**Music-Synced Smart Lighting System**

A dissertation submitted in

partial fulfilment of  
The requirement for the degree of  
**MASTER OF SCIENCE**

in

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By

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* aiXander – On GitHub, created a repo that I adapted, it provided fast Fourier transformations that I built the beat detection algorithm on top of.

Abstract:

This report covers the development of a Music-Synced Smart Light System. The development of this system was successful, however, due to time constraints the system is missing many aspects that would be desirable should the project be continued on. This is aided by the style of development of the system, the system has been developed in such a manner as to allow easy continued development. The system takes advantage of FFT of audio data from PyAudio to allow the system to detect the beat of music and change bulb brightness in time with that beat.

Table of Contents

[Introduction: 5](#_Toc195705077)

[1. Understanding the Problem 6](#_Toc195705078)

## Introduction:

This report is focusing on the development of a Music-Synced Light Control System (hereafter referred to as, Bulb Bop). The report will consist of six chapters, Chapter One, Understanding the Problem, Chapter Two, User interface-design, Chapter Three, Architecture design and algorithm explanation, Chapter Four, Experimentation, Chapter Five, Testing, Chapter Six, Evaluation and Conclusion. The content of these chapters will be explained in the rest of the introduction.

Chapter One will contain my exploration of the problem and the basis on which I started undertaking the development of the software system. This will include my initial understanding of the project, based on the title and the preliminary meetings with my supervisor. It will then progress into my initial investigations about the potential solutions to the problem at hand. Finally, this chapter will end with the decided upon plan of action for development.

Chapter Two will contain the plan and the development of the user-interface. This will include the early iterations of the user-interface, and how these early iterations influenced the final design. It should be noted however, that the bulk of the work in this project was the beat detection algorithm and therefore, there was less thought put into the user-interface than there was into the back end of the system.

Chapter Three will contain the plan and the development of the architecture and algorithm design. This section will explain the architecture upon which the system can be ran, and the algorithms that allow it to run. This is the chapter in which the bulk of the work of this project will be explained.

Chapter Four will contain the experimentation that I have conducted due to this project. This will include looking at different languages that I attempted to utilise, as well as the research and experimentation that went into the development of the beat detection algorithm. Various iterations and experiments will be present in this chapter.

Chapter Five will contain the testing carried out on the project, during its development, and before the submission of the project. This will include risk assessments of the project, and a discussion of the rationale of the tests that were designed, as well as an examination of the areas of the project that were not thoroughly tested and an explanation as to why.

Chapter Six will be the final evaluation and conclusion of the project. Discussing the success or failure of the development of the system. It will evaluate different technologies utilised and how they have impacted the final system shape. There will be a reflection on my own development of the project, highlighting areas that were handled well, and areas where there could have been further development.

# Understanding the Problem

The initial description of the project is as follows,

“Develop a system that integrates music with dynamic lighting displays to create an "instant smart disco light" function or a “smart lighting solution for improved well-being.” The system should control a Wi-Fi-enabled smart light bulb, adjusting its brightness and colour in sync with music rhythms, enhancing the atmosphere in any setting.”

As well as this, there were four main functional criteria for the development of the system.

1. The system should connect to and control a Wi-Fi enabled smart light bulb
2. The system should detect music rhythm and tempo from an audio source and synchronise the light settings accordingly
3. The system should provide a primary control interface
4. The system should offer multiple lighting modes

There was no restriction placed on the technologies to be utilised in this project. No specific bulbs, programming languages, or web frameworks. However, due to having to use third-party hardware (The smart bulbs) there may be a specific API dictated by the manufacturer that would have to be used.

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