

Public Opinion Channel: A System for Augmenting Social Intelligence of a Community

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Abstract. *We propose a novel community communication system called Public Opinion Channel (POC). Existing communication systems have limitations on eliciting and circulating opinions from community members because communication costs for receiving, sending, and selecting information are high. To augment social intelligence of a community, (1) eliciting diverse opinions from community members, and (2) circulating opinions in the community are important. We propose POC prototype system for augmenting social intelligence of a community by eliciting and circulating diverse opinions. We adopted (1) passive message viewing and (2) anonymous messaging of opinions for reducing the communication costs. The system generates and updates a story that is a series of opinions and broadcast to community members continuously. Design concept and an overview of the POC system are described.*

1 Introduction

Internet became a social place. We can exchange our thoughts and opinions with other people who have same interests or goals. However, existing communication systems such as e-mail, BBS (Bulletin Board System), chat, and other systems have limitations on eliciting and circulating opinions in a community¹. This is because communication costs for receiving, sending, and selecting a message is high. To augment social intelligence of a community, eliciting and circulating diverse opinions in a community are important.

We propose *Public Opinion Channel (POC)* for augmenting *social intelligence* of a community. Social intelligence here means a property of a community that enables community members to share and maintain knowledge. There are two points to augment social intelligence of a community, (1) eliciting opinions from community members, and (2) continuous circulation of opinions in a community.

The first is eliciting diverse opinions from community members as many as possible. We often have opinions for various things such as TV and radio programs, books and journals, Web pages and BBS, and so on. Although these opinions have underlying power to change things drastically, those hidden opinions are not always appeared as public

opinions. Hidden opinions are important for sharing knowledge in a community because community members acquire and think on various opinions. Eliciting hidden opinions from community member is important.

The second is continuous circulation of opinions. Messages on mailing list (ML), BBS, and chat system are not circulated continuously. We call these media as *volatile media* because these media broadcast messages only once, and never broadcast messages again. In contrast to the volatile media, we propose *continuous media* that broadcast messages continuously. Continuous media represented by TV and radio are suitable for sharing knowledge in a community. This is because these media always broadcast messages and opinions of community members. Members can easily get information from the continuous media. Thus, continuous broadcasting of opinions is needed.

In order to facilitate eliciting and circulation of opinions, *communication costs* that are expenses of cognitive resources for receiving, sending, and selecting a message should be declined. By reducing communication costs, POC facilitates social intelligence of a community.

This paper is organized as follows. Section 2 describes communication costs of existing communication systems and design concept of POC. Section 3 describes an overview of the POC system. Section 4 discusses on related works.

¹ Community here is a group of peoples who have same interests and goals, and discussing and working together.

2 Social intelligence of a community

2.1 Community as a live knowledge-base

Social intelligence in this paper is a property of community members that enables a community to share, maintain, and inherit knowledge of the community. Although productivity loss in a group thinking such as brainstorming is reported[1], we regard that there are another positive properties for a group or a community such as sharing, maintaining, expanding knowledge in the group or the community. In this paper, we focus on these properties of a community.

Community works as an intelligent system when there exists active communications between members. Active communications provide suitable situations and contexts for eliciting and sharing tacit knowledge from members. Knowledge here means useful information for the community. Each member has his or her knowledge on specific domains. Although, such knowledge has underlying possibilities to apply to the domains, it is not utilized usually because there are few situations or contexts for utilizing the knowledge. If appropriate situations or contexts are provided with members, their knowledge are much utilized.

POC aims to activate communications in a community by broadcasting a *story* to community members. Story is a set of information consisting of opinions from members and information on the Web. By broadcasting a story, we aim to increase situations and contexts that enable members to find and talk on various demands and needs in the community.

2.2 Communication costs

One of the issues for activating communications in a community is *communication costs* of communication systems. Communication costs here mean costs for receiving and sending a message, and cost for selecting a message from large amount of information. These costs are expenses of resources such as time, labor, and cognitive resources.

We consider three kinds of communication costs.

Receiving cost

An expense of resources for a user to receive and comprehend a message by using the system.

Sending cost

An expense of resources for a user to prepare and send a message by using the system.

Selection cost

An expense of resources for a user to select or choice a message to read.

Reducing communication costs is important for communication systems because those costs prevent community members to receive and send diverse opinions instantly. Communication costs must be reduced to augment social intelligence.

Table 1 compares communication costs between several communication systems and an e-mail system that receives and sends only a plain text message such as Eudora² and Microsoft Outlook³. A message here is a unit of information such as an article for BBS and network news, one or several lines of texts for chat systems and instant messaging tools⁴, and an utterance in video conferencing systems.

BBS and network news

BBS and network news require high costs for receiving and selecting a message. This is because a user has to keep track of messages in order to attend discussions. When BBS and network news are liven up, it is difficult to follow discussions. Furthermore, selecting messages from large amount of messages is difficult in BBS and network news.

Communication systems should be designed as follows: (1) systems should allow a user to attend discussions without requiring him or her to keep track of discussions, (2) systems help a user to find or select a message what he or she wants to read.

Chat system and instant messaging tool

Chat system and instant messaging tool require low cost in all costs. This is because these systems treat short messages consists of one or several lines of texts. Thus, one can receive and comprehend contents of the message easily and instantly. User can send his or her thought just like talking by using these systems.

Communication systems should be designed as follows: (1) short message is suitable for eliciting utterances from users.

Video conferencing system

Video conferencing system doesn't need much costs in all costs. This is because that a user can communicate with others by using non-linguistic representation such as gestures and facial expressions. Although video conferencing system is suitable for eliciting opinions, circulating elicited opinions in a community is difficult.

Communication systems should be designed for storing and reusing elicited opinions in order to circulate those opinions in a community.

² <http://www.eudora.com/>

³ <http://www.microsoft.com/office/outlook/default.htm>

⁴ including Yahoo Messenger and AOL Instant Messenger, and so on.

Table 1: Comparison of costs for receiving, sending, selecting a message between an e-mail system and other communication systems.

	Receiving	Sending	Selection
E-mail (baseline)	—	—	—
BBS	High	Medium	High
Network news	High	Medium	High
Chat system	Low	Low	Low
Instant messaging	Low	Low	Low
Video conference	Very low	Very low	—

2.3 Design concept of POC

We propose a concept of communication system called POC. POC is a concept of an automatic broadcasting system for a community[2][3]. POC elicits trifling opinions from community members, generate a story that includes those opinions, and broadcasts the story to the community. By broadcasting the story, POC aims to acquire feedback from members. POC updates the story by incorporating with the feedbacks. Consequently, POC elicits and evolves knowledge of the community by activating communications.

Design concept of POC is based on the following points.

- User is not forced to keep track of discussions.
- Message consists of short lines of text.
- System stores and reuses opinions.

We have implemented the POC. Here are the points of the system.

1. Real-time generating and updating of stories.
2. Continuous broadcasting of stories.
3. Passive viewing of stories.
4. Anonymous messaging.

Real-time generating and updating of stories

POC generates and updates stories on the fly. A story is a series of opinions that are related to each other. Similar opinions are summarized into one opinion, thus community members can send their opinions without keeping track of discussions.

Continuous broadcasting of stories

POC broadcasts stories continuously while generating and updating stories. POC serves fresh stories to a community continuously. By continuous broadcasting, POC elicits diverse opinions from community members.

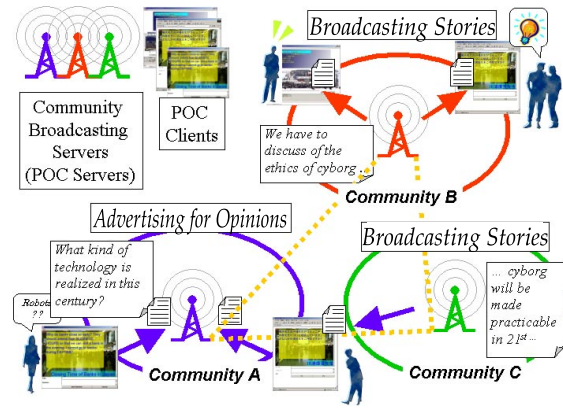


Figure 1: An overview of POC prototype system. The system advertises for opinions, generates and updates stories, and broadcasts to POC clients.

Passive viewing of stories

Communication cost for receiving and selecting messages should be declined. POC reduces these costs by showing stories automatically. Community members can view stories in passive viewing style in which the system displays stories automatically. In summary, receiving and selecting cost of a message is reduced.

Anonymous messaging

Community members can send their opinions in anonymous messaging style, i.e., one can send his or her opinion without revealing his or her social cues such name, age, gender and so on. POC doesn't broadcast these information. Members can send their opinion without revealing their social cues.

3 POC prototype system

3.1 Overview of POC prototype system

POC prototype system consists of a *community broadcasting server (POC server)* and several *POC clients* that serve stories to each community. An overview of the POC prototype system is shown in Figure 1.

In Figure 1, POC servers advertise for opinions on a topic in order to generate stories. On the other hand, some servers broadcast stories to community members continuously. Members can send their opinions to their community's POC server. The server generates and updates stories when the server accepts a new opinion. POC server communicates with another servers in order to exchange opinions and stories. Members can not only view stories on their community but also other communities instantly.

Table 2: An example of a message. Message consists of a title and a body. Message may include a reference to an another opinion and a URL on the Web.

```
<?xml version="1.0" encoding="Shift_JIS" ?>
<opinion name="tem_imf" date="2001/5/6 20:52:18"
  host="192.168.31.163" reference="comment5.xml">
<title>Diversity of plants</title>
<comment>
I found there are various colors and shapes of
plants in the gardening shop. It seems that
plants have various colors and shapes innately.
</comment>
<url>
http://daphne.palomar.edu/wayne/trmar98.htm
</url>
</opinion>
```

3.2 POC server

POC server is an automatic broadcasting system that receives opinions from community members, and broadcasts stories consisting of related opinions. POC server generates and updates stories continuously.

In the design of POC, similar opinions are summarized into a summary when a story is generated or updated. POC server broadcasts stories to POC clients. Members can choose POC servers that host specific stories for a community. Members can receive stories from those servers.

There are several functions for a POC server.

- Broadcasting text and audio stories
- Generating stories
- Gathering information from the Web
- Updating stories

Broadcasting text and audio stories

POC server serves stories by text and audio stream. An example of message is shown in Table 2. A message consists of a title and a body. A message is described in the XML format. In the table, body is described between comment tag, i.e., `<comment>` and `</comment>`. A message may includes references to an another message and URL. An attribute of `<option>` tag indicates that this message refers to `comment5.xml`. URL described between url tags indicates reference URL.

POC server broadcasts messages by text and Mpeg Layer 3 audio format (MP3 format). In case of text stories, POC clients request stories to the servers. CGI program on POC server accepts requests, and returns stories.

In case of MP3 format, the server generates audio files for narration by text-to-speech (TTS) sys-

tem. We use CHATR⁵ for TTS. Generated MP3 files are broadcasted by MP3 streaming server. We use icecast⁶ for the streaming server. Current POC server only broadcasts stories in Japanese. We are planning to broadcast stories in English, and other languages.

Generating stories

POC server generates a story that has a context. Context here means semantic relationship between sentences. Context is necessary for a story. It becomes difficult for humans to understand without context.

Context are made by linking related opinions. Context is generated as follows.

1. Pick up an opinion (source opinion) from opinion database.
2. Retrieve opinions from opinion database using title of the first opinion.
3. Sort retrieval results by date order, and first n opinions are added to the source opinion. (n is threshold)

First, the server picks up an opinion that becomes introduction of the story. Implemented system picks up a source opinion randomly from opinion database. Then, server retrieves related opinions based on keywords that are nouns exist in the title of the source opinion. Finally, retrieval results are sorted by date. First n opinions are added to the source opinion. In summary, a story consists of a source opinion and n opinions retrieved from opinion database.

Example of a story is shown in Table 3. In this table, presenter introduces three opinions related to “affordance”. These opinions are sorted by date order.

We are implementing various context generation methods. One of such methods is topic-based summarization method[4]. This method generates a context consisting of related sentences. Sentences are linked based on *theme* and *focus*. Theme indicates a subject of a sentence and focus indicates a concept that is emphasized in the sentence. We identify a theme and focuses by utilizing the case grammar. In the case grammar, each clause in a sentence has a case that indicates the function against a verb. We specify focuses and a theme of a sentence by identifying a case for each clause⁷.

⁵ <http://www.itl.atr.co.jp/chatr/>

⁶ <http://www.icecast.org/>

⁷ We use KN Parser to analyzes cases of Japanese sentences. <http://www-nagao.kuee.kyoto-u.ac.jp/nl-resource/knp-e.html>

Table 3: Example of a story.

Presenter	<i>Next opinion is “affordance”.</i>
Opinion	Does anyone know about affordance?
Presenter	<i>Related to this opinion, there is another opinion.</i>
Opinion	There is a workshop on designing intelligent artifacts. This is a good introduction to affordance.
Presenter	<i>This is the last opinion.</i>
Opinion	I found a good text on cognitive psychology when I was looking for affordance.
Presenter	<i>Thanks all. We’re waiting for your opinions.</i>

Table 4: An example of a context. Italicized terms indicate theme, and {term} indicates focuses. Context is generated by linking theme and focus.

1	Government expects the possibility of {wind power}.
2	<i>Wind power</i> is one of the most widely used {alternative sources}.
3	One of <i>alternative sources</i> is {geothermal energy}.

A context is generated by linking a focus and a theme of a sentence. A context is generated by as follows.

1. Pick up a sentence. (current sentence)
2. Do until n sentences are found.
 - (a) Pick up a focus of the *current sentence*.
 - (b) Pick up a sentence whose theme is the focus of *current sentence*. (next sentence)
 - (c) Link the next sentence to the current sentence.
 - (d) Rename the next sentence current sentence.

An example of context is shown in Table 4. The context is generated by linking a focus and a theme. In the table, we pick up a sentence, and find a focus of the sentence. In this case, we pick up “wind power” as a focus. Then, we select a next sentence whose theme is the focus of the previous sentence. As same as the first sentence, we pick up a focus (“alternative sources”) from the next sentence. Context is generated by repeating these procedures until n sentences are found (n is threshold).

Gathering information from the Web

The concept of POC gathers information from the

Table 5: Sentences found in retrieval results from a Web search engine. Sentences are extracted based on feature phrases.

1	Affordance is a coined term proposed by James J. Gibson.
2	Consequently, affordance is information given by an environment.
3	For example of an affordance, we can recognize a cup as an object that we can pour water into.

Web in order to incorporate related information into a story. Implemented system gets keywords from the title of an opinion, and retrieves related information based on the keywords from the Web.

In order to utilize information retrieved from the Web, POC server identifies types of sentences such as definitions, examples, explanations, and so on. Identified sentences are utilized as related topics.

An example utilizing such topics is shown in Table 5. There are three sentences found in retrieval results from the a Web search engine by the keyword “affordance”. First and second sentences are explanations. These sentences are extracted based on feature phrases. Feature phrase is a phrase that indicates the type of sentence, i.e., feature phrase “for example” indicates that the sentence includes an example. POC server extracts sentences based on these feature phrases. Third sentence is an example. POC server finds the types of sentences, and generates stories, i.e., inserting explanation of keyword.

Updating stories

POC server updates existing stories when new opinions are post by community members. POC server stores generated stories on story database. When a new opinion is sent to the server, the server searches related stories from the story database, and updates stories incorporating new opinions.

The problem is how to resolve incorrect stories. To maintain coherence or to correct errors of stories automatically is quite difficult. Thus, we are planning to enable community members to update and evaluate stories. By enabling community members to update stories, members can correct stories directly. Furthermore, stories that include inconsistency and doesn’t match with community’s interests are weeded out. Appropriate stories for the community are survived through selections of community members. We are planning to permit POC server to generate various stories that may contain incorrect or inconsistency ones. We aim that stories in a community are modified and selected gradually by community’s interests.

3.3 POC client

POC client is a passive story viewer. Users can view stories of communities, and send their opinion to their community's POC server.

Figure 2 shows a screen image of POC client. POC client shows stories in a telop style in which each character of a story appears one by one.

There are several functions for POC client.

- Opinion editor
- Story retrieval
- Local mode and network mode
- Capturing stories
- Showing URL
- Message filtering
- Continuous retrieval

Opinion editor

User can edit and send their opinions to the server. User can also save his or her opinion as a local opinion. User can modify opinions in his or her hard disk, and send them to the server.

Story retrieval

User can retrieve stories of their community. Actual retrieval process is ran on POC server. POC client sends queries to the POC server, then the server retrieves stories. The server returns the retrieval results.

We adopted n -gram search method that searches messages based on pieces of queries consisting of one or two characters[?]. Although this method is not good at precision measure, the method has advantage that various texts that include queries partially are retrieved.

Local mode and network mode

User can select mode of the POC client either *local mode* or *network mode*. In local mode, user can compose and store his or her opinions into local hard disk. In network mode, user can not only send his or her opinion but also view and download stories from POC server. Local mode are suitable for composing and viewing personal opinions. User can also edit local opinions, and upload the opinions to a POC server. By separating the local and network mode, user can store his or her immature ideas and thoughts.

Capturing stories

POC client allows user to capture stories into local hard disk. User can view captured stories in



Figure 2: Screen image of POC client. POC client receives stories from POC servers and displays stories in telop style.

local mode. User also edit and modify the captured stories, and send them to a POC server.

Showing URL

POC client shows a URL embedded in an opinion. User can copy the URL, and view the Web page to which the URL refers.

Message filtering

POC client shows opinions based on user's selected keywords. User can view opinions based on his or her interests.

There are three message displaying: (1) by date (descendent), (2) by date (ascendent), and (3) random. In any case, user can select messages based on their keywords.

Continuous retrieval

POC client retrieves opinions continuously. When a user retrieves on a keyword, POC client gets another keywords from retrieval results, and retrieves set of opinions using that keywords. Figure 3.3 shows an overview of the continuous retrieval.

User can view a set of opinions based on retrieval results. In Figure 3.3, opinions related to a keyword "Agent" is retrieved. When continuous retrieval mode is off, further retrievals are not made. When continuous retrieval mode is on, further retrievals based on previous retrieval are made. Further retrievals are made by extracting a keyword from previous retrieval results. The keyword is picked up according to the feature value of a word. In the implementation, we use frequency of word as the feature value. Retrievals are continued based on previous retrieval results. User can view another opinions originating from initial keyword given by the user.

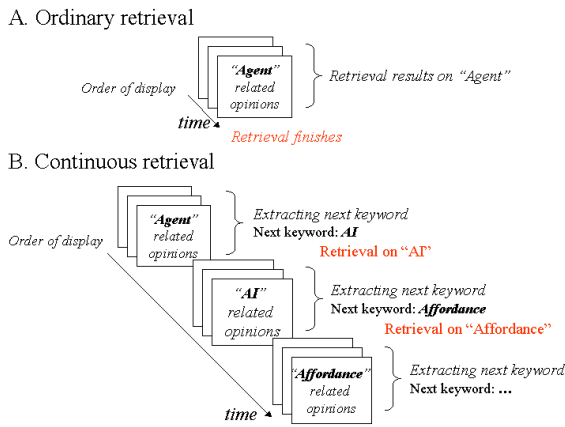


Figure 3: Continuous retrieval. Retrieval is made by extracting keywords from previous retrieval results, and retrieve continuously.

4 Discussion

In this section, we discuss on proposed POC system and related works. Topics discussed in this section are as follows.

- Passive viewing
- Modification of stories by community members
- POC and narrative intelligence
- Evaluation

4.1 Passive viewing

Tanaka and his colleagues proposed information visualization tools using a TV program metaphor[6]. By using the visualization tools, one can view Web documents or retrieval results of database in passive viewing style like viewing a TV program.

One of major differences between POC and the information visualization tools is real-time generating and updating of stories. POC client and the information visualization tools are similar in regard to their aims to reduce user’s receiving and selection costs by using passive viewing. However, POC focuses on automatic generating and updating of stories. We have proposed approaches to make stories automatically such as an identification of sentence types and topic-based summarization method. We are planning to focus on automatic story generation based on community members’s opinions.

4.2 Modification of stories by community members

One of the points in regard to generating and updating stories is the relationship between existing

stories and new stories. We consider the relationship between existing and new stories as “the struggle for existence”. This is because most new stories are considered to be generated by POC server automatically, and only a few of the stories are evaluated, modified, and circulated in the community. This process resembles to the competition between creatures in the world of nature. Only appropriate stories are survived and evolved in the community.

Process of updating stories by a community is important for accomplishing social intelligence of a community. We consider that editing or modifying an existing story is one of creative activities as well as proposing a new opinion. In real world, many cultures have been evolved their knowledge based on modification and customization of original knowledge. For example, Japanese Katakana characters are based on Chinese characters. Another example is free software. In recent years, free or open source software has been growing rapidly. Free software, that permits modification and distribution of softwares without represented as GNU Public License⁸, has proved that editing and copying of software have possibilities to produce valuable softwares represented as Linux. Thus, we consider that modification and redistribution of existing stories are important for sharing and evolving knowledge in a community. We are planning to enable community members to edit existing stories and broadcast in the community as evolved stories.

4.3 POC and narrative intelligence

Lawrence proposed to use storytelling to exchange knowledge in a group[7]. They argued that there is a function for collecting and sharing knowledge in storytelling. In regard to narrative intelligence, stories produced by POC server work as a basis of sharing knowledge in a community. Stories in a POC community are selected, modified, and redistributed repeatedly in a community. Through these process, knowledge in the community evolves gradually.

One of points of POC in regard to narrative intelligence is that messages of POC become seeds of narratives. Because length of a POC opinion is short, one can easily send his or her opinions to POC server. Furthermore, one can reply to an opinion quickly. Thus, it is easy to collect various opinions from community members. To facilitate social intelligence of a community, POC server provide seeds of narratives to members.

⁸ <http://www.gnu.org/copyleft/gpl.html>

4.4 Evaluation

Evaluation of POC in regard to knowledge sharing in a community is our future work. There are difficulties on evaluating of POC because target and purpose of evaluation is difficult to specify. POC aims to eliciting and circulating knowledge in a community, however, defining the target community and variables to investigate are difficult.

Fujihara argued evaluation method on social intelligence support systems[8]. We are planning to apply his method to evaluate elicitation and circulation of knowledge in a community.

We have two preliminary experiments of applying POC system to a practical community. One is a long term observation of opinions in a community, the other is a short term observation of group thinking.

First experiment is made during 10 January to 5 April 2001. The community consists of eight members who are all Japanese, and each member is familiar to another members. 1,329 opinions are collected during this experiment. From this experiment, we have observed that trifling opinions such as on TV program are shared mainly in the community. Thus, POC facilitates eliciting hidden knowledge of community members.

Second experiment is on evaluation of creativity support by POC[9]. Miura argued that POC enables group members to find an opinion to which they have not paid their attentions. In this experiment, members discussed on demands or requests for their university using POC system. POC server broadcasts opinions in order to provide various viewpoints for the members periodically. From this experiment, circulating opinions enabled members to recognize importance of previous opinions. We will continue of evaluation of creativity support aspect of POC.

Our future work is to apply POC to a heterogeneous cultural community that consists of peoples who have own cultures and languages. We consider that it is difficult to make consensus among members in the heterogeneous community. We are planning to apply POC to heterogeneous community as well as homogeneous cultural community,

5 Conclusion

We proposed the POC prototype system. POC system consists of (1) POC server that generates and broadcasts stories, and (2) POC client that receives and shows stories continuously. Proposed approaches to augment social intelligence are (1)eliciting and (2)circulating diverse opinions in a community. In order to accomplish these tasks, we implemented passive message viewing into POC

client. One of the points of POC prototype system is real-time generating and updating of stories. We are planning to experiment of an effectiveness of POC prototype system for knowledge creation from the viewpoint of social and cognitive psychology.

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