ABSTRACT

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Since the beginnings of mankind, questions about the method of sound processing in the brain, and hence the music, are part of the human imagination. Therefore, the researches related to this process constitute one of the largest fields of research in science. Among many attempts to understand the biological processing of sound, humans beings invented the automatic musical composition automatic process in order to verify the possibility of producing quality musical compositions, without the human interference, wich means, only by using the definitions and structures of existing pieces of music. This automatic music composition procedure, also known as random music, has been widely exploited over the past centuries, being used by greats musicians like *Mozart*. The advances in engineering and computing allowed the evolution of random music composition methods, making the application of cellular automata a viable alternative to determine the execution sequence of musical notes, as well as, other items used in this type of composition. This dissertation proposes a hardware architecture for random music composition using cellular automata to determine the melodic intervals order. A prototype has been implemented in FPGA. The proposed hardware architecture has four kind of cellular automata, modeled according to the one-dimensional *Wolfram* neighborhood, two-dimensional *Neumann* neighborhood, two-dimensional *Moore* neighborhood and three-dimensional *Neumann* neighborhood. These cellular automata can be combined in sixteen different ways for generating melodies. The processing result as conducted by the proposed architecture are melodies in the *.mid* format, through the use of two cellular automata, one for selecting notes and the others for choosing the instruments to be emulated, in accordance with the MIDI protocol. This hardware is composed by three main units, the frequency divider unit, which is responsible for the synchronizing of the tasks performed by the hardware architecture, the cellular automata set unit, which is responsible for the control and enabling of the cellular automata and the MIDI machine, which is responsible for organizing the iterations of the cellular automata and convert them to the MIDI protocol structure, generating the final musical composition. The proposed hardware architecture is parametrizable, so that the data settings that influence the final product, such as, the rules of the cellular automata, are informed by the user. There are no limits regarding the possible combinations to be performed in the hardware architecture. In order to validate the functionality and applicability of the proposed hardware, some results were presented and detailed through the use of techniques for musical information retrieval.

Keywords: Cellular Automata. FPGA. MIDI. Musical Composition. Random Music. VHDL.