The increased demand of Wireless Sensor Networks (WSNs) in different areas of application have intensified studies dedicated to the deployment of sensor nodes in a recent past. The deployment of sensor nodes required some of the key objectives that should be satisfied, which are the coverage ratio of the monitoring area and the lifetime of the network.

In this thesis, a mathematical model to optimize the coverage ratio and the lifetime of network is developed to ensure a better utility of the WSN. The model is formulated based on several parameters such as the size of the monitoring area, network topology, the total number of sensor nodes, visibility requirements, sensing/communication radius, etc.

Popular swarm based bio inspired algorithms have been used to optimize the WSN deployment. The coverage optimization process has been carried out by single objective optimization algorithms such as the Ant Colony Optimization (ACO) algorithm, modified version of Particle Swarm Optimization called Discrete PSO (DPSO), Discrete Artificial Bee Colony (DABC) algorithm and a new proposed algorithm called Quantum Artificial Bee Colony (QABC). Thereafter, a multi objective optimization algorithm has been utilized to optimize the coverage ratio and lifetime of WSN. The multi objective optimization has been carried out by Non-dominated Sorting Genetic Algorithm (NSGA-II). All of these algorithms are simple, effective and computationally efficient optimization techniques.

The WSN deployment has been simulated using MATLAB 7.12.0 (R2011a) package, NetBeans 7.4 Java integrated development environments, JMETAL 4.5 and Java Universal Network/Graph (JUNG 2.0.1) frameworks. The computer simulation results showed that the proposed algorithm for coverage ratio maximization was up to two times faster than the others. Furthermore, the conducted simulation indicated that the QABC algorithm offered (6%) better solution in terms of coverage in comparison with the others in some cases. In addition, QABC outperformed GA, PSO and ABC algorithms when applied to several test problems. Additionally, the results showed that the NSGA-II algorithm could effectively
optimize the network lifetime and coverage ratio and produced good convergent solutions to the Pareto front and was uniformly distributed along it.