AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer Engineering and Systems

A Hypervisor-Based Solution for Automotive Applications

A Thesis submitted in partial fulfillment of the requirements of
Master of Science in Electrical Engineering
(Computer Engineering and Systems)

by
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Bachelor of Science in Electrical Engineering
(Computer Engineering and Systems)
Faculty of Engineering, Ain Shams University, 2016

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Statement

This thesis is submitted as a partial fulfillment of Choose Degree in Choose Branch, Faculty of Engineering, Ain shams University. The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

Today's car manufacturers are racing in deploying new innovative functionalities in modern cars like human-machine interface (HMI) technologies, cloud-based services, vehicle ad-hoc networks (VANET) and autonomous driving. Such new technologies increase the complexity of vehicle's E/E architecture and add new requirements on automotive software systems. This can specially be seen in cockpit domain units like Advanced Driver Assistance Systems (ADAS), Infotainment Head Units (IHU) and Telematics (TEM). The software applications of such units now exhibit large variations in requirements in terms of safety, security and connectivity, as they are involved in both in-Vehicle network communication and cellular vehicle communication (V2X). In addition to that, Original Equipment Manufacturers (OEMs) are heading towards consolidating multiple units into single high computing platform. Although this simplifies the networking model of the vehicle, it adds more challenges on the architecture of automotive software systems. This research aims to study the different approaches to solve these problems. It focuses on utilizing hardware-assisted virtualization techniques to allow consolidating multiple heterogeneous automotive applications on the same hardware. The performance of used approach is evaluated and the overhead of running in virtualized environment is calculated.

Summary

The new technologies in automotive increase the complexity of vehicle's electrical and electronics (E/E) architecture and add new requirements for connected software systems. The number of Electronic Control Units (ECUs) is constantly increasing with over 100 ECUs in a modern vehicle. This research focus on studying how to apply virtualization technology in automotive software. It was found that hardware-assisted virtualization could be used as an efficient approach to consolidate a real-time application and a Linux application to run on the same hardware. The hard real timing requirements of realtime application were met as CPU load only increased by 0.2%. This is the overhead added to run the basic functionalities of operating system in virtualized environment. Moreover, there were no porting efforts to run an operating system that already runs natively on the target hardware.

The thesis is divided into seven chapters as listed below:

Chapter 1

This chapter gives and introduction on the motivations of this research and the objectives of this study.

Chapter 2

This chapter studies the AUTOSAR software architecture and presents how it is used to satisfy automotive software requirements.

Chapter 3

This chapter studies heterogeneous systems and explores different techniques to handle these systems.

Chapter 4

This chapter presents previous related work and current approaches used to address heterogeneous systems in automotive.

Chapter 5

This chapters describes the methods done in this study to apply the actualization techniques in case of automotive software.

Chapter 6

This chapter describes the experiments done in this study and discuss the result.

Chapter 7

This chapter summarizes the conclusions for this study and lists the future work for this research.

Key words: Hypervisor, AUTOSAR, Functional Safety, Hardware-Assisted Virtualization, Automotive Security, HW/SW Consolidation, Multicore systems, Virtual ECU.

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