Immersive Assisting Tool and Application for Visual Impaired People : Braille Video for Visual Impaired People

by

Nurul Hafiza binti Mohd Noor Azam

(11241)

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Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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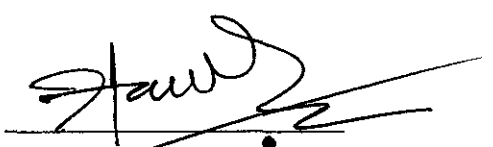

(DR HALABI BIN HASBULLAH)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NURUL HAFIZA BINTI MOHD NOOR AZAM

Abstract

In this paper, we describe the limitation of accessibilities and capabilities issues found for visual impaired people especially in sporting area. Some of them have interested in the specific type of sport game activities especially who are not naturally visual handicapped people. Based on this issue, we come out a solution focusing on development an assistive tool for them in order to get experience and immerse themselves on a specific game of their interest. Theory of immersive will be used as a prime development element to produce the intended engagement application. This objective can be achieved with the combination of three types of multimodal which are audio, haptic vibration and video. This report is mainly covered in the video development area while the other two modals areas are explained in another research papers. For this video's development part, we introduce a concept assistive tool of presenting Braille dots on the video screen as another way of delivery information to the visual impaired people other than just through audio.

Key Words : *visual impaired, immersive, video, Braille*

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We would like to thank Dr Halabi bin Hasbullah as our Supervisor of this Final Year Project, without whom this project would not have the focused objectives that it did. Because of his involvement, we targeted the real needs of blind people, and we kept in mind the cost-effectiveness, portability and other issues that he raised.

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CHAPTER 1
INTRODUCTION

1.1 Background

The main motivation behind of this research is due to the limitation of accessibilities and immersion some types of visual disabilities people to the facilities' environment around them especially in the sporting event. Some people were born naturally handicapped as a result of fate and some are having unfortunate life with some forms of disabilities caused by accidents, diseases or any other factors. Due to this issue, they have limited capabilities and accessibilities to the sport area of their interest compared to other normal sighted people.

This study will focus on some type of blindness people who are visually impaired people and they are totally blind after had some diseases. Some of them might already have the experience of seeing the environment around them like watching movies, experiencing playing some types of sport games and etc during their normal time. Therefore, the intention of this research project is to bring the visually impaired people to a game venue and to 'watch' the game lively. Due to the limitation of this intention to find the live game at the stadium, this approach will be using a video playback and mobile device as the prototype of this application with theory of immersive applied into this.

There are many assistive tools were provided for them to get accessibilities through audio as audio plays an important medium for them to get access to medias. However, the available audio tools are not enough to get them immerse and engage into a game. Therefore, more than audio description solution is required in order to achieve the immersion and engagement to the game. As a solution, a combination of three different types of multimodal which are audio, haptic vibration and video will be used to

build such an intended application. Further details of this application will be explained in the next chapter.

This report will mainly illustrates on how to provide an immersive system for them to 'watch' the sport games matches through the videos playback by presenting tactile Braille descriptions on the video mobile screen. This approach offers the better and more user interaction by focusing on the vibrotactile for them be able to get immerse and feel of fun watching the games.

1.2 Problem Statement

Nowadays, many facilities were provided by government for the society in the sporting area in order to make useful of it. However apart from the societies who are handicapped people especially blind or visually impaired people are having limited access and capability to sporting events. Some of them have their interest in the sport games activities but because of their visual disabilities, this has limited their desire to freely mix around with the society. As a result, they are separating or isolating themselves, and not participating in any society's activities.

Obviously the visual impaired cannot see normally as other normal sighted people and the ways for them to get to know about the sport games by accessing current media forces such as television, radio, and others through hearing. The problem is, during the live football match, whenever people around them cheer 'GOAL', they only hear the cheer with low excitement compared to other normal people. Therefore, the question is – how can we extend further their interest or immersion in a specific game so that they can get the feel and fun of 'watching' a game, similar to that experienced by other normal sighted people. Definition of 'watching' is defined as the act of imagine

and following something with the eyes or the mind. In the mind of a visually impaired person, when listening to a sound he is attempting to figure some images and imagine every move, every situation, where the character is, from the special effects done in the movie. In order to provide them the opportunity to get the feel and fun of 'watching' a game, a combination of multimodal will be used in leading through this solution. Therefore, an approach for particular to this problem is addressed to develop a simple tool or an assistive application for them by combining three elements of audio, haptic vibration and video into a system. This hope is possible to be achieved with the advanced use of ICT knowledge and technology nowadays.

For this research project, we narrow down the area scope of sport games activities to football or soccer games. The reason is soccer video attracts a wide range of audiences and the most preferable interest type of sport games among the visual impaired people. Initially, this project is objectively to bring the visual impaired people to the real sporting events or lively football matches together with the other normal sighted people. However, this is the limitation for this early proposed system stage development. Therefore, in order to cattle this limitation issue, some sample of video playback will be used in this proposed application as a representation of the real live matches for this current prototype development. This proposed application is theoretically for the mobile device application as providing more portable, convenient usage especially for handicapped people.

1.3 Objectives

The objectives of this project are:

- To model, design and develop a sample of assistive application prototype for visual impaired people to immerse and engage the specific game of their interest using video playback as the representation of the actual tool in the future.
- To combine three different types of multimodal audio, haptic vibration and video into an application system in order to achieve the goal of immersive and engagement concept for visual handicapped people.
- To provide another way of 'watching' the sport game match by providing tactile Braille presentation appeared on the screen as additional feature in the video part while running the application instead of using usual audio.
- To experiment on the efficiency and impact of using Braille translation on the media as the aid in representing the 'situation' to visual handicapped people.

1.4 Scope of Study

As mentioned earlier that this application is basically will be built with a combination of three different types of multimodal which are audio, haptic vibration and video in order to achieve the objective of immersion and engagement application concept specifically for visual handicapped people. However, this research project paper will be only focused on the development of the video part on how to provide an immersive system for them to 'watch' the sport games matches through the videos application by presenting tactile Braille dots during the playback. This approach is as the additional features for the proposed application instead of using audio and haptic vibration. Football or soccer games will be the focus domain in the type of sport games activities for this research project. This type of application is objectively developed for mobile devices application like smart phone, personal digital assistant (PDAs) and others specifically designed for visual impaired people.

1.5 Relevancy and Feasibility of the Project within the Scope and Time frame

This project idea is to design and develop an assistive tool for people with visually impaired problem to solve the segregation issue and their limitation capability to sporting area by implying the theory of immersive into the system. The project aims to provide an equal chance, experience and opportunity for the visually impaired people to appreciate any game of their interest without isolating themselves from the society. Therefore, we come out a solution with a combination of different multimodal consists audio, haptic vibration and video into the system and this paper will discuss on designing the video system part by presenting Braille on the video screen. Overall, this project will involve more on technical areas such as analysis, designing, processing, development and testing parts to complete this research. All of these procedures had been planned and scheduled according to the timeline. Based on the issues and elements discussed in this study, we are confident that this project can be performed within the time frame provided to us.

CHAPTER 2
LITERATURE REVIEW

Technology's trend continues change time to time, connecting us in many new ways. But for 12 million severely with vision loss in the U.S., the advancement of the used technology often poses new challenges [1, 2]. A study reported that accessing to information especially in computerized information systems or media, is one of the biggest problems of blindness people as they are frequently built with graphic element that are not accessible to the blind users [3]. For them, technology is often created without regards to the people with visual disabilities, creating unnecessary barriers to hundreds of millions blind people especially in accessing media contents like television channels, movies, videos and others [4].

> "Full enjoyment of television, videos and other forms of popular culture has been denied to people with visual impairment; now the technology is available to turn that situation around."
>
> Who's watching? A Profile of the Blind and Visually Impaired Audience for Television and Video (American Foundation for the Blind, 1997) [5]

There are many type of assistive technologies were designed and produced by Oracle, Apple and etc. for the usage of blind users that points out some important elements with more accessibility, more functionality, and ease to use. Descriptive Video Service developed by Boston public broadcaster, WGBH is the example of innovatively services provided for blind user to fuller access to television programming [5]. Voice-over descriptions specially added in this service to describe actions, costumes and scenes, helping visual impaired people to engage with the television information and story.

Audio description or audio commentator is an additional interpretation between the dialogue of a film, video or television programme that tells the viewer what is happening on the screen so that they able to keep up with the action. It bridges the gap in accessibility for a blind person when 'watching' a film, video or TV programme. This have been done by UK, Independent Television Commission (ITC) in 2000 rolled out a code giving assistance on how description for television programme to be made focusing for the blind users[6]. The code was available on the web called *Ofcom Code on Television Access Services*.

Immersion issue for blind users is another additional aspect focusing on how to make them feel and get same experience with the sighted people especially in media contents like video playback, movies, television channels and others. The way for them to access all of these media contents through hearing and their imagination is totally different from the reality. A Notre Dame Gameday 360 was produced by Immersive Media consists a number of sample Immersive Media full motion video episodes ranging from pre-game traditions and half-time festivities to the post-game finale [7]. But, the limitation of this media is this content is not fully accessible and immersive by blind people whenever they hear the video playbacks.

There has been some improvement in creating more accessible culture through closed captioning and video description. LiveDescribe [8], Softel [8], Capscribe [9] and Magpie [10], are the examples of tools used to assist in the video segmentation and description creation. Basically these tools provide the functionality of automatically space detection, text entering and saving functionality and voice recording features were used by the describers, specifically the describers who produced the highest quality description [11]. All of these features provided can be used to produce a new video with enhancement of video description usable for blind users through audio interpreters.

Several researchers had proposed many solutions in order to reach blind people's immersion of something that cannot be accessible by them through visualization. The approach is basically used the haptic technology that used sense of touch in order to get immerse. Haptic technology has great potentials in many applications [12]. For example the use of mobile phone with touch screen interface enable many application represents haptic approach were designed for blind people to get access [13,14,15]. A haptic interface is a computer-controlled motorized device to be held in the hand by a user, which displays information to that user's haptic senses. Moreover, using haptics significantly reduces the burden on the other senses such as vision and audition, thereby freeing these channels for other tasks.

For blind users, the development of an application using Braille concept for accessing digital contents give full of benefit to them. Job Access With Speech (JAWS) and Digital Information System (DAISY) are the example of applications use screen readers coupled with speech synthesizers that applied with the Braille concept especially in literacy. These samples of applications have screen reader software which translates the screen texts in either synthetic speech or Braille and provides functionality to explore and review the screen contents without executing any commands [16]. It attempts to identify and interpret what is being displayed on the screen. This interpretation is then represented to the user with text-to-speech, sound icons, or a Braille output device.

The development of an application using Braille technology enable on the mobile will allow blindness people to use mobile device very successfully. Many blind mobile device users are comfortable to use tactile sense for reading Braille and for them it is one of the common ways of getting information especially in reading the digital contents [17]. For example, Nokia Braille Reader gives SMS for the visual handicapped people. It captures received SMS messages and brings them to the foreground for reading using Braille and tactile feedback. With this new step of advancement of Braille technology

for mobile device, it means that this technology also can be supported and applied for this project application development.

Today image processing and Optical Character Recognition (OCR) become great importance in science and engineering. Both have been implemented in various applications such as computer vision, handwriting recognition, license plate recognition etc. There are various techniques, methods and algorithms that have been used for specific purposes. Text detection and recognition in images and video frames, which aims at integrating advanced Optical Character Recognition (OCR) and text-based searching technologies, is now recognized as a key component in the development of advanced image and video annotation and retrieval systems [18]. Text, which includes plentiful semantic information, can do some contributions to the retrieval tasks. As the crucial step for text recognition, text detection has been richly studied. Here we first briefly review some of the existing works.

Rainer Lienhart and Wolfgang Effelsberg had been done a research about the automatic text segmentation and text recognition for video indexing [19]. They present a method for automatic segmentation of text that appear in digital videos where the output is directly passed to a standard OCR software package in order to translate the segmented text into ASCII. The algorithms proposed make use of typical characteristics of text in videos in order to enable and enhance segmentation performance. Then, a straightforward indexing and retrieval scheme is introduced.

Another research about the enhancement of video retrieval database system did by Qixiang Ye and Qingming Huang. They proposed a new text detection algorithm in coarse-to-fine framework by integrating properties of text in spatial domain [20]. This algorithm has high detection speed and low false alarm rate even for text in complex background by using texture features combination and Support Vector Machine (SVM)

based classification. In the coarse detection, multiscale wavelet energy feature is employed to locate all possible text pixels and then a density-based region growing method is developed to connect these pixels into text lines. In the fine detection, four kinds of texture features are combined to represent a text line and a SVM classifier is employed to identify texts from the candidate ones.

There is another study proposed a robust text detection algorithm in images and video frames by using the edge and wavelet features [21]. The algorithm has a good detection performance and is robust to language, font-color and size. Edge feature and morphology operation are employed to locate edge-dense image blocks. Empirically rules are applied on these blocks to get candidate text. In the second step, wavelet-based features are employed to represent the texture property of text. A SVM classifier is used to identify text from the candidate ones.

Blind people cannot use printed or displayed text. They need a tactile or audile means to read and write. Braille was created in the nineteenth century to fulfill this need [22]. Braille font was devised in 1825 by Louis Braille, a blind Frenchman [23]. It consists of a system of six or eight possible dots combination that are arranged in a fixed matrix, called a cell. Characters in Braille consist not of visual symbols, printed or displayed, but of physical symbols constructed of raised dots on paper. It is a system of reading and writing based on touch rather than vision, where characters are embossed rather than ink printed.

There are about 50,000 deaf-blind people in the US [24, 25] and this group of people really relies on tactile communication. Touch-screens on mobile devices are now accessible and usable by blind people [26, 27]. In 1971, the Optacon (Optical to Tactile Converter) was invented, which enabled blind people to read text printed by raising the outlines of print letters [28]. There has also been work using online force feedback with

a commercial mouse for reading Braille [29]. Rantala et al. [30] studied different methods of reading haptic Braille with a stylus on a tablet, and achieved high accuracy overall. The Nokia Braille Reader prototype [31] uses the vibrating touch-screen on Nokia phones to convey Braille temporally; the user holds their finger on the screen in any one static location and will feel a linear off-on vibration. This has been shelved because of a lack of accompanying accessible applications.

Haptic perception involves sensing the movement and position of joints, limbs, and fingers through kinesthesia and proprioception, and sensing information through the skin's tactility [32]. Haptic output can be achieved through several techniques, including pneumatic, vibrotactile, electrotactile, and electromechanical stimulation [33]. This study examines only vibrotactile haptic output methods because vibrotactile stimulation is easily created, manipulated, and delivered. It is also easily perceived by users through the use of commonly available software and devices.

This paper will present about a framework of a prototype application for blind and visual impaired people to access video content through tactile perception by using Braille other than just access through hearing the audio. This system aims to give the blind and visual impaired people an immersive experience and fun for viewing the videos playback by providing Braille text display on the phone video screen. Basically, this system will imply some existing approaches and combine all the elements discussed above like tactile Braille display concept, video segmentation process, mobility, accessibility and immersion into a system designed for the use of visual disabilities people. The framework of development this proposed prototype application will be explained further in the next chapter.

CHAPTER 3
METHODOLOGY

This approach is basically a method designed to facilitate the creations of accessible for digital video content combination with Braille text displayed on the mobile screen for visually impaired and blind users. This type of interface is proposed to support these blind users the ability to view the video content through Braille descriptions besides hearing. Our focus domain will be the accessibility to the sport videos content which is for football or soccer games using mobile devices like smart phone, personal digital assistance (PDAs). The detailed description of this system is included in this chapter along with the conceptual approach and sample design interface that will be developed. An interaction method was designed for reading six-dot Braille characters for the touch screen of a mobile device.

3.1 System Model

Figure 1 shows the overview of the whole proposed system of an immersive and assistive application for people with visual impairment. This system model consists of three types of combination elements which are audio processing, haptic vibration process and video processing in a video application system.

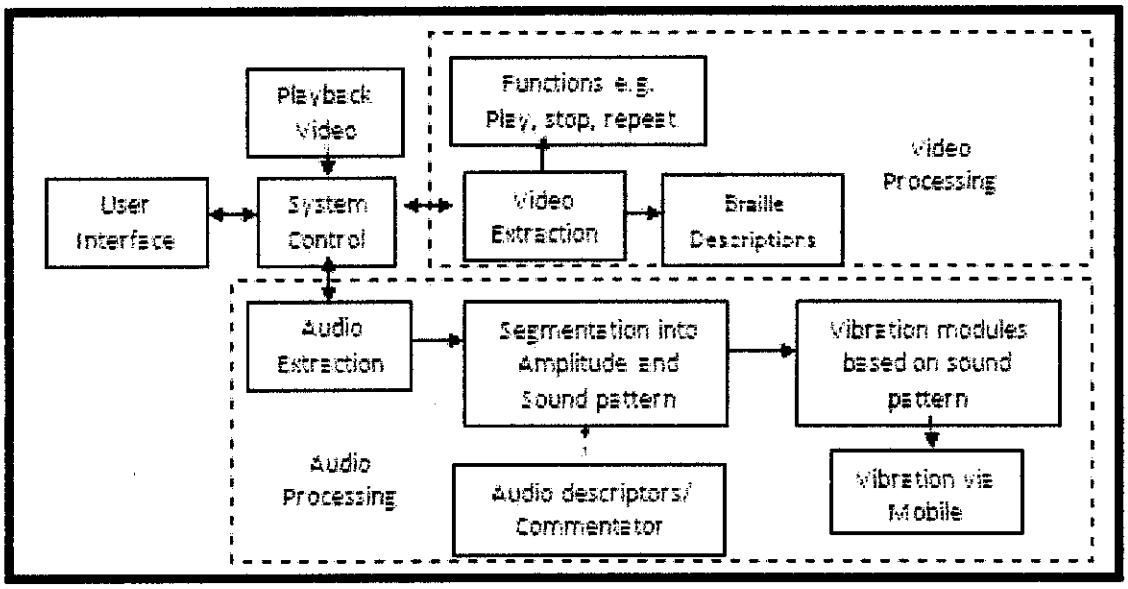

Figure 1 Overview of the whole proposed system

As mentioned in the previous chapter, this proposed prototype application will be used a video playback to represent the live broadcast video that used for the visual impaired people to 'watch' the football match lively. In this application, a user interface is the interface of mobile device and will be a medium of interaction between users and system application. System control is referring to a main control system device to direct or control the user interface system and manage the internal process between audio processing and video processing in the video playback. Here, to begin the process, from the video playback as an input, then the video will be having two different processes which are audio processing and video processing. Video processing consists of extraction process into frames for event analyzing and process of displaying Braille codes on the screen. Audio processing is about the segmentation process into different amplitudes and sound patterns where the output is significant for audio descriptors and vibration process. In vibration process, the amplitude and sound pattern determine the frequency of vibration produced. Finally, all the outputs from video processing, audio processing and vibration processing will be combined and produce an immersive video that specifically for visual impaired people. The details regarding on both processes of audio and vibration process is explained in other research paper while this paper will focus on the video processing.

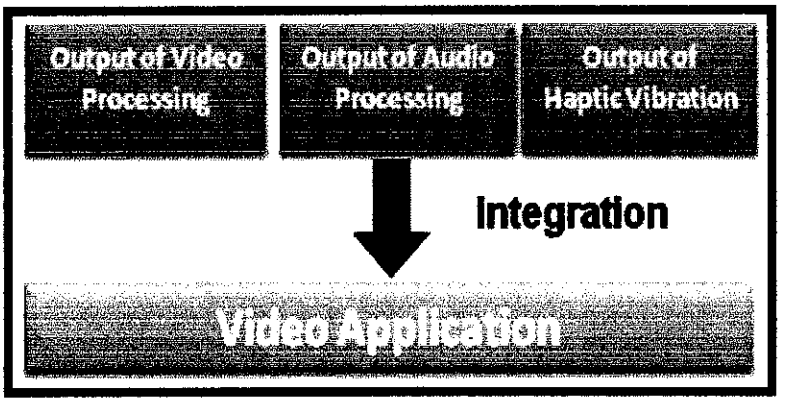

Figure 2 - Simple view of the System Model

3.2 Video System Model

The Figure 3 illustrates about the video segmentation processes consists of video frames segmentation, replay detection, shot boundary detection, highlight generation, Braille descriptions and finally is output video.

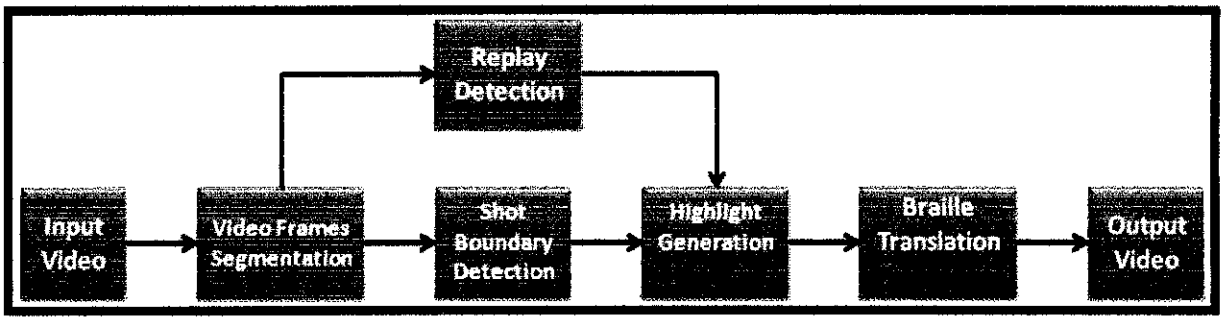

Figure 3 - Video System Model

Video frames segmentation is the process where the full length video will be extracted into frames within a specific time between the length of the original video. The frame is used to represent the content of a video shot. Thus, a video sequence that alternated between time cutting frames would consist of multiple shots. A scene can be defined as a set of one or more adjoining shots that focus on an object or event of interest. All of these elements are important and will be used in identifying the special

key events (event detection). Highlight generation is done after detecting the shot boundary in the certain interesting event in the video to identify for the Braille translation. The added of Braille description is to describe the scene will be aligned with the information commented by audio commentator during the interval time of the playback. Here synchronization between video, audio and vibration is an important element that is needed to be considered in this stage. Lastly, output video is a completed Braille add-on featured video that accessible for blind user is produced.

3.3 Analysis and Design

A number of steps were taken to address the problems identified at the start of this study. The first step was to analyze the football video domain, gathering as much information and knowledge as possible that is related. A video model for football broadcasts was also defined and collected, which will assist the explanation of the test collection later. In this study, there are three mains issue will be discovered; *video segmentation, immersion, event detection* and *Braille embedded descriptions.*

3.3.1 Video Extraction and Immersion of Excitement in Sport Videos

Immersion is the subjective impression that one is participating in a comprehensive, realistic experience [34]. The more an immersive experience is based on design strategies that combine actional, symbolic, and sensory factors, the greater the participant's suspension of disbelief that she or he is "inside" a digitally enhanced setting [35]. This paper presents a finding of accessibility and immersion to the users who are visual impaired users that have interested in sporting matches but limited of tools access. In this case, developing an assisting application and tool for visual impaired users with the immersion optimization of the most basic interactions, such as Braille, audio interpreter and vibration, so that the immersed participant can feel and experience

themselves on the sport matches video getting same opportunities with other normal sighted people.

To apply the immersion element in the video system part, this study illustrates about identifying exciting events in media playback content through video segmentation process [36]. This process involves the mapping content of the video to easy use for event detection. This constitutes the incentive for this work, where the segmentation of football videos are generated using some code to extract the full length videos into frames.

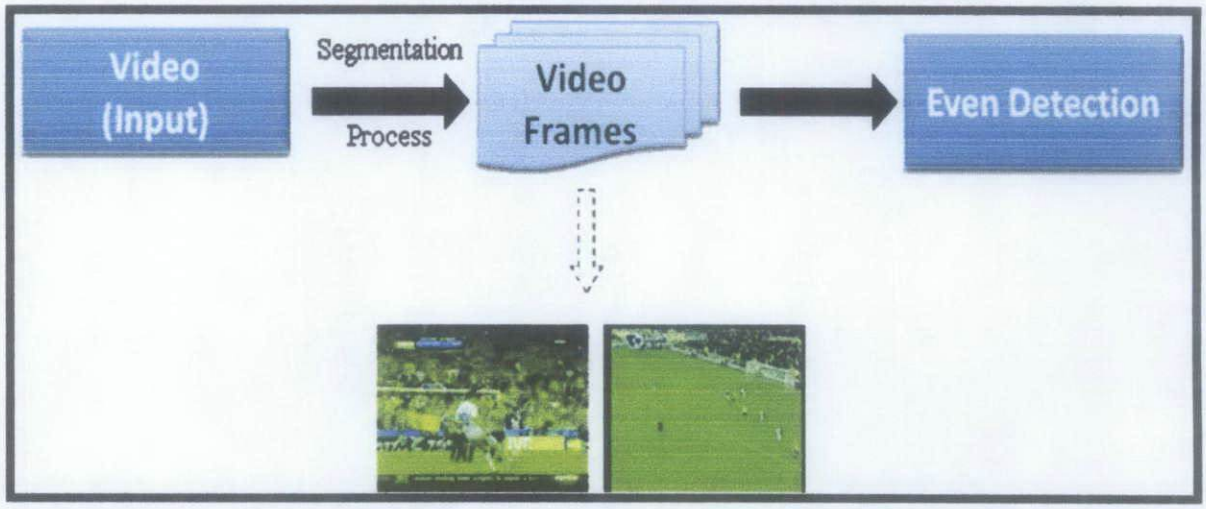

Figure 4 – Video Frames Segmentation Process

Event detection will be done with the analyzing video frames and speech characteristics that identify of strong emotion so that blind user can feel the excitement and get immersive while 'watching' their interest football game video [37]. In general, the ability to mark "interesting events" is very important in sports video playback in order to attract audience especially visual impaired users to feel the excitement and engagement into the video. This is very important aspect to be focused for the system application design for visual impaired users in accessing the video content. The excitement in scenes within sports videos is very likely to be identified "exciting" and

this information can be used to guide the process of immersion experience to the blind users. This feeling can be obtained by integrating the audio commentator and vibration part with the additional Braille translation function in the video during the playback.

3.3.2 Event detection

As discussed in the immersion study, event detection will be as a tool for generating summaries of the important moments during a football match in the video playback [38,39]. The detection of exciting events in the football video can be analyzed through the combination of crowd cheering, pitch location, slow-motion replay detection, player tracking, identification of commentator excitement and keywords. The example of events likes scoring goals, a missed penalty, a red card and others. In this research project, scoring goals event will be the targeted event to give the information about scoring goals number to the visual impaired people. This information will be highlighted and translated into the Braille code that accessible to the blind users.

3.3.3 Braille Translation/Description

Braille translation is reading and writing technique for blind and visually-impaired people to get knowledge and access information. In this translation process, Optical Character Recognition (OCR) will be involved automatically for text detection and recognition then translating the text into Braille. Each Braille character or "cell" is made up of 6 dot positions, arranged in a rectangle comprising 2 columns of 3 dots each and a dot may be raised at any of the 6 positions, or any combination represents the characters, symbols and numbers. Counting the space, in which no dots are raised, there are 64 such combinations [40]. In this study, Braille numbers are used to describe the basic highlight score currently obtain by each team.

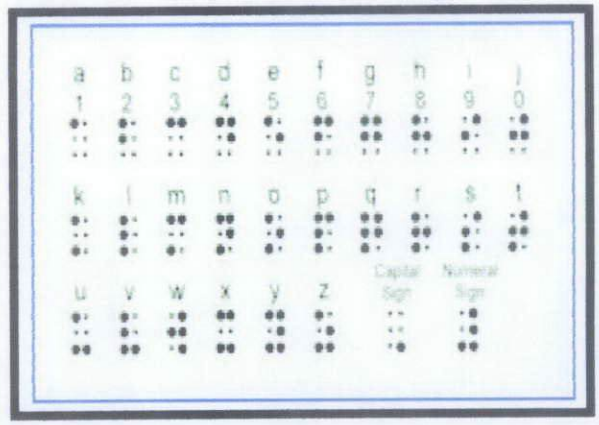

Figure 5 - Examples of six-dot Braille characters

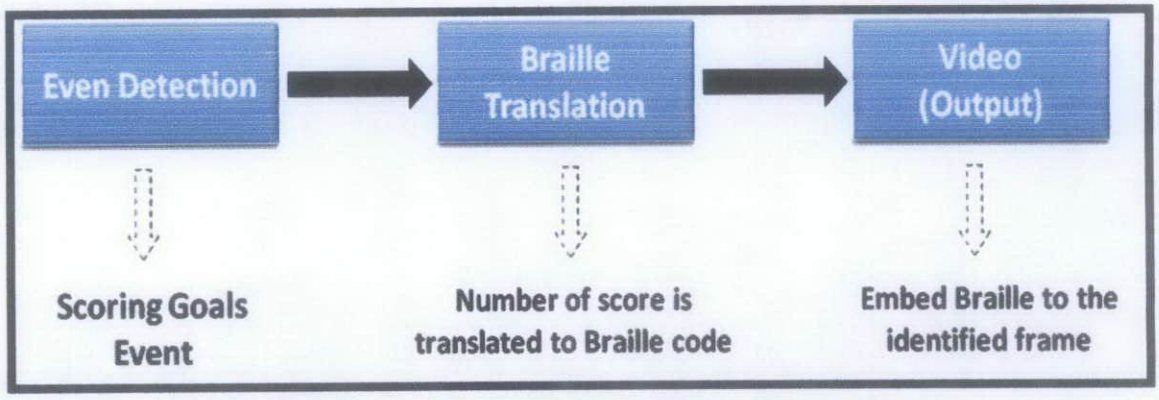

Figure 6 - Event detection and Braille Translation Process

Referring to the Figure 6, scoring goal event will be taken as the example of special event that is recognized as an exciting moment in the football match based on the strong emotion of crowd cheer and audio commentator. The number of goals scored by each team is used as the information to the visual impaired people. This information will be translated into the Braille codes and then embedded into the respective frame of the video. As being mentioned earlier, this application is intentionally for mobile device and in this device, this code will be automatically appearing on the video screen during the video playback. The visual impaired people will access the codes by gliding the fingers over the dots forming the characters. This objective can be achieved with the support of Braille technology specifically designed for this type of device for blind users in future.

Let's look an example of the actual design of this application. A sample of football video match between Selangor and Kedah teams had been chosen. This video is extracted into multiple frames. The moment of exciting in this match is during the time where both teams were trying to fight for a goal. For the first minute moment, both teams are failed to get any goal and their score were '0'. The audio commentator will announce the number of scored goal achieved by each team and the same time, the Braille codes appear on the screen as shown in Figure 7.

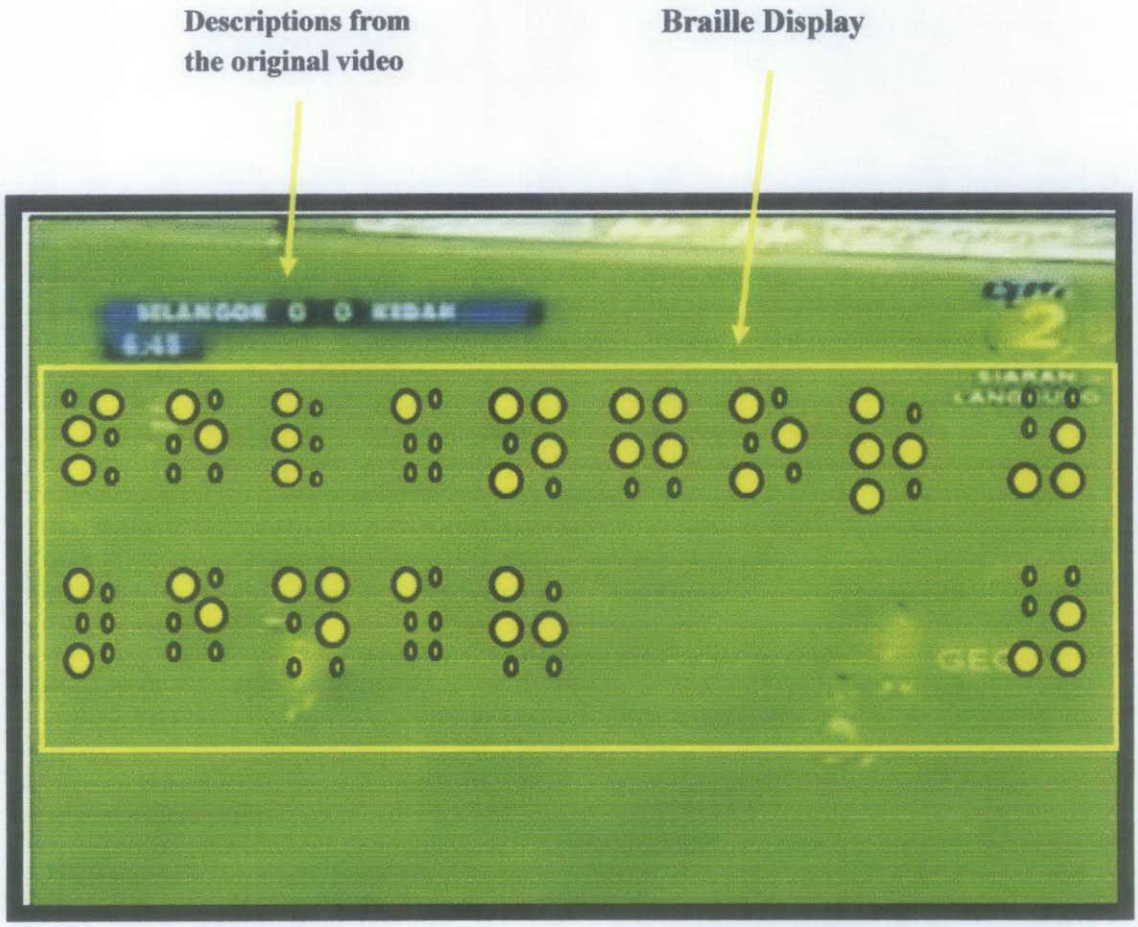

Figure 7 – Proposed Interface of Braille Codes Appear On The Video Mobile Screen

Figure 7, shows that the example of Braille codes shown on the interface of video mobile screen during playback. Below is the translation from the original fact texts into Braille codes.

SELANGOR 0
KEDAH 0

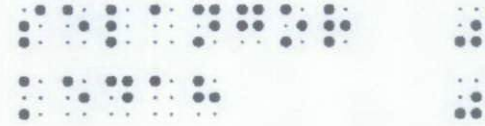

Figure 8 - Braille Codes Translation

Typically, for this prototype application, only Braille's number will be used to display on the video screen in order to test the feasibility as well as easily to read based on the mobile's size.

3.4 Refreshable Braille Device

Here are the current samples of refreshable Braille display devices used by visual handicapped people to read the digital contents through their fingertips. These devices are connected externally to the respective targeted device. Basically these refreshable Braille display devices are applying electromechanical concept to represent Braille characters by means of raising dots through holes in the flat surface. The intention of this project is to bring the concept of this electromechanical raised Braille dots on these devices into a mobile phone that is embedded internally.

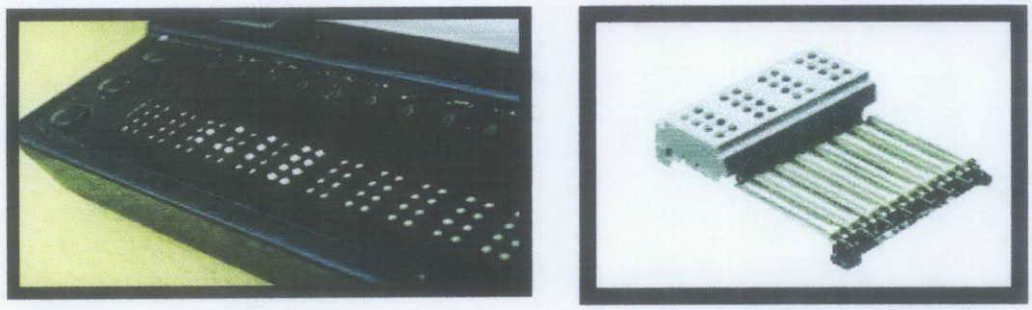

Figure 9 - Refreshable Braille Display Device

3.5 Resource Requirements

Below are the details of the tools needed for this video project :

Tools	Functions
Mobile Device	▪ The targeted device used for Braille Video application
Eclipse	▪ Software for code application development.
Device Android Emulator	▪ A virtual mobile device that runs on computer. The emulator is used to develop and test Android applications without using a physical device.
Matlab Program (version of R2010)	▪ A software used for Video segmentation and OCR code development.

Table 1 - Resource Requirements

3.6 Project Activities

3.6.1 Work Plan and Schedule

Below outlines the steps taken to complete this project research successfully.

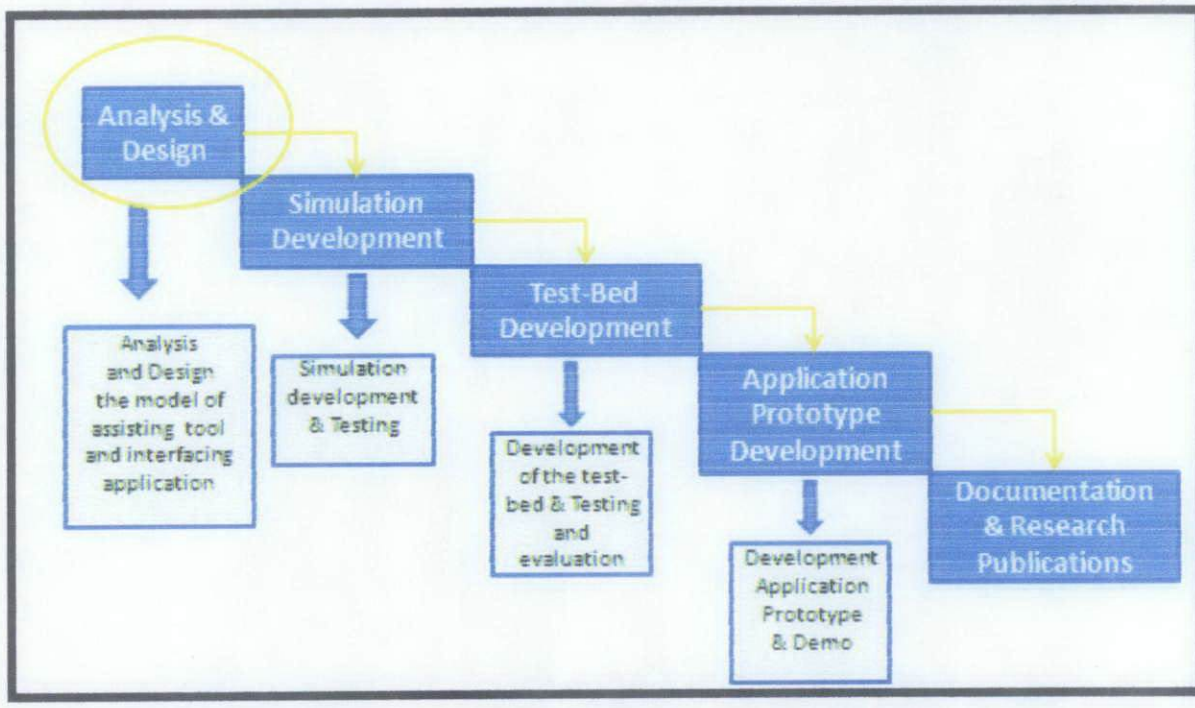

Figure 10 - Steps for Project Completion

1.1 Phase 1: Analysis and Design

This the initial stage of this project research. This is the process of identifying, modeling, designing method and documenting the data requirements of the system being designed. Overall, this stage is more on studying the critical reviews of related works.

1.2 Phase 2: Simulation Development

Focusing on the development of video extraction process by using coding and algorithm. Basically developments the type of simulation emphasizing the best suits the user

requirement, a feedback strategy, technical requirements, and the level of fidelity. Once the basic assumptions have been clarified, we rapidly develop a working prototype that sketches key portions of the final application.

1.3 Phase 3: Test-bed Development

Before actually implementing the new prototype system into operations, a test run of the system is done by removing all the bugs, if any. It is an important phase of a successful system. This process also needs the interaction with the users to ensure effective integration of Braille code into the system design and measure the feasibility of this appication.

1.4 Phase 4: Application prototype and Development

After finishing the test-bed development stage, each design application prototype will follow the requirements of the test-bed results. The completed prototype will be demonstrated to the end-users and gain the feedback. This project process will iterate to the first phase for continuation and enhancement purpose.

3.6.3 Gant Chart for Project Activities

Research activities / Month	1	2	3	4	5	6	7	8	9	10	11	12
1. Analysis and design	→	→	→	→								
- Analysis and design of immersive and engagement assisting tool												
- Analysis and design of an interfacing application												
2. Simulation development				→	→	→						
- Simulation development of the assisting tool and its application												
- Testing and evaluation of the simulation												
3. Test-bed development							→	→	→	→		
Development of the test-bed of the assisting tool and application												
- Testing and evaluation of the test-bed												
4. Application prototype development										→	→	→
- Development of the system prototype												
- Demo of the system prototype												
5. Documentation and publications	→	→	→	→	→	→	→	→	→	→	→	→

Table 2 – Milestones of Project Activities

The time ranges specified are only estimates and each section may take more or less time to complete.

CHAPTER 4
RESULTS AND DISCUSSION

At the beginning of this project work there were several unclear topics: How well defined were the theoretical ideas? How confident we can predict that our findings are true and reliable, and the limits beyond will not? Thus, we begin our evaluation with an exploratory approach to identify the mechanism related to perception and recognition. In this context, the evaluation of this application was an exploratory experiment. The evaluation of this tool was qualitative in a sense that we try to establish relevant elements about usability of immersive applications to be used without visual cues and to determine if our hypothesis was well grounded. In this chapter, we will discuss about the result of data gathering based on a survey, experimental results and user testing evaluation.

4.1 DATA GATHERING AND DATA ANALYSIS

4.1.1 Result of Survey

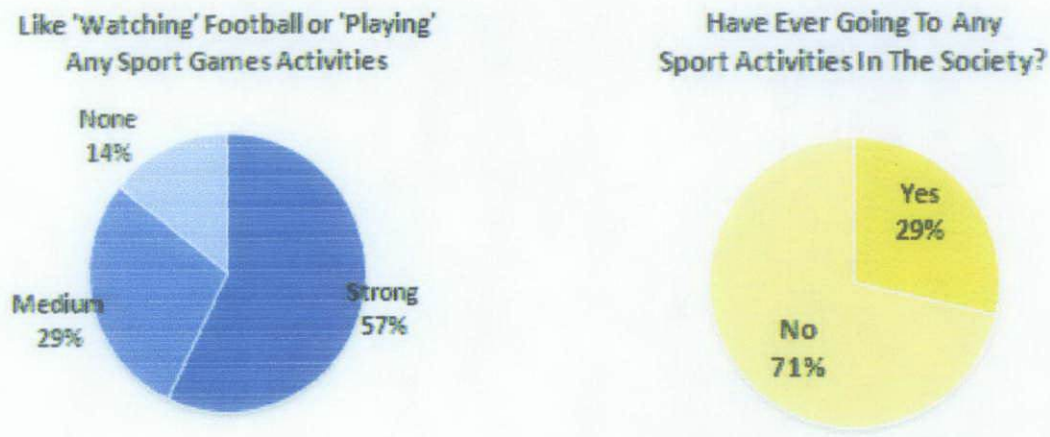

Figure 11 Result of Survey from 7 people of blind and visual impaired

These figures show the percentage of 7 people that who are blind and visual impaired people through a survey. Based on the pie chart, we can observe that for about 57% of them are interested in the sport games activites while 14% of them are not interested and have another hobbies. Even though, some of them have strong interest in the sport games activities, but not all of them had ever joining into any social sport games avtivities. It is only 29% have joining while the rest 71% are not. Most of their participation into the social sport activities are because of their active family joining the external activities and spend times together with them. This kind of activity some kinds can prevent the visual handicapped people from isolating and separating themselves from societies.

4.2 EXPERIMENTAL RESULT AND USER TESTING

A performance analysis of the experimental Braille Video prototype, can be divided into two categories: 1) the usefulness of the concept and 2) the performance of the recognizing the Braille dots. The actual Braille Video prototype was tested throughout its development. In total, about 7 people tested this prototype application. Their age ranged from 15 to 45 years. Three of the test subjects were blind and visual impaired while others were sighted but blindfolded. Most of the tests were done lasted between 5 and 15 minutes.

a) Test 1 : Briefing and Analyzing

The main result of our tests is that all test subjects only needed a few minutes of training to remember and recognize the way of touch the Braille dots displayed on the video screen. Blind subjects typically needed a few minutes to fully get the Braille Video concept, as they could not visually observe how the device works. Blindfolded subjects needed some time to simply become adapted to touch around without sight. In addition, blind and blindfolded subjects alike observed that using and touching the Braille dots on the video was very intuitive and required little conscious effort. The Braille Video concept thus fulfilled all our expectations and confirmed our initial hypothesis that following the Braille Video is a completely intuitive process.

b) Test 2 : Performance of the Braille dots recognition

The second category, the performance of the Braille dots recognition is about a test to see how much the blind subjects could read the Braille codes correctly after doing first practical test. In this experiment all the subjects need to guess the Braille numbers presented randomly on the screen. All dots presented have each vibrate module or vibrotactile and the subjects need to touch around the screen to capture the number and location of dots. Then, Text-to-Speech (TTS) audio will then tell what the number was. The result is true if the number guessed by the subject equals with the numbers told by the TTS audio.

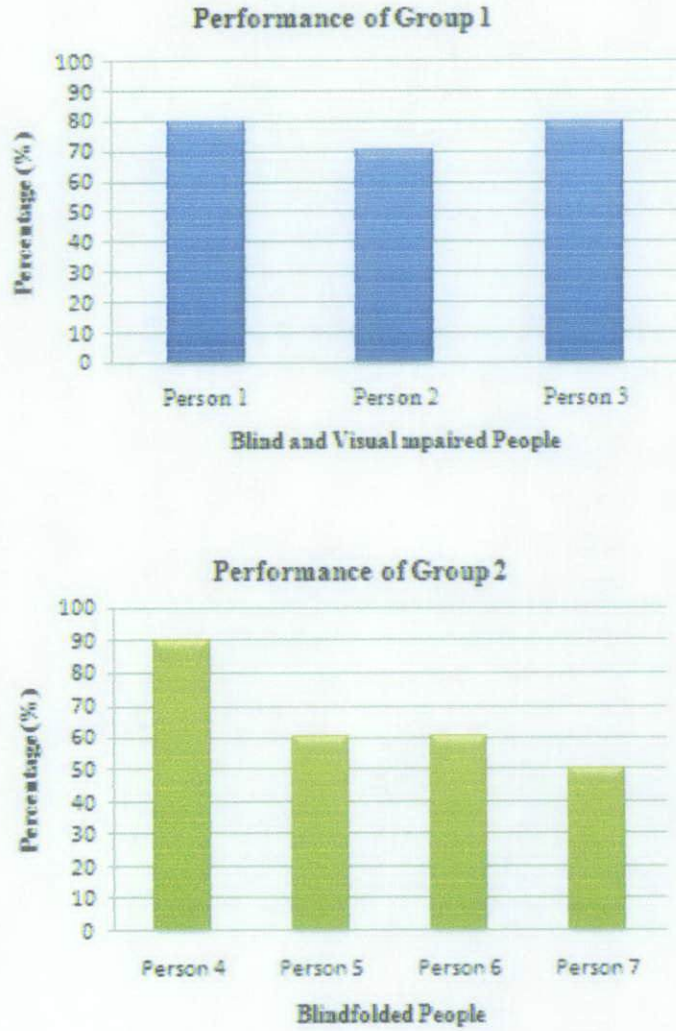

Figure 12 Performance of the Braille Recognition

Below shows the accuracy of Braille recognition test that had been collected:

Number & Braille/ Person		Person 1 (Blind)	Person 2 (Visual Impaired)	Person 3 (Visual Impaired)	Person 4	Person 5	Person 6	Person 7
1		TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
2		TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE
3		TRUE	TRUE	FALSE	TRUE	TRUE	FALSE	FALSE
4		TRUE	TRUE	TRUE	FALSE	TRUE	FALSE	TRUE
5		FALSE	TRUE	FALSE	TRUE	TRUE	TRUE	FALSE
6		TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	FALSE
7		TRUE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
8		FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
9		TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	FALSE
0		TRUE	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE
Percentage %		80%	70%	80%	90%	60%	60%	50%

Table 3 Accuracy of the Braille Recognition Test

4.3 PROJECT DELIVERABLES

4.3.1 System Prototype Application

Below illustrate the Braille Video prototype application in the Emulator that had been developed in the Android Platform using Eclipse.

Figure 13 Braille Application shows number of 0 in Android Emulator.

4.3.2 Product's Features :

1- This application basically consists of video, audio and tactile Braille that focuses on the displaying two Braille numbers of goals achieved by each team at a time.

2- Braille number will be displayed automatically on the screen according to the receiving goal event time. Currently, the setting for Braille display is just manual display by pressing the "MENU" button to change the Braille display on the screen.

3- In the real mobile device, the dots are touchable and vibrotactile where he user can feel the vibration within the dots area.

4- There is a background audible introducing the previous number after the user press the "MENU" button.

5- As Braille consists of six dots, the dots were divided into two levels : outer dots and center dots. Each level was differentiated by different of level frequency to help user easily recognize the dots position.

4.4 PROBLEMS AND CHALLENGES

Below shows some of the problems and challenges that we face during completing this project. This project consists of two parts : *internal video processing* and *interface video development.*

4.4.1 PART 1 : INTERNAL VIDEO PROCESSING

- As stated in the Figure 1 in the previous chapter, it shows that how the internal video processing for future real automation process creating the Braille Video application. This process is basically will automatically produce a new output video with Braille embedded into it by a single action and it can be done with the advancement tools in the future. Currently, we try to simulate using Matlab but it is not fully complete successful, because :
    - In video segmentation process, there is an error of reading the format of video file in the Matlab
    - The Optical Character Recognition algorithm has some error while detecting and recognizing the characters from the images.

4.4.2 PART 2 : INTERFACE VIDEO DEVELOPMENT

- This part consists of designing interface that accessible by visual impaired people. The challenges that we faced during the development of Braille Video interface in the mobile application are:
    - Repeat testing and debug the code whenever have an error
    - Sometimes Android Emulator hang whenever importing some type of video format
    - Error reading of vibration code on the Braille dots
    - Designing different frequency for vibrotactile Braille to easier recognize

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

This paper has outlined a framework for using a simple immersive system approach as a high-end visualization interface for exploring the sports video contents playback for the visual impaired users. In this study, a methodology that uses estimates of excitability in sports video through video segmentation process was presented. Video processing techniques are employed to extract the full length video into frames and detect pitching and slow motion scenes in order to identify end-points of plays and exciting events more effectively. The new method uses tactile Braille features displayed on the mobile's video screen as a way for the blind user to get accessibility to view the content of the video playback and get immerse or 'excited' to the highlighted scenes. Furthermore, the system is implemented as a software application that can be designed on an off-the-shelf phone, and it is the first such system we are aware of that is accessible to blind users that does not require the use of any additional hardware to read the Braille. Preliminary experiments with a blind and visual impaired subject demonstrate the system's feasibility. The techniques presented in this study are generic and may be equally applicable to a variety of domains such as television channels, movies, and others.

4.2 RECOMMENDATIONS

The intention of this project is to develop an integration immersive system or application consists of video, audio and haptic vibration modules specifically for the use of visual impaired or blind people to watch the football game video on the mobile device. In future, as technology rarely changed from time to time providing a new technology, hopefully there will be a Braille technology feature enabled and direct compatible in the mobile device without using any external Braille display device to connect it. This might be a software that providing a Braille driver for enabling this feature. Other than that, future improvements to this system include improving the speed and accuracy of the computer vision and OCR algorithms for finding and detecting character automatically. If this hope can be achieved, the actual of this product development will be successful. Furthermore, the approach introduced in this study can also be applied to other applications area like learning, education, television programme, movie or others that applicable in our daily life to provide assistive tools for them.

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