ASSISTIVE DEVICE FOR BLIND

A PROJECTREPORT

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BONAFIDE CERTIFICATE

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INTERNAL EXAMINAR

EXTERNAL EXAMINAR

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ABSTRACT

Good vision is a precious gift but unfortunately loss of vision is becoming common now a days. Blindness may result from a disease, injury or other conditions that limit vision and because of which Blind people confront a number of challenges everyday. Frequently, blindness affects a person's ability to live independently and this only adds to low self esteem. Hence we propose a camera-based assistive text and product label reading like medicines and rupee note denominations, object recognition and face recognition framework to help blind people read text labels and product packaging from hand-held objects in their daily lives, to help them know what product it is and also to know the person whom they meet regularly. It is based on the digital image processing. Here is a unique strategy that makes use of the microcomputer Raspberry Pi and a unique combination of a webcam for image acquisition and the open source image processing tools such as OpenCV and Python for our implementation. Raspberry Pi is used along with a web camera to provide for the identification of the objects. The web camera is used to take pictures of the objects and it is convert into the output voice command after processing in the raspberry pi 3, which is adopted in headset used by the blind person, thereby enabling object recognition, text recognition and face recognition at a more affordable cost.

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ABBREVIATIONS

SPI	Serial Peripheral Interface
UART	Universal synchronous receiver transmitter
TTS	Text To Speech
OCR	Optical Character Recognition
GPIO	General Purpose Input Output
ARM	Advanced risk machine
I^2C	Inter-Integrated Circuit
USB	Universal Serial Bus
SoC	System on Chip
LAN	Local Area Network
LED	Light Emitting Device

1 INTRODUCTION:

Among the 314 million visually impaired people in the world, 45 million are found to be blind. Even in developed countries like the United States, the 2008 National Health Interview Survey (NHIS) reported that 25.2 million adult Americans (over 8%) are blind or visually impaired [1]. Recent developments in computer vision, digital cameras, and portable computers make it feasible to assist these individuals by developing camera-based products that combine computer vision technology with other existing commercial products such OCR systems. Reading is essential in today's society. Printed text is everywhere in the form of reports, receipts, bank statements, restaurant menus, classroom handouts, product packages**,** instructions on medicine bottles, money denominations, etc. The ability of people who are blind or have significant visual impairments to read printed labels and product packages, to recognize objects and people, will enhance independent living, and foster economic and social self-sufficiency by the use of this assistive device.

1.1 ANALYSIS OF VISUAL IMPAIRMENT IN INDIA:

Blindness continues to be one of the major public health problems in developing countries. Cataract and corneal diseases are major causes of blindness in countries with less-developed economies. According to the World Health Organization, corneal diseases are among the major causes of vision loss and blindness in India today, after cataract and glaucoma. In India,

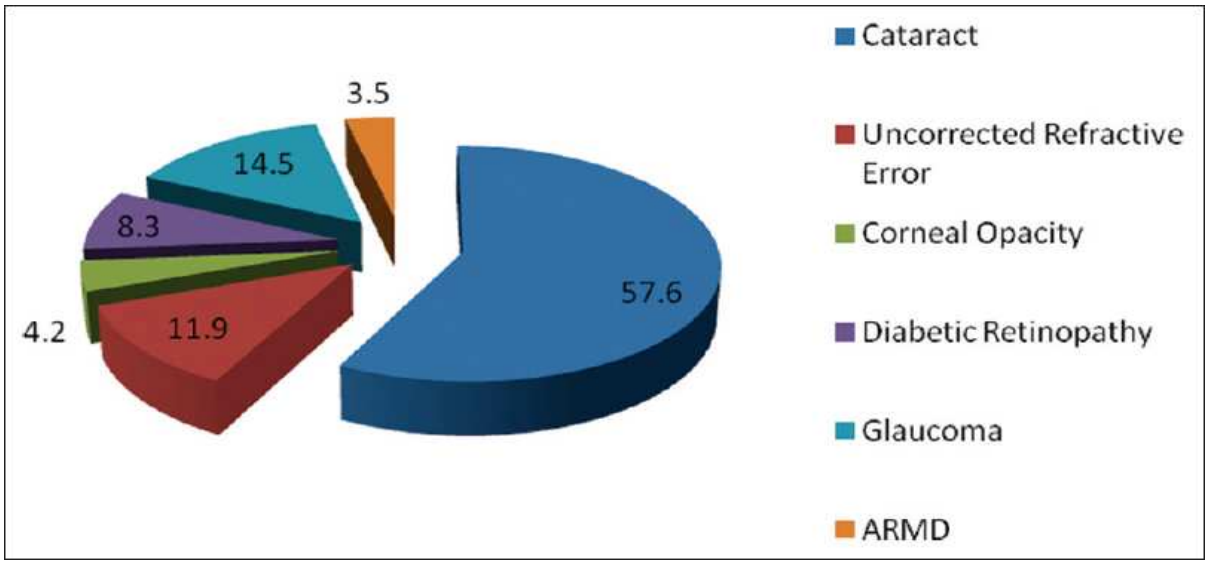

Fig 1.1: **WHO 2015- Distribution of various eye impairments**

It is estimated that there are approximately 6.8 million people who have vision less than 6/60 in at least one eye due to corneal diseases; of these, about a million have bilateral involvement. It is expected that the number of individuals with unilateral corneal blindness in India will increase to 10.6 million by 2020.According to the National Programme for Control of Blindness (NPCB) estimates; there are currently 120,000 corneal blind persons in the country. According to this estimate there is addition of 25,000-30,000 corneal blindness cases every year in the country. The burden of corneal disease in our country is reflected by the fact that 90% of the global cases of ocular trauma and corneal ulceration leading to corneal blindness occur in developing countries.

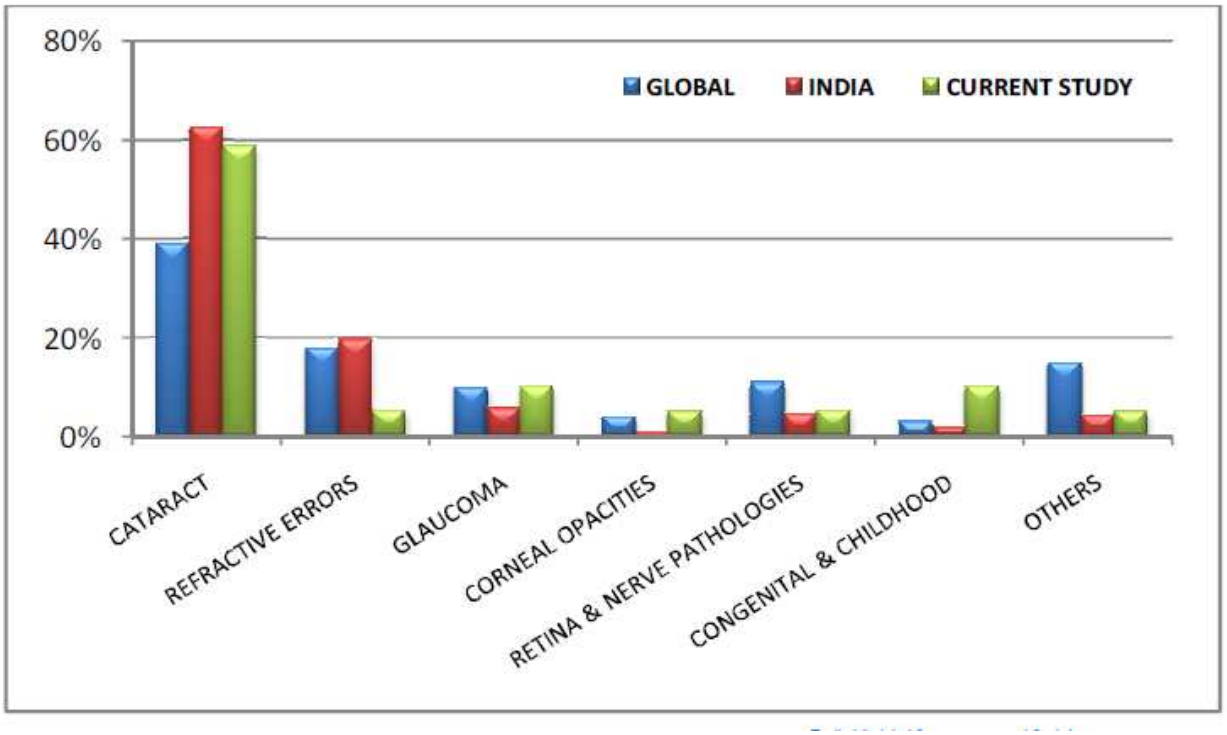

Fig:1.2 Comparison of Prevalence of Blindness

Consistent with other studies, cataract was found to be the leading cause of blindness, accounting for 58.7%

In India cataract (62.6%), refractive errors (19.7%), glaucoma (5.8%), corneal blindness (0.9%), posterior segment disorders (4.7%), others (6.3%).Thus cataract remains a major public health problem in India with regional variations similar to other developing countries in Asia. A comparison of prevalence of blindness has been shown. Blindness was more prevalent among males (54.6%) than females (45.4%), occurring in a ratio of 1.2: 1. While the study from Gujarat

in India, China and Latin America found no association, other studies from India found a significant association between gender and blindness.

	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	TOTAL
CATARACT	1	-	-	-	4	21	22	5	4	**57**
GLAUCOMA	-	-	-	-	2	4	3	1	-	**10**
CONGENITAL	2	1	-	4	3	-	-	-	-	**10**
REFRACTIVE ERRORS	-	-	1	1	2	1	-	-	-	**5**
CORNEAL OPACITIES	-	-	1	-	-	1	2	1	-	**5**
RETINA & NERVE PATHOLOGY	-	1	1	2	-	-	1	-	-	**5**
APHAKIA, TRAUMA & OTHERS	-	-	3	1	-	-	1	-	-	**5**

Table no.:1 Distribution of causes of blindness in age group

An increase among men was noted but it was not statistically significant. It is possible that some unknown socio-demographic factor is influencing this trend. A comparison of incidence of blindness in all age categories has been shown in Table. While blindness due to congenital causes was equal in both genders, a slight male preponderance was found in incidence of cataract and retina and optic nerve pathologies.[2] This was not statistically significant. But incidence of glaucoma and corneal disorders between males and females were in the ratio 4:1, which is significant.

While all cases of blindness due to uncorrected refractive errors occurred in females, blindness due to trauma and other causes occurred only in males. The age

specific blindness prevalence was found to be greater with increased age. Nearly 80.3% of blindness was noted over 40 years of age, consistent with other studies in India.

LITERATURE SURVEY:

This project is to design and develop a system to find objects, texts and human faces with voice announcements. The proposed system mainly consists of three functional components:

- Video capturing
- Text/face/object recognition and
- Audio output

A vision based assistive system for label detection with voice output is discussed. A camera based assistive text reading framework help blind persons read text labels and product packaging from hand-held object in their daily resides [3]. To isolate the object from cluttered backgrounds or other surroundings objects in the camera view, an efficient and effective motion based method to define a region of interest (ROI) in the video by asking the user to shake the object. In the extracted ROI, text localization and recognition are conducted to acquire text information. To automatically localize the text regions from the object ROI, a novel text localization algorithm by learning gradient features of stroke orientations and distributions of edge pixels in an Adaboost model is applied.

Text characters in the localized text regions are then binarized and recognized by off-the shelf optical character recognition software. The recognized text codes are output to blind users in speech.

Physically invisible people experience difficulty and inconvenience using computers through a keyboard and mouse. The purpose of this system is to provide a way the blind people population can easily control many functions of a computer via speech.[4] When blind people speak, the audio voice input is sent to the speech Browser .solenoid plated are very useful to convert this web search into braille. Many applications running on this purpose but not all the applications able to fulfill over it and this system has better aspects in future for normal people as well as blind people. This application is firstly embedded on raspberry pi and Qt creator is the software which is being useful to interface this GUI with the hardware connected to Pi.

Finding the properties of the obstacle (Human Being).,Human presence is identified with the help of human face detection algorithm written in Open CV. The constraints coming while running the algorithm on Embedded System are limited memory and processing time and speed to achieve the real time image processing requirements. The algorithm is implemented in Open CV, which runs on Debian based Linux environment.

In Belt-worn assistive devices, [5] sensory overload and long training time are the disadvantages. The brain simultaneously processes stimuli from several or all of the sensory modalities to interpret the surrounding environment. Because humans have a limited capacity to receive, hold in working memory and cognitively process information taken from the environment, the use of only one sensory modality to convey information can quickly overload that modality. After

a while, users may be limited in the perception of acoustical or tactile signals coming from assistive devices. Learning and mastering the visual-to-sound or visual-to-tactile new language is quite a challenge and requires long training time, patience and great effort from the user.

In a shoe integrated tactile display, acoustical feedback is useful only for reading applications. For mobility applications, it might interfere with the blind person's ability to pick up environmental cues. [6] Moreover, continuous acoustic feedback (20-30 min) might affect posture and equilibrium. Tactile feedback is a viable choice for mobility applications. However, the Information presented must be in accordance with the location of the tactile display on the body. Precise information can only be recognized with the fingers and tongue while simple information can be displayed on the rest of the body. It seems that simple directional information is the best choice for mobility of the blind. It does not require constant activity and cognitive effort that reduces walking speed and quickly fatigues the user.

Today, there are already a few systems that have some promise for portable use, but they cannot handle product labeling. [7] For example, portable bar code readers designed to help blind people identify different products in an extensive product database can enable users who are blind to access information about these products through speech and Braille.

But a big limitation is that it is very hard for blind users to find the position of the bar code and to correctly point the bar code reader at the bar code. It cannot read text with complex backgrounds, text printed on cylinders with warped or incomplete images (such as soup cans or medicine bottles). Furthermore, these systems require a blind user to manually localize areas of interest and text regions

on the objects in most cases. The physical object that displays information will be helpful for the blind.

2. HARDWARE DESCRIPTION:

2.1 PROJECT DESCRIPTION:

The main objective of this paper is to implement a system that will help the visually impaired person ease his lifestyle. A camera-based assistive text reading framework is used to help blind people read text and product labels from hand-held objects in their daily life. The Microcomputer Raspberry Pi, a webcam for image acquisition and the professional

Open source image processing tools such as openCV and Python are the major components of this project. Raspberry Pi is used along with a web camera to provide for the identification of the objects.

This converts the object that is sensed in the input by the combination of a webcam and an object sensor into the output. This is done by processing the read input into output in the form of a voice command that is adopted in headset which is used by the visually impaired people. So, the system consists of three major components: object capture, data processing and audio output. Thus in this paper, a prototype system framework to read printed text on hand held object for assisting blind person is proposed. The proposed circuit makes use of a micro-controller (RASPBERRY PI 3) that controls a web camera, a switch keypad and a headset.

The ability of people who are blind or have significant visual impairments to read printed labels and product packages will enhance independent living, and foster economic and social self-sufficiency by the use of this assistive device.

BLOCK DIAGRAM:

- In the switch keypad, when the desired switch is pressed the web camera opens and starts capturing the object in front of it.
- After it has captured, it sends the image to the raspberry pi.
- According to the function it triggers based on the button pressed (namely object recognition, human face recognition and text reading) the raspberry pi processes the captured image information and gives the result in the form of audio output audible to the blind person through the head phones.

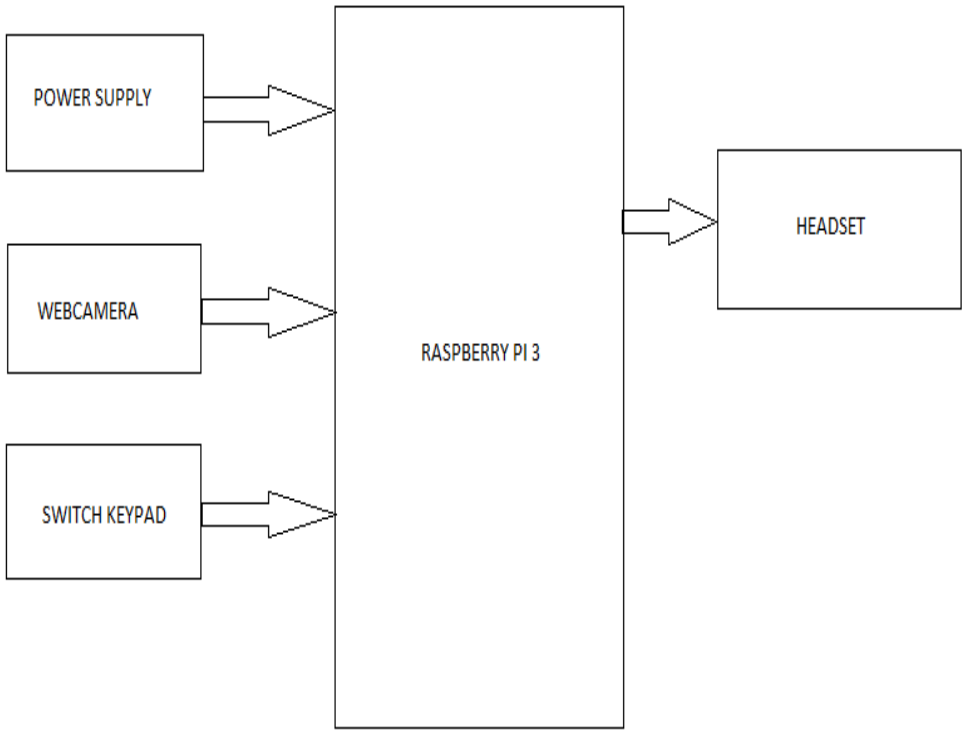

Fig: 2.1-Block Diagram

This is the block diagram of the project that we intend to implement. Block diagram is shown in fig 2.1.

2.2 PROJECT EXECUTION PLAN:

This project requires basic prototyping of embedded system coding with the help of RASPBERRY PI 3 and a PYTHON coding to interface the RASPBERRY PI 3 controller with Camera. It aims in bringing together the hardware and the software to achieve the necessity of making a automated device for blind.

We take the proposal to the prototype by Using Python language to code the microcontroller that in turn controls the web camera and the headset. Other softwares like raspberry pis also easy to understand and as the world is fast moving towards the advanced versions like Simulink coding with Model Based Development, raspberry pi is modern and brings innovation to action.

The prototype is made into a final product by, Understanding the work of web camera and coding raspberry pi based on the specifications of the microcontroller. Ultimately leading to the output as proposed in the project proposal. We aim to make this cost effective by using the products and the components that are not too expensive but at the same time meeting our requirements of temperature sensitivity and consuming less power thus making the system completely reliable at the same time affordable by the end users. This is the reason why we have used raspberry pi instead of other processors because it requires a less code space and it supports more tools and has an advanced debugging features and supports huge speed operation at low cost. There are three phases of this implementation.

- Object Recognition

- Text Recognition
- Face Recognition

OBJECT RECOGNITION:

The system framework consists of three functional components: scene capture, data processing and audio output. The scene capture component collects scenes containing objects of interest in the form of images or video. In our prototype, it corresponds to a camera attached to a pair of sunglasses.

The data processing component is used for deploying our proposed algorithms, including 1) object-of-interest detection to selectively extract the image of the object held by the blind user from the cluttered background or other neutral objects in the camera view; and 2) text localization to obtain image regions containing text, and text recognition to transform image-based text information into readable codes [8]. We use a mini-laptop as the processing device in our current prototype system. The audio output component is to inform the blind user of recognized text codes. This simple hardware configuration ensures the portability of the assistive text reading system.

One of the main fields within image analysis is that of recognizing objects, and there are a variety of such techniques coming from the field of computer vision and machine learning, which are two fields that often seems to go hand in hand, decision trees, cascade classifiers etc. can be trained based on features (distinct subregions in the image) and so forth.

Many approaches based on machine-learning have the advantageous of being computationally more efficient in object detecting, although generic detectors (feature matching) often performs better in terms of localization, scale and shape. Haar classification is a tree-based technique where in the training phase, a statistical boosted rejection cascade is created.

As input to these basic classifiers, that builds up the cascade, comes Haar-like features that are calculated. When the application is running a pane of different sizes is swept over the image, computing sums of pixel values based on these features, using integral images, and applies the trained rejection cascade.

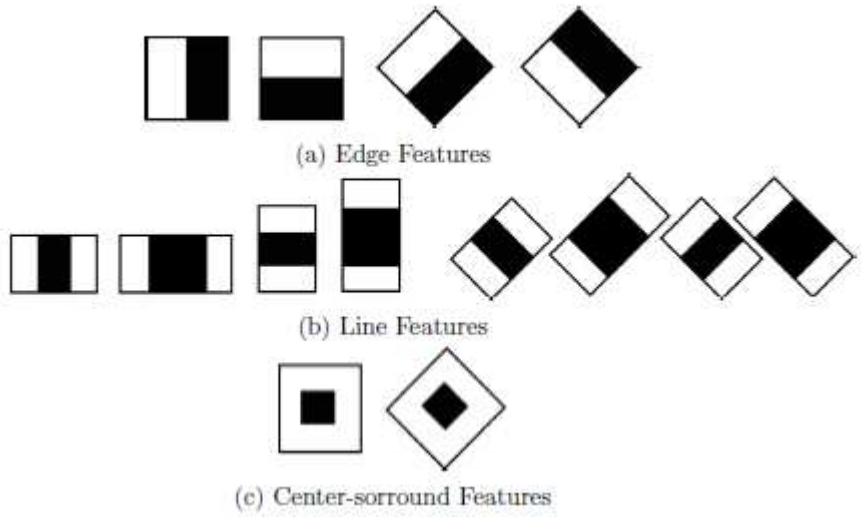

Fig 2.2: Haar wavelet features

SIFT and Haar-feature classification became the main candidates for recognition; SIFT because it is designed for efficiency and meets all intended

invariance requirements [9]. Both make use of integral images, e g. sum of pixel values in a rectangular region of an image.

TEXT RECOGNITION:

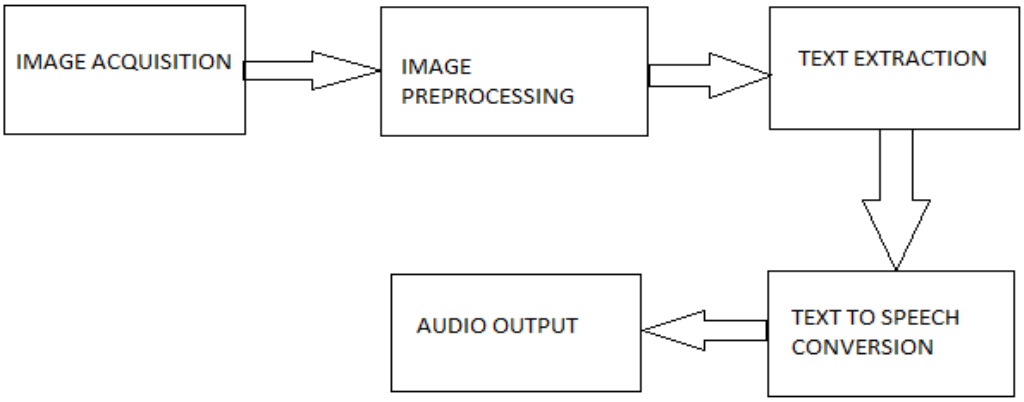

Fig 2.3: Text Recognition

This project presents a prototype system for recognition of text present in the image using raspberry pi. As illustrated in the block diagram the system framework consist of five functional components: Image acquisition, Image preprocessing, Text extraction, Text to speech conversion and Speech output. Text to speech conversion is done using the eSpeak speech synthesizer.

(i)IMAGE ACQUISITION:

Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually a hardware-based source, web camera so it can be passed through whatever processes need to occur afterward. Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible.

The image that is acquired is completely unprocessed and is the result of whatever hardware was used to generate it, which can be very important in some fields to have a consistent baseline from which to work. One of the ultimate goals of this process is to have a source of input that operates within such controlled and measured guidelines that the same image can, if necessary, be nearly perfectly reproduced under the same conditions so anomalous factors are easier to locate and eliminate.

(ii)IMAGE PREPROCESSING:

Pre-processing is a common name for operations with images at the lowest level of abstraction — both input and output are intensity images. These iconic images are of the same kind as the original data captured by the sensor, with an intensity image usually represented by a matrix of image function values (brightnesses). The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing, although geometric transformations of images (e.g. rotation, scaling, translation) are classified among pre-processing methods here since similar techniques are used.

(iii)TEXT EXTRACTION:

Text data present in images and video contain useful information for automatic annotation, indexing, and structuring of images. Extraction of this information involves detection, localization, tracking, extraction, enhancement, and recognition of the text from a given image. [10] However, variations of text due to differences in size, style, orientation, and alignment, as well as low image

contrast and complex background make the problem of automatic text extraction extremely challenging.

Property		Variants or sub-classes
Geo-metry	Size	Regularity in size of text
	Alignment	Horizontal/vertical
		Straight line with skew (implies vertical direction)
		Curves
		3D perspective distortion
	Inter-character distance	Aggregation of characters with uniform distance
Color		Gray
		Color (monochrome, polychrome)
Motion		Static
		Linear movement
		2D rigid constrained movement
		3D rigid constrained movement
		Free movement
Edge		Strong edges (contrast) at text boundaries
Compression		Un-compressed image
		JPEG, MPEG-compressed image

Table 2: Properties of image preprocessing

(iv)TEXT TO SPEECH CONVERSION:

A text-to-speech system is composed of two parts: a front-end and a back-end. The front-end has two major tasks. First, it converts raw text containing symbols like numbers and abbreviations into the equivalent of written-out words. This process is often called text normalization, pre-processing, or tokenization. The front-end then assigns phonetic transcriptions to each word, and divides and marks the text into prosodic units, like phrases, clauses, and sentences. The process of assigning phonetic transcriptions to words is called text-to-phoneme or grapheme-to-phoneme conversion. Phonetic transcriptions and prosody information together

make up the symbolic linguistic representation that is output by the front-end. The back-end—often referred to as the synthesizer—then converts the symbolic linguistic representation into sound. In certain systems, this part includes the computation of the target prosody (pitch contour, phoneme durations), which is then imposed on the output speech.

(v)AUDIO OUTPUT:

First the image of the text is captured using raspberry pi camera or an HD webcam with high resolution. The recognized text present in the image are extracted using OCR engines. In this project we use tesseract OCR engine which helps to extract the recognized text. The extracted text is first converted into speech using the speech synthesizer called eSpeak, a TTS engine, which is capable of converting text to speech using predefined libraries and the is given through a headset.

FACE RECOGNITION:

Face detection from an image has been playing a vital role in the active research area, especially in computer vision research for more decades. In this paper we intend to implement the Haar-Classifier for Face detection and tracking based on the HaarFeatures on System on Chip (SoC) to be used in a human machine interface and action interpretation. Haar-like features can be computed at any scale or location in constant time using the integral image representation for images [11]. Haar Classifier adapts the existing classification algorithms to the detection and recognition problems.

The face detection algorithm proposed by Viola and Jones is used as the basis of our design. The face detection algorithm looks for specific Haar features of a human face. When one of these features is found, the algorithm allows the face candidate to pass to the next stage of detection. A face candidate is a rectangular section of the original image called a sub-window. Generally this sub-window has a fixed size. This subwindow is often scaled in order to obtain a variety of different size faces. The algorithm scans the entire image with this window and denotes each respective section a face candidate.

The algorithm uses an integral image in order to process Haar features of a face candidate in constant time. It uses a cascade of stages which is used to eliminate non-face candidates quickly. Each stage consists of many different Haar features. Each feature is classified by a Haar feature classifier. The Haar feature classifiers generate an output which can then be provided to the stage comparator. The stage comparator sums the outputs of the Haar feature classifiers and compares this value with a stage threshold to determine if the stage should be passed. If all stages are passed the face candidate is concluded to be a face.

Haar features are composed of either two or three rectangles. Face candidates are scanned and searched for Haar features of the current stage. The weight and size of each feature and the features themselves are generated using a machine learning algorithm from AdaBoost. The weights are constants generated by the learning algorithm.Each Haar feature has a value that is calculated by taking the area of each rectangle, multiplying each by their respective weights, and then summing the results. The area of each rectangle is easily found using the integral image.

A Haar feature classifier uses the rectangle integral to calculate the value of

a feature. The Haar feature classifier multiplies the weight of each rectangle by its area and the results are added together.

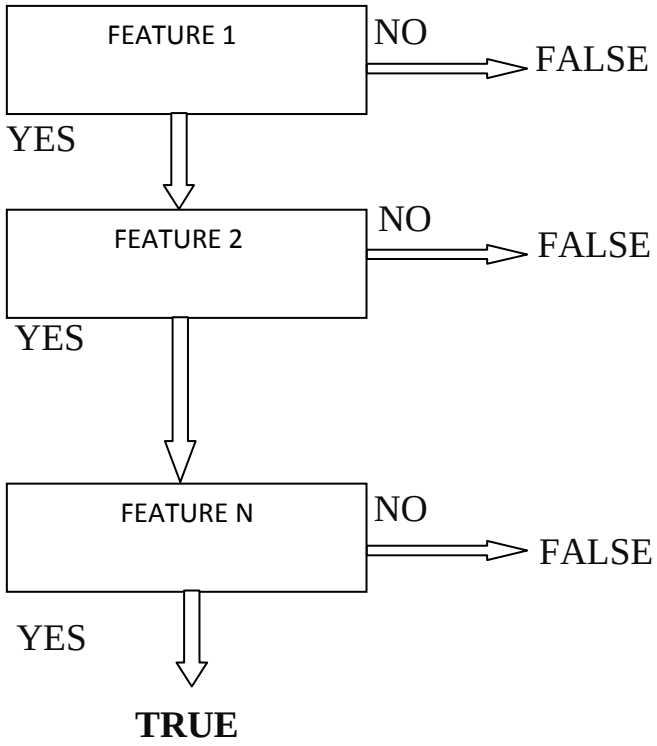

Fig:2.4 DECISION TREE BASED ON HAAR-LIKE FEATURES

Several Haar feature classifiers compose a stage. A stage comparator sums all the Haar feature classifier results in a stage and compares this summation with a stage threshold. The threshold is constant and obtained from the AdaBoost algorithm. Each stage does not have a set number of Haar features. Depending on the parameters of the training data individual stages can have a varying number of Haar features.

The feature extraction in face detection is done by localizing of the characteristics of face components (i.e., eyes, mouth, nose etc) in an image. In other terms, the feature extraction is a step in face detection and recognition where the system locates certain points on the faces such as corner and center of the eyes,

tip of the nose, mouth etc. It analyzes spatial geometry of differential feature of a face. Result of this analyzing is a set of template generated for each face .The template consists of a reduced set of data which represent the real time face detected in bounded box. The template comparison is done with the template stored in the database. Two phases are there in this phase identification and verification. These two term identification to detect the face in real time video and verification application for face recognition which scope out of this paper. The final phase of face detection is to declare the highest matching score resulted in the previous step.

Haar classifier face detection is used to create a search window that slide through a image and check whether a certain region of an image looks likes face or not. Haar like features and a large set of very weak classifier use a single feature to define a certain image as face or non face. Each feature is described by the template and its coordinate relative to the search window which is the origin of the size of the feature.

2.3:COMPONENTS AND ITS USES:

Components	Usage/Advantage
Web camera	To capture the images
Power supply	To supply power
Raspberry pi 3	Performance for various real-time control applications using programs
Switch keypad	To enable recognitions
Headset	To provide audio output

Table 3:Components and its uses

2.4 RASPBERRY PI 3 MICROCONTROLLER:

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B [12]. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings a more powerful processor, 10x faster than the first generation Raspberry Pi.

Fig: 2.5-RASPBERRY PI 3

Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

Raspberry Pi 3 - Model B Technical Specification

- Broadcom BCM2387 chipset
- 1.2GHz Quad-Core ARM Cortex-A53
- 802.11 bgn Wireless LAN and Bluetooth 4.1
- 1GB RAM
- 64 Bit CPU
- 4 x USB ports
- 4 pole Stereo output and Composite video port
- Full size HDMI
- 10/100 BaseT Ethernet socket
- CSI camera port for connecting the Raspberry Pi camera
- DSI display port for connecting the Raspberry Pi touch screen display
- Micro SD port for loading your operating system and storing data
- Micro USB power source

Raspberry Pi 3 - Model B Features

- 10x Faster - Broadcom BCM2387 ARM Cortex-A53 Quad Core Processor powered Single Board Computer running at 1.2GHz
- 1GB RAM so you can now run bigger and more powerful applications
- Fully HAT compatible
- 40pin extended GPIO to enhance your “real world” projects.
- Connect a Raspberry Pi camera and touch screen display (each sold separately)
- Stream and watch Hi-definition video output at 1080
- Micro SD slot for storing information and loading your operating systems.
- 10/100 BaseT Ethernet socket to quickly connect the Raspberry Pi to the Internet.

ADVANTAGES OF RASPBERRY PI 3 OVER OTHER PROCESSORS:

The advantages are :

- Cost
- Easy Availability in India
- Knowledge base is quite high for RPi
- Many addons are already available for RPi as it has completed almost 5/6 years
- Size and portability
- Conitnuous improvement and ability to load normal Linux OS and there are many Linux Distributions exclusively for RPi and Windows 10 IoT Core is also possible to load in RPi
- The Raspberry Pi uses an SD card for storage, which is fast and has no moving parts and the Pi is completely silent.

2.5 ARCHITECTURAL OVERVIEW:

The Raspberry Pi 3's four built-in USB ports provide enough connectivity for a mouse, keyboard, or anything else that the RPi needs, but to add even more a USB hub can still be used. A powered hub or a power bank is used so as not to overtax the on-board voltage regulator. Powering the Raspberry Pi 3 is easy, just plug any USB power supply into the micro-USB port. There's no power button so the Pi will begin to boot as soon as power is applied, to turn it off simply remove power. The four built-in USB ports can even output up to 1.2A enabling to connect more power hungry USB devices (This does require a 2Amp micro USB Power Supply)

The low-level peripherals on the Pi make it great for hardware hacking. The 0.1" spaced 40-pin GPIO header on the Pi gives you access to 27 GPIO, UART, I 2C, SPI as well as 3.3 and 5V sources. Each pin on the GPIO header is identical to its predecessor the Model B+.

Processor:

• Broadcom BCM2387 chipset.
• 1.2GHz Quad-Core ARM Cortex-A53 (64Bit)

802.11 b/g/n Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)

• IEEE 802.11 b / g / n Wi-Fi. Protocol: WEP, WPA WPA2, algorithms AES-

CCMP (maximum key length of 256 bits), the maximum range of 100 meters.

• IEEE 802.15 Bluetooth, symmetric encryption algorithm Advanced Encryption Standard (AES) with 128-bit key, the maximum range of 50 meters.

GPU:

• Dual Core Video Core IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high-profile decode.

• Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure

Memory:

• 1GB LPDDR2

Operating System:

• Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT

Dimensions:

• 85 x 56 x 17mm

Power:

• Micro USB socket 5V1, 2.5A

Connectors:

Ethernet:

• 10/100 BaseT Ethernet socket

Video Output:

• HDMI (rev 1.3 & 1.4)

• Composite RCA (PAL and NTSC)

Audio Output:

• Audio Output 3.5mm jack

• HDMI

• USB 4 x USB 2.0 Connector

GPIO Connector:

• 40-pin 2.54 mm (100 mil) expansion header: 2x20 strip

• Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines

Camera Connector:

• 15-pin MIPI Camera Serial Interface (CSI-2)

Display Connector:

• Display Serial Interface (DSI) 15 way flat flex cable connector with two data lanes and a clock lane

Memory Card Slot :

• Push/pull Micro SDIO

SoC:

Built specifically for the new Pi 3, the Broadcom BCM2837 system-on-chip (SoC) includes four high-performance ARM Cortex-A53 processing cores running

at 1.2GHz with 32kB Level 1 and 512kB Level 2 cache memory, a VideoCore IV graphics processor, and is linked to a 1GB LPDDR2 memory module on the rear of the board.

GPIO:

The Raspberry Pi 3 features the same 40-pin general-purpose input-output (GPIO) header as all the Pis going back to the Model B+ and Model A+. Any existing GPIO hardware will work without modification; the only change is a switch to which UART is exposed on the GPIO's pins, but that's handled internally by the operating system.

USB chip:

The Raspberry Pi 3 shares the same SMSC LAN9514 chip as its predecessor, the Raspberry Pi 2, adding 10/100 Ethernet connectivity and four USB channels to the board. As before, the SMSC chip connects to the SoC via a single USB channel, acting as a USB-to-Ethernet adaptor and USB hub.

Antenna:

There's no need to connect an external antenna to the Raspberry Pi 3. Its radios are connected to this chip antenna soldered directly to the board, in order to keep the size of the device to a minimum. Despite its diminutive stature, this antenna should be more than capable of picking up wireless LAN and Bluetooth signals – even through walls.

2.6 OVERVIEW:

Key Improvements from Pi 2 Model B to Pi 3 Model B are

• Next Generation QUAD Core Broadcom BCM2837 64bit ARMv7 processor

• Processor speed has increased from 900MHz on Pi 2 to 1.25Ghz on the RPi 3 Model B

• BCM43143 Wi-Fi on board

• Bluetooth Low Energy (BLE) on board

• Upgraded switched power source up to 2.5 Amps (can now power even more powerful devices over USB ports)

The main differences are the quad core 64-bit CPU and on-board Wi-Fi and Bluetooth. The RAM remains 1GB and there is no change to the USB or Ethernet ports. However, the upgraded power management should mean the Pi 3 can make use of more power hungry USB devices.

For Raspberry Pi 3, Broadcom have supported us with a new SoC, BCM2837. This retains the same basic architecture as its predecessors BCM2835 and BCM2836, so all those projects which rely on the precise details of the Raspberry Pi hardware will continue to work. The 900MHz 32-bit quad-core ARM CortexA7 CPU complex has been replaced by a custom-hardened 1.2GHz 64-bit quad-core ARM Cortex-A53.

In terms of size it is identical to the B+ and Pi 2. All the connectors and mounting holes are in the same place so all existing add-ons, HATs and cases should fit just fine although the power and activity LEDs have moved to make

room for the WiFi antenna.

The performance of the Pi 3 is roughly 50-60% faster than the Pi 2 which means it is ten times faster than the original Pi. All of the connectors are in the same place and have the same functionality, and the board can still be run from a 5V micro-USB power adapter.

2.7 PIN DESCRIPTION:

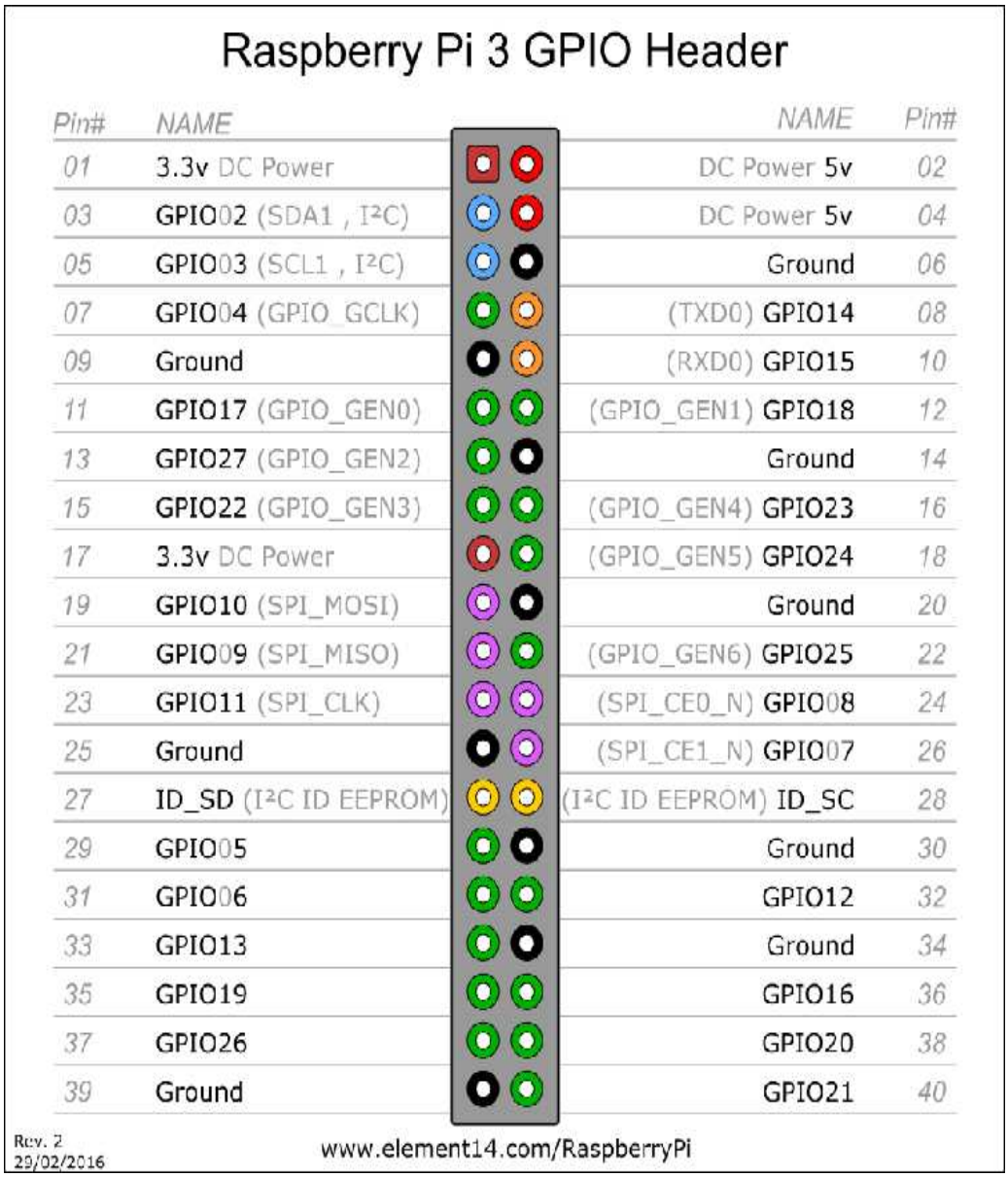

Fig: 2.6-Pin diagram

Power: These pull power directly form the Raspberry Pi 3.

Ground: Pins used to ground your devices[13].

UART: Serial pins that are used to communicate with other devices.

I^2C: Pins that connect and talk to hardware modules that support this protocol

SPI: Pins that connect and talk to hardware modules that support SPI protocol

GPIO: Standard pins that can be used to turn devices on and off

2.8 CIRCUIT DESCRIPTION:

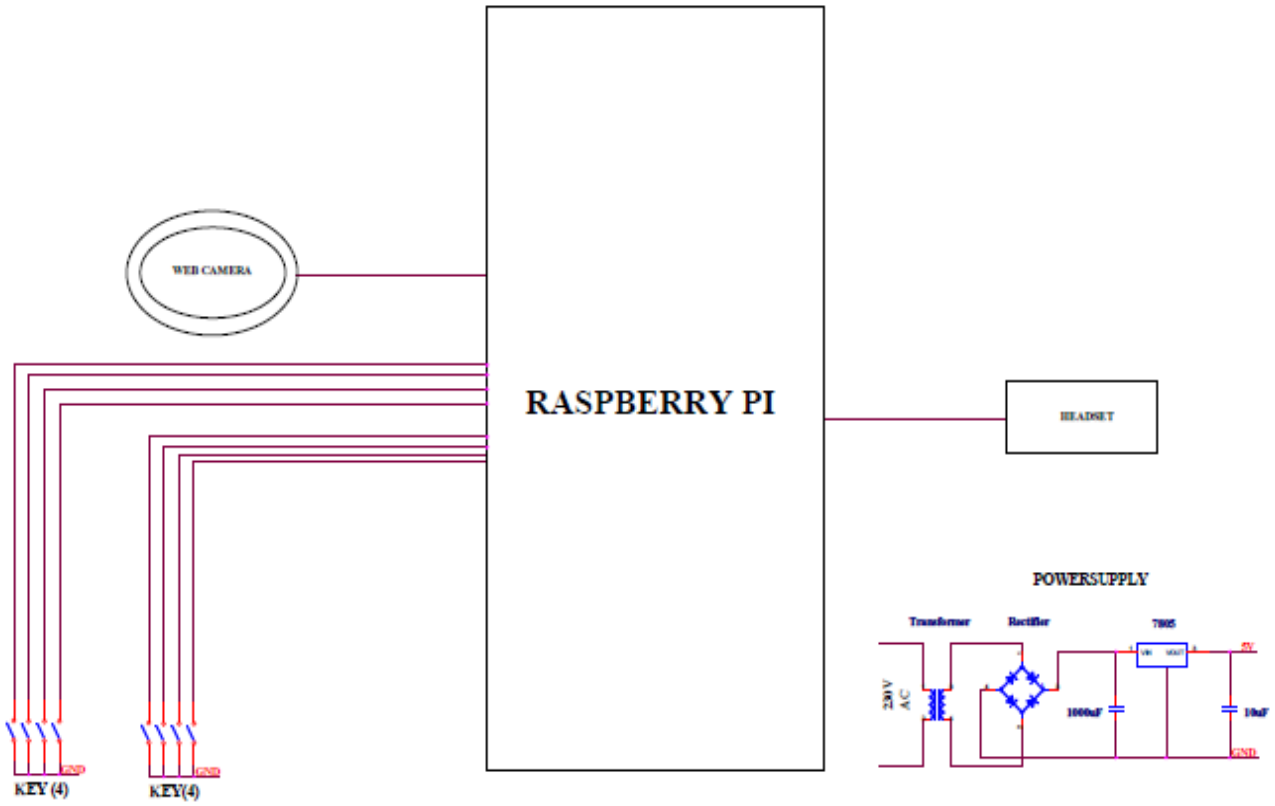

Fig 2.7:Circuit diagram

2.9 INTERFACES:

The various interfaces used are web camera, power supply, 8 switch keypad and a headset. The software used to interface are openCV and Python.

2.10 WEB CAMERA:

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.

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. The camera pictured to the right, for example, uses a Sonix SN9C101 to transmit its image over USB [14]. 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.

Characteristics:

- Impressive resolution
- High flexibility
- Long life
- low manufacturing cost

2.11 POWER SUPPLY:

Fig 2.8:Block diagram (Power supply)

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

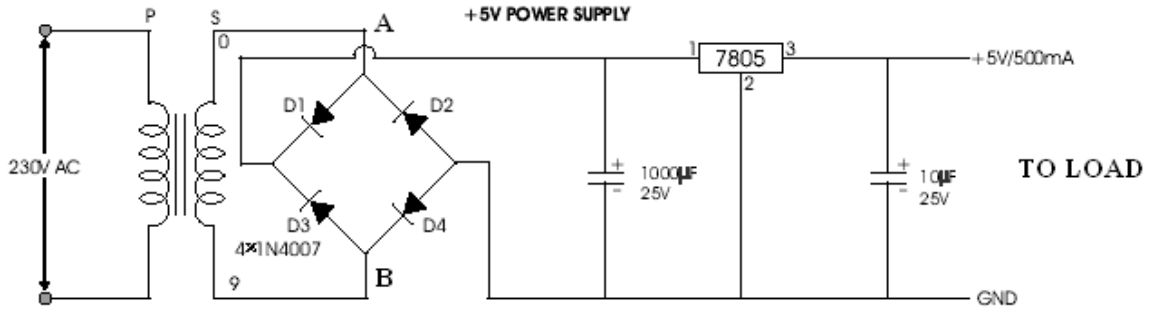

Fig 2.9:schematic diagram of Power Supply

The potential transformer will step down the power supply voltage (0-230V) to (0-9V) level. If the secondary has less turns in the coil then the primary, the secondary coil's voltage will decrease and the current or AMPS will increase or decreased depend upon the wire gauge. This is called a STEP-DOWN transformer. Then the secondary of the potential transformer will be connected to the rectifier.

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4. The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The path for current flow is from point B through D1, up through Load, through D3, through the secondary of the transformer back to point B.

One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through Load, through D2, through the secondary of transformer, and back to point A. Across D2 and D4. The current flow through Load is always in the same direction. In flowing through Load this current develops a voltage corresponding to that. Since current flows through the load during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier. One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional half-wave circuit. This bridge rectifier always drops 1.4Volt of the input voltage because of the diode. We are using 1N4007 PN junction diode, its cut off region is 0.7Volt.So any two diodes are always conducting, total drop voltage is 1.4 volt.

If a Capacitor is added in parallel with the load resistor of a Rectifier to form a simple Filter Circuit, the output of the Rectifier will be transformed into a more stable DC Voltage. At first, the capacitor is charged to the peak value of the rectified Waveform. Beyond the peak, the capacitor is discharged through the load

until the time at which the rectified voltage exceeds the capacitor voltage. Then the capacitor is charged again and the process repeats itself.

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. A fixed three-terminal voltage regulator has an unregulated dc input voltage, it is applied to one input terminal, a regulated dc output voltage from a third terminal, with the second terminal connected to ground.The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

2.12 SWITCH KEYPAD:

In electrical engineering, a switch is an electrical component that can "make" or "break" an electrical circuit, interrupting the current or diverting it from one conductor to another. The mechanism of a switch removes or restores the conducting path in a circuit when it is operated. It may be operated manually, for example, a light switch or a keyboard button, may be operated by a moving object such as a door, or may be operated by some sensing element for pressure, temperature or flow.

The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts, which are connected to external circuits. Each set of contacts can be in one of two states: either “closed” meaning the contacts are touching or electricity can flow

between them, or "open", meaning the contacts are separated and the switch is nonconducting.

The mechanism actuating the transition between these two states (open or closed) can be either a "toggle" (flip switch for continuous "on" or "off") or "momentary" (push-for "on" or push-for "off") type.

A switch may be directly manipulated by a human as a control signal to a system, such as a computer keyboard button, or to control power flow in a circuit, such as a light switch. Automatically operated switches can be used to control the motions of machines, for example, to indicate that a garage door has reached its full open position or that a machine tool is in a position to accept another workpiece. Switches may be operated by process variables such as pressure, temperature, flow, current, voltage, and force, acting as sensors in a process and used to automatically control a system. For example, a thermostat is a temperature-operated switch used to control a heating process. A switch that is operated by another electrical circuit is called a relay.

In the simplest case, a switch has two conductive pieces, often metal, called contacts, connected to an external circuit, that touch to complete (make) the circuit, and separate to open (break) the circuit. The contact material is chosen for its resistance to corrosion, because most metals form insulating oxides that would prevent the switch from working. Contact materials are also chosen on the basis of electrical conductivity, hardness (resistance to abrasive wear), mechanical strength, low cost and low toxicity.

Sometimes the contacts are plated with noble metals. They may be designed to wipe against each other to clean off any contamination. Nonmetallic conductors, such as conductive plastic, are sometimes used. To

prevent the formation of insulating oxides, a minimum wetting current may be specified for a given switch design.

ELECTRONIC SWITCH KEYPAD:

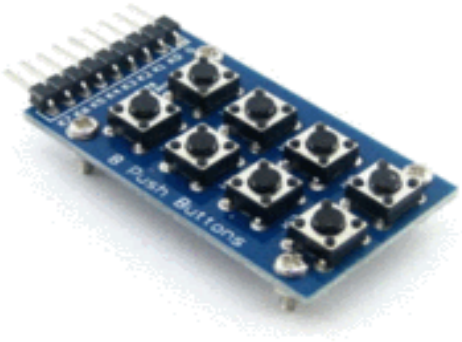

Fig 2.10: switch keypad

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching—often a silicon-controlled rectifier or triac [15].

The analogue switch uses two MOSFET transistors in a transmission gate arrangement as a switch that works much like a relay, with some advantages and several limitations compared to an electromechanical relay.The power transistor(s) in a switching voltage regulator, such as a power supply unit, are used like a switch to alternately let power flow and block power from flowing.

2.13 HEADSET:

A headset combines a headphone with a microphone. Headsets are made with either a single-earpiece (mono) or a double-earpiece (mono to both ears or stereo). Headsets provide the equivalent functionality of a telephone handset but with hands-free operation. They have many uses including in call centers and other telephone-intensive jobs and for anybody wishing to have both hands free during a telephone conversation. Headphones are a pair of small electronic or electric listening devices that are designed to be worn on or around the head over a user's ears.

They are electro acoustic transducers, which convert an electrical signal to a corresponding sound in the user's ear. Headphones are designed to allow a single user to listen to an audio source privately, in contrast to a loudspeaker, which emits sound into the open air, for anyone nearby to hear.

3.SOFTWARE DESCRIPTION:

3.1 OPENCV:

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel's research center in Nizhny Novgorod (Russia), it was later supported by Willow Garage and is now maintained by Itseez. The library is cross-platform and free for use under the open-source BSD license.

OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface [16]. There are bindings in Python, Java and MATLAB/OCTAVE. The API for these interfaces can be found in the online documentation. Wrappers in other languages such as C#, Perl, Ch, Haskell and Ruby have been developed to encourage adoption by a

wider audience. OpenCV runs on a variety of platforms. Desktop: Windows, Linux, macOS, FreeBSD, NetBSD, OpenBSD;
Mobile: Android, iOS, Maemo, BlackBerry 10. The user can get official releases from SourceForge or take the latest sources from GitHub. OpenCV uses CMake.

OpenCV's application areas include:

- 2D and 3D feature toolkits
- Egomotion estimation
- Facial recognition system
- Gesture recognition
- Human–computer interaction (HCI)
- Mobile robotics
- Motion understanding
- Object identification
- Segmentation and recognition
- Stereopsis stereo vision: depth perception from 2 cameras
- Structure from motion (SFM)
- Motion tracking
- Augmented reality

To support some of the above areas, OpenCV includes a statistical machine learning library that contains:

- Boosting
- Decision tree learning
- Gradient boosting trees
- Expectation-maximization algorithm

- k-nearest neighbor algorithm
- Naive Bayes classifier
- Artificial neural networks
- Random forest
- Support vector machine (SVM)

3.2 PYTHON:

Python is a widely used high-level programming language used for general-purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy which emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly braces or keywords), and a syntax which allows programmers to express concepts in fewer lines of code than possible in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale.

Python features a dynamic type system and automatic memory management and supports multiple programming paradigms, including object-oriented, imperative, functional programming, and procedural styles. It has a large and comprehensive standard library. Python is widely used and interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems. CPython, the reference implementation of Python, is open source software and has a community-based development model, as do nearly all of its variant implementations. CPython is managed by the non-profit Python Software Foundation.

Since 2003, Python has consistently ranked in the top ten most popular programming languages as measured by the TIOBE Programming Community Index. As of August 2016, it is the fifth most popular language. It was ranked as Programming Language of the Year for the year 2007 and 2010. It is the third most popular language whose grammatical syntax is not predominantly based on C, e.g. C++, Objective-C (note, C# and Java only have partial syntactic similarity to C, such as the use of curly braces, and are closer in similarity to each other than C).

An empirical study found scripting languages (such as Python) more productive than conventional languages (such as C and Java) for a programming problem involving string manipulation and search in a dictionary. Memory consumption was often "better than Java and not much worse than C or C++" [17]. Large organizations that make use of Python include Wikipedia, Google, Yahoo!, CERN, NASA, and some smaller entities like ILM, and ITA. The social news networking site Reddit is written entirely in Python.

Python can serve as a scripting language for web applications, e.g., via mod_wsgi for the Apache web server. With Web Server Gateway Interface, a standard API has evolved to facilitate these applications. Web frameworks like Django, Pylons, Pyramid, TurboGears, web2py, Tornado, Flask, Bottle and Zope support developers in the design and maintenance of complex applications. Pyjamas and IronPython can be used to develop the client-side of Ajax-based applications. SQLAlchemy can be used as data mapper to a relational database. Twisted is a framework to program communications between computers, and is used (for example) by Dropbox.

Libraries like NumPy, SciPy and Matplotlib allow the effective use of Python in scientific computing, with specialized libraries such

as Biopython and Astropy providing domain-specific functionality. SageMath is a mathematical software with a "notebook" programmable in Python: its library covers many aspects of mathematics, including algebra, combinatorics, numerical mathematics, number theory, and calculus. The Python language re-implemented in Java platform is used for numeric and statistical calculations with 2D/3D visualization by the DMelt project.

Python has been successfully embedded in many software products as a scripting language, including in finite element method software such as Abaqus, 3D parametric modeler like FreeCAD, 3D animation packages such as 3ds Max, Blender, Cinema4D, Lightwave, Houdini, Maya, modo, MotionBuilder, Softimage, the visual effects compositor Nuke, 2D imaging programs like GIMP, Inkscape, Scribus and Paint Shop Pro, and musical notation programs like scorewriter and capella. GNU Debugger uses Python as a pretty printer to show complex structures such as C++ containers. Esri promotes Python as the best choice for writing scripts in ArcGIS. It has also been used in several video games, and has been adopted as first of the three available programming languages in Google App Engine, the other two being Java and Go. Python is also used in algorithmic trading and quantitative finance.

Python can also be implemented in APIs of online brokerages that run on other languages by using wrappers. Python has been used in artificial intelligence tasks. As a scripting language with module architecture, simple syntax and rich text processing tools, Python is often used for natural language processing tasks. Many operating systems include Python as a standard component; the language ships with most Linux distributions, AmigaOS 4, FreeBSD, NetBSD, OpenBSD and macOS, and can be used from the terminal. Many Linux distributions use installers written in Python: Ubuntu uses

the Ubiquity installer, while Red Hat Linux and Fedora use the Anaconda installer. Gentoo Linux uses Python in its package management system, Portage. Python has also seen extensive use in the information security industry, including in exploit development.

The Raspberry Pi single-board computer project has adopted Python as its main user-programming language.

3.3 RASPBIAN SOFTWARE PACKAGES:

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. Recent versions of Raspbian have been based on Debian Wheezy, but Raspbian has now been updated to the new stable version of Debian, which is called Jessie. The main softwares used for the implementation of this project are tesseract and eSpeak.

3.3.1 Tesseract software:

Tesseract is an optical character recognition engine for various operating systems. It is considered one of the most accurate open-source OCR engines currently available [18]. For a visually impaired person reading hard copy letters/brochures is a challenge since some sort of magnification is required. A good Optical Character Recognition (OCR) can be used to convert an image of a document to text. Tesseract (OCR) is found to be the best Open Source solution for converting images to text. It is highly accurate.

3.3.2 eSpeak software:

eSpeak is a compact open source software speech synthesizer for English and other languages, for Linux and Windows [19]. It is an artificial speech synthesis software which converts text to audio. eSpeak uses a "formant synthesis" method. This allows many languages to be provided in a small size. The speech is clear, and can be used at high speeds, but is not as natural or smooth as larger synthesizers which are based on human speech recordings.

Features of eSpeak:

- Includes different Voices, whose characteristics can be altered.
- Can produce speech output as a WAV file.
- SSML (Speech Synthesis Markup Language) is supported (not complete), and also HTML.
- Compact size. The program and its data, including many languages, totals about 2 Mbytes.
- Can be used as a front-end to MBROLA diphone voices, see mbrola.html. eSpeak converts text to phonemes with pitch and length information.
- Can translate text into phoneme codes, so it could be adapted as a front end for another speech synthesis engine.
- Potential for other languages. Several are included in varying stages of progress. Help from native speakers for these or other languages is welcome.
- Development tools are available for producing and tuning phoneme data.
- Written in C.

3.4 ADVANTAGES:

The diverse application of the Python language is a result of the combination of features which give this language an edge over others. Some of the benefits of programming in Python include:

1. Presence of Third Party Modules:

The Python Package Index (PyPI) contains numerous third-party modules that make Python capable of interacting with most of the other languages and platforms.

2. Extensive Support Libraries:

Python provides a large standard library which includes areas like internet protocols, string operations, web services tools and operating system interfaces. Many high use programming tasks have already been scripted into the standard library which reduces length of code to be written significantly.

3. Open Source and Community Development:

Python language is developed under an OSI-approved open source license, which makes it free to use and distribute, including for commercial purposes. Further, its development is driven by the community which collaborates for its code through hosting conferences and mailing lists, and provides for its numerous modules.

4. Learning Ease and Support Available:

Python offers excellent readability and uncluttered simple-to-learn syntax which helps beginners to utilize this programming language. The code style guidelines, PEP 8, provide a set of rules to facilitate the formatting of code. Additionally, the wide base of users and active developers has resulted in a rich

internet resource bank to encourage development and the continued adoption of the language.

5. User-friendly Data Structures:

Python has built-in list and dictionary data structures which can be used to construct fast runtime data structures. Further, Python also provides the option of dynamic high-level data typing which reduces the length of support code that is needed.

6. Productivity and Speed:

Python has clean object-oriented design, provides enhanced process control capabilities, and possesses strong integration and text processing capabilities and its own unit testing framework, all of which contribute to the increase in its speed and productivity. Python is considered a viable option for building complex multi-protocol network applications.

3.5 SIGNIFICANCE OF THE PROJECT:

Using RASPBERRY PI 3 controller and a combination of a web camera , a swtich keypad and a headset for our implementation, this project achieves in assisting blind facilitating object recognition, text recognition and face recognition.

3.6 ENHANCEMENTS OF THE PROJECT:

The further enhancement that can be made is interfacing the raspberry pi 3 database with the internet to get a wider database. This leads to significantly large improvement in the accuracy and comparatively a large number of products can be recognized.

4. WORKING MODEL:

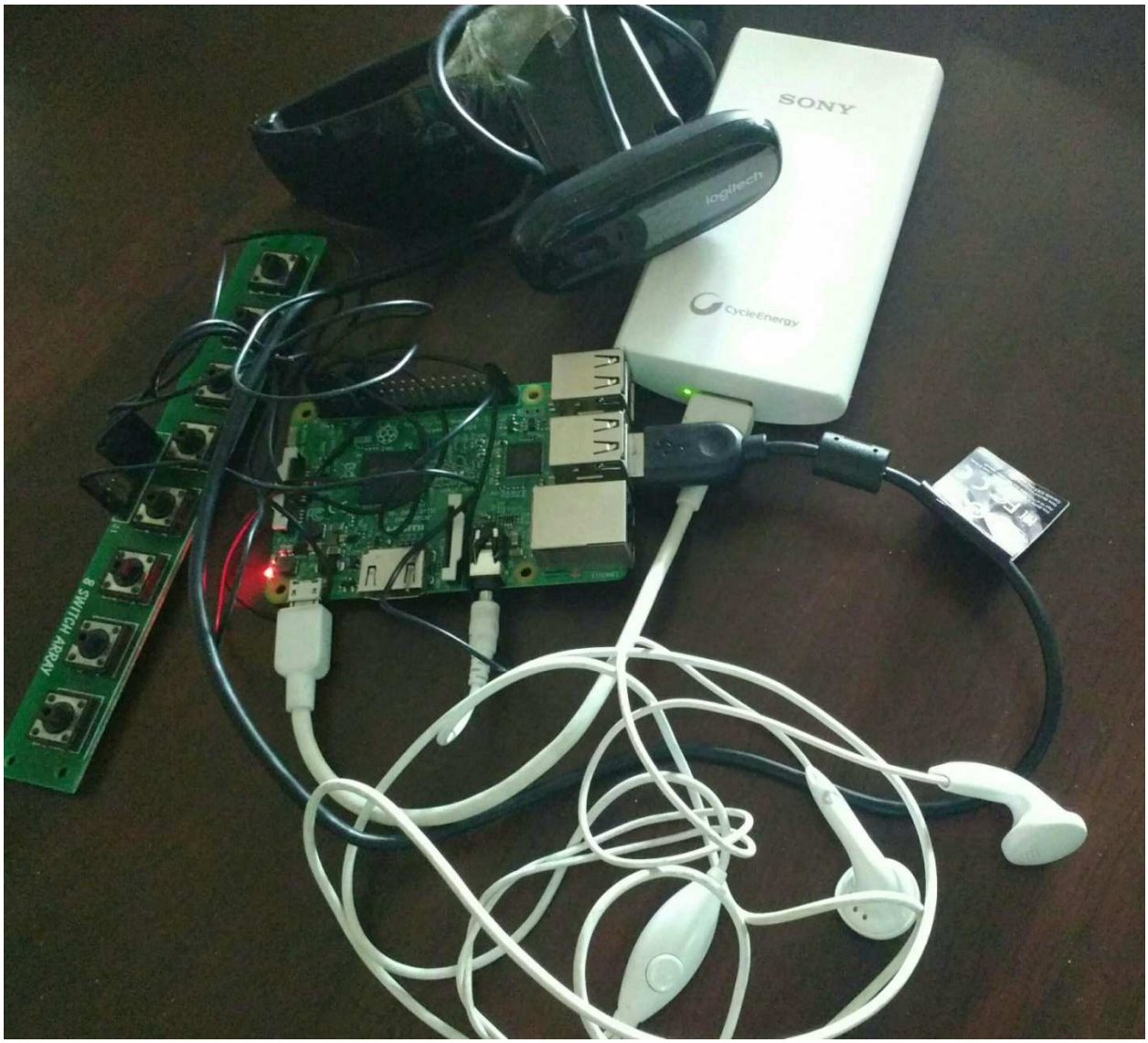

Fig 4.1:Working Model

5. CONCLUSION:

In this project, a prototype system to recognize human face, object and any text through a compact hand-held device for assisting blind people is proposed. In order to solve the common problems of an assistive device and to incorporate the ease of handling, array switch is added to distinguish the needs of the impaired person. To extract text regions from backgrounds we have implemented the use of the effective raspberry pi 3 mini computer's tesseract software. The method is very simple, comparatively less expensive and efficient. This algorithm has been employed on several structured images with different backgrounds and has obtained encouraging results.

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