and embedded controllers which will be helpful for deaf and dumb persons to express their needs to normal person. The frequently spoken words are stored in audio pre recorder which can be easily retrieved and also displayed using liquid crystal display.

An innovative idea was propose by[8] [11]P. Subha Rajama, G. Balakrishnanb by introducing binary sign language. This work proposes a method that provides the conversion of a set of 32 combination of the binary number Which represents the UP and DOWN positions of fiver fingers into decimal numbers and then converted it into corresponding Tamil letters i.e 12 vowels, 18 consonants and 1 Aayutha Ezhuthu.

Later in "A Static Tamil Sign Language Recognition System."[9] An image processing technique has been presented and designed for recognizing the signs of Tamil language for deaf-dumb persons. Instead of taking only static hand gestures additionally hand with facial gestures are taken. The results of the classification technique are evaluated with 91% accuracy. The work presented in this paper recognizes static signs only. The system deals images with uniform background, but it could be made background independent.

The glove based deaf-mute communication interpreter introduced by Anbarasi Rajamohan, Hemavathy R., Dhanalakshmi M[10][12][13]. The glove is internally equipped with five flex sensors, tactile sensors and accelerometer. The evaluation was carried out for ten beginners for letters 'A' 'B' 'C' 'D' 'F' 'I' 'L' O' 'M' 'N' 'T' 'S' 'W'. Word formation from letters is also performed using an end signal. The project can be enhanced to include two or more accelerometer's to capture the orientation of hand movements once the gesture is made. This will expand the capability to translate larger gestures.

3. Research Elaboration

System hardware consist of flex sensor mounted on five fingers of hand gloves. As shown in Table 1 below newly introduced maths sign language uses the combination of up and down position of fingers only, need of accelerometer is eliminated. The flex sensors are resistive carbon element which shows the property of change in resistance from 10Kohms to 30Kohms for normal to full bend condition. Thus for each gesture we get combination of high and low resistance which is converted to equivalent voltage using voltage divider bias circuit. Further voltage signal is provided to inbuilt ADC of the processor. This data can further processed via Arm Cortex M3 to display corresponding maths function. Processor is also interfaced with external memory. Depending upon voltage across each flex, processor checks the lookup table and accordingly fetched pre-recorded file from external memory to give audio output simultaneously. For equation formation processor is trained for mode selection to display trigonometry identity shown in table 3.

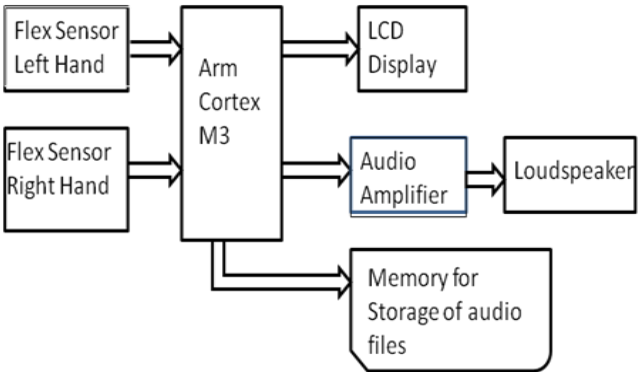

Figure 1: Block Diagram of Proposed System

The system is trained for the proposed signs. As shown in table 1 below the position of finger is either straight or bending. 10 flex sensor of 4 & half inch each is used to record the position of each finger. Though 1024 (2^{10})combination are possible with 10 fingers, at present we have attempted to expressed only 13 maths notation ,13 alphabets, 9 digits which are further used in combination to expressed 17 trigonometry function.

Table1: Proposed sign language for maths notation

Sr.No	Finger position of left hand [L,R,M,I,T]	Finger position of right hand [L,R,M,I,T]	Corresponding maths notation
01	0 0 0 0 0	0 0 1 1 1	Sin
02	0 0 0 0 0	0 0 0 1 1	Cos
03	0 0 0 0 0	0 0 1 0 0	Tan
04	0 0 0 0 0	1 0 0 0 0	(
05	0 0 0 0 0	0 0 0 0 1	)
06	0 0 1 0 0	0 0 1 0 0	^
07	0 0 0 0 0	0 0 0 0 0	Θ
08	0 0 0 1 0	0 0 0 1 0	+
09	0 0 0 0 0	0 1 0 0 0	-
10	0 0 1 1 0	0 0 0 1 0	÷
11	0 0 1 1 0	0 0 1 1 0	×
12	1 1 1 1 0	1 1 1 1 0	∫
13	1 1 1 1 1	1 1 1 1 1	=

Table 2: Proposed sign language for English alphabet and digits 0 to 9

English Alphabet	Finger position of left hand [L,R,M,I,T]	Digits	Finger position of right hand [L,R,M,I,T]
A	0 0 0 0 0	1	0 0 0 1 0
B	1 1 1 1 0	2	0 0 1 1 0
C	0 0 0 0 1	3	0 1 1 1 0
D	0 0 0 1 0	4	1 1 1 1 0
F	1 1 1 0 0	5	1 1 1 1 1
H	0 1 0 1 0	6	1 0 0 0 0
I	1 0 0 0 0	7	1 1 0 0 0
K	0 0 1 1 1	8	1 1 1 0 0
L	0 0 0 1 1	9	1 1 1 0 1
U	1 0 0 1 0	0	0 0 0 0 0
V	0 0 1 1 0		
W	0 1 1 1 0		
Y	1 0 0 0 1		

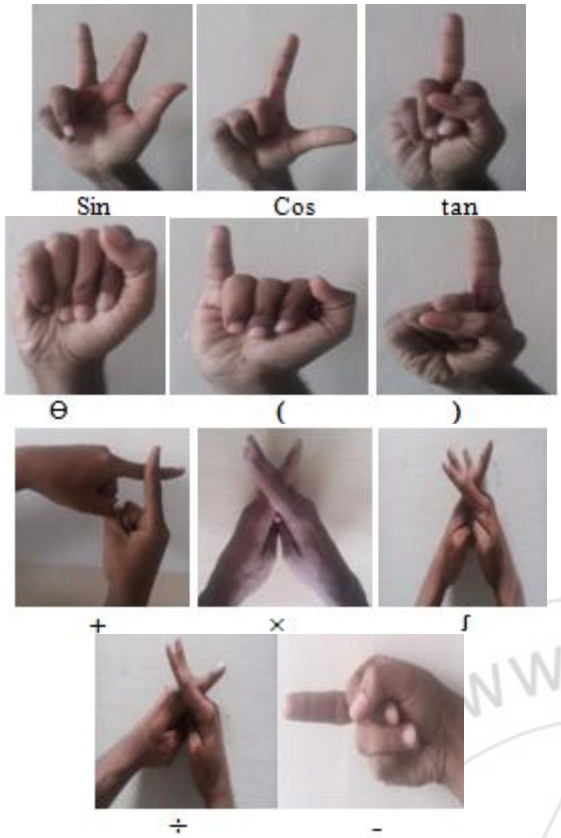

Figure 2: Gesture for sign proposed in Table 1.

Table 3: Trigonometric identities interpreted by the system

Sr.No	Trigonometric Identity
01	Sin Θ
02	Cos Θ
03	Tan Θ
04	$Sin^2 Θ$
05	$Cos^2 Θ$
06	$Tan^2 Θ$
07	$Sin^2 Θ + Cos^2 Θ = 1$
08	$Cos^2 Θ = \frac{1}{2}(1 + cos2Θ)$
09	$Sin^2 Θ = \frac{1}{2}(1 - cos2Θ)$
10	$Sin2Θ = 2sinΘcosΘ$
11	$Cos2Θ = Cos^2 Θ - Sin^2 Θ$
12	Sin(A+B)=SinACosB + CosASinB
13	Sin(A-B)=SinACosB – CosASinB
14	Cos(A+B) = CosACosB – SinASinB
15	Cos(A-B) = CosACosB + SinASinB
16	$Cos3Θ = 4Cos^3 Θ - 3Cos Θ$
17	$Sin3Θ = 3Sin Θ - 4Sin^3 Θ$

4. Samlpe Results

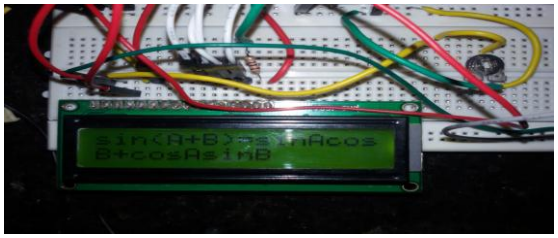

Figure 3: Trignometric identiy interpreted by the system

5. Conclusion

The proposed system has successfully interpreted 13 alphabets, 9 digits, 13 math's notation notations and 17 trigonometry identities It is hoped that the proposed system, which solely concerned with higher mathematics function will be the first one to explore the need and importance of system in deaf community. Learning mathematics will become learning like a language. For deaf/hearing-impaired children proposed language of mathematics features as their third/fourth language, using more than one language to express mathematical ideas is additive in itself. It will give sufficient proficiency in both languages, students are liable to have better understanding because they have two modes in which to think and communicate.

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