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MOBILE SCANNER ADOPTION ANALYSIS BETWEEN EMPLOYMENT AND EDUCATIONAL BACKGROUND – AN ANALYSIS OF LOGISTIC REGRESSION

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ABSTRACT

As of today, the mobile apps may be downloaded everywhere. The development of mobile apps depends on the type of the work. An increasing use of mobile app is scanner apps due to an easy use. This paper presents the regression analysis on employment and educational background of the mobile scanner app because this research used category in the questionnaire. The use of logistic regression is to prove that any different comparisons are detected between employment and educational background so that the use of mobile scanner can be optimally used. The results show that educational background and employment have vital roles for mobile scanner adoption. This study also proves that previous researches on mobile scanner adoption were true for UTAUT model and comparison analysis.

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INTRODUCTION

The use of smartphone is increasing rapidly in Indonesia from time to time. As of today, the ownership of smartphone is almost equal of the number of total mobile phone used [1]. It means that mostly people in Indonesia uses smartphone as mobile device to communicate and get other things done [2].

About 85% of total population in Indonesia already owned mobile phone with any type, while the smartphone ownership itself raised from only 43 % from total mobile phone owned up to 94% in 2019 of total population in comparison of 96% total mobile phone owned [2]. This proves that almost of mobile phone owned in Indonesia in 2019 are smartphone and it became important device for most Indonesian users.

As for smartphone's operation system used in Indonesia, there are almost no competition due to the number of total android operating system used in Indonesia reach out up from 76% in 2016 to 92% in 2020 of total percentage mobile operating system used in Indonesia [2]. The only operating system that is able to catch up is iOS even though the gap is still far behind [3].

Table 1 is several most downloaded digital image scanner apps in Google play.

Table 1. Most Download Digital Image Scanner [4]

Apps	Download	Published by	Output File	OCR
CamScanner HD	100,000,000 +	INSTIG	PDF	Yes
Adobe Scan:PDF	10,000,000 +	Adobe	PDF	Yes
Office Lens	10,000,000 +	Microsoft Corporation	PDF, JPG, onenote	Yes
Clear Scan	10,000,000 +	Indi Mobile App	PDF, JPG	Yes
Camera Scanner to PDF	10,000,000 +	Tap-Mobile	PDF	Yes
Google Drive	5,000,000,000 +	Google LLC	PDF	No

The latest researches on mobile scanner adoption had proven the positive results. The UTAUT analysis for mobile scanner adoption education and employment had positive effects compared to age, gender, experience, habit, and

so on using Partial Least Square-Structural Equation Modelling (PLS-SEM) [5]. While, the comparison analysis on mobile phone scanner technology adoption showed that employment/work purpose is main reason for adoption rather than education using two-way ANOVA analysis [6]. So that, this research aim is to prove that the combination of employment and education may deliver better adoption for mobile phone scanner.

This paper will follow some sections. The next section is our literature regarding this study purpose. The following section discusses our method to reach the aim and shows the results. The last section is conclusions and limitation of the study.

LITERATURE REVIEW

Several research about smartphone's app have been conducted. There is discussion about smartphone user segmentation resulted some segments [7], among them is called utilitarians which use primarily and spend most of time on productivity apps with such age ranges [8]. Other study revealed that productivity apps is important, but not creating addiction [9]. While some other observe behavioral intentions toward apps [10] or users comparison with or without apps in their daily activities [11], but very few had discussed about productivity apps, especially within this article which will discuss influences of educational background and employment on the tendency of productivity apps usage, in this case digital mobile scanner [12].

RESEARCH METHOD

This research used quantitative approach with data collection from questionnaires with logistic regression model [13] because we use categorical that converted to number as dependent variable [14]. Below is the research flowchart:

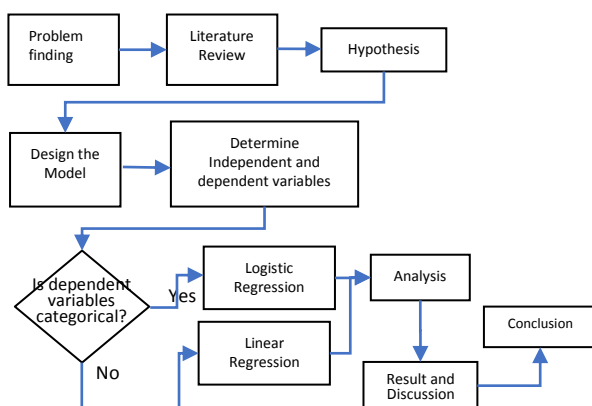


Figure 1. Research Logistic Regression

Sampling

Variabels in this research consisted of educational background (ED), employment (EM) as independent variables and digital mobile scanner usage (DMS) as dependent variables [15]. About 340 respondents across several big cities in Indonesia from various backgrounds participated in this research but reduced to 310 due to lack of completed informations [16]. The employment status that has been collected came from numerous background so we divided it into only 5 categories, i.e: unemployment, student, employee, self employee, and entrepreneur. As for education background, we categorized in from high school up to doctoral (Ph.D) degree, while it is considered to represent the user of Portable Digital Scanner through the smartphone.

Regression Logistic Analysis

Hypotheses testing that conducted in this article consist of two as follows:

H_1 : Education background has significant effect to usage of smartphone's digital mobile scanner apps

H_2 : Employment has significant effect to usage of smartphone's digital mobile scanner apps

Below is the basic function of logistic regression model in this research [17]:

$$\ln\left(\frac{\hat{p}}{1-\hat{p}}\right) = \beta_0 + \beta_1 \cdot ED + \beta_2 \cdot EM \quad (1)$$

If \hat{p} is probability of the event from dependent variable $DMS = 1$ then, with simple algebraic calculation, we have [18]:

$$\hat{p} = \frac{b(\beta_0 + \beta_1 \cdot ED + \beta_2 \cdot EM)}{b(\beta_0 + \beta_1 \cdot ED + \beta_2 \cdot EM) + 1} \text{ for } 0 < \hat{p} < 1 \quad (2)$$

As of odds ratio (OR) for effect of each independent variables EDU and EM to dependent variable DMS in the logistic regression, the defined formula as follows [19]:

$$\text{Odds Ratio} = e^{\beta_1 \cdot ED + \beta_2 \cdot EM} \quad (3)$$

Wald statistic is used in this article for assessment alternative, where similar to t-test in linear regression [20]. It tested significance of each coefficients of independent variables [21]. This Wald statistic is later compared with χ^2 from table depended on DF (degree of freedom) each test is run. The wald statistic formula is as follows [22]:

$$W_j = \frac{\beta_j^2}{SE_{\beta_j}^2} \quad (4)$$

Where $\beta_j = \beta_0 + \beta_1.ED + \beta_2.EM$

Logistic regression in this article used Cox and Snell R^2 and Nagelkerke R^2 rather than measured as normal R^2 as of index of goodness of fit assessment which can be conducted as follows [23]:

$$R^2 = 1 - \left(\frac{L_0}{L_M} \right)^{\frac{2}{n}} \quad (5)$$

$$= 1 - e^{2(\ln(L_0) - \ln(L_M))/n}$$

L_0 and L_M are the likelihoods for the model being fitted, where the difference between Cox and Snell and Nagelkerke is only the maximum value of Cox and Snell approach is only about 0.75 and Nagelkerke is equal to 1.

Data Conversion and Coding

Data from each variable are converted into categorical as nominal and ordinal type of data values as follows:

Table 2. Data Conversion

Variable	Description	Categorical Values
DMS	Using DMS apps	1
	Not using DMS apps	0
EDU	High School	1
	Associate Degree	2
	Bachelor	3
	Master	4
	PhD	5
EM	Unemployment	1
	Student	2
	Employee	3
	Self Employed	4
	Entrepreneur	5

The number of categorical value in DMS and EM column represents the nominal type which does not have any rank or better value each other, while in the EDU variables represents the ordinal type which have rank that the higher the value is, means the better.

RESULTS AND DISCUSSION

Detailed respondent's description about educational backgrounds, employments, and digital mobile scanner usage that collected from questionnaires can be seen in table 3:

Table 3. Respondents Description

Education and Employment	Using Digital Mobile Scanner				Total
	Female		Male		
	No	Yes	No	Yes	
High School	34	50	17	83	184
Unemployed	11	4	2	7	24
Student	21	42	14	68	145
Employee	1	4	1	7	13
Entrepreneur	1			1	2
Associate Degree		3	1		4
Student		1			1
Employee		1			1
Entrepreneur		1	1		2
Bachelor	19	17	9	32	77
Unemployed	3	2	2	1	8
Student	1	7		10	18
Employee	13	7	5	17	42
Entrepreneur	2	1	2	1	6
Self Employed				3	3
Master	13	10	7	14	44
Unemployed	1	2	1	2	6
Employee	11	6	4	9	30
Entrepreneur	1		2		3
Self Employed		2		3	5
PhD				1	1
Employee				1	1
Grand Total	66	80	34	130	310

Table 4 is the result of Logistic Regression of the model.

Table 4. Results Regression

Description	Values	DF	P-Value	Explanation
Total Samples	310			
Not using DMS apps	100			
Using DMS apps	210			
Variable in the Equations (Step 0) before inserting independents variables		1	0.000	
Slope (B)	0.742			
Standard Error	0.121			
Wald	37.29			
Odd Ratio / Exp (B)	2.100			
Variables not in the Equation				
Educational Background	5.049	1	0.025	
Employment	13.221	1	0.000	
Iteration history				DF=N-k-1 =310-2-1=307
Step 1-2 log likelihood	375.693			

Step 2-2 log likelihood	375.320			χ^2_{table} (DF=307) =348.86
Step 3-2 log likelihood	373.320			
Step 4-2 log likelihood	373.320			
Omnibus Test (Maximum Likelihood) χ^2	14.536	2	0.001	χ^2_{table} (DF=2)=5.991
Pseudo R Square				
Cox & Snell R ²	0.46			independent variables ability to predict is 46 % based on Cox & Snell approach
Nagelkerke R ²	0.64			independent variables ability to predict is 64 % based on Nagelkerke approach
Goodness of Fit				
Hosmer and Lemeshow Test χ^2	11.057	5	0.05	χ^2_{table} (DF=5)=11.0705
Result				
Percentage Correct of Not using DMS Apps	14.0%			
Percentage Correct of using DMS Apps	91.4%			
Accuracy of Model	66.5%			
Equation Variables				
Education Background				
Exp (B)	1.157		0.16	
Standar Error	0.104			
Employment				
Exp (B)	1.282		0.002	
Standar Error	0.080			

From table 4 above, the number of total samples are 310, which divided into two category that are people who did not use Digital Mobile Service describe as "0" as many as 100 respondents and who did use it as "1" with total 210 respondents. -2 log Likelihood (373.320) < χ^2_{table} (348.86) which means accept null-hypothesis that indicate model above with independent variables is Fitted with the data. As the value of $\chi^2(14.536) > \chi^2_{table}$ (DF=2)=5.991 with significance p (0,001), then it means that null-hypothesis again is rejected that indicated

education and employment have significant effect toward desire to use digital mobile scanner application [24] with total effect of 64 % (with Nagelkerke R2 approach) [25]. As of Goodness of Fit test, we obtained χ^2 from Hosmer and Lemeshow Test 11.057 < χ^2_{table} (DF=5) = 11.0705 which indicated that null-hypothesis where the model is fit, is accepted. It means following hypothesis testing for the model can be done because there are no significant difference between model and observation values and can represent the actual conditions with overall percentage of the model's accuracy in this article is 66.5 %. While we accept both hypotheses testing from each independent variables, the effect of them respectively, are shown from the value of Odds Ratio (OR) for each independent variables namely EDU and EM. The logistic regression function in this article is as follows:

$$\ln\left(\frac{\hat{p}}{1-\hat{p}}\right) = 1.557 + 0.146 \text{ EDU} + 0.249 \text{ EM} \quad (6)$$

P value of Wald statistic for EDU as education background is < 0.05 means that educational background give no partial effect to desire to use digital mobile scanner apps, while on the contrary, p value of Wald statistic for EM as employment is > 0.05 which indicates that employment have significant partial effect of the observed desire to use digital mobile scanner apps. From the Table 1 and equation above, EDU give the result that people with higher education give 1.157 times the chance of using Digital Mobile Scanner (DMS) [26] And EM shows that as better employment give chances of 1.282 times of using DMS [27].

CONCLUSION

As for the result shown above, although we decided to accept both Null Hypotheses, it came with the interesting results. It indicated that smartphone usage in the modern day is not only for basic and social needs, but also served as work devices that can be relied on. People with higher education and better employment status tend to use Digital Mobile Scanner likely rather than people with less education and the one with less employment. One of significant development of smartphone today is the use of camera as modern digital scanner with a form of application as a replacement of old conventional scanner that can be downloaded anytime. Many people use it to increase their productivity in work and educational purposes. This study delivers the perspective of how educational background and

employment affect the usage of their smartphone, especially for advanced use such as camera utilization as documents scanner. It resulted that educational background has no partial effect but rather as supportive factor when combined with better employment.

LIMITATION OF THE STUDY

This study has some limitations. First limitation is that the variables are educational background and employment. Second limitation is that data conversion can be changed for better analysis. Third limitation is that bigger respondent can be national level. Hence, all limitations can be done for future works.

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SECURITY ARCHITECTURE ON WIRELESS NETWORK TRAFFIC HANDOFF : A REVIEW

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ABSTRACT

This paper provides an overview of the wireless handoff process on wireless networks by investigating Authentication Protocol using EAP - AKA (Extensible Authentication Protocol) - Authentication and Key Agreement. The EAP-AKA protocol was developed for LAN networks or mobile network devices, the authors found ineffective network procedures guaranteed that made the attacks MITM and DoS attacks may occur. In addition, we find the storage procedures and resource submissions not safe enough to withstand DoS attacks. Focusing on Both types of attacks, the authors are interested in existing security protocol methods and written by researchers, then perform Systematic Literature Review (SLR) by using international journals database ie from the IEEE organization with the use of wireless handoff attack keyword in the middle of the world and obtained some related journals which need further research to deepen the Systematic Literature review, by offering a structured, methodical, and meticulous approach to understanding the research trends of handoff security issues on wireless networks and mobile networks. The purpose of this research is to provide credible intellectual guidance for future researchers to help them identify areas in the study. Most SLR is limited to conference papers and journal articles published by IEEE from 2015 to 2021. This study reveals that the protocol, privacy and security of the handoff process are the least studied, while the operating problems, architecture, methods in the handoff process get much attention in the literature.

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INTRODUCTION

The wireless handoff process and overview of security architecture on wireless networks by investigating Authentication Protocol using EAP-AKA (Extensible Authentication Protocol) - Authentication and Key Agreement. The EAP-AKA protocol was developed by 3GPP LAN networks or mobile network devices, the authors found the initial network procedure is not effectively secure that makes any delinquent and issue [1], [2], [3]. Focusing on these investigating Authentication Protocol attacking and we propose A Systematic Literature Review of security wireless handoff security. Handoff method is used to maintain the connection. This is related to the performance due to the process of switching traffic channels automatically on the mobile station to communicate without the occurrence of termination of the connection. The main factor of success in handoff lies in the quality of service that provides different levels of service assurance

in managing and prioritizing network traffic handoff consideration.

Consideration of the need for power or signal strength required for stable communication requires stable power or signal strength. Each Access Point, BTS and Antenna Provider have user or user limits so that the user's network density must be taken care of in order to prevent jams and cause undisturbed communication.

Distance communication is far and wide so it requires handoff or handover to serve the communication needs so it is still affordable with good quality [4]. Administrative considerations are usually for the needs of the Administration of communication between the Access point or operator so that the data obtained utilized for the interests of the administration for example when done Preservation or maintenance so that users diverted to the Access Point, BTS or others antenna so required handoff [5].

RESEARCH METHOD

The method used in this study [6], [7] uses three stages with nine blocks or steps which will be explained as follows: the first step identifies systematic needs and the second step develops systematic needs then the third step evaluates the review protocol this stage is called the planning stage, then there are blocks or The following fifth step enters the implementation stage [8], [9], namely searching for primary studies, selecting primary studies, extracting data from primary studies, assessing the quality of primary studies and synthesizing data, for the last step is the form of reporting from research, namely the stage of distributing results as shown in Figure 1 as below.

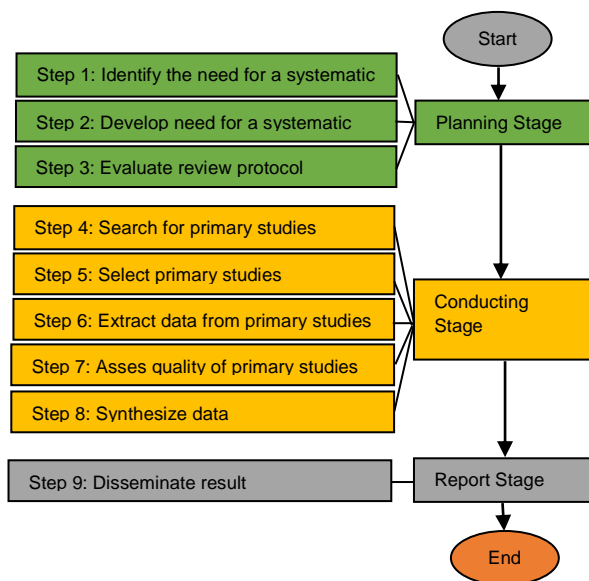


Figure 1. Prosesing Systematic Review Research

Research Question

The research Question (RQ) were specified to keep the review focused [10], [11]. They were design with the help of the Population, Intervention, Comparison, Outcomes, and Context (PICOC) criteria (kitchenham and Charters 2007). Table 1 shows the PICOC structure of research questions.

Table 1. Summary of PICOC

Question	Result
Population	Wireless handoffs, security, protocol, Authentication
Intervention	Wireless Handover, fault prediction, error, classification, models, methodes, techniques, authentication process
Outcomes	Prediction of the accuracy of the research area, revealing that the protocol, privacy and security of the handoff process
Context	Studies in industry and academia, small and large data sets

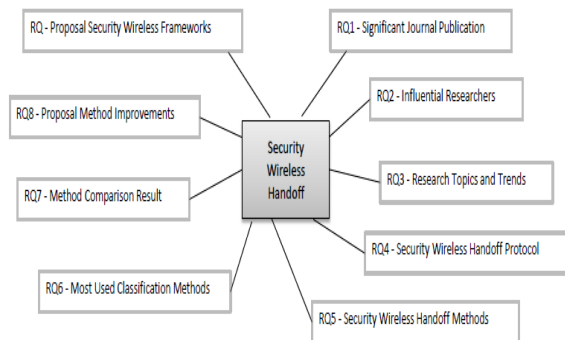


Figure 2. Basic Mind Map of the SLR on Security Wireless Handoff

The basic mind map is contained in a table which is grouped as a series of hypotheses in the form of research questions and motivation in table 2 below.

Table 2. Research Questions

ID	Research Question	Motivation
RQ1	Which Journal is the most significant security wireless handoff?	Identify the most significant journals in the security wireless handoff
RQ2	Who are the most active and influential researcher in the security wireless handoff field?	Identify the most active and influential researchers who contributed so much on are research area of security wireless handoff
RQ3	What kind of research topics are selected by researcher in the security handoff field?	Identify research topics and trend in software detect prediction
RQ4	What kind of protocols are the most used for security wireless handoff?	Identify protocols commonly used in security wireless handoff
RQ5	What kind of methods are used for security wireless handoff?	Identify opportunities and trend for security wireless handoff method
RQ6	What kind of methods are used most often for security wireless handoff?	Identify the most used methods for security wireless handoff
RQ7	Which methods performs best when used for security wireless handoff?	Identify the best method in security wireless handoff
RQ8	What kind of method improvements are proposed for security wireless handoff?	Identify the proposed method improvement for predicting security wireless handoff
RQ9	What kind of framework are proposed for security wireless handoff?	Identify the most used framework in security wireless handoff

Search Strategy

The search process (step 4) consists of several activities, such as selecting digital libraries, defining search strings, running pilot searches, refining search strings and retrieving

initial lists of primary studies from digital libraries that match search keywords. Before starting the search, an appropriate set of databases should be selected to increase the likelihood of finding highly relevant articles. The most popular library databases in the field are searched to have the widest possible set of studies the author determines the IEEE Xplore literature (ieeexplore.ieee.org) as reference for literature [12], [13].

The search string was developed according to the following steps:

1. Identification of the search terms from PICOC, especially from Population and Intervention
2. Identification of search terms from research questions
3. Identification of search terms in relevant titles, abstracts and keywords
4. Identification of synonyms, alternative spellings and antonyms of search terms
5. Construction of sophisticated search string using identified search terms, Boolean ANDs and ORs

The following search string was eventually used:

- **Wireless, handoff, handover, security, reliability process, wireless security authentication.**

A search string adjustment is performed, for the adjustment of the search string will dramatically increase the already extensive list an irrelevant study the search string is then adjusted to meet specific requirements. In Database searched with title, keyword and abstract. The Search is limited by the year of publication: 20015-2021. The type of publication of the journal papers and the limited Search conference on articles published in English.

Study Selection

The inclusion and exclusion criteria were used for selecting the primary studies. These criteria are shown in Table 3.

Table 3. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Studies in academic and industry using large and small wireless handoff authentication process	Studies without a strong validation or including experimental result of wireless handoff authentication process
Studies discussing and comparing modeling performance in the wireless handoff authentication process	Studies discussing defect prediction datasets methods framework in a context other than wireless handoff authentication issue
For studies that have both	Studies not written in English

the conference and journal version only the journal version will be include, and for duplicate publication of the same study only the most complete and newest one will be included

Data Extraction

In this study we will process research based on the characteristics of an object or called property, property is used to describe attributes related to a data structure. Property (or also called attribute) is data contained in a class it can be seen in table 4 below.

Table 4. Research Questions

Property	Research Question
Research and Publication	RQ1, RQ2 and RQ3
Research trends and topics	RQ4, RQ5 and RQ6
Wireless handoff process	RQ7
Wireless handoff authentication the middle metrics	RQ8 and RQ9

Study Quality Assessment and Data Analysis

The study quality assessment and Data Synthesis in the of the synthesis finding and to define the strength of the elaborate inferences the goal of data synthesis is to aggregate evidence from the selected studies for answering the research question. A single piece of evidence might have small evidence force but the aggregation of many of them can make a point stronger [14]. The data extracted in this review include both quantitative data and qualitative data. Different strategies were employed to synthesize the extracted data pertaining to different kinds of research questions. As a Rules the narrative synthesis method was used the data were tabulated in manner consistent with the questions. Some visualization tools including bar charts and tables were also used to enhance the presentation of distribution of wireless handoff authentication in the middle methods, reliability also one of method to examine or observese [15].

RESULTS AND DISCUSSION

Significant Journal Publication

In order to carry out activities such as those listed on the scope with the results as expected on the purpose of this activity and accompanied by effective cost utilization, the methodologies for carrying out such activities shall be so designed that all the variables and indicators who are involved in the review are fulfilled, therefore the methodology for carrying out this study is carried out as follows:

Table 5. Result Keyword in Journal

Keyword	Result
Wireless handoff	3274
Wireless handover	3862
Wireless handoff Process	921
Wireless handover Process	984
Wireless handoff attack	25
Wireless handover attack	49
Wireless handoff security authentication	4
Wireless handover security authentication	5

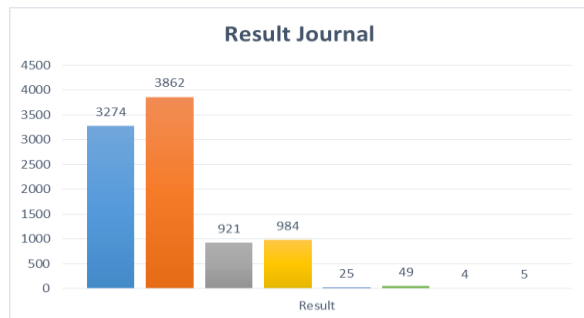


Figure 3. Result Journal by Keyword

Methods Used in wireless handoff

Conducting systematic review to know the position of research by doing the use of keywords literature studies on previous studies to obtain the analysis gap.

Table 6. Conducting Journal

Title	Researchers	Discussion
A Secure Certificate Based Authentication to reduce Overhead for Heterogeneous wireless networks	M.Prasad, R. Manoharan, Pondicherry Engineering College, India	Authentication algorithm signed also resists against man-in-the-middle-attack and replay attack
Secure 3GPP-WLAN authentication protocol based on EAP-AKA	"Shruti S. Patkar, Dayanand D. Ambawade, Dept. of Electronics & Telecommunication Sardar Patel Institute of Technology Mumbai, India"	Authentication Protocol using EAP -AKA (Extensible Authentication Protocol) - Authentication and Key Agreement The EAP-AKA protocol was developed by 3GPP
Secure handover in WSN using FLAP	"Manpreet Kaur, Simarpreet Kaur, Kamaljit Singh Saini, Dept. of Comp. Sci. and Engg. Chandigarh University Mohali, India"	Authentication protocol using FLAP (Frame Layer Protocol)

Secure and efficient uniform handover scheme for LTE-A networks

Reliability Analysis of Wireless 802.11 Networks with Reliability Block Diagram

Zaher Haddad, Mohamed Mahmoud, Imane Aly Saroit, and Sanaa Taha, Al-Aqsa University, Gaza, Palestine
Tennessee Tech University, USA
University, Cairo, Egypt"
Sigit Wibawa Mudrik Alaydrus Department of Electrical Engineering Universitas Mercu Buana Jakarta, Indonesia

LTEA Long Term Evolution-Advance scheme and use Home Subscriber Server (HSS)

Security holes in wireless technology were found in the management framework process handoff specifically when devices were first interconnected

CONCLUSION AND FUTURE WORK

This article is expected to make it easier to discovery the best wireless network, because we can also mapping the coverage of wireless networks by knowing the value of system reliability for components with series configurations written the value of success is successful on the system while for parallel components the value of failure is written on the system, In the future, our suggestions and proposals are to prepare wireless devices in this case study, Security Analysis of Handoff Process with Why we need security on handoff process allows users to use alternative passwords such as fingerprints, retina identifiers, face recognition and voice recognition to authenticate so that users no longer need to remember passwords to enter the system and are relatively more resistant to phishing because it is not easy to duplicate.

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HOW MACHINE LEARNING METHOD PERFORMANCE FOR IMBALANCED DATA (Case Study: Classification of Working Status of Banten Province)

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ABSTRACT

This study will examine the application of several classification methods to machine learning models by taking into account the case of imbalanced data. The research was conducted on a case study of classification modeling for working status in Banten Province in 2020. The data used comes from the National Labor Force Survey, Statistics Indonesia. The machine learning methods used are Classification and Regression Tree (CART), Naïve Bayes, Random Forest, Rotation Forest, Support Vector Machine (SVM), Neural Network Analysis, One Rule (OneR), and Boosting. Classification modeling using resample techniques in cases of imbalanced data and large data sets is proven to improve classification accuracy, especially for minority classes, which can be seen from the sensitivity and specificity values that are more balanced than the original data (without treatment). Furthermore, the eight classification models tested shows that the Boost model provides the best performance based on the highest sensitivity, specificity, G-mean, and kappa coefficient values. The most important/most influential variables in the classification of working status are marital status, education, and age.

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INTRODUCTION

Predictive analytics is one of the analytical methods often used in addition to descriptive and prescriptive analytics. Predictive models study the relationships between variables and then create a statistical model to predict the value of new events and future events. One of the predictive models is a classification technique other than the regression model. Along with the development of science and technology, classification models are growing. Several programs, especially in R software, continue to be developed to produce classification methods with good performance.

Some of the classification techniques that are often used include Classification and Regression Tree (CART), Naïve Bayes, Random Forest, Rotation Forest, Support Vector Machine (SVM), Analysis Neural Network (ANN), OneR, and Boosting. Each method has advantages and disadvantages. ANN has the advantage of acquiring knowledge even though there is no certainty, having fault tolerance, and the ability to calculate in parallel so that the process is shorter than others. The disadvantage of ANN is

that it cannot perform numerical operations with high precision and less able to perform arithmetic algorithm operations, logical operations, and symbolic operations. One of the packages in R for the ANN method is the “nnet” package developed by Venables and Ripley [1].

Random Forest has the advantage of not being sensitive to data; there is no overfitting problem and can sort variables that contribute to predicting. The disadvantage of this method is that tree predictions must be uncorrelated and often appear as black boxes (error messages). One of the packages in R for the Random Forest method is the “randomForest” package developed by Liaw and Wiene [2]. The oneR method has the advantage of producing an accurate model to establish a good baseline, efficient in processing big data. The drawback of the one R model is that it is less efficient for complex models. One of the One R packages uses the “OneR” package developed by Jouanne [3].

Rotation Forest has the advantage of improving the predictive ability of the decision tree by utilizing the principal component

principle and maintaining data diversity. One of the packages in R for the Rotation Forest method is the "rotationForest" package developed by Balling and Poel [4].

The CART method has the advantage of not requiring normalization or data scaling, data handling missing values, easy visualization. The drawbacks of the CART method are that it tends to be overfitting, sensitive to outliers, and less efficient for extensive data. One of the packages in R for the CART method is the "rpart" package developed by Therneau and Atkinson [5]. The SVM method has the advantage of performing well in classifying variables with high dimensions, such as image data, gene data, medical data. In addition, the SVM method is also not sensitive to outlier data. The disadvantage of the SVM method is that it is less efficient for larger data sets, so it takes much time. In addition, it requires expertise in selecting the appropriate hyper parameters and kernel functions so that the model's performance is good.

The Naïve Bayes method has advantages in time efficiency, which is very fast in data processing, can be scaled with large data sets, and can be used for multi-class predictions. The disadvantage of the Naive Bayes method is that feature independence does not apply: The basic assumption of Naive Bayes is that there is an assumption that the independent contribution between variables and training data must represent the population well. One of the packages in R for SVM and naive Bayes methods is the "e1071" package developed by Meyer et al. [6]. The Boosting method has the advantages of feature engineering, which is less required (no need for scaling, data normalization, can also handle missing values well), easy to interpret, suitable for large data, and efficient. Disadvantages of the Boosting method are difficult interpretation, complex visualization, and sometimes overfitting. One of the packages in R for the Boosting method is the "xgboost" package developed by Chen et al. [7].

In general, the assumption for classification method is based on that the data used has a balanced proportion. According to Maalouf and Siddiqi [8], one of the problems in data classification is a rare event or imbalanced data, namely the amount of data that is not balanced between different classes. One of the consequences of imbalanced data is that the classification results tend to eliminate opportunities from the minority class because the predicted value will tend to be in the majority category. The accuracy of the resulting classification is not good [9].

This study aims to compare the various existing classification methods. The case studies used are factors that affect a person's working status in Banten Province. In this study, a resampling technique was applied to overcome imbalanced data to improve the performance of the classification model used.

RESEARCH METHOD

Data Sources and Research Variables

The data used in this study came from the National Labor Force Survey of Banten Province for August 2020, which the BPS-Statistics Indonesia conducted [10]. The total sample used is 11,469 respondents, of which 10.2 percent are unemployed, the remaining 89.8 percent are working. The variables used in the study can be seen in Table 1.

Table 1. Research variable

Variable Name	Information	Scale
Working status	0 Working 1 Not Working	Nominal
Area type	0 Urban 1 Rural	Nominal
Gender	0 Women 1 Male	Nominal
Marital status	0 Not yet/ Not Married 1 Married 2 Divorce	Nominal
Age	0 15-25 years 1 26-50 years old 2 > 50 years	Nominal
Education	Not completed school Primary School Junior School High School University	ordinal
Course certificate	0 No 1 Yes	Nominal
Visual impairment	0 No 1 Yes	Nominal
Hearing impairment	0 No 1 Yes	Nominal
Walking impairment	0 No 1 Yes	Nominal
Holding impairment	0 No 1 Yes	Nominal
Speech impairment	0 No 1 Yes	Nominal
Other impairment	0 No 1 Yes	Nominal

Classification modeling

In this study, the data is divided into two: training data for model building and data testing to test model performance. The distribution of data is based on a deterministic/holdout method, namely by determining the ratio of the division of the two datasets, in this study using a ratio of 70 percent for training data and 30 percent for testing data. The resample technique was then carried out, using both/combine sampling

methods from the existing testing data so that the model's performance could be compared on the treated and untreated data.

Classification Performance Evaluation

Evaluation is done by using data testing both on models that use treatment or those that do not. The confusion matrix is used as a classification performance measure. According to Han et al. [11], a confusion matrix is a valuable tool for analyzing how well or how accurately the classification method can recognize objects of observation from different classes. Table 2 is a confusion matrix for binary classification. The column section shows the actual label for each class, while the row section shows the class label based on the predicted results.

Table 2. Confusion matrix

Confusion Matrix		Actual Class		Total
		Yes	No	
Prediction Class	Yes	TP	FP	P'
	No	FN	TN	N'
Total		P	N	

Some of the classification performance measures that can be obtained from the confusion matrix are as in Equations (1) - (4).

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN} \quad (1)$$

$$Sensitivity = \frac{TP}{TP + FN} \quad (2)$$

$$Specificity = \frac{TN}{TN + FP} \quad (3)$$

$$G - mean = \sqrt{Sensitivity \times Specificity} \quad (4)$$

Besides using the confusion matrix, according to Landis and Koch [12], the model's goodness can also be seen by the value of the Kappa coefficient. The value of this test is also used to determine the strength of agreement/reliability. In this case, the higher the Kappa value, the better the model used.

Data Analysis Stages

The stages of data analysis in this study are as follows:

- Divide the data into training data and testing data with proportions of 0.7 and 0.3 respectively
- Resample the training data using the combine/both sampling technique
- Perform classification modelling with 8 (eight) methods, namely Naive Bayes, ANN, SVM,

- Random Forest, CART, OneR, Rotation Forest, and Boost
- Conduct descriptive analysis of research variables
- Evaluating the classification performance of the 8 (eight) machine learning methods used
- Choose the best machine learning method to predict working status based on the balanced and highest specificity, sensitivity, G-mean, and Kappa coefficient criteria
- Displays the predictor variables that have the most influence on the model
- Data processing using R software version 4.1.0 and using the machine learning package mentioned in the introduction

RESULTS AND DISCUSSION

The first step before carrying out the classification method is to present descriptive statistics regarding the research variables. The research sample shows that as many as 10.2 percent of the population do not work in Banten Province. The unemployed population is dominated by people living in urban areas, unmarried/unmarried, male, and young (15-25 years old). Descriptive statistics for research variables in a thorough manner can be seen in Table 3.

Table 3. Descriptive Analysis of Research Variables

Variable	Indicator	Work	Does not work	Total
Area	rural	90.40	9.60	100
	urban	89.52	10.48	100
Marital status	Not yet/Not Married	71.85	28.15	100
	Marry	95.82	4.18	100
Gender	Divorce	92.97	7.03	100
	Male	89.2	10.8	100
Education	Woman	91.0	9.0	100
	Not completed	94.5	5.5	100
	Primary	94.6	5.4	100
	Junior High School	88.6	11.4	100
	Senior High School	84.4	15.6	100
	University	93.3	6.7	100
Age	15-25	69.9	30.1	100
	26-50	94.2	5.8	100
Course certificate	>50	95.6	4.4	100
	Not	89.9	10.1	100
	Yes	89.6	10.4	100

Next, there is a discussion about the performance of the classification method with machine learning techniques. Based on the information in the descriptive analysis, there is a relatively significant difference in the proportion between those who do not work and those who work. If you pay attention to the value of accuracy and specificity, then the modelling for imbalanced data, without treatment, the value is higher than

the data that has used resample combine/both samplings. However, the performance of other classifications on classification modelling without treatment, such as specificity, G-mean, and Kappa coefficient, has a value of 0 in the SVM, Random Forest, CART, OneR, Rotation Forest, and Boost techniques. Meanwhile, for the Naïve Bayes and ANN models, the sensitivity and G-mean values are below 0.6, and Kappa values are below 0.3.

Without treatment on the eight models, classification modeling showed almost the same classification performance values, namely accuracy and sensitivity around 0.9. This result is that the predicted value tends to be classified in the majority class (the class that is not considered) compared to the minority class (the class that is considered in this case the population does not work). So the level of accuracy in the classification modeling without treatment on the eight models gives poor results. The existence of misclassification will result in inaccurate errors in planning or government policymaking in handling unemployed residents.

To improve the classification accuracy, especially for the minority class, this study applies both sampling methods in handling cases of imbalanced data, where the proportion of training data for both categories is balanced. The results obtained show that in the eight models for the specificity value, which shows a measure of classification accuracy in the minority class that is correctly predicted by the model, ranging from Sensitivity to 0.751. In addition, it also increases the G-mean value, which ranges from 0.5 to 0.75, and increases the Kappa value, which ranges from 0.234 to 0.302. On the other hand, a decrease in the value of accuracy to be in the range of 0.532 to 0.674. In other words, the handling of imbalanced data cases results in more balanced specificity and sensitivity values resulting in lower accuracy values, ranging from 0.740 to 0.800.

Classification modelling to predict the proportion of the population does not work by considering the values of accuracy, sensitivity, specificity, G-mean, and Kappa coefficient; the best model is the boost model with a combined/both sampling scheme. This result is because the model has the most significant and balanced classification performance value compared to other classification models. The model has an accuracy value of 0.789, sensitivity of 0.798, specificity of 0.751, G-mean of 0.750, and a kappa coefficient of 0.302. Because the classification performance measure in the best model is above the cut-off (0.5), the model can be said to be good. This result shows that the best

classification model can correctly classify the working status of the population in Banten Province.

Indicator	Methods	No Treatment	Treatment
Accuracy	Naïve Bayes	0.851	0.783
	ANN	0.902	0.74
	SVM	0.902	0.779
	Random Forest	0.902	0.786
	CART	0.902	0.789
	OneR	0.902	0.789
	Rotation Forest	0.899	0.8
	Boost	0.899	0.789
Sensitivity	Naïve Bayes	0.924	0.958
	ANN	0.903	0.959
	SVM	0.902	0.959
	Random Forest	0.902	0.959
	CART	0.902	0.958
	OneR	1	0.801
	Rotation Forest	1	0.812
	Boost	1	0.798
Specificity	Naïve Bayes	0.498	0.503
	ANN	0.549	0.47
	SVM	0	0.5
	Random Forest	0	0.507
	CART	0	0.507
	OneR	0	0.736
	Rotation Forest	0	0.751
	Boost	0	0.751

Figure 1a Comparison of Machine Learning's Performance

Indicator	Methods	No Treatment	Treatment
G-Mean	Naïve Bayes	0.498	0.503
	ANN	0.549	0.470
	SVM	0.000	0.500
	Random Forest	0.000	0.507
	CART	0.000	0.507
	OneR	0.000	0.736
	Rotation Forest	0.000	0.751
	Boost	0.000	0.751
Kappa	Naïve Bayes	0.203	0.279
	ANN	0.004	0.234
	SVM	0.000	0.276
	Random Forest	0.000	0.286
	CART	0.000	0.284
	OneR	0.000	0.284
	Rotation Forest	0.000	0.301
	Boost	0.000	0.302

Figure 1b Comparison of Machine Learning's Performance

Table 4 presents the mean decrease in *Modeling Classification Performance*. Gini from the best boost classification model. This result shows that the 4 (four) most important/most influential variables in the classification of working status are marital status, education, age, and hearing loss. The relationship between marital status and working status is quite close, as Yulianti et al. [13]. This result is related to a person's marital status related to the responsibility in meeting family needs. The relationship between

education and work status is quite close, as in the research of Mutiadanu et al. [14].

Table 4. The Most Influential Predictor Variables

Features	Gain	Cover	Frequency
Marital status	0.894	0.426	0.333
Education	0.046	0.191	0.333
Age	0.032	0.224	0.167
hearing impairment	0.027	0.159	0.167

This result relates to education being considered as an investment in employment opportunities. The relationship between age and working status is quite close, as in Dhanani's research [15]. This case relates to the level of establishment and experience that a person has in getting a job as he gets older than others.

CONCLUSION

In general, classification modeling using resample techniques in imbalanced data and large data sets is proven to improve classification accuracy, especially for minority classes which can be seen from the value specificity, which is higher than the original data (without treatment). The Naïve Bayes and ANN models can produce specificity values even though the data used are imbalanced, while the other six models produce zero specificity values. Using the resampling technique, the model's accuracy, sensitivity, and specificity values become more balanced than others. The Bost model is the best model with accuracy, sensitivity, specificity, a more balanced GMean, and the most significant Kappa coefficient.

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THE OPTIMIZE OF ASSOCIATION RULE METHOD FOR THE BEST BOOK PLACEMENT PATTERNS IN LIBRARY: A MONTHLY TRIAL

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Monthly Trial

ABSTRACT

Data mining is the process of finding interesting patterns and knowledge from large amounts of data. Sources of information service, especially in the library, include books, reference books, serials, scientific gray literature (newsletters, reports, proceedings, dissertations, theses, and others). The importance of this research being carried out in the library in this study aims to implement data mining with the association rule method to solve problems, especially in the placement of shelves based on the category of the printed version of the book collection. This research method uses a qualitative research approach. Data was collected using documentation techniques and deep analysis of existing weaknesses to identify user needs whose information was obtained through observation and interviews with key informants (admin, user, etc.). For example, the determination of the best book placement patterns can be done by looking at the results of the tendency of visitors to borrow books based on a combination of 2 item sets with 60 percent of confidence value every month or week and must be evaluated or take a calculate again.

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INTRODUCTION

The tendency to use text-based electronically continues to increase from time to time. In addition, the growth of data collected and archived with a computer base contributes to databases that have a large capacity; this requires a technique or method to process the data to become useful information for business decision-making. Therefore, the technology adopted to overcome the above problems is data mining. Data mining is the process of finding interesting patterns and knowledge from large amounts of data [1]. In the new millennium, global libraries are certainly a solution to serve users how to book storage by librarians or users physically in the world of information. However, the uniqueness of the database is that it is a source of information that can be made available to business people to the scientific community in all parts of the world [2]. Furthermore, data plays a central role in helping to understand changing user clearly needs and shaping and restructuring services and procedures suitability in the context of an academic library environment [3]. Sources of information in the library include books, reference books, serials,

scientific gray literature (newsletters, reports, proceedings, dissertations, theses, and others). In addition, the library also has digital-based information sources such as e-books, e-journals, audiovisuals, films, photos, slides, transparencies, and others. Most of them demand fast-paced services with complete digital/electronic collections in the context of library users [4]. Therefore, the librarian must have the integrity to provide optimal services following the development of technology and information.

The role of users of this information concerning data mining is inseparable from temporal decision support systems (TDSSs) are interactive decision systems that use temporal data and models to solve problems by considering the dimensions of temporal data, with the domain of knowledge discovery from data (KDD) and human-computer interaction (HCI) [5]. Furthermore, the difference between services, specifically based on traditional libraries and e-libraries, only differs in the media used, namely paper or digital, in accommodating the entire process and service [6].

This research was motivated by previous researchers through the concept of data mining using the algorithm with a particular approach to form a decision tree through the following stages: (i) preparing training data; (ii) determination of the roots of the tree; (iii) determination of gain value; and (iv) repeat the determination of the roots of the tree until all records are perfectly partitioned [7]. Association rule mining with unique specimens such as market-based analysis, which involves 9 customers and 5 item sets categories with letting the minimum confidence threshold is 60 percent, which produces was analyzed to identify potentially interesting patterns to make causal statements about the patterns of purchases according to existing database [8]. The application of data mining to predict wallpaper sales uses the C4.5 Algorithm with the classification method. Utilize 30 assessment data from 6 consumer interest ratings. The findings of this study get the highest factor that affects sales, namely the number of wallpaper motifs. In contrast, other factors such as price, size, material quality, and color do not affect purchasing decisions [9]. Furthermore, using the association rule method for placing books in the library. The above method is obtained based on Apriori algorithm calculations with 10 transactions of borrowing books. The system built can be arranged close to the book's layout to facilitate books that visitors will borrow with minimum confidence, i.e., 83.33 percent [10]. The analysis of the association rule method for product recommendations in online stores. The above method is obtained based on the test results using Apriori knowledge to identify buyers' user preferences and historical data on 20 transactions of 15 items product. The results of the analysis obtained by the association rules can produce the right recommendations with a confidence value of 76.92 percent [11]. Identifying the association rule method aims to the pattern of events' visit of foreign tourists to Bali every month for 37 years transaction. The results obtained by the association rules can produce the right recommendations for a pattern of tourists visiting Bali, with the minimum value of support is 15 percent and the minimum is 60 percent confidence from yield applications [12]. This study aims to merge the success of the Apriori Algorithm from prior research and specifically to determine a trial evaluation for would utilize of monthly period.

One of the libraries belonging to a boarding school in Sukabumi District, West Java, has implemented an online catalog to find information about its collections connected to

several computers with a LAN system using one server computer. The online catalog system above is operated using a desktop/laptop computer using software integrated with the SLiMS.web.id official website. However, the implementation of technology so far has not been able to see the results of the tendency of library visitors to the frequency of borrowing books based on the pattern of arrangement of the layout of the book collection. By utilizing the information obtained from library user data, the use of data mining in the case can be used to obtain information about the lending system, the layout of the shelves, and their relationship to obtain optimal book placement results and are easily searchable by library visitors, especially regular visitors within the organization's area. The importance of this research being carried out in the library aims to optimize implement data mining with the Association Rule method to solve best problems, especially in the placement based on the printed version as book collection and the result hope can utilize become the best pattern which evaluated as monthly even weekly by librarians.

LITERATURE REVIEW

Data mining is an activity and not an algorithm or program; ACM Press defines it as the process of discovering new patterns from vast data sets, including methods that are part of artificial intelligence, machine learning, statistics, and database systems [13]. Hereinafter, voted encryption algorithm also involves the asymmetric cryptographic name for a key to doing encryption and decryption [14,15]. Data mining is classified into several tasks/jobs undertaken, i.e., description, estimation, prediction, classification, clustering, and association [16]. In general, the study of data mining includes techniques such as classification, regression, variable selection, clustering, and market basket analysis. Process classification to find a database model can use data mining techniques with the Knowledge Discovery in Databases (KDD) Process Model approach.

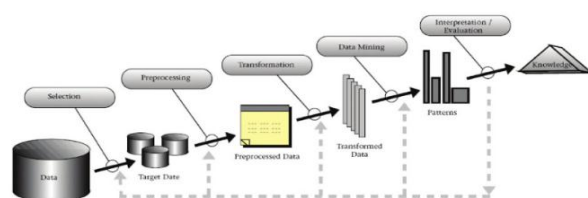


Figure 1. KDD Process Model [5,17]

The KDD process model based on Fayyad in 1995 developed from the following five stages (out of nine activities) as adhere:

1. Data selection consists of two steps. First, develop and understand the application domain. Second, create a target data set from a larger data store. Usually, the data mining maker asks the available data to select relevant data for the detection process. The result of this process is the target data.
2. Data preprocessing, consisting of division with error and missing data. Code values are also ensured to have the same coherent meaning. This stage means that the KDD process model produces the correct results. The result of this process is the data is cleaned or processed.
3. Data transformation, which is the final data processing stage before implementing data analysis techniques. This stage consists of finding useful attributes by applying dimension reduction and transformation methods and finding data representations that do not vary. This stage means that the KDD process model produces the correct results. The result of this process is that the data is transformed.
4. Data mining consists of three steps or sub-tasks. First, select the data mining assignment by matching the objectives defined in the first stage with certain data mining methods such as clustering, regression, classification, etc. Second, choosing a data mining algorithm and selecting methods and parameters to generate data patterns in a certain form of representation. The results of this process are patterns and models.
5. Interpretation/Evaluation consists of two steps. First, interpreting the unearthed pattern, it may be possible to return to the previous stage for further iterations (indicated by the dotted arrow). This stage can also visualize the extracted patterns and models or the extracted data from the extracted models. Second, combining the knowledge extracted by entering it into the performance system or simply documenting and reporting it to the intended party. This process may include checking for and correcting potential errors or discrepancies with previously believed knowledge. This process results from the knowledge that develops from the analysis of existing data with potential knowledge [5].

Apriori algorithm is given by [18] in 1994 for finding frequent itemsets in a dataset for Boolean association rule. Association analysis is one of the data mining techniques used to find interesting relationships between combinations of hidden items in a database. This relationship is

represented in the form of association rules [19]. Apriori algorithm is a data retrieval algorithm with associative rules to determine the associative relationship of a combination of items. This algorithm is based on the fact that a priori uses prior knowledge of an item set with frequent occurrences or is called the frequent item set. Apriori uses an iterative approach where the k-item set is used to explore the next (k+1) – item set [1]. The Apriori algorithm scans the database repeatedly to find frequent item sets in forming association rules. Then, the algorithm takes the iteration time is calculated from the time the algorithm ends until it gets the association rule minus the initial time the algorithm is run according to the following formula:

$$t_old = t_end - t_beg$$

Annotation:

t_beg : record the start time of the iteration process

t_end : record the end of time the iteration process

Association rules take the form “If precursor, then the aftermath,” throughout with a gauge of the support and confidence associated with the rule. An association rule brings form A, then B (i.e., $A \Rightarrow B$), where the forerunner A and aftermath B are proper subsets of I, and A and B are mutually exclusive. The support 'S' for a particular association rule $A \Rightarrow B$ is the proportion of D transactions containing both A and B calculation like the following formula:

$$Support(I) = \frac{\text{Number of transactions containing } I}{\sum \text{Number of transactions}} \dots \quad (1)$$

The support value of two items is obtained using the following formula:

$$Support(A, B) = P(A \cap B) = \frac{\text{Number of transactions containing both A and B}}{\sum \text{Number of transactions}} \dots \quad (2)$$

The confidence 'c' of the association rule $A \Rightarrow B$ is a gauge of the precision of the rule, as set by the percentage of transactions in D containing A that also contains B as the following formula:

$$confidence = P(A|B) = \frac{P(A \cap B)}{P(A)} = \frac{\text{Number of transactions containing A and B}}{\text{Number of transactions containing A}} \quad [16]$$

To determine the association rules to be selected, they must be sorted by Support \times Confidence. Rules are taken as many as 'n' rules that have the largest result [10], [20].

RESEARCH METHOD

This research method uses a qualitative research approach. Data was collected using documentation techniques and deep analysis of existing weaknesses to identify user needs whose information was obtained through observation and interviews with key informants (admin, user, etc.). However, several procedures still need to be made a decision support model, namely solving problems, especially in placement shelves based on the printed version of the book collection category to make it easier for library visitors to find books within the framework of placing library collections.

The research methodology used and applied in this research includes implementing a concept for library and information science to satisfy the end-users through several phases of data mining as follows [17,21]:

1. The demand of the data by the user's, which requests from visitors to library services in a professional manner in daily activities for users who are involved using a certain approach. This approach can be carried out on different subjects in the form of a top-down or bottom-up approach. In addition, different techniques can obtain data collection to identify problems faced by users.
2. Data mining through disparate warehouses by the library professionals, who library professionals necessities to recognize the things of the users effectively and systematically.
3. Data filtration and analysis, which data aggregation could be thru the different warehouses.
4. Data export and utilization of data, which the assignment of the library professionals is to analyze and integrate the data for creating beneficial data.
5. Achievement of library goal thru end user's satisfaction, which the commitment of every professional librarian satisfying the request of the users as the destination of assigning the library could be glorious in the evidence scenario nowadays.

Implement Association Rule Mining using Apriori algorithm on borrowing data uses software alternative to perform classification, prediction, cluster, and market basket analysis processes. This software also can normalize the data in an algorithm that may be required via automatic feature selection from wherein each category contribution is proportional to the scale (item set) [21].

RESULTS AND DISCUSSION

Tabulation of data per book item based on 17 days (table 1) as raw data. Hereinafter it aims to find out the yield of book lending activities that book borrowing pattern (table 2) and recapitulate and support each item (table 3).

Table 1. Recapitulation of Borrowing Transaction Data in Class (17-Days)

Recapitulation Date of Transactions	CLASS												
	000	100	200	300	400	500	600	700	800	900	813	Khusus	
	General Books	Philosophy Psychology	Religion	Social Sciences	Language	Pure Science	Applied Science	Art	Literature	History	Fiction Collection	Reference	
13-Feb-2020	1	1	0	1	0	1	1	0	1	0	1	1	
14-Feb-2020	1	0	1	0	1	1	0	0	0	1	1	1	
15-Feb-2020	0	0	1	0	0	1	1	1	1	1	0	0	
16-Feb-2020	0	0	0	0	0	1	1	1	0	1	1	0	
17-Feb-2020	0	0	1	1	1	1	1	0	0	1	0	1	
18-Feb-2020	0	0	0	1	0	1	0	0	0	0	0	1	
19-Feb-2020	0	1	1	0	1	1	1	0	1	1	0	0	
20-Feb-2020	1	1	1	0	0	0	1	0	0	1	1	0	
21-Feb-2020	0	0	1	0	0	1	0	0	0	1	0	1	
22-Feb-2020	0	0	0	0	0	1	1	0	1	0	0	0	
23-Feb-2020	0	0	0	1	1	1	0	1	0	1	1	0	
24-Feb-2020	0	1	1	0	0	1	0	1	0	1	0	1	
25-Feb-2020	1	1	0	1	1	1	1	0	1	1	0	0	
26-Feb-2020	0	0	1	1	0	1	1	1	1	0	0	1	
27-Feb-2020	1	1	1	0	0	1	1	0	0	0	1	1	
28-Feb-2020	0	0	1	0	1	0	1	0	1	1	0	1	
29-Feb-2020	0	1	0	0	0	1	0	1	0	1	0	0	

Table 1 describes the specification of library visitor needs must be stated in clear technical terms to fulfill the analysis conducted by a librarian. The recapitulation of transaction data groups the types of categories of books that are borrowed the most to determine the pattern of borrowing certain books that are reprocessed in table 2 below:

Table 2. Book Borrowing Pattern

Day	General Books	Philosophy Psychology	Social Sciences	Pure Science	Applied Science	Literature	Fiction Collection	Reference
Day 1	General Books	Philosophy Psychology	Social Sciences	Pure Science	Applied Science	Literature	Fiction Collection	Reference
Day 2	General Books	Religion	Language	Pure Science	Literature	History	Fiction Collection	Reference
Day 3	Religion	Pure Science	Applied Science	Art	Literature	History	-	-
Day 4	Pure Science	Applied Science	Art	History	Fiction Collection	-	-	-
Day 5	Religion	Social Sciences	Language	Pure Science	Applied Science	Reference	-	-
Day 6	Social Sciences	Pure Science	Reference	-	-	-	-	-
Day 7	Philosophy Psychology	Religion	Language	Pure Science	Applied Science	Literature	Reference	-
Day 8	General Books	Philosophy Psychology	Religion	Applied Science	History	Fiction Collection	-	-
Day 9	Religion	Pure Science	History	Reference	-	-	-	-
Day 10	Pure Science	Applied Science	Literature	-	-	-	-	-
Day 11	Social Sciences	Language	Pure Science	Art	History	Fiction Collection	-	-
Day 12	Philosophy Psychology	Religion	Pure Science	Art	History	Reference	-	-
Day 13	General Books	Philosophy Psychology	Social Sciences	Language	Pure Science	Applied Science	Literature	History
Day 14	Religion	Social Sciences	Pure Science	Applied Science	Fiction Collection	Reference	-	-
Day 15	General Books	Philosophy Psychology	Religion	Pure Science	Applied Science	Fiction Collection	Reference	-
Day 16	Religion	Language	Applied Science	Literature	History	Reference	-	-
Day 17	Philosophy Psychology	Pure Science	Art	History	-	-	-	-

Table 2 describes the number of book borrowings made by library visitors, which will be used as data for the needs of the calculation process using the Apriori algorithm. This next stage is looking for a combination of items that meet the minimum requirements of the value of the support in the data. The settling based on the loan data category in Table 3 below is 1 item set. Here's one example of the calculation C1 with item set:

$$\text{Support}(Pu_Science) : \frac{15}{17} \rightarrow 88,24\%$$

And so until all categories support 1 item set.

Table 3. Support of each 1 item set

Book Category	Total	Support
General Books	5	29,41%
Philosophy Psychology	7	41,18%
Religion	10	58,82%
Social Sciences	6	35,29%
Language	6	35,29%
Pure Science	15	88,24%
Applied Science	11	64,71%
Art	6	35,29%
Literature	7	41,18%
History	12	70,59%
Fiction Collection	6	35,29%
Reference	9	52,94%

The process of formation of C2 with 2 item sets. Here's one example of calculation 2 item set (from table 2 pattern):

$$\text{Support}(PuScie_AppScie) : \frac{9}{17} \rightarrow 52,94\%$$

Table 4. Support of 2 item set

Book Category	Total	Support
Pure Science, Applied Science	9	52.94%
Pure Science, Religion	5	29.41%
Pure Science, History	8	47.06%
Pure Science, Reference	8	47.06%
Applied Science, Religion	7	41.18%
Applied Science, History	5	29.41%
Applied Science, Reference	6	35.29%
Religion, History	6	35.29%
Religion, Reference	9	52.94%
History, Reference	4	23.53%

Based on the combination of 2 item sets with minimum support, the combination of 2 item sets that meet the minimum support standard is the book category Pure | Applied Science and Religion | Reference with each support, i.e., 52,94 percent. After one of the patterns of borrowing

frequency can be identified and found, then look for associative rules that meet the minimum requirements for confidence by calculating the confidence of the associative rule $A \rightarrow B$. One example of the confidence value of the $A \rightarrow B$ rule is obtained as follows:

$$\text{Confidence}(PuScie_AppScie) : \frac{9}{15} \rightarrow 60\%$$

Table 5. Confidence 2 items

Book Category	Total	Confidence
Pure, Applied Science	9	60%
Pure Science, Religion	5	33,33%
Pure Science, History	8	53,33%
Pure Science, Reference	8	53,33%
Applied Science, Religion	7	46,67%
Applied Science, History	5	33,33%
Applied Science, Reference	6	40%
Religion, History	6	40%
Religion, Reference	9	60%
History, Reference	4	26,67%

Based on manual compute with association rule method from Table 5, the combination of 2 item sets with minimum support of 60 percent yields that the combination of 2 item sets meets the minimum standard of support [8], namely Pure | Applied Science and Religion | Reference classify with support each of 60 percent.

The evaluation stage from a calculation with the Association Rule method produces the best confidence value determined is 60 percent. Therefore, the belief that a value of 1 means the rule must have occurred for 17 days can be enforced, and each month must calculate a book placement pattern with the same technique. If library visitors during that period borrow books in the Pure Science, Applied Science category, the books collection of category arranged in the closest position or front of the library service gates in the one of next month.

CONCLUSION

Determining the pattern of placement books in the library can be done by applying Apriori algorithm with the Association Rule method. The determination of the pattern of book placement can be done by looking at the results of the tendency of visitors to borrow books based on a combination of 2 item sets. This technique is obtained based on the results of Apriori algorithm calculations. The system built can be arranged close to the book's placement to facilitate books that visitors will borrow.

Categories take in this study are the presence or absence of an amount that is only at least one transaction in the borrowing of the diary. Therefore, data sets in evaluating monthly trials should use one full month concern nowadays of daily transactions to produce evaluation results that can be used more accurately next month. The evaluation method can use software testing to make it easier for the user (librarian) to calculate this Apriori Algorithm method.

Hereinafter, proposed calculating can be done every beginning month of time even weekly transactions by future research. This evaluation to obtain the best book placement pattern so that it is easier for always visitors to find.

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A STUDY OF THE INFLUENCE OF 650 nm LASER INTERFERENCE ON VISIBLE LASER LIGHT COMMUNICATION SYSTEM

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ABSTRACT

Visible Laser Light Communication System (VLLC) is a wireless communication system, using laser as the medium. In the data transfer process, it is possible to have optical interference where 2 laser beams coincide with one point on the reflector. Research on the effect of laser source interference has been carried out by several researchers including mitigation actions to reduce its effects. This experiment uses 2 optical distance sensors that produce a laser with a wavelength of 650 nm with a power ≤ 4.1 mW and with the direction of the laser beam both of them cross each other. To determine the effect of the interference of two laser beams when crossing the communication process in the visible light communication system, a reflector is used which can capture the two laser beams and the reflector can be shifted gradually so that a condition can be obtained where the two laser beams meet at one point. From the measurements made at the points after the laser beam crossing, the measurements at the point where the beam crossed, and the measurements at the points before the beam crossing, it was obtained data, at the exact point where the laser beam crossed the interference occurred, which is indicated by unstable output voltage of the two lasers, so that communication at the point of intersection is disrupted. However, if outside the point of contact both before and after the point of contact, interference and communication systems will not occur.

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INTRODUCTION

The Visible Laser Light Communication System performs wireless communication, transferring data anywhere freely using a laser beam. This system is effective because it does not overcrowd the spectrum and is not regulated by the Government [1], [2], [3], [4], no electromagnetic radiation [5], [6], good security [5], low cost [6], and high signal power [7]. This system belongs to the visible light category which works in the 350nm to 750nm spectrum [1], [2], [5], [8], [9]. As with radio communications, this system has no overhead of processing different regulatory rules and is quite fast. The system is secure because intercepting transmission interrupts uses low power, communicating at 1.25 Gbps up to a distance of 6 Km. However, they need a Line of sight [1], [4], [10], [11] where the sender's receiver pair

can't be mobile. Communication is successful when the path is set accurately, and the transmitting receiving antenna is tilted properly. However, it is dangerous when living things are intensively exposed to laser light [10].

Optical interference is generated when two beams of the same laser source coincide. The intensity and phase of the relationship between these two beams create a pattern of light and dark areas. The phase difference between the two beams creates an interference pattern if it happens to occur at a distance lower than the coherence length [12].

Chen et al [13] conducted research on multi-cell VLC in an indoor area, which uses two LED sources to transfer information to the receiver. When the signal receiver is in the intersection area of several adjacent transmitter cells, the signal performance is greatly degraded

due to the effects of interference between cells which cannot be ignored in Multi-cell VLC systems. To minimize the influence of interference from the two LED sources, the researchers modified the receiver angle with a method called Angle Diversity Receiver (ADR) where the results can increase the SINR value from 3 dB increase to 8.6 dB compared to the same VLC system that uses a single element receiver without angle diversity. The illustration like shown in figure 1.

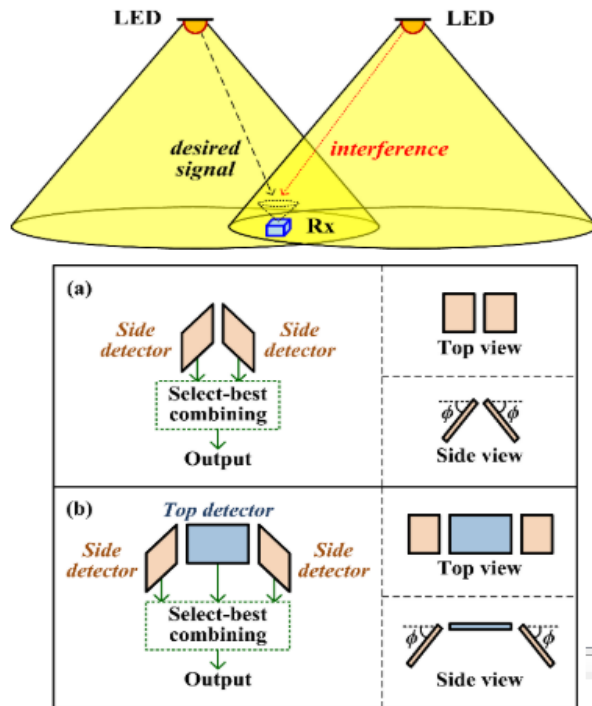


Figure 1. Illustration of Inter-Cell Interference in an Indoor Multi-cell VLC with Angle Diversity Receiver [13]

Hosney [14] conducted a study to reduce the effect of Co-Channel Interference (CCI) by optimizing the Field of View (FOV) and adjusting the tilt angle of the ADR and pyramidal, the results can reduce the influence of interference by designing ADR with a limited FOV angle to reduce the number of signals (Line of Sight) Disrupted LOS. The simulation results show that the optimum FOV is achieved for each ADR tilt angle. Also, an acceptable BER bit error rate can be achieved at the most disturbed position (centre of the room, and between the two LEDs) at an optimal tilt angle equal to 30°.

Serguey Odoulov et al [15] research on the effect of interference and laser holography with different colors using a femtosecond laser where the color are blue and green (fig.3).

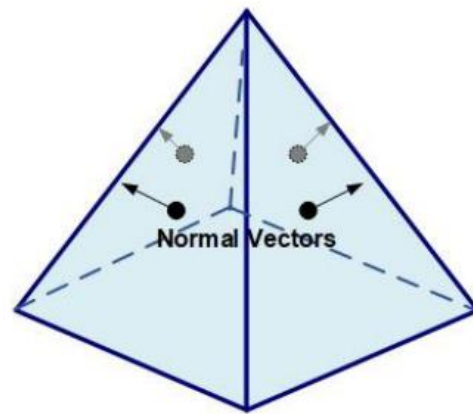


Figure 2. The Proposed ADR Receiver with PDs's Normal Vectors [14]

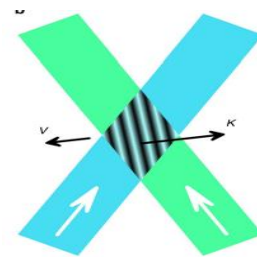


Figure 3. Interference and Holography in The Blue and Green Colors Femtosecond Laser [15]

From some existing research, it only describes the problem of interference from laser beams at the meeting point between 2 or more laser beams, does not explain whether there is an effect on the points located before or after the presence of these 2 crossing laser beams occurs.

This paper will discuss the experimental results to determine the effect of interference on the VLLC communication process if two red laser sources are made at a certain angle so that the two laser beams meet at one point on the reflector. The measurement of the effect of this interference is carried out in three areas, namely before the laser beam crossing occurs, right at the laser beam crossing point and the point after the laser beam crossing occurs. Section 2 will discuss the literature review which correlation with this research. Section 3, it is explained the research methodology carried out by the author to obtain data. Section 4 presents the data and analysis of the experimental results, and section 5 presents the conclusions from the results of this research.

RESEARCH METHOD

Material and Methods

In this study, the author uses an optical distance sensor O1D100 from IFM electronics where this sensor uses a 650 nm laser (Red colour, class 2 laser product), with a power of less than 4.1mW. This sensor is equipped with a transducer and amplifier so that it can convert the distance between the sensor and the reflector into an analogue voltage of 0-10 VDC or analogue direct current 4-20mA. The author uses these 2 lasers and makes the laser beams cross each other at a point.

This Optical Distance sensors haven a product characteristics and analogue type as shown in the following data (fig. 4, fig 5, fig 6):

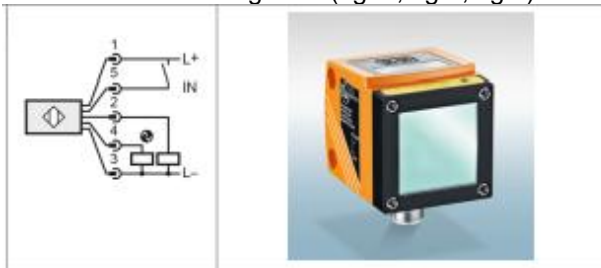


Figure 4. Optical Distance Sensor O1D100 [16]

Product Characteristic	
Photoelectric distance Sensor	
Visible laser light, protection class 2 laser	
4-digit alphanumeric display	
Measuring range 0.2... 10 m (Range referred to white paper 200 x 200 mm, 90% remission)	
Application	
Application [m]	0...19
Electrical data	
Electrical design	DC PNP
Operating voltage	18...30 VDC
Current Consumption	<150 mA
Output	
Current output	4...20mA according to IEC 61131.2
Max. load	250 Ohm
Voltage output	0...10 V according to IEC 61131.2
Remark	
Caution : Laser	
Power <=4.1 mW wavelength = 650nm	
pulse 1.3 ns	
Do not stare into beam	
Avoid exposure	
Class 2 laser product	
EN 60825-1:2003-10	

Figure 5. Product Characteristic of Optical Distance Sensor O1D100 [17]

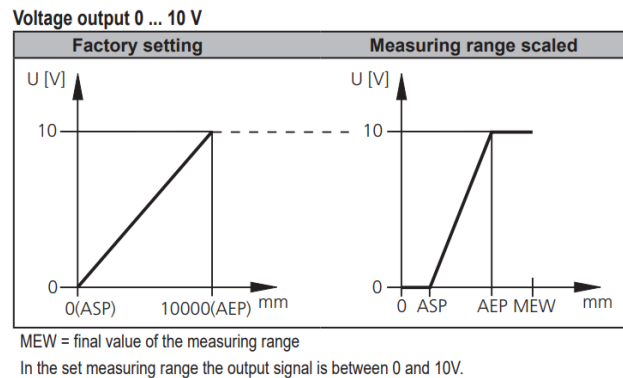


Figure 6. Analogue Output Characteristic of Optical Distance Sensor O1D100 [18]

For the reflector of this laser the author uses a book covered with white paper. The paper is equipped with a scale to read the distance between the points of the two lasers reflected on the reflector. The author measured the output voltage using a Fluke brand Voltmeter. The distance between the laser source and the reflector is read from the display on the distance display located on the sensor body. To turn on the sensor the author uses a 24 VDC Omron brand power supply.

The sequence of work is as follows: (fig. 7, fig. 8 and fig. 9). The sensor is supplied with a 24VDC voltage, then emits a laser beam. The distance between the two sensors is set to 100 mm, then made to form an angle so that the two laser beams intersect at a point Y. Each time data collection is complete, the reflector is shifted closer to the laser source so that the distance between the laser points is getting closer, then data is taken every time the reflector is shifted.

In this experiment the author uses two optical distance sensors that are capable of measuring distances by converting the output quantity in the form of a voltage of 0-10 volts or 4-20 mA depending on the settings of the device parameters.

This sensor emits a laser beam and if it hits an object or reflector, the sensor will read the distance between the sensor point and the reflector, which is shown on the sensor display. Analog output 0-10 V or 4-20 mA correlates with reflector point distance and can be measured using a Fluke digital Voltmeter.

The method of data collection is by measuring the value of X and then reading the distance L that is read, then measuring the output voltage on the sensor with a Voltmeter. The positive X distance is the distance between the laser points to the left of the Y point (the distance

after the lasers cross), while the negative X distance is the distance between the laser points to the right of Y (the distance between the laser points before crossing). The block diagram of the component arrangement for the experiment is as shown in figure 7.

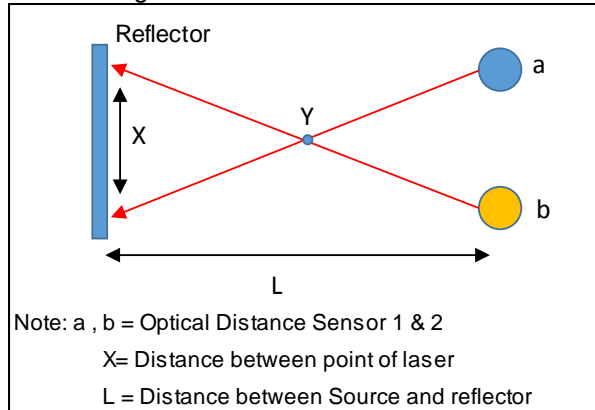


Figure 7. Block Diagram



Figure 8. Experiment Process

Table 1. Parameter Setting in Optical Distance sensor O1D100

Parameter	Setting range	Factory setting	Own setting
Uni	mm, m, inch	mm	mm
OU1	Hno, Hnc, Fno, Fnc	Hno	Hno
SP1	200...9999	1000	1000
nSP1	200...9999	800	800
FSP1	200...9999	1200	1200
OU2	Hno, Hnc, Fno, Fnc, I, U	I	U
SP2	200...9999	2000	2000
nSP2	200...9999	1800	1800
FSP2	200...9999	2200	2200
ASP	0...9999	0	200
AEP	0...9999	9999	670
rATE	1...50	50 Hz	50
dS1	0...0.1...5	0 s	0
dr1	0...0.1...5	0 s	0
dS2	0...0.1...5	0 s	0
dr2	0...0.1...5	0 s	0
dFo	0...0.1...0.2...0.5...1...2...5	0 s	0
diS	d1...3; rd1...3; OFF	d3	d3

Parameter settings on both sensors according to the table 1. In this table there are only 3 parameters that are changed, while the other parameters follow the factory settings. These parameters are OUT2 set to "U" which is the output voltage 0-10 VDC, the next parameter is "ASP" (Analog Start Point) which is the desired distance when the output is 0 VDC and the parameter "AEP" (Analog End Point) is a certain distance with the desired output. desired is 10 VDC[18]. For the settings in this experiment, ASP = 200, which means that when the distance between the sensor and the reflector is 200 mm, the sensor produces an output of 0 VDC and when the distance is 670 mm, the output is 10 VDC. The setting values for ASP and AEP can be reversed, for example ASP is greater than AEP so that the output voltage will also be reversed, when the short distance output is 10 Volts, and when the long distance is 0 volts.

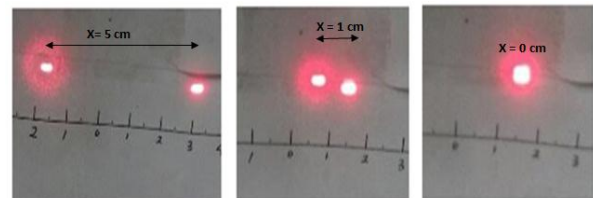


Figure 9. Experimental Results (distance between laser points on reflector=X)

RESULTS AND DISCUSSION

The table 2 shows the measurement data from the experimental results. X notation is the distance between the laser points on the reflector, L1 is the distance between the laser source on 1st sensor and the reflector, L2 is the distance between laser source 2nd sensor and the reflector. V1 and V2 are the output voltages measured at 1st sensor and 2nd sensor when showing a certain L and X distance.

When X indicates a distance of 110 mm, 1st sensor reads the distance between laser sources no 1 and its reflector as 535 mm, and 2nd sensor as 538 mm. The output that can be measured on 1st sensor is 7.03 volts while the output on 2nd sensor is 7.23 volts.

The reflector is then shifted closer to the laser source, so that the distance between the X laser points is also getting closer. The determination of the X value is made in such a way, so that data is obtained that can describe the condition of the distance between the laser beams, if the X value is positive, it means that the distance between the laser beams is measured after the laser beam crossing point, if the X value is negative, it means that the distance between

the laser beams is measured before the beam crossing point. When the laser point distance is $X = 110$ mm, $L_1 = 535$ mm, $L_2 = 538$, the output is $V_1 = 7.03$ Volt and $V_2 = 7.23$ and so on, until the laser point distance is $X = 10$ mm, $L_1 = 304$ mm, $L_2 = 310$, the output is $V_1 = 2.173$ Volt and $V_2 = 2.471$. Up to this data there is no disturbance in the sensor output reading value, meaning that from the first experimental data up to this point the sensor output reading can be done by reading with a Voltmeter. However, when the laser points of the two sensors are brought together (laser point 1st sensor and 2nd sensor meet in one point on the reflector ($X=0$) where a reflector at point Y) the display that shows the distance to the hunting sensor is moving continuously (unstable). The indication cannot be stable at a certain number, even reading from 100 to "FAR" (if the sensor reads FAR, it means that the sensor reads the distance beyond its farthest reading capability, which is 9999 mm.) because reading the distance is unstable, the output voltage cannot be read either (at table filled with "error"). After the reflector passes through Y, the reading returns to normal. Detail of data measurement shown in the table 2.

Table 2. Data Measurement

X (mm)	L1 (mm)	L2 (mm)	V1 (Volt)	V2 (Volt)
110	535	538	7,03	7,23
90	488	489	6,063	6,442
70	432	438	4,92	5,132
35	361	368	3,36	3,592
10	304	310	2,173	2,471
0	270	279	error	error
-10	242	251	0,916	1,446
-40	172	184	0,415	0,45

From the table 2, for more details, it is presented in graphical form as Figure 10. From the graph it can be seen that the output voltage (V_1 & V_2) is directly proportional to the distance between the sensor and the reflector (L_1 & L_2) as long as there is no laser beam crushing on the reflector ($X=0$). When $X = 0$ the output voltage is unstable so it is difficult to determine the amount, and the author fills it with the value "error". This shows that interference occurs when the laser beams coincide at one point on the reflector because the laser beam used in this experiment cannot be seen in its line of light, but can only be seen at the end point on the reflector.

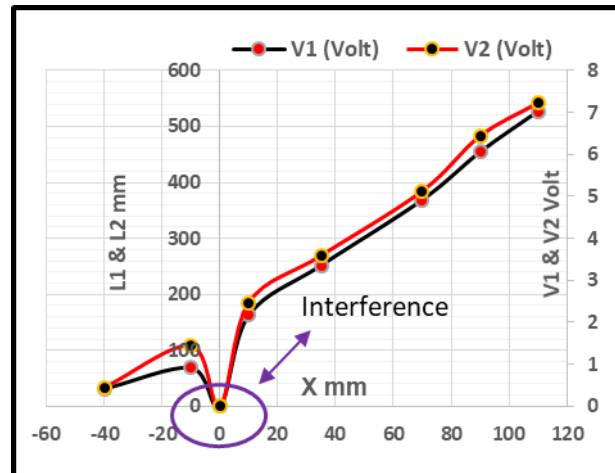


Figure 10. Graph of interference

CONCLUSION

Interference occurs when the laser point on the reflector coincides with a laser point from another source. Whereas if the point does not coincide with one point on the reflector, even if a straight line is drawn, the paths actually intersect, there is no interference. This can be used as one of the things that must be considered when laser light is used for communication systems (Visible Laser Light Communication). This means that when using VLLC, even using multiple lasers and the laser beams touching each other will not interfere with the communication process if the recipient of the information is not at the point of contact of the laser.

The author suggests that if you want to know in more detail how much interference is and how the condition of the output voltage when interference occurs, use more complete measuring equipment such as an oscilloscope, so that the graph / chart can be seen in real time.

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