A

Dissertation

On

MACHINE LEARNING ALGORITHMS, DESIGN & IMPLEMENTATION DETAILS IN SMART TELEVISION BY IMAGE AND MULTIMEDIA PROCESSING

For the submission of partial fulfilment of degree of

Master of Technology
In
Computer Science and Engineering
2014

Submitted by:
VIKRANT GHAI
2K11/CSE/27

Under the supervision of:
Dr. Kapil Sharma
Associate Professor, DTU.

Department of Computer Engineering

Delhi Technological University

(Formerly Delhi College of Engineering)

New Delhi

DECLARATION

I hereby declare that the thesis entitled "**MACHINE LEARNING ALGORITHMS, DESIGN & IMPLEMENTATION DETAILS IN SMART TELEVISION BY IMAGE AND MULTIMEDIA PROCESSING**" which is being submitted to the Delhi Technological University, in partial fulfilment of the requirements for the award of degree of **Master of Technology in Computer Science & Engineering** is an authentic work carried out by me. The material contained in this thesis has not been submitted to any university or institution for the award of any degree.

Vikrant Ghai,

2k11/CSE/27(2011-2014),

Department of Computer Engineering,

Delhi Technological University,

Certificate

This is to certify that the work submitted in this dissertation entitled **"MACHINE LEARNING ALGORITHMS, DESIGN & IMPLEMENTATION DETAILS IN SMART TELEVISION BY IMAGE AND MULTIMEDIA PROCESSING"** submitted in partial fulfilment for the award of degree of **Master of Technology in Computer Science & Engineering** at **Department of Computer Engineering, Delhi Technological University** by VIKRANT GHAI, Roll No. 2K11/CSE/27 is carried out by him under my supervision and guidance. The matter embodied in this dissertation work has not been submitted earlier for the award of any degree or diploma in any institution to the best of my knowledge and belief. He has completed his work with utmost diligence and sincerity.

Dr. Kapil Sharma
Associate Professor,
Department of Computer Engineering,
Delhi Technological University.

VIKRANT GHAI
2K11/CSE/27,
Master of Technology,
Computer Science & Engineering

Acknowledgement

I would like to express my deepest gratitude to my supervisor **Dr. Kapil Sharma** for his invaluable guidance and support. His creativity and innovative skills have always been a constant source of motivation for me. He is a great person and one of the best mentors. I will always be thankful to him. I would also like to thank **Mr. Sujit Kumar Sinha (Senior Development Manager/Samsung Research Institute- Delhi)** for devoting his precious time in discussing ideas with me, guidance on relevant topics and giving his invaluable feedback. I would like to extend the thanks to all the faculty members for their motivation and moral support. I would like to thank all my classmates for their cooperation and support. I would like to dedicate this dissertation thesis to my supportive parents and whole DTU staff with all the faculty who have always been with me to make it a complete success.

VIKRANT GHAI

2K11/CSE/27,

Master of Technology,

In Computer Science & Engineering,

Delhi Technological University

Contents

Abstract 7

List of Figures 8

Chapter 1: Introduction 9

1.1 Introduction 9

1.2 Organization of the Thesis 10

Chapter 2: Literature Review 11

2.1 Television History 11

2.2 Television TimeLine 12

2.3 CRT Television: 12

2.4 SMART Television: 13

Chapter 3: Proposed Methodology 15

3.1 Definition: 15

3.2 Functions: 15

3.3 Technology: 15

3.4 Challenges: 16

3.4.1 Getting connected: 16

3.4.2 Standards drive growth: 16

3.4.3 The next big thing: 17

Chapter 4: IMPLEMENTING MACHINE LEARNING 18

4.1 Background and Abstract of Invention: 18

4.2 Novelty of the Invention / Improvement over Prior Arts: 18

4.2.1 Phase 1 19

4.2.2 Phase 2 20

4.2.3 Phase 3 20

4.2.4 Phase 4 20

4.2.5 Phase 5 21

4.3 Working Mechanism: 21

4.4 OUTPUT: 22

Chapter 5: VIEWING QULALITY ENHANCEMENT 24

5.1 Background and Abstract of Invention: 24

5.2 Novelty of the Invention / Improvement over Prior Arts: 26

5.2.1 Prerequisite: 27

5.2.2 Recognition Path ➔ 27

5.2.3 Locatable Path ➔ 27

5.3 Working Mechanism: 28
5.4 OUTPUT (Model Understanding): 29
Chapter 6: LISTENING QULALITY ENHANCEMENT 32
6.1 Background and Abstract of Invention: 32
6.2 Novelty of the Invention / Improvement over Prior Arts: 33
6.3 Automatic speaker calibration: 35
6.3.1 Prerequisite: 35
6.3.2 Recognition Path ➔ 36
6.3.3 Locatable Path ➔ 36
Chapter 7: Experimental Evaluation 37
Chapter 8: Conclusion and Future Work 38
8.1 Conclusion 38
8.2 Scope for future work 38
References 39

Abstract

A solution for better view ability and audibility features for Smart Television has been proposed in this thesis which will provide better and enhanced technological benefits to end user (Television Consumer); moreover, it will provide an opportunity to Smart Television manufacturers to implement machine learning algorithms, which is not possible in current situation because Multimedia stream specific decoding is done at Set-Top box. Since in this setup television act as a dumb rendering device; we have developed a novel approach by which television can extract intelligent information from data stream which was intended for rendering of multimedia frames pixel by pixel. Smart Television Industry will also get an opportunity to revive the consumerism which is now slowing down in industry because many of the technologies described in this thesis would not be possible only merely by software upgrade; since it requires new hardware changes which means that television manufactures have an edge to sell brand new hardware (Television) to customers which simply means more sales and can revive the slowdown that television industry is experiencing in emerging markets.

List of Figures

Figure 1 : User Preferences Sorted as per Viewer's Choice 22
Figure 2 : Browsing History 23
Figure 3 : Viewing Angle Possibilities 24
Figure 4 : Viewing Angle Comparison 25
Figure 5 : LCD Contrasts in different views 25
Figure 6 : Device for Manual Movement 26
Figure 7 : Automatic Alignment before Movement 29
Figure 8 : Automatic Alignment at Movement 30
Figure 9 : Automatic Alignment after Movement 31
Figure 10 : 5.1 Audio System Configurations 32
Figure 11 : 5.1 Audio Systems Angular Configuration 33
Figure 12 : 2.1 Audio Devices Normal Balanced Configuration 34
Figure 13 : 5.1 Audio Devices Normal Balanced Configuration 34
Figure 14 : 7.1 Audio Devices Normal Balanced Configuration 35

Chapter 1: Introduction

1.1 Introduction

A Smart Televsion, sometimes referred to as connected TV or hybrid TV, (not to be confused with IPTV, Internet TV, or with Web TV) is a television set or set-top box with integrated Internet and Web 2.0features, and is an example of technological convergence between computers and television sets and set-top boxes. Besides the traditional functions of television sets and set-top boxes provided through traditional broadcasting media, these devices can also provide online interactive media, Internet TV, over-the-top content, as well as on-demand streaming media, and home networking access.

The software that runs smart TVs can be preloaded into the device, or updated or installed on demand via an app store or app marketplace, in a similar manner to how the Internet, Web widgets, and software applications (in this context commonly just referred to as "apps") are integrated in modern smartphones.

The technology that enables smart TVs is also incorporated in devices such as set-top boxes, digital media players, Blu-ray players, game consoles, digital signage hotel television systems, and other network connected interactive devices that utilize television type display outputs. These devices allow viewers to search, find and play videos, movies, photos and other content from the Web, on a cable TV channel, on a satellite TV channel, or on a local storage drive.

A smart TV device is either a television set with integrated Internet capabilities or a set-top box for television that offers more advanced computing ability and connectivity than a contemporary basic television set. Smart TVs may be thought of as an information appliance or the computer system from a handheld computer integrated within a television set unit, as such smart TV often allows the user to install and run more advanced applications or plugins/add-ons based on a specific platform. Smart TVs run complete operating system or mobile operating system software providing a platform for application developers.

Smart TV platforms or middleware have a public Software development kit (SDK) and/or Native development kit (NDK) for apps so that third-party developers can develop applications for it, and an app store so that the end-users can install and uninstall apps themselves. The public SDK enables third-party companies and other interactive application developers to “write” applications once and see them run successfully on any device that supports the smart TV platform or middleware architecture which it was written for, no matter who the hardware manufacturer is.

1.2 Organization of the Thesis

This thesis is divided into eight chapters. A brief overview of all the chapters is as follows:-

- **Chapter 1**; Introduction.
- **Chapter 2**; discusses the Literature review and related work done in the field.
- **Chapter 3**; Proposed Methodology
- **Chapter 4**; consists of the Implementation of Machine Learning Algorithms for Smart Television.
- **Chapter 5**; consists of the Technology, Algorithm and Design to improve viewing angles of Smart Television in Large Room Hall.
- **Chapter 6**; consists of the Technology, Algorithm and Design to improve listening Quality of devices connected with Smart Television in Large Room Hall.
- **Chapter 7**; Experimental Evaluation
- **Chapter 8**; Conclusion and Future Work

Chapter 2: Literature Review

2.1 Television History

The first television was developed using electro mechanical methods to scan, transmit, and reproduce an image. As electronic camera and display tubes were perfected, electromechanical television gave way to all-electronic systems in nearly all applications.

Television was not invented by a single inventor, instead many people working together and alone over the years, contributed to the evolution of television.

Electronic television systems worked better and eventual replaced mechanical systems.

Time line of various technologies evolved over the period of time. Television industry as a whole was not a contribution of single inventor or single organisation; in fact it has evolved co-operatively with the help of various organisations like Samsung, L.G, Sony, Panasonic, ONIDA, Vega, over the period of time as well as it has evolved with the cooperation of various inventors which has contributed in terms of technology enhancements for a final product known as Smart Television what we know it today.

- Paul Gottlieb Nipkow - Mechanical Television
- John Logie Baird - Mechanical
- Charles Francis Jenkins - Mechanical
- Cathode Ray Tube - Electronic Television
- Vladimir Kosma Zworykin - Electronic
- Philo T. Farnsworth - Electronic
- Louis Parker - Television Receiver
- Rabbit Ears - Antennae
- Color Television
- History of Cable TV
- Remote Controls
- Origins of Children's Programming
- Plasma TV
- History of Closed Captioning TV
- Web TV

Television as a product has evolved from two broad categories:

- **CRT Televisions**
- **Smart Televisions**

2.2 Television TimeLine

- 1 Jan 1926, the television was invented.
- 8 Apr 1953, First 3D film was invented.
- 25 Mar 1954, First colour TV was invented.
- 1 Jan 1956, First TV Remote was invented.
- 3 Oct 1983, First Monshcrome Television display was invented.
- 20 Jun 1997, First 42 Inch Plasma Television was invented.
- 1 Jan 2010, First 3D TV was invented.
- 1 Jan 2012, First Smart Television was invented.

2.3 CRT Television:

The experimentation of cathode rays is largely accredited to J. J. Thomson, an English physicist who, in his three famous experiments, was able to deflect cathode rays, a fundamental function of the modern CRT. The earliest version of the CRT was invented by the German physicist Ferdinand Braun in 1897 and is also known as the Braun tube. It was a cold-cathode diode, a modification of the Crookes tube with a phosphor-coated screen.

In 1907, Russian scientist Boris Rosing used a CRT in the receiving end of an experimental video signal to form a picture. He managed to display simple geometric shapes onto the screen, which marked the first time that CRT technology was used for what is now known as television

It was named by inventor Vladimir K. Zworykin in 1929. RCA was granted a trademark for the term (for its cathode ray tube) in 1932; it voluntarily released the term to the public domain in 1950. The first commercially made electronic television sets with cathode ray tubes were manufactured by Telefunken in Germany in 1934.

The cathode ray tube or (CRT) is a vacuum tube containing one or more electron guns, and a fluorescent screen used to view images. It has a means to accelerate and deflect the electron beam(s) onto the screen to create the images. The images may represent electrical waveforms (oscilloscope), pictures (television, computer monitor), radar targets or others. CRTs have also been used as memory devices, in which case the visible light emitted from the fluorescent material (if any) is not intended to have significant meaning to a visual observer (though the visible pattern on the tube face may cryptically represent the stored data).

The cathode ray tube or (CRT) is a vacuum tube containing one or more electron guns, and a fluorescent screen used to view images. It has a means to accelerate and deflect the electron beam(s) onto the screen to create the images. The images may represent electrical waveforms (oscilloscope), pictures (television, computer monitor), radar targets or others. CRTs have also been used as memory devices, in which case the visible light emitted from the fluorescent material (if any) is not intended to have significant meaning to a visual observer (though the visible pattern on the tube face may cryptically represent the stored data).

A CRT works by moving an electron beam back and forth across the back of the screen. Each time the beam makes a pass across the screen, it lights up phosphor dots on the inside of the glass tube, thereby illuminating the active portions of the screen. By drawing many such lines from the top to the bottom of the screen, it creates an entire screen full of images.

2.4 SMART Television:

When you put a powerful processor which has the capabilities to run conventional software code into a television or inside a device which displays on the television, you have the ingredients of a smart TV platform. Of course, putting a cow and a sack of potatoes in a kitchen doesn't automatically result in steak and chips: there also needs to be considerable thought into how those ingredients are used so that we end up with something desirable. Intel has the research and expertise required to do just that – specifically without leaving the TV feeling anything like a computer.

Fundamental limitations of the TV now disappear, then. And there are immediate benefits: smart TV provides the technology to unlock every source of content and entertainment, and bring it to us through that screen we love most. Yes, they are technically capable of rendering all of the content available on the internet: this is not just the web, and it is not just the customized – and often diluted – versions of YouTube or Facebook which are proprietary to most "Internet TVs" today. Furthermore they can run rich games and apps, and even be feature upgraded "over the wire", transparently to the user.

There are some not-so-obvious benefits too. Smart TV will propose content based on our interests, preferences or social networks. It promises the ability to offer immediate information about a car/restaurant/handbag etc, simply by pointing at it. If we like what we see, we can buy it or book it there and then. Adding a camera will change the nature of telephony. And gesture recognition has the potential to send information about our body shape and size to online clothes shops, generating onscreen models so we can see exactly what the clothes look like on us before we buy.

Not all of these new usages are ready yet, but it's just a matter of time now that the platform is here. This will be fun to watch – literally. First smart TV products like Google TV and the Boxee Box by D-Link are already on the market. Some countries in Europe can even get products based on Intel's smart TV processors from service providers like Free or Telecom Italia.

A Smart TV is connected to the Internet either wirelessly or via an ethernet cable which accesses the internet via your broadband modem / router.

Samsung, LG, Toshiba, Sony and Panasonic have led the way when it comes to Smart TV technology. Like any new technology, it's also changing rapidly

Chapter 3: Proposed Methodology

3.1 Definition:

“Smart TV"s:

1. Deliver content (such as photos, movies and music) from other computers or network attached storage devices on a network using either a Digital Living Network Alliance / Universal Plug and Play media server or similar service program like Windows Media Player or Network-attached storage (NAS), or via iTunes.
2. Provide access to Internet-based services including traditional broadcast TV channels, catch-up services, video-on-demand (VOD), electronic program guide, interactive advertising, personalization, voting, games, social networking, and other multimedia applications.

3.2 Functions:

Smart TV devices also provide access to user-generated content (either stored on an external hard drive or in cloud storage) and to interactive services and Internet applications, such as YouTube, many using HTTP Live Streaming (also known as HLS) adaptive streaming.[24]

Smart TV devices facilitate the cu ration of traditional content by combining information from the Internet with content from TV Providers. Services offer users a means to track and receive reminders about shows or sporting events, as well as the ability to change channels for immediate viewing.

Some devices feature additional interactive organic user interface / natural user interface technologies for navigation controls and other human interaction with a Smart TV, with such as second screen companion devices, spatial gestures input like with Xbox Kinect, and even for speech recognition for natural language user interface.

3.3 Technology:

Smart TV technology and software is still evolving, with both proprietary and open source software frameworks already available. Some can run applications (sometimes available via an 'app store' digital distribution platform), interactive on-demand media, personalized communications, and have social networking features.

Some smart TV platforms come pre-packaged, or can be optionally extended, with social networking technology capabilities. The addition of social networking synchronization to smart TV and HTPC platforms may provide an interaction with both on-screen content and other viewers than is currently available to most televisions, while simultaneously providing a much more cinematic experience of the content than is currently available with most computers.

Some smart TV platforms also support interactive advertising, addressable advertising with local advertising insertion and targeted advertising, and other advanced advertising features such as ad telescoping, using VOD and PVR, enhanced TV for consumer call-to-action and audience measurement solutions for ad campaign effectiveness. Taken together, this bidirectional data flow means that smart TVs can be and are used for clandestine observation of the owners. Even in sets that are not configured off-the-shelf to do so, default security measures are often weak and will allow hackers to easily break into the TV.

3.4 Challenges:

3.4.1 Getting connected:

A key challenge is getting viewers to connect their televisions in the first place. According to the Tech News Daily website only 47% of connected TVs are actually hooked up to the internet – this is a major barrier to mainstream adoption. Viewers feel it's either too complicated to connect or that the range of additional services does not justify the investment required modifying their home setup to connect their televisions.

The industry as a whole must work together to deliver a simple, consistent message to educate consumers about how to get the most out of today's new connected TVs. We've seen a lot of promotion for the digital switch over campaign but almost nothing for connected TVs. This message needs to be delivered by services providers, TV manufacturers and retailers alike; consumers have a variety of choices when it comes to connecting their TVs to the internet whether it's by power line, Ethernet or wireless connectivity – the industry must work together to help them find the best solution.

In addition to helping consumers get connected the industry must also remain focused on delivering a TV-centric experience. Connected TV is not just about putting smartphone applications on to the TV, it's about delivering value-added TV content for viewers, tailoring online content and on-demand programming for the TV.

3.4.2 Standards drive growth:

The absence of open standards across TV devices presents a real barrier for application development. At the moment, every application or service must be tailored to work for each TV manufacturer's range of products. This inefficient approach is both costly and time consuming and ultimately means that innovation is stifled.

Connected TV standards bodies, such as HbbTV (Hybrid Broadcast Broadband TV), a pan-European initiative, are already addressing these issues by promoting open standards across all TV devices.

This approach has already been successfully adopted in both France and Germany. The success of this activity depends on the level of support from the TV industry as a whole – not just device manufacturers but application developers and broadcasters as well. The goal of a standards-based approach is to reduce development time and increase consistency across different products, which will in turn lead to more new services being developed for consumers.

3.4.3 The next big thing:

TV viewers today want much more from their viewing experience. Research suggests that around 70% of tablet and smartphone owners use their devices while watching TV. The next step is to combine these activities to enhance the TV experience.

So far these devices have been treated entirely independently from the main TV set but with new multiscreen technology there's a real opportunity to deliver a converged service that combines the best of TV with the best of tablet and smartphone functionality. In turn this will provide truly personalized services to the viewer.

Before we can take advantage of this, the TV or set-top box and tablet devices need to be "talking" to each other. The more a device such as an iPad knows about what you are watching, the better recommendations it can make to you, whether it's access to IMDb when you're watching a film or links to where you can find more episodes of the same or similar programmes. We'll also start to see set-top boxes and TVs streaming live and recorded programmes directly to tablet and smartphones creating another TV screen in the home.

Chapter 4: IMPLEMENTING MACHINE LEARNING

4.1 Background and Abstract of Invention:

Smart Television doesn't have any history details of channels viewed:

Parental Lock is a feature where we can lock out adult channels so that younger one should not watch, but what if they know password. It would be better if some browsing history is available.

We display history of channels browsed by the most distinguishable and recognisable feature of a channel which is nothing but a channel logo itself.

Smart Television can learn itself via Machine Learning algorithms.

In this way User way can recognise easily what it has browsed without involving various technical background of multimedia.

4.2 Novelty of the Invention / Improvement over Prior Arts:

Smart Television can provide a solution to end user: Where a user can see the browsing history of the watched channels throughout the time.

We can provide a mechanism where a user can view the history of the channels watched irrespective of the media and container formats.

All the channels around the world have their respective logos; which are generally most recognizable and visually distinctive to the end users. We need to fetch out channel logo by some logo detection algorithm. Smart Television will contain/append the list of logos automatically on detection.

This feature in Smart Television can be attributed as Automatic Machine Learning:

Pseudo Data Structure

```
Class LogoScanner
{
        Corner Detail;
        Logo Bitmap;
        Expected Co-ordinates;
        Total Time Run;
        Last Start Time;
        Last Stop Time;
}
ListOfScannedLogo → {Compiled_list_of_parsed_out_logos_throughout_the_time};
```

The five phases of Machine learning are:-

1. Phase-I Identification.
2. Phase-II Extraction.
3. Phase-III Analyser.
4. Phase-IV Learning and Feedback
5. Phase-V Computation and Display

4.2.1 Phase 1

Initially television has the list as empty list; once TV boots up; we will detect out the constant 4 corners of our display panel. Cutting out the 10% of height and width, of four corners like (top-left, top-right, bottom-left, bottom-right) will give us good approximation of finding a channel logo with this proximity,

We will come to know that histogram of one of the corner is quite static as compared to rest of the three corners; If we analyse for some constant time say for 1 Minute;

Over 30 FPS; we can analyse

$30 * 60 = 1800$ frames

Compute Average histogram of four corners over 1800 frames.

4.2.2 Phase 2

Once we get any section which has more static histogram then the rest of the corners. This will give us a more probability of finding a channel logo in this particular region. Then, we will run out edge detection, bit map deltas algorithm for some time (Say 10 Minutes) to extract out the channel logo out of numerous Multimedia Frame buffers. Rest of the background will continuously change in meantime while logo being at specific position and constantly rendering at very same position we can extract it out very sharply.

Once we extracted out the transparent logo out of video/frame buffer; we will append this newly created/generated logo in our Smart Television logo list with expected co-ordinates to search on these expected co-ordinates next time. This logo list will be constantly and continuously monitored though out the Machine Learning process and will stay locally but in Televisions non-volatile memory.

Then our history tracking algorithm will start which will run the Phase 1 only; if we get any static corner in our display panel based on histogram tracking; then we try to map it with whole list and with expected corners which we previously stored. We will iterate the whole list; once a match is found.

4.2.3 Phase 3

In Phase 3, a constant thread will keep on monitoring the presence of logo by comparing histogram and expected co-ordinates, and keep on incrementing the TotalTimeCounter, while updating the LastStartTime and LastStopTime counters.

4.2.4 Phase 4

Next time whenever television will boot up; we will start out process from phase 1;

- ➔ Detect any of the static corners based on histogram comparison out of four corners; get one corner which is more static than others.
- ➔ Once get a static corners as per histogram, start searching the previously stored logo list

IF (MATCH_IS_FOUND)

{

UPDATE THE DATA STRUCTURE ACCORDINGLY

}

ELSE
{

RUN_THE_LOGO_EXTRACTION_ALGORITHM

From phase 2 and append it to the existing logoList.

}

4.2.5 Phase 5

In Phase 5; we will dispose out created/generated logoList as a well-defined UI Application as per various application logic. This logoList will be fed to various Machine Learning Algorithms and Applications for higher Application Level Processing.

Let's assume we have collected 4 different logos;

All this can be summarised as one of the basic of decreasing order od TotalTimeCounter; which will give an end user an idea which channel has been watched out most of the time and so and so on.

4.3 Working Mechanism:

- ➔ Browsing history can be provided in television in following ways.
- ➔ Side by Side different sort of reports can be generated by sorting out LastStartTime and LastStopTime counters

With this technology we can provide browsing history to end users irrespective of the Media/Codec/Container details. Smart television with this technology can be produced without considering the details of country specific digital broadcasting. Moreover we don't need to bother about Source details whether it is Set-Top Box, Dish TV, Streamed Media etc.

Smart Television will itself create the user browsing history and favourites by applying various higher level application logic having Machine learning algorithms.

4.4 OUTPUT:

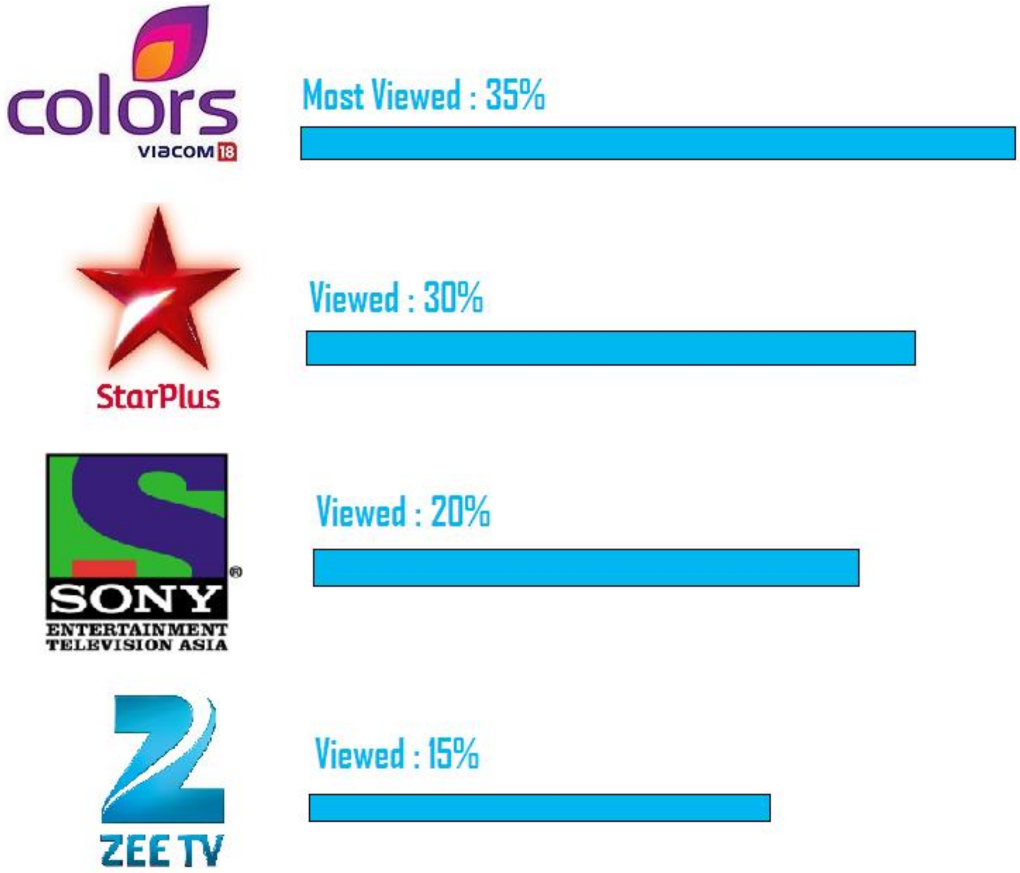

Figure 1 : User Preferences Sorted as per Viewer's Choice

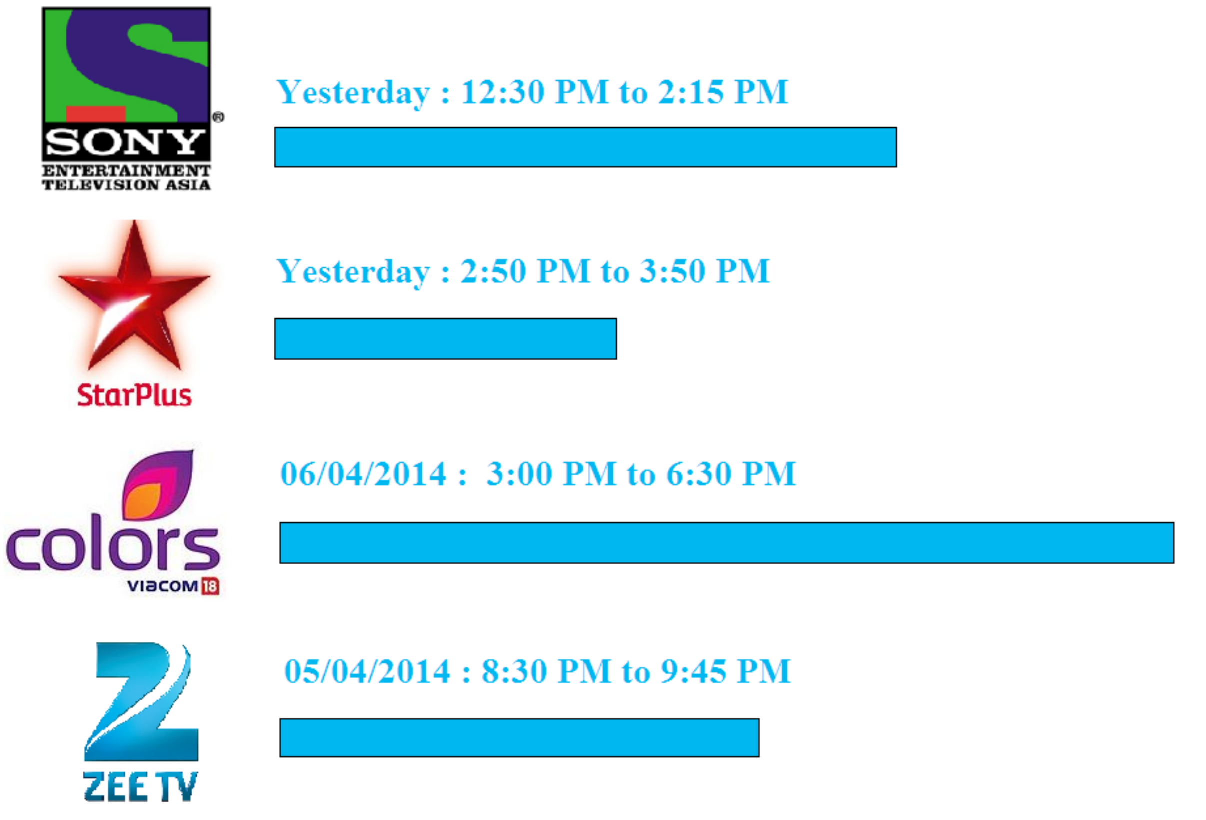

Figure 2 : Browsing History

Chapter 5: VIEWING QULALITY ENHANCEMENT

5.1 Background and Abstract of Invention:

Many a times we fall into a situation where we are not sitting exactly perpendicular to the plane of television's display panel. This led to reduction of television's display colours and contrast at some point of screen, due to non-alignment of perpendicular originating from television's display panel is not coinciding with the viewer's line of sight.

The viewing angle of an LCD is important depending on its use or location. The viewing angle is usually measured as the angle where the contrast of the LCD falls below 10:1. At this point the colours usually start to change and can even invert, red becoming green and so forth.

Optimal or ideal viewing can be defined as watching TV directly in front of the screen at eye level (0 degree below). As soon as one moves off centre, either vertically or horizontally, TV picture quality begins to decrease—the screen looks dim and the colour is faded. In fact, recent industry research indicates there is noticeable picture quality degradation in as little as 10 degrees from the optimal viewing angle, even with the most expensive LCD TV.

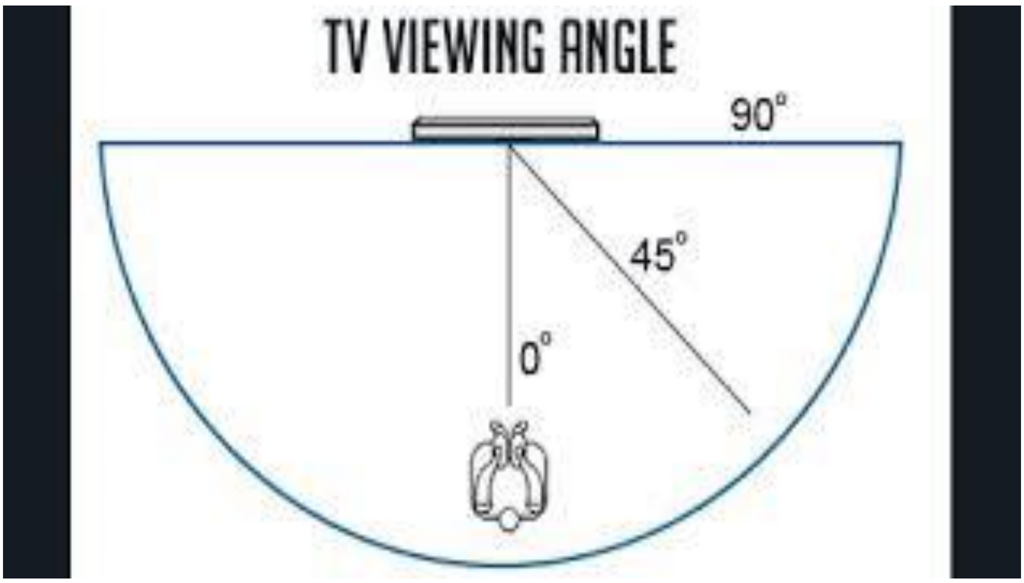

Figure 3 : Viewing Angle Possibilities

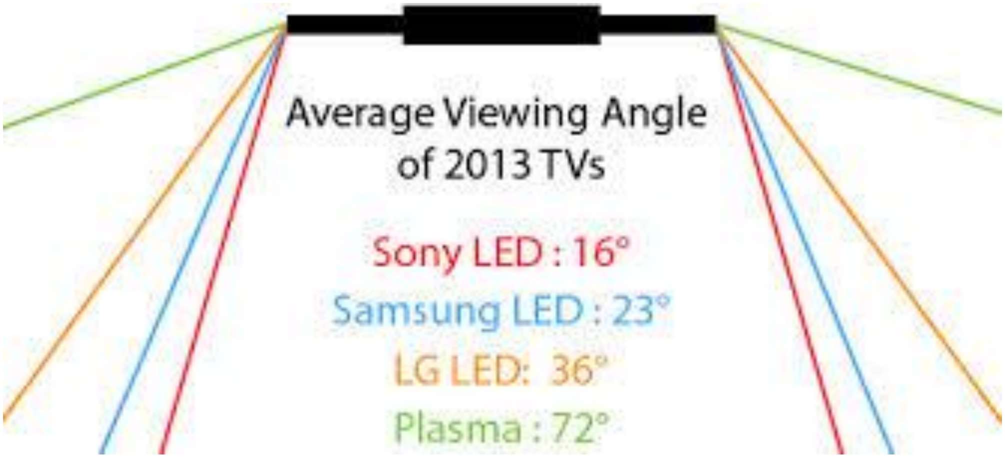

Figure 4 : Viewing Angle Comparison

All LCD TVs shows noticeable degradation in colour accuracy at a viewing angle of just 15 degrees, and this accuracy decreases exponentially at 30 degree off-axis.

Figure 5 : LCD Contrasts in different views

Best Solution to view LCD Television seamlessly remains same that full-motion TV wall mounts are the ideal solution with their ability to tilt, swivel and extend in every direction.

Figure 6 : Device for Manual Movement

5.2 Novelty of the Invention / Improvement over Prior Arts:
This wall mount solution will be based on sound recognition and locatable technology.

Television is generally 1 meter wide. We will place two separate sound/voice receivers at both edges.

Viewer will speak pre-recorded voice commands like "Move Here", "Look Here", "Align" etc. Viewer can initiate the movement from DTV application using Smart Remote Control (Bluetooth remote or BT-remote).

Now Television need to do two different steps (Computing Paths). It should recognise voice commands as well as it should locate viewer's exact spatial location in a given room.

5.2.1 Prerequisite:

- Smart Television will have dedicated Smart Control (Bluetooth remote control). Smart control will have two specific hardware/software embedded units.
- Smart Television will have dedicated sound receivers at both edges.

5.2.2 Recognition Path ➔

This path will be handled by usual voice recognition software technique.

UNIT-1) this functionality will be handled by dedicated voice recognition software embedded in Smart Control. Once Voice is recognised with pre-recorded command; then following action sequence will be initiated.

a) Smart Control will activate Smart Television for angular alignment
b) Smart Control will initiate the sound waves as described below.

5.2.3 Locatable Path ➔

This Path will be handled as below mentioned Novelty of approach.

UNIT-2)

a) Smart control will pair up with Smart Television/ already paired.
b) Smart control will issue a command to Smart Television – START_ALIGNMENT
c) Smart Television will respond ALIGNMENT_STARTED
d) Smart control will have a dedicated sound emitter which will blast sound waves of > 20KHZ in room; which will not be recognizable to human wars because Human being ears can hear up to 20Hz-20KHz. Sound waves would be travelled as pulse train of specific frequency. Because to calculate the differences of received time.
e) One of the receivers will receive the sound waves earlier than the other one.
f) Smart Television will start to rotate on the receiver-side which has received the sound pulse earlier.
g) Smart Television will keep on rotating, until both the receivers are not receiving the corresponding sound pulses; exactly at the same time or simultaneously with respect to master clock embedded into Televisions chipset.
h) Smart Television will stop rotating when it receives the sound waves exactly on the same time on both of the receivers. This orientation/position will be the exact perpendicular to viewer's line of sight.
i) Smart Television will send ALIGNMENT_COMPLETED to Smart Control and Smart Control will shut down its Sound Wave blaster.
j) So, at the end Smart Televisions display panel will be aligned perpendicularly to the line of sight.

Rotation of Smart Television is required on the basis of difference in timing of sound pulses received at both edges television.

Smart Television will be aligned to line of sight of viewer as per the above mentioned novelty / implementation.

5.3 Working Mechanism:

Normal Setup: (Example) Delay Perceived 1 Second

R1 ➔ Receiver 1

R2 ➔ Receiver 2

T1 ➔ Sound Received at Receiver 1

T2 ➔ Sound Received at Receiver 2

ALGORITHM / LOGIC:

IF (T1 – T2) is Positive (> 0)

ROTATE ANTI_CLOCK_WISE

ELSE IF (T2 – T1) is Positive (> 0)

ROTATE CLOCK_WISE

ELSE

ALIGNMENT_COMPLETED

5.4 OUTPUT (Model Understanding):

T1 – T2 = 1 second;

Since T2 received sound signal earlier; ROTATE ANTI_CLOCK_WISE

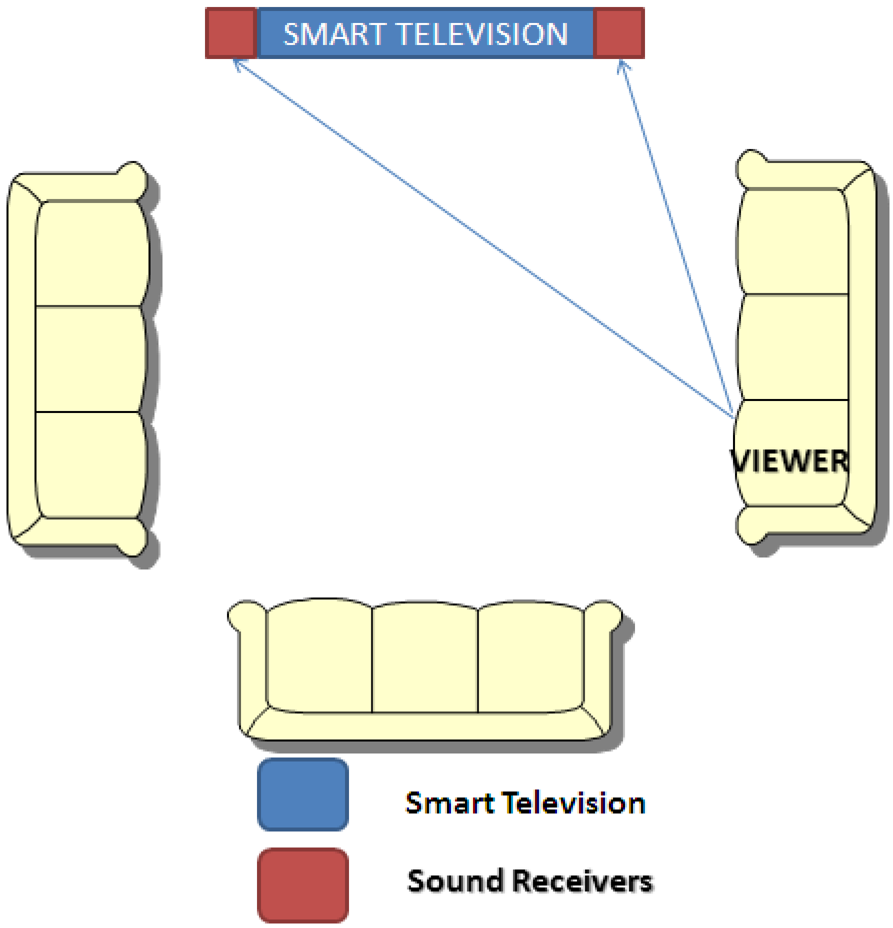

Figure 7 : Automatic Alignment before Movement

T1 – T2 = 0.5 Second

Since T2 Received sound signal earlier; ROTATE ANTI_CLOCK_WISE

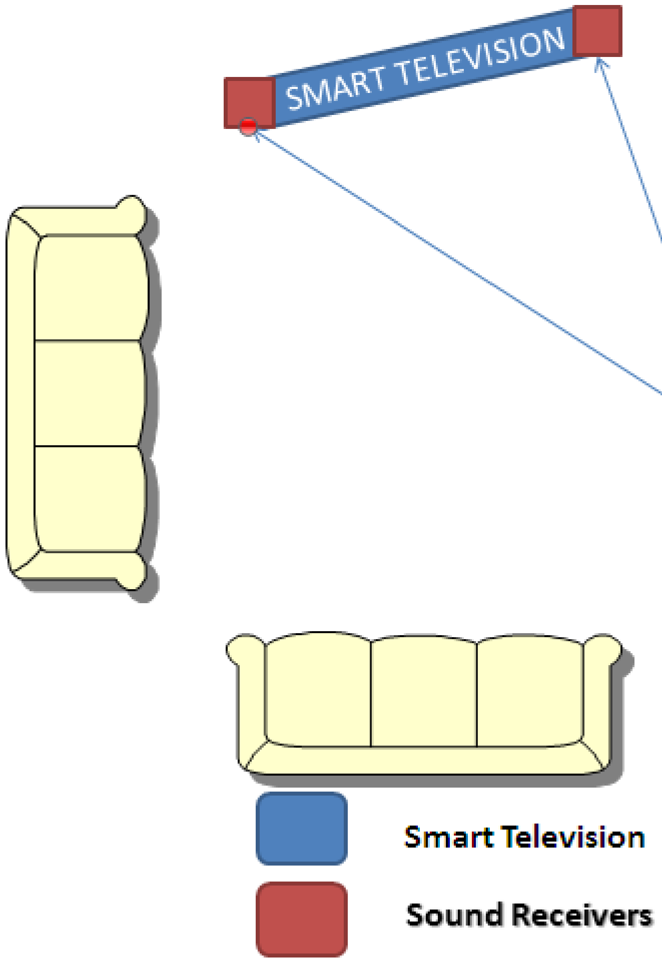

Figure 8 : Automatic Alignment at Movement

T1 – T2 = 0 Second

Since T1and T2, Both Received Sound signal simultaneously; ALIGNMENT_COMPLETED

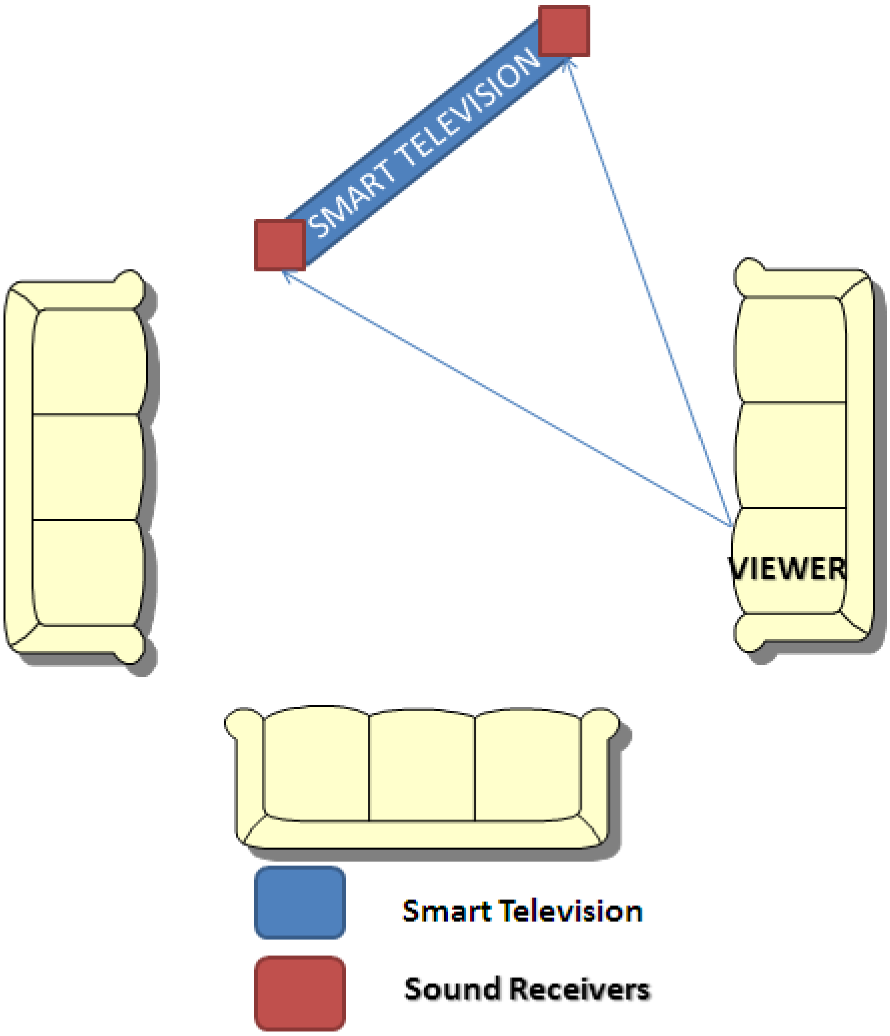

Figure 9 : Automatic Alignment after Movement

Chapter 6: LISTENING QULALITY ENHANCEMENT

6.1 Background and Abstract of Invention:

Now a day, Smart Television is coming various audio devices like woofers, subwoofers, amplifiers and speakers. Though all these supplementary audio devices has capability to produce desired sound effects with crystal clear beats; but the problem arise with listening quality when the end user is not located at the centre or the expected locality within these sound devices.

5.1("five point one") is the common name for six channel surround sound multichannel audio systems. 5.1 is now the most commonly used layout in both commercial cinemas and home theatres. It uses five full bandwidth channels and one low-frequency effects channel (the "point one"). Dolby Digital, Dolby Pro Logic II, DTS, and SDDS are all common 5.1 systems. 5.1 is also the standard surround sound audio component of digital broadcast and music.

All 5.1 systems use the same speaker channels and configuration, having a front left and right, a center channel, two surround channels and a subwoofer.

5.1 Channels

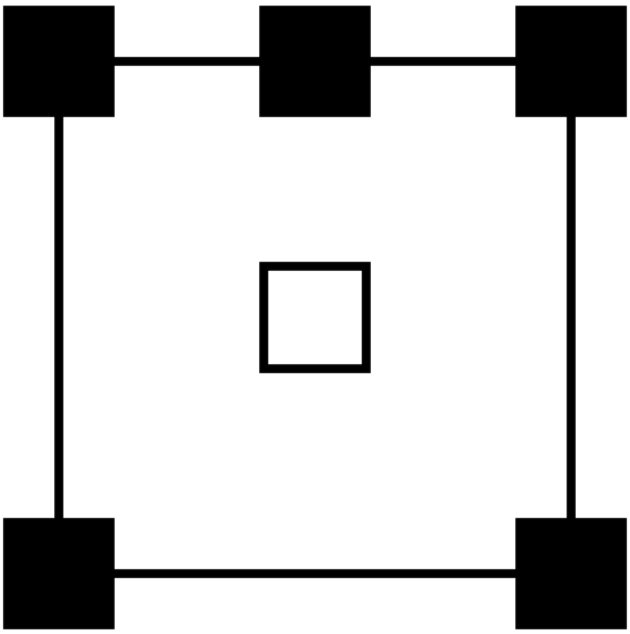

Figure 10 : 5.1 Audio System Configurations

5.1 Surround Setup

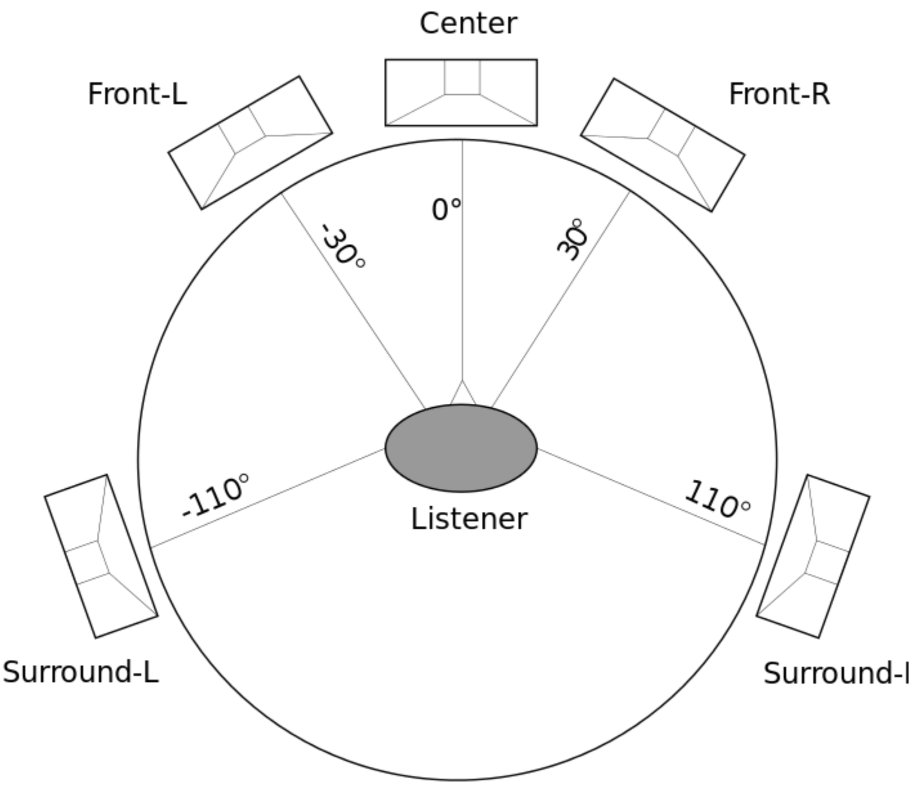

Figure 11 : 5.1 Audio Systems Angular Configuration

6.2 Novelty of the Invention / Improvement over Prior Arts:

All 5.1 Music systems suffer a serious flaw in their design what if the user is not located at the very center as expected. Then; in this case due to various speakers involved in music setup' end user end up listening distorted music/Audio. Because sound from different speakers take different time to reach end user which produces noise due to interferences of sound waves which were generated at the very same time; but reach at different time to end users ear drums.

2.1 Surround Sound Music System Setup

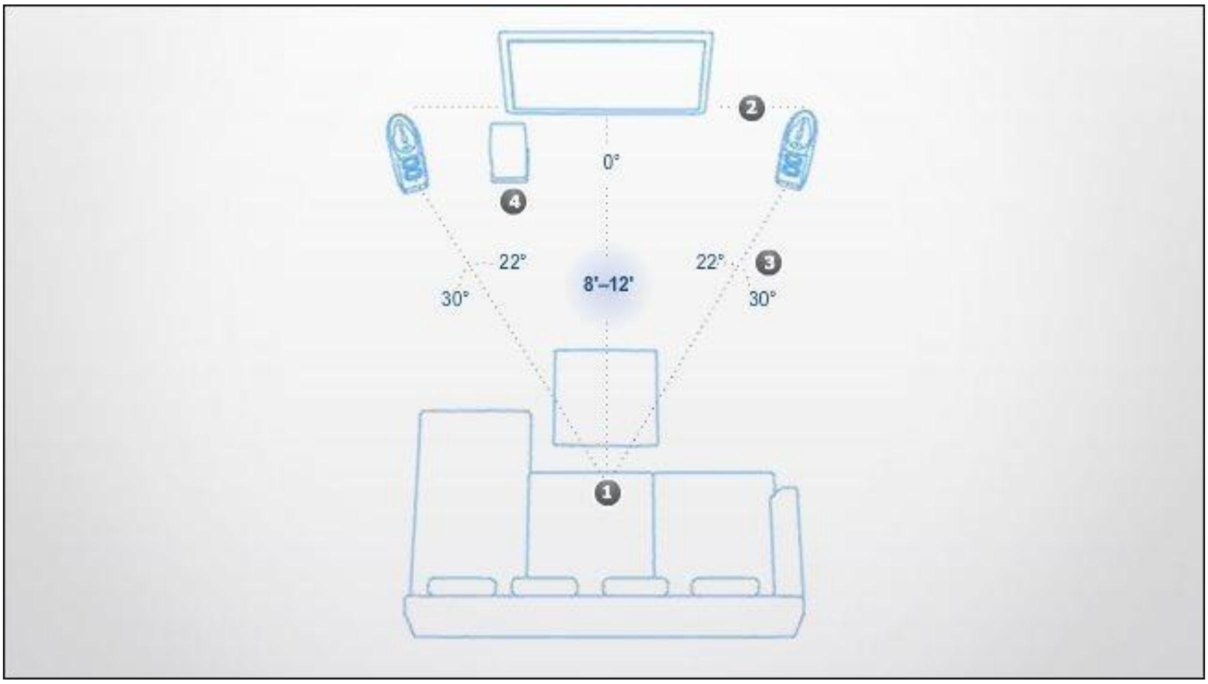

Figure 12 : 2.1 Audio Devices Normal Balanced Configuration

5.1 Surround Sound Music System Setup

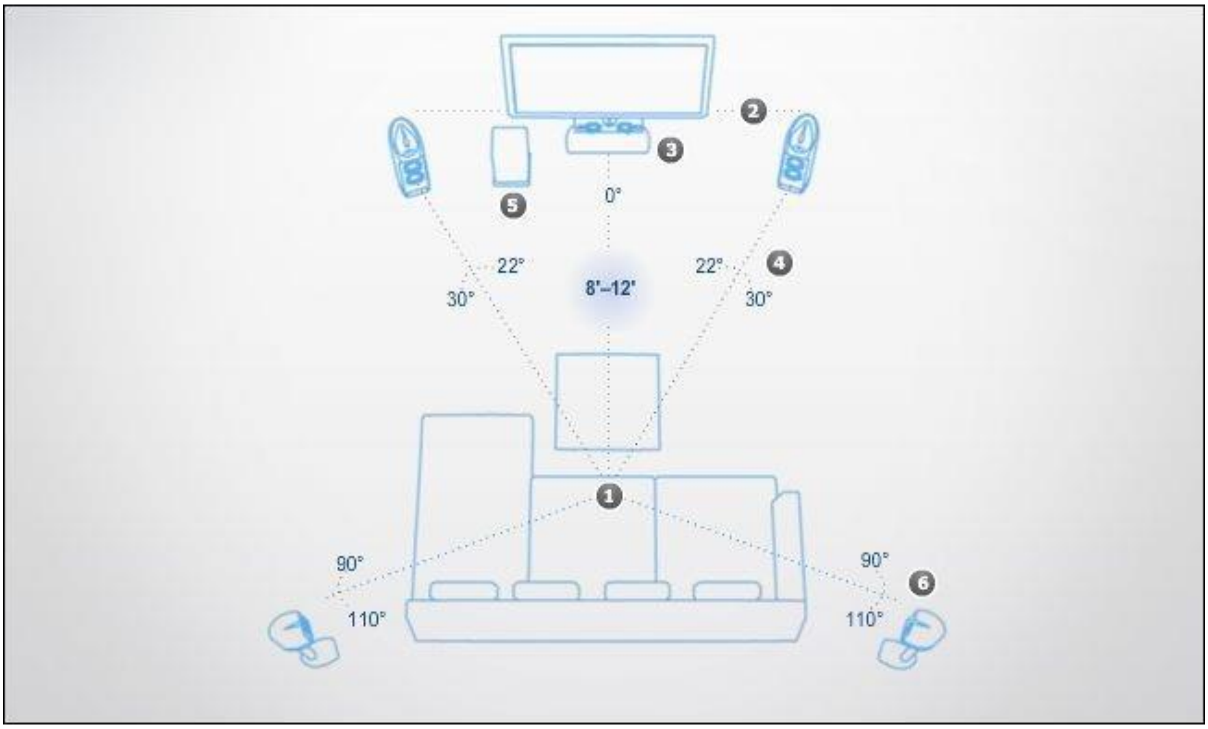

Figure 13 : 5.1 Audio Devices Normal Balanced Configuration

7.1 Surround Sound Music System Setup

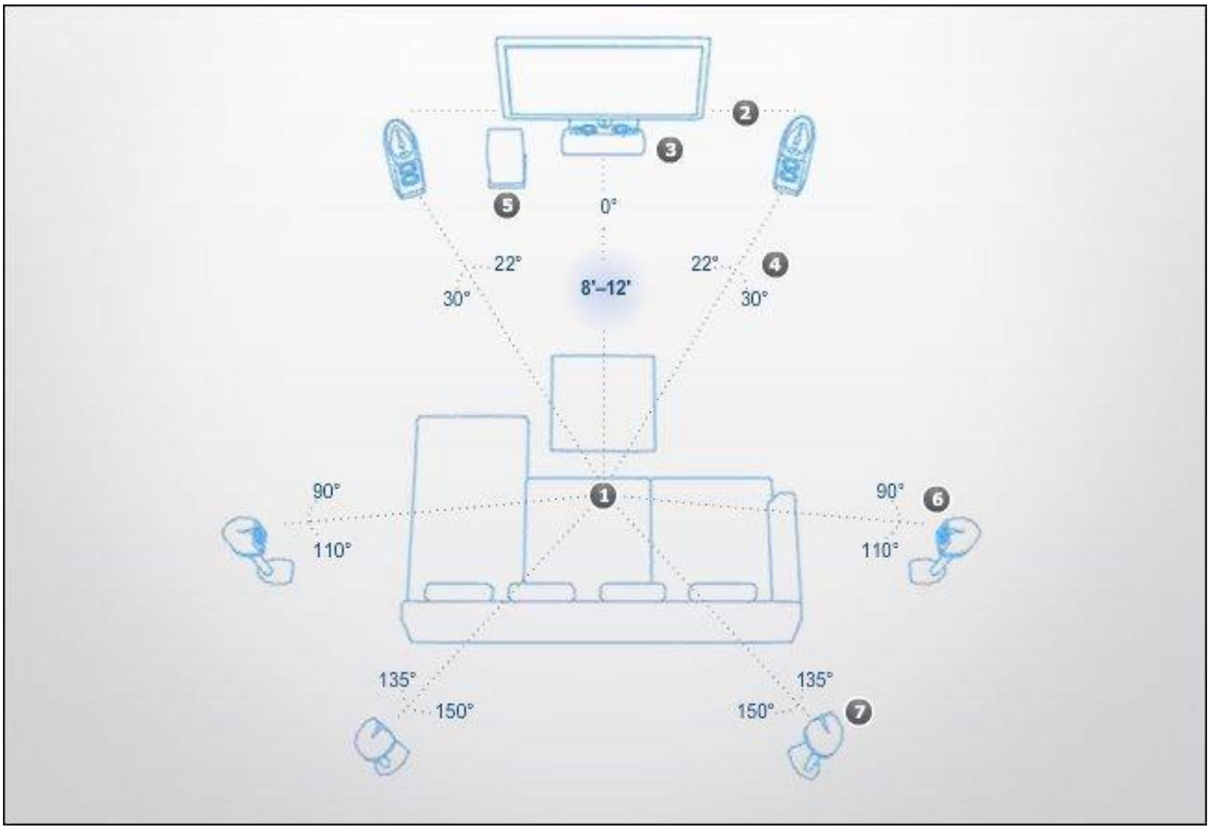

Figure 14 : 7.1 Audio Devices Normal Balanced Configuration

6.3 Automatic speaker calibration:

Receivers with this feature analyse and automatically adjust the sound of connected speakers. The receiver sends a series of test signals to each speaker in your surround sound system, and then measures the response with an included calibration microphone to optimize the speakers' volume level, time delay settings, and frequency response — making speaker setup easier and usually more accurate than manual methods. The most advanced auto calibration systems allow multiple measurements to be taken from different listening positions in the room to provide even greater sonic accuracy.

6.3.1 Prerequisite:

- Smart Television will have dedicated Smart Control (Bluetooth remote control). Smart control will have two specific hardware/software embedded units.
- Speaker Systems will have dedicated sound receivers at all the Woofers, Sub-Woofers, amplifiers and Speakers.

6.3.2 Recognition Path ➔

This path will be handled by usual voice recognition software technique.

UNIT-1) This functionality will be handled by dedicated voice recognition software embedded in Smart Control. Once Voice is recognised with pre-recorded command; then following action sequence will be initiated.

c) Smart Control will activate Smart Television for Speaker/Audio Alignment as per user locality.
d) Smart Control will initiate the sound waves as described below.

6.3.3 Locatable Path ➔

This Path will be handled as below mentioned Novelty of approach.

UNIT-2)

k) Smart control will pair up with Smart Television/ already paired.
l) Smart control will issue a command to Smart Television – START_CALIBRATION
m) Smart Television will respond CALIBRATION_STARTED
n) Smart control will have a dedicated sound emitter which will blast sound waves of > 20KHZ in room; which will not be recognizable to human wars because Human being ears can hear up to 20Hz-20KHz. Sound waves would be travelled as pulse train of specific frequency. Because to calculate the differences of received time.
o) All of the receivers will receive the sound waves emitted from Bluetooth remote.
p) Now; All the music system devices like Woofers, Sub-Woofers, Amplifiers and Speakers will calibrate according to the received sound pulses.
q) All the Speakers will collect the sound waves data and send it to Smart Television.
r) Smart Television will process the data; shift its own Audio clock if all speaker systems and connected with Smart Television dedicatedly.
s) If All Speaker Systems are connected via some single Audio Channel (Physical Channel like wire); Then exact amount of delay that needs to be produced at certain speaker which will let user to listen sound waves exactly at the same time; must be sent by some other means (Bluetooth in this case).
t) All this information must be collected by Bluetooth music systems and All subsystems must attenuate the Audio clocks or more precisely; they must induce some artificial time delay in it.
u) Smart Television will send CALIBRATION_COMPLETED to Smart Control and Smart Control will shut down its Sound Wave blaster.
v) So, at the end Smart Televisions Sound system will calibrate with each other as well as with users locality also. All the sound systems will calibrate their audio waves by inducing some latency/time lag/delay which will attenuate the sound waves that will reach the end user exactly at the same time.

Rotation of Smart Television is required on the basis of difference in timing of sound pulses received at both edges television.

Chapter 7: Experimental Evaluation

All the technologies expansions described above can be implemented in Smart televisions with divergence of cost in research and development. Above mentioned technologies described above will enhance the television viewing experience for end user. It will provide better display, better sound audibility, and better navigation between various channels and as well as it provides Smart Television a part where it can apply machine learning algorithms and approaches.

Chapter 8: Conclusion and Future Work

8.1 Conclusion

With the applicability of above mentioned technologies user will get more benefits over conventional Smart Televisions; end user will get better visual and audibility experience as compared to current scenario. Smart Television Industry will also get as opportunity to revive the consumerism which is now slowing down in industry because many of the technologies described in this thesis would not be possible only merely by software upgrade; since it requires new hardware changes which means that television manufactures have an edge to sell brand new hardware to customers which simply means more sales.

8.2 Scope for future work

Similarly, we can enhance these technologies more by inducing few changes between the technologies described above which are enhancing audio and video quality.

References

http://inventors.about.com/od/tstartinventions/a/Television.htm

https://sites.google.com/site/televisionandnewmedia/project-definition

http://en.wikipedia.org/wiki/History_of_television

scoop.intel.com/smart-tv-most-significant-change-tv-history/