Neural Networks – Term Project

Neural Network based Video Surveillance System for Intruder Detection from Complex Background

Image Processing Lab.

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Motivation

- Automated video surveillance technologies as well as intrusion detection systems are important research areas for it widespread applications in diverse disciplines.
- These system isolates the events of potential objects from a large volume of redundant image data, since human observers can easily get distracted from these tasks.
- Challenges: They should have robustness against
  - Illumination changes
  - Color changes
  - Shadows
  - Avoid false alarm generation.
- Since EBPN stores information in terms of weights, we go for Neural Network based Intruder Detection System.

Problem Definition

- A basic moving object recognition algorithm takes the image sequence as input, detects frame having significant changes from the previous frames or background and identifies the changed region.
- Here we will take one reference image as background and check in subsequence images whether they have an intruder or not.
- The system will be implemented on Error Back Propagation algorithm initially trained with some sample training frames with/without intruders.
- Test Images will be checked for Intruders and set Alarm.
- Tools: VC++, MTES(Multimedia Technology Education System)

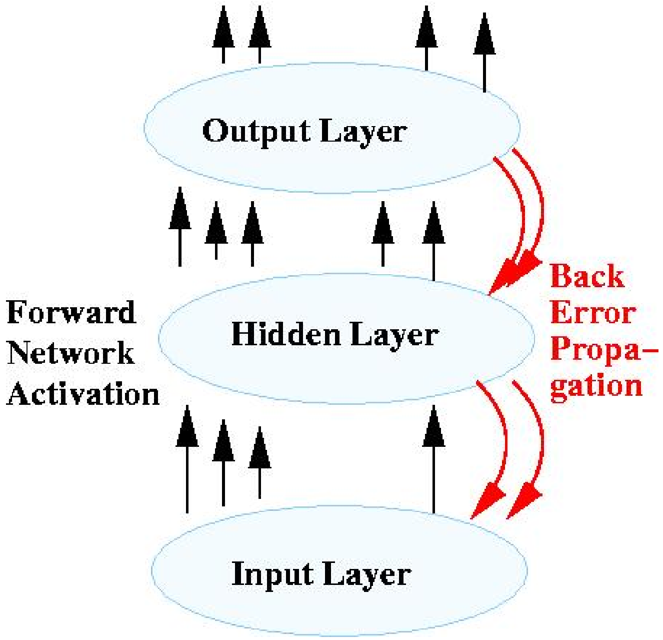
Sample Scenario

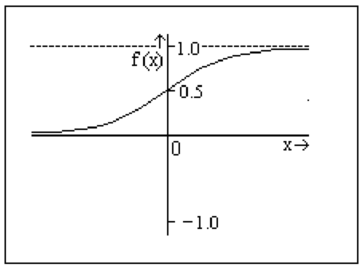
- Video Surveillance System captured image of the area being monitored.
- Safe as long as no one else is there.

- Video Surveillance System captured image of something else than the usual captured scene.
- Potential threat to security.
- Generate Alarm

Error Back Propagation

- **Training Phase:** Training a network involves 3 stages:
  - Feed forward of the input training patterns.
  - Back propagation of associated error computed from known outputs of training patterns.
  - Adjustment of the weights.
- Sigmoid function used as activation function
  - Its output range (0 to 1) is perfect for learning to output Boolean values.





Error Back Propagation Contd..

- We might also have some bias, which acts like weight on connections from units whose output is always 1.
- Modification of weights

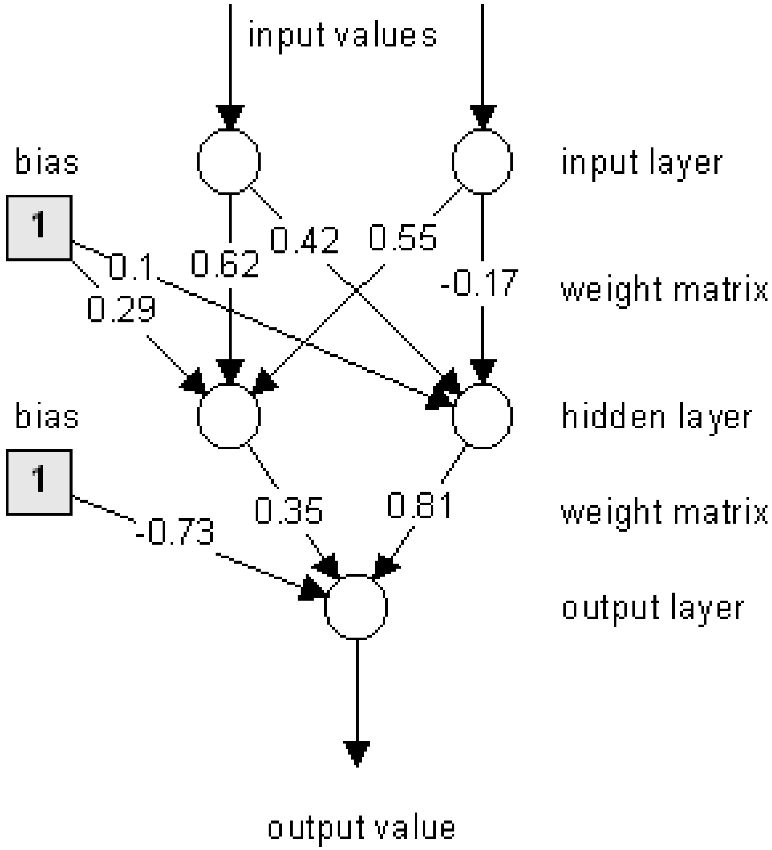
$$w_{ij}(t+1) = w_{ij}(t) + \eta \delta_j x_i^o$$

- For Output layer

$$\delta_j = y_j^o (1 - y_j^o)(d_j - y_j^o)$$

- For Hidden layer

$$\delta_j = x_j^o (1 - x_j^o) \sum_k \delta_k w_{jk}$$



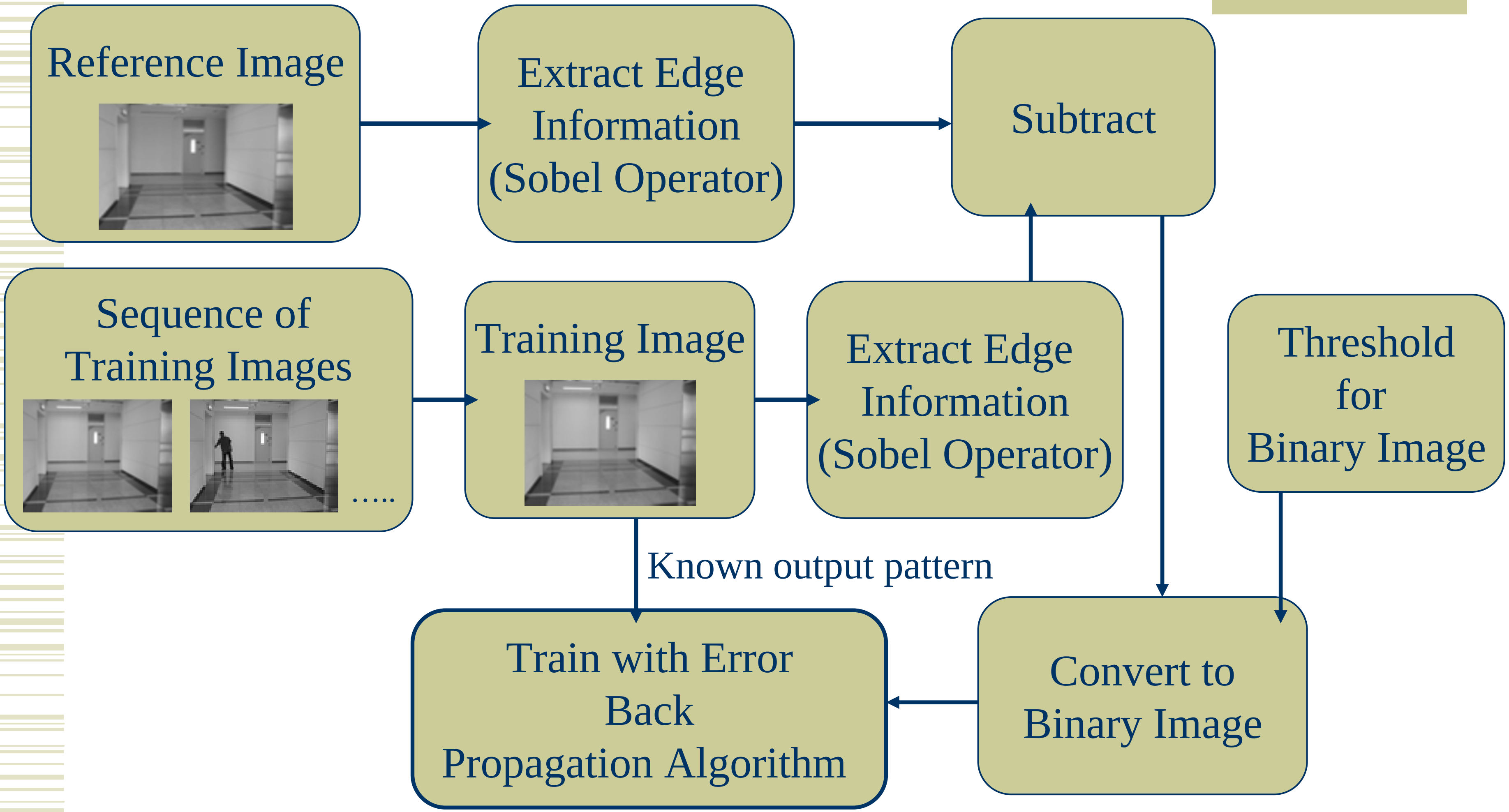
System Specification

- Learning Phase
  - Input: One reference image and six training images with known outputs: 3 of them are with intruder and 3 without intruder
  - Images are of size 100×75 pixels. So input layer of EBPN has 7500 nodes.
  - Hidden layer is chosen to have 100 hidden nodes(if Multi-layer Perceptron network).
  - Since we want to know whether intruder is present or not, output layer has only 1 output node. If present then 1 otherwise 0 for absence of intruder.

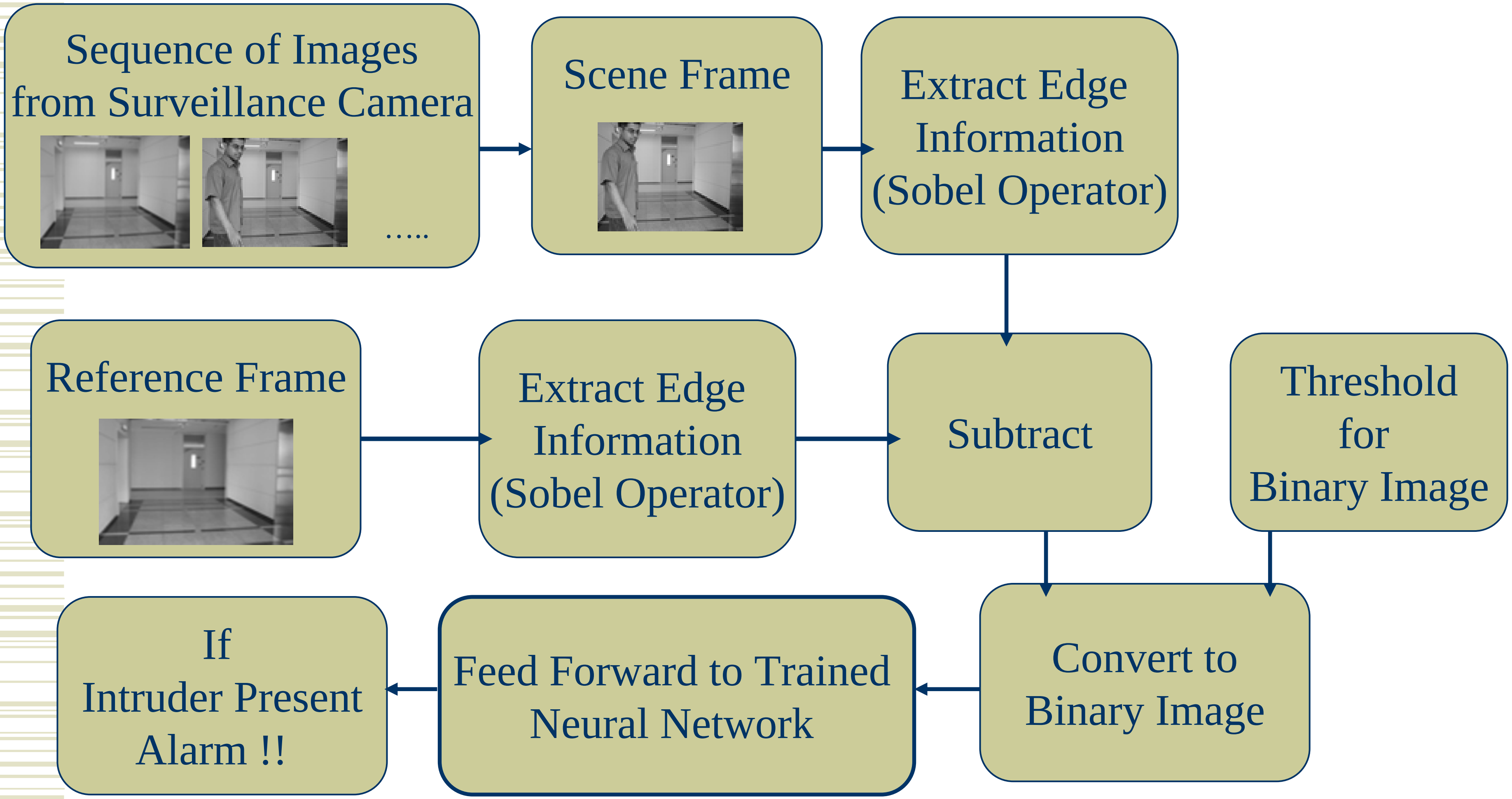
System Specification Contd..

- Instead of using the whole image, we feed edge information.
- **Preprocessing:** Most information lies on the boundaries of different regions. Extraction of edges from an image
  - Significantly reduce the amount of data
  - Filter out the useless information.
  - Less sensitive to noise.
  - Consistent more that illumination changes.
- We use Sobel operator to get the gradient information of image. Actually gives us edge information.
- As we want to know the change in scene, we take image difference.
- Finally convert image into binary image with a predetermined threshold prior to Neural Network feeding.

System Overview (Learning)



System Overview (Application)



Experimental Results

Reference Image

Edge(Gradient) Information

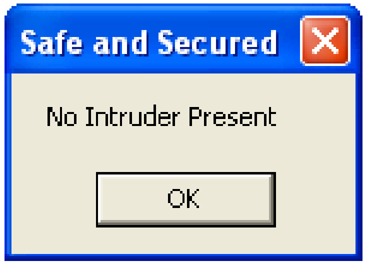
after Subtraction.

[Ideal case with exact match]

Experimental Results Contd..

Another scene frame

Edge(Gradient) Information after Subtraction.



Experimental Results Contd..

Another scene frame

Edge(Gradient) Information after Subtraction.

Discussion

- Since Training sample was not large enough (Only Six training patterns were taken for this System), Some false alarm generates or Intruder is not detected.
- Fast operating and Requires less human interaction

Thank You

MTES can be downloaded from
http://vision.khu.ac.kr/hellovision/download/MTES.zip