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IJNMT (International Journal of New Media Technology) is a scholarly open access, peer-reviewed, and interdisciplinary journal focusing on theories, methods and implementations of new media technology. Topics include, but not limited to digital technology for creative industry, infrastructure technology, computing communication and networking, signal and image processing, intelligent system, control and embedded system, mobile and web based system, and robotics. IJNMT is published regularly twice a year (June and December) by Faculty of Engineering and Informatics, Universitas Multimedia Nusantara in cooperation with UMN Press.

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FOREWORD

Greetings!

IJNMT (International Journal of New Media Technology) is a scholarly open access, peer-reviewed, and interdisciplinary journal focusing on theories, methods and implementations of new media technology. Topics include, but not limited to digital technology for creative industry, infrastructure technology, computing communication and networking, signal and image processing, intelligent system, control and embedded system, mobile and web based system, and robotics. IJNMT is published regularly twice a year (June and December) by Faculty of Engineering and Informatics, Universitas Multimedia Nusantara in cooperation with UMN Press.

In this December 2021 edition, IJNMT enters the 2nd Edition of Volume 8. In this edition there are six scientific papers from researchers, academics and practitioners in the fields covered by IJNMT. Some of the topics raised in this journal are: Ultraviolet – C Dose Spread Simulation based on the Fixed-Lamp System in Universitas Multimedia Nusantara, Analysis Of UMN Student Graduation Timeliness Using Supervised Learning Method, The Design of Final Project Information System, Implementation of Model View Controller Architecture in Object Oriented Programming Learning, Application of Dynamic Segmentation in Stroke Detection Software with ANN and Prototype Project SCADA on Hemodialysis Mixing Tank Operation.

On this occasion we would also like to invite the participation of our dear readers, researchers, academics, and practitioners, in the field of Engineering and Informatics, to submit quality scientific papers to: International Journal of New Media Technology (IJNMT), Ultimatics : Jurnal Teknik Informatics, Ultima Infosys: Journal of Information Systems and Ultima Computing: Journal of Computer Systems. Information regarding writing guidelines and templates, as well as other related information can be obtained through the email address ultimaijnmt@umn.ac.id and the web page of our Journal here.

Finally, we would like to thank all contributors to this December 2021 Edition of IJNMT. We hope that scientific articles from research in this journal can be useful and contribute to the development of research and science in Indonesia.

December 2021,

Suryasari, S.Kom., M.T.
Editor-in-Chief

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Ultraviolet – C Dose Spread Simulation based on the Fixed-Lamp System in Universitas Multimedia Nusantara

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***Abstract*—Since Corona Virus Disease (COVID) – 19 is considered a pandemic by the World Health Organization (WHO), governments, and communities, worldwide trying to prevent transmission and reduce the number of deaths caused by the virus. One method of preventing transmission is spraying disinfectants using certain chemical compounds. However, chemicals can also hurt the environment and humans themselves if the doses used are not by existing standards. An alternative disinfectant method that does not use chemicals and is environmentally friendly, namely by using the UV (Ultraviolet)-decontamination method, UV-C rays. This research aims to find out the results of UV irradiation from UV-C lamps in theory and measurement. Then, the optimal placement of a fixed - UV lamp system to obtain an effective disinfectant dose and the length of time it takes to reach the target dose prevent the spread of the COVID-19 virus. The methods include theoretical calculations and data measurements to see the results of UV radiation irradiation on UV-C lamps and look for correlations between the two to find the conversion value. Moreover, with the help of DIALux Evo 9.2 software to find out the radiation value from the conversion equation, see the optimum UV dose spread, and reach the desired dose target time. The result is that there are differences in the results of UV irradiation on UV-C lamps with the efficiency of lamps and ballasts as well as on the measurement method that affects UV-C radiation, but according to field conditions and does not affect the actual application. The number of lamp placements and the dimensions of the room affects the dose spread. Moreover, the minimum time to achieve the target dose in the case study is 29 minutes using six placements of UV-C lamps with two lamps each at the six placement points.**

***Index Terms*—COVID-19; disinfectant; UV(Ultraviolet)-decontamination; DiaLux Evo 9.2; UV-C lamp**

I. INTRODUCTION

Since Corona Virus Disease (COVID) – 19 is considered a pandemic by the World Health Organization (WHO), governments and communities from all parts of the world are working to prevent transmission and reduce the number of deaths caused by the virus [1]. COVID-19 is a new type of virus, which is spreading very quickly. The virus has the potential to infect a person if the person makes direct contact with an already infected person. Even a person who touches the surface of an object in a public place, can be exposed to the virus because the surface has been contacted with the infected. One method of preventing its transmission is spraying disinfectants using certain chemical compounds. Spraying is carried out on common areas before use or traversed by many people. However, the use of chemicals can also adversely affect the environment as well as humans themselves if the dosage is not appropriate and the side effects of the chemical are not noticed [2]. There is an alternative disinfectant method that does not use chemicals and is environmentally friendly, namely by using the UV (Ultraviolet)-decontamination method, in this case UV-C light (Type C) [3,4].

David Welch and his research team tested the use of UV-C light with the need to prevent the transmission of influenza A/H1N1 virus through the air. The method used is the observation of viruses with UV-C rays with a wavelength of 222 nm with a target dose reached of 2 mJ/cm^2. With results above 95% that the virus is no longer able to develop and the number decreases over time [5]. The research is one of many studies that support the development of UV-C light technology in previous years [6]. Currently, the application of technology has been widely applied in addressing the spread/transmission of COVID-19, namely for the stelirization of hospital rooms [7,8] and medical equipment such as masks [9,10]. The research that has been mentioned using the method of measuring and installing UV-C technology to meet the required dose, there are already conducting simulations to find out the spread of UV-C rays in the room or area. The simulation was conducted to find out which areas were not illuminated by UV-C lights. In research dr. Hui Leng Choo from Malaysia, also used measurement and simulation methods to estimate the dose achieved in a certain area or equalization, without having to install UV lamps first [11]. Another simulation of uv-C light dissemination was conducted with a case study of

aircraft cabins, of which there are three ways of spreading the dose, one of which is with a fixed-lamp system [12]. Previous research did not include a complete theory (formula or equation) about UV light itself and its limited application to medical or hospital activities. Researchers want to apply UV-C light technology to be used outside of these activities, one of which is used in educational or campus activities.

This reserch will simulate UV-C light with fixed-lamp system to obtain the spread of UV-C light in one of the classrooms at Multimedia Nusantara University (UMN). The room is a classroom that will be used by students in conducting lectures if face-to-face meetings can take place in the future. The simulation was conducted with DIALux Evo 9.2 software device and supported by theoretical calculations of UV-C lamps to be simulated, as well as the target dose as well as the time or duration to achieve the dose.

II. FUNDAMENTAL THEORY

A. *UV-C light (Ultraviolet – C)*

UV-C rays are classified as UV rays, which are electromagnetic radiation with wavelengths shorter than visible light and longer than X-rays. UV rays are divided into 2, namely Vacuum UV rays (200 - 10 nm) and Almost UV Rays (380 - 200 nm). When viewed from the wavelength, Figure 1 describes UV rays divided into 3 types, namely UV-A (380 - 315 nm), UV-B (315 - 280 nm), and UV-C (280 - 10 nm) [13].

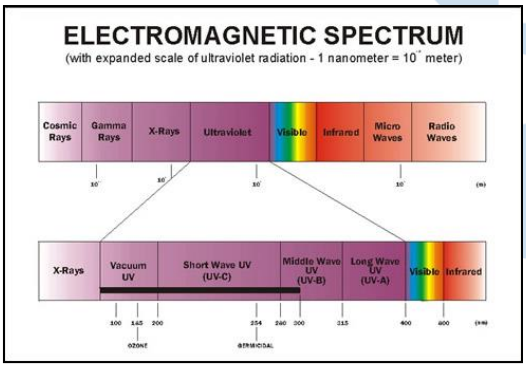


Figure 1. Spectrum Division of Ultraviolet (UV) Light[19]

UV-C light is an artificial light if it wants to be used in certain purposes (not free in nature). Because when UV light from the sun enters the Earth, UV light is absorbed by Earth's ozone, only a portion of UV light can reach the surface of the Earth, depicted in Figure 2 (such as: Full UV-A rays and 5-10% UV-B rays). UV-C rays are classified as UV rays that are quite dangerous because the effect can damage the surface of human skin if exposed directly [14].

In various studies, UV-C rays can be used to kill microbes and viruses, which can absorb up to the size of cells, which damage the R/DNA of microbial cells and viruses so that they can not develop again [4]. For this reason, the development of UV-C light is applied in light products used to illuminate certain areas that have the potential for microbes or viruses attached to an object/object surface.

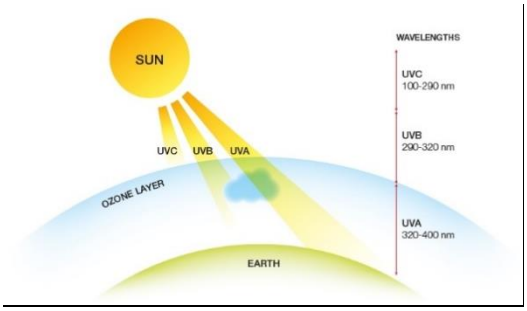


Figure 2. Ultraviolet (UV) Light Passing Through Earth's Atmosphere[20]

B. *Definition of Illumination or Irradiance*

Illumination is a term for the process of dispersing a wave of light from a light source that reaches an area or area with a certain distance. Physically, by radiometry method, radiation/illumination is the radiation flux (optical power) received by a surface per unit area, which has watts per square meter (W/m^2) [15].

C. *Mathematical Equations in Lighting Engineering*

In finding a light illumination value, a mathematical solution is needed to determine that value. In theory about lighting techniques, this can be achieved using existing formulas/theorems. However, the theorem in lighting techniques only applies if the electromagnetic wave is a visible wave of light, which in this study, the electromagnetic wave is UV light, which has different wavelengths and energy. So there needs to be another theorem/method to know the irradiation value of UV rays.

The Keitz equation found that with a line-shaped light source of a certain length, it can be known the illumination value of the lamp, in this case the UV lamp [16]. Keitz's equation is based on two laws of photometry lighting physics, namely Inverse-Square Law and Lambert's Cosine Law. Which is then adapted to line-shaped light sources and radiometry lighting. At first, Keitz equation to find the power value of the UV lamp, which can be searched with the following equation:

$$P = \frac{(2ELD\pi^2)}{(2\alpha+\sin(2\alpha))} \quad (1)$$

where P is the total UV power of lamp (Watt); α is Arctan value(L/2D) (radians); L is Lamp length (m); E is Illumination/Irradiance (W/m^2); and D is Distance of the lamp to the illumination point (m).

With the formula, if you want to know the irradiance value of the UV lamp, then the Equation (1) is changed to:

$$E = \frac{P}{2\pi^2 LD}(2\alpha + \sin(2\alpha)) \quad (2)$$

D. Mathematical Equations of Time Reaching Target Dosage

In achieving the desired dosage target, it must be identified the type of virus that will be illuminated by UV cyanr. Because for each type of virus, different dosage targets will be achieved. The target dose taken is SARS coronavirus (Urbani) type of 241 J/m^2, because it is the latest dosage information [17]. It should be understood in advance that the target dose is the result of irradiance and exposure time. So when we have set a target dose at a wavelength and have targeted the surface or object that will be subjected to UV light at a certain distance, we can get the irradiance value using the Keitz equation. Therefore, to obtain exposure time on a surface or object can be calculated as the following equation [18]:

$$Time\ (s) = \frac{target\ dose\ (\frac{J}{m^2})}{Irradiance\ (\frac{W}{m^2})} \quad (3)$$

III. METHOD

A. Tools and Materials

There is several hardware needed in this research, such as: Philips TUV 36W SLV/6 Lamp, Lutron YK-37UVSD, Lutron LX-105, and Laser Distance Meter (LDM). As well as for software, use DIALux Evo 9.2 to simulate case studies.

B. Research Methods

1) Theoretical Calculation Methods

The calculation uses the Kertz Equation to determine the radiation value of the UV-C lamp. Data to find out which variables are in the formula have been searched before. As the radiation value from the source is seen in the product catalog and the distance of the lamp to the area to be illuminated. Distance data is taken by measuring the average height of the area in the classroom as the location of the case study. In this case, the point or distance measured is just below the lamp and the center point of the lamp. The goal is to facilitate calculation and know the maximum value of radiation produced.

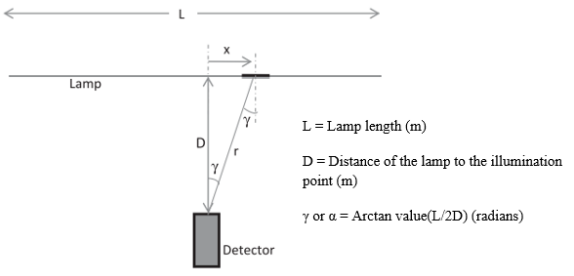


Figure 3. Geometry Used for the Keitz Equation[16]

In theoretical calculations, several variables have been determined based on the specifications of the lamp and have been measured the desired distance. Based on the Equation (2), for the values P and L is 15 watts and 1.2 meters according to the specifications. D values vary between 0.5 metres, 1.0 metres, 1.5 metres and 2.0 metres, while the α values depend on the D value and point you want to calculate. The calculated value is the irradiance value of UV-C radiation at a certain point. If the point is exactly in the middle and under the lamp (Fig. 3), then the Equation (2) can be used directly. However, if the calculated point is not exactly in the middle and bottom of the lamp, then the Equation (2) must be adjusted. Equation (2) is a simple form of the following equation:

$$E = \frac{P}{\pi^2 LD}\frac{1}{4}(2\alpha_1 + \sin(2\alpha_1) + 2\alpha_2 + \sin(2\alpha_2)) \quad (4)$$

The values α_1 and α_2 are angles formed from a point calculated by the position of the lamp against that point perpendicular (Figure 4). Because the value $\alpha_1 = \alpha_2$, the value at the midpoint of the lamp follows the Equation (2). Beyond that, the values α1 and α2 can be calculated by the formula:

$$\alpha_1 = \tan^{-1}\frac{L}{2D} \quad (5)$$

$$\alpha_2 = \left(\tan^{-1}\frac{L}{D}\right) - \alpha_1 \quad (6)$$

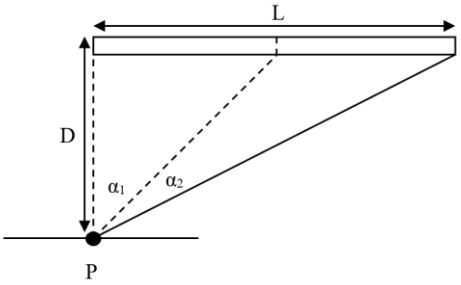


Figure 4. Geometry Illustration for Keitz Equations with $\alpha 1 \neq \alpha 2$ values

2) Data Measurement Methods with Experimental Experiments

Measurements are performed by means of lighting techniques in measuring the intensity of light on a lamp. When the UV-C lamp will be turned on, Lutron YK-37UVSD as a UV radiation measuring device will measure the radiation received on the table and chairs in the area. Philips TUV 36W SLV/6 lamps are installed at a certain distance and at the measuring point that is used as a reference as a comparison with the calculation results. The position of the lamp will be horizontal with the measuring instrument (Fig. 5). Then the measurement results are used to compare theoretical calculations and correlated with simulations.

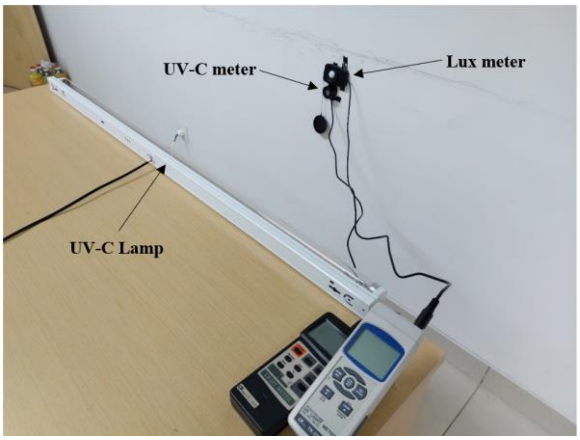


Figure 5. Position of Lamps and Measuring Instruments in Measurement Methods

In data measurement, there are two measured data, namely: UV-C light data in μW/cm^2 and UV-C lamp lighting data in Lux units. UV-C light data is obtained with Lutron YK-37UVSD measuring instrument, while UV-C lamp lighting with Lux meter measuring instrument. The two tools are mounted close together on the wall and parallel to the center point of the lamp with a certain distance. The second purpose of the data was measured to look for the correlation of both data and find conversion equations to convert the value of UV-C light into UV-C lamp lighting [11].

The position of the lamp in Figure 5 is on the edge of the table, the purpose of which is so that the lamp's radiation light has no effect on the reflection of the table material. This measurement aims to see the radiation light of the lamp without being affected by the reflection of nearby object material, such as a lamp mounted on the ceiling of the room and the measuring instrument is just below it. Therefore, the position of the lamp is not hung but placed horizontally with a measuring instrument. Furthermore, there are two things that are varied for measurement, namely the measuring point on the lamp and the distance of the lamp to the measuring instrument (Figure 6). Measuring points 1 and 3 are at the end of the lamp, while measuring point 2 is in the middle of the lamp. The distance variation depends on the value of variable D that was previously mentioned in theoretical calculations.

Measurements are performed in a room where the lights are turned off and during the day. Measurements are performed at measuring points 2, 1, and 3 with the position of the lamp changing (the lamp is shifted with the measuring point right in front of the measuring instrument), and repeated for 5 times at a distance of D. When retrieving measurement data, the UV-C lamp is turned on for 2 minutes, in order to keep the measurement result value stable/unchanged – change. The results of UV-C radiation measurement can be directly seen on the device. While Lux measurement is done before and after the lamp is turned on, the goal is to be able to know the lighting value of UV-C lamps. After obtaining both measurement data, the data was processed by looking for a correlation between radiation illumination and the lighting value of the UV-C Lamp. The correlation results will be used to compare theoretical calculation values in order to be analyzed, while in simulations to find out the lumen flux that will be simulated in the classroom.

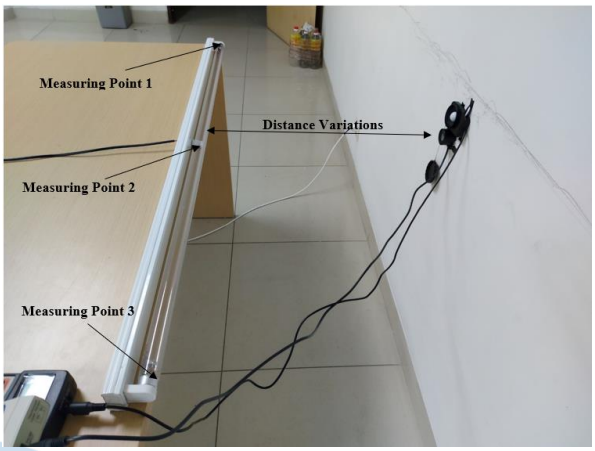


Figure 6. Position of Measuring Points and Distance Variations on Lamps and Measuring Instruments

3) Simulation Method or Case Study Modeling

DiaLux Evo 9.2 software will be modeled from the classroom as well as UV-C lights, which will be put together for simulation. The focus of the simulation was to see the dissemination of the received lighting value (illuminace) in the room instead of the uv radiation illumination value. The equations used in the simulation are unknown due to the lack of information about the use of mathematical equations on both official websites and other scientific research that also uses DIALux, for that there needs to be other methods. To get the value, the search for the equation of conversion of lighting value into the value of UV radiation illumination obtained when conducting analysis on the results of the exposure. This is true because the position of the lamp with the distance in the simulation is adjusted to the layout of the lamp and the measuring instrument in the measurement method. After obtaining the conversion equation, the equation is used to calculate the dose and calculate the minimum time of achieving the target (Eq. (3)) based on simulation.

Data to model of the classroom was obtained from Building Management (BM) Multimedia Nusantara University. In simulation, modeling from a case study of this project requires a room plan and an overview of the room. The room plan given is the floor plan of the New Media Tower Building 7th Floor overall, so that when creating a model of the room focuses only on the room. An overview of the room is obtained when reviewing the room (Fig. 7). The purpose of reviewing to make the modeling of the room as similar as possible to the original room.

Figure 7. Class Room Photo C703

Modeling is made in DIALux Evo 9.2 software, the initial design of the room only contains the dimensions / size of the room along with the funiture model in the software. One of the advantages of this software, can include the type of material or type of color that can be added to the simulation model. Due to the materials and colors included in the simulation, it affects the final result of the spread of UV-C lamp lighting. The interior design in the simulation follows Figure 7, including the layout of furniture, doors and windows.

Figure 8. Screenshots modeling on DIALux Evo 9.2

After modeling the room in DIALux (Fig. 8), the next stage is the layout and model of the lamp used for simulation. The UV-C lamp layout does not follow the layout of the room lamp for artificial lighting, the reason is the function of UV-C lamps for UV-decontamination or sterilization of the room. So, if in the future UV-C lamps are installed do not interfere or wrongly turn on the lights because the light switches are not separated. For the lamp model in the simulation, the length dimension of the model in the simulation is only half the size of the actual UV-C lamp size, so the model is combined in length to fit.

In the simulation lamp photometry data settings, the data set is the luminous flux value that will be obtained when connecting the luminous flux value of the software with the Lux value of the measurement results. Next is the number of lights in the simulation, to know the exact amount required, the conduct of trial and error in the simulation. By using 1 to 8 lights interchangeably, to see which lighting spreads evenly in the room area (Fig. 9).

For lighting data taken in the simulation is the lighting data of each table in the room (lecturer's desk and student table) which amounts to 22 tables to see the spread. After knowing the number of lights needed, a simulation is then carried out on the number of lights. Then taken all lighting data on the table, senderan chair, and seat base with the minimum lighting value, so that when looking for time to reach the target dose with the Equation (7) and (3) can get a minimum time how long the sterilization process of the room.

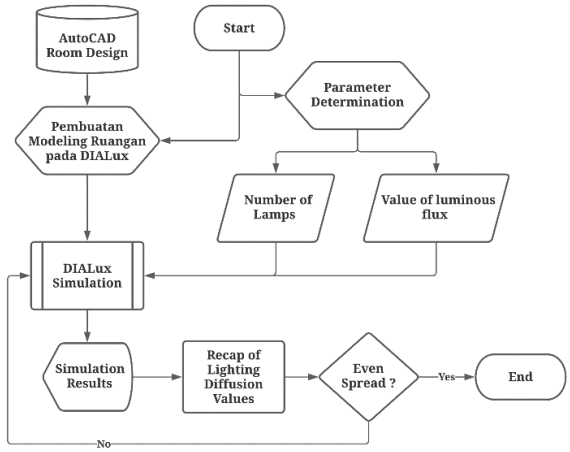


Figure 9. Scheme or Flow of Simulation Method or Case Study Modeling.

IV. RESULTS

A. Theoretical Calculation and Measurement Analysis

After taking measurements in the UV-C lamp experiment, the data of the measurement results are processed with the standard deviation statistical formula or Standard Deviation (S.D.), in Excel is already available in the STDEV function. Standard Deviation has a function to see the spread of data and see if the data deviates from the average value of the data obtained. In measurement data, S.D. serves to calculate how much the upper and lower limits of each data obtained, to see if the measurement results are trustworthy and precise with the results obtained. The S.D. value specified in the final task is 10% of the average value of the measurement data per measuring point. The value is obtained with the consideration that the measurement data results have a minimum confidence level of 90%, which means that the data is trustworthy and has a relatively small error rate [19].

TABLE I. UV-C RADIATION MEASUREMENT DATA ON UV-C LAMPS

Distance (m)	Measuring Point	Measurement Results						
		UV-C (μW/cm²)						S.D.
		1	2	3	4	5	Average	
0,5	1	86	84	84	84	84	84,4	0,894
	2	195	192	193	191	192	192,6	1,517
	3	83	93	84	81	81	84,4	4,980
1	1	42	42	42	42	42	42,0	0,000
	2	76	76	78	77	78	77,0	1,000
	3	41	41	41	42	42	41,4	0,548
1,5	1	27	25	27	27	27	26,6	0,894
	2	40	39	39	39	40	39,4	0,548
	3	26	26	26	26	27	26,2	0,447
2	1	18	19	18	18	17	18,0	0,707
	2	24	24	24	24	24	24,0	0,000
	3	17	18	18	17	18	17,6	0,548

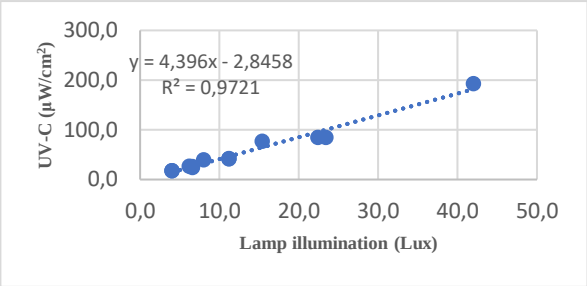
TABLE II. EXPOSURE MEASUREMENT DATA ON UV-C LAMPS

Distance (m)	Measuring Point	Measurement Results						
		Lux						S.D.
		1	2	3	4	5	Average	
0,5	1	25	22	23	23	24	23,4	1,140
	2	44	42	42	41	41	42,0	1,225
	3	22	25	22	22	21	22,4	1,517
1	1	12	11	10	11	12	11,2	0,837
	2	16	17	15	14	15	15,4	1,140
	3	11	11	12	11	11	11,2	0,447
1,5	1	7	6	6	6	6	6,2	0,447
	2	7	8	9	8	8	8,0	0,707
	3	7	6	6	7	7	6,6	0,548
2	1	4	4	4	4	4	4,0	0,000
	2	6	7	7	7	6	6,6	0,548
	3	4	4	4	4	4	4,0	0,000

Processed in Excel, measurement data of both UV-C radiation values (Table I) and UV-C lighting (Table II) have measurement errors below 10%, so both measurement result data can be trusted and proven to be the true value of the UV-C lamp used in this final task. The error in question is the dissemination of measurement result data, which if measured the value does not differ much from other measurement values, so that the measurement results are not anomalous / distorted. The error value obtained is a random error that is not estimated by the researcher because of unexpected factors, while in the measuring instrument used already has a calibration certificate so that systematic errors on the tool do not occur. Then both data are re-processed to find relationships / correlations between data using simple linear regression. Linear regression is one statistical method to test whether there is a closeness between variables to be tested. The data collected is the average data of UV-C radiation values and UV-C lamp lighting, which aims to find multiplier factors when compensating lux values to μW/cm^2 and see correlation values between those variables. The result of the regression that has been done (Graph 1), it was obtained that the R^2 value in linear regression is 0.9721 which indicates a strong correlation between the two variables. The multiplier factor value obtained is 4,396 μW/lux-cm^2 from the following equation:

$$Irradiance\ \left(\frac{\mu W}{cm^2}\right) = 4{,}396 \times Illumination\ (\text{Lux}) - 2{,}8458 \qquad (7)$$

Equation (7) will help to find the uv-C illumination value in the simulation result whose value is in the form of lighting (Lux), and can find the time to reach the dose with the equation (3).



Graph 1. Graph comparing radiation illumination with UV-C Lamp Lighting in Tables 2 and 3

To compare with the calculation results, Table 4 captures the results of calculations performed with equations (2) and (4), as well as the average measurement values taken from Table 2. The result is different from what is expected from the theoretical calculations that have been done, with an average ratio of 50%. The Keitz equation used has been diderivated by the latest method in previous scientific journals, so that the equation has been updated [16]. The assumption used in his update was that Keitz's equation did not describe that the UV radiation was uneven throughout the lamp, so previous research has again reduced the formula to look for the value of the "normalization factor" of the actual spread of UV radiation. `

To analyze the power of UV-C lamps at the time of experiment (compared to the ideal specifications of the tool), it was attributed to the average value of UV-C radiation Measuring Point 2 at each distance in Table 2, and then included in the equation (1). With the aim of recalculating the total power of UV radiation beams emitted on uv-C lamps on each data taken. After recalculating, the total power of UV radiation rays is averaged by:

$$P_1 = \frac{(2 \times 1{,}926\ \mu W/m^2 \times 1{,}2\ m \times 0{,}5\ m \times \pi^2)}{(2 \times 0{,}876 + \sin(2 \times 0{,}876))}$$

$$P_1 = 8{,}338\ Watt, at\ a\ distance\ of\ 0{,}5\ meters$$

$$P_2 = \frac{(2 \times 0{,}77\ \mu W/m^2 \times 1{,}2\ m \times 1\ m \times \pi^2)}{(2 \times 0{,}54 + \sin(2 \times 0{,}54))}$$

$$P_2 = 9{,}29\ Watt\ at\ a\ distance\ of\ 1\ meters$$

$$P_3 = \frac{(2 \times 0{,}394\ \mu W/m^2 \times 1{,}2\ m \times 1{,}5\ m \times \pi^2)}{(2 \times 0{,}381 + \sin(2 \times 0{,}381))}$$

$$P_3 = 9{,}65\ Watt, at\ a\ distance\ of\ 1{,}5\ meters$$

$$P_4 = \frac{(2 \times 0{,}24 \mu W/m^2 \times 1{,}2\ m \times 2\ m \times \pi^2)}{(2 \times 0{,}291 + \sin(2 \times 0{,}291))}$$

$$P_4 = 10{,}032\ Watt, at\ a\ distance\ of\ 2\ meters$$

$$Average\ \bar{P} = \frac{(P_1 + P_2 + P_3 + P_4)}{4}$$

$Average\ \bar{P} = 9{,}328$ Watt , different from the specifications of UV-C lamps listed at 15 Watts.

There are two factors that can influence the measurement results, including the efficiency of the lamp and ballast (lamp holder) and the material at the measurement site. Lamp output power is generally compared to the electrical power (channel) consumed to calculate the efficiency of the lamp/ballast system, or compared to the electrical power transmitted to the lamp to calculate the efficiency of the lamp [20]. Electrical power needs to be measured accurately, so that efficiency can be determined accurately. This electrical power measurement should be done using calibrated instruments for power measurement, using equipment such as power analyzers with adequate frequency response. In particular, it is not enough to measure the voltage and reciprocating current to obtain lamp power with a theoretical formula. While the measurement location is in class, the material on the table and wall can affect the measurement result, namely uv reflection on the material. It is recommended that measurements be made with a room on the wall and the floor covered in black cloth [20], black color itself being a color/material that does not reflect UV light. It can be done if you want to actually get the same measurement results as theoretical. However, when applied in the field must be adjusted to the real conditions of the room. If black fabric is attached to the room, it can make the use of UV-C light technology inefficient. Therefore, for comparison with the simulation used is the result of measurement, not theoretical value.

TABLE III. THEORETICAL CALCULATION DATA COMPARISON WITH UV-C LAMP MEASUREMENT DATA

Distance (m)	Measuring Point	Theoretical Calculation of UV-C (µW/cm²)	Average UV-C Measurement Results (µW/cm²)	Percenta Differenc
0,5	1	247	84,4	34%
	2	346	192,6	56%
	3	247	84,4	34%
1	1	103	42,0	41%
	2	124	77,0	62%
	3	103	41,4	40%
1,5	1	55	26,6	49%
	2	61	39,4	64%
	3	55	26,2	48%
2	1	33	18,0	54%
	2	36	24,0	67%
	3	33	17,6	53%

B. *Measurement Analysis and Simulation*

1) *Correlation of Lumen Flux with Illuminance*

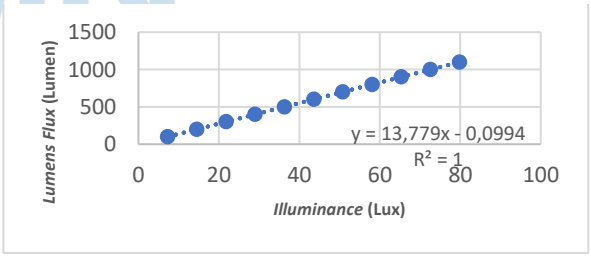
After obtaining the results of uv-C lamp lighting measurement, UV-C lamp lighting data was obtained to be compared with simulation. For lumen flux values (light source output of lights, in Lumen or Candela.Steradian units) in simulations obtained by looking for linear regressions that connect with lighting values in DIALux simulations. This is done to find alternative methods in finding the value of lumen flux, due to the lack of information about the equation/solution used in the software (some previous studies do not explain the details to get the value of lumen flux on DIALux). In the simulation, the range of flux lumen values varied by 1100 to 10 lumens, with the position of the lights in the simulation being above and parallel to the table 2 meters away. After the regression (Graph 2), the multiplier factor value from illuminance to lumens flux was obtained in the simulation of 13,779 lumens/lux with a correlation of R^2 value of 1, which is a strong correlation between the two variables, in accordance with the following equation:

$$Lumens\ Flux\ (lumen) = 13{,}779 \times Illuminace\ (lux) - 0{,}0994 \quad (8)$$

The point of exposure value taken in the simulation as in point 2, which is at the center point of the lamp, where the lighting value with a distance of 2 meters and the measuring point 2 in the measurement results table 2 averaged 6.6 Lux. So, when the value of 6.6 Lux is entered into the equation (8), then the value of lumen flux that must be entered in the simulation is:

$$Lumens\ Flux\ (lumen) = 13{,}779 \times 6{,}6\ lux - 0{,}0994$$

$$Lumens\ Flux = 91\ Lumen$$



Graph 2. Graph comparing lamp lighting with Lumen Flux Lamp In DIALux Simulation

2) *Determination of The Number of Lamp Placements*

After knowing the lumens flux entered, the number of lamp placements required is taken into consideration with the reason that the spread of UV-C lamp lighting in the simulation is evenly distributed and the amount is optimum. One method of finding it with trial and error experiments, by recording the lighting value of each table in the simulation, as the number of lamp placements increases. The rate of spread can be calculated by S.D. , the smaller the percentage value of S.D. hence the spread is evenly distributed. Figure 10 is

the result of a simulation using 1 lamp placement, it appears that the lighting spread is uneven on all tables. To support this, Table IV is the result of a recap of lighting value data on all areas of the table in the simulation. With the percentage of S.D. obtained by 77%, so it is necessary to increase the number of lights back in the simulation to find the smallest percentage value of S.D. The result is shown in Graph 3, the number of lights needed to achieve the most even spread as much as 6 placements.

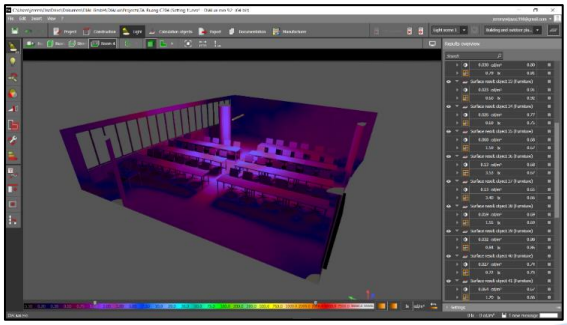
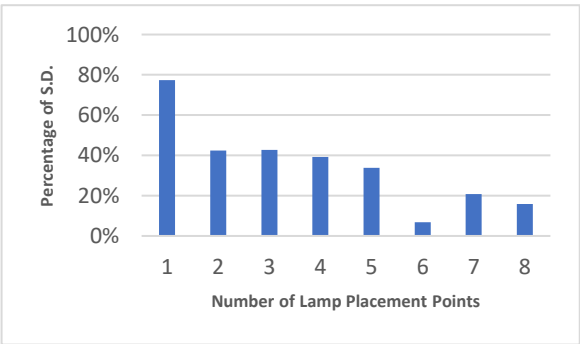


Figure 10. Screenshot of Lighting Simulation Results with 1 Lamp

TABLE IV. SPREADING LIGHTING VALUES IN THE TABLE AREA USING 1 LAMP

Desk Area	Lux Value
1	0,76
2	0,47
3	0,29
4	1,14
5	1,17
6	0,85
7	0,62
8	0,68
9	1,54
10	3,68
11	3,79
12	1,66
13	0,87
14	0,67
15	1,6
16	3,69
17	3,78
18	1,68
19	0,85
20	1,39
21	0,94
22	0,61
S.D.	1,152
Mean	1,488
% S.D	77%



Graph 3. Graph comparing number of lamp placements with percentage S.D. Table Area Rupture Data in DIALux Simulation

3) Lighting simulation and Time to Reach Dosage Target

After finding the value of lumens flux and the number of lights in the simulation, the data was entered into the simulation to find the lighting value on the table, seat back and seat base (Figure 11).

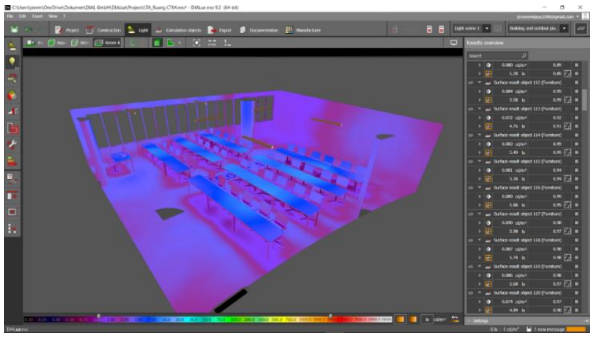


Figure 11. Screenshot of Lighting Simulation Results with 6 Lights

All of these values are recorded and searched for the smallest/least exposure values. It was obtained that the minimum exposure value in the simulation was 2.1 Lux (complete data attached to the Appendix). If included in the equation (7) and (3), the minimum time to reach the target dose is:

$$Irradiance\ \left(\frac{\mu W}{cm^2}\right) = 4{,}396\ \times 2{,}1\ \text{Lux} - 2{,}8458$$

$$Irradiance\ = 6{,}39\ \frac{\mu W}{cm^2}$$

$$Time\ (s) = \frac{241\ \frac{J}{m^2}}{0{,}0639\ \frac{W}{m^2}}$$

$$Time\ =\ 3774\ seconds\ or\ 63\ minutes$$

The time is very long considering if this UV-C light system will apply to the room or other classrooms. If the condition of the campus environment returns to normal with the classroom used as scheduled, the transition of class change is between 15 to 30 minutes depending on the number of semester credit unit courses. Thus, in the simulation the number of each lamp location is doubled to 2. After re-simulating with double lights, the result is a minimum exposure value of 3.81 Lux (complete data attached to Appendix), re-inserted in the equation (7) and (3), obtained the minimum time to reach the target dose to be:

$$Irradiance\ \left(\frac{\mu W}{cm^2}\right) = 4{,}396\ \times 3{,}81\ \text{Lux} -\ 2{,}8458$$

$$Irradiance\ = 13{,}90\ \frac{\mu W}{cm^2}$$

$$Time\ (s) = \frac{241\ \frac{J}{m^2}}{0{,}139\ \frac{W}{m^2}}$$

$$Time\ =\ 1733\ seconds\ or\ 29\ minutes$$

That time is already in the time span of the class change mentioned earlier. Table 6 is a recap of the minimum value of lighting and the time to reach the dose on the table, seat back and seat base by comparing the number of lamps installed at 1 point of placement of the lamp.

TABLE V. SPREADING LIGHTING VALUES IN THE TABLE AREA USING 1 LAMP

Number of Lights	Area (m^2)			Minimal Illuminance Value (Lux)			Minimum Time To Reach Target Dose (Minutes)		
	Table	Seat Back	Seat Cushions	Table	Seat Back	Seat Cushions	Table	Seat Back	Seat Cushions
1	0,9	0,15	0,18	7,25	3,44	2,1	14	33	63
2				12,3	6,59	3,81	8	15	29

After knowing the fastest minimum time by using 6 placement points with each point 2 lights, please be aware of the effect produced if the funiture material / object is too long exposed to UV-C radiation. UV radiation absorbs in all kinds of materials both organic and non-organic [21]. In living things / organisms, the effect that is often associated even if it does not cause directly, is skin cancer in humans. However, UV rays can have a good or bad impact, depending on radiation exposure and the dose to be achieved in order to be on target [22]. In inanimate objects/objects/non-organisms, few types of material can be affected by UV rays, especially with UV-A and UV-B rays, one of which is color fading in fabric products[23] and structural and physical changes of polymer products [24]. To date, there has been no scientific research that shows changes that occur in object/non-organism material due to UV-C radiation overdose. But some types of material objects / non-organisms exist that can reflect or deflect UV-C rays, depending on certain interests.

In the real use case, if the distance between the object and the UVC lamp is longer, then there needs to be a re-measurement to measure the radiation received by the object in the room installed by the UVC lamp. Because distance will affect the exposure of UV radiation from UVC lights in an area of objects that want to be sterilized.

V. CONCLUSIONS AND SUGGESTIONS

Based on the research, it can be concluded that:

1. There are differences in the value of UV illumination from UV-C lamps in theory as well as direct measurements. Direct measurements show an average illumination value of 50% of the theoretical calculations. The efficiency factors of lights and ballast as well as the conditions and methods of measurement influence the difference. However, because for the purposes of field applications need to adjust to real conditions, then what is then used for the simulation process is the irradiation value of direct measurement.
2. The number of fixed placements - UV lamp system that is optimal for obtaining effective disinfectant doses depends on the seating position in a room. In the classroom space case study, the placement of lamps at 6 points resulted in an even spread of UV-C radiation with a deviation of 7%
3. The minimum time or duration of UV-C dose for COVID-19 virus disinfection is 29 minutes using each of the 2 lights at the six placement points.

Based on the conclusion of the analysis, there are several suggestions that should be considered for the future works, including:

1. This article can be an introduction to a future research article to discuss the effect of the distance between objects and UVC lamps on UV radiation presented.
2. There needs to be a measurement method to determine the efficiency of lights and ballastes that can affect the performance of UV-C lamps.

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Analysis Of UMN Student Graduation Timeliness Using Supervised Learning Method

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***Abstract*—— Education is one of the most important things in human life, and in the world of education. However, there are still many students who graduate not on time. The purpose of this study is to find out an overview of what factors influence, then data analysis, and visualization so that students can graduate on time or not on time for UMN student graduates in 2018-2020. The method or approach used to solve the problem is data collection, independent variable, dependent variable, CRISP-DM, with SQLYog tools, to store data, rapid miner for data cleaning, then calculate prediction accuracy with rapid miner using nave Bayes algorithm, and regression logistics, using the included 10-fold validation method, and visualizing the data with Tableau. The conclusion of the final result that is done from this research is for the project to be able to process simple mysql pentaho storage, For data mining, suggesting using the model with the greatest accuracy in each semester in the Information Systems study program is for Semester 1 to use the IPS model - Cross Validation Logistic Regression, then Semester 2 to Semester 7 using the GPA-NaiveBayes (Normal) or GPA-NaiveBayes (Traning With CrossValidation) model). For Data Visualization, there are also insights that will be discussed further in this thesis.**

***Index Terms*—Data Analysis; Data Cleaning; Data Mining; Data Visualization; Education**

I. INTRODUCTION

Education is one of the most important things for human life, education itself has the meaning of knowledge, skills, to a group of people that are passed on from generation to generation through teaching, or research, education is important for generational transfer, because the future is determined by a new generation, current work many are replaced by the new generation [1]. Universities in Indonesia, can take the form of institute, polytechnic, Academy,University and high School. Universities can organizeeducation, vocation, profession, academic, with educational programs Diploma, or Bachelor, or Master, or Doctoral, and Specialist [2].

Multimedia Nusantara University is a university that was established in 2005 with 4 faculties with 12 study programs at the undergraduate level (S1) in 2020, and 1 study program, namely hospitality at the Diploma level (D3) UMN is located in Kelapa Dua Summarecon Serpong, Tangerang Regency. Students graduate in the Bachelor (S1) program with a minimum credit that must be completed is 144 semester credit units (credits), and the maximum length of learning is 7 years, the length of study for undergraduate students (S1) normally according to the curriculum is 8 semesters or for 4 years. However, many students who complete their studies pass the general standard of graduation or can be said to be in the category of not graduating on time. In education, especially Indonesia, the quality of education must be improved, so that it can be useful in the world of work, especially for service to the country[3]. The number and percentage of graduate study programs that are not punctual in 2018 to 2020, where in 3 years the percentage of study programs that increase in punctuality is Accounting, Film, and Television, Communication Studies, and finally Information Systems, data obtained from the Academic Information Bureau (BIA) of Multimedia Nusantara University. [4]. However, there is lack of research that analyzes the category of UMN graduates that has been traced on the UMN knowledge center website [4]. From the existing background, the formulation of the problem emerges, where the questions that will discuss what are the factors that affect the punctuality of graduation for students at Multimedia Nusantara University in the 2018-2020 graduation year.

II. METHODOLOGY

A. Object of research

The object of research in this thesis proposal is UMN students, many UMN students want to graduate quickly or want to improve grades in the intermediate semester, for the Bachelor program is an academic education level that has a study load of between 144 semester credit units (credits) to 160 credits, with a curriculum of 8 semesters. and the length of the program is between 7 to 14 semesters [5], Diploma Three Program (D-3) is an academic education level that has a study load between 108 to 120 semester credit

units (credits), with a curriculum of 6 semesters and program duration between 6 to 10 semesters [6].

The research method is a quantitative research, because it measures a data problem through numbers, and also measures as descriptive words pass on time, or not. Data can be converted in statistical form and taken into account in making a solution and the method used is not from questionnaires, surveys, polls, or interviews that are questions, the number of participants in quantitative methods tends to be more than qualitative[7].

B. *Research Method*

Fig. 1 explaining about CRISP-DM, CRISP-DM stands for Cross-Industry Standard Process for Data Mining which was developed in 1996 by several analysts from the industry, namely NCR, SPSS, Daimler Chrysler. CRISP-DM is a standardization process in data mining for general problem solving for business or for research.

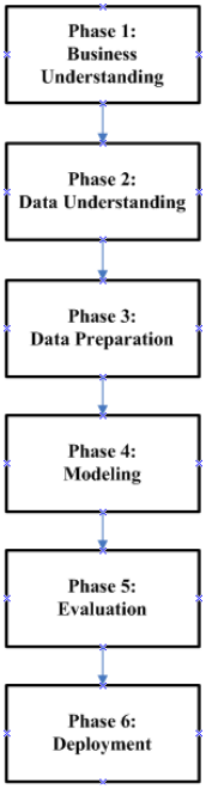

Fig. 1 CRISP-DM Graphics [8]

1) *Business Understanding*

Business Understanding in this thesis is an analysis of UMN student graduation per study program, and per semester, the rate of non-graduation on time is still large and increasing in the 2018-2020 period at UMN, chapter 4 will discuss graduation in the UMN academic guide. Pass is when you have completed all the credits of lessons in each study program including internship and thesis sessions, and have taken the IELTS English exam, pass on time for Bachelor (S1) if you pass 3.5 years or 4 years, for not being on time pass above this number, including students who drop out of lectures[5].

2) *Data Understanding*

The data used is graduate student data (S1) who have graduated from 2018 to 2020 at Multimedia Nusantara University. data was obtained from the Academic Information Bureau (BIA) of Multimedia Nusantara University. The data rows were 3625 rows of data. The dependent variable is a variable that is influenced by the independent variable, the data obtained by students who have graduated from 2018 to 2020 only, in the dataset, the dependent variable is as follows: Category Of Graduates. Whilst independent variables are variables that can affect other variables. In the dataset, the independent variables are as follows: Force, Origin School, Study Program, Faculty, Sex, Ips Semester 1, Ips Semester 2, Semester Between 1, Ips Semester 3, Ips Semester 4, Ips Semester Between 2, Ips Semester 5, Ips Semester 6, Ips Semester Between 3, Ips Semester 7, Gpa Semester 1, Gpa Semester 2, Semester Between 1, Gpa Semester 3, Gpa Semester 4, Gpa Semester Between 2, Gpa Semester 5, Gpa Semester 6, Gpa Semester Between 3 , Semester Gpa 7, Place Of Birth.

3) *Data Preparation*

The data must be clean and free from missing values, therefore by eliminating the missing row labels and missing row attributes, and removing duplicates so that the resulting data is more valid, connect the data to Pentaho MySQL. This project saves MySQL pentaho data using SQLYog software to input data into a table, or create a table, which has a data type, and the length of each column.

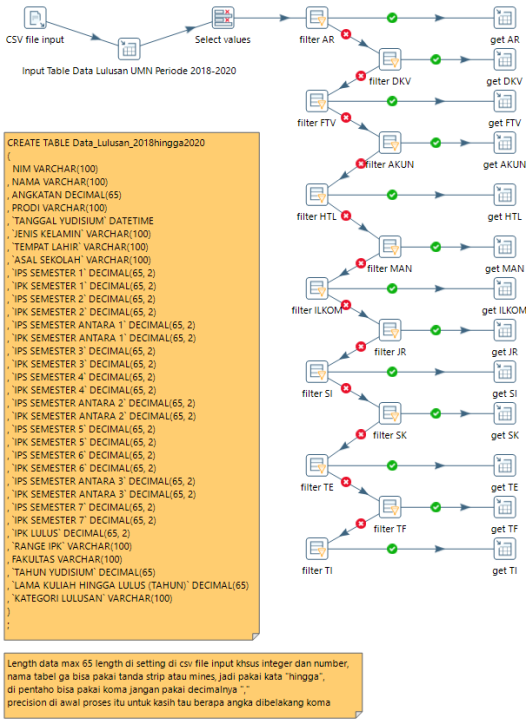

Fig. 2. Image Database Schema

Fig. 2 explain about making data tables getting from csv format a total of 3625 data, inputting MySQL pentaho data from each study program so that it can store data optimally, the name of the thesis database, with the data_graduate_2018 to 2020 table, for a small part of the data, divided into 13 study programs namely the account table, architecture, DKV, FTV, Hospitality, Communication Studies, Journalism, Management, SI, SK, TE, TF, IT.

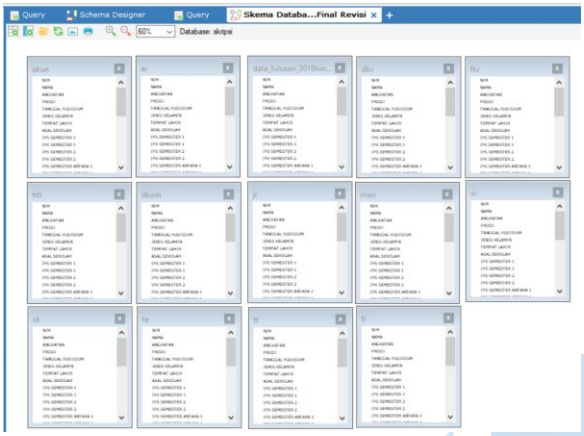

Fig. 3 Image Database Schema

Fig. 3 explain about relational tables, or a collection of tables.

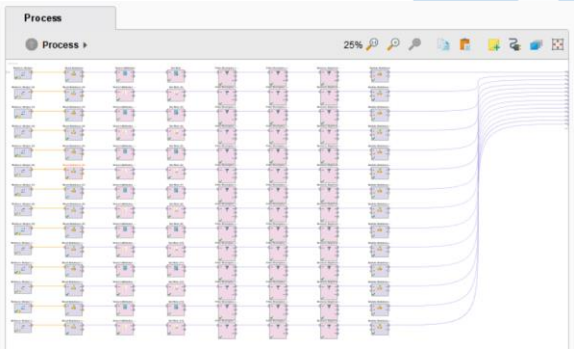

Fig. 4 Data Cleaning

Fig. 4 explain about data cleaning on all tables, by connecting with mysql, then select attributes, and set labels, namely the graduate category, with filters for no missing labels, and no missing attributes so that the data is clean, as well as remove duplicates.

4) Modeling

There are two pupular algorithms that have been applied for this topic. The first algorithm is Naïve Bayes with 96.67% accuracy [9] and and 80% accuracy [10]. Secondly, reseachers uses a logistic regression algorithm with 90.2 % accuracy [11]. The reasons for choosing Naïve Bayes because, it does not have to be numerical for all predicted variables such as neural networks, can be used for quantitative and qualitative data, does not require a large amount of data, if used in programming languages, the code is simple, can be used for problem classification. binary or multiclass, compared to logistic regression where the dependent variable must be binary yes or no, the more variables the more precise. The reason for choosing Logistics Regression is because the independent variables or attributes in logistic regression do not have to be all numeric to predict the dependent variable, using logarithmic or logarithmic logistics, suitable for 2-choice logistic regression or true, false.

The modeling used is classification, using Naïve Bayes data mining algorithm, and logistic regression, for data mining using rapidminer tools, in this study by making a combination of naive bayes and logistic regression with the normal model, Cross Validation, and reducing the IPS attribute per semester with 70% training data, and 30% testing data, after getting a conclusion, data visualization is formed using the Tableau tools.

TABLE I. DATA MINING SOFTWARE COMPARISON

Software	**Advantages**	**Deficiency**
Rapid Miner	*Open source* using 10,000 Rows of data, usage is simpler because it uses the drag and drop method for data mining and data cleansing processes	The data mining process is not described in detail, usually it's just simple, for example, how much accuracy is directly in the result
Python	*Open source*, Multiplatforms there are operating systems windows, Linux, mac, neural network in rapid miner if you want to get accuracy the label must be text, so use python	*coding* more complex than rapid miner and r studio
R Studio	*Open source*, Multiplatforms there are windows, Linux, mac operating systems, relatively good graphics facilities	Coding is more complex than rapid miner and 91amper is the same as complex with r studio

Based on Table I. explains about the selection of data mining software for research from the advantages and disadvantages that exist, then the rapid miner is used because Open-source uses 10,000 data rows, usage is simpler because it uses the drag and drop method for data mining and data cleansing processes.

TABLE II. COMPARISON OF DATA VISUALIZATION SOFTWARE

Software	Advantages	Deficiency
tableau	Interactive visual options, there are moving graphics, User friendly , does not require a lot of hard coding, Dashboard is mobile friendly , can process data on mobile, can connect with many types of databases, there are story features, and dashboards	Paid software, the cost is quite expensive
Power BI	*Open source* software , Can create dashboards, User friendly , doesn't need a lot of hard coding	The amount of data has reached 2GB, must upgrade to the paid version of power BI

Table II. explained about the selection of data visualization software for research from the advantages and disadvantages that exist, by choosing the Tableau software because of the interactive visual options, there are moving graphics, User friendly, does not need a lot of hard coding, Mobile friendly dashboard, can process data on mobile, can connected to a database of many types, there is a story feature, and a dashboard.

5) Evaluation

The evaluation in this study is to compare the accuracy of the Naive Bayes model and logistic regression with the normal model, cross validation, and reduce the Social Studies attribute per semester with 70% training data and 30% testing data.

6) Deployment

In this study, it was used only for learning, the deployment stage was not used because it did not use a system model to UMN students

III. RESULT AND DISCUSSIONS

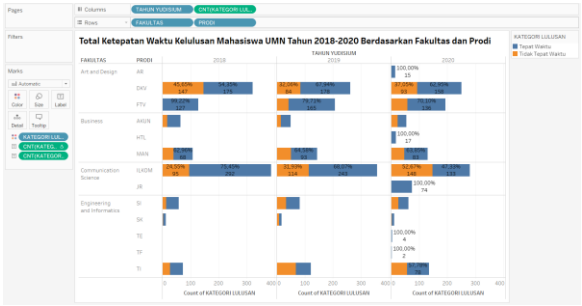

Fig. 5 Graph of Total Timeliness of Graduation of UMN Students in 2018-2020 Based on Faculties and Study Programs

Fig. 5 Explaining the Total Timeliness of Graduation of UMN Students in 2018-2020 Based on Faculties and Study Programs or within a period of 3 years, the blue color indicates the number of students on time, and the orange color indicates the number of students who are not on time, in the graph there is also a number label for see how many students graduate on time or not, including the percentage per pane, from the conclusion that in 2020 graduates, architecture, hospitality, journalism, electrical engineering, engineering physics get graduates 100% on time.

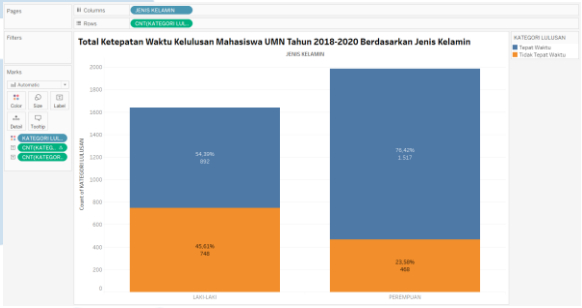

Fig. 6 Graph of Total Timeliness of Graduation of UMN Students in 2018-2020 by Gender

Fig. 6 Explaining the Total Timeliness of Graduation of UMN Students in 2018-2020 Based on Gender or in a 3 year period, the blue color indicates the number of students on time, and the orange color indicates the number of students who are not on time, in the graph there is also a number label to see how many students graduate on time or not, including the percentage, it can be seen that the percentage of women is 76.42% graduating on time compared to 54.39% for men.

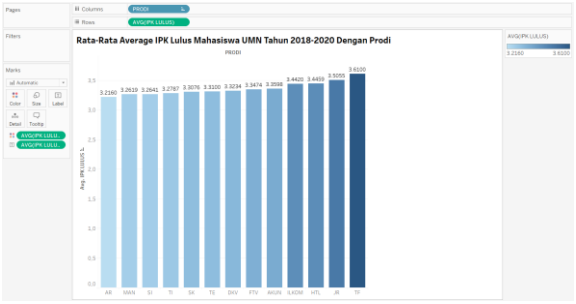

Fig. 7 Graph of Average GPA of Graduated UMN Students in 2018-2020 Based on Study Program

Fig. 7 explained about the average GPA of UMN students from 2018 to 2020 based on study programs, with the winner being engineering physics with an average GPA of 3.61.

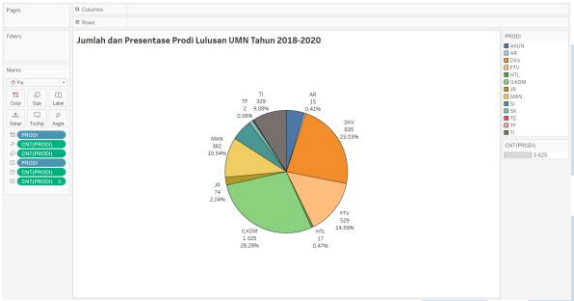

Fig. 8 Number and Percentage of 2018-2020 UMN Graduate Study Programs Based on Study Program

Fig. 8 explains the number, and percentage of study programs at UMN graduates in 2018-2020 based on study programs, with the largest percentage of ILKOM being 1025 students with a percentage of 28.28%, and for diplomas only 17 people, with a percentage of 0.47%.

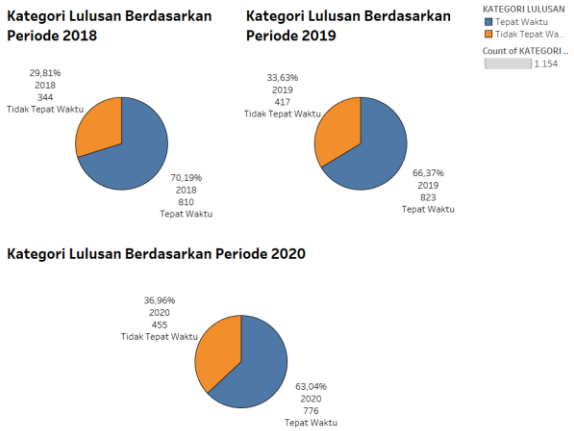

Fig. 9 Graph of Graduate Categories by Period 2018-2020

Fig. 9 Explaining the dashboard of graduates of UMN S1 students over a 3 year period with the percentage, year, number, and category of graduates, from this dashboard it can be said that the percentage of inaccuracy of UMN student graduates increased from a period of 3 years, the blue color shows the number of students on time, and the orange color indicates the number of students is not on time, the data is obtained from the Academic Information Bureau (BIA) Universitas Multimedia Nusantara which was approved by the head of the Information Systems study program, Mrs. Ririn Ikana Desanti.

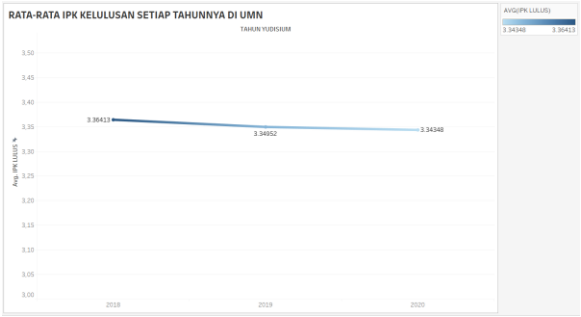

Fig. 10 Average Graduation GPA every year at UMN for the 2018-2020 period

Seen from Fig. 10 that there is also a problem in this research, namely the Average GPA of Graduation Annually at UMN for the 2018-2020 period decreases every year in a special 3-year period for S1, data obtained from the Academic Information Bureau (BIA) Universitas Multimedia Nusantara which was approved by the chairman Information Systems study program, namely Mrs. Ririn Ikana Desanti.

A. Evaluation

TABLE III. ACCURACY RESULTS

Study Program and Semester	Model Algorithm	Accuracy
Semester 1 Information System	IPS - CrossValidationLogisticRegression	75.31
Semester 2 Information System	GPA - NaiveBayes (Normal)	73.77
	GPA - NaiveBayes (Traning With CrossValidation)	73.77
Intermediate Semester Information System 1	GPA - NaiveBayes (Normal)	86.89
	GPA - NaiveBayes (Traning With CrossValidation)	86.89
Semester 3 Information Systems	IPS - NaiveBayes (Normal)	83.61
	IPS - NaiveBayes (Traning With CrossValidation)	83.61
Information System Semester 4	IPS - NaiveBayes (Normal)	83.61
	IPS - NaiveBayes (Traning With CrossValidation)	83.61
Intermediate Semester Information System 2	IPS - NaiveBayes (Normal)	83.61
	IPS - NaiveBayes (Traning With CrossValidation)	83.61
Semester 5 Informasi Information System	IPS - NaiveBayes (Normal)	81.97
	IPS - NaiveBayes (Traning With CrossValidation)	81.97
Information	IPS - NaiveBayes (Normal)	81.97

Study Program and Semester	Model Algorithm	Accuracy
Systems Semester 6 Sistem	IPS - NaiveBayes (Traning With CrossValidation)	81.97
SI Semester Between 3	IPS - NaiveBayes (Normal)	81.97
	IPS - NaiveBayes (Traning With CrossValidation)	81.97
SI Semester 7	IPS - NaiveBayes (Normal)	80.33
	IPS - NaiveBayes (Traning With CrossValidation)	80.33

Table III. describes the comparison of the output accuracy of the winning model in each semester in each study program which for 3 years from 2018 to 2020 experienced an increase in untimely graduation, in this thesis data mining all using the most influencing variable with the greatest accuracy is class, school origin, IPS Semester 1, IPS Semester 2, GPA Semester 2, IPS Semester 1, IPS Semester 3, IPS Semester 4, IPS Semester 2, IPS Semester 5, IPS Semester 6, IPS Semester 3, IPS Semester 7.

In conclusion, suggesting using the model with the greatest accuracy in each semester in the Information Systems study program is for Semester 1 to use the IPS model - Cross Validation Logistic Regression, then Semester 2 to Semester 7 using the GPA-NaiveBayes (Normal) or GPA-NaiveBayes (Traning With CrossValidation) model).

TABLE IV. RESULTS OF COMPARISON OF DATA ANALYSIS

Category	Before Data Analysis	With Data Analysis
Data storage on Pentaho MySQL	Previously there was no data that wanted to be analyzed on the data stored in Pentaho MySQL	Now there is data then it can be stored in Pentaho MySQL
Data Mining	Previously there was no data that you wanted to mine	Now that there is data, it can be mined to get new knowledge
Data Visualization	Previously there was no data, which was used for visualization	Now it helps to see visualizations, to get new knowledge

Table IV. describes the results of the comparison of data analysis from 3 categories, namely data storage in Pentaho MySQL, data mining, and data visualization.

IV. CONCLUSIONS

A. *Conclusions*

From the results of the practicum in this thesis report, the goal was achieved. By knowing the factors that affect the timeliness of graduation for Bachelor (S1) students at Multimedia Nusantara University in the 2018-2020 graduation year with the variable of the algorithm winner from each semester in the Information Systems study program, namely the generation, origin school, IPS Semester 1, IPS Semester 2, GPA Semester 2, IPS Semester 1, IPS Semester 3, IPS Semester 4, IPS Semester 2, IPS Semester 5, IPS Semester 6, IPS Semester 3, IPS Semester 7, with processing where MySQL data input was successful using Pentaho software, and SQLYog, for visualization data, the percentage of inaccuracy level of UMN student graduates increased from a 3-year period, Average Graduation GPA Annually at UMN 2018-2020 period decreased every year in a 3-year periodit can be seen that there are more percentages of women graduating on time than men, and in 2020 graduates, architecture, hospitality, journalism, electrical engineering, physics engineering obtained graduates 100% on time, then the average GPA graduated from UMN students in 2018 to 2020 based on study programs, the winner is engineering physics with an average GPA of 3.61, the number, and percentage of study programs at UMN graduates in 2018-2020 based on study programs, with the largest percentage of ILKOM being 1025 students with a percentage of 28.28%, and for diplomas only 17 people, with a percentage of 0.47%.then the average GPA graduated from UMN students in 2018 to 2020 based on study programs, the winner was physics engineering with an average GPA of 3.61, the number, and percentage of study programs for UMN graduates in 2018-2020 based on study programs, with the largest percentage of ILKOM being 1025 students with a percentage of 28.28%, and for diploma only 17 people, with a percentage of 0.47%.then the average GPA graduated from UMN students in 2018 to 2020 based on study programs, the winner was physics engineering with an average GPA of 3.61, the number, and percentage of study programs for UMN graduates in 2018-2020 based on study programs, with the largest percentage of ILKOM being 1025 students with a percentage of 28.28%, and for diploma only 17 people, with a percentage of 0.47%.

B. *Suggestions*

The findings of this model can be used as input to create a database, or create a timely graduation rate analysis system for UMN students, so that with a directly connected database they can issue reports and complete the analysis.

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The Design of Final Project Information System

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***Abstract*—The final project is an educational method to determine the competence of a student regarding the knowledge that has been obtained during lectures. The implementation of the final project activities is currently still done manually, causing problems that often occur such as misinformation of each actor involved, the difficulty of the supervisor in monitoring the development of his student guidance, besides that the final project form files are not well organized. which makes searching for files take a long time. The creation of a website-based Final Project Information System aims to make the final project implementation process more efficient and effective in solving current problems. In this study, the method used in system design is the Software Development Lifecycle method. While the testing method used is the black box testing method with the equivalence partitioning technique. The results obtained in this study are the design of the final project management information system with test results that there are still some bugs that must be fixed before being used in general.**

***Index Terms*— Final Project Management; Information System; SDLC**

I. INTRODUCTION

Most of the activities carried out during this period were related to information systems. Not only in developed countries, but in Indonesia information systems are also widely used in various sectors such as government, industry, and education. Management information systems provide added value to the decision-making process in problem-solving efforts, as well as a competitive advantage, which is certainly beneficial for business activities [1].

At this time, many universities in Indonesia provide services to their students with an information system. The use of information systems for the activities of the university will be a factor in the success and progress of the university [2]. One of the applications is the final project/thesis information system.

The final project is a term used to describe a scientific work by presenting the results of the investigation in written form following the applicable regulations. The final project contains the accumulation of scientific fields that have been obtained during the lecture period. The purpose of the final project is that students are expected to be able to formulate and compile a scientific work following the scientific aspects that have been studied, this has an impact on increasing the quality of human resources due to organized and systematic work system [3].

Final project data administration in the form of preparation activities, final project data archiving carried out by the final project commission. The administration of the final project carried out at the Bangka Belitung State Manufacturing Polytechnic is still done manually, for example, such as submitting proposals, mentoring, monitoring and scheduling sessions. With the current condition, there are problems such as frequent misinformation of each actor involved, and this affects the difficulty of the supervisor in monitoring the development of his guidance students besides that the final project form files are not well organized which makes searching for files belong. The current conditions result in the less effective delivery of information about the final project.

Taking into account the current problems, the purpose of this research is to design a management information system to support all student final project management activities.

II. LITERATURE REVIEW

A. *Management Information System*

The management information system at this time has become one of the indispensable vitalities. This is because the management information system is able to provide information and is also able to support decision making or management of activity using information technology [1]. Implementation in the field of education is very useful in making decisions of every

lecture activity, it can also be implemented for policies in achieving educational goals [4]. Not only present events but also past events are useful for evaluation and input for future planning. The main functions of a management information system (MIS) are data retrieval, data management, information media, and data storage. As information processing in general, management information systems can also be understood as a series that includes design procedures, supervision, instructions and can be processed so that they are of value to the organization [5].

B. *Final project*

The final project can be defined as a series of activities designed to assist Bangka Belitung State Manufacturing Polytechnic students in applying the knowledge and skills acquired during the study period by developing creative and constructive ideas [6].

In addition, research is a student's scientific paper that is formulated as an effort to fulfil the requirements to complete the Education program [7].

It can be concluded that the final project is an activity to determine the competence of a student to the knowledge gained during lectures.

C. *Previous Study*

In the research, M.A.Dharmawan et al. [3] explained that the existence of an information system for submitting a thesis title could speed up the data processing for submitting a student thesis title and speed up the validation of approval for the proposed title. Another research conducted by D. Lestari, et al [8] explained that the Final Project Information System is useful to support the final project management activities so that the final project activities can run effectively and efficiently. A.Sari et al's research [9] explains that this information system can help final project activities in scheduling exams, information on test scores and information on students and examiners lecturers. As well as in the research of F.J. Wibawa [10] explaining the impact of scheduling information systems and financial management on scheduling activities for seminars and Final Project / Thesis sessions to make it easier and minimize the possibility of conflicting schedules.

Based on the research above, the writer discusses the design of the final project management information system with the addition of several processes to support all student final project management activities. In designing this management information system, it is also based on research from Teguh [11] the author will design a website-based final project management information system which is expected to assist the approval, monitoring and scheduling process of this final project. In the process of modelling or designing the system, the author will use structural modelling as well as using several components of the UML model in accordance with the explanations of the research [11], [12], [13].

III. SYSTEM DESIGN METHOD

A. *System Development Model*

The method used in making this final project management information system is the Waterfall model. The waterfall model is one of the models in the Software Development Live Cycle (SDLC) method, where this model is suitable to be implemented in the development of a new system with several stages, namely: Requirements analysis, Design, Development, Testing, Maintenance. SDLC is an operating step used by a systems analyst and programmer when creating an information system. In addition, SDLC is also a tool in project management that can be used to plan, make decisions and control the information system development process [13]. Regarding the stages of system development with the waterfall model, it can be seen in Fig.1:

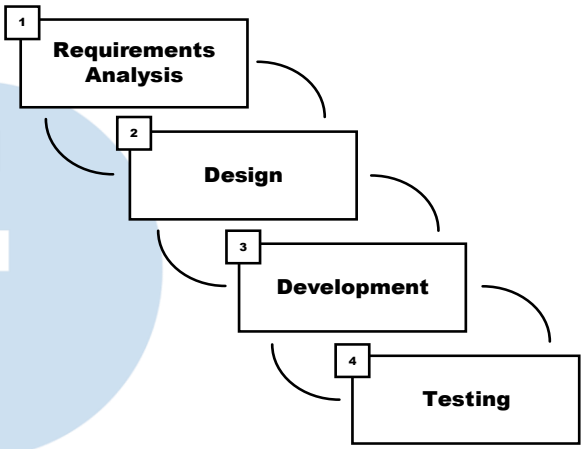

Fig. 1. Waterfall model

- Requirements analysis

  Is the initial stage to identify problems and analyze system requirements needed in system development. This is a form of problem-solving so that it can be resolved properly and the expected data is in accordance with the results. At this stage, data collection in the form of literature was carried out using previous research articles and interviews with the final project commission.

- Design

  At this stage, the design of the proposed system includes determining software specifications that are adapted to the system and compiling a final project management information system model framework in the form of programming algorithms.

- Development

  The development stage is implementing the results of various design models that have been designed into a language that can be understood

by computers. At this stage, the results of the design are translated into machine language using the PHP programming language.

- Testing

At the testing stage, a test is carried out on the system that has been built, testing is carried out using one of the testing methods, namely the black box method with the Equivalence Partitions Technique. The Equivalence Partitions technique in this study is useful in testing each input data and then dividing the input into several modules based on their functionality. . Testing using the equivalence partitioning technique has stages that must be carried out such as: making test cases based on the existing functions in the tested module, creating a test model based on the functionality and modules tested, testing the previously created model.

B. Process Design

- Usecase

Use case diagram is a model that describes the behavior of a system to be built. Use cases are useful to describe the interactions that occur between one or more actors in the system created [14].

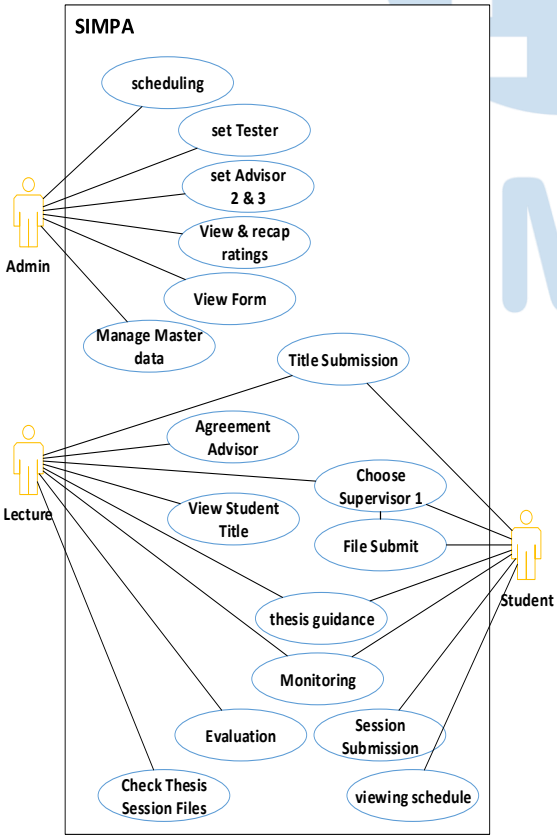

Fig. 2. Usecase

The use case depicted in Fig.2 can be seen that in general the application system built has 3 actors, namely admin, lecturer and students. The three actors have shared access to the system. Each actor can only access or perform according to the access grantedn.

- Activity Diagram

Activity diagrams useful for describing the workflow on the system or business processes contained in the software [14]. In the development of this research activity diagram is needed as a design of activities that occur in this system which can facilitate coding. The design of the Activity Diagram in this study can be seen in Fig.3.

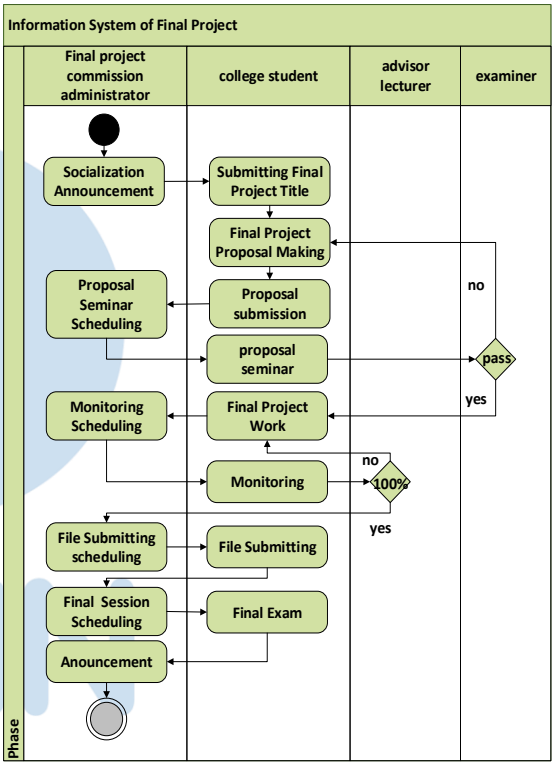

Fig. 3. Activity Diagram

Fig.3 shows specifically the actors involved in this system. The process flow of the system starts with the admin announcing the opening of the final project schedule, followed by students submitting titles and then preparing and submitting proposals. After all student proposals have been collected, the admin arranges the proposal seminar schedule along with the examiners. If after the seminar the student's proposal is approved, then proceed with the final project work, otherwise, the student is required to change the title and conduct the seminar again. When the monitoring process takes place, the student is said to be ready to take part in the final trial, then the student is required to collect supporting documents for the trial. After that, the admin will arrange the trial schedule and the examiners.

IV. RESULT AND DISCUSSION

Based on the results of the analysis of the system design that has been carried out, it produces a final project management information system. The results of the implementation of the system are divided into several user roles, namely admin, lecturer, student.

In the admin role there are several menus in the sidebar, namely:

- Home

  On the home menu there is information related to the number of titles ready for seminars, completed seminars, titles ready for trial and finished sessions. On the admin home page there is also a list of lecturer recommendation titles.

- Master Data

  The master data menu contains master data that can only be managed by the admin, such as departmental data, study programs, lecturer data, student data, room data, level data. Management on these pages such as adding new data, or making changes when desired.

- Schedule Setting

  On the schedule setting page, the admin can schedule title settings, monitoring scheduling, scheduling early semester assessments, scheduling trial file collection.

- File Announcement

  On the announcement menu, this file has 3 sub menus such as announcements, download files, and links. In the announcements sub menu, admins can make announcements related to the latest information. In addition, the download sub menu is useful for managing forms or files that can be downloaded by other users. As for the link sub menu, it is useful to provide a link to the user about the system connected to this system.

- Final Project Proposal

  In the final project proposal menu, there is a process for scheduling seminars, viewing the seminar minutes form, and adding supervisors.

- Final project

  The final project menu admin has access to scheduling trials and examiners, admins can also view proposed titles that have been completed in court.

- Rating Data

  The assessment menu contains student data who have completed the initial semester assessment and guidance assessment.

- Initial Value Recap

  The initial value recap menu contains student values that can be recapitulated

- Final Score Recap

  The final grade recap menu contains student grades that can be recapitulated.

- Final Project History

  The final project history menu contains the titles of students who have finished the trial and become references later. In the admin role, you can see detailed information on the proposal.

The student role is divided into 3 menus, namely:

- Final Project Proposal

  The final project proposal menu contains the process of submitting a title, submitting a supervisor, and collecting proposals as well as viewing the session schedule that students can do.

- Final project

  In the final project menu there is a process of filling out the guidance and monitoring form. In addition, there is a report collection page. In the final project menu, students can also see the schedule for their PA session.

- Final Project History

  The final project history menu contains a history of the proposed final project titles that have been reviewed.

The lecturer role is divided into 5 menus

- Final Project Proposal

  In the role of lecturer in the final project menu, there are 2 accesses as supervisors and examiners. As a supervising lecturer, there is a process for submitting the title of a lecturer recommendation, approving the list of student proposals and being able to see the schedule for the student guidance seminar. Meanwhile, the examiner lecturer can see a list of student proposals to be tested and can see the student's schedule.

- Final project

  In the final project menu there is a process of filling out the guidance and monitoring form. In addition, there are lecturers who can also see the schedule for the session of the guidance student or those who will be tested.

- Evaluation

  This assessment menu contains the process used by lecturers in conducting initial semester assessments and guidance assessments.

- Final Project History

  The final project history menu contains a history of the proposed final project titles that have been reviewed.

After the development stage has been completed, it is necessary to test the information system. Tests carried out on this final project management information system use the black box testing method using the equivalence partitioning technique. By using this technique, testing is carried out based on the division of several modules.

From the test results, which are divided into 3 access testing roles for students, lecturers and admins and different modules for each role.

In the admin role there are 59 modules with details in TABLE I.

TABLE I. ADMIN MODULE DETAILS

Test Case	*Module*
Level Data	3
Department Data	3
Study Program Data	3
Religious Data	3
Lecturer Data	3
Student Data	3
Space Data	3
Scheduling	4
announcement	3
Files Download	3
URL Link	3
Seminar scheduling	5
Seminar Schedule	2
Set Advisor 2	2
Initial Assessment	2
Session Scheduling	5
Session Schedule	2
Completed List of Sessions	2
Guidance Assessment	2
Value Recap	2
Session History	1

In TABLE I. testing was carried out by the tester, the examiner is considered experienced because he is a lecturer who is also a member of the final project commission and a head of a study program. From the results of the tests carried out by the examiner, a graph as shown in Fig.4 is obtained

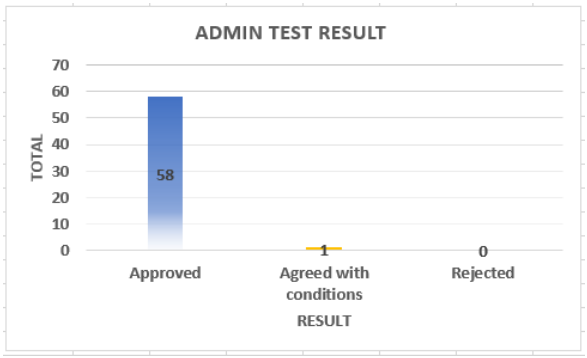

Fig. 4. Admin Test Result

From the results of the Fig.4 test, 58 approved results, 1 conditionally approved, and 0 rejected. In this test, 1 bug was found when the admin tried to set a trial schedule with a faster start time with the existing schedule, the bug was categorized not fatal so it can still be repaired.

In the Student role, there are 18 modules with details in TABLE II.

TABLE II. STUDENT MODULE DETAILS

Test Case	*Module*
Title Proposal	2
Proposal Information	3
Proposal Submission	2
Seminar Schedule	1
Guidance	2
Monitoring	2
Submit trial file	4
Session Submission	1
Session Schedule	1

In TABLE II. It is a breakdown of the number of student modules that will be tested by the examiner. The examiners here consist of 2 final year students who are working on a final project. From the test results obtained results in accordance with Fig.5

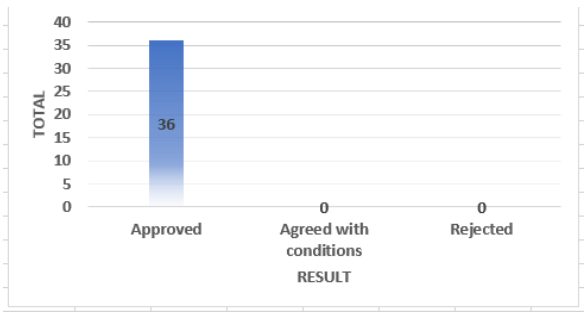

Fig. 5. Student Test Result

Based on the test results in Fig.5, it was found that all the modules tested were accepted by 2 student examiners in total.

In the Lecturer role there are 18 modules with details in TABLE III.

TABLE III. LECTURER MODULE DETAILS

Test Case	*Module*
Recommended Title	2
Title Approval	4
Seminar Schedule	2
Guidance Form	2
Monitoring Form	3
Session Schedule	2
Initial Assessment	2
Guidance Assessment	2
Session Assessment	2
Proposal Information	1
Event News Form	1
Session Assessment Form	2
Final Project History	1

In TABLE III. It is a breakdown of the number of lecturer modules that will be tested by the examiner. The examiners here consist of 2 lecturers who are experienced in guiding and testing students' final projects. From the test results obtained results in accordance with Fig.6

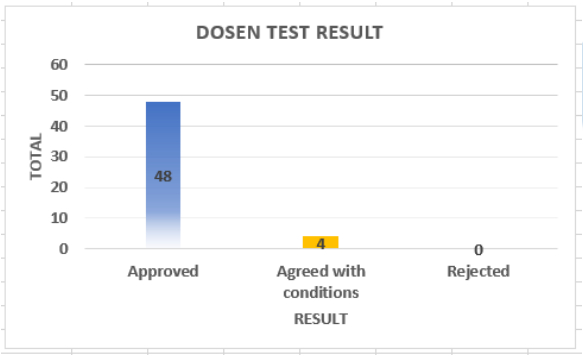

Fig. 6. Dosen Test Result

Based on the test results in Fig.6 there are 4 modules that have bugs. Where each tester gets the same 2 process bugs. The 2 modules are when printing the form and at the final trial assessment. But the bug is harmless so it can still be fixed.

Based on the results of the tests that have been carried out, the final project management information system is quite good in its functional process but still needs a little improvement so that it can run even better.

V. CONCLUSIONS AND SUGGESTIONS

Based on the results and discussion above, it can be concluded that the final project management information system was successfully developed, but during testing there were some bugs that were not dangerous and needed to be fixed as soon as possible so that they could be used in general in assisting the implementation of the final project.

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Implementation of Model View Controller Architecture in Object Oriented Programming Learning

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***Abstract*—This study aims to provide an overview of the application of software design patterns, namely Model View Controller (MVC) in object-oriented programming learning. In the software development industry, most application development uses frameworks. MVC architecture is a design pattern that is widely used by various frameworks. Students as prospective programmers or software developers must master and be able to translate object-oriented programming concepts into programming languages. In this study, the Java programming language is used to apply the object-oriented concept and implement the MVC architecture. This research resulted in an increase in students' programming skills and abilities as well as being able to apply the MVC architecture in developing applications using Java.**

***Index Terms*—architecture, framework, Java, MVC, object-oriented**

I. INTRODUCTION

Bachelor of computer science, especially graduates majoring in Informatics should be able to make computer programs. But in reality, many informatics graduates do not master programming techniques, especially object-oriented programming. On the other hand, the software industry requires graduates who are qualified in their fields. Based on our observations, most graduates majoring in Informatics are not ready to apply their knowledge in the world of work. This is because there is a gap in the learning materials obtained during the study with the needs of the industry. Universities where students study have provided curricula and compulsory subjects related to computer science, including Programming Algorithms and Object-Oriented Programming which are applied to certain programming languages. However, in the learning process sometimes there are obstacles, including the lecturers have not mastered the material and the syllabus provided does not follow the needs of the industry. In addition, lecturers who teach are fixated on the provided teaching materials provided which only come from textbooks. The learning process and the materials presented are not oriented to the needs of the industry. This causes students majoring in Informatics do not have adequate competence.

In the digital era, the industry needs a lot of programmers for application development. Based on data from the national occupational map in the field of information and communication technology (ICT), the need for IT human resources has not been met in almost all categories [1]. Informatics graduates should be able to create computer programs or applications. However, the programming ability of Informatics graduates is generally inadequate. Based on the search results through the google.com search engine with the keywords "Informatics graduates cannot code" (Informatics graduates cannot code) shows that there are many blogs, forums and opinions in various online media, that the programming ability of most Informatics graduates are inadequate. On the other hand, programming languages continue to evolve [2][3]. Many programming languages are developed using an object-oriented paradigm [4][5][6]. Therefore, it is a must for a developer to master the concept of object-oriented programming and be able to apply it to programming languages such as Java, .NET, Python, PHP and so on.

This research uses the Java programming language. Java is a programming language that fully supports object-oriented programming concepts [7][8]. Referring to the Tiobe Programming Community website report, it is stated that Java is a language that has been continuously popular among programmers since late 2014 [9]. The Tiobe site indexes a wide variety of programming languages. The index is calculated from the number of search engine results based on a query containing the name of the programming language which is updated every month. This index includes searches on search engines, Wikipedia and Amazon. Fig. 1 shows the ranking of programming languages. Based on the graph in Fig. 1, it can be seen that Java is a programming language that is ranked at the top.

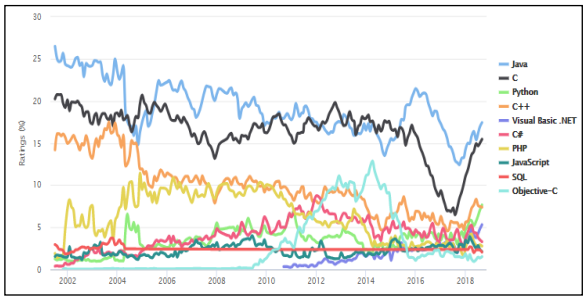

Fig. 1. Tiobe Programming Community Index

Computer applications are generally built using object-oriented programming languages [10][11]. Apart from being object-oriented, it also implements the Model View Controller (MVC) architecture. MVC is a design pattern that is widely used by various frameworks [12] and application development [13].

Students of the Informatics Department as prospective programmers must master object-oriented programming concepts, design patterns such as MVC and be able to translate into programming languages. Therefore, we consider it necessary to introduce and apply this MVC architecture to Object Oriented Programming learning. To clarify the research, a research question was made as follows: "How to apply the MVC architectural design pattern in learning Object Oriented Programming using the Java programming language?" The purpose of this study is to provide an overview of how to apply the MVC architectural design pattern to desktop applications and how to implement object-oriented programming concepts in the Java programming language.

II. METHODOLOGY

The research process is divided into three main stages as shown in Fig. 2.

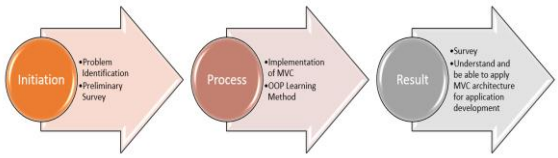

Fig. 2. Research Stages

A. Problem Identification and Preliminary Survey

In the first stage, the research team conducted a preliminary survey to identify problems. The research team is a lecturer who specializes in Object Oriented Programming (OOP) courses. At the beginning of the lecture, the researcher conducted a questionnaire to students who took OOP courses. The purpose of the researcher conducting this questionnaire is to obtain the needs and expectations of Informatics students after graduating and after attending OOP courses. The researcher made 8 questions which are presented in Table 1.

TABLE I. QUESTIONS AND QUESTIONNAIRE RESULTS BEFORE CLASS

No	Statement	Score				
		1	2	3	4	5
1	As a computer graduate candidate do you want to master programming techniques.	0	0	0	14	33
2	As a candidate for computer science, I want to have the ability to make computer programs	0	0	1	1	29
3	I now understand the concept of object-oriented programming	17	23	7	0	0
4	I want to master object-oriented programming	0	0	4	17	26
5	I understand how to implement object-oriented programming concepts in the Java programming language	15	26	6	0	0
6	Currently I have heard and understood the concept of Model View Controller (MVC) architecture.	24	17	6	0	0
7	I already understand how to implement the Model View Controller architecture in the Java programming language	34	12	1	0	0
8	I have been able to implement the Model View Controller architecture for desktop application development	37	9	1	0	0

A total of 47 students filled out the questionnaire as shown in table 1 above. In general, Informatics students want to master the techniques and concepts of object-oriented programming.

B. Object Oriented Programming Concept

The case study in this research uses Object Oriented Programming (OOP) courses. Researchers teach important concepts that must be understood in OOP, namely abstraction, encapsulation, inheritance and polymorphism. The programming language used is Java because it fully supports this concept. The coding technique is done by applying the MVC architecture. The researcher as well as a lecturer in the PBO course begins an explanation of classes, objects and properties using a diagram as shown in Fig. 3.

In figure 3, the property is used to identify the lecturer object. Where a lecturer (object lecturer) will have a NIDN, name and income (income). Meanwhile, to fill and change the value of each property using the set and get methods.

Based on the diagram in Fig. 3, it will then be elaborated into the Unified Modeling Language (UML) which is the standard modeling language [14]. The UML notation used is a class diagram. Class diagram is a static model that describes the structure of a system by showing the class names, attributes, operations or methods and the relationships between objects.

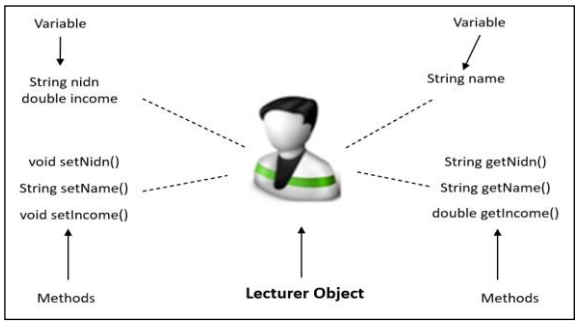

Fig. 3. Properties and methods of the lecturer object

In general, universities have lecturers in the category of permanent lecturers and part time lecturers. Researchers make class diagrams to explain the concept of inheritance. Fig. 4 shows a class diagram and the concept of inheritance that will be used to form the lecturer object.

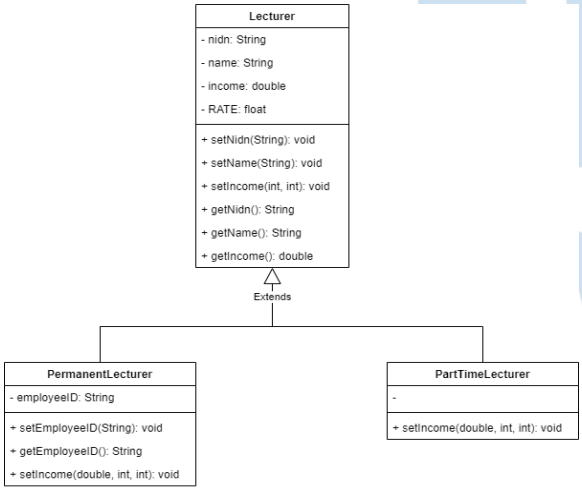

Fig. 4. Class diagram - inheritance concept

Next, the researcher translated the class diagram and the concept of inheritance on the lecturer object using the Java programming language. The coding technique uses the MVC architectural design pattern.

C. MVC Implementation

Model View Controller (MVC) is an architecture that is often used in web-based application development [5]. MVC architecture is basically a three-layer architecture (Fig. 5) that has different characteristics in each layer. The first layer is related to user input logic, the second layer is related to business logic and the third layer is used to implement user interface logic.

Many developers use MVC as the standard design pattern. The purpose of this design pattern is to create a program that can be used repeatedly for the same thing (code reuse). In MVC there are three types of classes that are placed in different packages, namely:

1. Model is a class used to implement data domain logic. These classes are used to retrieve, insert or update data into the database associated with the application.
2. View is used to create the application interface. The user interacts with the application using the interface design.
3. A controller is a class that is used to respond to user requests and relate them to the model.

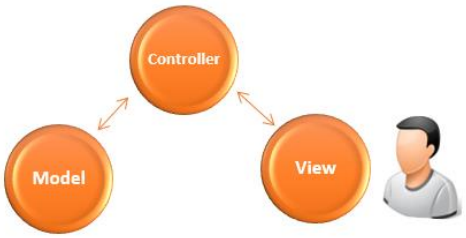

Fig. 5. MVC Architecture

MVC architecture really helps developers to control the complexity of application development by dividing it into three parts, namely model, view and controller. The MVC architecture makes it easy to maintain a program. Because all parts of the program have been mapped out in a clear structure. Changes to the design do not change the logic or data. On the other hand, changes to the logic or program can be made in a separate program section [15]. The steps for implementing MVC on desktop applications using the Java programming language and Apache Netbeans IDE version 12.0 are as follows:

The first step is to prepare packages to place program codes according to the MVC design pattern as shown in Fig. 6.

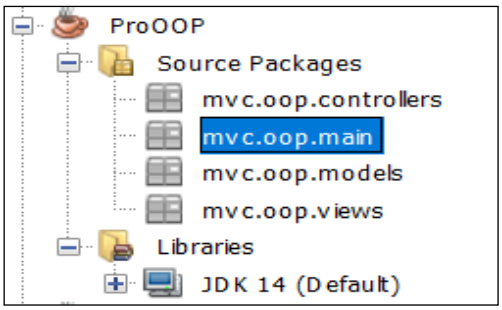

Fig. 6. Packages & libraries

In the source packages section there is a package mvc.oop.controllers used to accommodate all controllers involved in the application. Package mvc.oop.main contains the main program code that contains the main method, so that the program can be run or executed. The mvc.oop.models package contains classes or program codes related to the model. The mvc.oop.views package contains program code to generate output or design the application user interface. The libraries section is a collection of libraries that are used in the application. In the libraries section there is JDK 14 or Java Development Kit version 14.

After preparing the package, then translating the class diagram in Fig. 4 into Java program code and placing it in the appropriate package.

1) Creating Model

The first class is the Lecturer class which is a super class of the Permanent Lecturer and Part Time Lecturer sub classes. The Lecturer class which is a super class is shown in the Fig. 7 program listings.

```
12  public abstract class Lecturer {
13      private String nidn;
14      private String name;
15      double income;
16      final float RATE = 100000;
17
18      public String getNidn() {
19          return nidn;
20      }
21      public void setNidn(String nidn) {
22          this.nidn = nidn;
23      }
24      public String getName() {
25          return name;
26      }
27      public void setName(String name) {
28          this.name = name;
29      }
30      public void setIncome(int credit, int numOfMt){
31          this.income = RATE * credit * numOfMt;
32      }
33      public double getIncome(){
34          return income;
35      }
36  }
```

Fig. 7. Program Listing: Lecturer Class

The Lecturer class declaration on the first line uses the abstract keyword. The abstract keyword means that it does not allow instantiating objects of this class. Object instantiation must be performed on its child class. In this class, the attribute or field declarations that are owned by each lecturer, both permanent lecturers and part time lecturers are declared. This class also contains methods for both changing values and reading values from attributes. After creating the base class, the next step is to create a Permanent Lecturer sub class and a Part Time Lecturer class which is a derivative of the Lecturer class. Fig. 8 is a listing of the Permanent Lecturer class program.

```
12  public class PermanentLecturer extends Lecturer{
13      private String EmployeeID;
14
15      public String getEmployeeID() {
16          return EmployeeID;
17      }
18      public void setEmployeeID(String EmployeeID) {
19          this.EmployeeID = EmployeeID;
20      }
21      public void setIncome(double bs,int credit, int numOfMt){
22          income = bs + RATE * credit * numOfMt;
23      }
24  }
```

Fig. 8. Code Listing: PermanentLecturer Class

In the program code, the extends keyword in the first line indicates that the Lecturer class is a subclass of the Lecturer class. In the next line, a specific attribute is declared to identify the permanent lecturer object, namely EmployeeID. The setIncome() method is a method used to calculate the income of a full-time lecturer. The setIncome() method overloads the setIncome() method in the super class. Method overloading occurs because in the super class the setIncome() method has 2 parameters while the sub class has 3 parameters. Still in the model section, then create a PartTimeLecturer sub class. Listing of the LecturerTransactional class program is shown in Fig. 9.

```
12  public class PartTimeLecturer extends Lecturer{
13      public void setIncome(int credit, int numOfMt) {
14          income = RATE * credit * numOfMt;
15      }
16  }
```

Fig. 9. Code Listing: PartTimeLecturer Class

Just like the Lecturer class, the presence of the extends keyword in the first line indicates that the PartTimeLecturer class is an instance of the Lecturer class. This class contains only one method, namely setIncome(). The setIncome() method in this class overrides the setIncome() method in the super class. The override method occurs because the setIncome() method in the sub class and in the super class has the same number of parameters. Method overloading and override is a way to implement the concept of polymorphism in object-oriented programming. In the Lecturer class and the PermanentLecturer class there is a private keyword that is used in the attribute declaration. The private keyword is a way to implement the concept of encapsulation in programs.

2) Creating View

To create output that can be seen by the user or users in the Java programming language use the System.out.println() command and to create a graphical display use the JFrame object. The view will be designed based on the properties of the lecturer object that have been defined in the model section. Fig. 10 is a program listing of the LecturerView class.

```
12    public class LecturerView {
13      public void lecturerInfo(String nidn, String name,
14          String employeeID, double income){
15          System.out.println("Permanent Lecturer Information");
16          System.out.println("------------------------------");
17          System.out.println("NIDN \t\t: "+nidn);
18          System.out.println("Name \t\t: "+name);
19          System.out.println("Employee ID \t: "+employeeID);
20          System.out.println("Income \t\t: "+income);
21      }
22      public void lecturerInfo(String nidn, String name,
23              double income){
24          System.out.println("\nPart Time Lecturer Information");
25          System.out.println("------------------------------");
26          System.out.println("NIDN \t\t: "+nidn);
27          System.out.println("Name \t\t: "+name);
28          System.out.println("Income \t\t: "+income);
29      }
30    }
```

Fig. 10. Code Listing: LecturerView Class

The LecturerView class has two methods with the same name, namely the lecturerInfo() method. This method is an overloading method because it has a different number of parameters. The first lecturerInfo() method is used to display permanent lecturer information and the second lecturerInfo() method is used to display part time lecturer information.

3) Creating Controller

In the MVC architecture, the controller is the link between the model and the view. Fig. 11 is a listing of the Controller class.

```
8   import mvc.oop.models.PartTimeLecturer;
9   import mvc.oop.models.PermanentLecturer;
10  import mvc.oop.views.LecturerView;
11
12  /**...4 lines */
16  public class LecturerController {
17    private PermanentLecturer model;
      private LecturerView view;
19    private PartTimeLecturer model1;
20
21    public LecturerController(PermanentLecturer
22        model, LecturerView view) {
23        this.model = model;
24        this.view = view;
25    }
26     public LecturerController(PartTimeLecturer
27         model1, LecturerView view) {
28        this.model1 = model1;
29        this.view = view;
30    }
31    public void viewInfoPermanentLect(){
32        view.lecturerInfo(model.getNidn(),
33            model.getName(), model.getEmployeeID(),
34            model.getIncome());
35    }
36    public void viewInfoPartTimeLect(){
37        view.lecturerInfo(model1.getNidn(),
38            model1.getName(), model1.getIncome());
39    }
40  }
```

Fig. 11. Code Listing: LecturerController Class

The LecturerController class above is a liaison between the PermanentLecturer class, PartTime Lecturer in the mvc.oop.models package and the LecturerView in the mvc.oop.views package. In this class, the model and view object declarations are declared. Then define the constructor that will be used to initialize the permanent lecturer object and the part time lecturer object.

In the viewInfoPermanentLect() and viewInfoPartTimeLect() methods, the view object calls the lecturerInfo() method which corresponds to the number of parameters in the LecturerView class. The parameter in the lecturerInfo() method consists of a model object that calls the get method contained in the Lecturer and Permanent Lecturer classes.

4) Creating Main Program

To run the program, you must create a class that contains the main() method. In this class, each lecturer object is instantiated, both permanent lecturers and part time lecturers (Fig. 12).

```
8   import mvc.oop.controllers.LecturerController;
9   import mvc.oop.models.PartTimeLecturer;
10  import mvc.oop.models.PermanentLecturer;
11  import mvc.oop.views.LecturerView;
12
13  /**...4 lines */
17  public class MainMenu {
18    public static void main (String args[]){
19      PermanentLecturer model = permanentLectInfo();
20      PartTimeLecturer model1 = partTimeLectInfo();
21      LecturerView view = new LecturerView();
22      LecturerController c = new LecturerController(model, view);
23      LecturerController c1 = new LecturerController(model1, view);
24      c.viewInfoPermanentLect();
25      c1.viewInfoPartTimeLect();
26    }
27    private static PermanentLecturer permanentLectInfo(){
28      PermanentLecturer permanentL = new PermanentLecturer();
29      permanentL.setNidn("0309111901");
30      permanentL.setName("Brino Jefferson");
31      permanentL.setEmployeeID("K-0140");
32      permanentL.setIncome(5000000, 10, 4);
33      return permanentL;
34    }
35    private static PartTimeLecturer partTimeLectInfo(){
36      PartTimeLecturer partTimeL = new PartTimeLecturer();
37      partTimeL.setNidn("0309111902");
38      partTimeL.setName("Blessy Jeniffer");
39      partTimeL.setIncome(10, 4);
40      return partTimeL;
41    }
42  }
```

Fig. 12. Code Listing: Main Class

Line 19 is the declaration of the model object which is initiated by the call to the permanentLectInfo() method defined in line 27. Line 20 is the declaration of the model1 object which is initiated by the call to the partTimeLectInfo() method defined in line 35. Next line 21 declares the view object. Lines 22-23 are instantiating the LecturerController object as well as initiating the model and view objects. Lines 24-25 are method calls by LecturerController objects, namely c and c1, where both viewInfoPermanentLect() and viewInfoPartTimeLect() methods have been defined in the LecturerController class.

After finishing coding on each part of the MVC architecture, the program can be run. The class that is executed is the Main Menu class. If there is no error (error), it will display the results as shown in Fig. 13.

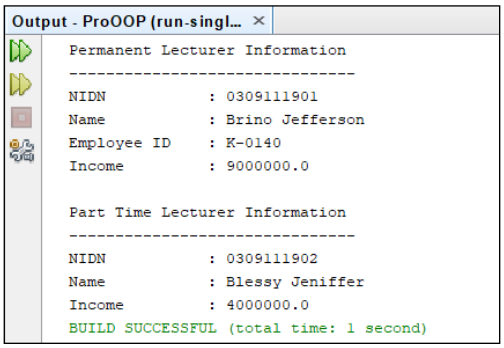

Fig. 13. Program Result

III. Result and Discussion

This research produces a computer application that implements:

1. The concepts of abstraction, inheritance, encapsulation and polymorphism in object-oriented programming using the Java language.
2. The MVC architectural design pattern is shown in Fig. 14. The entire package will contain program codes that are interconnected.

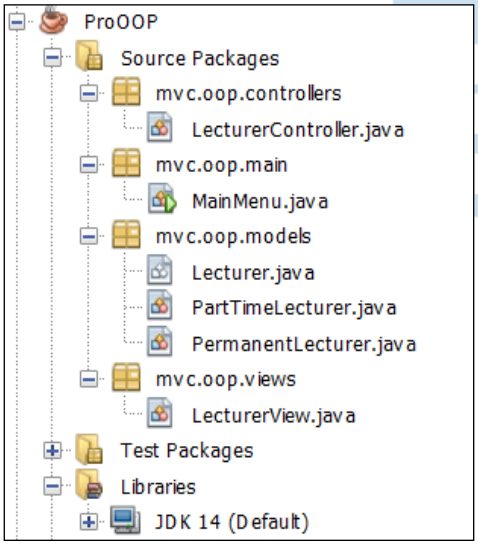

Fig. 14. Package Structure

After attending the lecture, the researcher distributed questionnaires to get feedback from the lecture process and tested whether the lecture process met the expectations of the students. The researcher presents the same questions that were done before the lecture process. Table 2 presents the questions and the results of the questionnaire. A total of 45 students filled out the questionnaire and the difference were 2 people from the respondent's data before the lecture.

To make it clearer, we present the data from the questionnaire which has been processed using a spreadsheet application in the form of a bar chart. For example, the researcher presents two questions, namely question 1 and question 8. The results displayed are data before the lecture (meeting 1) and after the lecture is over (meeting 13). The results on the bar chart of Fig. 15 show that informatics students have a desire to master programming techniques. Furthermore, the same question is asked after following the lecture process and the results are shown in Fig 16. Based on student feedback conducted through questions on the questionnaire that after attending lectures and doing assignments with various topics, the average student understands how to implement MVC architecture in the Java programming language (Fig. 17, 18).

TABLE II. Questions and Questionnaire Results After Class

No	Statement	Score				
		1	2	3	4	5
1	As a computer graduate candidate do you want to master programming techniques.	0	0	2	8	35
2	As a candidate for computer science, I want to have the ability to make computer programs	0	0	3	15	27
3	I now understand the concept of object-oriented programming	0	0	12	25	8
4	I want to master object-oriented programming	0	0	6	12	27
5	I understand how to implement object-oriented programming concepts in the Java programming language	0	0	16	22	7
6	Currently I have heard and understood the concept of Model View Controller (MVC) architecture.	0	0	6	20	19
7	I already understand how to implement the Model View Controller architecture in the Java programming language	0	0	11	27	7
8	I have been able to implement the Model View Controller architecture for desktop application development	0	1	12	24	8

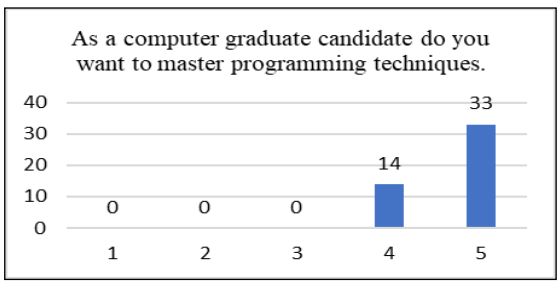

Fig. 15. Before class questionnaire result (Question 1)

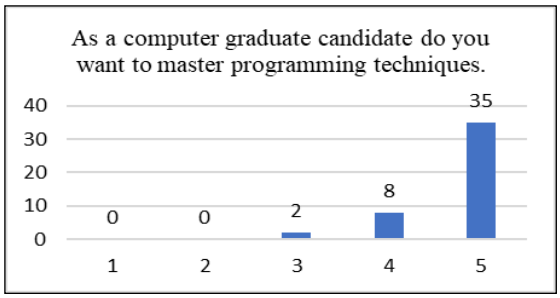

Fig. 16. After class questionnaire result (Question 1)

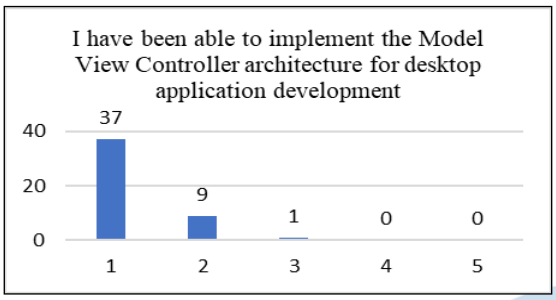

Fig. 17. Before class questionnaire result (Question 8)

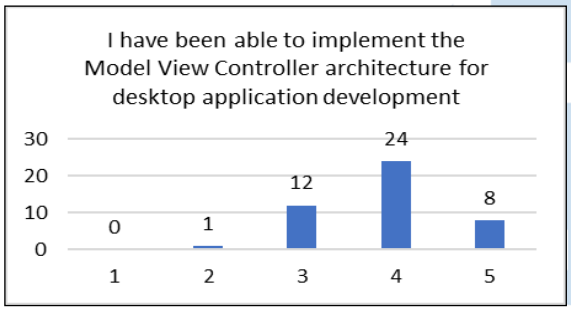

Fig. 18. After class questionnaire result (Question 8)

IV. CONCLUSION

Based on the results of the questionnaire after the lecture, 78% of students strongly agreed and had a desire to master programming techniques, this result increased by 8% from the questionnaire before the lecture. Furthermore, the ability to implement the MVC architecture increases after going through the lecture process. The results of the questionnaire before the lecture showed as many as 79% of students answered strongly disagree, which means that they have not been able to apply the MVC architecture to software development. However, after attending the lecture, 27% answered agree and 53% answered strongly agree. This shows that there is an increase in students' ability to apply MVC architecture in software development. Learning materials in core competency courses must be taught according to industry needs. Understanding how to implement the MVC architectural design pattern can facilitate the development of neater applications, making it easier to detect errors and build complex applications.

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Application of Dynamic Segmentation in Stroke Detection Software with ANN

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***Abstract*—One way to find out whether there is a stroke is to do a CT scan . But the results of the examination with a new CT scan can be obtained in quite a long time. In addition, sometimes there are differences of opinion between doctors and radiologists regarding what is seen from the results of the examination. This research was conducted to produce a software that can later be integrated with the existing system on the CT Scan tool so that it can immediately be known whether or not stroke is present from the CT Scan results. In this study, a dynamic image segmentation method is implemented, namely the watershed transformation method which will later produce regions as a feature for the stroke detection process carried out with the backpropagation algorithm. From experiments conducted on CT scan images of the brain, this method can detect stroke well. The results obtained are 100% for training data (20 images consist of 10 normal brain and 10 stroke brain) and 90% for test 10 images of data.**

***Index Terms*—backpropagation; segmentation; stroke; watershed**

I. INTRODUCTION

A. Problem Background

Stroke is the second leading cause of death in the world, Valery Feigen in [1]. Every year, more than 700,000 people have a stroke, 25% of whom are under 65 years old [2]. Stroke can be interpreted as damage to blood vessels in the brain which results in persistent nerve disorders. Stroke occurs suddenly due to disruption of blood supply to the brain. A series of biochemical reactions caused by lack of blood flow and oxygen can kill nerve cells and damage these cells, causing speech disorders, paralysis and decreased consciousness [3].

In order to prevent errors in diagnosis, it is advisable to carry out diagnostic investigations. Diagnostic support tests that can be performed include laboratory tests such as angiography, Magnetic Resonance Imaging (MRI) and Computed Tomography Scan (CT-Scan).

By doing a CT scan, we can get very accurate pictures of the bones, blood vessels and organs in the body. A CT scan uses X-rays to take pictures. In the brain and head, X-rays are absorbed differently by different parts of the body. Bone will absorb the most X-rays, so the image that appears to be photographed is white. Meanwhile, the fluid in the brain is black [3]. However, CT-Scan cannot detect damage when the damage is too small. CT-Scan cannot determine instantly the type of disorder. This causes some cases of stroke difficult to detect quickly using a CT-Scan.

To establish the diagnosis that someone has a stroke or not is not an easy thing. Various examination procedures must be carried out by the patient before the doctor finally diagnoses a mild or severe stroke. One of the steps that is usually done is an examination of the brain and head with a CT-Scan. Problems that usually occur when examining the brain and head with a CT scan include:

- The results of the CT-Scan examination are obtained in quite a long time
- The patient or the patient's family cannot see or translate the CT-Scan results
- Doctors and radiologists who make diagnoses often have different opinions

Therefore, we need a software that is integrated with the existing system on the CT-Scan so that it can detect the damage that occurs more quickly and accurately.

One of the processes used to process the CT-Scan images of the brain is the segmentation process. Segmentation is the first thing that is usually used before we perform the analysis process on an image [4]. The segmentation process can be interpreted as a process to separate one object from another, a process that separates between objects, or object with a background in an image. By doing the segmentation process, each object in the image can be taken individually so that it can be used as input for other processes [5]. Some of the methods included in image segmentation are: Histogram-Based Methods, Region Growing Methods, Clustering Methods, Level

Set Methods, Edge Detection Methods, Semiautomatic segmentation Graph Partitioning Methods, Multi-scale segmentation, Model based segmentation, Watershed Transformation, [6].

In medical imagery, identification of the object or area of interest can provide useful information for the diagnosis and treatment of disease. However, often the segmentation process involved is done manually and depends on user involvement so it is very time consuming and difficult for users. Therefore, the dynamic segmentation process is more popular. Dynamic segmentation means that all segmentation processes are carried out automatically without user intervention in determining the starting point of segmentation, target tracking and contour formation. The segmentation used is segmentation based on area where the segmentation process is carried out to get an area that is believed to be an object [7]. We are using the watershed transformation as the method of dynamic segmentation that is good for getting an object from segmentation [7].

From the results of segmentation, it will be obtained patterns that become dominant characteristics. This dominant characteristic is used in artificial neural networks for the stages of learning, training and testing or simulation [8].

B. *Problem Background*

The aims of this research are:

- Develop software that applies dynamic segmentation with the Watershed Transformation method in detecting stroke from CT-Scan images
- Knowing the level of accuracy of the Watershed transformation in the CT-Scan image segmentation process that will be used to detect stroke

While the benefits to be achieved from this research are to produce software that can be integrated with existing systems on CT scans so that they can find out early diagnoses of stroke faster.

II. LITERATURE REVIEW

A. *Stroke Disease*

Based on the cause, stroke can be divided into two types, namely [9]:

1) *Bleeding Stroke*

This type of stroke is often referred to as a haemorrhagic stroke. It is usually caused by the rupture of a blood vessel in the brain resulting in the accumulation of blood in the brain. As we know, that the brain is located in a hard cranium so that there is not enough room for blood, this can cause pressure or compression on brain tissue, causing brain tissue to be damaged or die. This type of stroke can usually be detected with a CT-Scan examination where a collection of blood will be found pressing on the brain tissue. The following image shows white area discharge that is bleeding.

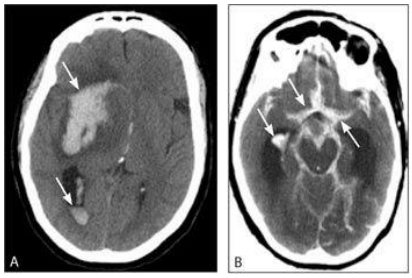


Figure 1. Haemorrhagic Stroke

2) *Non-Bleeding Stroke*

This type of stroke is often referred to as an infarct stroke or ischemic stroke . This type of stroke is caused by a lack of blood supply to the brain as a result of blockages in blood vessels that cause brain tissue to lack nutrients and oxygen obtained from the blood which is usually caused by fat blockages or blood clots. This type of stroke can also be examined through a CT-Scan. The following CT-scan image shows the area on the left is darker which indicates the presence of tissue death in the brain.


Figure 2. Stroke Infarct

B. *Image Preprocessing*

Watershed transformation is one method that is quite good for getting an object from segmentation results. But this method has one weakness, namely the presence of excessive segmentation (over segmentation) [10]. Therefore, before doing the transformation, it is necessary to do a pre- processing. Pre- processing used is a collection of processes that can produce better segmentation. There are many processes that can be used. The processes used are: grayscaling, dilation, erosion, morphological gradient and minima removal

1) *Grayscaling*

Grayscaling is the process of changing the pixel value from color (RGB) to gray-level [11]. Basically this process is done by leveling the pixel values from 3 RGB values to 1 value. using the YUV system by taking the Y component (illumination). Y value is obtained from 29.9% of red (Red), 58.7% of green (Green) and 11.4% of blue (Blue) [11]. Mathematically, it can be seen in the following equation:

$$\text{grayscale} = Y = \frac{(0{,}299*R) + (0{,}587*G) + (0{,}114*B)}{3} \quad (1)$$

2) Histogram Equalization

Histogram equalization aims to change the intensity of an image into an image with relatively the same histogram value at each level. The purpose of using the histogram equalization process in this study is to bring out the parts that are not visible so that they become clearer.

3) Dilation

The dilation process can also be interpreted as a thickening process. Dilation is done to produce a smoother image so that it is easy to segment. With A and B lying on Z^2, the dilation of A by B , denoted by A B , is defined

$$A \oplus B = \{x \mid (\hat{B})_x \cap A \neq \emptyset\} \ldots\ldots (2)$$

In the above equation, the dilation process A by B means that for each point a, shift will be made and then combined.

4) Erosion

This process is the opposite of the dilation process . This process is an image thinning process. Erosion is done to produce a smoother image, by increasing the value of darker colors.

With A and B located at Z^2, erosion A by B , characterized by a Θ B , defined

$$A \ominus B \{x \mid (B)_x \subseteq A\} \ldots\ldots (3)$$

Based on the above equation, the erosion process of A by B consists of all points x = (x, y) where B_x is in the set A. To carry out erosion, B is shifted in A and looks for anywhere B is actually in the A. For conditions that meet these requirements, mark the point (0,0) that corresponds to B. These points are the result of erosion of A by B.

5) Morphological Gradient

Morphological gradient will produces output in the form of images. This process make the output obtained from reducing the dilation of the first (original) image with the erosion of the first (original) image, so it can be defined:

$$g = (f \oplus b) - (f \ominus b) \ldots\ldots (4)$$

In this study, Morphological Gradient is used to find the edges of the image.

6) Minima Removal

The minima removal process can be said to be a basic smoothing process from the minimum area to make the minimum area has a uniform value. As we know that the image produced by preprocessing without a threshold has an uneven minimun value, so this process carried out before the image is segmented.

C. Image Segmentation

In this study, image segmentation is carried out dynamically using the watershed transformation. Because it uses morphological preprocessing the watershed transformation is also called morphological watershed. The watershed transformation is an approach to segmentation. The concept of the watershed transformation is to assume that an image is 3 dimensional[12] and assuming the gray level is the height and it is assumed that the higher the white color, the higher". The principle of the watershed transformation is to find the watershed line. The watershed line is a line where the points are the highest points of the depiction of an image into a 3-dimensional form, namely the x position and y position, where the x and y positions are the base plane and pixel color. In this case, the gray level that is close to white has the highest value [13]. The segmentation stage in the CT Scan brain image is very important because the more accurate the segmentation results to separate objects and backgrounds, the more information that can be built and developed from the calculation stage to stroke identification. [14]

D. Artificial Neural Network

Artificial Neural Network (ANN) is an information processing model that was developed based on the working principle of the human brain's nervous system [15]. In the neural network, neurons will be collected in layers (layer) layer called neurons (neurons layers). Usually the neurons in one layer will be connected to the layers before and after it. The information given to the neural network will be propagated layer to layer, starting from the input layer to the output layer through another hidden layer, which is often known as the hidden layer.

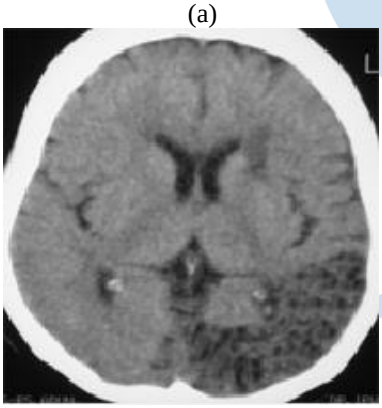
The ANN using backpropagation algorithm consists of a forward action process and a backward action process . In the forward action process , the first thing to do is create a random weight as the initial weight. The next process is to get the output value (y) using the random weights that have been obtained. If the output value obtained is not in accordance with the target, then the program will perform a backward action process . The process carried out is the training process or the training process. In this process, the program will again look for the right weight so that the resulting output value is in accordance with the set target. Next, the program will look for the values of z and y as was done in the forward action stage . If the y value obtained is not in accordance with the intended target, then the next

process is to calculate the output weight variable and the hidden layer weight variable factor . Next the weights are updated. The process of updating the weights is carried out by adding up the old weights with the weight variables that have been obtained. The training process is carried out continuously until it converges. After obtaining the optimum weight , the program is ready to be tested.

III. Result and Discussion

The study was conducted using 20 training data consisting of 10 CT scan images containing infarction and 10 normal brain CT scan images. In addition, 10 test data were used, consisting of 4 CT scan images containing infarction and 6 normal brain CT scan images.

(a)



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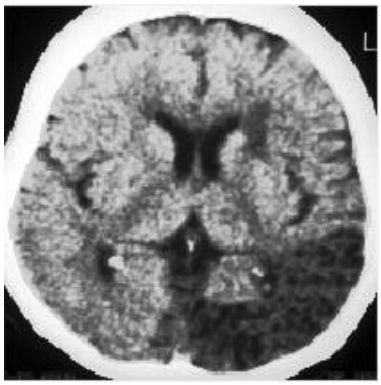
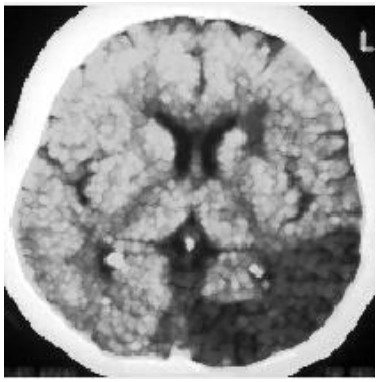
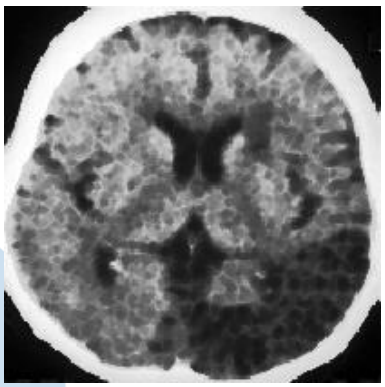


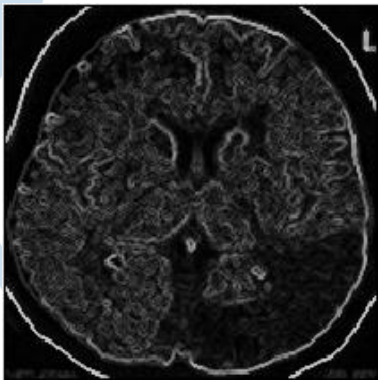
(c)



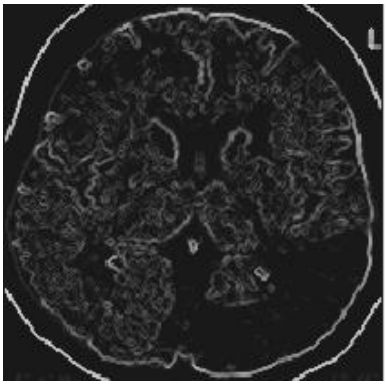
(d)



(e)



(f)



(g)

Figure 3. Image preprocessing process. (a) input image, (b) grayscaling image, (c) histogram equalization image, (d) dilation image , (e) erosion image, (f) morp hological gradient image and (g) minima removal image

The results of image preprocessing can be seen in Figure 3. Figure 3 (a) is the initial input image. Then the image is processed to produce a grayscalling image as shown in Figure 3(b). The next process is histogram equalization which can be seen in Figure 3(c). The next process is the morphological gradient process as shown in Figure 3(f). The morphological gradient process is the result of the reduction of the dilation process in Figure 3(d) and the erosion process in Figure 3(e). The last step in preprocessing is the minima removal process, the results of which can be seen in Figure 3(g).

After preprocessing, the image is ready for segmentation. The segmentation results can be seen in the following figure:

Figure 4. The results of the watershed transformation

From the segmented image, we have the obtained regions that will be used for the detection process by the backpropagation algorithm. ANN using backpropagation will do the detection process consists of a learning process and a testing process. In the learning process, the input value is obtained from the segmentation results. The segmented image is divided into 10x10 blocks. From each block will be taken how many regions are in the block. So in the end obtained 100 blocks containing the segmented regions. The 100 blocks will then become input neurons in the backpropagation algorithm . The trained patterns are 10 patterns for images containing infarction and 10 patterns for normal images. The target set for the first 10 patterns (patterns containing infarction) was 0 and the target for the next 10 patterns (normal brain patterns) was 1.

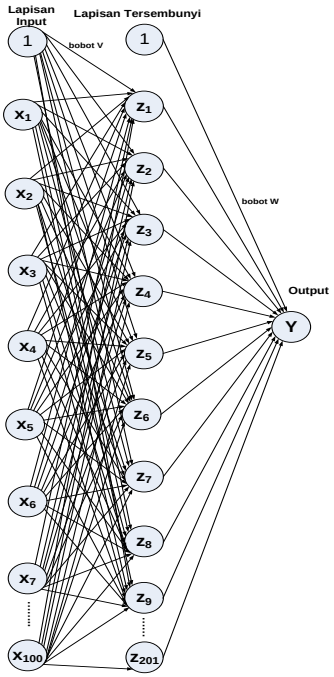


Figure 5. The architecture of the artificial neural network used

After the learning process is carried out and the optimum weight is obtained, we are ready to test the image. The test results can be seen from the following picture:

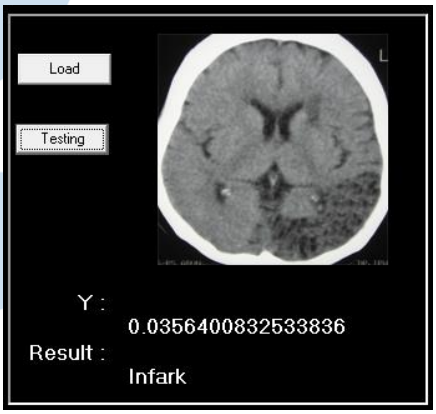


Figure 6. Test Results

All the process can be seen in Fig. 7. There is three main process in this research. The first is preprocessing, the second is dynamic segmentation and the third is detection using ANN. In the preprocessing segment, we are using grayscale, histogram equalization, morphological processing (dilation, erosion, morphological gradient and minima removal). For the dynamic segmentation we used Watershed transformation. And last for detection we used backpropagation algorithm.

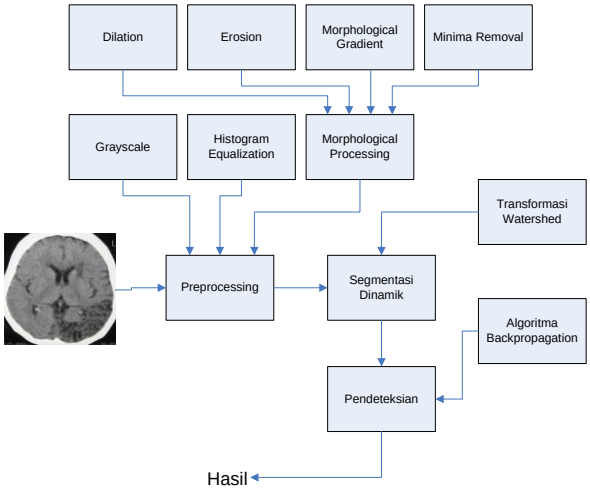


Figure 7. Flow Process

.

IV. CONCLUSION

The conclusion obtained in this study is that this software has been able to detect stroke. From the results of this study, the accuracy of this software is 100% for training data and 90% for test data. Of the 10 test data, there is one data that failed to be detected. This is probably due to the similarity between normal brain images and brain images that have not too large infarcts.

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Prototype Project SCADA on Hemodialysis Mixing Tank Operation

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***Abstract*—Pharmaceutical companies are an example of an industrial sector that uses technology-based systems in its production process. In this research the author will develop a SCADA (Supervisory Control Acquisition Data) system as a platform to solve several problems that are present in pharmaceutical production, namely in the drug production process using hemodilysis mixing tanks. The method that the author uses for this research is experimental research and data collection methods, which use the independent variables of the study, water level control and temperature control, while the independent variables related to the system reading results are displayed on the SCADA screen. Based on the results of mathematical calculations, it can be concluded that the production process using the SCADA system produces a more efficient time with a total time difference of 38 minutes/batch. Operations using SCADA technology within 24 hours were able to produce 4 batches of Infusion Bags, while using the conventional system only 3 batches. Operational needs using SCADA technology will generate more benefits in terms of cost and time, creating more effective and efficient work system for the company.**

***Index Terms*—Control, Mixing tank, SCADA, Temperature, Water Level**

I. INTRODUCTION

Technological progress is running faster as time goes by, the industrial revolution 4.0 is proof that humans have succeeded in developing technology to help in all areas of life. Technology has made people's lives easier. In addition to daily life, the impact of technological developments has also affected the economic pattern of society, including production patterns in various industrial fields.

A pharmaceutical company is an example of an industrial sector that uses a technology-based system in its production process, one system that is quite good in its use is the SCADA system. By using this system, the machine operator only has to supervise the production process, this proves that the use of technology has penetrated various aspects of life.

Several studies have been developed related to the SCADA system and monitoring. Among them are research conducted by (Nugroho S.A, 2018) studying and designing a monitoring and control system on 150 KV to 20 KV distribution panels using the Adobe Flash CS3 simulation method. This research has succeeded in designing a SCADA system in a 150 KV to 20 KV substation at PT PLN. With a monitoring and control system on the distribution panel that the system can work in real time, another research was carried out by (Nugroho S.A, 2018).

Another study conducted by (Handy Wicaksono, 2012) discusses a software called Wonderware InTouch as a SCADA software application that can be used as a monitoring and control medium, this can be seen from the types of SCADA network topology that are used whenever reviewing a SCADA design. .

In addition, research conducted by (Teguh PM, 2013) examines a SCADA water level control system, in this case the SCADA system can function as Monitoring and Control of a water level in a container / place using animation so that it can be seen in real time, the Valve is controlled in the form of a water opening position so that the water level can be adjusted to meet a predetermined set-point. The results of the SCADA system display test are included in the good category and are real time because it uses a level transmitter sensor as a supporting instrument device.

In this paper, the author will develop a SCADA (Supervisory Control Acquisition Data) system as a platform to solve several problems that exist in pharmaceutical production, namely in the drug production process. In the drug production process, companies generally use a lot of human labor as the main power in terms of mobility and operation, this is

This causes a lot of time and money needed, because the conventional method requires a longer process in the work.

Based on this, we developed the SCADA system to reduce operator mobility at work so that no time is wasted and increase the amount of production due to time efficiency, so the company will get more income because it maximizes the time and costs available.

A. SCADA Definition

Definition of SCADA System (Supervisory Control and Data Acquisition SCADA or Supervisory Control and Data Acquisition in general is a system

that collects data and analyzes it in real time. SCADA is not strictly a controller but focuses on the level of supervision and monitoring. The SCADA system is a combination of telemetering, telesignalling, and telecontrolling. SCADA (Supervisory Control and Data Acquisition) has long been known as a control system. The SCADA system was the first to acquire data using panel meters, lights, and graphs with tape recorders. Operators manually operate several buttons for supervision and control This device is still used for monitoring, control and data acquisition in factories and power generation facilities [1].

SCADA system provides flexibility in setting up and configuring the system. The more things that can be monitored, the more detailed operations are seen, and everything works in realtime. No matter how complex the process handled by the PLC, the operator can see the operation of the process at large or small scale and operators can trace if something goes wrong to increase efficiency [1].

B. *Supervisory Control Mechanism*

Control or Master Terminal Unit (MTU) is control carried out on top of local control or Remote Terminal Unit (RTU). Supervisory Control and Data Acquisition (SCADA) is a system that collects information or data from the field and then sends it to a central computer that will manage and control the data. In its application, the subsystems that make up SCADA consist of: 1. HMI (Human Machine Interface) 2. MTU (Master Terminal Unit) 3. RTU (Remote Terminal Unit) 4. SPAJ and SPAU 5. Communication System (Between MTU and RTU) Basic architecture of a scada system can be seen in figure 1.

Fig 1. SCADA Basic Architecture [2]

II. RESEARCH VARIABLE

The preparation of this paper is based on an applicable problem that is realized in the manufacture of a prototype, namely the planning and realization of the tool so that it can display the performance as planned with reference to the problem formulation. Data and component specifications used in planning are data taken from the component data sheet. Selection of components based on planning and adapted to components on the market.

The steps taken to realize the tool to be made include system design, manufacture of hardware (hardware) and software (software), tool testing and analysis, as well as drawing conclusions and suggestions.

The analysis used in this study uses two research variables:

a) Independent variable (independent variable): a variable that influences or causes a change in the value of the dependent variable and is the most important influence variable in research. The independent variables of this research are variations of water level control and temperature control.

b) Dependent variable (dependent variable): The dependent variable in this study is the result of reading the SCADA water level control and Temperature Control system which is displayed on the SCADA screen.

A. *System Design and Manufacturing*

System design is carried out as an initial step before the formation of a system and its supporting electronic circuits that are ready to be realized. This is done so that the system created can run as it should. The system design carried out includes:

1) Hardware Design such as tool specifications, components, wiring, and designing valve placement.
   - Using CX Supervisory software as HMI (Human Machine Interface).
   - Using a Simatic Field PG laptop as the Master Terminal Unit (MTU).
   - PLC OMRON CP1H XA as Remote Terminal Unit (RTU).
   - USB serial cable as a communication link between MTU and RTU.
   - Loop Calibrator as Simulation of water level sensor and temperature sensor for analog PLC input.
   - Aquarium pump 60 watts, 2500 L/hour for simulation of entering water into the tank.
   - Silicon hose as jacketing for tank heat exchange
   - Valve Actuator has a voltage of 220 VAC.

The hardware manufacturing stage begins with making a miniature tank mechanism and making a holder for the valve placement according to the design that has been made. After the mechanical manufacture of the miniature tank is completed, the next process is the process of installing the jacketing hose on the tank body and installing the valve and hose according to the design. Then do the merging of the valve cable with the I/O PLC according to the plan. As the final stage of hardware manufacturing is the incorporation of PLC panel wiring, valves, and hose installation.

2) After the hardware is designed, the next step is software design. This software functions to regulate the overall performance of the system which consists of several hardware so that this

system can work properly. This design begins with making a PLC ladder diagram using software cx programmer version 9.6 which is a software programmer issued by OMRON, then making a SCADA HMI (Human Machine Interface) display design using CX Supervisory software which is a paid software issued by OMRON.Software design, making PLC ladder diagrams using the cx-programmer, making HMI (Human Machine Interface) designs using CX-Supervisory

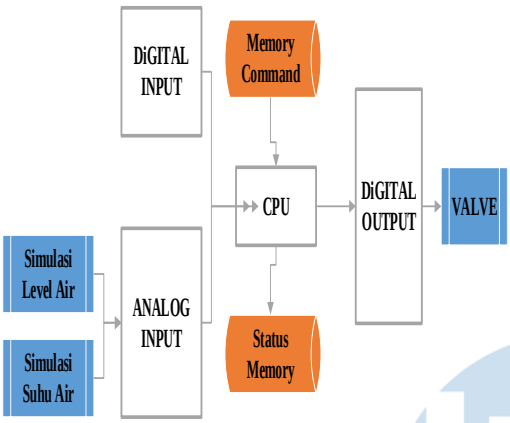


Fig 2. Block Diagram

Making PLC software is done by implementing a flow diagram of the program that has been planned, and then converting it in the form of a ladder diagram using software cx-programmer version 9.6 to then be transferred to the PLC. After the PLC programming is done, the next step is to design the HMI (Human Machine Interface) display. In making the HMI display design, operational ease must be prioritized, so that the operator does not have difficulty in operating it. The making of the SCADA HMI in this paper uses the CX Supervisory software as the SCADA platform that I use.

B. Testing Tool

To ensure that this system runs according to plan, it is necessary to do a test. The test method used is to test the system for each mode in SCADA and to test the system as a whole, then analyze the results of each test. These tests include:

1) Hardware Testing

Hardware testing is carried out with the aim of adjusting the condition of whether the Valve is working in accordance with SCADA orders and testing the toughness of the tool being tested from the Mechanism side. The test uses water to find out whether the water fills all parts of the tank or hose and is checked again so that there are no leaks.

2) Software Testing

Software testing is done by observing the HMI display on the computer screen in runtime mode. Testing this software includes testing the function of the HMI display button and the work of the program that has been transferred to the PLC.

3) Overall System Test

After the hardware and software are integrated into system, then the overall system is tested with runtime mode on the CX Supervisory software. It aims to determine the performance of the tool.

III. Test Result and Analysis

The results analysis of the SCADA Mixing Tank prototype in this paper are to calculate the length of time produced in an effort to produce a drug and compare the length of the process when using a conventional system with the SCADA system. This can use the Sequential Time calculation method, which is to calculate the length of time 1 process that can be calculated into output and profit. The test is carried out by comparing the results of the manual output of one day (3 shifts) 4 times mixing the tank with the results of the automation output of one day (3 shifts) 5 times of mixing the tank, in this test we have to test in detail and also many times so that the results are accurate.

The final results of the tools made in this paper include software (software) and hardware (hardware). The combination of these two devices forms a SCADA Mixing Tank system.

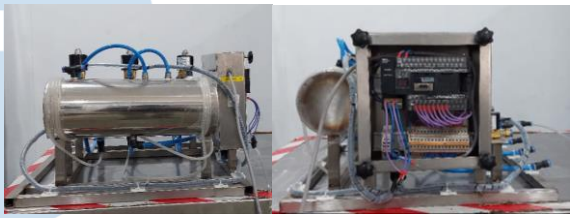


Fig 3. Prototype Mixing Tank

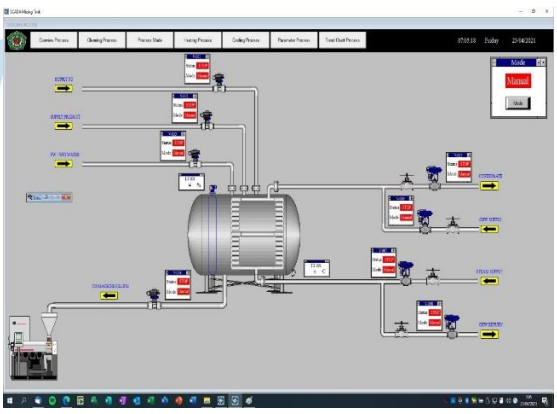


Fig 4. SCADA Display

The parameters used in the SCADA system are several processes, including:

1. Cleaning
2. Mixing (water & product filling)
3. Heating
4. Cooling
5. Transfer Mode

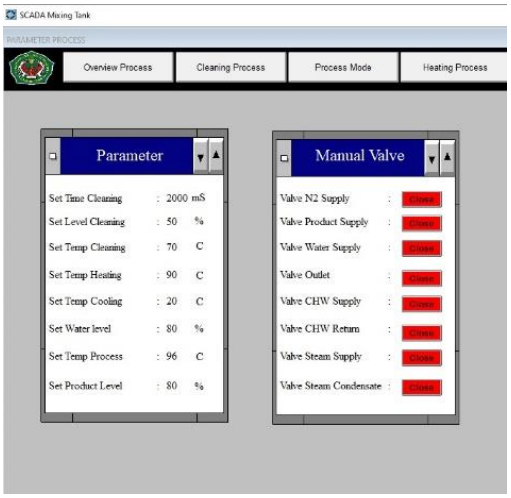
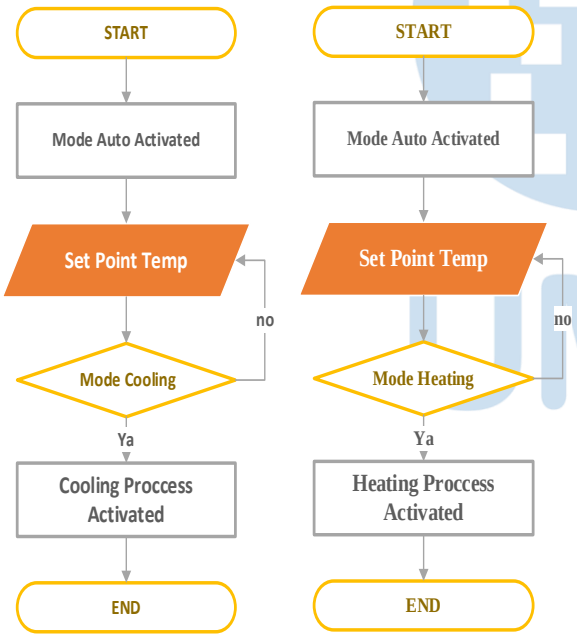


Fig 5. Parameter Display on SCADA

The result of reading the SCADA Mixing Tank system in this study is to calculate the length of time produced in an effort to produce a drug comparing the length of the process when using conventional systems and SCADA systems. This can use the Sequential Time calculation method, which is to calculate how long it takes one production process and conclusions can be made and calculated into outputs and profits.



(a) (b)

Fig 6. Flowchart of Cooling(a) and Heating(b) Process.

The test was carried out by comparing the results of the manual output one day (3 shifts) is 4 times mixing the liquid and the results of the automation output in one day (3 shifts) 5 times mixing the liquid.

A. Cleaning Process Analysis

Mathematical calculation results from an analysis of the cleaning process, which can be concluded that conventional systems take ± 25 minutes, when compared to using the SCADA system, the time required is ± 11 minutes, it can be concluded that using SCADA can save time for ± 14 minutes.

B. Cooling Process Analysis

The results of mathematical calculations from an analysis of the Cooling Process, which can be concluded that the conventional system takes ± 24.30 minutes, this can be compared between the conventional system and the SCADA system which only takes ± 21.00 minutes, it can be concluded that this system can save time for ± 3.30 minutes this writer can describe in a Time Chart.

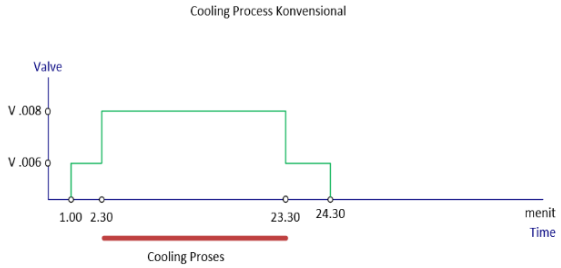


Fig 7. Conventional Process Cooling Time Chart

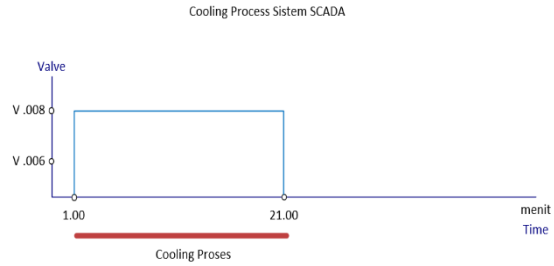


Fig 8. Time Chart Cooling SCADA Process

C. Heating Process Analysis

The results of mathematical calculations from an analysis of the Heating Process, which can be concluded that the conventional system takes ± 64.30 minutes, this can be compared with the SCADA system which only takes ± 61.00 minutes, it can be concluded that this system can save time for ± 3.30 minutes I can describe this in a Time Chart.

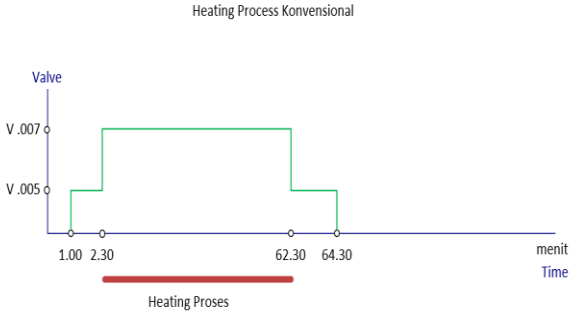


Fig 9. Conventional Process Heating Time Chart

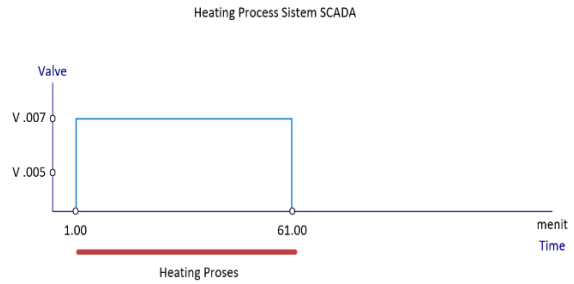


Fig 10. Time Chart of SCADA Process Heating

D. *Process Mode Analysis*

The results of mathematical calculations from the Process Mode analysis can be concluded that the conventional system takes ± 201.00 minutes, this can be compared with the SCADA system which only takes ± 190.00 minutes, it can be concluded that this system can make time efficient for ± 11 minutes.

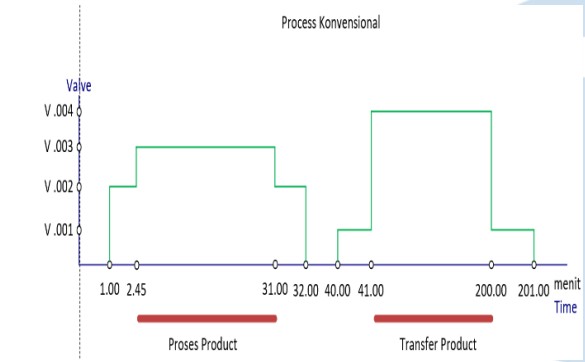


Fig **11**. Time Chart of Conventional Process Mode

Fig 12. Time Chart of SCADA Process Mode

IV. Data Analysis

The results of the mathematical calculation of a system that can be concluded for the conventional system takes a longer time when compared to the SCADA system, this can be seen in the operational mathematical analysis within one full day this can be calculated by combining all processes into one Sequential time optimal and comprehensive.

TABLE 1. PROCESS TIME COMPARISON

No	Process	Conventional	SCADA system	Efficiency
1	Cleaning	25 Minutes	10 minutes	20 minutes
2	Process	201 Minutes	190 Minutes	11 Minutes
3	Cooling	24.30 Minutes	21 Minutes	3.30 minutes
4	heating	64.30 Minutes	61 Minutes	3.30 minutes
5	ready	60 Minutes	60 Minutes	0 minutes
Total		375 minutes	342 Minutes	38 Minutes

1) Conventional System

1 time Production = 375 Minutes = 6.25 Hours / Batch

1 Shift = 8 Hours
3 Shifts = 24 Hours
3 Shifts = 3 Batches
(19.10 Hours + 1 hour Rest in each Shift)

2) SCADA system

1 time Production = 342 Minutes = 5.7 Hours / Batch

1 Shift = 8 Hours
3 Shifts = 24 Hours
3 Shifts = 4 Batches
(22.8 Hours + 1 hour Rest in each Shift)

3) Company Profit Assumption

The price of the infusion product produced from this machine production 500 cc double port type with the latest 2021 price, which is Rp. 20,000, we hereby calculate the company's profits using the SCADA system are:

1 bag of infusion = 500 cc or $\frac{1}{2}$ ***Liter***
1 Tank = **2000 *Liter***
1 Tank = 4000 Bags of Infusion

With this results of the calculation one time production / Batch is 4000 Bag Infusion:

1 bag of infusion = IDR 20,000

4000 Bags of Infusion = IDR 80,000,000 / Batch

From this calculation, it is obtained that if the SCADA system is used, which is Rp. 320,000,000 in 3 shifts, and if use the Conventional system which can only generate Rp. 240,000,000 in 3 shifts, this is a profit difference of Rp. 80,000,000 from 3 shifts a day.

V. Conclusion

✓ A SCADA-based system has been created for a prototype hemodialysis mixing tank using a cx-programmer and a cx-supervisory.

- ✓ The production process using the SCADA system results in a more efficient time with a total time difference of 38 minutes/batch.
- ✓ Operations using SCADA technology within 24 hours are able to produce 4 batches of Infusion Bags, while using the conventional system only 3 batches.
- ✓ The SCADA system assumed to be able generate a profit increase of 32% from Rp. 240,000,000/day to Rp. 320,000,000/day.

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AUTHOR GUIDELINES

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- Article should be prepared according to the following author guidelines in this template. Article contain of minimum 3500 words.
- References contain of minimum 15 references (primary references) from reputable journals/conferences

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  Abstract consists of 150-250 words. The abstract should contain logical argumentation of the research taken, problem-solving methodology, research results, and a brief conclusion.
- Index terms
  A list in alphabetical order in between 4 to 6 words or short phrases separated by a semicolon (;), excluding words used in the title and chosen carefully to reflect the precise content of the paper.
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  Introduction commonly contains the background, purpose of the research, problem identification, research methodology, and state of the art conducted by the authors which describe implicitly.
- Method
  Include sufficient details for the work to be repeated. Where specific equipment and materials are named, the manufacturer's details (name, city and country) should be given so that readers can trace specifications by contacting the manufacturer. Where commercially available software has been used, details of the supplier should be given in brackets or the reference given in full in the reference list.
- Results and Discussion
  State the results of experimental or modeling work, drawing attention to important details in tables and figures, and discuss them intensively by comparing and/or citing other references.
- Conclusion
  Explicitly describes the research's results been taken. Future works or suggestion could be explained after it
- Appendix and acknowledgment, if available, could be placed after Conclusion.
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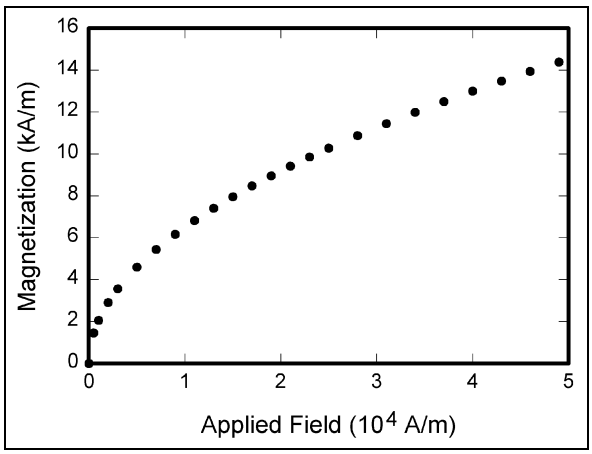

Fig. 1. Example of a figure caption

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Appendix

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[1] G. Eason, B. Noble, and I.N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

[2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.

[3] I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.

[4] K. Elissa, "Title of paper if known," unpublished.

[5] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[7] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

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