

Data Visualization Dashboard for Flood Disaster Management: A Review

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ABSTRACT: The use of a data visualization dashboard for decision support systems in several disasters emergency response becoming essential. In fact, the dashboard helps for disasters monitoring and providing an early warning. Thus, good development of data visualization is vital that demands a combination of relevant information, proper analysis techniques, and fitting visualization. The dashboard assists in making unpredictable incidents or disasters into nearly predicted events since it reduces the environmental impact. This paper aims to study the criteria and information needed to develop an effective dashboard for data visualization in flood disaster management.

Keywords: Data Visualisation, Dashboard, Disaster Management

1. INTRODUCTION

The dashboard has become a prominent tool in this age where the data has become excessive. Entities from different industries begin to visualize the data to have a better understanding for analysis. Dashboard tools used in health [1]–[4], education [5],[6], business [7]–[9], military domains [10] and disaster management [11]. The use of dashboard brings a beneficial factor towards human and environment especially when there are disasters such as flood, drought, and pandemic. Flood event has been the highest level of disasters in the Malaysia's research community. Studies on flood disaster management dashboard [12]–[19] have been explored.

2. MATERIALS AND METHODS

The method used in the study is based on narrative review, which provides summary of literature on data visualization dashboard for flood disaster management [20]. We perform searches on related articles from several databases (IEEE and Scopus). The topic focuses on dashboard for flood disaster management and classifies according to category and information needed. The materials are

gathered from articles, books and other published texts.

3. RESULTS AND DISCUSSION

The development of flood disaster management dashboard requires the criteria for testing and connectivity check. In Table 1, the research papers are classified into three that is based on their approach of using similar data, which are weather, geographic and administrative.

Table 1 The Criteria of Dashboard Development

Research Papers	Dashboard Criteria
[12]–[19]	Use weather to produce prediction.
[12]–[19]	Use geographic to create maps of possible target or affected areas.
[12]–[14], [16], [17], [19]	Use administrative to assess civil damage.

Based on the dashboard criteria, which is the weather, geographic and administrative, findings indicate that several important information needed in developing an effective dashboard. The information is rainfall, humidity, land elevation water level, latitude, longitude and more as shown as in Table 2.

Table 2 Important information in the flood disaster management dashboard

Research Papers	Criteria	Information
[12]–[14]	Weather	Rainfall
[14]	Weather	Humidity
[13], [15], [19]	Geographic	Land Elevation
[12]–[15], [17]–[19]	Geographic	Water Level
[12]–[14], [19]	Geographic	Latitude
[12]–[14], [19]	Geographic	Longitude
[14], [19]	Geographic	Soil Type
[13], [16]	Administrative	Employment
[13], [16]	Administrative	Population

[13], [16]	Administrative	Age
[13], [16]	Administrative	Property Ownership
[13], [16]	Administrative	Car Ownership
[13], [19]	Administrative	Hospitals
[13], [19]	Administrative	Schools

4. CONCLUSION

This study concludes that the important information needed in the dashboard for flood disaster management are rainfall, land elevation, water level, latitude, and longitude, which falls under the category of weather and geographic of the dashboard criteria.

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REFERENCES

[1] J. M. Jamil and I. N. M. Shaharane, "An innovative forecasting and dashboard system for Malaysian dengue trends," *AIP Conf. Proc.*, vol. 1761, pp. 1–6, 2016, DOI: 10.1063/1.4960910.

[2] M. Rahman and B. Wadhwa, "GEAR Analytics - A Clinician Dashboard for a Mobile Game Assisted Rehabilitation System Mufizur," *4th Int. Conf. User Sci. Eng.*, pp. 193–198, 2016.

[3] S. R. Hamidi, A. M. Lokman, S. M. Shuhidan, and M. I. M. N. Hilmi, "CancerMAS Dashboard: Data Visualization of Cancer Cases in Malaysia," *J. Phys. Conf. Ser.*, vol. 1529, no. 2, 2020, DOI: 10.1088/1742-6596/1529/2/022019.

[4] J. S. Stevens et al., "Dashboards to Facilitate Nephrology Disaster Planning in the COVID-19 Era," *Kidney Int. Reports*, vol. 5, no. 8, pp. 1298–1302, 2020, DOI: 10.1016/j.ekir.2020.06.033.

[5] B. A. Schwendimann et al., "Perceiving learning at a glance: A systematic literature review of learning dashboard research," *IEEE Trans. Learn. Technol.*, vol. 10, no. 1, pp. 30–41, 2017, DOI: 10.1109/TLT.2016.2599522.

[6] D. Wang and H. Han, "Applying learning analytics dashboards based on process-oriented feedback to improve students' learning effectiveness," *J. Comput. Assist. Learn.*, vol. 37, no. 2, pp. 487–499, 2021, DOI: 10.1111/jcal.12502.

[7] A. Fatnani, J. Nwachukwu, and F. Makhmoor, "Operations management dashboards: A production life cycle management study," *Soc. Pet. Eng. - SPE Symp. Prod. Enhance. Cost Optim.* 2017, 2017, DOI: 10.2118/189214-ms.

[8] M. I. Rizni and G. Poravi, "Best of breed ERP: A dashboard for strategic decision-makers," *Proc. - Int. Conf. Intell. Syst. Model. Simulation, ISMS*, vol. 2018-May, pp. 58–61, 2018, DOI:

10.1109/ISMS.2018.00020.

[9] A. Zagorecki, J. Ristvej, L. K. Comfort, and T. Lovecek, "Executive dashboard systems for emergency management," *Komunikacie*, vol. 14, no. 2, pp. 82–89, 2012.

[10] E. B. Sloane, E. Rosow, J. Adam, and D. Shine, "JEDI - An executive dashboard and decision support system for lean global military medical resource and logistics management," *Annu. Int. Conf. IEEE Eng. Med. Biol. - Proc.*, pp. 5440–5443, 2006, DOI: 10.1109/IEMBS.2006.259658.

[11] M.A. Khalid, A. Roxin, C. Cruz and D. Ginhas, "A Review On Applications Of Big Data For Disaster Management" in *2017 13th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS)*, 2017, pp. 370-375.

[12] E. Sung, M. Tsai, and S. Kang, "An Interactive Data Visualization System for Flood Warnings in Taiwan," *Proc. 13th Int. Conf. Constr. Appl. Virtual Real.*, no. October, pp. 384–394, 2013.

[13] S. Saha, S. Shekhar, S. Sadhukhan, and P. Das, "An Analytics Dashboard Visualization for Flood Decision Support System," *J. Vis.*, vol. 21, no. 2, pp. 295–307, 2018, DOI: 10.1007/s12650-017-0453-3.

[14] J. Ibarreche et al., "Flash Flood Early Warning System in Colima, Mexico," *Sensors (Switzerland)*, vol. 20, no. 18, pp. 1–26, 2020, DOI: 10.3390/s20185231.

[15] A. Faruq, H. P. Arsa, S. F. M. Hussein, C. M. C. Razali, A. Marto, and S. S. Abdullah, "Deep Learning-Based Forecast and Warning of Floods in Klang River, Malaysia," *Ing. des Syst. d'Information*, vol. 25, no. 3, pp. 365–370, 2020, DOI: 10.18280/isi.250311.

[16] Z. Maksom, "Developing Malaysian Community based Flood Warning Initiatives Through Activity Centered Design," no. October 2012.

[17] M. S. Mohd Sabre, S. S. Abdullah, and A. Faruq, "Flood Warning and Monitoring System Utilizing Internet of Things Technology," *Kinet. Game Technol. Inf. Syst. Comput. Network, Comput. Electron. Control*, no. December, pp. 287–296, 2019, DOI: 10.22219/Kinetik.v4i4.898.

[18] N. K. R. Obili, B. S. R. Chinthapanti, K. Sola, R. A, T. R. Prasad, and D. M. M, "Design and Implementation of The Prediction Model for Floods and Drought," *J. Xi'an Univ. Archit. Technol.*, vol. XII, no. November, pp. 216–225, 2020, DOI: 10.13140/RG.2.2.26298.21448.

[19] K. K. Lwin, Y. Sekimoto, W. Takeuchi, and K. Zettsu, "City Geospatial Dashboard: IoT and Big Data Analytics for Geospatial Solutions Provider in Disaster Management," *6th Int. Conf. Inf. Commun. Technol. Disaster Manag. ICT-DM 2019*, no. December 2019, DOI: 10.1109/ICT-DM47966.2019.9032921.

[20] G. Wong, T. Greenhalgh, G. Westhorp, J. Buckingham, and R. Pawson, "RAMESES publication standards: Meta-narrative reviews." *BMC Medicine*, vol 11, no. 20, pp. 1-15, 2013.