ISSN (Print) : 0974-6846
**Indian Journal of Science and Technology,** *Vol 10(6), DOI: 10.17485/ijst/2017/v10i6/109419, February 2017* ISSN (Online) : 0974-5645

# Power Efficiency of WSN - A Survey on Usage of AI Algorithms

**Renuka Rajesh Patil*** **and Suresha**

Shri Venkateswara College of Engineering, Bengaluru - 562157, Karnataka, India;
svce.r.patil@gmail.com, suresha_rec@rediffmail.com

## Abstract

Wireless Sensor Networks (WSN)s and Artificial Intelligence are the important emerging technologies of computer science. Wireless Sensor Networks keeps track of the dynamic environment that changes rapidly and artificial intelligence is making the machines intelligence. The wireless sensor networks are consisting of several sensor nodes which are designed with the little memory, smaller power and less strength of communication among neighbor nodes. The dynamic behavior of an environment is due to the external conditions or WSN system designers. To adjust to these varying conditions, sensor networks are implemented based on the artificial intelligence techniques. Artificial intelligence also incorporates the utilization of the available resources to the extent by minimizing the energy consumption of sensor nodes. In the present paper, it is involved with the address of common problems associated with the sensor nodes and how it is incorporated by applying Artificial Intelligence.

**Keywords:** Artificial Intelligence, Dynamic, Sensor Node, WSN

## 1. Introduction

The WSN is the very fastest emerging field in infinite number of applications which includes, weather monitoring, healthcare applications, agriculture field condition reading etc., The architecture of WSN consists of sensing field, sensor nodes, Gateway, Internet and an end user as in the below Figure 1.

WSN consists of various sensor nodes and these nodes are differentiated as normal sensor node and gateway sensor node as mentioned in the Figure 1. The size of each node is different from other nodes with the different capacity of memory, power and communication range. The nodes collect the statistics from various neighboring nodes and pass the same with neighboring nodes and to the end-user through gateway. A high rate of power is consumed for the collection and passing of the information to end-user through the different nodes and a gateway.

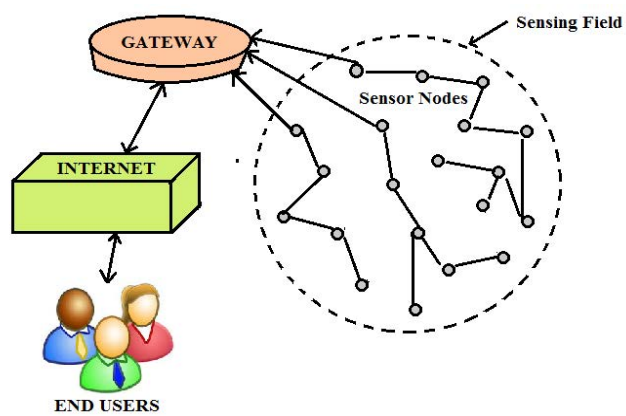


**Figure 1.** Architecture of WSN.

As the rate of power consumption goes high, the nodes will start entering into the idle state. To overcome with this problem of more power consumption, nodes are made to behave very intelligently by applying Artificial Intelligence. The nodes are made to enter the sleep mode

* *Author for correspondence*

once they stop perceiving and transferring of information to the end user. The different techniques of Artificial Intelligence includes Machine Learning, Game Theory and so on as in the below Figure 2.

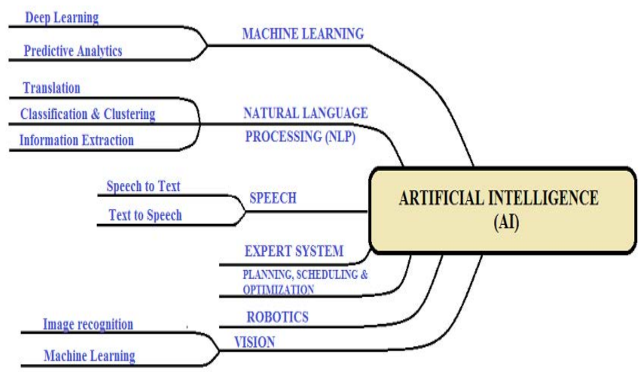


**Figure 2.** Techniques of Artificial Intelligence.

This paper is organized as Unit 2 gives the details of Literature Reviews. Unit 3 discusses about the binding of Artificial intelligence with Wireless Sensor Networks. Unit4 includes the idea of Artificial Intelligence Algorithms, Unit 5 includes Artificial Bee Colony Algorithm which enhances with the lesser power consumption and Unit 6 provides the Conclusion about the paper.

## 2. Literature Reviews

The WSN nodes are deployed in the selected area in WSN which are having the minimal mobility for sensors with the high rate of power consumption. Hence the important aspects to be considered hers are how to condense the consumption of power by the nodes, so that the lifetime of network can be increased to sensible periods[1]. Author in[1] discussed the problem of increased rate of power consumption by partitioning the power consumption for the typical nodes, and discussed the main objectives to energy conservation in WSNs. This paper has also presented the systematic taxonomy of energy preservation models as in the Figure 3[1].

- Author in[2] proposed a network and node-level architecture and demonstrated that sensor node consists of four vital components as,
  - The radio subsystem.
  - The processing subsystem.
  - The sensing subsystem.
  - The power supply sub unit as in the Figure 4[2].
- A detailed discussion on mobility of sensor nodes is presented in the paper presented by author[3]. The mobile nodes called as sensor nodes are broadly classified as *network infrastructure part*

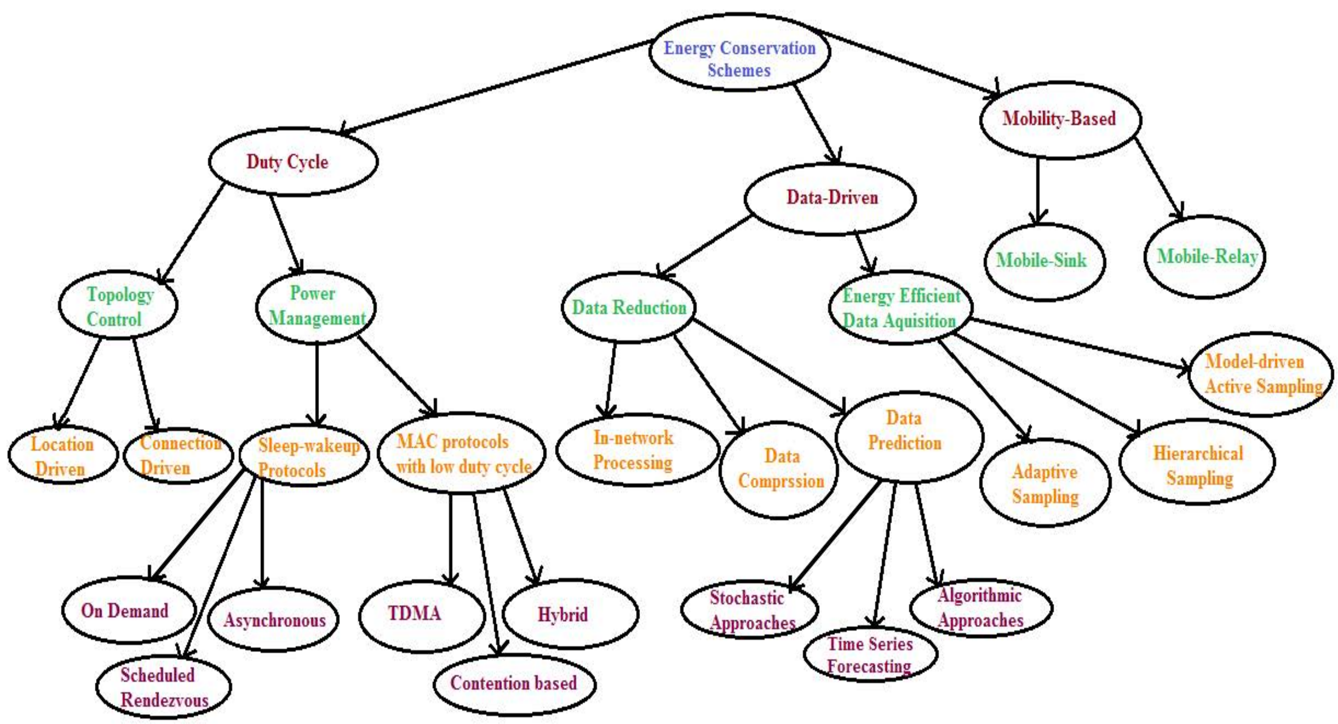


**Figure 3.** Taxonomy of approaches to power consumption savings in WSN.

and *environment part*. When the sensor nodes are infrastructure the movement is completely controlled and is fully robotized. But when the nodes are environment part, they are not able to be controlled[4].

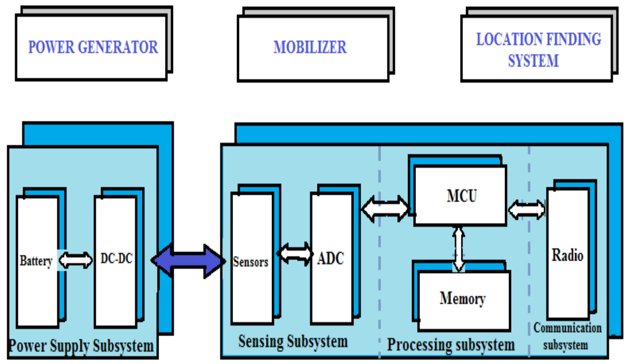


Figure 4. Power system of sensor node in WSN.

- The Author in[5] generalize a scheme as there are several of models for sensor nodes and each approach is duplicated near the sink node and source node. Here the base model is probabilistic.
- Author in[6] considered Intrusion Detection System (IDS) as an important role in protecting the network from intruders by providing the security to the network. The security is provided by the implementation of Artificial Immune System (AIS) based on IDSs in WSN. The architecture of IDS using AIS is as in the Figure 5.

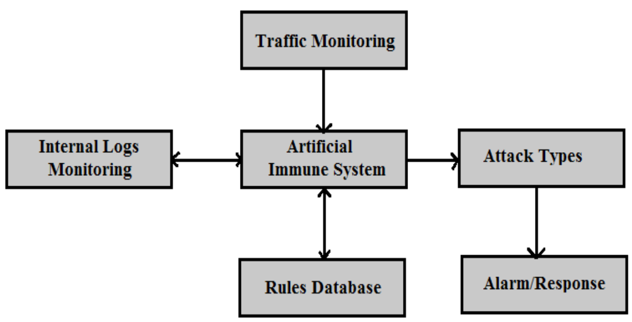


Figure 5. Architecture of IDS using AIS.

- Author in[7] discussed the Artificial Intelligence use cases for the Energy forecasting in sensor nodes.

## 3. Binding of Artificial Intelligence with WSN

This segment delivers some of the theoretical notions and policies in implementing Artificial Intelligence in the environment of WSNs. Usually, WSN designers describe Artificial Intelligence as a group of algorithms and tools which are used to create estimated models[10].

## 4. Artificial Intelligence Algorithms to find the Least Path Cost

The Artificial intelligence algorithms such as, Single Agent Path finding Problems, Brute-Force Search Strategies like Generate and Test algorithm are used to find out the least path cost between the edges of a graph. In the architecture of WSN, sensor nodes act as Vertices of graph and sensors are acting as the edges connecting those nodes[14]. The brief description of these Artificial Intelligence Algorithms is;

### 4.1 Single Agent Path Finding Problems

Multi-agent path finding is a challenging combinatorial problem that involves multiple agents moving on a graph from a set of initial nodes to a set of desired goals without inter-agent collisions[8].

### 4.2 Brute-Force Search Strategy

The brute force algorithm consists in checking, at all positions in the text between 0 and n-m, whether an occurrence of the pattern starts there or not.

### 4.3 Generate and Test Algorithm

Generate-and-test search algorithm is used systematically in a very simple way. The working principle of Generate and Test algorithm is as shown in the Figure 6.

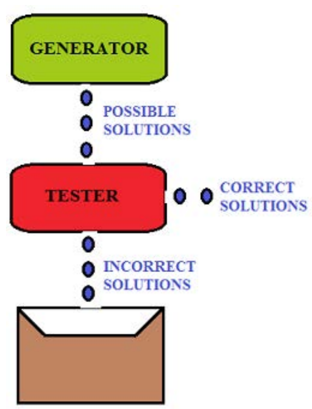


Figure 6. Working of generate and test algorithm.

This algorithm is very beneficial for simple problems, but for complex problems even heuristic generate-and-test is not very effective technique.

## 5. Artificial Bee Colony Algorithm

The Artificial Bee Colony algorithm is an approach for the study of both the types of node deployment of WSN that is dynamic and static. The coverage rate of ABC algorithm is compared with other dynamic deployments algorithms and has come up with good result (99.34% for 10,000 iterations)[17]. Locations of the sensor nodes in the selected application area, directly affects the performance of the WSN. With the applications of Artificial Intelligence Techniques and algorithms as discussed in Section 4 the ABC algorithm will yield a better result as compared with the previous generated result.

## 6. Conclusion

Wireless Sensor Networks may be deployed in many places based on their different requirements and applications. Due to the varying sensor range, the rate of power consumption is high. To reduce this power consumption the Artificial intelligence Algorithms those are used for finding the shortest path between the neighbor nodes are implemented for the sensor nodes.

Another point is that many solutions proposed in the literature predict the power utilization of the radio is much higher than the power utilization due to data sampling or data processing.

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