FORMAT FOR SUBMISSION OF PROPOSAL UNDER

COGNITIVE SCIENCE RESEARCH INITIATIVE (CSRI)

(To be filled by applicant)
{Sections 101 to 192 to be on separate sheet(s)}

101	Project Title	:	Sign Language Translator for Speech Impaired Persons Communication
102	Broad Subject	:	Engineering
103	Sub Area	:	Design of Communication Tool
104	Duration in months	:	24 Months
105	Total Cost	:	RS.9,65,250/-
106	FE Component	:	Nil
107	Project Category	:	Applied Research (Product Development)

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Project Title:.....Registration No.....(to be filled by DST)

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Investigator **Dr. R. Rajavel**, Institution: SSN College of Engineering, Chennai

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191. Project summary (maximum 150 words)

Sign Language is a form of non-verbal communication used by those who are challenged in hearing or speaking. Sign gestures are a non-verbal visual language, different from the spoken language, but serving the same function. It is often very difficult for the hearing impaired or speech impaired community to communicate their ideas and creativity to their friends, and relatives. This is not only for their ideas and creativity, even for their basic needs, they have to interact with people those who don't know sign language. Hence, this project aims to develop a system using the current technology to enable communication between those who use sign language and those who don't. The proposed system will have a camera to acquire the images of hand gestures. Image segmentation and feature extraction algorithm will be used to recognize the hand gestures of the person using sign language. Finally, according to the recognized hand gestures, the text and/or pre-recorded voice output will be played, in this way, the hearing impaired or speech impaired person can easily communicate with normal people.

192. Key words (maximum 6) : Sign Language Translator, Communication tool for Hearing Impaired People, Gesture Recognition System, Image Processing for Sign Language, Gesture to Speech System and Gesture to Text System.

200. Technical details :

This project proposes a low-cost sign language translator (hand gesture recognition) system for hearing or speech impaired persons to communicate with normal people. It consists of two stages, (a) Image acquisition and processing and (b) Hand gesture recognition and text/voice output. The schematic of the proposed system is shown below.

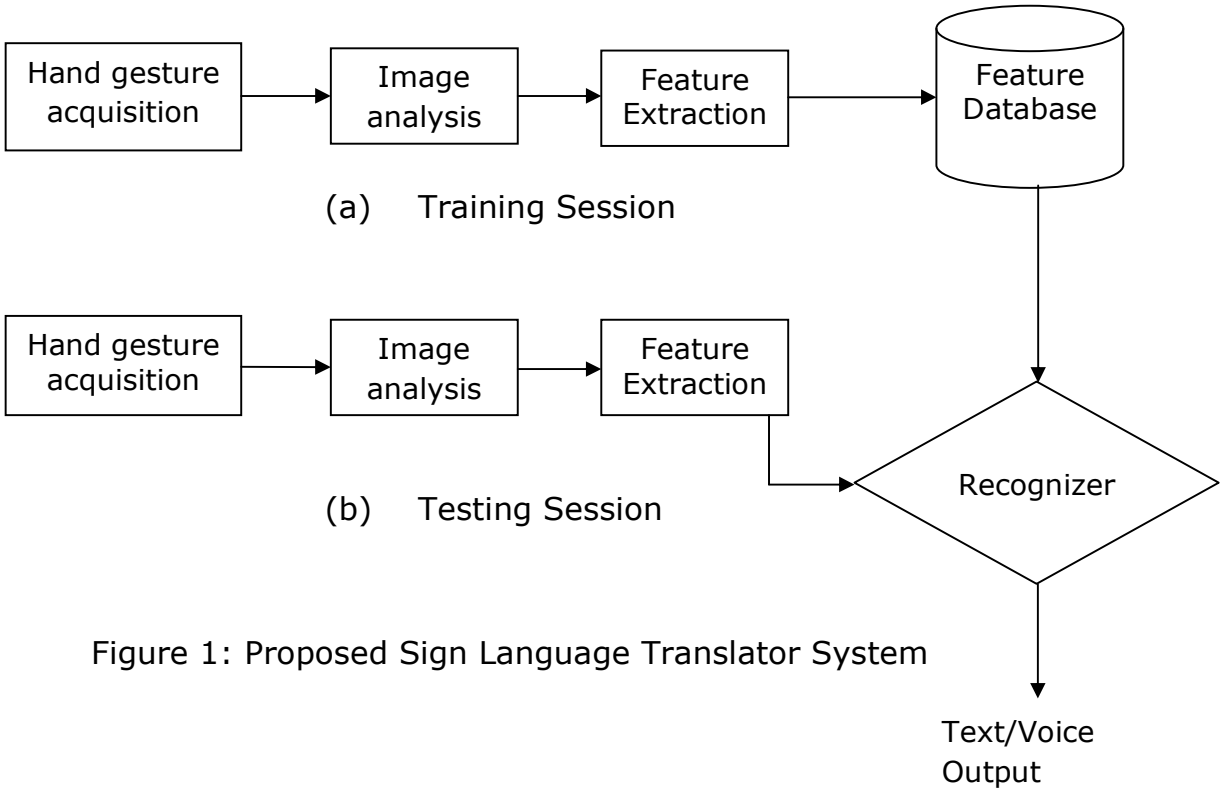

Figure 1: Proposed Sign Language Translator System

The project starts with image acquisition, i.e. sign images capturing by the camera. The acquired images are pre-processed and the region of interest is identified. The unique features of each sign in the region of interest are extracted and used in the recognition stage.

In the recognition stage, the features extracted from the new hand gesture are compared with the available database of hand gesture templates. A threshold value is set for the maximum difference between the input sign and the database, if the difference is below the maximum limit, a match is found and the sign is recognized. Corresponding text and/or audio file is played on audio device. The project can be simulated initially in a computer using MATLAB. After successful completion of the simulation, the same

would be designed as a standalone system using microcontrollers with necessary build-in hardwires.

210. Introduction (under the following heads)

211. Origin of the proposal

Sign Language is the natural way of communication of hearing and/or speech - impaired people. A sign is a movement of one or both hands, accompanied with facial expression, which corresponds to a specific meaning. Although the deaf and speech impaired persons can communicate without problems amongst themselves, there is a serious challenge for the deaf community to communicate their ideas and creativity to their friends, relatives and in work environments. The overall goal of this project is to develop a new standalone system for recognizing and translating continuous sign language to text or voice output.

212. Definition of the problem

Sign Language is a form of non-verbal communication used by hearing and speaking impaired people. Sign gestures are a non-verbal visual language, different from the spoken language, but serving the same function. It is often very difficult for speech or hearing impaired people to communicate with people those who don't know sign language, and this may severely affect their day to day activities.

This project aims to provide a solution to this problem by developing an automatic translation of Indian sign language into speech and/or text in English to assist the hearing and/or speech impaired people to communicate with hearing people in a natural way of speaking. The proposed system acquires the sign language gesture images using a camera. The acquired images will be pre-processed and the reliable features from the area of interest will be extracted. The feature extracted from the test gesture images are compared with the existing gesture image templates and the one which gives minimum value will be recognized. Finally, the corresponding text and/or speech output will be played using the audio device. Once the prototype system is designed and implemented in computer using MATLAB, the same will be developed as a standalone system using microcontroller and with necessary additional hardwires.

213. Objective

The objectives of this project are;

1. To identify the core sign language vocabulary set being frequently used by the deaf and dumb people.

2. Design and develop a sign language translator (SLT) system using image processing concepts.

3. Simulate and validate the designed SLT system using MATLAB.

4. Design a standalone SLT system using microcontroller with necessary hardwires.

220. Review of status of Research and Development in the subject

There has already been a great deal of work done both in India and abroad in the area of text to sign language conversion. The area of sign language-to-text (or audio) is less mature, although there have been some recent breakthroughs incorporating data gloves for positional extraction. Here we list few ongoing researches in this field in India and abroad.

221. International status

1. Chance M. Glenn et al., Laboratory for Advanced Communications Technology/CASCI, Rochester Institute of Technology Rochester, New York, have developed an image processing technique for the translation of American Sign Language (ASL) finger-spelling to text. Currently, they work with the project called, "The Sign2 Project" that is focused on a complete technological approach to the translation of ASL to digital audio and/or text.

   Reference: Glenn, et. al., "An Image Processing Technique for the Translation of ASL Finger-Spelling to Digital Audio or Text", NTID International Instructional Technology and Education of the Deaf Symposium, June 2005.

2. Sign language recognition has been explored in recent years by using multiple input sensors, and now, researchers at the Chinese Academy of Sciences and Beijing Union University have teamed up with Microsoft Research Asia to research such a

system. Microsoft Kinect technology was used to create a cost-effective and capable technology prototype that enables sign-language communication between signer and non-signer, and offers translation between different sign languages.

Reference: http://research.microsoft.com/en-us/collaboration/stories/kinect-sign-language-translator.aspx.

222. National status

1. Prince Nagar et al., School of Engineering & Technology, Sharda University, Noida, India, has developed a system to recognize and classify ten hand gestures based solely on their shapes. The system takes an input image of a hand gesture and calculates three features of the image, two based on compactness, and one based on radial distance. The parameters found in the classification step were obtained empirically using 200 hand images. The system was tested on another 200 hand images, and was able to successfully classify 182 images, or with an overall success rate of 91 percent.

   Reference: Prince Nagar, Ashwani Sengar and Mayank Sharma, "Hand shape based gesture recognition in hardware," Archives of Applied Science Research, Vol. 5, No. 3, pp. 261-269, 2013.

2. Meenakshi Panwar, Centre for Development of Advanced Computing, Noida, India has developed a system for hand gesture recognition to provide an interface for aiding visually impaired users. His system can recognize around 36 different gestures on the bases of 7 bit binary sequence or string generated as an output of this system. The proposed system has been tested on 360 images, and it gives approximate recognition rate of 94%.

   Reference: Meenakshi Panwar, "Hand Gesture based Interface for Aiding Visually Impaired," International Conference on Recent Advances in Computing and Software Systems, SSN College of Engineering, Chennai, 2012.

3. Mokhtar M. Hasan et al., Computer Science Department, Banaras Hindu University, India, presented the role of geometric features in gesture recognition. Geometric features considered live features as compared with non-geometric features which considered as blind features.

   Reference: Mokhtar M. Hasan, and Pramod K. Mishra, "Hand Gesture Modeling and Recognition using Geometric Features: A Review," Canadian Journal on Image Processing and Computer Vision, Vol. 3 No. 1, March 2012.

223. Importance of the proposed project in the context of current ` status

The area of sign language-to-text (or audio) is less mature, and the existing work is limited to the recognition of letters, digits and symbols hand gesture. Currently, many labs from education sector and industries are trying to develop systems to translate sign language to text or speech. Examples of such systems are; "The Sign2" American Sign Language (ASL) finger-spelling to text translator and Microsoft Kinect. Still there is a room for developing a smart Indian Sign Language translation system.

The ultimate aim of this project is to develop a smart standalone system using image processing techniques and integrate with developing technologies such as smart-phones, video-phones, etc. If such a smart system comes, that would help the dumb persons to communicate with the normal people for their daily needs and may lead their life happily.

224. Review of expertise available with proposed investigating Group/institution in the subject of the project

The Principle Investigator have strong working knowledge in image processing techniques and also worked as Image processing specialist in one of the R&D industry. Moreover, his PhD work involves the development of an algorithm to tract the lip movement for enhancing the speech recognition accuracy. The Co-PI is currently working at National Institute for Empowerment of Persons with Multiple Disabilities (NIEPMD), Chennai. He knows sign language and can help to design the

core sign language vocabulary set being frequently used by the dumb people. We hope that, jointly with NIEPMD faculty team, this project would be completed successfully in the stipulated time.

225. Patent details (domestic and international)

Patent Title	:	Sign language translator
Patent No	:	US 8566077 B2
Publication Date	:	22 – 10 – 2013
Inventors	:	Barbara Ander
		Sidney Ander

Abstract:

A digital sign language translator has a case configured to be supported by a hand of a user, a touch screen display located on a face of the case, a microprocessor for selectively translating words, letters, and numbers into video clips of an actual person performing a sign language translation. The translator has an internal memory device for storing a standard database selected words, letters, and numbers and the corresponding video clip of an actual person performing a sign language translation of words, letters, and numbers. The translator further includes a memory card slot for receiving an external memory card, the external memory card having an expanded vocabulary to supplement the standard database contained on the internal memory. The translator further includes a battery for powering the translator and a keyboard selectively shown on the touch screen display.

230. Work plan

231. Methodology

1. First identify the core sign language (SL) vocabulary set by consulting with the experts.

2. Record the identified SL words from at least 30-50 deaf and dumb persons using the video camera.

3. Organize the recorded SL words into training set and testing set in the ratio of 80:20.

4. Develop an image processing based software SLT system to pre-process, identify the region of interest, extract features, compress the features and recognize the SL words.

5. Once the SL word is identified, the corresponding text and/or audio will be played by the audio device.

6. Finally, after successful completion of the software SLT system, we are intended to design the same as a standalone system using microcontroller with additional hardwires.

232. Organisation of work elements

The proposed project is organized as follows:

1. Identify and record the core sign language (SL) vocabulary set.

2. Design and develop an image processing based sign language translator (SLT) system to recognize the hand gesture and output the corresponding text/speech.

3. Validate the working of the developed software SLT system with the recorded gesture images.

4. Finally, design a smart standalone SLT system using microcontroller and additional hardwires.

233. Time schedule of activities giving milestones (also append to bar diagram and mark it as Section 410)

1. Equipment/consumables purchase – 1 Month
2. Identify SL words and recording - 2 Months
3. Design and develop a software SLT system – 9 Months
4. Simulate & validate the software SLT system –4 Months
5. Design a smart standalone SLT system - 8 Months

234. Suggested plan of action for utilization of research outcome expected from the project.

The ultimate aim of this project is to provide a solution to the hearing and/or speech impaired people to communicate with the normal hearing people in a natural way by developing an automatic translation of Indian sign language into speech and/or text in English.

After successful completion of the project, the developed smart standalone SLT system would help the deaf and dumb persons studying at National Institute for Empowerment of Persons with Multiple Disabilities (NIEPMD-Chennai), to communicate with the normal hearing people without the need of an intermediate person.

300. BUDGET ESTIMATES: SUMMARY

	Item	BUDGET			(in Rupees)
		1st Year	2nd Year	3rd Year	Total
A.	Recurring				
	1.Salaries/wages	240000	240000		480000
	2. Consumables	12500			12500
	3. Travel	10000	10000		20000
	4. Other costs	43875	43875		87750
B.	Equipment	165000	200000		365000
	Grand total (A+B) Total FEC*				965250

*FEC- Foreign Exchange Component

Foreign Exchange component (in US$) equivalent of rupee amount at the prevailing rates may be furnished.

N.B. Entries here should match with those given in section 310 to 350; justification for each item is to be given in Section following it that is section 311, 321, 331, 341 and 351.

310. BUDGET FOR SALARIES/WAGES

		BUDGET			(in Rupees)
		1st Year (m.m.*)	2nd Year (m.m.)	3rd Year (m.m.)	Total (m.m.)
Designation & number of persons	Monthly Emoluments				
Image Processing Specialist (1 Person)	20,000 (per month)	240000 (12 Months)	240000 (12 Months)		480000 (24 Months)
Total					480000

*m.m.:man months to be given within brackets before the budget amount

311. Justification for the manpower requirement.

The whole project is based on image processing concepts, so at least one image processing specialist is mandatory to implement the proposed image processing algorithms in MATLAB as well as in hardware.

320. BUDGET FOR CONSUMABLE MATERIALS

		BUDGET			(in Rupees)
Item		1st Year	2nd Year	3rd Year	Total
1	2 TB Hard drive	10000			10000
2	32 GB Pen drive	2500			2500
	F***				
Total	B	12500	----	-----	12500
	F				

*Q: Quantity or number, ** Budget, ***F: Foreign Exchange Component in US$

321. Justification for costly consumable (if not provided for in Section 231 i.e. Methodology)

The Hard drive and pen drive are required to store the acquired hand gesture images for backup purpose.

330. BUDGET FOR TRAVEL

	BUDGET			(in Rupees)
	1st Year	2nd Year	3rd Year	Total
Travel (Only inland travel)	10000	10000		20000

331. Justification for intensive travel, if any.

The image processing specialist needs to travel to acquire hand gesture images. And the PI and/or Co-PI needs to travel to purchase consumables and equipments.

340. BUDGET FOR OTHER COSTS/CONTINGENCIES

		BUDGET			(in Rupees)
		1st Year	2nd Year	3rd Year	Total
	Other costs/Contingency costs	43874	43874		87750

341. Justification for specific costs under other costs, if any.

The other cost includes purchasing the Laser printer, System speakers (Voice output), LCD panel (Text output), Books, Papers and Stationary items etc.

350. BUDGET FOR EQUIPMENT

Sl. No.	Generic name of the Equipment along with make & model	Imported/Indigenous	Estimated Costs (in Foreign Currency also)*	Spare time for other users (in %)
1	HP Envy Recline 23k100in Touch Smart	Online purchase	125000	25 %
2	Sony 16GB HDR-PJ340E/W	Online purchase	40000	---
3	Stand alone embedded sign language translation system	System to be developed at the end of the project	200000	---

351. Justification for the proposed equipment.

Video Camera – To record the hand gesture of the speech/hearing Impaired people.

Computer - Higher end computer needs to process the acquired images during training and testing sessions with minimum amount of time.

Embedded sign language translator system – After successful completion of the design and implementation of the sign language translation system using computers, the same has to be developed using microcontroller with necessary build-in hardwires.

410. Time Schedule of Activities through BAR Diagram

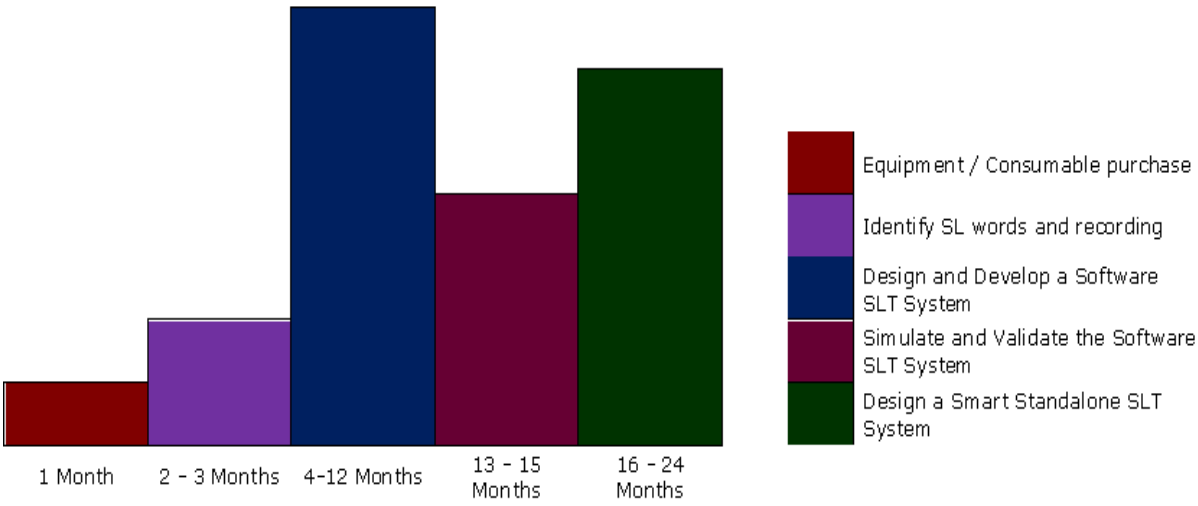

Figure 2: Time Schedule of Activities of the proposed project through BAR Diagram

420. List of facilities being extended by parent institution(s) for the project implementation.

A) Infrastructural Facilities:

Sl. No.	Infrastructural Facility	Yes/No/ Not required Full or sharing basis
1.	Workshop Facility	Not required
2.	Water & Electricity	Yes
3.	Laboratory Space/ Furniture	Yes
4.	Power Generator	Yes
5.	AC Room or AC	Yes
6.	Telecommunication including e-mail & fax	Yes
7.	Transportation	No
8.	Administrative/ Secretarial support	Sharing Basis
9.	Information facilities like Internet/ Library	Yes
10.	Computational facilities	Yes
11.	Animal/ Glass House	Not required
12.	Any other special facility being provided	No

B. Equipment available with the Institute/ Group/ Department/ Other Institutes for the project:

Equipment available with	Generic Name of Equipment/ Software	Model, Make & year of purchase	Remarks including accessories available and current usage of equipment
PI & his group			
PI's Department	MATLAB	v6.5, 2003	MATLAB can be used to simulate the system before to develop hardware.
Other Inst In the region			

430. Detailed Bio-data of the Investigator(s)/Co-Investigator(s)

Bio-data of the PI and Co-PI is attached separately.

45 ng implemented/ completed/
su Investigators

Su

50