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Thesis

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Facial Recognition System : A State Of The Art

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Dedication

Dedication

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*First and foremost, I would like to express my deepest
gratitude to my loving father, whose unwavering support,
guidance, and encouragement have been instrumental in
shaping me into the person I am today. To my incredible
mother, thank you for your endless love, sacrifices, and
belief in my dreams,*

*To my beloved sister, Zahra, and my dear brother, Nadhir,
you have been my constant companions, cheerleaders, and
confidants. Thank you for your consistent support,
encouragement, and uncoditional love,*

*To my lovely sarah, for her kind support, understanding
and for all the great moments we had together while
accomplishing this work,*

*To all those who have offered me help and support, whether
in close proximity or from afar,and to the cherished
friends, mentors, and loved ones who have wholeheartedly
believed in me,*

"

- Lina

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Abstract

This thesis explores the field of face recognition, aiming to provide a comprehensive understanding of its fundamental concepts, advancements, and challenges. The study begins by introducing key concepts such as artificial intelligence, machine learning, computer vision, deep learning, neural networks, evaluation metrics, biometrics, and face recognition itself.

The thesis further delves into a comparative analysis of face recognition datasets and state-of-the-art techniques across various components of the face recognition pipeline. Specifically, it investigates data augmentation, face detection, face anti-spoofing, face features extraction, and face recognition techniques. By evaluating and contrasting these approaches, the strengths, limitations, and potential areas for improvement are identified.

Based on the insights gained, a novel approach for a full facial recognition system is proposed.

The findings of this thesis contribute to the field of face recognition by providing a comprehensive overview of its underlying concepts and the latest advancements. The proposed approach offers a promising solution to address the challenges in face recognition, enhancing security, surveillance, and authentication systems.

Keywords : Artificial Intelligence, Machine Learning, Computer Vision, Deep Learning, Neural Networks, Biometrics, Evaluation metrics, Data Augmentation, Face Detection, Face Anti-Spoofing, Face Feature Extraction, Face Recognition, Dataset.

Résumé

Cette thèse explore le domaine de la reconnaissance faciale dans le but de fournir une compréhension approfondie de ses concepts fondamentaux, de ses avancées et de ses défis. L'étude commence par l'introduction de concepts clés tels que l'intelligence artificielle, l'apprentissage automatique, la vision par ordinateur, l'apprentissage profond, les réseaux neuronaux, les mesures d'évaluation, la biométrie et la reconnaissance faciale elle-même.

La thèse se penche ensuite sur une analyse comparative des bases de données de reconnaissance faciale et des techniques de pointe utilisées dans divers composants du processus de reconnaissance faciale. Plus précisément, elle examine les techniques d'augmentation de donées, de détection faciale, d'anti-contrefaçon faciale, d'extraction des caractéristiques faciales et de reconnaissance faciale. En évaluant et en comparant ces approches, les avantages, les limites et les domaines potentiels d'amélioration sont identifiés.

Sur la base des connaissances acquises, une nouvelle approche pour un système complet de reconnaissance faciale est proposée.

Les conclusions de cette thèse contribuent au domaine de la reconnaissance faciale en fournissant un aperçu complet de ses concepts sous-jacents et des dernières avancées. L'approche proposée offre une solution prometteuse pour relever les défis de la reconnaissance faciale, améliorant ainsi les systèmes de sécurité, de surveillance et d'authentification.

Mots clés : Intelligence Artificielle, Apprentissage Automatique, Vision par Ordinateur, Apprentissage Profond, Réseaux Neuronaux, Biométrie, Mesures d'Évaluation, Augmentation des Données, Détection Faciale, Anti-Contrefaçon Faciale, Extraction des Caractéristiques Faciales, Reconnaissance Faciale, Ensemble de Données.

ملخص

تتناول هذه المذكرة موضوع التعرف على الوجوه، بهدف توفير نظرة شاملة للمفاهيم الأساسية والتطورات والتحديات المتعلقة بهذا المجال. تبدأ الدراسة بتقديم مفاهيم رئيسية مثل الذكاء الاصطناعي، تعلم الآلة، رؤية الحاسوب، التعلم العميق، الشبكات العصبية، مقاييس التقييم، البيومتريقيا والتعرف على الوجوه.

تحمل المذكرة كذلك تحليلًا مقارنًا لمجموعات بيانات التعرف على الوجه وأحدث التقنيات في مختلف مكونات نظام التعرف على الوجه. تحديدًا، يتم التعمق في تقنيات كشف الوجه، مكافحة التزييف، استخلاص سمات الوجه وتقنيات التعرف على الوجه. من خلال تقييم ومقارنة هذه المناهج، يتم تحديد نقاط القوة والقيود والمجالات المحتملة للتحسين.

استنادًا على المعلومات المكتسبة، تم اقتراح نهج جديد لنظام شامل للتعرف على الوجه.

تساهم نتائج هذه المذكرة في مجال التعرف على الوجوه من خلال توفير نظرة شاملة للمفاهيم الأساسية وأحدث التطورات. يقدم النهج المقترح حلاً واعدًا لمعالجة التحديات في مجال التعرف على الوجه، مما يعزز أنظمة الأمان والمراقبة والمصادقة.

كلمات مفتاحية : الذكاء الاصطناعي، تعلم الآلة، رؤية الحاسوب، التعلم العميق، الشبكات العصبية، البيومتريقيا، مقاييس التقييم، كشف الوجه، مكافحة تزوير الوجه، استخلاص سمات الوجه، التعرف على الوجه، مجموعة البيانات.

List of abbreviations and acronyms

AI   *Artificial Intelligence*

ML   *Machine Learning*

DL   *Deep Learning*

TL   *Transfer Learning*

LFW   *Labeled Faces in the Wild*

FD   *Face Detection*

FAS   *Face Anti-Spoofing*

FE   *Feature Extraction*

FR   *Face Recognition*

AR   *Augmented Reality*

CNN   *Convolutional Neural Network*

L-CNN   *Loacl Convolutional Neural Network*

G-CNN   *Global Convolutional Neural Network*

SCNN   *Siamese Convolutional Neural Network*

SNN   *Siamese Neural Network*

DNN   *Deep Neural Network*

RNN   *Recurrent Neural Network*

CAN   *Convolutional Adversarial Network*

DBN   *Deep Belief Network*

STASN   *Spatio-Temporal Anti-Spoofing Network*

MTCNN   *Multi-task Cascaded Convolutional Networks*

GAN   *Generative Adversarial Network*

List of Tables

PA-GAN	*Progressive Attention Generative Adversarial Network*
DCGAN	*Deep Convolutional Generative Adversarial Network*
ConvNet	*Convolutional Neural Network*
ResNet	*Residual Network*
3DPV-Net	*3D Point Cloud Network*
3DDFA	*3D Dense Face Alignment*
SSD	*Single Shot Multibox Detector*
NCC	*Normalized Cross Correlation*
LBP	*Local Binary Pattern*
PCA	*Principal Component Analysis*
LDA	*Linear Discriminant Analysis*
ICA	*Independent Component Analysis*
LPQ	*Local Phase Quantization*
SVM	*Support Vector Machine*
VGG	*Visual Geometry Group*
TASM	*Temporal Anti-Spoofing Module*
RAM	*Region Attention Module*
SASM	*Spatial Anti-Spoofing Module*
2DAAM	*D Morphable Model*
3DMM	*2D Active Appearance Model*
SURF	*Speeded-Up Robust Features*
VAE	*Variational Autoencoder*
SIFT	*Scale-Invariant Feature Transform*
ReLu	*Rectified Linear Unit*
LUPI	*Learning Using Privileged Information*
AUC	*Area Under Curve*
ROC	*Receiver Operating Characteristic*
HTER	*Half Total Error Rate*
ACER	*Average Classification Error Rate*