CHAPTER 1: THE PROBLEM

1.1 Background

Polycystic Ovary Syndrome (PCOS) is the common hormonal disorder among female in reproductive age. It associated with oligo-anovulation and hyperandrogenism. The exact cause of PCOS is not well established, but insulin resistance and androgen excess play an important role in its onset. The condition is one of the most common endocrines and metabolic disorders also called "the female metabolic syndrome". Infertility is one of the most common PCOS symptoms. The other symptoms are irregular or missing menstrual periods, weight problem (often gaining weight on waist), excessed hair growth on the face, thinning hair on scalp and skin problem (ex: acne). The common PCOS symptoms are difficult enough for most women, but some will experience further complications, including diabetes, heart and blood vessel problems, uterine cancer and sleep apnea. Infertility is one of the most common PCOS symptoms. PCOS affects 5-10% of women worldwide [1].

In NIH Evidence-based Methodology Workshop on 2012 [2], there are 3 references to enlighten the PCOS criteria. The criteria of PCOS refer to NIH 1990, Rotterdam 2003 and AE-PCOS Society 2006. These criteria will become a reference to define the PCOS criteria.

Normally, follicles in female reproduction organ will disappear when the egg became mature. Immature follicles cannot disappear will become a cyst that remains in female reproduction (ovaries). Polycystic means many cysts in ovaries. The cysts are fluid-filled and contain immature eggs. PCO definition is followed: "either 12 or more follicles measuring 2-9 mm in diameter or increased ovarian volume (>10 cm3)" [3].

Commonly, the detection of PCOS is based on the ultrasound image. Generally, some follicles on PCO ultrasound image can be identified as the dark region [4], the darker area than surrounding. The identifying of the follicles is done by doctor vision manually. Human error in this manual method would become a risk of identifying the follicle on the ultrasound image. Automatic detection in high precision can be a promising solution to reduce doctor's burden. However, the shortcomings of ultrasound images, such as low contrast, serious speckles, and low spatial resolution, make it difficult for doctors to read and analyze these suspicious lesions [5]. Furthermore, with an increasing number of patients, doctors feel heavily burdened, resulting in a higher rate of misdiagnosis.

Some research ultrasound image segmentation on a biomedical image using many techniques, boundary based techniques, region-based techniques, and hybrid techniques [6]. Follicle whose structural and geometric characteristics have to be determined where segmented using region

growing. The segmented area and its properties will be the main objective of this research. The segmentation process of ultrasound image can become an evaluation of previous research [7, 8, 9] that uses edge detection as segmentation process. Several segmentation techniques are summarized in [10].

Thresholding techniques using scan line for follicles segmentation have already implemented by Palak Mehrotra et al. [7] and Sandy Rihana et al. [8].Hiremath et al. [9] used edge based method for follicles detection.

Eni et al [4], uses edge detection and particle swarm optimization (PSO) in order do segmentation of follicle. Edge detection that used in this research using Canny's edge detection [11] and Particle Swarm Optimization. The researcher proposed an image clustering approach for follicles segmentation using PSO with a new modified nonparametric fitness function.

Region based also implement on ultrasound image [12, 13, 14] in finding the segmented region. The region that segmented is coming from the several initial seeds that grow to its neighbor and called by region growing.

Some research in image segmentation using region growing area use threshold technique [13]. In [15], ideal seed candidate on automatic seed initialization is described. The ideal candidate of the seed becomes a rule for the algorithm to find the proper seed.

In region growing, the seed initialization becomes an important issue since it will affect the region result. In [15, 16, 17], manual seed initialization is proposed, single seed in the center is applied. Since the suspected follicle is not only one, we proposed to place a single seed in each suspected follicle by edge detection. In this research, we present hybrid method for segmentation. An automatic seed initialization using edge detection will be to present in region growing algorithm.

Region growing with automatic seed initialization is proposed in this research. This technique will create a segmented area between suspected follicle and not follicle. The other segmentation method is presented as well. Edge detection as in previous research [3] and watershed segmentation will be presented as well and will be compared with proposed segmentation method. We evaluate the segmentation result with Liu's Factor and accuracy of all technique that presented.

1.2 Statement of the Problem

The following are some problems that become the background of this thesis:

a. Placing a seed outside the region of interest will create a region outside the follicle. However using manual or random seed in region growing will create inconsistent placed seed. How to make automatically seeded region growing to place a seed inside the expected follicle.

b. How the comparison between the proposed method and the random seed placed on region growing.

c. How the comparison between the proposed method with another segmentation method.

1.3 Objectives

The following are the objectives of this thesis:

a. Provide the automatically seeded region growing and generate the seed inside the region of interest to find the area of follicle

b. To evaluate the proposed automatic seeded method and random seeded region

c. To evaluate the region growing segmentation on ultrasound image and it's comparison with another segmentation method

1.4 Assumption

The following are the assumption used in this thesis:

a. The follicles mentioned in this thesis means the follicles which have not developed properly due to hormonal abnormalities (abnormal follicles).

b. All ultrasound images used in this thesis have same brightness level.

c. Segmented follicle validation is only based on the diameter of the segmented area. The diameter of the follicle is based on NIH criteria. No feature extraction and classification applied.

1.5 Scope and Delimitation

The following are the scope and delimitation used in this thesis:

a. Only the ovarian ultrasound images of PCOS patients are used.

b. The threshold of homogenous region is constant for all image

c. The neighboring technique in this research using 4-neighbor and 8-neighbor.

d. Other segmentation techniques that used to compare the segmentation result are a watershed segmentation and edge detection.

1.6 Importance of the Study

Automatic follicle detection proposed in this thesis can help the doctor to identify the cysts on PCO ovary and to reduce the burden of doctor diagnosis. Besides that, the other contributions of this thesis

are the development of segmentation process for follicle segmentation which never been used in previous follicle detection research. Hopefully, with this research, the best method of segmentation can consider as segmentation process for a further process such as classification process and/or feature extraction process.