Qualitative Research report about the User Experience of Smart TVs

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Abstract

Entertainment has expanded its boundaries to come up with best experiences for its users. Not only the size of Entertainment devices has had changed a lot, but the functionality also. With the introduction of Graphical User Interface (GUI), user friendly products are the new sensations of the era. The software engineers and designers have been trying to make user-friendly UIs for various computing devices, including smartphones, tablets, and computers. The modern smart TV also comes with built-in operating systems. However, little attention has been given to this prominent entertainment device, i.e., smart TV. The technological advancement and proliferation of smart TV enabled the manufacturer to provide rich functionalities and features; however, this richness resulted in more clutter and attention-demanding interfaces.

A new report published in Business Standard Article states that even a user base of more than 665 million homes worldwide owned a Smart TV by the end of 2020 (34 per cent of global households) which is set to rise to 51 per cent by 2026 when Smart TV ownership will reach 1.1 billion homes. Besides, smart TV is a lean-back supporting device having a diverse range of users. Therefore, smart TV's usability and user experience (UX) are questionable due to diverse user interests and limited features of traditional remote controls. This study aimed to discuss and critically analyze the features and functionalities of the existing well-known smart TV UIs of various operating systems in the context of usability, cognition, and UX.

This study draws attentions to the issues and challenges in the User imterface shortcomings of current smart TV's in the market. Also recommends some research opportunities to put emphasis on in order to better the UI of smart TV for a seamless user experience for customers.

This document also facilitates the further reports and highlights some of the overlooked factors affecting the UI & UX of Smart TV's. A subjective study supported by secondary research , unmoderated usability testing from diverse users is presented to validate the findings.

Introduction

Smart TV is a new AI based interface that works on two way human interaction it includes an open system and chip together with the application platform .Alongwith the older requirements of fully integrated audio, video and entertainment source, smart TV opens a wide range of watchable OTT platforms and other application of video content in addition to the older cable and Dishtv connection services.
TVs now are more interactive with loaded technical features to be operated on the basis of internet. These attractive features are easy and welcoming for younger genration but not all. Even sometimes tuning in to your favourite show is also a path through countless clicks on remote. These functions bring convenience for young people who are familiar with the Internet, while feelings of the old people are ignored. Faced with many uncommon functions and complex interfaces, intellectualization becomes the obstacle of other people and shake confidence of them using smart TV. As people have an increasing demand for the user interface, user-centered design is one of the trends of the interface design in recent years.

Comparison of the features of best TV operating systems

Operating Systems	Google Assistant	Voice Search	Content Recommendation	Screen Casting	Channel Customization	Smart Home
Roku TV	☑	☑	☑	☑	☑	☒
Android TV	☑	☑	☑	☑	☑	☒
Fire TV	☑	☑	☑	☑	☑	☑
Web0S	☑	☑	☑	☑	☑	☑
TizenOS	☑	☑	☑	☑	☑	☑

Android TV.

(https://www.android.com/tv/)

Google developed an Android operating system for smart TVs and was first announced in the annual conference of Google in June 2014 as the successor of Google TV. It is an opensource operating system based on the Linux kernel. It is developed to operate digital media players, set-top boxes, and smart TVs. Most brands, vendors, and companies use Android TV operating systems for smart TVs, set-top boxes, and Android TV sticks. According to the Statista Research Department report in 2018, Android was the world's leading smart TV operating system with a market share of about 40%. This Google's popular platform outperformed its closest competitor, i.e., Tizen by around 17% [19]. The operating system versions of Android TV are regularly updating, redesigning, and embedding the new features and functionalities to attract customers and market shares worldwide. However, these enrichments of features create usability and UX in the context of smart TV user interfaces. Besides, various vendors and companies are using Android TV operating systems.)is diversification of user interfaces can create the issue of usability and UX for the viewers. The latest version of the Android TV operating system is Android TV 10.)

WebOS

http://webostv.developer.lge.com/discover/discover-webos-tv/

The WebOS is developed by LG Electronics for smart TV, an open-source platform based on Linux kernel. Like the Android TV operating system, it is used by various vendors and companies for smart TVs, settop boxes, and dongles.)is operating system is especially well known for its speed; however, it is not easily customizable. It provides various services, features, and functionalities to the viewers depicted in Tables 1 and 2. With the advent of technological advancement, the parts and functionalities of WebOS are regularly updating, redesigning, and adding new features in the OS to attract viewers and gain high market value in the world.)erefore, these changes may create the issue of usability and UXs in the viewers. The latest version of the LG smart TV is WebOS TV 5.0.

Tizen

(https://www.tizen.org/)

The Tizen is an open-source operating system developed by Samsung and used mainly by Samsung's smart devices, including smart TV. It provides full-pledge support for native applications developed for smart devices. Like other smart TV operatingSamsung smart TV is Tizen 5.5 TV OS. , it is also used by various vendors and companies for the smart TV, set-top boxes, and dongles.)e Tizen OS also provides various services, features, and functionalities to the viewers depicted in Tables 1 and 2.)e latest version of the

tvOS

(https://developer.apple.com/tvos/)

The tvOS is an operating system that operates Apple TVs and digital media players developed by Apple. It is based on the iOS and adapts many similar features, technologies, concepts, and frameworks of the iOS. The initial generations of tvOS, including 2nd and 3rd, consist of several built-in applications but do not support third-party apps. The other generations of tvOS, including 4th and upward, support the capabilities of the third-party apps. Like other smart TV operating systems, it regularly updates, redesigns, and embeds new features and functionalities to the tvOS to maintain the business status and attract viewers.)e latest version of the tvOS 14 has adopted many parts of the iOS 14 operating system, such as picture-in-picture to third-party apps, HomeKit, redesigned the control center. The tvOS also provides various services, features, and functionalities to the viewers depicted in Table 1. The latest version of the Apple smart TV operating system is tvOS 14.

Roku TV

https://www.roku.com/

Roku TV OS. Roku OS is a smart operating TV developed by Roku. It is specially designed to work with smart TVs, digital media players, dongles, and soundbars.)e popularity of the Roku TV platform is increasingly growing in the USA. According to the statistics of Statista (https://www.statista.com/statistics/ 1021332/united-states-connected-tv-devices-market-share/), the streaming TV platform of the Roku Company in the first quarter of 2019 is about 30% of all connected TV device sales in the USA. In the first quarter of 2019, Roku reported close to 30 million monthly active users in the USA. The annual revenue of Roku was over 325 million US dollars in 2018. It is an open-source platform and is based on Linux operating system. In addition, it is also used by various vendors and companies for smart TVs, set-top boxes, and dongles. It provides multiple services, features, and functionalities to the viewers, depicted in Tables 1 .The features and functionalities of Roku OS are regularly updating, redesigning, and adding new features in the OS to attract viewers and gain high market value in the world. These changes may create the issue of usability and UXs in the viewers. The latest version of the Roku OS of smart TV is Roku OS 9.3

UX Xomparison of all the operating systems

Smart TV OS	Android TV	WebOS	Tizen	TVOS	RokuOS
Content organisation type	1. Horizontal view pane in cards. 2. List view (using cards) 3. Grid view (using cards)	1. Tile View(using cards) 2. List view (using cards) 3. Panel View	1. Tile view (using cards) 2. List View (using cards) 3. Panel View	1.Tile-Type view 2. List-Type view 3. Panel view	1. Tile type view. 2. List-Type view 3. Panel View
Main menu items on home screen	1. On/Off TV 2. Apps 3. Movies/TV shows 4. Watch next curated content list 5. Recommended content list 6. system setting 7. Universal search 8. Voice search via remote	1. Ribbon Menu (taskbar at bottom) 2. App Tiles(Scrolling right to left) 3. Preview area 4. Promotion Area 5. Background setting menu 6. system apps 7. Voice search via remote 8. Universal search	1. Smart hub (taskbar at bottom) 2. App tiles (Scrolling right to left) 3. Preview area. 4. Recent and fetaured 5. System setting menu 6. App menu 7. Input selection menu 8. Voice search remote 9. Universal search	1. Preview Area 2. System setting 3. App list/ row(scrolling right to left and upto down) 4. Apple TV 5. iTunes 6. Control centre 7. Apple arcade 8. Memories 9. Voice search via remote 10. Universal search	1. Vertical menu (scrolling upto down) 2. App list 3. My feed 4. Movies store 5. TV store 6. Universal search 7. Voice search via remote 8. Streaming channels 9. Setting 10. Option
Development platform	Yes	Yes	Yes	Yes	Yes
Peripheral Device Support	Yes	Yes	Yes	Yes	Yes
Display Quality	4k	4k	4k	4k	4k
Open API Support	Yes	Yes	Yes	No	Yes
App Store	Google play store	Lg content store	Samsung app store	Apple app store	Roku app store
UI Type	1. Tile-type view (using cards) 2. List-type view (using cards) 3. Panel-type view	1. Tile-type view (using cards) 2. List-type view (using cards) 3. Dock-type view 4. Panel-type view	1. Tile-type view 2. List-type view 3. Panel-type view	1. Tile-type view 2. List-type view 3. Panel-type view	1. Tile-type view 2. List-type view 3. Panel-type view
Logs/history	Yes	Yes	Yes	Yes	Yes
Adaptive UI support	No	No	No	No	No
UI personalization and customization support	Static and limited UI customization	Static and limited UI customization	Static and limited UI customization	Static and limited UI customization	Static and limited UI customization

Usability Issues in Smart TV UIs

User Interface Issues.

- Companies **developing various user interfaces for smart TVs adds new features and advanced functionalities** to the smart TV to attract customers and gain a high market share worldwide
- **Creating the issue of usability** and UX, **makes the user interface complex and cluttered which makes users unable to use all the features and functions.**
-

Visual Experience Issues:

- There are Smart TVs with different sizes, user interfaces, and display resolutions.The viewing distance, viewing angle, viewing environment (living room, dining hall, room color), and viewing height, brightness, and background color of each smart TV are different from one another. **These factors can cause various UI issues for viewers .The viewing distance of each viewer varies from one another.**
- Each family member has different preferences and characteristics, such as education level, skills, personality, and age. For example, the features and preferences of children vary from adolescence and aged persons. Besides, each age group member may have distinct attributes and preferences. For example, **some individuals may enjoy the smart TV from a standard distance, and some may have problems (such as senior citizens with low vision). Similarly, some of them are interested in large font styles, large icons, and the brightness of the screen; the others may not.**
- The room lighting can affect smart TV viewing quality, such as reading, watching, interaction, usability, UX, and learnability. Besides, **other factors such as room color and darkness can cause viewing and interactivity problems . These parameters can also create eyesight problems such as eyestrain and headaches**

Searching Issues.

- Smart TV provides various contents from various data sources to the viewers, such as on-demand video, live channels, video and audio, social networking, browsing, gaming, and Web 2.0 features.
- Most **viewers can interact with smart TV by a remote control that makes interaction complex.**
- All viewers do not have the same skills, knowledge, learnability, and capabilities to interact with a smart TV.
- Although the electronic program guide (EPGS) may facilitate the viewers to search the programs and channels, however, **increasing channels and programs can create searching difficulties on EPGs.**
- Each brand's UI structure and layout are different, **creating usability, UX, learnability, interactivity, and accessibility issue in the viewers**

Channel Switching Issues.

- In contrast to legacy TV, channel searching, switching, and retrieving applications in smart TV are not an easy task. **The switching and searching Scientific Programming of a channel are easy tasks in traditional TV.**
- A smart TV has a complex and clutter UI, and many channel switching options and retrieving applications create problems for the viewers.
- Smart TV supports different interactivity devices such as remote control, mini-keyboard, mouse, gesture, and voice assistant, but the most remote control is the primary interaction device.
- Households with a diverse range of users, including kids, technical and nontechnical, house views, senior citizens, and disability viewers, may struggle to retrieve the desired channel in apps.

Browsing and Scrolling Issues.

- **The browsing of smart TV browsers is a complex task** by interacting with remote control and keyboard/mouse due to the clutter UI and interactivity devices.
- A survey showed that only **one of four viewers had used smart TV to browse the online content.** Another report showed that most people using a smart TV are an entertainment device for watching video, movie, live channel, and playing games on a big screen.
- Simultaneously, other functionalities such as social networking, shopping, and maps are rare activities.
- Browsing in the smart TV browser is a complex task, among other tasks. Each individual's characteristics are different, and the UI of smart is complex,
- **Another issue with a smart TV is the system setting**. Smart TV is accessed and watched from 10 feet distance through remote control. The setting of apps or systems or another device configuration is **cumbersome for the users in smart TV environments due to clutter user interface, interaction devices, long viewing distance, etc.**
- Due to the watching distance and complex UI of the smart TV, viewers may not perform operations and process as much information on smart TV as they would perform on smartphones or tablets, or computers. The viewing distance and complex user interface have created these types of problems.

Interaction Device Issue.

- The conventional remote controls (RCs) have many keys on a small handset to cause three problems. First, **keys are generally minor, with the limited size of the handset. Most people have difficulty finding and clicking the correct tickets**.
- Second, **the functional information of the keys is overloaded and difficult to remember for the users.** Additionally, roughly grouped keys make the problem even worse.
- Third, a **high risk of mode error exists**. For example, suppose a user mistakenly presses a function key to alter the video source. In that case, they are automatically redirected from the current workflow to another unknown interface without clarification as to how or why this happened.
- Also it is **difficult to switch between different RCs in multimedia home platforms with multiple RCs** when inconsistent and incompatible .
- Fourthly, it is **complicated to map between input devices and screen design.**

Research Study Plan

Objective

Background:

These days smart televisions are on boom. People prefer watching OTT platforms on the tv. Although there are remotes which have alphanumeric keypad, voice control and short cut keys still typing and searching is not a seemless experience there. How might we make this TV viewing experience seamless .

Research Goals :

1. Understand the UX/UI of the range of smart TVs available
2. And how do users interact with them
3. Factors that make TV watching experience less cumbersome for users.

Participants

Participants must be smart TV users who watches OTT platorms on TV.

6 users in total

- One male & female from age group 40-60
- One male & female from age group 20-40
- One teenage user
- One user who uses assistant features, like voice assistant and screen reader

Research Questions

1. Who uses TV the most in the family and why ?
2. What do they watch it most for?
3. How is remote control experience?
4. Which features do they use most?
5. What are the difficulties they face in operating TV?

Methodology

Zoom call interview

Questions will be asked and the session was recorded so that to rewatch it later and make notes.

Unmoderated Usability Study

An unmoderated usability study is where respondents are not guided by a moderator. The test is prepared beforehand, and respondents complete it on their own. With an unmoderated usability study, all you have to do is to prepare the study and recruit people to complete it. The advantage of this study is that the number of participants is unlimited.

Script

During the unmoderated usability study
A list of prompts appears on the device screen
Prompt 1: turn on the TV and select a OTT Platform
Prompt 2: Type Search something to watch in it.
Prompt 2 follow-up: How do you feel about this searching technique? Can you do this by Voice search? Which one you find better and why?
Prompt 3: Let's say you want to apply/change the subtitles for it, how will you do it?
Prompt 3 follow-up: Was this particular feature or functionality useful? Why or why not? What was easy and what was challenging?
Prompt 4: Do you use these like/dislike icons ?
Prompt 4 follow-up: What do you think what they are for? Do you categorize things in your favourites and rewatch them?

After the unmoderated usability study
Participants will complete the System Usability Scale
Participants will score the following ten statements by selecting one of five responses that range from "Strongly Disagree" to "Strongly Agree."
I think that I would use this feature frequently.
I find the feature unnecessarily complex.
I think the feature is easy to use.
I need the support of a technical person in order to use this feature.
I find the various functions in this feature to be well integrated.
I think there is inconsistency in this feature.
I imagine that most people would learn to use this feature quickly.
I feel confident using the feature.
I need to learn a lot of things before I can use this feature.

Persona Mapping and interview Analysis

I took interviews and did unmoderated usability study on how they perform the tasks given in the prompts for having a better understanding of their user experience. The users have samsung TV(Tizen OS), Panasonic TV (FiretV OS), and LG TV (WebOS)

Avinash
37 years old
Engineer

Education : Btech
Lifestyle : WFH, family lover, lives simple
Behavioral Habit : Web series, News, Youtube for her daughter

User Goal
- Some settings for kid's eye
- Advanced remote settings.

Difficulty
- The operation interface is tough
- Finds difficult to operate if someone else's TV
- he watches rarely because of work and hence finds it difficult

Roshni
30 years
Housewife

Education : M.com
Lifestyle : Doing home chores, dance class, meetng people, parties
Behavioral Habit : Web series, Old movies, Binge watcher

User Goal
- Looking for less cluttered version
- More educational programmes for kid

Difficulty
- Pressing remote keys for scrolling is irritating.
- Hard to map into remote and TV with a kid.
- Voice input is not obvious

Satya Singh
26 years
Engineer

Education : Btech
Lifestyle : WFH, Fitness freak, leisure time.
Behavioral Habit : Web series, Hollywood movies, latest releases, Matches

User Goal
- easy interface so that elders in home can operate themselves, so that they need not to wait for him to come from office and operate it.

Difficulty
- if i want to switch from prime to netflix, there are many clicks to go back and select netflix from home.
- ott buttons might be added in remote

Vineeta Singh
42 years old
Housewife

Education : Graduate
Lifestyle : Housewife, Social Butterfly, Cooking lover
Behavioral Habit : Web series, TV serials, Reality shows.

User Goal
- Hardships in mapping remote buttons with screen must be lessen

Difficulty
- Finds it difficult to type search things from distance
- Her hindi diction turns her voice search into some another words

Jagjahir singh
88 yrs old
Retired

Education : M.A
Lifestyle : Can't move much, family time, People gather to meet him.
Behavioral Habit : Holy preaches, News , Matches

User Goal
- Proper tutorial and if he can put his best shows on the speed dial system as it works on phone.

Difficulty
- Totally dependent on other people to turn on the show he wants to watch.
- He needs to wait until anyone is around.

Shambhavi
13 years old
Student

Education : 9th
Lifestyle : Schoolwork, Playtime, Dance reels
Behavioral Habit : Web series, News, Movies, Listening trendy songs

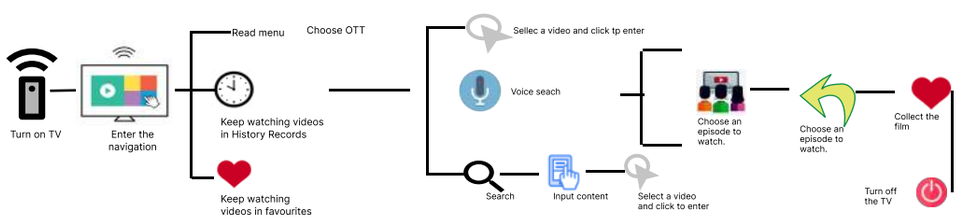
User Goal
- Interface with lesser clicks.
- Better voice input.
- Less cluttered screen.

Difficulty
- Video selection feedback is confusing as the whole screen is full of colours.

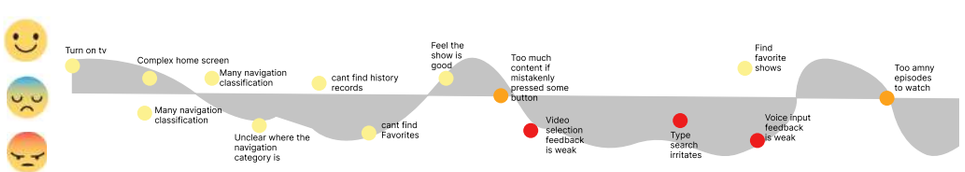
User Needs

- Find Videos efficiently and get more details
- Search for videos quickly and effeciently
- Estimate the quality of film
- Find the films collection accurately
- Find the hisory and continue watching
- Reduce the chance to press the wrong buttons
- Collect films
- Categorize content watchable for children
- Efficient voice input recognition

Behavior



Emotional experience



Stage	Turn on the TV	Read the content	Choose the video	Watch the video	Turn off TV

Key Findings of Research

1. Many levels, the home page is on the second level.
2. Navigation menu has too many categories
3. Content switch of navigation menu is out of sync
4. There are too many features of liking disliking or reporting content which they rarely use.
5. When entering the video content selection, the navigation category is not clear enough.
6. The icon of History Records is not obvious.
7. hard to Accurately find the icon of favourites.
8. 8. Too much video content
9. 9. Uncleared Video description
10. 10. Complicated and hard to comprehend search keyboard
11. 11. Unobvious Voice input feedback .
12. 12. No back reminder when playing video in full screen
13. 13. The icon of add to favourites is not obvious.

Pains

1. Simplified information architecture
2. Simplified navigation menu; personalised navigation menu; circular navigation menu
3. Enhance the interaction of content selection; optimize the distribution of content modues; add the sound feedback when the button is pressed
4. Highlight the favourites record mobile
5. Highlight voice input feedback, using dynamic acoustic display
6. Add the switching function of alphanumeric keyboard and numeric keyboard ; add an operation prompt.

Opportunites

Results

The results of the subjective study are presented in the subsections.

Smart TV's Operating System Type.

The research show that the Android operating system is dominant among all. However, this depends on the region and price of smart TVs. Although the operating system based smart TV creates interactions, learnability, and cognitive overload, the future is operating system. However, the smart TV needs a more robust operating system than existing operating systems.

Watching Behavior.

TV is enjoyed for watching videos and live channels. For most other tasks, most people use their smartphones. We asked about the watching behavior by asking about the favorite channel type. We received diverse kinds of channels. Although the answer to this question depends on individual interests, we observed that live channels and web series are the primary watching activity on the smart TV.
It should be noted that young people and kids who received a better response in terms of learnability are better than senior citizens. I observed and interviewed for the completion of a task, and found elders hesitate to use it mostly and are dependent on others to operate and turn it on. Other people have jsut learnt the basic route and do not feel a need to explore other features.

Primary Communication Device with Smart TVs.

Besides, a few viewers (5%) use the app for communication with smart TV; still, the primary device is the common remote control. The communication on the remote control is quite complex This indicates that the interaction difficulties remain unresolved. The brand-dependent remote controls further create issues in making a standard interaction device for smart TVs. This further shows that besides many smartphones' app-based remote control, the universal communication device is still remote control.

NavigationComplexity.

The analysis show that navigating among channels and content is complex. The viewers rate 4.8 (average) of 5 difficulty levels. These difficulties are remote control, complex interface, too many, and irrelevant apps. The difficulty is also due to the clutter interfaces of smart TV. About 5/6 of respondents showed that smart TV interfaces are complex.

Inter-App Navigational Complexities.

Navigational complexities are among the major challenges for smart TV viewers. The results showed that inter-app navigational complexity is high. We received 4.3 (average) of 5 rates. This figure is high, especially for the low-level experience of smart TV users. The learnability may be increased after some time, but initially, the user faces difficulties searching the desired content on the smart TV.

Recommendations

- Switching between apps when already watching something else should be easier. Lesser click-through will help
- If remotes can be customized with OTT and Primary app buttons, so rather scrolling left to right on screen , it will be just one click access by direct pressing the desired button on remote.
- Digitalized remote should be promoted rather than using remote apps, as many of people might be wanting to use remote and phone at the same time.
- Also elder people might find the remote to screen mapping easy if selection or typing feedback is given on remote.

REFERENCES

https://www.researchgate.net/publication/350992270_Automatic_Symbol_Resolution_on_Embedded_Platforms_by_the_Example_of_Smart_TV_Device/fulltext/609a61b6458515d3150fa4a6/Automatic-Symbol-Resolution-on-Embedded-Platforms-by-the-Example-of-Smart-TV-Device.pdf?origin=homeFeed_download&_iepl%5BactivityId%5D=1477957084397577&_iepl%5BactivityTimestamp%5D=1646813628&_iepl%5BactivityType%5D=person_add_bookmark_publication&_iepl%5Bcontexts%5D%5B0%5D=homeFeed&_iepl%5BrecommendationActualVariant%5D=&_iepl%5BrecommendationDomain%5D=&_iepl%5BrecommendationScore%5D=&_iepl%5BrecommendationTargetActivityCombination%5D=&_iepl%5BrecommendationType%5D=&_iepl%5BfeedVisitIdentifier%5D=&_iepl%5BpositionInFeed%5D=5&_iepl%5BsingleItemViewId%5D=c8XVxIdcg17ucLsumyoJ89tb&_iepl%5BviewId%5D=kmAbXPm2XuKBRI51qg0jlKsg&_iepl%5BhomeFeedVariantCode%5D=nu&_iepl%5B__typename%5D=HomeFeedTrackingPayload&_iepl%5BinteractionType%5D=publicationDownload&_iepl%5BtargetEntityId%5D=PB%3A350992270 - Accessed on 21/04/2022

https://www.researchgate.net/profile/Ana-Grasielle-Correa/publication/269268570_Usability_inspection_of_a_smart_TV/links/55a6d47208aeb4e8e646c60e/Usability-inspection-of-a-smart-TV.pdf?origin=searchReact&_iepl%5BgeneralViewId%5D=qLqzqQuGvSXdLIhrs0psDkyd35EXZ3qzq3MV&_iepl%5Bcontexts%5D%5B0%5D=searchReact&_iepl%5BviewId%5D=QIH1jQtnqacPDO4ShQFqZxcmLd2pUSk339VV&_iepl%5BsearchType%5D=publication&_iepl%5Bdata%5D%5BcountLessEqual20%5D=1&_iepl%5Bdata%5D%5BinteractedWithPosition20plus%5D=1&_iepl%5Bdata%5D%5BwithoutEnrichment%5D=1&_iepl%5Bposition%5D=43&_iepl%5BrqKey%5D=PB%3A269268570&_iepl%5BinteractionType%5D=publicationDownload - Accessed on 22/04/2022

https://www.researchgate.net/profile/Seyeon-Lee-4/publication/284513485_My_Smart_TV_Agent_Designing_Smart_TV_Persona_for_Linguistic_UX/links/56546c6808aefe619b19e34d/My-Smart-TV-Agent-Designing-Smart-TV-Persona-for-Linguistic-UX.pdf?origin=searchReact&_iepl%5BgeneralViewId%5D=qLqzqQuGvSXdLIhrs0psDkyd35EXZ3qzq3MV&_iepl%5Bcontexts%5D%5B0%5D=searchReact&_iepl%5BviewId%5D=QIH1jQtnqacPDO4ShQFqZxcmLd2pUSk339VV&_iepl%5BsearchType%5D=publication&_iepl%5Bdata%5D%5BcountLessEqual20%5D=1&_iepl%5Bdata%5D%5BinteractedWithPosition20plus%5D=1&_iepl%5Bdata%5D%5BwithoutEnrichment%5D=1&_iepl%5Bposition%5D=27&_iepl%5BrqKey%5D=PB%3A284513485&_iepl%5BinteractionType%5D=publicationDownload - Accessed on 22/04/22

https://www.makeuseof.com/tag/best-smart-tv-operating-system/ - accessed on 25/04/2022

https://www.statista.com/topics/4761/smart-and-connected-tvs/ - accessed on 25/04/2022