

Public summary of PhD-thesis of Gabriela Breaban

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A new methodology for designing embedded applications

Embedded systems have conquered almost every area of human activity, from multimedia to automotive and healthcare. Their complexity is increasing rapidly as new functionalities are being added to the system in which they are residing that have to be realized with the required quality. The PhD research of Gabriela Breaban has led to a new design methodology for embedded applications that are required to process data fast and realize their functions timely.

An embedded application is usually referred to as the software application that controls (part of) the functionality of the system of which it is part of. However, as opposed to software applications that run on a personal computer, the embedded applications typically interact with mechanical and electrical parts via sensors and actuators. These applications traditionally include functions that have to be performed periodically such as measurements of voltage, temperature or other physical properties. Moreover, nowadays they are becoming more data-intensive as the number of sensors and actuators that produce and consume data is increasing. Thus their quality depends not only on their capability of performing the periodic functions, but also on the data processing speed needed for the new data-intensive functionalities. Thus both time and data are two important aspects of many modern embedded applications.

One example of a modern embedded application is an advanced driver assistance system (ADAS). It is an automotive application, hence it includes traditional periodic functions such as the ones mentioned above. However ADAS systems include a large number of sensors and actuators, many of which involve image processing functions, that are data-intensive functions. Examples of such sensors are radar sensors, front/back cameras, driver monitoring and traffic sign detection. Thus designing such systems with the focus on both time and data aspects ensures that the corresponding quality requirements are met and that, in consequence, the user can benefit from the resulting competitive and reliable product.

Embedded applications are nowadays being implemented on multi-processor hardware platforms that offer the required processing power. To cope with the increasing complexity involved when designing embedded applications for multi-processor platforms, the model-based approach has emerged in which abstract models are used to capture the important aspects of the application being designed. Recent research efforts have focused on finding new models that can cope with the complexity of present-day embedded applications. However, the combination of the time and data aspects has not received significant attention. In addition, when designing a system, engineers need a methodology that guides them into using the model of the application in order to arrive at the final product that meets the data and time quality requirements.

My PhD thesis proposes a new formal model that captures the data and time aspects of embedded applications and offers an accompanying methodology that the engineers can use to design the applications for multi-processor platforms. The model together with the methodology lead to a final implemented application for which the data and time -related performance is guaranteed to be within the required limits. This is a step towards engineering high quality embedded applications.

Title of PhD-thesis: A Model-Based Design Methodology for Time-Driven and Data-Driven Embedded Applications. Supervisor: Kees Goossens.