Weapon Control system for an Autonomous Robot Using Image Processing and Artificial Neural Networks

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Abstract- **Replacing human soldiers with autonomous robots can have many advantages such as saving human lives in a war field. Applying technology in the war field not only helps to save the life of soldiers, further it will definitely give more chances for the team to win over the enemy attacks. The robots can apply as spying, attacking or defending mechanism in the front battle field. In this research, a weapon control system has designed using image processing, Artificial neural network and servo motor control mechanism to fix in to an autonomous robot to track the enemy and control a robot arm with a fixed weapon to exactly target the enemy object by accurately turning the servo motors to the required angle.**

***Index Terms*—** **Image Processing, Artificial Neural Network, Motor Control.**

I. INTRODUCTION

The system consists of major three parts,

1. Image capturing and image processing.
2. Artificial Neural Network.
3. Servo Motor Controlling using a micro controller.

Image Capturing and Image Processing- Image processing is similar to signal processing but using inputs such as image or a video frame. Image processing involves treating the input image or the video frame with standard signal processing techniques. In this project the image is captured by a camera is processed using the MATLAB software using blob analysis to extract the interested part and calculate the centroid of the selected area. The basic processing using the Blob Analysis contains the following steps

1. Extraction
2. Refinement
3. Analysis

In the extraction, thresholding techniques are applied to extract the region of the interest. In the research it is limited to a green color object using the RGB color modal.

In the next step region transformation techniques are used to enhance the quality of the selected area. To reduce the noise of the image median filter which is a nonlinear digital filter is used.

Final results are computed in the analysis stage. In the research, the coordinates of the centroid of the interested region is calculated.

Artificial neural network – The artificial neural network is capable of making decisions with respect to prior information provided to the system. According to the provided information the system will generate an output for any given test input. The architecture used for this approach is shown in Fig 1.1.

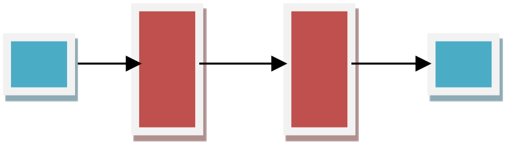

Fig 1.1 Architecture of ANN

It is a two layer feed forward network with sigmoid hidden neurons. Levenberg –Marquardt algorithm is used to train the network for the known pattern of inputs and outputs.

Servo motor controlling mechanism– Servo Motors is rotary actuators which has the ability to control the angle precisely. It consists with a feedback signal which is used in close loop control mechanism. The motor requires a separate driving mechanism to deliver the output.

II. TESTING CONFIGURATION

As the robot arm a mechanical structure with two degree of freedom was used. Two servo motors were attached to the structure to enable the movement of the arm.

Figure 1.2 shows the system block diagram arrangement used in the research. A camera was used to capture the image which transfers the image to MATLAB image processing program. The program calculated the centroid of the interested object. The coordinates of the centroid was transferred to the Artificial Neural Network which was pre trained with multiple number of inputs to predict the servo motor angles. The Artificial Neural Networks predicted motor angles are fed to the servo control mechanism and fed to individual motors.

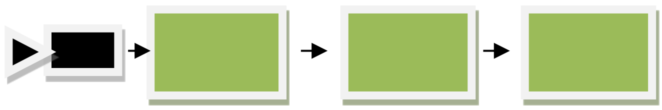

Fig 1.2 System Block Diagram

Configurations of the ANN was done as in table 1.3.

Number of hidden neurons	10
Number of training samples	100
Training function	trainlm

Table 1.3 ANN Configurations

III. TEST RESULTS

Artificial Neural Network was trained with 100 samples and a validation performance was carried out using MATLAB software the result is shown in Fig 1.4

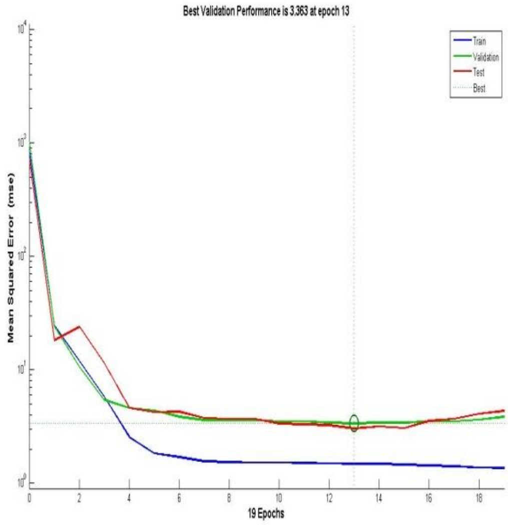

Fig 1.4 Training performance of ANN

A comparison between the required servo angles to make an accurate target taking and predicted servo angles from the ANN when the robot arm and the camera was placed 15 meters away from the target was taken and the table 1.5 shows the results which are in the expected values

Target Coordinates		Required Servo Angles		Output from ANN	
43.46	28.21	99	53	98.84	52.16
42.7	87.94	91	40	90.29	38.84
136.32	93.89	74	40	74.73	39.68
147.8	43.98	74	47	75.58	48.52
73.73	55.97	85	45	86.48	44.39

Table 1.5 Test inputs and outputs

IV. CONCLUSION

Test outputs were generated using MATLAB software. Simulation clearly shows that the output follows the required angles of the servo motors. The servo motors were successfully controlled using the centroid values of the target object chosen from the camera input and processed by the image processing techniques. Increasing the training samples to the artificial neural network can affect the accuracy of the output data. The system can be further modified by training the ANN with different distance from the target so that the system can be programmed to take a target form any distance from the target object.

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