Chapter 8

Analysis of Human Gait for Designing a Recognition and Classification System

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ABSTRACT

Identification and recognition of a human subject by monitoring a video/image by using various biometric features such as fingerprints, retina/iris scans, palm prints have been of interest to researchers. In this chapter, an attempt has been made to recognize a human subject uniquely by monitoring his/her gait. This has been done by analyzing sampled frames of a video sequence to first detect the presence of a human form and then extract the silhouette of the subject in question. The extracted silhouette is then used to find the skeleton from it. The skeleton contains a set of points that retains the connectivity of the form and maintains the geometric properties of the silhouette. From the skeleton, a novel method has been proposed involving the neighborhood of interest pixels to identify the end points representing the heel, toe, etc. These points finally lead to the calculation of gait attributes. The extracted attributes represented in the form of a pattern vector are matched using cosine distance with features stored in the database resulting in identification/rejection.

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INTRODUCTION

Human walking is a complicated motion. However, there is a rhythm which can be easily observed in the walk of a person. Human gait refers to the manner in which one walks and achieves translator motion through the movement of his/her limbs. Studying human gait helps one understand how different people move in a complex way. We can also identify different human beings by observing their style of walking. Gait based recognition systems try to identify entities on the basis of human gait. The objective is to develop an automated system which would not require human intervention to study the gait of an individual and uniquely identify him/her. The topic is extremely relevant in the current volatile scenario, both nationally as well as internationally. Such a system may be used in military bases, airports, parks, etc. Some researchers have been involved in researching this, as yet nascent field and have had a mixed success rate.

The recent times have intensely felt the need for video analysis. It has been observed that security has become an integral issue in our society. Be it the finance sector like banks and ATMs or residential locations or offices, security is a serious issue everywhere. Hence, there crept in the concept of live footages of a wholesome timeframe being recorded since that helps in keeping a check on the regular activities. In the recent times of research dealing with image and video processing, an immense concentration has been put in the field of analysing human behavior from videos. Understanding human activity has been a prospective area of research for years since it has got a lot of applications in virtual reality, automated surveillance systems, biomechanical analysis for sports and medicines etc.

As explained before, that human gait refers to the manner in which one walks and that there is a systematic, co-ordinated rhythm and periodicity to this walk. Let us start by considering the gait/walk cycle of a person and identify the rhythm in it. The gait cycle is formed by a repetition of two major movements – the step and the stride. The step-and-stride sequence can be further expanded to be composed of six basic stages. The Figure 1 shows the gait cycle of a human being.

The six stages (Durward, et. al., 1999) in the cycle are Heel Strike (HS), Foot Flat (FF), Mid Stance (MS), Heel Off (HO), Toe Off (TO) and Mid Swing (MSW). These six stages are followed by a Heel Strike again to continue with the subsequent cycle. Using gait as a biometric technique involves measuring and analysing various aspects of the gait cycle such as the time taken between two successive heel strikes, distance between the front foot toe and the back foot heel in the heel strike stage, distance of the back heel from the ground in the toe off stage, etc. However, of all of these various measures, any one of them may not be capable of representing the complete dynamics of human gait uniquely. Instead, two or more of these measures may have to be combined together to uniquely represent the gait characteristics of an individual (mason, et. al., 2016).

Use of gait as a biometric tool for identification purposes is increasingly becoming popular. One of the major reasons for that is other biometrics such as finger prints, retinal scans, palm images, etc.