Methods and Uses of Face Recognition

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ABSTRACT

The use of biometric systems (systems whose methods take as parameters physical and behavioral characteristics to identify a human) is a relevant and active field of study in the field of Human-Computer-Interaction. Face Recognition is a form of identity detection that has grown in demand in recent years due to its wide range of versatility.

Section 1 provides an overview of the generic process of Face Recognition. Section 2 focuses on the history and background of Face Recognition, and the main goal in research of the study. Section 3 focuses on specific conditions and elements that can impair a computer’s ability to detect a face, along with feasible solutions. Section 4 illustrates example applications for Face Recognition, in addition to its benefit to people’s ability to interact with computers and each other. Section 5 concludes the relevance of Face Recognition, in addition to providing ideas and direction for any future research in the field.

KEY WORDS
Face recognition, Identity detection,

1. INTRODUCTION

Face Recognition is a subfield of Human-Computer Interaction (HCI), and refers to the ability for a computer to detect a person’s face in a photograph or video image and recognize the person’s identity. This paper reports on the challenges of Face Recognition, viable solutions to these challenges, and practical applications of the technology [12].

The relevance of HCI has grown in recent years due to the demand for electronic applications that are intuitive for both physically capable consumers, in addition to the physically disabled [5]. Recent interest in Face Recognition is credited to its capabilities of preventing the fraudulent use and identity theft of ATMs, unauthorized use of cell phones, and illegal access to computer data security.

As opposed to common biometric systems used for identification, including fingerprint and retinal scans, the use of Face Recognition for proof of identity is a method that is least dependent on the user’s cooperation with the detection device, or knowledge of how the device operates [12].

2. FACE RECOGNITION

Detecting and identifying faces is a routine function that occurs subconsciously in our minds every day. Human perceptions take into account every complication that comes with Face Recognition, including pose, angle, facial expression, luminosity, and scale. If a human’s perception takes into consideration all the different attributes that can affect the way a face is interpreted, then also should a computer system that attempts to achieve an equally efficient if not better recognition of a face [10].

Face recognition is considered by experts in the field of HCI to be one of the most beneficial applications of image interpretation and analysis. High regard for face recognition techniques is credited to over 30 years of research in the field, which has produced a plethora of practical technologies and innovations in human identification. Its prevalence has extended to a wide range of areas, including digital photography [3], criminal surveillance [12], and healthcare.

2.1. THE PROCESS

A key to understanding what qualifies as Face Recognition is to break down the process into its two principle components or phases: Identification and Verification.

Identification is the phase of Face Recognition that consists of Face Detection and Feature Extraction. The basic functions of this phase are to take an unknown face as a parameter, and to return the identity of that face by
matching it up against a database of known individuals’ faces.

Features that are extracted include eyes, nose, mouth, and shape of head and the relative proportions of these features. A collection of information including age, race, gender, and facial expressions are identified in this phase. These characteristics help to narrow the choices of possible identities of the face under examination [12].

The phase of Face Verification simply confirms or rejects the claimed identity, which can be done by the user notifying the computer whether or not the claimed identity is correct. This phase is especially important for calculating a statistic of how dependable an application is, and also for identifying its weaknesses. The process in which an assessment of some software not only reveals its deficiencies, but also presents new requirements essential for fluent interaction, is known as the iterative approach to development, and is the foundation for quality assurance in applications that exhibit some form of HCI [4].

2.2. ISSUES TO BE addRESSED

Face Recognition is a powerful tool, and one that is often working in the background without people even aware that they are being identified. The technology is now being implemented for security measures in airports and football stadiums.

The first issue to address is the dependability of the technology. How does the error rate of Face Recognition match up with that of human error? Most identification today is still handled by humans. Should Face Recognition replace humans’ judgments, or should they be used only to supplement and optimize human decisions?

In addition, while Face Recognition may seem beneficial to the security of the people, great power must be handled carefully, especially in a nation (United States of America) grounded heavily in civil liberties. Is better security always a logical trade-off for civil liberties and individuals’ right to privacy [5]?

3. OBSTACLES AND INNOVATIONS

Face Recognition works best when it is invulnerable to changes in the environment, and can adjust accordingly to the pose, scale, and facial expression of a face. Recognizing a face under ideally neutral conditions is a feat that has already been accomplished by modern technology. Face Recognition research is now at the stage of finding ways to recognize faces under different conditions and increase its robustness, so that it may be used as a practical tool.

3.1. LUMINOSITY

Luminosity is a measurement of brightness. Many Face Recognition implementations use algorithms that rely on the symmetry of a face. This symmetry is distorted by the dark and bright contrasts in the image of a face, therefore often making such algorithms useless.

To work around issues of luminosity, the computer must find a way to reduce the effects of luminosity as much as possible through a process known as Intensity Distribution Formation. The process begins with a mean face, which is a template of what the face is known to look like under neutral lighting conditions. It is a frontal pose of the face under non-destructive illumination. Through a process known as linear transformation, the computer searches through the face horizontally and slowly transforms the image of the face to reduce the lighting effects. The computer may find that the left side of the face is much darker than the right side, and will then brighten or darken the correct sides accordingly [7].

3.2. POSE AND SCALE

For face recognition to be used in video capture, the elements of pose and scale must be put into consideration. Position for face recognition purposes refers to the angle of the face, which can be looking up, looking down, looking to the side, or looking diagonally. Scale refers to how large or small a representation is of an object is compared to its actual size.

The solution to issues of position and scale are grounded in making estimations as to where the individual’s face...
will be next. Once a face is detected in a video, it is tracked through the entire shot to collect a face sequence of the same individual. The tracker estimates the face’s position and scale in the next frame, and adjusts its field of view accordingly [1].

Figure 2: Use of a tracker to return a face sequence. Field of view size changes in each new image, and faces different from the one locked onto in the first capture is distinguished as such [1].

4. APPLICATIONS

Face Recognition has been successfully implemented into various applications that contribute to the interaction between humans and computers.

4.1. ICARE ASSISTANT

Face Recognition has been proven to be beneficial to the physically disabled, especially those with sight impairments. A device known as the iCare Assistant is built on algorithms that can interpret facial expressions, emotions, and gestures.

The algorithm for any given interpretation begins with its first step of isolating frames where human faces are detected. This is achieved by analyzing the associativity of regions. The eye sockets, for example, are lower intensity regions than the forehead.

The second step is to now recognize whose face it is, which is done by matching the face with those saved in a tightly controlled face database that has images of faces taken under different poses and luminosities.

In the third and final step, once the device has made a decision on the identity of the person, it will notify the person through a standard text-to-speech converter (Microsoft Speech Engine) [6].

4.2. USING FACE AS A MOUSE

Cutting edge research is currently underway for finding ways to use a face to move the cursor of a mouse.

The type of mouse that can achieve these capabilities is known as a camera mouse. Researchers initially proposed navigating the mouse using eye and nose movements. This approach proved to be un-intuitive and problematic. The video seldom coincides with the user’s focus of interest on the display.

Therefore, the idea of using 3D head poses was introduced, and accepted as a generally sound innovation.

The use of 3D head poses is a technology that takes advantages of human facial movements. These movements are categorized into two different categories: rigid motions and non-rigid motions. Those facial movements that qualify as rigid motions are rotation and translation. Those that are typified as non-rigid motions are the opening, closing, and stretching, of the mouth.

These retrieved rigid motion parameters can be used to navigate rigid motion parameters can be used to navigate the mouse cursor. Non-rigid motions invoke mouse events in the operating system.

This technology can be especially beneficial to people with hand and speech disabilities, allowing them to use head movements as an alternative to eye movements for cursor control [8].

Figure 3: Initializing the Tracker [8]

4.2. IDENTIFYING SOCCER PLAYERS

Research in face tracking is working to solve the problem of automatically identifying soccer players present in close-up shots in video capture. Due to the elements of pose and illumination, a typical Face Recognition implementation would be unreliable, and alternative means of measuring face similarity must be developed.

The proposed alternative method involves a player recognition algorithm that consists of detecting the face,
reading the name on the jersey, and using the collected information to come to conclusion on the identity of the player. Figure 2 above illustrates tracking a soccer player’s face throughout a video capture [1].

4.3. PHOTO ORGANIZER

Face Recognition has proven to be useful for the organization of digital photos. Today, many people own a digital camera, which means many photos can easily be taken, and research shows that more photos on average are being taken by people.

However, while technology introduces the convenience of taking pictures at whim, it presents the problem of organizing the photos in a coherent manner so that they can be enjoyed by the user.

Studies show that users typically have trouble finding photos depicting a particular person, or combination of people. Therefore, a proposed Face Recognition implementation organizes digital photos based on the people in them.

A Face Recognition process for digital photos is initiated through user input. When the program first runs, it simply extracts faces from the photos, and has the user identify the faces. Using the identifications, the program builds a model for each face. Since each photo may depict the same face under different illuminations and pose, the implementation can account for the same face under different conditions by referencing the models of each face. Once a reliable model is developed, the application can begin to efficiently identify a face by itself over an album or collection of photos [3].

5. PROPOSED WORK

Face recognition is a relevant field of computing research today, with new breakthroughs occurring every year. Research in this area should look to improve the robustness of the Face Recognition process, and to broaden its application across a variety of fields, whether it be security, gaming [9], spectator sports [1], or healthcare [6].

When Face Recognition simply works without any preconfigured conditions or settings, it can then reach closer its full potential of use in every day applications.

Based on the applications discussed in this paper, cutting edge Face Recognition seeks to eliminate any effects that can impede the Face Recognition process (luminosity, pose, angle, facial expressions, and multiple faces in one video capture).

The proposed innovations attempt to either improve the algorithm that can digital reduce the harmful effects to a point in which they are no longer an obstacle, or to develop more efficient databases of face images, so that one face under many different illuminations, poses, and facial expressions are accounted for in advance.

Further research can be done in analyzing the pros and cons to having prepared faces under different conditions in a database, versus the pros and cons of creating applications that can alter a face and make the proper adjustments dynamically.

5.1. “PROJECT NATAL”

“Project Natal” is Microsoft’s answer to controller-free gaming. It has the ability to recognize the player simply by looking at the face. Future Research pertaining to “Project Natal” can introduce new possibilities for Human-Computer Interaction, including the use of Face and Speech Recognition together, creating a unique and personal gaming experience, especially when incorporated into Xbox LIVE [9].

5. CONCLUSION

Face Recognition is a process that requires some fine tuning for it realize its true potential. Once robust enough, Face Recognition applications can be used to optimize security measures, serve as aids for the physically disabled, and in general, allow for a more personal and interactive experiences with everyday electronic devices. If the future demands intuitive and easy-to-use application, Face Recognition is relevant and essential in meeting consumer’s requirements.

REFERENCES


