Abstract

The Institute of Numerical Methods and Informatics in Civil Engineering (IIB) develops, within the scope of the research project integrative Safety-Awareness-Model (iSAM), methods to detect and warn about endangerment to raise the safety of construction site workers. The objective of this thesis is to develop a concept for a real-time capable sensor for the recognition of construction processes by acoustic signal patterns within this research project. Therefore, literature research was conducted to investigate different models/algorithms of acoustic signal pattern detection and recognition. In addition, the literature research includes an overview of applications of sound recognition systems with the focus on surveillance and security. Furthermore, fundamentals of sound, acoustic signals, digital signal processing and signal flow are also described.

As part of this thesis, field recordings were performed and analysed to assess the researched detection and recognition models with regard to the application in construction site environments. Within the analysis of the field recordings it was further investigated if the inclusion of ultrasound leads to additional information which could benefit the recognition process.

Based on the fundamentals, a concept for the sensor positioning in the construction site environment was developed. With the results of this concept and regarding the literature research, the sensor hardware with focus on the microphone is conceptually described. The concept of the sensor software is based on existing detection, feature extraction and classification algorithms. The selection of these algorithms relies on the analysis of the field recordings as well as a systematic comparison of existing literature. A prototype of the sensor software was implemented using C++ and corresponds (except for the detection algorithm) to the concept of the sensor software. In this context, the conversion of previously recorded reference sounds took place. This was a necessary step to allow the classification algorithm to match incoming acoustic signal patterns against these reference sounds. Therefore, a software was developed and implemented to partially automate this conversion process. Subsequently, the implemented detection and recognition system was tested to determine its possibility of material differentiation and the necessity of reference sounds for different tools of the same type. The results have been evaluated, interpreted and the recognition rate was determined. Finally, suggestions for the future development of the sensor and its software are presented.