61419-0.0001	76.92-100.00	0.0004
6*6	1-5	51.15-218.28	2.3335-0.1172	46.15-100.00	0.0001
	1-10	40.52-471.59	1.5820-0.0263	46.15-100.00	0.0001
	1-15	46.14-699.42	1.6154-0.0010	46.15-100.00	0.0001
	1-20	38.55-783.85	1.1147-0.0000	46.15-100.00	0.0001
	1-5	39.02-192.31	0.9035-0.3521	69.23-92.31	0.0004
	1-10	38.88-381.69	0.9466-0.0007	76.92-100.00	0.0004
	1-15	32.07-455.57	1.7594-(-0.0000)	46.15-100.00	0.0004
	1-20	38.22-698.64	3.2383-0.4366	53.85-76.92	0.0004

IV.CONCLUSION

Retinopathy of prematurity is a kind of optic nerve disease which leads to blindness if it remains untreated. In medical field Retinopathy of prematurity is the most important research topic. For the detection

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and diagnosis of ROP many devices has come into existence but their use is very much expensive. Due to this serious eye disease large number of people are affected. In this work, to detect and diagnosis ROP convolution neural network. The main purpose is to highlight the severity of ROP across the globe as well as covering the research work done so far on this disease. From the results it is identified that learning rate of 0.001 gives 100% accuracy in detection of ROP compared to other values and provides minimum batch loss

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