



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer Engineering and Systems

Automatic Sign Language Recognition

A Thesis submitted in partial fulfillment of the requirements of
Master of Science degree in Electrical Engineering
Computer and Systems Engineering Department

by

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Bachelor of Science of Electrical Engineering
Computer and Systems Engineering Department
Faculty of Engineering, Ain Shams University, 2011

Supervised By

Prof. Hoda Korashy Mohamed
Dr. Hazem Said Ahmed Mohammed

Cairo, 2019



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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

**Faculty of Engineering – Ain Shams University
Computer and Systems Engineering Department**

Thesis title: **"Automatic Sign Language Recognition"**

Submitted by: **Omar Mohamed Amin Ali Mohamed**

Degree: **Master of Science degree in Electrical Engineering**

Abstract

This thesis proposes two different methods for Isolated sign language recognition, A Hidden Markov Model based classifier that uses trajectory information for classifying a dataset of 40 Arabic Sign Language dataset, It works on relative and scaled trajectories and extracts features from Kinect device, it achieves a real time performance and an accuracy of 99.25% in signer dependent settings and an accuracy of 92.5% in signer independent settings, We also propose a multichannel deep learning model for isolated sign language recognition, The model uses hand trajectories data and leverages hand shape sequential patterns, MobileNet was adapted as a pretrained CNN model for the hand shape features, and a one dimensional Google inception like architecture is proposed for hand trajectory feature extraction along with an LSTM based model, Experimental results shows that the proposed model

achieved second best performance on the Argentinian Sign Language Dataset with 99.54% signer dependent accuracy and 97.5% accuracy on Signer Independent settings, Experimental results also shows the importance of Pooling Layers in hand trajectory deep neural networks based models for signer independent settings with an average increase of 1.9% absolute increase over not using the pooling layers in trajectory based models.

Thesis Summary

Summary

This Thesis proposes two models for isolated sign language recognition, one that uses Hidden Markov Model with features extracted from Kinect device and the other uses multi-channel deep neural networks for multimodal isolated sign language recognition.

The main contribution is to develop a reliable real-time multimodal deep learning based model for isolated sign language recognition.

Thesis is divided to five chapters, along with a list of figures, list of tables, and a bibliography.

Chapter 1 starts by introducing general overview about Sign Language,

then it shows some of the challenges facing sign language recognition field, reviews different devices used for data capture, and gives an overview over the available datasets.

Chapter 2 describes the history of automatic sign language recognition. It

first summarizes the techniques used for Isolated Sign Language Recognition, then discusses the different techniques used for Continuous Sign Language Recognition, Finally, It ends with a dedicated section for the state of the art methods for Sign language Recognition using deep learning techniques.

Chapter 3 describes the background for models and algorithms (with a

focus on Sign Language Recognition) that are used in our two proposed methods, it first explain the Hidden Markov Model (HMM), then it explains the progress of Deep learning techniques that evolved through the recent years.

Chapter 4 describes the two proposed methods, it first explains the Hidden

Markov Model used for sign language, its topology, and the extracted features, then it explains the proposed multi-channel deep neural network for isolated sign language recognition, its architecture and each separate channel proposed model.

Chapter 5 shows the experimental work and results on the Arabic sign

language dataset for the Hidden Markov Model and gives a detailed description for the dataset recording and recording setup, and also show the experimental work and results on the Argentinian sign language dataset for the multi-channel deep neural network model.

Key words: Hidden Markov Model, Deep Neural Networks, Recurrent Neural Learning, Convolutional Neural Network, Multi-Modal Deep Learning

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