3D Biometrics
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Systems and Applications
Recently, biometric technology has been one of the hottest research topics in the IT field, because of the demands for accurate personal identification or verification to solve security problems in various applications, such as, e-commerce, Internet banking, access control, immigration, law enforcement and so on. Especially after the 9/11 terrorist attacks, the interest in biometrics-based security solutions and applications has increased dramatically.

Although a lot of traditional biometric technologies and systems such as fingerprint, face, palmprint, voice and signature have been greatly developed over the past decades, they are application dependent and still have some limitations. 3D biometric technologies are emerging for high security requirement with their advantages: 3D biometrics are much more robust to illumination and pose variations from 2D biometrics; 3D range data may offer a richer information source for feature extraction. Besides, it can fuse with 2D biometrics to enhance the system accuracy; 3D biometric systems are more robust to attack, since 3D information is more difficult to be duplicated or counterfeited.

With the development of 3D imaging techniques, it is possible to capture real-time 3D biometric characteristics. Recently, 3D techniques have been used in biometric authentication, such as 3D face, 3D fingerprint, 3D palmprint and 3D ear recognition, and some commercial 3D biometric systems have been pushed into the market already.

Our team certainly regards 3D biometrics as a very potential research field, and has worked on it since 2005. We are the first group that developed the 3D palmprint technology and system, and our first technical paper of 3D palmprint, “Three dimensional palmprint recognition using structured light imaging”, was published in 2008. We built the first 3D palmprint database (PolyU 3D Palmprint Database), which contains 8,000 samples collected from 400 different palms, and have published it online since 2010. Until now this database has been downloaded by many researchers. This work was followed by more extensive investigations into 3D palmprint technology, and this research has now evolved to other 3D biometric fields, such as 3D ear by line structured light, 3D fingerprint by multi-view imaging and 3D face by time-of-flight methods. Then, a number of algorithms have been proposed for these 3D biometric technologies, including calibration, 3D modeling, segmentation approaches, feature extraction methodologies, matching
strategies and classification ideas. Both explosion of interest and diversity of approaches have been reflected in the wide range of recently published technical papers.

This book seeks to gather and present current knowledge relevant to the basic concepts, definition and features of 3D biometric technology in a unified way, and demonstrates some 3D biometric identification system prototypes. We hope thereby to provide readers with a concrete survey of the field in one volume. Selected chapters provide in-depth guides to specific 3D imaging methods, algorithm designs and implementations.

This book provides a comprehensive introduction to 3D biometric technologies. It is suitable for different levels of readers: those who want to learn more about 3D biometric technology, and those who wish to understand, participate in and/or develop a 3D biometric authentication system. We have tried to keep explanations elementary without sacrificing depth of coverage or mathematical rigor. Part I of this book explains the background of 3D biometrics. 3D ear recognition by line structured light is introduced in Part II. Part III presents 3D palmprint technologies by using modulated structured light imaging. 3D fingerprint identification by multi-view imaging and 3D face verification by time-of-flight method are developed in Part IV and Part V, respectively.

This book is a comprehensive introduction to both theoretical issues and practical implementation in 3D biometric authentication. It will serve as a textbook or as a useful reference for graduate students and researchers in the fields of computer science, electrical engineering, systems science and information technology. Researchers and practitioners in industry and R&D laboratories working on security system design, biometrics, immigration, law enforcement, control and pattern recognition will also find much of interest in this book.

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