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Date : 23th June 2016

ANALYSIS OF PERFORMANCE FOR CART GANTRY CRANE SYSTEM USING SCHEDULING ALGORITHM VIA CONTROLLER AREA NETWORK (CAN)

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This Report Is Submitted In Partial Fullfillment Of Requirements For The Bachelor Of Electrical Engineering (Control, Instrumentation, and Automation)

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I declare that this report entitle “Analysis of Performance for Cart Gantry Crane System using Scheduling Algorithm via Controller Area Network (CAN)” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

Gantry Crane System (GCS) is one of the huge machinery that carrying a heavy load from one place to another. If the load could not handle properly, it can be effected to the workers at the working area. In order to prevent this issue, the Deadline Monotonic Priority Assignment (DMPA) and the Earliest Deadline First (EDF) are implemented for this GCS. In addition, the presence of Controller Area Network (CAN) is also implemented for the model for Multi-Cart GCS analysis. The analysis is based on the Settling Time (Ts) and Overshoot (%OS). PID Controller is used to the implementation of this project that serves as a basic requirement of control system. All conducive to the implementation of the simulation results and the impact of input-output is the same environment that will be implemented in MATLAB. Based on the results, the implementation of DMPA and EDF scheduling algorithm via CAN is successfully analyzed whereby the execution time could not exceed to the period time to make ensure the GCS in safe condition.

ABSTRAK

Sistem Gantri Kren (SGK) adalah salah satu daripada jentera besar yang membawa beban berat dari satu tempat ke tempat lain. Jika beban tidak dapat dikendalikan dengan baik, ia boleh menjadi kesan kepada pekerja di kawasan kerja. Untuk mengelakkan masalah ini, *Deadline Monotonic Priority Assignment (DMPA)* dan *Earliest Deadline First (EDF)* dilaksanakan untuk SGK ini. Di samping itu, kehadiran *Controller Area Network (CAN)* juga dilaksanakan untuk model. Analisis ini adalah berdasarkan kepada Masa Penyelesaian dan Masa Lonjakan. *PID Controller* digunakan untuk pelaksanaan projek ini yang berfungsi sebagai keperluan asas sistem kawalan. Semua kondusif untuk pelaksanaan keputusan simulasi dan kesan masukkan-keluaran adalah persekitaran yang sama yang akan dilaksanakan dalam MATLAB. Berdasarkan keputusan, pelaksanaan DMPA dan EDF algoritma penjadualan melalui CAN berjaya dianalisis di mana masa pelaksanaan tidak boleh melebihi tempoh sistem untuk memastikan SGK dalam keadaan selamat.

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LIST OF ABRREVIOTIONS

GCS	-	Gantry Crane System
DMPA	-	Deadline Monotonic Priority Assignment
PID	-	Proportional, Integrator and Derivative
EDF	-	Earliest Deadline First
CAN	-	Controller Area Network

CHAPTER 1

INTRODUCTION

This chapter will explain descriptions of Gantry Crane System (GCS) that will be discussed to provide knowledge about the project. The objectives, statements of issues, scope and project outlines for the project as a whole is clearly stated in this chapter.

1.1 Gantry Crane System

Gantry Crane is a vehicle that is also known as cart. The cart used to carry loads from one place to another place in time. Gantry Crane Systems (GCS) need a good control system because GCS heavily involved in the work environment and must be controlled precisely to avoid any unwanted accidents in [1]. The GCS is the most popular in the form of container gantry cranes. It is used for loading containers used to load and transport hub in the outer container ships. It can be categorized as huge gantry crane "full", capable of carrying the heaviest in the world. The small gantry crane normally carries out the work of lifting loads less severe as the engine to be removed or inserted into the vehicle.

The main purpose of this study was to perform a good system of gantry crane, where it gives merit to the work done on the gantry crane without disruption to the load swing. it also

aims to put some gantry crane on a common platform. Figure 1.1 shows one example of a gantry crane used in the industry in Malaysia.

Figure 1.1 : Example of a Gantry Crane System

1.2 Objectives

This study embarks on the following objectives :

i. To design TRUETIME simulation environment for analyzing Single Cart Gantry Crane System (GCS) via Deadline Monotonic Priority Assignment (DMPA) and Earliest Deadline First (EDF) scheduling techniques.

ii. To analyze the DMPA and EDF for three model of Cart GCS running concurrently in terms of transient response performance.

iii. To evaluate the DMPA and EDF scheduling techniques by using Controller Area Network (CAN) on the global schedule performances.

1.3 Motivation

In the work done by the GCS is primarily concerned with safety. This is because the work performed by GCS very dangerous to the environment and can kill workers who were around. Operating conducted by GCS is associated with heavy materials and may have dangerous substances like explosives or other. The main objective of this project is to give attention to the position of the cart at GCS. In addition, this project will to the favorable impact on the speed of GCS without much effect on load swing.

1.4 Problem Statement

Gantry crane is a system for carrying loads from one place to another. Gantry cranes facilitate the work carrying heavy loads. Gantry cranes have to pay for the speed of its tasks to save time without giving too much power to the load swing. One had accidents is human error, which operates in the state of GCS manual. Furthermore, the percentage of accidents is high if the load is bigger and heavier. Ranking trolley must immediately follow the requirements of the system to stop the trolley in the current move. Scheduling methods are very important for GCS to control the position and speed of the trolley is good and in accordance with the requirements of the system.

1.5 Scopes

The scope on this project, state as below:

I. Analyze the system of Deadline Monotonic Priority Assignment (DMPA) and Earliest Deadline First (EDF) in Single Trolley Gantry Crane System (GCS).
II. The scheduling algorithm and simulation purpose via MATLAB environment.
III. Implement the Controller Area Network (CAN) into the system to analyze the DMPA and EDF scheduling algorithm.

1.6 Report outlines

There are report outlines, as below:

Chapter 1 is the introduction to the project. The objectively, problem statement and scope of the project is obviously in this report.

Chapter 2 is the study of GCS through some paper work that has been done by the researchers of this wipeout, scheduling algorithms, and network control method.

Chapter 3 is about the methodology of the entire project, which will tell you the steps from the beginning of the project until the end of the project. Additionally, it will tell you the materials used during this project, such as Matlab Software will be used to perform simulations on the project.

Chapter 4 is showing the results of the implementation of the project. As a result of the implementation of this project divides into three parts, of which the first part is a result of the Single Trolley GCS to implement scheduling algorithms. Part two is the Multi-Cart GCS and the top three were Cart GCS with scheduling algorithms in the Controller Area Network (CAN). The outcome this time, Single Trolley GCS only executed.

Chapter 5 is the end of the evaluation and discussion of the overall project for future work.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, it discusses previously associated in this research. The method used in this research scheduling algorithm through the Control Area Network (CAN) and some other methods used in the implementation of GCS. The main purpose of this chapter is to understand and delve more deeply into the methods used.

2.2 Control System of GCS

In 2012, researchers have used genetic Fuzzy System to control the gantry crane [2]. This method is a form of gain scheduling control system. This technique is appropriate and broad based multi-parameter controller by exogenous variables. In addition, this technique is aimed at finding the minimum linear scheduled set by the fuzzy controller interpolation schema. But the researchers are just focusing sheets y axis on which anti-swing crane. The GCS has a range of effects to make the work go smoothly and safely.

In 2011, a researcher has focused on the effects of heavy load on the system response GCS. In his research [3], he uses feedback control schemes for GCS. To achieve this result were evaluated with different weights in algorithm. Three different control strategies used by researchers, namely LQR, PD controller for DFS and simulation exercises in Matlab, and the results were compared with the uncontrolled system. Many researchers have used the term open loop optimal strategy as discussed in [4,5]. However, they come out with results that are not good for open-loop strategy because it is sensitive to parameters (eg rope long) and cannot recompense for wind noise. Singhose [6] introduced the importance of open-loop strategy is the input form. However input form the method is still open loop approach. But others with feedback control, it is less sensitive to noise and parameter variation [7] is also used to control the GCS.

2.3 Deadline Monotonic Priority Assignment (DMPA)

DMPA is the inverse of the deadline and it is similar in concept to rate monotonic priority. Where priority is given to the process is inversely proportional to the length of the deadline. Short deadlines or quickly given the highest priority and due date of the oldest of the lowest priority. The patient is the priority order when the next rate monotonic order to match the deadline (period = the deadline). DMPA is a static priority scheme optimal for fast sharing of critical process. This was stated as Theorem 2.4 in [8] “Reverse-deadline optimum priority assignment for the processors”. In [9] states that any set of processes whose characteristics appropriate time to rate monotonic analysis will also be accepted by virtue of static theory that justifies the deadline and within different processes.

Generally, where a deadline-monotonic scheme who are not working due to lack of sufficient schedulability test. The rate-monotonic scheduling schedulability test can be used to reduce the length of the individual so that the same process with deadlines. This situation obviously test it will not be optimal because the workload on the processor will exceed the estimate. The priority assignment is optimal for a set of tasks that are given priority according

to their deadline, the task with a short deadline given the highest priority. Optimal assignment policy priorities for a set of tasks on a regular or occasional strictly compliant system model like, all tasks have deadlines of less than or equal to the minimum their time between the arrival (or periods) and all tasks have the worst-case execution times (WCET) of less than or equal to their end date. All tasks are independent and so do not prevent their implementation. This is because there is a duty voluntarily suspends itself. There is a point in time, the so-called critical instant, where all tasks to be ready to execute simultaneously and when scheduling overhead is zero. Over scheduling is intended to switch from one task to another. All tasks have zero emissions jitter (time of assignment arrived for it to be ready to implement).

Besides that, for the example in [10] if the restriction is lifted 7, then "deadline less jitter" monotonic priority assignment is optimal. If the restrictions lifted to allow the deadline to be greater than the last, then Audsley optimum priority assignment algorithm can be used to find the optimum priority assignment.

2.4 Earliest Deadline First (EDF)

The Earliest Deadline First (EDF) is a dynamic scheduling algorithm used in real-time operating system to put a process in the priority queue. The priority queue is an abstract data type as a stack data is unusual, but in which every element has an additional "priority" associated with it. In the priority queue, an element with priority served before the element with low priority. If two elements have the same priority, they are served according to their order in the queue. Although priority queue are often implemented with a stack, they are conceptually different from the stack.

The priority queue is an abstract concept such as “list” or “map”. It is only as a list can be implemented with a linked list or array. In addition, the priority queue can be implemented with a stack or various other method such as multiple unordered. Whenever an event occurs

such as a completed task scheduling, the line will be searched for the closest to the deadline. This process is next scheduled for execution. EDF is an optimal scheduling algorithm in uniprocessors advance. It means, if the collection of independent and each has features that moment arrived, the implementation requirements and deadlines, it can be scheduled with any algorithm in a way that ensures all work completed by their deadlines. EDF will schedule the collection so that they all complete the work according to their deadline. EDF can guarantee all the deadlines met provided that the total CPU usage is more than 100%. EDF can ensure that all deadlines in the system of higher loading compared with fixed priority scheduling techniques such as scheduling classes monotonic [11].

In [12], the researchers have used the EDF for automotive applications. Generally, automotive applications are cyber ordinary physical systems, where it performs real-time processing of continuous data using a variety of sensors and communication on board from outside the vehicle. However, transmission of data outside-the-vehicles often has problems when introducing data rate fluctuations are large, where the arrival time can vary or not be guaranteed. The researchers have determined the flow and have been using EDF Scheduling. These techniques can be used not only EDF-PStream, but also for general data processing flow-based EDF. EDF-Tstream is a method that uses rescheduling by EDF preemtable data stream. The design method preemptable data flow task by their characteristics, and the researchers confirmed the effectiveness of this method is based on analysis and experiments [12]. It showed improved efficacy in a real-time implementation constraints, reduction of vehicle accidents, and vehicle positional accuracy, compared to the scheduling method based on data flow. existing real-time scheduling cannot handle the data flow out of order queuing, and search out-of-order queue by EDF performance degrades as frequently accessing queues. Weighted Fair Queueing (WFQ) [13] and the earliest Deadline First (EDF) [14] have been extensively studied in recent years. WFQ and EDF using dynamic priority mechanisms in the packet and both can provide end-to-end delay limits for regulated traffic flow. In a packet network, the scheduling is an important mechanism for realizing the Quality-of-Service (QoS) as it directly controls the packet delay. WFQ has good properties for the protection of traffic, while EDF is known to be the optimum delay in providing limits on single node [15]. If in the case of end-to-end EDF overcome if traffic WFQ each node to form implemented [16].

2.5 Control Area Network (CAN)

A Controller Area Network (CAN) is a vehicle bus standard designed to allow microcontrollers. CAN is also for the tools to communicate with each other in the application without a host computer. It is a message-based protocol, originally designed for a multiplex electrical wiring in cars, but also used in many other contexts. Car accidents or vehicle on the road is often the case. One of the reasons is because drivers are often sleepy when driving. Therefore, in [17] the researchers have been using CAN as control Advanced RISC Machines (ARM). The system is safe for drivers who often sleepy when driving. Both ARM controller, Master and Slave are connected to the CAN bus protocol for exchanging information and for commu-nication. The CAN be used for faster and reliable Communi-cations.

In a study [18], a system developed using ARM controller as the main control unit and CAN bus in a car. ARM is used to get high performance. CAN makes use of high-speed communication in control networks. Besides, it also helps the sharing of data between all nodes resulting increase their collaborative work. Vehicle reliability is largely influenced by the complexity of the circuits used in control systems [19, 20] in an increasing number of electronic controllers and instruments in the modern automotive industry. Maintenance is difficult to carry out and from the point of view of the layout, electrical systems using point-topoint traditional single communication approach, which inevitably will lead to the big problem of cable pets. Thus, CAN is used as a high quality vehicle for the bus system to connect all the controllers in the system to achieve unified management [21]. The CAN lead to easier data sharing and interoperability between different control systems. Due to the complexity of the vehicle, for example, the entire vehicle with a sensor assigned to various standard and automotive systems is the data in various formats such as complex data, heterogeneous data etc. [22].

Vehicle systems need information to the maintainer and driver. It is necessary to design an efficient, reliable gateway and data processing systems. The gap between different systems is difficult to meet is a concoction. This problem can be solved by the entrance bridge to connect multiple CAN buses with different speed ratio.