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Braille and Text To Speech Using Digital Signal Processing for Visually Impaired Individuals

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ABSTRACT

In the Philippines, half a million are blind and many more are visually impaired and up to one hundred children lose their sight every week. According to SWS, unemployment rate hit twenty-seven percent equivalents to 12.4 million jobless Filipinos in 2015 of the country's total population. An annual growth rate of six percent from 2013 to 2015 has been assumed with contribution of students, victims, retired, and PWDs. If this will continue the economic status of the Philippines will fall. BPO Industry boost on the Philippines giving job to the unemployed Filipinos that contributed to the economic growth of the country. BPO consists of call centers, data transcription, back office processing, and etc. Assistive technologies are readily available to assist the PWDs in their daily lives and educating them. In this paper, it will discuss how this technology will contribute to the society as a whole.

Keywords: *Social Weather Station (SWS), Person with Disability (PWD), Business Process Outsourcing (BPO), Philippine Statistics Authority (PSA), Census of Population and Housing (CPH), Information and Communications Technology (ICT), Braille; Text-to-Speech.*

1. INTRODUCTION

Unemployment rate continues to rise at minimal seven and a half percent every year. A survey made by Philippine Statistics Authority (PSA), more than 2.78 million Filipino families was jobless in the year 2013 and 2.96 million in 2014. In the data gathered by the Social Weather Station (SWS) it have shown that 11.8 million or 55 percent of families rated themselves as poor, 8.8 million or 44 percent of families said they were poor in food. Based on the 2010 Census of Population and Housing (CPH) results of PSA, the proportion of Persons with Disabilities (PWDs) in the Philippines was registered at 1.57 percent of the country's total population. The economic growth may be assessed or evaluated by means of the gathered data from PSA and SWS.

Economic growth can be simply defined if the people in the society can support their basic needs like food, shelter, education and this is only possible if they have source of income. The accelerated growth in Philippines' economy makes the rich people become wealthier but ordinary people remain poor. With this at hand, the researchers observed that the economic status of the Philippines falls due to inappropriate priority establishment by the government involving the community's underdogs-pertaining to commoners' involvement.

Table 1: Household Population and Persons With Disability by Region: Philippines, 2010

Region	Household Population (in 1,000)	Household Population with Disability (in 1,000)	Proportion of Persons with Disability to the Household Population (in percent)
Philippines	92,098	1,443	1.57
National Capital Region (NCR)	11,797	167	1.41
Cordillera Administrative Region (CAR)	1,612	26	1.63
Region I - Ilocos	4,743	78	1.64
Region II - Cagayan Valley	3,226	56	1.72
Region III - Central Luzon	10,118	139	1.38
Region IV-A - CALABARZON	12,583	193	1.53
Region IV-B - MIMAROPA	2,732	50	1.85
Region V - Bicol	5,412	100	1.85
Region VI - Western Visayas	7,090	138	1.95
Region VII - Central Visayas	6,785	109	1.6
Region VIII - Eastern Visayas	4,090	72	1.75
Region IX - Zamboanga Peninsula	3,398	46	1.35
Region X - Northern Mindanao	4,285	67	1.56
Region XI - Davao	4,453	71	1.6
Region XII - SOCCSKSARGEN	4,103	59	1.43
Autonomous Region in Muslim Mindanao (ARMM)	3,249	35	1.07
Region XIII - Caraga	2,425	38	1.58

Source: National Statistics Office, *2010 Census of Population and Housing*

Table 2: Household Population with Disability by Broad Age Group and Sex: Philippines, 2010

Age Group	Persons with Disability (in 1,000) by Sex			Sex Ratio
	Total	Male	Female	
All Ages	1,443	734	709	104
0 – 14	272	149	123	121
15 – 49	578	312	266	117
50 – 64	274	141	133	106
65 years and over	319	132	187	70

Source: National Statistics Office, *2010 Census of Population and Housing*

The data from CPH 2010 in Table 2 shows that ages 15 to 64 years old have the highest count that have disability. This age group is the ages that can work. Since they have disabilities they were limited to perform tasks or job that sometimes ends on depending from their families or government.

Table 3: Household Population and PWD Functional Difficulty by Type: Philippines, 2010 source PSA

Region, Province, and City/Municipality	Number of households with at least one member having functional difficulty by type					
	Number of households with at least one member having functional difficulty in seeing	Number of households with at least one member having functional difficulty in hearing	Number of households with at least one member having functional difficulty in walking	Number of households with at least one member having functional difficulty in remembering	Number of households with at least one member having functional difficulty in self-caring	Number of households with at least one member having functional difficulty in communicating
PHILIPPINES	1,315,149	466,679	543,365	314,406	229,851	260,287
NATIONAL CAPITAL REGION	185,672	39,997	52,306	24,925	21,910	21,079
CITY OF MANILA	25,209	6,643	8,094	4,229	3,638	3,476
CITY OF MANDALUYONG	4,444	827	1,949	645	1,239	611
CITY OF MARIKINA	5,395	1,355	2,066	933	836	884

Table 3 specifies the population of disabled person according to the types of disabilities that has showed the count of households that has at least one member suffering functional difficulty in seeing, hearing, walking, remembering, self-caring, and communicating. The data shows that the highest population of PWD was from functional difficulty in seeing there are 1.315 million total households with this difficulty.

Table 4: Philippines Labor Population 2016, source Trading Economics

Philippines Labour	Last	Previous	Highest	Lowest	Unit
Unemployment Rate	4.70	5.40	13.90	4.70	percent
Employed Persons	41664.00	40974.00	41664.00	18567.00	Thousand
Unemployed Persons	2040.00	2335.00	4989.00	1720.00	Thousand
Labor Force Participation Rate	63.60	63.30	71.50	62.90	percent
Job Vacancies	199942.00	199942.00	290741.00	3036.00	
Wages	8280.00	7995.00	8280.00	5798.00	PHP/Month
Wages in Manufacturing	1072.65	1406.07	1519.25	638.86	Index Points
Population	102.20	100.50	102.20	26.27	Million
Employment Rate	95.30	94.60	95.30	85.60	percent

Table 4 shows the unemployment rate as of 2015 and 2016. Out of 102.2 million populations in 2016 there were 4.70 percent unemployed people.

PWD contributes to unemployment specifically visually impaired person because of limitation of their abilities to do tasks compared to considered normal individual. The education and development for physically challenged individuals are still for enhancement.

The Philippines is one of the outstanding countries among the finest Business Process Outsourcing (BPO) locations because of the assistance of the government to investors, economical telecommunication infrastructure, low-cost high quality locations, and abundant number of graduates with good oral skills in English and knowledge in Information and Communications Technology (ICT). The BPO industry has been one of the rapid growing sectors in the country for the past 7 years. In 2010, there are 525,000 Filipinos employed at call centers since 75 percent of the total population is fluent in English. BPO industry handles different outsourcing services. Like for example, call center services involves handling phone calls that requires minimal physical activity to work. If only, the developed framework can be implemented in the BPO industry it could give a chance to visually impaired to earn a living and help the government to decrease the rate of unemployment.

The developed system will be operational on the BPO industry using normal desktop computer. It will work by means of voice input that will be recognized by means of speech synthesizer and the input from enhanced Braille keyboard. The concept of the developed system is to integrate text to speech engine for the text conversion to speech since some of the visually impaired person is having a hard time to read and usage of the Braille keyboard for text inputs since they can hardly write. If this will be implemented, it could give a chance for the visually impaired that are low vision and low visual acuity or partially sighted to operate computers just like the sighted people do.

2. RELATED WORKS

1) The Future of Braille: National Library Service (NLS) Braille Summit

The goal of the Braille summit in Massachusetts is to assess the present state of braille literacy, technology, and access of the braille readers to make recommendations for future enhancement. The concern arise is the high cost of braille production, need for improvement of the technology, availability of skilled braille instructors, and necessity of improving the public perception of braille. In the conference, participants suggested that NLS mount a public education campaign to raise awareness of the importance of braille. The U.S. Department of Education is working to ensure that the next generation of blind individuals will be equipped with braille literacy skills. The National Braille Press Center for Braille Innovation (CBI) and the Daisy Consortium Transforming Braille Group are working on developing an affordable braille [1].

2) Adaptive Technology for Rehabilitation, Integration, and Empowerment of the Visually Impaired (ATRIEV) Inc.

The Adaptive Technology for Rehabilitation, Integration, and Empowerment of the Visually Impaired (ATRIEV) Inc. is the only school for the blind in Philippines that trains its students to technology. Using adaptive technology, blind and sight impaired persons can gain access to post-secondary education and mainstream employment. Their technology includes the screen reader software that provides every stroke of the keyboard and mouse click with a vocal response. The adaptive technology allows the blind or visually impaired person to build confidence in word processing, e-mail, web surfing, and knowing the events on the screen by an instant feedback [2].

3) Impact of Text-to-Speech Software on Access to Print:A Longitudinal Study

The study of Joan Hodapp and Cinda Rachow evaluates the effectiveness of the text-to-speech software as an accommodation to improve the students access to core content with fluency and comprehension. The inclusion of assistive technology for special education student to improve academic performance, better on-task behavior, and improve independent work completion [3].

3. METHODOLOGY

3.1 Proposed Work

The researchers conceptualize the development of the system to provide its usefulness to the users of the system. The proposed application also contains different aspects that will be beneficial to the user.

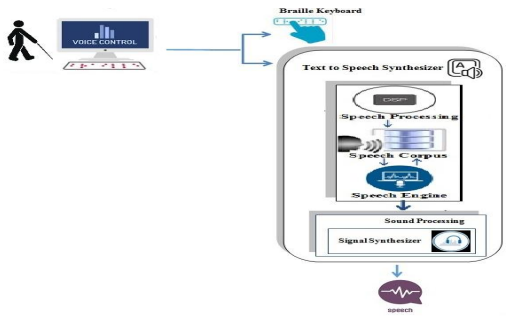


Fig. 1. Conceptual Framework

The framework shows the conceptual model that will work on a normal desktop computer. It will enhance the computer keyboard with a Braille overlay sticker, Text to Speech is also included to translate text by means of using the Text to Speech Synthesizer engine tools and will output as sound. The developed system contains voice control to ease the computer operation of the visually impaired.

3.2 Research Design

Quasi-Experimental Design, Time-Series Design will be used for evaluating the specific beneficiaries to manipulate one variable and control the rest. It only tests one effect at a time to explain and validate findings in the survey.

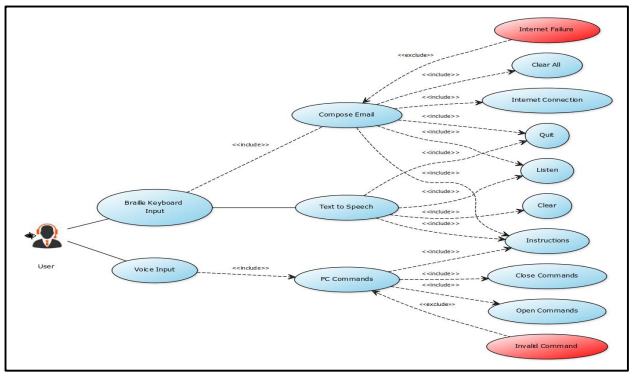


Fig. 2. Use Case Diagram

Figure 2 shows the modules inside the developed system. Hardware is included which is the enhanced keyboard with overlay Braille sticker. The software includes modules like PC commands, Text to Speech, and Compose Email. Screen Reader was also included to ease the computer operation of the visually impaired.

3.2 Software Model

The Agile Model was used which shows each phase of a project relates to development stage which are integration and testing phase, with the goal that the user acceptance test is created to meet the requirements of the users.

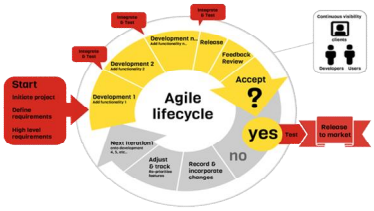


Fig. 3. Agile Lifecycle Software Development

First, gathering and identifying the user requirements. Next is development which includes iteration, an incomplete but functional system will be deployed or demonstrated for the users. Development will be completed when the entire tests pass based on the clients feedback and review. At this point, it will start again on

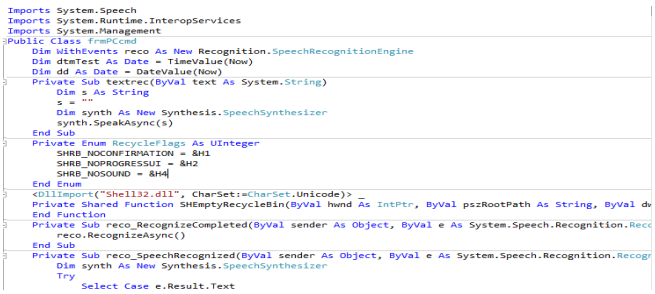
writing tests for the next most important part of the system.

4. RESULTS AND ANALYSIS

The system evaluations are presented in Tables 5 to 10.

4.1 Answer to Specific Problems

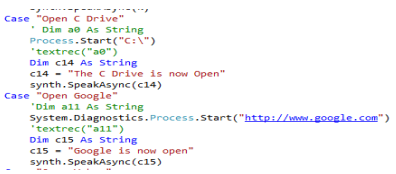
1. How will the Text to Speech Synthesizer technology used by the visually impaired to process voice inputs?



```
Imports System.Speech
Imports System.Runtime.InteropServices
Imports System.Management
Public Class frmPCcmd
    Dim WithEvents reco As New Recognition.SpeechRecognitionEngine
    Dim dteTest As Date = TimeValue(Now)
    Dim dd As Date = DateValue(Now)
    Private Sub textrec(ByVal text As System.String)
        Dim s As String
        s = ""
        Dim synth As New Synthesis.SpeechSynthesizer
        synth.SpeakAsync(s)
    End Sub
    Private Enum RecycleFlags As UInteger
        SHRB_NOCONFIRMATION = &H1
        SHRB_NOPROGRESSUI = &H2
        SHRB_NOSOUND = &H4
    End Enum
    <DllImport("Shell32.dll", CharSet:=CharSet.Unicode)> _
    Private Shared Function SHEmptyRecycleBin(ByVal hwnd As IntPtr, ByVal pszRootPath As String, ByVal dw
    End Function
    Private Sub reco_RecognizeCompleted(ByVal sender As Object, ByVal e As System.Speech.Recognition.Recc
        reco.RecognizeAsync()
    End Sub
    Private Sub reco_SpeechRecognized(ByVal sender As Object, ByVal e As System.Speech.Recognition.Recogr
        Dim synth As New Synthesis.SpeechSynthesizer
        Try
            Select Case e.Result.Text
```

Fig. 4. Snippet code for Recognizing Speech Commands

The codes shown in Figure 4 were the codes for speech processing, speech engine, and speech synthesizer to recognize speech inputs from the user.



```
Case "Open C Drive"
    ' Dim a0 As String
    Process.Start("C:\")
    'textrec("a0")
    Dim c14 As String
    c14 = "The C Drive is now Open"
    synth.SpeakAsync(c14)
Case "Open Google"
    'Dim a11 As String
    System.Diagnostics.Process.Start("http://www.google.com")
    'textrec("a11")
    Dim c15 As String
    c15 = "Google is now open"
    synth.SpeakAsync(c15)
```

Fig. 5. Snippet code for Start or Open Commands

The codes shown in Figure 5 are the Open and Start commands to start or open a software application that was processed by speech processing, speech engine, and speech synthesizer to recognize command or speech inputs from the user.

Table 5: Test Case 001 PC Commands

TC 001 PC Command (Test Voice Input Accuracy)				
PC COMMANDS	TE001	TE002	TE001-1	TE002-1
Hello Computer	Ok	Ok	Ok	Ok
Activate PC Command	Ok	Ok	Ok	Ok
What is the time	Ok	Ok	Ok	Ok
Date Today	Ok	Ok	Ok	Ok
Lock My Screen	Ok	Ok	Ok	Ok
Restart the System	Ok	Ok	Ok	Ok
Shutdown the System	Ok	Ok	Ok	Ok
Empty Recycle Bin	Ok	Ok	Ok	Ok
Start Screen Reader	Ok	Ok	Ok	Ok
Stop Screen Reader	Ok	Ok	Ok	Ok
Open Microsoft Word	Ok	Ok	Ok	Ok
Close Microsoft Word	Ok	Ok	Ok	Ok
Open Microsoft Excel	Ok	Ok	Ok	Ok
Close Microsoft Excel	Ok	Ok	Ok	Ok
Open Microsoft Access	Ok	Ok	Ok	Ok
Close Microsoft Access	Ok	Ok	Ok	Ok
Open Microsoft PowerPoint	Ok	Ok	Ok	Ok
Close Microsoft PowerPoint	Ok	Ok	Ok	Ok
Open Microsoft Visio	Ok	Ok	Ok	Ok
Close Microsoft Visio	Ok	Ok	Ok	Ok
Open Notepad	Ok	Ok	Ok	Ok
Close Notepad	Ok	Ok	Ok	Ok
Open Calculator	Ok	Ok	Ok	Ok
Close Calculator	Ok	Ok	Ok	Ok
Open Music Player	Ok	Ok	Ok	Ok
Close Music Player	Ok	Ok	Ok	Ok
Open My Documents	Ok	Ok	Ok	Ok
Close My Documents	Ok	Ok	Ok	Ok
Open My Music	Ok	Ok	Ok	Ok
Close My Music	Ok	Ok	Ok	Ok
Open My Pictures	Ok	Ok	Ok	Ok
Close My Pictures	Ok	Ok	Ok	Ok
Open My Videos	Ok	Ok	Ok	Ok
Close My	Ok	Ok	Ok	Ok

Videos				
Open Downloads	Ok	Ok	Ok	Ok
Close Downloads	Ok	Ok	Ok	Ok
Open C Drive	Ok	Ok	Ok	Ok
Close C Drive	Ok	Ok	Ok	Ok
Open D Drive	Ok	Ok	Ok	Ok
Close D Drive	Ok	Ok	Ok	Ok
Open CD	Ok	Ok	Ok	Ok
Close CD	Ok	Ok	Ok	Ok
Open Firefox	Ok	Ok	Ok	Ok
Close Firefox	Ok	Ok	Ok	Ok
Open Google Chrome	Ok	Ok	Ok	Ok
Close Google Chrome	Ok	Ok	Ok	Ok
Open Internet Explorer	Ok	Ok	Ok	Ok
Close Internet Explorer	Ok	Ok	Ok	Ok
Open Yahoo	Ok	Ok	Ok	Ok
Close Yahoo	Ok	Ok	Ok	Ok
Open Google	Ok	Ok	Ok	Ok
Close Google	Ok	Ok	Ok	Ok
Open Facebook	Ok	Ok	Ok	Ok
Close Facebook	Ok	Ok	Ok	Ok
Open Mail Form	Ok	Ok	Ok	Ok
Close Mail Form	Ok	Ok	Ok	Ok
Open Text to Speech Form	Ok	Ok	Ok	Ok
Close Text to Speech Form	Ok	Ok	Ok	Ok
Open Task Manager	Ok	Ok	Ok	Ok
Close Task Manager	Ok	Ok	Ok	Ok
Open Desktop	Ok	Ok	Ok	Ok
Close Desktop	Ok	Ok	Ok	Ok

Table 5 reveals that on Test Case 001 (TC001) there is no issue detected and all were marked as "Okay" in Test Execution 001 (TE001), TE002, TE001-1, and TE002-1. Test Case 001 shows that the list of available PC commands are functioning according to the user's requests.

2. How will the Braille keyboard technology used by the visually impaired to process text inputs?

The Braille keys used the standard Braille cell dimension that shows the diameter of dots within a cell and the gap between the dots. The radius is 1.5 mm, horizontal and vertical spacing between dot centers within a cell is 2.5 mm, cell vertical spacing to other cell is, 2.6mm, and cell horizontal spacing to other cell is 6.2mm. The Braille keys were tested and used based on the sound output it produces when keys were pressed by the users.
The following table shows the results of Braille keys functionalities:

Table 6: Test Case 005 Braille Keyboard for Alphabets

Test Braille Keys Accuracy (Key pressed Sound)				
LETTERS	TE001	TE002	TE001-1	TE002-1
A	Ok	Not Tested	Ok	Ok
B	Ok	Not Tested	Ok	Ok
C	Ok	Not Tested	Ok	Ok
D	Ok	Not Tested	Ok	Ok
E	Ok	Not Tested	Ok	Ok
F	Ok	Not Tested	Ok	Ok
G	Ok	Not Tested	Ok	Ok
H	Ok	Not Tested	Ok	Ok
I	Ok	Not Tested	Ok	Ok
J	Ok	Not Tested	Ok	Ok
K	Ok	Not Tested	Ok	Ok
L	Ok	Not Tested	Ok	Ok
M	Ok	Not Tested	Ok	Ok
N	Ok	Not Tested	Ok	Ok
O	Ok	Not Tested	Ok	Ok
P	Ok	Not Tested	Ok	Ok
Q	Ok	Not Tested	Ok	Ok
R	Ok	Not Tested	Ok	Ok
S	Ok	Not Tested	Ok	Ok

T	Ok	Not Tested	Ok	Ok
U	Ok	Not Tested	Ok	Ok
V	Ok	Not Tested	Ok	Ok
W	Ok	Not Tested	Ok	Ok
X	Ok	Not Tested	Ok	Ok
Y	Ok	Not Tested	Ok	Ok
Z	Ok	Not Tested	Ok	Ok

Table 6 shows TE002 was marked as "Not Tested" due to unavailability of the keyboard during evaluation. Test Case 005 shows that the Test Execution 002 "Failed" thus, reevaluation was performed under TE002-1. After presenting the Braille keyboard for evaluation in TE002-1, the respondents verified that the appropriate sound for the letter was played with respect to the Braille characters.

Table 7: Test Case 005 Braille Keyboard for Numbers

Test Braille Keys Accuracy (Key pressed Sound)				
NUMBERS	TE001	TE002	TE001-1	TE002-1
0	Ok	Not Tested	Ok	Ok
1	Ok	Not Tested	Ok	Ok
2	Ok	Not Tested	Ok	Ok
3	Ok	Not Tested	Ok	Ok
4	Ok	Not Tested	Ok	Ok
5	Ok	Not Tested	Ok	Ok
6	Ok	Not Tested	Ok	Ok
7	Ok	Not Tested	Ok	Ok
8	Ok	Not Tested	Ok	Ok
9	Ok	Not Tested	Ok	Ok

Based on Table 7, appropriate sound file for numbers was played with respect to Braille characters.

Table 8: Test Case 005 Braille Keyboard for Special Characters

Test Braille Keys Accuracy (Key pressed Sound)				
SPECIAL CHARACTERS	TE001	TE002	TE001-1	TE002-1
Capital Letters	Ok	Not Tested	Ok	Ok
Numbers	Ok	Not Tested	Ok	Ok
Apostrophe	Ok	Not Tested	Ok	Ok
Period	Ok	Not Tested	Ok	Ok
Comma	Ok	Not Tested	Ok	Ok
Semicolon	Ok	Not Tested	Ok	Ok
Exclamation Point	Ok	Not Tested	Ok	Ok
Opening Quotation Mark	Ok	Not Tested	Ok	Ok
Parentheses	Ok	Not Tested	Ok	Ok
Hypen	Ok	Not Tested	Ok	Ok

Based on Table 8, appropriate sound file for special characters was played with respect to Braille characters.

3. How does the developed system accepted by the visually impaired individuals?

Table 9: Summary of Test Case Execution First Phase

Test Case Execution Number TEs	Total No. TCs	Number of Closed TCs	Number of TCs Not Tested	Number of TCs Failed	Number of TCs Tested	Number of TCs Resolved
TE001	6	6	0	0	6	0
TE002	6	4	1	1	5	0

Table 9 revealed that in the Test case Execution 001, the total number TCs tested and closed are 6. All of those 6 TCs were closed, tested, and have a "Passed" status. In the Test case Execution 002, the total number TCs tested were 5 and the number of the closed TCs was four (4). Out of the 6 TCs, one (1) TC "Failed" and the other one is "Not Tested". Five (5) TCs were closed, tested, and have a "Passed" status while there were TCs that "Failed" and was "Not Tested" which needs to be resolved.

Table 10: Summary of Test Case Execution Second Phase

Test Case Execution Number TEs	Total No TCs	Number of Closed TCs	Number of TCs Not Tested	Number of TCs Failed	Number of TCs Tested	Number of TCs Resolved
TE001-1	6	6	0	0	6	0
TE002-1	6	6	0	0	6	2

Table 10 revealed that in the Test case Execution 001-1 the total number TCs tested and closed were 6. All of those 6 TCs were closed, tested, and have a "Passed" status. In the Test case Execution 002-1, the total number TCs tested and closed were 6. All of those 6 TCs are closed, tested, and have a "Passed" status. Out of the 6 TCs, two (2) TCs were resolved and have a "Passed" status after resolving the issues.

5. CONCLUSIONS

"Braille and Text To Speech Using Digital Signal Processing for Visually Impaired Individuals" is a developed system for computer operation to have job acquisition for the visually impaired that has low vision or low visual acuity. It will give assistance for the intended respondents' to perform their tasks in a computer. The intention of the proposed study is to integrate this system to a BPO company to give a chance for the visually impaired to have other options for their working career.
The main problem of the study is to develop a system to assist the visually impaired to have other options in choosing a career and remove barriers to the sighted and unsighted individuals.
To summarize the evaluation, there are 4 Test Case Executions. The four (4) UAT tests has been done on different dates to pass for the test outcome and accept the system. Overall, test cases TE001, TE001-1 were "Accepted" and recommendations are given, while TE002 was "Rejected" due the issues and defects detected by the tester. Upon software revision, test case TE002 the system was "Accepted" and issues has been resolved.
Based on the findings of the study, the following conclusions are formulated:

1. The use of TTS for speech processing will be a great tool for the visually impaired individuals;
2. The use of Braille technology has a great significant for text inputs and recognizing keys from the keyboard; and
3. The developed system was accepted in the second phase of Test Case Execution by the experts for visually impaired individuals.

Based on the final testing and result of the User Acceptance Test, the respondents accepted the system. "Braille and Text To Speech Using Digital Signal Processing for Visually Impaired Individuals" proved that the existence of the assistive technology will help the visually impaired and that they are capable of working like the sighted people can do. With this, the researchers of this study have also completed and met the objectives of the project.

REFERENCES

[1] Bernstein, N. 2013. The Future of Braille: NLS Braille Summit, Watertown, Massachusets. [Online] Available: http://www.loc.gov/nls/other/futureofbraille.html
[2] NCC, CICT, 2014. Adaptive Technology for Rehabilitation, Integration, and Empowerment of the Visually Impaired (ATRIEV), Quezon City
[3] Hodapp, J. and Rachow C. 2010. Impact of Text-to-Speech Software on Access to Print:A Longitudinal Study, IGI Global, Area of Education, USA DOI: 10.4018/978-1-61520-817-3.ch014
[4] "Resources for the Blind, Inc." [Online] Available: http://www.blind.org.ph/blind_phil.html
[5] C. Hermoso and L.A. Aquino, "Unemployment, poverty alarm Cardinal Tagle", Manila Bulletin Broadsheet [Online] Available: http://www.mb.com.ph/unemployment-poverty-alarm-cardinal-tagle/
[6] Jobless Filipinos hit 12.1 M, 2014 [Online] Available: http://newsinfo.inquirer.net/576322/ph-unemployment-worsens-sws-survey-shows
[7] Garcia, E. 2014. Person with Disabilities: Status in the Philippines, MPA, Deafblind Support Philippines [Online] Available: http://web.nlp.gov.ph/nlp/sites/default/files/20 Mar2014/Persons%20with%20Disabilities%20by%20Edgardo %20garcia.pdf
[8] Republic of the Philippines, Philippine Statistics Authority, Person with Disability in the Philippines (Results from the 2010 Census), 2013 [Online] Available: https://psa.gov.ph/content/persons-disability-philippines-results-2010-census
[9] BPO history in the Philippines, [Online] Available: http://www.bpoc.uk.com/research.html
[10] World Braille Day, 2014 [Online] Available: https://www.google.com.ph/search?q=braille+code&biw=1440&bih=747&source=lnms&tbm=isch&sa=X&ved=0CAYQ_AUoAWoVChMIkqOLn--CxwIVyYuUCh0x1gcw#imgrc=gdYhYL6Shr6ZmM%3A.