

CHAPTER ONE

INTRODUCTION

1.1 General View

Breast cancer has been known for decades to be woman's most highly rated death call. Worldwide, statistics have it, that it is the cause of staggering mortality rates at an estimated percentage of 15% (40,230 deaths) in the US and is regarded, the most frequently diagnosed [1].

In global medical research, detection of the inherent malignancy has perked to innumerable options; ranging from primary breast self-examinations (BSEs) to current precise detection by means of digital mammography. However, this level of update is yet, still merging at a very slow pace into the medical field of the country Sudan.

Digital mammography is currently, the best in aiding the diagnosis and early detection of breast cancer. Although recognized as the optimum technique for breast cancer detection, the estimated sensitivity of radiologists in breast cancer screening still lies at about 75% [2]. This is probably due to fatigue or oversight on part of the radiologist, varying decision criteria or distraction by more prominent image features that could result in interpretation errors in deciding a missed abnormality.

As established, mammographic interpretation still remains a posing challenge. These problems can be decomposed into two sub-problems. The first deals with the detection and localization of the regions of interest (ROIs), which include suspicious lesions. The second, and more difficult sub-problem, is the categorization of the identified lesions as malignant or benign. The differentiation is difficult due to the presence of considered overlap between benign and malignant patterns [3].

Among the various types of breast abnormalities which are visible in mammograms, clustered microcalcifications (or 'calcifications') and mass lesions, distortion in breast architecture, and asymmetry between breasts are the most dangerous ones. Masses and clustered microcalcifications often characterize early breast cancer that is detectable in mammograms before a woman or the physician can sense them. Masses appear as dense regions of varying sizes and properties and can be characterized as circumscribed, spiculated, or ill defined. On the other hand, microcalcifications appear as small bright arbitrarily shaped regions on the large variety of breast texture background.

Early detection of breast carcinoma has proven to greatly upgrade prognosis and diagnosis levels. However, masses are more difficult to detect as compared to microcalcifications, because their features can be obscured or similar to normal breast parenchyma. This is because masses normally develop from the epithelial and connective tissues of breasts and their densities on mammograms blend with parenchyma pattern.

Masses are quite subtle, and often occur in the dense areas of the breast tissue. They have smoother boundaries than microcalcifications, and a wide variety of shapes [2].

Given all the factors above clearly establishes automatic mass detection, segmentation and its classification a major challenge in comparison to the detection of other types of breast carcinoma.

1.2 Hypothesis

Many studies have shown that African women are more prone to get breast cancer at an early age as compared to Western women. This is especially proven as it being the most common occurring malignancy in women in the Sub-Saharan region of Sudan.

Recent statistics file the percentage of Sudanese women diagnosed with late stage breast cancer at a hike of 80-85%. Furthermore, in the country's capital, at the Radiology and Isotope Center of Khartoum (RICK), breast cancer is the most highly diagnosed cancer constituting 29-34.5% of all cancers alone [4].

Another appalling observation is the concentration of the prognosis in women less than 50 years of age with about 40% below the age of 45 years [4]; a clear indication of early onset of the disease in younger women.

There are many reasons that might have led to such alarming numbers such as; disregard to early detection and diagnosis of cancer, poverty, illiteracy, ignorance, lack of breast cancer awareness and deficiency of proper population-based cancer registry.

Despite digital mammography being the optimum means by which breast cancer is detected today, it has unfortunately, been implemented only in under a handful number of hospitals in Sudan. Therefore, with the devices that are available, it is most necessary that the mammograms should be of greatest accuracy possible for early detection and possible prognosis of the disease. Worldwide, a lot of algorithms and methods have proven to be successful in demonstrating much clearer images for cancer analysis and in correspondence, in the creation of fully/semi automated breast cancer detection systems.

Therefore, it is imperative for the hopes of upgrading systems in Sudan that mammogram images be properly enhanced to enable the visibility of malignancy detail. In turn, this will assist in the creation of an automated mass detection and classification system that will present a second-hand aid to radiologists in tumor classification. This will ensure early detection of breast cancer, reduce mortality associated with the disease, help supersede the large numbers of metastasized cancers being detected and augment prognosis.

1.3 Objectives

- To introduce ANFIS (Adaptive-Network-based Fuzzy Inference Systems) as a diagnosis system for the classification of breast tumors.
- To enhance breast images using image enhancement tools
- To create a dynamic computer interfacing system using the algorithms mentioned that can hopefully later be directly implemented on a digital mammogram device.

1.4 Dissertation Layout

The thesis consists of:

Chapter I: provides an introductory view on the project along with a statement of the hypothesis and the concerned objectives with overcoming the stated issue at hand.

Chapter II: provides some anatomical background, a quick overview of all the concerned topics in relevance to the problem and the basic elements for the methodology development.

Chapter III: is a brief recollection of the various works exhausted both in the areas of image processing and enhancement and pattern recognition and classification of tumors.

Chapter IV: includes a detailed assembly of the various algorithms and methodologies that have been manipulated and implemented for the achievement of the project objectives.

Chapter V: demonstrates the gathering of results with its various illustrations, the respective discussions for the created systems and the evaluation of the efficacy of the results obtained.

Chapter VI: provides the overall conclusions drawn up from the thesis and some directions that could present as useful suggestions for future work.