



**Republic of Iraq**  
**Ministry of Higher Education and Scientific Research**  
**Mustansiriya University**  
**College of Science/Department of Computer Sciences**

**An application to convert text into the spelling of sign  
language letters (for deaf and dumb)**

**A project submitted to the Department of Computer Sciences in partial  
fulfillment of the requirements for the degree of Bachelor of Science in  
Computer Sciences – branch name**

**BY**

**Mustafa Mohammed gahli**

**Muntazir Ahmed Jabaar**

**SUPERVISED BY**

**Lecturer Yasmin Makki Mohialden**

**Baghdad, Iraq**

**Academic year (2021-2022)**

## *Supervisor Certification*

**This is to certify that the project entitled**

..... ,

**prepared by** ..... ,

**and** ..... ,

**submitted to the Department of Computer Sciences / Collage of Science at Mustansiriyah University in partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Sciences – branch name was made under my supervision and guidance.**

**Signature:**

**Name:** (Supervisor)

**Title:**

**Date:** / /

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿ إِنَّمَا يَخْشَى اللَّهَ مِنْ عِبَادِهِ الْعُلَمَاءُ إِنَّ اللَّهَ عَزِيزٌ غَفُورٌ ﴾

صدق الله العظيم

[فاطر: 28]

## **DEDICATION**

To my parents, brothers, sisters and friends who made this accomplishment possible.

# الإهداء

بعد سنين من المشوار الدراسي  
ها قد وصلت الى نهاية المطاف سنين قضيتها  
بالتعب وسهر الليالي وظروف الحياة الصعبة  
التي لم تستطع الوقوف في طريقي  
اهدي مشروع تخرجي وإلى من تتسابق الكلمات  
لتخرج معبرة عن مكنون ذاتها  
من علمتني وعانت الصعاب لأصل إلى ما أنا فيه  
وعندما تكسوني الهموم أسبح في بحر حنانها  
ليخفف من آلامي ... أُمي  
وابي واخوتي واخواني واصدقائي  
ثم إلى كل من علمني حرفاً أصبح سنا برقه يضيء الطريق أمامي.

## **ACKNOWLEDGMENTS**

Thanks and appreciation I would like to thank everyone who contributed to the successful completion this project. I would like to express my gratitude to my research supervisor assistant teacher. Yasmine Makki for her valuable advice and guidance Tremendous patience throughout the research development, In addition, I would also like to express my gratitude to my loving father and Friends who helped and encouraged me...

## الشكر والتقدير

الحمد لله حمداً كثيراً طيباً مباركاً فيه ... اللهم لك الحمد حتى ترضى ولك الحمد إذا

رضيت ولك الحمد بعد الرضا

لا يسع حروفي إلا أن تمتزج لتكون كلمات شكر

وعرفان

ليس لأحد معين وإنما لكل من ساهم في تقديم المساعدة لي ولغيري

الى التدريسين في قسم علوم الحاسوب

والدكتور المشرف الذي لم يبخل بمساعدتي

إن قلت شكراً فشكري لن يوفيكم حقاً

سعيتم فكان السعي مشكوراً

جميل من الانسان أن يكون شمعة ينير درب الحائرين

ويأخذ بأيديهم ليقودهم إلى بر الأمان متجاوزاً بهم أمواج الفشل والقصور فشكراً لكم

من الأعماق...

ومن الله التوفيق

## **ABSTRACT**

With the country's progress in civilization and technology, it has become important to include people with special needs in society by giving them ways to communicate using sign language so they can express themselves and become part of society instead of being a financial burden on the state. There are a lot of people in the Arab world who don't know the Arabic Sign Language. Because of this, they don't have the chance to learn about the rest of the world and its cultures.

In this project, a new way for the deaf and dumb to communicate using sign language for Arabic letters were created. It is a mechanical palm phrase that can be used to teach sign language to deaf or dumb people and translate sign language into Arabic when linked to a mobile app designed to communicate with the industrial palm. Every single sign in the hand means something special. It is easy to understand and follow because of how it is set up.

The application software was developed using the Arduino IDE (C++) and MIT App Inventor.



## TABLE OF CONTENTS

SUBJECT	Page No.
Supervisor Certification.....	i
Dedication .....	iii
Acknowledgments .....	iv
Abstract .....	v
Table of Contents .....	vi
List of Figures .....	ix
List of Tables .....	x

<b>CHAPTER ONE: GENERAL INTRODUCTION</b>	<b>1</b>
1.1 Introduction .....	2
1.2 Related Work .....	2
1.3 Aim of the Project.....	4
1.4 Project Outlines .....	5

<b>CHAPTER TWO: Sign language</b>	<b>6</b>
<b>2.1 Introduction.....</b>	<b>7</b>
<b>2.2 Ways to learn sign language.....</b>	<b>7</b>
<b>2.3 How to communicate with the deaf and dumb.....</b>	<b>8</b>
<b>2.4 How to deal with the deaf and dumb.....</b>	<b>10</b>
<b>2.5 The importance of sign language.....</b>	<b>10</b>
<b>2.6 Sign Language Basics.....</b>	<b>10</b>
<b>2.6.1 Hand movements.....</b>	<b>11</b>
<b>2.6.2 Letters.....</b>	<b>11</b>

<b>CHAPTER THREE : Design and implementation</b>	<b>12</b>
<b>3.1 Introduction.....</b>	<b>13</b>
<b>3.2 The proposed system.....</b>	<b>13</b>
<b>3.3 Hardware parts.....</b>	<b>14</b>
<b>3.3.1 InMoov Hand.....</b>	<b>14</b>
<b>3.3.2 3D print of InMoov hand.....</b>	<b>15</b>

<b>3.3.3 Connect the parts of the hand.....</b>	<b>15</b>
<b>3.3.4 MG996R Servo Motor.....</b>	<b>18</b>
<b>3.3.5 Arduino.....</b>	<b>19</b>
<b>3.3.5.1 Arduino Uno.....</b>	<b>20</b>
<b>3.3.6 Servo Driver- PCA9685 .....</b>	<b>21</b>
<b>3.3.7 Jumper wires.....</b>	<b>22</b>
<b>3.3.8 NCR18650B Battery and Holder box.....</b>	<b>22</b>
<b>3.3.9 HC-05 Bluetooth .....</b>	<b>23</b>
<b>3.3.10 Huawei P smart mobile .....</b>	<b>24</b>
<b>3.4 The component of the software .....</b>	<b>25</b>
<b>3.4.1 MIT App Inventor .....</b>	<b>25</b>
<b>3.4.1.1 Mapping the Arabic letters .....</b>	<b>26</b>
<b>3.4.1.2 Mobile Application programming .....</b>	<b>27</b>
<b>3.4.2 Hand software .....</b>	<b>29</b>
<b>3.4.2.1 Hand programming .....</b>	<b>30</b>

<b>CHAPTER four: Conclusions and recommenders</b>	<b>32</b>
<b>4.1 Conclusion.....</b>	<b>33</b>
<b>4.2 Recommendations.....</b>	<b>33</b>
<b>4.3 Appendix .....</b>	<b>33</b>
<b>References.....</b>	<b>35</b>

## LIST OF FIGURES

<b>Fig. No.</b>	<b>SUBJECT</b>	<b>Page No.</b>
<b>2.1</b>	<b>The use of hand signals .....</b>	<b>8</b>
<b>2.2</b>	<b>Hint language .....</b>	<b>9</b>
<b>2.3</b>	<b>Tonal pronunciation</b>	<b>9</b>
<b>3.1</b>	<b>The main units of the system</b>	<b>13</b>
<b>3.2</b>	<b>The proposed system in more details .....</b>	<b>14</b>
<b>3.3</b>	<b>3D printer Ender-3 V2 .....</b>	<b>15</b>
<b>3.4</b>	<b>Hand parts1 .....</b>	<b>16</b>
<b>3.5</b>	<b>Hand parts2 .....</b>	<b>16</b>
<b>3.6</b>	<b>Servo Motor and RobRing – ServoPulley ....</b>	<b>17</b>
<b>3.7</b>	<b>The Hand .....</b>	<b>18</b>
<b>3.8</b>	<b>Servo motor .....</b>	<b>18</b>
<b>3.9</b>	<b>Shows the Arduino Uno device .....</b>	<b>21</b>
<b>3.10</b>	<b>Driver-PCA9685 with Arduino and Servo motor</b>	<b>21</b>

<b>3.11</b>	<b>Jumper wires .....</b>	<b>22</b>
<b>3.12</b>	<b>Battery and Holder box .....</b>	<b>23</b>
<b>3.13</b>	<b>HC-05 Bluetooth .....</b>	<b>23</b>
<b>3.14</b>	<b>Huawei P smart mobile .....</b>	<b>25</b>
<b>3.15</b>	<b>The software processes in sequence .....</b>	<b>26</b>
<b>3.16(a)</b>	<b>Flowchart of the Bluetooth communication link</b>	<b>27</b>
<b>3.16(b)</b>	<b>Pairing result between the Bluetooth transceiver</b>	<b>27</b>
<b>3.17(a)</b>	<b>The welcoming screen .....</b>	<b>28</b>
<b>3.17(b)</b>	<b>We developed Bluetooth .....</b>	<b>28</b>
<b>3.18</b>	<b>Displaying all the available devices. User action either to connect or not</b>	<b>28</b>
<b>3.19(a)</b>	<b>Converts the text into an array of Arabic letters</b>	<b>29</b>
<b>3.19(b)</b>	<b>converts it to English.....</b>	<b>29</b>
<b>3.19(c)</b>	<b>Send them via Bluetooth .....</b>	<b>29</b>
<b>3.20</b>	<b>System Circuit .....</b>	<b>30</b>
<b>3.21</b>	<b>Hardware components .....</b>	<b>30</b>
<b>3.22</b>	<b>Hand Programming .....</b>	<b>31</b>
<b>4.1</b>	<b>Certificate of participation.....</b>	<b>34</b>
<b>4.2</b>	<b>Certificate of participation .....</b>	<b>34</b>

## LIST OF TABLES

<b>Table No.</b>	<b>SUBJECT</b>	<b>Page No.</b>
<b>3.1</b>	<b>Wire configuration .....</b>	<b>19</b>
<b>3.2</b>	<b>HC-05 .....</b>	<b>24</b>
<b>3.3</b>	<b>Data mapping .....</b>	<b>27</b>

# **CHAPTER ONE**

## **GENERAL INTRODUCTION**

## 1.1 introduction

Sign language It is a term that refers to a non-audio means of communication, used by people with special needs, such as the audio-dumb and the audio-deaf. Hand movements as a means of communication and the fingers of the hands in reference to numbers, as well as expressions drawn on the face to convey tendencies and feelings accompanied by some movements in the hands, to construct many meanings, in addition to following the movements of the lips, which is the most advanced stage for the power of observation, where the deaf can read words through lip movements. And there are body movements, like placing some signs on the side of the head or above or on the shoulder, chest, or abdomen as a kind of hint to clarify desires and meanings and to express oneself. These languages and signs vary from country to country.

## 1.2 Related Work

[Nashwa ,Hossam ,Mahmoud Aboul Ella, and Kazumi ,2011] This paper presents an automatic translation system for gestures of manual alphabets in the Arabic sign language. The proposed Arabic Sign Language Alphabets Translator (ArSLAT) system does not rely on using any gloves or visual markings to accomplish the recognition job. As an alternative, it deals with images of bare hands, which allows the user to interact with the system in a natural way. The proposed ArSLAT system consists of five main phases: the preprocessing phase, best-frame detection phase, category detection phase, feature extraction phase, and classification phase. The used extracted features are translation, scale, and rotation invariant in order to make the system more flexible. Experiments revealed that the proposed ArSLAT system was able to recognize the Arabic alphabets with an accuracy of 91.3% and 83.7% using the minimum distance classifier (MDC) and multilayer perceptron (MLP) classifier, respectively [2].

[Hosnia and Elbourhamy,2016] This paper suggests a new way to translate the Arabic Sign Language (ArSL). The system is made up of two subsystems. The first is the Speech to ArSL Translation Subsystem. This subsystem is mostly based on the speech recognition engine. The second is the ArSL to speech translation subsystem, which uses the GTTS library



to turn images of signs into speech. Both hearing-impaired people and hearing people who want to learn ArSL will find it easy to use this system, which will help them talk to each other more. One of the good things about this system is that it can be made bigger by adding new signs to the database. It can also be accessed online at <https://sr.gravita-demo.com/>. Several ways were used to evaluate the proposed system. With a recognition rate of 99 percent, the results show that the system can translate ArSL. An experimental approach was used to evaluate the effectiveness of the proposed system. Results show that the proposed system was effective and the ability of Arab deaf students to learn improved significantly. In addition, the system's performance evaluation questionnaire revealed that system users preferred this approach to ArSL learning and teaching and acquired new concepts, which predicts a promising future for this system in academic environments [3].

[Bala, Song, 2020] In this paper, they introduce the Simple Sign Language Translator Application (SSLATA) that will help people to learn and master sign language. The introduced application will translate words from sign language to English or Hausa languages; text to speech to sign; speech to text to sign and vice-versa. The SSLATA, through its user-friendly interface, will enable users to interact with one another via either spoken language or sign language. A constructivist research approach and an agile model were adopted for the study. Android Studio, SQLite, and Java were the environment and languages used in developing the app. The application runs on Android operating system devices [4].

[Abdallaha, Fayyoubi, 2016] This paper aims to provide an interesting application that guarantees ultimate communication with disabled users and vice versa.

and vice versa The key feature of this application is employing the Arabic language as a medium of communication to learn all the signs language terms.

The power of this app comes from two places. First, it lets regular people talk to those who are being targeted.

people without having any previous knowledge of sign language. This can be achieved either by voice recognition or words.

or by typing the words in the Arabic language. The application then displays the appropriate sign language image(s).

Secondly, and more importantly, people with special needs communicate with normal people by choosing the sign images on

their phones from the numerous categories stored in the databases that express their ideas and thoughts. Consequently, the A set of images is transformed into a text paragraph. We evaluated our application by testing it on real deaf and dumb users. We

carefully created scenarios based on realistic situations. The early results are promising, as all the deaf found the proposed technology.90% of them wanted to use it on a daily basis.

### **1.3 Aim of the project**

1. It enables communication with deaf and mute people.
2. To facilitate the learning of sign language for the deaf and dumb.
3. It helps to express the different needs of the deaf and dumb.
4. It works on the mental, verbal, and indicative development of deaf and mute people with special abilities.
5. reducing the internal and psychological pressures caused by not speaking and hearing.
6. It helps to get rid of fear, depression, and frustration among the deaf and dumb.
7. There is no better way to teach sign language than with a 3D model.

## **1.4 Project Outlines**

In addition to this chapter which gives a general introduction, the project consists

From:

The second chapter: gives basic concepts of the proposed work in terms of its importance and uses

The third chapter: explains, a flowchart of the stages of the project work from designing the hand, printing it and connecting its parts, programming the hand through the Arduino Uno and making an application via Bluetooth for the Arduino to give the signal

The fourth chapter: draws some conclusions and recommendations for future work.

## **CHAPTER TWO**

### **SIGN LANGUAGE**

## Sign language

### 2.1 Introduction

Sign language has always been an important tool for persons who cannot hear or speak to communicate with the outside world. Although it is a worldwide language, it is related to every language with signals denoting its letters, including Arabic.

Information about sign language and its development. It's a means to communicate by using signs to convey what someone wants to say. Hearing and speech so that talking with the deaf and dumb is simpler to grasp is a fundamental element of society and must be dealt with; Our topic on the Wikipedia website today will talk about sign language, how to learn it, and why it's important.

United Nations International Day of the Deaf and Dumb is September 23, while the World Federation of the Deaf celebrates it on the final Saturday of September. Regardless of the date, we are still in the last week of September to commemorate the deaf and dumb and promote sign language. To speak with them, understanding that this language dates to the 17th century and is a set of hand and finger gestures that make helpful phrases to tackle the deaf and mute's first problem: communicating with society, [1].

### 2.2 Ways to learn sign language

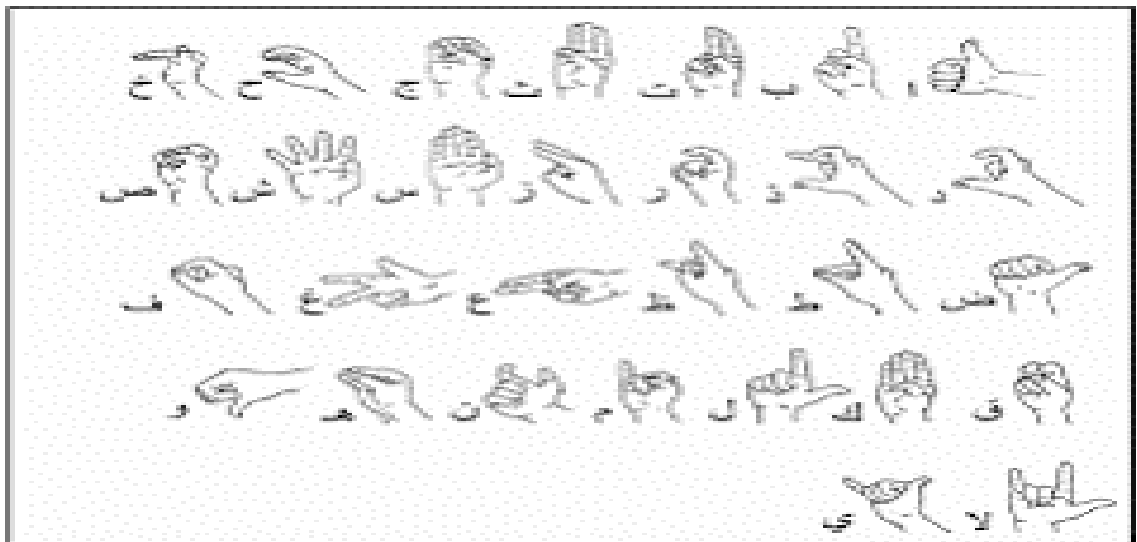
- **Educational courses:** There are many educational institutions that provide opportunities to learn sign language by providing educational courses, and there are centers for teaching sign language, and this method provides direct learning.
- **Teaching guides and dictionaries:** These dictionaries and guides not only show movements and signs, but also allow the trainee to learn how to form sentences and phrases.
- **Communicating with the deaf and dumb directly:** It allows direct communication and learning, as it benefits the deaf person as well as

the trainee, as it increases the language of each of them in the language and develops it and learns new skills for each of them.

- **E-learning websites:** websites have appeared that provide opportunities to learn sign language by providing educational videos, and some websites provide the opportunity to communicate with trainees to correct the mistakes they make while learning.
- **Programs and applications for download on mobile:** These programs provide educational videos and sign language dictionaries, as well as some instructions for errors that the trainee can fall into. These programs can be downloaded for free or for a fee, [2].

### 2.3 How to communicate with the deaf and dumb

- **Oral Communication:** Deaf and mute people are taught sign language and use lips only to communicate without using reading and writing.
- **The use of hand signals:** the two parties use the hands to express in a random and spontaneous manner. The aim of this method is to clarify and teach the deaf and mute the spoken language by indicating the exits of the sounds.



**Fig 2.1 the use of hand signals**

- **Lip reading:** The person observes and observes the movement of the lips and tries to understand the spoken words by linking the movement of the lips and identifying the exits of the letters.

- **Hint language:** The hands are used to clarify the meanings of spoken words as the speaker moves his hands with signs that indicate the meaning of the words.

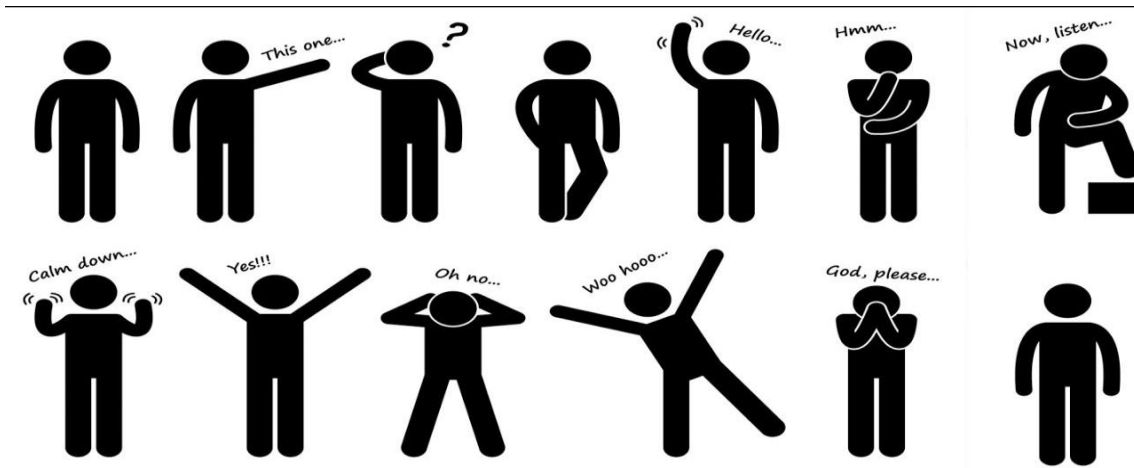


Fig 2.2 Hint language

- **Finger pointing alphabet:** This method is based on clarifying letters through different finger movements. It is considered a spelling of words and is used to clarify words for which a sign is not agreed upon.
- **Tonal pronunciation method:** This method depends on the fact that the words are not the sounds that come out of the mouth, but rather all the movements that the body makes during speech, such as the expression of the face, the tone and intensity of the voice, and others.



Fig 2.3 Tonal pronunciation

- **Total communication:** All available means of expression are used, such as: body movements, pointing with hands, reading and writing

## **2.4 How to deal with the deaf and dumb**

Learning sign language is the first means of communicating with the deaf and dumb, and we explain to you in this paragraph a set of tips when dealing with them as follows:

- It is necessary to deal gently with the deaf and dumb and not to provoke them by waving them near the face area.
- Talk to deaf and dumb people in a cheerful, spontaneous manner, and in a more casual manner so as not to hurt their feelings.
- You should speak to them in sign language without using very long sentences so that it is easier for you to communicate and understand.
- It is preferable to talk to the deaf and dumb without drawing the attention of those around you, so keep calm while talking by pointing.
- Do not be ashamed to talk to the deaf and dumb, and do not ignore them, but speak with your lips exposed.
- Finally, sign language should be trained and practiced continuously before using it with deaf and mute people so that you are not inadvertently misunderstood, [3].

## **2.5 The importance of sign language (the language of deaf and dumb people)**

- Hearing and speaking are gifts that can only be appreciated by people who have lost them. Imagine you couldn't talk or hear what was going on around you.
- People who are deaf or dumb live in a different world than most people. They try to show society who they are so they can say what's on their minds.
- Some people didn't get this blessing for reasons only God knows, but that didn't stop them from doing well in many fields and helping people.

## **2.6 Sign Language Basics**

- Like with any language, the essentials must be learned before practicing.
- These fundamentals include:



### **2.6.1 Hand movements**

Every movement symbolizes a specific thing or the message of what you wish to portray. For example, the hand could be clenched and facing upwards, flat and facing upwards, or facing downward with curved fingers. One of these approaches is to place the fingers at a straight angle with the palm of the hand.

### **2.6.2 Letters**

- It is in two ways:

#### **1- Alphabet signs**

The alphabet varies by country and in turn, the sign language and the gestures that express each letter differ.

#### **2- Fingerspelling**

As we have already mentioned, there are certain movements that correspond to the letters of the alphabet, and through them, we can formulate complete sentences with finger movements.

## **CHAPTER THREE**

### **Design and implementation**

### 3.1 Introduction

This study creates and tests a smartphone application that converts text into the spelling of deaf and dumb sign language characters.

The research is divided into two parts: the first is the development of a mobile application to send the entered word or text via Bluetooth; the second part is the hand, which is responsible for receiving the word or text and processing it to form the spelling of sign language characters (for the deaf and dumb) for the entered word. Using an Arduino UNO with servo motors Figure (3.1) shows this.

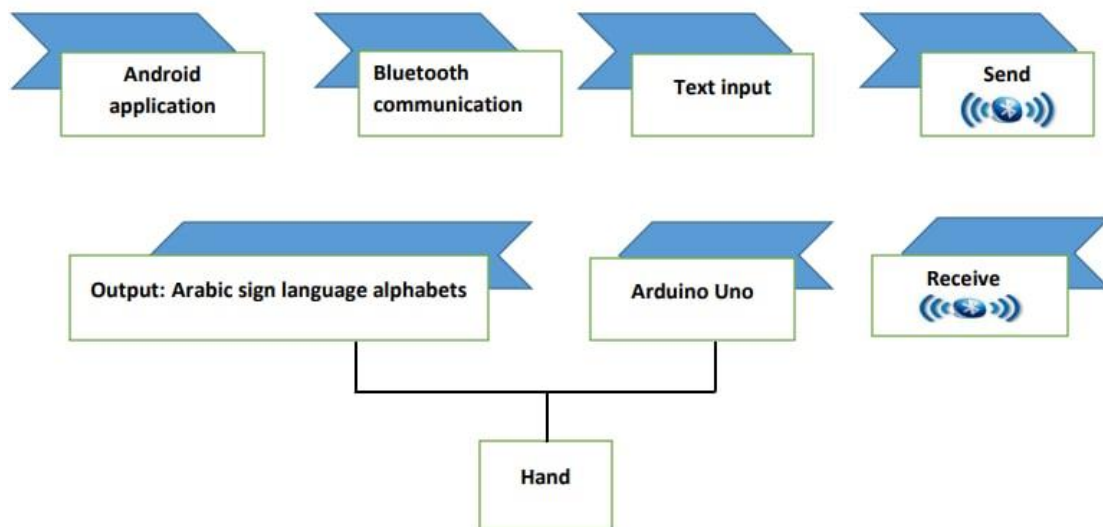
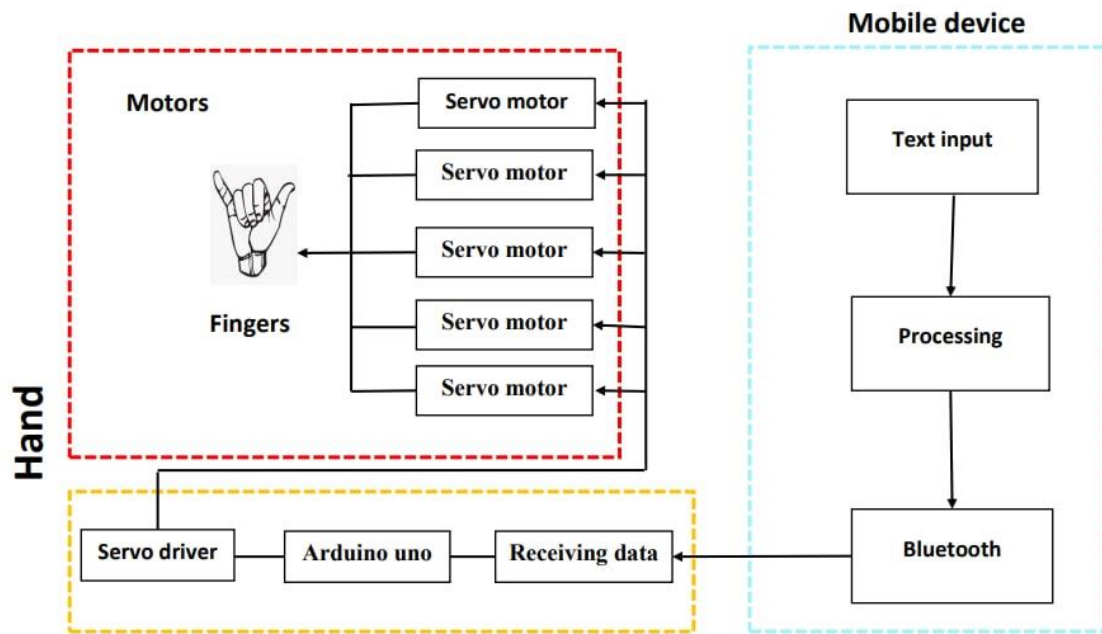


Fig. 3.1. The main units of the system.

### 3.2 The proposed system

The proposed system consists of a part of the hardware and a software part that includes the hardware part, the Bluetooth communication unit, and the Android phone. The software part includes the open-source Arduino Software (IDE) and the MIT Invertor cloud-based tool. Figure 3.2 shows these two main parts arranged on the sender and receiver sides. The mobile phone's transmitter module uses the MIT Invertor app program to make an

Android phone app that lets you type in the word or text, process it, and send it to your hand via Bluetooth. The hand (receiver) includes a Bluetooth connection link to connect with the phone (HC-05), a driver server, five server motors, and an Arduino Uno, which processes the received word or text and sends the signal to the servo motor (fingers) to form the spelling of the sign language letters of the received word. Figure (3.2) show the details of the proposed system [4].



**Fig 3.2 the proposed system in more details.**

### 3.3 Hardware parts:

#### 3.3.1 InMoov Hand

French sculptor and designer Gael Langevin Since 1987, he's worked for top brands. InMoov is his own project; it was started in January 2012 as the first Open Source prosthetic hand[5].

InMoov is the first 3D-printed life-size robot.

Replicable on any home 3D printer with a 12x12x12cm area, it's designed for universities, labs, hobbyists, and Makers.

Its principle of sharing and community has been used for innumerable initiatives around the world. initiatives around the world.

### 3.3.2 3D Printe of InMoov Hand

InMoov is an open source project for a biomimetic humanoid robot with downloadable construction instructions. We developed the arm based on the original design, and it can be used to manually print on a Creality Ender-3 V2 3D printer with a print size of 220 x 220 x 250 mm. It is one of the most well-known 3D printers in the world, and its upgraded version is the most popular [6] as shown in figure (3.2).



**Figure 3.3 3D printer Ender-3 V2.**

### 3.3.3 Connect the hand's components.

**Step1** We make sure that parts of the hand are 3D printed. Then, we take off the anti-warp supports and trim the hand with a knife. Finally, we use a drill to re-drill the holes on the side as shown in figure (3.4) and figure (3.5)..



**Fig 3.4 hand parts1.**



**Fig 3.5 hand parts2.**

**Step2** The servos are mounted on a simple servo bed. Use an MG996R servo motor. When downloading my parts from Thingiverse, you have the option of printing either the RobRing or the ServoPulley. It all depends on whether or not we receive the black actuator pictured in my hand with your servos. Use this Arduino script to adjust all of your servos to 90 degrees. Install all ServoPulleys according to the illustration. Once the ServoPulleys have been repaired, rerun the script to set all servos to 0 degrees. when we join the fishing

lines together. If they are moved throughout the next phases, we will have to reset them to zero afterwards. as shown in Figures (3-6).



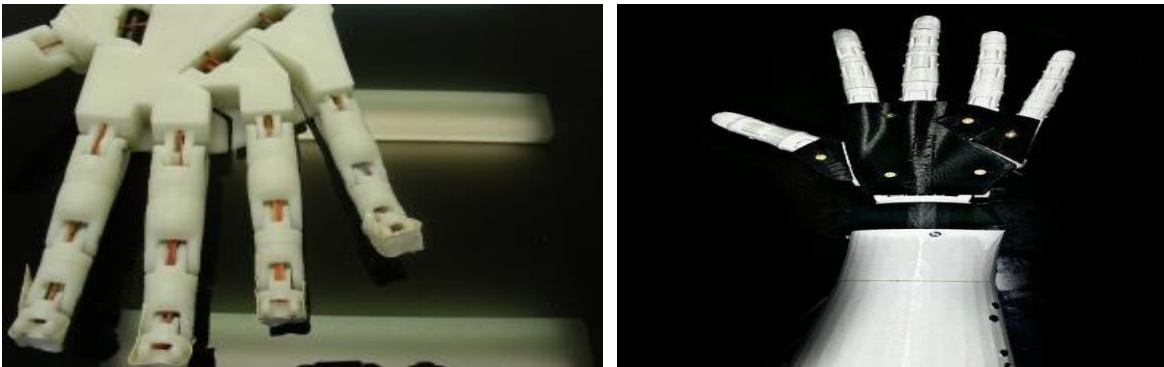
**Fig 3.6 Servo Motor and RobRing – ServoPulley**

**Step3** The finger hinges were redrilled. We keep the fingers in different bags so they don't get mixed up. A 3mm drill is used to make new holes in the outside hinge. A 3.2 mm or 3.5 mm drill is used to make new holes in the inside hinge. and Use Acetone to glue the parts together (ABS). We make pegs with our 3mm filament. Use a knife to cut the thread. The filament works great, is cheap, and moves quickly.

**Step4:** We use the nerves of the hand to braid fish. Cut your 200LB braided fishing line into 10 pieces that are 75 cm long. We put the braided fishing lines into Wrist Large's holes. Wristsmall should receive the linings. We make sure they don't get twisted on the way through, though. Put the hand in line with the wrist. Now, we wire the wrist to the forearm. Each line has a slot. Use the "Entretoise" between the cables and use the "C" ring to stop the bolt from coming out as shown in figures (3.7) and (3.8).

### Step5:

Now that all your fingers are assembled, we ensure that the holes are clear and large enough for the tension cables. and the thumb cover and wrist tiny do the same. We glue them first and then screw them, which works wonderfully. Cut the thumb hinge's corners again. Fish braiding requires hand nerves. pieces of 200LB braided fishing line. We put fishing lines in wrist-large holes. Linings for Wristmalls We make sure they don't twist. Hand-wrist alignment. The wrist and forearm are wired. Lines have slots. "Entretoise" between the cables and "C" ring to stop the bolt.as shown in figure (3.9).



**Fig 3.7 the hand.**

### **3.3.4 MG996R Servo Motor**

The MG996R has a stall torque of 11kg/cm. The motor revolves from 0 to 180 degrees, dependent on the PWM wave given to its signal pin [7], as shown in figure (3.10).



**Fig 3.8 Servo motor.**



wire configuration in accordance with the information shown in table (3-1).

**Table 3.1 wire configuration.**

Wire Number	Wire Colour	Description
1	Brown	The ground wire connected to the ground the of system
2	Red	Powers the motor typically +5V is used
3	Orange	PWM signal is given in through this wire to drive the motor

### **MG996R Servo Motor Features**

- Operating Voltage is +5V typically
- Current: 2.5A (6V)
- Stall Torque: 9.4 kg/cm (at 4.8V)
- Maximum Stall Torque: 11 kg/cm (6V)
- Operating speed is 0.17 s/60°
- Gear Type: Metal
- Rotation: 0°-180°
- Weight of motor: 55gm

### **3.3.5 Arduino sensors**

The Arduino is an open-source electronics platform. Arduino is a programmable circuit board and a piece of software, or IDE (Integrated Development Environment), that runs on your computer [8].

#### **Arduino Types**

- 1-Arduino Mega ADK
- 2-Arduino Uno
- 3- Arduino Due
- 4- Arduino Leonardo
- 5- Arduino micro
- 6- Lily Pad Arduino USB
- 7- Arduino Pro Mini

8- Arduino Fio

9- Arduino Esplora

### 3.3.5.1 Arduino Uno[9]:

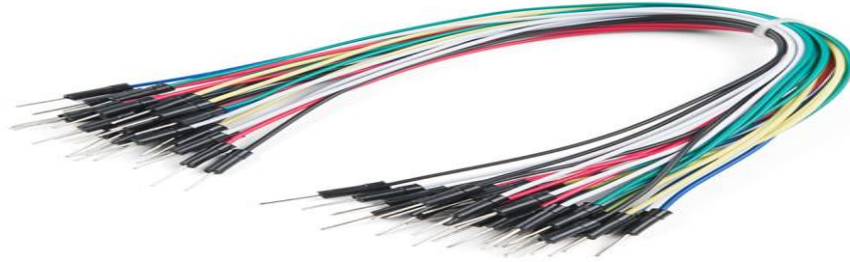
In this project, we use the Arduino Uno, which is an open-source-electronic-prototyping-base for simple hardware and software in the field of micro-controlling. It is made up of:

- **Reset Button:** This will restart any code that is loaded onto the Arduino board.
- **USB port:** The USB port is used to connect the computer to the computer or to provide power to the computer.
- **DC power jack:** By using it, the power supply is connected to an external power supply that acts as a battery when the USB is not being used to run it. Read the information manual for the Arduino panel to find out the proposed voltage and operating modes. For Uno, the panel runs on a 5-volt current, which can be connected to a current of 6–20 volts, but a current of 7–12 volts is best.
- **Power pins:** It contains 5-volt and 3.3-volt power outlets, ground outlets, and a vin port, which may be used to power it and can suck power from the power jack if it is utilized as an energy source.
- **Analog pins:** Uno's pins 6 and 7 are used for the introduction of analogue signals.
- **Digital I / O pins:** Pins that insert or output digital signals Digital signal value is 1 or 0, or high or low or true, falls. Ordainians added a reset button to restart the microcontroller's program and a small LED to indicate operation.
- **Power LED Indicator :** This LED illuminates whenever the board is connected to a power source.



### 3.3.7 Jumper wires

A jumper wire is an electric wire that is used to connect electrical circuits on printed circuit boards that are far apart. By attaching a jumper wire to the circuit, it can be short-circuited and connected to the electric circuit quickly.



**Fig 3.11 Jumper wires**

### 3.3.8 Battery and Holder Box NCR18650B

In this project, an NCR18650B and two batteries are used. NCR18650B battery: 3.6V Lithium-Ion High Capacity Cylindrical Battery, 3.4Ah, Panasonic, NCR18650B. used by a huge number of manufacturers in laptop batteries for a wide range of applications. With a powerful 3400mAh and a maximum continuous discharge current of 4900mA, this is a great power source for high-capacity packs.

Battery holder: two 6-inch, 24-gauge lines with 5 mm of insulation peeled off. Red wire connects to the batteries' positive end and black wire to the negative end, as shown in figure (3.12)

Size: 59 × 32 × 15 mm - Cells: 2 AA.



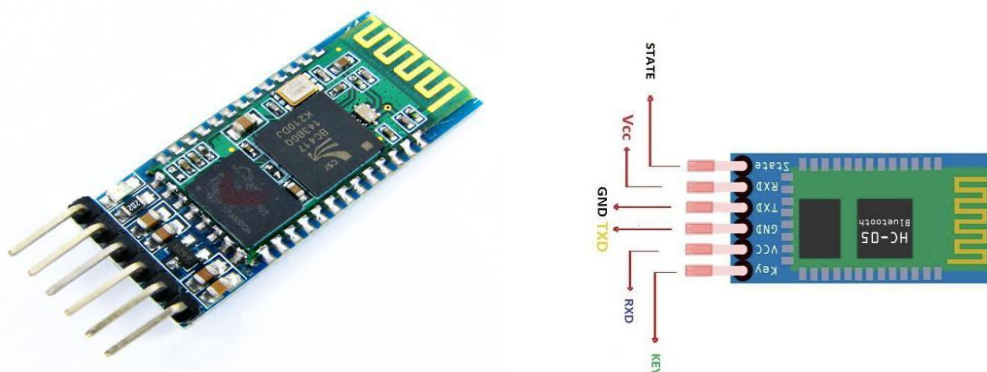
**Fig 3.12 Battery and Holder box.**

### 3.3.9 HC-05 Bluetooth

The HC-05 Bluetooth Module is a Bluetooth SPP (Serial Port Protocol) module designed for transparent wireless serial connection establishment. Serial communication makes it simple to interface with a controller or computer. The HC-05 Bluetooth module has a switch that lets it switch between master mode and slave mode, so it can either receive data or send data [11].

#### **Specification:**

- Model: HC-05
- Input Voltage: DC 5V
- Communication Method: Serial Communication
- Master and slave mode can be switched



**Figure 3.13 HC-05 Bluetooth**

**Table 3.2 HC-05**

<b>pin</b>	<b>Description</b>	<b>Function</b>
VCC	+5V	Connect to +5V
GND	Ground	Connect to Ground
TXD	UART_TXD, Bluetooth serial signal sending PIN	Connect with the MCU's (Microcontroller and <u>etc</u> ) RXD PIN.
RXD	UART_RXD, Bluetooth serial signal receiving PIN	Connect with the MCU's (Microcontroller and <u>etc</u> ) TXD PIN.
KEY	Mode switch input	If it is input low level or connect to the air, the module is at paired or communication mode. If it's input high level, the module will enter to AT mode.

**3.3.10 Huawei P smart mobile:**

It has an Android-8 operating system and an Octa-core CPU. It has 64 GB of storage and 4 GB of random access memory (RAM). It uses Bluetooth 4.2 A2DP. It has a 5.65-inch screen with a resolution of 1080 x 2160 pixels and a 65-dB loudspeaker. Figure (3.14) shows the mobile.



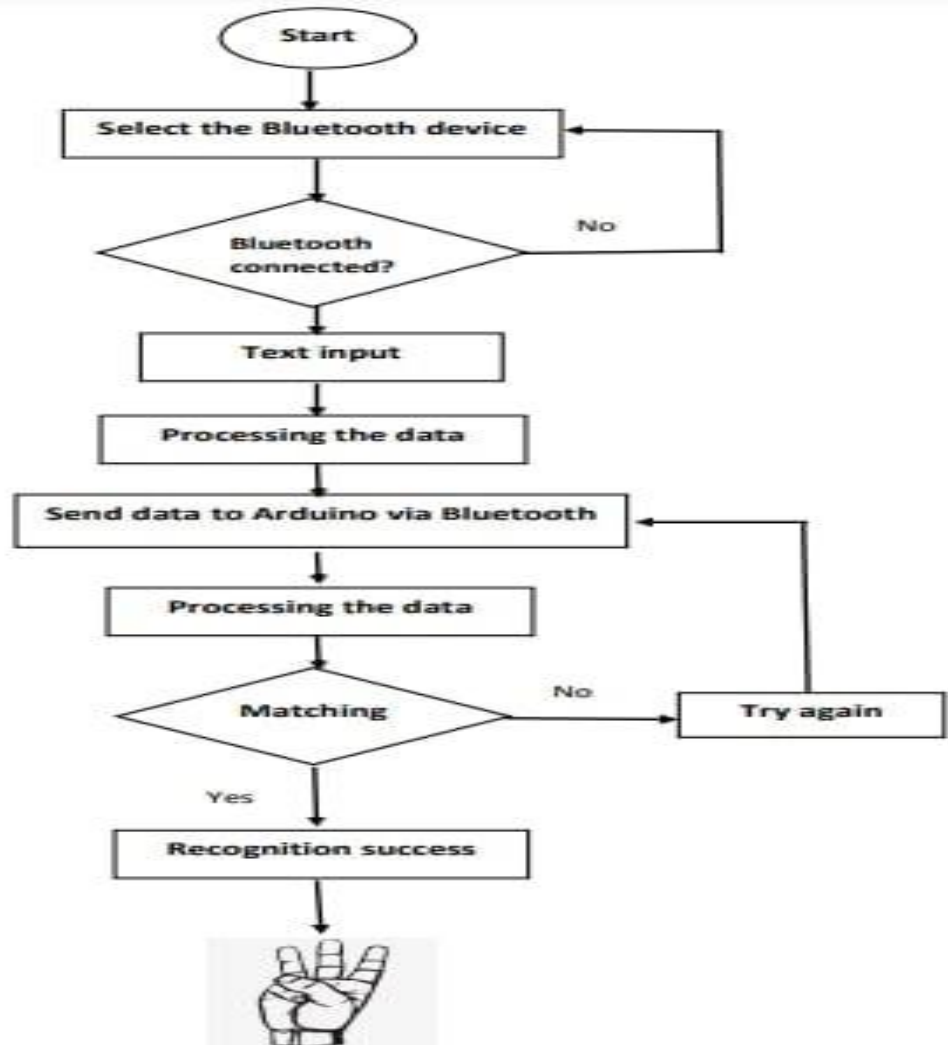
**Fig 3.14 Huawei P smart mobile**

### **3.4 The component of the software**

#### **3.4.1 MIT App Inventor**

MIT Inventor is a drag-and-drop visual programming tool for Android. It advocates a new era of personal mobile computing in which people may design, create, and employ mobile technology solutions for their daily lives in unique settings. It allows developers to focus on application logic rather than syntax, increasing digital literacy for everyone [6].

Our research used MIT Inventor to access Bluetooth, memory, and the phone's screen. Once selecting the Bluetooth device (HC-05) and connecting to it, the application starts after the user enters a word or text and sends it through Bluetooth. [12] Figure (3.15) displays the application process in order.



**Fig 3.15 the software processes in sequence**

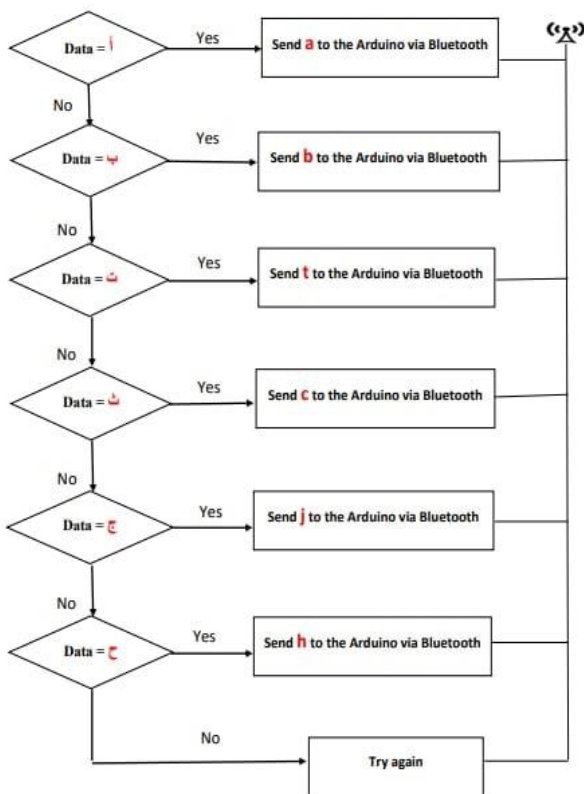
### **3.4.2 Mapping the Arabic letters and the Bluetooth communication**

We utilized the Arduino Uno as a data receiver between the application and the Bluetooth unit. Since the Arduino is not compatible with Arabic letters, we programmed the MIT App Inventor to convert the Arabic letters to the English letters shown in Table (3-3). Moreover, configuring the Arduino appropriately Fig. 3.16a depicts the flowchart of this communication channel. Fig. 3.16 depicts the conversion of characters in the application, followed by the transmission of data to the user's hand through Bluetooth HC-05, while Fig. 3.16. b depicts the conversion of characters in the application. Figure 3.18b depicts the pairing of the (HC-05) module and the Bluetooth mobile device.

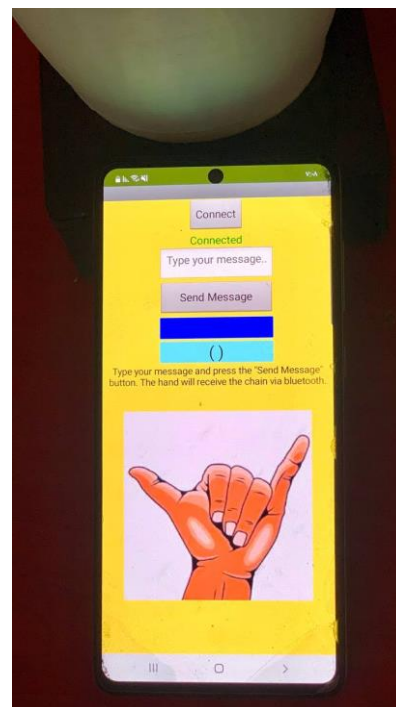


**Table 3.3 Data mapping.**

Letter	Corresponding data
“أ”	a
“ب”	b
“ت”	t
“ث”	c
“ج”	j
“ح”	h



**Fig 3.16 (a) Flowchart of the Bluetooth communication link**



**Fig 3.16(b). Pairing result between the Bluetooth transceiver**

### 3.4.3 Mobile application programming:

The MIT App Inventor was utilized to create the welcome screen, Bluetooth connectivity, and data management and transfer. Figure 3.17.a depicts the first button on the welcome screen, which consists of two buttons. We developed Bluetooth communication using the "ListPicker" and "Connection" components. As depicted in Figure 3.17.b, "ListPicker"

prompts the user to choose a Bluetooth device, and "BluetoothClint1" comes from a file that Connectivity uses to create the connection.

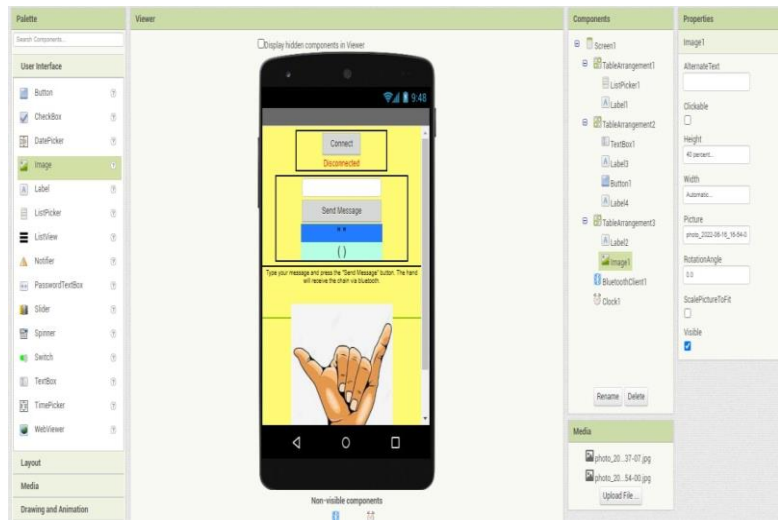
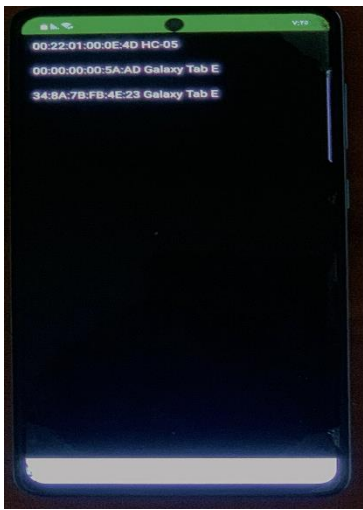


Fig 3.17 (b) we developed Bluetooth

Fig 3.17 (a) The welcoming screen

Figure 3.19. It shows the MIT blocks that list all available Bluetooth devices. If the user chooses one of them, then the connection is made and the word "Connected" appears in green; otherwise, "Offline" is displayed in red; Figure 3.18.

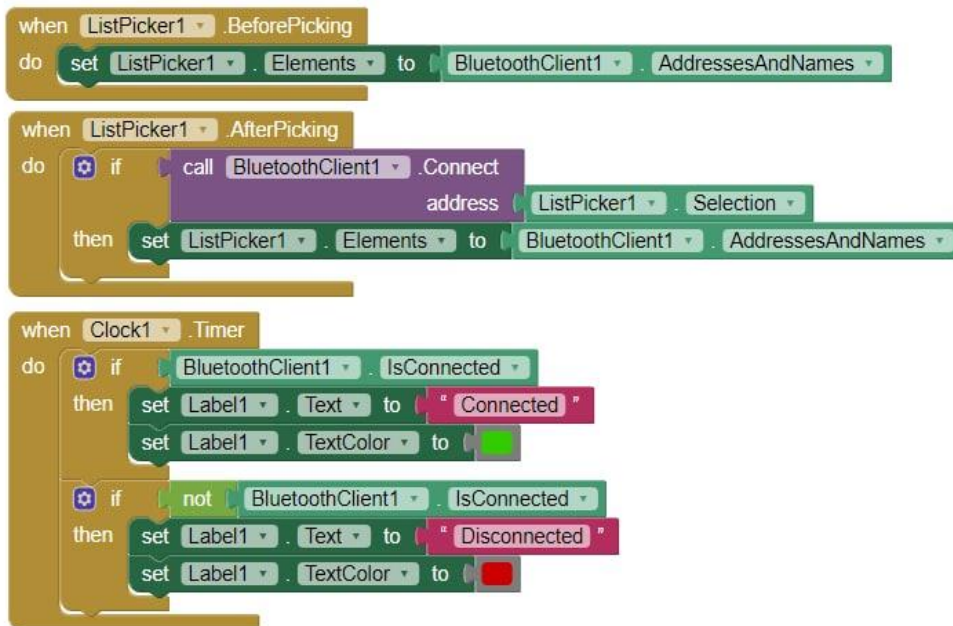


Fig 3.18 displaying all the available devices. User action either to connect or not

The second button, after entering the text, converts the text into an array of Arabic letters as in Figure 3.19.a, then converts it to English letters, for example, the letter “أ” turns into the letter “a”, the letter “ب” turns into the letter “b” and so on all the letters of the entered text as in Figure 3.19.b, then collect the letters of the matrix (English) and send them via Bluetooth as in Figure 3.19 c.

```

when Button1 Click
do
  set global text to TextBox1.Text
  set global iters to split text
  replace all text
  trim
  get global text
  segment
  replacement
  at
  set global length to length of list
  list
  get global iters
  for each i from 1
  to get global length
  by 1
  do
    set global t to select list item list
    get global iters
    index
    get i
  
```

```

for each i from 1
to get global length
by 1
do
  set global t to select list item list
  get global iters
  index
  get i
  if compare texts
  get global t
  =
  'ا'
  then
  replace list item list
  get global iters
  index
  get i
  replacement
  'a'
  else if compare texts
  get global t
  =
  'ب'
  then
  replace list item list
  get global iters
  index
  get i
  replacement
  'b'
  else if compare texts
  get global t
  =
  'ج'
  then
  replace list item list
  get global iters
  index
  get i
  replacement
  'c'
  
```

**Fig 3.19.a** converts the text into an array of Arabic

**Fig 3.19.b** converts it to English

```

set global msg to join items using separator
' '
list
get global iters
call BluetoothClient1.SendText
text
get global msg
  
```

**Fig 3.19.c** send them via Bluetooth

### 3.4.2 Hand software

**The hand consists of the following devices:**

Arduino Uno, HC-05 Bluetooth, servo motor, five servo motors, connecting wires, battery, and holder box. As in figure 3.20, we connected all the parts of the hand together as in figure 3.21.

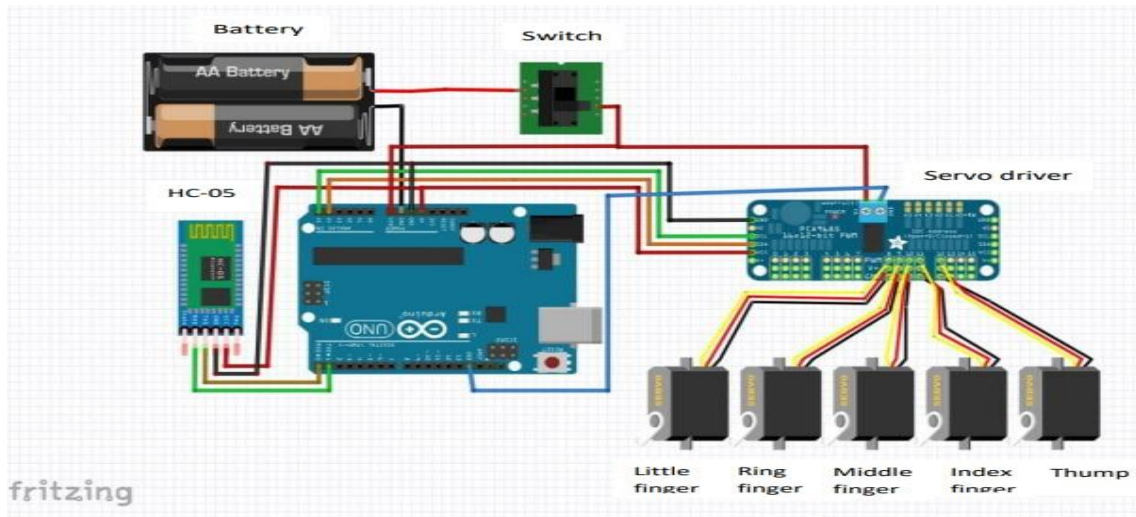


Fig 3.20 System Circuit.



Figure 3.21 Hardware components

### 3.4.3 Hand programming

We used the open-source Arduino software (IDE) to process the received text, recognize it, and break it up into characters. It then recognizes each character, and when it does, it sends a signal to the five servo motors (fingers) to spell out the sign language characters, as shown in Figure (3.22).

```

void loop()
{
    if (mys1.available()) {
        ms = Serial.readString();
        int ln = ms.length();
        Serial.println(ms);
        Serial.println(ln);
        for (int i = 0; i < ln; i++) {
            Serial.println(ms[i]);
            shown(ms[i]);
            delay(1000);
        }
    }
}

void let_fin(int wrist, int thum, int fi, int se, int tho, int fo)
{
    HCPCA9685.Servo(9, fi);
    HCPCA9685.Servo(10, se);
    HCPCA9685.Servo(11, tho);
    HCPCA9685.Servo(12, fo);
    HCPCA9685.Servo(8, thum);
}

void shown(char c)
{
    if (c == 'a') { // |
        let_fin(400, 160, 380, 380, 430, 330);
    }
    else if (c == 'b') { // |
        let_fin(400, 380, 190, 380, 430, 330);
    }
    else if (c == 't') { // |
        let_fin(400, 360, 190, 150, 430, 330);
    }
    else if (c == 'c') { // |
        let_fin(400, 360, 190, 150, 180, 330);
    }
    else if (c == 'j') { // |

```

Fig 3.22 Hand Programming

## **CHAPTER FOUR**

### **CONCLUSIONS & RECOMMENDATIONS**

## **4.1 Conclusion**

Arabic Deaf and dumb people can communicate with the rest of the world by utilizing Arabic sign language. Many Arabs do not know or comprehend Arabic sign language, making it difficult for them to learn about the rest of the world and its cultures.

In this project, the system provides a mechanism enabling deaf and dumb people to communicate via sign language. It is essentially a robotic hand that may be used to teach sign language to deaf and dumb individuals as well as interpret sign language into Arabic. Each of the hand signs has a different meaning. It is written in an easy-to-understand and follows format. The system has been tested, and the overall satisfaction rate is believed to be around 90%, which means that the system is working well.

## **4.2 Recommendations**

Here are some suggestions for future work.

The system can be developed into a multi-platform mobile app that can be installed and run on different mobile operating systems, not just Android mobile apps. It can be improved to be a universal application that contains more than just Arabic and English.

And it can be improved to create a complete robot to translate the language of the deaf and mute.

## **4.3 Appendix**

We represented the Computer Science Department of Al-Mustansiriya University in the National Al-Kafeel Youth Forum for Artificial Intelligence and Robot Applications at Al-Ameed University in Karbala Governorate, and the practical forum included activists.

1. A specialized workshop on the latest developments in the world in the field of robotics, artificial intelligence and the Internet of Things.



2. Designing a scientific competition in which the participants compete to design and program robots and artificial intelligence applications, all to support vocational and university students, who possess the resources and competence that qualify them to participate in the competition and shed light on them in the service of our dear country Iraq in this field.

We enclose the certificates of participation in the forum as shown in Figure 4.1 and Figure 4.2



Fig 4.1 Certificate of participation



Fig 4.2 Certificate of participation



## Reference:

- [1] - Hanafi, A. p. A., & Ali Abd Rab Al-Nabi. (2015). Presentation of the sign language book. *Journal of Special Education and Rehabilitation*, 3(9), 503-505.
- [2] - Abdul Majeed Abdul Majid Muhammad Ali, s. (2018). Take advantage of sign language. *The Scientific Journal of Educational and Quality Studies and Research*, 6(2), 159-183.
- [3] - Abdul Majeed Abdul Majid Muhammad Ali, s. (2018). Take advantage of sign language. *The Scientific Journal of Educational and Quality Studies and Research*, 6(2), 159-183.
- [4] - Salem, N., Alharbi, S., Khezendar, R., & Alshami, H. (2019). Real-time glove and android application for visual and audible Arabic sign language translation. *Procedia Computer Science*, 163, 450-459.
- [5] - Tian, L., Magnenat Thalmann, N., Thalmann, D., & Zheng, J. (2017). The making of a 3D-printed, cable-driven, single-model, lightweight humanoid robotic hand. *Frontiers in Robotics and AI*, 4, 65.
- [6] - Tian, L., Magnenat Thalmann, N., Thalmann, D., & Zheng, J. (2017). The making of a 3D-printed, cable-driven, single-model, lightweight humanoid robotic hand. *Frontiers in Robotics and AI*, 4, 65.
- [7] - Eridani, D., Wardhani, O., & Widiyanto, E. D. (2017, October). Designing and implementing the arduino-based nutrition feeding automation system of a prototype scaled nutrient film technique (NFT) hydroponics using total dissolved solids (TDS) sensor. In *2017 4th International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE)* (pp. 170-175). IEEE.
- [8] - Badamasi, Y. A. (2014, September). The working principle of an Arduino. In *2014 11th international conference on electronics, computer and computation (ICECCO)* (pp. 1-4). IEEE.
- [9] - Samsugi, S., Mardiyansyah, Z., & Nurkholis, A. (2020). Sistem Pengontrol Irigasi Otomatis Menggunakan Mikrokontroler Arduino UNO. *Jurnal Teknologi Dan Sistem Tertanam*, 1(1), 17-22.
- [10] - Triwiyanto, T., Yulianto, E., Luthfiah, S., Musvika, S. D., Miftahul Maghfiroh, A., Mak'ruf, M. R., ... & Ichwan, S. B. (2022). Hand Exoskeleton Development Based on Voice Recognition Using Embedded Machine Learning on Raspberry Pi. In *Journal of Biomimetics, Biomaterials and Biomedical Engineering* (Vol. 55, pp. 81-92). Trans Tech Publications Ltd.
- [11] - Puri, V., & Nayyar, A. (2016, March). Real time smart home automation based on PIC microcontroller, Bluetooth and Android technology. In *2016 3rd International*

Conference on Computing for Sustainable Global Development (INDIACom) (pp. 1478-1484). IEEE.

[12] - Pokress, S. C., & Veiga, J. J. D. (2013). MIT App Inventor: Enabling personal mobile computing. arXiv preprint arXiv:1310.2830.

[13] - Tsarouchi, P., Athanasatos, A., Makris, S., Chatzigeorgiou, X., & Chryssolouris, G. (2016). High level robot programming using body and hand gestures. *Procedia Cirp*, 55, 1-5.

## الخلاصة

مع تقدم الدولة حضاريا وتقنيا ، اصبح من الضروري دمج ذوي الاحتياجات الخاصة من الصم أو ضعاف السمع في المجتمع عن طريق وسائل التخاطب باستخدام لغة الإشارة للتعبير عن أنفسهم والاندماج مع المجتمع بدلا من ان يشكوا عبئا اقتصاديا على الدولة ومن ضمن هؤلاء الكثير في عالمنا العربي لا يفهمون لغة الإشارة العربية ، ونتيجة لذلك ، لا تتاح لهذه المجموعة فرصة التعرف على بقية العالم وحضارته.

في هذا المشروع، تم تطوير طريقه جديدة للصم والبكم للتواصل باستخدام لغة الإشارة للحروف العربية وهي عباره كف آلية يمكن استخدامها لتعليم لغة الإشارة للأشخاص الصم أو البكم ، وكذلك ترجمة لغة الإشارة إلى اللغة العربية ترتبط بتطبيق موبايل تم تصميمه للتواصل مع الكف الصناعية كل علامة من علامات اليد لها معنى مميز. لقد تم وضعه بطريقة تجعل من السهل فهمه ومتابعته.

تم تطوير برنامج التطبيق باستخدام (C ++ IDE Arduino و MIT App Inventor

## إقرار المشرف

اوكد بأن هذا المشروع الموسوم:

تطبيق لتحويل النص الى تهجئة حروف لغة الإشارة ( للصم والبكم )

الذي تم اعداده من قبل الطالبين:

منتظر احمد جبار

مصطفى محمد غالي

والمقدم الى قسم علوم الحاسوب - كلية العلوم - الجامعة المستنصرية كجزء من متطلبات نيل شهادة البكالوريوس في علوم الحاسوب - تخصص قد تم تحت اشرافي وتوجيهاتي.

التوقيع:

( المشرف )

الاسم:

المرتبة العلمية:

التاريخ:



جمهورية العراق  
وزارة التعليم العالي والبحث العلمي  
الجامعة المستنصرية  
كلية العلوم – قسم علوم الحاسوب

عنوان المشروع  
تطبيق لتحويل النص الى تهجئة حروف لغة الإشارة ( للصم والبكم )  
مشروع تخرج مقدم الى كلية العلوم / قسم علوم الحاسوب كجزء من متطلبات نيل  
شهادة البكالوريوس في علوم الحاسوب – علوم الحاسوب

من قبل

منتظر احمد جبار

مصطفى محمد غالي

بأشراف

المدرس ياسمين مكي محي الدين

بغداد، العراق

العام الدراسي ( 2021-2022 )