BIOGRAPHICAL SKETCH

Faisal Ali Alkhaldi was born in Sakaka, Aljouf Province, Saudi Arabia, on January 6th, 1979. He attended elementary through high school in Aljouf Province and graduate high school in 1997. In the fall of 2008, he joined Tennessee Technological University as an international student. He received his B.S., M.S. degrees, and is currently pursuing his PhD degree in Electrical and Computer Engineering. Currently, Mr. Alkhaldi works for Prince Mohammed Medical City (PMMC), Saudi Arabia. He joined the PMMC since he started his PhD. He has been working on a project of PMMC's interest which has become his Dissertation subject. While pursuing his PhD studies, Faisal has published peer-reviewed papers in various prestigious venues such as the IEEE High Assurance Systems Engineering, IEEE e-Health Networking, Applications and Services, IEEE Systems, Man, and Cybernetics, and MDPI Sensors, IEEE Engineering in Medicine and Biology. Mr. Alkhaldi has also reviewed papers for IEEE Systems, Man, and Cybernetics, and other publication venues. He also has been and still serving as a member in the Technical Program Committee of Global Health Conference, a growing conference for engineers and healthcare professionals to tackle current and future healthcare systems' problems. Mr. Alkhaldi's area of research is in control and systems engineering. His research interests include modeling and real-time control of healthcare systems at the operational level with the focus on improving the resulting health value at the patient level.

EDUCATION

Tennessee Technological University
Cookeville, Tennessee, USA
B.S., Electrical Engineering, 2011

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College of Engineering

TENNESSEE TECH

The Department of

Electrical & Computer Engineering

Announces the Dissertation Defense

of

Faisal Ali Alkhaldi

In Partial Fulfillment of the Requirements

For the degree of

Doctorate of Philosophy

October 30, 2019

Held in

208 Brown Hall at 12:30 p.m.
115 West 10th Street
Tennessee Tech University

FIELD OF STUDY

Control and systems engineering

DISSERTATION TOPIC

"Universal Systematic Platform Design for Real-Time Patients Flow Control and Resource Utilization in Healthcare Organizations"

EXAMINING COMMITTEE

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Abstract

The cost of care (COC) and quality of care (QOC) have been a central issue in the US healthcare system for several years. Patient waiting time and resource allocation, which can be controlled in real time, are two of the major factors that affect the cost and quality of care in healthcare organizations (HCOs). The objective of this work is to minimize the patient waiting time, while maximizing the utilization of the resources for HCOs.

First, using the augmented System Engineering Multiple-Domain Matrix (SE-MDM) as well as a concept of traceability, it is shown that a network topology can be developed to provide a universal structure for a model-based approach to automate patient flow and resource utilization in any HCOs. Second, the problem of patients flow control and resource utilization is formulated as an optimization problem. The solution to this problem is an optimal global routing strategy (OGRS) to control the patient flow and resource utilization in real time for a HCO; assuming that the OGRS can be ideally implemented in a HCO. The solution is then extended to include practical situations, in which the ideal OGRS cannot be implemented due to realistic events such as delay in care time and unpredictable events such as arrival of patient with high risk factors, etc. The extension uses the concept of feedback control systems, where healthcare professionals provide the feedback information.

The proposed solution is tested, on the basis of scenarios that took place in an ambulatory HOC of visiting patients, and compared to that of the existing best performing solutions. It was found that the proposed solution outperforms these solutions by at least a fifteen-percent in terms of reducing patient waiting time and maximizing resource utilization. Considering the *ad hoc* approach currently practiced by the majority of hospitals, the total patient waiting times is about thirty-eight percent higher compared to the proposed solution. To show the effectiveness of the proposed feedback solution, simulation experiments were conducted for an ambulatory HCO of few patients to larger HOCs of 50 patients competing on different resource nodes. The results suggest that the proposed system is effective in tackling the uncertainties encountered in care delivery.

The contribution of this work includes a universal structural model as well as systematic solution to the control problem of patient flow and resource utilization. Both contributions are applicable to any HOCs. Furthermore, the proposed control solution can be adopted to extend the theory of resource allocation for non-sequential tasks scheduling.