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Face Recognition with 3D Head Pose Estimation and Land Mark extraction Using Gabor Wavelets

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Abstract

3D pose estimation is the problem of determining the transformation of an object in a 2D image which gives the 3D object. Automatic estimation of head relative to camera centered coordinate system is called head pose estimation. The need for 3D pose estimation arises from the limitations of feature based pose estimation where shape of the head changes due to light and different poses of head. For the detection of head pose, the basic spatial orientation of face are described in this paper.In 3D head pose estimation the faces are scanned and shape ,intensity of image is combined and is used for facial matching. In this paper Gabor jet wavelets is used for getting the accurate land marks for the detection of face. And for detection of head pose we use parametric linear subspace model (PPLS). There are many application of face recognition and head pose estimation such as security, communication and credit card verification to surveillance video image.

Index Terms: 3D head pose, Parametric Linear Subspace Model (PPLS), Gabor Wavelets, and Face recognition.…

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1. INTRODUCTION

A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. To prevent a face mould from faking out the system, many systems now require the user to smile, blink, or move in a way that is human before verifying. Some of the existing applications for facial recognition technology include: Journey measurement (people journey times – passenger / shopper), document control (passports, drivers' licenses), transactional authentication (credit cards, ATMs, point-of-sale). The most important factor in any facial recognition application is head pose variation because the human head can move freely.Under this assumption the human head is limited to 3 degree of freedom (DOF) in head pose which can be characterize by pitch,roll,yaw[10].In this paper we are using Gabor wavelat for effective and efficient land mark detection. With the help of this wavelets it is possible to detect facial.land marks such as eyes,lips,nose even in presence of different facial expression, opticals or beard. Due to the linear approximation, LPCMAP model can only be accurate within a limited range of pose parameters. Piecewise linear approach approximates the non-linear pose variation within a wider range by piecing together a number of locally valid models distributed over the pose parameter space [1].In next section we will describe about various techniques for head pose estimation with their advantages and disadvantages.

2. TYPES OF POSE ESTIMATION TECHNIQUE

There are many types pose estimation technique having its own advantages on disadvantages .Some of the successful approaches towards pose-invariant face recognition are:

- **Multi-view approach**: This approach is based on the multi-view gallery, which consists of multiple views of various poses for each known person.[1]
- .**Single-view approach**: The pose invariance is achieved by representing each known person by a facial image with a fixed canonical head pose and by transforming each test image to the canonical pose.[1]
- **Piecewise Linear Subspace Method:** This method describes an arbitrary facial image as a linear combination of a small number of orthonormal principal components (PCs) learned from training samples [1].
- **Biased Manifold Embedding (BME):** The **BME** framework is pivoted on the ideology of using the pose angle information of the face images to compute a biased neighborhood of each point in the feature space, before determining the low-dimensional embedding [5] .
- **Appearance-based techniques:** This technique uses the whole subimage containing the face. Most of them concentrate on face detection and consider the pose estimation problem as a classification problem. The range of head orientations is divided into a limited number of classes and classifiers for each class are trained [6].
- **Model-based approaches**: Model-based approaches for head pose estimation use a geometric model of the face [3] .

3. BASICS OF HEAD POSE TECHNIQUE

Estimating the head pose is crucial since it usually coincides with the gaze direction. Furthermore, head pose estimation is also essential for analyzing complex meaningful gestures such as pointing gestures or head nodding and shaking [7]. Under this assumption the human head is limited to 3 degree of freedom (DOF) in head pose which can be characterize by pitch,roll,yaw[10].

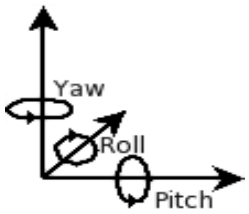

Fig: 3.1 Complete description of orientation through graph.

Yaw is the angle when moving the head left ↔ right (rotation around Y-axis). Pitch is up and down (rotation around X-axis). Roll, which we usually don't experience is when you tilt your head (rotation around Z-axis).For detection of head in any pose and locate land marks we have introduced Gabor land marking system in next topic.

4. METHODOLOGY

A. LAND MARKING SYSTEM

In any face recognition system or any other biometric security system, the characteristics of a person is compared with a database in order to identify that person. Land mark is a measurable biological and behavioral characteristics that can be use for automated recognition. Basically in face recognition system facial geometry is used as biometric characteristics and distance of specific facial features (eyes, nose, mouth) is used as **landmarks.** Since the head shape is based in a spherical harmonics; the human head grid is mapped into a sphere and then expanded in the basics or spherical harmonics. For face recognition, the relationship between various points such as the distance between the eyes is compared.

B. PARAMETRIC PIECEWISE LINEAR SUBSPACE

The parametric piecewise linear subspace (PPLS) model [19] extends the (LPCMAP) model by using the piecewise linear approach [20]. Basically two types of models are used for estimation of head pose :

- A model is called *personalized* when it is learned with pose-varying samples from a single individual.[1]
- A model is called *interpersonalized* when the training set contains multiple individuals. [1]

Image variation due to non-linear structure make difficult for us to compact the pose representation. In order to solve the compact pose representation problem we are using the Parametric Piecewise Linear Subspace Model. One of the advantage of using Parametric Piecewise Linear Subspace Model is that it consist of **Analysis-Synthesis chain.**

- **Analysis Mapping:** A mapping from face to pose is called analysis mapping.
- **Synthesis Mapping:** A mapping from pose to face is called synthesis mapping**.**

The parametric piecewise linear subspace have advantages of mapping face to pose in both the direction.

CONCLUSION

This Paper focused on the **Gabor Land marking system**, with combination of **Parametric piecewise linear subspace** for head poses estimation which will be more efficient for detection and recognition of face. The basic possible head poses are discussed in this paper. And 3 degree of freedom (DOF) of head is discussed in this paper.

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