سامية محمد مصطفى

شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

سامية محمد مصطفى

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

سامية محمد مصطفى

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

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سامية محمد مصطفى

شبكة المعلومات الجامعية

بعض الوثائق الأصلية تالفة

سامية محمد مصطفى

بالرسالة صفحات لم ترد بالأصل

PERFORMANCE OF GIGABIT ETHERNET IN NETWORKED CONTROL SYSTEMS

by

Ramez Maher Daoud

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
AUTOMATIC CONTROL

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Under the Supervision
of

Prof. Shawky Z. Eid
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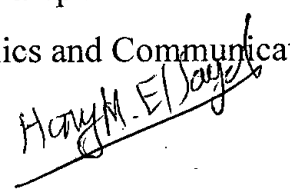

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ABSTRACT

INDUSTRIAL control was traditionally based on point to point communication, where single point failures could drive the whole system into instability. With the introduction of control networks, individual machines can be interconnected to share control as well as information throughout the complete industrial line. New "intelligent" machines are based on having an intelligent control scheme to facilitate diagnostic and solve problems that may arise during operation.

In Networked Control Systems (NCS), entire machines are implemented in the form of a control network that accommodates sensors, controllers, and actuators. These are nodes communicating over the network to form automated workcells. NCS were studied in the literature when running on-top-of deterministic networks like ControlNet and DeviceNet. Also, several suggestions to use the Ethernet protocol were made.

All Ethernet protocol versions may show non-deterministic behavior. To be used in control systems, modifying the standard protocol to bound control packets transmission delay was discussed in previous studies.

In this study, it is shown that with the high speeds of the new Ethernet versions, the requirements of a particular control system may be satisfied without modifying the standard protocol. Both, Fast and Gigabit Ethernet were used in star topology without modifying the IEEE 802.3 LAN protocol. Industrial models where built and systems under research by the Open DeviceNet's Vendor Association (ODVA) were tested.

OPNET simulations were run to test five industrial models. Studies were made for comparison and performance evaluation of both Fast and Gigabit Ethernet when used in NCS to satisfy real-time round-trip delay constraints. Mixed environment of control packets of deterministic nature and communication packets of non-deterministic nature was implemented.

Simulation scenarios covered small as well as large scale machines when Ethernet NCS forms the control closed loop. Integration of in-line production machines with high traffic loads was also simulated. Fast machine operation for increased production took also part in the study.

Results showed that Fast as well as Gigabit Star Ethernet can be used for real-time NCS on small scale machines, although Gigabit Ethernet had much better performance. For large scale machines as described throughout this research, Gigabit Ethernet showed satisfactory performance whereas Fast Ethernet failed to satisfy the prescribed requirements.

When more complicated schemes were simulated, results were in favor of Gigabit Ethernet, as Fast Ethernet failed to satisfy the round-trip delay requirements. That is to say that Ethernet in star topology running at 1Gbps is a viable option to build NCS machines as the proposed ones. An open subject of study still under research by the ODVA of integrating IP cameras over industrial NCS was also tested. Results came unsatisfactory based on the proposed model.