Multilayer Processing Architecture of RAM Based Neural Network with Memory Optimization for Navigation System

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Abstract—Robots also have been trusted to help human to complete difficult jobs, for example, finding for the earthquake, a fire, or a sinking ship victims. The robot must be reliable, clever and moving automatically. The aim of this study is to develop and apply the application of artificial RAM-based neural networks (WNNs) on a mobile robot using a multilayer processing architecture with memory optimizations on to address and input pattern, so that producing smart navigation model which it has a simpler computational load and faster execution time. The gained result from the first study was the percentage of memory optimization in the amount of 50%. This result obtained from the formerly RAM using 8 bit data width has been optimized to 4 bits. Both of the percentage of data optimization pattern is 93.75%. This percentage is obtained from the optimization pattern (pattern taken is 4 bits MSB), each 1 bit data can handle 15 unseen patterns.

Keywords—RAM based neural network, mobile robot, multilayer processing, memory optimization.

I. INTRODUCTION

Robots also have been trusted to help human to complete difficult jobs, for example, finding for the earthquake, a fire, or a sinking ship victims. The robot must be reliable, clever and moving automatically. It is very important if a robot has a high level of smart navigation to avoid the bad things that might happen. One of application of smart navigation model is using RAM-based neural networks technique[5]. The neuron model used in the great majority of work involving neural networks related to variations of the McCulloch-Pitts (1943) neuron, which be called the weighted-sum-and-threshold neuron, or weightless neural networks [2].

The implementation of the network operation requires the use of multiplier unit, which can be problematic for embedded application due to the large size of resource because the training the generalized data required both the forward propagation phase and backward (back error) propagation phase. A typical weighted neurons specifies a linear weighted sum of the inputs, followed by some non-linear transfer function [3]. The complexity of the training algorithm has limited its implementation in dedicated hardware. In contrast, the ANNs investigated are based on artificial neurons which often have binary inputs and outputs, and no adjustable weights between nodes.

Application of multilayer processing architecture is good for the design of intelligent mobile robot navigation system, which uses a lot of input patterns (2^n). Mechanisms which is conducted on this study is by grouping of input patterns (a number of 2^n) and output patterns into a few small groups, each group data will be processed to a certain extent, until produce expected output data. Memory optimization is done by using the strategy that only processing data 4 bits of most significant bit (MSB). On the other hand the algorithm will help solving data processing problems in each group of data in certain level.

This technique was expected to improve the performance of system that have been studied previously. Technique was choosing because it has a high speed when processing the input data, can tolerate inaccuracies in the environment, and could be traced to the map of surroundings. Performance of system that measured was percentage of memory optimization (memory bandwidth), percentage of patterns optimization (unseen pattern), success in recognizing the environment and speed of mobile robot to reach the target.