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Research Article

CHALLENGES IN DISTRIBUTED EMBEDDED SYSTEM DESIGNING FOR INDIAN NATURAL EVAPORATION TYPE SALT PRODUCTION INDUSTRIES

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ABSTRACT

Embedded System designing is a latest research trend for science and technology based development. Researchers develop new models day-to-day which have strong industrial, social and research and technological relevance. There are various kind of DES (Distributed Embedded System) designs, which gives broad selection and adoption opportunities to industrialists as per their requirements of the projects. Building the next generation of DES for Indian salt manufacturing industries pose a number of difficult challenges in all aspects of selection process in sensors, microcontroller units and integrated development environments, wireless networking including media standards and protocols, network topology and location dependent mobile technologies. The contribution of this paper is to help in setting the methodology and choosing proper components on the base of this specific application, without the requirement for intensive performance testing.

INTRODUCTION

Now a days, embedded systems have became an integrated part of human life. Embedded system development was started with the invention of microcontroller and initially it was used for machine control applications. But now it has exponential growth in various fields like smart phones, medical devices, home appliances, automobiles, industries and almost in the all fields related with the science and technology. So many manufacturers are involved in production of variety of hardware components, making vast number of choice for a specific application, creating confusion in the mind of embedded system designer. There are so many system designs are possible, but it is difficult to decide that which one is most suitable for given application. Each and every effort of system designer during development phase requires intensive time and cost, as they involved in performance testing. In industrial applications, critical embedded systems are more and more subjected to a large range of parameters to be sensed and on the other side large variation in actuator types to be controlled, as a result complexity increases.

There are so many industrial applications of embedded systems. More and more industrial fields are adopting up-to-date technologies using microcontroller based systems. This trend in India is also synchronized with the trend in other countries of the world. There is a wide spectrum to create a technological revolution in Indian salt manufacturing industries through this type of automation. Natural salt manufacturing process in India remained almost untouched through this kind of technology in the first decade of twenty first century. Sensing of evaporation parameters in the field of salt pan through distributed systems is a part of this process. Harsh environment of the salt pan fields limits the sensor deployment and life of the sensor. Up to what extent we should use wired and wireless data transmission in the design of a system is a significant consideration in this specific application.

However tremendous numbers of system designs are possible, considering varieties of microcontrollers, sensors and communication protocols available in electronic market. Generally the system may be portable, are easy to use and must provide robust services. In order to give proper direction for the selection and to aware the designer with the challenges in this path, I will explore few important points in this paper.

System Description

Figure-1 shows one of the simple designs, a prototype of distributed embedded system, for natural evaporation type salt manufacturing unit. To simplify the discussion, we assume distributed system has two components: Sensor and actuator nodes (field control units) and Base Station. The nodes may have one or more sensors, a power supply, controller area network, one or more actuators and a wireless link (attached module). They have been equipped with embedded microcontroller board. The base station is simply a personal

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computer having wireless module attached with it. The base station receives field data from various nodes, analyses and processes them, sends signals to operate the actuators at selected field nodes. Some node may have partial data processing and control capabilities also.

They can also be classified according to criteria or parameters that decide selection process, e.g., physical attributes-based, task-utility based, information gain-based, etc [4]. Sensor networks are expected to work for a long periods of time, such as months or even years. However due to limited energy available on board, if sensor remains active continuously, its energy will be depleted quickly leading to its death.

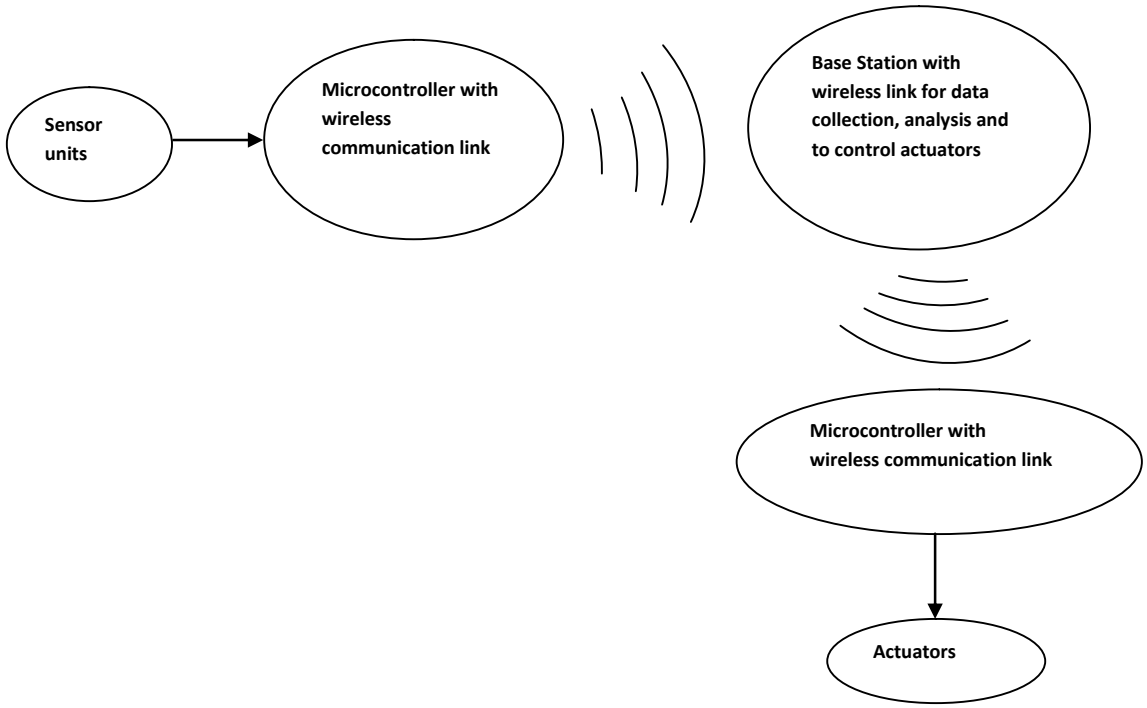

Figure-1

Research Challenges

We are currently in the process of designing the next-generation of Embedded System for natural evaporation type salt production, and in the process I have identified a number of research issues which no satisfactory solution currently exists. The following subsections identify the key problems in this effort. In the interests of space, we have restricted the discussion to research issues involving hardware design and wireless networking [3]. Wireless sensors positions are not determined prior to the network deployment, thus sensors should be able to operate in a way that can automatically generate an optimum routing path and deliver the sensed information back to the base station [9]. It is certainly debatable which issues are important enough to be explicitly considered as challenges in the designing and one can argue in favour of adding more challenges or removing some from my set detailed below. In fact, I expect that this might become reasonable in the future as the field and its application evolve. However I have tried to ensure that my initial discussion consisted of a sensible set of research challenges [8].

Selection of Sensors: *The* sensor units can have cost, power, size, and weight constraints, the environment in which they run is variable, and the units may be capable of changing their location [3]. There are so many different schemes available for the selection of the sensors. These schemes can be categorized in many different ways. For example, they can be centralized (all processing is done by a single node) or distributed (processing cost is divided upon many nodes).

To prolong the network lifetime, sensors alternate between being active and sleeping [4]. In our system the environmental parameters like temperature, humidity, solar radiation, wind speed, etc. need not to be monitored continuous, thus there is a requirement to do active for very short time duration and for the rest of time they are kept in sleeping mode.

Selection of Microcontroller And Ide: *In* prototyping and design of embedded systems, selection of the smallest possible microcontroller necessary to meet system requirements while minimizing power consumption and design size is desirable [6]. With the myriad of microcontrollers available on the market, selecting the ideal microcontroller is a non-trivial task [6]. There are so many constraint satisfaction algorithms that assist in microcontroller selection by matching design requirements to the capabilities of individual microcontroller pins [6]. Unfortunately, unless you gain a comprehensive experience using several alternative microcontrollers in multiple, identical application domains, there are only two ways to objectively determine the fitness of a product for a given application. The first is to rely on third party reports of success or failure. These around and are published widely on the web. The second is to compare alternatives based on manufacturer's published information from brochures, technical reports and websites [7]. Now days, a variety of microcontroller boards are available in the market. One has to choose very carefully the microcontroller as per his/her requirement in the specific application. One has to consider all the external interfaces that the microcontroller will need to

support. In our prototype system, microcontroller interface with sensors like DHT22, LM35, WMT700, 6450SS, EC1500 etc and relays of the actuators must be possible properly. This is a challenge for the system designer. Select a specific microcontroller according software architecture and requirement, processing power required, Memory needs, cost and power constraints, available compilers and tools. Considering all these parameters there are so many microcontroller configurations possible. From all available configurations, for natural evaporation type salt manufacturing unit requirements, one can be confused to find most suitable, from 8051(Intel), PIC (Microchip), AVR series (ATMega), MSP430 (Texas) or ARM (32-bit controller from NXP Semiconductors) and many more other controllers for wireless sensor nodes.

Network Configuration and Topology: The topological design is important because it decides cost, complexity, robustness, latency, and capacity. If configuration and topology not properly chosen, system complexity of data routing and cost will be increased. Application –to-application topology may vary. One important property of a sensor network is its diameter, that is, the maximum number of hops between any two nodes in the network. In its simplest form, a sensor network forms a single-hop network, with every sensor node being able to directly communicate with every other node. Network with a single base station forms a star network with a diameter of two. A multi-hop network may form an arbitrary graph, but often an overlay network with a simpler structure is constructed such as a tree or a set of connected stars [8]. After long experimental efforts, considering the series of salt pans to be monitored, I suggest hybrid (interconnected stars) topology, in above discussed prototype system. However location based decision is always better in this regards.

Power Consumption: Flexibility of wireless sensor networks comes with a series of challenges. Since wireless sensors are not physically connected to any central source they are completely dependent on their battery to operate [9]. Long seashore and deserts (with inland saline water) in India provides suitable environment for the production of salt mainly NaCl. At all these places, for the deployment of embedded system, most nodes obviously require battery operated power supplies. Considering easy available solar power, solar operated power banks are most suitable for this purpose.

Challenges In Selection of Communication Protocol: It is challenging task for the system developer that he has to select a wired communication bus or wireless communications using international standards respectively CAN (Controller Area Network) protocol or wireless standards like Zigbee, blue-tooth, ultra wide band, Wi-Fi etc. Proper selection of routing protocol is also necessary as it decides balancing criteria between latency and energy-efficiency [8]. In the market microcontroller and wireless communication modules separately available generally, but in last few years, Atmel and Texas instruments (TI) are the manufacturers who have been revolutionizing the wireless microcontroller device market by introducing an inbuilt radio module with the microcontroller, controlled via microcontroller registers[13]. In specific designs, as in our application in the automation of natural evaporation type salt manufacturing process, a combination of CAN and ZigBee is suggested as a better solution.

Selection of Actuators: Relays and actuators are integrated part of hardware design. In the initial stage LEDs and 5V DC motors must be used as an output interfacing part. Actuators are always application specific. In above system brine drawing pump is the main actuator, which draws underground brine and fill it in to the salt-pan. There is not a more considerable issue in the selection of the actuators, but task scheduling and synchronization always require more attention of programmer.

Software: As far as software is concerned, the situation becomes even more complex. As with hardware, one could try to cover the design idea with a larger set of different algorithms and basic services [8]. Many simulators and emulators are available in the market. Choice of the middleware and compiler is dependent on the microcontroller selection and integrated development environment. These embedded software selection is dependent on components selected on the hardware section. Each company providing hardware of microcontroller gives their own integrated development environment software to facilitate easy system design to the programmers.

Location Dependent Challenges: This system differs from other industrial and agricultural automation systems in the context that the system has been deployed in salty environment therefore life expected for the components will be affected. Dust is another location based challenge. Temperature variation in wide range requires higher grade quality of the components used in the hardware. Water proofing and hermetical sealing of components is basic need of the project. Maintenance of the system is also the site based criteria, if components of higher standards are used; frequency of visits for the maintenance can be reduced. Sometimes location needs reposition of sensors used in the system.

Figure-2 Traditional Natural Evaporation Type Indian Salt Pan and Workers

CONCLUSION

In this paper I have described an idea for new class design of proposed distributed sensor network called DES for salt manufacturing process particularly designed for Indian salt industries. This system collects streams of sensor data from in-situ sensor nodes over wireless networks, and feed this data to computationally Physical models in order to manage resources and improve quality of the produced salt. I discussed challenges in detail for the design faced by a researcher, who is involved in study for different type of embedded designs that differentiate them from traditional distributed systems. I also

presented several hardware specific research problems, whose solution will enable the next generation of DES using WSN in Indian Salt Production Industries.

Glossary

CAN: Controller Area Network
DES: Distributed Embedded System
IDE: Integrated Development Environment
LED: Light Emitting Diode
WSN: Wireless Sensor Network

References

1. Hiteshkumar Lad, Vibhutikumar Joshi, RameshchandraMakavana, Natural evaporation type salt manufacturing process resource management using Distributed Embedded System, *International Journal of Computer Applications(0975-8887)*, 117(23), 2015, 33-37
2. Sukriti Jalali, Trends and Implications in Embedded Systems Development: *White Paper from Tata Consultancy Services*, 2009
3. David C. Steere, Antonio Baptista, Dylan McNamee, Calton Pu, and Jonathan Walpole, Research Challenges in Environmental Observation and Forecasting Systems, (source: DBLP conference: 6th annual international conference on Mobile Computing and Networking (MobCom'00), January 2000.
4. Hosam Rowaihy, Sharanya Eswaran, Matthew Johnson, Dinesh Verma, Amotz Bar-Noy, Theodore Brown, Thomas La Porta, *A survey of sensor selection schemes in Wireless Sensor Networks, (proceedings of SPIE-The International Society for Optical Engineering, May-2007).*
5. M Ozaki, Y. Adachi, Y. Iwahori, and N. Ishii, Application of fuzzy theory to writer recognition of Chinese characters, *International Journal of Modelling and Simulation, 18(2)*, 1998, 112-116.
6. Jacob A Berlier. James M. McCollum, A constraint satisfaction algorithm for microcontroller selection and pin assignment, *proceeding of the IEEE Southeast Con-2010, 18-21 March, 2010*, added to IEEE Xplore: 22 April, 2010.
7. Phillip A. Laplante, Criteria and an objective approach to selecting commercial Real-Time operating systems based on published information, *International Journal of Computers and Applications* 27(2), January, 2005.
8. Kay Römer and FriedemannMattern, The design space of wireless sensor networks, *IEEE wireless communications*, December 2004.
9. Ahmad Hosseingholizadeh, Dr.AbdolrezaAbhari, A Neural Network Approach for Wireless sensor network power management, Ryerson University, Toronto, Canada, Proceedings of 2nd International Workshop on Dependable Network Computing and Mobile Systems, 2009/9
10. Anthony FernandesPires, StėphaneDuprat, Tristan Faure, CédrikBesseyre, Jack Beringuier, Jean-François Rolland, Use of Modelling Methods and Tools in an Industrial Embedded System Project: Works and Feedback, John Wiley & Sons, 2012.
11. Byte Craft Limited, *First Steps with Embedded Systems* (Byte Craft Limited, 1997, 2002).
12. *Selecting the right microcontroller unit* (source: WWW.nxp.com/files/microcontrollers/doc/app_note/AN 1057.pdf)
13. T.A.S. AchalaPerera, *Zigbee wireless soil moisture sensor design for vineyard management system*, M. Phil. Diss. Auckland University of Technology, May, 2010.
14. D.D.Chaudhry, Pranav Pawar, Dr.L.M.Waghmare, *Comparison and Performance Evaluation of Wireless Sensor Network with different Routing Protocols, 2011International Conference on information and Electronics Engineering* IPCSIT vol.6.(2011)

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