UNIVERSITI PUTRA MALAYSIA

SOFT BIOMETRIC SYSTEM USING FUZZY LOGIC DECISION FUSION FOR IDENTIFICATION

ARIGBABU OLASIMBO AYODEJI

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By

ARIGBABU OLASIMBO AYODEJI

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the requirements for the Degree of Master of Science

August 2014

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Dedicated to:

My Father, Mother, Brothers, and Sister

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

SOFT BIOMETRIC SYSTEM USING FUZZY LOGIC DECISION FUSION FOR IDENTIFICATION

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ARIGBABU OLASIMBO AYODEJI

August 2014

Chair: Sharifah Mumtazah bt Syed Ahmad Abdul Rahman, PhD
Faculty: Engineering

Traditional biometrics such as fingerprint, retina and iris are highly accurate and efficient biometric modalities. However, their disadvantages include intrusiveness, inability to work at far distance, and requirement of human cooperation to function effectively. On the other hand, some biometric applications such as identification of humans from distance may not require a high degree of accuracy, yet they cannot tolerate the need for human cooperation and intrusiveness.

Therefore, soft biometrics is an alternative biometric modality to perform identification of humans from distance. In this situation, soft biometrics can provide a moderate level of identification when the subjects are not cooperative with acquisition system. In addition, intrusiveness issues can be sufficiently minimized by using soft biometrics, because the attribute can be extracted without interaction with the subjects.

In this thesis, the possibility of using multiple soft biometrics for identification is investigated. The thesis shows that when multiple soft biometric attributes are combined together, they can be logically applied to find a specific identity in the database. The main focus is placed on combining face and body related soft biometric attributes like facial shape, skin colour, height, and weight for identification purposes. Here, each attribute performs individual identification process, which includes sub-processes of pre-processing, feature extraction, and template matching. This is followed by decision fusion which combines the identification decisions of all soft biometrics to find a particular target in the list of subjects with the closest resemblance in the database.

Two main contributions are presented in this thesis. First, techniques for extracting facial shape, height, and body weight are proposed. Second, the thesis evaluates three match score fusion techniques such as SUM, Adaptive Weighted SUM, and Fuzzy Logic to determine the most reliable fusion technique for the soft biometric identification system. The results demonstrate

that soft biometric identification system that utilizes fuzzy decision fusion which is based on facial shape, height, and weight is the most optimum with a rank-1 identification rate of 88%.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
Sebagai memenuhi keperluan untuk ijazah Master Sains

SISTEM *'SOFT'* BIOMETRIK MELALUI GABUNGAN KEPUTUSAN LOGIK *'FUZZY'* UNTUK PENGECAMAN

Oleh

ARIGBABU OLASIMBO AYODEJI

Ogos 2014

Pengerusi :Sharifah Mumtazah bt Syed Ahmad Abdul Rahman, PhD
Fakulti : Kejuruteraan

Biometrik tradisional seperti pengecaman cap jari dan corak iris mempunyai beberapa kelemahan seperti gangguan, jarak yang terhad ke sensor, dan keperluan kepada pematuhan manusia. Manakala, tradisional biometrik yang lain seperti pengecaman muka, tandatangan dan suara agak mudah dipengaruhi oleh kepelbagaian factor luaran. Namun begitu, *'soft'* biometrik adalah tidak mengganggu dan boleh diekstrakkan di bawah beberapa keadaan yang berbeza-beza dari pelbagai jarak.

Disebabken, sifat *'soft'* biometrik itu sendiri yang kurang jitu,pengecaman bersdasarkan hanya satu jenis *'soft'* biometrik adalah tidak cukup unik dan tidak cukup kekal untuk dijadikan sebagai asas pengenalan diri. Oleh itu, penggunaan *'soft'* biometrik pada masa kini adalah terhad bagi meningkatkan ketepatan pengecaman sistem biometrik tradisional. Maka, penggunaan *'soft'* biometrik ini masih menghadapi cabaran dari segi keperluan kepada pematuhan manusia dan ganguan yang dimiliki oleh tradisional biometrik. Pengecaman berdasarkan *'soft'* biometrik semata-mata masih belum diterokai sepenuhnya.

Di dalam tesis ini, kebarangkalian penggunaan berbilang jenis*'soft'* biometrik telah dikaji. Thesis ini menunjukkan bahawa pelbagai jenis *'soft'* biometrik boleh digabungkan dan digunakan dengan logik untuk mencari identiti yang tertentu di dalam pengkalan data. Fokus utama diberikan terhadap penggabungan *'soft'* biometrik pada bahagian muka dan badan seperti bentuk muka, warna kulit, ketinggian dan berat badan untuk tujuan pengenalan. Di sini, setiap jenis*'soft'* biometrik menjalankan proses pengenalan individu, termasuk sub-proces seperti pra-pemprosesan, pengekstrakan ciri-ciri unik dan pemadanan templat. Ini diikuti dengan kaedah gabungan keputusan yang menggabungkan keputusan asas pengenalan kesemua jenis *'soft'* biometrik untuk mencari identiti sasaran tertentu yang mempunyai persamaan yang paling dekat di dalam senarai individu pada pangkalan data.

Tiga sumbangan utama telah dibentangkan di dalam tesis ini. Yang pertama, cara-cara mengekstrak bentuk muka, ketinggian dan berat badan telah disyorkan. Kedua, memandangkan sesetengah jenis ‘soft’ biometrik adalah lebih jitu daripada yang lain, hasil kajian di dalam tesis ini telah membuktikan bahawa perlukan kepada ketelitian semasa pemilihan jenis *‘soft’* biometrik sebelum penggunaaannya di dalam proses pengecaman. Akhir sekali, di dalam tesis ini telah dibentangkan ujikaji terhadap penggunaan tiga kaedah gabuangan keputusan seperti. kaedah jumlah, jumlah wajaran mudah suai dan logik *‘fuzzy’* untuk menentukan teknik yang memberikan prestasi yang optimum. Hasil kajian menunjukkan bahawa sistem pengecaman ‘soft’ biometrik yang menggunakan teknik gabungan keputusan logik *‘fuzzy’* berdasarkan rupa bentuk, ketinggian dan berat dalah yang paling optimum.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank almighty ALLAH (S.W.T), the Most Beneficent and the Most Merciful for giving me the strength, courage, and his blessed guidance during my post graduate period.

I would like to thank my grandmother for her supportive prayers, calls, and blessings. I am also thankful to my uncle Mr. Arigbabu Adebayo and his family, Mrs. Koletowo, Mrs. Adigun, Mr. Kuyinu, Femi Fatade, and many others for their support.

I am grateful to my supervisor, **Dr. Sharifah Mumtazah bt Syed Ahmad Abdul Rahman** for giving me the opportunity to embark on this research. Her consistent motivation, support, and guidance have been very crucial in the completion of my research. This research would not have been possible without her insightful conversations and recommendations. Also, her wonderful and persistent suggestions have been very important in improving this thesis.

I would like to express my sincere gratitude to my supervisory committee members, **Dr. Wan Azizun bt. Wan Adnan** and **Dr. Salman bin Yussof** for their constructive suggestions during my research period and for dedicating their time in reviewing this thesis. Their valuable suggestions and comments have been very helpful in modifying the thesis.
I also thank the management of Computer and Embedded Systems Engineering laboratory for providing an excellent studying environment with great support and assistance.

Finally, I would like to thank my parents who deserve my utmost appreciation. I am immensely indebted to them for everything they have provided for me in life. I also thank my brothers and sister for their love and affection. May ALLAH bless and protect my family, and may they live long with sound health.

In addition, I would like to show my appreciation to the sponsors of the SGRA grant under the management of my supervisor Dr. Sharifah Mumtazah bt Syed Ahmad Abdul Rahman, which is supported by Ministry of Higher Education of Malaysia through the Exploratory Research Grant Scheme (ERGS).

I certify that a Thesis Examination Committee has met on 19 August 2014 to conduct the final examination of Arigbabu Olasimbo Ayodeji on his thesis entitled "Soft Biometric System using Fuzzy Logic Decision Fusion for Identification" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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DECLARATION

Declaration by Graduate Student

I hereby confirm that:

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This is to confirm that:

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