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Visualisation Application Development for Mosque Financial Report Using Linked Data and Crowd-sourcing

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Abstract

Indonesia is a country with the largest Muslim population in the world. In 2014, the number of mosques is 850 thousands. The lack of financial information of the mosques for public is the main problem. As a result, the funds cannot distribute evenly to each mosque. Therefore, a centralised mosque financial report to collect and publish mosque financial information is developed in this research. Collecting mosque financial information from all mosques is not easy task. Thus, we use crowdsourcing method for getting input from citizens who often come to mosque. These collected data will then be compiled into a relational database. We generate public data in the Linked Data format every month. Through the Linked Data technology, the financial data can be accessed by anyone for a particular application development using financial data mosque.

1. Introduction

Indonesia is a country with the largest Muslim population in the world where the Muslim population in Indonesia reached 88% of the total population[1]. Thus, Indonesia would also have a lot of mosques as a place of worship for Muslims. In 2014 there were approximately 850,000 mosques[2]. As one of public services, management of a mosque is mostly carried out by a group of local volunteers. A mosque funding generally is obtained from its local community. The mosque board generally publish the financial information at a traditional whiteboard and speech during Friday prayer. Donors who are not located around the mosque, get difficulty to distribute their funds to certain mosques because of the unavailability of public and real time mosques financial information. As a result, the mosque fund distribution sometimes is only populated in a certain area. Therefore, the mosque should submit public financial reports. However, to the best of our knowledge, there is no a centralised mosque financial report to collect and publish mosque financial information. Collecting mosque financial information from all mosques is not easy task. Thus, we use crowdsourcing method for getting input from citizens who often come to mosque. According to a survey conducted by TNS Infratest, Yahoo and e-Marketer about online activities carried out by mobile internet users in Indonesia in mid quarter of 2012, activity for accessing social media website is in the first rank (76%). Thus, it is a great potential to use data from social media to produce useful information. In this work, Twitter is used for collecting data from user since as of 4th quarter 2014 Twitter penetration in Indonesia was 11% [3]
These collected data will then be compiled into a relational database. We generate public data in the Linked Data[4] format every month. By utilising the Linked Data technologies, mosque financial data will be easily accessible by other applications connected to various other external data sources. For instance, we can see the role of mosque in term of welfare improvement by combining the mosque financial report and poverty rate.

The primary contributions of our work are: 1) Propose a centralised mosque financial report ; 2) publishing the mosque financial report in the Linked Data format. In the remainder of this paper starts with reviewing related works in Section 2 followed by our methodology in Section 3. The system is evaluated in Section 4. Finally, we conclude it in Section 6.

2. Related works

MosqueLife [5] and Masjeed [6] are two mosque social medias that allow its user to report about mosque activities. MosqueLife is a web based application, while Masjeed is an Android application. These social media focus only on mosque activities, they do no provide the mosque financial report. Fikri [7] developed an accounting information system for a mosque in Lampung. Likewise, Nico [8] proposed a web accounting information system for a group of registered mosques. These applications depend on mosque board which does not often update the financial information.

There are several noteworthy crowdsourcing applications such as Peta Jakarta[9] and PetaJakarta.org is an application that presents real time information about flooding in Jakarta area. The crowdsourcing input is from twitter. Netcitizen who reports the flooding information must mention @petajkt following by #banjir hashtag. This application shows the user reports through a Jakarta map. [10] presented crowdsourcing applications for Haiti disaster relief namely CrisisCamp Haiti, OpenStreetMap, Ushahidi, and GeoCommons.

3. Methodology

This section describes our methodology for gathering and visualising data.

3.1. Preliminary

We initially define terminology used in our work. There are three main components in this work namely mosque, user and financial report which can be explained as follows.

A list of mosques that is published by Ministry of Religion Affairs of Indonesia in http://simbi.kemenag.go.id/simas/index.php/profil/ is stored in this stage. In addition, the application allows user to input the frequently visited mosque. To sum up, the set of mosque data can be formally defined as follows:

Definition 1. \( M \) is a set of registered and unregistered mosques data, which can be defined \( M = \{m_1, m_2, \ldots, m_n\} \), where each \( m \) consists of name of the mosque and address of the mosque.

In order to avoid data redundancy, the Jaro-Winkler [11] is implemented for checking the similarity between the existing mosque data and the user input. The threshold level of Jaro Winkler for mosque name and mosque address are 0.8 and 0.85 respectively.

This application receives an input either from the Twitter platform or web application. If a user report through web application interface, he must login using either his Facebook, Twitter or Google account.

Definition 2. \( U \) is a set of users that report either from Twitter or web application, which can be defined \( U = \{u_1, u_2, \ldots, u_n\} \).

The last main component is a mosque financial report that can be defined as follows:

Definition 3. \( r \) is a financial report, which can be represented as a tuple \((u, m, i, e, t)\), where \( u \) is the user, \( m \) is the mosque, \( i \) is the mosque income, \( e \) is the mosque expense and \( t \) is time stamp where the data is reported.
3.2. Architecture

Figure 1 depicts our system architecture. A user can report a mosque financial information via a web form or Twitter. These inputs are stored in MySQL database and visualized in the Google Maps and charts. In term of data accuracy, we also provide a validation page which can only be accessed by a mosque board.

3.3. Data Collection

As mentioned above, there is two input types from a user: a web form and Twitter. On this form the user will input data on the mosque name, address, beginning balances, income, expenses, and the date of the final balance of financial mosque reported. The user must be logged in to their social media accounts (Facebook, Twitter, Google). Building a mosque financial data input form on the website is to provide alternative financial reporting mosque without having to go through Twitter and to reduce the error rate in the data entered by the user.

The application does not retrieve public timelines from Twitter, but the input must follow the pattern that we have defined as follows:

@opendatazis mosque name *address*income*expense#kasmasjid

opendatazis is a Twitter account that we use for receiving input from users. Regular Expression (RegEx) is used to perform parsing of any specific word or phrase on the data taken from the Twitter tweet. The data will be processed and sorted in accordance with the required data. We automatically track the data on those who do tweet to such information, mosques, address, income and expenditure of the mosque. After receiving a tweet mention from a user, we reply the tweet by saying a thank if the user uses the correct pattern. However, if the user delivers the tweet with wrong patterns, we will notify that his input are wrong. In a tweet, the user does not need to enable the GPS to transmit the location of the mosque. The location information is sent only using the address user and then we use Google Maps
to determine the location of the mosque. This is because the delivery of the GPS location of the user is a privacy and dangerous for distribution to the public.

3.4. Data Selection

We retrieve all incoming data every 15 minutes and we then aggregate the financial information for each mosque every Thursday since we assume that mosques generally announce their financial report on Friday prayer.

Let $r_1, r_2$ be financial reports in one week period. The following are possibilities of incoming data:

1. $r_1 = (u_1, m_1, i_1, e_1, t_1)$ and $r_2 = (u_2, m_2, i_2, e_2, t_2)$ if one mosque financial report is only delivered by a user.
2. $r_1 = (u_1, m_1, i_1, e_1, t_1)$ and $r_2 = (u_2, m_1, i_2, e_2, t_2)$ if several users report the same mosque, but different financial reports.
3. $r_1 = (u_1, m_1, i_1, e_1, t_1)$ and $r_2 = (u_2, m_1, i_1, e_1, t_2)$ if several users report the same mosque financial report.

To address the second and third possibilities, we propose the following methods:

- if there are multiple tweets for the same mosque, then the same income and expense for a mosque is considered as the correct input because they reinforce the information. For instance, we retrieved the following tweets:
  
  Tweet 1: @opendatazis Manarul Ilmi*ITS*750,000*200,000 #kasmasjid
  Tweet 2: @opendatazis Manarul Ilmi*ITS*750,000*200,000 #kasmasjid
  Tweet 3: @opendatazis Manarul Ilmi*ITS*650,000*100,000 #kasmasjid

  Then we choose the income and expenditure from the first or second tweet because of the same income and expense. This approach is also applied for inputs from a web form.

- The data are selected from the user who often reports information. Users that are frequently updated information will be treated as Trusted Users. This method reduces spammers who give invalid information because of certain interests.

- Lastly, we choose the data that is closest to the average of a set of data for a certain mosque. This approach will be applied when there are multiple financial information for a mosque and there is no trusted users. For example, we obtain the following tweets:
  
  Tweet 1: @opendatazis Manarul Ilmi*ITS*850,000*200,000 #kasmasjid
  Tweet 2: @opendatazis Manarul Ilmi*ITS*750,000*300,000 #kasmasjid
  Tweet 3: @opendatazis Manarul Ilmi*ITS*650,000*100,000 #kasmasjid

  The average income is $\frac{850,000+750,000+650,000}{3} = 750,000$ and average expense is $\frac{200,000+300,000+100,000}{3} = 200,000$

  then the selected income is Tweet 2 and selected expenditure is Tweet 1.

3.5. Data Dissemination

This section describes how we display data in web and present the data in Linked Data.

3.5.1. Data Visualisation

We store the list of coordinates of the location of the mosque. As shown in Figure 2, these coordinates will be used to display the location of the mosque on the map with additional other information. When the icon of the mosque clicked on the map, it will display a pop-up information related to the name of the mosque, the mosque address, as well as the financial condition of the mosque. This will facilitate the user in search a mosque which is in need of funding and location information of the mosque.

Apart from the map, bar chart is also used to display aggregation data weekly and monthly for each city. (Figure 3) In that graph, the blue bar denotes the income, the black bar displays the expense and the green bar presents the balance.
3.5.2. Linked Data

We provide a public dataset for the mosque financial report by applying Linked Data [4] principles. Data related to the mosque, address, income, expenses, months and years will be published in RDF [12] format. The aims of this
RDF publication is to allow other application reuse the data. For instance we can combine our data with population data from DBPedia (http://DBpedia.org). In the dataset, we only provide the mosque financial summary data monthly. Listing 1 is an example of a financial report for Manarul Ilmi mosque in June 2015.

<table>
<thead>
<tr>
<th>Page</th>
<th>Page Size</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>60236 bytes</td>
<td>Google Map (10 Mosques)</td>
</tr>
<tr>
<td>Mosque Map</td>
<td>30685 bytes</td>
<td>Google Map (all mosques)</td>
</tr>
<tr>
<td>Financial report graph</td>
<td>24232 bytes</td>
<td>chart</td>
</tr>
</tbody>
</table>

Table 1: The pages used in evaluation

Listing 1: Financial Mosque Information in RDF

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix odi:masjid: <http://localhost:85/odislam/data/masjid/> .
@prefix odi: <http://localhost:85/odislam/data/odi#> .
@prefix odz: <http://localhost/opendatazis/ns/odi#> .

odi:masjid:Manarul_Ilmi a odi:masjid .
```

3.6. Data Validation

According to [13], one of the drawback of crowdsourcing is report verification. Therefore, we build a form validation for mosque board that can verify in the data received by our application. The validation process performed by a mosque board that are registered in our application.

4. Evaluation

The aims of our evaluation is to test the performance of our application to handle request from users. We measure the response time and bandwidth usage of the web pages. In order to evaluate our web application, we use JMeter\(^1\) to load test functional behavior. We perform JMeter over three main pages and a form input. The details of our evaluation can be explained as follows:

4.1. Evaluation of main pages

There are three main pages evaluated: namely home, mosque map and financial report graph. We perform three scenarios for each page. Each scenario has different number of users: 50 users, 100 users and 200 users. The details of these web pages can be found in Table 1.

4.2. Evaluation of a form input

For a form input, we perform three scenarios with different number of users: 20 users, 50 users and 100 users.

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\(^1\)JMeter: http://jmeter.apache.org/
5. Results and Discussions

As shown in Figure 4, accessing the mosque map is the most consumed bandwidth even the size of mosque map page is smaller than the size of home page. The reason is that the mosque map loads the location of each mosque. Consequently, the response time of the mosque map size is the slowest (Figure 5).

The bandwidth usage for 50 concurrent users is not much different with the bandwidth usage for 100 users. However, the bandwidth usage for 200 concurrent users increases sharply.

As shown in Table 2, average response time of the input form increases linearly from 20 concurrent users to 100 users. There is no error occurred during executing the input form.

6. Conclusions

We have presented our web application that visualises the mosque financial reports in Indonesia. As the input, we apply crowd sourcing method from Twitter and a web form. We publish all incoming data by using Google Map, charts and Linked Data. Our evaluation results revealed that our website has a good performance in dealing with the concurrent users. As the next step, we will apply a gamification method to encourage more netcitizen to contribute in reporting the mosque financial information.
References

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  URL http://www.w3.org/DesignIssues/LinkedData.html
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