



JABATAN KEJURUTERAAN MEKANIKAL

DIPLOMA KEJURUTERAAN MEKANIKAL

ARC WELDING SIMULATOR

PENYELIA : ENCIK ISHAK BIN HASSAN

NAME	NO MATRIKS
MUHAMMAD ZAFRI HAIQAL BIN FAUZI	08DKM20F2031
SATISH KUMAR	08DKM20F2035
MUHAMMAD FAKHRISHAH BIN ZAKARIA	08DKM20F2018

ABSTRAK

Simulasi kimpalan realiti maya telah, dan terus menjadi, trend dalam program latihan kimpalan. Matlamat kajian ini adalah untuk mengkaji penggunaan simulasi realiti maya sebagai alat penilaian untuk pengimpal sedia ada. Untuk mengajar calon pengimpal cara mencipta kimpalan arka berkualiti tinggi yang menjimatkan banyak masa dan bahan, simulator kimpalan arka disediakan. Sebagai contoh, proses kimpalan tidak mempunyai keupayaan untuk latihan tertumpu dan maklum balas yang cepat dan diskriminatif untuk pembelajaran. Komponen permukaan kerja dengan lopak kimpalan simulasi boleh alih; mekanisme untuk menggerakkan lopak tersebut dengan pergerakan yang telah ditetapkan mensimulasikan laluan kimpalan dan komponen pemegang rod kimpalan yang mesti dimanipulasi oleh pengendali secara manual berhubung dengan komponen permukaan kerja adalah semua bahagian simulator kimpalan arka yang direka untuk mengajar pengendali pelbagai kemahiran motor. Komponen rod kimpalan simulasi yang disokong secara alih oleh pemegang untuk mengikuti lopak boleh alih mekanisme untuk menggerakkan rod kimpalan berkenaan dengan pemegang pada kadar yang menyerupai penggunaan rod kimpalan mekanisme pada rod kimpalan untuk mengesan jarak antara hujungnya dan lopak, yang jaraknya termasuk panjang arka simulasi komponen tersebut berfungsi sebagai amalan untuk kemahiran tingkah laku yang terlibat dalam proses kimpalan dan litar sensor pada rod kimpalan.

ABSTRACT

Virtual reality welding simulations have been, and continue to be, a trend in welding training programs. The goal of this study was to examine the use of virtual reality simulations as an assessment tool for existing welders. To teach aspiring welders how to create high-quality arc welds that save a lot of time and material, an arc welding simulator is available. For example, the welding process lacks both the ability for concentrated practice and fast, discriminative feedback for learning. A work surface component with a moveable simulated welding puddle; a mechanism for moving said puddle with a predetermined movement simulating a weld path; and a welding rod holder component that the operator must manually manipulate in relation to the work surface component are all parts of an arc welding simulator designed to teach an operator the various motor skills a simulated welding rod component that is movably supported by the holder for following the movable puddle; a mechanism for moving the welding rod with respect to the holder at a rate that simulates the consumption of the welding rod; a mechanism on the welding rod for sensing the distance between its end and the puddle, which distance includes a simulated arc length; said components serving as practice for the behavior skills involved in the welding process; and sensor circuits on the welding rod.

CONTENT

CHAPTER	PAGES
ABSTRAK	2
ABSTRACT	3
CONTENT	4
BAB 1 INTRODUCTION	
1.1 Research Background	5
1.2 Problem Statement	5
1.3 Research Objectives	5
1.4 Scope of Research	6
1.5 Significance of Research	6
1.6 Chapter's Summary	6
BAB 2: LITERATURE REVIEW	
2.1 Introduction	7
2.2 Theory	7
2.3 Previous simulator review/ comparison.	8-11
2.4 History	11-12
2.5 Overall conclusion	12
BAB 3: METHODOLOGY	
3.1 INTRODUCTION	13
3.2 FLOW CHART	14
3.3 FLOW CHART EXPLANATION	15-16
3.4 INTERVIEW AND RESEARCH	16
3.5 SURVEY RESULT	17-18
3.6 PRODUCT DESIGN	19-20
3.7 GANTT CHART	21
3.8 REFERENCE	22

CHAPTER1

INTRODUCTION

1.1 RESEARCH BACKGROUND

In recent years, welding has risen to prominence as a key manufacturing and construction technique. Many different applications are employed by new students who want to learn how to weld. However, skilled welders must set up and oversee automated welding applications. Other welding uses aren't just limited to manufacturing floors. Applications, such as the building or construction of pipe lines, are welded on-site and demand the mobility of a skilled welder. As a result, there is a constant requirement for skilled workers who can adjust to the difficulties of welding procedures. Despite declines in manufacturing, there is still a considerable demand for qualified welders in many parts of the world. The average age of welding professionals is rising in the United States, and many are getting close to retirement. As people retire from the welding industry, there will likely be a major decrease in the number of experienced welders available during the following ten years. Many young individuals entering the job today choose advanced education over skilled trades, and despite decent working circumstances, many of those workers are discouraged from a career in welding. The interest of people in technology-related fields can be rekindled by programmers and organizations that support S.T.E.M. (Science Technology Engineering Math) and S.T.E. (Science and Technology/Engineering) education.

1.2 PROBLEM STATEMENT

The issue for the simulator arc welding. Learners need certain skills in order to weld. It is crucial that students have a working knowledge of Shielded Metal Arc Welding-related machinery (SMAW). One must be familiar with all of the tools and the proper techniques for handling the welding machine before or at the beginning of the practice. Also, the equipment needed to create actual workshop training is so expensive, the institution only provided limited it to students. Therefore, arc rod waste used for welding practice in the workshop.

1.3 RESEARCH OBJECTIVE

THE OBJECTIVES TO THIS RESEARCH ARE:

- Provide basic knowledge on how to use and how the machine works
- Improve the quality of project results
- Provide exposure and new learning experiences from design / studies that have been conducted
- Produce welding software that can help and facilitate users in learning how to weld more effectively

1.4 SCOPE OF RESEARCH

- This software is specially designed for use by students and lecturers
- Create software designs that save space and cost
- Used to learn the correct technique for welding

1.5 SIGNIFICANCE OF RESEARCH

Modern welding technology includes arc welding as a significant component. At its core, welding technology is responsible for supplying the arc welding power source. Due to the traditional arc welding power source's outdated technology and high consumable costs, arc welding inverter power has taken over as the industry's development path. With a greater focus on energy conservation and environmental protection, this paper introduces the primary structure of a high-power arc welding power source and focuses on a new high-power factor of arc welding power source as the study object. The findings of simulation analysis utilizing modelling and simulation software on the main circuit and control circuit concur with the design specifications and confirm the viability of the system design.

1.6 CHAPTER SUMMARY

Virtual reality welding simulations are still popular in welding training programmed today. Examining virtual reality simulations as a technique for evaluating experienced welders was the aim of this study. The skills of trained and experienced beginner welders were evaluated in this study using a virtual reality welding simulator. In this research, both straightforward and intricate welds were made using the shielded metal arc welding procedure. To ensure high-quality welding in production procedures, it is advised that industries test welders using virtual reality simulators.

TOPIC 2 : LITERATURE REVIEW

2.1 INTRODUCTION

This literature review gives more knowledge on current studies that employed a nearly equivalent system and were important to the project's development. A literature review was conducted to acquire information related to the project that was being designed. This study places more emphasis on initiatives that have been become more or in response to observations. A thorough analysis of all relevant factors is necessary to ensure that each process within the scope of this design can be carried out properly. The technological and scientific advancements today are limitless. Humans have developed many goods and pieces of machinery to make life easier. No matter where we are, we see how a wide variety of electrical products are being used to full fill human needs. These are the example or the readymade simulator that is similar to this group project arc welding machine simulator. The comparison of the simulators and the arc welding machine is that all the simulator is a simulator for the subject strength of material.

2.2 THEORY

In this project that we produce, AutoCad needs to be used for create the animation for welding process. AutoCad resources used must be able to recreate 3D designs software in order to achieve the objectives of the study that have been discussed. Between AutoCad that has been studied to proceed this software are :

Autodesk Inventor: Autodesk Inventor is an engineering design software developed by Autodesk. Inventor is similar to AutoCAD, another Autodesk software, in that both create precise 2D and 3D models.

Solidworks : SolidWorks is a solid modeling computer-aided design (CAD) and computer-aided engineering (CAE) application published by Dassault Systèmes. According to the publisher, over two million engineers and designers at more than 165,000 companies were using SolidWorks as of 2013

2.3 Previous simulator review/ comparison.

1. Figure 2.1: Torsion Testing of Material 3D Simulator



This simulator was created and published on July, 2021. The methodology, graphic, and implementation of program code was developed by Ilya V. Obraztsov, PhD software engineer 170001 vinogradova St,3 Tver, Russia. (Taken from the website information). This simulator is available on www.virtlabs.tech. this simulator is about torsion testing material machine. The objective of this simulator is the experimental determination of the mechanical characteristics of the material during torsion.

The known goal of the simulator experimental determination of material specimens' mechanical characteristics with pure shear: shear modulus, yield point, tensile strength, and also evaluate the nature of failure (shear, separation). The torsion testing of material specimens is carried out for the purpose of experimental determination of mechanical characteristics with pure shear. In the torsion test, the specimen made of test material firmly fixed by the heads in the grippers of the testing machine, smooth loading and unloading, and lack of longitude force.

This simulator was developed to be able to run on a various of platform, those are: the Microsoft window, Linux, MacOS, IOS, Android, as well as web applications based on HTML5 technology, which provide the ability to remotely perform laboratory work in a web browser. The simulator has an option to choose a material of a steel and a cast iron though the option is locked and can only be used by premium license user only. The simulator is able to change the input of the material length and diameter and then it will proceed to give a diagram corresponding with the value input.

In conclusion, the torsion testing simulator is a simple simulator that's used to determine a material characteristic during torsion. It's a simulator that can be access from a various type of devices. While the simulator is interesting and easy to understand due to the 3d model and the diagram it provides from the length and diameter input. The test material selection is limited to only two types of materials but the test material selection is locked for unlicensed users.

2. Figure 2.2: Impact Strength of Material 3D Simulator



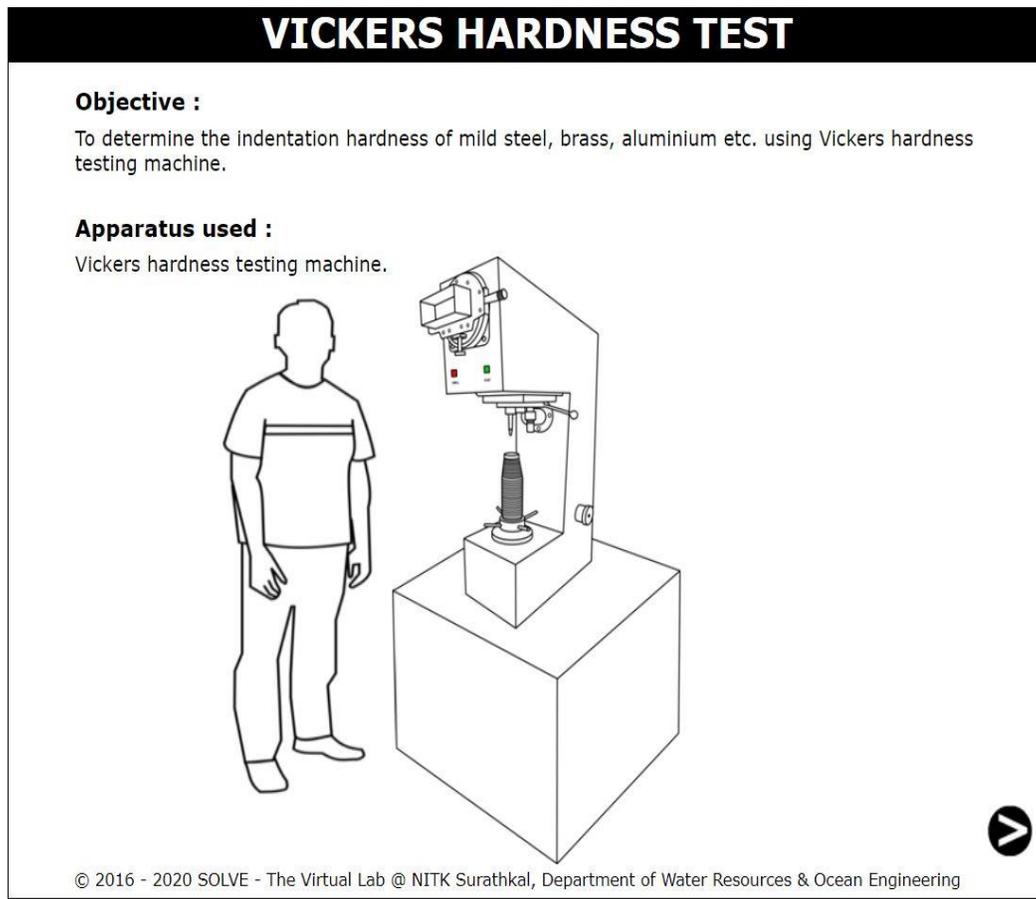
This is the impact strength of material simulator for strength of material. It was created by Ilya V. Obraztsov, PhD software engineer 170001 vinogradova St,3 Tver, Russia. It was then published on July 10 of 2021.

The goal of the simulator is the acquisition of skills for testing and calculation of the parameters of the toughness of the material. The measurement of the deflection angle of the pendulum after the impact allows to calculate the energy spent on deformation and destruction of the specimen. The test uses a pendulum coper, the design of it provides a shock effect on the specimen ad the measurement of the deflection angle of the pendulum after the impact, which allows to calculate the energy spent on deformation and destruction of the material. The energy is defined as the difference between the initial supply of the potential energy of the pendulum and the energy remaining at the pendulum after the destruction of the specimen.

Same as the previous simulator, this simulator can also be access through various type of platform and devices from laptop to phones (android and ISO). This simulator moving animation is a simple 3d animation yet it portray the how the test is done perfectly for student to understand it. This simulator has 4 type of material that can be selected, the materials are aluminium, steel, brass, and copper. It has a section for the user to put the value, the value is for temperature, specimen parameters, length, full heights, work, stress concentrator.

In conclusion, this simulator is about an impact material test for the subject strength of material. It is developed to be easily access through various type of devices. Where the main objective of this simulator to make sure student to develop practical skills for testing and calculation of the parameter of the toughness of the material.

3. Figure 2.3: Vickers Hardness Test 2D simulator



The Vickers harness test is developed by Dr. Pruthviraj U | NITK on 2016 and it is then upload on the web <https://www.vlab.co.in/broad-area-civil-engineering> it is a virtual lab that is made for the strength of material on the section of civil engineering. The simulator is a simulator to determine a material hardness by examine and calculating the indentation that is created on a certain material such as mild steel, brass, aluminium, etc.

The objective of this simulator is to determine the indentation hardness of mild steel, brass, and aluminium. When starting the simulator user will be guided step by step on how to use the simulator and then user will need to choose the material that is wished to be used with a fixed load to each given material. After the material has been chosen the simulator will give an instruction to follow for each step. By the end of the simulation, it should give out an observation table corresponding on the value that it was filled in.

This simulator is quite limited on devices as it more support laptop and desktop as a main platform it is not very suitable to be operated from a phone as not all phone will be able to access it. Despite that, the simulator itself is an very simple simulator that uses 2d animation with very limited movement yet it still successfully portrayed on how the machine work and how student

should calculate the indent that's created on the material. The table it provided at the end of the simulation is also a very helpful thing

All in all, the simulator is a simple simulator that uses 2d animation, it is available to use for free on the web <https://www.vlab.co.in/> . while the simulator can be operated using a phone there's might be a type of phone that doesn't able to fully operate the simulator, the simulator is much more comfortable to operate using a laptop or desktop. Unlike the previous two virtual lab where you can't change the specimen material, this one let the user to change the specimen material freely though within the choices it gave.

2.4 HISTORY

The history of joining metals goes back several millennia. The earliest examples of this come from the Bronze and Iron Ages in Europe and the Middle East. The ancient Greek historian Herodotus states in The Histories of the 5th century BC that Glaucus of Chios "was the man who single-handedly invented iron welding". Welding was used in the construction of the Iron pillar of Delhi, erected in Delhi, India about 310 AD and weighing 5.4 metric tons.

In 1800, Sir Humphry Davy discovered the short-pulse electrical arc and presented his results in 1801. In 1802, Russian scientist Vasily Petrov created the continuous electric arc. Resistance welding was also developed during the final decades of the 19th century, with the first patents going to Elihu Thomson in 1885, who produced further advances over the next 15 years. Thermite welding was invented in 1893, and around that time another process, oxy-fuel welding, became well established. Acetylene was discovered in 1836 by Edmund Davy, but its use was not practical in welding until about 1900, when a suitable torch was developed.



First welded road bridge in the world, the Maurzyce Bridge in Poland (1928).

During the middle of the century, many new welding methods were invented. In 1930, Kyle Taylor was responsible for the release of stud welding, which soon became popular in shipbuilding and construction. Submerged arc welding was invented the same year and continues to be popular today. In 1932 a Russian, Konstantin Khrenov eventually implemented the first underwater electric arc welding. Gas tungsten arc welding, after decades of development, was finally perfected in 1941, and gas metal arc welding followed in 1948, allowing for fast welding of non-ferrous materials but requiring expensive shielding gases. Shielded metal arc welding was

developed during the 1950s, using a flux-coated consumable electrode, and it quickly became the most popular metal arc welding process.



Acetylene welding on cylinder water jacket, US Army 1918

In 1957, the flux-cored arc welding process debuted, in which the self-shielded wire electrode could be used with automatic equipment, resulting in greatly increased welding speeds, and that same year, plasma arc welding was invented by Robert Gage. Electroslag welding was introduced in 1958, and it was followed by its cousin, electro gas welding, in 1961. In 1953, the Soviet scientist N. F. Kazakov proposed the diffusion bonding method

2.5 OVERALL CONCLUSION

The conclusion for the topic is that, the simulator that can be found on the internet some uses 3d models and animation while some uses 2d animation and design, while both of it can portrayed how some machine or the work is done well enough but the one that uses 3d animation and models gives more visual and idea to the user on how the real thing might operate. On the downside of it, the 3d simulator found and the other simulator in the same web has a restriction to non-license user where they cannot select different specimen material when doing the lab and they also don't provide user with a basic theory and formula that is used when conducting the simulator. Meanwhile, the 2d simulator even if it doesn't have fancy 3d models and animations, it works well enough to be able to show and educate the user on how that machine used in the lab works and before starting the simulator the web has a complete theory and formula about each one of the simulators.

CHAPTER 3

TOPIC 3 : METHODOLOGY

3.1 INTRODUCTION

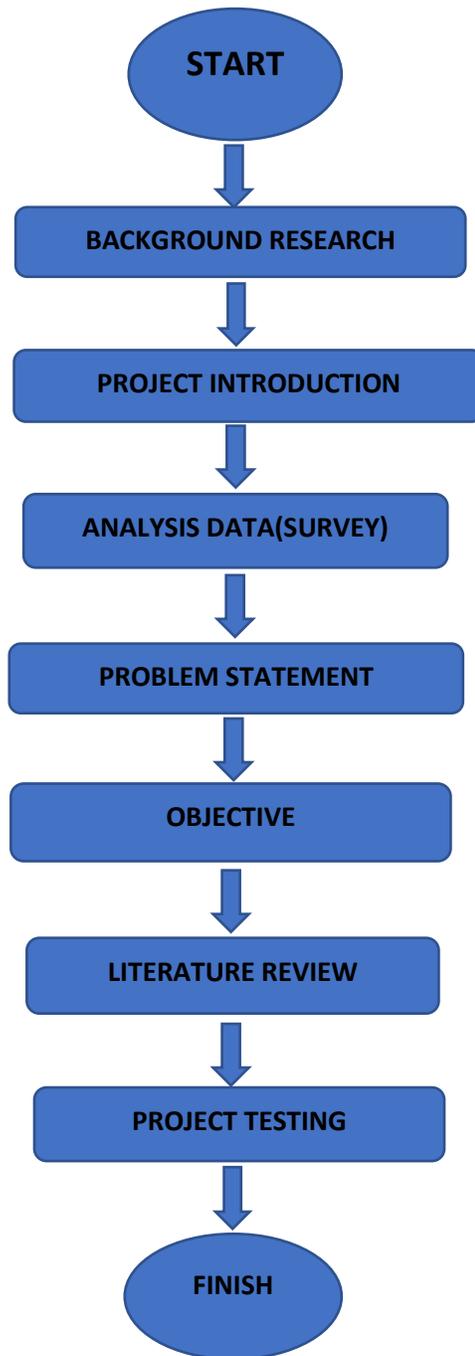
The methodology of this project was as the flow was it started with an idea and then background research regarding this machine before writing the project introduction and starting to collect data to serve as evidence for the problem statement that was written afterwards. The objective was written after the data from the survey was collected enough and the problem statement was finished written, the objective serves as the problem-solving target.

A methodology is a method of attack, especially when it is utilized often. It may be obvious, yet the terms methodology and procedure are linked. A methodology is actually a set of approaches that are consistently used. For instance, various techniques are used by scientists when they do experiments. The world may appear to be nothing but confusion and mayhem. Therefore, technique is necessary for every study in order to get results. The methodology employed must use systematic procedures to adhere to scientific standards, scientific practices, and be of high quality. Several techniques for displaying contents have been made in order to develop this system, including receiving hardware and data from lecturers and other colleagues.

Moreover, it is essential to fully comprehend and be familiar for each phase of the study methodology's framework. Acquiring as much information as you can is one of the tasks that must be accomplished. The concept behind the welding simulator system was to born a solution to the issue of student welding a bad weld. There may also be a methodology.

There will be a lot of information on the processes we made to develop our final project in this chapter. A flowchart outlining our entire project-making process will be accessible. The steps we conducted are detailed in this flowchart. The Gantt Chart follows, which will represent the major progress and planning throughout the course of the 13 weeks of our final project

3.2 FLOW CHART



3.3 FLOW CHART EXPLANATION

- **BACKGROUND RESEARCH**

In recent years, welding has risen to prominence as a key manufacturing and construction technique. Many different applications are employed by new students who want to learn how to weld. However, skilled welders must set up and oversee automated welding applications. Other welding uses aren't just limited to manufacturing floors. Applications, such as the building or construction of pipe lines, are welded on-site and demand the mobility of a skilled welder. As a result, there is a constant requirement for skilled workers who can adjust to the difficulties of welding procedures.

- **PROJECT INTRODUCTION**

The comparison of the simulators and the arc welding machine is that all the simulator is a simulator for the subject strength of material.

- **ANALYSIS DATA (SURVEY)**

The discussions were held with the supervisor first before it was done to the working group. The survey is more focused on the effectiveness of the clothes dryer system produced. The main purpose of conducting this survey is to enable us to gather feedback that will be received from those who use regarding the project we are running.

- **PROBLEM STATEMENT**

Learners need certain skills in order to weld. It is crucial that students have a working knowledge of Shielded Metal Arc Welding-related machinery (SMAW). One must be familiar with all of the tools and the proper techniques for handling the welding machine before or at the beginning of the practice.

- **OBJECTIVE**

Produce welding software that can help and facilitate users in learning how to weld more effectively. Also, Provide exposure and new learning experiences from design / studies that have been conducted.

- **LITERATURE REVIEW**

To acquire data and information on the project being developed, a literature review is performed. The projects being carried out directly or purely based on observations are more the focus of this study.

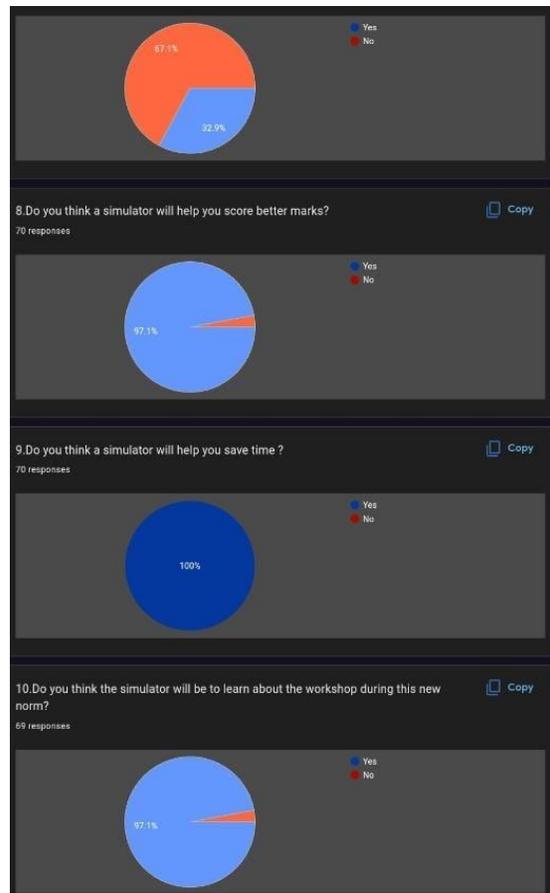
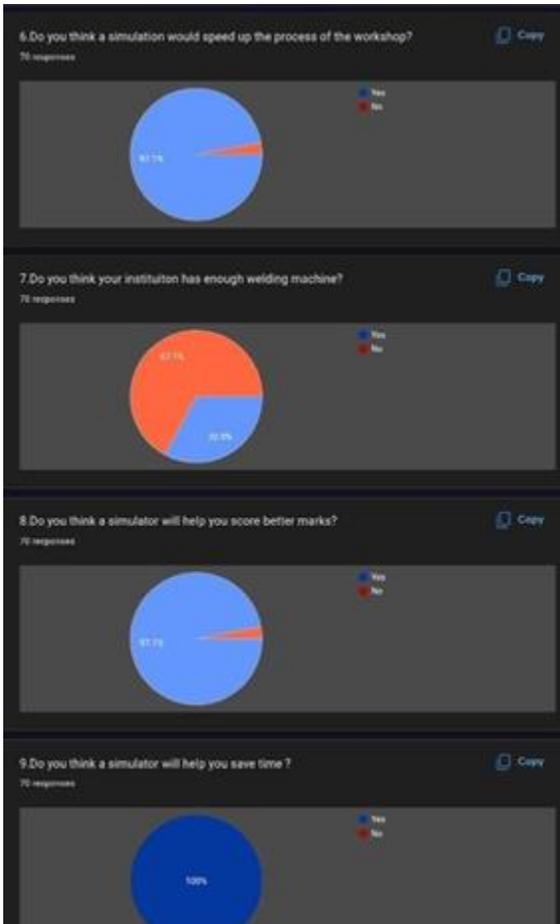
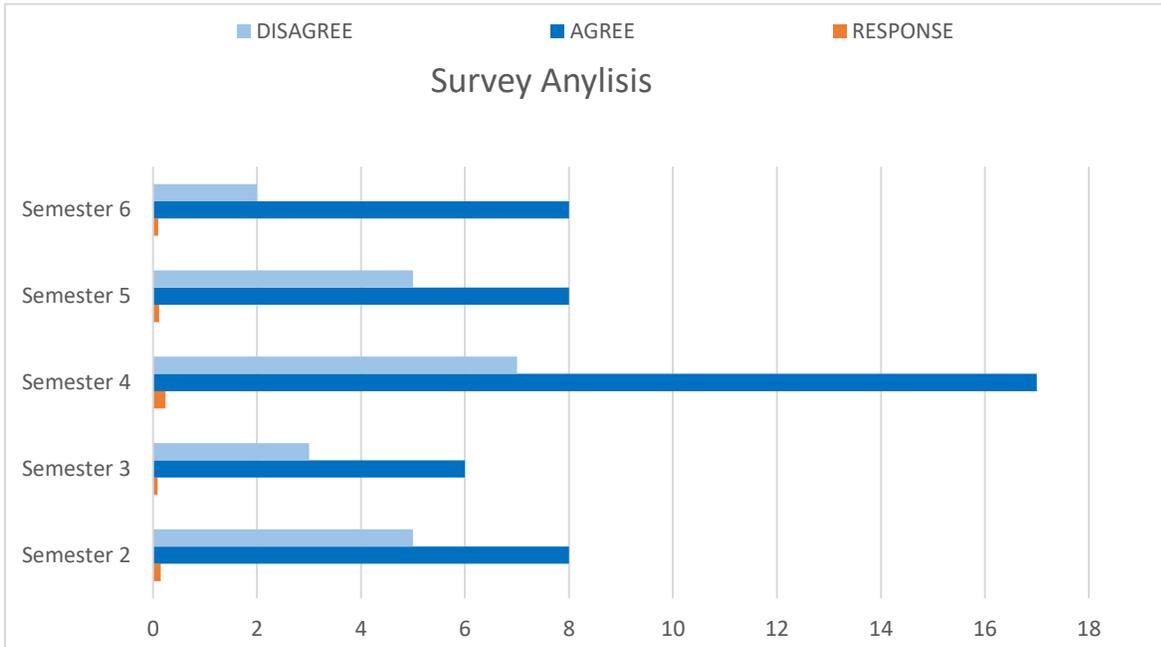
- **PROJECT TESTING**

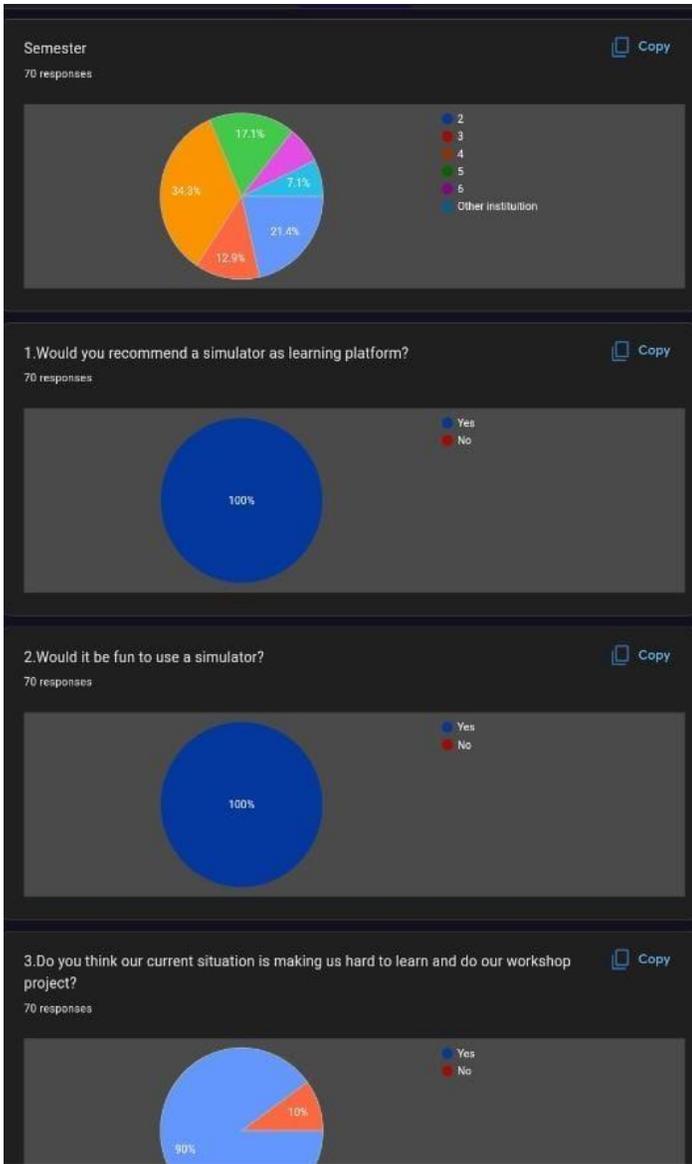
- To learn about the outcomes and issues the project encountered, testing needed to be done. Additionally, issues that emerge during testing can be identified before a product is released.

3.4 INTERVIEW AND RESEARCH

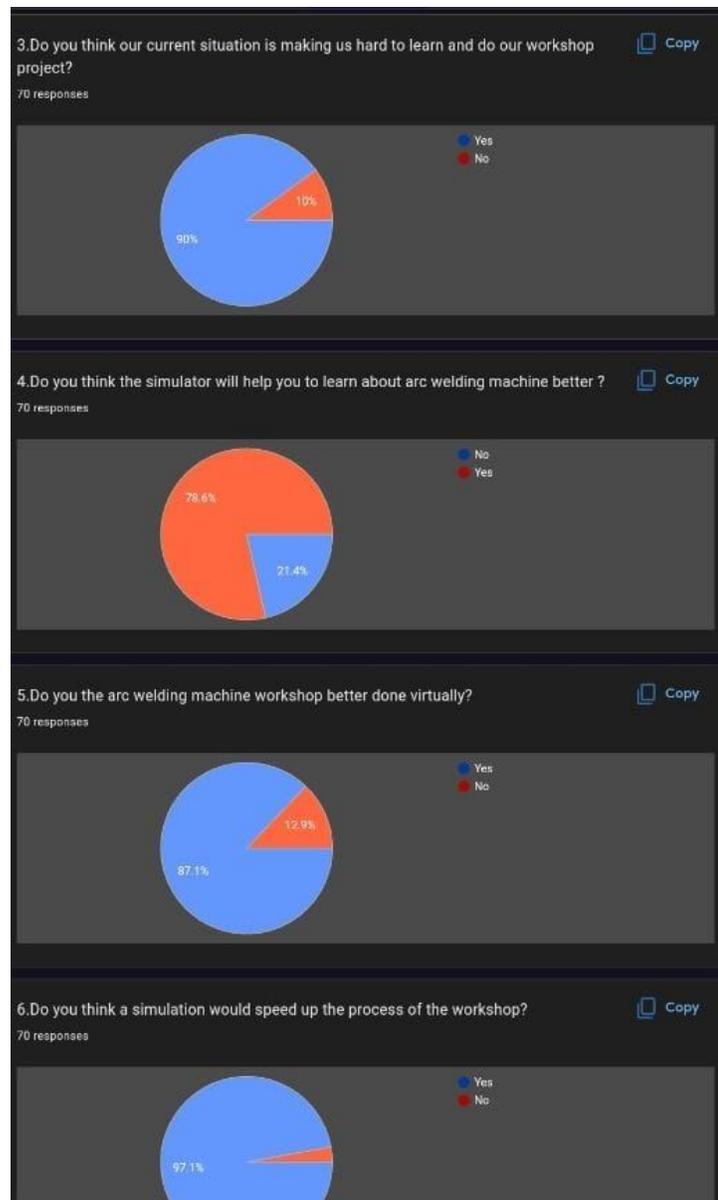
Modifications to earlier theses and publications on the arc welding simulator led to this interview and research. Before it had been done to the taskforce, discussions were first had with the supervisor. The efficiency of the produced arc welding simulator is the survey's main focus. The real aim of conducting this survey is to provide us the chance to gather user feedback on the project we are operating. Members of the group distribute survey forms at the housing site in order to conduct the survey. After a week, we've performed surveys and in-person and online interviews with the people involved. With that, the outcomes will be evaluated to provide us with recommendations, conclusions, and incentive for our final project. From the survey we did, we can conclude here that a simulator is a need for student. All the students that answered the survey recommend the simulator to be a learning platform and they also think it'd fun to use a simulator to learn. Not to deny the fact that there is lack of machine in the institution where students are unable to have hands on experiences.

3.5 SURVEY RESULT



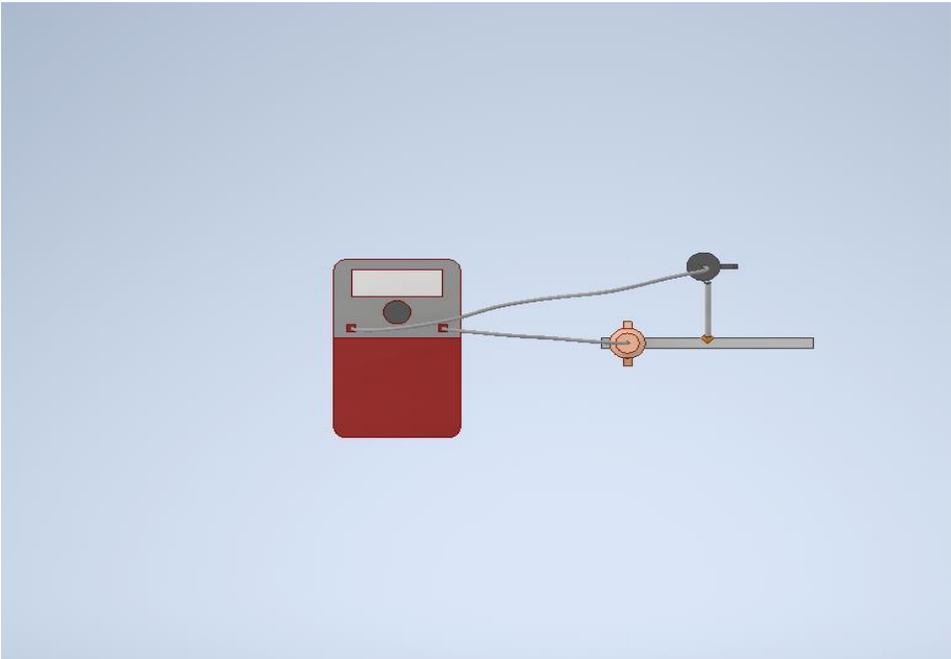


3.6

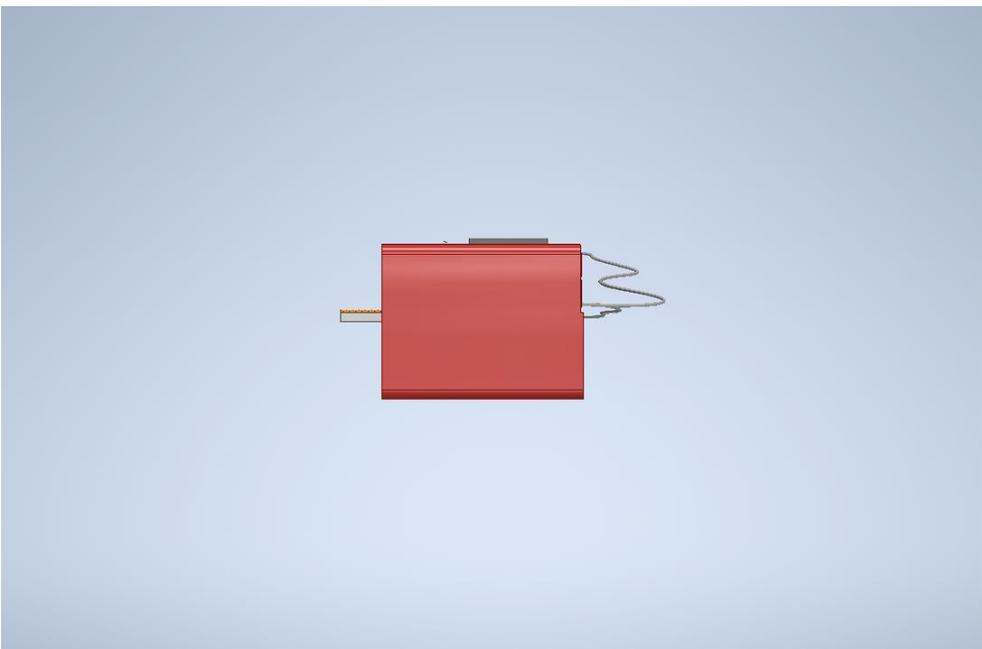


3.6 PRODUCT DESIGN

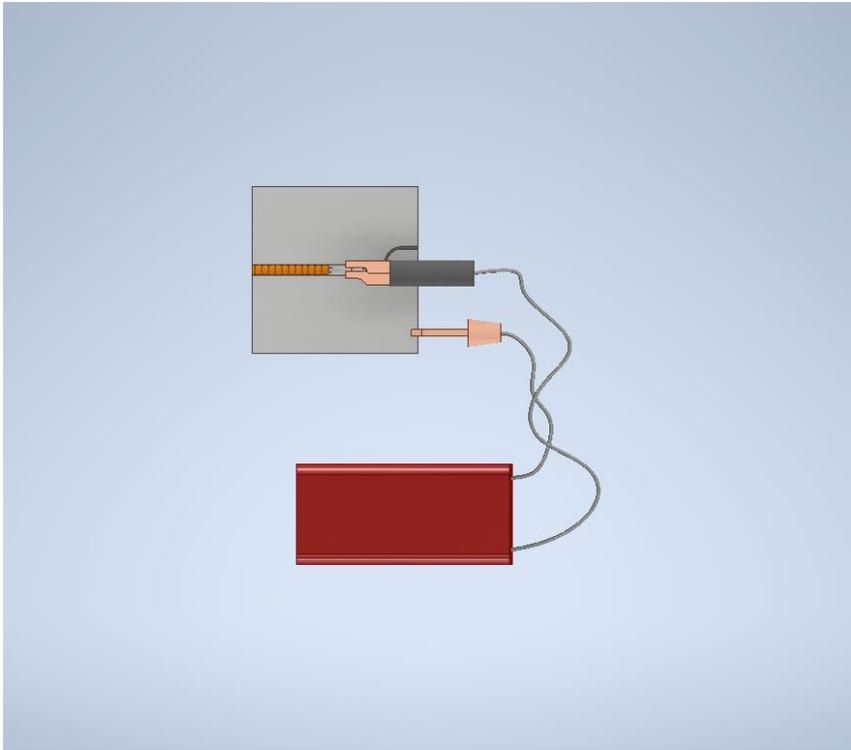
Side view



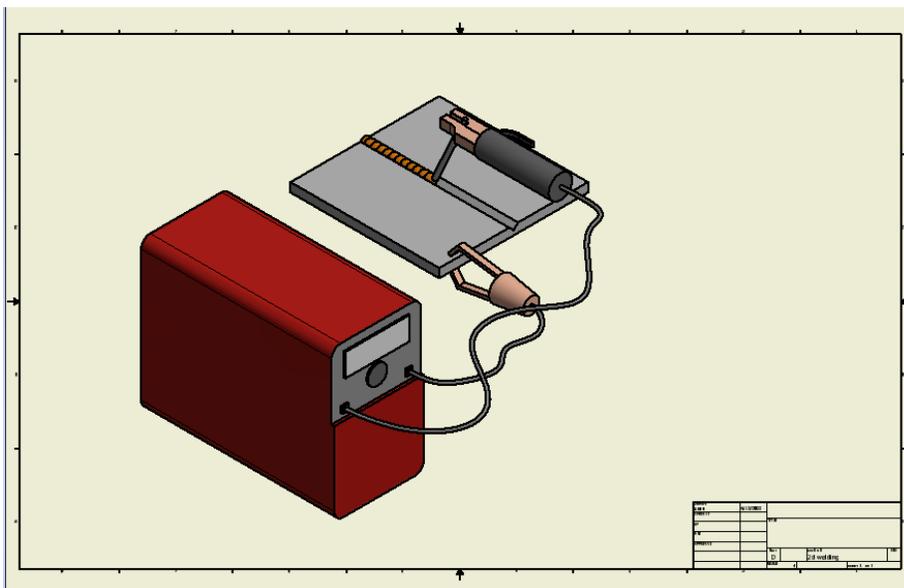
Front view



Top view



Orthographic view



3.7 GANTT CHART

GANTT CHART 1 (2022)																
Week /	Status	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Activities Status																
Student	P	█														
Registration	C	█														
Presentation of	P		█	█	█	█										
Ideas	C		█	█	█	█										
Preparing	P					█	█	█								
Proposal	C					█	█	█								
Survey / Design	P						█	█	█	█						
	C						█	█	█	█						
Literature	P						█	█	█	█						
Review	C						█	█	█	█						
Methodology	P										█	█				
	C										█	█				
Writing	P												█	█		
Proposal	C												█	█		
Presentation	P													█	█	
Proposal	C													█	█	
Submission	P															█
Proposal	C															█

P	PLANNING
C	COMPLETE

3.8 REFERENCE

<https://ehs.fullerton.edu/documents/library/Arc%20Welding.pdf>

<https://almacam.com/products/almacam-weld/>

<https://en.m.wikipedia.org/wiki/Welding>

<https://weldmart.com.my/product/welding-simulator/>

<https://weldguru.com/what-is-arc-welding/>

<https://www.keyence.com/ss/products/measure/welding/arc/mechanism.jsp>