Software Design Description

for

SIGN LANGUAGE RECOGNITION

WITH MACHINE LEARNING

(SLRWML)

Version 1.0

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1.   Introduction

Sign Language has been used to express feelings, thoughts without speaking because of some diseases related to the speaking ability or lack of hearing ability which is called deafness. The Sign Language Recognition with Machine Learning provides a translation between sign language and normal language. The translated sign language can be easily converted to other languages or vice versa.

1.1   Purpose

This project has been aiming to generate a useful, fast translation among sign language and normal language. The program will use machine learning to improve correctness of the translation.

1.2   Scope

The Software Design Description has been explaining what will be used in the project, what the system will look like. The required functions, definitions, basics of the project are explained in the report. The main structure of this project will be explained briefly in the following sections.

1.3   Definitions, Abbreviations, Acronyms

- **CSV -** A file format that contains strings, numbers separated with comma. - Comma(C)-Separated(S) Variables(V).
- **GIF-** This means Graphics Interchange Format. It is a bitmap image format.
- **Machine Learning -** A branch of science that deals with perception of computers, datasets or data types to design algorithms that allow learning based on data types.
- **Python-** Python is a programming language that allows users to build programs, it is preferred by data scientists, AI programmers or similar people because of its usability.

1.4   References

There are no references that were used for section 1.

1.5 Overview

The following sections will be investigated through this report.

- In section 2, used tools in the design of the system and the purpose of usage will be investigated.
- In section 3, the architecture of system, system existence and physical location will be mentioned.
- In section 4, the system interface will be explained.
- In section 5, the user interface of the system will be mentioned for design.
- In section 6, the process design will be mentioned as sketches.
- In section 7, the dataset design and relations of data will be mentioned.

2. Design Considerations

2.1 Approach

- Software architecture diagram-It was used to show how users of a typical software system can interact with external systems, data sources and services.
- Hardware architecture diagram-This diagram presents the hardware (servers, workstations) that are interconnected by a network, as well as the technical and application components that are deployed on this hardware.
- We made the dataset to keep the information of the users who reported the error with the dataset.

2.2 Tools Used

- For ER diagrams no specific software will be used, instead of software, "draw.io" will be used.
- The Phyton will be used as a programming language on the "Anaconda".
- For analyzing the pictures, a sort of webcam will be used.
- "OpenCV" library, "PyTorch" and "onnx" will be used also.
- Keras
- Tensorflow
- For the documentation, MS office documentation will be used.

2.3 Constraints

The perceiver of the computer will perceive the movement of the hand instead of perceiving face expression.

2.4 Assumptions and Dependencies

- The Sign Language will be expected as in American. Thus, other languages will not be expected from the user.

3. Architecture

3.1 Software Architecture

We do not use database design in this project. We will keep the data in the text file with the extension 'csv' instead of database. There will be pictures other than this text file. The format of the pictures will be GIF.

3.2 Hardware Architecture

The hardware architecture to be used in this project is client-server architecture. The client-server model describes how a server provides resources and services to one or more clients. When a client requests a connection to a server, the server can accept or deny the connection. If the connection is accepted, the server establishes and maintains a connection with the client over a specific protocol.
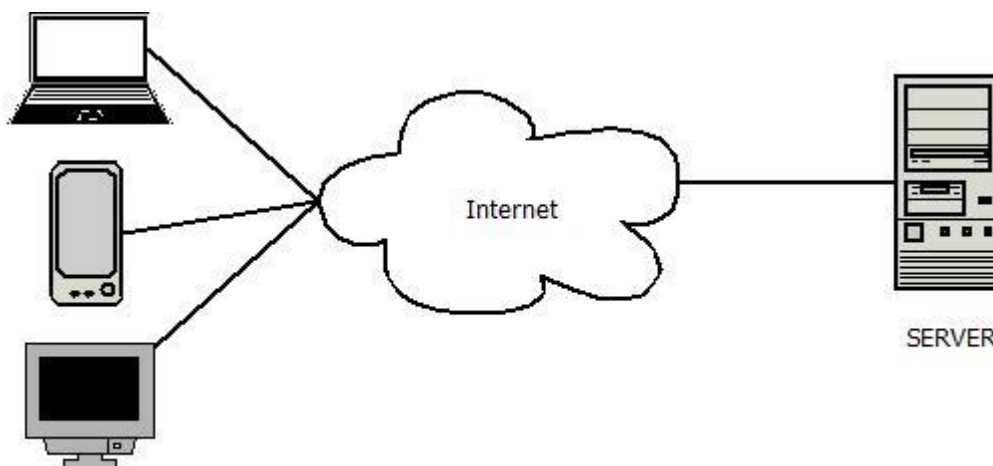
In this project, the client will make a request to the SLRWML application server and the connection will be made using the TCP / IP protocol.
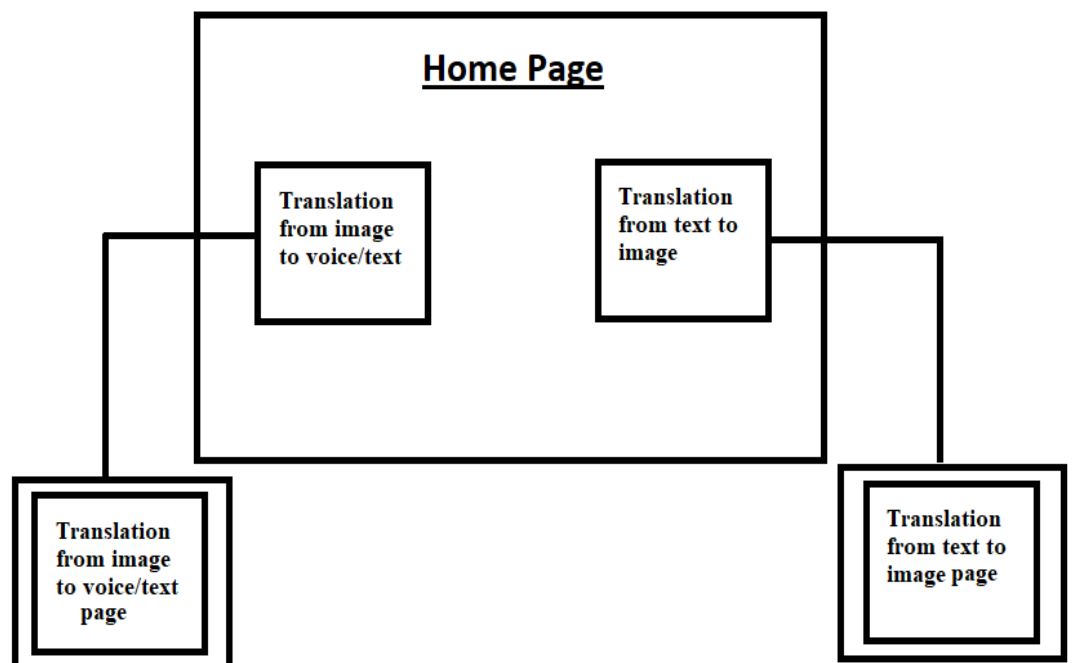
4. System Interfaces

4.1 External System Interfaces

There is no external interface in this system.

5. User Interface Design

The general view of the site is shown in this section.

5.1 Navigation

```
                    Home Page

        ┌──────────────┐      ┌──────────────┐
        │ Translation  │      │ Translation  │
        │ from image   │      │ from text to │
        │ to voice/text│      │ image        │
        └──────────────┘      └──────────────┘

  ┌──────────────┐                  ┌──────────────┐
  │ Translation  │                  │ Translation  │
  │ from image   │                  │ from text to │
  │ to voice/text│                  │ image page   │
  │ page         │                  │              │
  └──────────────┘                  └──────────────┘
```

- Users will be directed to "Home Page" by opening the application they downloaded on their android phone or by using the URL link.
- There are 2 different buttons on the homepage. The first is "Translation from image to voice/text" and the other is "Translation from text to image" button.
- When the "Translation from image to sound / text" button is pressed, it is directed to the desired page. This page asks for camera permission when first opened.After this permission is given, words are explained using sign language through the camera, and then the words corresponding to this sign language appear in the text box below. The user can press the loudspeaker button if they want and listen to the text box out loud.
- When the "Translate from text to image" button is clicked, it is directed to the desired page. The text is written in the text box. Then, when the 'translate' button is pressed, an animation appears at the top, this animation shows the equivalence of those words in sign language.

5.2   Screen Definitions

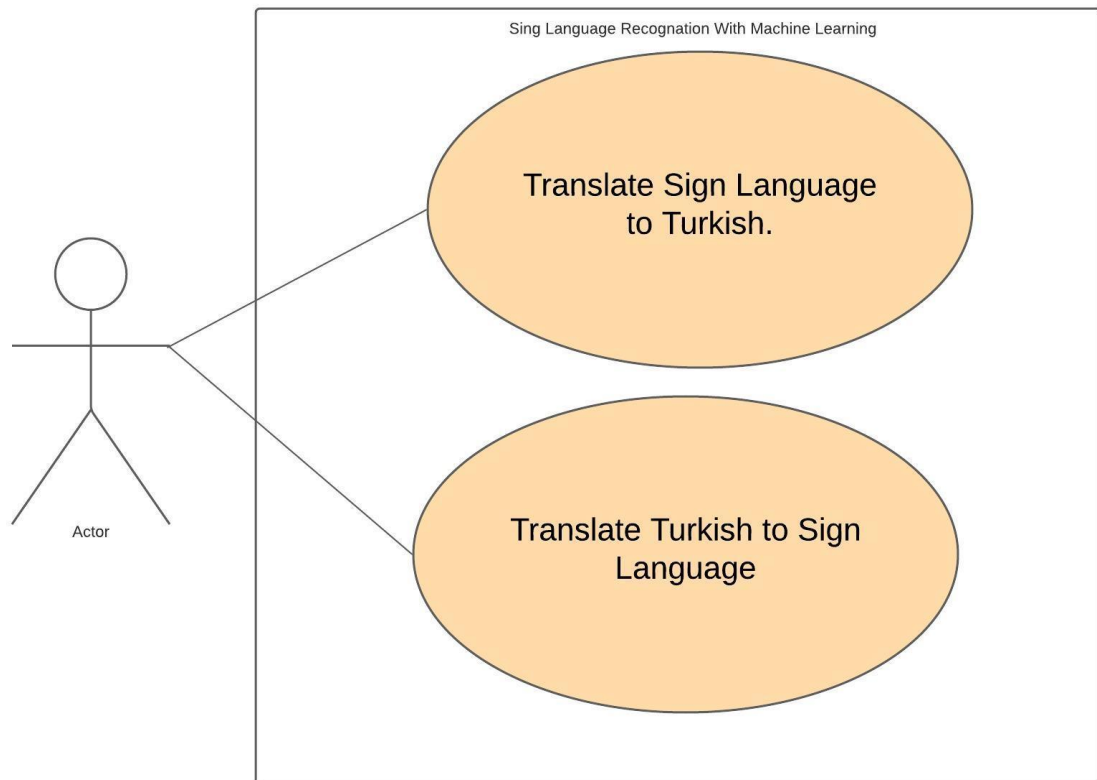### 5.2.1 Home Page

5.2.2 Translation from text to image page
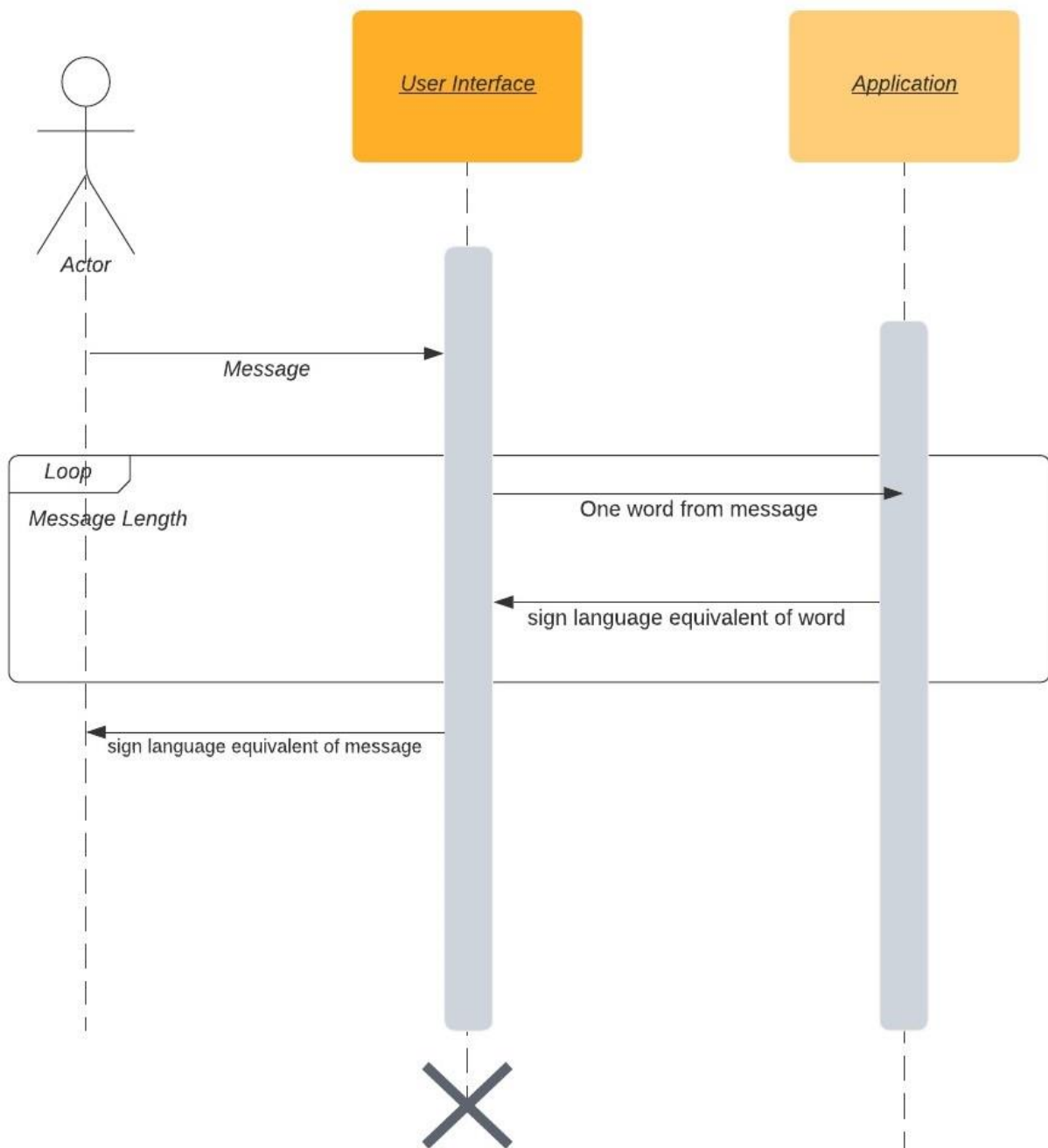

5.2.3 Translation from image to sound / text

6. Process Design
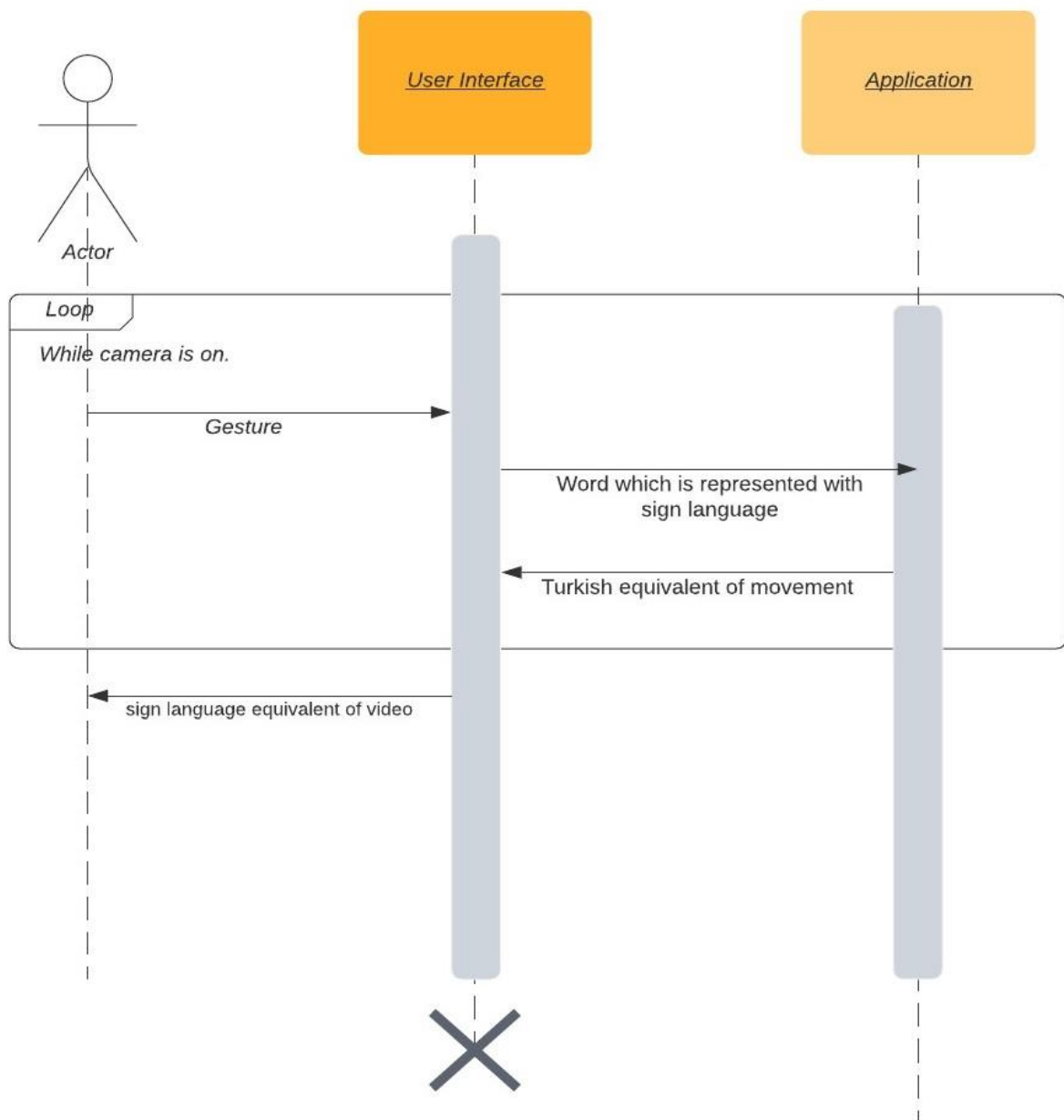
6.1 Use Case

6.2   Sequence Diagrams

Text to Sign Language

Sign Language to text

7. Dataset Design

This section describes the how SLRWML handle with data. In this project, we prefer that hold data in csv files instead of dataset management systems.

7.1 CSV File Definitions

7.1.1. Word.csv

This csv file builded for storing words and signs which are used in daily life constantly.

- WordID: Field that holds unique ID for each word.
- Word: Field that holds Turkish words.
- Sign: Field that holds path of gif which represents sign language equivalent of word

7.1.2. Character.csv

This csv file builded for storing letters and numbers. The words which are not in word.csv will represent thanks to letters.

- CharID: Field that holds unique ID for each character.
- Character: Field that holds numbers and letters.
- Sign: Field that holds path of gif which represents sign language equivalent of characters.

8. References

- Sketching Graph Tool - https://www.lucidchart.com/
- IEEE SDD Description - http://cengproject.cankaya.edu.tr/wp-content/uploads/sites/10/2017/12/SDD-ieee-1016-2009.pdf