

UNIVERSITI TEKNOLOGI MARA

**DEVELOPMENT OF LIVE
FINGERPRINT GENERALIZATION
MODEL USING SEMI-SUPERVISED
ADVERSARIAL LEARNED ONE-
CLASS CLASSIFIER FOR
FINGERPRINT PRESENTATION
ATTACK DETECTION**

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Thesis submitted in fulfilment
of the requirements for the degree of
Doctor of Philosophy
(Electrical Engineering)

College of Engineering

July 2023

ABSTRACT

Due to the increasing population in our societies, the accurate identification of individuals has become crucial. As a result, the concept of access control has gained significance. Currently, the Automatic Fingerprint Identification System (AFIS) is the predominant method used for access control in restricted areas like immigration borders, labs, offices, and even smart devices. However, despite its widespread use, AFIS is highly vulnerable to presentation attacks involving the fabrication and presentation of fake fingerprints to AFIS. Efforts have been made to address this concern through hardware and software-based approaches. Hardware-based methods incorporate additional sensors to capture other live human traits during fingerprint authentication, such as pulse rate, blood flow, and odor. Unfortunately, attackers have found ways to create thin layered spoofs that can deceive these systems. As a result, software-based methods have emerged, which focus on learning inherent live fingerprint features to distinguish against spoofs. However, one challenge with software-based method is that most approaches tend to treat the issue of fingerprint presentation attack as a closed-set classification problem (known spoofing materials). As a result, such models manifest high classification errors when presented with novel spoofs not seen during their training. Motivated by this problem, this study proposes an adversarial learned one-class classifier that leverages the Generative Adversarial Network (GAN) architecture. The classifier is trained in a semi-supervised manner and comprises a generator and discriminator, with the discriminator acting as the final classifier. In contrast to traditional GANs, the generator is trained to produce pristine but discernible images as determined by the discriminator. The rationale behind this training paradigm is that since the number of fake fingerprint materials is unknown, the generator can automatically generate variations of fingerprint impressions that cover a wide range of unknown spoofing materials. This enhances the classifier to acquire sufficient knowledge of what constitutes a "live" fingerprint and learn diverse intricacies of "fake" fingerprints to effectively discriminate against spoofs. The proposed model was evaluated using the LivDet-2015 dataset, which contains nine distinct fingerprint spoofing materials captured by five fingerprint readers. The cross-material performance demonstrated an average True Detection Rate (TDR) of 80.1%, surpassing most state-of-the-art models. The findings from this study not only provide a foundation for further research on fingerprint presentation attacks but also offer a potential solution to mitigate the issue of spoofing attacks faced by various establishments such as immigration units, banks, labs, and other areas where access control is essential.

ACKNOWLEDGEMENT

I am deeply grateful to the Almighty God for blessing me with the gift of life, good health, strength, and the continuous growth of wisdom and knowledge in all aspects of my life. I would like to express my utmost gratitude to my esteemed and dedicated supervisors, Ir. Ts. Dr. Suzi Seroja Binti Sarnin and Assoc. Prof. Ir. Dr. Darmaway Binti Mohd Ali. Their patience, warm reception, invaluable intellectual guidance, and unwavering academic direction have been instrumental in the completion of my work.

I extend my special thanks to the Graduate Office of Electrical Engineering (GOEE) at UiTM for their cordial and supportive environment, as well as their willingness to provide essential information whenever needed. I also want to express my gratitude to all the faculty staff members who have contributed to the success of this study.

I would like to convey my heartfelt appreciation to my dear parents and siblings for their constant inspiration and financial support throughout the course of this work. I am also immensely grateful to the UiTM Endowment Unit for their significant contribution to the successful completion of this work through their generous financial assistance.

Lastly, I would like to express my special gratitude to Dr. Dah John Barau, Mr. Aliu Abdulmalik Adozuka, Dr. Aziz Caliskan, Engr. Dr. Yusuf Lanre Busari, Engr. Dr. Macaulay M. Owen and Mr. Jeeventh Kubenthiran for their valuable input, ideas, and vital roles in accomplishing this work. May God bless each and every one of you abundantly.

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