
Functional Requirements Document

MEXICAN SIGN LANGUAGE ALPHABET IMAGE CLASIFICACION SYSTEM

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1 INTRODUCTION

A system will be designed and developed capable of detecting a hand sign in an image and predicting a classification for it amongst the possible letters of the alphabet from the Mexican Sign Language. This system needs a way to obtain as an input images in which a hand is posing as a letter from this alphabet with a background which makes the hand colors easily distinguishable from the rest of the colors of the image and it should produce as an output the classification of which letter it is representing.

1.1 PURPOSE

This document will describe the different functions and quality attributes that the Mexican Sign Language Alphabet Image Clasification System needs to cover in order to fulfill its purpose and achieve the business goals which led to its creation. The purpose of the system is to create a different way in which people with hearing and speaking disabilities may interact with computers, as well as generating knowledge and spreading the interest to this type of problem.

1.2 SCOPE

The system is going to be composed mainly of a script which receives as an input an image and determines whether a hand or a similar object is in the frame and it should get its location in order to cut that region. Once the image of just the sign is obtained, it should be evaluated by the best trained machine learning algorithm found for the task and it should produce as an output a predicted class which corresponds to the correct letter of the alphabet which is being represented in the image, this may enable different ways of communication between people with disabilities and the computers. It should be displayed in a usable and understandable way, in which the process of creation and evaluation is displayed in order to generate knowledge and spread the interest.

1.3 ASSUMPTIONS AND CONSTRAINTS

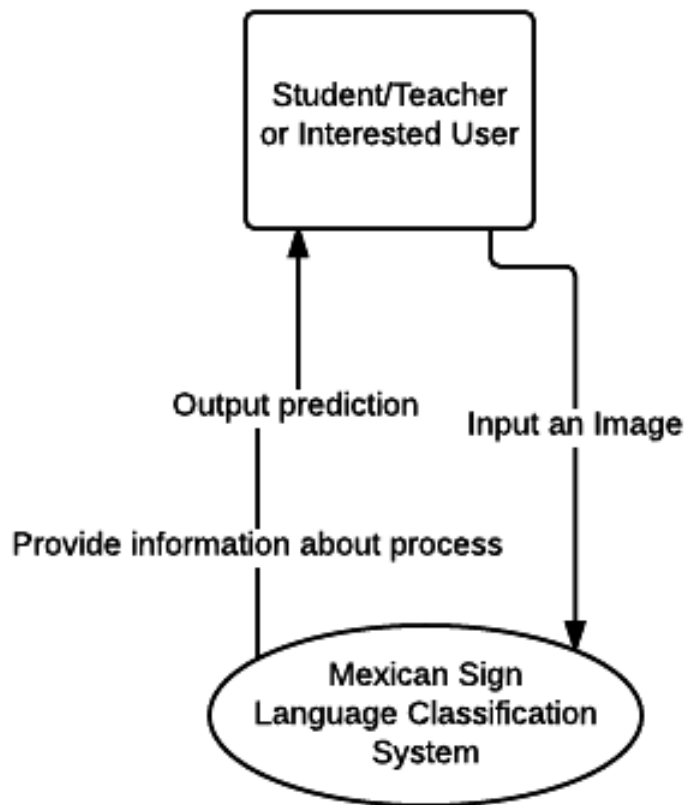
This project provides some constraints such as the time limit to develop the solution which is dependant on the semester and it should be delivered by the 27 of March and gives a total of 6 weeks. Other constraint is that the problem is considered solved at the moment the algorithm predicts the class with an accuracy of 90% or more. Other than that the solution needs to be achieved no matter what.

Some of the assumptions made for this project and problem are that the images are almost staged to the point where the hand is easily distinguishable from the rest of the image and is a sign from the Mexican Sign Language. Other assumption made is that the way of showing the result doesn't really matter as long as it is understandable and accesible.

2 FUNCTIONAL REQUIREMENTS

In the following part of the document, the functional requirements for the system will be described:

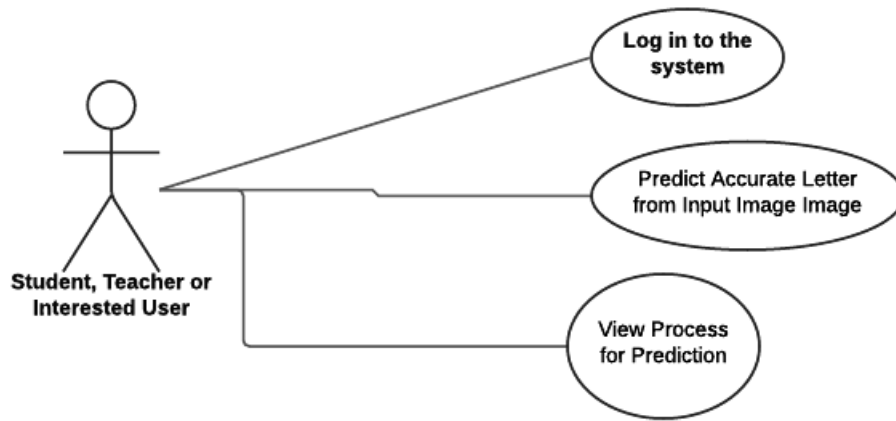
2.1 CONTEXT DIAGRAM



This diagram represents the possible interactions with the system from the different users in the scope of the project. In this case the desired users are just the ones which will test and use the main function of the system. An interaction which will be necessary initially is to train the model by the developer, but at the end it should be able to learn automatically. The most important interaction involves the input of the image which will output the prediction.

2.2 USER REQUIREMENTS

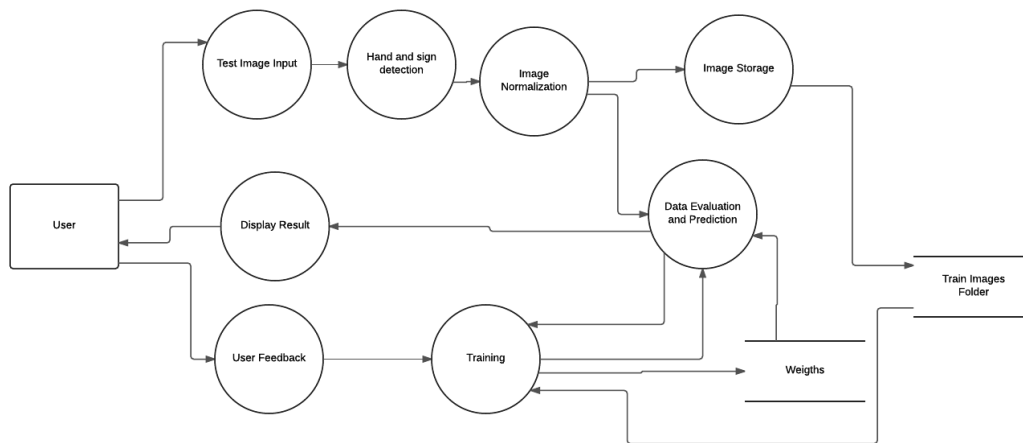
Most of the general requirements for the system are covered in the following use case diagram:



The business goals desired to be achieved with this project involve generating interest and knowledge of the problem area amongst students and interested communities. Also, it is necessary for the system to be available and accesible in order to be shown, for this requirement to be met the user should be able to login to the system and restrict the demand on the system given this process may have a high cost on the system resources. Also a functionality that should be met is that the system should upgrade or update its knowledge by itself.

2.3 DATA FLOW DIAGRAM

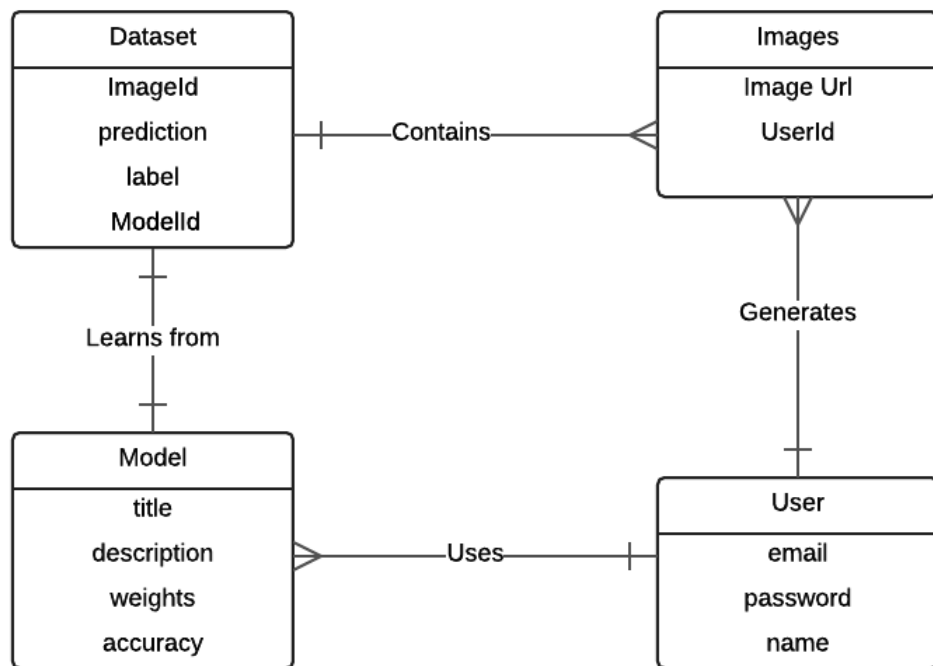
The following diagram represents the main interactions between the system and the user and between the system itself and how the data flows through different processes which achieve the desired output. In this case how images are taken and displayed with their prediction. And how the system improves its weights or knowledge.



The initial weights or values for prediction in the model will be random values, as the project progresses, this values will be modified to achieve the desired accuracy. Once the system is deployed, the user will be able to input an image and the system will realize the displayed functionality in that order. This series of processes will have as an output the prediction for the user and a new image added to the dataset in case it meets the conditions. Also if the user gives feedback on the prediction the model should retrain itself on that feedback. It is important to note that only the most important functions are displayed in this diagram to start to make sense of the different parts of the system, for practical reasons, functions such as the login are not represented in the diagram since this functions are a way in which to ensure the demand for the system is met by restricting access to the possible users.

2.4 LOGICAL DATA MODEL & DATA DICTIONARY

The system should count with the following data model in order to achieve the desired functions. Following the data model will be its description with the help of the data dictionary. This will be the initial strategy and can be tweaked to make the system work better.



Data Dictionary:

- Model:
 - title:String
 - description:String
 - weights:File
 - accuracy:Double
- User:
 - name:String
 - email:String
 - password:String
- Dataset:
 - imageId:ID

- modelId:ID
 - label:String
 - prediction:String
- Image:
 - imageURL:String
 - userId:ID

2.5 FUNCTIONAL REQUIREMENTS

Since the goals for this project are really narrow, the functionality needed to achieve the possible interactions with the user are really just a few. But the functions and the components developed in order to deliver said interactions requires trying different solutions and iterating through them to constantly improve the accuracy of the model.

2.5.1 FUNCTIONAL REQUIREMENT 1

The system shall be able to accurately predict the letter from the alphabet represented in an image.

2.5.2 FUNCTIONAL REQUIREMENT 2

The system shall allow the user to login with the credentials generated by the administrator.

2.5.3 FUNCTIONAL REQUIREMENT 3

The system shall be able to display the process by which certain image went in order to predict its value.

2.5.4 FUNCTIONAL REQUIREMENT 4

The system shall be able to take an image as an input in order to predict its letter.

2.5.5 FUNCTIONAL REQUIREMENT 5

The system shall be able to detect wheter an image contains a hand or not.

2.5.6 FUNCTIONAL REQUIREMENT 6

The system shall be able to detect the location of the hand given that the image contains one.

2.5.7 FUNCTIONAL REQUIREMENT 7

The system shall be able to normalize a given image that contains a hand to fit the rest of the dataset.

2.5.8 FUNCTIONAL REQUIREMENT 8

The system shall be able to train itself to improve its accuracy.

2.5.9 FUNCTIONAL REQUIREMENT 9

The system shall be able to store the images that are accepted by the process.

2.5.10 FUNCTIONAL REQUIREMENT 10

The system shall be able to take the feedback of the user in order to train.

3 NON-FUNCTIONAL REQUIREMENTS

In the following part of the document the other types of requirements will be described, these involve the non-functional requirements or the quality attributes the system shall meet in order to work as expected and with some standards and not just to work sometimes. These type of requirement describe the non-behavioral part of the system.

3.1 INTERFACES

3.1.1 HARDWARE

A computer with a camera is needed to support the system. There is no other hardware interface to be implemented by the system.

3.1.2 SOFTWARE

In order to access and use the application a computer running any operating system with internet connectivity is needed. This computer must run a recent version of any of the browser in order to acces the site and upload the image.

3.2 DATA CONVERSION

There is no legacy data needed for this project. All the data needed to train the model will be generated by taking pictures in the specified format. In case the algorithm needs to generalize the information to different scenarios and not just the specified one, the model will need to be expanded in order to find a hand in any image no matter what.

3.3 HARDWARE

The system requires a way in which images will be taken as an input. Depending on the time left once the accuracy is met, the solution may require a camera to take pictures and later upload them or a webcam directly attached to the computer. The system will also need server in which the application will reside and will take the requests.

3.4 HARDWARE

The solution has some software assumptions and requirements which help in the process of the developing the final product. The key requirements in order to develop and release this solution are listed next:

- OpenCV - An open source computer vision library which helps in the manipulation of images.
- Django - An open source python web development framework which will enable to release the solution to production in an effortless manner since python is the desired language to develop the solution, in case time is not a problem this requirement may change.
- Some Machine Learning Library - Through the project, these libraries will be iterated in order to achieve the best accuracy in the model.

3.5 OPERATIONAL

In the following section the different operational requirements for the system will be described as needed by the business rules.

3.5.1 SECURITY AND PRIVACY

The application shall count with an access control module which will moderate the users of the system, this helps with not leaving the functionalities open to the public since they require a lot of computational resources. There is no private or confidential information to be stored on the system.

3.5.2 RECOVERABILITY

In the event the application is unavailable to users because of a system failure, the administrator shall be able bring the application back up within 48 hours. The database of the system shall be capable of being restored to the initial point where the accuracy of the model is 90% or above.

3.5.3 AVAILABILITY

One of the most important attributes of the application is that it is available when it is needed. For this reason the system will be delivered in the form of a web application. The actual dates for the system to be up and running are just before finishing the semester. With no exact date known, but with the warranty it will be stated with anticipation.

3.5.4 PERFORMANCE

The system should be able take the image as an input and produce a prediction as an output in a reasonable response time of less than 4 or 5 seconds and depending on the user internet connectivity.

3.5.5 CAPACITY

The system should be able to handle an approximate maximum capacity of 10 concurrent users and 1 process of prediction at a time. The access control will help in achieving this.

3.5.6 DATA RETENTION

The images uploaded should be stored as long as the model will be used or tested and may be uploaded to a different site in order for them to be shared to the general public. No other information should be retained by the system and should be destroyed as soon as the system is not used.