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ARM Based Smart Home Embedded System for Voice And Face Recognition

JYOTHI GORIPARTHI[1], KAMESH SONTI[2], LALITHA BHAVANI MADDIPATI[3]

[1]PG Scholar, Dept of ECE, Sasi Institute of Technology and Engineering, Tadepalligudem, AP, India,
E-mail: Jyoti.goriparthi@gmail.com.

[2]Assistant Professor, Dept of ECE, Sasi Institute of Technology and Engineering, Tadepalligudem, AP, India,
E-mail: Kamesh@sasi.ac.in.

[3]Assistant Professor, Dept of ECE, Sasi Institute of Technology and Engineering, Tadepalligudem, AP, India,
E-mail: mlalitha@sasi.ac.in.

Abstract: Security systems are becoming the unavoidable systems in today's life because of the increasing criminal activities. ARM Based Smart Home Embedded System for voice and face based user recognition is mainly used for security purpose. A natural way to identify a person is through their voice and face. In this paper a real time security system is implemented. If any person wants to open the door, the security system will check the person's authentication. The system allows only the authorized user to open the door. First users pronounce a password through MIC which he enrolled and the MIC is present on ARM 9 board. Secondly, using an USB camera interface images is captured and the image is processed with help of compared with existing database. And finally if the current image is matched with any of existing image the system opens the door. If it finds any unauthorized person, the Smart Home Embedded System will block the person to open the door and it will send the unauthorized image as a MMS to mobile.

Keywords: GSM Module, Person Authentication System (PAS), Voice Recognition, Face Recognition, Face Detection, Security Mobile Number (SMN).

I. INTRODUCTION

Now a day's the fting is increased and it is the main problem everywhere. Many security systems such as, home security systems are to prevent thieves from intruding are available in market. Due to advancement in technology, there is a wide development of these security systems to protect from security attacks. Home security is becoming necessary as the possibilities of intrusion are increasing day by day. Home security has changed a lot from the last century and will be changing in coming years. The new and emerging concept of smart homes offers a comfortable, convenient, and safe environment for occupants. Conventional security systems keep homeowners, and their property, safe from intruders by giving the indication in terms of Multimedia Messaging service (MMS). However, a Smart Home Embedded System offers many more benefits. The system mainly focuses on the security of a home when the user is away from the place. Two systems are proposed, one is based on voice recognition technology and other uses web camera to detect the intruder. A natural way to identify a person is through their voice and face. Voice characteristics are different among individuals due to differences in their sound dynamics, vocal chords, teeth etc. Voice recognition systems are in general very useful in many tasks. Among those very important applications in our everyday life are secure telephony, voice-based login, and voice locks. They are also used as a security key we can use the voiceprint of every human being [1]. But, voice based security systems are accurate methods of identification, so the Smart Home Embedded System we introduce face recognition system for automatic door access. Face recognition process can be implemented easily in security systems rather than other biometric systems such as fingerprint, signature, etc. Face recognition is the process where that detected and processed face is compared to a database of known faces, to decide who that person is.

II. RELATED WORK

According to T. Kinnunen and H. Li [2], the technology advancement in the recent years has addressed several technical challenges such as text/language dependency, channel effects and cross-talk speech, so they developed text independent telephone-based services with integrated speech recognition. F. T. H. den, M. Balm [3] states that, a residential gateway connects one or more access networks to one or more home networks and delivers services to the home environment. Saeed and M. K. Nammous [4] implemented speech and speaker identification method. It is based on spoken Arabic digit recognition. The success rate of the speaker-identifying system obtained for individually uttered words is excellent and has reached about 98.8 %. S. J. Young [5] states that continuous speech from any speaker with average word error rates of between 15 and 30%. LVCSR systems are not robust to mismatched training and test conditions and cannot handle context. Face detection using artificial neural networks was done by Rowley [6]. Neural

network is a nonlinear network adding features to the learning system. Hence, the features extraction step may be more efficient than the linear Karhunen- Loeve methods which chose a dimensionality reducing linear projection that maximizes the scatter of all projected samples [7]. This has classification time less than 0.5 seconds, but has training time more than hour or hours. Geometrical features image of a face is done by T Kanade [8]. The overall configuration can be described by a vector representing the position and size of the main facial features, such as eyes and eyebrows, nose, mouth, and the shape of face outline. Their system achieved a peak performance of 75% recognition rate. Graph matching is another method used to recognize face. M. Lades et al [9] presented a dynamic link structure for distortion invariant object recognition, which employed elastic graph matching to find the closest stored graph. But the matching process is complex and computationally expensive. I.J. I.J. Cox el [10] introduced a mixture-distance technique which achieved 95% recognition rate on a query database of 685 individuals. In this, each of the face was represented by 30 manually extracted distances.

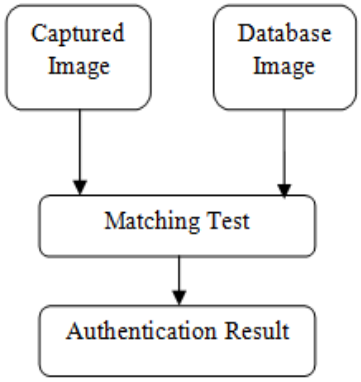

Fig.1. PAS Block Representation.

The Smart Home Embedded system consists of a Processor using ARM core, GSM module and GPS receiver unit as hardware parts and an effective face recognition system using Matlab platform as shown in Fig.1. Initially the owner's image and the members of the family should be stored in the database. Whenever a person is trying to open the door, the face detection recognition unit will takes the image and it will compare with the database image. If the image is matched then the door will be opened without any problem. In case if the image is unmatched, then the captured image will be send to the stored Security Mobile Number (SMN). Most case we can store the owner's mobile number as the SMN. Now, the owner has to check whether it is a known person or unknown person. If it is a known person, then the owner can leave it simply. But if it is an unknown person, then owner can send a password to the system. Once the system received this command it will block the user to open the door.

III. OVERVIEW OF THE SYSTEM

In this concept, Password through voice and image of face should be enrolled by user before recognized by the system. First, users pronounce a password through mic and mic is present on board. If system recognize user password it goes to face recognition process. In this process, camera captures the image of user. Suppose if the system recognizes the user face, then the door gets open. In our designed system users pronounce a password through MIC which he enrolled and the MIC is present on ARM 9 board. Secondly, using an usb camera interface images is captured and the image is processed with help of Matlab and compared with existing database. And finally if the current image is matched with any of existing image the system allows the user to open the door. If the current image is not matched with the database image the system blocks the user to open the door.

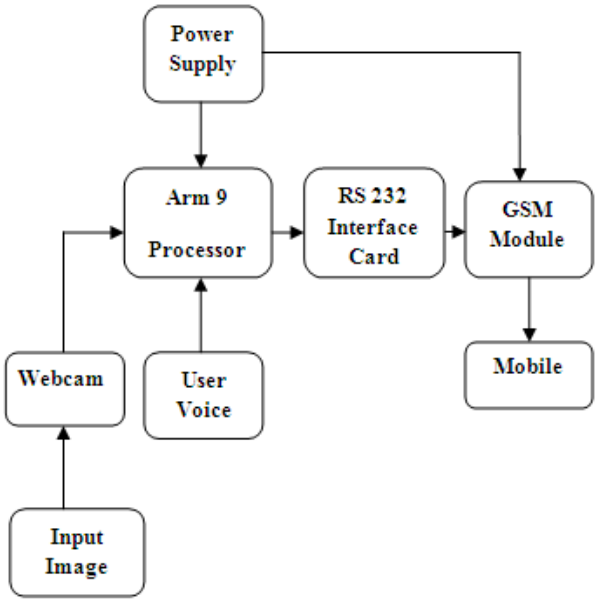

Fig.2. Block Diagram.

The block diagram of Smart home embedded system is shown in fig.2.and its blocks are explained briefly below.

A. ARM 9 Processor

ARM9 is an ARM architecture 32-bit RISC family. With this design generation, ARM moved from von Neumann architecture (Princeton architecture) to Harvard architecture with separate instruction and data busses, significantly increasing its potential speed. Most silicon chips integrating these cores will package them as modified Harvard architecture chips, combining the two address busses on the other side of separated CPU caches and tightly coupled memories. The ARM968E-S is a general purpose 32-bit RISC processor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective controller core.

B. GSM Module

Global System for Mobile communication (GSM) is a globally accepted standard for digital cellular communication.

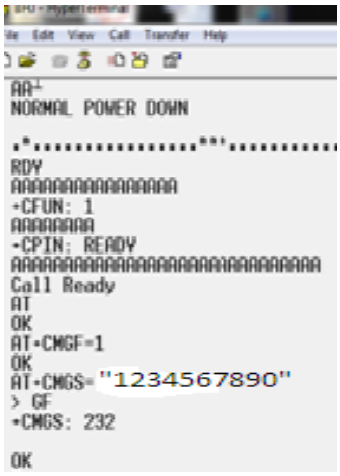

Fig.3. GSM Modem Configuration.

GSM was designed with a moderate level of service security as shown in Fig.3. The system was designed to authenticate the subscriber using a pre-shared key and challenge-response. Communications between the subscriber and the base station can be encrypted. Standards extended AT commands are defined in the below. The development of UMTS introduces an optional Universal Subscriber Identity Module (USIM), that uses a longer authentication key to give greater security, as well as mutually authenticating the network and the user whereas GSM only authenticates the user to the network (and not vice versa). The security model therefore offers confidentiality and authentication, but limited as shown in Fig.4. To send the SMS message to check the GSM Modem is correctly configured or not, type the following command:

AT+CMGS="+31638740161" <ENTER> you can now type the message text and send the message.

Using the <CTRL>-<Z> key combination:

TEST MMS! <CTRL-Z>

Here CTRL-Z is keyword for sending a sms through modem.

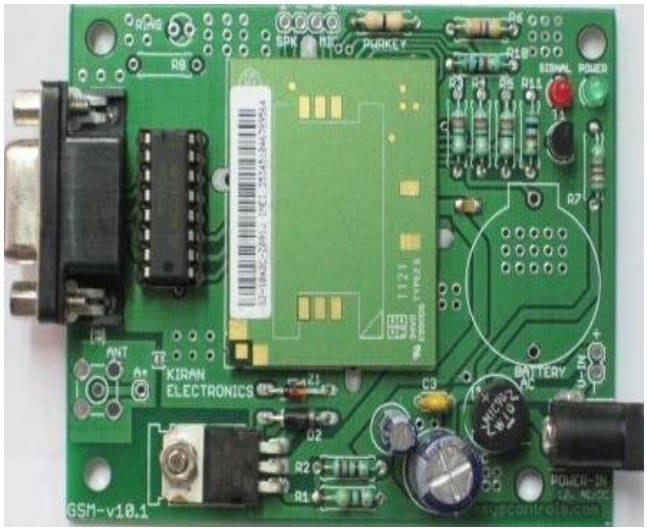

Fig.4. GSM Modem.

C. Speech Recognition Module

This speech project design takes a modular approach. Both the keypad and digital display are removable from the main circuit board. Once the circuit is trained and tested, the keypad and display are not needed. They only need to be reconnected for changing words and retraining. Removing the keypad and display from the main circuit board simplifies embedding the speech recognition board into your design. The two speech interfaces we will build later, both plug into the digital display connector on the main circuit board.

D. Webcam

The term 'webcam' is 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. A webcam is a video camera that feeds or streams its image in real time to or through a computer to 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 email 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.

E. Software Platform

A face recognition system is used which will do the key role in the entire operation. For the face recognition system, we are using the MATLAB and for sending MMS and Processor communication VB Platform is used.. The image recognition will process in the following way. For capturing the image we need to use a camera which should support a YUY2_640x480 format. Initially we have to take the data base image and should store in the project folder. The supportable camera configuration in the MATLAB is given in the form of the following data function vid= videoinput ('winvideo',1,'YUY2_640x480'); Initially ten data base sample image have to be stored in the project folder to get the effective feature extraction. Once the camera captured the image means it will be send to MATLAB. Whenever MATLAB reads an image it will convert into grey scale format because for recognition purpose the image should be a single plane. After capturing the image, we need to click on the database. As an acknowledgement we will get the following help dialogue. Then pre-processing will be done within the captured image and the database image which involves Similarity checks and probability finding. Here similarity checking is nothing but the comparison between two images by calculating the distance between the input and data base image. We can do this by an effective edge analysis and pixel analysis. Using the function value = Euclidean Distance(X, Y), we can find the similarities between the input image and data base image and also the changes in the same input after a particular time period. Finally, pixel value result will be compared with the mean and median value to find the authentication. Then the result will be shown on the MATLAB. If the image is matched then there will not be any response to the SMN. But if the image is not authorized then,

the captured image will be send to the SMN through GSM modem. This MMS sending will be done through Visual Basic software. The GSM module will be configured through VB platform. when the image is unauthorized, MMS will be sending through the Security Mobile Number. If the owner replied a command, then the GSM module will read the data and send to the Visual Basic platform which in turns passes the command to the Processor.

```
if (cnt1>2 || cnt2>2)
if cnt1>cnt2
warndlg ('Authorized Person');
else
errordlg('Person not Authorized');
```

IV. EXPERIMENT RESULTS

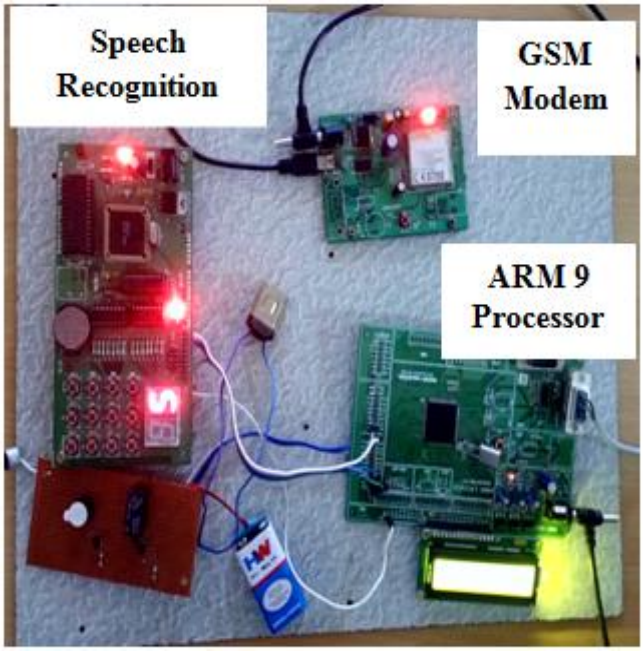

Fig.5. Smart Home Embedded System.

The Smart home embedded system proposes an algorithm for the real-time recognition of voice and face. This real-time algorithm is based on implementation of voice recognition, face detection, and face recognition. The system uses Matlab and VB Platform. The Smart Home Embedded system shown in Fig.5. If any person wants to open the door, the security system will check the person's authentication. Smart home Embedded System allows only the authorized user to open the door. In this particular implementation first user should pronounce a password and next password verification will be processed. If it is verified it goes to face recognition. The live input real-time image is captured through camera. The system detects face and next face recognition process takes place. The Weber's law is used to detect only the face. System compares the current image with the images stored in the database. Only the owner and member's of family. Suppose user face is matched with existing database then the system allows the user to open the door as shown in Fig.6. If it is not matched then the system blocks the user to open and the system sends an unauthorized image as an MMS to the registered mobile number.

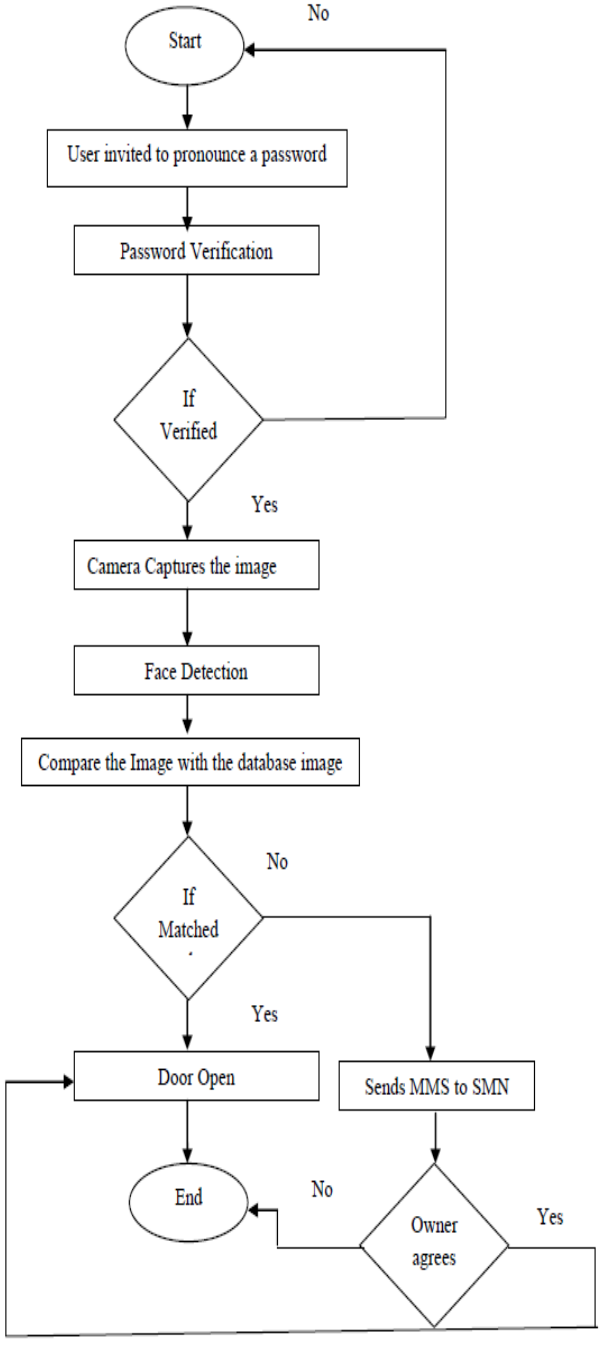

Fig.6. Proposed System.

Step 1: Once all connections are provided for the Smart Home Embedded System then turn on the processor. LCD display starts with Smart home Embedded system when we turn on processor as shown in Fig.7.

Fig.7. Display when we switch on the Processor.

Step 2: First a user starts with voice verification User should give the password through mic which he enrolled and the mic is present on board. If it is recognized it will goes to the next step that is face recognition.

Step 3: The Train button is used for enrolling the owner and their family member's images in database.

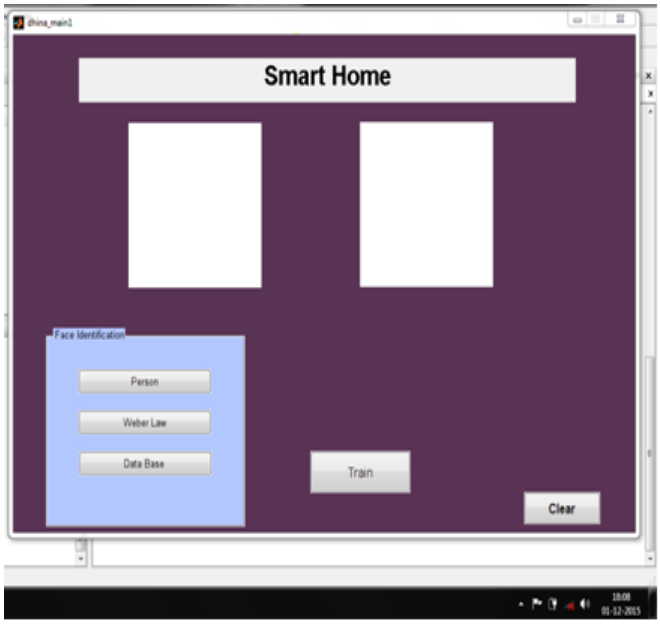

Fig.8. User's enrolling images.

We've to capture user images using Person button. Image can be capture in different angles. When the training process is completed we will get a dialogue box as shown in fig 9.

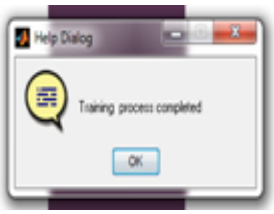

Fig.9. Training Process.

But we've to capture only facial features eyes, nose and mouth. So, The Weber's law button is used to detect only the face. And the captured image is converting into gray scale image as shown in fig.10.

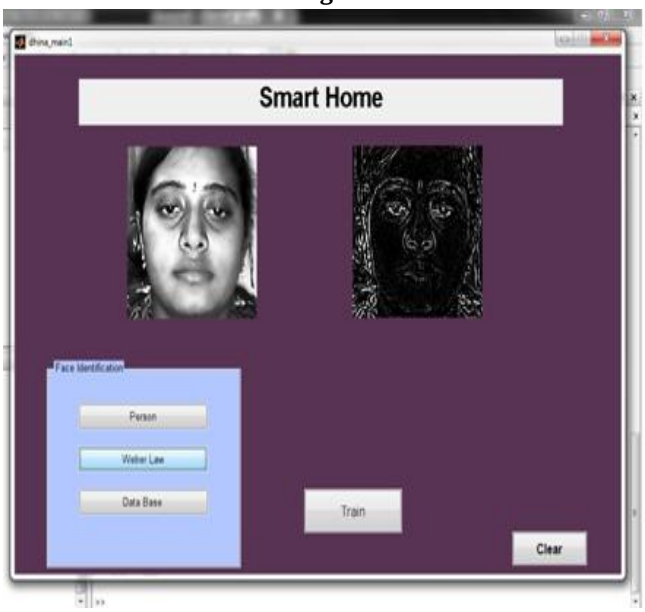

Fig.10. Gray Scale Image.

Step 4: By using database we can compare the current image with the database image. If it is matched then the LCD display is as shown in the fig.11 and the Door gets open.

Fig.11. LCD Display.

Step 5: If the current image is mismatched with the database image then system displays unauthorized and it calls the MMS function as shown in Fig.12.

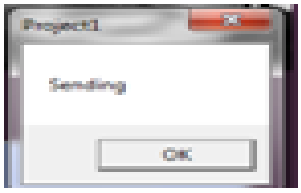

Fig.12. Sending an MMS.

Step 6:

Fig.13. After MMS Sent.

The MMS function gets called by the system and it sends the mismatched image as an MMS to the registered mobile number as shown in Fig.13. If the Owner sends reply to the system then the door gets open else it won't as shown in Fig.14.

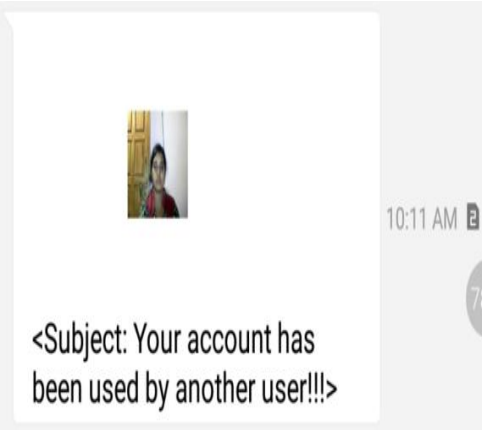

Fig.14. MMS Received.

V. CONCLUSION

From this we have implemented person authentication system (PAS) that can provide the important functions required by advanced intelligent home Security system. Secured and safety environment system and also key points for the investigators can easily find out the unauthorized image. We can predict the theft by using this in our day to day life. This project will help to reduce the complexity and improve security, also much cheaper and smarter than traditional ones.

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Author's Profile:

Jyothi Goriparthi pursuing her M.Tech in Very Large Scale Integration and Embedded Systems From Sasi Institute of Technology and Engineering, West Godavari District, Tadepalligudem, Andhra Pradesh 534101,
Email: jyoti.goriparthi@gmail.com.

Kamesh Sonti Working as Assistant Professor, from Electronics and communication Engineering in Sasi Institute of Technology and Engineering, West Godavari District, Tadepalligudem, Andhra Pradesh 534101,
Email: kamesh@sasi.ac.in.

Lalitha Bhavani Maddipati Working as Assistant Professor, from Electronics and communication Engineering in Sasi Institute of Technology and Engineering, West Godavari District, Tadepalligudem, Andhra Pradesh 534101,
Email: mlalitha@sasi.ac.in.