Exploring the ability of Virtual Set Systems in helping Small Broadcasters entering the Digital Television scene: Addressing the Technical, Licensing, and Operational Challenges of Fatwa TV

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Abstract. In 2022, Indonesia migrated its television broadcasts system to digital, opening up opportunities for new players to enter public television scenery. This study explores the use of Unreal gaming engine-powered Virtual Set systems for small broadcasters. The results show that they can use it to produce television shows that meet recent broadcast standards. The methodology used was case study of Fatwa TV, a small broadcaster, using observations and interviews. The results show that aside from technical matters, two other key concerns must be resolved before these broadcasters may enter the digital television broadcasting industry: licensing and operational issues, which could come at a large cost, especially for broadcasters who are not dependent on advertising. Streamlining should be included in the licensing and multiplexing procedures, and broadcasters should be encouraged to accept advertising to ease their entry into the digital broadcasting market, even if it means sacrificing some of their independence.

Keywords: Virtual Set, Unreal Engine, Television Production, Digital Television Broadcast, Small Broadcasters

1   Background

One of the most popular information media outlets in Indonesia is the TV network. TV users or viewers in Indonesia are even more evenly dispersed than other information channels like the internet and landline telephone [1]. According to statistics from the Academic Business Enterprise (BUA), Universitas Brawijaya, Indonesia, there are approximately 1 TV sets in every household, or 60 million TV sets in Indonesia, which has an adult population of about 270 million [2][3].

1.1   Virtual Sets in Broadcasting

Virtual Sets is a technology that allow talent or actors to interact with environments or objects which are generated by the computer in real time. This leads to a new generation of programmes and films which are produced with lower cost.

The talents or actors stand in front of a plain blue or green screen background employing the classic "chromakey" special effects. To capture all motions in the scene, the camera is fitted with various sensors to record its movements: the zooms, tilts, pans, rolls, and tracks. The background would then be replaced with a pre-recorded scene, which moves in sync with camera movements.

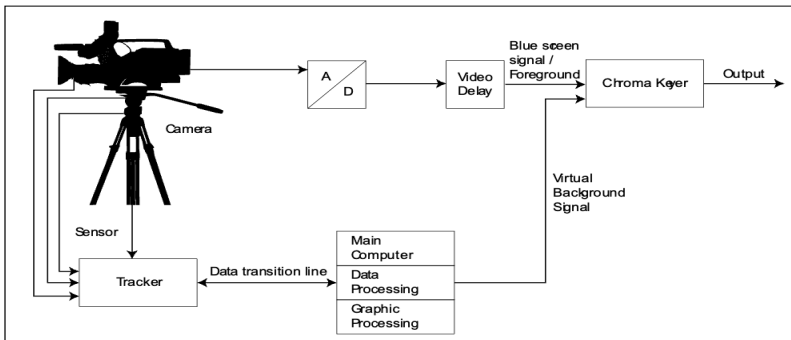**Fig. 1.** One example of Virtual Set use. [4]

Fig. 2. Typical Block Diagram of a Virtual Set System

A few benefits of the Virtual Sets include:

1. Easy customization; as each scene is made up of layers and is compatible with almost any image manipulation program, making it simple for a graphics designer to create new creations or modify existing ones.
2. Flexibility; all of the Virtual Sets' layers are completely compatible with all of the top graphics and editing programs.

3. Compatibility; every Virtual Sets system comes with an image manipulation program as standard equipment. Because the layers in the program are compatible with the Virtual Set Editor, organization of the layers is simple.
4. Low cost, because the majority of production operations are carried out by computer sets, the Virtual Set application's low cost can lower program production costs by reducing the need for production devices and tools.
5. Reduction of the production staff; the majority of production tasks are now completed by computers, which eliminates the need for manual labor [5].

According to Huang & Chang (2016), in their research on the impact of Virtual Sets on Taiwanese television production, Virtual Sets have had a significant impact on TV broadcasters who are fascinated by television technology and its potential to support television production [6].

There were not many research that explains the relation between the use of Virtual Sets and television viewership or television viewing experience. However, according to Lin Sun (2022), the use of Digital Media Art and Special Effects in Television can bring better viewing effects, strengthen the perception of the viewers, and creating interesting and strong sense of immersion for them [7].

1.2   Using Unreal Engine to Create a Virtual Set System

Unreal Engine, first developed by Epic Games in 1995, is one of the most commonly used open-source game engine [8]. The Unreal Engine has found use in television and film industry to build virtual sets that can track a talent or item as the camera moves around them and be rendered in real time. This makes it possible to compose shots in real-time, edit virtual sets right away as needed, and shoot different scenes quickly by simply switching the virtual setting behind the actors. It was noted that the entire appearance seemed more authentic than normal chromakey effects.

Similar to developing a gaming asset, creating assets for a virtual set entail combining art and 3D modeling software like Photoshop and Substance Painter as well as 3D modeling applications like Maya, Blender, and zBrush to create props and set pieces for the virtual world. The scene can then be organized and finished using the Unreal game engine.

Once the virtual world has been created, the camera tracking system of Unreal can be used to configure the virtual camera within it to sync with the actual camera. This ensures that the camera's perspective matches the perspective of the environment being viewed, creating a realistic-looking scenes [9].

1.3   Digital Television Broadcasting

Indonesia terrestrial TV transmission's transition to digital TV media in 2022 [10] will transform television into a digital transport technology that can handle heavier content loads in the future. Budiarto et al. (2007) asserted that the adoption of digital TV broadcasting technology is more focused on digital signals from the transmitters, so that the

viewers' TV set that is on the viewer simply needs to be equipped with a set-top box device to receive digital TV signals.

In terms of service, the digital TV broadcasting system is capable of improving broadcast quality, as well as providing viewers with more program options and enabling convergence with various media such as the internet, cell phone media, and PDAs (See Fig. 3) [1].
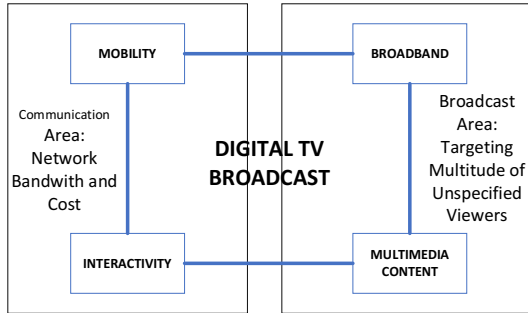

Fig. 3. Service Convergence in Communication and Broadcasting Areas [1]

The digital transmission system that was chosen by Indonesia is called DVB-T2 or Digital Video Broadcasting – 2nd Generation Terrestrial. It is a European standard released in 2009. Also, The DVB-T2 standard has several new technologies not available in the previous standard, the DVB-T, which allow DVB-T2 to offer much higher data rate then DVB-T [11]. In Colombia, in 2015, DVB-T2 expanded the national covered population by 7.3%, provided 70.2% more transmission capacity, or increased the size of the SFN (Single Frequency Network) by 135% while maintaining total power transmission and the geographic distribution of the transmitters, compared to the original DVB-T architecture [12].

Furthermore, the DVB-T2 still maintain compatibility with the H.264 compression format and MPEG-2 transport format [13]. The H.264, the widely used video compression, developed by The International Telecommunication Union (ITU) and Moving Pictures Expert Group (MPEG) is capable of a wide range of tasks with great performance, including videoconferencing, streaming, and sending videos across wired and wireless networks using various transport protocols [14][15]. Additionally, the majority of consumer gadgets, including DVD players, digital satellite receivers, and TVs, use the MPEG-2 standard for video coding today [16]. Video was also increasingly be available for viewing on smaller devices like mobile phones and tablets in addition to traditional televisions, enabling greater mobility [17].

By allowing the licensing of new terrestrial channels and/or new participants, the adoption of a multiplexing policy in the regulation of digital television transmission has the potential to increase the diversity of television programming and diversity of ownership in commercial television. Australia and Finland have both recorded observations of this occurrence. Indonesia also adopts similar licensing and multiplexing policy [18].

Furthermore, in Australia, the introduction of Digital Television has enabled a bigger variety of programs and services, which has provided consumers with more motivation to purchase digital reception equipment than high-resolution picture quality does [19].

1.4   About Fatwa TV

Fatwa TV is a broadcasting organization founded on 2018, which focuses on Islamic preaching broadcasts from religious leaders. They have television production facilities in the cities of Jakarta, Solo, and Jember. They currently operate on Youtube (https://www.youtube.com/c/FatwaTVOfficial),   Facebook   (https://www.facebook.com/FATWA-TV-360867914500145),   and   Instagram   (https://www.instagram.com/fatwatv/) and have hundreds of individual productions.

1.5   Necessity of the Study

This study is deemed necessary considering the changes in the terrestrial television broadcasting system in Indonesia, which have been proven in other countries to make television broadcasts more diverse.

1.6   Question of the Study

The question of this study is, is the ease in making television broadcasts with good appearance, provided by Virtual Set, enough to encourage the emergence of new players in the television industry?

2   Theoretical Review

This study tries to review the adoption of the Virtual Set technology using three Communication Theories.

2.1   Uses and Gratification Theory

This theory, proposed by Katz, Blumler, and Gurevitch (1973) holds that people will choose which media to use and when since they are rational beings with choices and free will, and people watch television in order to gratify particular wants or desires [20]. To give viewers a more immersive and aesthetically compelling viewing experience that can satiate their desire for pleasure and engagement, Virtual Sets are employed in television production.

   To fulfill the audience's desire for knowledge or comprehension, Virtual Sets can also be utilized to impart instruction or information. Virtual sets can also be employed to provide the audience a sense of "being there," which can satiate their need for social contact or a sense of belonging.

   In general, the Uses and Gratifications theory, which contends that individuals use media to satisfy particular needs and desires, can be used to describe Virtual Sets' use in television production.

2.2   Media Richness Theory

According to the Media Richness Theory, which was proposed by Lengel & Daft (1988), the level of richness of the communication medium is what determines how successful a message is [20].

Table 1. Media Richness [20]

Richer Media	**Face-to-face**
	Video conferencing, social networking, interactive websites
	Telephone
	E-mail
	Texting, instant messaging, microblogs
	Video or audio recordings
	Memos, letters
Leaner Media	Bulk mail, brochures, pamphlets, flyers

Virtual Sets can be used in television production to give viewers a more immersive and aesthetically appealing experience, which adds to the depth of the communication medium. This can be particularly crucial for some programming types, like newscasts or sporting events, when it's crucial to create a sense of immediacy and realism.

Virtual sets can also offer a sense of presence, or the sensation of being in the same physical location as the performers or presenters, increasing the depth of the communication experience.

2.3   Diffusion of Innovation Theory

According to this hypothesis, proposed by Rogers (2003) innovations gradually propagate throughout a social system [20].

Virtual sets can be viewed as a television production innovation that is being utilized by an increasing number of producers and broadcasters. Virtual sets are anticipated to grow in popularity and become more widespread as their advantages are more widely understood.

The complexity of the technology, the expense of implementation, and the perceived advantages of adopting virtual sets over regular sets can all have an impact on the adoption of virtual sets.

Virtual sets are an innovation that is gradually becoming more prevalent in television production, which can be explained by the Diffusion of Innovation theory.

This theory can also explain the application of terrestrial digital television technology in Indonesia. In analog broadcasting, one broadcast frequency is used for only one television, which cannot meet the demand for television channels. Meanwhile, with digital broadcasting, one broadcast frequency can be used for a maximum of 12 TV stations, while the remaining bandwidth can be diverted to meet digital needs for increasing public internet access, for e-commerce, startups, and others [21].

3   Methodology

This research uses a descriptive qualitative approach with a case study method. Data from research sources is presented as descriptions in the form of words and images (Subandi in Andari, 2020) [22][23][24]. To analyze issues and difficulties in a phenomenon and provide "how" and "why" answers, the case study approach is used (Prihatsanti in Kamilia, 2020) [25][26].

3.1   Data Collection Technique

The case studied is Fatwa TV, a commercial-free Islamic Religious Television Channel which uses the PW Virtual Studio Virtual Set system. The research data collection technique was carried out using observation and in-depth interviews. The observations were done on-site at Fatwa TV's Jakarta studio and by examining their Youtube and Facebook channels. Observations were made by directly inspecting the architecture and operation of the PW Virtual Production 2.5.

In the process of examining the results of observations, interviews were conducted with three expert parties: Nurman Yusuf, the Vice Director of Fatwa TV (Source 1); Edi Purwanto, the Director of PT Era Mandiri Indojaya (Source 2); and Denny Hariadi, a University Lecturer and former broadcaster (Source 3).

The researcher interviewed Mr. Nurman Yusuf in May 2023, who is both the system developer and Vice-Director of Fatwa TV, the primary operator of the PW Virtual Studio Virtual Set System, to gain comprehensive insights into the system. These interviews explored the architecture, operation, advantages, and disadvantages of the PW Virtual Production 2.5. Additionally, visual data from photos and videos of the PW Virtual Production 2.5 in action were used to complement the gathered information from observations and interviews.

The researcher also interviewed Mr. Edi Purwanto, the Director of PT. Era Mandiri Indojaya, a company specializing in technical aspects of television broadcasting, as well as Mr. Denny Hariadi, a lecturer and former broadcaster with expertise in licensing and multiplexing of digital TV channels, as additional sources of information.

3.2   Data Analysis

The information gathered through observations, interviews, and documentation was then examined qualitatively. Below is the table categorizing the interviews.

Table 2. Interview Sources

Interview Excerpts	Code	Fact Summarization	Interpretation
Source 1:	1	Fatwa TV signal output is	Fatwa TV is technically prepared for Digital TV Broadcast,

Interview Excerpts	Code	Fact Summarization	Interpretation
∞ We have output signals ready to code into current Indonesia digital television standard, which is MPEG4. ∞ The process of Digital TV licensing and operational is too cumbersome not to mention we need to do it three times for each station, and currently we have no such plan in the horizon. Currently we focus on improving our productions and maintaining our existing channel in Youtube and Facebook.		digital-ready (1a) Licensing is a cumbersome process (1b)	but is not ready in the terms of licensing and operational needs.
Source 2: ∞ Fatwa TV is already digital. ∞ If Fatwa TV were to go through the process of entering the digital broadcasting environment, they would need to find the financial resources to go through the licensing process, which is complicated and very costly. ∞ The cost of broadcasting digital operational can be very expensive, dependent on each multiplexer rights owner.	2	Fatwa TV is already digital (2a) Licensing process is complicated and costly (2b) Digital TV broadcasting operational cost can be very expensive (2c)	Fatwa TV is technically prepared for Digital TV Broadcast, but is not ready in the terms of licensing and operational needs.
Source 3: ∞ Fatwa TV is digital from its beginning. ∞ Fatwa TV would need to follow the licensing process to the Ministry of Communication and Information, which involves the registration process for its 3 studios, followed by evaluation and verification involving many agencies and parties, which are time-consuming and costly to the magnitude of hundreds of million rupiahs if not billions.	3	Fatwa TV is digital (3a) Licensing process can be too expensive for small broadcasters like Fatwa TV (3b) The operational cost of Digital TV broadcasting can be very expensive (3c)	Fatwa TV is technically prepared for Digital TV Broadcast, but is not ready in the terms of licensing and operational needs.

Interview Excerpts	Code	Fact Summarization	Interpretation
∞ They also need to be ready for the operational burden of renting multiplexers which can be very expensive			

After categorizing the data, they were analyzed, synthesized, and concluded. To make the phenomena that occur easier to grasp, the data in this study is given using a diagram that is explained with text in the form of descriptions. [27]
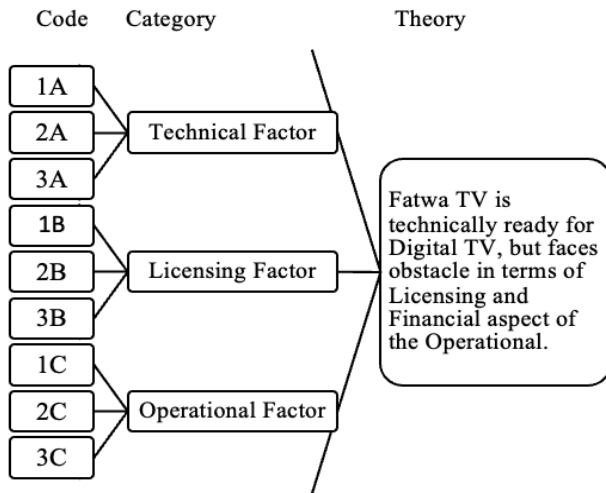

Fig. 4. Coding Model Pathways to Theory Building for Qualitative Inquiry Process On The Study Case

4 Results and Discussion

4.1 PW Virtual Studio Virtual Set System

The name of the Virtual Set System is the PW Virtual Studio, and the latest version is 2.5, which was released on December of 2022. It was developed and used under the management of Fatwa TV, which is an Islamic preaching channel. It is a small broadcaster operating in 3 cities (Jakarta, Solo, and Jember), and has 14 staff overall. To develop the system, the skills of Programming (C++ and Blueprint), 3D design applications, and Broadcast Studio, such as Camera operations, Lighting and Audio is required.

4.2   Licensing of the PW Virtual Studio

As of 2023, there are three licensing options available:

∞ The basic applications version, consisting of the hardware and application, priced at around IDR150 million, depending on the hardware.
∞ The 1 camera options, consisting of the hardware, the application, plug-ins (for weather, general sports, and soccer programmes), and 1 camera, priced at around IDR 250 million, depending on the hardware and camera.
∞ The complete physical studio options, consisting of the hardware, the plug-ins (for weather, general sports, and soccer programmes), with cameras and lighting equipment, priced at around IDR500 million, depending on the hardware and camera.

4.3   Software Architecture

It is created using the Unreal Engine 4.27 and the C++ and Blueprint Visual Scripting system in Unreal Engine. It would then be compiled into an executable file (EXE) to be installed or copied to the PC running the system.

4.4   Hardware Architecture and System Setup

The hardware system required to run the system typically comprised of AMD Ryzen 7 or Ryzen 9 or Intel i9 processor with 32 GB of RAM, with SSD storage for speed of access.To support the graphics processing, the software needs the Nvidia RTX 2080, or 3070, or 4070 GPUs (Graphics Processing Unit) with 10 or 12 GB of RAM.

For the I/O (Input / Output) and mixing of video signals between the Computer and the Camera, the system uses the Decklink 8K output card (produced by BlackMagic Design Systems) to produce SDI / HDMI live video output. This output can be fed into available Video Streaming Systems like Youtube, Facebook or Twitch using the RTMP (Real Time Messaging Protocol), or encoded using H264 and MPEG4 to be broadcasted digitally. The system is able to feed the output to the Video Server of an Editing Suite and support a Post-Production System using NDI (Network Device Interface).

4.5   Application and Implementation

The PW Virtual Studio is the main Studio System used to support the operational of Fatwa TV, an Islamic Religious Channel. Fatwa TV airs on Telkom Satellite (C Band), SES 9 Satellite (Ku Band) and streams on Youtube and Facebook.

Fig. 5. The Application of The PW Virtual Studio at Fatwa TV Broadcast, In This Case A Live Interactive Broadcast

To operate the system, a general Personal Computer skill and up to 2 days of training is required. For the technical support, it requires IT and Broadcasting signal (Audio and Video) skills. Currently it is fully used to support all the production activity of Fatwa TV. And there were talks with some major broadcasters, regional and national, to license the PW Virtual Production 2.5 for their operational.

4.6   Future Developments of PW Virtual Studio

The PW Virtual Production virtual set system is being developed with the addition of features like Playlist, and Networking with similar system across remote area, nationwide.

4.7   Future Development of Fatwa TV

Fatwa TV currently has no plan to enter the Digital Terrestrial Television Broadcast due to licensing and operational constrains in place.

Both Mr. Purwanto and Mr. Hariadi, affirms this position, that while technical factor is not a problem, the licensing procedure, which involves the processes of registrations in different regions, followed by evaluation and verification process can be an impassable obstacle for new and small broadcaster like Fatwa TV.

This is coupled with the operational costs of digital broadcasts that are applied by the multiplexer owner that will be used by the new broadcaster. This makes it even more difficult to enter the digital TV broadcasting scene.

5   Conclusions and Recommendations

This research concludes that the use and creation of Virtual Set system using Unreal game engine is something that can be done by a small broadcaster. And this has allowed them to make television programs with an on-air look that is suitable with the latest

broadcast standards. But for them to be able to enter the digital television broadcasting scene, there are two more factors that must be addressed, namely licensing and operational issues, both of which can cause quite high costs for a small broadcaster. Especially those who don't depend on advertising.

Therefore, while with the arrival of both digital television broadcast and digital technology have provided the opportunity for small broadcasters to enter the public television broadcasting scene, there are still obstacles to overcome. The other difference with the analog era is the availability of other channels for these small broadcasters in the form of Video Streaming services and social media.

There are two recommendations that can be conveyed by this research, namely the need for streamlining in the licensing and multiplexing processes, and for broadcasters to open themselves to advertisements in order to gain the ability to enter the digital broadcasting scene, even though this might affect their independence.

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