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Developing Website-Based Logistic Models with Migration Factors for Population Prediction

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The need for public information increases as information technology, such as internet, develops. Internet is a tool that is used to access information through a website. The SISIK Website is a site used to calculate the population prediction in a region at a certain time. The aims of this research is to apply the website-based logistic model with migration factors as the function of the population in predicting a population in a region. The SISIK Website was developed by using waterfall software development method which covers the analysing, designing, implementing, testing, maintaining, and documenting phase. The modelling technique described from this research is Unified Modelling Language (UML). The results of this website are prediction reports on population in a region which can be a solution for policy makers like government or entrepreneurs to determine the relevant decisions for certain aspects such as the population, economy, education, as well as social and cultural aspects.

Key words: *Reports, population, prediction, waterfall, website.*

Introduction

One benefit of using the Internet is that it can be used to access the public information through the governments website. Based on Article No. 18 Year 2008 on the Disclosure of Public Information Act, the rights to information are very important, so that the state administration is more accessible and can be held accountable for public scrutiny. Therefore, in an effort to maximalise the disclosure of information to public, it is necessary to develop an official Indonesian government website which promotes the use of information technology.

Websites are a site that contain services related to online information which facilitates the communication with the website owner and the user. People can use websites as the source of information that can be accessed quickly. (Deema & Jawad, 2018).

The SISIK Website (Population Predicting Website) is a site that contains the online information on population prediction in a region. The SISIK website can be a solution for the society to acquire data on population prediction in a region accurately and quickly. Furthermore, this website can also become a solution for the government during policy making that is related to the population, economy, education, social and cultural aspects that relevant with the region, all by knowing the prediction of the population (Hsiao, et al., 2017).

Population prediction in the SISIK website can be completed with a mathematical model. As the number of the population is affected not only by aspects of fertility and mortality factors like the usual logistic model (Edwards & Penney, 2008), but it is also affected by migration factors (Borelli & Coleman, 1987), the mathematical model is used in predicting the number of the population is the modified logistic model with migration factors as function of population (Fransisca & Marbun, 2018).

In developing the SISIK website that requires data to ease the developing process, this research is conducted on a village named Purwanegara in North Purwokerto subdistrict, Banyumas district. This village was chosen due to its growing economy, its location in the city centre and also the number of universities, thus leaving the village as a temporary place to live. One of the universities in the Purwanegara village is Jenderal Soedirman University. Based on this explanation, the researchers are interested in applying the development of website-based logistic models with the migration factors in population predictions (a case study of population prediction in Purwanegara, Banyumas district).

Population

Population, according to (Lynn , et al., 2015), can be said statistically as a measure used to describe a unit of either the population or an institution. The number of population in a region can be increased or decreased due to several factors such as: fertility, mortality and migration (Harper, 2016). The fertility rate is the number of babies that survived infancy from 1 woman, while the mortality rate is the loss of life permanently. The other factor is migration, which consists of immigration; the immigration of people into a region and emigration; the migration of people out of a region.

Logistic Model with Migration Factor

The modified logistic model has been studied by the researchers, like the logistic model for the heterogenous population (Wang, McCue, & Simpson, 2018), modified logistic model for grouping binary data (Sun, Nguyen , Luan, & Jiang, 2018). However, the logistic models can be modified by adding the migration factor (Borelli and Coleman, 1987).

$$\frac{dP}{dt} = rP\left(1-\frac{P}{K}\right)+Q. \qquad (1)$$

Where P is a number of population in a region, r is the rate of population growth, K is the capacity in a region, Q is the migration factor. The migration factor is calculated in the logistic model that can be a constant value or a particular function. The certain function in migration factor can be a function of time and function of population. Modified logistic models with the migration factors as the constant function has been studied by (Rakhim, 2015) and modified by the logistic model with migration factors as the functions of population which have been studied by (Fransisca & Marbun, 2018).

The modified logistic model with the migration factor and functions of the population is a model developed by substituting the Q factor in the equation (1) with a function (Fransisca & Marbun, 2018) below.

$$Q = \frac{(\alpha-\beta)P^2}{K}. \qquad (2)$$

Where $(\alpha-\beta)$ is the migration rate in a region. If Q in equation (2) is substituted into equation (1), a logistic model with migration factor as function of population is obtained as follows,

$$\frac{dP}{dt} = rP\left(1-\frac{P}{K}\right)+\frac{(\alpha-\beta)P^2}{K}. \qquad (3)$$

With an average prediction error rate of 2,979% (less than 5%). This model has two solutions:

1. If $r > (\alpha - \beta)$, then the solution of logistic model with migration factor as functions of population is

$$P = \frac{P_0 K}{\left[\frac{P_0(r-(\alpha-\beta))\left(1-e^{r(t_0-t)}\right)}{r}+K\left(e^{r(t_0-t)}\right)\right]}. \qquad (4)$$

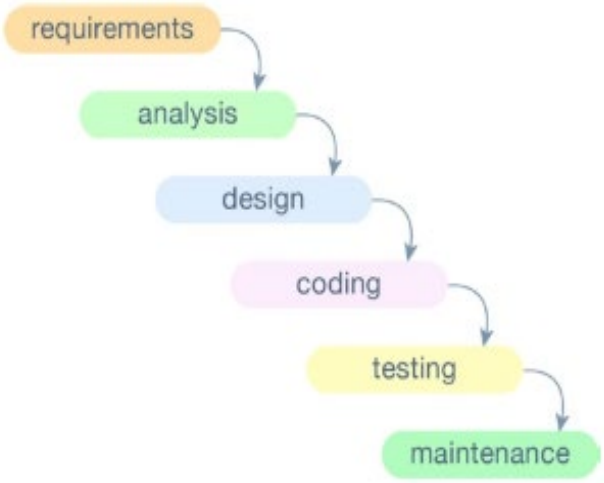
2. If $r < (\alpha - \beta)$, then the solution of logistic model with migration factor as functions of population is

$$P = \frac{P_0 K}{\left[\frac{-P_0(r-(\alpha-\beta))\left(1-e^{r(t_0-t)}\right)}{r}+K\left(e^{r(t_0-t)}\right)\right]}. \qquad (5)$$

Waterfall Method

In order to ease the software development, it requires the developmental steps called the method. The development of the SISIK website used the Waterfall method to facilitate the development of the population prediction systems. The Waterfall method is the sequential steps in the software (Filipova & Vilão, 2018). Below are the steps that must be done in developing the software by using waterfall method:

Picture 1. Steps of Waterfall Development Model



- Requirement:

Is a process of collecting the data and the user's needs, either primary or secondary.

- Analysis:

Analysis is a process of collecting the needs as required by the systems users. The needs collected will be met by creating the system.

- Design:

Software design is the collection of steps that focus on making the design for the software program including data structures, software architecture, software interface and implementation procedures. This step can be said as a step to convert the user's needs into a technical specifications so that it is easy to implement.

- Implementation:

The user's needs that have been converted into technical specifications must be implemented so that the software can be created.

- Testing:

The software created must be tested first before it is launched in order to reduce the possibility of errors in the software and to ensure that the software meets with what the user wants. The testing step is done logically and functionally.

- Maintenance:

Although the software has been tested, it does not close any possibility of errors or changes when it is used by the user. This step focuses on the software maintenance without having to create a new software.

Result and Discussion

Software Requirements

The softwares used in developing SISIK website are:

Table 1: Software Requirements

Name	*Type*
Operational System	Windows 10 Professional
Applications	Visual Studio Code, Microsoft Office 2019, Navicat Premium, XAMPP v3.2.1, Google Chrome, Corel Draw, Microsoft Visio, SPSS 25.

Hardware Requirements

The hardwares used in developing SISIK website are the ones with specifications below:

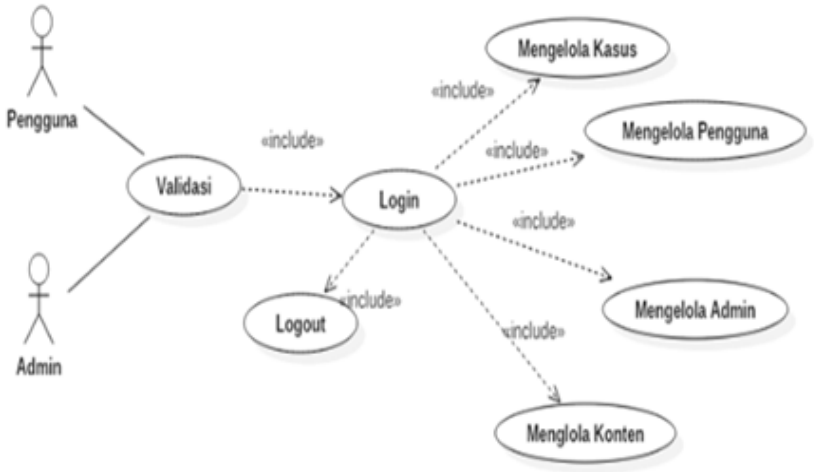
Table 2: Hardware Requirements

Name	*Type*
Processor	Intel(R) Core(TM) i7-6700HQ
Memory	16 GB DDR4
Harddisk	1000 GB HDD + 256 GB SSD
Display	15,6”
Printer	Canon MP287

Use Case Diagram of SISIK Website

In developing the system, the user’s needs will be be defined into technical needs using UML (Unified Modelling Language) consisting of diagrams (S & M, 2015). Use Case is a type of modelling used to describe the interaction model from the actor or system user with the system itself. Use Case is capable in finding out the website functionality (Adamu & Zainon, 2017). The SISIK website has two actors; the user and admin. Before these two actors login to the system, validation is done to find out whether the actors login as the user or admin. Then, the admin or user is able to communicate with the system based on the access rights they have. Below is the illustration of the interaction between the SISIK website and the involved actors:

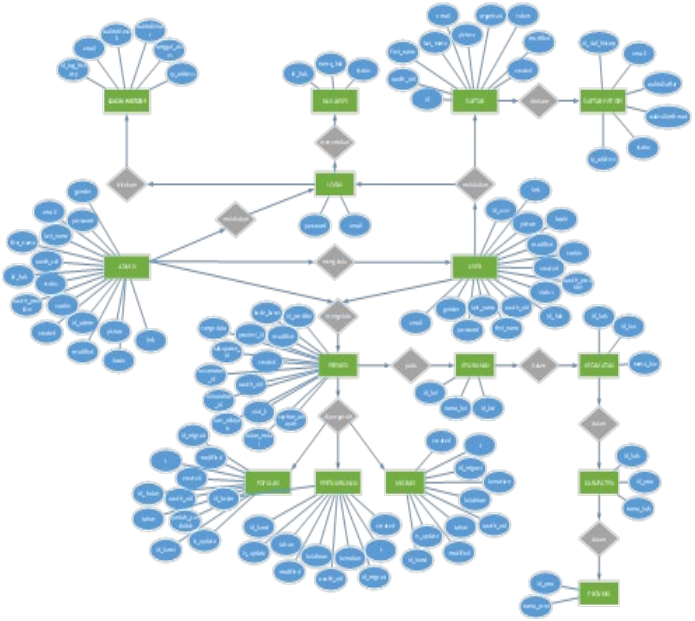
Picture 1. Use case diagram of SISIK website.



Entity Relation Diagram of SISIK Website

The SISIK website requires data management or databases (Filipova & Vilão, 2018) to save the data related with the prediction, users, and any other data such as names of villages, sub-districts, districts, and provinces in Indonesia. The database is a storage area used to save the information or data on a particular company, organization or institution. Below is the ERD which describes the database implementation from SISIK website:

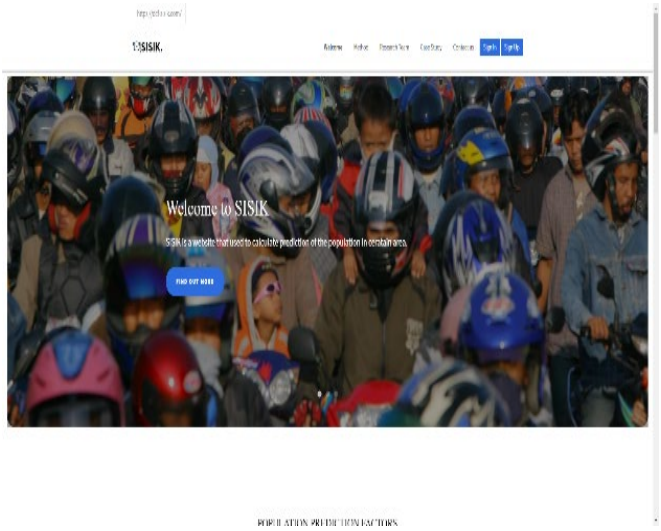
Picture 2. Entity relation diagram of SISIK website



Interface Implementation

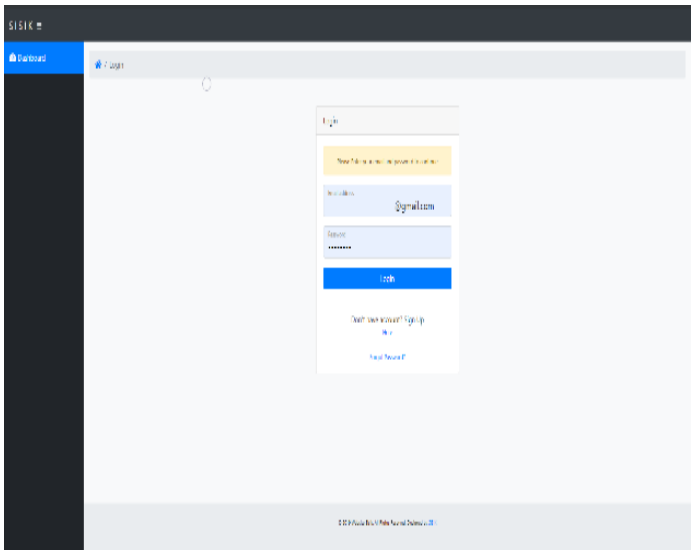
a) Front Page

Picture 3. Front page of SISIK website



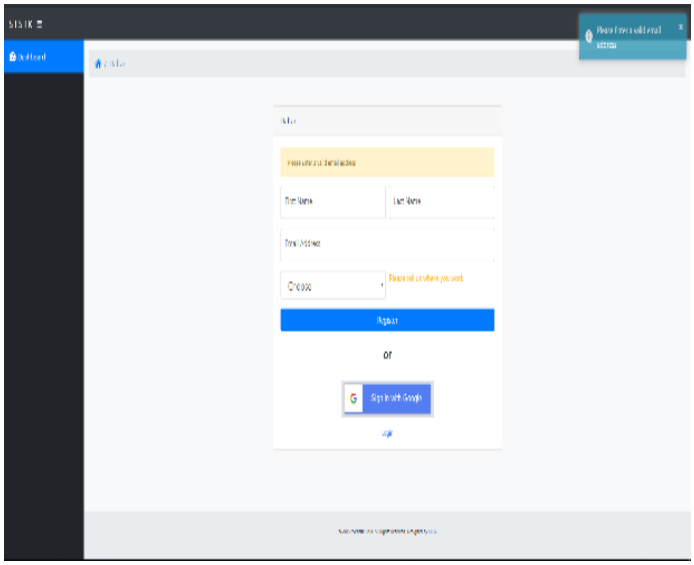
b) Login Page

Picture 4. Login page of SISIK website



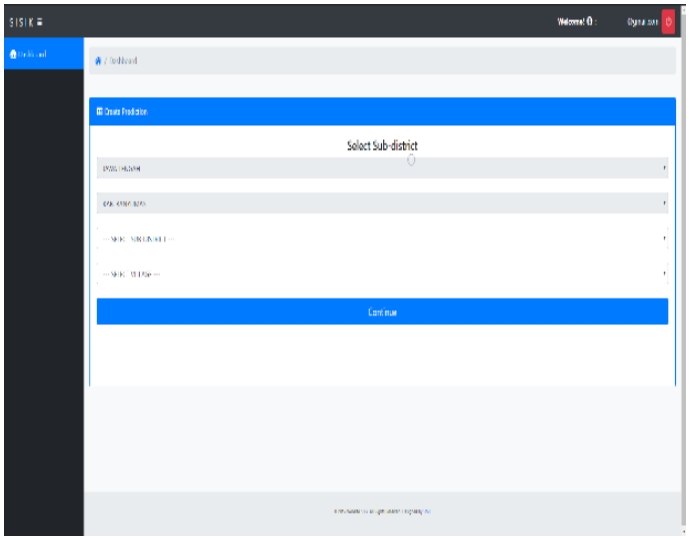
C) Register Page

Picture 5. Register page of SISIK website



d) Prediction Making Page

Picture 6. Start page of the SISIK website for the population prediction making

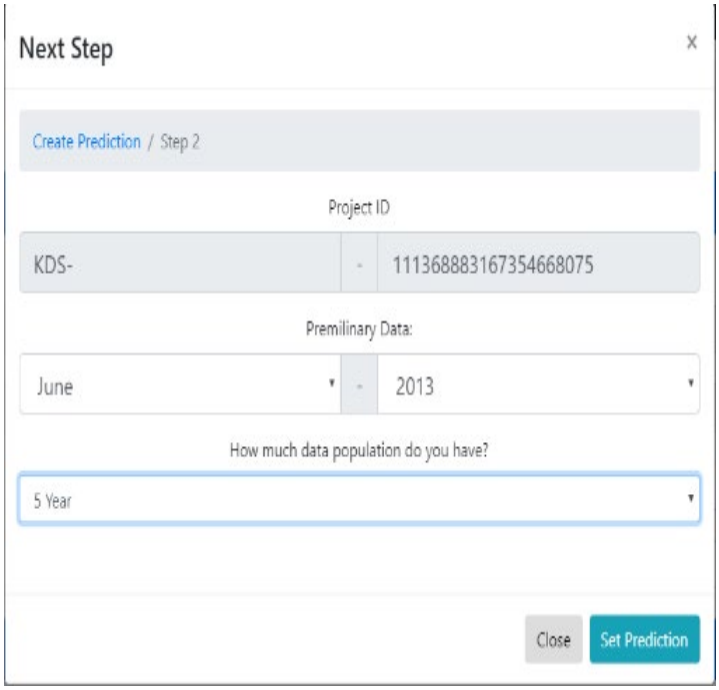


e) Region-width input Page

Picture 7. Region-width input page for population prediction making

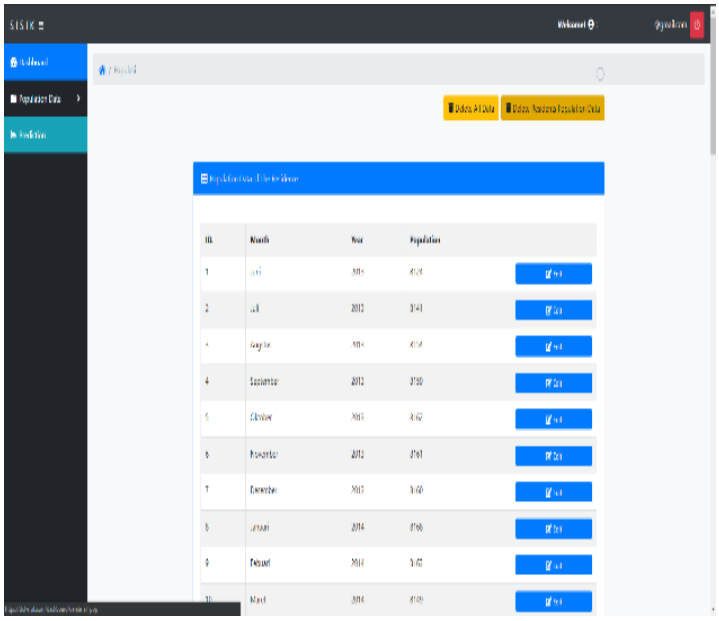
f) Data Range Input Page

Picture 8. Choosing the data range page for population prediction making



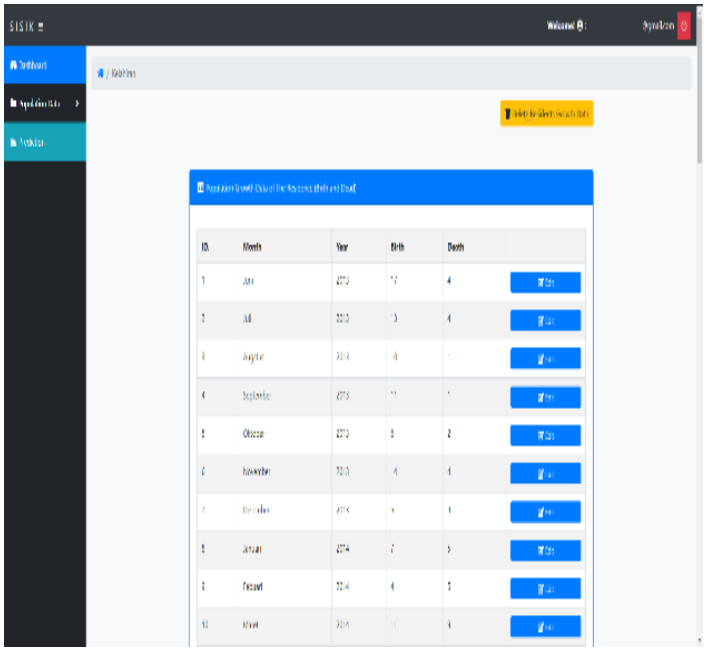
g) Population Input Page

Picture 9. The population input page



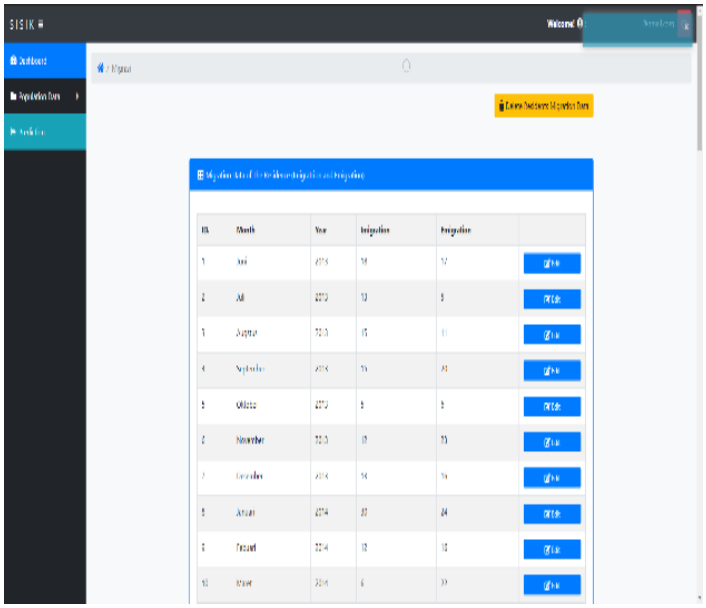
h) Population Growth Input Page

Picture 10. Population growth input page (fertility and mortality)



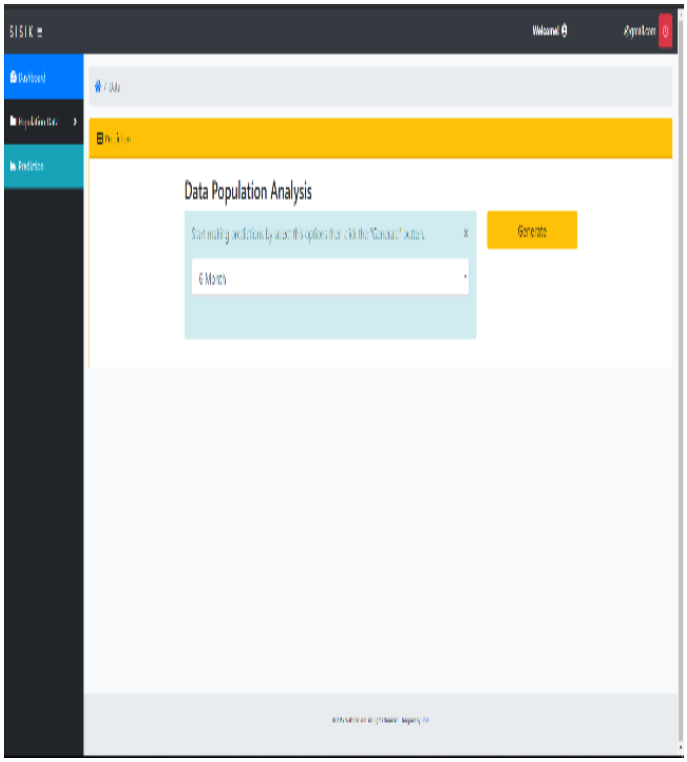
i) Migration Data Input Page

Picture 11. Migration data input page (immigration or emmigration))



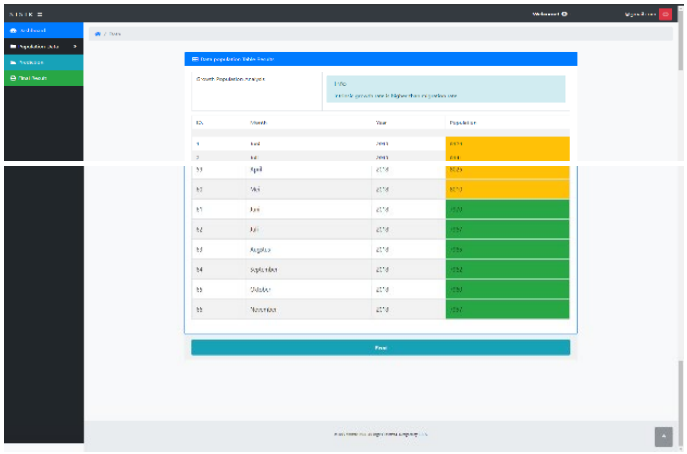
j) Range Prediction Page

Picture 12. Selecting the prediction month page



k) Prediction Result Page

Picture 13. Result of population prediction page



Unit Testing

Unit system testing is the series of tests on small parts of the system or functions (Dooley , 2017), which aim to find out whether the programs are able to give the expected results without regard to the structure of program code (Filipova & Vilão, 2018). Below is the unit testing result of login process for population prediction by using the logistic model with migration factor:

Table 3: Unit testing result of login process

No	*Test Case*	*Input*	*Output*	Result
1.	Email column, Password column, Login Key	Email column : *Null* Password column : *Null*	Warning message appeared: *error.*	Succeed
2.	Email column, Password column, Login Key	Email column: *admin* Password column: *Null*	Warning message appeared: *error*	Succeed.
3.	Email column, Password column, Login Key	Email column: *Null* Password column: *pass1234*	Warning message appeared: *error*	Succeed
4.	Email column, Password column, Login Key	Email column: *email@email.com* Password column: *admin*	Warning message appeared: *error*	Succeed

5.	Email column, Password column, Login Key	Email column: *bukanemail@email.com* Password column: 1234	Warning message appeared: *error*	Succeed
6.	Email column, Password column, Login Key	Email column: *email@email.com* Password column: *pass1234*	Entering the front page for admin.	Succeed

Conclusion

Based on the results of the website-based population prediction system, it can be concluded that:

a. The design of this population prediction system uses the waterfall system development method, which undergoes five steps such as analyzing, designing, implementing, testing, and maintaining steps.
b. The function of the web system for the population prediction application is to calculate the population prediction in a region on demand.
c. This website can help the government and entrepreneurs make relevant policies, which will relevant with the problems in a region.

REFERENCES

Adamu, A., & Zainon, W. M. (2017). Multiview Similarity Assessment Technique of UML Diagrams . 311–318.

Borelli, R., & Coleman, C. (1987). *Differential Equation, A Modelling Approach.* New Jersey: Prentice-Hall Inc.

Deema, A., & Jawad, B. (2018). Similarity Calculation Framework for Heterogeneous Multimedia Web. *Journal of Information Technology and Software Engineering, 8*(2). doi:10.4172/2175-7866.1000227

Dooley , J. F. (2017). *Software Development, Design and Coding.* New York: Springer Science+Business Media New York.

Edwards, C., & Penney, D. (2008). *Elementary Differential Equations, Sixth Edition.* New Jersey: Prentice-Hall Inc.

Filipova , O., & Vilão, R. (2018). *Software Development From A to Z.* New York: Springer Science+Business Media .

Fransisca, D. C., & Marbun, P. (2018). Population of Purwanegara vilaage, Indonesia using model logistic with migration factor. *International Journal of Enginering and Technology*, 1962-1969.

Harper, S. (2016). *How Population Change Will Transform Our World.* New York: Oxford University Press .

Lynn , P., Terrera, G. M., Hardy , R., O'Muircheartaigh , C., Skinner , C., & Lehtonen, R. (2015). Population sampling in longitudinal surveys. *Longitudinal and Life Course Studies*. doi: 10.14301/llcs.v6i4.345

Prahono, A., & Elidjen. (2017). Evaluating the Implementation of Public Information Disclosure on the Official Website of Indonesian Ministries . *Computer Science*, 54-60.

Rakhim, A. A. (2015). *Model Logistik dengan Migrasi dan Aplikasinya pada Data Penduduk Kelurahan Purwanegara Kecamatan Purwokerto Utara.* Universitas Jendral Soedirman.

S, K., & M, P. (2015). A semi-automated approach to adapt activity diagrams for new use cases. *Information and Software, 57*.

Sun, H., Nguyen , T., Luan, Y., & Jiang, J. (2018). Classified Mixed Logistic Model Prediction. *Journal of Multivariate Analysis, 168*, 63-74.

Wang, J., McCue, S. W., & Simpson, J. (2018). Extended Logistic Growth Model For Heterogeneus Population. *Journal of Theoretical Biology, 445*, 51-61.

Hsiao, C. M., Zhang, W. F., Chiu, C. C., Huang, J. C., & Huang, Y. L. (2017). The Enterprise Risk Management of Foreign Exchange Exposures: Evidence from Taiwanese Hospitality Industry. Asian Journal of Economics and Empirical Research, 4(1), 32-48.