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Performance validation of a cascade control system through various network architectures

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Abstract The work analyzes the performance characteristics of a cascade control system when interconnected with various network architectures, such as Internet, mobile and wireless networks. The cascade control system consists of level and flow as primary and secondary variables, respectively. The web-enabled monitoring and control are realized using three techniques namely remote client–server, ActiveX-data socket and web publishing tool. Mobile network is established by interfacing the control system with a GSM modem which enables the monitoring of process parameters through mobile phones. The cascade control system is also monitored wirelessly from remote locations with advent of an indigenous wireless sensor node. The performance analysis proved that wireless monitoring may be considered as an effective alternate technique to the Internet-based communication especially for shorter distances.

1. Introduction

The vital role of network mediated automation has been significantly appreciated in almost all kinds of industries in the last three decades. The networking of industrial processes can be established over a small-scale network as intranet (LAN) or over a large-scale network as Internet (WAN). The makeover process of Internet communication in conventional process environment is influenced by many factors, including number of nodes, Internet bandwidth, time-delay, processing speed, amount of data, managerial policies, safety and security [1,2]. Classical control theory suggested that a delay in the control loop is an important factor causing the system instability as it increases the phase shift between the input and the output signals of the control system and this limits the maximum allowable gain [3]. Some researchers reported as today's Internet provide no real time guaranteed delivery and have essentially unbounded end-to-end latency [4]. On the other hand, reports have experimentally proven that time-delays associated with the network do not affect most of the industrial process plants because of their sluggish nature [5,14]. In general, Programmable Logic Controller (PLC) and SCADA have been widely adopted for monitoring and controlling in many

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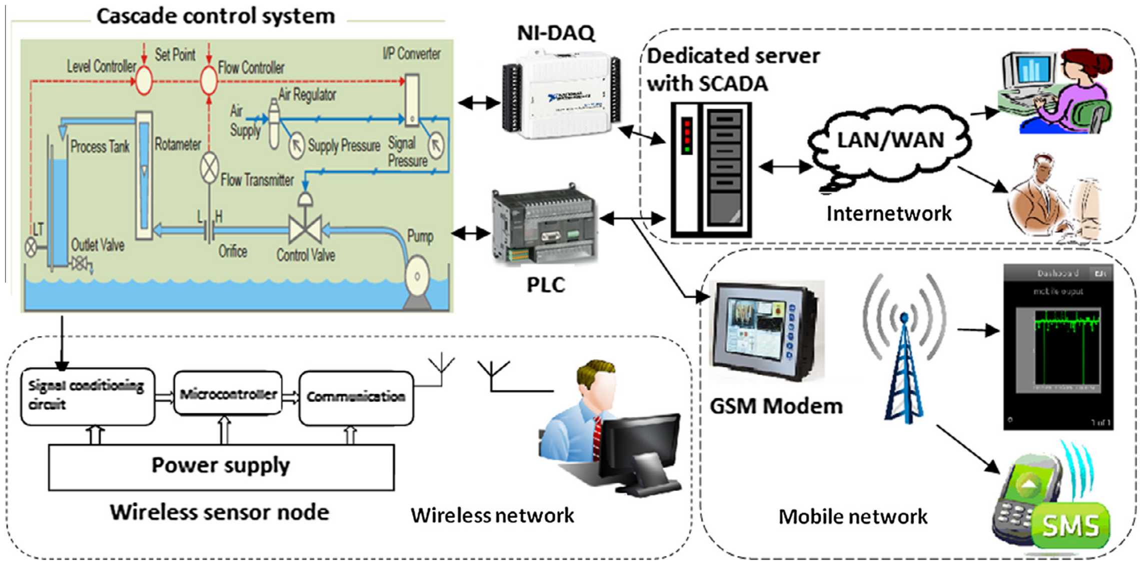

Figure 1 Functional block diagram of various network architectures enabled cascade control system.

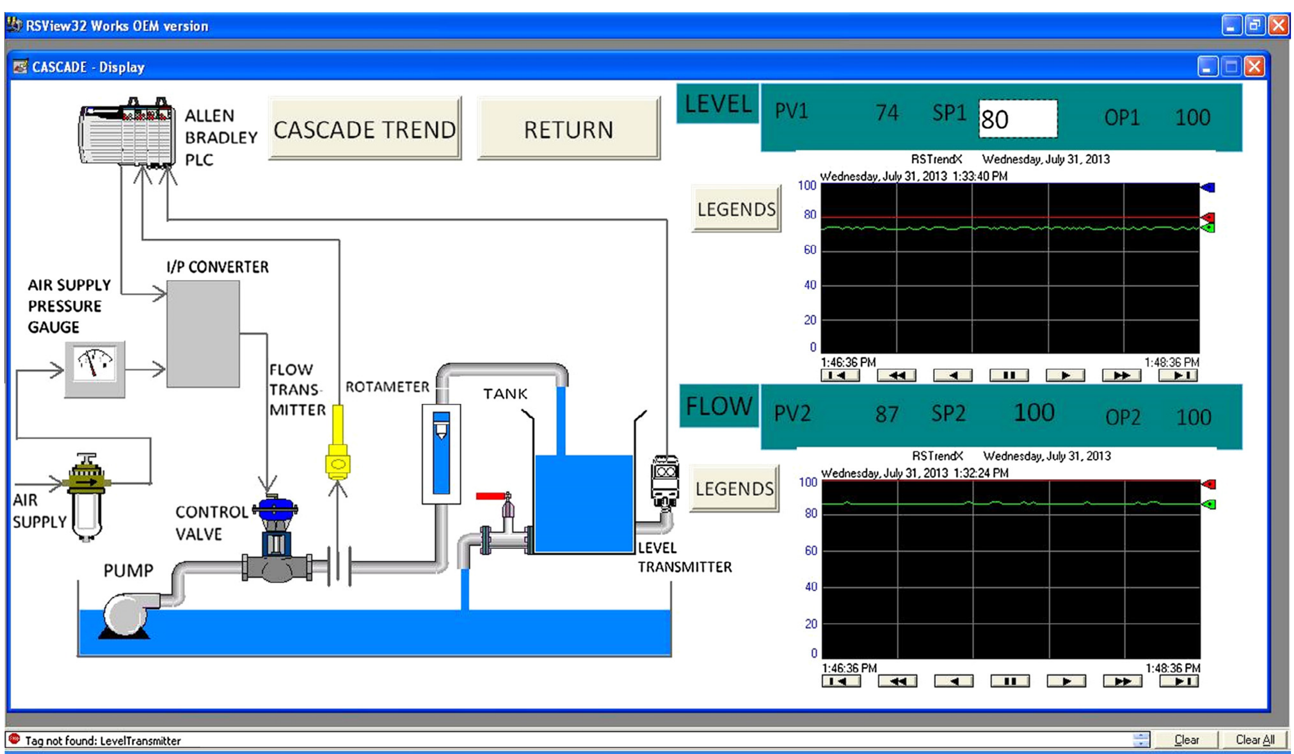

Figure 2 SCADA representation of cascade control system.

process industries. They have great features, including flexibility, reliability, low power consumption and ease of expandability [6,7]. SCADA stands for Supervisory, control and data acquisition which offers graphical visual representation of process parameters even from the remote places [7]. It is understood that the efficiency of plant automation can be further improved by integrating PLC with SCADA through tags of information [8–11]. The Internet based engineering laboratories are seen as revolution in technical education which not merely brings the equipments to the student's home but also ensures sharing of resources among universities [12,13]. All the leading PLC manufacturers including Siemens and Allen-Bradley have started to adapt the web-enabled automation in order to increase the productivity.

Most of the industries prefer to use wireless communication as it scores better than the wired to monitor the process parameters from remote locations. The mobile and wireless network requires minimal effort for the installation and maintenance

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