**CHAPTER ONE**

**INTRODUCTION**

**1.1 Background to the Study**

Wood is a useful raw material for furniture, railway sleepers, tools, shipping and construction industry, etc. Researchers from different domains such as palaeontologists, archaeologists, forensic experts and art historians may be interested in the identification of wood (Wheeler and Baas, 1998). Wood is broadly classified as hardwood and softwood species. Softwood species are conifers and 90.00–95.00% of their cells (called longitudinal tracheid) have simple cellular structure making it difficult to discriminate amongst themselves due to limited number of cell types. On the contrary, hardwood species (angiosperm) possess complex cellular structure and are clearly distinguishable among intra-species. Anatomical characteristics like vessels, fibers, parenchymas and rays play significant role in hardwood species identification (Hermanson and Wiedenhoeft, 2011).

There are two methods normally used for wood identification, viz., traditional approach and machine vision techniques. For many decades, traditional approaches have been instrumental in wood identification, like using 10× hand lenses to analyze the surface of the wood specimen in conjunction with their color, scent, hardness and weight. However for more reliable results, cross-sectional micro-structures of the wood samples are analyzed in the laboratory and their features are compared with available samples of hardwood species for identification (Baas *et al.,* 1989).

**1.2 Problem Statement**

Wood species recognition is a relatively new problem to be solved using computer vision techniques. The Artificial Neural Network and Support Vector Machine algorithms have been proven to be useful to solve several real world problems, such as rock texture classification, face detection, and wood species recognition. This is possible due to the property of the cross section surface of trees that has a pattern for different species. Therefore, by inspecting the patterns on the cross section surface, the species of the tree can be determined. The unique cellular structure of each of the hardwood species varies widely among intra-species and serves as a signature for their identification. It is necessary to identify wood as its characteristics vary widely. Accurate recognition of wood species is essential for price fixation based on color, texture, scent, hardness, durability, availability and rational use of available resources, this would also help in avoiding deception by timber traders. This project work seeks to solve this critical problem.

**1.3 Aim and Objectives**

The aim of this project is to design and develop a wood species classification platform using Artificial Neural Network (ANN) and Support Vector Machine (SVM) comparatively. The objectives are to:

1. Acquire the wood species images;
2. To recognize the wood species through the cross section surface of the wood samples through different texture classification techniques
3. Perform feature extraction using Discrete Cosine Transform (DCT),
4. Implement ANN and SVM for feature extraction;
5. To compare the performance of each texture classification technique.
6. Evaluate the performance of the algorithms based on the following parameters: Training time, testing time and recognition accuracy.

**1.4 Significance of Study**

The successful completion of this project will help in determining the more efficient metaheuristic between Artificial Neural Network (ANN) and Support Vector Machine (SVM) for wood species feature extraction in the designed classification system. The system can be implemented by Agricultural Agencies to supply accurate information to palaeontologists, archaeologists, forensic experts and art historians who may be interested in the identification of wood and ensure accurate recognition of wood species for proper use.

**1.5 Methodology**

The whole project implementation will be divided into five phases:

* Phase 1 (Requirement Engineering)**:** This phase will involve the gathering of required data (wood prints) and sampling the opinions of people on the subjects touched by this topic. This phase aids the getting of various information that gives insight into what area of the project to ponder more upon. Various methods will be applied in gathering of the information ranging from questionnaires, personal interview etc. The acquired wood prints will be pre-processed using DCT.
* Phase 2 (analysis): Here, the implementation of ANN and SVM will be done.
* Phase 3 (Coding): This phase deals with programming of the algorithms used. The coding would be done with MATLAB programming coding environment.
* Phase 4 (Testing): This phase involves testing/training the algorithm with wood prints. Every bug noticed here to be reported and corrected.
* Phase 5 (Maintenance): This phase involves correction of bugs and improvements.

**1.6 Scope of Study**

The scope of this project is to carry out a comparative analysis of Artificial Neural Network (ANN) and Support Vector Machine (SVM) on wood prints classification as the case study in order to solve wood print feature extraction problem, which is an optimisation problem. Each of the two metaheuristics is analysed using the wood print images and the results of the analyses used to determine the more efficient of the two i.e. the one that optimises the solution.

**1.7 Organization of Thesis**

The remainder of this project work is divided into five chapters as follows:

• Chapter Two: In chapter two, relevant literatures on past works on wood species classification, SVM and ANN algorithms, to be intensively reviewed. This done in order to perfectly understand the full details of the key subject matters involved in this project work in general as well as the technologies behind desktop application development using MATLAB programming language. The chapter also contained a brief overview of the tools used in the implementation of the system.

• Chapter Three: This chapter carefully explains the procedure followed in the implementation (the design and development) of the desktop application software for the comparative analysis. Algorithms and analysis of the desktop app design and development methodologies and tools used presented in this chapter. The relationships between the programming tools used were properly given. The source code written in this chapter are to be attached as an appendix at the back of the project report when done.

• Chapter four: Here, the result of the implementation in chapter three is to be presented. The tools used in the design and presentation of the finished comparative software to be showcased and explain the way the system works. Snapshots of the working web app were captured and shown in this chapter as well.

• Chapter Five: This is the chapter where a brief summary of the whole project work was given. Some conclusions drawn and further study recommendations were given as well.