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Intelligent Vehicle Tracking For Detection of Objects

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Abstract- This paper introduces the real time implementation of a vehicle in the changing environment, changes in the environment is notified through video motion transmitter and receiver. The receiver takes snapshot of an image to detect threatening objects in the environment. Those images are trained and tested by using Associative memory. The runtime image has been trained, tested and quickly retrieved for fast decision making. This robot detects threatening objects in the environment with HAM network. After making decision the remote control access is done through Zigbee device to monitor and control the speed of a Roving robot in an accurate path. Supervised learning method has been applied to detect the object correctly. Delta learning rule is applied in HAM network to test and train the image.

Index Terms- HAM, Associative memory, Supervised Learning, Delta learning rule and roving robot.

I. Introduction

Navigation of a robot in real time environment is possible and it should be adaptable to the changing environment [1]. CIR is the Compact Internal Representation method. This method creates IR of an arena; sub-conscious and conscious pathway has been created to move in the path with CNN [1]. In this paper real time changes are continuously monitored and controlled, when there is a loss of control Cognition is a group of mental processes that includes attention, memory, producing, problem solving, and decision making. Cognition is the development of a rigorous method of analyzing behavior and a character [2]. The roving robot is designed and trained and the objects in the area are found and trained using this cognition method. Proto-cognition is the word meant for its structure and model. There is a necessary to set trajectory for the navigation purpose to launch the vehicle in specified path. In our work, we proposed to find the track of robot in the dynamic environment. Dynamic neural network is used to train the robot in each level of motion [3]. Trajectory setting is controlled by the user or the person who is monitoring the environment. In this work the robot is trained and controlled at two levels in static as well in dynamic condition. A final and fine decision is made by the monitor or user. It is not an autonomous robot; it is controlled and monitored by the user. A robot is an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robot may be fully autonomous or partially autonomous such as ASIMO to Nano robots and industrial robots. The robot conveys its purpose through sense of intelligence. It is an electrical product coated with physical object and it is programmed to do specific task and action. It is has some sensors and actuators to do task in the environment. Sensors monitor the environment and produce logic output that is processed by the robot. Motors and actuators are used for motion control and to rectify the problem acquiring in the environment.

The video transmitted to the PC is changed to a continuous video motion frames. Those image frames are stored in the memory to recognize an object using Bayesian method [4]. Instead of Bayesian method, HAM network is used to train and test the image to recognize an object. Test and train process is not possible by using Bayesian method. Haar like structure is taken over full image to recognize object using Bayesian method. In this work whole image is taken to recognize object in an image. Haar structure takes some height and width to partition the image. Image database is created and computed image is compared with those images to recognize an object, threatening objects such as gun, bomb, etc. The object in various views such as in top, bottom, right and left side views has been stored to detect the object. Morphological structures of an object can be stored and recognized easily [5]. Hetero Associaitve Memories are usually used as content addressable memories. The most likely applications for the neural networks are (1) Classification (2) Association and Reasoning. One of the applications of neural networks is applied in the field of object recognition. Object recognition is a branch of artificial intelligence concerned with the classification or description of observations. The images are classified based on shape, texture, color, etc. Statistical pattern recognition method is used to test and train pattern using probability density function. Probability function is similar to Bayesian method. In syntactic pattern recognition method sub-patterns are used to recognize, it is used for grammatical error checking purpose. In Knowledge-based pattern recognition rules are laid down to check an output. The datasets are paired to estimate the correct output [6]. The ANN type of method is used to recognize an object. Instead of pattern recognition, object recognition is focused on in this paper. Object recognition technique is used here to recognize threatening objects. The novelty of this paper approach is to detect and recognize threatening objects in space using HAM network. Eye-bots and foot-bots are placed in the arena. Foot-bots sense the signal of eye-bots by this sensing effect; it could reach the destination [7]. Instead of this sensing effect, real time monitoring is done to control the robot to reach the target.

II. Methodology

2.1 Proposed work:

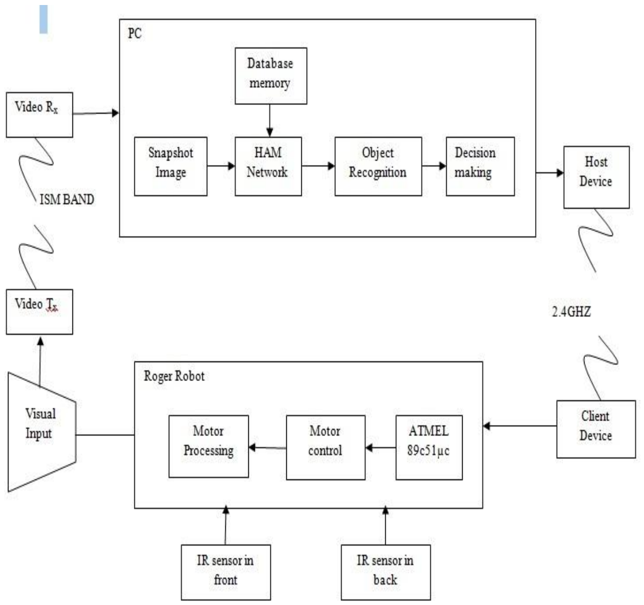

Fig1:This is the general architecture of real time implementation of robot.

Visual input is a OEM capture device as input. Snapshot type of camera is taken and fixed to the Robot. This camera transfers real time motion to the PC through video motion transmitter and receiver. Video Tx section is fixed to the robot. Video Rx section is fixed to the PC through cable. Video Tx and Rx communicates through ISM band. Roger Robot is a type of a robot; its purpose is to make a Human –Robot interactions. IR sensor is an Infrared sensor, these sensors has been used in the front and back of a robot to detect the obstacles. Once the obstacle is detected, the robot stops in that location, until the signal comes from the Host device. These Infrared sensors are installed in the robot to avoid hitting the wall when there is a loss of a signal. Host device signals to the client device, the serially transferred data is stored in the RAM of AT89C52µc. Host device and Client device communicates through the ISM band. Roger robot is composed of microcontroller and motor. Microcontroller controls the motion and direction of a robot. The command from Host device is received by client device, serially communicated data is fed to the microcontroller. Then microcontroller controls the motor of a robot as per coding in the device. The Snapshot image is taken from the video; those images are fed to the HAM network. HAM network test and train the images. HAM network compares the real time images with the database to recognize the object. The robot is controlled and monitored.

2.2 HAM Architecture:

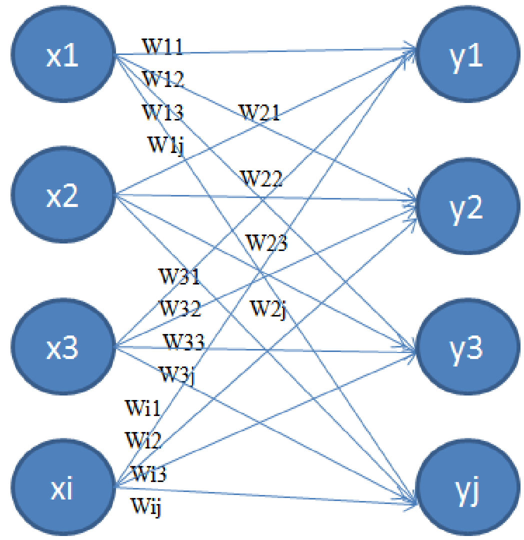

Fig2: This figure shows the architecture of HAM. Hidden neurons are not fixed, it is dynamic in nature.

HAM is a Hetero-Associative memory. It is called as content addressable memory. It maps one pattern to another. One type of format to another format. Values of red frame are mapped with an image. Input is fed as values and output as image.

Step 1: Weights are initialized using Hebb or delta rule.
Step 2: For each input vector do steps 3 to 5.
Step 3: Set the activation for input layer units equal to the current vector xi.
Step 4: Compute net input to the output units

$$Y\text{-}inj = \Sigma\, x_i\, w_{ij} \quad (1)$$

Step 5: Determine the activation of the output unit.

The simple method for determining the weights for an associative memory neural network is Hebb rule (HR). The other learning rule that can be used with Associative memory is Delta Learning Rule (DLR). The algorithm is as follows:

Step 1: Initialize all weight to random values.
Step 2: For each training input-target output vector, do steps 3-5.
Step 3: Set activations for input units to present training input.
Step 4: Set activations for output units to current target output.
Step 5: Adjust the weights.

$$W_{ij}(new) = w_{ij}(old) + \Delta w \quad (2)$$

Weight correction Δw is

$$\Delta w = \alpha(t_j - y_{inj})x_i \quad (3)$$

Where i= 1 to n, j= 1 to m
t- target vector,
y_{inj}– actual output vector
α- learning rate.

III. EXPERIMENTAL SETUP

3.1Prototype model creation:

This is the first stage of this paper. A prototype robot model has been created for a simple application.

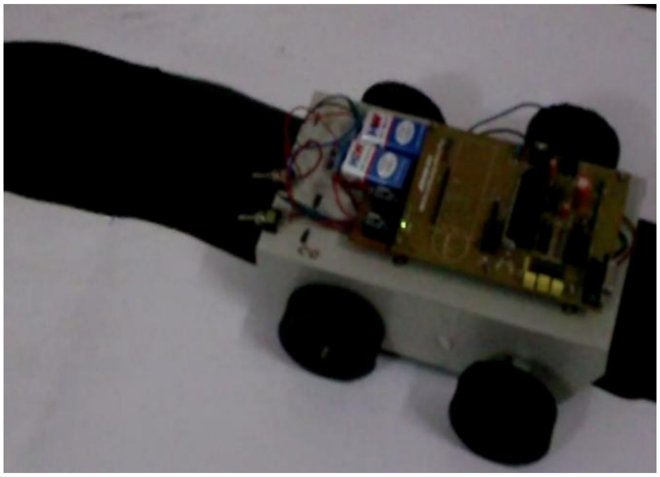

Fig3: This shows a simple prototype model of a line tracking robot. This robot is designed by using microcontroller AT89C52. This atmel chip is programmed by using Keil software.

The goal of this prototype model is to design a robot that can follow a line. The track is created on a white (reflecting) surface. White shiny chart can be used. A black line is created by using paint (optically absorbing). The turning ratio should be smooth enough, so that robot won't have to back up while following the line. The contrast colors are large enough to determine the robot over the track. The robot could be configured for a one track and a timed race, or configured to make two closed loop tracks for head-to-head racing. The robot will have two optical sensors placed close together on the bottom. Each sensor will return a logic signal depending on whether it senses those contrast colors. If both sensors expose with black color, then the robot is properly positioned on the track. When the left sensor is exposed to a white signal (and the right sensor still sees black) then the software knows the robot is veering off to the left. Similarly, when the right sensor is exposed to a white signal then the robot is veering off to the right. It is important to note that the two sensors should be close enough so that both will be black when the robot is on the track, but far apart to avoid optical crosstalk. Crosstalk occurs when the infrared transmission of one sensor is sensed by the receiver of the other sensor.

3.2 Image Preprocessing techniques:

In the second stage of this work, image could be taken from the cited environment. Those images are treated or preprocessed to remove unwanted noise present in it. Original image is taken Gaussian noise, salt and pepper noise is removed from those images. The unwanted signals and noise is removed by using filtering techniques [8]. Neural Network are non-linear statistical data modeling tools and can be used to model complex relationships between inputs and outputs or to find patterns in a dataset [9]. Salt and pepper noise is a form of noise seen on images. The image contains randomly occurring white and black pixels. Salt and pepper noise occurs on images in situations where quick transients, such as faulty switching, take place. Gaussian noise is statistical noise that has its probability density function equal to that of the normal distribution, which is also known as the Gaussian distribution. In other words, the values that the noise can take on are Gaussian-distributed. Image is blurred to reduce noise and details in the image.

(a) Blurred Image

(b) Gaussian noise Image

(c) Salt & Pepper noise Image

(d) Original Image

Fig4: This Image shows Original, Blurred, Gaussian noise and Salt & pepper noise image.

In this stage, the preprocessed image is taken. The RGB value of an image could be noted. Any one frame value can be loaded into the network. The network goes for several iterations and it finds out the original image. The database should be created. The HAM network associates frame values with those images to recognize original image from the database.

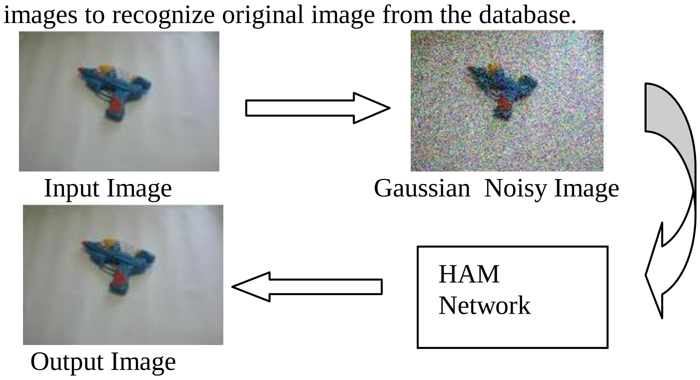

Fig5: This architecture is used for training image using HAM.

Image has RGB frame. RGB refers to Red, Green and Blue frame. Original image is taken and it is blurred by adding noise. Gaussian noise is used to blur the original image. Gaussian noise is a statistical noise, its probability density function is equal to normal distribution. Blurrednoisy image value is taken. Red frame is first frame so, when the program is runned, in the command window variable values are available. Those values are fed as input to the HAM. HAM accepts input in numeric value format. It displays the output in image format. Here the images are represented and stored in jpeg format. JPEG is a Joint Photographic Experts Group. This is commonly used method for

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lossy compression of digital photogrpah. An eigenvector of a square matrix is a non-zero vector t, when multiplied by the matrix yields a vector that differs from the original at most by a multiplicative scalar.Specifically, a non-zero column vector v is a right eigenvector of a matrix A if (and only if) there exists a number λ such that Av = λv. If the vector satisfies vA = λv instead, it is said to be a left eigenvector. The number λ is called the eigen value corresponding to that vector. The set of all eigenvectors of a matrix, each paired with its corresponding eigen value, is called the eigen system of that matrix.

The eigen values of a matrix A are precisely the solutions λ to the equation

$$\det(A-\lambda I)=0. \qquad (4)$$

Here det is the determinant of the matrix formed by A-λI and I is the n×n identity matrix. This equation is called

the characteristic equation (or, less often, the secular equation) of A. For example, consider the special case of a diagonal matrix A:

$$A=\begin{bmatrix} a1,1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & an,n \end{bmatrix} \qquad (5)$$

The characteristic equation of A would read:

$$\det(A-\lambda I)=\det\left(\begin{bmatrix} a1,1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & an,n \end{bmatrix} - \lambda \begin{bmatrix} 1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1 \end{bmatrix}\right.$$

$$=\det\begin{bmatrix} a1,1-\lambda & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & an,n-\lambda \end{bmatrix}$$

$$=(a_{1,1}-\lambda)(a_{2,2}-\lambda)\ldots\ldots(a_{n,n}-\lambda) \qquad (6)$$

The solutions to this equation are the eigenvalues

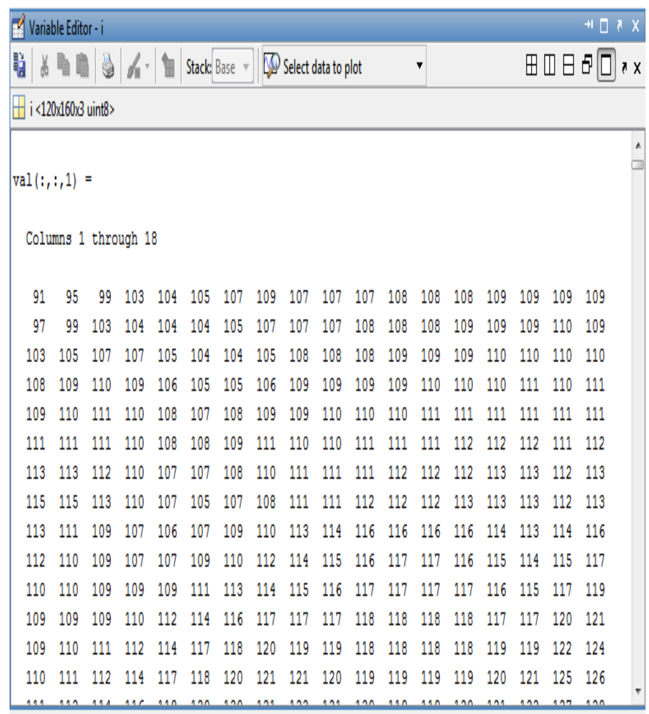
$\lambda_i = a_{i,i}$ (i = 1, ..., n).

the characteristic equation (or, less often, the secular equation) of A.

The data base is created to recognize image. The threatening objects are stored in a database for future recognition. The object in the environment is captured and matched with the database image[11]. Instead of using markov chain model ANN used to recognize an image.

Fig 6: This is the database of a set of threatening objects.

IV.SIMULATION RESULTS



91	95	99	103	104	105	107	109	107	107	107	108	108	108	109	109	109	109
97	99	103	104	104	104	105	107	107	107	108	108	108	109	109	109	110	109
103	105	107	107	105	104	104	105	108	108	108	109	109	109	110	110	110	110
108	109	110	109	106	105	105	106	109	109	109	109	110	110	110	111	110	111
109	110	111	110	108	107	108	109	109	110	110	110	111	111	111	111	111	111
111	111	111	110	108	108	109	111	110	110	111	111	111	112	112	112	111	112
113	113	112	110	107	107	108	110	111	111	111	112	112	112	113	113	112	113
115	115	113	110	107	105	107	108	111	111	112	112	112	113	113	113	112	113
113	111	109	107	106	107	109	110	113	114	116	116	116	116	114	113	114	116
112	110	109	107	107	109	110	112	114	115	116	117	117	116	115	114	115	117
110	110	109	109	109	111	113	114	115	116	117	117	117	117	116	115	117	119
109	109	109	110	112	114	116	117	117	117	118	118	118	118	117	117	120	121
109	110	111	112	114	117	118	120	119	119	118	118	118	118	119	119	122	124
110	111	112	114	117	118	120	121	121	120	119	119	119	119	120	121	125	126

Fig7: R frame value of an object image.

Variable editor in command window is used to show the gray scale value of an image in matrix format. Gray scale Value ranges from 0 to 255. Color image is three types RGB, CMY and CMYK. RGB consist of three frames they are R-frame, G-frame and B-frame[10]. Variable editor displays R frame value in the window. The Euclidean distance is calculated between train and test part of an image. If both the images are same and the distance calculated is less, it would recognize the opted image from the database as equivalent image. The computation time is calculated for each image. The computation time is also called as elapsed time.

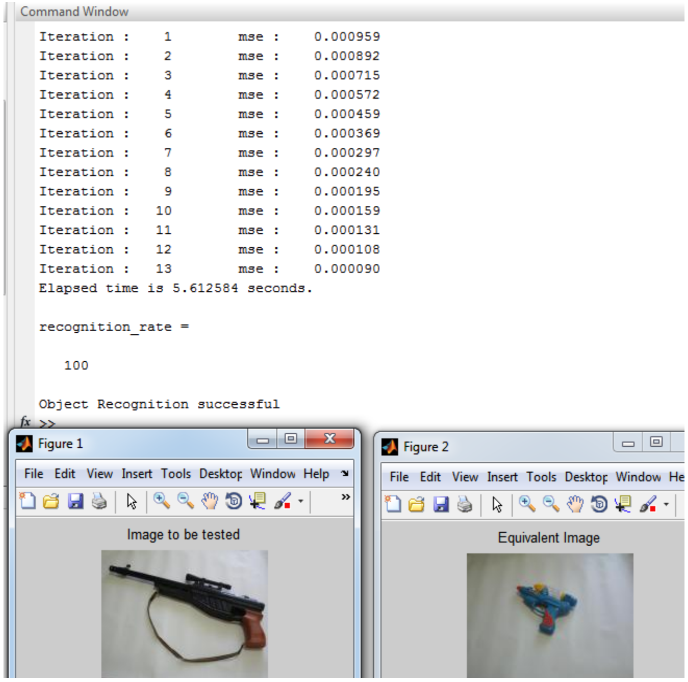


Fig8: Simulation result of Object recognition using HAM with 10 hidden neurons.

During the execution of the program the necessary file directory is checked. The MSE is calculated for several epochs. The elapsed time to recognize object for 10 hidden neurons are approximately 6 seconds. Iterations achieved are 13 and MSE is 0.000090.

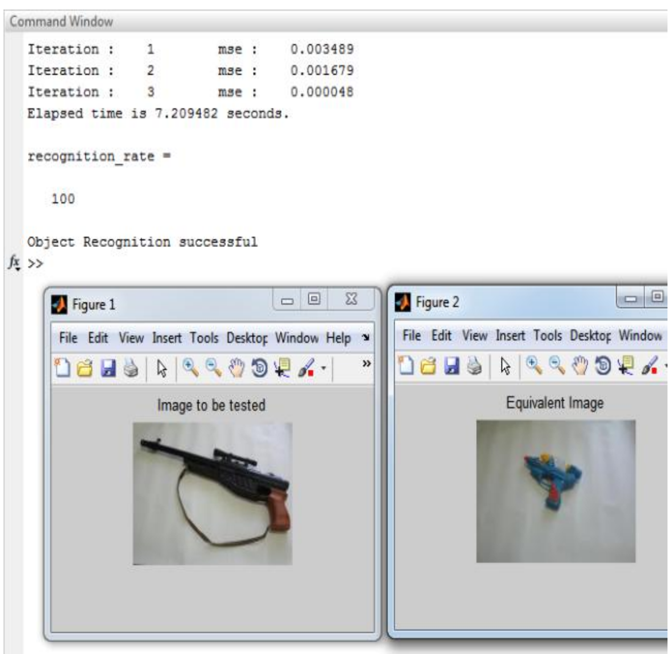


Fig9: Simulation result of Object recognition using HAM with 90 hidden neurons.

P matrix shows the Rframe value of an image. S1 and S2 are the number of nodes in the hidden and output layer they are 90 and 3. Since it is a matrix form, output layer has 3 nodes, because of matrix dimension. Iteration limit is 120000 and the maximum error limit is kept as 10e-5. For the 90 hidden neurons the elapsed time is 7.2 seconds, iteration reaches 3, MSE is 0.000048. We can select the image to be tested. Image classification is done to train and test the image. Elapsed time is the CPU usage time.

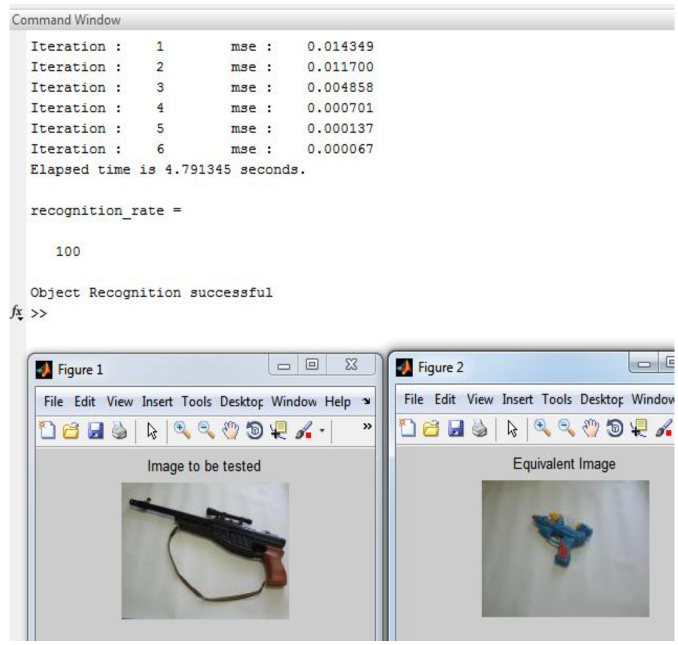


Fig 10: Simulation result of Object recognition using HAM with 100 hidden neurons.

In this number of hidden neurons are set as 100. The test image is changed. The user suggest some other image, if it is unknown to him, the user can select and test the image randomly from the database. The elapsed time to recognize object using 100 hidden neurons is 4.7 seconds. Since the network is dynamic in nature the elapsed time, Iterations and MSE(Mean Square Error) also varies dynamically with respect to an images.

V. CONCLUSION AND FUTURE WORK

Thus the robot is programmed and real time controlling has been done through that the arena or area is surveyed continuously. The object in the environment is tested and trained using HAM network. This Associative memory associates the image and detects the object present in the environment. It could be used for detecting threatening objects in the unarmed space and area. This type of robot is useful for military purpose to detect threatening objects in opponent place.

The input window contains more background pixels. Because of those pixels have less stable features. So, it is tuff to view objects and detect it. Simultaneously background separation could be done to capture same object in different environment and to detect those objects in real time.

V I. ACKNOWLEDGEMENT

The images used in this project are real time captured image and those objects used in this work are dummy toy objects.

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