



Design of Vaccine Distribution Mapping using Geographic Information System

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ABSTRACTS

The Indonesian government is moving quickly to provide vaccines to reduce the spread of Covid-19. The difficulty in determining the distribution of this vaccine is the Ministry of Health's problem to see which areas have been vaccinated and which have not. Therefore, this study aims to design an information system model for mapping vaccine distribution using Geographical Information Systems (GIS). For this reason, this study seeks to map the distribution of vaccines in Indonesia, particularly parts of West Java Province, which indicate the location of vaccinations to the public. The method used was a descriptive method consisting of formulating the problem, determining goals, and determining boundaries. Data obtained by interviewing and asking informants about the research topic. The system has a map tip feature to find out information from each coordinate point. Each coordinate can display the coordinate information of the area that received the vaccine distribution with accurate distribution location information. The results of this study are used to show the measurements for community vaccination.

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1. INTRODUCTION

At the end of March 2020, the global number of confirmed Covid-19 cases was around 441,000 and had caused about 20,000 deaths in 172 countries/territories [1]. The government has appealed to work from their respective homes to minimize the spread of the virus. However, loosening the lockdown is necessary to sustain employment and social life until an appropriate, workable vaccine is developed [2]. The belief related to vaccines also has not been the basis of society in general. This history shows that public confidence in vaccines and immunization programs is varied and specific [3]. People may have strong preferences for a vaccine to be highly effective, and a vaccine with a low effectiveness estimate could impact people's willingness to be vaccinated. High vaccination coverage globally may be required to stop the Covid-19 pandemic. Indonesia is a middle-income country with relatively low vaccine coverage and a lack of confidence in vaccines [4]. Dealing with recovery, strategies, and approaches requires government information about the virus's potential causes in implementing the vaccination program [5].

GIS is useful for defining different model types. GIS can also be used to analyze data for manufacturing models [6]. Therefore, a geographic information system approach to government is essential to assess the situation and needs as well as guide the policy decisions [7]. To assist this role, the government determining the optimal policy requires an information system media made by the Covid-19 information center accessible to the broader community [8].

West Java residents have difficulty finding places for vaccination distribution because they still use the table containing the places' names [9]. Vaccine distribution mapping needs to be done to make it easier for the public to vaccinate using the Geographic Information System (GIS). GIS mapping of vaccine distribution in West Java can be used as scientific data for various parties, both government and society [10].

This study aimed to provide a design for an information system for mapping vaccine distribution in West Java. The research method used in this research was descriptive analysis—meanwhile, the information system design process used the prototype method. The results show that the mapping of information systems' distribution could provide information on vaccines' existence for West Java people.

2. METHOD

In system development, object-oriented development methods were used using prototype development methods. This study's design produced the grand design for further development by adjusting to the needs and uses. The following is an overview of the prototyping method used in this study shows in Figure 1.

The Prototyping Method stages in Figure 1 are as follows: (1) Planning collects all data that the system will use were filtered whether it meets the system requirements. (2) Create Prototype, after the data was collected, a prototype was immediately made in detail. (3) Test Prototype, after the prototype was made, the system developer would ask the user

to test the system after asking for opinions that need to be improved. At this stage, it can be seen whether our system is suitable or should be improved for the better. (4) Improving Prototype, if the prototype is specific and ready for user needs, a sustainable information system would be developed so that the display is more attractive and practical. In this research, the authors conducted two stages i.e., planning and creating the prototype.

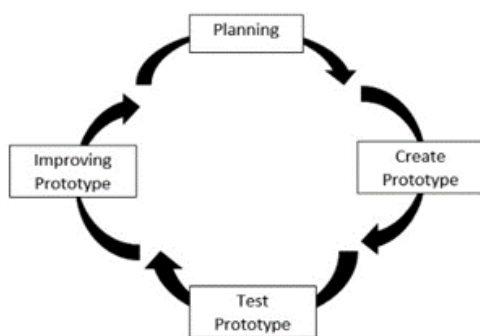


Figure 1. Prototyping Method

3. RESULTS AND DISCUSSION

3.1. Design Planning

In the planning stage, we applied Use Case Diagram. This design is used by two actors, namely Admin and Public User, to display each actor's duties and their role in the information system being built. Figure 2 shows Use Case Diagram in each actor's responsibilities. The Admin is in charge of preparing and entering the necessary data, including hospital addresses and vaccine availability. Meanwhile, Public Users search for hospital information, disseminate information and download maps. (Nolte, *et al.*, 2020).

In the design of application for vaccine distribution, spatial analysis is an important thing. The spatial analysis can be done by looking at the distribution of

Covid-19 with a GIS, which shows that actors in the public health sector are the center of information [11].

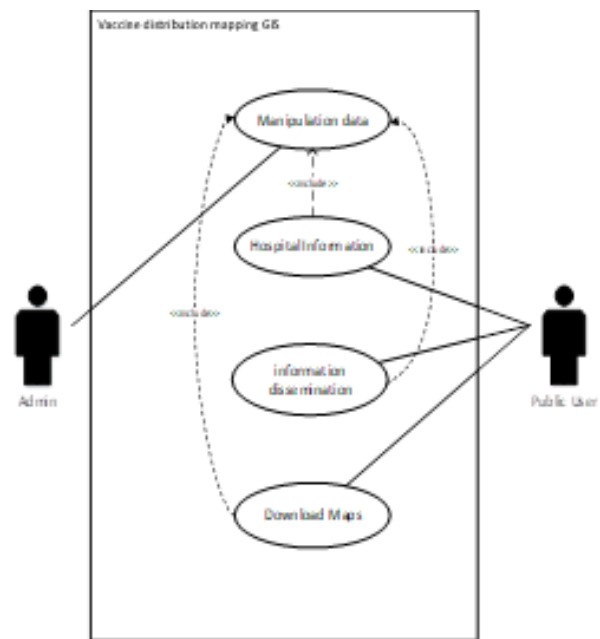


Figure 2. Use Case Diagram

3.2. Creating Prototype by User Interface Design

The application of ArcGIS is used to simplify and accommodate various needs in the management of natural resources and the environment. Figure 3 presents the ArcGIS Earth page's main view for vaccine mapping in the West Java region. This main page view can be accessed by everyone and can see a map of vaccine distribution mapping, especially in the West Java region. The function is to navigate the map that the user will access by clicking, holding, and dragging to find the desired map on this map. ArcGIS Earth provides situational awareness on desktops devices to make better decisions, especially to find the location of the Covid-19 vaccine in West Java. At this stage, data accuracy is essential. In designing public health management planning, data accuracy is needed. One of

the pieces of information required is distribution data based on disease [12].



Figure 3. Homepage ArcGIS.

Geographical coordinates are used for a point on earth based on latitude and longitude. Latitude is a horizontal line measuring the angle between a point and the equator. The point north of the equator is North Latitude, while south of the equator is called South Latitude. Longitude is a vertical measurement that measures the angle between a point and zero on earth. Figure 4 on the map view

serves to display coordinate points on the map and the information available when choosing according to the direction of the point the user wants, especially on the map of the distribution of the Covid-19 vaccine in the West Java region. In developing a GIS-based application for vaccine distribution, other considerations need to be considered. The use of GIS-based applications has been successful for vaccines for pneumonia. The environment and infrastructure need to be considered in the GIS application for vaccine distribution, as has been done for the pneumonia vaccine [13]. In dealing with the spread of the Covid-19, big data has been tried. This big-data technique is used for spatial-based decision-making [14-16].



Figure 4. Coordinate Point Page ArcGIS.

Figure 5 shows vaccine distribution mapping, displaying hospital data and information about vaccines in West Java.

Vaccine distribution mapping can help the community to get information about vaccine availability in West Java. Therefore, people do not need to ask the

hospital, they can find the information at any time instead.



Figure 5. Mapping Results ArcGIS.

4. CONCLUSION

The conclusion of this vaccine distribution mapping design is presented to users to easily find out the location of the spread of the Covid-19 vaccine in hospitals in West Java. This mapping design can serve as an initial model for

the government. This mapping uses the ArcGIS Earth software.

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REFERENCES

- Deximo, R. T., & Lucero, E. G. (2021). Perceived social responsibility and vaccine hesitancy among parents of grade 12 student in laboratory high school. *Indonesian Journal of Community and Special Needs Education*, 1(1), 25-30.
- Ebener, S., Guerra-Arias, M., Campbell, J., Tatem, A. J., Moran, A. C., Amoako Johnson, F., ... & Matthews, Z. (2015). The geography of maternal and newborn health: the state of the art. *International journal of health geographics*, 14, 1-10. DOI 10.1186/s12942-015-0012-x
- Franch-Pardo, I., Napoletano, B. M., Rosete-Verges, F., & Billa, L. (2020). Spatial analysis and GIS in the study of COVID-19. A review. *Science of the total environment*, 739, 140033. <https://doi.org/10.1016/j.scitotenv.2020.140033>
- Hadiana, A. I. (2020). Fog Computing Architecture for Indoor Disaster Management. *International Journal of Informatics, Information System and Computer*

- Engineering (INJIISCOM), 1(1), 79-90.
<https://doi.org/10.34010/injiiscom.v1i1.4022>
- Harapan, H., Wagner, A. L., Yufika, A., Winardi, W., Anwar, S., Gan, A. K., ... & Mudatsir, M. (2020). Acceptance of a COVID-19 vaccine in Southeast Asia: a cross-sectional study in Indonesia. *Frontiers in public health*, 8, 381.
<http://doi.org/10.6084/m9.figshare.12477143>
- Izmaniar, H., Mahyudin, I., Agusliani, E., & Ahmadi, A. (2018). The Business Prospect of Climbing Perch Fish Farming with Biofloc Technology at De'Papuyu Farm Banjarbaru. *The Business Prospect of Climbing Perch Fish Farming with Biofloc Technology at De'Papuyu Farm Banjarbaru*, 3.
<http://dx.doi.org/10.22161/ijeab/3.3.55>
- Khashoggi, B. F., & Murad, A. (2020). Issues of healthcare planning and GIS: a review. *ISPRS International Journal of Geo-Information*, 9(6), 352.
<https://doi.org/10.3390/ijgi9060352>
- Kusrini, E., Cindelas, S., & Prasetio, AB (2015). Development of Local Koi (*Cyprinus carpio*) Ornamental Fish Cultivation at the Depok Research and Development Center for Ornamental Fish Cultivation. *Aquaculture Media*, 10(2), 71-78.
- Larson, H. J., Clarke, R. M., Jarrett, C., Eckersberger, E., Levine, Z., Schulz, W. S., & Paterson, P. (2018). Measuring trust in vaccination: A systematic review. *Human vaccines & immunotherapeutics*, 14(7), 1599-1609.
<https://doi.org/10.1080/21645515.2018.1459252>
- Parry, M. (2018). The Future of Science Parks and Areas of Innovation: Science and Technology Parks Shaping the Future. *World Technopolis Review*, 7(1), 44-58.
<https://doi.org/10.7165/wtr18a0430.18>
- Rahman, A., & Mansyur, A. (2016). The suitability of water use for the development of aquaculture in the staring bay area of southern Konawe. *Journal of Fisheries Business*, 3(1), 31-38.
- Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 13 of 2019 concerning the Master Plan for the Development of National Science and Technology Areas for 2015-2030.
- Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 25 of 2019 concerning Governance for the Implementation of Science and Technology Areas.
- Rosales-Mendoza, S., Márquez-Escobar, V. A., González-Ortega, O., Nieto-Gómez, R., & Arévalo-Villalobos, J. I. (2020). What does plant-based vaccine technology

- offer to the fight against COVID-19?. *Vaccines*, 8(2), 183. <https://doi.org/10.3390/vaccines8020183>
- Sari, NM, & Retnaningsih, E. (2020). Science Techno Park Development Strategy Through Innovation Ecosystems In The Order Of Increasing The Competitiveness Of The South Sumatra Province. *Applied Research and Policy Publications*, 3(1), 1-20.
- Shervani, Z., Khan, I., Khan, T., & Qazi, U. Y. (2020). COVID-19 vaccine. *Advances in Infectious Diseases*, 10(03), 195. <https://doi.org/10.4236/aid.2020.103020>
- Sort, JC, & Nielsen, C. (2018). Using the business model canvas to improve investment processes *Journal of Research in Marketing and Entrepreneurship*. <https://doi.org/10.1108/JRME-11-2016-0048>
- Shiferaw, A. M., Zegeye, D. T., Assefa, S., & Yenit, M. K. (2017). Routine health information system utilization and factors associated thereof among health workers at government health institutions in East Gojjam Zone, Northwest Ethiopia. *BMC medical informatics and decision making*, 17, 1-9. DOI 10.1186/s12911-017-0509-2
- Supardan, D. (2019). Pemetaan Distribusi Vektor Virus Dengue di Kota Mataram Berbasis Geographic Information Systems (GIS). *Celebes Biodiversitas*, 2(2), 32-41.
- Suwantika, A. A., Boersma, C., & Postma, M. J. (2020). The potential impact of COVID-19 pandemic on the immunization performance in Indonesia. *Expert Review of Vaccines*, 19(8), 687-690. <https://doi.org/10.1080/14760584.2020.1800461>
- Tail9.com. (2021, 25 July), 5 Important Tools to Keep Koi Healthy. Accessed 25 July 2021.
- Tanskanen, A., Nillos, L. T., Lehtinen, A., Nohynek, H., Sanvictores, D. H. M., Simões, E. A., ... & ARIVAC Consortium. (2012). Geographic Information System and tools of spatial analysis in a pneumococcal vaccine trial. *BMC research notes*, 5, 1-9.
- Tarife, R. P., Tahud, A. P., Gulben, E. J. G., Macalisang, H. A. R. C. P., & Ignacio, M. T. T. (2017). Application of geographic information system (GIS) in hydropower resource assessment: A case study in Misamis Occidental, Philippines. *Int. J. Environ. Sci. Dev*, 8(7), 507-511.
- Triyani, E. (2020). Sistem Informasi Geografis Peta Sebaran Data Penyembuhan Covid-19 Daerah Kecamatan Ciampea. *PKM Maju UDA*, 1(2), 56-64. <http://dx.doi.org/10.46930/pkmmajuuda.v1i2.749>

Zhou, C., Su, F., Pei, T., Zhang, A., Du, Y., Luo, B., ... & Xiao, H. (2020). COVID-19: challenges to GIS with big data. *Geography and sustainability*, 1(1), 77-87.
<https://doi.org/10.1016/j.geosus.2020.03.005>