Introduction:
Breast cancer is one of the major reasons for the death in women. It has been found through several studies that early stage diagnosis of the breast cancer can help to cure the cancer. However, it is important to consider that the early detection of lesion should be detected when it’s size is not more than one centimetre. To identify at such an early stage is very difficult task as the size is too small to identify. Most popular way to detect the lesion at early stage is using screening mammography. Primary objective of this study is to identify early stage lesion of smaller size using the digital image enhancement and analysis technique for auto detection and classification of breast tumours.

Mammogram is one of the popular technique to identify the breast tumor. It is widely used by the radiologist and doctors for identification, diagnose and evaluation of breast cancer. Technically mammogram is an based on x-ray photography which is in practice since more than 45 years. Two types of mammogram techniques are widely popular: (i) Screening Mammogram and (ii) Diagnostic Mammogram.

Purpose of screening Mammogram is to identify the formation of lesion at early stage which further results into cancer. However, the Diagnostic Mammogram are used once the cancer tumor is already developed or there is suspects of having possibilities of lump which may result into tumor. In this technique, more images are taken from different angles compared to the Screening Mammogram.

Two major types of Screening Mammogram techniques are widely used:
(i) Film-screen mammography and
(ii) Full-field digital mammography (FFDM). It is also known as Digital Mammography.

Digital technology has replaced the former techniques and it is widely used in practice. According to one survey, 92% of mammography is based on digital technique. Before applying the FFDM, it was compared with the old technology SFM using clinical trials and it was found to be more reliable and provide better diagnosis means at early stage. Two major studies have been taken place so far which compares both techniques of Mammography. The outcome shows that the FFDM shows statistically more significant outcomes compared to the SFM.

In the FFDM technique, the digital images are taken from two angles. The breast is compressed between the plates and the digital images are taken from horizontal angle and
another from approximately 45 degree angle. These two angle images are scientifically termed as Cranio-caudal (CC) and Mediolateral-oblique (MLO).

**Breast Cancer Classification:**

Purpose of classifying the breast cancer is to understand its intensity and differentiate the stages for the purpose of further curing measures. There are various ways for classification. Breast cancer classification is based in three ways: Histological Appearance of the tumor, Based on shapes and grading and Based on size of the tumor which is termed as stage. This classification helps to understand the type and stage of the cancer in better way. It is also helpful for the further treatment and to understand the intensity of the tumor for the purpose of treatment.

1. **Histopathology**: This is most primary classification of Breast cancer. It is based on its histological appearance. Most breast cancers are derived from the epithelium lining the ducts or lobules.

2. **Grade**: Grading of tumor is based on comparing the tissues with the normal tissues which are identified. The grading is formed by comparing the suspected tumor with the normal tissue shapes, formation and appearance. The cells are categorized in three grading stages: (i) Low Grade: The difference found between the tumor and normal cell appearance is very nominal. (ii) Intermediate grade: In this case, the difference between normal cell and cancerous cell is more visible compared to the Low grade stage. (iii) High Grade: This type of grading shows there is visibly higher difference between normal and cancerous cells. In this case the prognosis is at worst level.

3. **Stages**: Staging of Breast cancer is categorized in three ways: This staging is also termed as TNM staging. Staging are formed depending on the size of the tumor. It is also considered that what is the spread level of the cancer. The classification is based on the spread of cancer at the level of lymph nodes. The higher the spread of the cancer, the higher is the stage. The stages are divided into majorly four levels and categorized in three stages:

1. **Stage 0**: It is a initial stage which shows the state of pre-cancerous stage. 2. **Stages 1 to 3**: These stages are at different level ranging from the breast or up to the regional lymph nodes.
.3) Stage 4: It is widely spread up to the region of inner body part and having severe condition.

The cancer cells are categorized in three types. These categorization is based on the formation of the cells. The three category are:

**Calcifications:** It is a composition of tiny flecks of calcium. They are of smaller size very tiny and approximately having size similar to a granule like sugar. It appears in the soft in the soft tissue of the breast and shows the indication of possibility of having early stage of breast cancer. It is difficult to feel the Calcifications. However, using the mammogram image, it can be identified provided proper investigation of image. The identification also depends on the size of the cluster, its size, shape and quantity. Physician can only suspect of its presence without having surety about it.

**Clustered Calcifications:** It is macro version of calcification. It is bigger in size compare to the previous counterpart. However, it is less likely to be associated with the cancer. It is consists of multiple calcifications and form the macro version which is often called as Big Calcification. This cluster is due to the additional and unwanted activities observed by the breast cells. are associated with extra breast cell activity. In very rare case these macro-calcification results into early stage of cancer.

**Cysts:** Normally, the cancer tumors are closely associated cells and thus they form a solid formation. However, the cysts are formations which are composed of fluids. The composition is different from the solid formation and thus, compared to the solid-formation, they are easily identified even using the ultra-sound techniques.

Another type of common formation of mass is known as Fibroadenomas. They are usually seen in the young women, by nature they are noncancerous cells. Normally they are removed in process to make sure that they are not forming any tumor.

**Digital Image Processing:**

Digital image is image composition consists of pixels. Each pixel represents the intensity and through which the characteristic of the real image is differentiated with the another part of the image. It is represented as two-dimensional image which is consists of finite set of digital values. These values are representing the intensity.

Each pixel characteristic depicts the depth of the color, depth, opacity and gray level in case of grayscale image. The process of *Digitization* is showing the near features of the real image. However, number of factors involved in the digitization technique. It involves many
extraneous impurities which are known as noise. These noise are required to be filtered before the analysis of digital image is to be carried out. Digitization process focus on two important aspects: (1) For improvement of the image information and (2) storing the data for the purpose of representation of information for the purpose of independent analysis.

Types of process occur on digital Images: (a) Low level process (b) Middle Level Process and (c) High Level Process.

In case of low level processes, the primary goal is to remove noise by applying appropriate filters. The output is sharpening image which is used for further process. In case of middle level process, the sharpen images are used to recognize particular object from the image. The third level of process attributes higher degree of image process, which involves identification of clustering and for the purpose of pattern identification.

**Importance of proposed Research Work:**

As the title suggest, the main objective of this research is to study, analyze and apply various image processing filters on FFDM. The outcome is analyzed by developed algorithm which is standardized and applied on FFDM.

Three major features are required to be covered for digital image analysis:

**Segmentation:** It is related to extraction of Region of Interest. Major purpose is to identify and isolate the region which contains cells having abnormalities. It is also used to identify the prospective lesion candidates from ROI. **Feature extraction:** It is related to extracting relevant information from the segmented processed image. **Feature selection:** Out of extracted regions, the required portion is selected based on certain pre-defined criteria. The classification process is applied on selected features to perform the feature selection process effectively.

**Classification:** In the classification step of the mammographic image analysis algorithms lesions are classified as benign or malignant on the basis of selected features.