



**SMART AID FOR HEARING
IMPAIRED – MUTE PEOPLE**



A PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

This project gives a detailed description about the smart aid for hearing impaired-mute people implemented using Raspberry pi. Generally dumb people use sign language for communication but they find difficulty in communicating with others who don't understand sign language. This project aims to lower this barrier in communication. The goal of our project is to design and develop an assistive technology module that is able to recognize single handed gestures and convert into text and voice message which facilitates the communication between hearing impaired-mute people and normal people as well as with blind people. A gesture in a sign language is a particular movement of the hands with a specific shape made out of them. The signs are captured by using web camera. Captured image is then recognized by thresholding technique using Raspberry pi. Finally, recognized sign is spelled out through speaker and displayed in LCD module. This system provides an opportunity for a deaf-dumb people to communicate with normal people without the need of an interpreter.

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LIST OF ABBREVIATIONS

LCD – LIQUID CRYSTAL DISPLAY

RGB – RED, GREEN, BLUE

JPEG – JOINT PHOTOGRAPHIC EXPORTS GROUP

ARM – ADVANCED RISK MACHINE

CHAPTER-1

INTRODUCTION

“SMART AID FOR HEARING IMPAIRED MUTE PEOPLE”. The main objective of our project is to design and develop an assistive technology module that is able to recognize single handed gestures and convert into text and voice message which facilitates the communication between hearing impaired-mute people and normal people as well as with blind people.

In our society we have people with disabilities. The hearing disable and mute people cannot mingle into the social world because of their physical disabilities. Unintentionally, they are treated in an unusual manner by the rest of the society. They cannot be a part of the social events, say students cannot study in schools with normal students, elderly persons cannot work at work places, and much more. Simple activities like going and buying a commodity from the grocery shop is very complicated task for the deaf and dumb person.

The technology is developing day by day but no significant developments are undertaken for the betterment of these people. About 9 billion people in the world are deaf and dumb. Communication between deaf-mute and normal person have always been a challenging task. So, we implement a system which make the communication gap between deaf people and hearing people as less as possible.

Sign language helps deaf and dumb people to communicate with other people. Human hand has remind a popular choice to convey information in situations where other forms like speech cannot be used. Hand gestures which can represent ideas using unique shapes and finger orientation. But not all people understand sign language. This project aims to lower this barrier in communication. It is based on the need of developing an electronic device that can translate sign language into speech in order to make the communication take place between the mute communities with the general public possible.

Nowadays android is appearing as main prime trends in all application. Due to that change our life style in smart way. Gesture recognition has been a research area which received much attention from many research communities such as human computer interaction and image processing. The increase in human-machine interactions in our daily lives has made user interface technology progressively more important. Physical gestures as intuitive expressions will greatly ease the interaction process and enable humans to more naturally command computers or machines.

A gesture may be defined as a movement, usually of hand or face that expresses an idea, sentiment or emotion e.g. rising of eyebrows, shrugging of shoulders are some of the gestures we use in our day to day life. Sign language is a more organized and defined way of communication in which every word or alphabet is assigned some gesture.

The gesture recognition system is an embedded system with less power consumption and efficient image capturing system. Hand gestures are physical movement by using eyes and hand and non-physical movement is facial appearance, head movement, body position etc. Dumb people can express their feeling with different hand shapes and facial expression. Each gesture has meaning allocate to it. Sign language is different in each country.

Sign language has different approaches 1. Kinect sensor 2. Image processing, 3. Data glove 4. Leap motion. In kinetic sensor technique, sensor is used to detect sign language. Image processing use web camera to capture images. In data glove technique, flex sensor, accelerometer and motion tracker is used. Leap motion controller is sensor.

Experimental results has shown that it is an effective method to use Raspberry Pi board to actualize embedded image capturing system. Dynamic gestures which are performed in complex background can be identified by hand gesture recognition system. Raspberry Pi which is a mini computer is an embedded system which is more efficient in controlling a system through gestures. Linux operating system provides many software choices in order to do a specific task which adds additional functionality in choosing Raspberry Pi.

There are numerous interactive application of this small size computer from high quality audio, video playback to playing 3D games etc.

It has inbuilt ARM processor in it. ARM processors can be considered as the brain of Raspberry-pi. They are highly efficient in solving complex algorithm in less fraction of time. That is why they are used in small devices like mobile phones, gaming devices and other digital devices.

Here, a software called open CV is used to train raspberry pi. Open CV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. There are bindings in Python, Java and MATLAB/OCTAVE. Open CV runs on a variety of platforms. Desktop: Windows, Linux, mac OS, FreeBSD, Net BSD, Open BSD; Mobile: Android, iOS, Black Berry 10. The user can get official releases from Source Forge or take the latest sources from GitHub. Open CV uses C Make. Open CV was designed for computational efficiency and with a strong focus on real-time applications.

Python is a general purpose programming language that is able to be used on any modern computer operating system. It may easily be used for processing text, numbers, images, scientific data, or anything else which one might save on a computer. Python is also an interpreted language. This means that it is not converted to computer-readable code before the program is run but at runtime. In days gone by, this type of language was called a scripting language, intimating its use for trivial or banal tasks.

CHAPTER-2

LITERATURE SURVEY

2.1 INTRODUCTION

Human Computer Interaction (HCI) is one of the most outstanding inventions which works to find more effective method to develop the current system. Among them, the system of using a mouse or a keyboard is the most popular. But now a new technology has been arrived for Human Computer Interaction (HCI) which is based on gesture recognition means a move to convey intention or to evoke response. Actually gesture technique is used who can understand it and is being used today to control the computer instead of mouse or keyboard. This paper presents three new interactive methods which will make the system more reliable. It also describes an effective hand based interaction method that needs preprocessing means conversion of the user's hand image from one form to another form for implementation that makes a connection with the next step which leads to hand detection. As many new technologies have been arrived to do our work and among them hand gesture based technology is the latest, so its usage is very limited. This technique is being used in television, computer, and robots without using remote control, joystick to complete the least job. It will also be used in some applications such as holographic technology, gadgets like phone, editing and copying data, creating programs etc.

2.2 METHODOLOGY

The whole systems are based on contour of hand. Contours are the line or surface of which no part is straight or flat connecting all the continuous points throughout the boundary. This process is executed after thresholding.

A simple hand image is taken which is in RGB format captured by a web camera. Some preliminary process need to be performed to generate a binary image which provides information of hand contour. Here binary image is used to determine the contour and convex-hull of contour. The convex-hull of a set of points is the smallest outline of a closed figure encircling the points. It is drawn on all sides of contour of hand as if every contour point is in the limits of convex-hull. It creates a folded paper container around contour of hand. A defect is seen in the hand gesture when convex-hull is drawn on every side of contour of hand which fits sets of contour points of the hand. It uses maximum positions to construct the hull to assemble every contour point inside. Convexity defects give set of values in the vector form. The fingertip position is detected from contour of hand and palm position is determined by the information which is extracted from convex-hull. As computation geometry algorithm performed, so computation cost is low in this system.

2.3 CONCLUSION:

In this system, different effective techniques for man-machine interaction are observed. A few systems for preprocessing of input image are presented. This paper also introduced about fingertip and palm detection in the hand gesture which increases the freedom of usability. These methods are going to use in different applications in future.

2.4 PROPOSED SYSTEM:

Generally dumb people use sign language for communication but they find difficulty in communicating with others who don't understand sign language. It is based on the need of developing an electronic device that can translate sign language into speech in order to make the communication take place between the mute communities with the general public possible. Input is captured through web camera. Captured image is then recognized using thresholding technique. Captured frame is then converted into gray scale. Gray scale image is then blurred to improve the smoothening of an image and then to avoid noise in an image. Thresholding technique is used to segment the particular region of an image which represents the sign. Contours are the line or surface of which no part is straight or flat connecting all the continuous points throughout the boundary. Convex hull and convexity defect is then calculated from convex and defect points. Then, the recognized sign is then converted into text and voice message.

CHAPTER-3

HARDWARE COMPONENTS

3.1 RASPBERRY PI

The Raspberry Pi is a mini sized computer that plugs into a TV and a keyboard, which can be used for many of the things that your average desktop does- spreadsheets, word-processing, games and it also plays high definition-video. Raspberry pi does not contain any hard disk, in which OS and other files are stored in SD card that has been inserted in raspberry pi.

Pi was introduced as an educational gadget to be used for prototyping by hobbyists and for those who want to learn more about programming. It certainly cannot be a substitute for our day to day Linux, Mac or Windows PC.

Pi is based on a Broadcom SOC (System of Chip) with an ARM processor [~700 MHz], a GPU and 256 to 512 MB RAM. They are highly efficient in solving complex algorithm in less fraction of time. That is why they are used in small devices like mobile phones, gaming devices and other digital devices. The boot media is an SD card [which is not included], and the SD card can also be used for persist data. Now that you know that the RAM and processing power are not nearly close to the power house machines you might have at home, these Pi's can be used as a Cheap computer for some basic functions, especially for experiments and education. The Pi comes in three Configurations and we will discuss the specifications of those in the coming sections. The cost of a Pi is around \$35 for a B Model and is available through many online and physical stores.

3.1.1 LAYOUT DIAGRAM

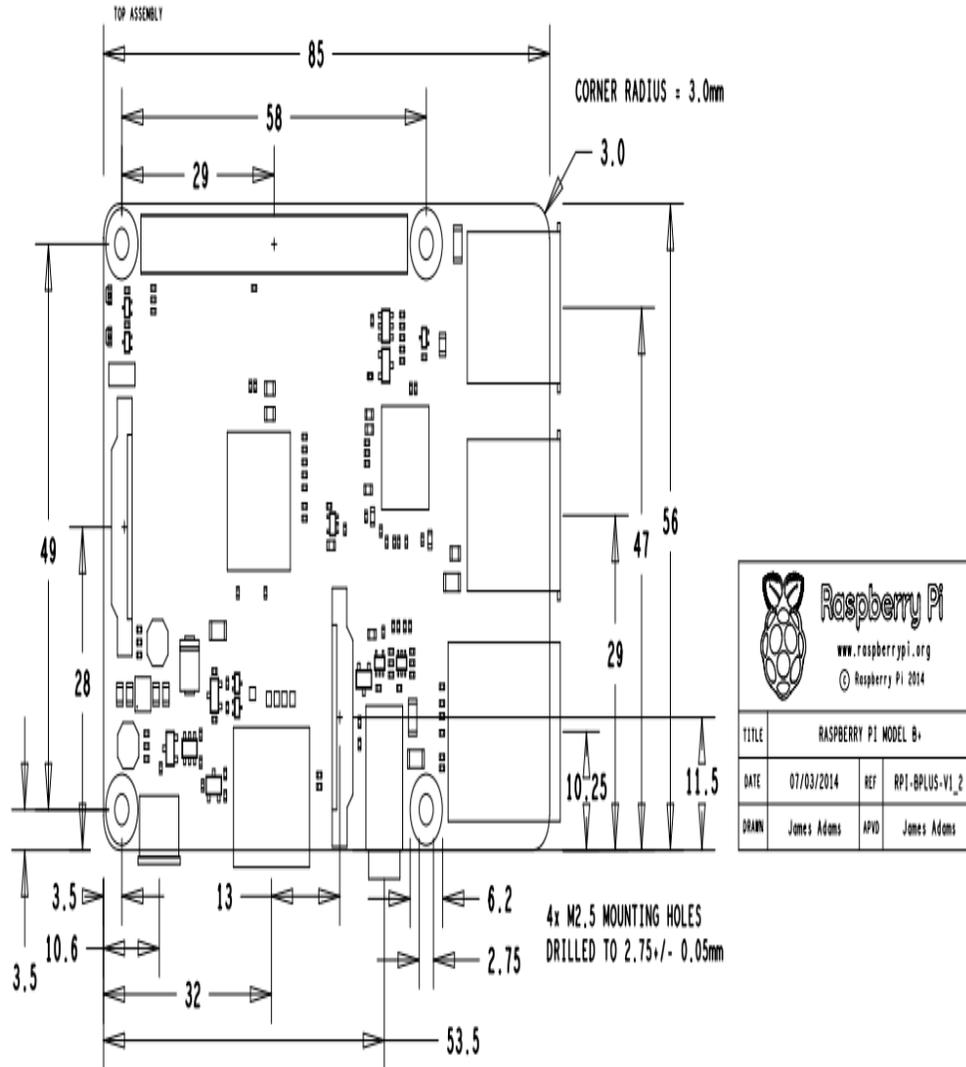


Fig no. 3.1

Layout diagram of Raspberry Pi

3.1.2 SPECIFICATIONS

DESCRIPTION	MODEL B
Chip	Broadcom BCM2835(CPU, GPU, DSP, SDRAM, and single USB port)
Processor	700 MHz ARM1176JZF-S core(ARM11 family, ARMv6 instruction set)
RAM	512 MB
USB	2 on board
Storage	SD Card
Voltage	750mA upto 1.2A @ 5v
GPO	26

Table no. 3.1
Specifications of Raspberry Pi

One other important pin is the GPIO.

GPIO stands for General Purpose Input and Output.

There are 26 pins on a Model B in total.

- ❖ There are three power supply pins (3.3v, 5.0v and 0v).
- ❖ 6 Do not Connect (DNC) pins.
- ❖ 17 GPIO pins.

Raspberry Pi 3 GPIO Header

Pin#	NAME		NAME	Pin#
01	3.3v DC Power		DC Power 5v	02
03	GPIO02 (SDA1 , I ² C)		DC Power 5v	04
05	GPIO03 (SCL1 , I ² C)		Ground	06
07	GPIO04 (GPIO_GCLK)		(TXD0) GPIO14	08
09	Ground		(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)		(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)		Ground	14
15	GPIO22 (GPIO_GEN3)		(GPIO_GEN4) GPIO23	16
17	3.3v DC Power		(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)		Ground	20
21	GPIO09 (SPI_MISO)		(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)		(SPI_CE0_N) GPIO08	24
25	Ground		(SPI_CE1_N) GPIO07	26
27	ID_SD (I ² C ID EEPROM)		(I ² C ID EEPROM) ID_SC	28
29	GPIO05		Ground	30
31	GPIO06		GPIO12	32
33	GPIO13		Ground	34
35	GPIO19		GPIO16	36
37	GPIO26		GPIO20	38
39	Ground		GPIO21	40

Rev. 2
29/02/2016

www.element14.com/RaspberryPi

Fig no.3.2
Raspberry Pi GPIO Header

3.1.3 PORT, PINS AND THEIR USES:

USB	Mainly used for peripherals like keyboard, mouse and a Wi-Fi Adapter. A powered USB hub can be connected and be explained.
HDMI	This is High Definition Multimedia Interface [HDMI] and is use to connect to a display unit like TV or Monitor or sometimes a Projector.
Stereo Audio	Audio connection using a 3.5 mm jack.
SD Card	SD Card is used as a boot device and also persistent storage. More storage can be attached to the USB.
Micro USB	The Micro USB is used for supplying power to the unit.
CSI Connector	CSI [Camera Serial Interface] is used for connecting camera to the unit.
Ethernet	Used for connecting to a network using a network cable.
DSI Connector	DSI [Digital Serial Interface] is used for connecting LCD to the unit.

Table no. 3.2

Ports and Pins of Raspberry Pi

3.1.4 BCM2835 ARM PERIPHERALS

BCM2835 is the Broadcom chip used in the Raspberry Pi model A, B, B+ and the Raspberry Pi Zero.

It contains the following peripherals which may safely be accessed by the ARM:

- Timers
- Interrupt controller
- GPIO
- USB
- PCM / I2S
- DMA controller
- I2C master
- I2C / SPI slave
- SPI0, SPI1, SPI2
- PWM
- UART0, UART1

There are a number of peripherals which are intended to be controlled by the GPU. In addition to the ARM's MMU, BCM2835 includes a second coarse-grained MMU for mapping ARM physical addresses onto system bus addresses.

3.1.5 GENERAL PURPOSE I/O:

There are 54 general-purpose I/O (GPIO) lines split into two banks. All GPIO pins have at least two alternative functions within BCM.

The alternate functions are usually peripheral IO and a single peripheral may appear in each bank to allow flexibility on the choice of IO voltage. The maximum operating frequency of the General Purpose clocks is ~125MHz at 1.2V but this will be reduced if the GPIO pins are heavily loaded or have a capacitive load.

3.1.6 INTERRUPTS:

The ARM has two types of interrupt sources:

- Interrupts coming from the GPU peripherals.
- Interrupts coming from local ARM control peripherals.

The ARM processor gets three types of interrupts:

- Interrupts from ARM specific peripherals.
- Interrupts from GPU peripherals.
- Special events interrupts.

The ARM specific interrupts are:

- One timer.
- One Mailbox.
- Two Doorbells.
- Two GPU halted interrupts.
- Two Address/access error interrupt

The Mailbox and Doorbell registers are not for general usage.

For each interrupt source (ARM or GPU) there is an interrupt enable bit (read/write) and an interrupt pending bit (Read Only). All interrupts generated by the arm control block are level sensitive interrupts. Thus all interrupts remain asserted until disabled or the interrupt source is cleared.

3.2 POWER SUPPLY

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. Every power supply must obtain the energy it supplies to its load, as well as any energy it consumes while performing that task, from an energy source.

All power supplies have a power input, which receives energy from the energy source, and a power output that delivers energy to the load. A DC power supply is one that supplies a constant DC voltage to its load. Depending on its design, a DC power supply may be powered from a DC source or from an AC source such as the power mains.

The Raspberry Pi 3 is powered by a +5.1V micro USB supply. Typically, the model B uses between 700-1000mA depending on what peripherals are connected; the model A can use as little as 500mA with no peripherals attached. The maximum power the Raspberry Pi can use is 1 Amp.

The power requirements of the Raspberry Pi increase as you make use of the various interfaces on the Raspberry Pi. The GPIO pins can draw 50mA safely, distributed across all the pins; an individual GPIO pin can only safely draw 16mA. The HDMI port uses 50mA, the camera module requires 250mA, and keyboards and mice can take as little as 100mA or over 1000mA.

3.3 WEB CAMERA

3.3.1 INTRODUCTION

A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and emailed as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera (which connects using Ethernet or Wi-Fi), a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

The term "webcam" (a clipped compound) may also be used in its original sense of a video camera connected to the Web continuously for an indefinite time, rather than for a particular session, generally supplying a view for anyone who visits its web page over the Internet. Some of them, for example, those used as online traffic cameras, are expensive, rugged professional video cameras.

3.3.2 CHARACTERISTICS

Webcams are known for their low manufacturing cost and their high flexibility, making them the lowest-cost form of video telephony. Despite the low cost, the resolution offered at present (2015) is rather impressive, with low-end webcams offering resolutions of 320×240, medium webcams offering 640×480 resolution, and high-end webcams offering 1280×720 (aka 720p) or even 1920×1080 (aka 1080p) resolution.

They have also become a source of security and privacy issues, as some built-in webcams can be remotely activated by spyware.

3.3.3 TECHNOLOGY

Webcams typically include a lens, an image sensor, support electronics, and may also include a microphone for sound. Various lenses are available, the most common in consumer-grade webcams being a plastic lens that can be screwed in and out to focus the camera. Fixed-focus lenses, which have no provision for adjustment, are also available. As a camera system's depth of field is greater for small image formats and is greater for lenses with a large f-number (small aperture), the systems used in webcams have a sufficiently large depth of field that the use of a fixed-focus lens does not impact image sharpness to a great extent.

Image sensors can be CMOS or CCD, the former being dominant for low-cost cameras, but CCD cameras do not necessarily outperform CMOS-based cameras in the low-price range. Most consumer webcams are capable of providing VGA-resolution video at a frame rate of 30 frames per second. Many newer devices can produce video in multi-megapixel resolutions, and a few can run at high frame rates such as the PlayStation Eye, which can produce 320×240 video at 120 frames per second.

Support electronics read the image from the sensor and transmit it to the host computer. Typically, each frame is transmitted uncompressed in RGB or YUV or compressed as JPEG. Some cameras, such as mobile-phone cameras, use a CMOS sensor with supporting electronics "on die", i.e. the sensor and the support electronics are built on a single silicon chip to save space and manufacturing costs. Most webcams feature built-in microphones to make video calling and videoconferencing more convenient.

3.3.4 WEBCAM C170

The Logitech Webcam C170 is easy to use and supports plug-and-play connectivity with USB 2.0. It features Logitech's Fluid Crystal Technology and the VGA sensor supports video clear video calling at 640 x 480 resolution. You can use the C170 to capture video at 1024 x 768 resolution. Plus, it captures up to 5-megapixel photos with a little help from the Logitech software. There's a built-in microphone with noise reduction, so you can clearly hear who you are talking with. And, the webcam includes a universal clip that can attach to your laptop or desktop monitor.

3.3.5 TECHNICAL SPECIFICATIONS

- Video calling (640 x 480 pixels) with recommended system
- Video capture: up to 1024 x 768 pixels
- Logitech Fluid Crystal™ Technology*
- Photos: up to 5 megapixels (software enhanced)
- Built-in mic with noise reduction
- Hi-Speed USB 2.0 c
- Universal clip fits laptops, LCD or CRT monitors

3.3.6 SYSTEM REQUIREMENTS

- 1 GHz (1.6 GHz recommended)
- 512 MB RAM or more
- 200 MB hard drive space
- Internet connection
- USB 1.1 port (2.0 recommended)

3.3.7 USES

- Healthcare
- Video monitoring
- Commerce
- Video calling and Video conferencing
- Video security
- Video clips and stills
- Input controlled devices
- Astro photography

3.4LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc.

The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

3.4.2 BLOCK DIAGRAM

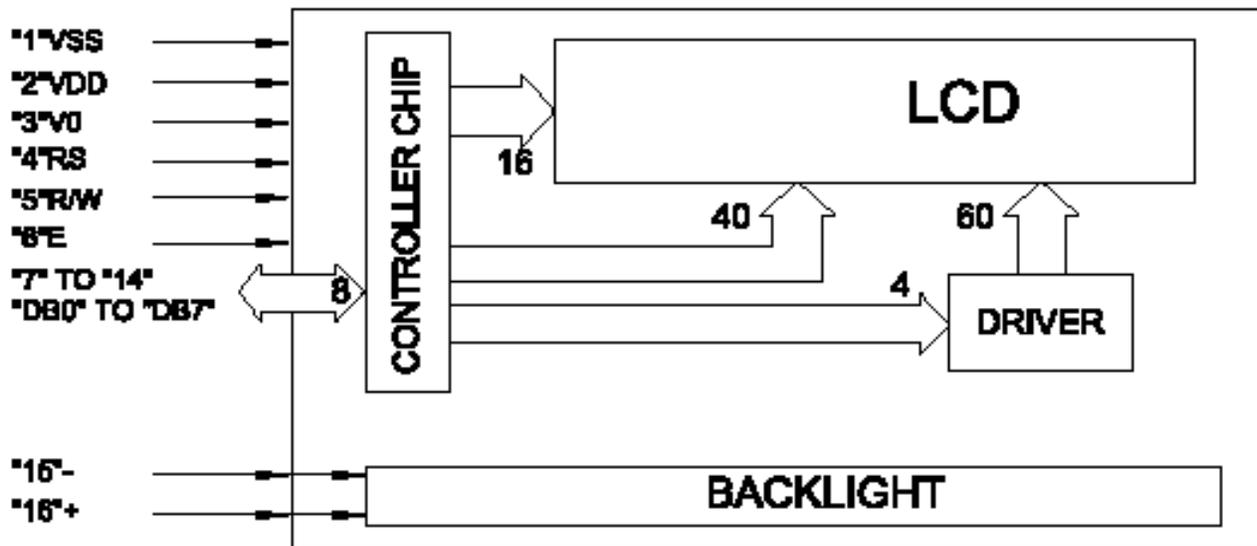


Fig no.3.3

Block diagram of LCD

3.4.1 FEATURES

- Display Mode: STN, BLUB
- Display Format: 16 Character x 2 Line
- Viewing Direction: 6 O' Clock
- Input Data: 4-Bits or 8-Bits interface available
- Display Font: 5 x 8 Dots

- Power Supply: Single Power Supply ($5V \pm 10\%$)
- Driving Scheme: 1/16Duty,1/5Bias
- BACKLIGHT (SIDE) : LED (WHITE)

3.4.3 PIN DESCRIPTION

PINNO	FUNCTION	NAME
1	Ground(0V)	Ground
2	Supply voltage; 5V(4.7V-5.3V)	V_{CC}
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/Write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Table no.3.3
Pin description of LCD

3.5 SPEAKER

A loudspeaker (loudspeaker or speaker) is an electroacoustic transducer; which converts an electrical audio signal into corresponding sound. The most widely used type of speaker is the dynamic speaker.

The dynamic speaker operates on the same basic principle as a dynamic microphone, but in reverse, to produce sound from an electrical signal. When an alternating current electrical audio signal is applied to its voice coil, a coil of wire suspended in a circular gap between the poles of a permanent magnet, the coil is forced to move rapidly back and forth due to Faraday's law of induction, which causes a diaphragm (usually conically shaped) attached to the coil to move back and forth, pushing on the air to create sound waves. The sound source (e.g., a sound recording or a microphone) must be amplified or strengthened with an audio power amplifier before the signal is sent to the speaker.

The term "loudspeaker" may refer to individual transducers (known as "drivers") or to complete speaker systems consisting of an enclosure including one or more drivers.

To adequately reproduce a wide range of frequencies with even coverage, most loudspeaker systems employ more than one driver, particularly for higher sound pressure level or maximum accuracy. Individual drivers are used to reproduce different frequency ranges.

The drivers are named

- Subwoofers (for very low frequencies)
- Woofers (low frequencies)
- Mid-range speakers (middle frequencies)
- Tweeters (high frequencies)
- Supertweeters, optimized for the highest audible frequencies.

The terms for different speaker drivers differ, depending on the application. In two-way systems there is no mid-range driver, so the task of reproducing the mid-range sounds falls upon the woofer and tweeter. Home stereos use the designation "tweeter" for the high frequency driver, while professional concert systems may designate them as "HF" or "highs".

3.5.1 SPECIFICATION

Speaker specifications generally include:

- Speaker or driver type (individual units only) – Full-range, woofer, tweeter, or mid-range.
- Impedance – 9 ohms.
- Number of drivers (complete speaker systems only) – two-way.
- Crossover frequency(ies) (multi-driver systems only) – The nominal frequency boundaries of the division between drivers.
- Power-3W RMS
- 3.5MM JACK Portable Speaker
- Rechargeable battery

3.5.2 FEATURES

- Output Power : 3W x 1(RMS)
- S/N Ratio : 89dB
- Separation Rate : 70dB
- Distortion : 1%
- Frequency Response : 90Hz-19KHz
- Frequency :60 Hz- 20 KHz
- Connectivity : USB 2.0
- Dimension:11x9.1x9.5 cm

CHAPTER-4
BLOCK DIAGRAM

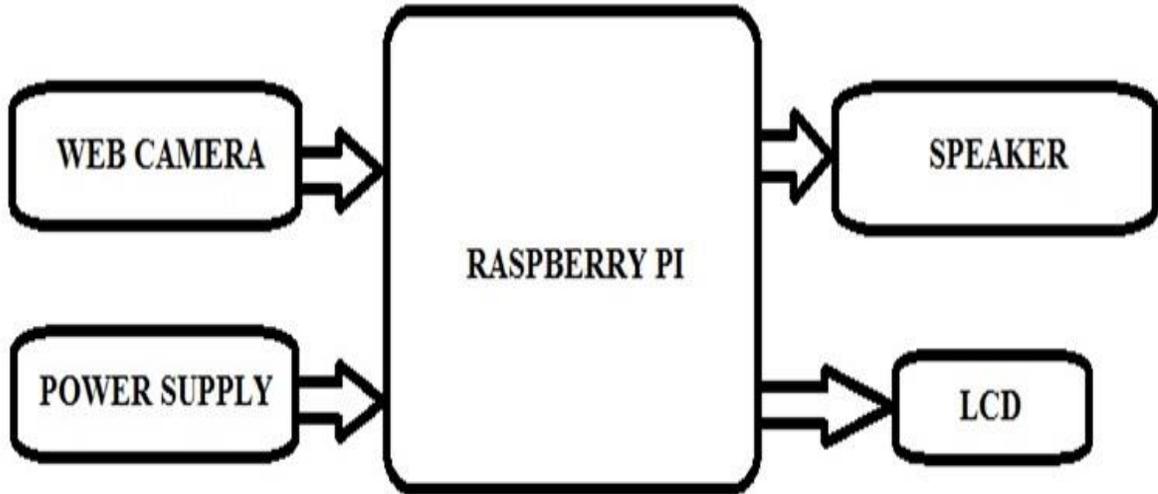


Fig no.4.1
Block diagram

In this Raspberry Pi act as a main module. In this system, image is captured through web camera. Here we recognize the image by threshold values. The system is implemented in offline mode and also in real time mode. Recognized is then converted into text and displayed in LCD. Text is then converted into speech using Raspberry pi module. Finally, audio is heard through speakers or headphones.

(i) WEB CAMERA

Web camera is used to capture the input image. For more clarity and accuracy we are using web camera C170, here resolution of input image is 1024 X 768 pixels. The input image must be a gestures used by deaf and dumb people.

(ii) POWER SUPPLY

We are using a power supply of +5v. For power supply we are using a power bank of capacity 6000mAh.

(iii) RASPBERRY PI

Raspberry pi 3 model B act a heart of our module. It is a mini computer, which contain inbuilt Bluetooth and Wi-Fi connection. Power supply, Speaker, LCD, Web camera are interface with raspberry pi. Received input image are recognized by thresholding technique using raspberry pi. In thresholding technique, captured input image is converted into gray scale image and then to binary image. Binary image is thresholded and using contour technique, the input image is recognized.

(iv) LCD

Liquid Crystal Display (LCD) is used to display the recognized sign in text format. We are using 16 X 2 LCD display. Text is display in the font size of 5 X 7 pixels. LCD helps the deaf people to easily understand the language.

(v) SPEAKER

Recognized sign is heard through speaker which is usefull for blind people to understand the language.

CHAPTER-5

CIRCUIT DIAGRAM

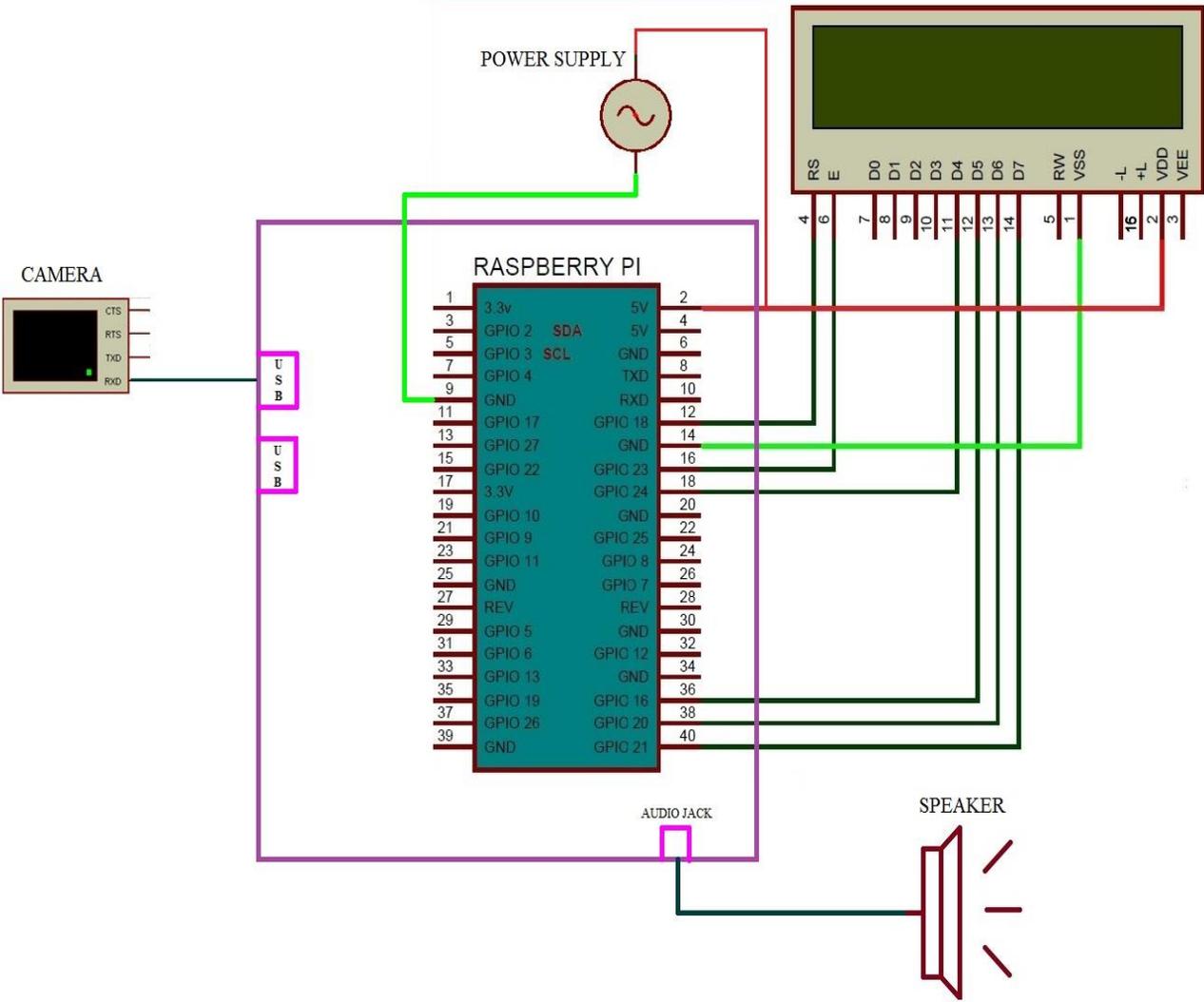


Fig no.5.1
Circuit diagram

The components used are

- Raspberry Pi 3 model B
- Webcam C170
- Power supply
- LCD
- Speaker

Our project mainly concerned with the implementation of the hand gestures recognition technology (using Image processing) using a Raspberry Pi board and a webcam interfaced to it. First of all the OS is installed into the Raspberry Pi board via Micro SD card and appropriate code is written in python language using the open CV libraries and is dumped in the board.

Power supply of 5v is given to the Raspberry pi, where positive pin of power supply is connected to GPIO pin no.2 (5v) of Raspberry Pi and negative pin of power supply is connected to GPIO pin no.9 (gnd) of Raspberry Pi.

Raspberry Pi act as a main device in our module. Raspberry pi 3 model B have inbuilt Bluetooth and Wi-Fi connection and is powered by a Quad Core Broadcom BCM2837 64bit ARMv8 processor. Raspberry Pi supports OS like Linux, Android, Arch Linux ARM, and Unix. The Raspberry Pi consists of USB ports through which external devices are interfaced with the board. Web camera, LCD, Speaker are interfaced with Raspberry Pi.

Ports and Pins of Raspberry Pi

PINS	FUNCTIONS
3, 5, 7, 8, 10, 11, 12, 13, 15, 16, 18, 19, 21, 22, 23, 24, 26, 29, 31, 32, 33, 35, 36, 37, 38, 40.	GPIO
6, 9, 14, 20, 25, 30, 34, 39	Ground
1, 17	3.3v
2, 4	5v

Table no.5.1
Ports and pins of Raspberry Pi

Webcam is interface with Raspberry Pi through one of the USB ports. The webcam will capture the images and send to the board, where the image processing will be done. Input image must be a gesture and Webcam C170 capture image in the resolution of 1024 X 768 pixels. Gestures are a form of nonverbal communication in which bodily actions are used to communicate important messages, either in place of speech or together and in parallel with spoken words. Gestures include movement of the hands, face, or other parts of the body. Each gesture has a unique meaning and it differs from place to place.

LCD is connected to GPIO pins and it is used to display the recognized sign. Raspberry pi recognize the input image through thresholding technique. In thresholding, captured image is converted into gray scale image and then to binary image. Using contour method the input image is recognized and text is displayed in 16 x 2 LCD display. Font size of an LCD is 5 X 7.

RS (ReSet) pin of LCD is connected to GPIO pin no.12 (GPIO pin). E (Enable) pin of LCD is connected to GPIO pin no.16 (GPIO pin). Vdd (5v) of LCD is interface with GPIO pin no.2 (5v). Vss of LCD is connected to GPIO pin no.14 (gnd) of Raspberry pi. D4, D5, D6, D7 pins of LCD is connected to GPIO pin no.18, 36, 38, 40 of Raspberry Pi respectively. Recognized sign is displayed in LCD which is usefull for the deaf people.

The recognized sign is heard through speakers, which helps the blind people to communicate with normal people. Speaker is interface with Raspberry pi through the audio jack port.

CHAPTER-6
FLOW DIAGRAM

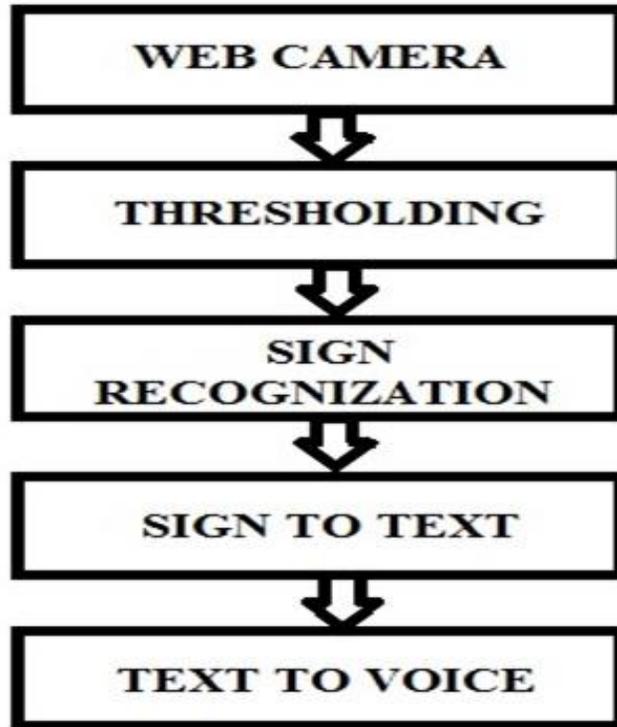


Fig no.6.1

Flow diagram

6.1 WEB CAMERA:

Input image is captured through Web camera. For capturing the image we are using C170 HD web camera, it is easy to use and supports plug-and-play connectivity with USB 2.0.

It features Logitech's Fluid Crystal Technology and the VGA sensor supports video clear video calling at 640 x 480 resolution.. Here, input image is gesture which was used by deaf-mute people. Image is captured frame by frame. Input image is in RGB format. Captured image is in the resolution of 1024 X 768 pixels.

Input images are,

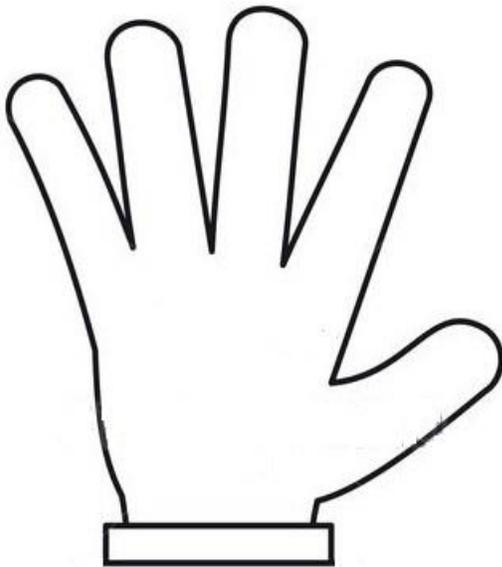


Fig no.6.2

Talk to the hand



Fig no.6.3

Ok, Excellent

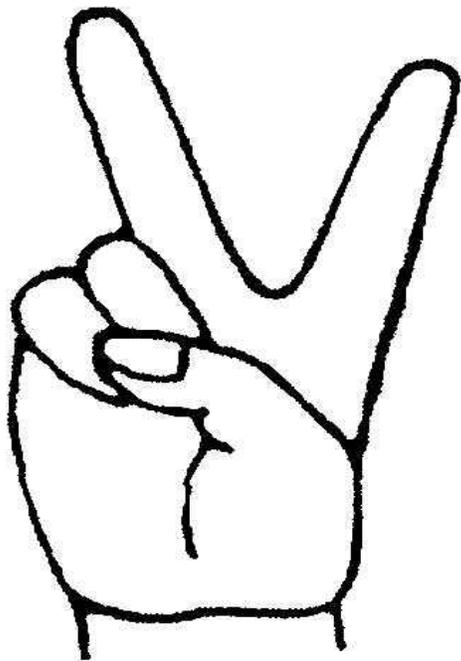


Fig no.6.4
Peace



Fig no.6.5
Shocker



Fig no.6.6
Unity

6.2 THRESHOLDING:

Thresholding is the simplest way to segment images. Although thresholding methods and algorithms are available for colored images, it works best on grayscale images. Thresholding usually (but not always) converts grayscale images into binary images (in a binary image, each pixel can only have one of two possible values: white or black). Thresholding the image is usually the first step in many image processing applications.

The hand is then extracted from the background by using a threshold using the sampled color profile.

Thresholding technique involves following steps,

1. Capture frames and convert to grayscale

The image is captured frame by frame. Our ROI (Region of Interest) is the hand region, so we capture the images of the hand and convert them into grayscale image. We convert an image from RGB to grayscale and then to binary in order to find the ROI i.e. the portion of the image we are further interested for image processing. Conversion of gray scale image into binary is called thresholding technique. Thresholding is used to process the particular region of image that recognize the specified sign.



Fig no.6.7
Gray scale image

2. Blur image

We used Gaussian Blurring on the original image. In image processing, a **Gaussian blur** (also known as **Gaussian smoothing**) is the result of blurring an image by a Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise and reduce detail. The visual effect of this blurring technique is a smooth blur resembling that of viewing the image through a translucent screen.

We blur the image for smoothing and to reduce noise and details from the image. We are not interested in the details of the image but in the shape of the object to track. By blurring, we create smooth transition from one color to another and reduce the edge content.

We use thresholding for image segmentation, to create binary images from grayscale images.



Fig no.6.8
Blur image

3. Thresholding

In very basic terms, thresholding is like a Low Pass Filter by allowing only particular color ranges to be highlighted as white while the other colors are suppressed by showing them as black. We used Otsu's Binarization method. In computer vision and image processing, Otsu's method, is used to automatically perform clustering-based image thresholding, or the reduction of a gray level image to a binary image.

In this method, Open CV automatically calculates/approximates the threshold value of a bimodal image from its image histogram. But for optimal results, we may need a clear background in front of the webcam which sometimes may not be possible.



Fig no.6.9
Threshold image

4. Draw Contour

Contour tracing is one of many preprocessing techniques performed on digital images in order to extract information about their general shape.

Contours is simply as a curve joining all the continuous points (along the boundary), having same color or intensity. The contours are a useful tool for shape analysis and object detection and recognition.

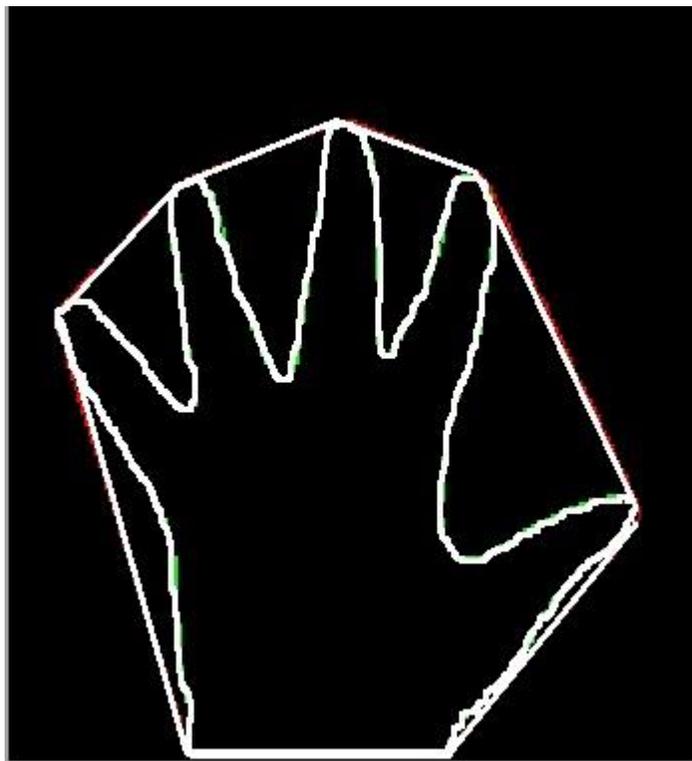


Fig no.6.10
Contour image

In binary valued digital imaging, a pixel can either have a value of 1 -when it's part of the pattern- , or 0 -when it's part of the background- i.e. there is no grayscale level.

5. Convex hull and Convexity defects

We now find the convex points and the defect points. The convex points are generally, the tip of the fingers. But there are other convex point too.

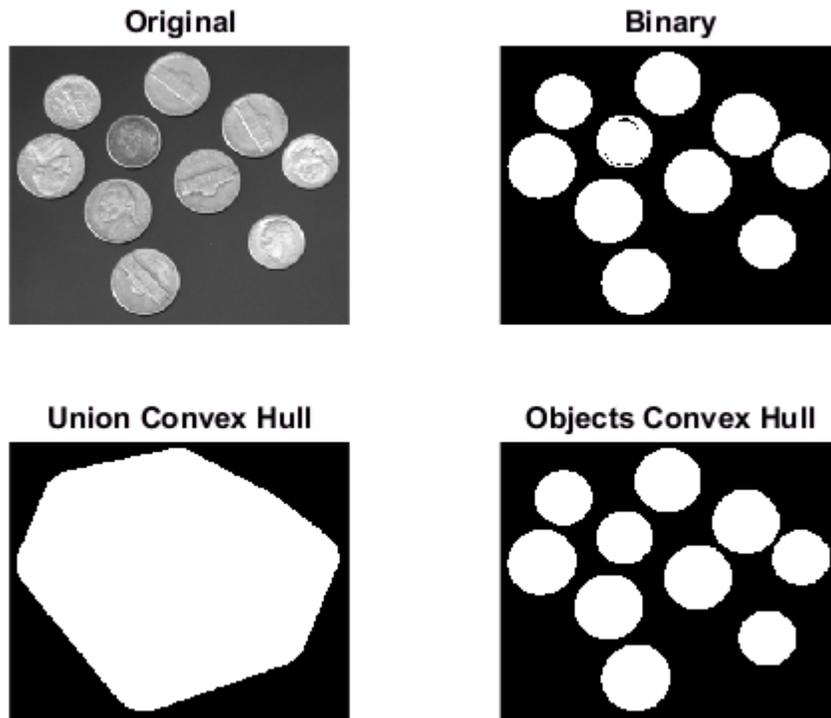


Fig no.6.11

Convex hull and Convexity defects

So, we find convexity defects, which is the deepest point of deviation on the contour. By this we can find the number of fingers extended and then we can perform different functions according to the number of fingers extended.

Convexity defect is a cavity in an object (blob, contour) segmented out from an image. That means an area that do not belong to the object but located inside of its outer boundary -convex hull.

Areas between fingers (all marked with arrows) in this schematics of a hand contour are the convexity defects.

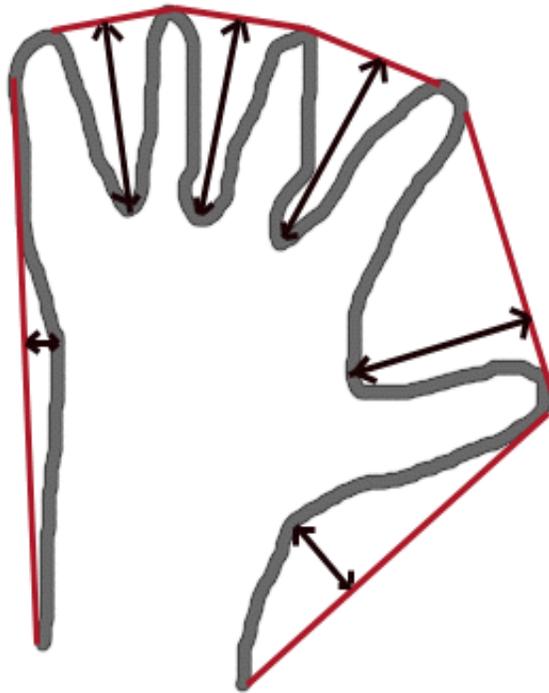


Fig no.6.12

Measuring Contour and Convexity defect points

The convex hull is commonly known as the minimum convex polygon (MCP) in ethology, where it is a classic, though perhaps simplistic, approach in estimating an animal's home range based on points

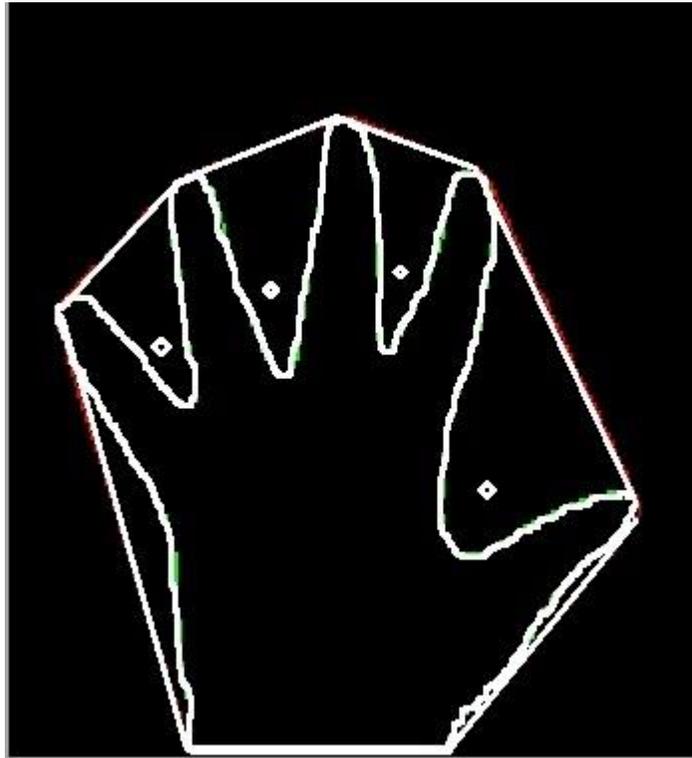


Fig no.6.13

Measured contour and convexity defect

The problem of finding convex hulls finds its practical applications in

- Pattern recognition
- Image processing
- Statistics
- Geographic information system
- Game theory
- Construction of Phase diagrams
- Static code analysis by Abstract interpretation.

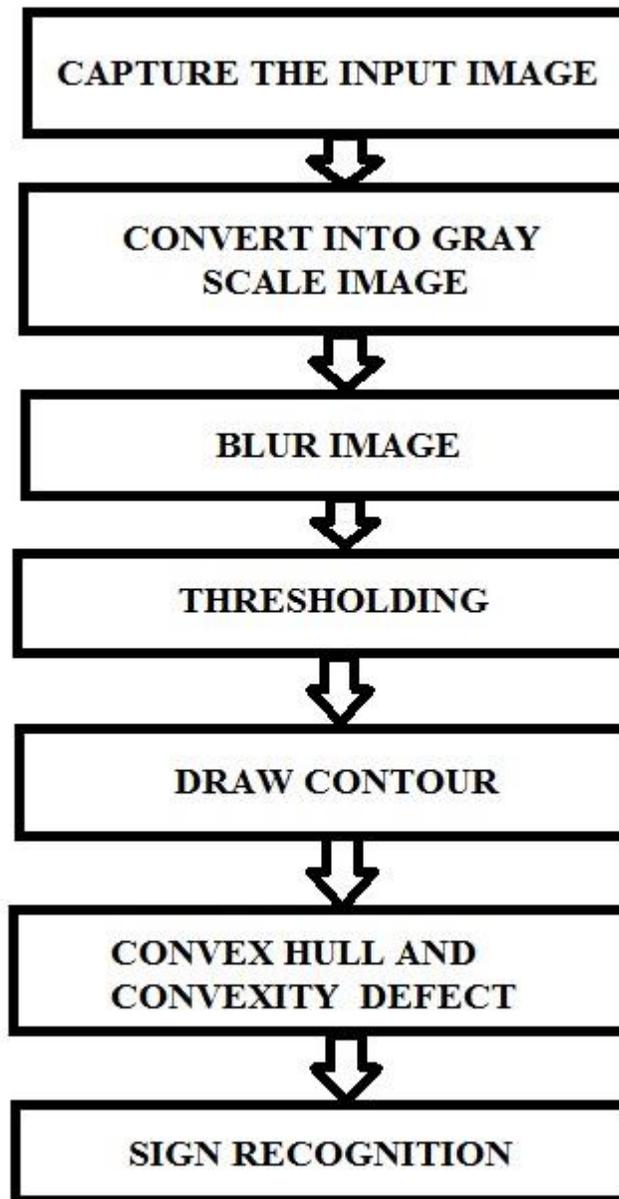


Fig no.6.14

Flow diagram of Thresholding technique

6.3 SIGN RECOGNITION

Gesture recognition is the mathematical interpretation of a human motion by a computing device. A sign language (also signed language) is a language which chiefly uses manual communication to convey meaning, as opposed to acoustically conveyed sound patterns. This can involve simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to express a speaker's thoughts.

Although signing is used primarily by the deaf, it is also used by others, such as people who can hear but cannot physically speak, or have trouble with spoken language due to some other disability (augmentative and alternative communication).

Gestures must be simple, intuitive and universally acceptable. In personal computing, gestures are most often used for input commands. Recognizing gestures as input allows computers to be more accessible for the physically-impaired and makes interaction more natural in a gaming or 3-D virtual reality environment.

Gesture Recognition Features:

- More Accurate
- High Stability
- Time saving to unlock a device

6.4 SIGN TO TEXT CONVERSION

Here, recognized sign is converted into text that has been stored in the coding.

Process of sending data to LCD is explained briefly:

- E is set high (enabling the module) and RS is set low (telling LCD we are giving command)
- Giving value 0x01 to data port as a command to clear screen.
- E is set high (enabling the module) and RS is set high (telling LCD we are giving data)
- Providing the ASCII code for characters need to be displayed.
- E is set low (telling LCD that we are done sending data)
- Once this E pin goes low, the LCD process the received data and shows the corresponding result.

In this way, the recognized sign is displayed in the LCD module as text. Then the corresponding text is converted into voice message that has been heard through speaker which may be useful for blind people to easily communicate with normal people.

6.5 TEXT TO SPEECH CONVERSION

There are number of ways though which the input text can be converted into speech like string matching, frequency matching etc. Initially, the GPIO pins should be initialized in order to use them as input or output. This can be coded in python by importing GPIO module. At first the coding is done for matching the English alphabets with the user defined alphabets and playing the corresponding audio file. Audio files can be database or voice recordings.

Python coding provides one more logic called frequency matching. In this method the frequencies on the basis of repetition of alphabets for each word should be written and then as per the coding logic all the words having matched frequencies

should be called and corresponding audio for that word should be played.

Another method for converting the text into speech can be through the ASCII values of English letters. By using this method the coding length can be decreased. There are many Text to Speech converters are there but their performance depends on the fact that the output voice is how much close to the human natural voice. For example, consider a name pretty, it can be a name of a person as well as it can be defined as beautiful. Thus it depends on how the words are pronounced.

Many text to speech engines do not give the proper pronunciation for such words thus combining some voice recordings can give more accurate results. The TTS system converts an English text into a speech signal with prosodic attributes that improve its naturalness. There are many systems which include prosodic processing and generation of synthesized control Parameters.

The proposed system provides good quality of synthesized speech. The text processing component provides reliable grammatical classification and phonetic transcription. Here, one of the most frequently used methods is Espeak text to speech conversion. Espeak is a more modern speech synthesis package than Festival. It sounds clearer but does wail a little. Its sound is clearly as human sounds.

Steps to convert text to speech:

- Install Espeak.
- Import it into the Linux field (Linux is the platform to run raspberry pi).
- Write the required command to convert text into speech.
- Voice message is heard through speaker.

CHAPTER-7

SOFTWARE IMPLEMENTATION

7.1 INTRODUCTION

Since the Raspberry Pi is powered by a so-called ARM processor it cannot run the same operating system as your computer. Instead it must run one of the operating systems that have been optimized and ported to the Raspberry Pi ARM hardware architecture. There are a few different operating systems available as listed here. It is important to note that most of them are based on the Linux kernel and that it is not possible to run windows on the Raspberry Pi.

Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi. Raspbian uses PIXEL, Pi Improved X windows Environment, Lightweight as its main desktop environment as of the latest update. It is composed of a modified LXDE desktop environment and the Open box stacking window manager with a new theme and few other changes. The distribution is shipped with a free copy of computer algebra program Mathematica. It also includes a version of Minecraft called Minecraft Pi and a Pi-enhanced version of Chromium as of the latest version.

7.2 RASPBIAN JESSIE

The first thing anyone starting the new Jessie image from scratch will notice is that the default behaviour is to boot straight to the desktop GUI, not to the Linux command line.

The Raspbian with PIXEL image contained in the ZIP archive is over 4GB in size, which means that these archives use features which are not supported by older unzip tools on some platforms.

OS installation steps are briefly explained below:

- Download the Raspbian Jessie software into your windows.
- Download Win32 Disk imager to write the OS into the SD card.
- Insert the SD card into the laptop/pc and run the image writer. Once open, browse and select the downloaded Raspbian image file.
- After booting the OS username and password will be asked.
- Then “Setup options” screen will appear.
- Select the first option in the list of the setup options window, that is select the "Expand Filesystem" option and hit the enter key. We do this to make use of all the space present on the SD card as a full partition. All this does is, expand the OS to fit the whole space on the SD card which can then be used as the storage memory for the pi.
- Select the third option in the list of the setup options window, that is select the "Enable Boot To Desktop/Scratch" option and hit the enter key. It will take you to another window called the "choose boot option" window.
- In the "choose boot option window", select the second option, that is, "Desktop Log in as user 'pi' at the graphical desktop" and hit the enter button. Once done you will be taken back to the "Setup Options" page, then select the finish option.

- Update the firmware after automatic reboot of the system.
- Updating the firmware is necessary because certain models of the Pi might not have all the required dependencies to run smoothly or it may have some bug. The latest firmware might have the fix to those bugs, thus it is very important to update it in the beginning itself.

7.2 OPEN CV

Open CV was started at Intel in 1999 by Gary Brad sky and the first release came out in 2000. Vadim Pisarev sky joined Gary Brad sky to manage Intel's Russian software Open CV team. In 2005, Open CV was used on Stanley, the vehicle who won 2005 DARPA Grand Challenge. Later its active development continued under the support of Willow Garage, with Gary Brad sky and Vadim Pisarev sky leading the project. Right now, Open CV supports a lot of algorithms related to Computer Vision and Machine Learning and it is expanding day-by-day.

Currently Open CV supports a wide variety of programming languages like C++, C, Python, Java etc and is available on different platforms including Windows, Linux, OS X, Android, iOS etc. Also, interfaces based on CUDA and OpenCL are also under active development for high-speed GPU operations.

Open CV-Python is the Python API of Open CV. It combines the best qualities of Open CV C++ API and Python language.

7.3 PYTHON:

Python was developed by Guido van Rossum in the late eighties and early nineties at the National Research Institute for Mathematics and Computer Science in the Netherlands. Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language.

Python is derived from many other languages, including ABC, Modula-3, C, C++, Algol-68, Small Talk, and Unix shell and other scripting languages.

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

There are variety of platform in which python can be used:

- Unix (Solaris, Linux, FreeBSD, AIX, HP/UX, SunOS, IRIX, etc.)
- Win 9x/NT/2000
- Macintosh (Intel, PPC, 68K)
- OS/2
- DOS (multiple versions)
- Palm OS
- Nokia mobile phones
- Windows CE
- Acorn/RISC OS

- BeOS
- Amiga
- VMS/OpenVMS
- QNX
- VxWorks
- Psion
- Python has also been ported to the Java and .NET virtual machines

7.4 FEATURES:

- It supports functional and structured programming methods as well as OOP.
- It can be used as a scripting language or can be compiled to byte-code for building large applications.
- It provides very high-level dynamic data types and supports dynamic type checking.
- IT supports automatic garbage collection.
- It can be easily integrated with C, C++, COM, ActiveX, CORBA, and Java.

7.5 CODING

```
import cv2
import numpy as np
import math
import RPi.GPIO as GPIO
```

```

from lcd_raspi import*
from espeak import espeak
GPIO.setwarnings(False)
Cap = cv2.VideoCapture(0)
lcd_init()
time.sleep(0.5)
lcd_string("    GESTURE    ", LCD_LINE_1)
lcd_string("  RECOGNITION  ", LCD_LINE_1)
while(cap.isOpened()):
    ret , img = cap . read()
cv2.rectangle(img,(500,500),(100,100),(0,255,0),0)
crop_img = img[150:400 , 150:400]
grey = cv2.cvtColor(crop_img, cv2.COLOR_BGR2GRAY)
value = (35,35)
blurred = cv2.GuassianBlur(grey,value,0)
_ , thresh1 = cv2.threshold(blurred, 127, 255,
        Cv2.THRESH_BINARY_INV+cv2.THRESH_OSTU
Cv2.imshow('Thresholded', thresh1)
(version, -, -) = cv2._version_.split('.')
If version is '3':
    image, contours, hierarchy = cv2.findContours(thresh1.copy(), \

```

```

    Cv2.RETR_TREE, cv2.CHANAPPROX_NONE)
elif version is '2':
    contours, hierarchy = cv2.findContours(thresh1.copy(), cv2.RETR_TREE,\
cv2.CHANAPPROX_NONE)
    cnt = max(contours, key = lambda x: cv2.contourArea(x))
    x,y,w,h = cv2.boundingRect(cnt)
    cv2.rectangle(crop_img, (x,y) , (x+w,y+h) , (0,0,255) , 0)
    hull = cv2.convexHull(cnt)
    drawing = np.zeros(crop_ima,shape,np,unit8)
    cv2.drawContours(drawing , [cnt] , 0, (0,255,0) , 0)
    cv2.drawContours(drawing , [hull] , 0, (0,0,255) , 0)
    hull = cv2. convexHull(cnt , returnPoints = False)
    defects = cv2.convexityDefects(cnt , hull)
    count_defects = 0
    cv2.drawContours(thresh1, contours, -1, (0,255,0), 3)
    print "defects.shape[0]",defects.shape[0]
    if defects.shape[0] > 18
        cv2.putText(img, "Unity" , (50,50), cv2.FONT_HERSHEY_SIMPLEX, 2, 2)
    print "Processing Espeak..."
    espeak.synth("Unity")#2
    lcd_string("    UNITY    ",LCD_LINE_1)
    lcd_string("                ",LCD_LINE_2)

```

```

time.sleep(1)
for i in range(defects.shape[0]):
s,e,f,d = defects[I,0]
start = tuple(cnt[s][0])
end= tuple(cnt[e][0])
far = tuple(cnt[f][0])
a = math.sqrt((end[0] - start[0])**2 + (end[1] - start[1])**2)
b = math.sqrt((far[0] - start[0])**2 + (far[1] - start[1])**2)
c = math.sqrt((end[0] - far[0])**2 + (end[1] - far[1])**2)
if angle <= 90:
    count_defects += 1
cv2.circle(crop_img, far, 1, [0, 255, 255] , -1)
cv2.line(crop_img, far, 1, [0, 255, 0] , 2)
if count_defects == 1:
cv2.putText(img , "Peace", (50,50), cv2.FONT_HERSHEY_SIMPLEX, 2, 2)
    print "Processing Espeak..."
    espeak.synth("Peace")#2
    lcd_string("    PEACE    ",LCD_LINE_1)
    lcd_string("                ",LCD_LINE_2)
    time.sleep(1)
elif count_defects == 2:

```

```

str = "Ok; Excellent"
cv2.putText(img , str , (50,50), cv2.FONT_HERSHEY_SIMPLEX, 1, 2)
print "Processing Espeak..."
espeak.synth("Ok,Excellent")#3
lcd_string("      OK      ",LCD_LINE_1)
lcd_string("    EXCELLNT    ",LCD_LINE_2)
time.sleep(1)
elif count_defects == 3:
cv2.putText(img , "Shocker", (50,50), cv2.FONT_HERSHEY_SIMPLEX, 2, 2)
print "Processing Espeak..."
espeak.synth("Shocker")#4
lcd_string("    SHOCKER    ",LCD_LINE_1)
lcd_string("                  ",LCD_LINE_2)
time.sleep(1)
elif count_defects == 4:
cv2.putText(img , "Talk to the hand" , (50,50),
cv2.FONT_HERSHEY_SIMPLEX, 2, 2)
print "Processing Espeak..."
espeak.synth("Talk to the hand")#5
lcd_string("    TALK TO THE    ",LCD_LINE_1)
lcd_string("      HAND      ",LCD_LINE_2)
time.sleep(1)

```

```
else:
    cv2.putText(img, "Hello World!!!", (50,50), \
               cv2.FONT_HERSHEY_SIMPLEX, 2, 2)
    print "count_defects ",count_defects
    cv2.imshow('Gesture', img)
    all_img = np.hstack((drawing, crop_img))
    cv2.imshow('Contours' , all_img)
    k = cv2.waitKey(10)
    if k == 27:
        break
```

CHAPTER-8

RESULTS

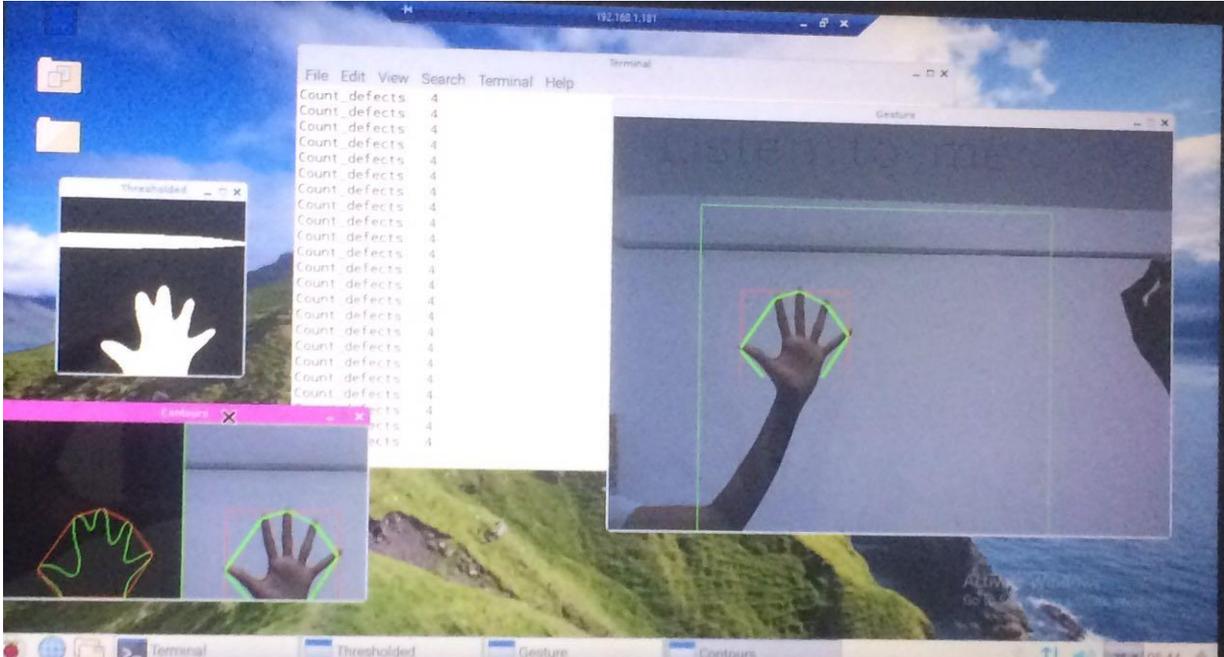


Fig no.8.1

Analyzed Talk to the hand



Fig no.8.2

TALK TO THE HAND is displayed in LCD

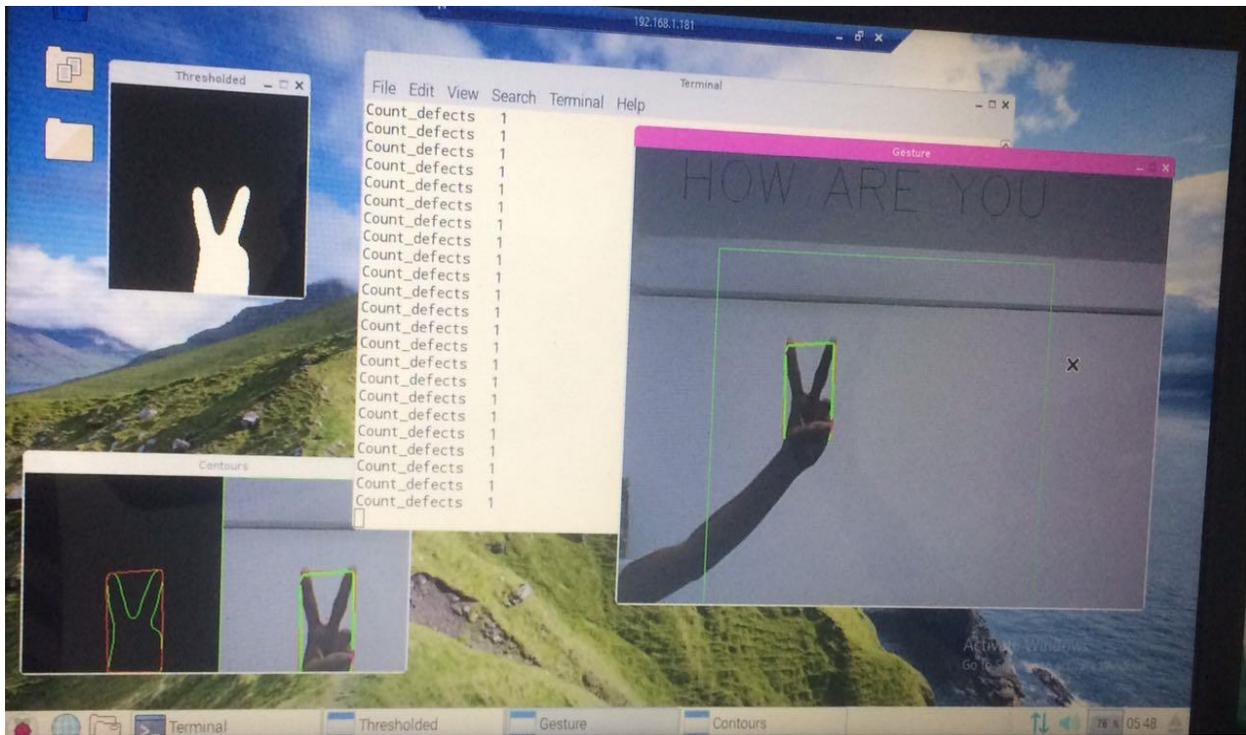


Fig no.8.3
Analyzed Peace



Fig no.8.4
LCD display of PEACE

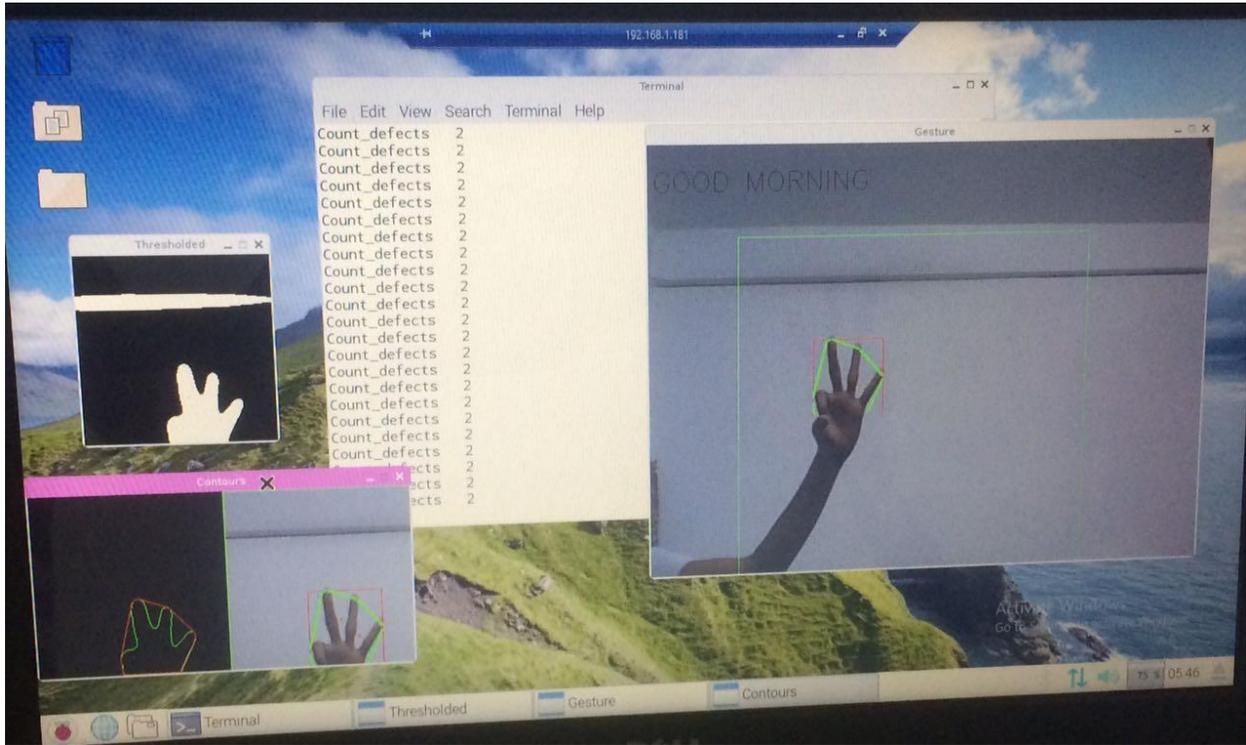


Fig no.8.5

Analyzed ok, Excellent



Fig no.8.6

LCD display of OK, EXCELLENT

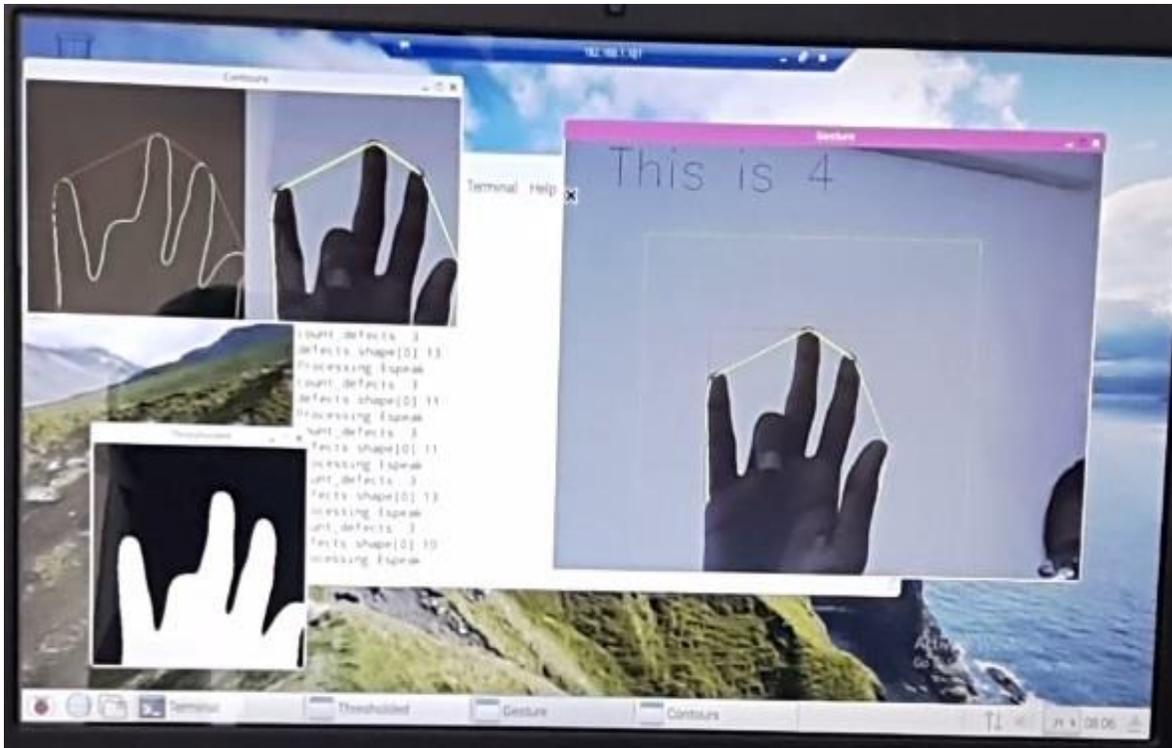


Fig no.8.7
Analyzed Shocker

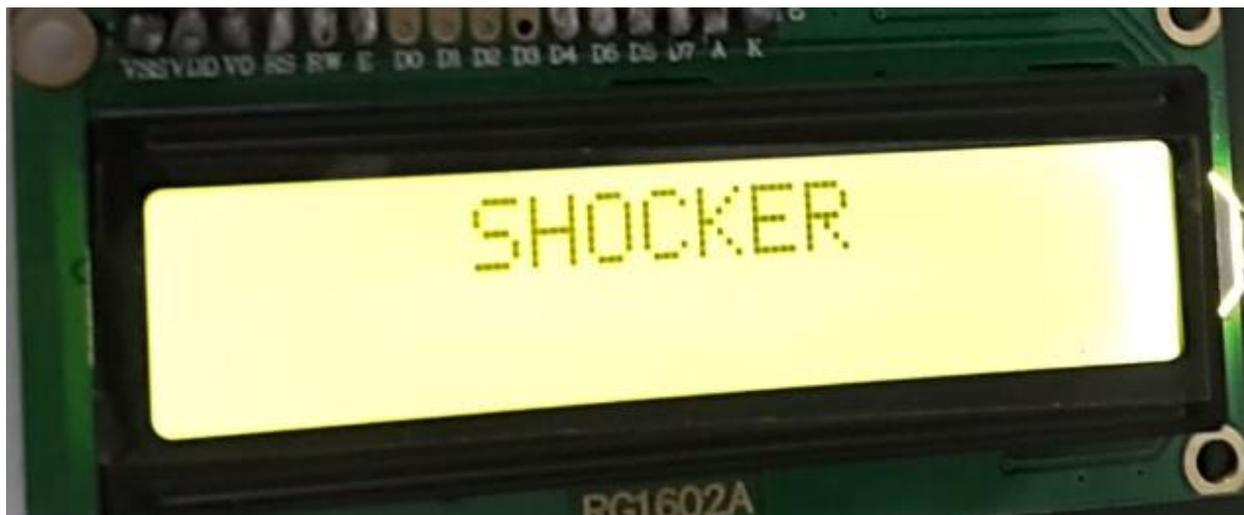


Fig no.8.8
LCD Display of SHOCKER



Fig no.8.9
Analyzed Unity



Fig no.8.10
LCD display of UNITY

CHAPTER-9

SMART AID KIT

The working model of the project along with all its components is shown below,

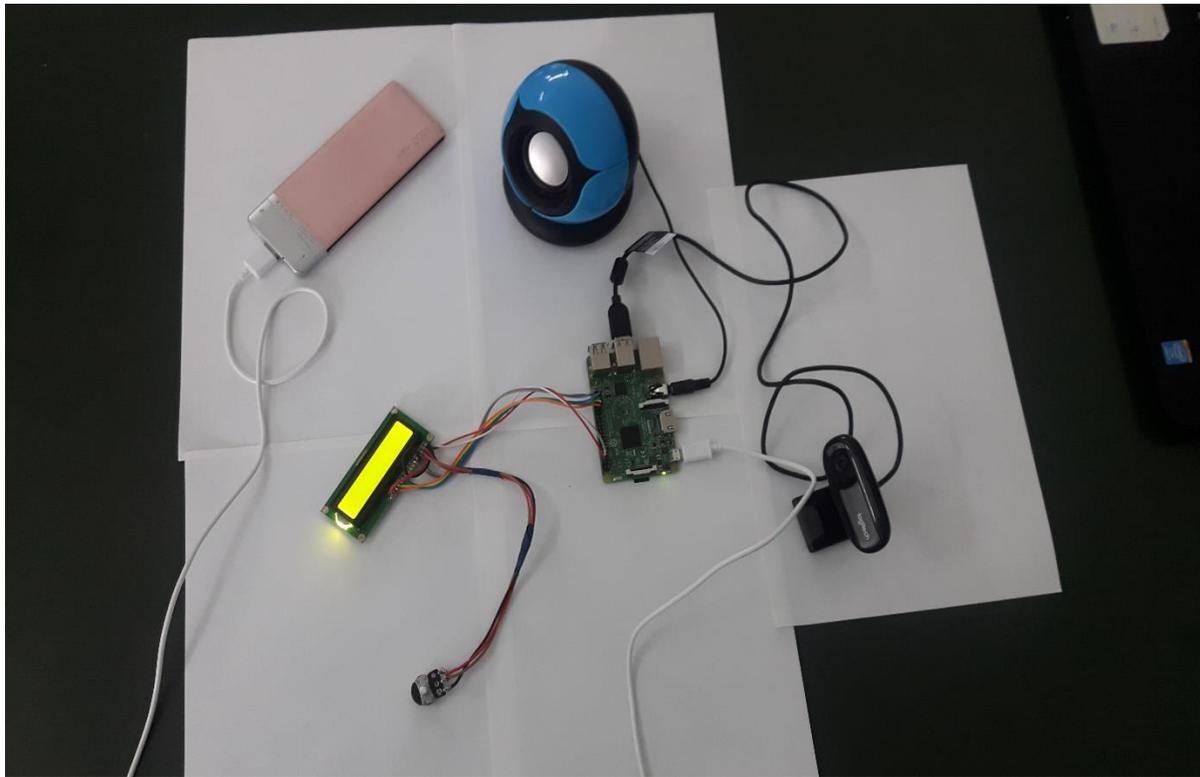


Fig no.9.1
Smart Aid Kit

CHAPTER-10

CONCLUSION

Sign language is one of the useful tools to ease the communication between the deaf and mute communities and normal society. Though sign language can be implemented to communicate, the target person must have an idea of the sign language which is not possible always. A Raspberry pi based hand gesture recognition for hearing impaired-mute people using thresholding technique is successfully implemented with accuracy, comparable to recent contributions. Thus, we proposed a system which facilitates communication between hearing impaired – mute people and normal people as well as with blind people. This module helps to improve self confidence for the disabled people who feel difficulty to communicate with normal people in the society. Here, recognized sign is spelled out through speaker and displayed in LCD module.

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