Three week Activity Report
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During these three weeks I went through number of research papers, focusing International Conference on Dependable Systems and Networks (DSN) 2002 and other conferences related to Sensor Networks and Ad hoc Networks. I also met with Jan Steffan of ITO group and exchanged views regarding Sensor Networks in general and particularly Scopes approach to middleware for Sensor Networks.
The section 1 describes two papers from DSN 2002. In section 2, I will talk about other papers from different conferences. Section 3 describes some applications available for Sensor Networks and in section 4, I will describe about future progression.

1. DSN 2002

Andy Franz et al [A] have described a framework called as Mr. Fusion for data fusion in middleware. There are two main parts of Mr. Fusion, the Fusion Core (FC) and Fusion Status Service (FSS). In FC the Fusion algorithms are implemented and FSS is used to indicate the output from FC to the subscribers. Mr. Fusion is very much inspired form the voting process. The main component of FC is Fusion Virtual Machine (FVM) which is successor of Voter Core [1]. To specify policies there are policy wrappers, and policy chooser component choose the policy depending upon information gathered on the start of fusion section and current policy information than send it to Policy Runner component. Mr. Fusion supports multidimensional data fusion but in limited manner. The FC and FVM are monitored by FSS. FSS is a multidimensional database, and provide same information in different ways. The implementation borrows techniques from data warehousing and data mining.

[B] This paper describes propagation of information in Gryphon System which is wide area content based publish subscriber system, employing a redundant overlay network of brokers [2]. The proposed guaranteed delivery service provides exactly once delivery of messages to subscribers by using abstract knowledge graph. They have made some modification in the abstract model of Gryphon System. In this algorithm the knowledge graph is divided into Virtual Brokers i.e. Publish end brokers, Subscriber end brokers and Intermediate Brokers. These virtual brokers will be mapped onto physical nodes. In this algorithm the messages are filtered at Intermediate node and a soft state is maintained at intermediate brokers as compared to traditional approach of store and forward. This allows the system to sustain high throughput despite errors,

and makes it simple to dynamically replace brokers in overlay network. Algorithm has 4% overhead of CPU utilization without failure occurrence as compared to that of best effort delivery algorithms.

2. Other Conferences

[C] In this paper authors supported the Sentient Object Programming Model (SOMP) which is using Publish Subscribe communication method and build a middleware based on it, which is used to enable support between autonomous and proactive vehicles. To investigate the feasibility of programming model and middleware they have constructed small number of autonomous robot cars which include GPS, compass, and ultra sonic sensors and is controlled by iPAQ. Sensors information is collected by iPAQ and used to provide actuation. Relevant information is passed to others cars by using 802.11b ad hoc mode. The context awareness is achieved by using SOMP. For the future work, some other domain can be used to investigate the generality of the approach.

In this paper Heinzelman et al [D] describe the new middleware approach called as Middleware Linking Applications and Networks (MiLAN). The approach of MiLAN is to change the network according to the Quality of Service (QoS) required by the application instead of changing the application itself to achieve the QoS with respect to change in network. MiLan receives QoS requirements from applications and information from network and accordingly changes the sensor network configurations for optimization of application. MiLAN exchange state variable graphs and QoS graphs to map the network for optimization. To discover different node in network it uses service discovery protocols.
To manage the network completely it is viable not to consider the application needs, so the authors argue to integrate the network management and application QoS needs into a single, unified middleware system. Through this tight coupling, the middleware can trade application performance for network cost, while still retaining the separation between the policy specifying how to react to a dynamic environment (obtained from the application) and the mechanisms to implement the policy (performed in the middleware).

3. Sensor Network Applications

To deploy a large-scale, low power, inexpensive sensor networks is no more dreams with the advancement in Micro-electro-mechanical system (MEMS) and wireless communications technologies. Such an approach has many advantages over traditional sensing methods. It not only increases fault tolerance and robustness of system but also extend spatial coverage to make it more suitable for military applications and other risk based application.

COUGAR [E] envision the sensor networks as the databases and communicate with it in the form of Queries. Today's sensors are preprogrammed and send data to sink for further processing; this approach has two main drawbacks, first we can not change the behavior of network on the fly second, sending the raw data will consume more power than local computation. COUGAR database approach for sensor network is to unite the seemingly conflicting requirements of scalability and flexibility in monitoring the physical world.
The project has laid out a set of challenging research problems, including distributed in network processing, query optimization, integration of query processing with routing layer and a probabilistic data model for sensor data.

Loren et al [F] describe a biomedical application for the artificial retina. In the Smart Sensors and Integrated Microsystems (SSIM) project, retina prosthesis chips are built and used within eye. This allows acceptable level of vision to patients with no vision or limited vision. The wireless communication is required to suit the need for feedback control, image identification and validation. The communication pattern is deterministic and periodic, so TDMA fits best in this application to serve the purpose of energy conservation. Two group communication schemes are investigated: a LEACH-like cluster head based approach and tree-based approach. The idea of embedding wireless biomedical sensors inside human body is promising, although many additional challenges exist: the system must be ultra safe and reliable; require minimal maintenance. With more researches and progresses in this field, better quality of life can be achieved and medical cost can be reduced.

[G] Societal-scale sensor network can greatly improve the efficiency of energy-consumption chain, which consists of 3 components, the energy-generation, distribution, and utilization. It is reported that 1 percent load reduction due to demand response can lead to a 10 percent reduction in wholesale prices, while a 5 percent load response can cut the wholesale price in half. In the wake of recent energy regulation in California, proposes a gradual roll-out plan to make energy supply chain part of an integrated network of monitoring, information processing, controlling, and actuating devices, in a hope to spread the consumption of energy over time reducing peak demand. The full impact of these societal-scale systems requires two or more decades.

4. Future Progression

Sensor Networks is hot field right now and there is lot of room to work in security and middleware approaches. The whole field is analogical to the situation of Internet back in 25 years ago. In my opinion, this is a highly application-specific field, so I'll be finding some new application for Sensor Networks alongside reading different papers from Mobihoc, Mobile Computing, SigMobile Proceedings.

References

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