

Interactive, Dynamic data visualization in Inventory Management

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Abstract – Inventory management is the key to success of the business. Quickly able to understand and analyze the inventory can help business progress. Inventory management tools have been there around from a long time, but they have been focusing on improving the functionality of input and output. The data visualization has been limited to basic graphs which does not provide meaningful insights. In this paper, I present better ways to represent data used in inventory management. Usually, the inventory management is managed by non-technical and non-analysts. If we introduce complex visualizations, it will be difficult for these people to understand. So, the problem statement here is that present better visualization but in a simpler manner. This drives me to use of interactive data visualization.

1.INTRODUCTION

1.1) Motivation:

There are two major problems with static data graphics: Simple data visualizations cannot convey lot of the information and

complex visualization is hard to interpret. It is the need of an hour to have visualized data such that it gives lucid picture in lesser time. When user can control, which parameters they want to see and analyze it gives them better understanding and power to drive. All the current inventory management system such as Quickbooks, NetSuite, Logiwa, Tradegecko etc produces simple visualization for profits and sales. This has two problems: 1) No visual interaction 2) Lack of usage of advance techniques of visualization available. So, inspired to solve these problems in this paper I propose introduction of the interactive visualization in the inventory management. Examples: Suppose if the user want to visualize sales of each country, each country has number of customers, peak times, quantity of the products sold. This data can be represented by using multi-dimensional visualization(but it will be complex for most of them to interpret and less analytical as well). But if instead present pair the dimension and show as the user wants. Do not present everything at the once and and let user decide which parameters they want to look at, this inspires me to present the interactivity in the data visualization.

2) **TECHNOLOGIES USED:**

1. HTML5
2. CSS3
3. Node Javascript
4. D3 Javascript
5. MySQL
6. Google maps API
7. Bootstrap
8. JQuery Javascript

3) **CONCEPTS USED**

3.1) Interactive and dynamic visualization:

Benefits of Interactive and dynamic visualization:

1. Multi-analysis perspective is given in a easier way.
2. More detailed information can be represented. As interactively user can keep on digging.
3. Allows user to see data that is required at that time.
4. Give user more power.
5. Allows to break down the complexity of the static, convoluted views.
6. Permits to narrate stories, which is easier to perceive and quickly understand.
7. Transitions allow to see patterns which is not quickly observable.
8. Dynamic charts help business owners to take decision on a run time, rather waiting for analysis.
9. Interactive visualization if used properly targets more audience. As they can be simple to understand.
10. It facilitates to answer multiple questions in single visualization.

3.2) Drill-down visualization:

A drill down report is a report which allows users to navigate to a different layer of data

granularity by navigating and clicking a specific data element on a web page or in an application. Drill down allows users to explore multidimensional data by navigating from one level down to a more detailed level. This allows users to view aggregated, summary data and then hierarchically explore deeper levels of the data for more specific analysis. For example, you might have a visualization that looks at Olympic medal count by a hierarchy made up of sport, discipline, and event. By default, the visualization would show medal count by sport -- gymnastics, skiing, aquatics, and so on. But, because it has a hierarchy, selecting one of the visual elements (such as a bar, line, or bubble), would display an increasingly more-detailed picture. Select the aquatics element to see data for swimming, diving, and water polo. Select the diving element to see details for springboard, platform, and synchronized diving events. Drill-down enables user to narrow data selection through either setting data filters to specific dictionary values or/and achieve similar result by visually choosing regions (e.g. rectangles) on interactive charts, so only values associated with regions will stay in data selection. In 2nd case charts behave as filters and as such eliminating need for filters if user prefer to use only selection tools like mouse.

Benefits:

1. Helps user to dig in a variety of the ways without efforts of creating different views.
2. It gives user power to quickly look at the different layers.
3. Allows to look at different angles with clicks on interface.

3.3) Reusable charts: Graphs following these pattern falls into the category of the reusable charts:

1. Configuration : Want to modify the appearance and behavior of the graph without modifying actual code. or example, you may need to specify the width and height, or the color palette. A simple method of configuration is passing arguments:


```
function chart(width, height) {
  // generate chart here, using `width`
  and `height` }
var myChart = chart({ width: 720,
  height: 80});
```

2. Power to be built independently : Every graph element associated with data point in the dataset is independent.

By taking a selection as input, charts have greater flexibility. For example, you can render a chart into multiple elements simultaneously, or easily move a chart between elements without explicitly unbinding and rebinding. You can control exactly when and how the chart gets updated when data or configuration changes (for example, using a transition rather than an instantaneous update). In effect, the chart becomes a rubber stamp for rendering data visually. With D3 it is easy to do. I am not aware of other libraries.

3.4) Google maps for visualization:

1. User can load the dataset containing latitude or longitude or valid name of the location. The advantage is unlike other libraries, user don't have to provide latitudes or longitudes or any

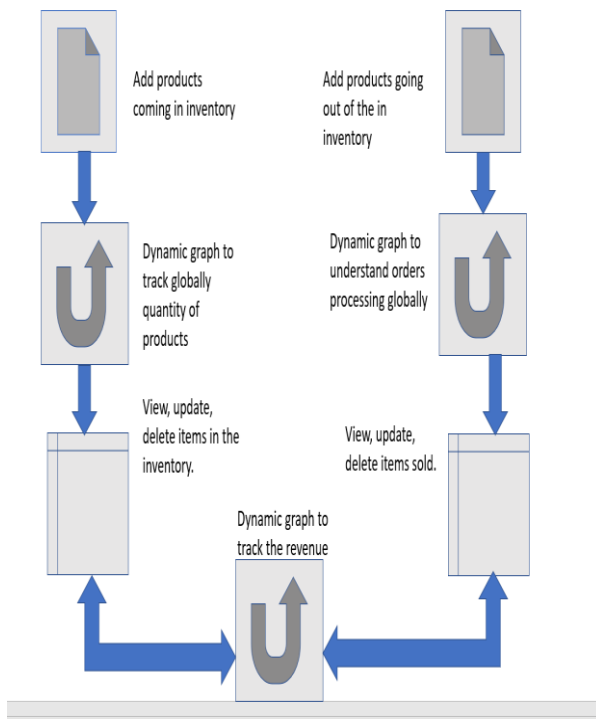
other additional information required to locate places on the map.

2. They can easily display two dimensional data.
3. It is not useful for big data visualization as it supports only 2000 records.
4. It allows user to define style and color for the data points.
5. Since, maps are very famous now a days, visualizing uses this API provides familiarity to use.
6. It has zooming, sharing and mobile view features in built.
7. Cannot be used for private analysis as the maps has to be made public before embedding.

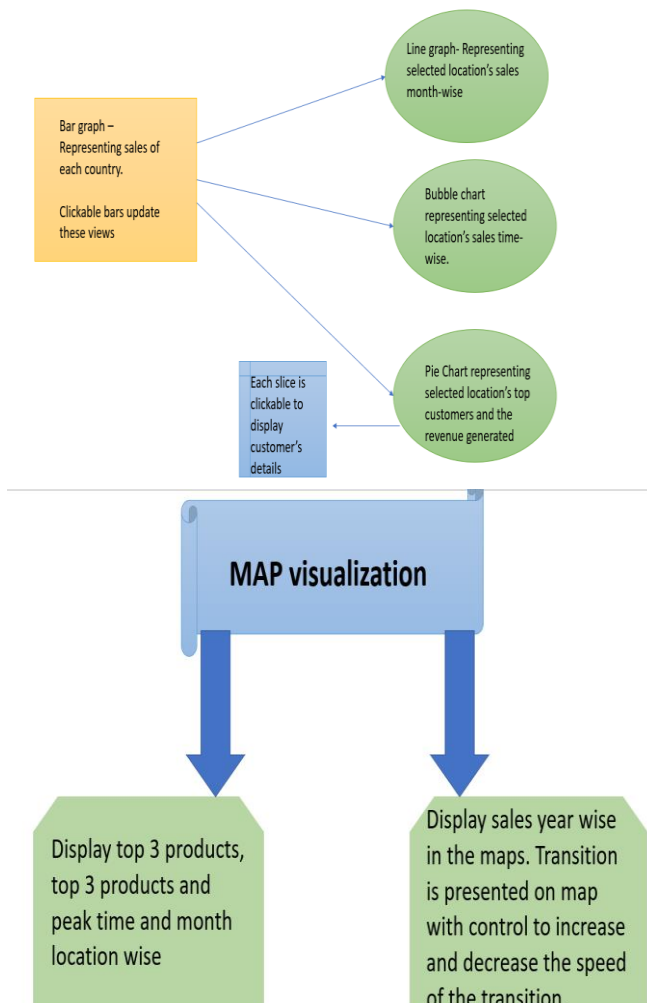
4) PROJECT FLOW:

Project is divided into three parts:

- 4.1) In Stock visualization(Products coming in the inventory). Out Stock visualization (Products selling i.e going out of the inventory)



4.2) Analysis visualization:



5) PROJECT INTERFACES

5.1) Analysis visualization:

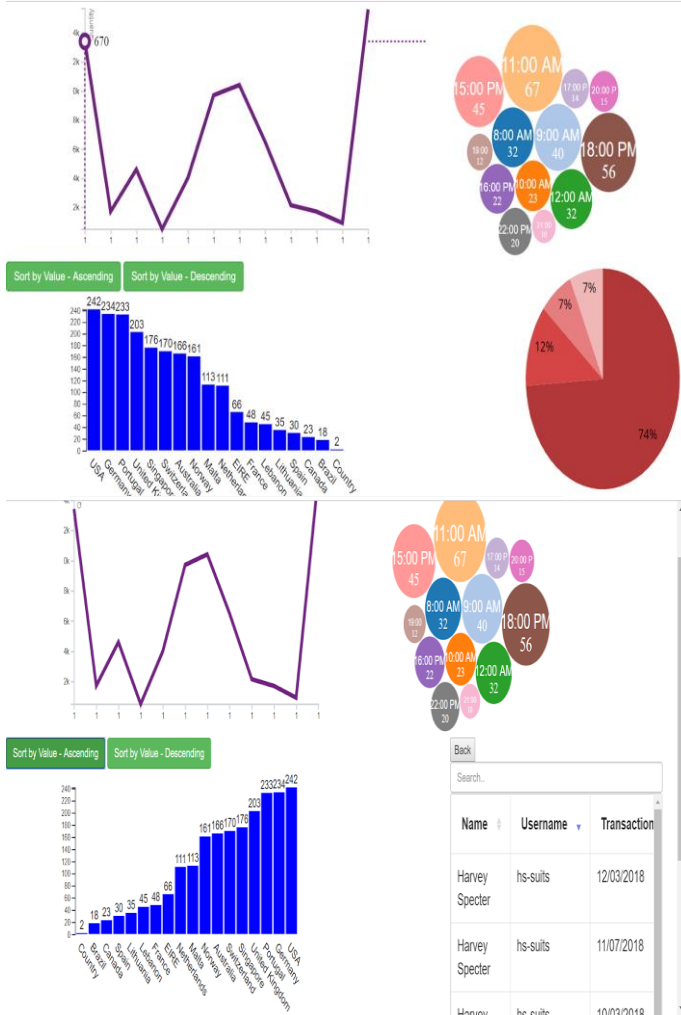
a. Multiple linked graphs: A bar chart has a country on the x-axis and quantity of products sold on y-axis. Each **bar is clickable and passes country to update line-chart, pie-chart and bubble chart**. Line-chart has months(1-12) on x-axis and quantity of products sold in that month in the selected country. Bubble chart has 1-24 possible bubbles and size of the bubble depends on the quantity of products sold in that hour in the selected country. Pie chart represents top three customers and remaining countries as each slice, the size of slice depends on the revenue generated by this four different entities in the selected country. Each **slice is clickable to drill down to provide information of the customers**.

Benefits:

1. Allows the inventory owner to analyse which months, time and customers are the best suitable for marketing.
2. It gives owner understanding of how each region is performing by comparison(multiple

graphs in one view) and drill-down.

3.It grants owner to decide resource allotment better(example in the peak time and month, owner can hire more part time people to increase the pace of the customer service).



b) Transition in maps with speed control input: A chlorepth is represented to **display sales globally sequentially for twelve years.** Additionally, there are three **buttons to**

control speed of the transition.

Benefits:

1. Transition provides easy way to analyze and understand pattern across the years.
- 2.Speed controls enables various users to perceive at their suitable pace.



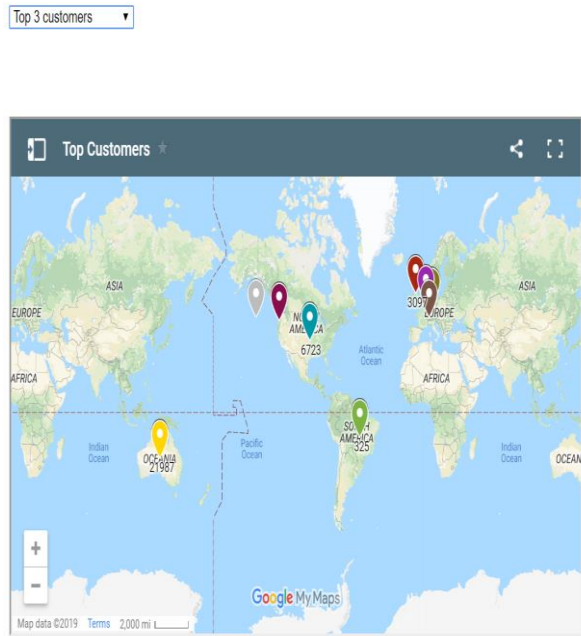
c) Interactive Map visualization: The dropdown grants user to select among “top 3 customers”, “top 3 products” and “peak time and month”.

Zoomable and shareable map displays data according to the user’s input. Each **data point** on click provide **additional details.**

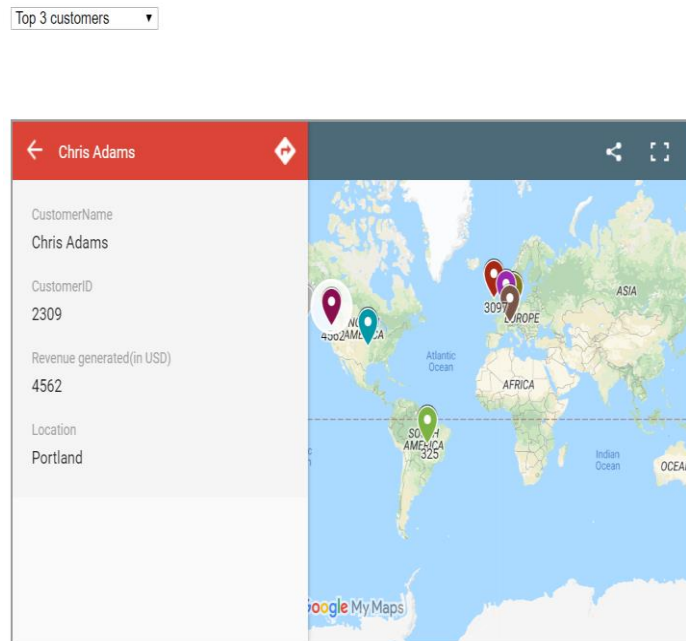
Benefits:

1. Knowing in which region how the products and customers are performing will help owner advertise in a better manner than the random target.
2. Peak time and month region wise clearly gives owner to offer various schemes at that time to boost the sales.

Analyze customers, products and time of your BUSINESS



Analyze customers, products and time of your BUSINESS



- 5.2) InStock and OutStock visualization:
- a. Forms to record products coming inside and outside the inventory. The data in the form is stored in the **database to render data for dynamic charts.**
 - b. Sortable, searchable and color coded table view: The table displaying in inventory is **sortable and searchable**

interactively. The products **whose quantity beyond five is shown in red** to indicate that they need to be filled soon to prevent from running out of the stock. The table also has **option to update and delete product details.** The table data is rendered from the backend.

Inventory Management

AadiPradhan Home In Stock Live updates Analysis

Search

ID	Product name	Quantity	Product code	Cost	Date	Description	Country	Action
1	WOODLAND MINI BACKPACK	10	5	5632	03/31/2002	Leather bag	USA	Edit Delete
2	WOODLAND MINI BACKPACK	4	581276	100	3/31/2019		USA	Edit Delete
3	ELEPHANT BIRTHDAY CARD	56	581267	45	3/29/2019		USA	Edit Delete
4	GIN & TONIC	63	581268	12	3/20/2019		United	Edit Delete

Inventory Management

AadiPradhan Home In Stock Live updates Analysis

Product name: Quantity: Cost:

M/M/YY: Description:

115A Product code:

[Add Products](#)

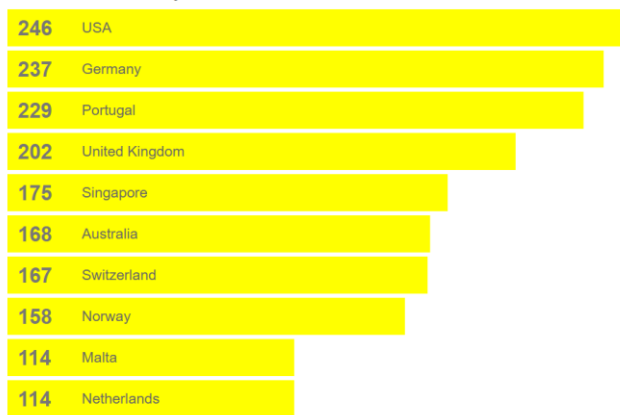
c. Dynamic update charts:

1. Horizontal sorted bar chart keeps on **updating after every three seconds.** As the bar value changes it keeps itself sorted.

Benefits:

1. This helps owner understand how sales are going per country for that day.
2. It helps him take action if required immediately. Instead of waiting to get analyzed.

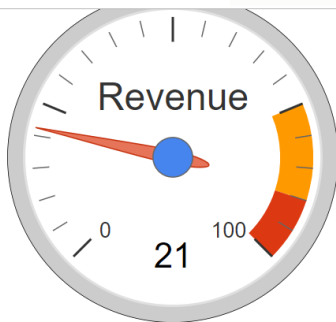
Sales of the day



2) Speedometer order and revenue visualization: **Speedometer for orders** is used to track globally how many pending orders are left. **For revenue**, it helps calculate profit and loss. InStock and OutStock both the table is used to calculate revenue.

Benefits:

1. It aids to track and very quickly analyze orders and revenue.

**6) OBSERVATION:**

1. D3 provides flexible way to develop graphs.

2. D3 is not easy to use for object oriented pattern.
3. There are very less resources to know how to integrate graphs with the backend which is crucial for at least dynamic graphs.
4. Drill down is the famous concept among the paid data visualization tools.
5. There are lot of examples on D3, but none(as per my knowledge) examples for linking and updating graphs simultaneously.

7) CONCLUSION:

1. This web application will be useful for non technical staff and stakeholders to quickly take decisions.
2. Various details at different levels allows them to use their marketing strategies for right person at the right time.
3. D3 javascript framework is the great library for building graphs. It requires knowledge of DOM and SVG.
4. Interactivity and dynamic graphs introduced in this paper, should be further explored.
5. Simple graphs via interactivity can give deep insights.

8) FUTURE WORK:

1. Turn this web application to android application.
2. Implement or include barcode api to insert, update and delete products.
3. Include more layers to go in granularity.
4. Improve front end by taking some feedback.
5. Taking survey for non technical and technical analysts to understand benefits of the interactivity and dynamic graphs.

9) LINKS:

1)Source code:

<https://github.com/NidhiPankajShah/InteractiveAndDynamicDataVisualization>

2) Project report(PDF):

<https://github.com/NidhiPankajShah/InteractiveAndDynamicDataVisualization/blob/master/CMPS%202021-DataVisualizationProjectReport.pdf>

3) Online project report:

<https://nidhipankajshah.github.io/Website2/>

4) Dataset:

<https://archive.ics.uci.edu/ml/datasets/Online+Retail>

9) REFERENCES:

<https://docs.microsoft.com/en-us/power-bi/consumer/end-user-drill>

<https://apandre.wordpress.com/visible-data/drilldown/>

<https://www.jinfont.com/resources/bi-defined/drill-down-drill-through/>

<https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7846608&tag=1>

<http://vis.stanford.edu/files/2011-D3-InfoVis.pdf>

<https://dl.acm.org/citation.cfm?id=2068631>

<http://uu.divaportal.org/smash/get/diva2:1211346/FULLTEXT01.pdf>

<http://getdolphins.com/blog/interactive-data-visualizations-new-york-times/>

https://www.researchgate.net/publication/311456424_Sensemaking_with_Interactive_Data_Visualization

<https://arxiv.org/ftp/arxiv/papers/1805/1805.11300.pdf>

<https://jeffjianzhao.bitbucket.io/papers/thesis-zhao.pdf>

<https://bl.ocks.org/mbostock>

<https://github.com/d3/d3/wiki/Tutorials>