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Innovation in the Utilization of Fashion Pattern-Based Technology Computer Aided Design

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ABSTRACT

The purpose of this study is to produce a video tutorial on making digital patterns in Men's Fashion that is feasible, practical and effective. This research was conducted to align the demands of the curriculum where students are required to be able to make fashion patterns using computer-assisted applications. The method used is a development research method consisting of three steps, namely instructional, develop and implementation. The results of the analysis of student needs were obtained 47.5% needed teaching materials in the form of video tutorials in making men's fashion patterns. Men's Fashion digital pattern making video tutorial is stated to be very feasible on video material aspect 0.87 and video feasibility 0.85. Men's Fashion digital pattern making video tutorials based on the responses of lecturers and students are declared very practical. Effective video tutorials can improve student pattern making skills results by 12.89%. Based on the research findings, it was concluded that this Men's Fashion digital pattern making video tutorial is feasible, practical and effective to be used as learning material in Men's Fashion courses at the college level. Digital fashion pattern making reduces errors in the pattern making process and provides more capabilities in terms of speed, cleanliness and accuracy of students in pattern making compared to conventional techniques.

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1. INTRODUCTION

The good shape of a garment when used one of them is influenced by whether or not the pattern applied to the clothing. Producing a good form of clothing is inseparable from the systematic making of patterns and the flexibility of the results of pattern lines. This is what fashion design students experienced for the 2021/2022 academic year, where from the results of making fashion patterns manually, there are many shortcomings in the results of patterns made by students. Starting from the accuracy in connecting pattern lines, the flexibility of the shape of curved pattern lines and cleanliness in making patterns [1] [2].

Furthermore, difficulties can be seen from diverse school backgrounds such as: General High School (SMA) both from the Department of Natural Sciences (IPA) and from the Department of Social Sciences (IPS), Madrasah Aliyah Negeri (MAN), Vocational High School (SMK) both from the Department of Fashion Design and other majors. This clearly makes the learning process and outcomes for students who do not have a SMK (Fashion Style) background have difficulty following learning. The origin of the Fashion Design student school for the 2021/2022 academic year can be seen in the **Table 1** [3]:

Table 1. Data on Schools of Origin of Class of 2021 Students

No	Origin of school	Many
1	SMK (Fashion Vocational High School)	34 people
2	SMK (Vocational High School Other Than Clothing)	6 people
3	High School (High School)	43 people
4	MAN (Madrasah Aliyah Negeri)	12 people
	Sum	97 people

From the table above, it can be seen that fashion design students are dominated by high school graduates. Following in second place, students graduated from SMK fashion design and then filled by students who graduated from MAN and SMK in addition to fashion design. The quality of student input greatly affects the learning process in the classroom. For students who graduated from SMA/MAN and SMK in addition to fashion design, lessons in making fashion patterns are new knowledge that must be trained in pattern making, while students graduating from SMK foam.

Digital pattern making is a solution in the learning process. The effective implementation of new technology can transform traditional processes and address long-standing challenges. An example of this technological integration can be found in the development of futuristic trash bins with an automatic sorting system, which helps address improper mixed waste disposal and enhances efficiency [4]. In light of this, digital technology enables students to create pattern lines and ensure the accuracy of pattern sizes according to the specifications on the work sheet by checking the sizes using tools on the RP-DGS. The competency results of students who use video tutorial learning media are better than the competency results of students who only use modules in the practice of making blouse patterns with CAD RP-DGS. The use of digital pattern electronic learning media has been tested for feasibility to be used as an independent student learning aid and teaching media for teachers who teach Industrial Fashion Making subjects, digital shirt pattern making materials [5].

From the **Table 2**, it can be explained that in the men's fashion course that gets a score range of 85-100 in the practice of making patterns manually as many as 40 people. Students who get

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scores ranging from 75-84 are 18 people. Students who get scores in the range of 65-74 as many as 8 people and students who get scores in the range of 0-64 as many as 31 people. In the student assessment, as many as 31 people were declared to have not passed the practice of making patterns manually. In brief interviews with several students who have taken menswear courses, students argue that the difficulty that students often encounter when making patterns manually is to form the flexibility of pattern lines accurately and the technique of making pattern lines precisely has not been understood [6].

Table 2. Results of Manual Pattern Making for 2021/2022 Students

No	Manual assessment of patterning practices			
	Grade 85-100	Grade 75-84	Grade 65-74	Grade 0-64
1	40 student	18 student	8 student	31 student

The findings of the empirical data above require an educator to innovate in the learning process so that findings like this are not found again. Therefore, the author makes a solution in the pattern making learning process that utilizes technological developments by using the Reachpeace-DGS application in pattern making. This application has had many positive effects in the pattern making process. This application aims to overcome errors in making patterns encountered manually with the help of the Reachpeace-DGS application. With the transformation of pattern making digitally, students' abilities and skills will increase thanks to the help of the Reachpeace-DGS application [7] [8] [9].

2. METHODS

Research and development is the term for this kind of study. Research and development is a research technique used to create a specific product and boost its efficacy [10] [11] [12] [13] [14] [15] See **Figure 1**.

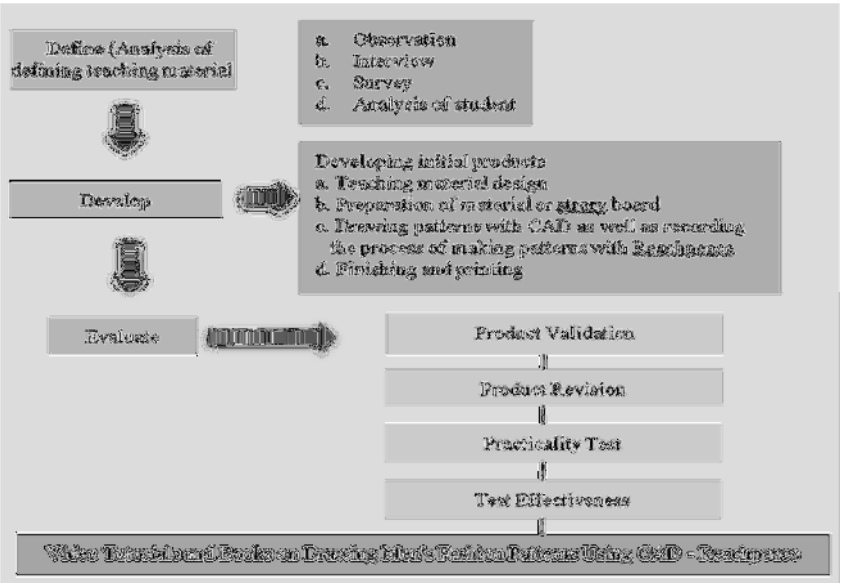


Figure 1. Research Procedure.

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2.1 Define

2.1.1. Observation

Observation activities are carried out to get an overview of the research activity plan to be carried out.

2.1.2. Interview

The interview was conducted to obtain in-depth data related to men's fashion courses. Interviews were conducted with lecturers and students who had taken men's fashion courses.

2.1.3. Survey

Survey activities include looking at learning activities, documentation and collecting supporting data needed.

2.1.4. Analysis of student

Analysis of student needs is carried out to obtain information related to what kind of learning media students want during the learning process.

2.2 Develop

2.2.1. Teaching Material Design

The first product development activity is to design teaching materials that will be used in men's fashion courses.

2.2.2. Preparation of material of strory board

After the teaching materials are designed, the material is arranged according to learning outcomes.

2.2.3. Drawing pattern with CAD

Creating patterns with the Reachpeace-DGS application while recording pattern making activities with the ultimate goal of producing a digital pattern making tutorial video.

2.2.4. Finishing dan printing

Finishing activities include setting video speed, video sound and duration.

2.3 Evaluate

2.3.1. Product validation

After the teaching material product has been made, then product validation is carried out to experts. Product validation is carried out to two experts, first material experts and two media experts.

2.3.2. Product revission

After validation with material and media experts. If there are improvements in accordance with expert comments, then the teaching material products are revised according to the suggestions.

2.3.3. Practicallity test

After the product is valid, trials are carried out for students and lecturers related to the practicality of the teaching materials made.

2.3.4. Test effectiviness

From the results of product trials with students, the effectiveness of the teaching material products developed was obtained.

2.4 Research Locations

Research location Design of CAD (Computer-Aided Design) Based Teaching Materials to Improve the Quality of Pattern Drawing in Men's Fashion Courses in the Fashion Education Study

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Program, Department of Family Welfare Education, Faculty of Engineering, Medan State University, Jl. Willem Iskandar Psr.V- Post Box 1589 Medan 20221.

2.5 Research Population

The research sample is a subset of the population chosen at random from the study population, which is made up of all students enrolled in the study program for fashion education in 2021. Students in the fashion education study program who completed men's fashion courses in the even semester of 2022/2023 and who passed the fashion archetype construction course are the respondents to this survey.

2.3 Develop Model

The IDI (Instructional Development Institute) model is applied in the development model. The three steps of the systems approach—define, develop, and evaluate—are established by the IDI model. [14]. The define stage is the first and includes the stages for problem identification, needs analysis, needs analysis, interviews, surveys, observations, and reference gathering. The second step, known as the develop stage, is when the product developed and the product generated are validated. The third stage is assessment, which includes trial procedures and trial outcome analysis.

2.6 Data Collection and Analysis Techniques

2.6.1 Validity Questionnaire

Validation questionnaires are used to determine the validity of the product developed The validation sheet contains several aspects of assessment of the components of teaching materials. There are two categories of validation questionnaires, namely content validity and media validity [16] [17].

2.6.1.1 Material validation questionnaire

The material validation questionnaire contains several validator responses to the suitability of the material in the teaching materials with the syllabus and RPS, the correctness of concepts that can be accounted for and the suitability of descriptions with indicators.

2.6.1.2 Media validation questionnaire

The validation questionnaire for learning media includes the opinions and comments of the validators. By examining quantitative data from validation questionnaires supplied to media and material specialists, quantitative descriptive analysis techniques are used to analyze validity data. Aiken's calculation's outcome has a range of values from 0 to 1, and the number 0.6 may be considered to have a high coefficient. Accordingly, the Validity value of 0.6 and above is expressed in the valid category [17].

2.6.2 Practicality Questionnaire

This practicality questionnaire is used to see the practicality of the teaching materials developed. This questionnaire contains assessment responses by lecturers and students who take men's fashion courses. Practicality analysis is obtained from data in the form of response sheets given to lecturers and students to the use of developed teaching materials, to analyze response sheets and students used descriptive analysis.

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$$NA = \frac{S}{SM} x100\%$$

2.6.3 Effectiveness Sheet

The efficacy sheet is calculated using the outcomes of manual pattern-drawing techniques and digitally created men's fashion patterns. The difference between the findings of the study of the assessment of pattern drawing abilities when done manually and when done digitally is used to calculate the percentage of media effectiveness.

3. RESULTS AND DISCUSSION

3.1 Results of the Needs Analysis

The survey was conducted by distributing online questionnaires to 40 students, the aim was to obtain information from trial students on what teaching materials were most dominantly in demand during the learning process of men's fashion courses, can be seen in the **Table 3**.

Table 3. Results of Needs Analysis

No	Content of the question	Survey results
1	Book/Jobsheet/Module/Handout PRINT version	35%
2	Book/Jobsheet/Module/Handout ONLINE version	17,5 %
3	Video Tutorial	47,5 %

From the results of the student needs analysis survey that 47.5% of students need video tutorials in making patterns in men's clothing courses. 17.5% of students need printed versions of teaching materials and 35% of students need online versions of teaching materials. So it was decided that the learning media made was a video tutorial in making patterns in men's fashion courses [17] [18].

3.2 Results of Material Validity Analysis

Validity of the digital pattern making tutorial video for this menswear course is data obtained through input from validators using questionnaires. The results of the digital pattern making video tutorial for menswear courses can be seen in the following **Table 4**:

Table 4. Results of Material Validity Analysis

No	Material expert validation		
	Question indicator	Score Obs 1	Score Obs 2
1	Adaptability of the content to fundamental skills	4	5
2	The information is understandable	5	4
3	The information is in line with the goals of learning	4	4
4	The learning video's subject matter is of an appropriate size	4	4
5	The learning video's lesson material adheres to the syllabus in terms of content.	5	4
6	This video tutorial's learning curve is obvious.	4	5
7	This educational movie may pique kids' interests.	4	4
8	This educational movie can help pupils study on their own.	4	4
9	In line with Indonesian laws, the language in the video is utilized.	5	5
10	Sentences include information that can guide students' activities.	5	4

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No	Material expert validation		
	Question indicator	Score Obs 1	Score Obs 2
	Score of each observer	44	43
	Average result achieved	43,5	
	Maximum point	50	
	43/50		
	Validity = 0, 87		

*Obs1=Observer 1, *Obs2=Observer 2

Validation of men's fashion course video tutorial material is given to material experts who understand studies in the field of men's fashion courses. The validation results from both experts obtained an average score of 0.87. In accordance with the results of Aiken's calculations ranging from 0 to 1, the number 0.6 can be interpreted to have a fairly high coefficient, then the Validation value of 0.6 and above is declared in the valid category [18].

3.3 Results of Media Validity Analysis

Media validation of men's fashion course video tutorials is obtained from media experts who understand studies in the field of learning media. The validation results of the three experts obtained an average score of 0.85. In accordance with the results of Aiken's calculations ranging from 0 to 1, the number 0.6 can be interpreted to have a high enough coefficient then the Validation value of 0.6 and above is expressed in the valid category, can be seen in the following **Table 5**:

Table 5. Results of Media Validity

No	Media expert validation			
	Question indicator	A	B	C
1	The content and cover picture choices support the information offered.	5	4	4
2	The lesson video's pictures are simple to grasp.	4	4	4
3	The image's look is consistent with its dimensions.	4	5	4
4	Students' attention may be drawn by the sight of this instructional film.	4	4	4
5	Front cover (text and picture layout) cover layout that is proportionate to the necessities	4	4	5
6	For lecturers and students involved in the learning process, videos can serve as an alternate instructional resource.	4	5	4
7	color, text, and picture choices made in accordance with requirements	4	5	4
8	The hue of the text does not interfere with vision.	4	4	5
9	adjusting the video text size as necessary	5	4	4
10	The lesson films' text and phrases are simple to read.	4	4	5
	The sum of each observer's score	42	43	43
	Average result achieved	42,7		
	Maximum point	50		
	42,7/50			
	Validity = 0, 85			

Media validation of men's fashion course video tutorials is given to media experts. The validation results from both experts obtained an average score of 0.85. In accordance with the results of Aiken's calculations ranging from 0 to 1, the number 0.6 can be interpreted to have a fairly high coefficient, then the Validation value of 0.6 and above is declared in the valid category [18].

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3.4 Results of Media Practicality Analysis

3.4.1 Results of Lecturer Practicality Analysis

The usefulness of created Men's Fashion video tutorials is connected to their usability. Data regarding practicality was gathered by having men's fashion course teachers complete surveys, can be seen in the following **Table 6**:

Table 6: Results of Lecturer Practicality Analysis

.No	Results of the analysis of lecturer practicality		
	Question indicator	Score Obs 1	Score Obs 2
1	Adaptability of the content to fundamental skills	4	4
2	The information is understandable.	5	5
3	The content complies with the learning objectives.	4	4
4	The lesson video's subject matter is of an adequate size.	4	4
5	The learning video's lesson material adheres to the syllabus in terms of content.	5	5
6	The learning path in the video is clear	4	4
7	Learning videos can interest students in learning	4	4
8	Learning via videos can help pupils progress independently.	4	4
9	The language in the video complies with Indonesian regulations.	5	4
10	Sentences include information that can guide students' activities.	5	4
	Score of each observer	44	42
	Average result achieved	43	
	Maximum point	50	
	44/50 X 100%		
	Practicality = 86%		

The results of the practical analysis of men's fashion course video tutorials were given to lecturers who taught men's fashion courses. Practicality questionnaires were given to two lecturers who taught men's fashion courses. The practical results of learning videos by lecturers who teach men's fashion courses get a score of 86%. From the results of the practical analysis of the use of video tutorials, this learning media is very practical to use in the practice of making patterns, especially in men's fashion courses [19] [20] [21].

3.4.2 Results of Student Practicality Analysis

The practicality of learning videos for men's fashion courses also requires a response from students. This data was obtained through questionnaires given to students after learning using learning videos for men's clothing courses, can be seen in the following **Table 7**.

The results of the practical analysis of men's fashion course video tutorials are also given to students who take men's fashion courses. A practicality questionnaire was given to all students who took men's fashion courses. The results of the practicality of learning videos by students received a score of 93.18%. From the results of the practical analysis of the use of video tutorials, this learning media is very practical to be used by students in the practice of making patterns, especially in men's fashion courses [22] [23].

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Table 7. Results of Student Practicality Analysis

No	Results of student practicality analysis				
		Number of scores obtained by each respondent			
	Valuation indicator	4	3	2	1
1	I can learn material for making men's fashion patterns digitally by using this video tutorial media.	14	27	-	-
2	Video tutorial media provides an opportunity to learn according to my ability.	14	27	-	-
3	I easily follow the steps of making men's fashion patterns digitally in this video tutorial media.	9	30	2	-
4	Video tutorial media provides an opportunity to learn according to my ability.	12	29	-	-
5	I know well the difference between making conventional menswear patterns and digitally	16	25	-	-
6	I think this Men's Fashion digital pattern making video tutorial media provides benefits in my scientific field.	21	20	-	-
7	In my opinion, making digital patterns can be used as guidelines in making clothes in accordance with growing fashion trends.	20	21	-	-
8	I'm more interested in creating patterns digitally than conventionally	9	23	9	-
9	Making patterns digitally is more efficient in terms of pattern results and processing time.	16	21	4	-
10	This digital pattern provides my creative and innovative space in developing various types of fashion patterns.	15	26	-	-
11	I want to learn continuously in the use and making of digital fashion patterns.	14	27	-	-
	Number of scores per interval	160	276	15	-
	Total score count	451			
	Average score	41			
	Maximum score	44			
	41/44 X 100%				
	Practicallity = 93,18 %				

3.5 Results of Media Effectiveness Analysis

Learning outcome data was taken to see the results of students' ability to make men's fashion patterns digitally. The results of the ability test are given to students by giving assignments in the form of making shirt patterns digitally using the body measurements used at the beginning of the practice of making manual patterns. This is done in order to be able to take a psychomotor assessment of the results of making manual patterns and digital patterns, can be seen in the following **Table 8.**

The results of the analysis of the effectiveness of the use of learning media obtained an average assessment of manual patterning skills of 75.17, while the average value of digital pattern-making skills was 88,047. Thus, there was an increase in the average results of student pattern drawing skills by 12.89%. The results of the analysis showed a significant increase in the ability of students in the process of making special patterns of shirt patterns that were used as test objects in this study [24] [25].

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Table 8. Results of Media Effectiveness Analysis

Responden	Pre test dan post test		
	Observation indicator	Average Pre test	Average Post test
1	Accuracy and flexibility of the neckline	75.86	89.65
2	Shoulder line precision and flexibility	71.96	82.75
3	Front and rear shoulder down precision	70.27	90.86
4	Accuracy and suppleness of arm convoluted lines	72.41	82.75
5	Accuracy and flexibility of body side lines	73.22	84.25
6	Precision and flexibility of shirt bottom lines	86.22	92.31
7	Accuracy and flexibility of arm pattern peak lines	69.41	82.75
8	Compatibility of arm coil circumference body pattern and arm pattern	89.65	86.28
9	The accuracy of the size of the body circumference in the pattern	62.08	93.12
10	The accuracy of the length of the shirt on the pattern	80.62	95.75
	Average	75.17	88.047
	88.047 – 75.17		
	Efektivity = 12.89%		

4. CONCLUSION

The design of learning materials in the form of pattern making video tutorials in men's clothing courses has a positive effect on the learning process. This innovation breaks the opinion that those who can make patterns quickly, precisely and accurately are only students who graduate from SMK fashion design. After going through the research process, it turns out that all graduates who study in the fashion design study program can make good fashion patterns. This fashion design study program is an applied science. Every applied science always has factors that affect the ability of students both internally and externally. One of the external factors is how an educator can increase the interest and motivation of students in learning. This digital pattern making tutorial video greatly contributes greatly to the learning process. Based on the research findings, it can be concluded that this Men's Fashion digital pattern making video tutorial is feasible, practical and effective to be used as learning material in Men's Fashion courses at the college level.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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Digitalization of Weight and Height Measurement at Posyandu

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ABSTRACT

To monitor child growth, parents must routinely bring their children to integrated health posts, where height and weight measurements of toddlers are taken. This activity is crucial for monitoring development and detecting stunting. However, field challenges often arise, as integrated health post cadres struggle with calibrating and reading measurement results, particularly when dealing with uncooperative babies, which affects the accuracy of recording. This study aims to design and develop a tool to enhance the accuracy of height and weight measurements at integrated health posts. The tool employs a load cell sensor to measure weight, an ultrasonic sensor to measure height, and an ESP32 microcontroller to manage the circuit, with RFID for input processing. Measurement results are displayed on an LCD screen. The research methodology involves designing, creating, and implementing a moving average program for the measuring device. This research contributes to science and technology by applying Industry 4.0 technologies in public health. The study's findings will be published in a SINTA-accredited scientific journal and will serve as a digital measurement tool for integrated health posts.

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1. INTRODUCTION

Posyandu is a form of Community-Based Health Effort (UKBM) managed and organized by the community to implement health development, aiming to empower the community and facilitate access to basic health services, especially to accelerate the reduction of maternal and infant mortality rates [1] [2]. Additionally, the government is actively working to combat child stunting [3][4]. Research by Daracantika indicates that one in three children in Indonesia is categorized as stunted [5]. According to Nutritionist Dr. Laila Hayati Sp. G (K), nutritional disorders in children can be prevented through regular monitoring of body mass and height, calculating the child's Body Mass Index (BMI) consistently, engaging in routine activities three to five times a week, and managing children's diets [6].

This underscores the need for effective monitoring of children's growth and development [7]. Currently, monitoring toddler nutrition at Posyandu involves measuring body mass and length using conventional scales and meters, which results in a time-consuming process [8] [9]. This situation presents a challenge to develop a more optimal, accurate, safe, comfortable, and efficient measuring tool [10]. The goal is to create a single device that integrates both body mass and height measurement systems, using strain gauge sensors and ultrasonic transducers for evaluating toddler nutrition.

2. METHODS

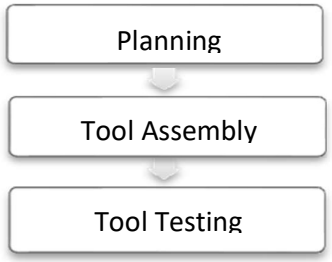


Figure 1. The research stages outlined in this section describe the methods used in the study.

From the problems described above, the approach taken to solve the problem was to design an automatic tool for measuring the weight and height of toddlers. The research stages to be carried out are outlined in **Figure 1**. The stages are as follows:

1) Planning

During the design stage, technical designs for measuring both the weight and height of toddlers will be developed [11] [12]. This stage involves three main components: electronic hardware design, software design for the microcontroller, and the mechanical system for measuring the height and weight of toddlers [13].

2) Tool Assembly

At this stage, the tools will be assembled according to the designs that have been developed [14] [15].

3) Tool Testing

This is the final stage before field implementation [16]. The tool will first undergo calibration [17]. For the body mass sensor, a manual scale will be used as a calibration

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benchmark. For the body length sensor, the ruler will be tested for functionality and reliability until it is deemed suitable for application directly in the Posyandu (integrated health service post).

2.1. Block Diagram

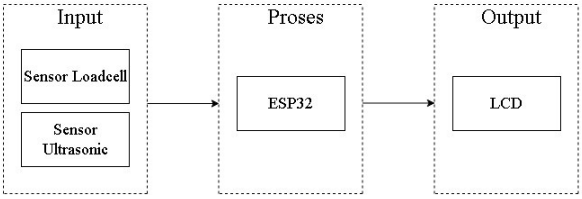


Figure 2. Diagram Block System

The components that constitute a digitalization system for measuring weight and height at the Posyandu can be grouped into three parts: input, process, and output. The block diagram of the prototype system for digitizing weight and height measurements is illustrated in **Figure 2**.

2.2. Design

1) Electronic Hardware Design

In the Electronic Hardware Design phase, the first step is to determine the specifications required by the system [18][19]. Next, the series of tools to be created are planned by selecting appropriate components and ensuring the correct voltage and current levels for the equipment [20]. An illustration of the electronic hardware design can be seen in **Figure 3**.

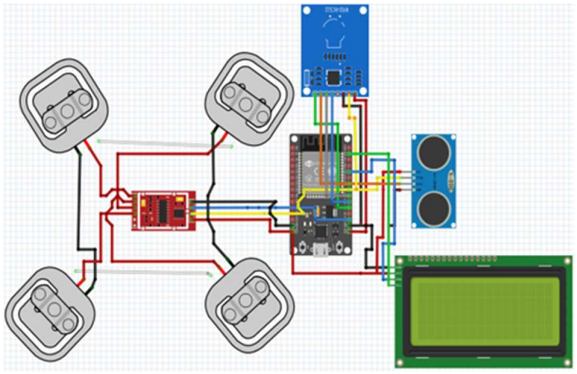


Figure 3. Wiring Circuit

2) Microcontroller Program Design

The software design involves programming the ESP32 microcontroller using C++. The text editor used for designing this microcontroller program is the Arduino IDE sketch, which is the default Arduino programming application and includes a feature to directly upload the program code to the ESP32. For details on the microcontroller program design process, refer to **Figure 4**.

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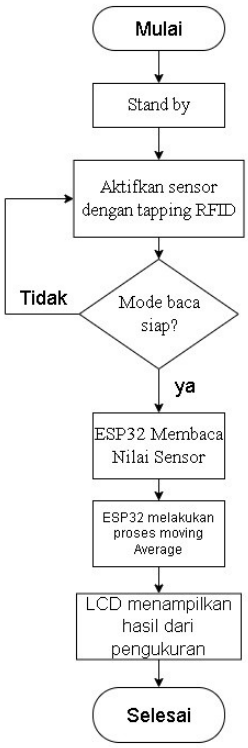


Figure 4. Flowchart System

3) Mechanical design of measuring instruments

At this stage, the design of a tool for measuring the weight and height of toddlers is explained. This explanation facilitates understanding of the tool that will be developed in this research [13]. Below are the results of the tool design drawings:



Figure 5. Tool's Design

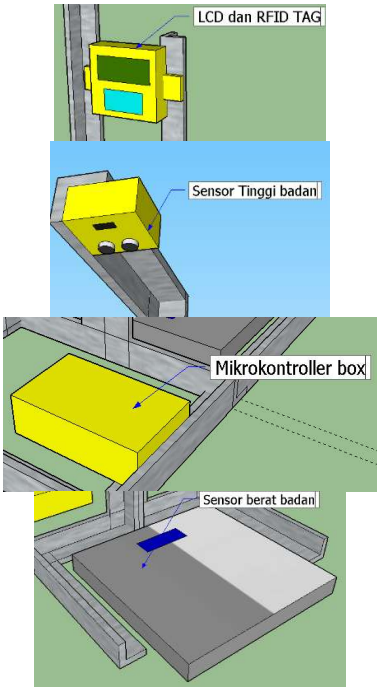


Figure 6. Design and Microcontroller

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In **Figure 5** and **Figure 6** above, the overall design of the toddler weight and height measuring device is shown. It can be seen in **Figure 2**. In the first row, there is a design image of a height sensor that contains an HC SR-04 ultrasonic sensor. In the second row, there is an RFID tag and display screen which contains an RFID mfrc-522 sensor and a 20x4 LCD along with its i2c. In the third row, there is a microcontroller box that contains an ESP32 microcontroller and an HX711 module, and in the fourth row, there is a weight sensor that contains a sensor.

3. RESULTS AND DISCUSSION

3.1. Tool Assembly

1) Electronic Hardware Assembly

In the process of assembling electronic hardware, the first thing to do is to make a casing to protect the components, making this casing using a 3d printer. The casing has protected the components, the next step is to do the wiring of each electronic hardware where each module and sensor are connected to the ESP32. Refer to **figure 7** and **figure 8**.



Figure 7. Assembly of ultrasonic sensors, LCD, and RFID

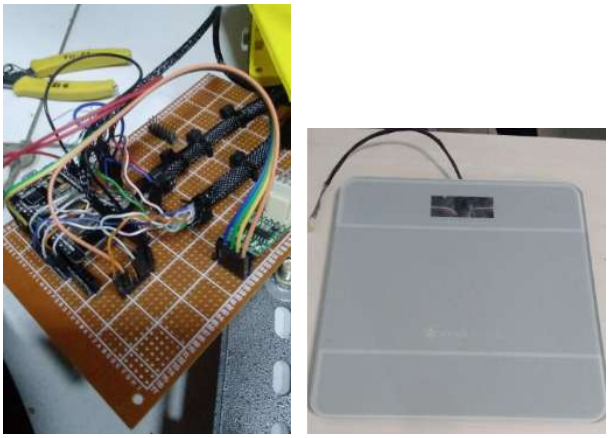


Figure 8. Assembly of Load cell sensors, hx711, and ESP32

2) Microcontroller Program Assembly

In the assembly stage of the microcontroller program, the first step is to install the Arduino IDE application. Next, install all the necessary initialization requirements for each module or sensor that will be used. The final step is to create a program using C++ that is tailored to meet the desired objectives.

3) Mechanical Assembly of the Measuring Tool

In the process of assembling the mechanics of the measuring instrument, the first step is to design the frame and dimensions according to the requirements. Next, gather the tools and materials needed to construct the frame. The frame, which supports each sensor and

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the LCD, is made using perforated angle iron. An image of the toddler's weight and height measuring instrument can be seen in **Figure 9**.

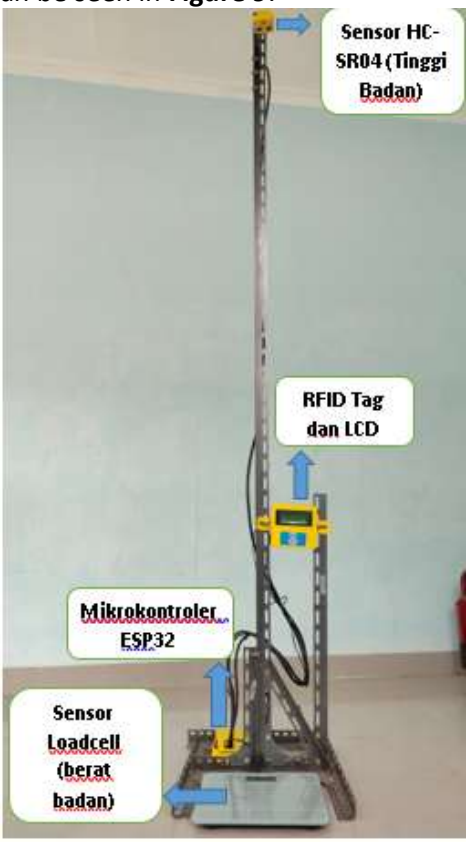


Figure 9. Measuring instrument for toddlers' weight and height

3.2. Testing

Sensor testing is conducted to determine the accuracy of the sensor measurements. Of the two types of sensors to be tested—height sensors and weight sensors—only the testing and validation for the height sensor have been completed. The results of the height sensor test are shown in **Table 1**. Meanwhile, the results of the weight sensor test will be displayed in **Table 2**. The following are the results of the distance sensor test, which will be used as a height-measuring tool.

1) Testing of the height sensor

Table 1. Results of the HC-SR04 Ultrasonic Sensor Testing.

Measurement Distance (cm)					
Ruler Distance	**Measure Element 1**	**Measure Element 2**	**Measure Element 3**	**Average Measurement**	**Average Error (%)**
30	29,6	30,2	30,4	30,068	1,11%
40	39,7	39,5	40,1	39,7	0,75%
50	50,7	50,2	50,5	50,46	0,993%
60	60,4	59,7	60,0	60,03	0,39%
70	69,1	70,1	69,6	69,60	0,647%
80	81,3	81	80,5	80,93	1,167%

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90	90,7	90,9	90,4	90,60	0,74%
100	100,9	101,5	100,8	101,08	1,067%
110	111	111,6	110,7	111,10	0,67%
120	121.8	119,8	120,7	120,50	0,75%

Table 1 shows the results of the height sensor measurement test. The data were collected at 10-cm intervals within a height range of 30 centimeters to 1.2 meters. At each measurement point, three readings were taken, and the average value was calculated. The results indicate that the average error in the height sensor test is 1.1%, which is below the target error specification of 5%. The graph for measurement test can be seen in **Figure 10.**

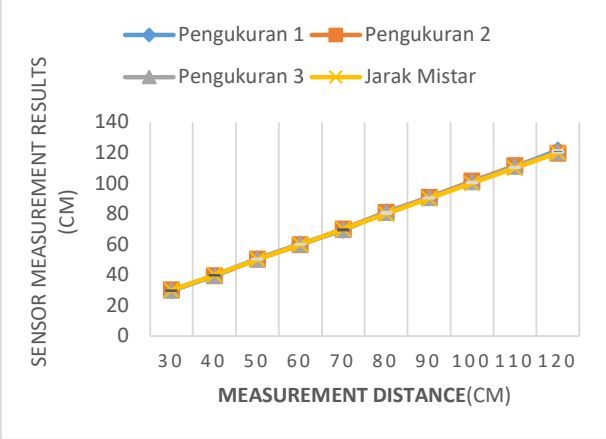


Figure 10. Distance Sensor Testing Graph

2) Weight Sensor Testing

Table 2. Results of the Load Cell Sensor Testing

Measurement Period (KG)					
Body Weight	**Measure Element 1**	**Measure Element 2**	**Measure Element 3**	**Average Measurement**	**Average Error (%)**
5	5,14	5,1	5	5,08	1,60%
10	10,25	9,99	10,09	10,11	1,17%
15	15,18	15,2	14,97	15,12	0,91%
20	20,17	19,97	20	20,05	0,33%
25	25,19	25,3	24,95	25,15	0,72%
30	30,5	31	30,9	30,80	2,67%
35	36,1	34,2	35	35,10	1,81%
40	40,19	40,1	40,28	40,19	0,48%
45	40,5	45,61	45,7	45,60	1,34%
50	50,18	49,98	50,25	50,14	0,30%

Table 2 shows the results of the Load Cell Sensor Measurement Test. The data were collected at 1 kg intervals within the 3 kg to 12 kg range. At each measurement point, three readings were taken, and the average value was calculated. From these measurements, it can be concluded that the average error of the load cell sensor test is 2.67%, which is below the target error specification of 5%.

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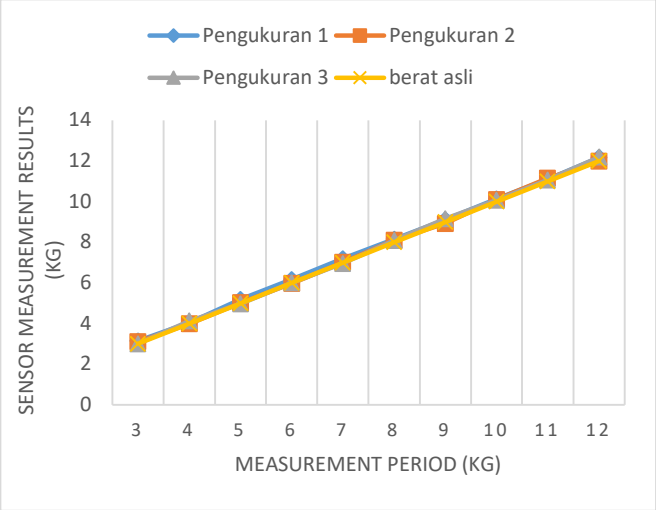


Figure 11. Comparison of the Load Cell with a Standard Scale

In **Figure 11**, you can see that the measurements from the ruler serve as a reference for the load cell sensor. The results from the three measurements consistently match and increase, which is due to the increasing mass. It can be concluded that the error in the sensor measurements is not always linear and tends to be greater as the distance between the object and the sensor increases.

4. CONCLUSION

Based on the research conducted, it was concluded that height and weight measurements can be performed using an automated measuring tool. The height sensor has a measurement range of 30 cm to 1.2 meters, while the weight sensor has a range of 3 kg to 12 kg. The average error for the height sensor test results is 0.75%, and for the weight sensor testing, it is 1.13%.

For the distance used as a height sensor and the mass used as a weight sensor, the average error is below 2%. These results indicate that the sensor is suitable for use as a height-measuring tool. However, the frame design still requires improvements, particularly regarding the durability of the frame, which needs to be stronger. Weight sensor testing will be conducted in the next stage. The application development is expected to be completed by early December.

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Prototype Design of Automatic Irrigation System for Precision Agriculture Application Using Mamdani Fuzzy Logic Controller

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ABSTRACT

Precision Agriculture aims to make every determining variable in agriculture measurable and used precisely or efficiently to maximize agricultural productivity, so we intend to develop smart irrigation systems that are controlled based on soil humidity and temperature level using Fuzzy Logic to improve water use. This study aims to design, implement, and evaluate an automated system capable of real-time monitoring of soil moisture and temperature conditions to regulate crop irrigation. This research utilizes soil moisture and temperature sensor technology connected to a system controller. The data obtained from these sensors is processed using a fuzzy logic approach to decide the amount of water that must be distributed to the plants. The fuzzy logic concept is used to handle uncertainty and ambiguity in sensor data, allowing the system to make irrigation decisions that are more adaptive and responsive to changes in soil conditions. Our experiment was tested in a lab-scale agricultural environment, and the evaluation results showed that this automatic irrigation system is capable of providing more efficient and timely irrigation according to crop needs. The results of the Fuzzy Logic Implementation concept using low-cost components to automate the irrigation system are possible and pave the way for wider use of agricultural water management in barren or arid areas and precision agriculture environment systems.

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1. INTRODUCTION

Agriculture is one of the main sectors in human life that are affected by environmental factors, especially the proper supply of water and soil conditions. One example is the rice paddy sector, which receives water that does not match the required soil moisture and temperature accuracy, necessitating improvement to manage water resources effectively. Furthermore, if resources are well-managed, the agricultural sector will improve [1]. In efforts to enhance agricultural yields and resource use efficiency, the development of automatic irrigation systems that detect soil moisture and temperature is increasingly needed [2]. Soil moisture control according to plant requirements is conducted by watering when the soil moisture and air temperature do not meet the expected levels and stopping watering when sufficient moisture is detected, using fuzzy logic methods [3]. This research discusses the design, implementation, and testing of such a system. The automatic irrigation system is tailored to the needs of rice plants based on soil moisture. This system is beneficial for automatic irrigation and saves labor and time in watering rice plants [4].

The integration of soil moisture and temperature sensor technology with fuzzy logic provides a solid foundation for developing intelligent irrigation systems. This is expected to increase water use efficiency, promote balanced plant growth, and provide a better understanding of plant water needs under various environmental conditions [5][6][7]. The research utilizes electronic components with an ESP32 microcontroller, soil sensor, DHT11, relay to switch electrical currents, water pump, and LCD as output. It is hoped that this research will be beneficial for a wide audience, from the agricultural sector to education, for future research applications.

2. METHODS

The methods discussed in this research include problem identification, literature review, device design, prototype development, prototype testing, and prototype evaluation. The design process for creating the prototype begins with block diagrams, flowchart diagrams, wiring diagrams, and fuzzy logic designs for the device.

2.1. Research Flow

The research flow outlines the steps to research and create a prototype to ensure the research stays on track and does not deviate from the plan. The researcher begins by identifying the problem and then conducts a literature review on similar devices. After the literature review, the next step is to design the device and build a prototype according to the planned design. The device is then tested and evaluated for further improvements. The Research Flow is shown schematically in **Figure 1.**

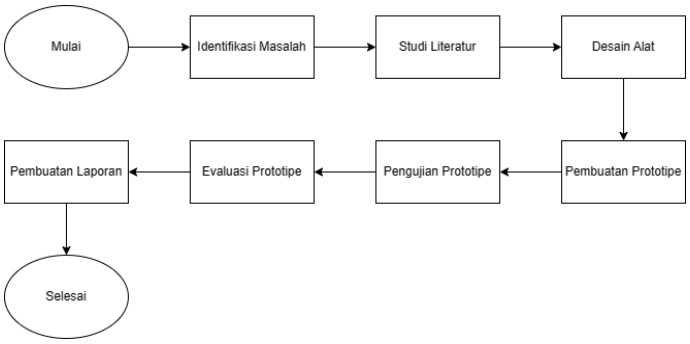


Figure 1. Schematic diagram of Research Flow.

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2.2. Problem Identification

The agricultural sector currently still uses manual and natural irrigation systems, relying on natural resources. This makes the irrigation system unregulated and less accurate in agricultural irrigation using water resources [8]. Often, the water received does not match the required soil moisture and temperature, necessitating improvement for better water resource management.

2.3. Literature Review

The agricultural sector currently still uses manual and natural irrigation systems, relying on natural resources.

2.3.1. ESP32

ESP32 is a microcontroller developed by Espressif Systems. This microcontroller has various features that allow it to be used in various electronic applications, especially in Internet of Things (IoT) projects [9]. With many advantageous features at an affordable price, ESP32 has dual-core capabilities and larger memory. In this research, ESP is used because of its features and the availability of ESP32, which supports software and IoT project users [10].

2.3.2. Capacitive Soil Sensor

A soil sensor is a type of sensor used to measure soil moisture levels. Its working principle is based on changes in soil capacitance correlated with soil moisture [11][12]. Capacitive soil sensors use electrodes embedded in or around the soil [13][14]. When the soil contains water, the capacitance (capacity to store electric charge) around the electrodes changes. When the soil is dry, the capacitance is low, while when the soil is wet, the capacitance is high.

2.3.3. DHT11 Sensor

DHT11 is a simple and easy-to-use temperature and humidity sensor. This sensor is often used in DIY (Do It Yourself) projects and various electronic applications that require temperature and humidity monitoring. In this research, DHT11 is used as a temperature sensor for soil and air [15].

2.3.4. Relay

A relay is an electronic component that acts as a switch that can be automatically activated or deactivated by electrical signals from control devices such as microcontrollers, sensors, or other devices. When an electric current passes through the relay, it can change the state of its contacts from open to closed or vice versa, depending on the signal given to the relay. Relays typically have two states, open and closed [16]. When a relay is activated through an electrical signal, its contacts switch to the opposite state.

2.3.5. Water Pump

A water pump is a component used to move water from one place to another. The water pump works by converting electrical energy into mechanical energy to move water through pipes or channels [17]. When the pump is turned on, the motor starts spinning and drives the impeller inside. This spinning motion causes the surrounding water to enter the pump through the intake channel. The impeller then pumps the water out through the outlet channel, moving it to the desired location.

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2.3.6. Fuzzy Logic

Fuzzy logic is an algorithm with a computer science and mathematics approach similar to human thinking in making decisions in uncertain or gray areas. This concept departs from conventional logic that considers something only true or false [18]. In general, fuzzy logic extends the thinking framework in describing problems that do not have clear boundaries between conditions. This helps us handle uncertainty and ambiguity in decision-making. Fuzzy logic is widely used in control systems with uncertain conditions, such as room temperature control, car braking systems, or washing machine control systems [19][20].

2.4. Block Diagram

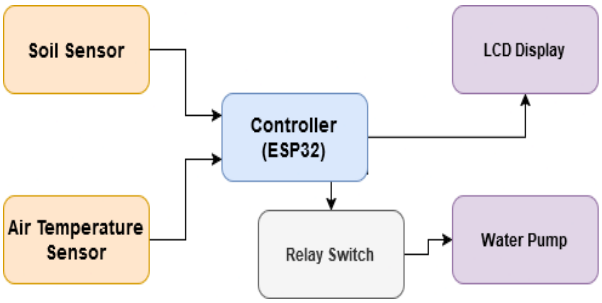


Figure 2. Block Diagram.

Figure 2. A block diagram representing the graphic depiction of the system or process functions, elements, or components in the automatic soil moisture and temperature irrigation system. Initial interactions from the sensors and fuzzy logic to the microcontroller are processed in the ESP32, then the data is sent to the LCD and relay to be forwarded to the water pump.

2.5. Flowchart Diagram

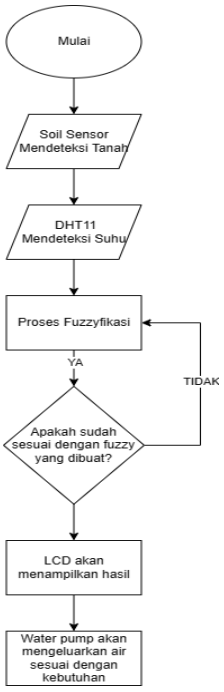


Figure 3. Flowchart

Figure 3. The flowchart above shows the working procedure of the automatic irrigation system during the irrigation conditioning process. The system starts the flow by reading

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sensor detections, which are then processed using fuzzy logic with the established conditions. The output will then appear on the LCD and the water pump according to the results of the fuzzy processing.

2.6. Wiring Diagram

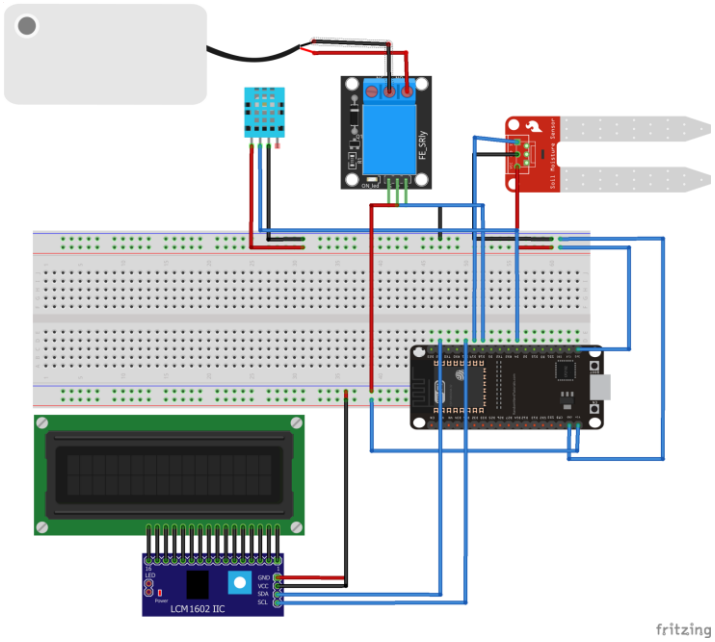


Figure 4. Wiring Diagram

Figure 4. The wiring diagram above shows the wiring design to connect one component to another. This wiring diagram also functions to identify the connections and interactions that occur, which will then be adjusted according to the algorithm.

2.7. Architecture Diagram

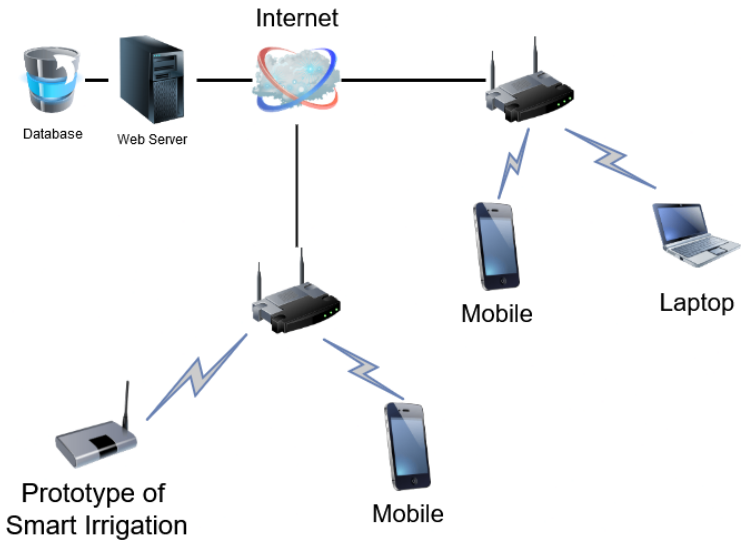


Figure 5. Architecture Diagram

Figure 5. The architecture diagram above represents the relationships or connections in the design system. The components used in this prototype development include the ESP32

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microcontroller, Capacitive Soil Sensor, DHT11 Sensor, LCD, Relay, and Water Pump, as well as a 5 Volt Adapter as the power source.

2.8. Implementation of Fuzzy Logic

The implementation of fuzzy logic in MATLAB involves several stages. Here are the steps for fuzzy logic implementation.

2.8.1. Fuzzification

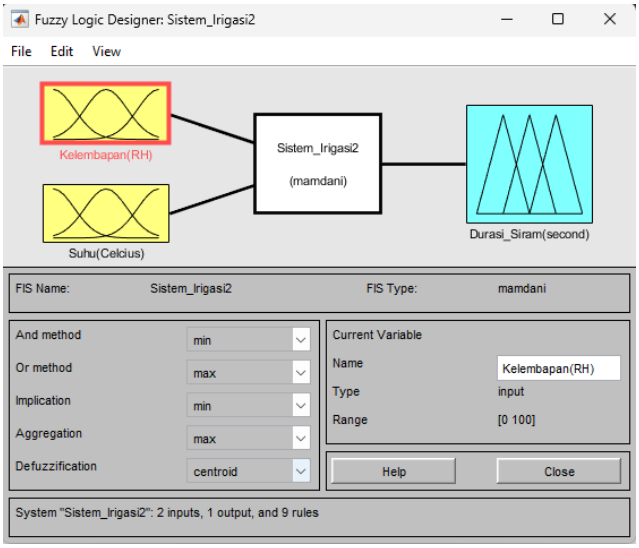


Figure 6. Fuzzification MATLAB

Figure 6. The fuzzification above includes inputs for humidity (RH) and temperature (Celsius), which will produce a watering duration using the Mamdani method.

2.8.2. Membership Function

1. Humidity (Input)

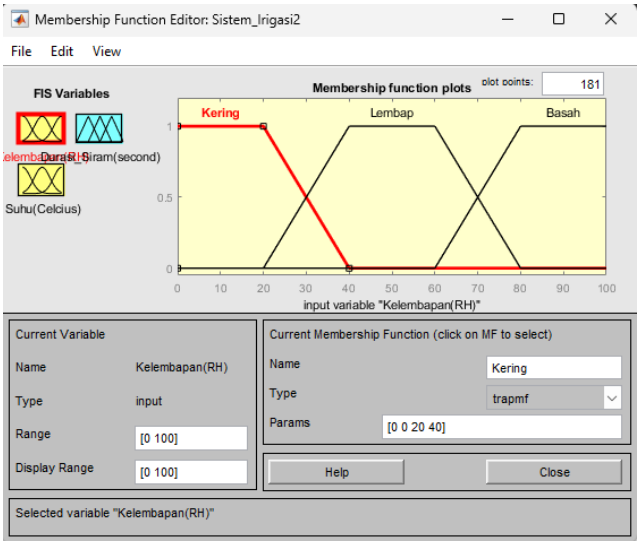


Figure 7. Membership function for Humidity

Figure 7. the input for humidity has the following ranges

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In the image above, the input for humidity has the following ranges: Dry [0 0 20 40], Moist [20 40 60 80], and Wet [60 80 100 100].

2. Temperature (Input)

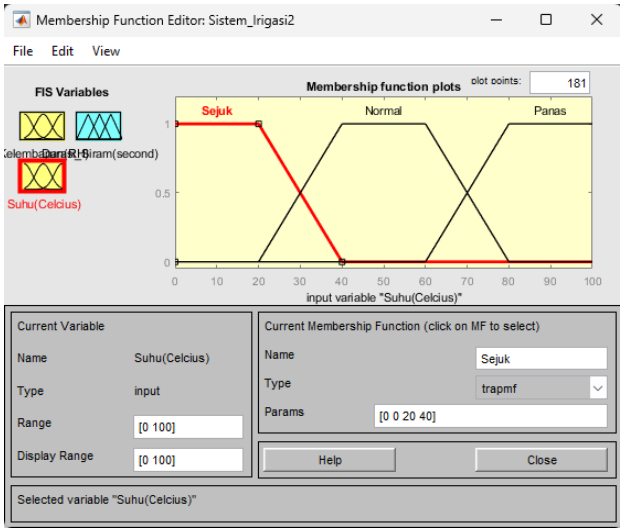


Figure 8. Membership function temperature

Figure 8. the input for temperature has the following ranges: Cool [0 0 20 40], Normal [20 40 60 80], and Hot [60 80 100 100].

3. Watering Duration (Output)

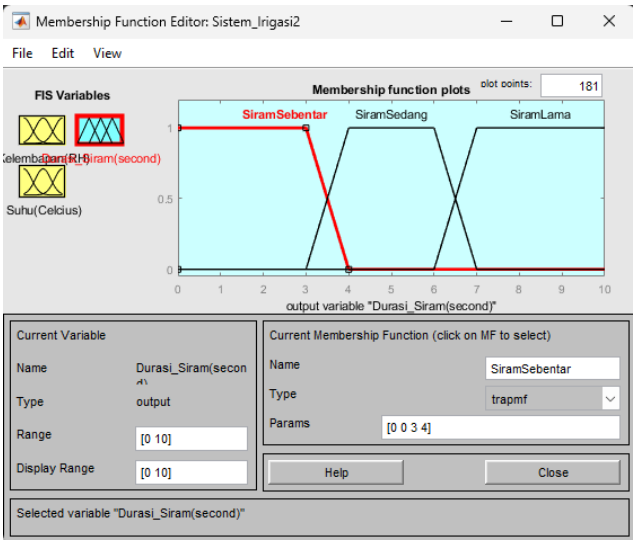


Figure 9. Membership function Durasi_Siram

Figure 6. the output is Durasi_Siram or the duration for watering the plants. It has the following ranges: Siram Sebentar (Short Watering) [0 0 3 4], Siram Sedang (Medium Watering) [3 4 6 7], and Siram Lama (Long Watering) [6 7 10 10].

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2.8.3. Fuzzy Interface

1. Fuzzy Rules

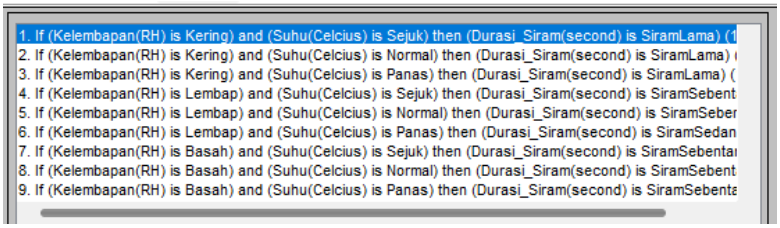


Figure 10. Fuzzy Rules

Figure 10. In the image above, the fuzzy rules for the two inputs, humidity and temperature, are shown, resulting in the output Durasi_Siram (Watering Duration). There are 9 rules, each with 3 conditions.

2. Tabel Interface

	Suhu Sejuk	Suhu Normal	Suhu Panas
Kelembapan Kering	Siram Lama	Siram Lama	Siram Lama
Kelembapan Lembap	Siram Sebentar	Siram Sebentar	Siram Sedang
Kelembapan Basah	Siram Sebentar	Siram Sebentar	Siram Sebentar

Figure 11. Tabel Interface

Figure 11. The Interface Table for conditioning humidity with ranges dry, moist, and wet, then temperature with ranges cool, normal, and hot, producing the output for watering duration with ranges long, medium, and short.

2. Defuzzification

The defuzzification stage results from the trials of each condition set in the fuzzy interface stage.

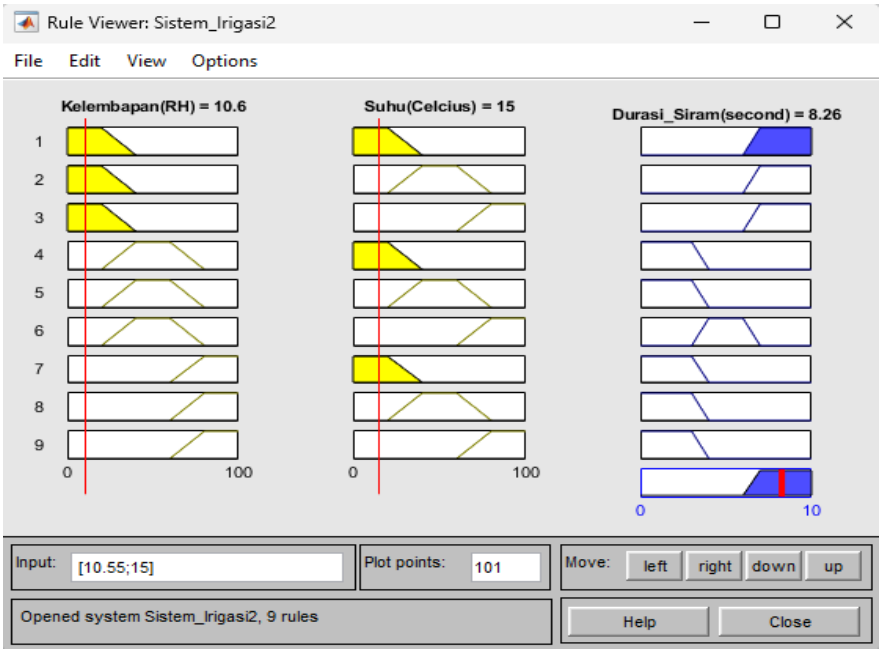


Figure 12. (a) Defuzzification with the rule [If (Humidity(RH) is Dry) and (Temperature_(Celsius) is Cool) then (Watering_Duration is Long_Watering)]

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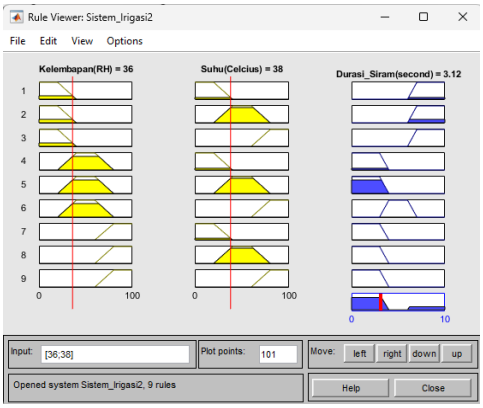


Figure 13. (b) Defuzzification with the rule [If (Humidity(RH) is Moist) and (Temperature_(Celsius) is Normal) then (Watering_Duration is Medium_Watering)]

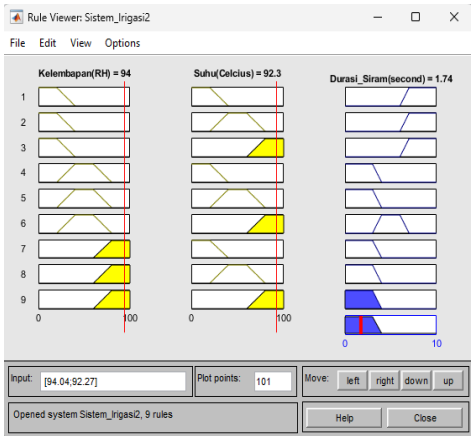


Figure 14. (c) Defuzzification with the rule [If (Humidity(RH) is Wet) and (Temperature_(Celsius) is Hot) then (Watering_Duration is Short_Watering)]

3. RESULTS AND DISCUSSION

3.3. Testing Results on the Device

Table 1. Test result on device

Humidity (RH)	Temperature (Celsius)	Watering Duration (seconds)	Conformity
36.00	29.30	3.61	Discrepancy in interval value > 2
37.00	29.80	3.33	Discrepancy in interval value > 2
37.00	30.80	3.26	Discrepancy in interval value > 1
59.00	30.80	1.87	Discrepancy in interval value > 3
38.00	30.80	2.88	Discrepancy in interval value > 2
36.00	30.80	3.59	Discrepancy in interval value > 1
36.00	30.20	3.67	Discrepancy in interval value > 2

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3.4. Testing Results on MATLAB

Table 2. Testing Results on MATLAB

Humidity (RH)	Temperature (Celsius)	Watering Duration (seconds)	Conformity
36.00	29.30	3.59	Discrepancy in interval value > 2
37.00	29.80	3.31	Discrepancy in interval value > 2
37.00	30.80	3.25	Discrepancy in interval value > 1
59.00	30.80	1.84	Discrepancy in interval value > 3
38.00	30.80	2.86	Discrepancy in interval value > 2
36.00	30.80	3.58	Discrepancy in interval value > 1
36.00	30.20	3.65	Discrepancy in interval value > 2

4. DISCUSSION

The irrigation system implemented with fuzzy logic achieved results with a discrepancy value of 1 to 2 between the device and the fuzzy logic. However, with a small difference, the implementation of fuzzy logic is considered acceptable. From the above tests, the fuzzy logic using the Mamdani method in the automatic irrigation system prototype for plants was successfully achieved as desired. Fuzzy logic can demonstrate that this method can handle the uncertainty of watering duration, aligning it with soil moisture and temperature conditions. In the discussion, researchers utilized soil and DHT11 sensors, where the DHT11 sensor can detect both room temperature and humidity. Researchers have not yet tried using the DHT11 sensor in the soil.

5. CONCLUSION

This journal aims to design and implement an automatic irrigation system that can monitor soil moisture and temperature using the fuzzy logic concept with soil moisture and temperature sensors to measure soil environmental conditions. The information obtained from these sensors forms the basis for decision-making in the irrigation system. The fuzzy logic approach is used to process data obtained from the soil moisture and temperature sensors. This concept allows the system to make irrigation decisions by considering uncertain or fuzzy soil moisture and temperature values. In conclusion, despite some discrepancies in the device implementation and MATLAB conditioning, this is considered normal due to possible sensor inaccuracies. However, the application of the Mamdani fuzzy method successfully enhances the management of water resources and periodic plant irrigation automatically.

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3D Large-Screen Immersive Video Mapping Installations & Interactive Light Game for Conference Seminars

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ABSTRACT

Technological improvements, especially in immersive technologies such as spatial augmented reality (SAR), commonly known as video mapping, have generated opportunities in the arts and performance industry, for example for exhibitions. This study examines the incorporation of interactive video mapping into conference seminars, emphasizing the design of large-screen 3D immersive installations and interactive light games in a college auditorium environment. The research employs a User-Centered Design (UCD) methodology, integrating user feedback during the design and prototyping phases to develop an engaging and immersive experience for conference participants. The project entails the development of two immersive themes: Forest and Underwater, utilizing 3D modeling and animation techniques. MediaPipe incorporates interactive features, enabling participants to participate in the exhibits via hand gestures, augmenting involvement and participation during conference panel sessions and breaks. The successful performance of these interactive zones and solutions for technical setup and optimization of high-quality, interactive 3D video mapping experiences in conference venues are examined.

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Mediapipe.

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1. INTRODUCTION

Technological advancements, particularly in immersive technology like spatial augmented reality (SAR), also referred to as video mapping, have created opportunities in the arts and performance sector. Viewers can directly experience reality through 2D or 3D animations, as well as light games and projected images on a surface, without the need for gadgets like head-mounted displays or mobile devices [1].

Video mapping can be projected onto flat surfaces like screens or walls, as well as irregular rooms or surfaces, including mock-ups, facades, buildings, or complicated 3D constructions [2]. PT. Daihatsu employs video mapping for the promotion of the All-New Sirion Car, projecting images, textures, themes, patterns, and animated films onto the car's facade [3]. Video mapping is utilized in cultural events, such as Wayang [4], and for tourism sites in Minahasa, projected onto a traditional building model [5]. A person's face can serve as a projection surface, like the technique employed by video editors when creating a music video for the band Kotak [6].

Video mapping is employed in formal settings within enclosed areas as an element of interior design for educational or recreational purposes [7]. Florencia et al. developed a video mapping project titled "Marine Life Experience," utilizing two projectors on a flat surface for the presentation. Furthermore, video project mapping is developed interactively using two scenarios: biota and atmosphere. The sea will react to the movements of visitors and alterations in things upon contact, although this study did not provide a technical explanation of the sensor utilization [8].

An interactive impression is often attainable when 3D animation projection can be modified in real-time in response to activities or events triggered by external variables, including sensors like cameras, mobile devices, or commands based on gestures, eye movements, or actions of visitors [9] [10]. Static movement in situ can be facilitated by motion detection software such as MediaPipe. MediaPipe has been applied in diverse domains including education [11] [12], health [13] [14], and performances or exhibitions [15] [16]. The visitor experience can be improved by technology, offering a more interactive and tailored performance guide.

Nevertheless, conventional conference environments frequently restrict audience participation and interaction. Static presentations restrict visual engagement, and passive learning settings might reduce retention and attendance pleasure [17] [18]. This project investigates the feasibility of incorporating interactive video mapping into conference seminars to overcome these limitations. This study specifically examines the design and implementation of immersive zones and interactive zones (light game) in a large-scene 3D video mapping installation within a college auditorium. The zones will enable participants to interact with the video mapping content during conference intermissions.

This research quantitatively examines the effectiveness of interactive zones within large-screen 3D video mapping installations for enhancing audience engagement and attention during conference seminars. The study will investigate the correlation between content creation techniques and user engagement, as well as analyze the technical setup and optimization strategies for delivering high-quality, interactive 3D video mapping experiences in conference venues.

2. METHODS

This study will adopt a User-Centered Design (UCD) methodology [19] [20]. The UCD process will be executed iteratively, involving cycles of prototype, user feedback, and refining. Drawing from [21], the application of the UCD is illustrated on **Figure 1**.

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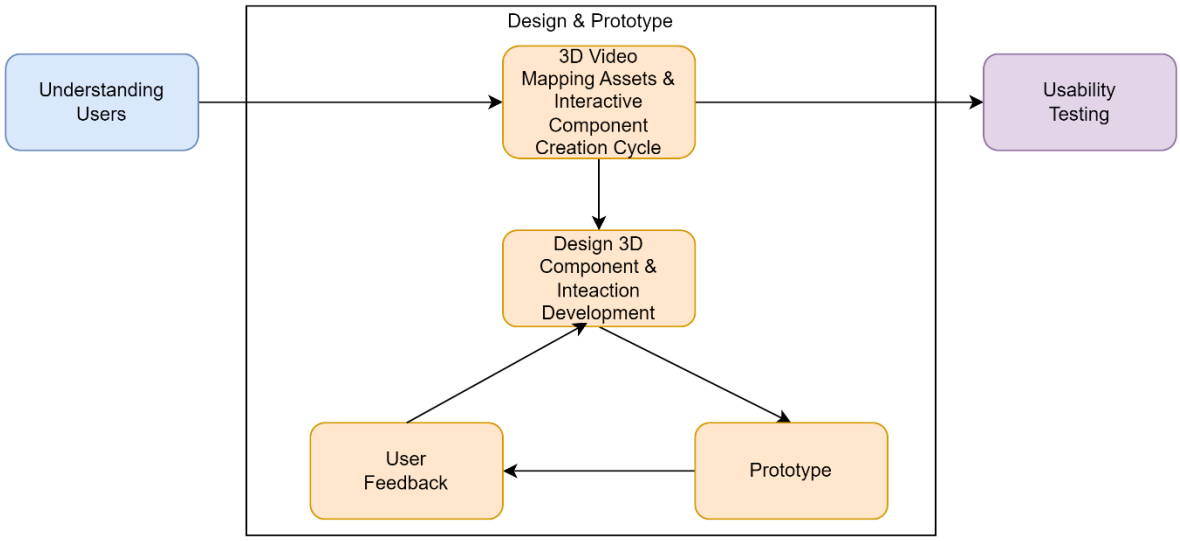


Figure 1. UCD for 3D Immersive Video Mapping and Interaction

2.1. Understanding Users

This study utilizes user research, comprising observations and interviews, to determine user needs and preferences for large-screen video mapping and interactive zones in conference seminars. This information will facilitate the development of user personas to direct design decisions and ensure the final product aligns with the requirements of the target audience.

2.2 Design & Prototyping

This Step includes the **Video Mapping & Interactive Component Creation Cycle,** the cycle consists of three steps loop namely Design of 3D Component and Interaction Development, Prototype, and User Feedback.

2.2.1 Design 3D Component & Interaction Development

- 3D Immersive Realistic Video Mapping Loop: Conduct user research to generate several animation scenarios for looping on a large 3D screen. There are two themes: Forest and Underwater.
    1. Forest Theme: Design visual content for the forest theme, considering elements such as tree species, vegetation, illumination, and ambiance.
    2. Underwater Theme: Design visual content for the underwater theme, encompassing the design of the shark, other marine organisms, coral reefs, and aquatic lighting effects.
    3. Design animations and transitions that are aesthetically pleasing for conference settings.
- 3D Immersive Interactivity for light game on normal-screen Video mapping with MediaPipe & Touch Designer
    1. Ideation: Conduct user research to generate several interaction ways via MediaPipe. Investigate diverse hand gestures for manipulating the 3D model's movements (e.g., direction, velocity) and evaluate the integration of these interactions with the comprehensive video mapping information.
    2. Low-Fidelity Prototype Development: Create a basic prototype to evaluate the fundamental concept of MediaPipe interaction with the 3D model, either utilizing a 2D representation or a simplified variant of the 3D model.

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3. Integration with Touch Designer: Transfer the 3D models from Blender to TouchDesigner. Incorporate MediaPipe for hand gesture recognition and develop interactive components that enable users to manipulate elements of the 3D environments (e.g., relocating the shark, initiating animations).

2.2.2 Prototyping

- 3D Assets Creation for Large-Screen Video Mapping:
  1. 3D Modeling (Blender 3D) to create realistic 3D models for Large-Screen Video Mapping and develop the visual content for the forest theme and underwater theme.
  2. Develop animations and transitions that are aesthetically pleasing for conference settings.
- Interactive Zone Development:
  1. 3D Modeling (Blender 3D): Use Blender 3D to create realistic 3D models for the interactive zones (e.g., the shark in the underwater theme). Consider realism, scale, and optimization for real-time rendering.
  2. Prototyping Interactive Zones: Develop prototypes of the interactive zones within Touch Designer, combining the 3D models and MediaPipe interactions. Experiment with different visual effects, animations, and feedback mechanisms to enhance user engagement.
- **Technical Setup for Large-Screen Video Mapping:**
  1. Projection Mapping: Plan the projection mapping setup, including projector placement, lens selection, and edge blending techniques to ensure a seamless and immersive visual experience across the two facades of the auditorium.
  2. Content Layout and Sequencing: Design the layout and sequencing of the video mapping content on the large screens, considering factors such as visual flow, storytelling, and integration with the conference schedule.
  3. Synchronization and Control: Establish a system for synchronizing the video mapping content across multiple projectors and controlling the playback and transitions.

2.2.3 User Feedback

- Iterative Feedback and Design Reviews: Present the prototype to stakeholders at various stages of development. Gather their feedback on the design, functionality, and overall user experience. Incorporate their input into iterative design revisions, ensuring alignment with their needs and expectations.

2.3 Usability Testing

- **Observation and Field Studies:** Conduct observations of users interacting with the prototype in a realistic setting, simulating a conference environment as much as possible. Carefully document user behaviors, interactions, and any challenges they encounter.

3. RESULTS AND DISCUSSION

3.1 User Research Findings

The initial phase focused on understanding the users, specifically conference attendees and organizers, to identify their requirements and preferences for extensive video mapping and interactive areas within a conference seminar context. The 15th Industrial Research Workshop and National Seminar (IRWNS), which took place at Politeknik Negeri Bandung (POLBAN) from July 24 to 25, 2024, served as the basis for this study.

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Firstly, there was a pronounced desire for increased engagement and interaction during conferences. Organizers expressed that traditional conference formats often lacked stimulating elements to maintain their attention. They highlighted that interactive and immersive experiences could significantly enhance their engagement, particularly during panel sessions and intermissions. Secondly, Layout The auditorium as illustrated in **Figure 2**, has two prominent facades—left and right—which will serve as the canvas for the large-scene video mapping projections (**Figure 3**). The interactive zones will be strategically positioned on the back within the left facades to encourage interaction and engagement during conference breaks and presentations.

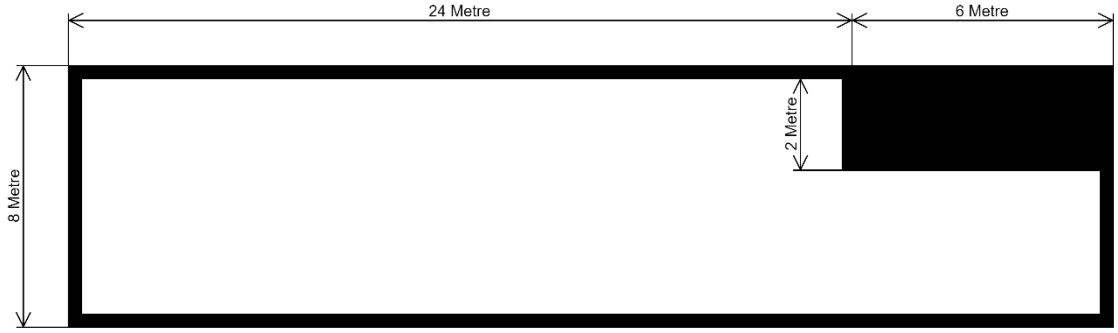


Figure 2. Auditorium Room Layout

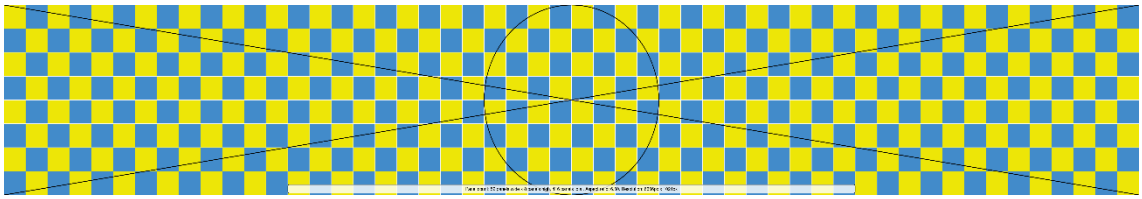


Figure 3. Left or Right Auditorium Video Mapping Target (24m width x 4 m height)

3.2 Design and Prototyping Outcomes

Based on the user research findings, the design and prototyping phase focused on developing two immersive themes: a **Forest Theme** and an **Underwater Theme**. This phase involved iterative cycles of creating immersive 3D environments and integrating interactive components using MediaPipe for gesture recognition.

3.2.1 Design 3D Component & Interaction Development

The key objectives in developing the immersive themes were realism and participation. The Forest Theme showcased immersive 3D representations of trees, flora, and fauna, establishing a verdant ecosystem. Dynamic lighting techniques replicated various times of day, transitioning from dawn to dusk, so enhancing the depth and diversity of the experience. Natural ambient sounds, including birdsong and the rustle of leaves, were integrated to augment immersion. The Underwater Theme showcased a dynamic marine ecosystem featuring lifelike representations of sea creatures such as sharks, fish, and coral reefs. Sophisticated lighting techniques replicated underwater caustics, establishing a genuine aquatic ambiance. Animations depicting sea life movements created a dynamic landscape that engaged users' attention.

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3.2.2 Prototyping

There are two phases of prototyping: the initial phase involves creating Full HD (1920x1080) 3D Forest Themes, followed by the development of Large-Screen (6656 x 1080) forest and underwater themes. **Figure 4**, **Figure 5**, and **Figure 6** present instances of developed Full HD 3D video mapping assets for Forest, featuring three primary quests: Hutan Bercerita I, Hutan Bercerita II, and Berjalan di Hutan.

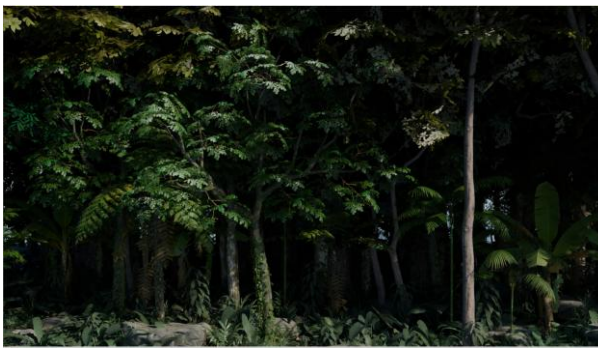


Figure 4a. Hutan Bercerita I Scene A.



Gambar 4b. Hutan Bercerita I Scene B



Figure 5a. Hutan Bercerita II Scene A.



Gambar 5b. Hutan Bercerita II Scene B



Figure 6a. Berjalan di Hutan Scene A.



Gambar 6b. Berjalan di Hutan Scene B

The result of the second phase can be seen in **Figure 7**, **Figure 8, Figure 9, Figure 10**, **and Figure 11** Resulted Large-Screen 3D Assets for Forest and Underwater themes.

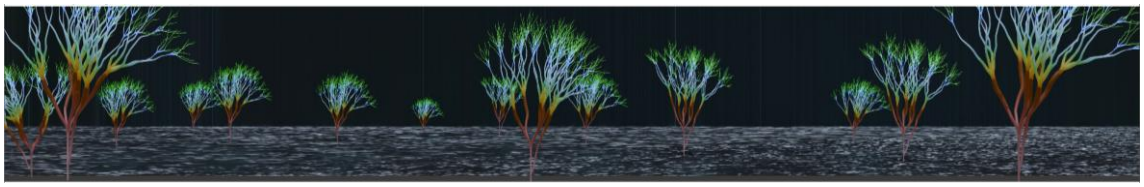


Figure 7. Large-Screen Fractal Forrest

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Figure 8. Large-Screen Forest I



Figure 9. Large-Screen Forest II

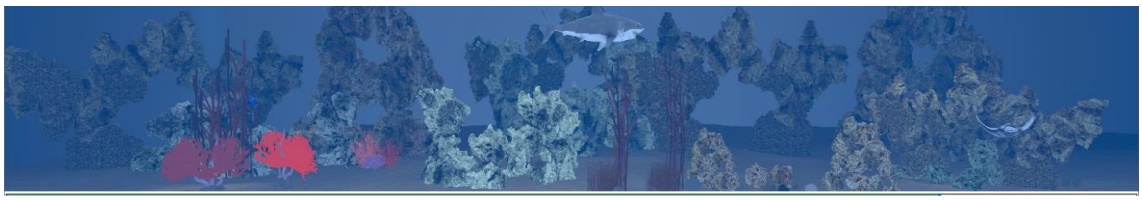


Figure 10. Large-Screen Underwater I

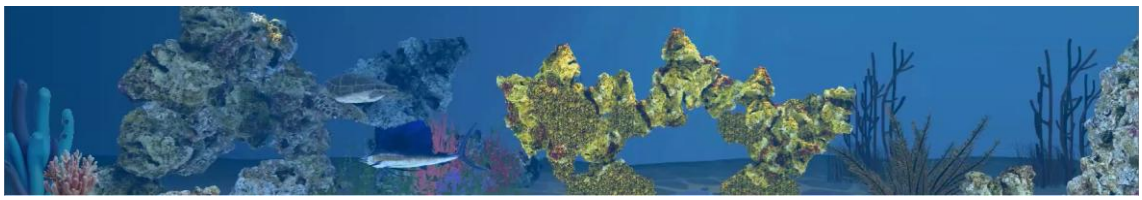


Figure 11. Large-Screen Underwater II

Interactive elements were crucial in converting passive visual presentations into immersive experiences. MediaPipe was employed to program unique hand motions for controlling objects within the scenes. In the Underwater Theme, users can manipulate the movement of a virtual shark through specific hand gestures. This intuitive control system enabled people to engage spontaneously without requiring additional guidance. The integration with Touch Designer facilitated real-time rendering and interactivity. The technology delivered prompt feedback to user inputs, so augmenting the sensation of action and immersion. Numerous iterations were performed to enhance the responsiveness and precision of interactions, guaranteeing a seamless user experience. **Figure 12**, **Figure 13, Figure 14, Figure 15, and Figure 16** are the process of creating interactive video mapping based on gesture recognition.



Figure 12. Interactive hand gesture video main projects

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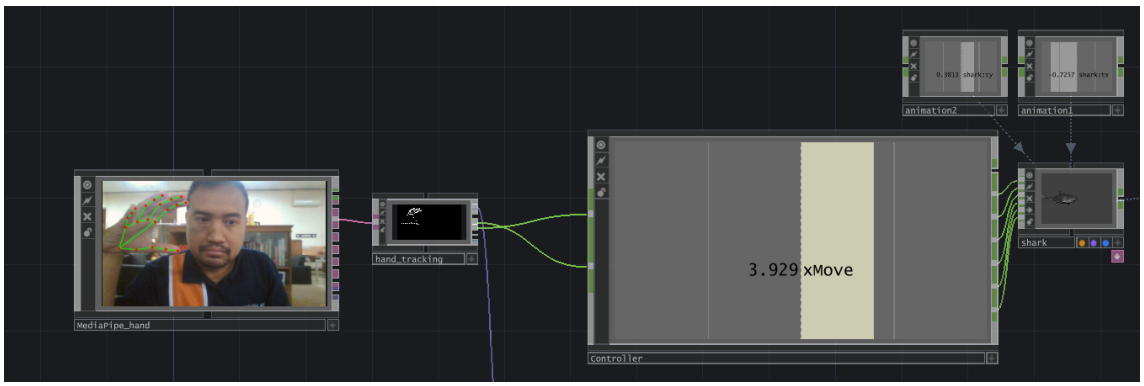


Figure 13. Medipipe integration with Touch Designer with media pipe-touch designer [22]



Figure 14. 3D Shark Render and Movement

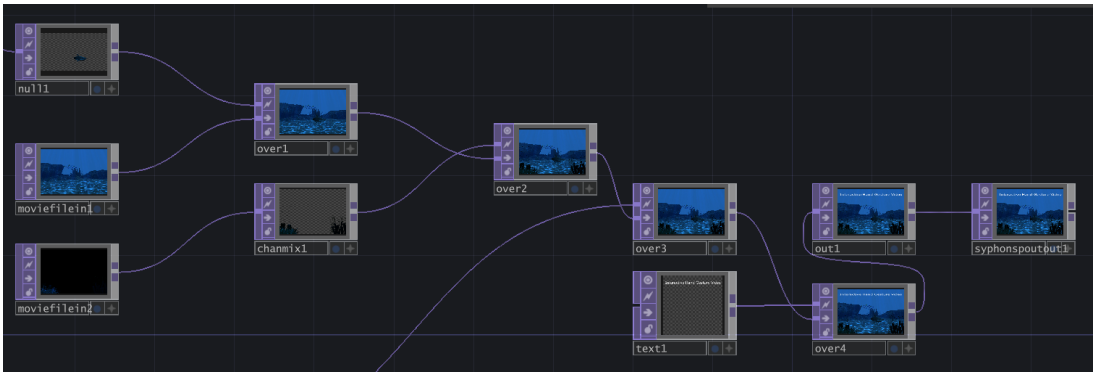


Figure 15. Underwater video background

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Figure 16. Final Light Game Interactive Hand Gesture Video

3.2.3 Usability Testing

Executing large-screen projection mapping needed careful preparation. A triple-projector configuration was implemented for showing each side of the auditorium's facades, as depicted in **Figure 17**. The positioning of the projector was chosen to reduce shadows and distortions, while the lens selection guaranteed suitable throw lengths and image dimensions.

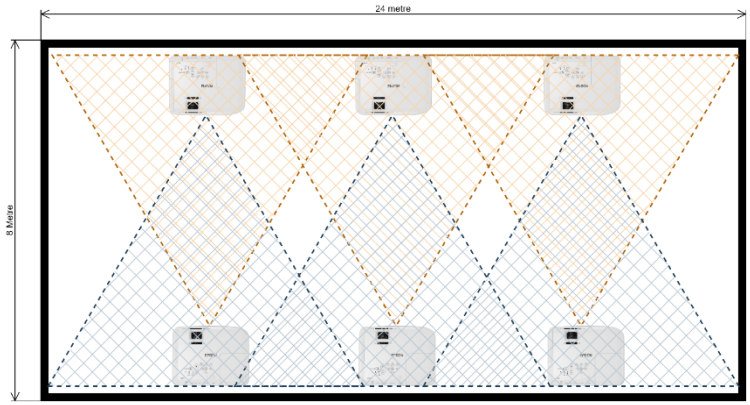
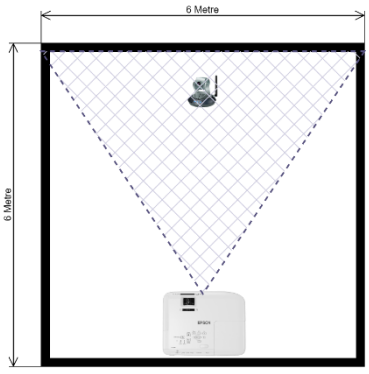


Figure 17a. Triple-projector setup placing



Gambar 17b. Light Game setup

Edge blending techniques were utilized to attain seamless transitions between projections. This entailed calibrating overlapping regions to harmonize brightness and hue, resulting in a cohesive image across both facades. Synchronization protocols were established to coordinate animations and interactions among the many projectors, maintaining uniformity in the user experience. **Figure 19** and **Figure 20** illustrate the application of video mapping for the opening day of the IRWNS sessions.





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Figure 19a. Left Forest Theme Facade

Gambar 19b. Right Forest Theme Facade





Figure 20a. Planning Light Game Facade

Gambar 20b. Light Game Facade

3.3 Discussion

The immersive themes and gesture-based interactivity provided a novel method for participants to connect with the event beyond conventional formats. Occasional misreading of gestures resulted in undesired actions within the interactive settings. The problem became more evident when numerous users engaged concurrently, resulting in the system misattributing gestures.

Integration of numerous projectors via edge blending and synchronization facilitated seamless real-time rendering for 3D assets, essential for preserving immersion throughout interactions. These technical solutions may serve as a benchmark for analogous future initiatives. The incorporation of interactive zones signifies a transition towards more engaging and participatory conference designs. Such installations can distinguish events, offering distinctive experiences that differentiate conferences in a competitive environment.

4. CONCLUSION

This study effectively incorporated interactive 3D video mapping installations into conference seminars, improving audience engagement and happiness through immersive Forest and Underwater themes with gesture-based interactions. The installations successfully converted inactive conference areas into vibrant settings, promoting greater engagement and maybe improving information retention and networking prospects. The technological viability of executing large-screen projection mapping in conference venues was validated, showcasing the practicality and efficacy of these new solutions.

Future research should concentrate on improving gesture recognition algorithms, investigating multimodal interaction techniques, and broadening thematic content to augment the significance and influence of interactive 3D video mapping installations in conference seminars. By maintaining a focus on user-centered design principles and resolving technical problems, such installations can revolutionize conference and event design within the realm of multimedia technology.

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research within the context of their event. In addition, thanks to the talented students who dedicated their time and skills to developing the 3D assets and interactive light games that were essential to this research.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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Mapping ISO 27001:2013 and COBIT 2019 Framework to STRIDE Threat Modeling Using Qualitative Descriptive Research

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ABSTRACT

Information is a fundamental asset in every organization. The protection of this asset, through information security processes, is critical. COBIT and ISO27001 are reference frameworks for information security management that help organizations assess their security risks and implement appropriate security controls. One of the most important parts of IT in the COBIT framework is information security management which includes confidentiality, integrity, and availability of resources. Since the issues addressed in COBIT information security management are areas covered by the ISO/IEC27001 standard, the best option to address information security management in a COBIT infrastructure is to use the ISO/IEC27001 standard. For the existence and complementary use of COBIT and ISO27001, mapping COBIT processes to ISO/IEC 27001 controls is very useful. This paper explores the role of information security in COBIT and describes the approach of mapping COBIT processes to ISO/IEC27001 controls for information security management.

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1. INTRODUCTION

In the era of globalization, information security and information technology (IT) governance have become critical factors in determining the operational success of an organization. Along with the increasing dependence on technology, the risks related to information security and IT management are also increasingly complex and diverse. Organizations are faced with the challenge of managing and protecting their information assets from various threats, both internal and external.

Based on a report from Badan Siber dan Sandi Negara (BSSN), it was recorded that the number of cyber-attack cases in Indonesia from the beginning of 2020 to April 12, 2020 was 88 million. From this number, 56% were identified as cases of trojan-activity attacks, 43% were cases of information-gathering attempts, and 1% were cases of web application attacks [1]. Meanwhile, the results of monitoring the total number of cyber-attack cases in Indonesia at the end of 2020 reached 495 million with the most attacks being trojan activity and data theft [2]. This shows that there has been an increase in cyber-attacks in Indonesia by 205 million when compared to the number of cyber-attack cases in 2019 which was 290 million cases [3].

Implementation of information security is an important thing for an organization to do. Information security is defined as the protection of information from creation to disposal of data, through logical, technical, physical, and organizational steps that prevent the loss of confidentiality, integrity, and availability of information [4]. This information security needs to be implemented to ensure specific security so that the objectives of a company or organization can be met [5]. According to a survey conducted in the United Kingdom (UK), it is known that 74% of the technology industry sector its research results revealed that high technology security is one of the most crucial things in their organization's senior management [6].

Cybersecurity is part of information security that protects information assets from threats to information processed, stored, and transmitted by interconnected information systems [7]. To improve information security within an organization, special controls need to be carried out to measure the level of cybersecurity that has been implemented. https://drive.google.com/drive/folders/1nh_raMhoknQlt-YzzRVmc5m-SYRJFVazbe used to audit/measure the level of cybersecurity, including COBIT and ISO 27001 [8]. However, although there are various standards, the unique needs of each organization limit the use of the types of frameworks available [1].

An effective IT governance and information security management framework is essential to help organizations achieve their strategic objectives while ensuring the security and integrity of data. Two of the most well-known and widely used frameworks in this area are COBIT (Control Objectives for Information and Related Technologies) and ISO/IEC 27001. While both aim to improve information governance and security, their approaches and focus differ significantly.

COBIT, developed by ISACA, is a framework that provides comprehensive guidance on IT governance and management. COBIT provides a structure that enables organizations to achieve their business objectives through effective IT management. The framework covers various aspects of IT, including risk management, internal control, and regulatory compliance. COBIT is designed to help organizations ensure that IT supports and enhances their business strategy.

ISO/IEC 27001, on the other hand, is an international standard that specifies requirements for an information security management system (ISMS). This standard is designed to help

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organizations manage and protect their information through the systematic and structured implementation of policies and procedures. ISO/IEC 27001 emphasizes the importance of risk management and ongoing information protection, ensuring that organizations can address and mitigate the impact of information security threats.

Although both frameworks share the same ultimate goal of improving information security and governance, their approaches differ. COBIT focuses more on the overall governance of IT, including how IT can support the achievement of business objectives and the management of IT risks in general. Meanwhile, ISO/IEC 27001 focuses on managing information security through the implementation of an internationally recognized ISMS.

Organizations are often faced with the dilemma of choosing the most appropriate framework for their needs. Understanding the differences, advantages, and disadvantages of each framework is an important step in making the right decision. This study aims to provide a comparative analysis between COBIT and ISO/IEC 27001.

2. METHODS

In this study, a comparison and mapping of features in the cybersecurity framework based on existing literature studies with descriptive methods will be conducted, where the object of research is in the form of literature. The literature in question is in the form of scientific journals, books, articles in the mass media, and statistical data [9]. This study presents a comparison and mapping of two standards for measuring information security, namely COBIT and ISO 27001. Each standard has advantages and disadvantages. The analysis was carried out using qualitative analysis based on the STRIDE threat model.

3. BASIC CONCEPT

3.1. COBIT Framework

Control Objectives for Information and Related Technology (COBIT) is a set of best practices for information technology governance created by the Information Systems Audit and Control Association (ISACA), and the IT Governance Institute (ITGI) [10].

COBIT provides IT managers, auditors, and users with a set of generally accepted measures, indicators, processes, and best practices to assist them in maximizing the benefits gained through the use of information technology and developing appropriate IT governance and control within an enterprise. COBIT's mission is to help managers, auditors, and users understand their IT systems and decide on the level of security and control needed to protect their enterprise assets through the development of an IT governance model [10]. COBIT can be applied broadly for a variety of purposes. COBIT covers security in addition to all other risks that can occur with the use of IT.

Enterprise governance (the systems used to manage and control an organization) and IT governance (the systems used to manage and control an organization's IT) are closely related from a COBIT perspective. Enterprise governance is inadequate without IT governance and vice versa. IT can extend and influence an organization's performance, but it must be subject to adequate governance. On the other hand, business processes require information from IT processes, and this interdependence must also be managed [11].

The purpose of the COBIT framework is to provide management with an IT governance model that helps them control and manage information and related technology. The framework describes how IT processes deliver the information the business needs to achieve its objectives. This delivery is driven through 34 high-level control objectives, one for each IT process, contained in four domains. This framework identifies information criteria (effectiveness, efficiency, confidentiality, integrity, availability, compliance, and reliability), as well as IT resources (people, applications, technology, facilities, and data) that are critical for

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IT processes to fully support business objectives. The IT Governance Institute has identified four domains as the building blocks of the COBIT framework, as illustrated in **Figure 1** [12]. This structure is based on the PDCA cycle.

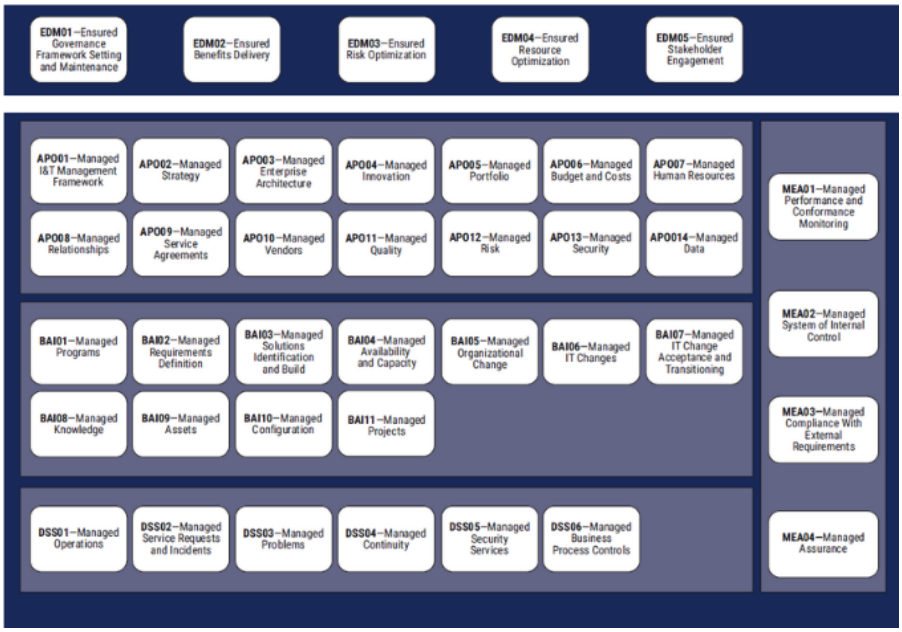


Figure 1. COBIT Domain

Effective information security requires an integrated set of security, management, and governance processes to plan, organize, and address an organization's information security risks. COBIT provides an integrated governance, management, and process framework for implementing and executing information security. COBIT describes sound processes, practices, and control objectives for managing and operating IT systems, including their security status. Organizations using this framework report an improved ability to deliver high-quality services to their customers, including the ability to measure and meet confidentiality, availability, and integrity requirements. COBIT supports the need for security to be addressed as part of every business function. Although only one COBIT process (DS5) is specifically dedicated to security, the control objectives related to security are spread across processes in each domain. The COBIT security baseline document [13] highlights the high-level COBIT control objectives related to information security across the four domains in the COBIT framework.

3.2 ISO/IEC 27001 Framework

ISO/IEC 27001 originated from a code of good practice published by the UK Department of Trade and Industry in 1989, which later evolved into BS7799 [14]. ISO/IEC 27001 specifies the requirements for establishing, implementing, operating, monitoring, reviewing, maintaining, and improving a documented Information Security Management System (ISMS) in the context of the organization's overall business risks. ISO/IEC 27001 specifies requirements for the implementation of security controls tailored to the needs of the organization or part of it. The ISMS is designed to ensure the selection of adequate and proportionate security controls that protect information assets and provide confidence to interested parties. The proposed requirements are structured in an 11-clause classification covering 39 objectives driven by 133 controls [15][16].

ISO/IEC 27001 specifies how an organization should address the confidentiality, integrity, and availability requirements of its information assets and integrate these into its Information

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Security Management System (ISMS) [17][19]. This standard is used worldwide by organizations, both commercial and governmental, as a basis for the management of organizational policies and the implementation of information security. It is used by small, medium, and large organizations in a variety of business sectors. It is designed to be flexible enough to be used by all types of organizations. It has become the de facto "common language" for information security management [15][16].

The standard introduces a cyclical model known as the "Plan-Do-Check-Act" (PDCA) model that aims to establish, implement, monitor, and improve the effectiveness of an organization's ISMS. The PDCA cycle has the following four phases as shown in **Figure 2**.

- Plan – establish the ISMS: Establish relevant ISMS policies, objectives, processes, and procedures to manage risk and improve information security to produce outcomes consistent with the organization's overall policies and objectives [10].
- Do – implement and operate the ISMS: Implement and operate the ISMS policies, controls, processes, and procedures [18].
- Check – monitor and review the ISMS: Assess and, where applicable, measure process performance against the ISMS policies, objectives, and practical experience and report the results to management for review [20].
- Act – maintain and improve the ISMS: Take corrective and preventive actions, based on the results of ISMS internal audits and management reviews or other relevant information, to achieve continual improvement of the ISMS [4].

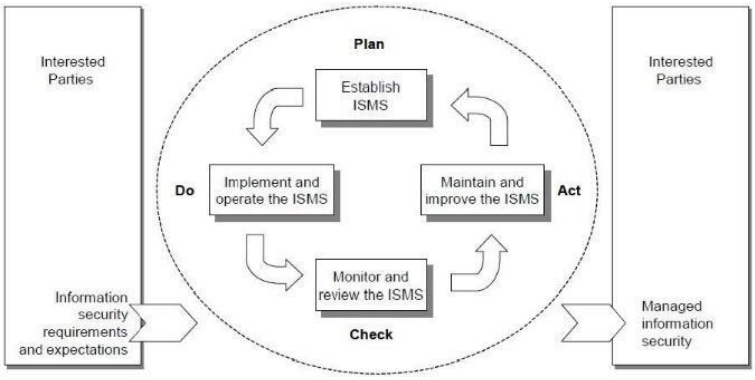


Figure 2. PDCA Model in ISMS Process

Table 1 below serves as a comprehensive overview of the key components necessary for establishing, implementing, maintaining, and continually improving an information security management system (ISMS) in alignment with ISO/IEC 27001.

Table 1. ISO/IEC 27001 Control Objectives.

Controls	Control Objectives
A.5 Security policy	A.5.1 Information security policy
A.6 Organizational information security	A.6.1
A.6.2	External parties
A.7 Asset Management	A.7.1
A.6.3	Information classification
A.8 Human resources security	A.8.1
A.8.2	During employment
A.6.4	Termination or change of employment
A.9 Physical and environmental security	A.9.1
A.6.5	Equipment security

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A.10 Communications and operations management A.10.1

3.3 STRIDE

STRIDE is a threat modelling method used in security analysis to identify and categorize different types of security threats. STRIDE is an acronym for Spoofing, Tampering, Repudiation, Information Disclosure, Denial of Service, and Elevation of Privilege [21]. This methodology helps in systematically analyzing potential threats across a wide range of systems, including cyber-physical systems, automotive security, distributed control systems, software-defined network applications, and computer network security [21]. The STRIDE model helps in detecting and preventing threats by guiding Spoofing (a threat to authentication where an unauthorized entity pretends to be a legitimate entity), Tampering (a threat to integrity where data or systems are altered unauthorizedly), Repudiation (a threat to accountability where an entity can deny actions that have been taken), Information Disclosure (a threat to confidentiality where information is leaked to unauthorized parties), Denial of Service (a threat to availability where a service or system becomes unavailable to authorized users), and Elevation of Privilege (a threat to authorization where an entity is granted higher access rights than it should be). The explanation can also be seen in **Figure 3**.

STRIDE-LM	Threat	Property	Definition	Controls
S	Spoofing	Authentication	Impersonating someone or something	Authentication Stores, Strong Authentication mechanisms
T	Tampering	Integrity / Access Controls	Modifying data or code	Crypto Hash, Digital watermark/ isolation and access checks
R	Repudiation	Non-repudiation	Claiming to have not performed a specific action	Logging infrastructure, full-packet-capture
I	Information Disclosure	Confidentiality	Exposing information or data to unauthorized individuals or roles	Encryption or Isolation
D	Denial of Service	Availability	Deny or degrade service	Redundancy, failover, QoS, Bandwidth throttle
E	Elevation of Privilege	Authorization / Least Privilege	Gain capabilities without proper authorization	RBAC, DACL, MAC; Sudo, UAC, Privileged account protections

Figure 3. Figure of Explanation STRIDE Threat Model

4. RESULTS AND DISCUSSION

The fundamental difference between COBIT and ISO 27001 is that ISO 27001 focuses only on information security, while COBIT focuses on more general information technology controls. As such, COBIT has a broader scope of general information technology topics but does not have the detailed information security requirements of ISO 27001. If an organization were to address all of the security controls in ISO 27001, then they would cover most of COBIT in the process—especially the DS5 section that ensures system security. However, COBIT covers a much larger set of issues related to information technology governance and is typically used as part of an overall corporate governance framework. One of the most important areas of information technology in the COBIT framework is information security management, which covers the confidentiality, integrity, and availability of resources. Since the issues raised are areas covered by the ISO/IEC 27001 standard, and this standard also considers the PDCA cycle as an infrastructure, the best option to fulfill information security management in the COBIT infrastructure is to use the ISO/IEC 27001 standard. For the coexistence and complementary use of COBIT and ISO/IEC 27001, a mapping between COBIT and ISO/IEC 27001 is very useful.

The purpose of the mapping is to provide an integrated way for the complementary use of COBIT and ISO/IEC 27001 in information security management. Mapping ISO/IEC 27001 to COBIT processes allows organizations to reduce the overall cost of maintaining an acceptable level of security, manage risks effectively, and reduce the overall level of risk.

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For the mapping between these frameworks, each COBIT process is examined, and the corresponding ISO 27001 Annex A control objectives are indicated. Based on the ISO/IEC 27001:2005 domains and COBIT processes, the relationship between the subjects and control parameters of both standards is given in **Table 2**.

Table 2. Mapping of ISO/IEC 27001 and COBIT to STRIDE Threat Model.

No	ISO/IEC 27001	COBIT 2019	STRIDE Threat Model
1	Management direction for information security	EDM (Evaluate, Direct, and Monitor)	I - Information Disclosure
2	Internal organization	EDM	I - Information Disclosure
3	Mobile devices and teleworking	EDM	T - Tampering
4	Before employment	APO 07 (Manage Human Resources)	S - Spoofing
5	During employment	APO 07	S - Spoofing
6	Termination and change of employment	APO 07	S - Spoofing
7	Responsibility for assets	BAI 09 (Manage Assets)	I - Information Disclosure
8	Information classification	BAI 09	I - Information Disclosure
9	Media handling	BAI 09	T - Tampering
10	Business requirements of access control	DSS 05 (Manage Security)	T - Tampering
11	User access management	DSS 05	S - Spoofing
12	User Responsibilities	DSS 05	S - Spoofing
13	System and application access control	DSS 05	T - Tampering
14	Cryptographic controls	DSS 05	I - Information Disclosure, T - Tampering
15	Secure areas	DSS 05	T - Tampering
16	Equipment	DSS 05	T - Tampering
17	Operational procedures and responsibilities	DSS 01 (Manage Operations)	T - Tampering
18	Protection from malware	DSS 05	I - Information Disclosure, T - Tampering
19	Backup	APO 14 (Manage Availability)	T - Tampering
20	Logging and monitoring	DSS 05	S - Spoofing, T - Tampering
21	Control of operational software	DSS 05	T - Tampering
22	Technical vulnerability management	DSS 05	I - Information Disclosure, T - Tampering
23	Information systems audit considerations	MEA 04 (Monitor, Evaluate, and Assess)	S - Spoofing
24	Network security management	DSS 05	T - Tampering

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25	Information transfer	DSS 05	I - Information Disclosure
26	Security requirements of information systems	APO 13 (Manage Security)	S - Spoofing
27	Security in development and support processes	APO 04 (Manage Development)	S - Spoofing, T - Tampering
28	Test data	APO 14	T - Tampering
29	Information security in supplier relationships	APO 10 (Manage Supplier Relationships)	S - Spoofing
30	Supplier service delivery management	APO 10	S - Spoofing
31	Management of information security incidents and improvements	DSS 05	I - Information Disclosure, T - Tampering
32	Information security continuity	DSS 04 (Manage Continuity)	T - Tampering
33	Redundancies	DSS 04	T - Tampering
34	Compliance with legal and contractual requirements	MEA 03 (Monitor, Evaluate, and Assess Compliance)	S - Spoofing
35	Information security reviews	APO 13	S - Spoofing

The following **Table 3** provides a detailed overview of these mappings, highlighting the alignment between the standards and the threat model to enhance organizational security posture.

Table 3. Scenario Example of Threat

No	Scenario	Threat	ISO/IEC 27001	COBIT 2019	STRIDE
1	Data Theft through Unauthorized Access	Spoofing (S)	11. User Access Management	DSS 05 (Manage Security)	S – Spoofing
2	Malware Attack on the System	Tampering (T)	18. Protection from Malware	DSS 05 (Manage Security)	I - Information Disclosure, T – Tampering
3	Non-compliance with regulations	Spoofing (S)	34. Compliance with Legal and Contractual Requirements	MEA 03 (Monitor, Evaluate, and Assess Compliance)	S – Spoofing

In scenario 1, attackers gain unauthorized access to a system due to inadequate access controls. This poses a significant risk of data theft. By mapping the ISO/IEC 27001 standard, specifically the user access management controls, and the COBIT 2019 framework, particularly the DSS 05 domain focused on security management, organizations can implement stricter access controls and user management protocols. This reduces the risk of data theft through unauthorized access, ensuring that only authorized individuals have access to sensitive information.

Scenario 2 involves malware infiltrating the system, causing damage, or accessing sensitive information. Such an attack can lead to data tampering and information disclosure. By implementing the controls outlined in ISO/IEC 27001 for malware protection and leveraging the security management practices from COBIT 2019, organizations can enhance

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their ability to detect and prevent malware attacks. These measures include robust malware protection strategies and continuous security monitoring, which help safeguard systems from malicious software.

In scenario 3, an organization fails to meet applicable regulatory requirements, which can result in fines or reputational damage. By clearly mapping the requirements of ISO/IEC 27001 and COBIT 2019, organizations can ensure better compliance with legal and contractual obligations. The ISO/IEC 27001 standard emphasizes compliance with regulatory requirements, while COBIT 2019's MEA 03 domain focuses on monitoring, evaluating, and assessing compliance. Together, these frameworks provide a comprehensive approach to maintaining compliance and mitigating the risks associated with regulatory non-compliance.

5. CONCLUSION

Information security plays a critical role in protecting an organization's assets. Since no single formula can guarantee 100% security, a set of benchmarks or standards is needed to help ensure that adequate levels of security are achieved, resources are used efficiently, and best security practices are adopted. Systems such as COBIT and ISO/IEC 27001 can be used together as a foundation for developing a solid information security process. For the coexistence and complementary use of COBIT and ISO/IEC 27001 as a reference framework for information security management, mapping COBIT processes to ISO/IEC 27001 control objectives can be used. In this paper, we describe the mapping between COBIT and ISO/IEC 27001. Mapping ISO/IEC 27001 to COBIT processes enables organizations to reduce the overall cost of maintaining acceptable levels of security, manage risks effectively, and reduce the overall level of risk. In addition, the use of this mapping will also reduce confusion and dissonance that exists between IT and Audit. For future work, we plan to design a comprehensive and cost-effective framework for organizational use in balancing the implementation of ISO/IEC 27001 and COBIT processes.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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