Chapter 2

Ear Biometrics

Ear is a relatively new class of biometrics. Ear features have been used for many years in the forensic sciences for recognition. Ear is a stable biometric and does not vary with age. Ear has all the properties that a biometric trait should have, i.e. uniqueness, universality, permanence and collectability.

2.1 Anatomy of the Ear

Ear does not have a completely random structure. It has standard parts as other biometric traits like face. Figure 2.1 shows the standard features of the ear. Unlike human face, ear has no expression changes, make-up effects and moreover the color is constant through out the ear.

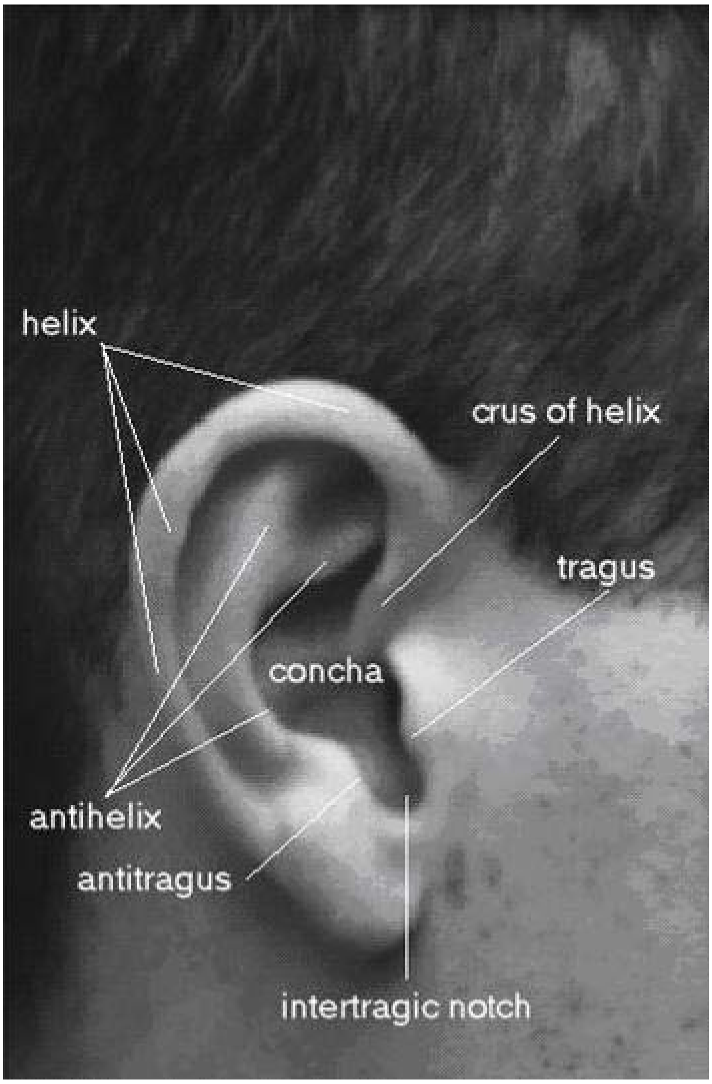

Figure 2.1: Anatomy of the ear

2.2 Literature Review

Studies say that ear biometrics is comparable to face biometrics and is also found to give better results than face. Many approaches have been proposed for ear recognition. The study of ear recognition begun after the work of Iannarelli[13]. He claims that the ear is unique to each individual. He has classified the ear by dividing it into eight parts as shown in Figure 2.2. The Iannarelli's system is based upon twelve measurements taken around the ear using the marks shown in Figure 2.2. They are measured by placing a transparent compass over an enlarged photograph of the ear. The transparent compass has eight spokes at equal 45° intervals. The reference line should be such that its top touches the intersection between the antihelix and crus of helix and bottom touches the innermost point on the tragus. For the purpose of normalization, the photograph should be enlarged until a second reference line exactly spans the concha from top to bottom.

Burge and Burger[4] proposed an approach for automating ear biometrics. According to the approach proposed, each subject's ear is modeled as an adjacency graph built from Voronoi diagram of its curve segments. They claim that the novel graph matching based algorithm for authentication that is proposed, is suitable for passive identification. Another approach is proposed by Moreno and Sanchez and Velez[2]. This approach combines the results of several neural classifiers which use the information obtained from ear shape and wrinkles, and macro features extracted by compression network.

Another significant approach is proposed by Hurley, Nixon and Carter[11, 12]. They have proposed an approach based on force filed transformations in

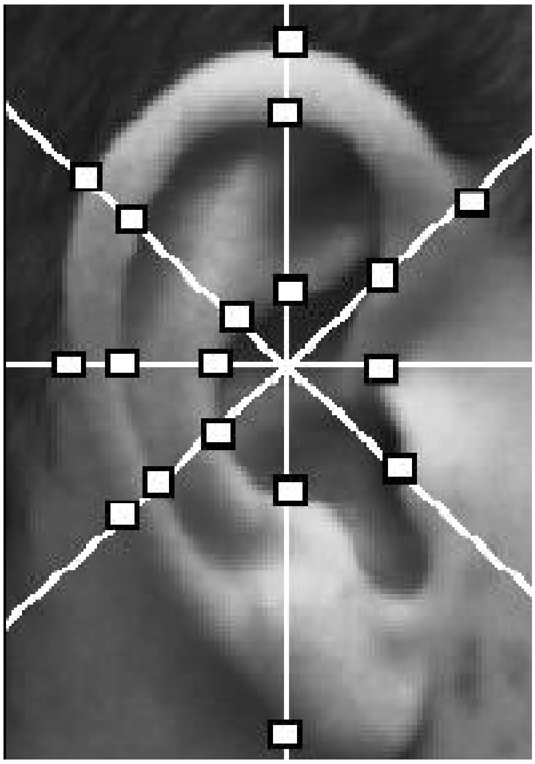

Figure 2.2: Iannarelli ear measurements

which the image is treated as an array of Gaussian attractors that act as the source of a force field. The ear is described using small number of wells and channels which are located by using the directional properties of the force field.

Victor, Bowyer, Chang and Sarkar[6, 22] have evaluated the face and ear recognition using principal component analysis (PCA), a dimensionality reduction technique which preserves the variation in the dataset. They have found that recognition performance is not much different for the ear and the face. They claim that the multimodal recognition using both the ear and the