ABSTRACT

A Wireless Sensor Network is deployed with the purpose of acquiring information about the environment in which it is deployed and then passing on the acquired information to a remote sink where the information can be used to estimate or re-construct the environment or event. This requires the WSN to have the ability to sense the parameter or event under consideration, in the region of deployment, and then ensure reliable delivery of the information to a centralized sink where the information sensed by it can be used to re-construct the events. This reliable delivery of sufficient information assumes more importance in a Wireless Sensor & Actuator Network since it has a direct impact on the decision making process for subsequent action by the actuators present in the network. However, in context of the Wireless Sensor & Actuator Networks the Network Latency time assumes much greater importance since the action taken by the Actuator nodes has to be time coherent with the event sensed by the deployed nodes failing which the control loop will become un-stable and erratic.

Reliable Data acquisition refers to the ability of the Wireless Sensor & Actuator Network to ensure delivery of sufficient amount of the gathered information, by the deployed sensor nodes, in a time-bound and coherent manner to the centralized sink for it to be able to faithfully re-construct or estimate the event and take necessary action in time. Reliability further includes the availability of the data acquisition service being provided by the network for as long as possible without compromising on the ability of the centralized sink to faithfully re-construct the event sensed by it. Reliability also includes the ability of the network to be tolerant to faults, within a limit, without comprising on the basic issue as mentioned above.

This thesis presents a novel Reliable Data Acquisition methodology using Wireless Sensor & Actuator Networks which meets the criterion of reliability as mentioned above. The proposed methodology,

a) ensures that sufficient amount of the information gathered by the deployed sensor nodes regarding a sensed event is reported to the centralized sink / Actuators for acceptable estimation or re-construction of the event detected, within the time-constraint fixed by the control action to be taken by the Actuator nodes.

b) results in delivery of the sensed information by the deployed nodes within the Actuation Latency Time of the application i.e. Network Latency Time (T\text{NLT}) of
the sensor network which is defined as time between sensing of information by the nodes and the time of delivery of information at Sink/Actuators.
c) results in delivery of sensed information by the deployed nodes in a coherent manner
d) results in the ability of the network to be tolerant to temporary communication faults, within a limit, without compromising on the ability of the centralized sink / Actuators to faithfully re-construct the event sensed by it.
e) has algorithm to disseminate a query within the network.
f) provides the above mentioned services while offering significant network life with acceptable reliability
g) includes algorithms for different modes of data acquisition by the WSAN
   a. Periodic Data Acquisition
   b. Event Based Data Acquisition
   c. Query Based Data Acquisition
   d. Data Acquisition in Single Sink Scenario
   e. Data Acquisition in Distributed Actuator Scenario
   f. Data Acquisition in Distributed Actuator Scenario