

DATA VISUALIZATION FOR AGRICULTURAL DATA: BENEFITS AND CHALLENGES

Fatimah Sidi¹, Iskandar Ishak² and Lilly Suriani Affendey³

¹*InfoComm Development Centre (iDEC), Universiti Putra Malaysia
fatimah@upm.edu.my*

^{1,2,3}*Department of Computer Science, Faculty of Computer Science and Information Technology,
Universiti Putra Malaysia
iskandar_i@upm.edu.my, lilly@upm.edu.my*

Abstract: Data visualization is an important field in the Big Data domain. Its purpose is to provide meaningful visual interpretation of data that comes from various resources for enabling users to interpret and understand the data. In agricultural research, data visualization is very important to enhance the discovery of information and to make sense of large amount of data that is complex in nature. This paper reviews the approaches that have been implemented in visualizing agricultural data. This paper also highlights the benefits as well as challenges and discusses future direction of the implementation of data visualization for agricultural data.

Keywords: data visualization, agriculture, big data, data management, visual analytics

INTRODUCTION

This paper reviews the approaches of data visualization that have been implemented in agriculture domain. Apart from that, the challenges of the implementation of data visualization and the opportunities of its implementation for agricultural data is also discussed. A number of literatures which have been reviewed are the most recent articles ranging from 2015 until 2017. This shows that data visualization is still new in the field of agriculture and therefore a lot of opportunities for researchers to enhance or improve the techniques according to the needs in agriculture fields and its data requirements. When the Big Data phenomenon started in the information technology world, business organizations are among the trigger to its starting due to the characteristics of data becomes larger, faster and comes from various sources. The implementation of Big Data management then being applied into other domains including agriculture. In agricultural domain, where precision agriculture is the main focus, Big Data approach is implemented to cater the needs of understanding complex agricultural information and turn the data to be comprehensible to assists decision making to improve agricultural processes. Data visualization which is part of Big Data approach is where data is gathered and transformed into visualized or graphical representation to make it easier for users to understand and analyze the data and provide insight to improve agricultural processes.

METHODS

In order to produce the findings, we performed the following processes:

1) Topic selection

In this stage, we initiated our work by deciding to find literary works based on the topic in data visualization for agricultural data. This is performed to know the level of works that have been conducted

and to determine how far data visualization have been used in agriculture. Based on that, we will identify any research issues regarding data visualization that have been implemented.

2) Literature searching

With the topic already in mind, we search related literatures on the web over multiple sources such as Google Scholar, Scopus libraries and IEEE Xplore portal.

3) Analyzing literature

After acquiring the related literatures, we conducted an analysis by looking into the implementation of the visualization, the achievement, benefits and challenges.

4) Literature writing

Lastly, we write all the findings from the literature analysis and we also proposed future works that can be pursued to enhance data visualization practice in agriculture. We reviewed a number of literatures that discussed or proposed approaches of data visualization in agriculture domain.

FINDINGS AND ARGUMENTS

According to Nocke et. al (2008), data visualization is the field dealing with visual representation of abstract data into clearer graphical way. The combination of Big Data computing and data visualization improve the use of data visualization for analysis purposes to branched out new field called visual analytics. Visual analytics blends analytical algorithms with data management, visualization, and interactive visual interfaces. Visual analytics tools and techniques are used to synthesize information from massive, frequently updated, ambiguous and often conflicting data; to detect the expected and discover the unexpected; to provide timely, defensible and understandable assessments; and to communicate those assessments effectively (Thomas and Cook, 2005).

Visualizing agricultural data is important where agricultural data such as spatial and complex data needs to be visualized for the users to understand and comprehend. Among its use is for farm management where the data visually display pixel based real monitoring product essential for farm monitoring and efficient irrigation management (Dutta et. al, 2015). Another use of data visualization in farm management is the use of 3D visualization in agricultural data through the visualization of sesame plant farm in Nigeria (Obiniyi & Ibrahim, 2015).

Data visualization is also used in biological experiments for agricultural process where crop improvement is sought through analysis and interpretation of time series data of physical phenomena that has become straight forward and routine. This activity requires sheer magnitude in terms of the number of observations using sensors operated by multiple users. The visualization of the multiple data from various users' observations are implemented in (Salehi et. al 2015).

Based on the literatures, data visualization has been implemented extensively in the agriculture domain especially after the year 2010s where computing resources are large and cheap. The benefits are tremendous for the agriculture community but there are also challenges and issues surrounding the implementation of data visualization which is discussed in detail in the next section.

RESULTS AND DISCUSSION

In this section, we highlight the benefits and challenges of data visualization implementation for agricultural data based on the literatures.

Among the benefits of data visualization for agricultural data is it can enhance the discovery and understanding of information for all users, including data collectors, model developers, model users, integrative research, application developers, and end-users (Fekete, 2013). This is to allow users to interpret large amount of data that is complex and to allow the discovery of patterns and emergent phenomena from the data.

In terms of challenges, one of the challenges in visualizing agriculture data is that, the availability of the data at the level of farming households and communities is low especially in the developing world compared to the developed world (Janssen et. al, 2016). This hinders the collection of adequate data to be analyzed and hence visualizing inadequate data may lead to providing misinformation to the users. Another challenge in visualizing agricultural data is, the data is organized in an ad-hoc ways (Fekete, 2013). Data are stored in spreadsheets or statistical tools in which the visualization package is limited or need experts to explore and manipulate the package to provide proper data visualization.

However, multiple available data visualization tools has emerge to help researchers to analyze their data. Tools such as Tableau, Exhibit, Many Eyes, D3.js, OpenLayers, Leaflet and InfoViz (Janssen et. al, 2016) are available to be used to visualize agricultural data with appropriate trainings time and fund needs to be spend in order to implement these tools.

CONCLUSIONS

In this paper, we have presented a number of implementation and approaches of data visualization for agriculture data. Apart from that, the benefits and challenges of the implementation is also highlighted. As a conclusion, data visualization implementation for agricultural data presents multiple benefits in terms of producing better and efficient management practices and also understanding agricultural process. However, the issues surrounding its implementation such as low data availability, lack of high performance computing resources and expertise needs to be addressed to ensure that the implementation of data visualization for agricultural data can improve agriculture activities.

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