# Chapter 12
# Security and Ethical Concerns of Affective Algorithmic Music Composition in Smart Spaces

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## ABSTRACT

*Affective algorithmic composition systems are emotionally intelligent automatic music generation systems that explore the current emotions or mood of a listener and compose an affective music to alter the person's mood to a predetermined one. The fusion of affective algorithmic composition systems and smart spaces have been identified to be beneficial. For instance, studies have shown that they can be used for therapeutic purposes. Amidst these benefits, research on its related security and ethical issues is lacking. This chapter therefore seeks to provoke discussion on security and ethical implications of using affective algorithmic compositions systems in smart spaces. It presents issues such as impersonation, eavesdropping, data tempering, malicious codes, and denial-of-service attacks associated with affective algorithmic composition systems. It also discusses some ethical implications relating to intensions, harm, and possible conflicts that users of such systems may experience.*

## INTRODUCTION

Development of computer or algorithmic music is one of the different technologies and techniques that aid music composition. Many artists attempt to compose music, however, some of these music lack the needed aesthetic and creativity. For instance, it is often difficult to meet the timing of instruments as well as adhere to well-defined musical keys in various octaves. Music composition requires in-depth

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knowledge on processes and techniques which mostly overwhelm human cognition. Hence, the introduction of automated music composition processes has presented benefits. For example, it enables novice musicians to compose music. Studies have argued that algorithmic composition reduces the amount of time "spent" due to failed efforts and ideas in composing music (Lopez-Rincon, Starostenko, & Ayala-San Martin, 2018). The use of computers for automatic composition presents an opportunity in which computer aided composition and emotional assessment is combined to produce *affective algorithmic composition (AAC).*

AACs are emotionally intelligent automatic music generation systems that explores the current emotions or mood of a listener to compose an affective music that aims at altering his or her mood to a predetermined one (Kirke et al., 2013, Williams et al., 2017). Specifically, it seeks to target an individual's affective descriptor (emotional response) in other to alter his or her mood (Williams et al., 2015). Considering the capabilities of AACs as affective systems, and its incorporation into smart spaces make it possible to use music to intentionally control a listener's mood within a defined space. A *smart space* is a space that uses networked sensors and other communication methods to facilitate device to device communication to improve user interactions and experiences within their immediate environment.

However, AACs are faced with security challenges: especially in cases where they are implemented in smart spaces. This is because smart spaces are networked, hence, they can be targeted by intruders. Once compromised, attackers can gain control and carry out malicious activities including changing contents of composed music, manipulating sensitive data, controlling moods of listeners and detecting user-influence profiles. More importantly, the lack of confidentiality, integrity and availability of music composed automatically, may potentially disrupt its widespread adoption. Therefore, mechanisms that seek the prevention and protection of unauthorized access, use or destruction of related user information is imperative. Yet, relevant studies that examine the possible security challenges and implications of AACs are lacking.

In response, this chapter discusses security challenges and threats associated with the fusion of AAC and smart spaces. It is motivated by the suspicion that formalized music and AAC has not explicitly confronted issues in cybersecurity. Hence, the chapter seeks to provoke thinking in research and practice in the use of AACs in smart spaces. The discussion is structured as follows: Section 2 provides an overview of affective algorithms composition of music, an exploration of related literature about security issues in Internet of Things (IoT) and a formal definition for a "secured AAC". Section 3 describes possible security threats associated with AAC, whereas section 4 is on related ethical issues. Lastly, section 5 proposes future work and conclusion.

## RELATED LITERATURE

### Affective Algorithmic Music Composition

Over the years, different algorithmic music composition models and applications have been developed based on artificial intelligent (AI) techniques including neural networks, deep learning, stochastic and heuristic composition models. Examples of algorithmic music compositions include works done by Scirea, Barros, Shaker, & Togelius (2015). They developed a Scientific Music Generator (SMUG) that is capable of producing lyrics and melodies from real-world data such as academic papers. Papadopoulos, Roy, & Pachet (2016) developed a web-based application (FlowComposer) for musical lead sheets that is able