Design of Fuzzy Controllers for Embedded Systems with JFML

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Autores J.M. Soto-Hidalgo, A. Vitiello, J.M. Alonso, G. Acampora, J. Alcala-Fdez

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Abstract Fuzzy Rule-Based Systems (FRBSs) have been successfully applied to a wide range of real-world problems. However, they suffer from some design issues related to the difficulty to implement them on different hardware platforms without additional efforts. To bridge this gap, recently, the IEEE Computational Intelligence Society has sponsored the publication of the standard IEEE Std 1855-2016 which is aimed at providing the fuzzy community with a well-defined approach to model FRBSs in a hardware-independent way. In order to provide a runnable version of an FRBS that is designed in accordance with the IEEE Std 1855-2016, the open source library Java Fuzzy Markup Language (JFML) has been developed. However, due to hardware and/or software limitations of embedded systems, it is not always possible to run an IEEE Std 1855-2016 FRBS on this kind of systems. The aim of this paper is to overcome this drawback by developing a new JFML module that assists developers in the design and implementation of FRBSs for open hardware embedded systems. In detail, the module supports several connection types (WiFi, Bluetooth and USB) in order to make feasible running FRBSs in a remote computer when, due to hardware limitations, it is not possible that they run locally in the embedded systems. The new JFML module is ready for ArduinoTM and Raspberry Pi, but it can be easily extended to other hardware architectures. Moreover, the new JFML module allows to automatically generate runnable files on ArduinoTM or Raspberry Pi in order to support non-expert users, i.e., users without specific knowledge about embedded systems or without strong programming skills. The use of the new JFML module is illustrated in two case studies.

Palabras chave Fuzzy Rule-Based Systems, JFML, Embedded Systems, IEEE Std 1855-2016, Open Source Software, Open Hardware

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