

Smart Bliss Board System for Multiple Disabilities

I.R.K. Seneviratne, C. J. Basnayake*

Department of Electrical & Computer, Faculty of Engineering Technology,
The Open University of Sri Lanka, Nawala, Nugeoda, Sri Lanka.

*Corresponding Author: email: cjbas@ou.ac.lk, Tele: +94714819196

Abstract – This paper presents a communication mechanism for multiple disabled in the world (such as blindness, deaf, mental retardation, vocal disabled etc.). They have very few mechanisms to learn and communicate (Braille system, Sign language etc.). This work focuses on the category of the multiple disabled named “Cerebral Palsy”. Cerebral palsy is a disorder with movement, difficulties with thinking, learning and feeling. Most people of cerebral palsy are suffering in inability to read, write or speech. Therefore, they are unable to express their ideas naturally to others. On the other hand, they are unable to perceive others ideas as well. These communication barriers caused them to their teaching and learning. The Bliss symbolic language board is a concept for a learning method for the Cerebral Palsy disabled.

At present, the Bliss symbols are printed on hard board. When using this printed Bliss board in the classroom, the teacher/tutor must concentrate each multiple disabled child separately to understand his/her expression using Bliss symbols. This is the main problem in their teaching and learning of multiple disabled children/adults. Basically, they use a head attached stick for touching each bliss symbols on a Bliss board. This is a difficult task for them to use this Bliss board and also multiple disabled children/adults are unable to use new technology such as send emails, chatting etc. due to their disabilities. Literature survey found that the other similar systems for Bliss symbolic language learning are also difficult for use by physically challenging persons because they are unable to access modern devices such as a computer or mobile phones directly. But in this research mainly consider about the accessibility of modern technology.

Proposed Smart Bliss Board system is running on a desktop application with a head movement tracking device to select appropriate Bliss symbol automatically. The proposed system is very interactive than the existing printed Bliss symbolic board because the users (physically challenging children or teachers) can select each Bliss symbol by using moving cursor. In this project, developed an electronic wearable device for controlling the cursor movement on a computer screen using a head attached accelerometer device. After pointing or touching Bliss symbols, then the device automatically lookup and convert to the English language text and voice of the pointed Bliss symbol and then the users can send the message to the teachers. The teachers can use a desktop PC or a tablet PC to response the respective message of the users. The results showed that the significant improvement of the communication of the physically challenging children with the proposed technology over the traditional printed Bliss board. When using the proposed system, teachers do not need to interact with Bliss symbolic words. They can easily type required messages using the English language, and then it will automatically convert to the Bliss symbolic language sentence and send back to the users. This Bliss symbolic language application is designed for simplifying the reading, writing for the people with cognitive, language, and learning disabilities or literacy problems. And also this application can be used internationally among many users and teachers those who do not speak the same spoken language.

Keywords: Bliss symbolic language, Cerebral Palsy, Multiple disability, Wearable electronic device, Head movement tracking

1. INTRODUCTION

1.1 Project Introduction

There is a significant amount of multiple disabled children and adults in Sri Lanka. According to the reference report (Gunasinghe, 2004), there were 4320 multiple disabled in Sri Lanka in 2003. Moreover, it can be seen more children with physical disabilities (Cerebral Palsy) in homes for disabled such as Preethipura infants' home (Wattala), Asokapura Farm and Cotagala School (Kadugannawa) and Anandapura Farm (Katana) there are more physically challenging (Cerebral Palsy) children. And also there are some physically challenging army soldiers in Ragama army hospital and Bellanwila army hospital in Sri Lanka, due to bomb blasts at the battle field. Some children are suffering from multiple disabilities such as Cerebral Palsy. And some children are suffering from multiply disabled after a vital shock of their lives like bomb blast or losing their very hopeful dreams.

Most of the special education teaching schools are following conductive traditional education system. Conductive education is a comprehensive method of learning by which individuals with neurological and mobility impairment learn to specifically and consciously perform actions that children without such impairment learn through normal life experiences. Those schools try to teach multiple disabled children using different techniques such as a book or poster with pictures that show things the child might want, or an alphabet board they can use to spell out their message, teaching with the Bliss symbolic board. But there is not achieving satisfaction level based on the interview (Deldeniya, 2014) and noted that some methods (such as using the alphabet board and express their message) hard to follow-up such children.

According to the interview (Deldeniya, 2014), the present successful learning and teaching method for multiple disabled (especially Cerebral Palsy) is a Bliss symbolic board. But that also has difficulties when using it with physically challenging people. The usage of the Bliss board system is less in Sri Lanka but all over the world currently use this technique to teach them using their own language integrations.

Therefore, the main aim of this project is to develop a method of teaching, learning and communicating with multiple disabled children using new technology and Bliss symbolic language and implement a mechanism, to express their message, feelings and ideas to other physically challenging people or normal not impaired people using the Bliss symbolic language to the English language and the English language to Bliss symbolic language vice versa using voice and text.

1.2 Issues in the Existing Systems

There are more ways to educate normal children, such as reading, writing, listening, and watching. Based on these four activities, they have various learning resources to refer such as books, radio, television, internet, normal observing environment, telephone, computers etc. However, there are some amounts of multiple disabilities (such as some are blindness, deaf, mental retardation, vocal disabled etc.), they have very few ways to learn (Braille system, Sign language etc.).

The Bliss symbolic language board can be used as learning tool for multiple disabled children (Bliss Communication International, 2014). But at present, this Bliss symbols

printed on a board, therefore when using it following problems may face by physically challenging users and tutors.

- In a classroom teacher/tutor must concentrate each multiple disabled child separately to understand his/her expression using printed Bliss board.
- Multiple disabled children/adults currently use the Bliss symbolic board using the head attached stick by touching each symbols on the printed board (Figure 1). This is a difficult task for them to express their view to the others.

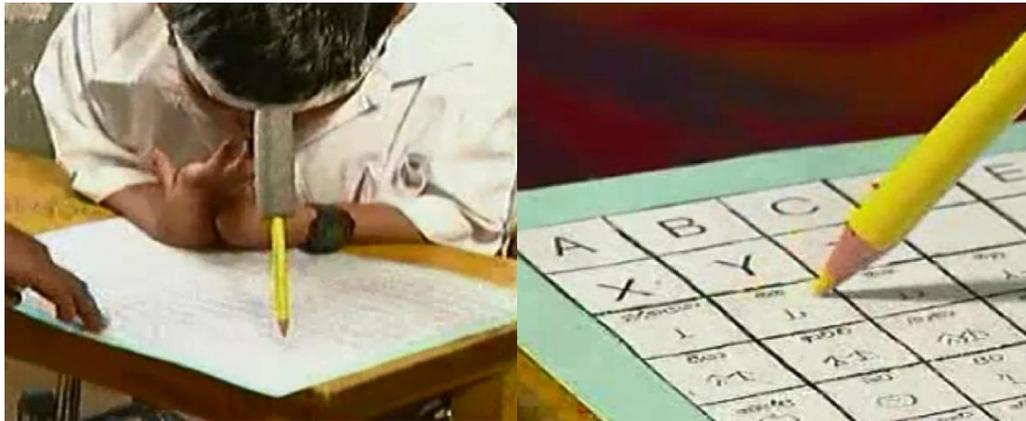


Figure 1: Current usage of the printed bliss board by physically challenging child

- Using this existing Bliss board, the physically challenging persons are unable to communicate their feeling or message to others directly.
- Multiple disabled children/adults unable to use new technology such as send emails, chatting etc. due to their disabilities.

1.3 Aim & Objectives

1.3.1 Aim

The aim of this project is to develop an interactive smart Bliss board system for multiple disabilities.

1.3.2 Objectives

- Identify the learning difficulties of children with multiple disabilities.
- Develop a wearable electronic headband unit to capture the head movement and locate a particular Bliss symbol in a Bliss Board.
- Develop a desktop application for Bliss symbolic language.
- Implement a mechanism to communicate Bliss symbolic messages among the users as individual or group.

1.4 Project overview

The Smart Bliss Board system contains Windows operating system based application. This system is very interactive than the current printed Bliss symbolic board. Because when using this Bliss board system, the users (physically challenging children or teacher)

can select each Bliss symbol by moving the cursor on to the required symbols or touching the symbols. There is an electronic hardware device for controlling the cursor movements on the computer screen using the user's head attached accelerometer device. After pointing or touching symbols using this electronic hardware device, then it will automatically convert to the respective English language text and voice, and then the users can send their messages to the teacher's computer.

In Windows based application teacher replies his/her answer as a symbolic message to the Bliss board user. When using this system, the teachers no need to interact with the Bliss symbolic words, they can type required message using English, and then it will automatically convert to the Bliss symbolic language sentence.

If there is more than one user in the classroom, each message list and displays in the desktop application, and then the teacher can reply to each message separately or as a group.

And also anyone who does not know about Bliss language can communicate with the physically challenging persons through this application. They can learn and express their ideas via Bliss symbolic language to physically challenging children. Therefore, this system can use as a Bliss symbolic language learning tool for physically challenging persons or the other persons.

2. LITERATURE SURVEY

2.1 Literature survey on Bliss symbolic language system

2.1.1 Bliss Symbol Communication Board

Bliss Symbol Communication Board has been used internationally for promoting communication among non-verbal adults and children, who cannot otherwise, read or spell. The Bliss symbols were selected to convey general concepts that could be combined together to form words. Bliss symbols are easily recognizable ideographic symbols and some of them are also pictographs. Bliss symbols have been used world-wide working with different clinical populations and have been found to be very effective in promoting communication. The Bliss symbol communication Board reproduced in Figure 2 contains five hundred seventeen (517) of symbols. The English word for each symbol is printed underneath for the convenience of the user (Bliss Communication International, 2014)(Bliss Communication UK, 2010).

Color index of the board

- White - Normal day today usage words
- Light blue - Person
- Brown / Pink - Tense and Verbs
- Green - Feelings and Adjectives
- Yellow - Nouns

1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Ä	Ö	.	
2	My name is	Yes	what	which	I don't know	No	action in the past	action in the present	shall/will	plural	opposite meaning	Let's start again	most	I don't understand	near, almost	What did you say?	head	Hello	Welcome	Goodbye	Thanks	Wow!	Sorry	Ugh!	combine indicator	belongs to	part of	same	similar	similar sound
3	question	who	what	which	not	see, am, are, is, was, were	become	want	live	much/many	more	Let's start again	most	I don't understand	near, almost	body	head	hair	ear	eye	food	dessert	bread	bun	cookie	drink	milk	fruit/juice	fluffy drink	liquor
4	when	where	how	why	maybe	has, have	can	must	be called	happy	sad	upset	afraid	anxious	ambitious	nose	mouth	teeth	neck	hand	sandwich	spread	sauce	marmalade, jam	cheese	coffee	tea	salt	sugar	flavouring
5	that	but	so	with	and	begin	continue	try	stop, end	good	bad	beautiful	funny	boring	stomach	back	buttocks	leg	meat	sausage	hamburger	hamburger	hamburger	pasta	yoghurt	vegetable	fruit	ice cream	candy	
6	ago	now	then	again	or	get	exchange	catch	barrow	nice	troublesome	frustrated	painful	uncomfortable	in love	arm	hug	massage	medicine	make-up	pie	egg	salad	soup	shellfish	straw	glass	dish	spoon	knife
7	a, an	the	all	nothing	who, which, that	see, look	hear, listen	go, walk	stand	angry	frustrated	frustrated	frustrated	sick	different	clothing	coat, sweater	underwear	shirt, blouse	dress	thing	paper, page	book	magazine	calendar	bliss symbol	word	internet	problem	idea
8	in	before, in front of	over, above	between	out	eat	taste	sit	lie	lie	hungry	thirsty	thirsty	lonely	strange	jeans	stockings	shoes	hat	helmet	letter	email	parcel	CD	cassette	secret	gathering	party	club	hobby
9	about, of	by, of	for	against	at	sleep	wash, bathe	shower	city	wrong	smart	careful	careful	together	dead	money	clock	blanket	napkin	bib	radio	tv	video/ DVD	tape, recorder	computer	gift	toy	play game	ball	camera
10	up	forward	to	from	on	feel	love	tease	nag	certain	careful	careful	long	high	linear	vehicle	whet, chair	glasses	brush	jewellery	telephone	key	container	machine	picture	music	gymnastics	sport	race	
11	person	I, me	you	he, him	she, her	do, does	read	write	draw, paint	big, large	dirty	broken	broken	disgusting	expensive	tail	bus	train	airplane	car	place	house	home	flat	group, home	room	toilet	kitchen	stairs	window
12	we, us	you	they, them	someone, anybody	my, mine	cook	buy	cost	count	wet	dirty	dirty	dirty	disgusting	expensive	taxi	bus	train	airplane	boat, ship	school	after school	day centre	working place	secret	table	chair	bed	shelf	mirror
13	family	father	mother	brother	sister	play	dance	swim	ride a horse	hot	soft	thick, fat	thick, fat	round	square	trip	outing	ticket	subcase	post office	bank	hospital	cinema, theatre	museum	cupboard	chest or drawers	stove	electricity	battery	
14	relative	grandfather	grandmother	uncle	aunt	ride	meet	turn	tail	difficult	quick	heavy	heavy	full	strong	city	country	material	metal	shop	restaurant	farm	garden	country side	lamp	bottle	scissors	strap, fitting		
15	man	woman	boy	girl	self	think	know	forget	destroy	early	always	often	often	sometimes	suddenly	environment	animal	bird	fish	snake	time	minute	hour	week	month	day	night	evening	break	
16	baby	child	teenager	adult	group	wish	decide	need	help	new	old	old	recently	soon	ongoing	insect	tree	flower	seed	forest	year	spring	summer	autumn	winter	morning	afternoon	today	tomorrow	
17	friend	visitor	manager	teacher	assistant	keep	close	put	wait	finished	light	light	quiet	open	only	lake	island	ice	water	fire	Christmas	Easter	holiday	birthday	vacation	monday	Monday	wednesday	Thursday	Friday
18	therapist	doctor	nurse	police officer	god	promise	phone	marry	fight	left	first	first	last	next	right	mountain	earth	sky	star	weather	rain	snow	air	wind	saturn	saturn	saturn	saturn	saturn	saturn
19	zero	one	two	three	four	five	six	seven	eight	ten	hundred	hundred	thousand	half	quarter	colour	white	yellow	orange	red	pink	purple	blue	green	brown	gray	black	black	black	black

Figure 2: Bliss Symbolic Board

2.1.2 Why Bliss?

The Bliss symbolic system has several features which make it a preferred means of communication for nonspeaking persons, for persons with limited literacy skills, and for persons who are ready and eager to use Bliss to communicate with persons whatever their language background may be (Bliss Communication International, 2014).

2.1.3 Who uses Bliss?

The system is used with persons with severe speech and physical impairments (SSPI) in over 33 countries and Bliss symbol materials have been translated into more than 15 languages. Mostly Bliss symbolic language system is used to teach to multiple disabled (handicapped) children who are suffering from Cerebral Palsy. And special thing is, to learn this Bliss symbolic language users (physically challenging person) must be intelligent to understand. Also this Bliss symbolic language can be used by anyone who doesn't know to speak country related language (Like Chinese, Japanese, Arabic, Sinhala, etc.) to express his idea/ message to other(Bliss Communication International, 2014).

2.1.4 How Bliss Works?

Bliss symbolic makes use of core symbols (Bliss-characters), many of which are intuitive and pictographic. They can be arranged to produce Bliss-words that can represent complex and abstract, yet easy-to-understand meanings. There are around 100 basic symbols, which can be combined endlessly to form new concepts. Nouns can be changed into verbs or adjectives with the addition of an indicator, and there are also simple past and future tenses. Bliss has simple, elegant, logically based rules that make it ideal as an on-phonetically based language. (Bliss Communication International, 2014)

➤ Bliss-character(Wikipedia, 2014)

Figure 3.1 shows an individual graphic symbol of Bliss language (ideograph).

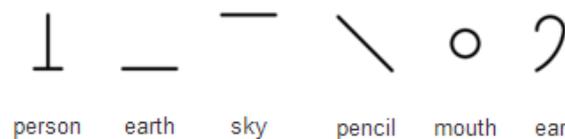


Figure 3.1: Bliss characters

➤ Bliss-word

Represents a concept or meaning and is spelled using a sequence of one or more Bliss-characters. (Figure 3.2)



Figure 3.2: Bliss words

➤ Indicators

Characters used to show the part of speech of a symbol. (Figure 3.3)

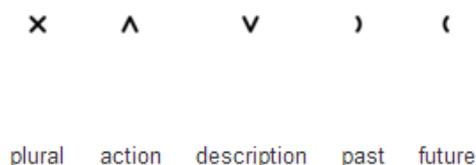


Figure 3.3: Bliss indicators symbols

➤ Now you can say, (same as Sinhala language can express idea) (Figure 3.4)

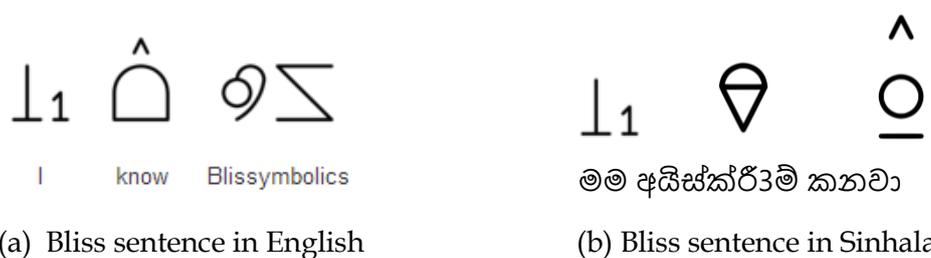


Figure 3.4: Bliss sentence expression

2.2 Literature survey on similar systems

Literature survey found that the other similar systems for Bliss symbolic language learning are also difficult for use by physically challenging persons because they unable to access modern devices such as a computer or mobile phones directly, due to their disabilities. But in this research mainly consider about the accessibility of modern technology (Sensorysoftware, 2001).

Table 1- Comparison of similar Bliss symbolic systems with the proposed system

Bliss symbolic system name	Can use disabled	Separate device	Software /Web	Required an internet connection	Email Facility	Text Output	Voice Output	Cursor cont. by Face movement
Bliss board (printed on paper)	✓	✓	-	-	-	-	-	-
Bliss Online!	-	-	✓	✓	-	-	-	-
The Grid 2	✓	-	✓	-	✓	-	✓	-
Blissvox	✓	-	✓	-	-	✓	✓	-
Proposed System	✓	-	✓	✓	✓	✓	✓	✓

3. METHODOLOGY

The proposed methodology is shown in the Figure 4. There are mainly two type of devices which are running on Windows operating system. A device for the physically challenging person and a device for the teacher or any normal user who wish to communicate with the physically challenging person as follows.

3.1 Approached of the Project

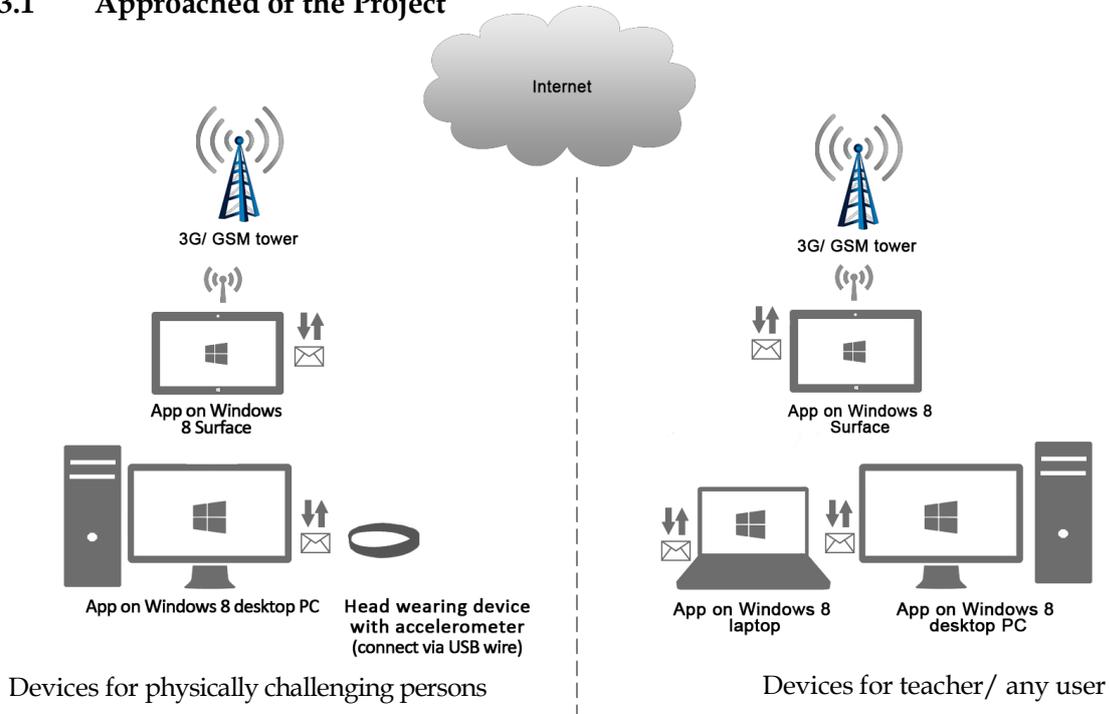


Figure 4: Proposed approach of the system

The device which is used by the physically challenging person (left hand side of the Figure 4) has a connection to the wearable electronic headband unit which can move the mouse cursor position in the developed software application. The other device is a normal device which is used by the teacher and has a separate software application. These devices connect via Wi-Fi or the internet to communicate with each other.

3.2 Features of the System

1. Physically challenging user can select Bliss symbols of the smart Bliss board by touching or pointing mouse cursor using headband unit.
2. Display the related Bliss symbols according to the user preference and translates to the voice output.
3. Any users can send their messages to the others via internet using smart software application.
4. After receiving the message to the teacher's or the normal user's device, then they can view the received messages and reply in English text.
5. Enriched with English text to Bliss symbolic and Bliss symbolic to English text language generator/converter of the smart software application to facilitate the communication between each other.

3.3 Advantages of proposed system

1. This Bliss system can access physically disabled and children with communication problems without any difficulty.
2. Teacher or tutor especially no needs to concentrate about each physically challenging child as existing method when using a developed Bliss system.
4. Teacher can get multiple message same time from each individual student separately.
5. More interactive, efficient than existing printed Bliss board.
6. Physically challenging people can use messages and email facility.
7. Anyone can learn about Bliss symbolic language through the smart Bliss board system.

4. DETAILED EXPLANATION

4.1 Components integration diagram of the system

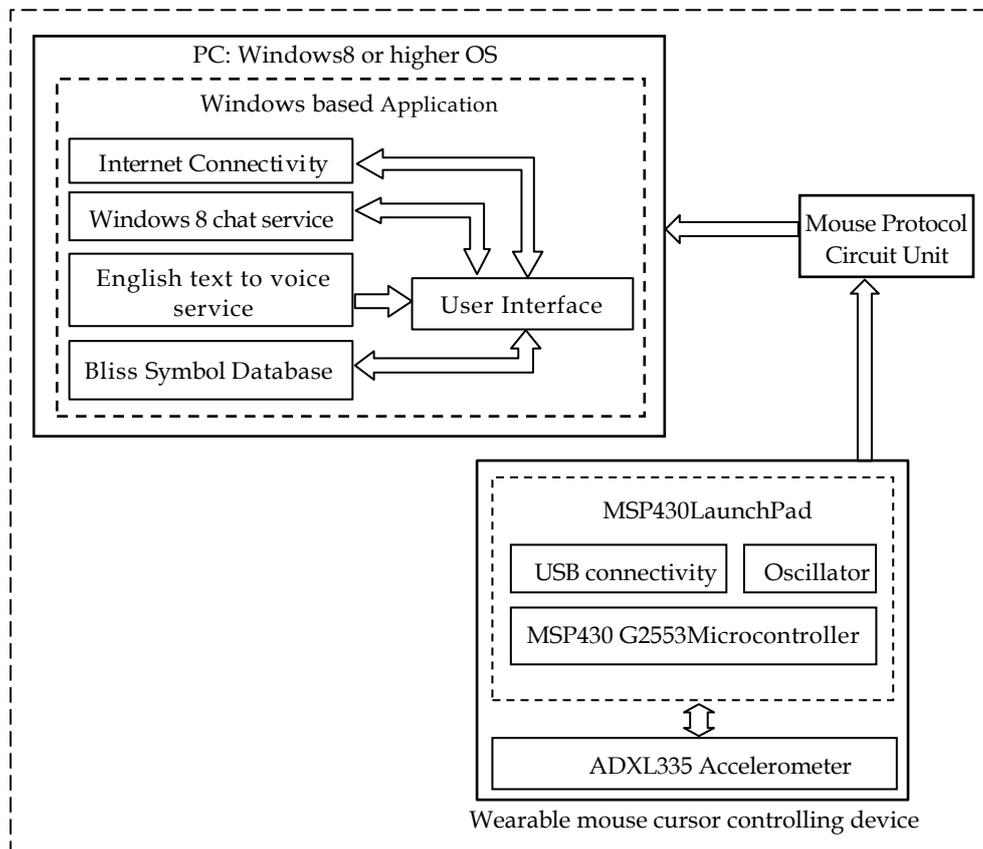


Figure 5: Component integration diagram of the system

Figure 5 shows the integration among each component of the proposed system such as Wearable mouse cursor controlling device, mouse protocol circuit unit and the 'Bliss Smart' application on the desktop PC.

Figure 6 shows the flowchart for the main control logic of the proposed system. There are two modes in the developed system. They are User mode and the Tutor mode. Based on the different mode selection, the developed software can be configured to use as a user device or a teacher/tutor device.

4.1 Flow Chart of the Operation of the System

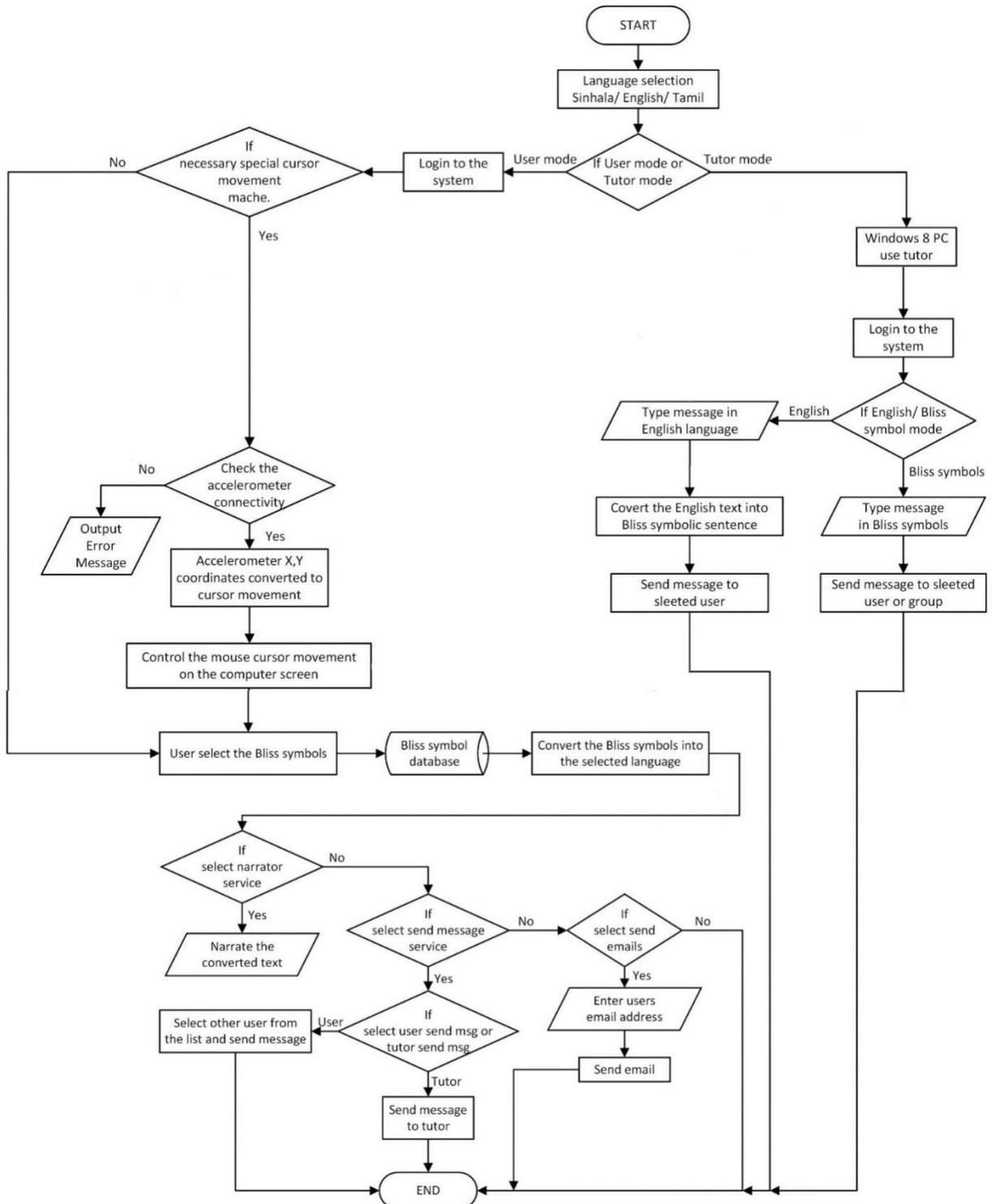


Figure 6: Flow diagram for smart Bliss board system

5. IMPLEMENTATION

5.1 Wearable Mouse Cursor Controlling Device Unit

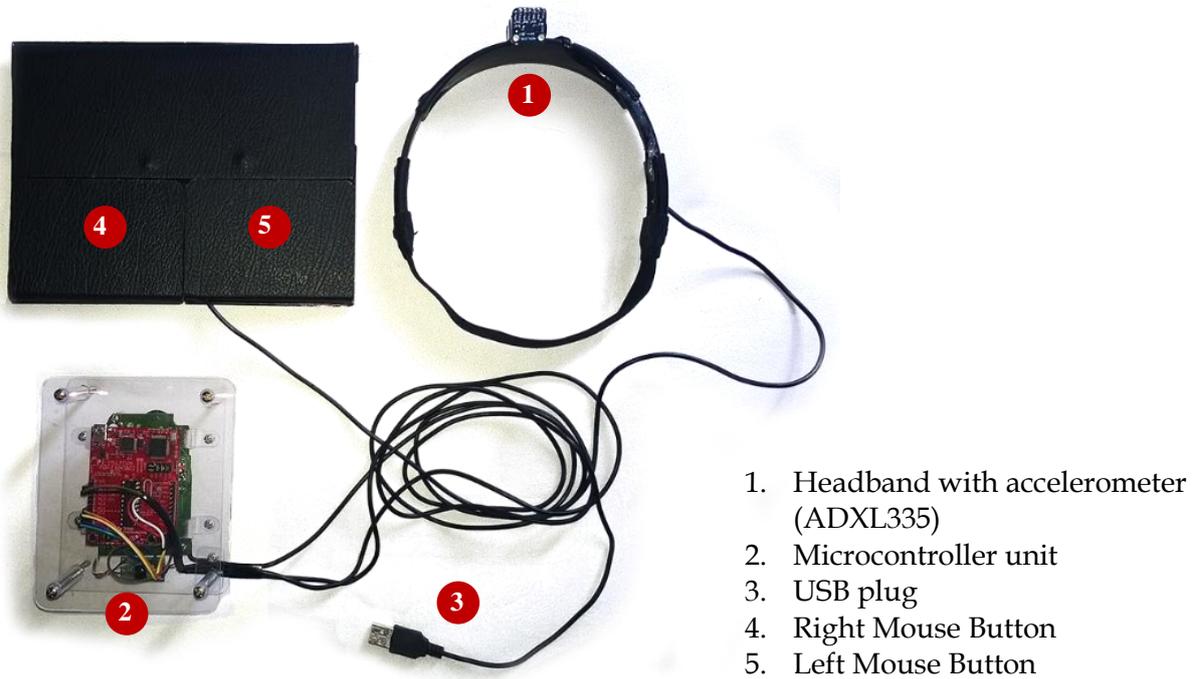


Figure 7: Wearable mouse cursor controlling device unit

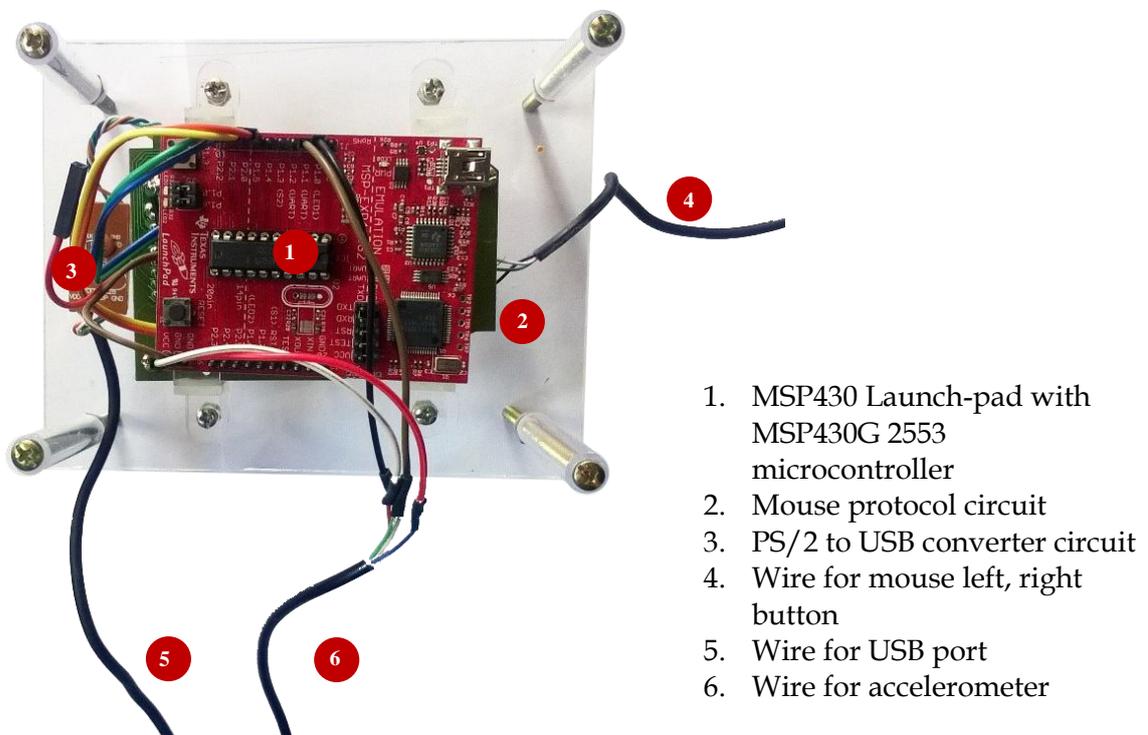


Figure 8: Microcontroller unit

The above images (Figure 7,8) describe the hardware integration with components. MSP430 launch pad (Texas Instruments, 2010) provides the MSP430 G2553 microcontroller to control all of functions of the system (Texas Instruments, 2014). ADXL335 accelerometer (Goodrich, 2014) connects to the MSP430 launch pad microcontroller. Accelerometer sends the signals of acceleration (movement on x, y, z axis) of each axis, then microcontroller identify those signals and convert it to mouse protocol signal using the programming language (Energia, 2010). That signal send to the mouse protocol circuit and it generate the signal for mouse cursor movement of the computer screen. In above hardware integration include a PS/2 to USB converter circuits (Chapweske, 2003) to enable USB connecting facility with computer.

5.2 Windows phone application GUI

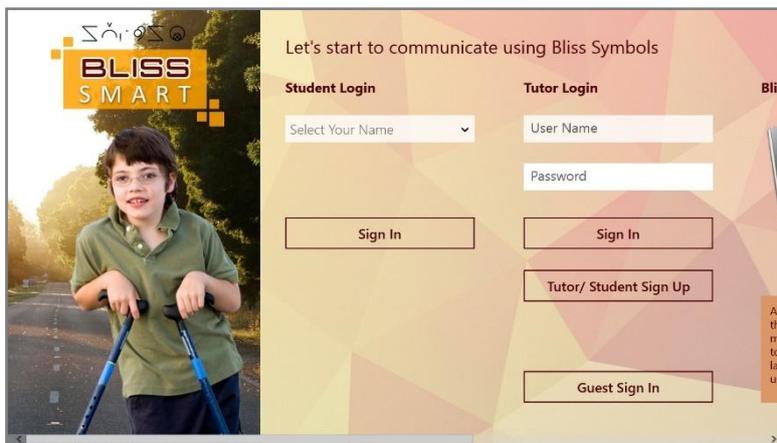


Figure 9.1 shows the home screen of the “Bliss Smart” Windows based app. It includes student sign in, tutor sign in and guest sign in links and it also include link to tutor/ student sign-up page. Rest of the page displays Bliss Smart user guide and information about Bliss language.

Figure 9.1: Login screen for students and tutors



Figure 9.2 shows a tutor sign up on screen. Tutors can register by providing required details of the interface. And also in this page provide a link to student sign up page. Tutors can register students via this link. In this page shows all are registered tutors in the

class room.

Figure 9.2: Tutor sign up screen



Figure 9.3: Student sign up screen (Sign up process must do by tutor)

Figure 9.3 shows the student register. The function can be accessible for tutors via their sign up page, because physically challenging users unable to enter their details by own. Therefore, tutors must input student details to the app via this interface, this page also shows all already registered students of the class room.



Figure 9.4: Bliss board for students

Figure 9.4 shows the Bliss board system for students. The screen shows standard Bliss board and chat function with friends or tutors of the class room. When selecting a Bliss symbol from the Bliss board, those symbols displayed on the user selected symbol field and it will convert to text.

In this screen, there is a facility to on/off chat service and chat with selected friend or tutor of the class room. Physically challenging users need to narrate the selected Bliss symbols meaning in English; they can narrate it by clicking on the speaker button.



Figure 9.5: Bliss board for guests

Figure 9.5 shows the Bliss board system for guests. The screen shows standard Bliss board and only a few features such as Bliss symbol to text service and narrates service. Because this interface provides users who are not registered in this system.

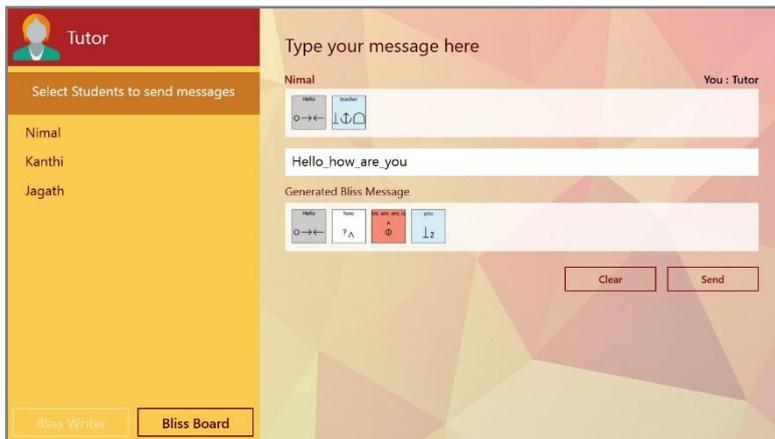


Figure 9.6 shows the tutor interface of the “Bliss Smart” windows based app. This screen provides only who are logging using correct credential for tutor login. In this interface, shows messages of students sent to him/her. And tutor provide a bliss writer interface, on that interface tutor can type

Figure 9.6: Tutor interface screen

his/her message in English and then that English words converted to the Bliss symbols. Then tutor can send the message to selected student or selected group of students. If user wants to use Bliss board, tutor can visit to that page also.

6. TEST EVALUATION

6.1 Test cases of the project

- ✓ Head movement tracking convert to mouse cursor feature.
- ✓ Head movement tracking device left & right buttons to check the working condition.
- ✓ Tutor & Student signup on the Smart Bliss windows application
- ✓ Login Function of Student & Tutor
- ✓ Display selected bliss symbols, when click on any symbol of the bliss board.
- ✓ Narrate selected word symbols, when click on the speaker button.
- ✓ Chat service with other users who logged into the system.
- ✓ Bliss writing function of the tutor page.

When testing the developed smart Bliss board system, I mainly considered about the percentage of the achievement of the objectives of the project which was defined in the Introduction Section. After identifying the learning and communication difficulties of multiple physically challenging students, I developed a new technological solution for overcome those difficulties. First, I developed a head movement tracking mechanism and then it tested on computer and finalized. Then, I started developing desktop application for Bliss symbolic language use standalone without communication facility. After clarifying the successful working condition, I started to develop a mechanism to communicate Bliss symbolic messages among desktop application users. After doing those successful steps it applied on actual environment at the Prithipura infant home - Wattala as shown in the Figure 10 (Prithipura Communities, 2008).



Figure 10: Developed Bliss board system applied on actual environment

7. CONCLUSION

This smart Bliss board system is designed for the physically challenging people who are having communication problems. This design helps to access new computer technology via head movement tracking device with special computer application. Head movement tracking device to capture the head movement and it converts to mouse cursor movement on the computer screen. This system will help physically challenging people to express their ideas and messages to others. After identify and complete the first objective, the second objective of the project could successfully achieve using an accelerometer sensor device with MSP430G2553 microcontroller. This device has great advantages over the other similar systems. Also, this head movement tracking device can be used to control other applicable applications on the computer, such as playing some games and educational applications.

Developing a desktop application for Bliss symbolic language was the third main objective of this project. To achieve this objective, I used Windows based operating system (Windows 8) platform to develop this desktop application. This application directly helps learning & teaching Bliss symbolic language to physically challenging persons. And also, it will help those who want to express an idea or communicate with the unknown language speaker. It could successfully complete with project mentioned features and facilities.

The final objective of the project was an implementation a mechanism to communicate Bliss symbolic messages among desktop application users as individual or group. This communication mechanism successfully runs in real time via the Internet. This application facilitates many of this 'Smart Bliss' application users for communication in real time.

In future developments, a web based Bliss symbol application will benefit the users who have a computer and an Internet facility. This project is not only for those who have multiple physical challenges but this can also be used by anyone who does not know how to communicate with unknown language using human in other country in the world.

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- ✓ Mr. Widura - Office assistant (Prithipura Infants Home - Wattala).
- ✓ Mr. Palinda - Cerebral Palsy suffering student (Prithipura Infants Home - Wattala).

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