MOHA: A Novel Target Recognition Scheme for WSNs

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1 Introduction

Macroscopic Object Heuristics Algorithm (MOHA) is a one-shot learning associative memory method for target recognition in wireless sensor networks. This method is able to address pattern displacement and pattern rotation issues. This scheme is also capable of reducing the power and memory consumptions of wireless sensor networks. The experimental results show that the proposed scheme can effectively handle pattern displaced and pattern rotation problems.

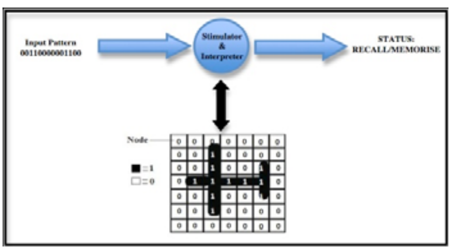

Fig. 1. MOHA architecture

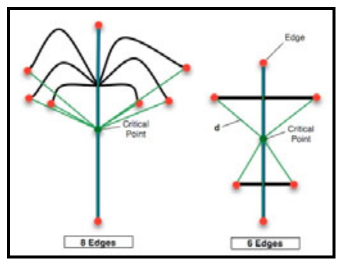

Fig. 2. The edges and the critical points of two targets

2 MOHA Scheme

MOHA builds on the novel one-shot learning associative memory (AM) concept of the Graph Neuron (GN) for template matching in wireless sensor networks. The pattern for the target is stored in a graph-like data structure, which is the same as that of the GN's bias array [1], [2]. The overall architecture of the MOHA algorithm is shown in Figure 1.

The Stimulator and Interpreter (SI module) assigns the target pattern to all nodes in the wireless sensor network, and it consequently obtains the information from the nodes at the edges of the pattern. After that, the SI determines the critical point and calculates the average distance between the critical point and the edges of the pattern. Finally, the SI checks the bias array to determine whether to recall or memorise the pattern (see Figure 2).

P. Sénac, M. Ott, and A. Seneviratne (Eds.): MobiQuitous 2010, LNICST 73, pp. 364–365, 2012.

3 Evaluation of the Proposed Scheme

In order to determine the MOHA's capability to recognise targets wherever they appear on the wireless sensor network field, we chose 3 different targets with different sizes, and inserted them in a 50×50 bits wireless sensor network field. After that, we tested all possible places where these targets could appear and checked each time whether MOHA could recognise these or not. Table 1 (a) shows that wherever the targets appear on the wireless sensor network field, MOHA could detect and recognise these at the success rate of 100%.

We also tested our scheme ability to recognise targets when these were rotated by 90°, 180°, and 270°. We used the same targets from the first test. The results showed that our scheme was able to recognise these targets after rotation (as seen on Table 1 (b)).

Table 1. a) Results from the first series testing. b) Results from the second series testing.

(a) Images	●	■	▲
Number of possible places	1122	841	1558
Number of Edges (NE)	22	4	13
Average Destination (AvgD)	4.92	7	5.09
States	Full recalls at all places	Full recalls at all places	Full recalls at all places

(b) Images		●	■	▲
Start position	NE	22	4	13
	AvgD	4.92	7	5.09
90°Rotation	NE	22	4	13
	AvgD	4.92	7	5.09
180°Rotation	NE	22	4	13
	AvgD	4.92	7	5.09
270°Rotation	NE	22	4	13
	AvgD	4.92	7	5.09

4 Conclusion

There are three main advantages of using this algorithm. Firstly, only nodes at the edges are required to recognise the target pattern, and the rest of the nodes will be in sleep mode. This will reduce the power consumption. Secondly, there is no need to store any pattern data in the sensor nodes, this will address the nodes memory limitation issue. All pattern data will be stored in the SI bias array, which can be created at the base station or at a more powerful node. Since the pattern data is not stored in the sensors, this algorithm will be able to detect and recognise the target when it appears at different locations or different angles within the wireless sensor network field.

References

1. Khan, A.: A peer-to-peer associative memory network for intelligent information systems. In: The Thirteenth Australasian Conference on Information Systems. AIS Electronic Library, Melbourne (2002)
2. Nasution, B.B., Khan, A.I.: A Hierarchical Graph Neuron Scheme for Real-Time Pattern Recognition. IEEE Transactions on Neural Networks 19, 212–229 (2008)