ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 4, February 2018

Energy Efficient with Inertial Sensors in WSN

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***Abstract*—Inertial sensors are tiny in nature that can be embedded in small apparatus. It is sensors based on multiple inertial values like capturing motion, frequency etc. These Micro machined inertial sensors, consisting of accelerometers and gyroscopes, are one of the most important types of silicon-based sensors. The application of accelerometers covers wider area where their small size and low cost have even a larger impact. This paper concentrates on the simulation of a heterogeneous Xilinx Zynq System-on-Chip processing core and custom hardware accelerator proposed by H.-P. Brückner et.al. Energy efficiency is enhanced by utilizing the hardware accelerator for orientation estimation based on a Kalman filter algorithm. Simulation results show the improvement in the energy efficiency.**

I. INTRODUCTION

Sensor networks are becoming increasingly prevalent in the modern computing environment. A sensor network consists of a number of physical devices called sensor nodes, spatially distributed within a geographic region of interest, equipped with sensing/monitoring/recording capabilities within a certain sensor region. Sensor networks and their data have many applications including environmental sensing, video surveillance, motion detection, and spectrum monitoring.

The sensor nodes are randomly deployed either inside or very close to the sensed circumstance. All sensors have cooperative capabilities that they perform wireless sensing, computing and act as a communication elements for gathering andforwarding data from one place to another in the network. The sensor node is the basic unit in the sensor network. The salient features of sensor nodes are self-organization, self-configuration, wireless infrastructure and ability to withstand in harsh environmental conditions. WSN system acts as a bridge which provides connectivity between virtual and physical world. It allows the ability to sense the unobservable node at a fine resolution over large spatial temporal scales. The potential applications are battlefield surveillance, nuclear, biological and chemical attack detection in military, monitoring of human physiological data and drug administration in hospitals, machine condition monitoring in industry, traffic management in transportation and civil infrastructure.

Every sensor node is filled with energy that should be used efficiently in both active and inactive state. The energy is utilized by minimizing energy consumption in each node and reducing the average communication distance over the area. This can be achieved using LEACH by making cluster.

Mobile Sink is used and often called as data collector. Sink mobility is classified as fixed mobility, random mobility and controlled mobility. The existing system used fixed mobility in which the sink predicts future positions of node without considering the load available in it. The random mobility pattern makes the sink to move autonomously and has no knowledge about mobility in terms of direction and speed. It is highly unpredictable. The simulated system uses controlled mobility and the mobile sink is guided based on residual energy of the nodes.

Micro machined inertial sensors, consisting of accelerometersand gyroscopes, are one of the most important typesof silicon-based sensors. Micro accelerometers alone havethe second largest sales volume after pressure sensors,and it is believed that gyroscopes will soon be mass produced at similar volumes. The large volume demandfor accelerometers is due to their automotive applications,where they are used to activate safety systems, including airbags, to implement vehicle stability systems and electronicsuspension. However, the application of accelerometerscovers a much broader spectrum where their small sizeand low cost have even a larger impact.

They are used inbiomedical applications for activity monitoring; in numerousconsumer applications, such as active stabilization ofpicture in

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camcorders, head-mounted displays and virtualreality, three-dimensional mouse, and sport equipment; industrial applications such as robotics and machine andvibration monitoring; in many other applications, such astracking and monitoring mechanical shock and vibrationduring transportation and handling of a variety of equipmentand goods; and in several military applications, includingimpact and void detection and safing and arming in missilesand other ordnance. High-sensitivity accelerometersare crucial components in self-contained navigation andguidance systems, seismometry for oil exploration andearthquake prediction, and microgravity measurements andplatform stabilization in space. The impact of low-cost,small, high-performance, micromachined accelerometers inthese applications is not just limited to reducing overallsize, cost, and weight. It opens up new market opportunitiessuch as personal navigators for consumer applications, orit enhances the overall accuracy and performance of thesystems by making formation of large arrays of devicesfeasible.

Micromachined gyroscopes for measuring rate or angleof rotation have also attracted a lot of attention duringthe past few years for several applications. They canbe used either as a low-cost miniature companion withmicromachined accelerometers to provide heading informationfor inertial navigation purposes or in other areas[1], including automotive applications for ride stabilizationand rollover detection; some consumer electronic applications,such as video-camera stabilization, virtual reality,and inertial mouse for computers; robotics applications.

II. LITERATURE SURVEY

1. Placement of Accelerometers for High Sensing Resolution in Micromanipulation:

W.T. LATT et.al

An approach of placement of accelerometers within an available space to obtain highest possible sensing resolution in sensing of rigid-body motion in micromanipulation tasks is proposed. Superiority of the proposed placement approach is shown in sensing of a microsurgical instrument angular motion by comparing sensing resolutions achieved as a result of employing the configuration following the proposed approach and the existing configurations.

2.A GPS aided full linear accelerometerbased gyroscope-free navigation system:

A. Buhmann, C. Peters et al.

A gyroscope-free inertial navigation system uses only accelerometers to compute navigation trajectories. It is a low-cost navigation system, but its output errordiverges at a rate that is an order faster than that of conventional gyroscope based system. So integration with an external reference system, such as the GlobalPositioning System, is necessary for long-term navigation applications. In this paper, an integrated GPS and gyroscope-free INS system is designed to achieve stablelong-term navigation. The linear and nonlinear error models of a gyroscope-free INS are derived and are used as Kalman filter equations to estimate the errors inthe gyroscope-free INS data.

3.Micro-machined accelerometer array withshield plane

R. Boysel and J. Sampsell

A microshutter array has a frame having a light transmissive portion. Linear microshutter elements extend across the light transmissive portion and in parallel to each other. Each microshutter element has a flat blade extended in a length direction and first and second torsion arms extending outwards from each side of the blade in the length direction, the blade extending across the light transmissive portion. There is at least one electrode associated with each linear microshutter element and extended in the length direction parallel to the microshutter element.

III. SYSTEM MODEL

In this proposed system, energy efficient communication system that combines Ineritial Sensors (EEIS)have taken the view that all layers of the design space influence power consumption, from the application and network to the architecture and circuits. In this research work follow an iterative approach through modeling, design and prototyping and our models incorporate inputs from a variety of design layers. The proposed model accepts inputs from the network and application layers and physical power measurements of nodes.

The system architecture combines the energy efficiency found in application specific integrated circuits (ASICs) with the flexibility and programmability of a general purpose processor. As power consumption is the main design constraint, the proposed eventdriven system for WSNs uses three techniques to reduce power consumptionIneritial Sensors.

- Lightweight event handling
- Hardware acceleration for WSN tasks

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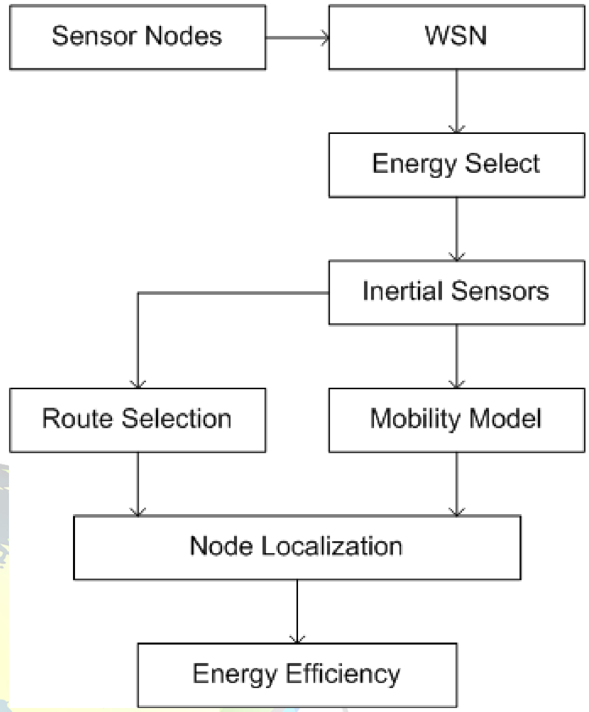
- Application-controlled

Consider a scenario where a sensor node either comes in contact with other nodes of a Wireless Sensor Network (WSN) or is already part of a WSN. In both cases, all nodes have information about their structure and host description of their resources. Namely, we assume that the nodes are aware about the available sensors, actuators, functionality extenders (localization engines, security accelerators), communication interfacesor power sourcesand data storage drives. Once node runs out of its available resources or faces a task which cannot be accomplished efficiently using node's capabilities, it can check if the desired functionality is available within the heterogeneous environment around it. For this, node initiates thewireless communication broadcasting a Resource Request to adjacent nodes.

The nodes which have received the Available Energy Request message check the availability of requested energy in their pool and decide if they can fulfill the request. While making the decision potential nodes takes into account its active applications, power supply type and remaining energy. [4] discussed about a method, End-to-end inference to diagnose and repair the data-forwarding failures, our optimization goal to minimize the faults at minimum expected cost of correcting all faulty nodes that cannot properly deliver data. First checking the nodes that has the least checking cost does not minimize the expected costin fault localization. We construct a potential function for identifying the candidate nodes, one of which should be first checked by an optimal strategy. We proposes efficient inferring approach to the node to be checked in large-scale networks.

Nodes that have the requested resources are capable to share these reply to the other nodes with Energy Offer message.It is obvious, that the efficiency of proposed system strongly depends on the number of nodes in the area, their duty cycles, and the diversity of their resource pools and tasks. Therefore, in the current project we assume that the network is dense enough or includes always-on nodes which might act as potential sender. This assumption will beapplicable for such applications and environment as Smart City or WSN in public places.



Depending on the requested energy the Select message may contain compressed data for the sendernodes. An acknowledgement for Energy Select message acknowledges the destination. Then two nodes switch back to channel and proceed with other tasks, whilst Supplier executes the requested WSN task in background.

V. PERFORMANCE ANALYSIS

A. ENERGY EFFICIENCY

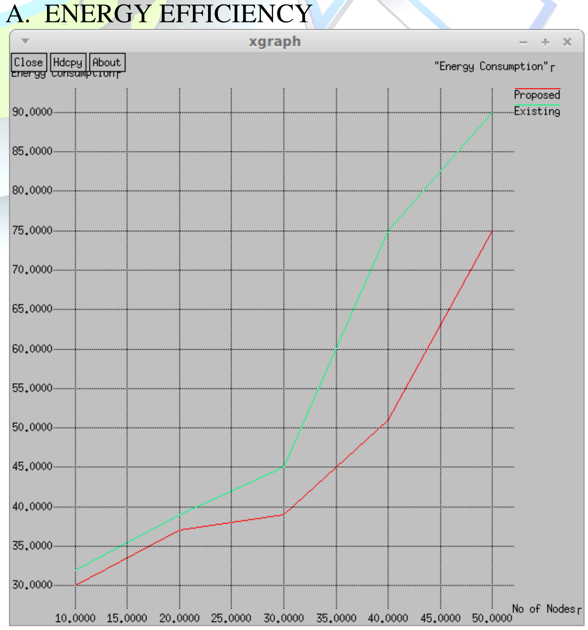


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Figure 2: Energy Efficient graph

VI. CONCLUSION

In this system, inertial sensors are embedded in small apparatus and gather multiple inertial values like capturing motion, frequency etc. These Micro machined are equipped with inertial sensors, consisting of accelerometers and gyroscopessensors. This system covers on theNS2 simulation. Energy efficiency is enhanced by utilizing the hardware accelerator for orientation estimation based on a Kalman filter algorithm. Simulation results show the improvement in the energy efficiency

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