DESIGN AND DEVELOPMENT OF

ASSISTIVE DEVICE FOR MUSEUM ACCESS

TO PERSONS WITH HEARING IMPAIRMENT

Project under AIISH Research Fund (ARF)

Year: 2012-14

Ref: SH/CDN/ARF/4.38/2011-12 dated 19.09.2011

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Department of Electronics

All India Institute of Speech and Hearing

Manasagangothri, Mysuru - 570006

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Abstract

Acoustic conditions in Museums are not conducive for comfortable listening for visitors with hearing impairment. Longer reverberation time, noise created by other visitors etc. make it difficult for these visitors to listen to the curator, even with their hearing aids. Our country, being a signatory of UNCRPD resolution, has a legal binding to make museums accessible to persons with hearing impairment. Aim of this project was to design and develop an assistive device, which can be coupled through a neck loop to the user's own hearing aid, when they visit the museum. The device can store the commentary of about hundred exhibits, each for a duration of 1 to 2 minutes. The description pertaining to a particular exhibit can be heard through their hearing aids by dialing the code number of the exhibit through the numerical keypad of the device. The device can handle any language and is battery operated. The device is compatible with the hearing aids worn by persons with mild, moderate, severe or profound hearing loss, in tele-coil mode of operation. Feedback obtained from the field trials of the device, done on hearing impaired visitors at Regional Museum of National History, Mysuru indicate comfortable listening by the user. Results also show that the technology provides sufficient signal to noise ratio even in poor acoustic conditions.

Keywords: - Assistive technology, Museum, visitors with hearing impairment, noise, poor acoustics.

Chapter I

Introduction

Article 30 of the agreement at United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) provides affirmative legislative framework for persons with disabilities towards participation in cultural life, recreation, leisure and sports ("Convention on Rights", 2006). Article 30.1 (c) says “Sates parties recognize the right of persons with disabilities to take part on an equal basis with others in cultural life, and shall take all appropriate measures to ensure that persons with disabilities enjoy access to places for cultural performances or services, such as theatres, museums, cinemas, libraries and tourism services and as far as possible, enjoy access to monuments and sites of national cultural importance". After signing and ratifying UNCRPD by Govt. of India, we are legally bound to implement various provisions of UNCRPD. Thus regardless of size or income, all museums in our country have legal obligations to provide and maintain accessibility for visitors with disabilities. In spite of all these legislations, there have been only very few attempts in India by museums for making its resources accessible to persons with hearing impairment.

Museum is a public institution which acquires, conserves, researches and exhibits various evidences and relics of social, cultural and religious history for the study and education of the people (Edward et.al., 2007). Directory of museums in India published by Usha Agarwal in 2009 contains a list of 748 museums (Usha Agarwal, 2003). Baring a few, none of these museums have done anything to improve the accessibility of their buildings and programs for visitors with speech and hearing disabilities, thus depriving the rights of about 39.8 lakhs

citizens (NSSO, 2003) who have speech and hearing disabilities. Lack of availability of indigenous technology is the major bottleneck. This project is an attempt to bridge this gap by developing a portable handheld device to cater to the special needs of museum visitors with hearing impairment.

The global scenario is different. Most of the famous museums across the globe have some or the other arrangements for visitors with hearing impairment. In the British Museum at London portable induction loops are available for hearing impaired visitors. Information desk and closer centre are also provided with induction loops ("Access Information", 2013). National museum, Cardiff, UK is also equipped with an induction loop system at the `Evolution of Wales' gallery, information desk, shop, restaurant and coffee shop counters ("Access advice", 2012). Meeting and learning rooms are also equipped with mobile induction loop. The Indiana state museum, Washington provides assistive listening devices and T coil devices on a first cum first serve basis for programs in the auditoriums within the museum ("Accessibility: Hearing", 2011). Headset and Assistive listening Devices are available free of cost from the information desk. The imperial war museum at London has an infra red induction loop in the cinema hall. The museum also provides an audio tour highlighting 40 main exhibits through an audio system compatible with T-coil of the hearing aid ("Accessibility: Deaf & Hearing Impaired", 2012).

Any one's visit to the museum will become fruitful with the assistance of curator. A curator acquires, cares for, develops, displays and interprets a collection of artifacts or works of art in order to inform, educate and entertain the visitors (Clough, 2013). People with hearing

impairment are deprived of this facility because of their inability to comprehend the curator's speech due to the following reasons:- i. Poor acoustics of museum halls – higher reverberation time prolongs speech sounds, masks following sounds, thereby reducing speech intelligibility; ii. Background noise – higher levels of background noise due to shuffling of feet, chatting of visitors with each other etc. This will reduce the speech to noise ratio (SNR) to a level below 20 dB where a person with hearing impairment cannot understand speech. iii. Distance from the curator – the curator will be near the exhibit increasing the distance with the visitors with hearing impairment, this will reduce the level of speech again reducing the SNR.

Concrete figures are not available about the recommended acoustical environment for visitors in the museum. ASHA's (American Speech Language – Hearing Association) working group on classroom acoustics has recommended an appropriate acoustical environment for all students in educational settings (ASHA, 2005). The acoustical factors which they considered in arriving at these guidelines include:- (1) the level of the ambient noise in the classroom (2) the signal to noise ratio in the classroom and (3) the reverberation time.

As these acoustical factors are also relevant to the listening environment in a museum the same recommendations can be considered for proper listening in a museum. The recommendations are:-

(1) Unoccupied classroom noise levels must not exceed 35 dBA.

(2) The signal-to-noise-ratio (SNR) should be at least +15dB at the child's ears.

(3) Unoccupied classroom reverberation times must not surpass 0.6 seconds in smaller classrooms (<10,000 ft^3) or 0.7 seconds in larger rooms (≥10,000 ft^3 and ≤ 20,000 ft^3).

An acoustic survey was conducted to find out the background noise and reverberation time at various locations in the Regional Museum of Natural History, Mysuru. The readings are tabulated in Table 1.

Location	**Background noise**	**Reverberation time**
Entrance Hall	77.5 dB SPL	1.9 s
Auditorium	80.4dB SPL	2.7 s
Cave	79.8 dB SPL	1.1 s

Table 1.1 : Acoustic conditions in the Regional Museum of Natural History, Mysuru.

For comfortable listening to the curator's speech, the background noise have to be brought down below 35 dBA from the values shown in Table 1. Reverberation time has to be brought down below 0.6 seconds. One way to achieve these targets are through acoustic modifications in the buildings which is a highly expensive affair and also not practically feasible in many cases. An alternative way is to have an assistive device which will override the poor acoustic condition and deliver the curator's commentary directly to their ears through their hearing aids.

The hearing aid worn by the person with hearing impairment will not be of any help in solving any of the above three issues. The hearing aid will amplify direct sound and reverberated sound with the same gain. The hearing aid cannot bifurcate speech from noise in most of the cases. Hearing aid cannot compensate on reduction in speech level of the curator. Hence there is a need for an assistive technology in all museums to provide accessibility to persons with hearing impairment. The assistive device has to function like binoculars for the ear.

The objectives of this project were:-

- To design & develop an assistive device which can be coupled with the hearing aid to override the inappropriate acoustic conditions in the museum and thus make museums accessible to persons with hearing impairment.
- To conduct the field trials on persons with hearing impairment for three languages – English, Hindi & Kannada

CHAPTER II

Method

2.1 Design requirements

Assistive technology is any item, piece of equipment or product system whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain or improve the functional capabilities of individuals with disabilities (Hersh & Johnson, 2003). Assistive technology system for museum should be able to perform the curator's job, effectively in three ways:- i. Minimizing background noise at the ear of the museum visitor with hearing impairment ii. Reducing the effect of distance between curator and the museum visitor with hearing impairment. iii. Over riding poor acoustics such as reverberation. The device should be able to provide description about each exhibit to the visitor with hearing impairment at a signal to noise ratio of above +15 dB. The speech output from the device should be coupled through a neck loop to the hearing aid worn by the person with hearing impairment. This will help him listen to the speech through his own hearing aid at the desired gain. The device should be of light weight, battery operated and easy to operate without any training or assistance.

The device should be able to handle any language and should have the ability to give the description of about 100 exhibits, each description of duration 1 to 2 minute. The battery should have sufficient back up to cater to the visitor throughout the entire duration of the visit. The neckloop should have a reasonably good frequency response so that the speech cues responsible for producing intelligible speech shall not get affected in the coupling process.

2.2 System design

The system consists of a handheld unit and a neckloop. The person with hearing impairment is provided with this handheld module while entering the museum. The module contains a 4 x 3 numerical key pad and a neck loop/headphone. All the exhibits in the museum are assigned a two digit code number. As the person approaches an exhibit, he has to press the two digit code of the exhibit with the numerical key pad in the handheld unit. An audio commentary about the exhibit is routed to the neck loop from the handheld device.

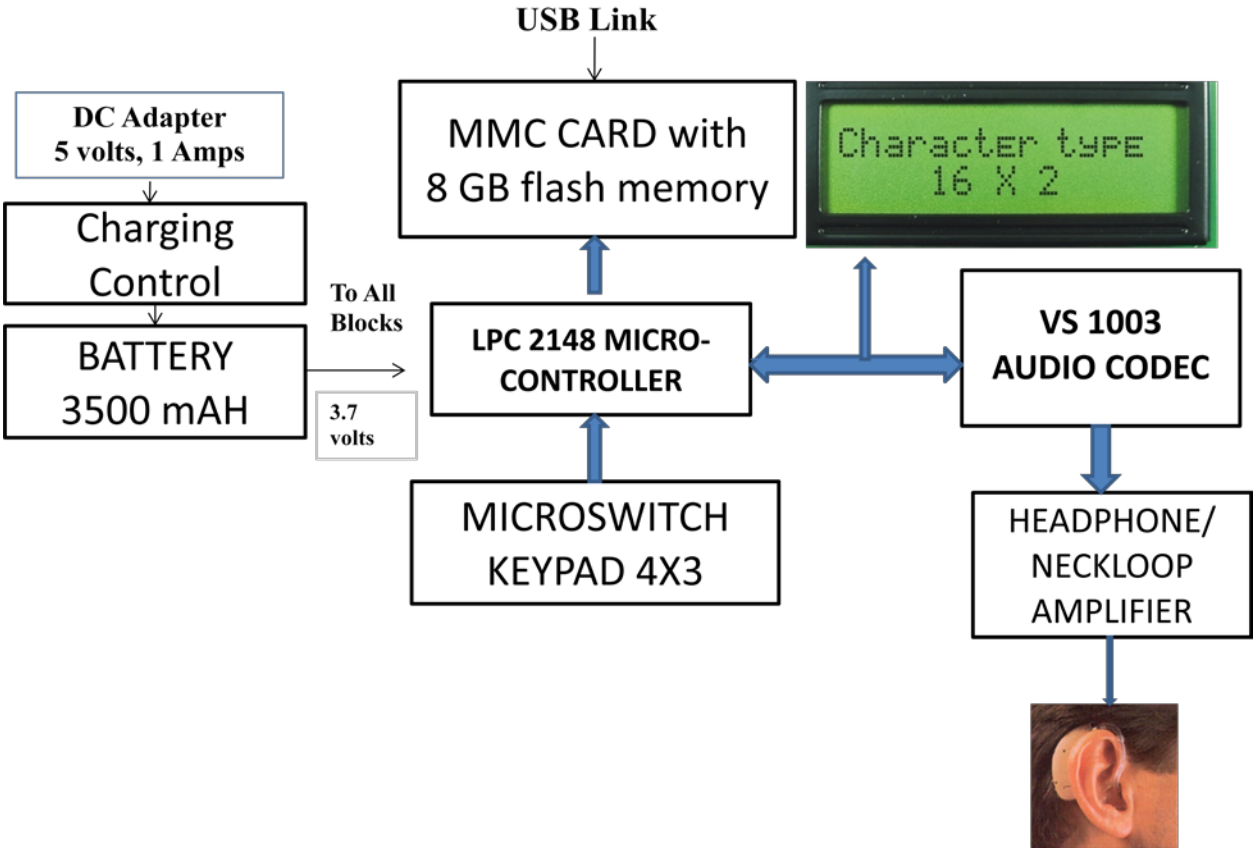


Figure 2.1: System Architecture

System Architecture of the assistive device built around LPC 2148 micro controller is shown in figure 2.1. The key pad is interfaced through the LPC 2148 micro controller. The key pad used is the standard numerical 4 x 3 keypad with keys marked `0' to `9' and also has keys marked with special characters such as * and #.

LPC 2148 is a 32 bit microcontroller chip from ARM-7 family, manufactured by Philips (Datasheet in Appendix IV) and is pre-loaded with many inbuilt peripherals. It consumes very less power and is thus suitable to be powered by a battery. It has 40 kB of on-chip static RAM and 512 kB of on-chip flash memory. Flash memory is used for storing the code as well as data. It provides a minimum of 100000 erase / write cycles and the data can be retained up to 20 years. 128 bit wide interface/accelerator enables high speed 60 MHz operation. In-System / In-Application Programming (ISP/IAP) facility is provided via on-chip boot-loader software. The device controller is USB 2.0 Full Speed compliant with 2 kB of endpoint RAM. In addition, the LPC 2148 provides 8 kB of on-chip RAM accessible to USB by DMA. Two 10-bit A/D converters in the chip provide a total of 14 analog inputs, with conversion times as low as 2.44 μs per channel. A 10-bit D/A converter is also available. The chip has 45 numbers of 5 V tolerant fast general purpose I/O pins. It has power saving modes such as Idle and Power-down, which helps to provide longer battery operation. Processor wake-up from Power-down mode is through external interrupt, USB, Brown-Out Detect (BOD) or Real-Time Clock (RTC). CPU has an operating voltage range of 3.0 V to 3.6V**,** which makes it suitable to be powered by a rechargeable battery.

The device is equipped with a 8 GB multimedia card (MMC), which is a standard flash memory card. This is used as the storage media for storing all the audio files corresponding

to the commentary of the exhibit. The MMC card receives the media files through the USB port interfaced through the micro controller.

The device is also incorporated with a VS1003 single chip Audio Codec built in with an Audio decoder and an ADPCM encoder. VS1003 Audio Codec has a high quality, variable sample rate, mono Analog to Digital Converter (ADC) and stereo Digital to Analog Converter (DAC) with a built in earphone amplifier and buffer (Appendix V). VS1003 receives its input bit stream through a serial input bus, which is controlled by the LPC 2148 micro controller.

When the user enters a two digit number through the key pad, the microcontroller encodes the number and then fetches the corresponding audio file from the MMC card where the description about the exhibit is stored. The handheld unit also contains a USB interface through which the audio description of the selected exhibit is transferred in the any audio file format compatible with Windows Operating System to the device from the computer. The audio commentary is decoded by the VS 1003 Audio codec and then fed to a neck loop through a neck loop amplifier. The neck loop will couple the audio signal of the commentary to the tele-coil of the hearing aid worn by the user. The hearing aid in `Tele-coil mode' converts this into an audible and intelligible sound and delivers it to the ears of person with hearing impairment at the required sound pressure level.

To incorporate a universal design strategy, headphones are also coupled to the device. With the headphones replacing the neck loop, the device can be used as an audio guide by any museum visitor.

The microcontroller controls the selection of the audio files stored in the MMC card. Microcontroller also controls the bit streaming between the MMC card and the Audio Codec. The low power consumption of flash memory in the MMC Card also helps this device suitable for battery driven applications. Recording of the commentary can be done through the PC or any digital recording device. The device accepts recording in any of the audio formats compatible with Windows operating system. The recorded files, need to be named according to the code number of the exhibit to which the commentary belongs to. For e.g., if the commentary is about exhibit number `02' the audio file should also be named `02'. The recorded commentary is transferred to the multimedia card through the USB connectivity.

The status of the device including the battery power, the number of the audio file being played etc. are all displayed in a 16x2 LCD display with back light.

2.3 System operation

When the key (code number of the exhibit) is pressed, the microcontroller will receive the decoded key number. Based on the decoded data, the microcontroller, through the encoder selects the corresponding audio file from the MMC card. The selected commentary is then streamed to the VS1003 Codec which is coupled to the neck loop through neck loop amplifier. There is an indication (forward arrow) for the play status in the LCD Display. The number of the file being played is also shown in the display. The neck loop receives the

audio signal after suitable amplification by the system. The neck loop is electromagnetically coupled to the user's hearing aid. Thus the information about the required exhibit reaches the wearer’s ear through the neck loop coupling with the hearing aid.

2.4 Field Trials

Subjective evaluation to check the overall functional performance of the system was done during field trials at Regional Museum of Natural History, Mysuru, as per the details below:-

a. Mode of field trial - Questionnaire method (sample questionnaire in English, Hindi, & Kannada Appendix I, II & II respectively)
b. Respondent for field trial - Museum visitors with hearing impairment.
c. Time given for respondents - One day during visit of the respondent to the museum.
d. Cadre of people participating in the field trial - All museum visitors with hearing impairment and fitted with a hearing aid with 'Telecoil' option.

2.5 Language selected - The system is language independent. The handset can accept and play the audio files in any language. The commentary was prepared in all the three languages (English, Hindi & Kannada) and were stored in the computer. Depending on the language requirement of the user, the corresponding media files can be downloaded to the handset.

Chapter - III

Results & Discussion

System developed was tested in the Regional Museum of Natural History, Mysuru. Feedback was obtained from the user in their preferred language (English / Hindi / Kannada) through a questionnaire.

3.1 Device in operation

a. Start Screen

b. Screen for selecting the commentary of the exhibit

c. Screen showing the code no. of the exhibit of which the commentary is being played

Figure 3.1: Screen shots of the device in operation

When the device is switched on, the start screen showing 'All India Inst Speech and Hearing' appears on the LCD as shown in figure 3.1a. This is followed by the screen (figure 3.1b) which allows the user to select the commentary of the exhibit by entering the code of the exhibit through the numerical keypad. The neckloop attached to the device has to be worn by the user on the neck of the user and the hearing aid has to be put in telecoil mode of operation. If the user doesn't have hearing aid with telecoil option he can hear the commentary through the headphone. Normal visitors can also use the device and hear the commentary through the headphone. After connecting the neck loop / head phone the user can press the `*' key on the key pad to start the commentary. The play status and the time of play will be shown on the LCD (figure 3.1c). The user can stop the commentary any time by pressing the `#' button.

3.2 Results of field trials

a. With Behind The Ear Hearing Aid

b. With Body worn Hearing Aid

Figure 3.2: Device undergoing field trials at RMNH, Mysuru

Field trials were conducted at Regional Museum of Natural History, Mysuru. Trials were done on fifty visitors with hearing impairment who were using either body worn or BTE hearing aids. The visitors belonged to different age groups as shown in Figure - 3.3.

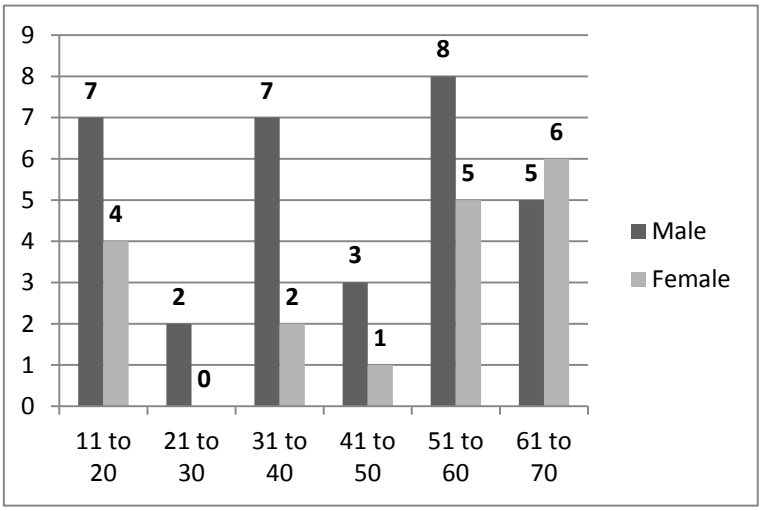
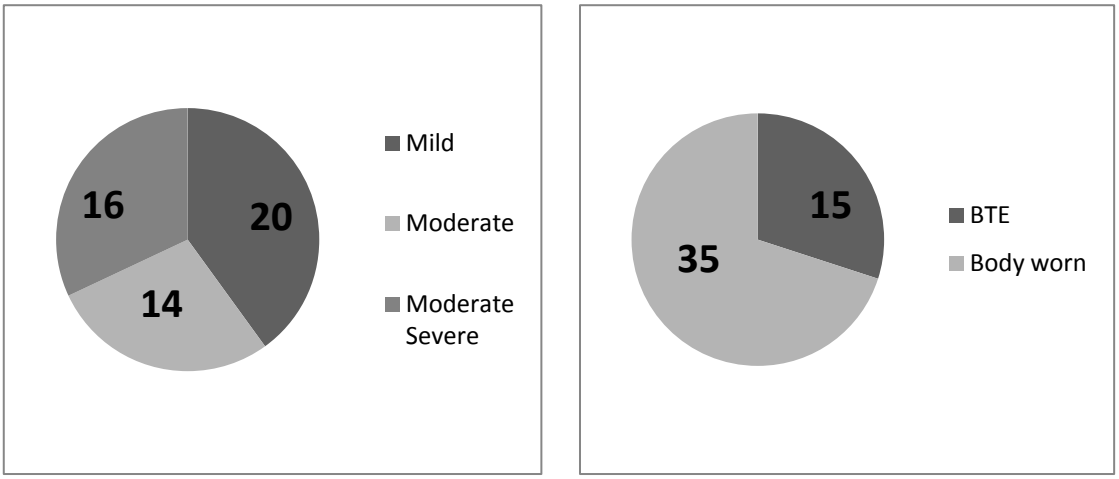


Figure 3.3 : Age group distribution of participants of field trials.



a. Degree of hearing loss of the participants b. Type of hearing aid worn by the participants

Figure 3.4 : Distribution of participants based on hearing loss and type of hearing aid.

The participants were having different degrees of hearing loss as shown in figure 3.4a. Thirty five of them were using BTE hearing aids whereas the rest were having body worn hearing aids as shown in figure 3.4b.

The assistive device was issued to the hearing impaired visitor at the reception counter, based on the language preferred (English / Hindi / Kannada) by the visitor. Language vise distribution of the participants are shown in figure 3.5. The device was fully charged before issuing to the visitor. The assistive device was coupled through the neck loop attached with the device to the hearing aids of the museum visitor for field trials. The museum staff helped the visitor to properly align the neck loop with the hearing aid. The feedback questionnaire in English / Hindi / Kannada (Appendix I, II & III) was issued to the visitor based on the language preference of the user.

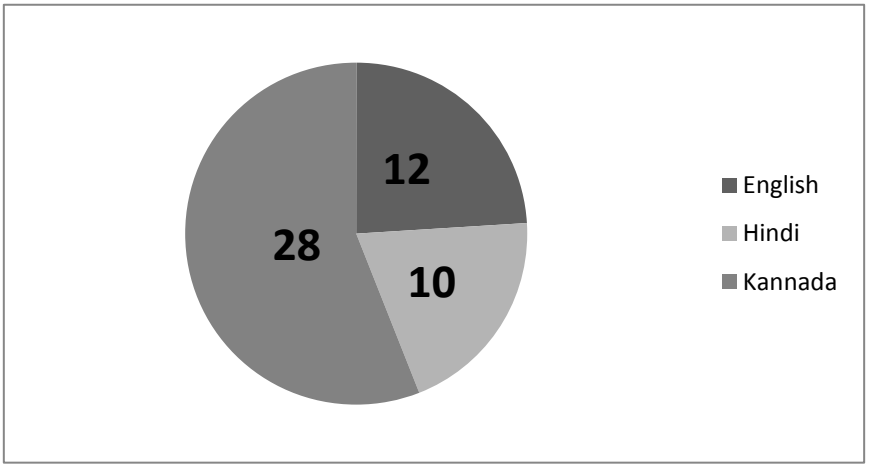


Figure 3.5 : Distribution of participants based on language preference

Five questions were put forth to the user in the questionnaire. All the questions had options and the user had to just tick the appropriate option. The first question was on the connectivity between handset of the assistive device and the hearing aid. `Always connected' / `disconnected in between' were the options given. As shown in figure 3.6, out of fifteen visitors who were using body worn hearing aids, twelve reported that the device was always connected whereas three of them reported disconnection in between. Thirty five users were having BTE hearing aid and all of them reported perfect connectivity.

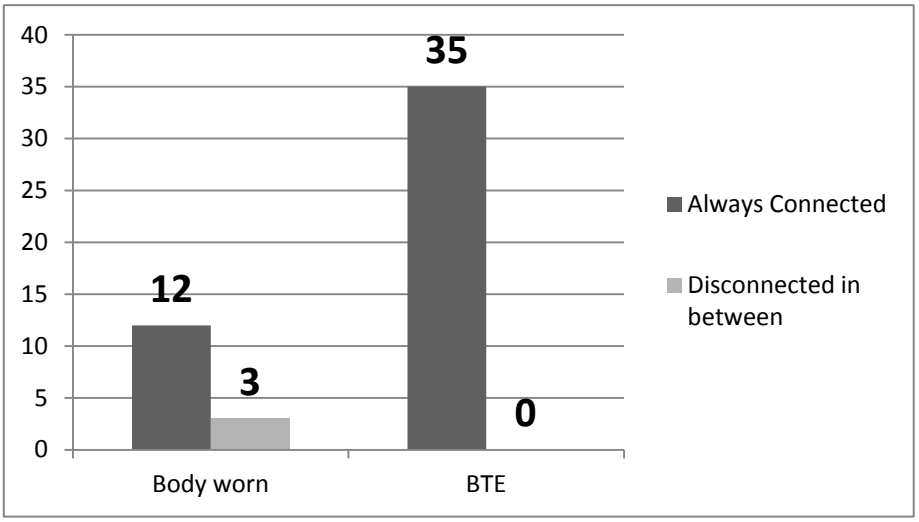


Figure 3.6 : Response to connectivity of the device with hearing aid of the visitors

The second query in the questionnaire was regarding the time taken by the assistive device to respond to the two digit code of the exhibit after being entered by the user. All the users gave the feedback that, the response was immediate. The third question asked in the feedback was on the intelligibility of the commentary heard through headphone without coupling it with the hearing aid. People with mild or moderate hearing loss were able to hear intelligible commentary through the head phones as shown in figure 3.7. Visitors with moderate to severe hearing loss had some difficulty in listening through the headphones. For eleven out of fifteen of them, it was intelligible only sometimes whereas it was not at all intelligible for the rest. The fourth question was to judge the intelligibility through neck loop coupling with the hearing aid. The responses from BTE and body worn hearing aid users are shown in figure 3.8. The output was always intelligible to all the thirty five BTE hearing aid users. For three out of fifteen body worn hearing aid users the output was intelligible only sometimes.

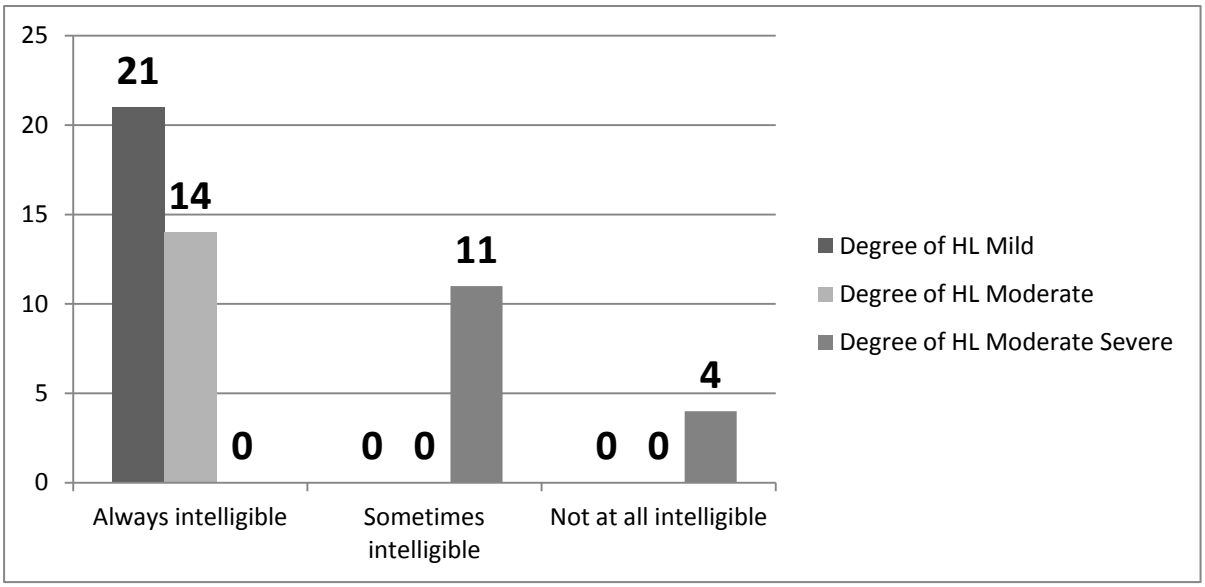


Figure 3.7 : Feedback towards intelligibility of output sound through head phone across degree of hearing loss.

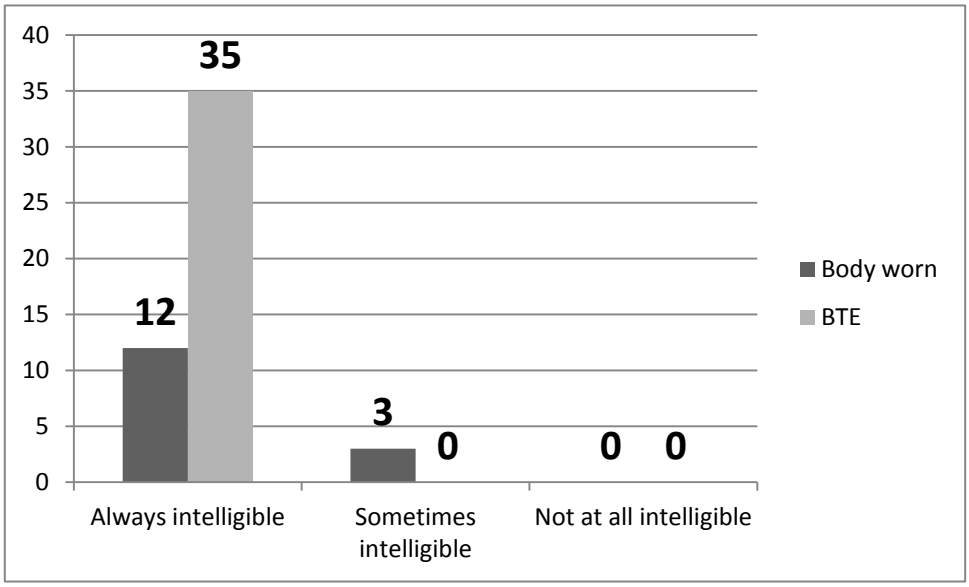


Figure 3.8 : Feedback towards intelligibility of output sound through neck loop coupling across different hearing aids.

The last question in the questionnaire was to assess the backup time of the battery of the device. For all the users the battery lasted till the end of their tour. The responses are depicted in figure 3.9.

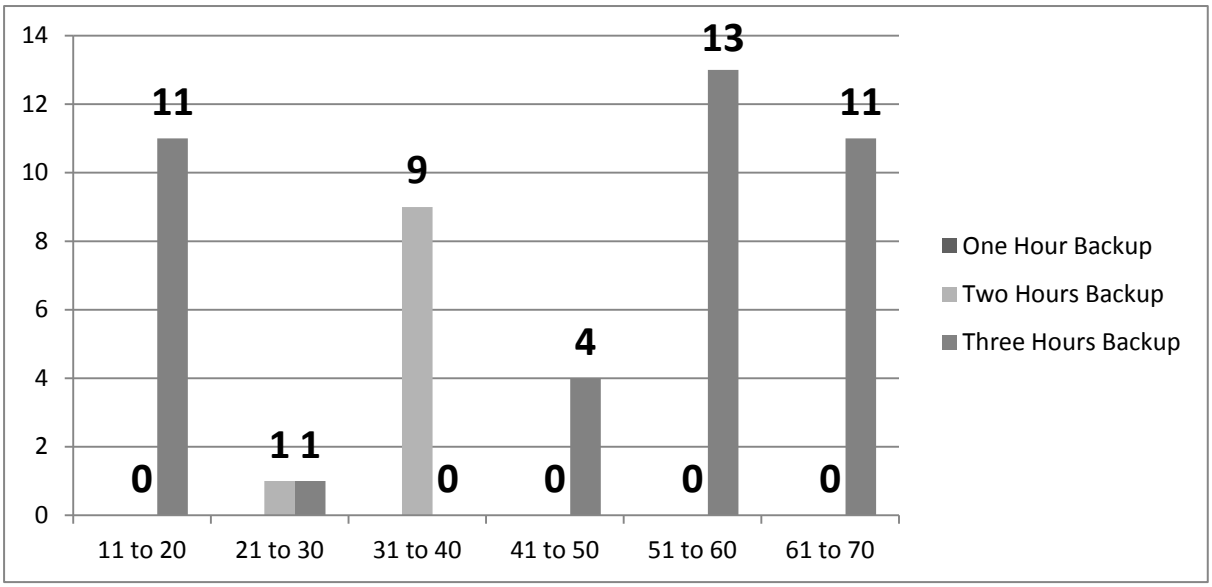


Figure 3.9: Feedback towards battery backup.

3.3 Discussion on the feedback from field trials

All the visitors with BTE hearing aids reported that the device was always connected to their hearing aids. Three out of fifteen visitors with body worn hearing aids had problem in connectivity in between. This was because of the neck loop getting shifted from its position, there by leading to week coupling between the hearing aid and the assistive device. This problem was solved later by adding a tie clip to the neck loop which ensured that the neck loop doesn't move from its position.

All the users reported that, once the code number of the device is entered through the key pad, the response from the device was immediate and they were able to hear the commentary without any delay.

All the users who took part in the trials were requested to use the device with head phone also. While using the device with head phone, their hearing aids were removed. Persons with mild hearing loss had no difficulty in listening through the head phone after adjusting the volume to their required level. Some participants with moderate to severe hearing loss had difficulty in listening through the head phones. They reported that, the commentary was not audible or intelligible sometimes. Five out of fifteen of the visitors with moderate to

severe impairment reported that the description was not at all intelligible. This may be because of their higher degree of hearing loss which could not be compensated by the volume adjustment in the device.

All the thirty five BTE users reported that, the commentary when heard through the neck loop coupling with their hearing aids was intelligible. Three out of fifteen body worn hearing aid users reported that, the intelligibility was poor in between. This was again due to the change in position of the neck loop which was corrected by providing the tie clip.

Feedback regarding battery backup was also satisfactory. Visitors in the age group of 11-20 reported one hour backup as they finished their tour in one hour. One visitor in the age range of 21-30 reported three hour backup and another one two hour backup. All visitors who belong to the age group of 31-40 reported a backup time of two hours. For all other visitors in the age range of 41-50, 51-60 and 61-70 the device provided three hours of back up. This difference in battery backup was due to the difference in time taken for the visitor to complete their visit. It may be noted that, in no case the device went out of charge during the tour.

3.4 Salient Features of the Design

- USB Compatible :- For downloading the commentary to the device in any language, the device can be coupled to the computer through USB port. After connecting, the audio files depicting the commentary can be transferred to the device just like transferring files to any external memory device. Each file transferred to the device should be named by the code number of the corresponding exhibit.
- Any language :- The audio files can be of any language. This suits the adaptability of the device to any part of the country. If the museum authorities can provide the commentary in their local language, the same can be recorded using the PC or any other digital recording device and can be transferred to the assistive device, to work in that language.

- Any degree of hearing loss : - The device is finally coupled through the neck loop to the hearing aid. As the hearing aid worn by the user will be compensating the hearing loss of the user, the assistive device can be provided to all hearing impaired visitors irrespective of their degree of hearing loss.
- Description for different age groups :- If the script is available for different categories such as children, adults etc. the same can be transferred to the device and thus different devices can be made available for children and adults. This will help the visitors to hear the commentary, matching their level of understanding.
- Battery back up of 4 Hrs :- After two hours of continuous charging the device can be used without interruption for four hours.
- Universal Design :- The sound output from the device can be heard through two modes - one through the head phone and the other one through the neck loop coupled with BTE. The head phone compatibility makes the design a universal one as it can used for people with normal hearing as well as for people who doesn't have a telecoil option in their hearing aid.
- Upgradable for totally deaf :- The device has an LCD display of character size 16 x 2. The text to be displayed is programmable with the help of micro controller. If fitted with the display of more number of characters, the device can display the text of the recorded material., thereby making the device suitable for totally deaf population.

Chapter IV

Conclusion

As the hearing aid in telecoil mode is totally immune to all sounds, the background noise will not have any effect on the performance of the hearing aid. SNR of curator's speech is enhanced with the developed system, to a level which is sufficient for a listener with hearing impairment. The tele-coil will pick up only the electromagnetic signal coupled to the hearing aid through the neck loop which is connected to the output of the device and hence will not pick up reverberated sound. Hence the evil effects of high reverberation time will be nullified.

The system normally works on recorded interpretations, (for a duration of 1 – 2 minutes) about the exhibits, which is stored in the memory chip. The system has provision for changing the contents of the memory chip as and when desired by the curator. The system also has provision for storing and playing back the commentary in any language. The present system has got 5 handsets, but is scalable to any number of handsets depending on the requirement of the museum. The handheld unit is powered by a rechargeable battery. With two hours of continuous charging, the battery will power the device nonstop for a playback time of about four hours.

The system designed has only provision for audio output either through headphone or through the neck loop coupled with the hearing aid and hence not suitable for totally deaf. The device has an LCD display for showing the status of the device. If this display is made little larger, it can be used for displaying the text of the description about the exhibit. With this modification, the device can be adapted to persons with total deafness also.

The system has got provision for connecting headphone. With the head phone connected, the device can the used by any visitor to the museum as an audio guide. This makes the device one of universal design and will also help to equip the normal visitors when the service of the curator is unavailable.

Results of the field trials of the device at Regional Museum of Natural History, Mysuru has been encouraging and the following are the highlights of the feedback received:-

- Field trials with BTE hearing aids indicate perfect audio quality.
- Field trials with body worn hearing aid shows perfect audibility and acceptable quality.
- Battery back up to three hours of continuous operation without recharging has been reported.

Implications of the project

1. The assistive device developed will make the visit of a hearing impaired person to the museum more informative and enjoyable.
2. The availability of the device in the museum will make the museum accessible to persons with hearing impairment as defined by the United Nations Commissions Resolution for Persons with Disabilities (UNCRPD).
3. The device when modified with visual display of the text of the commentary, will enable access of people with total deafness also to the museum.
4. Universal design of the assistive device make it suitable for use by normal persons also through head phones. Thus normal visitors can also enjoy their museum visit without depending on the curator.
5. Since the design of the device is indigenous, all the museums can afford to have this device at a nominal cost.
6. As the technology is indigenously developed, the maintenance of the device will also be feasible at a nominal cost.

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Appendix I

Assistive device for museum access to

Persons with hearing impairment

Questionnaire for field trail

Date: Venue of trails:

Name, Address & Contact No:

1. Connectivity between handset and server : Always connected/getting disconnected in between
2. Response from the server towards intermediate request by the handset : Immediate response/delayed response/ no response
3. Intelligibility of description heard through handset headphone : Always intelligible/ sometimes intelligible/ not intelligible
4. Intelligibility of description heard through neck loop coupling with hearing aid : Always intelligible/ sometimes intelligible/ not intelligible
5. Battery backup of the handheld unit : one hour/ two hours/ three hours

- Respondent for field trail: museum visitors with hearing impairment.
- Time given for respondents: one day during visit of the respondent to the museum.
- Cadre of people participating in the field trail: all museum visitors with hearing impairment.

Appendix II

श्रवण क्षतिग्रस्त व्यक्तियों के संग्रहालय अभिगमन हेतु सहायक उपकरण

क्षेत्र परीक्षण हेतु प्रश्नावली

दिनांक :

जाँचने की जगह :

नाम, पता एवं संपर्क संख्या :

१.	सर्वर एवं हैंड्सेट में संयोजकता	: हमेशा संपर्क में / बीच-बीच मे बाधित
२.	हैंड्सेट के मध्यवर्ती मांग पर सर्वर की प्रतिक्रिया	: तात्कालिक प्रतिक्रिया / विलंबित / प्रतिक्रिया नही ।
३.	हैंड्सेट हेड्फोन के द्वारा सुने गये विवरण की बोधगम्यता	: हमेशा बोधगम्य / कभी-कभी बोधगम्य / अबोधगम्य
४.	श्रवण यंत्र के साथ नेक लूप कपलिंग के द्वारा सुने गये विवरण की बोधगम्यता	: हमेशा बोधगम्य / कभी-कभी बोधगम्य / अबोधगम्य
५.	हैंड्हेल्ड ईकाई का बैटरी बैकअप	: एक दौर / दो दौर / तीन दौर

Appendix III

ಶ್ರವಣ ದೋಷವುಳ್ಳ ವ್ಯಕ್ತಿಗಳ
ಸಂಗ್ರಾಲಯ ಪ್ರವೇಶಕ್ಕೆ ಸಹಾಯಕ ಸಾಧನ

ದಿನಾಂಕ: ಸ್ಥಳ:

ಹೆಸರು, ವಿಳಾಸ, ದೂರವಾಣಿ:

೧. ಹ್ಯಾಂಡ್ಸೆಟ್ ಮತ್ತು ಸರ್ವರ್ ನಡುವಿನ ಸಂಪರ್ಕ :
ತಡೆರಹಿತ ಸಂಪರ್ಕ/ ಆಗಾಗ್ಗೆ ಸಂಪರ್ಕ ತುಂಡಾಗುವುದು

೨. ಹ್ಯಾಂಡ್ಸೆಟ್ ವಿನಂತಿಗೆ ಸರ್ವರ್ ಪ್ರತಿಕ್ರಿಯೆ :
ತಕ್ಷಣದ ಪ್ರತಿಕ್ರಿಯೆ/ತಡವಾದ ಪ್ರತಿಕ್ರಿಯೆ/ಪ್ರತಿಕ್ರಿಯೆ ಇಲ್ಲ

೩. ಹ್ಯಾಂಡ್ಸೆಟ್ ಹೆಡ್ಫೋನಿಂದ ತಿಳಿಯುವ ವಿವರಣೆ :
ಯಾವಾಗಲು ಗ್ರಹಿಸಬಹುದು/ ಕೆಲವೊಮ್ಮೆ ಗ್ರಹಿಸಬಹುದು/
ಗ್ರಹಿಸಲು ಸಾಧ್ಯವಿಲ್ಲ.

೪. ನೆಕ್ ಲೂಪ್ನೊಂದಿಗೆ ಶ್ರವಣ ಸಾಧನದಿಂದ ತಿಳಿಯುವ ವಿವರಣೆ :
ಯಾವಾಗಲು ಗ್ರಹಿಸಬಹುದು/ ಕೆಲವೊಮ್ಮೆ ಗ್ರಹಿಸಬಹುದು/
ಗ್ರಹಿಸಲು ಸಾಧ್ಯವಿಲ್ಲ.

೫. ಹ್ಯಾಂಡ್ ಹೆಲ್ಡ್ ಘಟಕದ ಬ್ಯಾಟರಿ ಬ್ಯಾಕ್ಕಪ್ :
ಒಂದು ಸರಧಿ/ ಎರಡು ಸರಧಿಗಳು/ ಮೂರು ಸರಧಿಗಳು

LPC2141/42/44/46/48

Single-chip 16-bit/32-bit microcontrollers; up to 512 kB flash with ISP/IAP, USB 2.0 full-speed device, 10-bit ADC and DAC

Rev. 04 — 17 November 2008 Product data sheet

1. General description

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty.

Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I^2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

2. Features

2.1 Key features

- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory. 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
- In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader software. Single flash sector or full chip erase in 400 ms and programming of 256 B in 1 ms.
- EmbeddedICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip RealMonitor software and high-speed tracing of instruction execution.
- USB 2.0 Full-speed compliant device controller with 2 kB of endpoint RAM.
  In addition, the LPC2146/48 provides 8 kB of on-chip RAM accessible to USB by DMA.
- One or two (LPC2141/42 vs. LPC2144/46/48) 10-bit ADCs provide a total of 6/14 analog inputs, with conversion times as low as 2.44 µs per channel.
- Single 10-bit DAC provides variable analog output (LPC2142/44/46/48 only).
- Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.

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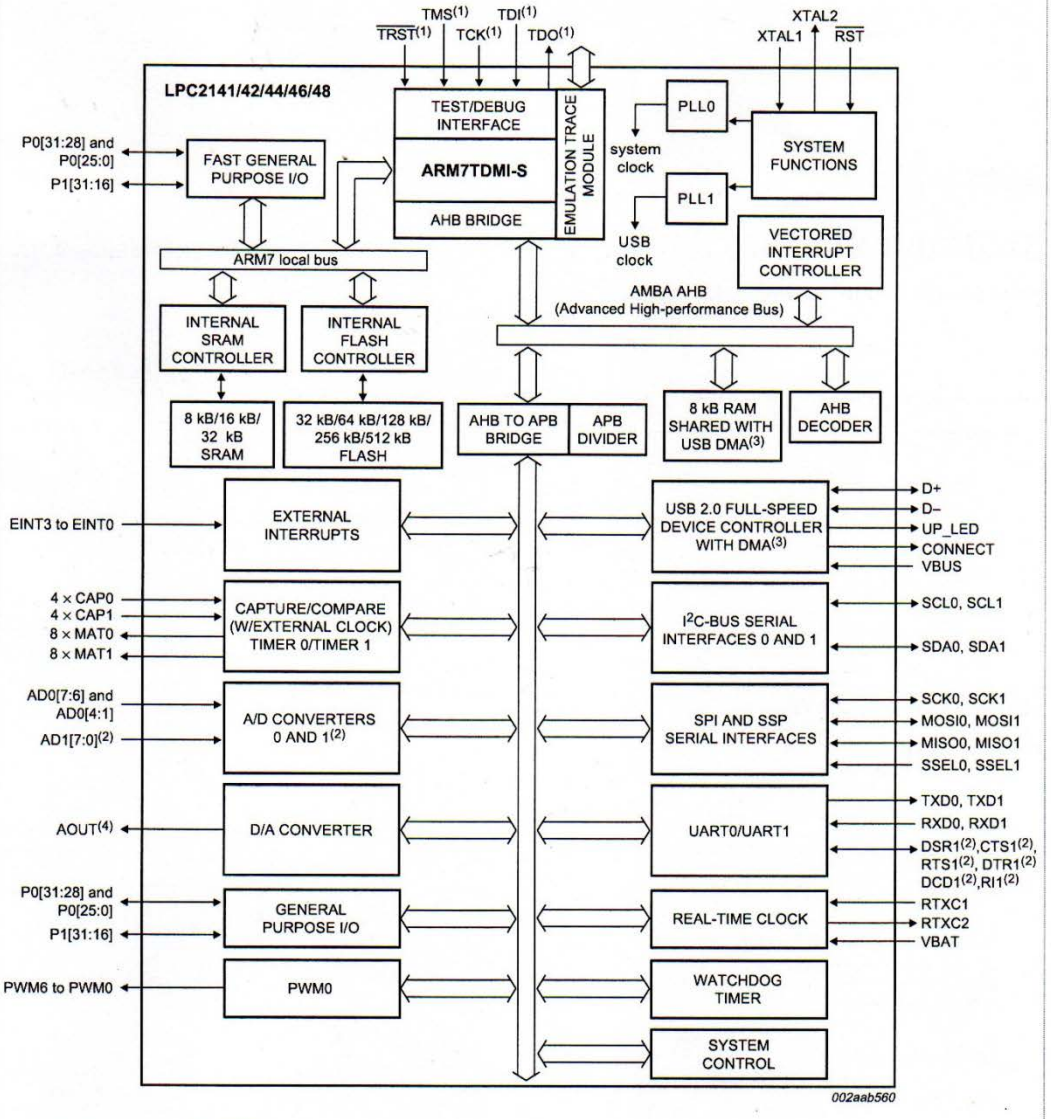
- Single 10-bit DAC provides variable analog output (LPC2142/44/46/48 only).
- Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.

4. Block diagram



(1) Pins shared with GPIO.

(2) LPC2144/46/48 only.

(3) USB DMA controller with 8 kB of RAM accessible as general purpose RAM and/or DMA is available in LPC2146/48 only.

(4) LPC2142/44/46/48 only.

Fig 1. Block diagram

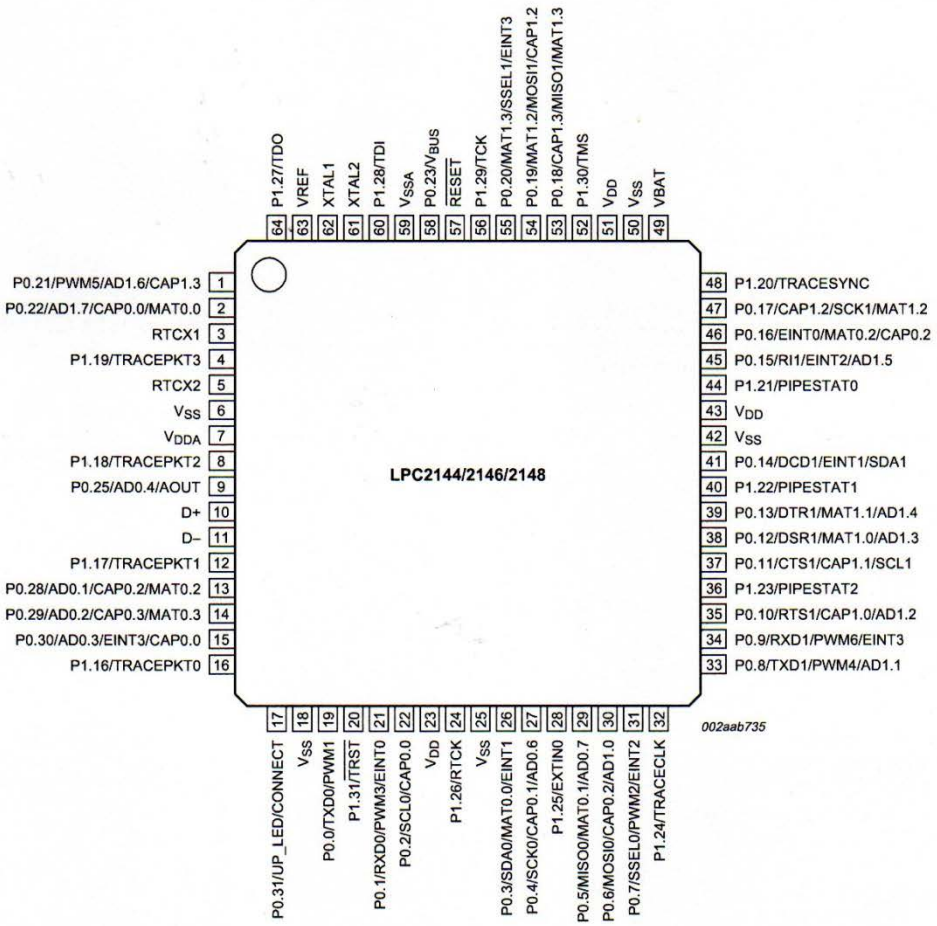


Fig 4. LPC2144/46/48 pinning

VS1003 - MP3/WMA AUDIO CODEC

Features

- Decodes MPEG 1 & 2 audio layer III (CBR +VBR +ABR); WMA 4.0/4.1/7/8/9 all profiles (5-384kbit/s); WAV (PCM + IMA ADPCM); General MIDI / SP-MIDI files
- Encodes IMA ADPCM from microphone or line input
- Streaming support for MP3 and WAV
- Bass and treble controls
- Operates with a single 12..13 MHz clock
- Internal PLL clock multiplier
- Low-power operation
- High-quality on-chip stereo DAC with no phase error between channels
- Stereo earphone driver capable of driving a 30Ω load
- Separate operating voltages for analog, digital and I/O
- 5.5 KiB On-chip RAM for user code / data
- Serial control and data interfaces
- Can be used as a slave co-processor
- SPI flash boot for special applications
- UART for debugging purposes
- New functions may be added with software and 4 GPIO pins

Description

VS1003 is a single-chip MP3/WMA/MIDI audio decoder and ADPCM encoder. It contains a high-performance, proprietary low-power DSP processor core VS_DSP[4], working data memory, 5 KiB instruction RAM and 0.5 KiB data RAM for user applications, serial control and input data interfaces, 4 general purpose I/O pins, an UART, as well as a high-quality variable-sample-rate mono ADC and stereo DAC, followed by an earphone amplifier and a common buffer.

VS1003 receives its input bitstream through a serial input bus, which it listens to as a system slave. The input stream is decoded and passed through a digital volume control to an 18-bit oversampling, multi-bit, sigma-delta DAC. The decoding is controlled via a serial control bus. In addition to the basic decoding, it is possible to add application specific features, like DSP effects, to the user RAM memory.