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Hand Gestureand Face Recognition System For Visually Impaired People

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Abstract
Visually impaired peoples are facing several problems to move independently, and also they need the help of others. In this fast-moving world, help to these peoples may not be possible for all the people. And recognition of peoples, through voice is also difficult in some situations. To improve the mobility of the visually impaired peopled, introduced a system simple, user friendly, and cheap. The existing systems are helpful for blind people up to some extent only. This proposed system consists of three applications, they are face recognition, hand gesture, and distance calculation. In the face recognition system, the images are taken from the dynamic video, for face recognition and object detection Haar cascade classifier and LBPH recognizer are used. While in hand gesture the convex hull is used in different features like fingertips, the angle between fingers is being extracted. According to the recognized gesture, various tasks can be performed like controlling home appliances like fans and lights. In this, another application is there that is distance calculation to alert the blind person about the obstacle nearer to them.

Keywords: Cascade classifier Convexhull Haarlike features Human computer interface Open CV LBPH

1. INTRODUCTION

WHO World Health Organization on Oct 8 as the day of world sight. During that day WHO Records national blindness and visual impairment. According to the WHO 2019 survey, over 285 million visually impaired people in the world have blind population of 39 million and visually impaired population of 246 million. Visual deficiency is a critical global issue. By 2020, WHO estimates that the number of people with disabilities will rise to 75 million blind and 200 million? For blind and visually disabled individuals, one of the most difficult tasks is to identify people in different social interactions. Voice detection is the most common form used; sometimes in some cases, it becomes very difficult. They face lots of communication difficulties in their everyday lives; perform repetitive tasks like recognizing obstacles, identifying items and moving to a different location.

Now for the blind, OCR, blind obstruction and many more are evolving many new innovations a day. These devices are however not adequate to solve blind and visually disabled individuals. Many researchers can help blind people to design creative, clever, compact and reliable hardware, along with the use of efficient software, with use of latest innovations such as blinking sticks, hand-wearable's, etc. Only special functions are available in existing systems where more than three

functions are combined together in this proposed framework. This device functions as a smart, virtual assistant to bring the world together. This system allows blind and visually disabled people to travel from one location to another without the assistance of others. You can also identify or sense different common objects around you. This will allow them to pursue their day-to-day lives quickly, independently and in an affordable way.

This project creates facial, object recognition and hand gesture identification systems. The pictures are taken from the video and processed using certain algorithms. The device uses machine visions technology, the HCI technology is a physical medium that is used for face recognition and hanging motion. Ycbcr color was used in the hand gesture detection system, which detects hand convex character and uses various features, such as fingertips (fingertips) angle between fingers. Different tasks can be carried out to monitor electrical devices such as fan and light, according to the known gesture. This hand gesture was employed in many applications, including military games, etc., and there were more methods developed including portable gloves but too expensive and require sensors without using a computer vision. Many algorithms for the recognition of hand movements, such as KNN (K Nearest Neighbour), Artificial Neural Networks (ANN), are in use, but mostly a large number of algorithms are used to detect this problem. They are a static and dynamic gesture, two forms of gesture recognition. We use a static gesture in this.

Haar cascade system recognition system for better prediction and Linear Binary Pattern (LBP). Any picture is translated to a series of codes using the open CV. The face is identified by means of a camera and the captured face compares to the database, otherwise the individual is unauthorized. Device provides the data about this entity via ear phones as an audio signal, if any kind obstacle is encountered. You can also identify some different objects around you.

Distance calculation is often used as any an-other applications of this framework. It gives the details on the distance between the persons and any obstacle to warn the person or persons is very helpful. Manuscripts must be in English. These guidelines include complete descriptions of the fonts, spacing, and related information for producing your proceedings manuscripts.

a) Hand Gesture Recognition

The hand gesture recognition system can be divided into three parts. They are

- Hand region detection
- Pulling out the features
- Gesture recognition

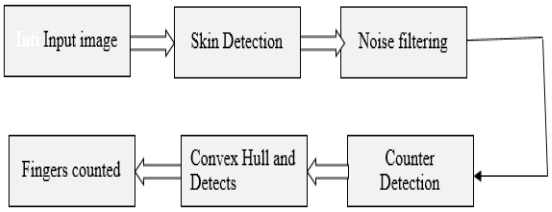

Figure 1 Hand Gesture Recognition System.

b) Hand Region Detection.

In this, first we have to separate the hand region from the input image for thresholding effect. It can be done in different colour spaces like RGB,YCBCR, LAB etc. Here thresholding means converting the image having multiple level intensities to two level intensities (0 or 1).

The image can be classified into wanted and unwanted pixels. These can be applicable according to their threshold value. Pixels value greater than the threshold value will be converted into 1 i.e., white and the pixel intensity value less than the threshold value be converted into 0 i.e, black.

Here the LAB colour space is using for thresholding images. In LAB colour space system hand and skin detection is performed using thresholding.

LAB is a 3-axis colour system with dimension L for lightness and A, B for the colour dimensions. The lightness rings for 0 to 100.Here'0' is black i.e, no light and 100 is white i.e, maximum illumination. In this model, a and b have two representation. They are +a,-a and +b,-b. Each one represents a different colours. They are +a means red,-a means green and +b means yellow,-b means blue. Theoretically they don't have any minimum and maximum values for a & b.

But in practice, they are usually numbered from -128 to +127(256 levels).The labs colour space is device independent and it also includes all according to the environment where the threshold value is taken as 80.The value above the threshold values represents the non-human skin and the values below the value represents the human skin. So that the human skin is detected in no light and the night also. After that a black and white image created for the hand detected and in this white colour determines the hand.

c) Pulling out the features

The next step of hand gesture recognition system is extracting the feature of detected skin. This can be done in the following sequence, they are contour detection, convex hull and detecting convex hull detects.

d) Counter Detection

Counter is one of the technique for edge detection. In this the line is drawn around which joins the points having similar features like colour, intensity and texture.to determine the hand gesture.

e) Bowed Hull

In convex hull first we have to know about the convex polygon. A convex polygon is a polygon which does not contain any concave part. In mathematics, it is defined as, take any two points in a polygon and connect the two points with in a straight line. If all the straight lines their connect any two points inside the polygon doesn't exceed the boundary of the polygon, then that the polygon is convex. The convex hull is smallest convex polygon that contains the set of points. It joins mainly fingertips because they are the hull points.

f) Convex Defects

Convexity defect is area in object segmented from an image. This means that area doesn't belong to the object but located inside the convex hull. Convexity defect is useful to understand the shape of a counter.

g) Gesture Recognition

To count the fingers and find the angle between the fingers three points are extracted from the convex hull. They are

- Starting point (St)
- Centre point (Ce)
- End point (En)

The length of the defects is calculated using these formula.

$$L1 = \sqrt{(st(0) - En(0)^2 + st(1) - En(1)^2)}$$
$$L2 = \sqrt{(Ce(0) - En(0)^2 + Ce(1) - En(1)^2)}$$
$$L3 = \sqrt{(st(0) - Ce(0)^2 + st(1) - Ce(1)^2)}$$

The area between the fingers is calculated by using herons formula .The distance between the defect point and the convex hull is computed using the formula.

Distance= (2*area)/L1

By using cosine formula. We have determined the angle between the fingers.

$$A=\cos^{-1}\left(\frac{L2+L3-L1}{2*L1*L2}\right)$$

The computed values of angle and distance are compared with the threshold values.

h) Face Recognition

Face Recognition consists of three categories to detect a face, they are

- ❖ Haar features.
- ❖ Integrated image
- ❖ Adaboost
- ❖ Cascading technique.

i) Haar features

It is a machine learning based approach. A cascade function is trained from a lot of positive and negative images, then we have to need extract the features from it Haar features are shown in figure The each feature is single value obtained subtracting sum of pixels under block rectangle.

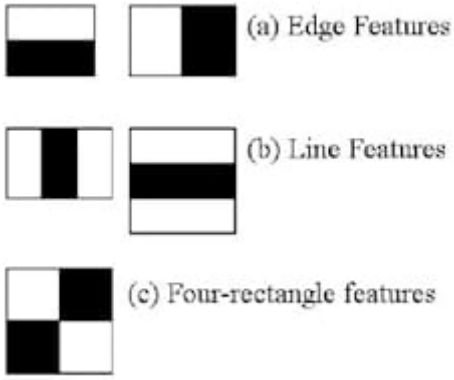

Figure 2 Haar features

j) Integral Image

Integral image is summing the pixels above and to the left an image so that pixels will not overall and extract insanities will be recorded.

To get new pixels value the top pixels and left pixels are added then all the values around the patch are added to obtain the sum of all pixel value.

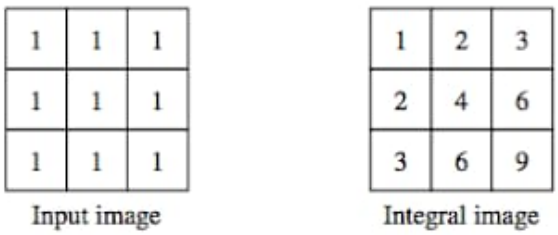

Figure 3 Integral Image Technique

k) Adaboost and cascading technique

In this technique, it finds the best relevant features and eliminations the irrelevant features. These linear combination is known as weak classifiers and adaboost constructs a strong classifier from the linear combination. The adaboost assigns a weight to all of them.

l) Local Binary Patterns

LPB is used for feature extraction. It is very useful and very advantages. Local structure of an image by comparing each pixel with its neighbourhood.

The steps to be followed are,

- The grayscale image resized is as input.
- In image 3x3 window size part is taken.
- This part is represented in the form of intensities of pixels & they are taken in the form of matrix.
- Take a centre pixel and threshold it with neighbouring pixels.
- The neighbouring pixels have an intense value greater than the centre pixel value consider it as '1' and which intensity value is lesser than the centre pixel value consider it as '0'.
- The process forms a matrix with '0' and '1'.The centre value will be neglected.
- The binary values are taken to form a decimal values.
- Decimal value placed in the centre value of the image.

m) Random-Forest classifier

Random-forest consists of large number of individual decision trues. Each individual tree split out a class prediction.

Random forest builds multiple decision tree & merges them together to get a more accurate & stable prediction.

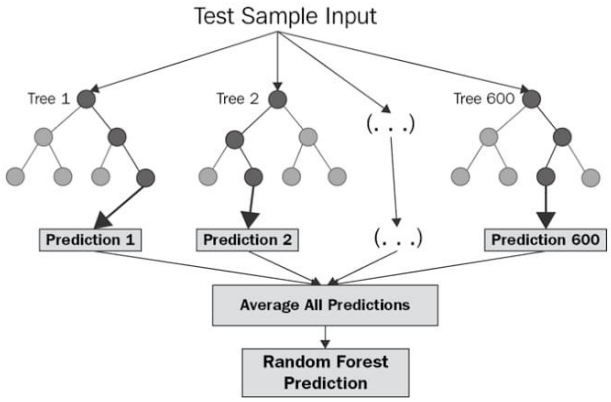

Figure 4 Test Sample

It efficiently runs on large number of database and it can be able to handle thousands of input variables without eliminating a single variable.

2. Block diagram

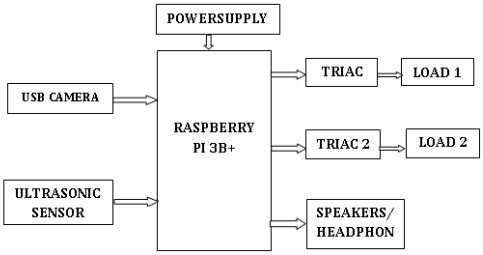

Figure. 5 Block diagram

The computer is fitted with Raspberry pi 3B+ devices, a speaker and earphone device, a Raspberry camera, an electricity supply (230V AC). The picture or live video is taken from the

camera for the identification of face and object. The output is as an audio signal, which tells the consumer the name of the entity or object. The ultrasound sensor gives the object's distance from the operator. The loads are triggered based on recognized hand signals and electrical equipment such as ventilators and lights are regulated. The block diagram shown above is the device block suggested.

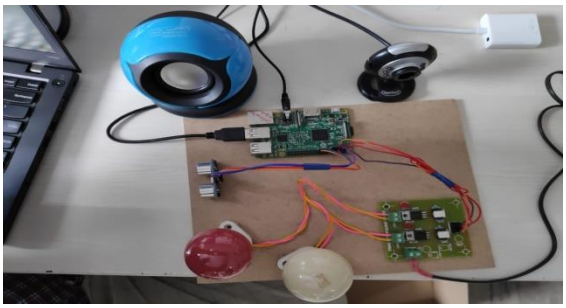

Figure 6 Project setup

2.1 Camera

For the capture of images, high-resolution camera is used. We used a low cost and high-resolution USB camera on the market with so many available cameras. Since the images can be easily transferred to the device. The camera records the user's pictures or dynamic video instructions.

2.2 Ultrasonic sensor

HC-SR04 echo sensor that uses a short echo ultrasound explosion and "listening" for detection of objects. The sensor emits a brief burst of 40KHZ (ultrasonic) under host microcontroller control (trigger pulse). It goes about 1130 feet per second through the air, hits an obstacle, and then goes back to the sensor. The sensor provides the host with an output pulse to terminate when the echo is detected, which ensures that the width of that pulse equals the distance from the destination. This output is transferred to an audio signal in the raspberry pi. This audio signal can then be heard through earphones/speakers. If there is an obstacle facing the sound signal, the gap is reversed by the time and the speed of the signal.

Range = (time * speed is running out)/2

2.3 BT 136 TRAIC

With the full terminal current 4A, the BT136 TRAIC is used. There is also very little gate voltage of the BT 136. So digital circuits will drive it. TRIACS are two-way switching systems; they are widely used for AC program switching. In this system I monitor the little domestic appliances operated by AC based on the loads triggered by the detected gesture of the hand.

2.4 RASPBERRY PI 3B+

The pi 3B+ is a little laptop in size MasterCard. We just need to connect keyboard, mouse, monitor, micro SD card, and power supply, install Linux distribution and run our Apps from word processors, spread sheets to game and then it's like a fully-fledged machine.

2.5 Face and object detection

It is a tool for people or cars or any object detecting faces or cars. This method contains both positive and negative images, and the classifier and integral images are chosen. The difference of pixels in both rectangular boxes is each characteristic. Here are darker and lighter regions of the rectangular boxes. These areas are horizontally and vertically identical in size and form. The definition of integral images is implemented in order to locate the number of pixels in black and white regions. No matter how high the pixel number might be, AdaBoost only works with a large number of features choosing the most important features. Weak categorizers form the final

categorizer together. They're bad because they can't recognize the object by themselves. Each step of the cascade must not have a low false negative rate as the classification stops if the face is identified as an entity. The defective detection of an object as facial would mean that each move has a high fake positive rate. Hence the error can be corrected in (n+1) the next stage and in successive classifications.

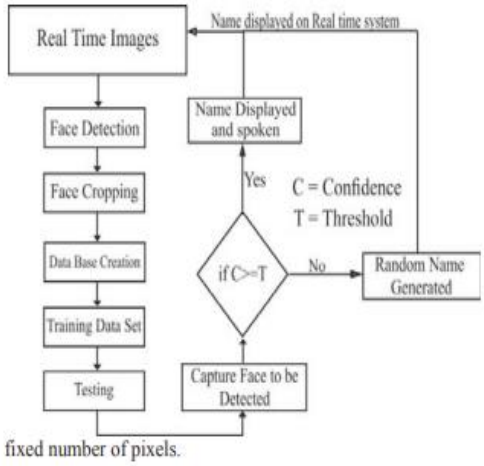

Figure. 7 Flow chart

If the blind man goes somewhere the face of the person is identified by the camera when someone goes through the webcam positioned in front of the device. The faces identified are transferred to the Raspberry Pi. In this Haar Classifier and ANN algorithm, the features are extracted and compared to the current database, which is the user's name by audio signals through the earphone.

2.6 Hand gesture recognition

Open computer vision APIs is included in the application. Open CV and Java CV process the input of the camera and use its frame algorithms. The system [3] has been developed so that 9 sign language gestures can be recognized in real mode via MATLAB. The color transformation model for the functionality extraction is captured via the webcam and YCbCr. PCA compares the captured image features with the training database and the minimum Euclidean distance calculated. The system consists of techniques such as pre-processing phase, transformation and extraction features and then ranking. The image in RGB format is transformed into a grey scale image that means the pre-processing procedure. The result is word for word. This system brings the auditory mute closer to the world. Capture images through a web camera. The results are compared to the stored database after pre-processing. The text appears if the value of a processed image matches the value of a stored image. Using a speech synthesizer, the text will be translated into speech. The image classification is based on the CNN neural networking algorithm. The CNN model is trained with pictures from every P gesture. The uploaded image (via android) is checked on the basis of these training data. The image uploaded goes through a few pre-processing steps before testing, such as resizing, gray scaling, and extraction of features. R belongs to the class group that is forecast.

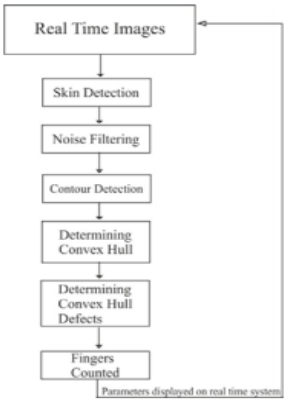

Figure. 8 Flow chart

For a deaf and stupid person with an Android device connected to a webcam, this system is useful to monitor appliances. Home automation for physically disabled uses wireless technology. Physically disabled people use home appliances very quickly in this method or use the machines comfortably.

2.7 Distance measurement

Measurement of distance is done by the ultrasonic sensor shown in the following fig. when the blind person is walking, if person or any obstacle is mounted in front of the device, the sensor will detect that object. The output of the sensor goes to the controller. This controller gives the output to the Raspberry pi which gives the output to the user in the form audio signal as object sensed trough the earphones/speakers.

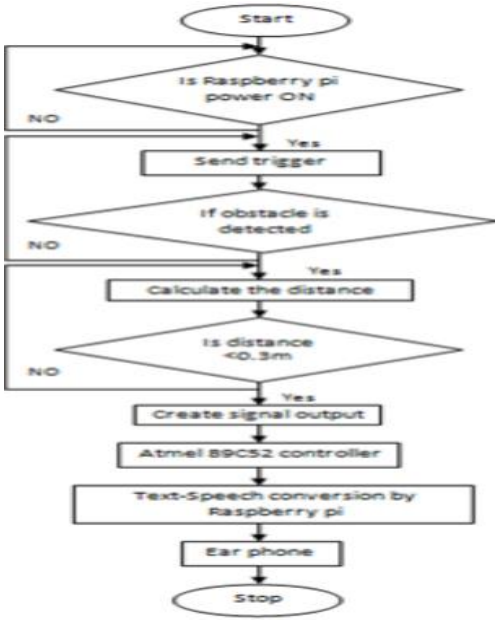

Figure 9 Flow chart

3. Literature review

Many researchers say that providing effective devices for impaired people is a challenging task for the engineers around the world. A search is being processed on this domain from four years. Astatic hand gesture and face recpgnition system for blind people [1] released in 2019, In this paper the author discus about the classifiers like Haar cascade and LBPH recognizers used for face recognition and identification, and Hand gestures are recognized for performing various tasks. A Raspberry pi B+ model is used for the processing.

K. N. Trong, H. Bui and C. Pham, "Recognizing hand gestures for controlling home appliances with mobile sensors [2]" released in 2019. This paper proposes an integrated method and system that utilize several deep models and mobile sensors for hand gestures applicable for smart homes. The system consists of three components of actual smart home configurations: (i) smart-watch worn on the user's wrist for capturing gesture patterns (ii) a recognition application that runs on the smart mobile and sends correspond commands to the house automation platform; and (iii) home automation platform with connected smart devices instrumented with ambient sensors. In addition, we define a simple yet easy-to-learn hand-gesture vocabulary composing of 18

gestures to the use.

MukundPatil, RohitPatil, RadhaBorikar, V. V. Khatavakar, “Obstacle Sensing Walng Stick for dim-sighted People using Raspberry-PI[3], This paper defines smart stick that uses associate unsounded device to note obstacles ahead exploitation unsounded waves. The data of detected obstacle is provided to the microcontroller, then microcontroller methodology data and if associate obstacle is detected, it sends an indication to the buzzer and buzzer beeps.

SamarthaKoharwal, SamerBaniAwwad, Aparna Vyakaranam ,” Navigation System for Blind - Third Eye [4]“In this paper proposes a simple electronic guidance embedded vision system which is configurable and efficient. The system utilizes three sorts of devices including IR sensor, sonar sensor and camera. A microcontroller processes the reflected signals from all devices so as to classify front obstacle.

G.A.E.Satish Kumar , M. Munindhar, “Intelligent Assistive System for Visually Disabled Persons”[5], This device has an obstacle detection sensor to intimate the obstacles to the visually impaired person and a camera connected to Raspberry pi to convert image to text using Optical Character Recognition (OCR). The read data is converted to speech using text to speech synthesizer.

4. Experimental results

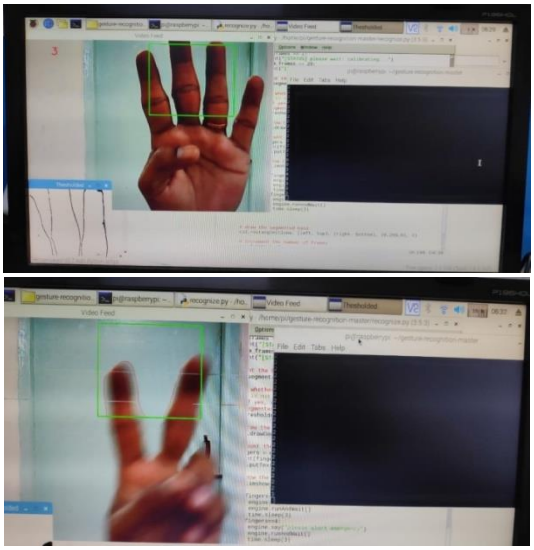

Figure. 10 Recognizing hand gestures: Showing the count of numbers

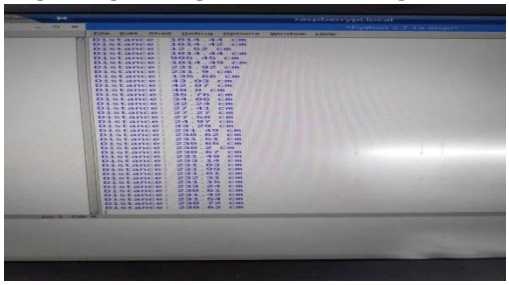

Figure. 11 Screen shot of measurement of distance

Figure. 12 Object detection

The image capturing, converting it into text and object detection are experimented many times to get the accurate results. We tabulated the no. of tests and accuracy of the device for image detection process as below.

Table 1. Testing the object detection and accuracy

Test case	No. of times	Result
Cell phone	10	85-95%
Book	7	60-75%
Cat	4	70-80%
Toothbrush	3	80-95%
Laptop	5	76-87%
Person	10	75-91%
Pen	8	73-85%

Table 2. Testing the ultrasonic accuracy

Condition	Instruction	Accuracy
Obstacle detected	Attention, obstacle detected at 45cm	9
Obstacle detected	Attention, obstacle detected at 25cm	10
Obstacle detected	Attention, obstacle detected at 15cm	10
No obstacle	-	10

5. CONCLUSIONS

The system introduced during this paper is extremely useful for visually impaired people and it can act as a virtual assistant for them. During this paper, a face recognition system is presented and

therefore the algorithm is validated by comparing it with a special state of the art face detection models. In object detection, the obstacle may reside on the still left, right or straight. The reactions are going to be given supported the obstacle's position and distance. This developed prototype facilitates free and self-reliant movement by a blind man. It detects solid type obstacles sort of a car, cycle, dog, truck etc. by using ultrasonic sensor. The image is going to be converted into text 'dog' and text is going to be converted to speech. In hand gesture recognition, various gestures are often recognized and various tasks are often performed consistent with them .And the blind man will ready to know the speech by earphones attached to the output of Raspberry Pi. The system helps blind and visually impaired people to be highly self-dependent by assisting their mobility no matter where they are; outdoor or indoor.

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	Dr J Krishna Chaithanya is a Certified IGIP (Austria) - IEE (International Engineering Educator) Pedagogy, with 14 years of experience as a successful engineering educator & always set high standards and consistently achieved his goals. In last 10 years at Vardhaman, have been commended major initiatives at department & college level where worked in the areas of Academics like TLP, Curriculum Design, Assessments (Course cum Practicum), Domain Lead & Administration like NBA Program Coordinator, EPICS Coordinator cum Evaluator under IEEE-EPICS INDIA, Mentor of change at AIM (ATAL Innovation Mission) NITI AAYOG & Organized many intra & inter college events/workshops for students & faculty. In R&D area, Supervising a DST-TIDE project & 2 more projects under recommendation to get sanction, Filed 2 patents one in defence, consultancy work done on Design & development of Industrial Timer for State of Telangana with Embedded RF Technologies formally known as ThinkIoT Solutions Pvt Ltd, Hyderabad & Published 21 research articles in various specializations under various national & international journal/conferences, Published an academic version book internationally andcreated some significant identity in college as well as society.

	Dr.S.Janardhan Rao completed PhD from NagarjunaUniversity.Has has worked in Indian Airforce in Rader operations and maintance. He has 15 years of teaching experience. Published Number of Papers in Image Processing.