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# ACKNOWLWDGEMENT

First and foremost, we offer our sincerest gratitude towards the **Department of Electronics Communication, and Information Engineering, Kathmandu Engineering College, Kalimati** and **Institute of Engineering (IOE)** for providing us the wonderful opportunity to undertake this project. We would also like to show our gratitude to our Head of Department of Electronics and Communication, **Er. Rajan Lama** for providing us this opportunity to showcase our major project. We extend our gratitude to our Major Project Coordinator, **Er. Dipen Manandhar** for his support and helping us to tackle different problems faced in this project.

We would also like to send our regards to faculty members, teachers and individuals who helped us with their support and suggestions for the making of this report.

# ABSTRACT

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# Chapter 1: INTRODUCTION

## Background

A human being is a social animal and has the natural ability to see, listen, speak and interact with the external environment. Unfortunately, there are some people who do not have the ability to interact by speaking. The deaf and dumb population is a result of the physical disability of hearing and speaking. In the recent years, there has been a rapid increase in the number of hearing impaired and speech disabled victims due to birth defects, oral diseases and accidents. When a speech impaired person speaks to a normal person, the normal person finds it difficult to understand and asks the deaf-dumb person to show gestures for his/her needs. Dumb persons have their own language to communicate with us; the only thing is we need a translator in between.

Sign language is used by deaf and mute people and it is a communication skill that uses gestures instead of sound to convey meaning simultaneously combining hand shapes, orientation and movement of the hands, arms or body and facial expressions to express fluidly a speaker’s thoughts. But most of the time normal people find it difficult to understand this sign language. This presents a major roadblock for people in the deaf and dumb communities when they try to engage in interaction with others, especially in their educational, social and professional environments. Therefore, it is necessary to have an advance gesture recognition or sign language detection system to bridge this communication gap.

The people who cannot speak or have lost their ability to speak in some accident, it becomes difficult for them to convey their message within the society. To overcome this, a project called ‘SMART GLOVE’ has been designed. Giving a voice to the voiceless has been a cause that many have championed throughout history, but it’s safe to say that none of those efforts involved packing a bunch of sensors into a glove. The main objective of this project is to help deaf and dumb people by removing communication barrier so they are not restricted in a small social circle and are able to convey their feelings and emotions whenever they want.

Smart glove is based on the wearable technology. It is basically a device which has some specific wearable sensors with phenomenal temperature stability. All the sensors are fitted on a glove which measures the different analog parameters associated with the movement of fingers and orientation of the hand during any particular gesture. These sensors read those particular analog values and coding is done in the microcontroller according to these values to recognize the corresponding sign language. The goal of this project is to develop a portable communication system having multiple sensors for Sign Language Recognition and to translate these gestures into text and sound.

## 1.2 Problem Statement

Deaf and normal person communication is as same as two different persons from different countries using two different languages for communication without any common language which leads to problem in communication. Sign language is the only communication tool used by deaf people to communicate to each other. However, normal people do not understand sign language and this creates a large communication barrier between deaf people and normal people. In addition, the sign language is also not easy to learn due to its natural differences in sentence structure and grammar. Therefore, there is a need to develop a system which can help in translating the sign language into text and voice in order to ensure the effective communication can easily take place in the community.

## 1.3 Objective

The objectives of the project are

To build a glove embedded with sensors to read the sign language and convert it into text and speech.

Help to deaf and dumb people to communicate with normal people especially during emergency situation.

## 1.4 Scope or Application

The scope or application of the project are

For all deaf and dumb people

Institution for deaf and dumb people

## 1.5 Organization of report

# Chapter 2: Literature Review

Enable Talk is a student project, whose main idea is to translate sign language into speech. The project was presented at the Microsoft Imagine Cup competition in 2012 at Sydney, Australia and won the first prize for software design competition [1]. The team was from country Ukraine with city Donetsk and school Computer Academy Step. The concept of the project consisted of two sensor embedded gloves and a mobile device, which entailed the recognition process.

Glove- based system is composed of an array of sensor, electronics for data acquisition or processing, power supply & a support for sensors that can be worn on user’s hand [2]. LED glove, data glove, Sayre glove, cyber glove are the different type of glove used here. Glove based system helps user for selecting a particular glove for particular application.

Glove Talk II is a system which translates hand gestures to speech, which is based on the gesture to format model developed by Sidney Fels and Geoffrey Hinton, Department of Computer Science of University of Toronto [3]. Neural networks were used to implement an adaptive interface, called Glove Talk II, which contains hand gestures to control the parameters of a parallel format speech synthesizer to allow a user to speak with his hands. It is used to implement an artificial vocal tract. Glove-Talk-II is a system which translates hand gestures to speech through an adaptive interface. Hand gestures are mapped continuously to 10 control parameters of a parallel format speech synthesizer. The mapping allows the hand to act as an artificial vocal tract that produces speech in real time. This gives an unlimited vocabulary, multiple languages in addition to direct control of fundamental frequency and volume. Currently, the best version of Glove-Talk II uses several input devices (including a Cyberglove, a Contact glove, a polhemus sensor, and a foot-pedal), a parallel formant speech synthesizer and 3 neural networks [4]. The gesture to speech task is divided into vowel and consonant production by using a gating network to weight the outputs of a vowel and a consonant neural network. The gating network and the consonant network are trained with examples from the user. The vowel network implements a fixed, user-defined relationship between hand-position and vowel sound and does not require any training examples from the user. Volume, fundamental frequency and stop consonants are produced with a fixed mapping from input devices.

Bend sensor modeling us used for motion recognition. The model is used to track human joint movement and it recovers the original signal waveforms, which shows the joint rotation for the fastest human speed. Bend sensor modeling is demonstrated that bend sensor can be applied for human posture recognition.

Harneet Kaur, et al. in their paper, presented a brief description about the past attemps that were made to convert sing language to understandable form. In their paper, they have thoroughly scrutinized the previous attempts over this technology and also suggested various possible ways to implement the design of a simple smart glove [5].

Speak jet is sound synthesizer which is used to convert text data into voice [6]. It uses mathematical Sound Architecture technique to control five channel sound synthesizer to generate a speech signal. It is having 72 speech elements, 43 sound effects and 12 DTMF touch tones by using MSA component and also pitch, rate, bend and volume parameter user can generate various sound effects. They tried to develop Electronic Speaking Glove, designed to facilitate an easy communication through synthesized speech for the benefit of speechless patients. Generally, a speechless person communicates through sing language which is not understood by the majority of people. The proposed system is designed to solve this problem. Gesture sof fingers of a user of this glove will be converted into synthesized speech to convey and audible message to others. For example in a critical communication with doctors. The glove is internally equipped with multiple flex sensors that are made up of “bend-sensitive resistance elements”. For each specific gesture internal flex sensors produce a proportional change in resistance of various elements. The processing of this information sends a unique set of signals to the PIC microcontroller and speaks jet IC which is pre-programmed to speak desired sentences.

In a P5 Glove from Essential reality was used. It is an inexpensive (~50 Euro) glove with integrated 6 DOF tracking designed as a game controller [7]. 6 DOF means six degrees of freedom, in fact the ability to move forward/backward, up/down, left/right (translation in three perpendicular axes) combined with rotation about three perpendicular axes (pitch, yaw, roll). The glove consists of five bend sensors to track the flexion of the wearer’s fingers. An infrared-based optical tracking system is used to compute the glove position and orientation without the need for additional hardware. The glove is connected with a cable to the base station.

Tushar Chouhan et al. implemented wired interactive glove, interfaced with a computer running MATLAB or Octave, with a high degree of accuracy for gesture recognition. The glove maps the orientation of the hands and fingers with the help of bend sensors, Hall Effect sensors and an accelerometer. The data is then transmitted to a computer using automatic repeat request (ARQ) as an error controlling scheme. The system is modelled for the differently abled section of the society to help convert sign language to a more human understandable form such as textual messages. The hardware section of their proposed design has its constituent electronic components as bend sensor, hall-effect sensor, accelerometer and Machine Learning Algorithms used for Gesture Recognition. The bend sensors outputs are fed to the analog multiplexer (HEF4051B by NXP Semiconductors). The output of this multiplexer is given to a current to voltage converter circuit. Since the voltage output of the Hall sensor is low, an amplifier is needed. Sensor outputs obtained are givent to the inbuilt ADC (analog to digital converter) of MSP430G25553(by Texas Instruments) for sampling the values given by the sensors, which is also used for interfacing the glove with a computer running the machine learning algorithms. The data acquisition process starts with the processor sending control signals to multiplexer for receiving values from the different sensors sequentially and temporarily storing it in an array. These stored values from the different sensors sequentially and temporarily storing it in an array.

# CHAPTER 4:METHODOLOGY

## 4.1 Hardware assembling

Six flex sensors is required. They are to be attached to thumb, index, middle, ring and pinky fingers respectively to measure the bend of the fingers. The final flex sensor is to be attached to the palm to measure the clench of hand. The MPU6050 connected with accelerometer and gyroscope is to be attached on the back of the hand. This determines the position and movement of the hand on the space. Flex sensors and MPU6050 is to be interfaced with Arduino Mega 2560.

All flex sensors is to be powered with 5V source voltage. Flex sensors with resistor is to be provided as input to the analog pins of the Arduino.

MPU6050 and Arduino Mega 2560 is to be interfaced with each other. I2C protocol is required which connects the SDA and SCL pin of the MPU6050 to pin 20 and 21 of Arduino Mega.

Arduino Mega is to be programmed to send data from flex sensors (estimated 6 data from 6 flex sensors), 3 accelerometer data and 3 gyroscope data. So, on a single period 12 data is to be collected. This data is to be received in the laptop and processable by python programming language.

## 4.2 Dataset Preparation

### 4.21 Dataset Collection

The dataset for training the machine is to be collected manually as this dataset couldn’t be found online. Search for dataset is ongoing but it is hard to say if the data acquired will be applicable as the hardware configurations might be completely different. It is preferable to collect data from the received hardware with the realistic parameters.

### 4.22 Data Preprocessing

The collected data is to be cleanly arranged in excel spreadsheet which will generate the csv file. This data also needs to be shuffled, randomized to generate more dataset. The risk of overfitting is expected in the training model in this process.

### 4.23 Dataset Description

The data is then categorized as to what it indicates and what output it should generate. This is a must required process for supervised learning models like Random Forest Classifier.

## 4.3 System Block Diagram

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Working process block diagram:

System connection block diagram:

## 4.4 Explanation of Block Diagram

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## 4.5 Algorithm

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## 4.6 Flowchart

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# Chapter 5: Expected Cost Estimation

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# Chapter 6: Expected Output

Following is a table that shows our expected output.

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# Chapter 7: Gantt Chart

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