Project Proposal
Sign Language Recognition Based on Deep Learning

Team Flash

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Chapter 1

Executive Summary

1.1 Overview

Computer Vision has many interesting applications ranging from industrial applications to social applications. It has also been applied in many support for physically challenged people. For deaf-mute people, computer vision can generate English alphabets based on the sign language symbols. Our team aims to design a camera based sign language recognition system. By placing the camera in a fixed place, a user can performing sign in front of the camera, then the system will classify the sign language symbols using the Convolutional Neural Network (CNN). After successful training of the CNN model, the corresponding alphabet of a sign language symbol will be predicted.

1.2 Product

The majority of the work is in installing the tools, data collection from the camera, data processing, and data analysis through Tensorflow CNN model. For hardware, we employ the Arduino nano 33 ble sense and Arducam Mini 2MP Plus camera module, which can be powered by the Arduino board's power supply. For software, we focus on coding in Python/Tensoflow to build the Convolutional Neural Network model and output results to users. We will use the American Sign Language (ASL) data set for training and testing, which is provided by MNIST and it is publicly available at Kaggle.

1.3 Financials

The budget for our system is about $60 per team member. Mainly for purchase of the Arduino board and Arducam Mini Camera.

1.4 Challenges

Our team will perform the design project in a very tight schedule requires exact execution regarding the timeline. For the software system platform, considerable effort required for implementing data processing and result analysis. Main challenges could be photo preprocessing, background filtering problems and output accuracy measurement.

Chapter 2

Background

This chapter provides background information for the project, including sign language and recognition algorithm based on deep learning,

2.1 Sign Language

2.1.1 Introduction

In the communicative hand gesture taxonomies, sign language (SL) is considered as the most organized and structured form out of various gesture categories. Sign language is an important means of communication among hearing impaired and deaf community[1]. Instead of using oral communication and sound patterns, signs in visual space are used by hearing impaired people for communication. The linguistic studies of sign language have started in 1970s [2]. It contains lingual information which includes different symbols and letters. Sign language symbols are able to indicate all the sign parameters that include hand shapes, movement, location and palm orientation.

2.1.2 American Sign Language (ASL)

American Sign Language (ASL) is a complete, natural language that has the same linguistic properties as spoken languages, with grammar that differs from English. ASL is expressed by movements of the hands and face. It is the primary language of many North Americans who are deaf and hard of hearing, and is used by many hearing people as well(Wikipedia).

2.2 Sign Language Recognition Using Deep Learning

The flourishing of deep learning technology brings new opportunities for more accurate and real-time sign language recognition.While Neural Networks have been applied to ASL letter recognition in the past with accuracies that are consistently over 90% [3], many of them require a 3-D capture element with motion-tracking gloves or a Microsoft Kinect, and only one of them provides real-time classifications. The constraints imposed by the extra requirements reduce the scalability and feasibility of these solutions[4].

Chapter 3

Narrative

This chapter discusses design procedure and details of the sign language recognition project.

3.1 Design Procedure

3.1.1 Hardware Implementation

The first goal is the hardware implementation. After purchasing the Arduino nano 33 ble sense board and Arducam Mini 2MP Plus camera online, we need to connect the two parts manually by soldering. To ensure the functionalities of the camera, we will do simple testing through Arduino web editor.

3.1.2 Photo Preprocessing

To feed the photo into a CNN model, we need to preprocess the input photo captured by the camera. The method including Graying, denoising, edge segmentation, etc.

3.1.3 Building CNN Model

We wil build the CNN model using Tensorflow and Keras.

3.1.4 Training and Testing

We will employ the American Sign Language (ASL) data set that is provided by MNIST and it is publicly available at Kaggle. This dataset contains 27455 training images and 7172 test images all with a shape of 28 x 28 pixels. These images belong to the 25 classes of English alphabet starting from A to Y. The dataset on Kaggle is available in the CSV format where training data has 27455 rows and 785 columns.

3.1.5 Sign Language Recognition

Feed the model with the preprocessed data, the system will output the corresponding alphabet.

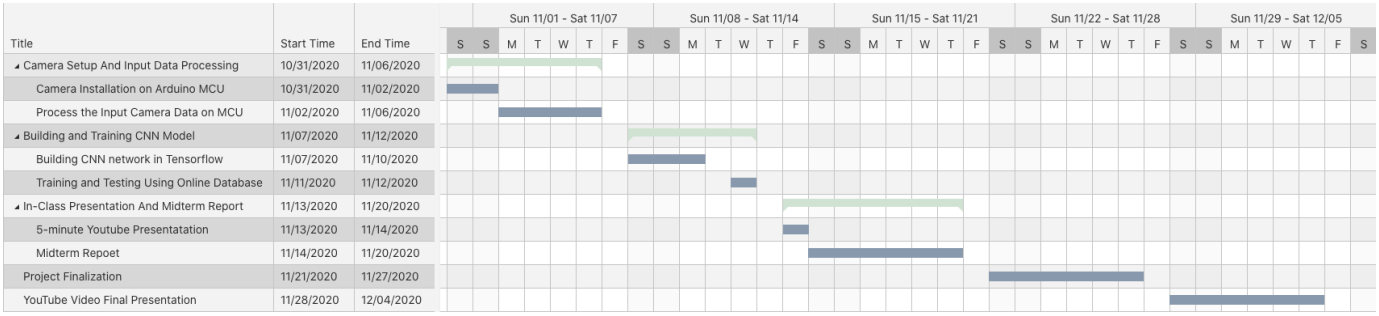
Chapter 4

Project Team

Jianian Wang is a Master student of UCLA majoring in Electrical and Computer Engineering with the track of Circuit and Embedded System. As the team leader and the only member of the group, he consistently shows incredible leadership and at the same time maintains an outstanding academic record. He barely mentions his peerless experience in teaching assistant and deep learning researches. His impeccable skills in Python, VHDL,Verilog, C/C++, Assembly Language, may be one of the reasons that accomplish him as a phenomenal engineer.

Chapter 5

Project Timeline



Title	Start Time	End Time
◢ Camera Setup And Input Data Processing	10/31/2020	11/06/2020
Camera Installation on Arduino MCU	10/31/2020	11/02/2020
Process the Input Camera Data on MCU	11/02/2020	11/06/2020
◢ Building and Training CNN Model	11/07/2020	11/12/2020
Building CNN network in Tensorflow	11/07/2020	11/10/2020
Training and Testing Using Online Database	11/11/2020	11/12/2020
◢ In-Class Presentation And Midterm Report	11/13/2020	11/20/2020
5-minute Youtube Presentatation	11/13/2020	11/14/2020
Midterm Repoet	11/14/2020	11/20/2020
Project Finalization	11/21/2020	11/27/2020
YouTube Video Final Presentation	11/28/2020	12/04/2020

References

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[2] SBadhe PC, Kulkarni V (2015) Indian Sign Language translator using gesture recognition algorithm. In: Proceedings of IEEE international conference on computer graphics on vision and information security (CGVIS), Bhubaneshwar, India, pp 195–200c1.

[3] Singha, J. and Das, K. "Hand Gesture Recognition Based on Karhunen-Loeve Transform", Mobile and Embedded 232 Technology International Conference (MECON), January 17-18, 2013, India. 365-371.

[4] R. Sharma et al. Recognition of Single Handed Sign Language Gestures using Contour Tracing descriptor. Proceedings of the World Congress on Engineering 2013 Vol. II, WCE 2013, July 3 - 5, 2013, London, U.K.