

# DonVis: An Interactive Tool for Donation Information Visualization

Arthur Sun, *Graduate Student, University of British Columbia*  
Tian Huaying, *Graduate Student, University of British Columbia*

**Abstract**—In recent years, public donation has already been widely accepted as an effective and efficient way to help people or communities who are in urgent needs of public help considering their current financial situations. The great influence of mass media has strongly raised people's awareness of public donation. Many people are enthusiastic about public donation but have no idea about where to donate. Nowadays, we witness an astonishing amount of public donations which has been noted by various non-governmental organizations (NGO). However, as for specific donation like classroom donation, which aims at donating to those mostly needed schools in high-poverty areas all over the world, many people may not know much about it. Unlike other public donations like disaster donation, classroom donation has not been paid enough attention due to the lack of relevant information and government support. In order to deal with the problem, we would like to introduce DonVis - an interactive tool for classroom donation visualization, to visualize the distribution and situation of classroom donations across several states and give those people who are enthusiastic about it useful information when they're making their donation choices.

**Index Terms**—Data Visualization, DonVis, Classroom Donation Visualization, Donation Analysis, Web Donation Visualization

---

## 1 INTRODUCTION

Nowadays, an increasing number of governments have started to realize that helping people or communities who are in urgent needs of public help is becoming increasingly significant in building a harmonious society. Under such circumstances, non-governmental organizations (which is known as NGO) is occupying an increasingly important position in helping individuals live better. Public donation is often regarded as an effective way to ease the living pressure of the poor. According to recent studies, people tend to donate money to those who are similar or familiar to them because people are group-aware[1]. However, there exist certain circumstances when individuals are willing to make a donation but do not have certain targets to donate to in their minds, and the number of those people is increasing at a high speed. Those people are willing to make donations to help others, but due to the lack of relevant information, they do not know who and which places are in urgent needs of public financial help. Thus, it is clear that donation recommendation plays an important role in helping the public and the people to get a better understanding about where donation is mostly needed and help is mostly appreciated[2].

The notion for donation information visualization was based on an accidental browse on YouTube about an American citizen who was doing charity work for Project Hope in China. He was really helpful and willing to contribute most of his energy and time to the charity business of China but found out that many poorest areas in China didn't receive governmental support for funding. The enthusiastic American wanted to donate money to the places which were in desperate needs of help with his friends, but sooner they found there was a huge gap between public's attention and their desperate needs of help due to the lack of relevant information on where to donate. Easy access to sufficient donation information helps a lot in public donation.

At first, we try to find an open dataset which is about donation status of Project Hope in China, but we failed to find a suitable one for our project. By accident, we found the classroom donation dataset for US on donorschoose.org, which is similar to that of China since both of them focus on classroom donation.

We hope our project can be a stepping stone for people to realize that there are still many places in the world where classroom donation is urgently needed, but due to some reasons, we may not have the access to know about it and realize it. In this case, classroom information visualization can help us solve the problem.

As for public classroom donation in the US, with the help of the class-

room dataset from Donorschoose.org, users can utilize certain information visualization system to visualize the dataset. The users can easily find that the amount of book donation in L.A for Grade 3 is much less sufficient than those in N.Y. If you are counting on reliable information source to give you recommendation about user donation, then the visualization tool will enlighten the user for recommendation to donate to L.A rather than N.Y. It is clear that given sufficient information and appropriate recommendation, most people would change their donation behavior on seeing the actual results, and donate to the state where public donation is mostly needed. However, there may exist certain doubts that people's donation behavior can be changed based on the visualization result to change their will to donate from one state to another. It may make sense under certain circumstances (i.e. it is the school where the user attended before, or the user was born in this state or some other reasons), but many people do not have certain targets before they donate. According to the investigation in this field, it is clear that appropriate guidance can make a big difference in public donation, especially to those who have no targets in their minds at the beginning. Moreover, a great proportion of people still have strong wills to donate to the places which are in desperate needs of public help rather than the places with personal emotions. Personal emotion is much less important than we thought, and people tend donate to the places where donation is desperately needed, which is the core meaning of public donation. Given this example, we want to clarify the goal for our visualization: to show relevant and reliable information about public donation, to give the public better understanding of the data, to illustrate which places are in urgent needs of help, and to give people recommendation on where to donate. Under such circumstances, it is of vital significance to visualize the data in classroom donation domain.

## 2 RELATED WORK

### 2.1 Public Donations

As for now, due to the fast development of big data analytic, there is an increasing number of startups and companies which are focusing on providing data strategy and recommendation to Non-Governmental Organization (NGO). This enables organization to have a better understanding about where the help is mostly needed. Websites such as Guide Star, specialize in providing enterprise solution for company and occupy the world's largest source of information on NGO donation[3]. Charity Navigator is a global platform which provides online donation foundation for a variety of donation projects which are currently used all over the world[4]. American Institute of Philanthropy is the largest donation decision recommendation website in the US which provides accurate watchdog information to help donors

---

• Arthur Sun is with Dependable Lab at ECE UBC. E-mail: sunb@ece.ubc.ca

make informed decision[5]. It provides charity rankings for the best NGO organizations and top-rated charity communities which inform people how to donate to the nearest NGO to help those in need. However, it is obvious that web organizations we mentioned above only give recommendations for the public on how to obtain information of certain NGOs and the places where certain NGOs are mainly focus on. Althoff, Tim, Leskovec, and Jure investigated online community donation project like donorschoose.org to study an online crowdfunding platform which enables people to get an overview of how people make their donations [6]. They explore various factors contributing to donor retention to identify different groups of donors and quantify their propensity to subsequent donations. Finally, they conclude that donors are more likely to re-donate if they had a positive interaction with the donation recipients. It is quite obvious that with the development of web technologies, donation choices for people are becoming more and more diverse, especially with website like donorschoose.org, which can make crowdfunding possible without the traditional help of NGOs. For certain donation specific visualization application, Tavi Nathanson, Ephrat Bitton and Ken Goldberg proposed a domain specific dashboard recommendation system that recommends non-profit organizations specific donation to users in the form of a portfolio of donation amounts, which is derived from a certain database for data integration and clustering[7]. Recommendations are made using Eigentaste 2.0 constant-time collaborative filtering algorithm in combination with a weighted portfolio of recommendations, which is fast in data processing but lacks specific visualization interface to show an overview donation status from NGOs. White, Howard, McGillivray, and Mark proposed Suits' index and McGillivray's adjusted performance index to help the public evaluating donor allocation performance with respect to the average income of recipients[8]. This proves to be an effective way to improve the performance of different donation objects, but it is far more complicated for ordinary people to use and get a clear picture in a short time. As for sharing visualization techniques which are popular among nowadays visualization industry, Murray mentioned interactive visualization technology called D3.js in his book, which is a popular data-driven visualization open-source framework based on javascript. It achieves rapid rendering speed with support for most of the existing web framework, which is a huge step towards web visualization technology[9].

Gregor Aisch developed an interactive graph which shows the network of German party donations from individuals and companies over 50 European countries using D3.js for data visualization using end-to-end line connection graph[10]. However, there exists certain limitations despite its advantage of instant overview of each party's donation source with end-to-end line connection as encoding technique, round line-connection graph cannot clearly show the individual donation amount and total part donation amount. Furthermore, it doesn't propose an interactive method for filtering, navigation and zooming, which makes reader hard to find detail information they want.

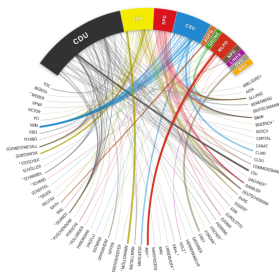


Fig. 1. German Party Donation Visualization

## 2.2 Sharing Visualizations

Asawari Samant [11] used Elastic Stack for data processing, Python to set up simple back-end server and DC.js to achieve the visualization of project and classroom datasets from DonorsChoose.org. They used

multiple static number display for donation amount display, GeoJSON to display the donation location in US as well as bar chart to show the donation trend by year. However, it lacks data selection and interaction with user because they provide no view for interaction and the project is only for data display.

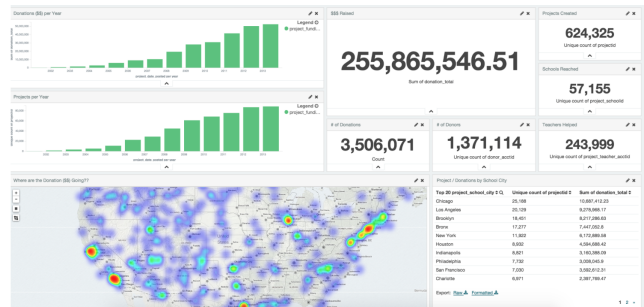


Fig. 2. Elastic Stack Data Visualization for Donorschoose.com

AADMI Party [12] released a website specializing in transparently analyzing the donations being received by the Aam Admi Party using traditional HTML+CSS technique while connecting to the parties official donation database, it presents live data for the public for live show. However, their encoding technique is not satisfactory because it is clear that multiple pie charts are used to show donation percentage from 15 countries, which makes people hard to see the difference between the low-contribution countries. Furthermore, no zooming or filtering is available for user to select the data they want.

Tableau proposed comprehensive donation portfolio visualization us-

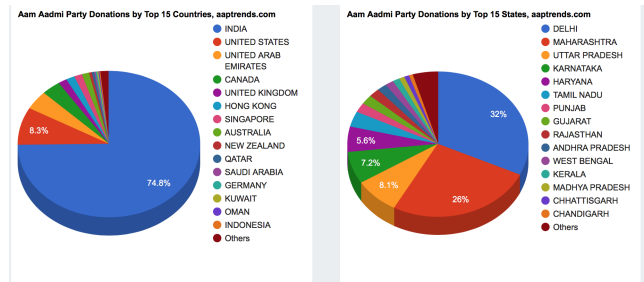


Fig. 3. AADMI Party Visualization

ing its own developed technology to show donation location in detail with summation of donation which can be filtered by amount in GeoJSON data and a menu for multiple selection for geographical location ranging from Central, East, South and West and visualization of donation trends by demographic using multiple composite line graph. It enjoys a good interaction with user with easy-to-use manipulation methods including zooming, filtering, and pinpoint for location. However, it is an enterprise version of software which requires certain amount of money for trial and license.

## 3 DATA AND TASK ABSTRACTIONS

### 3.1 Dataset

Donation data was collected from an open dataset called classroom dataset from crowdfunding website Donorschoose.org with downloadable format in CSV for six states, from September, 2002 to March, 2008. The original dataset is a two-dimension table with 1,048,576 items and 43 categorical key attributes which is more than 500MB in size.

### 3.2 Data Abstraction

#### 3.2.1 DataSet

Instead of choosing all items, we choose 9,000 items in order to avoid significant real-time processing delay, ensuring each state with 1490

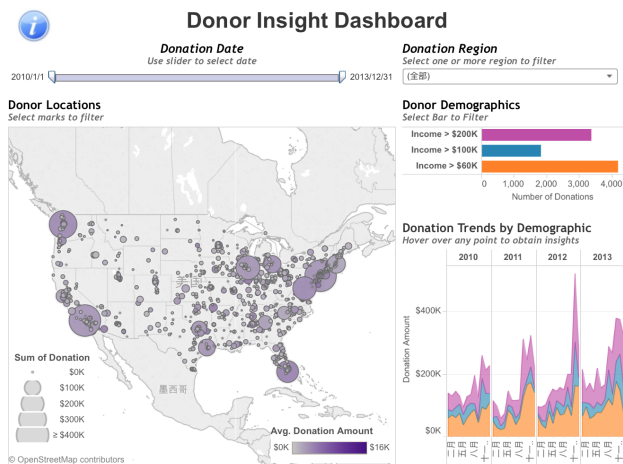


Fig. 4. Tableau Non-Profit Visualization

items. The way we choose the data is by randomly choosing from the pool but keep each state with 1490 items for fair comparison. As for the attributes, since we want to visualize state-specific donation by grade, year, resource type, poverty level, funding status, and donation amount, which occupy the most significant parts of people's donation choice making process, we define these 7 attributes as our key attributes. Resource types and funding status are categorical attributes, whereas grade levels, year, and poverty levels are ordered attributes. Besides, donation amount is a quantitative attribute. According to the effective and expressive rules of visualization, grade levels and poverty levels should be ordered from the lowest to the highest. Below is the original attributes extracted from classroom datasets.

- School State: California(CA), Illinois(IL), North Carolina(NC), South Carolina(SC), New York(NY), Texas(TX)
- Resource Type: Book, Supplies, Technology, Organized Trips, Other
- Poverty Level: Low, Moderate, High, Highest
- Year: 2002,2003,2004,2005,2006,2007,2008
- Funding Status: Expired, Completed
- Grade Level: PreK-2, Grade 3-5, 6-8, 9-12
- Donation Amount: Counted in thousand US Dollars, positive

The key attribute Grade level is a derived data. In the original dataset, grade levels are classified into PreK, grade 1, grade 2, grade 3 etc. In this case, it is not effective at all, we do not need to know this in details. As a result, the range of original attribute grade level is partitioned into bins, and the number of items that fall into each bin is computed and saved as a derived ordered quantitative attribute. It is binned into 4 blocks due to different study levels, known as PreK-2, Grade 3-5 etc. The Data Abstraction Tasks includes:

- Select 9000 items out of 1,048,576 items and 7 key attributes out of 43 attributes.
- Generate derived data by SQL COUNT(), GROUP BY(), ORDER BY() from raw items

### 3.3 Tasks Abstraction

DonVis is intended to be used by those who are enthusiastic about classroom donation but have no idea about where to donate since there is a lack of enough information about the areas in urgent need of public help. However, as we can learn in related work session,

specific donation like classroom donation, which aims at donating to those mostly needed schools in high-poverty areas in every country has not been paid enough attention. Under such circumstances, the main tasks that DonVis supports are:

1. Enjoy classroom donation statistics and visualizations
2. Discover a specific state's donation amount of different attributes: year, resource type, poverty level, and funding status
3. Compare donation distribution differences of a specific attribute among these states
4. Present general and specific donation trend
5. Give user recommendation on donation state and items given certain dataset
6. Explore appropriate information visualization portfolio for donation dataset visualization
7. Implement a front-end and back-end system with less real-time processing delay.
8. Visualize state general and specific donation trend and mutual difference by certain time interval

We abstract the above tasks into abstract tasks descriptions:

1. A general time interval selection function to enable user to choose time interval for specific time pinpoint.
2. A detailed state comparison chart for overall donation comparison of donation amount given the above time interval.
3. Comprehensive views of donation amount sorted and grouped by grade, poverty level and resource type.

## 4 DONVIS

We combine the latest web technologies D3.js with open dataset from donnorschoose.org to find out the distribution of classroom donation in the US. In this way we can give public donors interactive web-based donation recommendations just by clicking the mouse. DonVis is characterized as an interactive method between the user and the back-end database to achieve real-time data refreshing and loading with hard-to-notice delay. DonVis also provides a new insight into specific donation target: classroom donation, which used to be a government-sponsor funding project but due to certain factors, abundant funding is not available. This requires immediate public help to those children. Recommendation in DonVis also has an advantage because it is obvious that illustrative pictures are more acceptable to an ordinary person than descriptive words. DonVis combines multiple dimensions of data encoding into concrete illustrative pictures to offer people with better idea of the overall picture of current donation situation. We hope our project can be a stepping stone for people to realize that there are still many places in the world where donation is urgently needed but due to certain conditions.

## 5 SOLUTION

### 5.1 Overall Goal

DonVis is intended to support people who are enthusiastic about public donation but have no idea about where to donate. To make the solution as accessible as possible for most people, we implemented it by web technologies due to the fact that nowadays, web surfing has already become an everyday habit for most people. We want to use existing dataset of classroom donation projects provided by Donorschoose.org to help people understand and discover the fact that although the notion of public donation is widely-spread and supported by public or governments, yet most people don't have the access to know the truth that some areas obtain much donation while other

areas may be neglected. The unbalance between these areas need to be solved by public. Based on the goal of the previous work, we are planning to discover and derive the most needed states for public donation and what are most needed for donation: books, classroom or others given by the dataset we choose and illustrate the trend of donation given by year and by state.

For high-level target we want to show a trend, which is a high-level characterization of a pattern in the data and we want to show the trend of donation in six states to give people recommendation when they want to donate.

For low-level targets down to an attribute, we want to classify the distribution of each individual attribute we extracted from dataset: resource type, poverty level, funding status, etc which is correlated and have dependencies with previous chosen state and year.

We aim to provide target users with the easiest way to control the interactive visualization, to give the access to choose what kind of information they want to obtain and to give them a bird's overview with all the information in the dataset. So we are going to use multiple linked views and a selection tool to allow users to choose which state and time duration they are interested in. This visualization tool can search for states and years in detail with regard to the locations, which often begin from an overview of the whole dataset.

## 5.2 Reduce

As for the original dataset, there are more than 1,048,576 items, but we only need 9,000 items in our project. That is to say, we need to reduce. Typically, static data reduction idioms only reduce what is shown, as the name suggests. However, in the dynamic case, the outcome of changing a parameter or a choice may result in an increase in the number of visible elements. In order to solve the problem, we use attribute filtering and item filtering to reduce attributes and items respectively. The design choice of filtering is a straightforward way to reduce the number of attributes and items shown: some attributes are simply eliminated. Then we will use the result as the idiom for reduce stage because after a user select specific state and time during, requests will be sent to back-end database for sum() and select() calculation for aggregation, the different categories of most needed goods, etc, which will give a comprehensive view of what the viewer has chosen.

## 5.3 Aggregation

Data aggregation is necessary after reduce because donation information based on user's choice need to be specifically calculated by total amount of donation and total count of resource types, etc. We do item aggregation based on attributes after reduce stage by SQL. Below is the detailed process for aggregation by SQL to formulate the derived data for the project.

- Resource-Type: SUM() of resource type ordered by different types of resources
- Poverty-Level: SUM() of poverty level ordered by different types of poverty level
- Funding-Status: SUM() of funding status ordered by expired and completed
- Grade-Level: SUM() of grade level ordered by different types of grade level
- Funding-Status: Expired, Completed
- Grade-Level: PreK-2, Grade 3-5, 6-8, 9-12
- Donation-Amount-Time: SUM() of donation amount ordered by School State, Resource Type, Poverty Level and Grade Level group by Year
- ProjectbyResource: Resource-Type.GROUP()

- ProjectbyPoverty: Poverty-Level.GROUP()
- ProjectbyFunding: Funding-Status.GROUP()
- ProjectbyGrade: Grade-Level.GROUP()

## 5.4 Encoding Techniques

Encoding is the most important part of data visualization because this step will transform the abstract data into user-friendly visualized forms. The encoding techniques of DonVis are briefly summarized as follows:

- How: Encode: multiple linked bar chart, marks ordered by the quantitative, multiple linked donut chart, histogram the range of the original grade level into bins, color hues, color luminance;
- Manipulate: Navigate with pan/scroll/click, select and highlight;
- How: Facet: Multiple linked highlighting and shared attribute aggregation, overview-detail with selection in overview then populate detail view, superimposed line charts, share data;
- How: Reduce: Filtering, dynamic aggregation

## 5.5 DonVis Interface

This section introduces the interface for DonVis from a user's perspective.

- Superimposed total donation amount: For exploring total donation amount of a specific state you select or all states. Besides, you can use the reset button to get the original overview; This part supports DonVis tasks 1,2,5,7. See Fig.5.

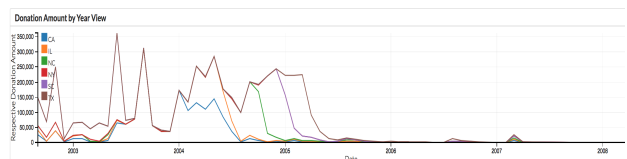


Fig. 5. Superimposed Total Donation Amount

- The amount of donation changed by time: For showing donation trends over time according to the time interval you select; This part supports DonVis tasks 1,2,4,6. See Fig.6.



Fig. 6. Donation Trends by Time Interval

- Donation Count by different resource types: For comparing the resource types of donation amount of different states; This part supports DonVis tasks 1, 2 and 3. See Fig.7.
- Funding status: For exploring the proportion of completed and expired public donation; This part supports DonVis tasks 1, 2 and 3. See Fig.8.
- Donation Amount By Grade: For showing donation amount by 4 different grade groups; This part supports DonVis tasks 1, 2 and 3. See Fig.9.



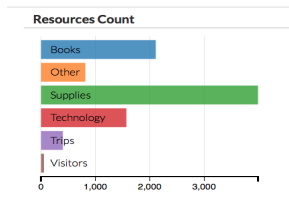


Fig. 7. Donation Count by Resource Types

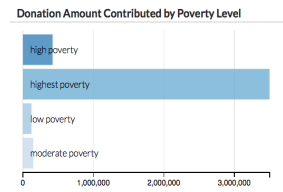


Fig. 10. Donation Amount By Poverty Level

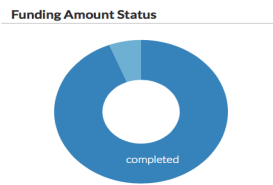


Fig. 8. Donation Count by Resource Types

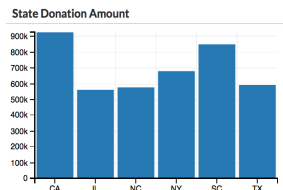


Fig. 11. State Donation Amount

- Donation Amount By Poverty Level: For illustrating donation amount by 4 levels ordered from low poverty level to highest poverty level; This part supports DonVis tasks 1, 2 and 3. See Fig.10.
- State Donation Amount: For comparing the total amount of six states; This part supports DonVis tasks 1, 2 and 3. See Fig.11.

### 5.5.1 Donation Amount by Year View

Multiple linked views is used to show the overall donation by a specific time duration, which can give clear information to the target users. We use superimposed line chart where several lines representing different data items are superimposed to create combined charts to show the donation amount of six states at the same time. This simple superimposition works well because the only mark is a thin line that is mostly disjoint with the other marks.

In the second donation amount by year view, the target users can control the time frame, choose what time range they are interested in to see corresponding tendency in different aspects. The central benefit of the multiple linked view is in seeing how a region that is contiguous in one view is distributed within another. The rationale behind multiform encoding across views is that a single monolithic view has strong limits on the number of attributes that can be shown simultaneously without introducing too much visual clutter. With multiple linked views as opposed to a single view, each view does not have to show all of the attributes. They can each show only a subset of the attributes, avoiding the visual clutter of trying to superimpose too many attributes in a single view.

All the figures are corresponded to the time range you choose. DonVis can help you see from an overview, then check more details and make comparisons between them. After using this visualization tool, it is much easier for the user to figure out the most needed areas, and donate money to the place.

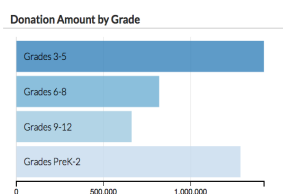


Fig. 9. Donation Amount By Grade

### 5.5.2 Grades, Poverty Level, Resources

For composition of resources and donation by grades, class, poverty levels, bar chart can best show the percentage of composition by different categories. The reason why we don't use line chart is largely due to the fact that they have a stronger implication of trend relationships, making them more suitable for the abstract task of spotting trends. Bar charts are the best-known examples for an idiom which shows one key and one value attribute, and are convenient to lookup and compare values. The key attributes like poverty levels and class, separate the marks along the vertical spatial axis. The value attribute, like amount of donation, expresses the value with aligned horizontal spatial position and line marks. Bar charts encourage discrete comparisons, which is exactly what we need, while line graphs encourage trend assessments.

### 5.5.3 Funding

Donut chart for funding status can best illustrate the proportion of the completed and expired statuses since there are just two statuses and using other visualization method will not be so efficient and clear to see. The most useful property of donut charts is that they show the relative contribution of parts to a whole, which is exactly what we want to show in our system. In funding system, what we care most is not the exact number of completed funding and expired funding, we just want to have a whole overview of funding status, so donut chart is the most suitable choice. As a result, we choose donut chart to show the funding status.

### 5.5.4 Multiple Linked Views

With multiple linked views as opposed to a single view, each view does not have to show all of the attributes; they can each show only a subset of the attributes, avoiding the visual clutter of trying to superimpose too many attributes in a single view. Even if two views show exactly the same set of attributes, the visual channels used to encode can differ.

## 6 IMPLEMENTATION

### 6.1 Applied Technology

We implement our system into two parts: the back-end database system using MongoDB and front-end Web system using Node.JS to establish the main Web framework and D3.js for donation data visualization with interactive response.

The reasons for building a comprehensive system can be listed as follows:

1. MongoDB: We take scalability into consideration for future dataset expansion because current database we are using is just 40MB total in CSV form. However, for real circumstances for donation information with scale for the total U.S, it may be consisted up to more than several gigabytes in scale. We regard MongoDB as a very popular NoSQL database as high-scalable for the back-end database for storing and processing JSON format data and it did show great advantage comparing to storing data and read directly from local files because of their fast processing speed by processing CSV format with 103,000 items for SQL data processing in less than 5 seconds.
2. Node.js: We use Node.js because of its easy-to-use feature and strong supports for most popular visualization plugin and framework with great support for various web browser framework like Chrome, FireFox, etc. Furthermore, it seamlessly integrates JavaScript runtime the purpose of fast building scalable internet applications, which is exactly the fundamental technical point for DonVis for the realization of real-time data-interactive web application
3. D3.js: D3.js is a perfect tool for easy-to-use and easy-to-implement visualization-driven web development because it accelerates the development process for the creation SVG based chart rendering into html DOM blocks with CSS. Furthermore, we adopts D3.js because it is open-source and plenty of online tutorials can be found for implementation in a short period of time.
4. DC.js: We use DC.js with the help to D3.js for quick data rendering into chart because it provides simple yet powerful chart generation functions within a few lines of code. However, there still exists a problem that the chart library of DC.js is still relatively small and for advanced chart rendering with customized requirement, we will need to find another tool.
5. Queue.js: Queue.js is a library of asynchronous data cleansing and processing template with easy-to-access APIs for javascript programming. The reason we use this JavaScript library is because it can easily help jQuery to read the MongoDB data by using Mongoose plugin in JavaScript.
6. Crossfilter.js: It is the most important part of real-time data rendering by user's command because it simplifies the real-time data slicing and grouping for browser based multivariate dataset visualization, which is the most important part of DonVis because DonVis enables real-time data manipulation by user's define of control.

## 6.2 What Have We Done for DonVis

DonVis fully utilizes the above open source JavaScript library and database to realize the whole DonVis. We implement DonVis by the following steps:

1. Import selected 7 data attributes with 9,000 items from the CSV dataset of classroom projects from [Donnorschoose.org](http://Donnorschoose.org) into MongoDB using `mongoimport` function.
2. Write SQL script to import into MongoDB for automation derived data generation and store derived data into MongoDB for further front-end system usage.
3. Set up Node.js server with localhost: 8,080 as local port for browser environment and use NPM install to install DC.js, D3.js, Query.js, Crossfilter.js into Node.js local folder.
4. Write Java script by using jQuery to import derived data into a queue-like data structure defined by Queue.js.
5. Write script using Crossfilter.js library to slice the queue data into real-time multi-property variables which will be used as the source data for chart rendering.

6. Write script using DC.js to define various chart styles with data import from previous step and define index.html with CSS to create DOM objects for all charts.

All above source code can be found in the source code package.

## 7 RESULTS

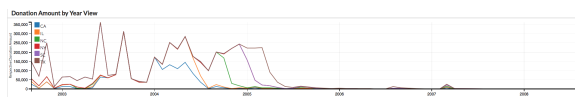
### 7.1 Scenario

In this scenario, Jeremy, a student who is enthusiastic about classroom donation but have no idea about where to donate, want to find out more clear information about how classroom donation is distributed and where money is most needed among all states.

First of all, when he uses this tool at first, he can see an overview of our visualization system. There are two numbers on the top. The left one is the total donation count number, whereas the second one is the total donation amount. Right below the two numbers, he can see there

Donation Count number	Donation Amount
8941	4.19M

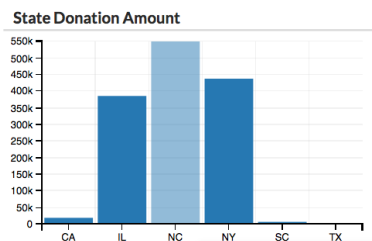
are two figures called donation amount by year view. The first one shows 6 different lines, which represents 6 different states. From this figure, Jeremy finds it is easy to compare their trends. Then Jeremy sees the donation amount trend of six states respectively by clicking each color cube. Then Jeremy moves to the second figure called



donation amount by year view. Although they share the same name, but they have totally different functions. In this figure, Jeremy choose a time range he is interested in, i.e from April, 2004-January, 2005. All other figures change corresponds to his choice, and he can select

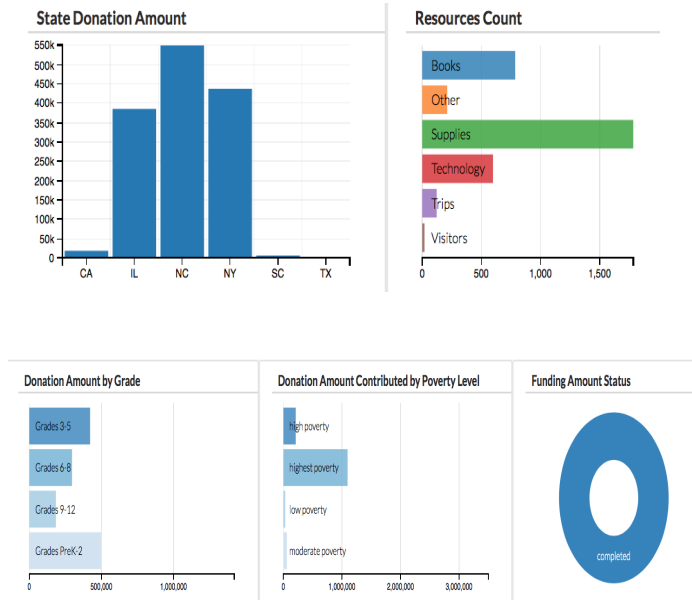


any time range he is interested in. This graph gives donation amount of all the states you select on the top left. Jeremy is from N.Y., then he select N.Y. on the selection button. Jeremy is curious about the donation amount of the six states during April, 2004-January, 2005 and even want to know the exact donation amount of each state. He moves down to the state donation amount figure, gets an overview of the relevant amount of each state and then check the exact donation amount of each state by clicking the mouse on corresponding state. Jeremy then wants to see the total donation amount of two states-CA



and IL, then he click both of them in figure state donation amount. This system allows him to choose multiple choices in every single figure. Jeremy wants to find out what kind of resource occupies the most significant part in people's classroom donation. He can find it easily in figure resources count and he can even observe the exact resource count by clicking different resource types in the

figure. At the bottom of the interface, Jeremy donation amount by grade, donation amount by poverty level and funding status. Just like previous figures, he can choose multiple choices at once and see the exact donation amount by clicking in the corresponding areas. After seeing so many graphs, Jeremy has already made his decision about where to donate.



Since we use multiple linked views in our visualization, all the graphs are changing corresponding to the time range you select. Our system can help you see from an overview, check more details and make comparisons. After using this visualization, it is much easier for the user to figure out the most needed areas, and donate money to the place.

## 8 DISCUSSION AND FUTURE WORK

### 8.1 Discussion

#### 8.1.1 Data

The dataset we use is not very up-to-date since there is no up-to-date dataset available on donorschoose.org. Besides, the dataset is not very complete, with only six states available. It would be more helpful if we can get the dataset of all the states. By obtaining complete datasets, we can do visualization better and our target users will find it more practical when they are making their donation choices. Besides, we think it would be better if we take the population of the six states into account. Without enough information about the population, the target users may find it difficult to determine the donation amount is whether sufficient or in lack. Same donation amount in N.Y. and Rhode Island are really not the same. In order to solve the problem, we can design an algorithm or a weighing coefficient to this visualization system so that people can have a brief overview of where to donate rather than using our system, surfing the Internet to check the population and making comparisons in their minds.

#### 8.1.2 Visual Encoding Techniques

In our time range selection area, we can select any time range you're interested in, and the granularity is by day. However, one limitation is that we do not know the exact time range we select, instead, we can only know the rough date, which we think can be improved in our future work. Although this may not be very significant in people's donation choice making process, but it is a good way to improve our visualization tool according to expressive and effective rule of visualization design. Due to the time limits, we do not superimpose on every

single view. However, we think it would be more helpful if we can superimpose on every single view. In that way, target users can get a better understanding of comparisons between several states. Besides, currently, users need to look at two different visualizations placed side by side to identify the differences between several states. A better solution would be to compute and display the differences directly.

### 8.2 Future Work

Our existing system has a number of limitations that we plan to address in future work. First, there is several shortcomings that comes from using a incomplete dataset. In order to give our target users a better understanding of today's classroom donation, we are going to extend our dataset to 10K and try to find up-to date dataset. We also need to implement more sophisticated caching schemes that allows us to handle much larger datasets. Second, we need to introduce more complex decision-making visualization technique to help user to make more personalized donation decision. For example, we are going to use an algorithm or weighing factor to find a balance between donation amount and the population of the state. Currently, our target customers have to use our system and then search for information about population on the website. We would like to analyze relevant papers about how to define a weighing factor, and then make it more practical to use. Third, as we mentioned above, currently users need to look at two different visualizations placed side by side to identify the differences of different attributes between several states. A better solution would be to compute and display the differences directly in our future system. Fourth, the time range granularity is by day, however, both of us think that it would be more effective if we introduce a granularity selection tool. Granularity selection tool allows target users to look at the time range at different levels of scale, which displayed different features of the data, and could be on demand. Fifth, since we are visualizing donation visualization in the US, another component target users would like to see integrated into the system is a map view. This issue needs further exploration since we tried this early in the project, but we were not satisfied with the results. Last but not least, we would like to use superimpose on every single view.

### 8.3 Lessons Learned

In this project, we've learned a lot. First of all, we learned how to manage a project. Both of us have never done a project before, this gives us a chance to manage a project using the knowledge we have learned in the course. Second, we learned how to do teamwork, how to allocate our jobs and how to come up with good solutions together. Unlike individual work, we need to discuss and compromise. Third, we learned a lot technical skills. Since both of us are in Electrical Engineering, we do not know much about the back-end database system and front-end Web system. We need to learn from the very beginning in order to do the project. But now, we are quite familiar with D3.js, Dc.js, Cross-filter, node.js, and mongo.db. We may not know these cutting-edge technologies if we didn't take the course in CS faculty, which strongly broaden our horizons. Last but not least, we learn the importance of time management. Time is really precious since we need to start from the very beginning, and poor time management may result in failure of the project. Although there are still many things need to be improved in our project, we are quite satisfied with it due to the lack of relevant backgrounds. We've tried our best, and this experience is well worth memorizing.

## 9 CONCLUSION

DonVis gives target users an overview of general donation trends and helps users with real-time data recommendation according to the various attributes they choose. It enriches data source with scalable back-end database system, and interactive chart rendering tools with relatively low response time. The real-time processing delay is relatively low. Given specific donation dataset, DonVis gives user comprehensive data discovery experience to help users better understand classroom donation distribution. For users with little experience in navigating previous visualization software, DonVis exhibits easy-to-use characteristic for user because it requires no previous experience and user

can actually learn the use of DonVis in several minutes. In conclusion, DonVis is a scalable, easy-to-use and real-time interactive donation visualization tool for users.

## REFERENCES

- [1] Karen Page Winterich, Vikas Mittal, and William T Ross. Donation behavior toward in-groups and out-groups: The role of gender and moral identity. *Journal of Consumer Research*, 36(2):199–214, 2009.
- [2] Beth Breeze. How donors choose charities: the role of personal taste and experiences in giving decisions. *Voluntary Sector Review*, 4(2):165–183, 2013.
- [3] GuideStar. Donation recommendation, 4 2015.
- [4] Charity navigator - <http://www.charitynavigator.org>.
- [5] American Institute of Philanthropy. American institute of philanthropy.
- [6] Tim Althoff and Jure Leskovec. Donor retention in online crowdfunding communities: A case study of donorschoose. org. *International World Wide Web Conferences Steering Committee*, pages 34–44, 2015.
- [7] Tavi Nathanson, Ephrat Bitton, and Ken Goldberg. Donation dashboard: a recommender system for donation portfolios. *Proceedings of the third ACM conference on Recommender systems*, pages 253–256, 2009.
- [8] Howard White and Mark McGillivray. How well is aid allocated? descriptive measures of aid allocation: a survey of methodology and results. *Development and Change*, 26(1):163–183, 1995.
- [9] Scott Murray. *Interactive data visualization for the Web*. O’Reilly Media, Inc., 2013.
- [10] German party donations from individuals and companies, 2015.
- [11] Asawari Samant. Data visualization using elastic stack for donorschoose.
- [12] AADMI Party. Aam admi party donation visualization, 2006.