

“English Text to Arabic Sign Language Translator”

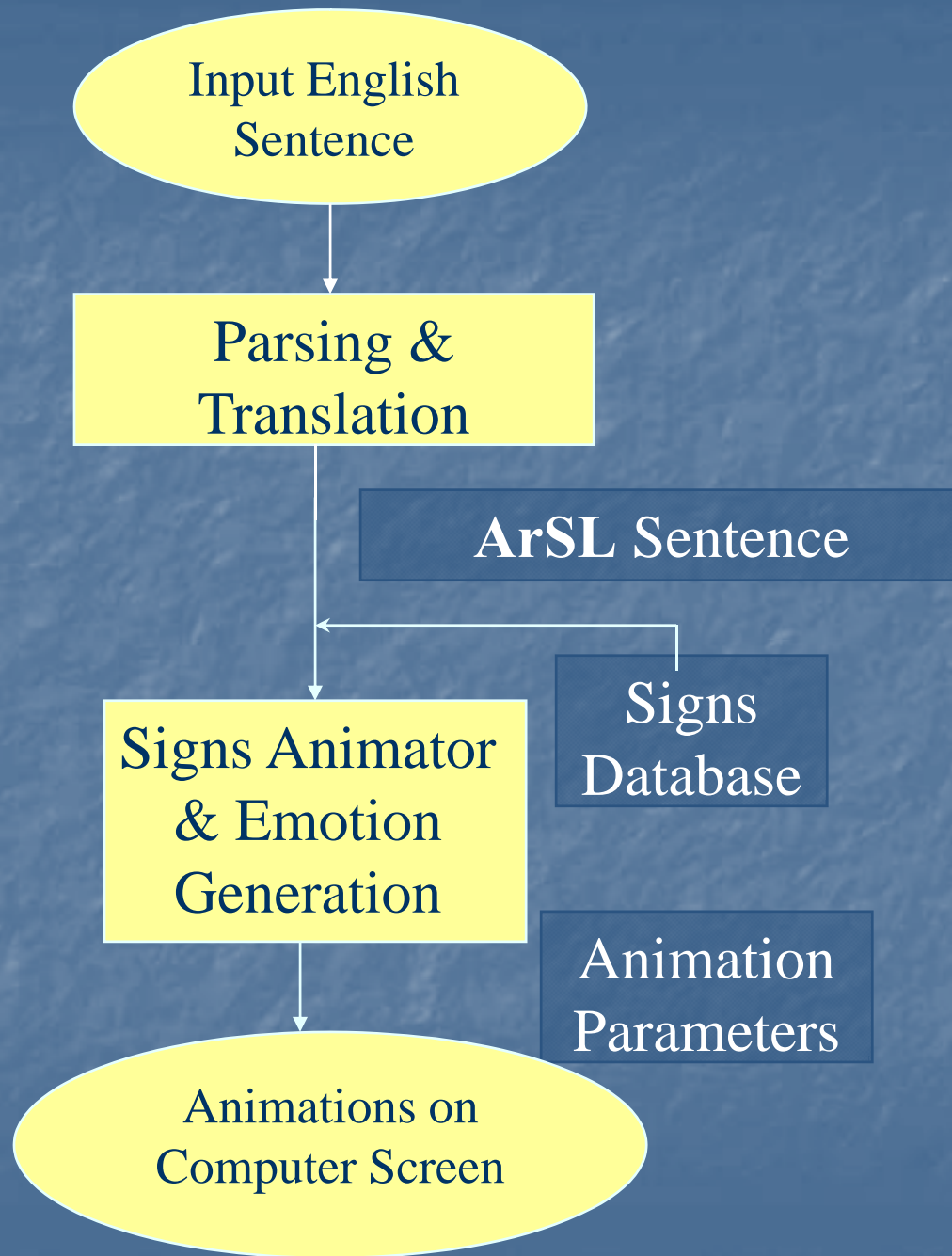
Thesis Objective

- Designing a fully functional machine translation system.
- The system translates from English Text to 3D animated Arabic Sign Language (**ArSL**) suitable for Arabic deaf people.

If such system is found, it can be used in applications such as:

- Real time Graphical interpretation for instructions in airports, train stations, public buildings, etc.
- It can be used as an English learning tool for Arabic deaf people.

System Structure

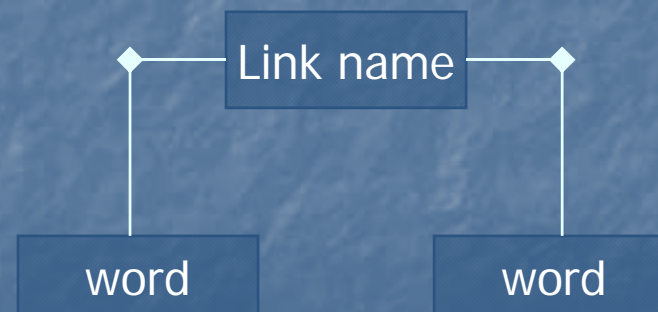


System Translator

- First, the input English sentence is parsed using the method of Link Grammar Parsing.
- The system then, translates the parsed English sentence to a simplified Arabic that follows most of the rules of the Arabic Language.
- The translator uses this Arabic like sentences to generate the set of signs that express the same meaning using **ArSL** rules.

Input Sentence Parsing :

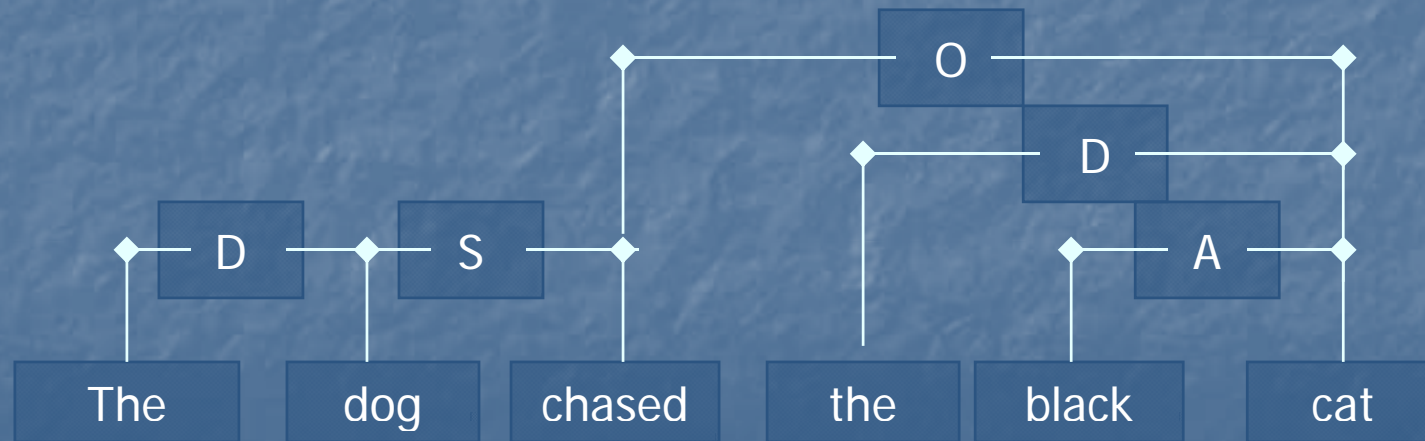
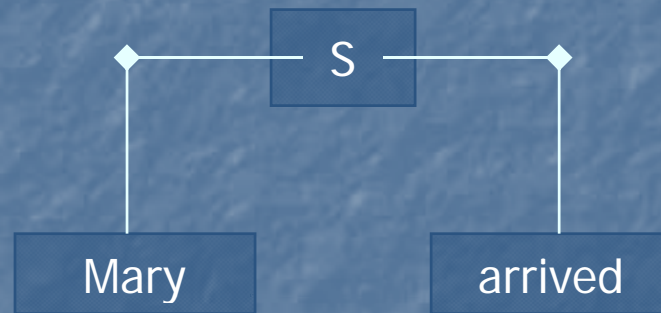
The method of Link Grammar is used. The basic idea is that, think of words as blocks with connectors coming out (or in) which are called links. These links describe the relations between words.



A few examples of the used links are:

- The S link is used to connect a noun to its verb.
- The O link is used to connect a verb to its object.
- The A link is used to connect an adjective to its noun.
- The D link is used to connect a determiner to its noun.

Examples of Parsed Simple Sentences:

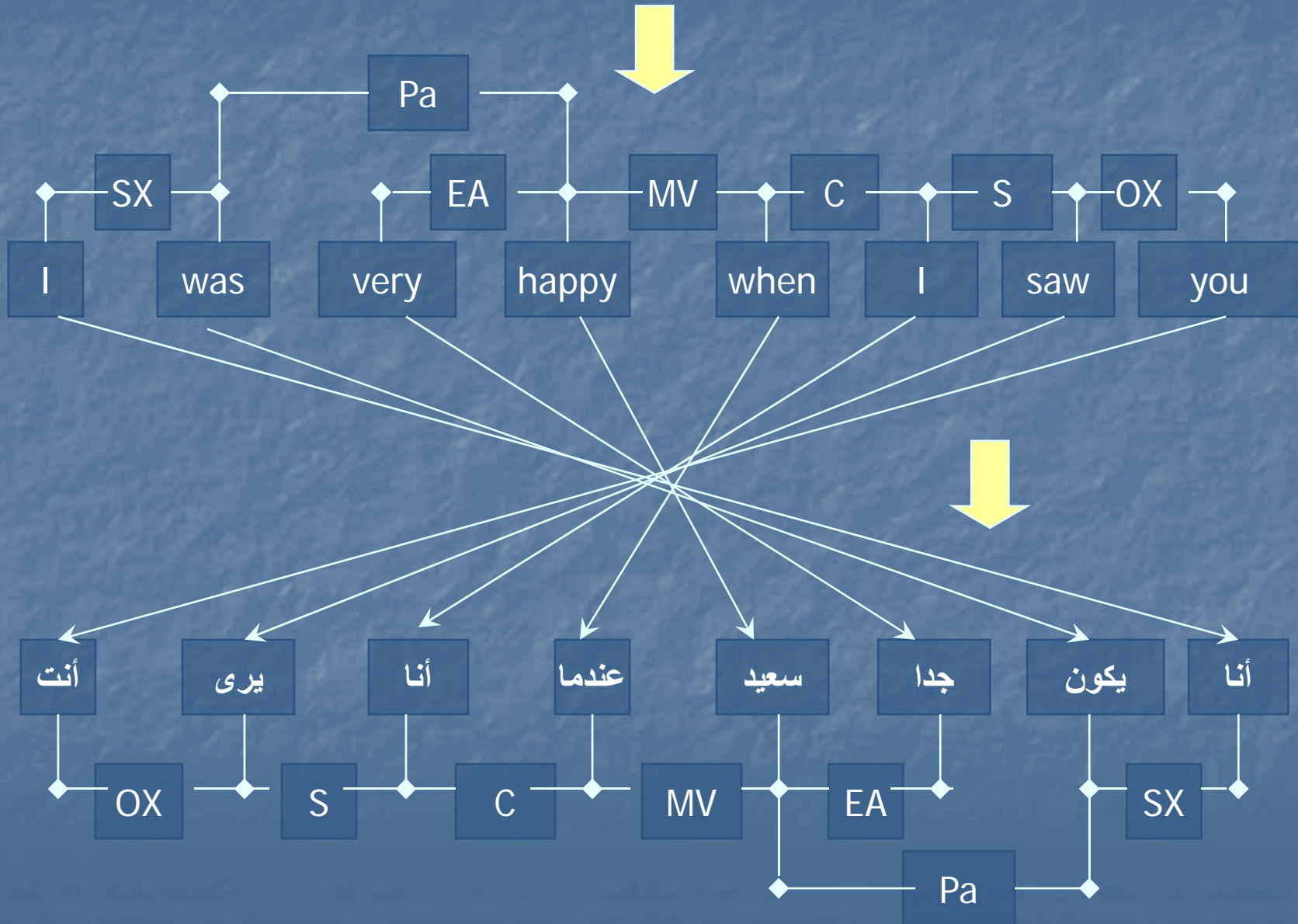


The result of this process is the sentence expressed completely as words and links names. Consequently, the links of the sentences can be viewed as a way of specifying the constituent structure of the sentence.

Vocabulary Mapping:

In this stage the translator replaces each English word with its Arabic equivalent using tables. The output is a naïve translation from input English words to Arabic ones. It is missing the right order of the words, which depends on the **ArSL** grammars.

I was very happy when I saw you

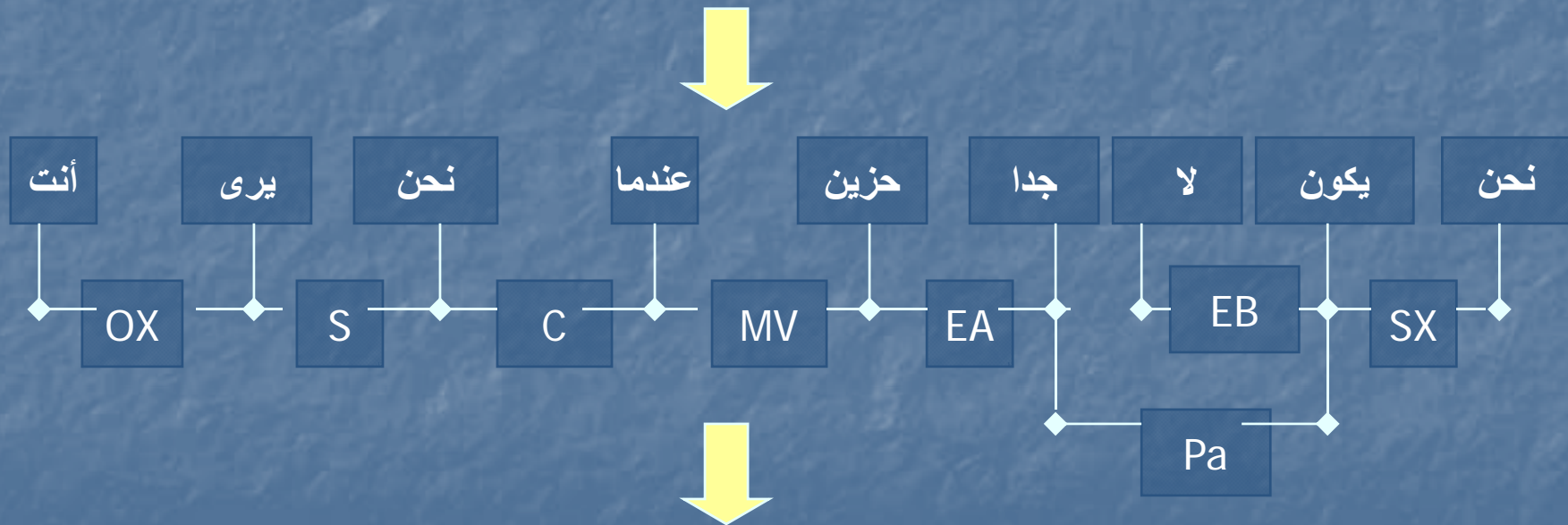
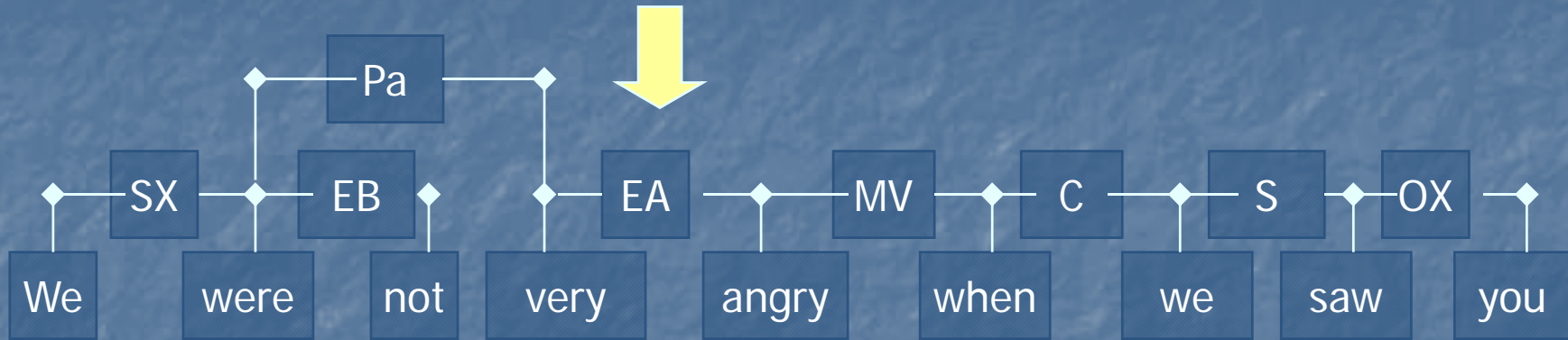


ArSL Sentence Construction:

After producing the naïve Arabic representation sentence, the translator generates the **ArSL** sentence (sequence of signs to be animated). This is done by applying the **ArSL** rules on the output of the previous stage.

A complete example to show
the previous 3 steps in the
translator:

We were not very angry when we saw you

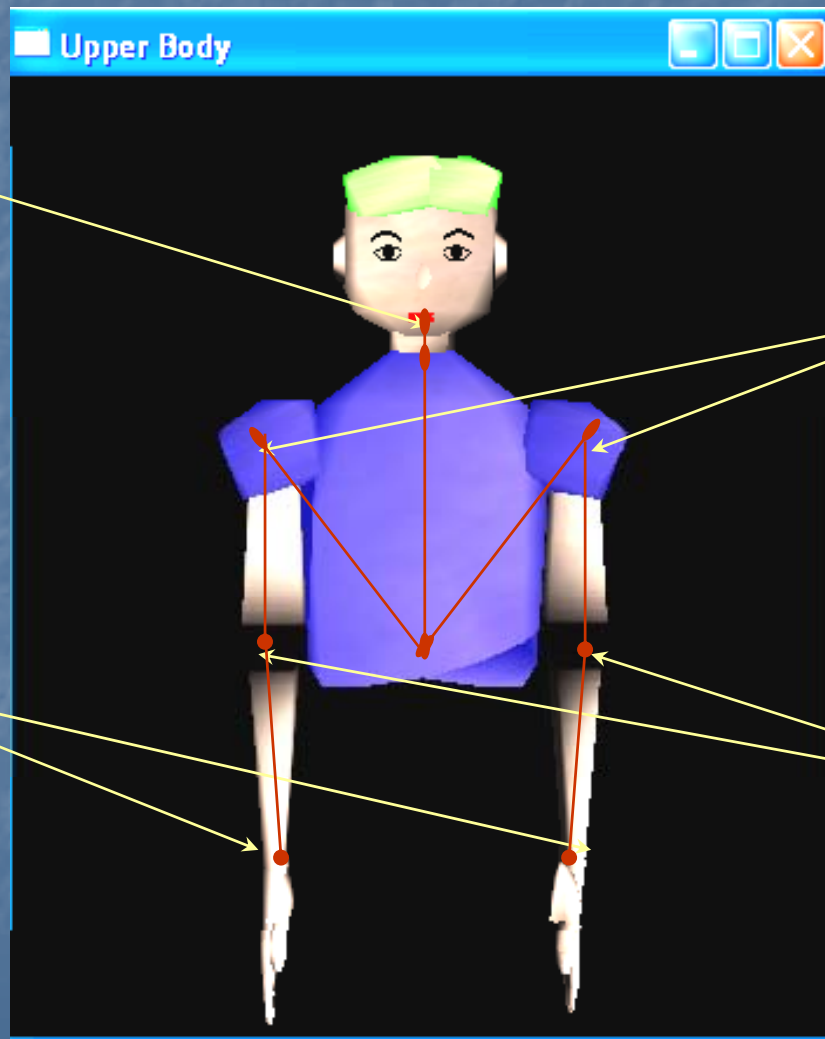


نحن / (إشارة الماضي) / حزين جدا عندما نحن / (إشارة الماضي) / يرون أنت

System Animator

3D Graphical Model

Head
joint

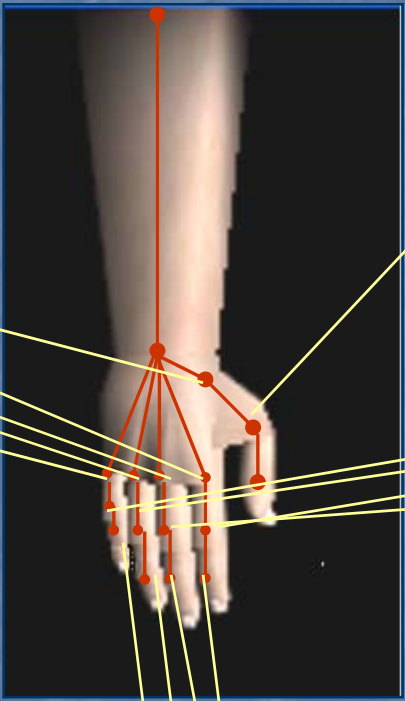


Shoulder
joints

Wrist
joints

Elbow
joints

MCP
joints



IP
joint

PIP
joints

DIP joints

- Most of the joints allow three Degrees Of Freedom (DOFs).
- Some of the joints are restricted to only one (PIP and DIP joints) or two (wrist joint) DOFs.

Emotion Generation

- The system provides a simple facial expressions.
- To implement these simple facial expressions, deformable curves that are controlled by few control points are used.
- Bezier Curves are used to model the facial components such as eyebrows, lips and eye edges.
- An emotion parameter is attached to each word in the signs database to display the right emotion during the animation of the sign.

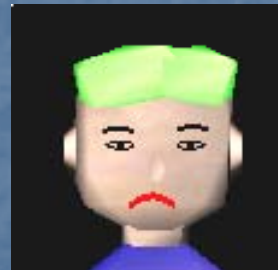
The system supports four kinds of facial emotions.



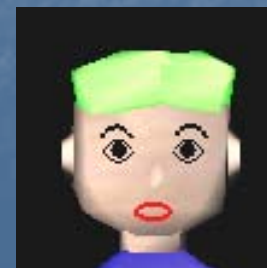
Normal



Smiling



Angry



Surprised

Sentence Animator

- The sentence animator is the part of the system which is responsible for animating a complete **ArSL** sentence.
- To animate each sign, the system searches the signs database for each word in the **ArSL** sentence.
- Each sign in the database has from 3 to 5 control points (key-frames) and the system interpolates between these points to generate the smooth animations.
- In order to achieve the smooth animations, Euler orientation representation is used and the method of forward kinematics is applied.

Graphical User Interface

Upper Body



yesterday I was very happy





Software Implementation

The system is implemented using C++ programming language with OpenGL to implement the graphical part.

Conclusions

- This thesis provides a 3D graphical system to translate from English text to Arabic Sign Language, taking into account not only linguistics but also visual and spatial information associated with **ArSL** signs.
- To our knowledge, this is the first attempt to construct a machine translation system from English to **3D** animated **ArSL**.
- The system was tested on a set of deaf students from age 14 to 22 years old and shown to be effective in communicating with them.

“Thanks For Your
Listening”