Automation of Administration using Web based Mobile Sensor Technology

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Summary:
Administration is an imperative requirement of technological or non-technological, intra disciplinary or inter disciplinary domain of mechanized world. Most of the administration mechanisms employed for this purpose involve monitoring, reporting and responding as critical and time bound sub-systems. Specific domain of administration addressed in this paper is Parametric Administration, where one or more parameters associated with system are monitored, reported and responded accordingly at site. Traffic administration, dam-level monitoring, thermal/nuclear power plant supervision etc. are some of the systems that demand such a critical and minuscule administration as stated above. Here by, during the administration of the system one or more numeric or non-numeric parameters are considered within a system, which direct us to monitoring the significant change in their values, reporting the change to a central system / commander and devising the response to such change. Nowadays, most of these administration requirements are mostly and majorly fulfilled through a manual support. This manual operation like any other is prone to various limitations like human-errors, exhaustion, time lag, moronity etc. Moreover, in certain cases, for instance, monitoring temperature levels at atomic power plants or water level at dam sites, etc. is surely a fatal task. Thus this paper focuses over a new and upgraded automated system for administration of such tasks. Here using a Web-portal combined with GSM devices, which monitor all the tasks, report of both normal and panic calls, and respond to the needs, Parametric Administration has been fully automated. This all is achieved by using programming algorithm execution with no human intervene. This system emphasizes not only on overcoming the demerits of manual supervision, but it presents easier and effective methodologies using automated features in administration for areas with critical time-based needs.

Keywords:
Parametric administration system, Sensor Networks, wireless networks, mobile sensor, responders etc.

1. Introduction

Administration for a system is basically a supervisory mechanism which assists the system to execute in a controlled manner. As mentioned before, administration forms a tripod of monitoring, reporting and responding according to the variation in the parameters under inspection. Now this tripod of administration gives rise to various questions. What to monitor? Whom to report? And how to respond? Before answering these questions let us see following parameters which decide, to what degree is the Administration mechanism practical to the needs of a particular system?

- **Automation**: To what degree does the administration mechanism is independent of human intervene?
- **Time Efficiency**: How much time lag can the administration mechanism tolerate while monitoring, reporting and responding?
- **Dynamic Architecture:** It defines that whether the administration architecture changes dynamically according to the variations in the structure of system.
- **Ease in Administration:** How many operational complications are encountered to get the operations done?
- **Fatigue & Failure:** It determines how much is the administration system free from failures and fatigue?

Till date most of the administration needs are fulfilled manually. A supervisor or monitor is posted on a particular site. He, according to his observation monitors the variation in some parameters of the system (for instance, the temperature of reactor at Nuclear Power Plant exceeding upper limit). According to his observation, he sends a report to the in-charge/commander for the site. According to the report received by in-charge he will send instruction to his worker/responder group for responding to the change (for instance, to switch off electric power from chimneys).
Now this system provides a great scope for human error or fatigue. Also, it gives large likelihood of system suffering from time lag. Considering all these cases in detail, this paper proposes a completely mechanized system where sensing, monitoring, reporting, analyzing and processing of parameter value and consequently responding is done by programmed mobile sensors, web based console and automatic responders respectively. Here, processing of parameter value and sending report to the commander is done through web portal by GSM simulation.
Rest of the paper is organized as follows. Section II discusses about existing manual system. Further section III

Manuscript received May 5, 2010
Manuscript revised May 20, 2010

expresses the need for a new approach for administration, presenting the complete problem structure. Also section IV describes outlines of Wireless Sensor Network Technology employed in the proposed system. Later section V discusses about proposed System in modular format, followed by conclusion.

2. Existing Manual System

Any system which is implemented using human as its predominating component, must suffer some of the most general shortcomings like fatigue, human error, time lag etc. For the administration work the same difficulties persist. As we know, for monitoring of a site a monitor is employed to watch over the site situation in terms of some predefined parameters. Usually, this vigilance is vision based (where amusingly the only vigilance tool used is human eye). According to the critical or non-critical parameter limits defined for the system and his (monitor's) relative observation, he reports the update to the commander about the system's all sites under vigilance. Commander utilizing the defined protocols and specifications for action pass the response message to the responder/worker group for that site. According to the receipt of action message at worker's end, he is activated towards the site. And finally defined action is taken to recover the system from critical situation it went under.

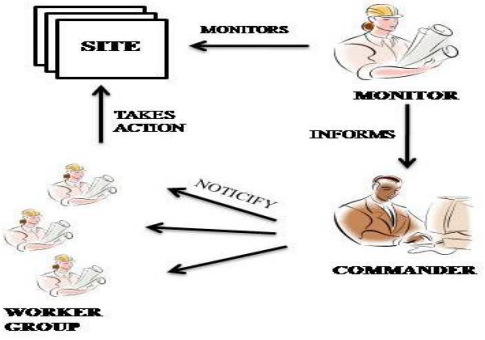

Fig1. Existing System Flow

Above system synopsis can be illustrated using following example and Fig 1. Considering the system to be an Atomic Power Plant, having various sites say Reactor 1, Reactor 2…Reactor N which is all supervised by M1, M2, M3….MN. Here M1, M2, M3…. are monitors or supervisors on site. C is the commander for all sites or all Reactors. W1, W2…WN is the responder/worker group for respective sites or Reactors. Now at Reactor 3 the temperature of compressor is sensed crossing the upper limit, which indicates the consequential blast in Reactor. Monitor M3 sensed the critical situation at the thermometric device fixed to Reactor 3. M3 reports the situation through a call to Commander C through Hotline. Commander C analyzed the parameter value sent by M3 according to typical Protocols defined for the Reactor. Accordingly C invokes the corresponding Responder/worker group W3 through mobile notification i.e. a message. The message includes the plan of action and site address. According to the notification received the responder W3 approach the site Reactor 3 and turn off the fuel injection and power up the cooling tower till the temperature of compressor reaches its customary value.

3. Need For New Approach

Although the existing approach is traditional and easily adaptable, still its drawbacks can't be neglected against the need for a fast, effective, efficient, prompt and automated alternative mechanism for the same. Considering the outlines of Existing System discussed in section 2, following features of the same has to be highlighted.

Firstly, there exists a grand set of sites and locations, where round the clock presence of monitor can not only be tiresome but fatal too [2]. For instance, more than a critical time limit if monitor remains in the vicinity of some nuclear reactor, genetic effects are must to happen. Thus, this situation allows an opportunity to look for some automated monitoring tool that can serve exactly like the monitor (i.e. continuous sensing and reporting) without any physical effect on it.

Secondly, since the parametric administration enters into time critical events quite often, in that situation monitoring, reporting, processing, analyzing and responding, all these execution steps have to be very time efficient, which is very much a dependent and unreliable property in case of a manual administration mechanism. Thus there arises a need to automate the existing system in a modular format i.e. monitoring, reporting, processing, analyzing and responding, all steps of execution can be automated independently.

Thirdly, existing system of administration limits the crucial role of commander over site. It makes commander very much dependent upon monitor's report, in order to know the event pattern at site i.e. there is no direct monitoring of commander over site but it is via monitor. Again this section of mechanism is quite dependent.

Also, there exists no full proof system of history maintenance that can actually reveal the pattern of events occurring on site so as to enhance decision making of Commander. Thus it limits Commander's domain of decisions.

4. Wireless Sensor Networks

Wireless sensor networks (WSNs) are networks of nodes that sense and potentially control their environment also.

They communicate the information through wireless links "enabling interaction between people or computers and the surrounding environment" The data gathered by the different nodes is sent to a sink which either uses the data locally, through actuators, or node which is connected to other networks (*e.g.* the Internet) through a gateway [7].
A sensor node typically consists of five main parts: one or more sensors gather data from the environment. The central unit in the form of a microprocessor manages the tasks. A transceiver (included in the communication module in Figure) communicates with the environment and a memory is used to store temporary data or data generated during processing. The battery supplies all parts with energy. Typically Sensors nodes are tiny Operating Systems. Sensors measure multiple physical properties and include electronic sensors, biosensors, and chemical sensors [9].
To put simply wireless sensor network is a set of wireless connections that can sense, compute and communicate over certain crucial parametric values. These networks are majorly multi hop, energy constrained and application specific networks. Wireless sensor networks are generally Self-Sustaining and possess dynamic topology [6].

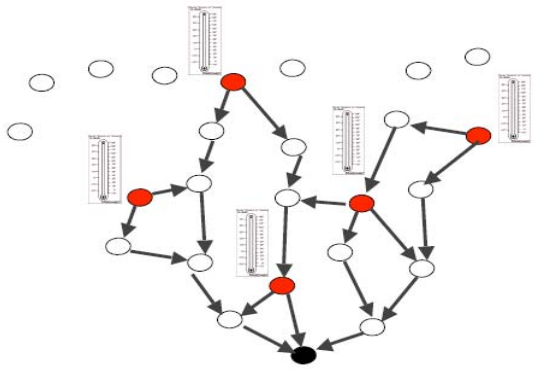

Fig 2. Self Sustaining Wireless Sensor Network Flooding Data Packet towards Sink [8]

Due to Self-sustenance property, as the data packet are flooded into the network, dynamic topology is developed and data packets drive from source towards sink. Data aggregation is done on intermediate nodes. Smart Buildings, Industrial, Environmental monitoring system, Assisted living, robotics are its current application areas. [8]

5. Proposed Architecture For Automation Of Present Administration Mechanism

As hinted in section 3, proposed automated mechanism for parametric administration is automated at modular levels which further integrate to form a complete compatible generic view of automated parametric administration system.
Let us start with monitoring and reporting on site with specific parameter. Initially mobile sensor nodes are installed and configured in network on site locations for sensing. All mobile sensors are programmed to generate SMSs as and when invoked. After the mobile sensors sense the parameter, it generates a SMS packet that is transmitted wirelessly to Base Station (say any GSM terminal device) connected to server. [1] Fig. 3 describes the monitoring and reporting automation of administration mechanism.

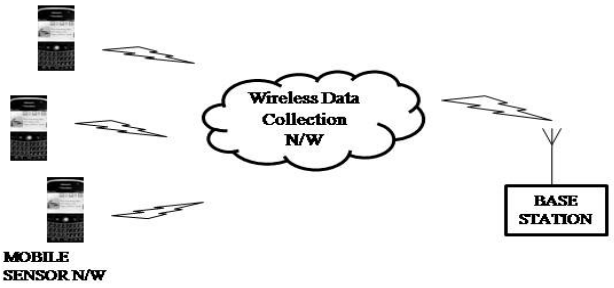

Fig 3. Monitoring And Reporting

Now, Base Station is linked to a Web based Server where Base Station Controller and Processor extracts the parameter value enveloped in SMS packet and analyze it against a rule-based algorithm that defines various protocols and specifications for particular parameter value. Database Manager of server that stores the history of parameter values sensed with certain timestamp updates its current pool of parameter values sensed. Moreover Base Station Controller updates the Data Distribution Controller which is expressed to various Subscribers/site owners as Web Portal [7].
Base Station Controller and Processor not only update Data Distribution Controller (DDC) and Database Manager, but it also facilitates the generation of Alert SMS (in case of critical parameter value) that can notify the Automatic programmed responders/peripherals onsite for some call of action. Considering the time efficiency factor, feature of acknowledgement of the SMS is added to system. Here, if the acknowledgement is not received within 5 seconds then the DDC itself sends a duplicate copy again to the Responders through base station. Fig. 4 describes the Automation of Analyzing, Processing and Data Distribution module of Proposed Administration Mechanism.

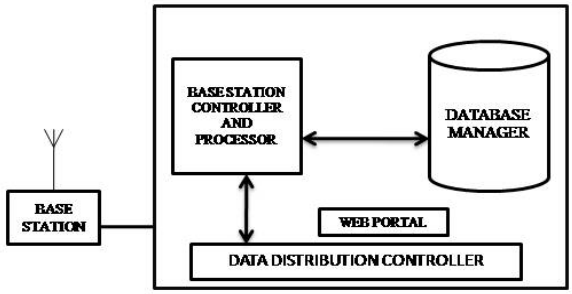

Fig 4. Analyzing, Processing And Data Distribution

Now, referring to fig. 5 given below, server utilizing its data distribution controller (DDC) dispatches the "call for action" or alerts messages to Automatic Responders/peripherals though Base station [1]. Also, irrespective of vicinity using any GSM enabled device, Subscriber is facilitated direct access and control over the on-site events.

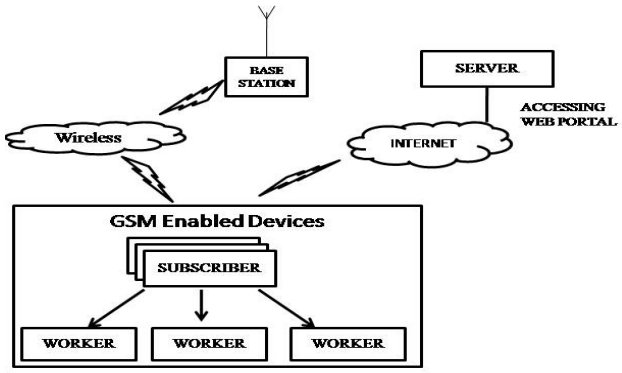

Fig 5. Notifying And Responding

Automatic Responders/peripherals can vary according to the area of implementation. A generic view can stimulate the need using robotic hand, automatic switches (ON/OFF tripps), programmed triggers, or motor actions [5]. These devices, will take the particular action for improving the situation and respond to the Controller of the updates of the site.

6. Conclusion

Doubtlessly as far as simplicity of implementation is concerned, manual mode of mechanism stands better. But considering the technical and efficiency based aspects of Administration scheme, automation turns out to be need.
The proposed automated Parametric administration system not only provides a mechanized format of execution but rather it provides a time efficient, prompt, easy to establish architecture and similar other factors in favour of expected mechanism. The complete administration cycle complete within 15 seconds with promptness which proves that proposed system is efficient enough to overcome limitations of fatigue and moronity.
Moreover, proposed system is not application-based, rather it provides a GENERIC ARCHTICTURE for any system that employs Parametric Administration.

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