

Model-driven Development of Device Tree Software for Different Embedded System Platforms

The Scientific and Technological Research Council of Turkey (TUBITAK) Academic Research Funding Program Directorate (ARDEB) Electrical, Electronics and Informatics Research Grant Committee (EEEAG) funded research project (TUBITAK ARDEB Grant no: 117E553)

TÜBİTAK

Abstract

Device tree (DT) files, which include hardware information and configuration, are used during the compilation of operating systems for various embedded platforms. DTs provide description of physical devices and peripherals inside an embedded system hardware with node specifications. However, software developers mostly have difficulties in developing such applications due to text-based syntax of DT source files which has a different structure from the well-known general purpose programming languages. For each new embedded platform, specific DT files should be coded separately from scratch. Furthermore, the developer needs to be familiar with the hardware specific for each different microprocessor to prepare such files. That process can be very challenging for the developers who possess domain knowledge for these hardware but little or no experience on software development. Moreover, both development and configuration of DT software components regarding different microprocessor architectures can be very hard and time-consuming. In order to eliminate these deficiencies and difficulties of current DT software development processes, a model-driven software development (MDS) methodology in which automatic generation and configuration of DT software for different embedded platforms is provided. Within this context, a domain-specific modeling language (DSML), called DSML4DT, with including all supporting visual modeling and automatic code generation tools for the application of the proposed MDS methodology were developed in the project. Various noteworthy studies exist in the related research field for the model-driven development and/or the generation of codes for hardware drivers in the embedded systems. However, these studies do not take into account the development of DT-based software. The work herein provided the achievement of the initial artifacts in order to bridge the abovementioned gap encountered in the field.

The evaluation of DSML4DT was performed over the development of DT software for four different embedded devices. The comparative evaluation results showed that a significant amount of the code required for DT software can be automatically achieved by using the DSML4DT. The time needed to develop DT software was reduced to half by applying the MDS methodology and using DSML4DT. Finally, qualitative assessment, based on the developers' feedback, exposed how DSML4DT facilitates DT software development.

Start Date: April 15, 2018

End Date: April 15, 2019

Total Budget: 18.189 TL (~\$5,000)

Project Team:

Assoc. Prof. Dr. Geylani KARDAS (Principal Investigator)

Sadık Arslan (Scholar) (Ph.D. Student)

Related Publications:

1. Arslan, S. and Kardas, G. (2020) “[DSML4DT: A domain-specific modeling language for device tree software](#)”, Computers in Industry, vol. 115, 103179, pp. 1-13, DOI: 10.1016/j.compind.2019.103179.
2. Arslan, S. and Kardas, G. (2019) “[Reverse Engineering Support for the Model-driven Development of Device Tree Software](#)”, In proceedings of the 13th Turkish National Software Engineering Symposium (UYMS 2019), September 23-25, 2019, Izmir, Turkey, pp. 1-12 (in Turkish).
3. Arslan, S. and Kardas, G. (2018) “[Modeling Device Tree Software](#)”, In proceedings of the 12th Turkish National Software Engineering Symposium (UYMS 2018), September 10-12, 2018, Istanbul, Turkey, CEUR Workshop Proceedings, vol. 2201, pp. 1-12 (in Turkish) (**best paper award**).
4. Arslan, S. (2018) “*Model-driven Development of Device Tree Software*”, M.Sc. Thesis, Ege University, 139 pages (in Turkish).