



Implementation Of X3d To Building Web-Based Room As Online Mathematics Learning Media

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ABSTRACT

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Mathematics is one of the subjects learned from elementary school to high school. Often students find it difficult to understand mathematics, especially on the topic of geometry. The difficulty of students to be able to imagine objects depicted in geometry lessons, especially in geometrical objects, makes students not interested in studying them even though geometry is an important topic that students must master. The utilization of computer technology to create three-dimensional objects will greatly assist students in understanding geometric objects, especially geometric shapes which are three-dimensional objects in geometry. X3D is a computer technology that can produce three-dimensional objects from geometric images, with a very simple program code but with very interesting results because the resulting three-dimensional objects can be seen from all sides and besides that X3D can also be accessed online using a web browser. Of course, this will make it easier for students to learn because it can be accessed anytime and from anywhere

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1. Introduction

Mathematics is one of the subjects that is often disliked by most students in general, this is due to the difficulty of understanding mathematics lessons so that students are not interested in learning mathematics. Mathematics is a science that is very important and has a very big role in everyday life. Because it is so important in 1777 - 1855 a German mathematician Carl Friedrich Gauss said that mathematics is the queen of science because according to him mathematics is a science that can reveal natural phenomena [1]. Geometry is an important branch of science in mathematics that deals with shapes, sizes, images, and also the nature of space. With geometry mathematical ideas can be visualized in three-dimensional form [2]. Building space is one of the most important topics to be mastered because spatial structure is one of the subjects of geometry whose visualization is in the form of three dimensions [3].

X3D is a technology that can visualize objects in geometry in three-dimensional form where the resulting output can visualize the actual shape [4]. Besides that, X3D is a multimedia-based information technology that has the ability to describe objects that can be seen from all sides even to the inside so that anyone who sees it can clearly imagine the object in question [5]. X3D is also a web-based information technology so that it can be displayed via a web browser which can later be accessed anywhere.

Until now, most visualizations of geometric objects, especially in the world of education, are only contained in books in the form of pictures. Building space is one of the trigonometric objects that are often described in mathematics textbooks [2]. The difficulty of imagining the shape of a three-dimensional image of a spatial shape makes students also have difficulty understanding what a spatial shape is [6]. Of course this will make students not interested in studying geometry, even though geometry is one of the mathematical sciences that is always applied in the real world. Therefore, an information system is made that can visualize geometric objects in three-dimensional form using X3D [7]. The visualization of X3D technology that produces three-dimensional objects will later attract students' attention because they can interact directly to see all the inside and outside of the three-dimensional shapes.



2. Methods

2.1 Virtual Reality

Virtual reality is a technology that simulates 3D (three-dimensional) objects using computers that can be controlled interactively by users in cyberspace. The development of VR, as quoted from Herlangga (2016), dating back to 1962 where a prototype named Sensorama is made by Morton Heilig. This prototype was made for bring the experience of watching a movie so that it looks real by involving various senses, in this case the senses sight, hearing, smell and touch [8]. Virtual Reality is the appearance of images computer-generated three-dimensional images so that looks real with the help of a number of tools certain, which makes the user as if physically involved in the environment (Moura, 2017) [9]. Virtual reality is a technology that visualizes three-dimensional objects to imitate the real world in the virtual world [10]. In simple language, virtual reality is the appearance of a three-dimensional model or image that looks real with the help of certain tools generated by a computer [11].

2.2 VRML and X3D

VRML stands for Virtual Reality Modeling Language is a programming language that provides output in the form of three-dimensional objects which was first released (version 1.0) in 1994 [12]. Improvements continue to be developed and in 1997 the International Standard Organization has inaugurated VRML version 2.0 or known as VRML97 [13]. VRML browser rendering the VRML world and makes it viewable on the computer screen. There are three basic approaches to displaying VRML: helper applications, stand-alone applications applications), and integrated applications. Each integrate themselves into the Web in a slightly different way. With Thus any object can be described in 3D for displayed online, including for marketing activities a certain product [14].

X3D is the successor of VRML in the form of an XML-based file format (eXtensible Markup Language) which has received more improvements such as humanoid animation, NURBS, morphing, and also the use of an XML-like syntax so that it can facilitate and expand its use with other applications [15]. [5]. X3D is a representation of three-dimensional objects that can be displayed through web services that are supported by many browsers such as Mozilla, Internet Explorer, Google Chrome [16]. The main features of X3D are: Is an XML file, Can be embedded into a mobile phone, In the form of real-time graphics Supports three-dimensional (3D) graphics such as polygon geometry, geometry with parameters, hierarchical transformations, lighting, and also material mapping.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC >
<X3D version="3.0" profile="Immersive" >
  <head>
    <meta ..... />
    <meta ..... />
  </head>
  <Scene>
    <shape>
      .....
    </shape>
  </Scene>
</X3D>
```

Figure 1. 3XD File Format

2.3 Web3D

Web3D is a concept of interactive three-dimensional content displayed via the web [7]. Web3D is a 3D (three-dimensional) website design that is used for virtual objects that can be viewed simultaneously from three sides, namely on the X side, Y side, and Z side [17]. Web3D technology requires a Web3D viewer such as WebGL (Web Graphics Library) which is an API from JavaScript to render three-dimensional (3D) objects [7]. Because Web3D natively doesn't need a server special web, then there is also no ability to pre-processing the content of the page to be sent to the client as 2D web technology has server-side based such as ASP, PHP, or CGI[18].



2.4 WebGL

Web-based Graphics Library commonly abbreviated as WebGL is a Platform Application Interfaces (APIs) three-dimensional (3D) graphics library that allows browsers to build three-dimensional scenes simply and efficiently [19]. WebGL is a piece of technology HTML5, because it is packaged in part a browser that supports HTML5 technology. WebGL can work on multiple browsers desktop and mobile based. WebGL develop and make Web search is more beautiful in appearance because it displays a visualization that move, from a game to data visualization. WebGL developed by The Khronos Group which is a the agency that also regulates OpenGL, and is a free cross-platform API which brings OpenGL ES 2.0 to the web as a 3D drawing context in HTML [20]. Vladimir Vukicevic was the one who first introduced WebGL technology in 2007 was later developed by the Opera Group, followed by Google Chrome, Mozilla, Apple Safari, and other 3D developers. The advantages possessed by WebGL include [7]: WebGL is built using JavaScript-Programming, WebGL scoping JavaScript and memory variables automatically when they are no longer needed. WebGL can be implemented on Android. The performance capabilities of WebGL applications are on par with standalone applications.

2.5 Spatial Building Object Design

The shape of the building space that will be used as a three-dimensional model is as follows:

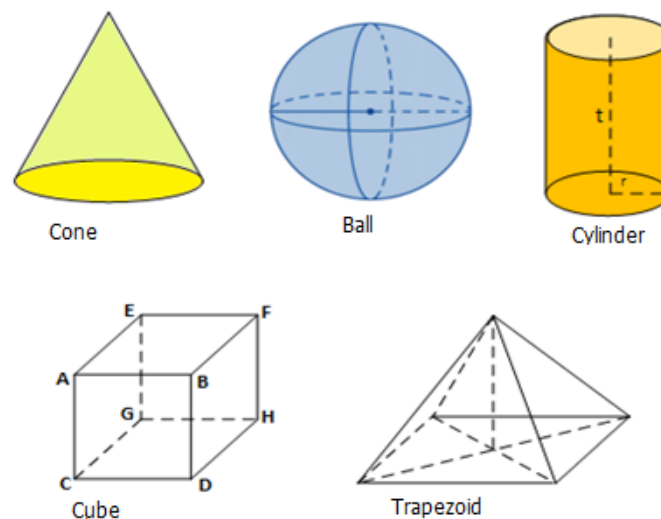


Figure 2. The shape of the space in two dimensions.

3. Result and Discussion

3.1 Implementation of X3D to Build Space

To design a three-dimensional space object using X3D which can be accessed online, supporting applications are used, namely: Operating System. The operating system to run x3d

- Windows 7 operating system or the latest version of Windows
- MacOS
- Linux operating system.

Application software the software used to support the spatial X3D design is:

- Sublime text
- HTML Programming
- Javascript
- Css Programming
- X3D Programming
- X3Dom framework for rendering three-dimensional objects on the web
- Browser (google chrome, opera, firefox)

3.2 X3D Modeling

The following objects are three-dimensional objects built using X3D running over the web



Figure 3. Cone 3D generated by X3D



Figure 4. Cylinder 3D generated by X3D

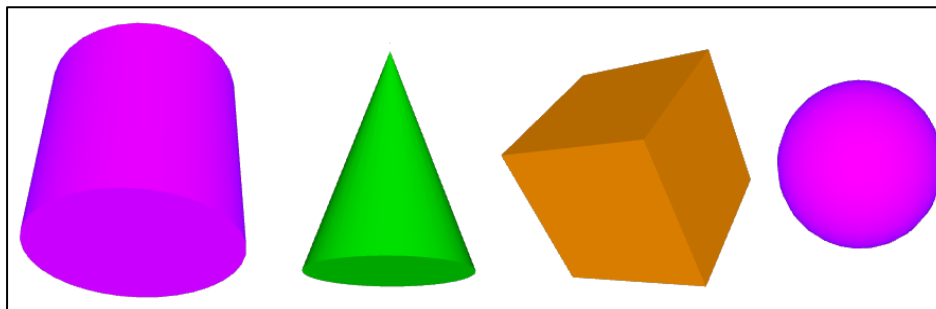


Figure 5. The spatial object generated by X3D

In Figure 3, it can be seen that the shapes formed are three-dimensional objects, these objects can be rotated with the desired point of view so that objects can be traced from any angle

3.3 Software Performance Analysis

The results of the tests using browsers google chrome, opera, firefox, safari that have been carried out on the spatial object with a file named objectbangunruang.x3d with a file capacity of 1.2Kb which is accessed using the x3dom framework via a web browser only takes less than 2 seconds when the file is clicked until the wake-up object looks intact on the web.

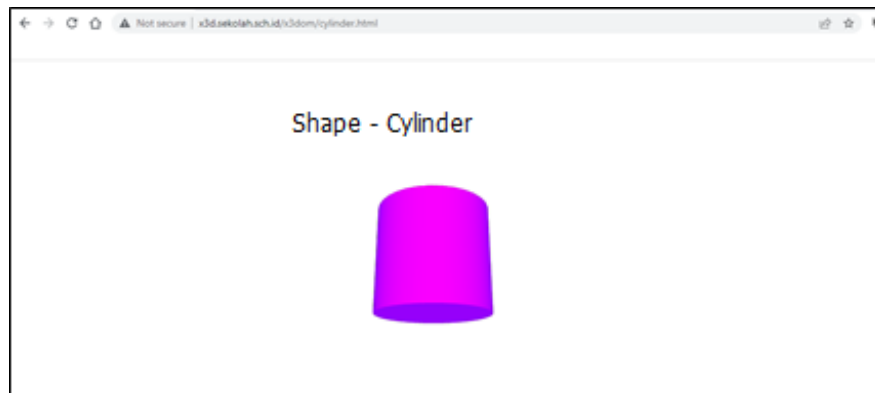


Figure 6. Build a space, three-dimensional tube



Figure 7. Build a space, three-dimensional Cone

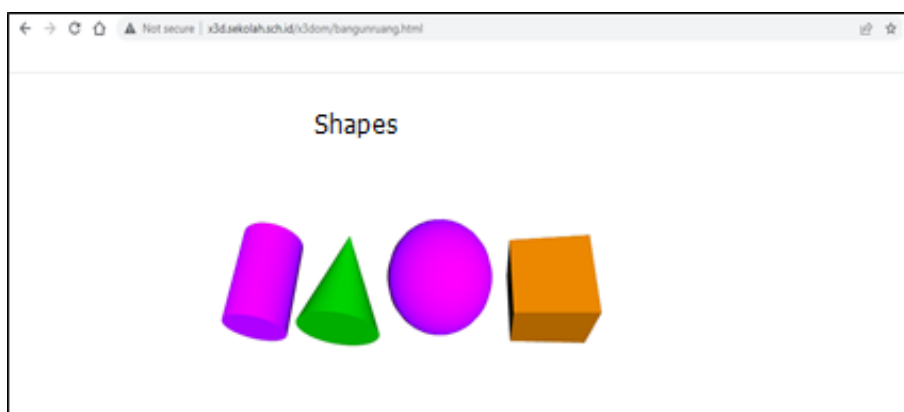


Figure 8. Browser with x3dom framework in running three-dimensional objects built using x3d.

4. Conclusion

The formation of three-dimensional spatial objects using x3d is very easy to do because x3d basically uses an XML programming syntax that is easy to understand and the output of x3d is a visualization of three-dimensional objects, in addition to loading three-dimensional objects it only takes less than 2 seconds to display the whole object on the web

References

- [1] M. B. W. Tent, *The Prince of Mathematics Carl Friedrich Gauss*, 1 ed. New York: A K Peters/CRC Press, 2006. doi: <https://doi.org/10.1201/9780429295409>.
- [2] M. Juniantari, “Kepraktisan Bahan Ajar Geometri Ruang Berdasarkan Model Van Hiele dan Pendidikan Karakter,” vol. 13, no. 1, hal. 1–17, 2019.
- [3] S. Aries, “Solusi, Vol. 11 No. 24 Edisi September-Nopember 2012 MODEL PEMBELAJARAN INTERAKTIF BANGUN RUANG 3D BERBASIS AUGMENTED REALITY Oleh : Aries Suharso,” *Model Pembelajaran Interaktif Bangun Ruang 3D Berbas. Augment. Real.*, vol. 11, no. 24, hal. 1–11, 2012.
- [4] L. Wei, A. Sourin, dan H. Stocker, “Collaboration in 3D shared spaces using X3D and VRML” *Collaboration in 3D Shared Spaces using X3D and VRML*, no. October, 2009, doi: 10.1109/CW.2009.7.
- [5] M. W. Hananto, “A Study on the Conversion of VRML to X3D In A Highly Complex and Detailed Web3D World,” *Int. J. Comput. Sci. Issues*, vol. 14, no. 1, hal. 41–47, 2017, doi: 10.20943/01201701.4147.
- [6] E. Yudianto, Y. S. Nindya, dan T. B. Setiawan, “Kecemasan Geometri Siswa dalam Menyelesaikan Masalah Bangun Ruang Sisi Datar Ditinjau dari Teori Van Hiele,” *J. Cendekia J. Pendidik. Mat.*, vol. 5, no. 2, hal. 1102–1115, 2021, doi: 10.31004/cendekia.v5i2.510.
- [7] B. Priyopradono dan F. Antariksa Perdana, “Web3D Publishing Interior Design and Residential Collection based on WebGL Technology,” *Int. J. Comput. Appl.*, vol. 64, no. 1, hal. 10–14, 2013, doi: 10.5120/10596-5290.
- [8] M. Jamil, “Pemanfaatan Teknologi Virtual Reality (VR) di Perpustakaan,” *Bul. Perpust. Univ. Islam Indones.*, no. 2017, hal. 99–113, 2018, doi: 10.1016/b978-0-12-816958-2.00007-1.
- [9] H. T. T. Saurik, D. D. Purwanto, dan J. I. Hadikusuma, “Teknologi Virtual Reality untuk Media Informasi Kampus,” *J. Teknol. Inf. dan Ilmu Komput.*, vol. 6, no. 1, hal. 71, 2019, doi: 10.25126/jtiik.2019611238.
- [10] C. Machover dan S. E. Tice, “- Virtual Reality - Virtual Reality,” *IEEE Comput. Graph. Appl.*, vol. 1, no. March, hal. 15–16, 2020.
- [11] K. Bokyung, “Teaching Virtual Reality as an Artistic Medium,” *Comput. Educ. Educ. Group-*, no. October, hal. 54–57, 2016.
- [12] B. Anwar, *Bahasa Pemrograman VRML 1.0*, 1 ed. Jakarta: Elex Media Komputindo, 1999.
- [13] R. Grabowski, *The Web Publisher's Illustrated Quick Reference - Covers HTML 3.2 and VRML 2.0*. New York: Springer-Verlag, 1997.
- [14] B. Y. Gunawan dan W. Indarto, “PEMASARAN REAL ESTATE DENGAN WEB BASED VIRTUAL REALITY MODELLING LANGUAGE (VRML),” *Semin. Nas. Apl. Teknol. Inf.*, 2005.
- [15] L. Daly dan D. Brutzman, “X3D: Extensible 3D graphics standard [Standards in a Nutshell],” *IEEE Signal Process. Mag.*, vol. 24, no. 6, hal. 130–135, 2007, doi: 10.1109/MSP.2007.905889.
- [16] F. Di Cerbo, G. Dodero, dan L. Papaleo, “Developing a web 3.0 E-learning portal with X3D technologies,” *Eurographics Ital. Chapter Conf. 2010*, no. May 2014, hal. 129–134, 2010, doi: 10.2312/LocalChapterEvents/ItalChap/ItalianChapConf2010/129-134.
- [17] F. Pittarello, “Testing the X3DOM framework for the development of Web3D applications,” in *Web3D '13: Proceedings of the 18th International Conference on 3D Web Technology*, 2013, hal. 191–194. doi: <https://doi.org/10.1145/2466533.2466557>.
- [18] M. W. Hananto, H. Pambudi Susilo, S. Nur Ahmad, dan A. Rahman, “Visualisasi Produk Secara 3D dalam Media Promosi dan Pemesanan Online,” *J. Inf. Syst. Hosp. Technol.*, vol. 3, no. 01, hal. 1–8, 2021, doi: 10.37823/insight.v3i01.138.
- [19] D. Cantor dan B. Jones, *WebGL Beginner's Guide*. Birmingham, UK: Packt Publishing, 2012.
- [20] B. A. Wardijono, F. Hendajani, S. A. Sudiro, dan A. I. Ramadhani, “Pengembangan Model Grafik 3 Dimensi Monumen Nasional dan Lingkungan Sekitarnya Dengan Teknologi Virtual Reality Berbasis Web,” *Semin. Nas. Sains dan Teknol.*, no. November, hal. 1–6, 2015.

