International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 3 Issue: 4 2273 – 2281

Marathi Speech Interface System for the Activation and Controlling of Electronic Equipment

Santosh Gaikwad , Bharti Gawali *, Suresh Mehrotra
System Communication Machine Learning Research Laboratory(SCM-RL),
Department of Computer Science and Information Technology,
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.), India
santosh.gaikwadcsit@gmail.com, bharti_rokade@yahoo.co.in, mehrotra_suresh15j@gmail.com

Abstract— This paper provides a framework to design Marathi speech recognition interface system to control the electronic equipment like fan and electric bulb. This system is designed using HM2007 speech recognition kit. HM2007 is a single chip CMOS LSI circuit with on chip front end and analysis. The interface system is trained with the database of total 15 most commonly used words to activate and control the equipment. The training and testing of Marathi speech interface system is done in noisy and noise free environment. The performance of MSAEE system calculated on the basis of False Acceptance Rate (FAR), False Recognition Rate (FRR), Word Error Rate (WER), sensitivity, specificity and F-Measure. The average accuracy obtained in noisy environment is **88.77%** whereas the accuracy of **98.88%** is achieved without noise. The sensitivity value is superior then specificity means MSAEE system is robust and dynamic. FAR values is most significant than value of FRR so, it means MSAEE system proved a best solution for controlling electrical appliances. HM2007 is found to be most promising speech recognition IC, through which many speech interface application can be built that will be beneficial to people with less mobility.

Keywords- *HM200;, WER; FAR;FRR; Speech Recognition;Electrical Appliances; Responding Time;, Human Machine Interaction.*

*****

I. INTRODUCTION

Interface between man and machine have always proved a challenging area in natural language processing and in speech recognition research. Current research emphasizes on difficulties in dealing with variation naturally present in speech. There is growing interest in developing interface machines that can accept speech as input. Normal person generally communicate with the computer through a mouse or keyboard. It requires training and hard work as well as knowledge about computer, which is a limitation at certain level [1]. From the enriched literature, it is observed that the substantial research efforts in speech recognition were done worldwide. In the current technological era, computer becomes faster and smaller so, expectation of researchers towards more applications development in speech recognition.

Creation of speech interface system is a need for needy and physically challenged people. The computer thus becomes suitable choice to design and develops speech interface system [2]. However, till date no suitable universal interaction model has yet been proposed, which is efficient and effortless for communication through voice[3]. Much more work has been carried out in speech recognition field and hence several ways are proposed to interface between the electric equipment. Most of control devices have been executed using wired as well as wireless system, which includes remote controls and internet [4].

This research explains the design and development of Marathi speech activated electronic equipment system (MSAEE). This interface system is implemented using HM2007 IC with integrated memory chip. It has limitation of storage capacity of total twenty words. For smooth functioning of MSAEE system isolated command words are used such as सुरु(start), बल्बसुरु(light on) and बल्बबंद (light off). Besides the basic operation of the electronic equipment such as on and off, we pursued to provide additional features of training which controls the speed of the fan. This also includes remote connectivity option and a direct testing of all electrical equipment of 230 A.C. volts. The remote connectivity is to allow hands free interaction with electronic devices. This research effort attempts to provide the solution for the physically handicapped and elderly persons in society. Using MSAEE system these peoples are control the electric appliances by sitting on a wheelchair, bed and working environment.

This paper is organized as follows: Section 2 describes the related work of this experiment. Section 3 describes detail information of HM2007 speech recognition kit. Section 4 explains the speech vocabulary for designing the system. Section 5 describes the designing of Marathi Speech Activated Electronic Equipment (MSAEE) system. Section 6 provides functionality of dimmer for controlling the fan. Section 7 describes the detail of performance evaluation of MSAEE system. Section 8 describes the results and discussion and Section 9 describes the concluding remark followed by references.

II. RELATED WORK

It is easy to have controlled devices using remote, instead of controlling the devices traditionally. The property of control devices varies on the basis of front end, back end and interaction techniques. The variability in properties of the control devices are observed using of interaction modalities, display dimension and available software platform. In the current technology the foreign mechanism for controlling devices are set the new requirement for the designing speech based interfaces [5].

Human beings are comfortable with speaking directly with computers rather than depending on primitive interfaces such as keyboards and pointing devices. The primitive interfaces like keyboard and pointing devices requires certain amount of skill

 ISSN: 2321-8169
2273 – 2281

for effective usage. Use of mouse requires good hand-eye coordination. It is very difficult for visually handicapped person to use computer. Moreover current computer interface assumes a certain level of literacy from the user. It expects the user to have certain level of proficiency in English apart from working skill. Speech interface helps to solve these issues [6].

Communication with computer through a suitable and user-friendly interface has always been an important technological issue. Machine-oriented interfaces restrict the computer usage to a minuscule fraction of the people, who are both computer well-educated and familiar with written English. Computers which can recognize speech in native languages enable common man to make use of the benefits of information technology [7]. As compared to traditional control interfaces the speech based interfaces reduces the amount of attention and benefitted with multitasking functionality.

The advantage of speech recognition includes user efficiency, productivity and compact key input. It improves timeliness and accuracy of information made available using voice [8].The speech based user interface is developed for keyboard access and mouse control. Such interface is helpful for the users with motor impairment [9].

An interface of speech is developed in English for dictionary searching through machine model for Automating Directory Assistants [10]. Various home automation system for safety are created using ZigBee wireless communication module along with microcontroller [11] . There is an existence of a Spoken Dialog interface in Dutch for Public Transport Information Service to get the information about journeys between two train stations [12].

Controlling devices for different application domain has always been a major area of interest. Much of work is done in this area and suggested many ways to control the devices, the clap sound is used to control wheelchair [13]. Most of research work done in the speech interface for different application domain with different language. The Marathi speech interface like speech activated calculator is developed by Hashimah et al.[14]. Till date no commercial application was developed for electric appliances control in Marathi language. This research attempts to provide controlling the electric appliances like bulb and fan using HM2007 speech recognition kit in Marathi language.

III. HM2007 Speech Recognition Kit

For the implementation of Marathi Speech Activated Electrical Equipment a HM2007 IC is used. HM2007 is a single chip CMOS LSI circuit with on chip front end and analysis. Circuit is composed of using the external microphone, keyboard, 8x8KSRAM and basic components [11]. The schematic diagram of HM2007 speech recognition kit is described in figure 1.

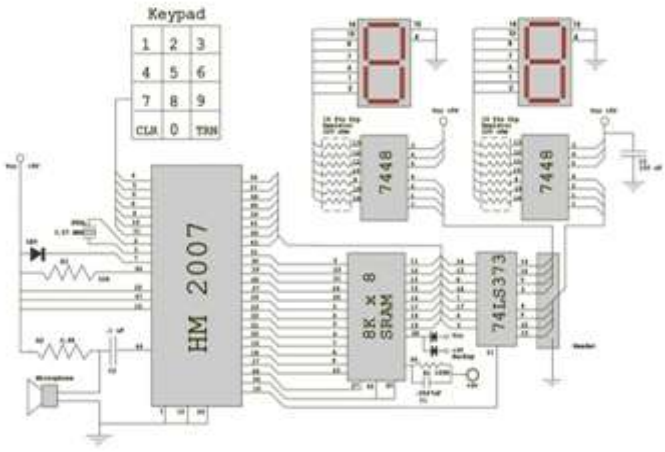

Figure 1. Schematic diagram of HM2007 Speech Recognition Kit

The circuit provides 13-bit address bus and 8-bit data bus for communication with the 8x8KSRAM. For communication with interface device a 4-bit wide K-bus was used for passing data and 3-bit S-bus for sending command towards HM2007 [15]. HM2007 is also available in 48-pin PDIP approach [16].The pin description of HM2007 is shown figure 2.

Figure 2. Functional Pin Description of HM2007

The kit includes a headset microphone and three PC boards component. The major component is shown in figure 3.

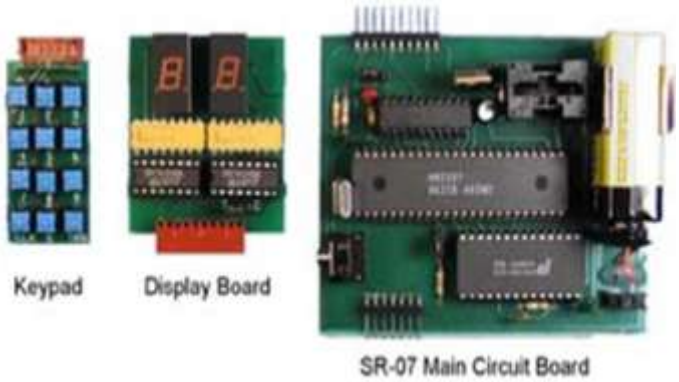

Figure 3. Major component of HM2007 speech recognition kit

 ISSN: 2321-8169
2273 – 2281

HM2007 circuit has 8 bit data, which can be interfaced with microcontroller for further interface development. It has non- volatile memory backup 3V battery onboard which will keep the speech recognition results in memory even after power off [11]. The schematic diagram of MSAEE system is shown in figure 4.

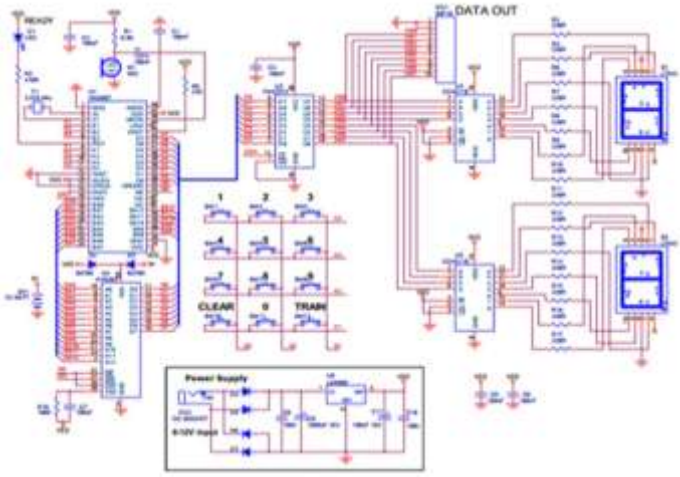

Figure 4. Schematic diagram of MSAEE system

The functionality of HM2007 speech recognition kit is depends on SC040B chip. It supports DAC voice input with high quality speech. It supports speech signal of 40 sec long under 16 KHz sampling and 4 bit hardware compression. It has an in-house built oscillator for system clock [17].

IV. Speech Vocabulary Used For MSAEE System

For the functionality of MSAEE system, we used the simple day to day life Marathi word vocabulary. This system is allowed to train single word for every operation. The speech vocabulary is selected as per operation such as to switch on the electric bulb, we used बल्बसुरु. System is executed for the functionality of electric fan and light. The details of common and precise vocabulary commands used for controlling the operations of Electric Fan and Bulb with their respective operation is described in table 1.

Table 1 Detail of isolate command and operation performed against it

Sr. No	Name of isolated command word	Operation Performed
1	बल्बसुरु	The Electric bulb will on
2	बल्ब	The Electric bulb will on
3	बल्बबंद	The Electric bulb will off
4	सुरु	The Electric Fan will start.
5	पंखासुरु	The Electric Fan will start.
6	बंद	The Electric Fan will stop.
7	पंखाबंद	The Electric Fan will stop.
8	एक	The speed of Fan will set as one
9	गतीएक	The speed of Fan will set as one

This interface application is trained as well as tested with and without noise environment. Noise environment is created using the Electric Air Conditioners, Fan and Natural Talking.

V. Design Of Marathi Speech Activated Electrical Equipment System (MSAEE)

The functionality of the electrical appliances is controlled by voice command that make it easier to use and increase its efficiency. The working of MSAEE system is divided into three main modules: a data acquition unit, a speech recognition using HM2007 and a microcontroller interface. ATMEL-AT89S52 microcontroller is used for the interfacing the devices. In the first module the speech input command is recorded and passes to the second module for processing (HM2007 kit). The recognized result from second module is passed to the output interface using Microcontroller. The basic block diagram of MSAEE system is shown in figure 5.

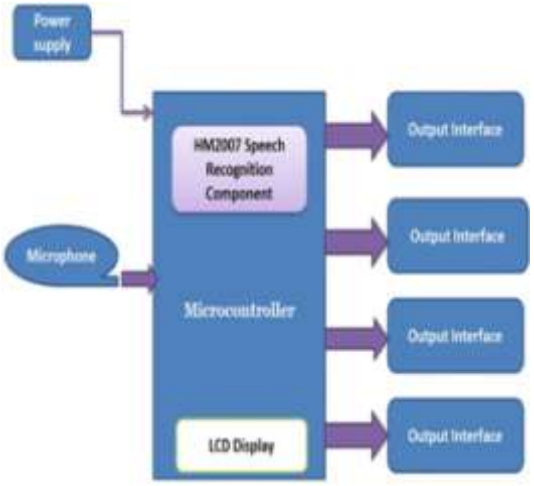

Figure 5. The basic block diagram of MSAEE system

The HM2007 speech recognition kit needed 5 Volts power supply. For the microcontroller activation A.C. current is used as 230 Volts. Figure 6 shows the graphical representation of the data interactions between the individual components that was contributed to MSAEE system design.

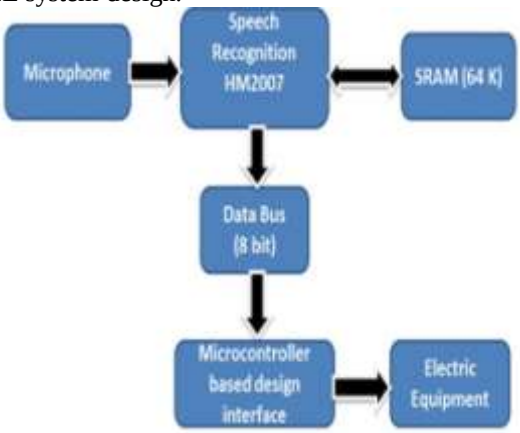

Figure 6. Graphical representation of data interaction in MSAEE circuit.

 ISSN: 2321-8169
2273 – 2281

The input speech is passed through the microphone which then goes to the voice recognition kit. The kit processes the input word and then it is recognized. This word is forwarded to the EPROM database. The trained database is stored in EPROM. The input speech is recognized from EPROM database and output is sent to LED. The detailed data flow for the HM2007 module is described in the figure 7. From the figure 7, the 8 bit data bus is matched on the basis of score index of EPROM database. The EPROM data is stored as 4 x 3 matrixes. The code 55, 66 and 77 are error codes which when occurred restart the system automatically.

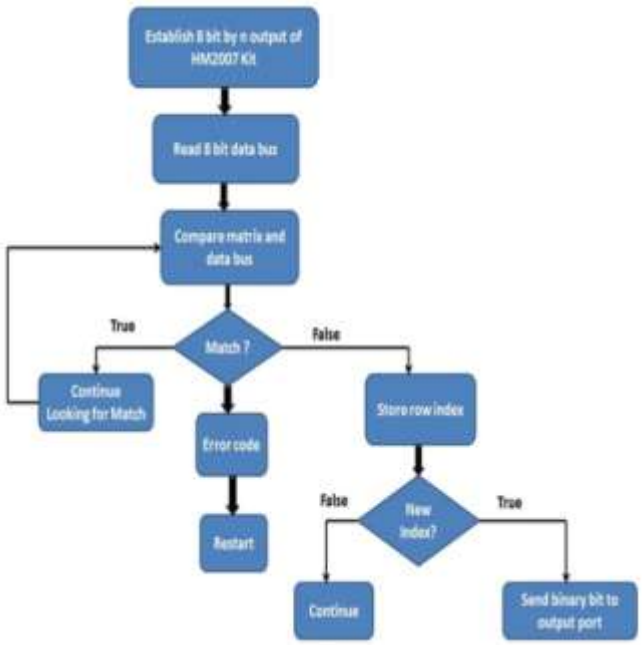

Figure 7. The working of interface module of MSAEE system

The successful recognition output is sent to interface by 8 pin data cable, which further controls the equipment. The AT89S52 is a low power, high performance CMOS 8-bit microcontroller. It has 4K bytes of in-system programmable flash memory. In this microcontroller on chip flash allows the program memory to be reprogrammed in-system. The graphical representation of pin structure of AT89S52 microcontroller is shown in figure 8. The pin description of the microcontroller is explained in table 2.

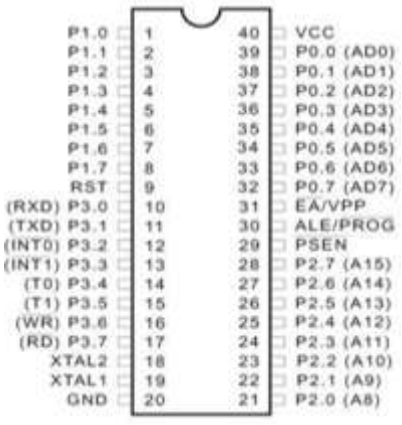

Figure 8. The pin representation of the AT89S52 microcontroller

Table 2 Pin description of AT89S52 microcontroller

Pin Number	***Description***
1 - 8	P1.0 - P1.7 - Port 1
9	RST - Reset
10 - 17	P3.0 - P3.7 - Port 3
18	XTAL2 - Crystal
19	XTAL1 - Crystal
20	GND - Ground
21 - 28	P2.0 - P2.7 - Port 2
29	PSEN - Program Store Enable
30	ALE - Address Latch Enable
31	EA - External Access Enable
32 - 39	P0.7 - P0.1 - Port 0
40	Vcc - Positive Power Supply

The output of HM2007 IC is provided to interface circuit. This interface circuit is designed using the AT89S52 microcontroller. This system is controlled using 230 A.C. Volts. The designed interface module is shown in figure 9.

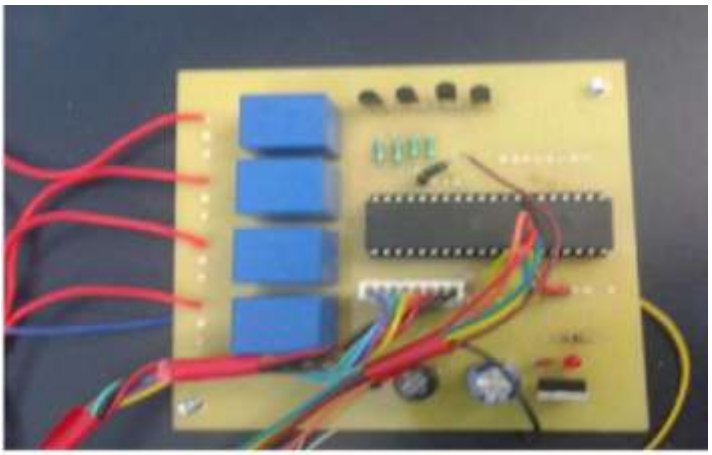

Figure 9. The design of interface module of MSAEE system

In the design interface the four relay unit is used. The recognized word with their 8 bit digital data is passed from HM 2007 kit. The action of interface is taken for appropriate equipment. This interface is designed to control the Electric bulb, Fan and also designed to control other equipment that works on 230 A.C. Volt. The overall circuit of MSAEE interface with four output module is shown in figure 10.

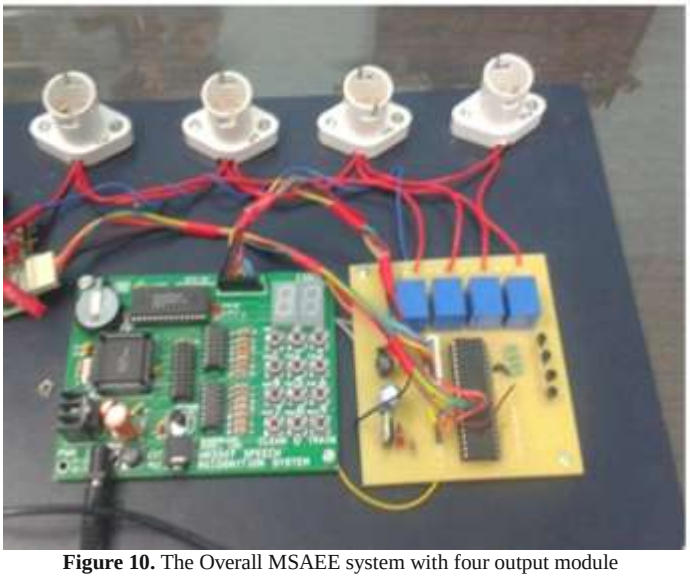

Figure 10. The Overall MSAEE system with four output module

 ISSN: 2321-8169
2273 – 2281

VI. DIMMER FOR CONTROLLING THE SPEED OF FAN

The output data from HM2007 IC is binary 8 bit format. Dimmer is needed to control the speed of fan. The mechanism of circuit is based on variation in the firing angle of the Triac. The resistors R1, R2 and capacitor C2 are associated with this circuit. The value of firing angle is varied by varying the value of any of these components. R1 is selected as the variable element of this circuit. The variation of the firing angle depends on value of R1. The firing angle directly varies the load power since load is determined by Triac. The firing pulses are specified to the gate of Triac T1 using Diac D1. This circuit controls the dimmer functionality for power supply less than 230 volts. The detail circuit diagram of the dimmer functionality for fan control is describes in figure 11.

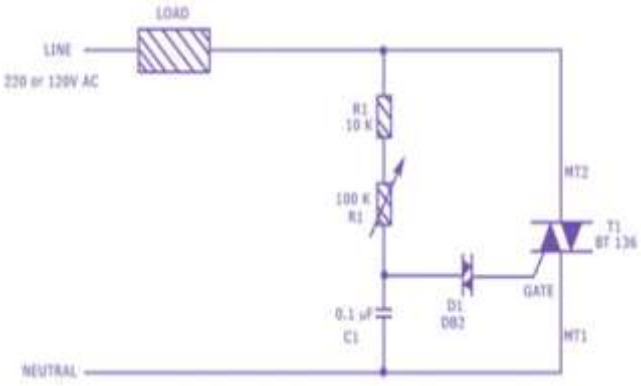

Figure 11. The circuit diagram of dimmer for fan control

This circuit used for the dimmer functionality. The detail pinning position, configuration and symbol is described in figure 12.

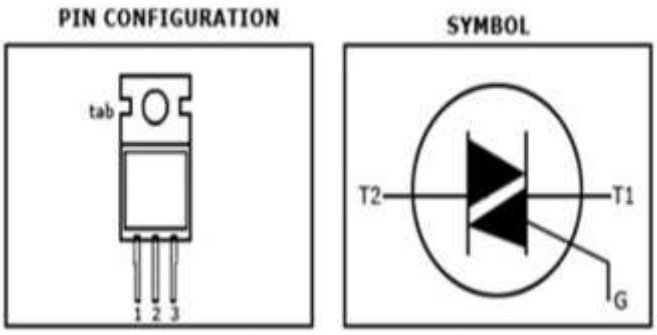

Figure 12. Pin configuration and symbol of dimmer circuit

VII. PERFORMANCE EVALUATION OF MSAEE SYSTEM

For the performance evaluation of MSAEE system, we focused on following parameter which are

a) Word Error Rate(WER)

b) Sensitivity and Specificity

c) False Acceptance Rate and False Recognition Rate

d) F-Measure

Pre-processing of the data is an important part of experimental analysis. The distance of speaker and microphone and the noise level are the parameters responsible to create a difference in the speech input. The command action of the interface depends on the binary output generated from HM2007 kit. For the every displayed number on LED and recognized command word a specific code word is generated. The generated output code and error code is shown in tables 3.

Table 3 Detail Truth Table and Error code of the MSAEE system

Command	No on 7 segment LED	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
1	01	1	0	0	0	0	0	0
2	02	0	1	0	0	0	0	0
3	03	1	1	0	0	0	0	0
4	04	0	0	1	0	0	0	0
5	05	1	0	1	0	0	0	0
6	06	0	1	1	0	0	0	0
7	07	1	1	1	0	0	0	0
8	08	0	0	0	1	0	0	0
9	09	1	0	0	1	0	0	0
10	10	0	0	0	0	1	0	0
11	11	1	0	0	0	1	0	0
Word to long	55	1	0	1	0	1	0	1
Word to short	66	0	1	1	0	0	1	1
No Match	77	1	1	1	0	1	1	1

a) Word Error Rate

Word Error rate is a common metric of the performance of a speech recognition or machine translation system. The general difficulty of measuring performance lies in the fact that the recognized word sequence can have a different length from the reference word sequence (corrected). The WER is resulting from the Levenshtein distance, which is working at the word level instead of the phoneme level[18] .Word Error rate, is computed as

$$WER = \frac{S + D + I}{N}$$

Where

[i] S is the number of substitutions,
[ii] D is the number of the deletions
[iii] I used the number of the insertions,
[iv] N is the number of words in the reference

Table 4 Responding time of training and testing of MSAEE system

Word for training	Training time (Seconds)		Testing(Average) (Seconds)
	Without noise	With noise	
बल्बसुरु	1.05	1.23	0.92
बल्बबंद	1.12	1.18	0.92
सुरु	0.78	0.98	0.90
बंद	0.75	0.97	0.88
एक	0.77	0.92	0.90
दोन	0.75	0.87	0.92
तीन	0.72	0.85	0.90
चार	0.68	0.83	0.91

 ISSN: 2321-8169
2273 – 2281

Table 5 Performance of the MSAEE system using WER for without noise training

	बल्बसुरु	बल्बबंद	सुरु	बंद	एक	दोन	तीन	चार	Insertion (Correct accepted) (I)	Substitution (Confusion) (S)	Reference word (N)	Deletion (No Match) Error (D)	WER (%)	Accuracy (100-WER) (%)
बल्बसुरु	45	-	04	-	-	-	-	-	50	04	45	01	1.22	98.78
बल्बबंद	01	44	-	03	-	-	-	-	50	04	44	02	1.27	98.73
सुरु	02	-	47	-	-	-	-	-	50	02	47	01	1.13	98.87
बंद	-	02	-	48	-	-	-	-	50	02	48	00	1.08	98.92
एक	-	-	-	-	49	-	-	-	50	00	49	01	1.04	98.96
दोन	-	-	-	-	-	49	-	-	50	00	49	01	1.04	98.96
तीन	-	-	-	-	-	-	48	-	50	00	48	02	1.08	98.92
चार	-	-	-	-	-	-	-	49	50	00	49	01	1.04	98.96
										Average				**98.88**

Table 6 Performance of the MSAEE system using WER with noise training

	बल्बसुरु	बल्बबंद	सुरु	बंद	एक	दोन	तीन	चार	Insertion (Correct accepted) (I)	Substitution (Confusion) (S)	Reference word (N)	Deletion (No Match) Error (D)	WER (%)	Accuracy (100-WER) (%)
बल्बसुरु	46	-	03	-	-	-	-	-	46	03	50	01	10.17	88.73
बल्बबंद	-	45	-	03	-	-	-	-	45	03	50	02	10.23	88.77
सुरु	01	-	48	-	-	-	-	-	48	01	50	01	10.09	88.91
बंद	-	02	-	47	-	-	-	-	47	02	50	01	10.13	88.87
एक	-	-	-	-	48	-	-	-	48	00	50	02	10.09	88.91
दोन	-	02	-	-		46	-	-	46	02	50	02	10.74	88.26
तीन	-	-	-	01	-	-	48	-	48	01	50	01	10.09	88.91
चार	-	-	-	-	-	01	-	47	47	01	50	02	10.13	88.87
											Average			**88.77**

The real time factor (RTF) is a common metric for computing the speed of an automatic speech recognition system. Using the RTF values the training and responding time is calculated for MSAEE system. If it takes time **P** to process an input of duration **I**, the real time factor is defined as

$$RTF = \frac{P}{I}$$

b) FAR and FRR

The false acceptance rate (FAR) is the measure of the probability that the recognition system will incorrectly accept an access attempt by an unauthorized user. A system's FAR typically is indicated as the ratio of the number of false acceptances divided by the number of identification attempts. The false rejection rate (FRR) is the quantity of the likelihood that the recognition system will incorrectly reject an access attempt by an authorized user. A system's FRR typically is stated as the ratio of the number of false rejections divided by the number of identification attempts [19].

Table 7 Performance of the system with FAR and FRR

Tested Spoken Commands	Token Passed	TA	TR	FA	FR	FAR	FRR
बल्बसुरु	50	35	4	8	3	0.16	0.06
बल्बबंद	50	37	3	6	4	0.12	0.08
सुरु	50	36	2	8	4	0.16	0.08
बंद	50	38	1	10	1	0.2	0.02
एक	50	45	1	2	1	0.04	0.02
दोन	50	41	1	7	1	0.14	0.02
तीन	50	43	2	1	4	0.02	0.08
चार	50	42	6	1	1	0.02	0.02
Average						**0.86**	**0.38**

TA: True Accepted, **TR**: True Rejected, **FA**: False Accepted, **FR**: False Rejected

c) Sensitivity and Specificity

Sensitivity and specificity are the statistical measures of performance of a recognition tests. The sensitivity measures the quantity of actual positive and specificity measures the proportion of negatives that are correctly identified. Sensitivity and specificity are usually expressed in percentage [20]. Sensitivity and specificity is computed as.

$$\text{Sensitivity} = \frac{TP}{TP + FN} \qquad \text{Specificity} = \frac{FP}{FP + TN}$$

Where
[i] TP is true positives
[ii] FP is false positive
[iii] FN is false negatives
[iv] TN is true negative

Table 8 Performance of the MSAEE system using sensitivity and specificity

Tested Spoken Commands	Token Passed	TP	TN	FP	FN	Sensitivity	Specificity
बल्बसुरु	50	35	4	8	3	0.92	0.33
बल्बबंद	50	37	3	6	4	0.90	0.33
सुरु	50	36	2	8	4	0.90	0.20
बंद	50	38	1	10	1	0.97	0.09
एक	50	45	1	2	1	0.98	0.33
दोन	50	41	1	7	1	0.98	0.13
तीन	50	43	2	1	4	0.91	0.67
चार	50	42	6	1	1	0.98	0.86
Average						**0.95**	**0.36**

d) F-measure

F-measure is a measure of a test's accuracy of speech recognition. It considers both the precision p and the recall r of the test to compute the score: p is the number of correct positive results divided by the number of all positive results, and r is the number of correct positive results divided by the number of positive results that should have been returned. The F-measure score can be interpreted as a weighted average of the precision and recall, where an F1 score reaches its best value at 1 and worst score at 0. F-Measure is computed as

$$\text{F-Measure} = \frac{2 * precision * recall}{precision + recall}$$

Table 9: Performance of MSAEE using F-Measure

Tested Spoken Commands	Token Passed	TP Rate	FP Rate	Precision	Recall	F Measure
बल्बसुरु	50	8.69	0.67	18.00	0.81	1.56
बल्बबंद	50	6.65	0.67	13.50	0.86	1.62
सुरु	50	8.89	0.80	12.50	0.82	1.54
बंद	50	10.26	0.91	12.10	0.79	1.49
एक	50	2.04	0.67	4.50	0.96	1.58
दोन	50	7.17	0.88	9.14	0.85	1.56
तीन	50	1.09	0.33	9.00	0.98	1.76
चार	50	1.02	0.14	49.00	0.98	1.92
Average						**1.62**

Table 10 Variation of system performance based on Microphone distance

Token (No. of Trials)	Distance (Cm)	Confusion	Accuracy
30	10	3	97
30	15	5	95
30	20	7	93
30	25	8	92

VIII. RESULT AND DISCUSSION

For the speech based MSAEE interface system the extracted output and error code towards LED is shown in table 3. The performance of MSAEE system is calculated using

a) Word Error Rate

b) False Acccptnace Rate and False Recognition Rate

c) Sensitivity and Specificity

d) F-Measure

- The MSAEE system controls the electrical equipment responding actions from the equipment's play an important role. The detail training and testing RTF time of MSAEE system is described in table 4. It is observed that the time for training same order in with noise environment is maximum than without noise environment.
- Table 5 provides information regarding performance of the MSAEE system using WER for without noise training environment. Table 6 is illustrating the information about performance of MSAEE system using WER for noise training environment environment. In this confusion matrix row and columns corresponds to commanding isolated word which is used for controlling the equipment real time. The overall accuracy was derived 98.88%, when system is trained without noise and 98.77 % for with noise training. It is observed that the performance of without noise training is better than with noise training.
- Table 7 expressed the detail performance of MSAEE system using FAR and FRR approach. The average FAR is 0.86 and FRR value is 0.38. It is observed that the FAR values is most significant than value of FRR so, it means MSAEE system is robust and dynamic for real time electrical appliances.
- Table 8 describes the performance of MSAEE system using sensitivity and specificity. From the table 6, the sensitivity is 0.95 and specificity is 0.36. The sensitivity value is superior then specificity means MSAEE system is robust and dynamic.
- Table 9 illustrates the performance of MSAEE system using F-measure score. The F0 score is calculated using precision and recall values. The average F-measure score is calculated as 1.62. As the F0 score is greater than 1 it means MSAEE system is the best solution for interface application.
- For the performance of real time system the distance of microphone and speakers plays an

important role. The variation in performance of the system based on microphone distance is described in table 10. It is observed that every 30 time testing approach maximum accuracy occurs for 10 meter distance and as distance increases confusion of the system also increases means accuracy decreases. The result obtained in this table motivated to use a higher quality microphone and 10 meter distance from speakers that improves the performance of the system.

IX. CONCLUSION

To bring technological advancement of speech recognition to the mass, it is important to research progress in regional languages. Much of work has been done in languages like English, Hindi, Tamil and Bengali. It is observed that work done in Marathi has not received much more attention. Thus we attempted design and developed Marathi Speech Activated Electrical Equipment (MSAEE). The MSAEE is computer independent system. MSAEE system developed using Microcontroller, HM2007 IC and basic component. The implemented MSAEE system controls the Fan on and off, Speed control, Light On and off using the Marathi speech command. This prototype of MSAEE system demonstrates its reliability for future development. It is observed that proposed system is indeed functional and it can be used for speech based electrical equipment control. The above system is implemented to control sixteen electrical appliances and the percentage performance of the correct recognition is found to be efficient.

The performance of MSAEE system evaluated using WER, FAR & FRR, sensitivity & specificity and F-measure approach. From the analysis we observed the following:

- The performance of MSAEE system using WER approach is shown promising average accuracy of 88.77 % in noisy environment and 98.88% in noise free environment. It is observed that the time for training same order in with noise environment is maximum than without noise environment.
- FAR values is most significant than value of FRR so, it means MSAEE system is best solution for controlling the real time electrical appliances.
- The sensitivity of MSAEE system is 0.95 and specificity is 0.36. The sensitivity value is superior then specificity means MSAEE system is robust and dynamic.
- The F-measure score is calculated using precision and recall values. The average F-measure score is calculated as 1.62. As the F0 score is greater than 1 it means MSAEE system is the best solution for interface application.
- The result obtained from a microphone distance variation motivated to use a higher quality microphone and 10 meter distance from speakers that improves the performance of the system.

REFERENCES

[1] **Anand Arokia Raj**, Rahul.Ch, Susitna (**2005**). A Voice Interface For Visually Impaired. SETIT 2005, 3rd International Conference: Sciences of Electronic, Technologies of Information and Telecommunications, March 27-31, TUNISIA.

[2] **S. M. Anamul** Haque, S.M Kamruzzaman, Md. Ashraful Islam (**2006**). A System for Smart-Home Control of Appliances Based on Timer and Speech Interaction. Proceeding of the 4th International conference of Electrical Engineering & second annual paper meet, 26-28 January, 2006.

[3] **Roni Rosenfeld**, Xiaojin Zhu, Arthur Toth, Stefanie Shriver, Kevin Lenzo, Alan W Black(**2014**). Towards A Universal Speech Interface. [Online] http://pages.cs.wisc.edu/~jerryzhu/pub/tausi.pdf . Accessed 12 Dec 2014.

[4] **M Z. Raza**, S. Soomro, M. S. Ehsan (**2013**). A. G. Memon, M. Siddique, Implementation of Device Control Technique Using Voice Signal. Sindh Univ. Res. Jour. (Sci. Ser.), Vol.45 (4) 721-726, 2013.

[5] **C.J. Plomp,** O. Mayora-Ibarra (**2002**). Generic Widget Vocabulary for the Generation of Graphical and Speech-Driven User Interfaces. International Journal of Speech Technology, 5, 39–47, 2002.

[6] **Sorin Dusan**, Larry R. Rabiner (**2005**). On integrating insights from human speech perception into automatic speech recognition. Proceedings of INTERSPEECH 2005, Lisbon, 2005.

[7] **Hill D. R**. (**2014**). Man-machine interaction using speech. In Advances in Computers (1997), [online] http://pages.cpsc.ucalgary.ca/~hill/papers/mm-int-using-speech.pdf, viewed on 23 Nov 2014.

[8] **Zhang Hua,** Wei Lieh. Ng (**2010**). Speech Recognition Interface Design for In-Vehicle System. Proceedings of the Second International Conference on Automotive User Interfaces and Interactive Vehicular Applications (Automotive UI 2010), November 11-12, 2010, Pittsburgh, Pennsylvania, USA, 2010.

[9] **Bill Manaris**, Valanne Macgyvers, Michail Lagoudakis (**2002**). A Listening Keyboard for Users with Motor Impairments—A Usability Study. International Journal of Speech Technology 5, 371–388, 2002

[10] **Harry M. Chang** (**2007**). Comparing Machine and Human Performance for Caller's Directory Assistance Requests. International Journal of Speech Technology, 10: 75–87, 2007.

[11] **Dhawan S. Thakur,** Aditi Sharma (**2013**). Voice Recognition Wireless Home Automation System Based On ZigBee. IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) Volume 6, Issue 1, PP 65-*75*, 2013.

[12] **Helmer Strik**, Albert Russel, Henk Van Den Heuvel, Catia Cucchiarini, Lou Boves (**1997**). A Spoken Dialog System for the Dutch Public Transport Information Service. International Journal of Speech Technology, 2, 12 -131, 1997

[13] **Brouwer**, W. H., W. Waterink, P.C. Van Wolffelaar, T. Rothengatter (**1991**). Divided attention in experienced young and older drivers: Lane tracking and visual analysis in a dynamic driving simulator. Human Factors, 33 (5). 573 – 582,1991.

[14] **Hashimah**, I. (**2004**). Motion Control Using Voice for Wheel Chair application. *M*.Sc. Thesis. Faculty of Electrical Eng., University Technology Malaysia, 2004.

[15] **Dinu Mathew** (**2012**), Voice Controlled Data Acquisition Car Based on ZigBee Technology. IOSR Journal of Electronics and Communication Engineering (IOSRJECE), ISSN: 2278-2834, Volume 2, Issue 3 (July-Aug 2012), PP 19-24, 2012.

[16] **Mohammed Fezari**, Mounir Bousbia-Salah (**2006**), A Voice Command system for Autonomous Robot Guidance. 9th IEEE International Workshop on Advanced Motion Control, PP.261-265, Istanbul, Turkey, 2006.

[17] **Reena Atul Panchal**, Rachana Papewar, Chaitali Gawali, Khushboo, Hotchandani (**2014**). Interactive Dictionary for Visually Impaired. IOSR Journal of Engineering (IOSRJEN), Vol. 04, Issue 03 (March. 2014), ||V4|| PP 42-46, 2014.

[18] **Santosh Gaikwad**, Bharti Gawali, Pravin Yannawar (**2011**). Performance Analysis of MFCC & DTW for Isolated Arabic Digit. International Journal of Advanced Research in Computer Science, Volume 2, Number 1, Jan –Feb (2011).

[19] **FAR and FRR** [Online] http://www.bayometric.com/blog/false-acceptance-rate-far-false-recognition-ratefrr/#sthash.FShA3maA.dpuf

[20] **Devashish Sharma,** U.B. Yadav, Pulak Sharma, "The Concept Of Sensitivity And Specificity In Relation To Two Types Of Errors And Its Application In Medical Research", Journal of Reliability and Statistical Studies (ISSN: 0974-8024) Vol. 2, Issue 2(2009): 53-58.