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Final information visualization prototype

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Executive Summary

This document presents the final prototype for real-time multilingual information visualization. The outcome of this deliverable contains several data services in the back-end and a visualization component in the front-end. The back-end data services accept the output of multilingual language processing pipeline and provides incremental cross language text document clustering and then package them into different web services which are called by the visualization component.

This document introduces the data services, incremental clustering and visualization component separately. Comparing with the first prototype, both the back-end and front-end have improved. Therefore, we lay stress on the updated parts in this deliverable.

As the prepositive modules of this prototype, WP2, WP3 and WP4 provides multilingual language processing, cross-lingual semantic annotation and cross-lingual semantic integration respectively. We assume that these modules are well prepared. Considering some of these modules are not finished, the content visualized in this prototype is incomplete. However, this prototype also provide full functionality for the visualization to fulfil the requirements of STA use case.

The developed prototype is available at http://sandbox-xlike.isoco.com/portal/ .

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Abbreviations

API	Application Programming Interface
B/S	Browser/Server

Definitions

Article	An instance of a news report.
Entity	*Person*, *Organization* or *Location* contained in the *Title* or *Content* of an *Article*
Story	A collection of *Articles* which talk about the same topic or event.

1 Introduction

Information visualization is a technique which helps people to quickly understanding the data. It is a hot issue in human computer interface (HCI) research as well as in industrial applications. Current research [Tho05] explains that "visual representations and interaction techniques take advantage of the human eye's broad bandwidth pathway into the mind to allow users to see, explore, and understand large amounts of information at once. Information visualization focused on the creation of approaches for conveying abstract information in intuitive ways." Nowadays, the volume of web text data is far beyond the human capacity of browsing the web pages one by one. What's more, it keeps increasing dramatically. Information visualization summaries the data and shows them graphically and provides another way for people to grasp and absorb the interesting part of the data. It is expected that information visualization can save the time on collecting information from large amount of data. On the other hand, with the help of multi-lingual techniques, the visualization prototype will be able to provide related or similar text data (including entities, articles and stories) in different languages.

This prototype is based on a bunch of services providing NLP techniques that include shallow processing, deep processing, semantic annotation, and knowledge extraction. It is designed to give users an intuitive image of the text data and provide tracking functions which helps people go deep into things they are interested in. Therefore, users are supposed to be able to find their interests easily and then tracking their interests conveniently.

This deliverable (D5.2.2) is the final version of the information visualization prototype. Comparing with the early prototype finished in the first year, this prototype provides more interactions for users to track news articles in different ways. For example, the new prototype will enable user to track articles by publishers, time stamps, keywords and languages.

Due to the incompleteness of depended ongoing work packages, the data shown in this prototype may be incomplete. For example, there is almost no articles in Slovenia, Catania and Hindu. However, the functionality of the prototype is completed, although not perfect. In this deliverable, we will focus on the prototype itself and show some examples on available data.

2 Web-end Visualization Component

There are several use cases in XLike project, including STA use case and Bloomberg use case. Although there are a lots of techniques that can be shared in both these two use cases, in this prototype, we mainly focus on STA use case, which aims to helping editors to tracking real time news articles and web blogs. To visualize the data to fulfill the requirements of STA use case, we designed a web-end visualization interface. This interface will provide both the visualization of information and interactions between user and the data services. The principle of the designing of the visualization component is to facilitate the daily routines of STA editors/journalists. Therefore, we have updated the visualization component according to the feedbacks of the first year evaluation.

The main user interface is show in Figure 1. The entire page is split into two area vertically. The left part shows the hot entity list and custom entity list. Users can switch these two list using the tabs on the top. The right part can switch between graphic visualization and article/story list.

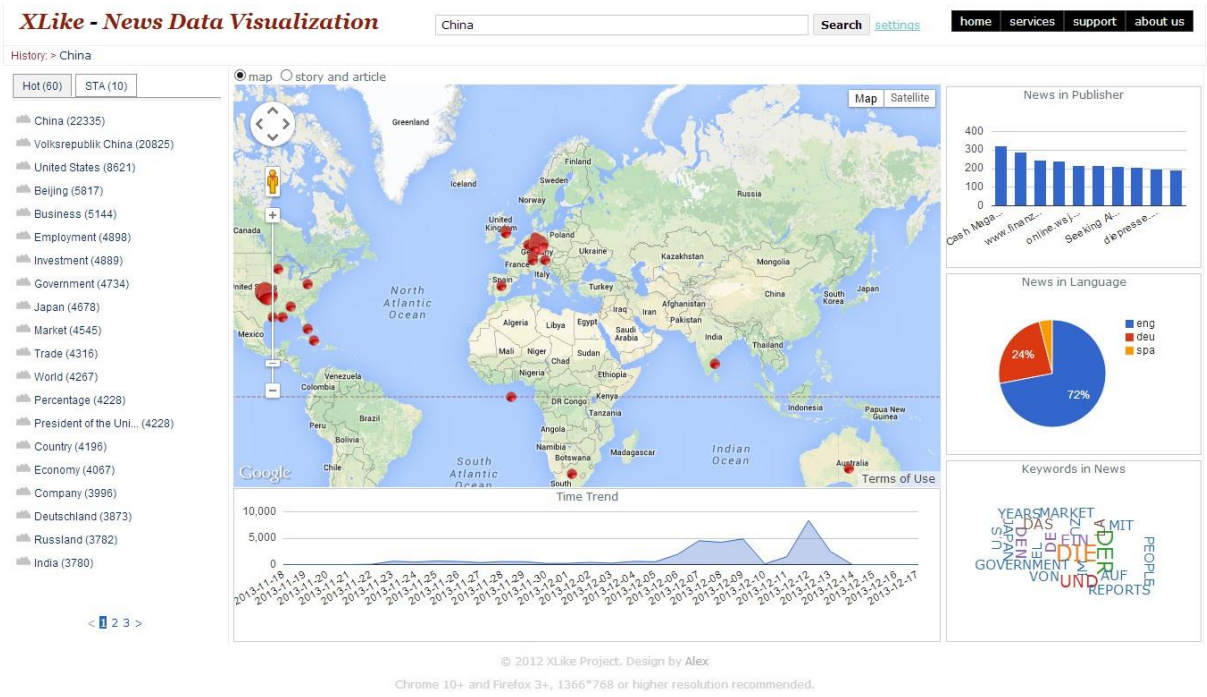

Figure 1. The Main UI of Visualization Component

2.1 Searching Box and Searching History Navigator

The searching box is located in the middle-top of the page, consists of a text box, a search button and a setting link-button. Users can input the keywords in the text box, or select an entity suggested by our web service and then click the search button to start a search.

- Searching box

User can input one or more keyword in to the searching box. Please note that if two or more words are inputted in a request, the server will return news contains all these words. Therefore, complexity word combinations may leads a request with a few or even no matched articles.

When user is inputting in the searching box, our UI will automatically suggests a list of Entities (Figure 2). User can selecting one of these entities to request a search. The selected entity will be automatically added to the searching box and surrounded by a pair of square brackets. Usually, searching by entity will returns more accurate results than searching by keywords.

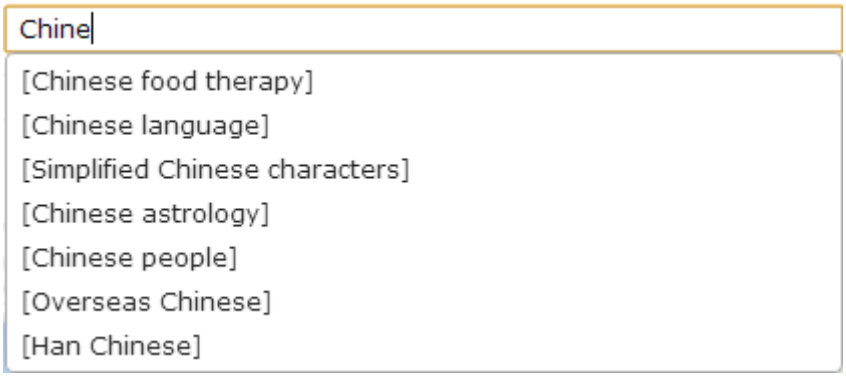

Figure 2. Entity Suggesting in Searching Box

- Setting Panel

Nearby the search button locates the setting link-button which shows/hides the setting panel (Figure 3). Users can configure the parameters of the request here. Please note that these configurations will affect all the request started by the local client, no matter by the searching button or other user interactions (will be described later).

As shown in Figure 3, in the setting panel, user can set:

PageSize: the maximum number of articles returned in each request.

TimeSpan: the time duration of the articles returned in each request.

Language: the request will return articles in languages which are checked.

Countries: The request will return articles published in the countries which are checked.

Figure 3. Search Settings

- History Navigator

History Navigator is an automatically generated control which records the history requests. It gives users a convenient way to go back to a keyword, entity or a story which is tracked in previous operations. The history navigator saves at most 7 previous request.

Figure 4. History Navigator

2.2 Entity Lists

The left part of the page shows two entity lists. One is hot entity list and another is STA custom entities. The hot entity list shows the hottest entities of current request ranked by frequency. At most 60 entities are returned in each request and shown in three pages with a page size 20. The STA entity list also shows at most 60 entities. Usually there are only a dozen of STA entities can be found in a request. In default, the STA entity list is shown and the hot entity list is hidden. Each of the entity is followed by a number which indicates the times it occurs in current request.

Each entity in the list is a link button and a click on one entity will trigger an event which starts a new request which returns an article collection containing this entity. In front of each entity, there is a gray icon. A click on this icon will turn this icon to blue and add this entity to the timeline chart and compares it with current request (See 2.3 for detail).

Figure 5. Hot Entities and STA Entities.

2.3 Map and Charts

The right part of the main page contains the graphic visualization controls. They are: 1) Map; 2) Time Trend; 3) Publisher bar chart; 4) Language Pie; and 5) keyword cloud. In previous modules, the metadata (Geographic location, publisher time, publisher, language and keywords) of the articles has been extracted and this prototype shows them in different visualization controls to help user to obtain the most interesting parts in a glance. In addition, these controls provide rich interactions which can help user to track news articles they are interested in.

- Map

The map control is the largest control in the page. It is based on Google Map API[1]. It shows the geographic distribution of the articles returned in current request. Articles belongs to the same/nearby place are clustered together and shown in the map as a red pie. The size of the pie indicates the number of articles. When zoom in/out the map, the articles will re-clustered according to the scale of the map.

The articles behind a red pie will be pop out when clicking the red pie. In this way, users will find what news are reported in which place. User can also track a specific article by click the title of the article in the list.

Figure 6. Geographic visualization.

- Time Trend

Time Trend shows the time trend of the articles of current request. The time span can be set in the setting panel. In default, the time span is seven days. Moving mouse to the node in the line will show the time stamp, entity/Story label and the frequency.

If users want to compare an entity with current request (no matter it is an entity request, search request or a story request), he or she can click the gray icon in front of one entity in the entity list.

[1] https://developers.google.com/map

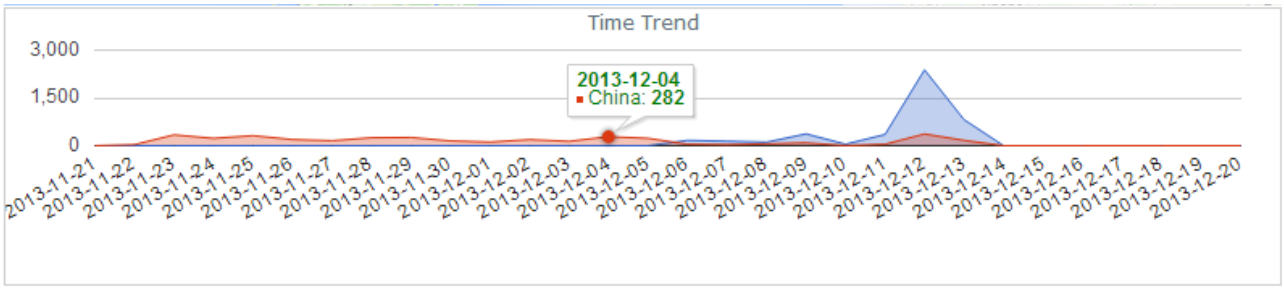

Figure 7. Comparing in Time Trend (Red is China and Blue is Japan in this chart).

The data shown in the Time Trend is limited dues to the limitation of space. In the this prototype, we designed a special user interaction which enlarges the graphic controls (including Time Trend, Publisher bar chart, Language pie and Keyword cloud) on a click (See Figure 8).

In the enlarged Time Trend, user can click the node in the line to request the articles about this entity published in the selected time stamp.

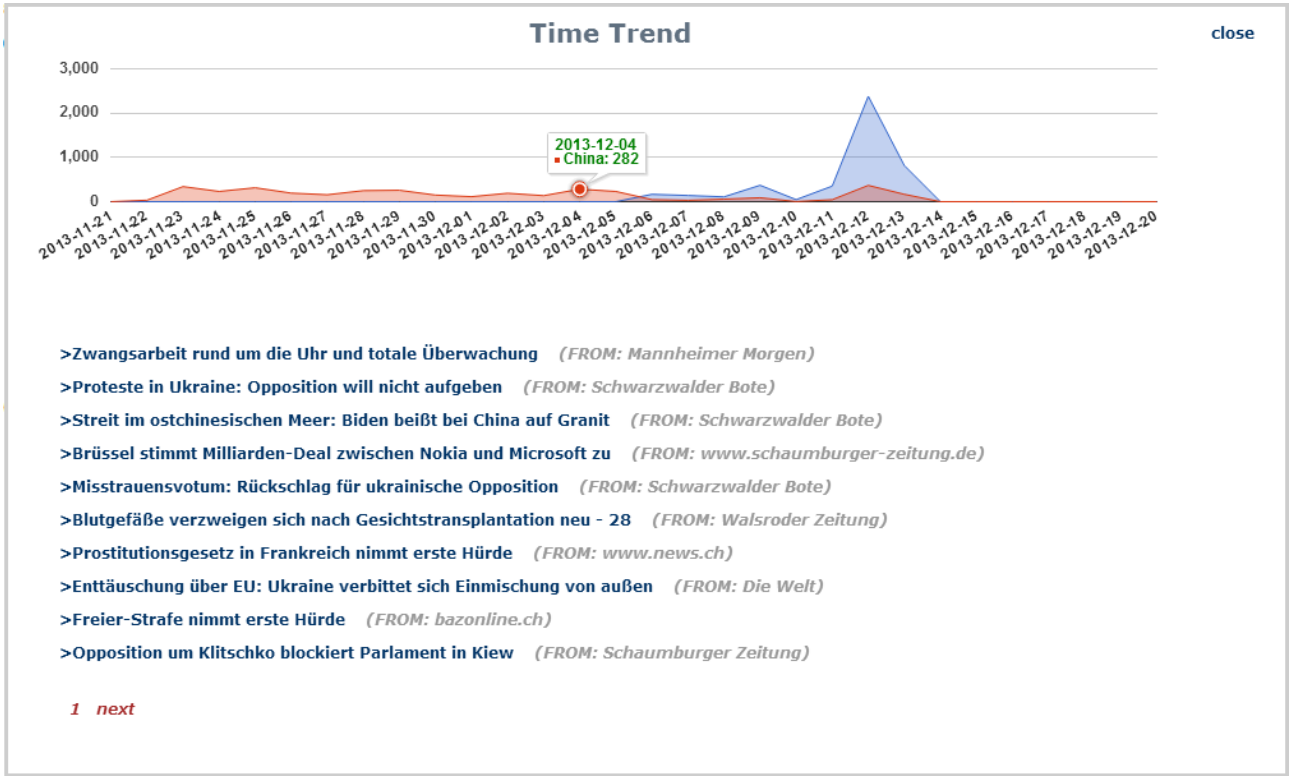

Figure 8. Enlarged Time Trend.

- News in Publishers

The publisher bar shows the top 10 publishers in current request ordered by the number of related articles the published. The same as the Time Trend, the Publishers Bar also allows further tracking by a single click in the chart. The enlarged Publisher Bar is shown in Figure 9. In the enlarged Publishers Bar, we show at most 20 publishers. A single click on the bar will start a request returning all the articles of the selected publisher.

Figure 9. Enlarged Publishers Bar Chart.

➢ News in Languages

The language pie shows the language distribution of the returned articles. A single click on this chart will show the enlarged Language Pie. The same as other enlarged controls, a click on a specific language in the pie will start a request returning all the articles in the selected language.

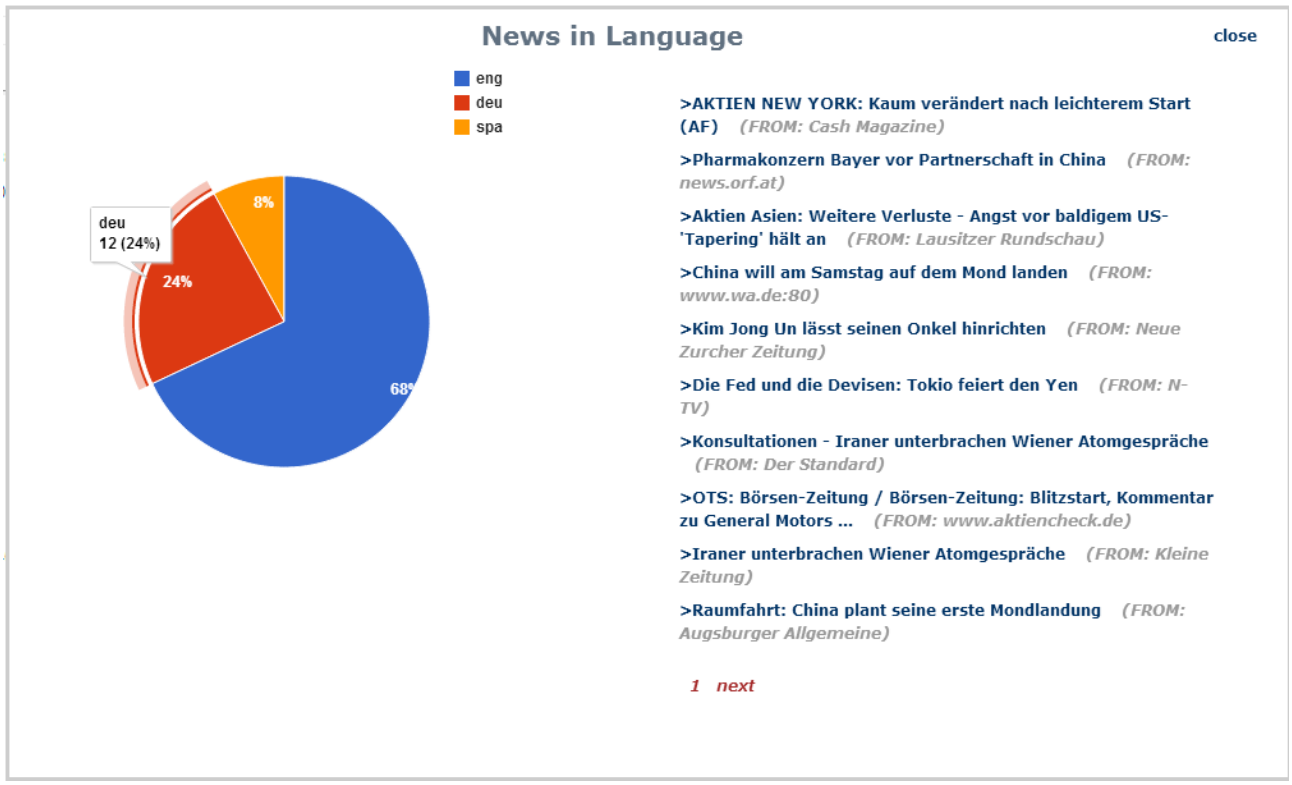

Figure 10. Enlarged Language Pie.

- Keywords in News

The Keyword Cloud shows the important words or terms in current request. The size of the word in cloud is decided by its importance.

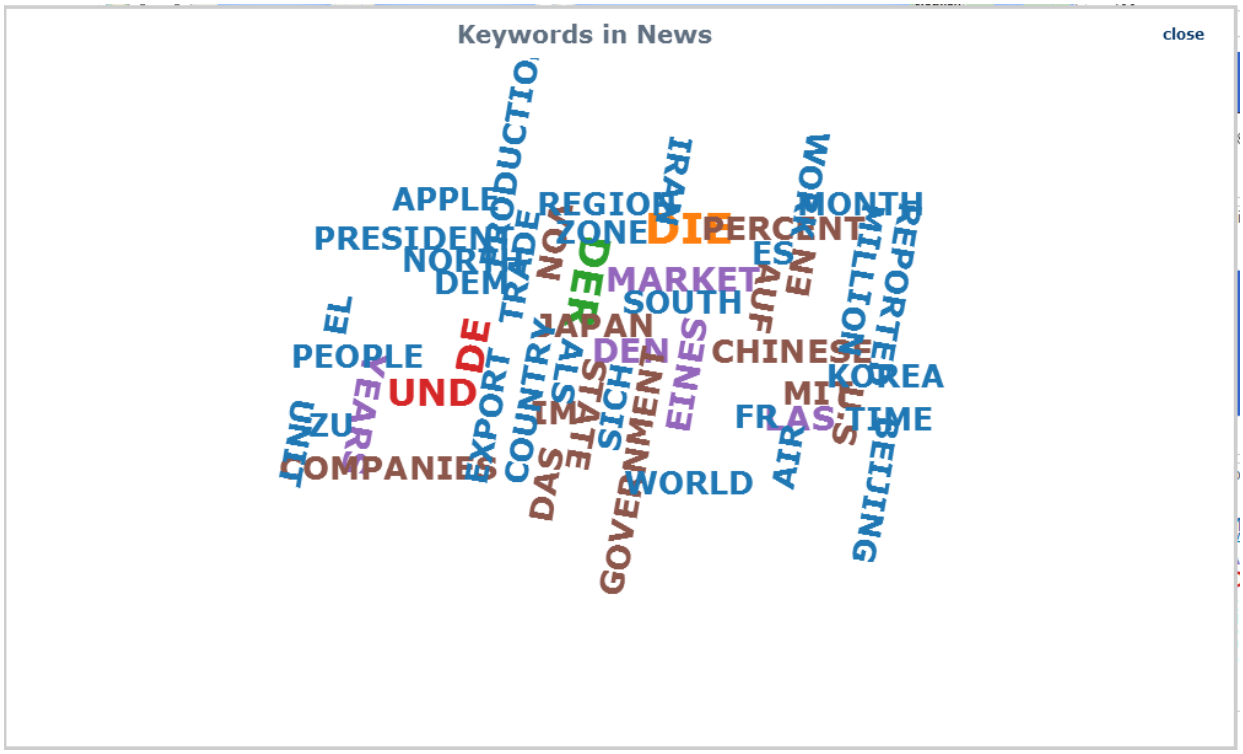

Figure 11. Enlarged Keyword Cloud.

Different from other visualization controls, a single click on a keyword in cloud won't show its frequency. It will trigger a new request that use the selected keyword as the searching word. In a word, a click on a keyword equals to search this keyword using searching box. However, a click in the space of the Keyword Cloud will enlarge the chart as other controls and it will show more keywords in a large cloud.

2.4 Stories and Articles

The right part of the page can switch between graphical visualization and textual displaying. This textual displaying contains two list (Figure 12). The first list is the story list which contains the top 40 related stories of current request. The second list contains the related articles of current request. The size of the article list is decided by the parameter in the setting panel.

A Click on the story will start a new request focused on the selected story. All other controls (except the story list itself) will be updated according to the returned data. The article list will show the articles that belongs to this story. The two entity lists will show the related entities in articles belonging to this story and so does all the graphical visualization controls.

A Click on the article will trigger a different action. A window containing the detail of the selected article will be popped out Figure 13. The window will show the entities in this article, the similar or related articles and the related stories. This action won't updates any of the controls in the page.

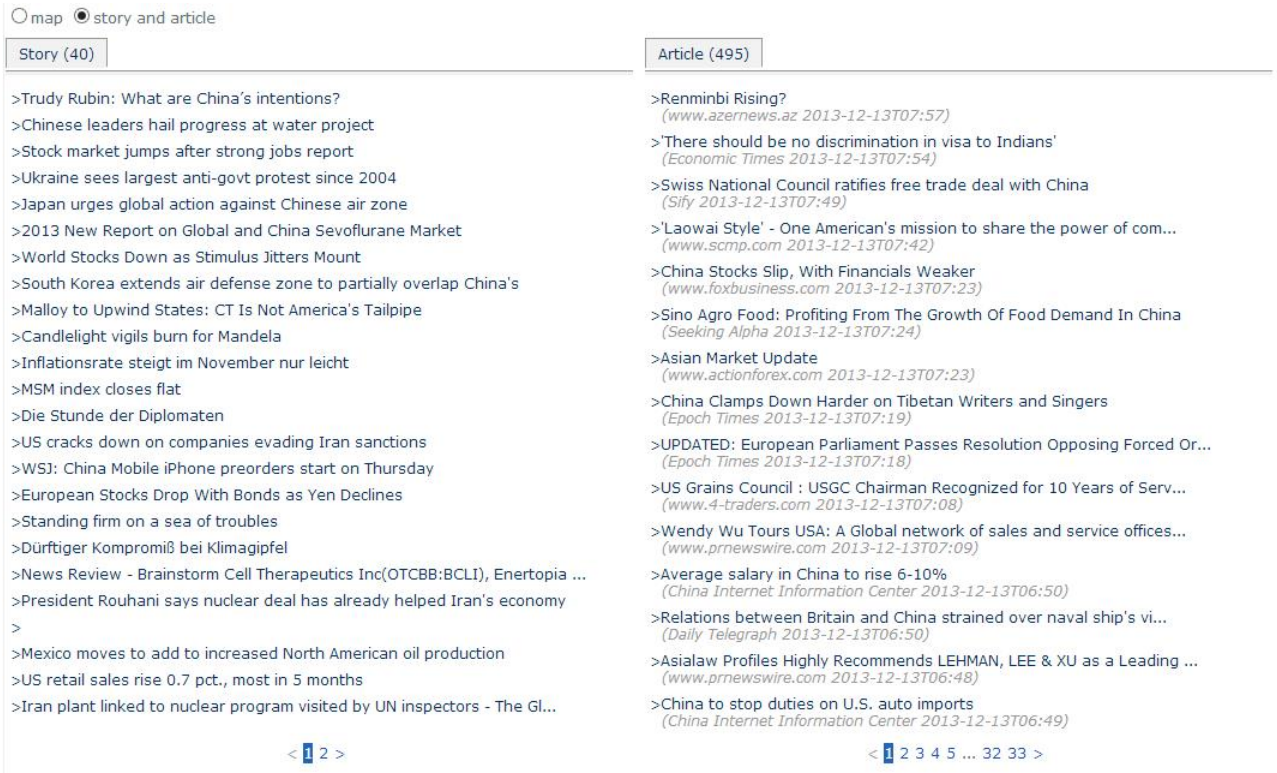

Figure 12. Stories and Articles.

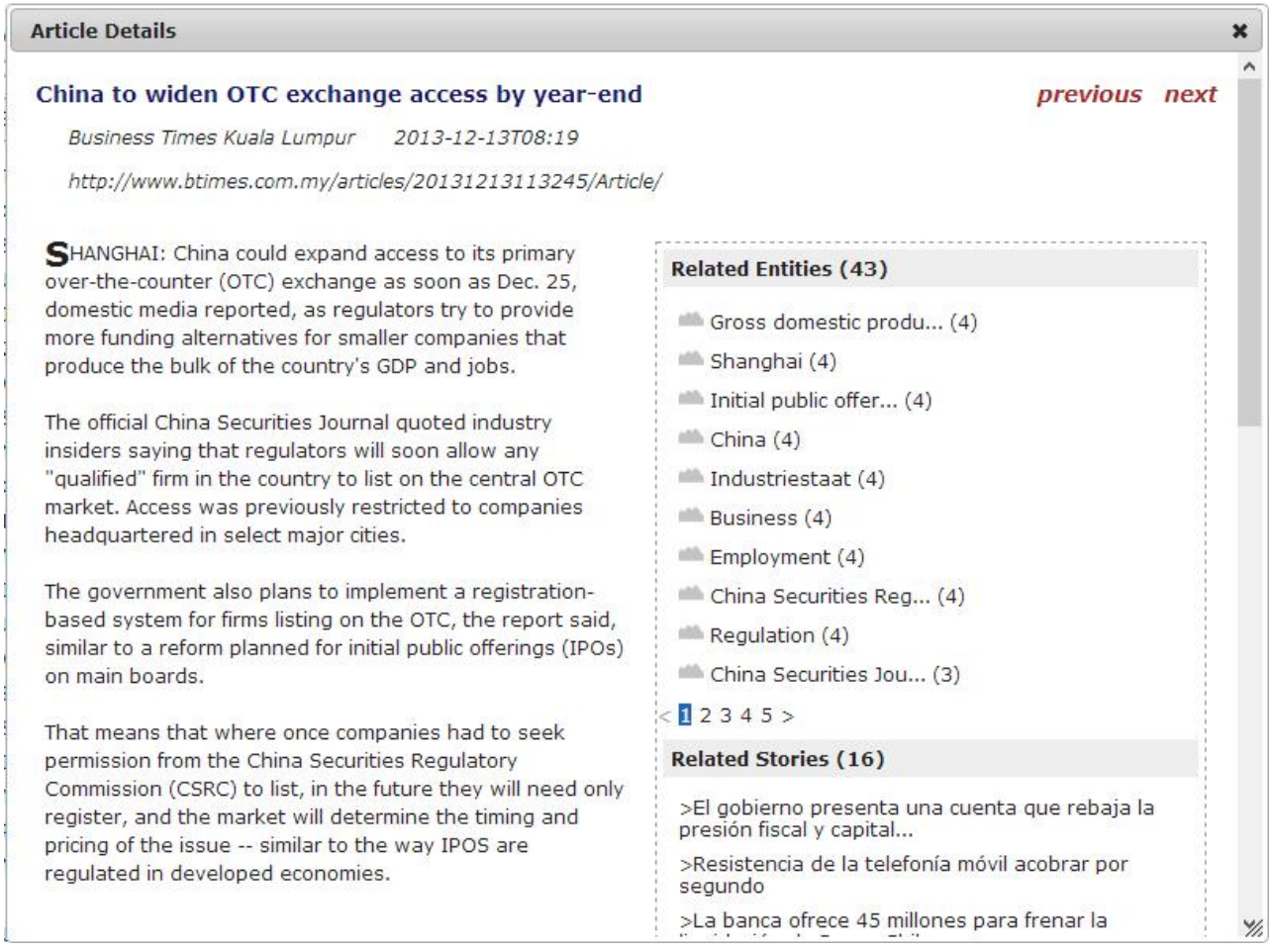

Figure 13. Article details.

3 Tracking News Using the Prototype

With the visualization controls described in Section 2, it is convenient to track real time news articles. According to the STA use case, there are three requirements, i.e., Article tracking, Topic tracking and Entity Tracking. In this section, we first review the requirements of STA use case and then introduce the interactions of this prototype.

3.1 STA Use Case

- Article Tracking

Given an article, users may want to find more articles which is related or similar to this article in different languages. In monolingual environment, article tracking requires the ability of finding duplicates of the given article. In cross-lingual cases, this function requires that the prototype has the ability of understanding the given article to some extent and then find similar articles in different languages. Besides these two function, article tracking also requires the ability of finding articles which are a part of the given article or contain the given article.

- Topic Tracking

Topic tracking refers to finding the related articles given a topic. STA has categorised their custom entities into different groups. However, these groups are too general as topics and in practice each of these group usually matches large amount of articles. A more practice way is clustering articles into different topic collections and each of these collections stands for a topic. In this way, it is more practical to tracking articles belong to the same topic.

- Entity Tracking

Entities are the important and meaningful instances or objects. Entity tracking aims to tracking the articles which contain some specific entities. In previous modules, we are able to recognize the entities (Names, Locations, Organizations and so on) from plain text. Both these entities and the custom entities defined by STA are included in Entity tracking.

3.2 Interactions

To satisfy the requirements of the STA use case, there are several kind of interactions designed in this prototype. In this subsection, we category them in to classes according to the STA use case.

- Interactions for Article Tracking

The focus of article tracking is to find the same/similar/related articles of a selected article. In this prototype, we designed an interaction that shows the article detail window (see Figure 13). In the window, the full content of the article will be displayed and followed by list of same/similar/related articles. Users can trigger this action by clicking an article in the story and article panel (Figure 12).

- Interactions for Entity Tracking

There are several methods to tracking an entity in this prototype. We designed an action for entity tracking. Once this action is triggered, the page will start a request to the data service. This request will return a dataset related to the selected entity and the visualization controls will be updated according to this dataset. Specifically, the Map, Time Trend, Publisher Bar Chart, Language Pie, Keyword Cloud and the Story and Article List will be updated. The description of the dataset will be given in Section 4. Users can start an Entity Tacking Action by:

a) Clicking an entity in the hot/Entity List (Figure 5).

b) Searching an entity in the searching box with the suggested entities (Figure 2).

c) Clicking an entity in the entity list of the article detail window (Figure 13).

There is a special interaction in the entity lists. By clicking the icon in front of the entity, the prototype will add/remove the selected entity front the Time Trend while other visualization controls will remain the same.

➢ Interactions for Topic Tracking

In this prototype, topic is defined as a set of similar articles that are talking about the same event. These topics are represented as stories in this prototype. The topic tracking action will start a request which returns a dataset focused on the selected story. Then the visualization controls, including Map, Time Trend, Publisher Bar Chart, Language Pie and Keyword Cloud will be updated. The article list in the Figure 12 will be updated too. Users can start a Topic Tracking action by:

a) Clicking a story in the story list in Figure 12;

b) Click a story in the story list in the article details window (Figure 13).

➢ Interactions for Keyword Searching

Keyword searching is similar to Entity Tracking. The different is that keyword searching uses arbitrary words as the target while entity tracking using a unique entity as target. As a result, entity tracking returns news data contains exactly the given entity while keyword searching won't disambiguate different semantic of the given keyword. Users can searching a keyword by:

a) Searching keyword using searching box;

b) Clicking a keyword in the Keyword Cloud or the Enlarged Keyword Cloud (Figure 11).

This section descripted the interactions of the visualization prototype. Although this prototype may be not good enough for realistic usage because some depended previous work packages are unfinished, the interactions in this prototype have covered the requirements of STA use case.

4 Data Services

To supporting the visualization prototype, we designed a bunch of data services, some of them provide datasets to the front-end and some other focus on data processing in the back end. In this section, we will introduce these services one by one but won't introduce the services provided by modules in previous work packages.

4.1 Entity Suggesting Service

Function: This service returns a list of entities containing the given string. The entities will be ordered by their frequency.

URL: http://mustang.ijs.si:8082/suggestConcepts?prefix=prefixStr

Here is a sample of the returned dataset:


```
[
  {
      "uri":"pm_wiki:http:\/\/en.wikipedia.org\/wiki\/Chinese_food_therapy",
      "fq":1302.000000,
      "id":"64212",
      "type":"pm_wiki",
      "label":"Chinese food therapy"
  },
  …
]
```


Figure 14. A Sample Dataset of Entity Suggesting Service

This service will be called when users is inputting in the searching box.

4.2 Article Service

Function: this service returns dataset centralized on the selected article.

URL: http://mustang.ijs.si:8082/xlike/article?id=articleID

Returned data: the returned data contains the ID, URI, title, abstract language, date, source, country, city, location of the selected article and the ID, language, label of the story which contains this article and:

a) A list of entities contained in this article;

b) Several lists of related articles grouped by language;

c) Several lists A list of related stories grouped by langauge;

Here is a sample of the returned dataset:


```
{
  "id":1334938,
  "url":"http://www.eluniversal.com.mx/finanzas-cartera/2013/abren-con-resultados-
  mixtos-principales-bolsas-europeas-972749.html",
  "title":"Abren con resultados mixtos principales bolsas europeas",
  "language":"spa",
  "date":"2013-12-13T09:23",
  "source":"www.eluniversal.com.mx",
  "country":"Mexico",
  "city":"",
  "location":[
      23,
      -102
  ],
  "story":{
      "id":"aeec771e-3ce9-49ef-ad5c-8743f565fe89-1857",
      "language":"spa",
```

```
        "label":"GM venderá el 7% que posee en Peugeot"
    },
    "entities":[
    ],
    "abstract":"GM explicó que venderá las 24.8 millones de acciones de…",
    "related":[
        {
            "lang":"eng",
            "articles":[
                {
                    "id":1312975,
                    "url":"http://www.nasdaq.com/article/european-markets-finished-
                    mostly-lower-despite-us-budget-deal-20131211-00756",
                    "title":"European Markets Finished Mostly Lower Despite U.S. Budget
                    Deal",
                    "language":"eng",
                    "date":"2013-12-13T07:46",
                    "source":"www.nasdaq.com",
                    "country":"United States",
                    "city":"",
                    "location":[
                        38,
                        -97]
                },
                …
            ],
            "stories":[
                {
                    "id":"87ead66b-1dd1-4eb7-a32a-098d4d819a57-3819",
                    "language":"eng",
                    "label":"European Stocks Drop With Bonds as Yen Declines",
                    "count":3
                },
                …
            ]
        },
        …
        ]
}
```


Figure 15. A Sample Dataset of the Article Service.

This service will be called on the interactions for Article Tracking.

4.3 Entity Service

Function: this service returns a dataset focused on the selected entity.

URL:
http://mustang.ijs.si:8082/xlike/entity?uri=entityURI&pagesize=500&ts=30d&lang=eng&lang=deu&lang=spa&lang=zho&lang=slv&lang=cat&group=general

(Please refer to D5.2.1 for the explanations of the parameters)

Returned data: The returned data contains the URI, type and label of the selected entity, and

A list of related articles;

A list of related stories;

A list of hot entities;

A list of custom (STA) entities.

A list of keywords;

A list of dates of the related articles;

Here is a sample data set of this service:


```
{
  "uri":"pm_wiki:http://en.wikipedia.org/wiki/Gross_domestic_product",
  "type":"pm_wiki",
  "label":"Gross domestic product",
  "articles":[
      {
          "id":1336994,
          "url":"http://lacrossetribune.com/news/world/nicaragua-in-thrall-of-canal-
          dream-worries-remain/article_9f6dfdc3-44dd-5e19-8991-0db935eab188.html",
          "title":"Nicaragua in thrall of canal dream; worries remain",
          "language":"eng",
          "date":"2013-12-13T09:32",
          "source":"Coulee News",
          "country":"USA",
          "city":"Westby",
          "location":[
              43.653191,
              -90.857483]
      },
      …
  ],
  "stories":[
      {
          "id":"87ead66b-1dd1-4eb7-a32a-098d4d819a57-3819",
          "language":"eng",
          "label":"European Stocks Drop With Bonds as Yen Declines",
          "count":34
      },
      …
  ],
  "entities":[
      {
          "uri":"pm_wiki:http://en.wikipedia.org/wiki/Gross_domestic_product",
          "type":"pm_wiki",
          "label":"Gross domestic product",
          "count":938
      },
      …
  ],
  "customEntities":[
      {
          "uri":"pm_wiki:http://en.wikipedia.org/wiki/Slovenia",
          "type":"pm_wiki",
          "label":"Slowenien",
          "count":51
      },
      …
  ],
  "sources":[
      {
          "uri":"economictimes.indiatimes.com",
          "source":"Economic Times",
          "country":"India",
          "city":"",
          "location":[
              21.7866,
              82.794762],
      },
      …
  ],
  "related":[
  ],
  "keywords":{
      "type":"keywords",
      "field":"",
      "join":"",
      "keywords":[
          {
              "keyword":"PERCENT",
              "weight":0.179835
          },
          …
      ]
  },
```

```
  "dates":[
      {
          "interval":"2013-12-06",
          "frequency":35,
          "precent":2.63
      },
      …
      ]
}
```


Figure 16. A Sample Dataset of the Entity Service.

This service will be called on entity tracking actions.

4.4 Story Service

Function: the story service will return a dataset that centralized on the selecting story.

URL:
http://mustang.ijs.si:8082/xlike/story?id=storyID&pagesize=500&ts=30d&lang=eng&lang=deu&lang=spa&lang=zho&lang=slv&lang=cat&group=general

(Please refer to D5.2.1 for the explanations of the parameters)

Returned Data: the returned dataset contains the id, language, label of the selected story, and

a) A list of articles belong to the selected story;

b) A list entities in this story;

c) A list of relates stories grouped by language;

d) A list of keywords in this story;

e) A list of date aggregated from the articles belonging to the selected story.

Here is a sample data of the story service.


```
{
  "id":"aeec771e-3ce9-49ef-ad5c-8743f565fe89-1857",
  "language":"spa",
  "label":"GM venderá el 7% que posee en Peugeot",
  "articles":[
      {
          "id":1334938,
          "url":"http://www.eluniversal.com.mx/finanzas-cartera/2013/abren-con-
          resultados-mixtos-principales-bolsas-europeas-972749.html",
          "title":"Abren con resultados mixtos principales bolsas europeas",
          "language":"spa",
          "date":"2013-12-13T09:23",
          "source":"www.eluniversal.com.mx",
          "country":"Mexico",
          "city":"",
          "location":[
              23,
              -102]
      },
      …
  ],
  "entities":[
      {
          "uri":"pm_wiki:http://en.wikipedia.org/wiki/General_Motors",
          "type":"pm_wiki",
          "label":"General Motors",
          "count":18
      },
```



```
        …
    ],
    "related":[
        {
            "lang":"eng",
            "stories":[
                {
                    "id":"87ead66b-1dd1-4eb7-a32a-098d4d819a57-3569",
                    "language":"eng",
                    "label":"GM to stop making cars in Australia by 2017",
                    "count":3
                },
                …
    ],
    "keywords":{
        "keywords":[
            {
                "keyword":"GM",
                "weight":0.1965
            },
            …
        ]
    },
    "dates":[
        {
            "interval":"2013-12-13",
            "frequency":14,
            "precent":100
        }
        …
    ]
}
```


Figure 17. A Sample Dataset of the Story Service

4.5 Search Service

Function: the search service returns a dataset centralized on the given keyword or selected entity.

URL:
http://mustang.ijs.si:8082/xlike/search?q=Keyword&url=EntityURI&page=0&pagesize=500&ts=30d&lang=eng&lang=deu&lang=spa&lang=zho&lang=slv&lang=cat&group=general&callback=

Returned data: the returned dataset of search service is similar to the entity service's, except that the search service won't return the detail of the entity. Generally, the search service will return:

a) The number of mentions of the selected keyword or entity;

b) A list of articles containing the selected keyword or entity;

c) A list of entities contained in the related articles;

d) A list of custom/STA entities contained in the related articles;

e) A list of publishers aggregated from the related articles;

f) A list of keywords contained in the related articles;

g) A list of dates aggregated from the related articles.

Here is a sample of the dataset of search service.


```
{
    "hits":35282,
    "articles":[
        {
```

```
            "id":1337192,
            "url":"http://tribune.com.pk/story/645023/iran-halts-nuclear-talks-after-us-
            blacklist-move-state-media/",
            "title":"Iran halts nuclear talks after US blacklist move: State media",
            "language":"eng",
            "date":"2013-12-13T09:39",
            "source":"tribune.com.pk",
            "country":"Pakistan",
            "city":"",
            "location":[
                30,
                70],
            "story":{
                "id":"87ead66b-1dd1-4eb7-a32a-098d4d819a57-1911",
                "language":"eng",
                "label":"US cracks down on companies evading Iran sanctions"
        }
        …
    ],
    "entities":[
        {
            "uri":"pm_wiki:http://de.wikipedia.org/wiki/China",
            "type":"pm_wiki",
            "label":"China",
            "count":22690
        },
        …
    ],
    "customEntities":[
        {
            "uri":"pm_wiki:http://en.wikipedia.org/wiki/Fire",
            "type":"pm_wiki",
            "label":"Fire",
            "count":479
        },
        …
    ],
    "stories":[
        {
            "id":"87ead66b-1dd1-4eb7-a32a-098d4d819a57-3267",
            "language":"eng",
            "label":"Trudy Rubin: What are China’s intentions?",
            "count":500
        },
        …
    ],
    "sources":[
        {
            "uri":"www.cash.ch",
            "source":"Cash Magazine",
            "country":"Switzerland",
            "city":"Zurich",
            "location":[
                47.37706,
                8.53955],
            "count":347
        },
        …
    ],

    "keywords":{
        "keywords":[
            {
                "keyword":"DIE",
                "weight":0.337098
            },
            …
        ]
    },
    "dates":[
```



```
        {
            "interval":"2013-11-23",
            "frequency":633,
            "precent":1.79
        },
        …
    ]
}
```


Figure 18. A Sample Dataset of Search Service

4.6 News Clustering Service and Cross-lingual Article Linking Service

The services provided by other work packages are not enough for the visualization prototype. In the backend, we deployed a news clustering service and a cross-lingual article linking service.

News clustering is a web service for micro-clustering a stream of news documents, based largely on the approach of C. Aggarwal *et al.* [AY10, AY10, AHWY03]. The service maintains a set of documents partitioned into a number of (relatively small) clusters. Old documents are periodically discarded, thereby keeping the cluster structure focused on the current state of the data stream.

Figure 19 shows the framework of news clustering service. The event registry prototype share the same clustering service with this visualization prototype and the details of the clustering service can be found in D4.3.1.

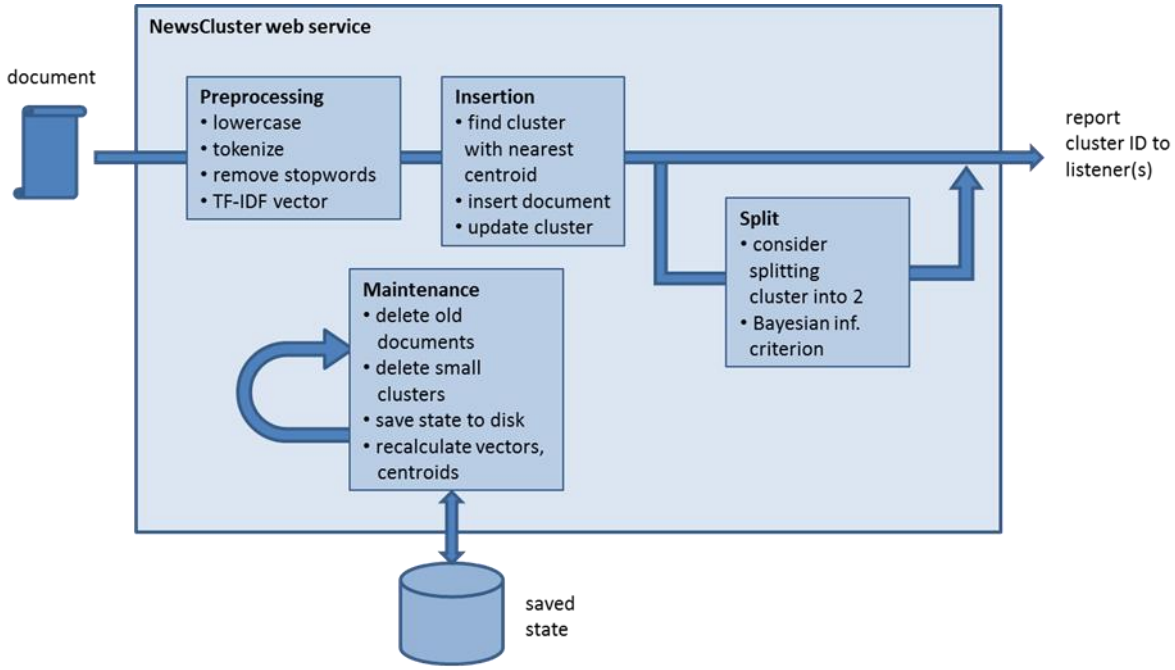

Figure 19 Architecture of NewsCluster service

We also integrate cross-lingual document linking with the Newsfeed for the task of tracking similar articles across languages. The approach is based on Cross-Lingual Similarity Service (CLSS) and computes the similarity between English, German, Spanish and Chinese news articles. Given the newsfeed article as an input it returns IDs of top 10 most similar articles for each language in JSON format (Figure 20). The architecture is depicted on Figure 21.


```
{"id":66701562,
  "similar_articles_spa": [{"id":66701512,"sim":0.1364}, …],
```

```
  "similar_articles_deu": […],
  "similar_articles_fra": […],
  …
}.
```

Figure 20. Output format of CLSS service.

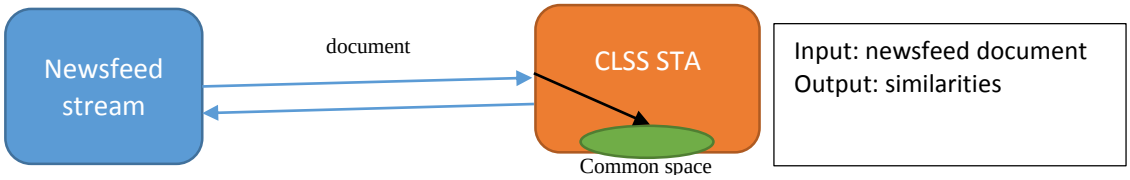

Figure 21. Diagram of intergtion between Newsfeed and CLSS.

Computation of the cross-lingual similarities is based on an aligned set of basis vectors obtained by one of two methods: latent semantic indexing (LSI) and a generalized version of canonical correlation analysis (CCA) by using an aligned multi-lingual corpus. The method enables us to map a multi-lingual collection of documents in the same (common) low dimensional space, where the similarity computation is fast and efficient. For details about the approach refer to [D4.1.1].

A circular one day buffer for each language is used to store documents projected in the common space. This enables the storage of multi-lingual documents in the low dimensional space, where the similarity computation is fast and efficient. Currently we use LSI approach in STA use-case.

5 Conclusion

This document presents the deliverable 5.2.2 “Final information visualization prototype”. This prototype designed a human computer interface for user to track real time news articles and blogs.

The prototype consists of a front-end visualization page and a bunch of back-end data services. In the front-end, the news articles are displayed in both graphic controls and textual controls. Graphic controls include Map, Time Trend, Publisher Bar Chart, Language Pie and Keyword Cloud. All these graphic controls can be enlarged for further tracking except the Map. Textual controls include hot entity list, STA entity list, Story list and article list.

To facilitate the tracking of real time news articles, there are four kinds of interactions designed in the prototype. I.e., interactions for article tracking, interaction for entity tracking, interactions for topic tracking and interactions for keyword tracking. These interactions provides interfaces for users to communicate with the data service.

To support the interactions, a set of service are developed and deployed in the backend. There are services for entity suggesting, article, entity, story and keyword tracking. And two extra service for news clustering and cross-lingual linking. In the future, we will keep improving the front-end to provide more user-friend interfaces and improving the data service to provide high quality contents.

The developed prototype is available at http://sandbox-xlike.isoco.com/portal/ .

References

[AHWY03] C. C. Aggarwal, J. Han, J. Wang, P. S. Yu. A framework for clustering evolving data streams. *Proc. of the 29th VLDB Conference*, 2003.

[AY06] C. C. Aggarwal, P. S. Yu. A framework for clustering massive text and categorical data streams. *Proc. 6th SIAM Int. Conf. on Data Mining* (SDM), 2006.

[AY10] C. C. Aggarwal, P. S. Yu. On clustering massive text and categorical data streams. *Knowledge and Information Systems*, 24(2):171-196 (2010).

[D4.1.1] Cross-lingual document linking prototype, XLike deliverable

[D4.3.1] Early event extraction prototype, XLike deliverable

[Tho05] James J. Thomas and Kristin A. Cook (Ed.) Illuminating the Path: The R&D Agenda for Visual Analytics. National Visualization and Analytics Center. p.30 (2005)

Annex A External components and tools

A.1 Google Maps

Google Maps is a set of services provided by Google. In the visualization component, the Google Maps Javascript API and Google Map API Geocoding web service are employed.

The Google Maps Javascript API lets developers embed Google Maps in your own web pages. Version 3 of this API is especially designed to be faster and more applicable to mobile devices, as well as traditional desktop browser applications.

The Google Map API Geocoding API provides interface to convert addresses (like "1600 Amphitheatre Parkway, Mountain View, CA") into geographic coordinates (like latitude 37.423021 and longitude -122.083739), which you can use to place markers or position the map. The Google Geocoding API provides a direct way to access a geocoder via an HTTP request. Additionally, the service allows you to perform the converse operation (turning coordinates into addresses); this process is known as "reverse geocoding."

Google provides a free license to these APIs but with a condition that our service must be **freely and publicly accessible** to end users.

A.2 Google Chart Tools

Google Chart Tools provide a perfect way to visualize data on your website. From simple line charts to complex hierarchical tree maps, the chart galley provides a large number of well-designed chart types. Populating your data is easy using the provided client- and server-side tools.

In this project, Charts are rendered using HTML5/SVG technology to provide cross-browser compatibility (including VML for older IE versions) and cross platform portability to iPhones, iPads and Android. **No plugins are needed**.

Annex B STA Entities

1) general section	
Slovenija	http://en.wikipedia.org/wiki/Slovenia
Ljubljana	http://en.wikipedia.org/wiki/Ljubljana
Maribor	http://en.wikipedia.org/wiki/Maribor
Koper	http://en.wikipedia.org/wiki/Koper
Celje	http://en.wikipedia.org/wiki/Celje
Kranj	http://en.wikipedia.org/wiki/Kranj
Ptuj	http://en.wikipedia.org/wiki/Ptuj
Novo mesto	http://en.wikipedia.org/wiki/Novo_mesto
Nova Gorica	http://en.wikipedia.org/wiki/Nova_Gorica
Slovenj Gradec	http://en.wikipedia.org/wiki/Slovenj_Gradec
Velenje	http://en.wikipedia.org/wiki/Velenje
Murska Sobota	http://en.wikipedia.org/wiki/Murska_Sobota
Bled	http://en.wikipedia.org/wiki/Bled
Bohinj	http://en.wikipedia.org/wiki/Bohinj
Kranjska Gora	http://en.wikipedia.org/wiki/Kranjska_Gora
reka Soča	http://en.wikipedia.org/wiki/So%C4%8Da
Portorož	http://en.wikipedia.org/wiki/Portoro%C5%BE
Izola	http://en.wikipedia.org/wiki/Izola
Piran	http://en.wikipedia.org/wiki/Piran
Pohorje	http://en.wikipedia.org/wiki/Pohorje
reka Mura	http://en.wikipedia.org/wiki/Mura_River
Kobarid	http://sl.wikipedia.org/wiki/Kobarid
predor Karavanke	http://en.wikipedia.org/wiki/Karavanke_Tunnel
Ljubelj	http://en.wikipedia.org/wiki/Ljubelj
Bovec	http://en.wikipedia.org/wiki/Bovec
Trenta	http://en.wikipedia.org/wiki/Trenta_%28valley%29
Triglav	http://en.wikipedia.org/wiki/Triglav
Otočec	http://en.wikipedia.org/wiki/Oto%C4%8Dec
Kolpa	http://en.wikipedia.org/wiki/Kupa
Lipica	http://en.wikipedia.org/wiki/Lipica
kranjska klobasa	http://en.wikipedia.org/wiki/Kranjska_klobasa http://sl.wikipedia.org/wiki/Kranjska_klobasa
Postojnska jama	http://en.wikipedia.org/wiki/Postojna_Cave
Predjamski grad	http://en.wikipedia.org/wiki/Predjama_Castle
Škocjanske jame	http://en.wikipedia.org/wiki/%C5%A0kocjan_Caves
potica	http://en.wikipedia.org/wiki/Nut_roll http://sl.wikipedia.org/wiki/Potica
štruklji	http://sl.wikipedia.org/wiki/%C5%A0truklji
prekmurska gibanica	http://en.wikipedia.org/wiki/Prekmurska_gibanica
poplava (flood)	http://en.wikipedia.org/wiki/Flood
neurje (storm)	http://en.wikipedia.org/wiki/Storm
požar (fire)	http://en.wikipedia.org/wiki/Fire

2) sport section	
Anže Kopitar	http://en.wikipedia.org/wiki/Anze_Kopitar
Planica	http://en.wikipedia.org/wiki/Planica
Tina Maze	http://en.wikipedia.org/wiki/Tina_Maze
Zlata Lisica	http://sl.wikipedia.org/wiki/Zlata_lisica
Pokal Vitranc	http://sl.wikipedia.org/wiki/Pokal_Vitranc
EP v košarki 2013	http://en.wikipedia.org/wiki/FIBA_EuroBasket_2013 http://sl.wikipedia.org/wiki/Evropsko_prvenstvo_v_ko%C5%A1arki_2013
Goran Dragić	http://en.wikipedia.org/wiki/Goran_Dragi%C4%87
Erazem Lorbek	http://en.wikipedia.org/wiki/Erazem_Lorbek
Samir Handanović	http://en.wikipedia.org/wiki/Samir_Handanovi%C4%87
Saša Vujačić	http://en.wikipedia.org/wiki/Sa%C5%A1a_Vuja%C4%8Di%C4%87
Pokljuka, biatlon	http://sl.wikipedia.org/wiki/Pokljuka
NK Maribor	http://en.wikipedia.org/wiki/FC_Maribor
Celje Pivovarna Laško	http://en.wikipedia.org/wiki/Celje_Pivovarna_La%C5%A1ko
Gorenje Velenje	http://en.wikipedia.org/wiki/RK_Gorenje
RK Krim	http://en.wikipedia.org/wiki/RK_Krim
ACH Volley	http://en.wikipedia.org/wiki/ACH_Volley_Ljubljana
Janez Brajkovič	http://en.wikipedia.org/wiki/Janez_Brajkovi%C4%8D
Lipica, tekmovanje v preskakovanju ovir, tekmovanje v dresurnem jahanju	http://en.wikipedia.org/wiki/Lipica http://en.wikipedia.org/wiki/Show_jumping
lipicanci	http://en.wikipedia.org/wiki/Lipizzaner
Polona Hercog	http://en.wikipedia.org/wiki/Polona_Hercog
Katarina Srebotnik	http://en.wikipedia.org/wiki/Katarina_Srebotnik
Peter Kauzer	http://en.wikipedia.org/wiki/Peter_Kauzer
Fiba Europe	http://en.wikipedia.org/wiki/FIBA_Europe
Eurobasket 2013	http://en.wikipedia.org/wiki/Eurobasket_2013
3) economy section	
Janez Šušteršič	http://sl.wikipedia.org/wiki/Janez_%C5%A0u%C5%A1ter%C5%A1i%C4%8D http://www.mf.gov.si/en/about_the_ministry/who_is_who/minister_of_finance/
Marko Kranjec	null
Krka	http://en.wikipedia.org/wiki/Krka_%28company%29
Petrol	http://en.wikipedia.org/wiki/Petrol_Group
Gorenje	http://en.wikipedia.org/wiki/Gorenje
Mercator	http://en.wikipedia.org/wiki/Mercator_%28retail%29
Telekom Slovenije	http://en.telekom.si/company/organization
Ipko	http://en.wikipedia.org/wiki/IPKO
One	http://en.wikipedia.org/wiki/One_%28Telekom_Slovenija_Group%29
Gibtelecom	http://en.wikipedia.org/wiki/Gibtelecom
Perutnina Ptuj	http://en.wikipedia.org/wiki/Perutnina_Ptuj
Aerodrom Ljubljana	http://en.wikipedia.org/wiki/Aerodrom_Ljubljana
Aerodrom Maribor	http://en.wikipedia.org/wiki/Maribor_Edvard_Rusjan_Airport

Adria Airways	http://en.wikipedia.org/wiki/Adria_Airways
Luka Koper	http://en.wikipedia.org/wiki/Luka_koper
Nova Ljubljanska banka (NLB)	http://en.wikipedia.org/wiki/Nova_Ljubljanska_banka http://www.nlb.si/the-bank-today
Nova Kreditna banka Maribor (Nova KBM)	http://www.nkbm.si/mission http://www.nkbm.si/novakbm-group-companies
Pipistrel	http://en.wikipedia.org/wiki/Pipistrel
Akrapovič	http://en.wikipedia.org/wiki/Akrapovi%C4%8D
Slovenske železnice	http://en.wikipedia.org/wiki/Slovenske_%C5%BEeleznice
Nuklearna elektrarna Krško (NEK)	http://en.wikipedia.org/wiki/Nuklearna_Elektrarna_Krsko
Termoelektrarna Šoštanj	http://www.te-sostanj.si/en/
Revoz	http://www.revoz.si/en/inside.cp2?cid=6CC9E0E9-BBC7-F39E-72A3-FD971F3A2537&linkid=inside
Terme Maribor	http://sl.wikipedia.org/wiki/Terme_Maribor,_d.d.
Terma Čatež	http://sl.wikipedia.org/wiki/Terme_%C4%8Cate%C5%BE
Pivovarna Laško	http://en.wikipedia.org/wiki/Pivovarna_La%C5%A1ko
Primorje	http://www.primorje.si/index.php?lng=eng
Banka Slovenije	http://en.wikipedia.org/wiki/Bank_of_Slovenia
Sloga	http://sl.wikipedia.org/wiki/Sloga
slovenske obveznice (Slovenija, obveznice)	http://en.wikipedia.org/wiki/Slovenia http://en.wikipedia.org/wiki/Bond_%28finance%29
slovensko gospodarstvo (Slovenija, gospodarstvo)	http://en.wikipedia.org/wiki/Slovenian_economy
Zavarovalnica Triglav	http://sl.wikipedia.org/wiki/Zavarovalnica_Triglav
Hidria	http://www.hidria.com/en/about-us/
Kolektor	http://www.kolektor.com/en/about-the-group
Holding Slovenske elektrarne	http://en.wikipedia.org/wiki/Holding_Slovenske_elektrarne
Lek	http://en.wikipedia.org/wiki/Lek_%28pharmaceutical_company%29
Sandoz	http://en.wikipedia.org/wiki/Sandoz
Merkur	http://sl.wikipedia.org/wiki/Merkur_Group
Tuš	http://www.tus.si/en/about-tus
Istrabenz	http://en.wikipedia.org/wiki/Istrabenz
Cinkarna Celje	http://sl.wikipedia.org/wiki/Cinkarna_Celje http://www.cinkarna.si/en/company-profile
Iskra Avtoelektrika - Letrika	http://www.letrika.com/en/group-letrika/about-group/
TAB	http://www.tab.si/teksti.php?id=1
Simobil	http://en.wikipedia.org/wiki/Simobil
Geoplin	http://en.wikipedia.org/wiki/Geoplin http://www.geoplin.si/eng/about-us
Hella Saturnus Slovenija	http://www.hella-saturnus.si
Slovenska industrija jekla	http://www.sij.si/en/who-we-are/
Metal Ravne	http://www.metalravne.com
Talum	http://en.wikipedia.org/wiki/Talum
Acroni	http://www.acroni.si/
Sava	http://www.sava.si/eng/about-sava.html

Seaway	http://sl.wikipedia.org/wiki/SeaWay
Lafarge Cement Trbovlje	http://sl.wikipedia.org/wiki/Lafarge_Cement
Elan	http://en.wikipedia.org/wiki/Elan_%28company%29
Splošna plovba	http://sl.wikipedia.org/wiki/Splo%C5%A1na_plovba
Intereuropa	http://www.intereuropa.si/index.php?page=about_us&item=1
Adria Mobil	http://en.wikipedia.org/wiki/Adria_Mobil
Alpina	http://en.wikipedia.org/wiki/Alpina_%C5%BDiri
Lisca	http://en.wikipedia.org/wiki/Lisca_%28company%29
Amis	http://www.amis.net
T-2	http://english.t-2.net/
Trimo	http://sl.wikipedia.org/wiki/Trimo
4) politics section	
Janez Janša	http://en.wikipedia.org/wiki/Janez_Jan%C5%A1a
slovenska vlada, Vlada Republike Slovenije	http://en.wikipedia.org/wiki/Government_of_the_Republic_of_Slovenia
predsednik Republike Slovenije, slovenski predsednik	http://en.wikipedia.org/wiki/President_of_Slovenia
Državni zbor RS	http://en.wikipedia.org/wiki/Parliament_of_Slovenia
Gregor Virant	http://en.wikipedia.org/wiki/Gregor_Virant
Danilo Türk	http://en.wikipedia.org/wiki/Danilo_T%C3%BCrk
Slovenska demokratska stranka (SDS)	http://en.wikipedia.org/wiki/Slovenian_Democratic_Party
Nova Slovenija (NSi)	http://en.wikipedia.org/wiki/New_Slovenia
Državljanska lista	http://en.wikipedia.org/wiki/Civic_List_%28Slovenia%29
Pozitivna Slovenija (PS)	http://en.wikipedia.org/wiki/Positive_Slovenia
Slovenska ljudska stranka (SLS)	http://en.wikipedia.org/wiki/Slovenian_People%27s_Party
Demokratična stranka upokojencev Slovenije (DsSUS)	http://en.wikipedia.org/wiki/Democratic_Party_of_Pensioners_of_Slovenia
SD	http://en.wikipedia.org/wiki/Social_Democrats_%28Slovenia%29
Zoran Janković	http://en.wikipedia.org/wiki/Zoran_Jankovi%C4%87
Karl Erjavec	http://en.wikipedia.org/wiki/Karl_Erjavec
Radovan Žerjav	http://en.wikipedia.org/wiki/Radovan_%C5%BDerjav
Borut Pahor	http://en.wikipedia.org/wiki/Borut_Pahor
slovenska policija / Slovenija, policija	http://en.wikipedia.org/wiki/Police
slovenska vojska	http://en.wikipedia.org/wiki/Military_of_Slovenia
Univerza v Ljubljani	http://en.wikipedia.org/wiki/University_of_ljubljana
Univerza v Mariboru	http://en.wikipedia.org/wiki/University_of_Maribor
Univerza na Primorskem	http://en.wikipedia.org/wiki/University_of_Primorska
slovenski profesor	http://en.wikipedia.org/wiki/Professor http://en.wikipedia.org/wiki/Slovenia
slovenski znanstvenik	http://en.wikipedia.org/wiki/Scientist http://en.wikipedia.org/wiki/Slovenia
Romi v Sloveniji	http://en.wikipedia.org/wiki/Romani_people

	http://en.wikipedia.org/wiki/Slovenia
5) foreign affairs section	
Ministrstvo RS za zunanje zadeve	http://en.wikipedia.org/wiki/Ministry_of_Foreign_Affairs_%28Slovenia%29
zunanji minister Karl Erjavec	http://en.wikipedia.org/wiki/Karl_Erjavec
Ministrstvo za obrambo RS	http://en.wikipedia.org/wiki/Ministry_of_Defence_%28Slovenia%29 http://www.mo.gov.si/en/
obrambni minister Aleš Hojs	http://www.mo.gov.si/en/about_the_ministry/leadership/
slovenska veleposlaništva in konzulati	http://en.wikipedia.org/wiki/Embassy http://en.wikipedia.org/wiki/Slovenia
Alojz Peterle	http://en.wikipedia.org/wiki/Alojz_Peterle
Ivo Vajgl	http://en.wikipedia.org/wiki/Ivo_Vajgl
Milan Zver	http://en.wikipedia.org/wiki/Milan_Zver
Tanja Fajon	http://en.wikipedia.org/wiki/Tanja_Fajon
Zofija Mazej Kukovič	http://www.zofijamazejkukovic.net/eng/about/
Mojca Kleva	http://mojcakleva.eu/about-me1/
Romana Jordan	http://en.wikipedia.org/wiki/Romana_Jordan_Cizelj
Jelko Kacin	http://en.wikipedia.org/wiki/Jelko_Kacin
Urad vlade za Slovence v zamejstvu in po svetu	http://www.uszs.gov.si/en/areas_of_activity/
Ljudmila Novak	http://en.wikipedia.org/wiki/Ljudmila_Novak http://www.uszs.gov.si/en/about_the_office/leadership/
Svetovni slovenski kongres	http://www.slokongres.com/index.php?option=com_content&view=article&id=1&Itemid=4&lang=sl
Slovenska izseljenska matica	http://sl.wikipedia.org/wiki/Slovenska_izseljenska_matica http://www.zdruzenje-sim.si/kdo_smo/sim_danes/
društvo Slovenija v svetu	http://www.drustvo-svs.si/jupgrade/index.php?option=com_content&view=article&id=458:ob-20-letnici-drutva-svs&catid=43&Itemid=79
Slovensko panevropsko gibanje	http://www.panevropa.si/o_gibanju.htm
Laris Gaiser	null
Rudolf Gabrovec	null
Jernej Sekolec	null
Ernest Petrič	http://sl.wikipedia.org/wiki/Ernest_Petri%C4%8D
Slovenci, kazenska ovadba	http://en.wikipedia.org/wiki/Slovenians http://en.wikipedia.org/wiki/Slovenia
Slovenci, smrt	http://en.wikipedia.org/wiki/Death
Ruska kapelica	http://en.wikipedia.org/wiki/Slovenia http://en.wikipedia.org/wiki/Russian_Chapel,_Vr%C5%A1i%C4%8D
6) culture section	
EPK, Maribor	http://en.wikipedia.org/wiki/European_Capital_of_Culture http://en.wikipedia.org/wiki/Maribor
Festival Ljubljana	http://en.wikipedia.org/wiki/Ljubljana_Summer_Festival http://sl.wikipedia.org/wiki/Festival_Ljubljana
Festival Brežice	http://seviqc-brezice.si/index.php/about-festival/name-of-the-festival http://seviqc-brezice.si/index.php/about-festival/programme-objectives

Liffe	http://en.wikipedia.org/wiki/Ljubljana_International_Film_Festival
Bienale industrijskega oblikovanja	http://www.bio.si/About-Biennial.aspx
Grafični bienale	http://www.mglc-lj.si/slo/index-onas.htm
festival Vilenica	http://en.wikipedia.org/wiki/Vilenica_Prize http://www.vilenica.si/about_vilenica/p/170/1/2/
Laibach	http://en.wikipedia.org/wiki/Laibach_%28band%29
Irwin	http://en.wikipedia.org/wiki/IRWIN http://sl.wikipedia.org/wiki/Irwin
Drago Jančar	http://en.wikipedia.org/wiki/Drago_Jan%C4%8Dar
Boris Pahor	http://en.wikipedia.org/wiki/Boris_Pahor
Sabina Cvilak	http://sl.wikipedia.org/wiki/Sabina_Cvilak_Damjanovi%C4%8D
Mesto žensk	http://www.cityofwomen.org/en/content/info
festival Fabula	http://en.wikipedia.org/wiki/Fabula_Award http://www.festival-fabula.org/2012/eng/
slovenski PEN center	http://sl.wikipedia.org/wiki/Slovenski_center_PEN
duo Silence	http://en.wikipedia.org/wiki/Silence_%28band%29
Marjana Lipovšek	http://en.wikipedia.org/wiki/Marjana_Lipov%C5%A1ek
Dragan Živadinov – KSEVT	http://en.wikipedia.org/wiki/Dragan_%C5%BDivadinov
Zavod Bunker	http://www.bunker.si/eng/about-bunker
Branimir Slokar	http://sl.wikipedia.org/wiki/Branimir_Slokar
Zavod Maska	http://www.maska.si/index.php?id=25&L=0&id=25
Marko Pogačnik	http://en.wikipedia.org/wiki/Marko_Poga%C4%8Dnik
Vinko Globokar	http://en.wikipedia.org/wiki/Vinko_Globokar
Perpetuum Jazzile	http://en.wikipedia.org/wiki/Perpetuum_Jazzile
Tomaž Pandur	http://www.pandurtheaters.com/#!/tomaz-pandur
festival Lent	http://sl.wikipedia.org/wiki/Festival_Lent
France Prešeren	http://en.wikipedia.org/wiki/France_Pre%C5%A1eren
Ivan Cankar	http://en.wikipedia.org/wiki/Ivan_Cankar
Janez Trdina	http://en.wikipedia.org/wiki/Janez_Trdina
Kobariški muzej	http://sl.wikipedia.org/wiki/Kobari%C5%A1ki_muzej
Hugo Wolf	http://en.wikipedia.org/wiki/Hugo_Wolf
Bolnica Franja	http://en.wikipedia.org/wiki/Franja_Partisan_Hospital
muzej Baza 20	http://www.burger.si/MuzejiInGalerije/DolenjskiMuzej/Baza20/Baza20_ENG.html
Sinagoga Maribor	http://sl.wikipedia.org/wiki/Sinagoga_Maribor
Kočevski rog	http://en.wikipedia.org/wiki/Ko%C4%8Devski_rog

Annex C Countries and regions

This list contains the countries and regions which may be used as the values of *country* parameter

Austria

China

Croatia

France

Germany

Hungary

India

Italy

Slovenia

Spain

Switzerland

United Kingdom

United States