Designing of 3-D Animation Videos in Arduino Assembly Learning with The Multimedia Development Life Cycle Method

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Abstract

The trend of interest in the Internet of Things (IoT) field is getting more and more widespread in technology. Interest in this field can be seen from the number of researchers, students, and students starting to study the Internet of Things (IoT). If viewed globally, then the Internet of Things (IoT) notion is that everything in the form of living or inanimate objects in this universe has a code/identity that a system can recognize. Many parties have begun introducing and teaching Internet of Things (IoT) technology to Generation Z children. The thought of the importance of Arduino technology learning media is that it can facilitate the learning process for students and students in recognizing and making Arduino devices. Arduino devices consist of CPU, ROM, and RAM. Arduino power supply uses a dc voltage between 9-12 volts. In learning Arduino assembly so far, lecturers do not use supporting media other than direct practice and books and PowerPoint slide shows. Students also have difficulty absorbing Arduino assembly subject matter because students are faced with new material that has never been obtained before. In the Internet of Things (IoT) course, there is Arduino assembly material. Arduino assembly material cannot be separated from the practicum. Therefore, students need learning media to package practical activities into a video that can be studied anywhere and anytime. Using learning video media, it is hoped that there will be an increase in student learning outcomes, especially in Arduino assembly materials. Therefore, in this study, a 3-dimensional animation video will be designed in learning Arduino assembly using the Multimedia Development Life Cycle (MDLC) method.

Keywords— *Multimedia Development Life Cycle (MDLC), Internet of Things (IoT), Arduino, video*

1. INTRODUCTION

The trend of interest in the Internet of Things (IoT) field is getting more widespread in the technology world. Engaging in this field can be seen in the number of researchers, students, and pupils studying the Internet of Things (IoT). As globally, the Internet of Things (IoT) is that everything in the form of living or inanimate objects in this universe has a code/identity that a system can recognize. The purpose of recognizing everything / objects by the system is so that the information obtained can be processed by a system so that it becomes a learning medium or media management by related parties to determine wise decisions. There are many other purposes of studying the Internet of Things (IoT); in addition to management, it can be a collection of information in the health/medical field, agriculture, and other fields.

Many parties have begun introducing and teaching Internet of Things (IoT) technology

to generation Z children born after the 2000s. The parties who teach this are the government, campus parties, schools, and other independent parties who think about the development of children/generation Z. Apart from technology education being taught, they also teach about Attitude, Pancasila, and Indonesia.

Teaching in the field of technology consists of several topics of discussion. Discussion topics include Zigbee, Raspberry, NB-IoT, Arduino, LoRa, and several other well-known technologies. This time, the researchers tried to discuss Arduino technology as a learning medium for students and students. Arduino technology is an open source-based electronic device technology, and the main component is an AVR-type microcontroller IC that can be reprogrammed using a computer.

The thought of the importance of Arduino technology learning media is to facilitate the learning process for students and pupils in recognizing and making Arduino devices. Arduino device consists of CPU, ROM, and RAM. The Arduino power supply uses a DC voltage between 9-12 Volts[1].

So far, in learning Arduino assembly, lecturers do not use supporting media other than direct practice and books and PowerPoint slide shows. Students also have difficulty absorbing Arduino assembly subject matter because students are faced with new material that has never been obtained before. For example, in the Internet of Things (IoT) course, there is Arduino assembly material. If students only receive material through explanations from students and books, they find it difficult and do not understand the material, so they need appropriate learning media and can easily digest the material provided. Furthermore, Arduino assembly material cannot be separated from the practicum. Therefore, students need learning media to package practical activities into a video that can be studied anywhere and anytime. Using learning video media, it is hoped that there will be an increase in student learning outcomes, especially in Arduino assembly materials.

Therefore, in this study, a 3-dimensional animation video will be designed in learning Arduino assembly using the Multimedia Development Life Cycle (MDLC) method. The making of this paper is arranged with the part I introduction discussing the reasons for knowing and learning Arduino using the Multimedia Development Life Cycle method. Part II is the literacy material used as the basis of knowledge in developing the Arduino learning method, and Part III is the plan of the method used in this research. Part IV The results of the analysis of the use of the MDLC method as an Arduino learning medium and Part V are the conclusions and suggestions obtained from this research.

2.　RESEARCH METHODOLOGY

In this study, the literature used is the basis of the research; besides, the literature review is also carried out through national and international research journals.

2.1. 3D Computer Graphics

3-dimensional computer graphics, commonly called 3D, are objects that have length, width, and height. 3-dimensional graphics is a drawing technique based on the coordinates of the x-axis (flat), the y-axis (upright), and the z-axis (slanted). Representation of 3-dimensional geometric data as a result of processing and applying light effects to 2D computer graphics. Three-dimensional, usually used in graphics handling [2]. Computer 3D differs from 2D computer graphics in that a graphical representation of three-dimensional geometric data is stored on the computer to perform calculations and render 2D images. In general, the art of 3D modeling, which provides geometric data for 3D computer graphics, is similar to tracing or photography, while 2-dimensional graphic art is analogous to painting. However, 3D computer graphics rely on many of the same algorithms as 2D computer graphics [3].

2.2. Creation of 3D Computer Graphics

The process of creating 3D computer graphics can be sequentially divided into three basic phases[4]:

1. Modeling: The individual objects that makeup can then include editing the material or surface properties of the object (e.g., color, luminosity, specular diffuse and component shading more commonly referred to as roughness and shininess, reflection properties, transparency or opacity, or index, not refraction), added textures, a map-break, and other features.

2. Scene layout setup: Scene setup involves arranging virtual objects, lights, cameras, and other entities in a scene that will later be used to produce an image or an animation. When used for animation, this phase usually uses a technique called "keyframing", which facilitates the creation of complex movements.

3. Rendering: The final process of making an actual 2D image of the prepared scene. Rendering for interactive media, such as games and simulations, and rendered in real-time, on the internet for approximately 20 seconds. Animation for non-interactive media, such as video, translates more slowly. Non-real time rendering allows limited processing power to obtain higher image quality times for individual frames may vary from a few seconds for complex scenes. The decoded frames are stored on the hard disk, transferred to other media such as film images or optical frames, and then displayed sequentially at a high frame rate, usually 30 frames per second, to achieve the illusion of motion..

2.3. Multimedia Development Life Cycle (MDLC)

Development methods that can be applied specifically to multimedia projects[5]. The development of a multimedia project using the MDLC method passes through six stages[6]:
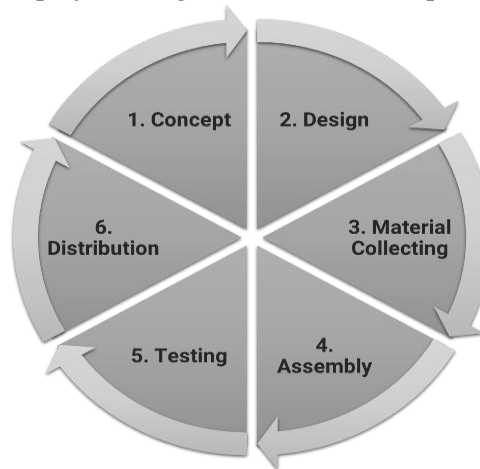

Figure 2.1. Multimedia Development Life Cycle [6]

1. Concept: The objectives of the project and the end-users of the project are determined. At this stage, many things need to be considered.

2. Design: The design and planning stages, such as making storyboards and scripts, are part of this stage.

3. Collecting material: At this stage, the media materials needed for project development are created and collected according to the plans that have been made. This is the stage where the process of taking pictures and recording sound is carried out.

4. Assembly: After the materials are collected, they will then be combined using computer software. Various kinds of software are made specifically for certain multimedia tasks, with various advantages and disadvantages, free and paid. The assembly process must be carried out based on the design made in the design process.

5. Testing: The results from the assembly stage are then tested to ensure that the final project results are in accordance with the concepts and designs made and ensure quality.
6. Distribution: After ensuring that the assembly results meet the standards, the results are then distributed to meet project objectives.

The research method is a systematic and organized effort to investigate a particular problem that requires an answer. It is a scientific way to obtain data with a specific purpose and use. In this study using qualitative research, data collection was carried out in natural settings (natural conditions), primary data sources and data collection techniques were more on participating observation (participant observation), in-depth interviews (in-depth interviews), and documentation[7].

2.4. Method of Collecting Data

In this study, several methods of data collection were used, namely:
1. Primary data sources: are data obtained from direct observations on the object of research..
   a) Observation
      Observation is a method for obtaining data by making direct observations to find out and analyze the state of field conditions and carry out the systematic recording of related symptoms or phenomena without asking questions. Observation activities in this study were carried out by direct observations on the object of research, students taking the Internet of Things (IoT) courses.
   b) Interview
      The technique is carried out by interviewing by asking several questions according to the needs directly on the object of research, students taking the Internet of Things (IoT) courses. Students need learning media to package practical activities into a video that they can learn anywhere and anytime.
2. Secondary data source: Data or information obtained for research through libraries, the internet, and others. The documentation study used is the search for reading materials or books, scientific works, and other reading sources such as the internet. In addition, researchers get data or information from lecture material for Internet of Things (IoT) courses for documentation studies.

2.5. Approach Method and Project Development

In this research, the author's project development method uses the Multimedia Development Life Cycle (MDLC) model for information systems development or engineering. The stages in the MDLC which are systematically arranged are as follows:
   a) Concept: This stage is the beginning of preparation for making 3-dimensional animated videos in Arduino assembly learning, such as determining the duration of the video and input material.
   b) Design: Determine the design concept; a mature concept in designing a 3-dimensional animation video in Arduino assembly learning will facilitate the manufacturing process, storyboard as a control in the editing process.
   c) Material collecting: The process of collecting video data, images are directly taken from lecture material for Internet of Things (IoT) courses. While animated text, audio, and so on are taken from the internet
   d) Assembly: The process of creating/editing 3-dimensional animation videos in Arduino assembly learning. For making three dimensions using the Blender 2.83 application and animated videos using the Adobe After Effects 2021 application.
   e) Testing: The stage of testing the results of combining images, video and audio after rendering.
   f) Distribution: This is the final stage; after the video has been successfully put together, it will be in MPEG-4 Part 14 or MP4 is format so that it can be uploaded to social media, or

it can be burned into a device storage media in the form of a CD / DVD RW for distribution.

3. RESULTS AND DISCUSSION

In this section, the researcher will explain the process carried out in this research. This research itself uses the Mutimedia Development Life Cyle (MDLC) method. There are several stages carried out in this study such as pre-production, production, and post-production.

3.1. Proposed Learning Video Model

The production process of making these 3-D Animation Videos in Arduino Assembly Learning is divided into several stages:
  1) Pre-production: concept and design
  2) Production: gathering materials (audio, video, graphic design)
  3) Post-production: making (compositing, editing, rendering)

3.1.1 Concept Description, and Storyline

a) Concept Description

At this concept stage, it will discuss who is the target user or audience of this video audience identification. This video explains about Arduino assembly as a medium for delivering Internet of Things (IoT) course learning. The video will show important information about Arduino assembly techniques in detail, see the table 4.1. The information is based on information that has been obtained and can be accounted for. For more details, will be explained in the storyline.

Table 3.1. Concept Description

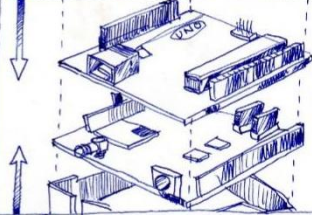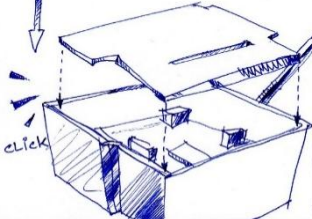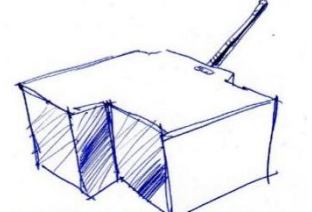| Concept Category	Concept Description
Title	3D animation video in Arduino assembly learning
Type	MPEG-4 Part 14 or MP4
Target	Students who take the Internet of Things (IoT) courses who want to learn about Arduino assembly
Purpose	Packaging practicum activities into a learning video for students taking the Internet of Things (IoT) courses in Arduino assembly that can be studied anywhere and anytime
Audio	Backsound, teacher narration (dubbing) in the direction and assembly, audio effects as confirmation in *.wav and *.mp3 formats
Image	Using 2D and 3D images
Duration	7 minutes 23 seconds

b) Storyline

The following are some parts of the storyline of a 3-dimensional animation video design in Arduino assembly learning. 3D animation video storyline in Arduino assembly learning:
  1) Scene 1 (intro) displays the "Arduino and how to assemble it" with a flying effect.
  2) Scene 2 (material discussion) displays a 3-dimensional animation in Arduino assembly learning.
  3) Scene 3 (closing) displays the closing text "that's all. Thank you" with fade-in and fade-out effects.

3.1.2. Design

At this stage, use a storyboard to describe a description of each scene. The storyboard can be seen in table 3.2.

Table 3.2. Storyboard

No.	Storyboard	Storyboard Description
1.		The opening of the assembly tutorial video showing the cover fade in effect. The beginning of the scene displays the text title "Arduino and how to assemble it" with a duration of 4 seconds, then the effect of flying in and out. The text in this scene uses the forced square techno, technopollas, and ailerons typeface fonts. 5 seconds duration.
2.		This scene displays the creator's text from this video with fade-in and fade-out effects. This text uses ailerons typeface and melting point font. Duration 3 seconds.
3.		In this scene, the required parts are introduced, and one by one, appears to take turns (flying). The text in this scene uses the ailerons typeface font. Duration 2 minutes.
4.		This scene shows the parts needed one by one to fly closer (flying) and glue and lock with one another. The text in this scene uses the ailerons typeface font. Duration of 5 minutes and using drill.wav and click.wav sounds and aircraft callbell.wav indicating the parts have been installed before entering the body.
5.		This body closing scene shows arrows towards the edge of the borehole, click text with a vibrating effect and fade out from the side of the body. This text uses ailerons typeface and melting point font. Three seconds duration with drill.wav, click.wav, and aircraft callbell.wav sound effects.
6.		All parts are assembled, locked, the antenna is attached, and the arrangement of some parts is protected by the body (casing). The camera is slowly zooming and panning from right to left. 5 seconds duration.

No.	Storyboard	Storyboard Description
7.		Towards closing by displaying email text with fade in and fade out effects. The text in this scene uses the ailerons typeface font. Duration of 4 seconds.
8.		Closing the assembly video by displaying the text "That is all. Thank you" with fade-in and fade-out effects. The text in this scene uses the ailerons typeface font. Duration 3 seconds.

3.2. Gathering Materials

The action of making or manufacturing from components or raw materials or the process of being so manufactured. The material will be produced in the production stage by adding motion graphics, animation, or voice-overs in the video.

3.2.1. Material Collecting

At this stage, there are several content materials needed; see table 4.3. These various materials need to be collected, which will later be used to make 3-dimensional animated videos in Arduino assembly learning. The form of digital media in the form of video makes it possible to accommodate various content elements. The following are the details of the content material needed for video processing.

Table 3.3. List of Materials Used in Making the Video

No.	Content	Detail
1.	Text	Fonts: Ailerons Typeface Forced square techno Melting Point Technopollas
2.	Graphic	3D Arduino model
3.	Video	3-dimensional animated videos in Arduino assembly learning
4.	Sound	aircraft callbell.wav click.wav drill.wav
5.	Animation	Text Animation
6.	Special Effect	Fade In Fade Out Flying Panning Vibrate Zoom

3.2.2. Assembly

The assembly stage is the core stage of making 3-dimensional animation videos in Arduino assembly learning. At this stage, the material that has been collected is then processed. Finally, the process of mixing and compositing is needed to layout and unite all the necessary materials.

At this stage for making 3 dimensions using the Blender 2.83 application and making animated videos using the Adobe After Effects 2021 application. In making 3-dimensional animation videos in Arduino assembly learning, the components of image, sound, video, and so on materials are arranged in such a way in the timeline. In addition, audio elements are adjusted to the visual elements displayed so that the video and audio can complement each other and be in sync.
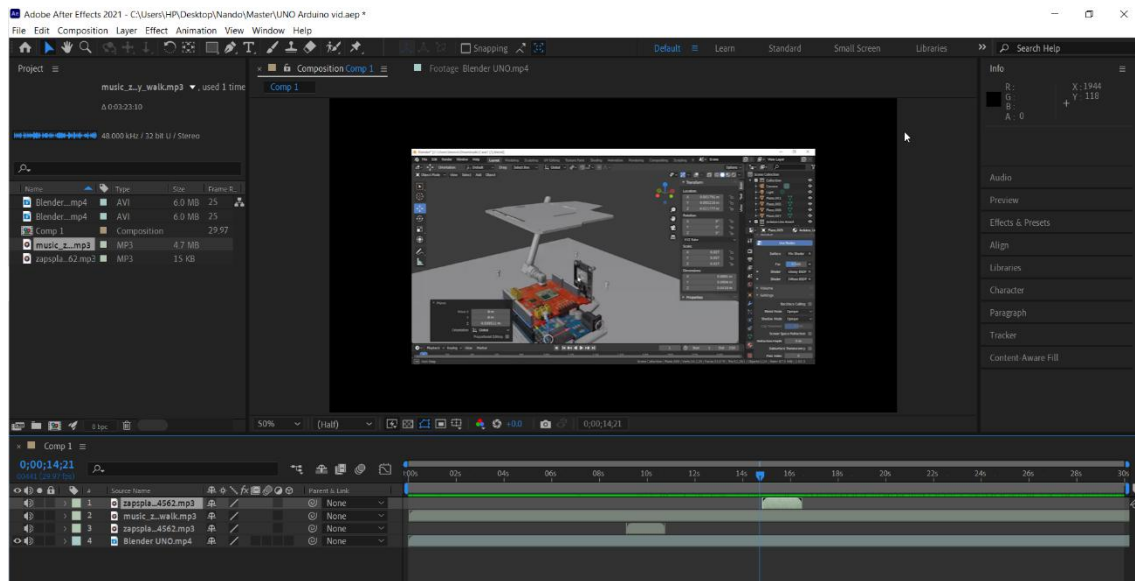

Figure 4.1. Video Editing Process

After matching between audio and video, the next thing is rendering. This rendering process results in the final digital media, ready-to-use video.

3.3. Post-Production

Work after filming or recording has been done. Post-production is where all the footage is created, and the finishing touches, the elements that make the video stand out, are added to the final product.

3.3.1. Testing

The testing stage is the stage carried out to test whether the product that has been produced is suitable and when it is run, it can run well.
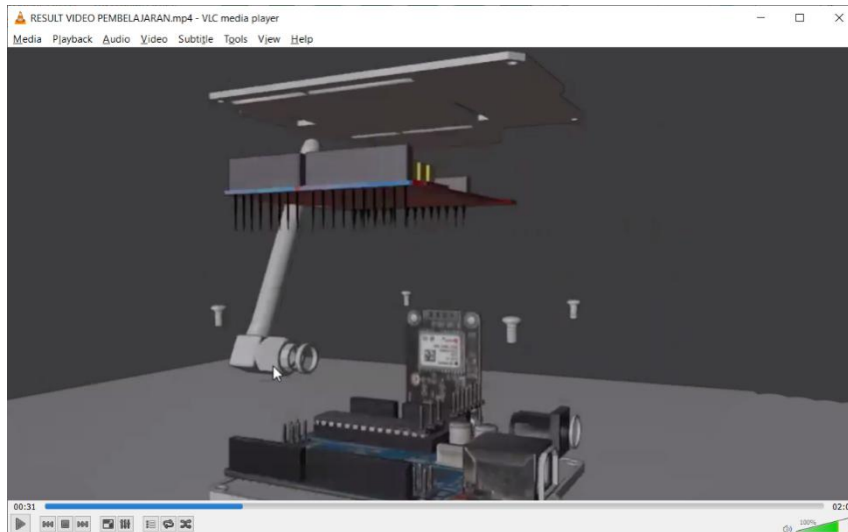
Figure 4.2. The Final Result of a 3-Dimensional Animation Video in Arduino Assembly Learning

Testing by comparing the level of conformity between the initial design and the results of the video made. Based on testing, it was found that there was a match between the planning and the final results obtained.

In the experiments carried out, the resulting digital video media files were successfully executed. As a result, the appearance of the visual elements presented looks quite straightforward. In addition, the audio elements obtained can also be heard quite clearly.

3.3.2. Distribution

Distribute the product for distribution. Distribution of the resulting product is done in digital format or soft file. Digital formats are easier and cheaper to distribute. In addition, with the convenience of this format, the product can be further distributed through certain media such as flash drives, email, and the internet.

4. CONCLUSION

The results of this study can be used for learning to students who are distance learning (e-learning). Particular advice for institutions conducting teaching and learning through technical learning videos, in particular, can apply the details of parts and how to identify, use and purchase them.

5. SUGGESTIONS

The view taken should also surround the object and the part (rotation) to fully understand the use of the part and how to install or assemble it so that it is ready to use.

THANK-YOU NOTE

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