

**DEVELOPMENT OF LOCALIZATION AND  
ROUTING ALGORITHMS FOR SENSOR  
NETWORKS IN AN INTEGRATED APPLICATION  
FRAMEWORK**

by  
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## Certificate

This is to certify that the thesis titled “*Development of Localization and Routing Algorithms for Sensor Networks in an Integrated Application Framework*” being submitted by Mr. Sanat Sarangi in fulfilment of the requirements for the award of the degree of Doctor of Philosophy in Bharti School of Telecommunication Technology and Management, Indian Institute of Technology Delhi is a record of bona fide work carried out by him under my supervision and guidance. It is also certified that this work has not been submitted to any other Institute or University for the award of any other degree or diploma.

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## Abstract

We propose novel algorithms for localization and routing in sensor networks. We also develop an application framework for deployment of geographically-distributed customized sensor network applications. The proposed algorithms seamlessly integrate with the application framework to facilitate their rapid deployment.

The application framework consists of (a) a scriptable rapid application deployment framework called RAPIDSNAP which addresses end-to-end requirements of heterogeneous sensor network deployments and (b) a novel Internet-of-Things (IOT) repository called the Wireless Sensor Knowledge Archive (Wisekar), hosted at <http://wisekar.iitd.ac.in>. Wisekar supports a variety of data inputs and archival capabilities.

We propose the concept of Graded Precision Localization (GPL), which refers to the ability to localize mobile nodes to different precision levels using a common infrastructure with a combination of coarse-grained localization, fine-grained localization and inertial navigation. Two algorithms for GPL—GRADELOC and IGRADELOC—are proposed, analysed and validated with an implemented prototype.

We propose a set of localization extensions—LORECOS—to a reactive routing algorithm—AODVjr, thereby leveraging its route-discovery phase for hop-distance based location estimation. An anchor node placement algorithm ANCHREG is proposed, which helps mobile nodes using an extended form of LORECOS to be able to estimate their region of presence in a deployment area. The geometric properties of the deployment area are used by

ANCHREG to arrive at an optimal anchor node placement configuration. Performance of machine learning models is compared for region prediction—a part of the region estimation process.

We propose a multi-hop routing algorithm called PARTROUTE for partially mobile sensor networks where reactive routing is coupled with partial route (trace) preservation over a set of stationary nodes to minimize packet overheads. We extend the use of mobility awareness to achieve energy-efficient clustering in sensor networks by proposing GAROUTE. GAROUTE uses genetic algorithms to arrive at optimal cluster configurations in a sensor network.

The impact of the proposed work is discussed in the context of a wireless sensor network based gait assessment system called Gaitsense which has been developed and implemented by us.

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