**CHAPTER 2**

**LITERATURE SURVEY**

In literature, Wu et al. (1996), Rudi Heriansyah and Abu-Bakar (2004), Rau and Wu (2005), and Ibrahim et al. (2011) have proposed PCB inspection systems in classifying defects. In this project, a new PCB inspection system on PCB images has been proposed by adapting similar algorithm that comes from Ibrahim et al., (2011). Image subtraction must be used to detect defects on the PCBs. However, image subtraction operation that has been utilized to detect defects between defective and template images cannot be used directly as it contributes unwanted noise due to misalignment and uneven binarization and thus, the accuracy of the defect detection could be decreased. Since the nature of real PCB images is different compared to computer generated PCB images, an image registration must be employed at first in order to get well-aligned defective image against template image. Then, all pixels in the template image are subtracted against the registered defective image to get two output images known as positive and negative images. Next, by applying image thresholding and filtering techniques, noise free positive and negative images are produced. Starting from here, the two images can be used as inputs for defect classification.

The first paper by Wu et al. (1996) gives us examples of how the noise filtering operation and thresholding operation takes place to make the image noise free. Also it gives us the value of how threshold parameter and focuses on automatic selection of threshold parameter. In the paper Medical Image Registration with Partial Data by Senthil Periaswamy and Hany Farid the authors shed some light on registration techniques and how to achieve them when you have a broken, scaled, translated or rotated image. The authors prime focus is onhow to registration for medical images for CT scan, MRI, Digital X-ray, Sonography, etc. The paper by Ibrahim et al. (2011) gives defect classification technique for images with extra pixels or images having lesser pixels. The paper also describes about how to detect and classify six defects but doesn’t say anything about registration of images.

The paper Image registration methods: a survey by Barbara Zitova, Jan Flusser describes each and every registration method which has been used and applied in some technology that exists or existed. The registration is explained to take place in four basic models which are described as follows:

* **Feature detection**: Salient and distinctive objects (closed-boundary regions, edges, contours, line intersections, corners, etc.) are manually or, preferably, automatically detected. For further processing, these features can be represented by their point representatives (centers of gravity, line endings, distinctive points), which are called control points (CPs) in the literature.
* **Feature matching**: In this step, the correspondence between the features detected in the sensed image and those detected in the reference image is established. Various feature descriptors and similarity measures along with spatial relationships among the features are used for that purpose.
* **Transform model estimation**: The type and parameters of the so-called mapping functions, aligning the sensed image with the reference image, are estimated. The parameters of the mapping functions are computed by means of the established feature correspondence.
* **Image resampling and transformation**: The sensed image is transformed by means of the mapping functions. Image values in non-integer coordinates are computed by the appropriate interpolation technique.