ADVANCED SUSPICIOUS ACTIVITY DETECION USING IOT

Mamta Rani[1], Dr. V.K. Srivastava[2]

[1]Mamta Rani, Research Scholar, BMU University, Rohtak
[2]Dr. V.K.Srivastava, Prof. & Head, Deptt. Computer Science, Baba Mastnath University, Asthal Bohar, Rohtak (Haryana)

ABSTARCT: Research paper is considering the research in field of IOT and advantages of IOT based devices are also discussed. The role of IOT is to develop an intelligent trained neural network that should be capable to capture the signal. Image processing allows the capturing and preprocessing of graphical content before training operation. Here pre-trained set is used to trace occurrence of particular event. Research paper has also presented existing research in relevant field. The limitations of existing researches have been explained. Moreover the result and proposal to resolve the issue are also presented. The limitation of previous researches where there time consumption and accuracy. It has been observed that there was need to do lot of work on performance and accuracy factor to make the IoT system more reliable. Moreover the previous work was able to deliver limited solutions. Thus there remains need of work that should be capable to deliver quality solution. The proposed work is providing best solution by integration of image processing, neural network in IOT system. The use of neural network has made system intelligent while use of image processing has increased the performance. Forecasting and taking decision according to trained neural network to lay foundation for proposed work. Simulation work has performed detection of suspicious activities with more accuracy in less time as compared to previous researches. Proposed research is considering experimental research and it is more scalable, flexible, versatile and efficient as compare to previous researches.

Keyword: IOT, Neural Network, Fire Detection, suspicious activity, Accuracy, Time consumption

1. INTRODUCTION

Research work has made use of IOT model to capture the signal. On other hand prediction and detection has been carried out on the basis of trained neural network. Image processing allows the capturing and preprocessing of graphical content before training operation. In this way, IOT and deep learning have been integrated to detect the fire, unauthentic vehicle and person. This section has introduced the IOT and deep neural network along with image processing.

1.1 IOT

Internet of Things is used for devices that are basically focusing on communication and computation capabilities. IOT is connection of physical objects. These objects might be vehicle, buildings and electronics. It may also consider the network that is allowing devices to interact. Network plays significant role in storing and exchange information. In other words IOT is a system of internet-connected and interrelated objects. These objects are capable to store and transmit data on the wireless network. All these operations are performed without human intervention. IOT is now becoming more commonly connected to the Internet. In case of various services, IOT have been built on top of services that are provided by devices jointly. Benefits of IOT are that it is providing new opportunities in commercial operations and it has latest capabilities to forecast and perform action. It is also found helpful in improving monitoring. Moreover it is providing scalability by fine tuned services as well as products and it is also improving control of operation processes.

The internet of things (IOT) is made up of digital objects and information that can be seen. This building is laden with tones of physical, devices, vehicles, and buildings, as well as much as with hardware. These components are built into the company's computing hardware, programming systems, as well as the sensing and networking devices, are all part of the business. Due to this, the information accumulation and data transferability of these items, we are able to save several records. When it is possible to feel and to handle objects a certain distance under the current framework, it provides an opportunity to perceive and govern things. Environmental interaction may come hand, not from a device, but instead, in direct relationship with computer systems. it improves efficiency, accuracy, as well as is more cost-effective the same for computers: Once Internet of Things sensors are mounted, computerized systems will easily become broader examples of geographical machines that manage, environmental and geologic features It incorporates equipment which allows automated home appliances, industrial automation, solar grids, intelligent buildings, and smart transportation. It also supports the operation of advanced smart grids and cities. As it is possible to classify an entity using the computational device enclosed by the

specified object, one can consider using only that one in order to achieve greater success. It is critical that these systems are present, though, for the use of it to be effective, as a supplement to the internet infrastructure. It is estimated that by the year 2020, internet connectivity would have reached the point where approximately fifty million things will be connected through the internet of things.

FIGURE Error! No text of specified style in document.**.1**
INTERNET OF THINGS

Figure 1.1 is presenting the interconnectivity of cloud to user, mobile, tablet, desktop pc, ear phone, mic, microcontroller and other domestic IOT devices to cloud. This figure is showing interconnectivity and dependencies among devices.

1.2 ADVANTAGES OF IOT BASED DEVICES

There are a variety of IoT-based gadgets that are effective in a variety of industries. The gadgets that are connected to the internet of things (IoT) can be readily monitored. The following are some of the benefits of IoT-based devices:

Improved Device Monitoring

There is no need for user involvement while using IOT devices. Device-to-device communication enables the user to keep processes as transparent as possible. In general, IoT-enabled devices are employed to carry out comparable tasks. These technologies make it simple to get high-quality service. IoT devices are simple to use and effective. These allow us to oversee and regulate the tasks. Such IOT-based gadgets are utilised to execute repetitive tasks and provide high-quality output.

Efficient and Time-Saving

It has been determined that IOT devices save us important time, which we can put to better use elsewhere. It is now simple to employ IoT devices to conduct comparable operations on a regular basis. As a result, device-to-device communication increases efficiency and improves the automation system. In this approach, one may utilise IOT devices to save time and utilise that time to acquire new things or abilities. As a result, IOT-based products may be considered to make our lives easier and more pleasant.

It is cost effective.

Using IoT-based devices, one may save energy and resources that would otherwise be squandered on comparable tasks. Using this technology, it is now possible to integrate gadgets into automation systems. Only one thing stands out here: it is necessary to monitor such devices in order for them to conduct routine functions.

A higher standard of living

Without a question, AI and IoT-based products are responsible for making our lives better and raising our living standards. These products make it simple to improve comfort, convenience, and management. It goes without saying that our lives will be easier and more pleasant if our gadgets function automatically and make decisions based on the circumstance.

Environment that is smart

IoT-based gadgets are offering a smart environment in a cost-effective manner. The gadgets in this smart environment are AI-based and react to the circumstance. AI-based windows, for example, adjust their position in response to the sun and wind. It's necessary to keep the rooms' temperature, humidity, and fresh air at a constant level. Furthermore, it is feasible to track emissions from enterprises and cars. As a result, we can reduce air pollution. Furthermore, there are various sensors that detect the presence of fire and alert us to the situation.

Health Observation

In the health-care industry, IoT-based gadgets play a key role. It is now quite simple to recognize the signs of a specific illness. Furthermore, IOT-based medical prescription systems assist our physicians in identifying specific diseases, as well as the appropriate drugs and precautions. The strain of patients on physicians may be readily reduced by using IoT-based gadgets. It is now simple for doctors to deliver services to all patients.

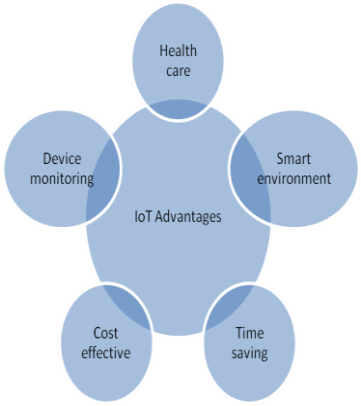

FIGURE Error! No text of specified style in document.**.2 ADVANTAGES OF IOT BASED DEVICES**

3. PROBLEM STATEMENT

However there are many research in field of IOT but they have certain limitation. Existing research related to IOT are suffering from self decision making and learning capabilities. Moreover there scope is limited. Those researches have resolved the limited issues. There have been need of scalable and flexible research that could make use of IOT and artificial intelligence. However some IOT based research has made use of AI but there is need to resolve real life problems. Moreover the image processing mechanism need to applied to reduce the decision making time. The real life implementation is time consuming. More over the system are supposed to be smart enough to take decision. The deep learning with image processing is capable to play significant role in decision making where decisions are taken on the basis of image identification. Image processing and neural network need to be integrated with IOT in order to detect fire event and presence of unauthentic persons.

4. PROPOSED APPROACH

Capabilities of existing devices for more security of any industries are enhanced and management of the devices remotely via IOT and AI has been performed. Our approach is considering research related to IOT, deep learning and image processing and investigating the limitation of previous researches. Proposed work has interconnected IOT model to capture the signal (Fire, Humans, Vehicle, etc.) and predict and detect on the basis of trained neural network. This work is allowing display of prediction on web page connected to web interface. Enhancement of performance of model using user defined trained neural network has been made in this research. Research is performing the comparative analysis of performance. The research methodology is experimental, and approach of this research is considering neural network to make system smarter. The focus of research is to improve the performance and reduce the time consumption and manpower and also focuses on security during its operation. In other work our approach is opting to improve accuracy, performance, functionality.

4.1 INTEGRATION OF DEEP LEARNING TO IOT SYSTEM TO DETECT THE SUSPICIOUS ACTIVITIES

Research work has focused on the integration of data capturing, feature extraction and decision making module to trigger the alert system. This system is capable to detect fire, unauthentic vehicle, unauthentic person and any suspicious activity. The camera has been used to capture the image after intervals then the captured image is preprocessed in order to reduce its size for further processing. Neural network mechanism is used to recognize the feature according to trained set. The dataset of image has been trained to find the pattern. Then the decision would be taken considering patterns whether to trigger for notification or not. The triggered information is set via IOT system to remote location. The essential steps would be taken to resolve the issue due to any suspicious activity.

4.2 THE OBJECTIVES OF PROPOSED RESEARCH ARE AS FOLLOW:

1. Considering research related to IOT, deep learning and image processing and investigating the limitation of previous researches.

2. Considering interconnected IOT model to capture the signal from existing research that are predicting and detect on the basis of trained neural network to lay foundation for proposed work.

3. The proposed work is supposed to perform detection of suspicious activities in more accurate fashion with high performance as compared to previous researches. The several operations that would be performed in proposed work with high accuracy, speed and reliability are:

    a. Detection of suspicious activity

    b. Detection of unauthorized vehicle

    c. Fire Detection

    d. Confirming present of authentic person

4. The display of prediction on web page connected to web interface to manage the devices remotely and comparing the accuracy and time of previous work to proposed work.

4.3 PROPOSED MODEL

In proposed model the n frame would be captured after time interval and would be preprocessed before apply train network classifier. After detection of any event that is supposed to be traced the status dataset is updated. The web interfaces gets data from status dataset and update the web page that is connected to web interface.

Fig 4.1 is showing the showing the process of proposed work. Captured image is preprocessed to reduce size then trained network is used to detect the captured content. Then decision making process takes place for updating status of frame and time in file. The updated status is saved in status dataset.

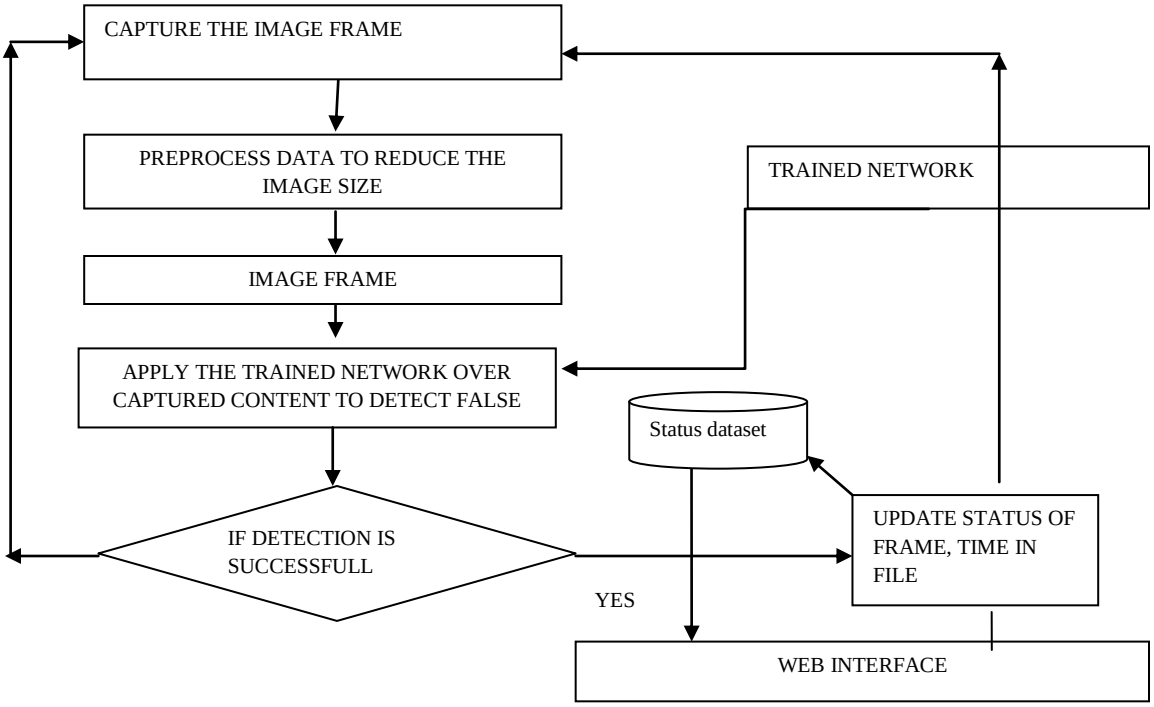

Figure 4.1: Flow chart of proposed model

The objectives of proposed research are considering research related to IOT, deep learning and image processing and investigating the limitation of previous researches. Research is proposing interconnected IOT model to capture the signal and predict and detect on the basis of trained neural network. Research is supposed to enhancement the performance of model using user defined trained neural network. The web page connected to web interface would display the prediction. Research work has focused on the integration of data capturing, feature extraction and decision making module to proposed the fire alert system. The camera has been used to capture the image after intervals then the captured image is preprocessed in order to reduce its size for further processing. Neural network mechanism is used to recognize the feature according to trained set. The dataset of image has been trained to find the fire pattern.

Figure 4.2 is showing process of image capturing and reducing its size. Then trained network is supporting decision making. Finally confusion matrix is extracted to get accuracy.

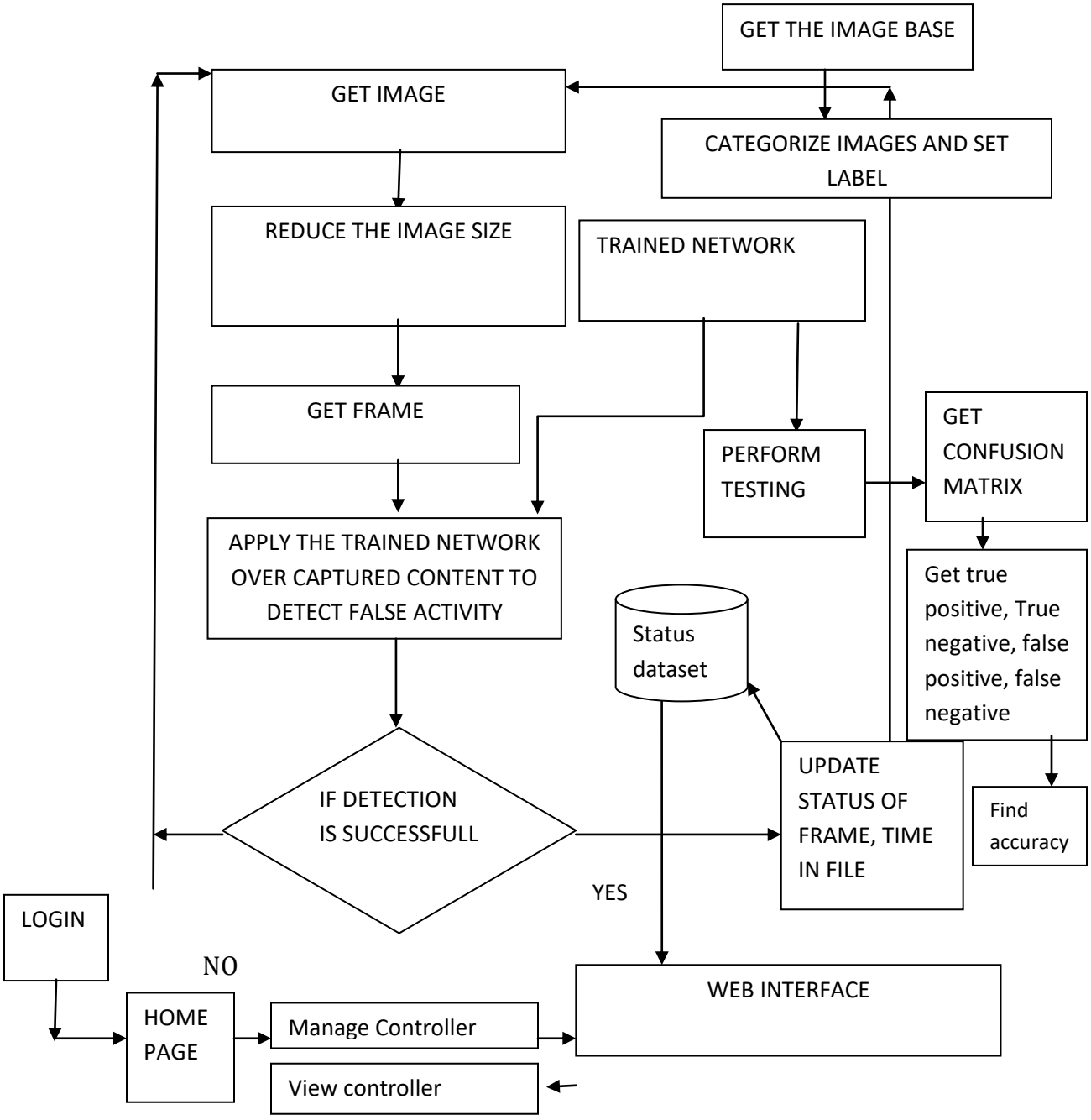

Fig 4.2 Proposed work

Then the decision would be taken considering patterns whether to trigger for fire notification or not. The triggered information is set via IOT system to remote location. The essential steps would be taken to resolve the fire issue. In proposed model the n frame will capture after time intervals and will preprocessed before apply train network classifier. After detection of any event that is supposed to be traced the status dataset is updated. The web interfaces gets data from status dataset and update the web page that is connected to web interface.

Proposed work is far better as compare to traditional work because it is providing more accurate, scalable and flexible solution. The comparison of proposed work to traditional work has been shown in following table.

Table 4.1 Comparison of proposed work to previous work

COMPARISON PARAMETER	PREVIOUS WORK	PROPOSED WORK
IOT system	Yes	Yes
Neural Network based training	Yes	Yes
Accuracy	Comparatively low	Comparatively more accurate
Confirming present of authentic person	Yes	Yes
Fire Detection	No	Yes
Detection of unauthorized vehicle	No	Yes
Detection of suspicious activity	No	Yes
Time consumption	Relatively high	Comparatively low

Table 4.1 is comparing the comparison parameters such as IOT system, Neural Network based training, Accuracy, Confirming present of authentic person, Fire Detection, Detection of unauthorized vehicle, Detection of suspicious activity, time consumption. It has been observed that proposed work is having additional features. More over time consumption is low and accuracy is high in case of proposed work as compare to previous work.

5. IMPLEMENTATION

Matlab has been used as tool used to capture the image and preprocess it. Neural network based training and feature detection is also made using Matlab. The successful detection statuses are updated in dataset using MATLAB script. On other hand the external interface that is visible to user is web based. The web based script would be written using PHP. The PHP is connecting the status dataset to web page. Image resizing mechanism can be used to reduce the size of image. Moreover edge detection mechanism should be used to eliminate the shading from graphical images. Neural network classifier is used to classify the pattern on the bases of trained network. The deep learning techniques are used to trace the pattern. The methodology used in research is experimental. The experimental methodology focuses on the technical implementation after processing input. Such methodology contributes technical experiment and proposes new mechanisms.

5.1 IMPLEMENTATION

The implementation of proposed work has been divided in different phases that are discussed below:

1. **PHASE 1 :** Training of neural network to perform detection and prediction
    a. During this face initially the image set of fire images, number plates and authentic persons are stored in three different folders. Then the CNN based training mechanism is used to train the network considering these images.
    b. The 70% data is used for training and 30% data is used for testing
    c. The trained network is taken for future decision making operation and testing operation.

Phase 1 involves considering image set for training

- Image set of Fires: the images of fire, volcano and flame are stored in a folder and labeled as fire in order to train the network to detect the fire event

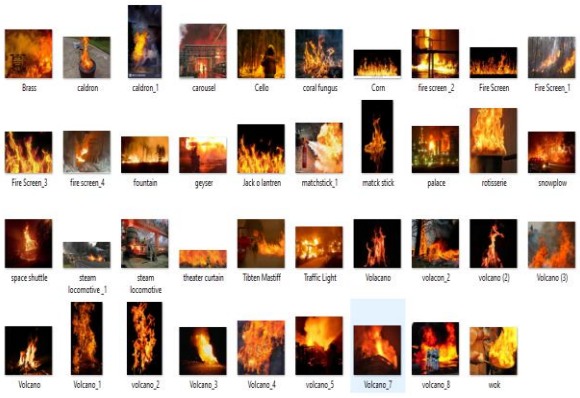

Fig 5.1 Fire images

- Image set of number plates

Fig 5.2 Images of Authentic vehicle with number plates

- Image set of authentic persons

Fig 5.3 Images of Authentic persons

Training of CNN Network is made in order to perform detection and prediction on bases of trained network using above image sets. The process flow is shown below:

Process of training image based neural network model

1. Get the initial instance of graphics related to every class.
2. Find the minimum amount of graphics in the class.
3. Set the limit of the count of graphical images in order to minimize time consumption.
4. Check whether every group is having same number of graphics.
5. Pre trained network is loaded
6. First section of the network is visualized.
7. Check the initial layer
8. Check the ending layer
9. Get the count of class names for graphical network classification operation
10. Make the preparation of training as well as test Image Sets
11. Apply the pre-processing on graphics for CNN
12. Get the training characteristics with the support of CNN
13. Find network weights for second convolutional layer
14. Set the size and weights for visualization operation
15. Perform the training characterization
16. Allow the training of Multiclass classifier with the help of CNN Features
17. Obtain training labels from trainingSet
18. Evaluate Classifier
19. Find the test characteristics with the help of CNN
20. Set the CNN graphical features to the trained classifier.
21. Obtain labels
22. Set results in tabular form with confusion matrix.
23. Apply the Trained Classifier On One Test Image
24. Image features are extracted using activations
25. Get graphical features with the help of CNN
26. Perform prediction with the help of classifier

During image classification is performed during training of neural network as shown in following figure. The count of image are shown correspondingly.

```
>> imageclassification

tbl =

  3×2 table

        Label         Count
    ______________    _____

    fire images        39
    human beings        6
    number plates      17


ans =

  3×2 table
```

Fig 5.4 Classification of images

Image_Input_Layer with properties:

Name : 'input_1 '

Input_Size : [224 224 3]

Hyperparameters

Data_Augmentation : 'none'

Normalization : 'zerocenter'

Normalization_Dimension : 'auto'

Mean: [224×224×3 single]

ans =

ClassificationOutputLayer with properties:

Name: 'ClassificationLayer_fc1000'

Classes: [1000×1 categorical]

OutputSize: 1000

Hyperparameters

LossFunction: 'crossentropyex'

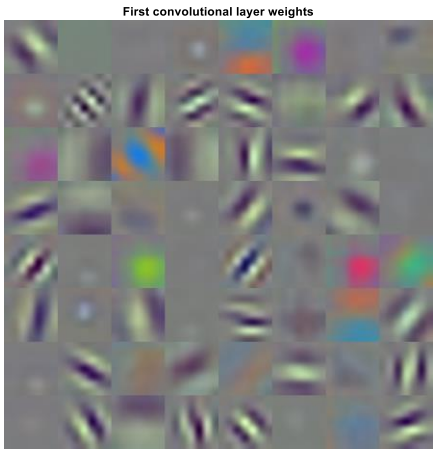

Fig 5.5 Convolution layer weights

PHASE 2: Testing of neural network in order to check the accuracy

d. Input from camera or storage device is taken in order to check the accuracy of trained model.
e. The input is taken in form of image
f. The input is processed with stored trained network to detect the category and take decision.

During testing operation an image of fire has been considered and processed with trained neural network. At the time of testing confusion matrix is created presenting the accuracy of model as shown below:

confMat =

1 0 0

0 1 0

0 0 1

ans = 1

testLabel =

categorical

fire images

predictedLabel =

categorical

fire images

PHASE 3: Applying the neural network in real system

In real system the Input is taken from camera

There could be three type of image.

1. Fire event
2. Image of person
3. Image of number plate of vehicle

The trained neural network is processed with input image to trace the fire or unauthentic person or vehicle. Following windows is presenting Matlab simulation to trace or detect the image from trained network and get the prediction for web interface.

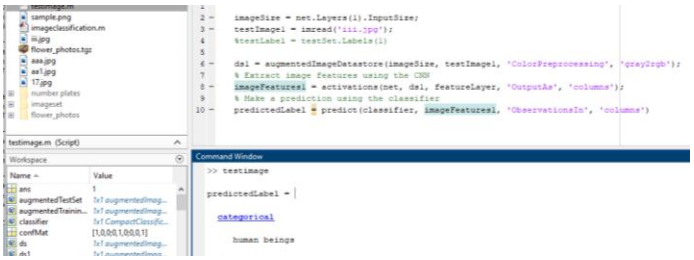

Fig 5.6 Matlab simulation for real life image detection and prediction

PHASE 4: Development of PHP based Web interface in order to present the prediction and detection on web page. The result or prediction by neural network would be transferred to web interface. The web interface developed in PHP would present manage the status of devices on web page

Implementation of web interface to manage devices remotely

1. Initially the XAMPP control panel is configured in order to host the PHP script. Different services named Apache, MySql are started.

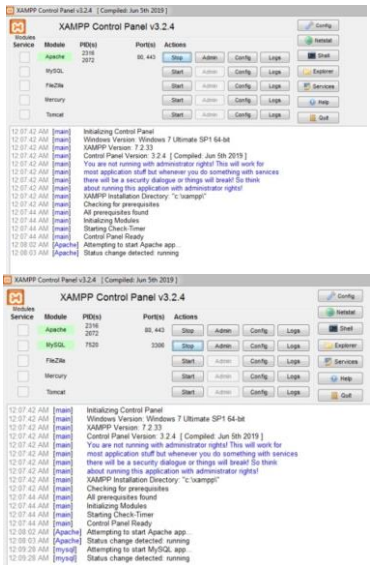

Fig 5.7 XAMPP CONROL PANEL

2. The web content are stored in web server. Then the login module is run. The following page is shown during login operation.

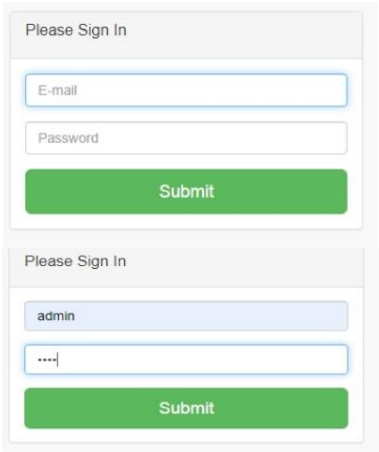

Fig 5.8 LOGIN

3. After successful login a welcome window with side menu appears. User could switch to view control and manage control to manage the devices. Moreover there is option to switch to alert system in order to detect the status of fire, authentic and unauthentic vehicle or human being

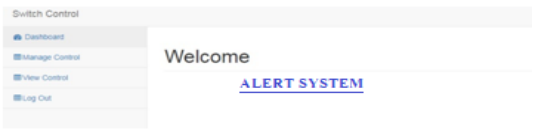

Fig 5.9 Welcome page

4. View control is representing the status of different devices whether they are on or off.

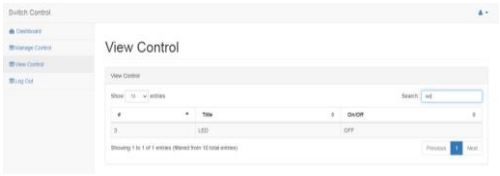

Fig 5.10 View control

5. In manage control different devices are shown to perform switch on or switch off operation.

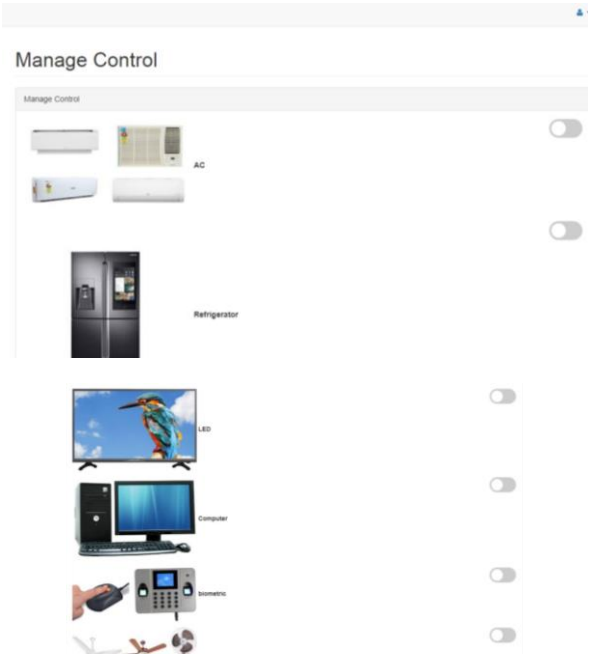

Fig 5.11 Manage control

After switching on following window appears.

Fig 5.12 Switching in management control

The modified status is shown in view control option.

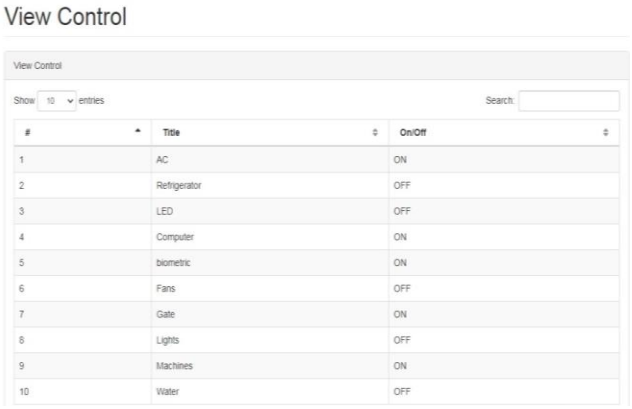

Fig 5.13 View control presents the status of switched on/off devices

Alert system

Iot based alert system would notify if any fire event of un authorized person or vehicle is detected. Following figure are displayed on web interface to present status of fire and unauthentic person on vehicle.

Alert System

	Status	Date/Time
Fire	Not Detected	N/A
UnAuthenticated person	Not Detected	N/A
UnAuthenticated Vehicle	Not Detected	N/A

Alert System

	Status	Date/Time
Fire	Detected	19/11/2020 5:33 PM
UnAuthenticated person	Not Detected	N/A
UnAuthenticated Vehicle	Not Detected	N/A

Fig 5.14 Alert system

5.2 RESULTS AND DISCUSSION

Proposed simulation has considered interconnected IOT model to get the signal from existing research that are forecasting and taking decision according to trained neural network to lay foundation for proposed work. Simulation work has performed detection of suspicious activities with more accuracy in less time as compared to previous researches. Many operations performed in proposed work with high accuracy, speed and reliability are for detection of suspicious activity, unauthorized vehicle, Fire, authentic person. Research work is showing result obtained after prediction on web page connected to web interface to manage the devices remotely and comparing the accuracy and time of previous work to proposed work. Considering proposed work of IOT that is providing solution to detect suspicious activities, fire detection, authentic person detection and vehicle authorization the time consumption and accuracy of proposed work has been compared to previous work.

Comparative analysis of time in case of proposed work and traditional work

Figure 5.15 is showing the time consumption in case of previous work and proposed work. Here green line is presenting the time consumption for proposed work in milliseconds, on other hand red line is presenting the time consumption for work that is case of traditional work. It is evident from comparison that proposed work is taking less time as compared to traditional work.

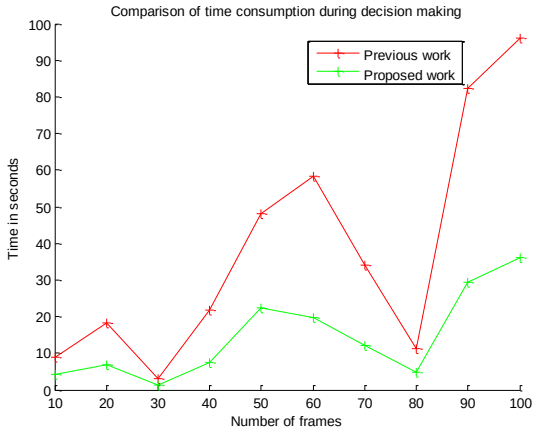

Fig 5.15 Comparison of time in case of fire alert

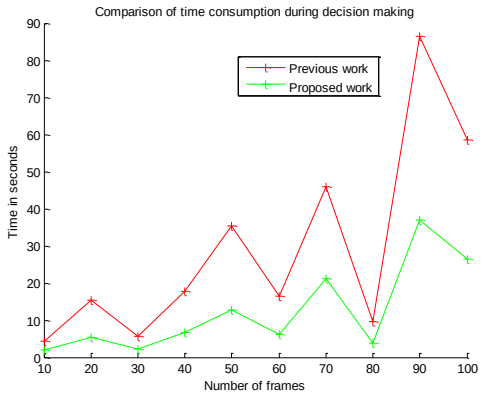

Fig 5.16 Comparison of time in case of detecting unauthentic person

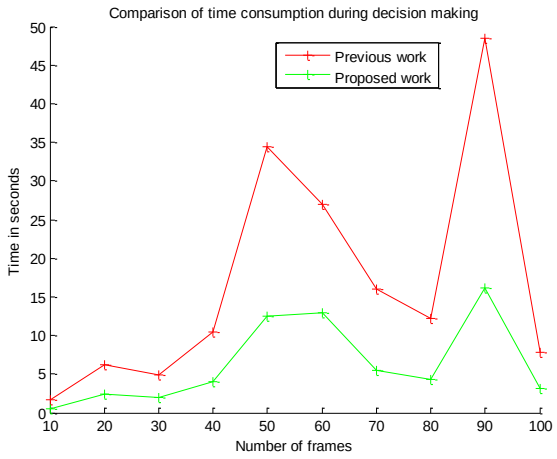

Fig 5.17 Comparison of time in case of detecting authentic vehicle

Comparative analysis of accuracy in case of proposed work and traditional work

Figure 5.16 is showing the accuracy in case of previous work and proposed work. Here green line is presenting the time consumption for proposed work in milliseconds, on other hand red line is presenting the time consumption for work that is case of traditional work. It is evident from comparison that proposed work is more accurate as compared to traditional work.

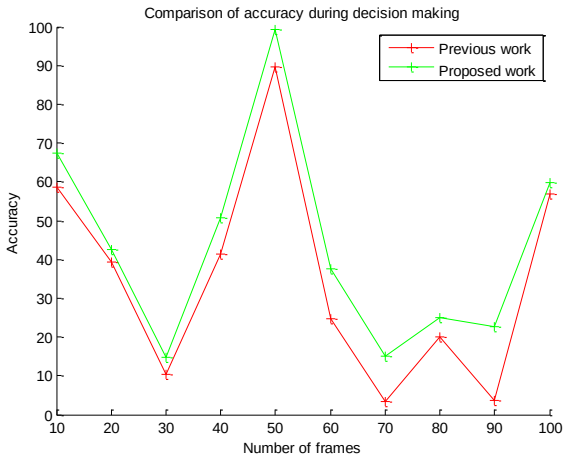

Fig 5.18 Comparison of accuracy for fire alert

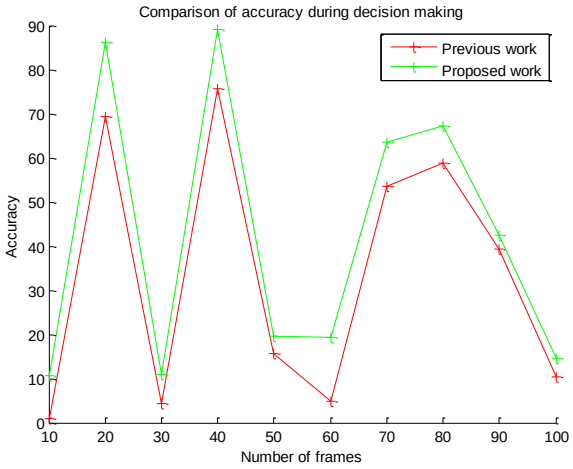

Fig 5.19 Comparison of accuracy for detecting unauthentic person

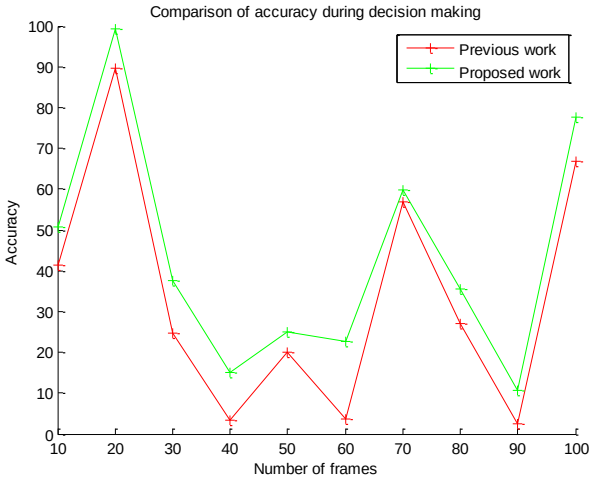

Fig 5.20 Comparison of accuracy for detecting authentic vehicle

6. CONCLUSION AND FUTURE SCOPE

The proposed system is more scalable, flexible and efficient as compare to previous systems. The proposed work is capable to performing variety of operations such as fire detection, detection of unauthentic vehicle along with unauthorized person. Moreover there is scope of web interface to present the prediction.

6.1 CONCLUSION

The limitation of previous researches where there time consumption and accuracy. It has been observed that there was need to do lot of work on performance and accuracy factor to make the IoT system more reliable. Moreover the previous work was able to deliver limited solutions. Thus

there remains need of work that should be capable to deliver quality solution. The proposed work is providing best solution by integration of image processing, neural network in IOT system. The use of neural network has made system intelligent while use of image processing has increased the performance. On other hand the use of IOT has made the system scalable and flexible. The prediction and detection made by neural network with support of image processing could be presented on remote location using web interface. The proposed research is supposed to provide scalable, flexible and efficient solution to detect the suspicious activities in organization such as presence of fire, unauthentic vehicle or person etc. The proposed work is supposed to occupy limited resources and perform operation more accurately in smart way. The integration of edge detection has reduced the time consumption in detection of pattern and reduces the storage space requirement. On other hand use of neural network has made the system smart enough to trace event on the bases of its experience. Use of PHP has made the web interface able to present the result on web page to the user. In other words it could be concluded that proposed work is more flexible, scalable, versatile and efficient as compare to previous researches.

6.2 SCOPE OF RESEARCH

The research would play significant role in industries, home automation and agricultural activities. Integration of image processing with neural network could also be used in field of healthcare, education and army. The IOT system that is making use of web interface could be used in opportunistic network. These systems are capable to trace any unusual activities in different type of organization. More over system could be helpful in managing home appliances remotely and could save the expense of electricity.

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