

Abstract

In the case of drummers and percussion players, it is essential to improve the tempo, and this is true, albeit to a lesser extent, of musicians playing other instruments. A tool that provides feedback on the pace played based on the analysis of the microphone signal is a great help in this. My task was to develop a tempo detection algorithm that can determine the tempo of short, few-second long music samples, and then implement this with an embedded system. Determining the tempo of musical recordings is a problem that has been studied quite extensively since the turn of the millennium, so have I found several sources that I could use to create my algorithm. Although the task of tempo detection was implemented in a specific way in each source, several similarities can be discovered between them, so that, for example, the main steps of the algorithm are clearly separated. After choosing the steps of my algorithm and further developing them, I had to tune the parameters to work with the highest possible accuracy for the application selected by my dissertation, i.e., to recognize the tempo of the rhythms produced by drum instruments. I developed the algorithm in MATLAB and the implementation on the embedded system in C language. My chosen device on which I implemented the algorithm was an STK3700 Giant Gecko microcontroller, to which I connected an external microphone and a preamplifier, the signal of which is processed by Gecko's built-in ADC. During implementation, the greatest difficulty was due to the physical limitations of the microcontroller, more specifically the limited memory size and computing capacity. I had to modify my algorithm written in MATLAB to ensure proper operation even with the limitations that occur. My finished device is suitable for a drummer to provide fast and sufficiently dense feedback on the pace of the music played; that is, in each second for the last 3 seconds. It works with satisfactory accuracy and safety if the noise level is low, although accuracy is reduced with the occurrence of background noise. I have configured the device to process drum sound samples so that it can determine the tempo of music with short, loud beats with the utmost accuracy. The device operates autonomously, does not require user intervention, and can also be operated from a battery, so it is easy to carry.