Newborn Recognition Using Multimodal Biometric

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INTRODUCTION

The problem of missing children is a very serious issue throughout the world and seeing the importance of this issue, May 25 is observed as National Missing Children's Day. Reliability and efficiency for newborn recognition are key to the stringent security requirements to control mixing, swapping, kidnapping and illegal adoption of newborn. The level of security is very crucial issue in maternity ward and the problem of missing and swapping of newborn is of prime concern to the persons involved and affected. There is a common perception in the society that nothing can be done to prevent this unfortunate tragedy. In comparison to developed nations the developing countries are facing more challenges because of overcrowding and scarcity of medical facilities in the hospital.

Recognition of newborns at birth is a critical issue for hospitals, birthing centers and other institutions where multiple births occur. With approximately 300,000 newborns born worldwide each day, a large hospital may experience over one hundred new births each day. A large hospital may see as many as a hundred new newborns each day. Correct recognition of newborns is essential to ensure that each mother travels home with her own child.

Situations like these could be avoided or considerably reduced, if reliable and fast methods of recognition for newborns were made available and used inside maternity ward, hospital, bus station and airports. The prime concern is that how the parents can be assured that their newborn will not be mixed up in hospital. The technique of the recognition procedure explained to identify newborn, hangs the peace of mind of the parents until such time as the newborn shows unmistakable evidences of its parentage.

Existing biometric and non-biometric methods fail to provide enough level of security and research done to solve this problem is very minimal. Biometrics is a technology which is expected to replace traditional authentication methods which are easy to be stolen, forgotten and duplicated. The use of biometrics may provide parents the peace of mind knowing that they now have a means of proving that the child, they are carrying home is their own child after the birth. But it is surprising that so little research for newborn recognition is reported, while biometric recognition of adults receives so much funding for research and development. Following are the strong reasons to study biometric technique for newborn personal authentication:

- Every year 80-90 million newborn come into the world and the total population of newborn and young children at the age of 0-5 years is around 400-500 million (Wei et al., 2011). With such a large population, this group cannot be ignored by biometric researchers otherwise whole architecture of biometrics technique is incomplete.

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- According to study performed in United States by Gray *et al*. concluded that, out of 34 newborns that are admitted to a neonatal intensive care unit at any given day, there is 50% chance of incorrect recognition (Gray et al., 2006).
- Switching and abduction of newborn babies are global challenges that are faced by hospitals across the world. It has been reported that in United States, every year around 1,00,000 - 5,00,000 newborn babies are switched by mistake[1]. Apart from incidental switching, there are instances of abduction of babies and illegal adoption.

The objective of our work is to demonstrate that biometric technique can be used to recognize newborn. To accomplish this objective we prepared a multimodal database of 280 newborn. The multimodal database includes face, ear, headprint and soft biometric. After preparation of multimodal newborn database we implemented several algorithms using unimodal and multimodal biometrics to recognize newborn. In case of unimodal we used face and ear for identification and headprint for verification. In order to increase the performance accuracy we perform fusion of face with soft biometrics, ear with soft biometrics and face with ear.

BACKGROUND

In real applications, the traits that are commonly measured in different systems are the face, fingerprints, hand geometry, palmprint, handwriting, iris, and voice etc (Jain, Ross, Prabhakar, 2004). Recently, some interesting biometrics systems have been developed by exploiting new traits including hand vein and finger-knuckle-print, etc (Kumar, Prathyusha, 2009; Kumar, Ravikanth, 2009; Zhang et al., 2010; Zhang et al., 2019; Zhang et al., 2019). However, most biometric systems mentioned above are developed for adults.

Hospitals have devised several procedures to ensure that babies are correctly recognized and one of the popular methods is the use of ID bracelets. Soon after the birth ID bracelets are put on babies hands/legs, but this has not been able to provide enough level of security for newborn. The medical technique like Deoxyribonucleic Acid (DNA) typing and Human Leukocyte Antigen (HLA) typing are very efficient and accurate methods for verifying the identity of babies but due to the amount of time it takes to process a DNA or HLA sample and the cost associated with it, these methods for recognition are not feasible for every individual. Further DNA is invasive so it cannot be used each time for recognition of newborn. Another method recommended by Federal Bureau of Investigation is foot and finger printing of the child and mother (M. E. Stapleton, 1999). According to survey report 90% of the hospitals in United States perform foot printing of the babies within 2 hours of their birth and hospitals maintain newborn recognition form on which footprint of the child and fingerprint of the mother are collected. The prints are generally collected using ink based methods and then printed on the recognition form.

Although capturing offline newborn's footprint has been exploited in many countries, there exists a big debate on the effectiveness of offline footprint recognition caused by the image quality of offline footprint. In fact, there is no innovation for offline newborn's footprint acquisition in the past 100 years, and nearly most of offline footprint images are illegible due to the following reasons: (1) Use of inadequate materials (ink, paper, cylinder); (2) Untrained personal for footprint acquisition; (3) Baby's skin covered with an oily substance; (4) Reduced thickness of the newborn epidermis easily deforming the ridges upon contact and filling the valleys between ridges with ink; (5) Reduced size of the newborns ridges, which are three to five times smaller than that of adults (Weingaertner et al., 2008).

Medical and computer scientist have explored the efficiency and authenticity of using footprints for newborn recognition and analysis done by Shepard *et al.* using footprints of 51 newborns was examined by fingerprint experts ant they were able to identified only 10 newborn (Shepard et al., 1966; Thompson et al., 1981).

Wierschem (1965), described a study in which footprints collected by Chicago's hospitals (USA) were analysed, concluding that 98% could not be used for recognition. After providing trainment and the right equipment to the medical team, a new analysis of the collected footprints was performed, showing that 99% allowed the newborn's recognition. But this recognition was not based on dactiloscopic ridges. It used the