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The design of flood disaster monitoring dashboard for DKI Jakarta

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ABSTRACT

Disasters are events that threaten and disrupt the lives of living things caused by natural or non-natural factors or human actions resulting in human casualties, environmental damage, property losses, and psychological impacts. One of the natural disasters is flooding. This includes the disasters that often occur in the community in any area regardless of location and time. Flooding means excessive waterlogging, particularly those that often occur during the rainy season. The puddle arises due to increased water flow above the ground surface, either due to high rainfall or overflow of river water. Information on flood incidence is recorded daily in detail. This information allows flood incidence data to be made into a visualization. This dashboard is designed to display a dashboard that can show visualization of flood incident data. The data employed data on DKI Jakarta flood incidence from 2018 to 2021. The dashboard design used the prototyping method. Visualizing the data aims to facilitate users in accessing information about flood incidents in DKI Jakarta. The results obtained by the dashboard will display reports of an annual increase or decrease in flood incidents.

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Introduction

Disasters are events that threaten and disrupt the lives of living things caused by natural or non-natural factors or human actions, resulting in human casualties, environmental damage, property losses, and psychological impacts (Swara, 2020). One of the natural disasters is flooding (Yin et al., 2021). This includes disasters that often occur in the community in any area regardless of location and time (Martono et al., 2019). Related to the intensity in a place and the number of locations, flood incidents occur more often in a year, which is about 40% among other natural disasters (Anugerah et al., 2021; Jafari et al., 2020; Osberghaus & Fugger, 2022; Singh et al., 2021; Zawawi et al., 2018).

Even in certain places, flooding is an annual routine (Huang et al., 2022; Oh & Oetzel, 2022). The location of the incident can be occurred in urban or rural areas (Cappelli et al., 2021; Osberghaus & Fugger, 2022; Zawawi et al., 2018). Among these locations can be distinguished based on the impact of the flood itself. The impact of floods on urban areas is commonly in the settlements, while in rural areas, the impact of floods also affects agricultural areas which can have an impact on food security in the region and nationally, especially if it occurs on a large scale in a country (Taufiqurrahman, 2020).

This flood incident is in the form of excessive waterlogging, particularly those that often occur during the rainy season (Dartanto, 2022; Zawawi et al., 2018). The puddle arises due to increased water flow above the ground surface, either due to high rainfall or overflow of river water. Flash floods are

part of hydrometeorological disasters that are indicated to have a significant impact on life and property. The main factor of flash floods is that they are triggered by extreme rain intensity. It is often associated with landslides that clogged the flow of the river to form a natural dam. Furthermore, the pressure of river flow breaks the natural dam and can occur flash floods characterized by high flow speeds by carrying mud, wood, and stone (Parmelian et al., 2022).

In obtaining the flood data, the researchers can get data that can be accessed directly, through the Open Data website. This provides data related to flooding. The data provided can be accessed by the public freely. This data is still data written using rows and columns in the form of excel file. Open Data provides information about a variety of data that is open to everyone. Some data that contains recapitulations and also complete data. Some of the data provided by Open Data involve: provincial data, regional budget data, natural disaster data, population data, birth data, death data, and so on (*Open data*, 2022)

Flood data contained in Open Data is processed to produce new information. These data will be processed into information in visual form. One way to create data visual is through the Dashboard model. The design of this dashboard aims to allow users in finding flood data that has occurred in DKI Jakarta into visual form. Users targeted to access this flood disaster dashboard are the Information Technology (IT) section of the DKI Jakarta Regional Disaster Management Agency (BPBD) which is located at Jl. Kyai Haji Zainul Arifin No. 71, RT. 10 RW. 10, North Petojo, Gambir District, Central Jakarta.

BPBD (Regional Disaster Management Agency) has the duty to establish disaster guidelines and directions that include disaster prevention, emergency management, rehabilitation, as well as reconstruction in a fair and equal manner. BPBD has an attachment to flood data management. Flood data information that has been processed, can be used to provide detailed flood information and can assist in making a decision. The flood disaster dashboard is designed using detailed flood data from Open Data and BPBD DKI Jakarta. The reason of selecting DKI Jakarta as a data source is because DKI Jakarta still needs a dashboard that provides detailed information on flood data. Therefore, with the existing problems, the author conduct a research entitled: "The Design of Flood Disaster Monitoring Dashboard for BPBD DKI Jakarta ."This dashboard design is expected to be useful for BPBD DKI Jakarta in recognizing detailed flood information and assisting in decision making.

Method

The type of research was process design and diagrams contained modeling designs that described the design process to be implemented (Kristianto, 2019; STMIK Pringsewu et al., 2019). The design process started with four stages; designing Use Case diagrams, class A good and correct database design depends on the ERD which can correctly provided the system requirements needed by the users, and ERD Design. According to Connolly & Begg (2015), a Star Schema is a logical structure with a fact table containing temporary fact data about the incident. Star Schema can be used to speed up query performance by denormalizing information into single-dimensional tables. The Star Schema design for the flood disaster dashboard provided a fact table called FactBanjir and has three dimensions, namely *DimKotaadm*, *DimKecamatan*, and *DimKelurahan*. The Star Schema design displayed in the user interface design on this dashboard was created to display clear information in a simple and attractive manner so that the users could easily understand it. Moreover, user interface design aims to provide convenience in the form of easy-to-understand graphics to help users find information and make decisions. User interface design in the form of a flood disaster data display described what happened in the dashboard's flood data. The data displayed on the dashboard included the filter of year, month, number of incidents, neighborhood unit (RT), community unit (RW), sub-district, sub-village (kelurahan), injured victims, water level, administrative city location map, flood incident graph, sub-district graph, sub-village graph, water level graph, and administrative city. Before designing the dashboard, data processing will be carried out first on the main data, namely flood detail data. Data processing was carried out to separate necessary and unnecessary data according to the results of interviews with the users. Based on the detailed flood data previously described, the main data information included the date, administrative_city *(kota_administrasi),* sub-village (kelurahan), subdistrict, injured_victims

(korban_luka), and (cm) water_level (ketinggian_air) data. Then, the main data processing continued, making changes, and updating the data to form data correlation between tables.

Dashboard creation was carried out in accordance with process design, database design, and user interface design. After the dashboard creation was complete, testing was carried out to ensure the dashboard created could function properly.

Results and Discussions

Result

The implementation of the created fire dashboard requires several supporting elements, such as hardware, software, and personnel who will use the dashboard. The flood disaster dashboard that has been created, can be run on a computer or laptop. The hardware used to run the dashboard are as follows RAM 8 GB, AMD Ryzen 5 processor and hard disk with 512 GB storage .

The software required to run the flood disaster dashboard are as follows microsoft Windows 11 operating system , powerBI Desktop and web browser (Google Chrome, Firefox, Opera or Safari)

Personnel who will apply the flood disaster dashboard can be divided into anti and user. The admin has a role as a dashboard manager related to managing the form of views, types of views, and some information that will be displayed in the flooded dashboard. The user acts as a flood dashboard user to obtain information about flood incidents that have occurred. The intended flood dashboard user is the Information Technology (IT) section of BPBD DKI Jakarta. This information can be used to make a decision later.

The dashboard produced for visualization of flood data in DKI Jakarta in this research is still in the form of a prototype. In order to be implemented effectively, this flood disaster dashboard needs to be connected to the real flood database in DKI Jakarta. It can be useful to add visualizable flood data information into the dashboard. To make it usable at the BPBD DKI Jakarta office, it is necessary to make preparations, which are as follows : (a) install the required tools, such as SQL Server, PowerBI Desktop, and supported browsers, (b) requires a dashboard file that has been created, (c) make adjustments between dashboard files and flood data sources.

Training is conducted for each dashboard user personnel to use the flood disaster dashboard that has been created correctly. Then, this training is also carried out so that implementing the flood dashboard can provide optimal results in making a decision. Personnel training was carried out by providing information related to procedures for using the dashboard to personnel who will use the dashboard. This training covers how to open the dashboard, how to use the dashboard, how to read the data on the dashboard visualization, and how to refresh the fire data. The procedure for using the dashboard is prepared to provide an explanation of the procedures for using the flood disaster dashboard that has been created. The usage procedure will be divided into program usage procedure, user manual dashboard interface, and maintenance procedure. The dashboard usage procedure contains information on how to use the flood disaster dashboard.

To facilitate users in accessing information on the flood dashboard, there is a user manual that contains an explanation of each visual information displayed on the dashboard. Overall, the flood dashboard view has five information areas and additional information pages that can be viewed on

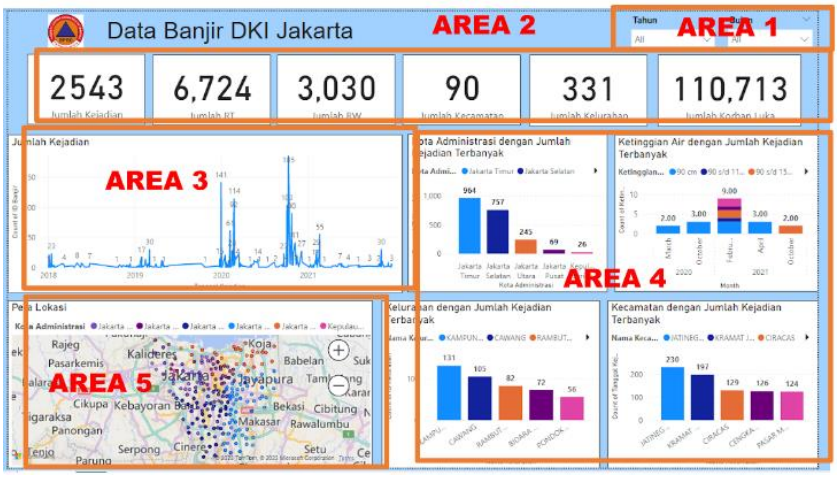

Figure 3. Display of each dashboard area

Information on the five areas is as follows:

1. Area 1
   Area 1 is the dashboard area that is located at the top of the dashboard. Area 1 is a time filter area that the users can use to see the visualization condition of flood incidents data information according to the expected conditions. Filter Area 1 can be seen on **Figure 4** with explanations:

Figure 4 Area 1 Display

   a. Year filter is used to select the year that the users want to show a visualization of flood incidents.
   b. The Month filter selects the month the users want to display in the flood incident visualization.

2. Area 2
   Area 2 is the dashboard area that is located below Area 1. Area 2 is an area that the users can use to see information on flood incidents that have occurred in DKI Jakarta. The display of Area 2 dashboard can be seen in **Figure 5** with the following explanation:

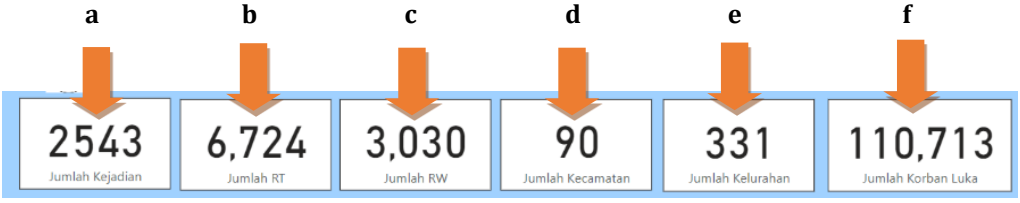

Figure 5 Area 2 Display

   a. Number of Incidents
      The display of the number of incidents display provides information on the number of flood incidents that have occurred in the form of numbers. It is the value of the number of flood incidents that have occurred based on the time filter in Area 1.
   b. Number of Neigborhood Units (RT)
      The RT number display contains information on the total number of RTs that have flood incidents information in the form of numbers. It is the number of RTs that have flood incidents information based on the time filter in Area 1.
   c. Number of Community Units (RW)

The RW count display contains information on the total number of RWs that have flood incident information in the form of numbers. It is the number of RWs that have flood incident information based on the time filter in Area 1.

d. Number of Sub-districts
The number of subdistricts display contains information on the total number of sub-districts that have flood incident information in the form of numbers. It is the number of sub-districts that have flood incident information based on the time filter in Area 1.

e. Number of Villages
The number of villages display contains information on the total number of villages that have flood incident information in the form of numbers. It is the number of sub-districts that have flood incident information based on the time filter in Area 1.

f. Injured Victims
The injured display contains information on the number of victims who have been injured due to flood incidents in the form of numbers. The number displayed on the injured is the number of injured based on the time filter in Area 1.

3. Area 3
Area 3 is the dashboard area that is located below Area 2. Area 3 is an area that the users can use to see information on trends in flood incidents that have occurred in DKI Jakarta. The display of Area 3 dashboard can be seen in Figure 6 with the following explanation:

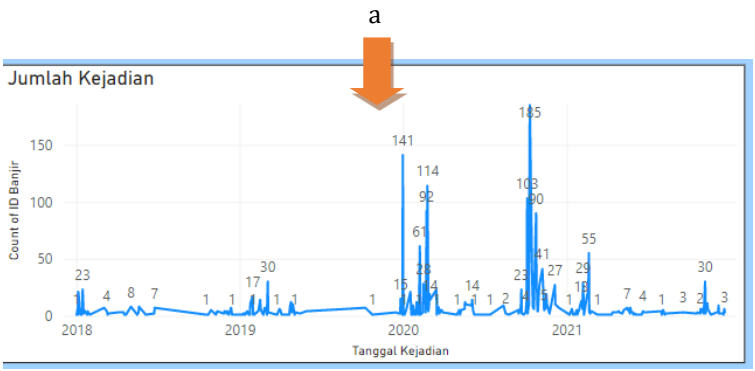

Figure 6 Area 3 Display

a. Flood Incident Graph
The display of flood incident graphs provides information about trends in the number of flood incidents in DKI Jakarta. It is displayed in the form per year. Then on the event graph display, a dotted line is a prediction of the trend that occurred. This trend prediction describes whether flood incidents are likely to increase or decrease. The flood incident graph display can be selected based on the time filter in Area 1.

4. Area 4
Area 4 is the dashboard area that is located below Area 3. Area 4 is an area that can be used by the users to see warning information related to flood incidents that have occurred in DKI Jakarta. The display of Area 4 dashboard can be seen in **Figure 7** with the following explanation:

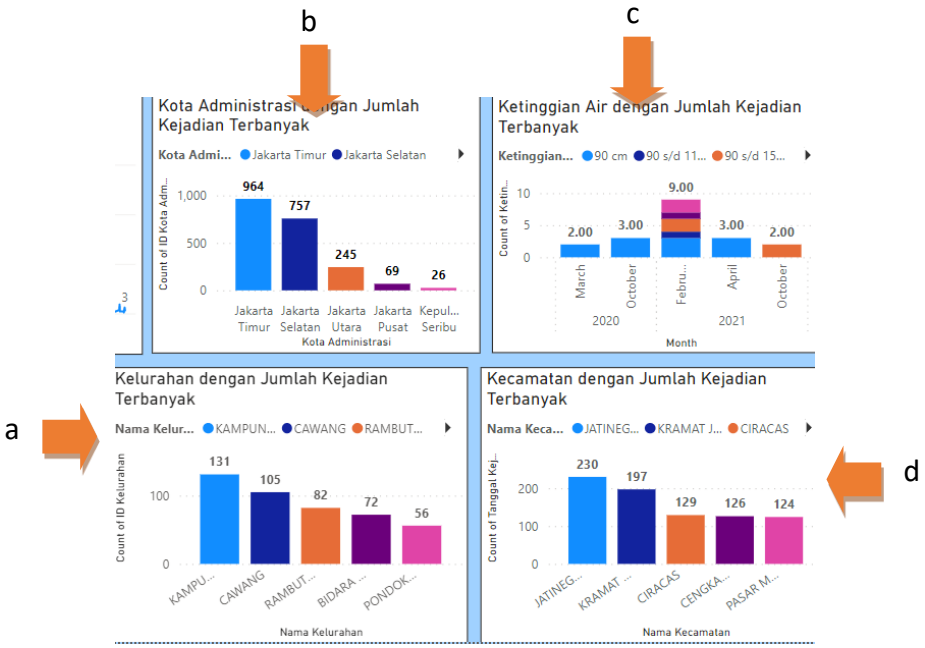

Figure 7 Area 4 Display

a. Villages with the highest number of incidents
The view of the villages with the highest number of incidents contains information about the villages with the most information on flood incidents displayed in the form of bar graphs. The information graph is sorted by the villages that experience the most flood incidents. The village graph display can be adjusted based on the time filter in Area 1.

b. Administrative cities with the highest number of incidents
The administrative cities with the highest number of incidents display information about the number of administrative cities with the most flood incidents information in the form of bar graphs. The information displayed on the bar graph is sorted by the administrative cities that experienced the most flood incidents. The village graph display can be adjusted based on the time filter in Area 1.

c. Water Levels with the Highest Number of Incidents
The water level display with the highest number of incidents contains information about the number of water levels that have the most flood incident information. Village information is displayed in the form of bar graphs. The information is sorted by the water level that experienced the most flood incidents. The village graph display can be adjusted based on the time filter in Area 1.

d. Subdistricts with the Highest Number of Incidents
The sub-district display with the highest number of incidents contains information about the number of sub-districts that have the most flood incident information in the form of bar graphs. The information displayed on the bar graph is sorted by the sub-districts that experience the most flood incidents. The sub-district graph display can be adjusted based on the time filter in Area 1.

5. Area 5
Area 5 is the dashboard area that is located below Area 3. Area 5 is an area that the users can use to see a map of administrative city location points that have information on flood incidents in DKI Jakarta. The map view is adjusted based on the administrative city with the highest number of incidents. The administrative city location displayed on the map can be adjusted based on the time filter in Area 1. Area 5 containing a map view of the administrative city can be seen in Figure 8

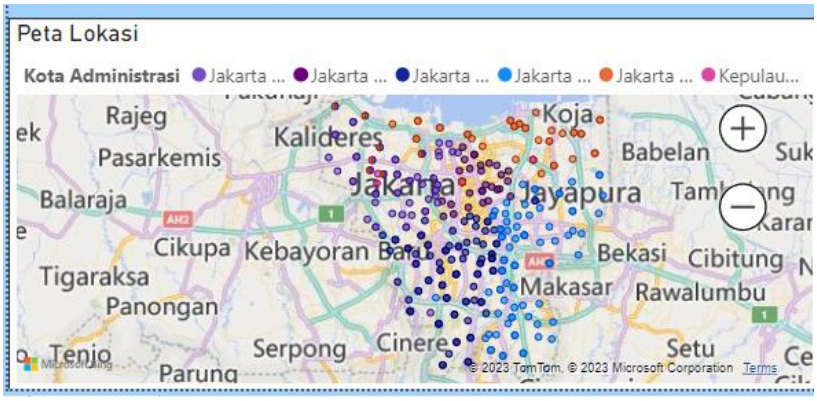

Figure 8 Area 5 Display

The successfully created and deployed fire disaster requires maintenance to ensures its long-term usability without any issues. Dashboard maintenance procedures are carried out for online and offline use. Dashboard maintenance for online access can be done: (a) sign-in to the PowerBI account by using the procedure according to the user manual instructions, (b) If the home page on the PowerBI website is unresponsive, reload the website page by clicking the refresh button in the web browser, (c) refresh visuals on the fire disaster dashboard regularly to ensure the visual display and data are always updated, (d) if the dashboard is no longer accessible, signing out before closing the web browser is better.
Dashboard maintenance for offline access can be done: (a) backup dashboard files by copying the "Flood Data" file to another directory location, (b) save the dashboard file that has been changed by selecting the file, save it in the PowerBI Desktop application, (c) refresh regularly on the dashboard view to update the dashboard data, (d) if already have saved the dashboard file, republish it is recommended so that the dashboard's visual appearance on PowerBI Desktop is synchronized with PowerBI Cloud.

Discussion

Dashboard design in this flood disaster focuses on strategic dashboards. This is because this dashboard aims to inform users about how flood data is converted into visual form. The results of this visual form that will be able to be used by the users to read information which can then provide new information (Habib et al., 2018). This new information can be used as a basis for predicting flood incidents and the causes of floods needs to be aware of.

Flood disaster dashboard creation activities in DKI Jakarta are carried out in four stages: (1) installing the necessary software, (2) data adjustment, (3) extracting, transforming, loading processes, and (4) creating dashboard visualizations. Dashboard testing was carried out using the Black Box Testing method. It is an application software to test the function of the program or application based on specifications and application responses in handling input provided by the users and expected output (Verma, et al., 2017).

The dashboard is a visual interface that provides important information or data used to achieve certain goals in the performance measurement system on the targets using appropriate time data (Wahyudi &; Syazili, 2021). Dashboard is a tool to present important data or information and is useful to facilitate the users in monitoring information (Bhaskara et al., 2020; Cappelli et al., 2021).

Conclusions

The flood trend graph has successfully presented the state of the flood trend. It can be seen that the flood trend has increased or decreased. The prototype dashboard has successfully displayed fire data information according to the user needs. Efforts should be made to use longitude and latitude point data on the administrative city map in order to display the location of administrative city points more accurately. Furthermore, related to the flood data, if more detailed information is available, the flood disaster dashboard information in DKI Jakarta would become even more interesting. Future research should use a broader range of research subjects.

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