Trend and Factor Analysis of Office Related Research in LOIS Technical Committee

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SUMMARY   The Life Intelligence and Office Information System (LOIS) Technical Committee of the Institute of Electronics, Information and Communication Engineers (IEICE) dates its origin to May 1986. This Technical Committee (TC) has covered the research fields of the office related systems for more than 30 years. Over this time, this TC, under its multiple name changes, has served as a forum for research and provided many opportunities for not only office users but also ordinary users of systems and services to present ideas and discussions. Therefore, these advanced technologies have been diffused from big enterprises to small companies and home users responsible for their management and operation. This paper sums up the technology trends and views of the office related systems and services covered in the 30 years of presentations of the LOIS Technical Committees by using the new literature analysis system based on the IEICE Knowledge Discovery system (I-Scover system).
key words: office study, LOIS, technical committee, technology trend, literature retrieval, I-Scover

1. Introduction

New technologies have been often introduced in advanced offices or big enterprises pursuing improved business efficiency. In order to solve office issues, an academic society named the Office Automation (OA) Society was founded in 1979 whose main goal was searching for efficient improvement of the office work. Later, the name of this Society was changed to Japan Society for Information and Management [1] in 2007. The main focus on the research of this society includes management, enterprise and social information systems in the office. Then the various technologies have been developed and experienced in the offices. Along with these activities, the Japan Society for Office Studies [2] was founded in 1999 to study the work style in the office and office environments, etc.

Since there was no study group related to the systems or network technologies of office matters, a new study group was established called Office System (OS) in the IEICE [3] in 1986. As the research viewpoint of each society is different, each study group has been progressed in each stand-

point.

This paper presents the activities of the LOIS Technical Committee [4] of the Information and Systems Society (ISS) in the IEICE. This LOIS TC is derived from the above OS Technical Committee and has been developed. It is easy to get the office related research papers submitted in the IEICE by using the recently developed I-Scover system [5]. There are five societies in the ICICE as shown in Table 1. This Institute is composed of Engineering Sciences Society (ESS), Communications Society (CS), Electronics Society (ES), Information and Systems Society (ISS) and Human Communication Group (HCG). The LOIS TC is within the ISS. There are 23 Technical Committees in the ISS as shown in Table 2.

This paper is organized as follows. The outline and history of the LOIS TC is presented in Sect. 2. In Sect. 3, we present the new system for literature analysis which utilizes the I-Scover system along with the trends of the LOIS TC and conferences in recent 10 years. Then the factors of the trends, various time series analysis and keyword network graphs are also described in Sect. 3. In the final section, the conclusions for this paper are summarized.

2. Outline of LOIS Technical Committee

As stated in the previous section, the LOIS Technical Committee was initially founded as a special interest group known as the Office System (OS) Technical Committee. In

Table 1   TCs and Societies in IEICE.

TSs	ESS	CS	ES	ISS	HCG
General	20	21	15	23	4
Ad-hoc	0	8	7	4	5

Table 2   Technical Committees in the ISS.

	Abbreviation	Formal Name
1	MBE	ME and Bio Cybernetics
2	LOIS	Life Intelligence and Office Information Systems
3	IE	Image Engineering
4	NLC	Natural Language Understanding and Models of Communication
5	CPSY	Computer Systems
6	COMP	Theoretical Foundations of Computing
...	…	…
23	SC	Services Computing

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Table 3　Keywords of LOIS Technical Committee.

Number	Keywords
D141000	**Office Information Systems, e-Business Modelling**
D141001	Office Architecture Models
D141002	SOHO and Telework Systems
D141003	Business Intelligence
D141004	Business Process Engineering
D141005	Business Support
.....	....
D141009	Social Information Systems
D141010	Human Behavioral Science
D141011	Office Environment and Design
.....	....
D141018	Construction of Enterprise Models and Business Process
D141019	Model Evaluation Techniques
D141020	Knowledge Sharing and Management Techniques
D141021	System Construction Techniques
D141022	Education, Human Resource Development, and Authentication

Fig. 1　System configuration of the new analysis system.

Table 4　I-Scover dataset.

Items	Records	Contents
Article	234,364	Article ID, Title, Abstract, Issued date, etc.
Author	775,910	Article ID, Person ID, Organization ID.
Person	266,261	Person ID, Person name, etc.
Organization	29,866	Organization ID, Organization name, etc.
Keyword	946,808	Article ID, Term ID.
Term	317,602	Term ID, Term, External links, etc.

this OS TC, the document related systems, multimedia communication systems in the offices or network application were mainly dealt with in the 1980 and 1990 era.

However, since the name of the OS TC was often confused with OS acronym standing for 'Operating System', the abbreviation was changed to the OFfice System (OFS) TC in 1999. In the following years, the topics of the presentation in the OFS TC have contained application of information systems and advanced systems using computer, so the name of the OFS TC was changed to Office Information System (OIS) in 2002. Furthermore, it was renamed as the Life Intelligence and Office Information Systems (LOIS) TC since the contents being discussed in the TC included the systems or services not only for business users but also for daily life activities for ordinary consumers. The keyword "Lifelog" is commonly used in the related presentations.

The main keywords for technical field classified in the LOIS TC are shown in Table 3 [6]. However, the keywords related to lifelogs are not included, so a revision of the table is necessary in the near future. On the other hand, the related fields are located in the number D140500 (Data engineering and Web information system), number D140600 (Information network), D140800 (Artificial Intelligence and Data mining) and D140900 (Human computer interaction) So the arrangement of the keyword table is also needed.

3. Trend and Factor Analysis Based on the I-Scover System

The activities of the Office related Technical Committee can be obtained by the new analysis system based on the I-Scover system in this section.
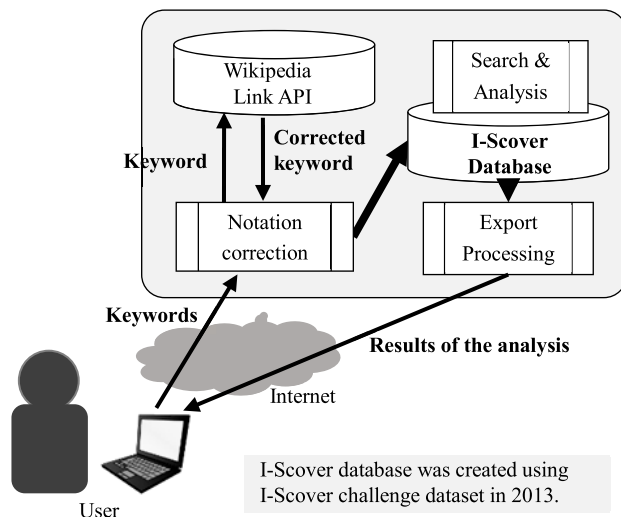
3.1 The New Literature Analysis System

We developed the new literature analysis system in order to identify the characteristic trend [7]. This system utilizes the Wikipedia Link API [8] together with I-Scover system to improve tracking over time given the fluctuation in notation commonly used. The first stage of I-Scover system was developed in April 2013. In this system, the papers are linked to another research papers by the metadata (Linked Open Data) in the external sites like CiNii [9].

The process flow of the new literature analysis system is shown in Fig. 1. Since the I-Scover system can only retrieve the literature from the metadata [10], the analysing function and visualizing functions are added through the I-Scover system. The Wikipedia Link API is introduced in order to reduce the impact of changing terminology.

If the keywords are entered into this system, the notation fluctuation is eliminated and the literature which is identified by the keywords are searched and presented.

The I-Scover dataset for this new literature analysis system is shown in Table 4. There are about 234,364 articles and 946,808 keywords in this archive. The specifications of the new analysis system are shown in Table 5. In this system, MySQL is used as the database, Apache 2

Table 5   Specifications of the new literature analysis system.

OS	CentOS 6.8, 64bit
CPU	Intel (R) Core (TM) i7-4770K, 4 cores, 3.50GHz
RAM	DDR3 16GB
SSD	RAID 5, 406 GB
Web server	Apache 2.2.15
Database	MySQL 5.1.73
Development language	PHP 5.3.3
Graph tool	JpGraph 3.0.7

Fig. 2   Time series analysis of "Lifelog".

Fig. 3   Time series analysis of the special plural keywords.

Fig. 4   Technology factor analysis.
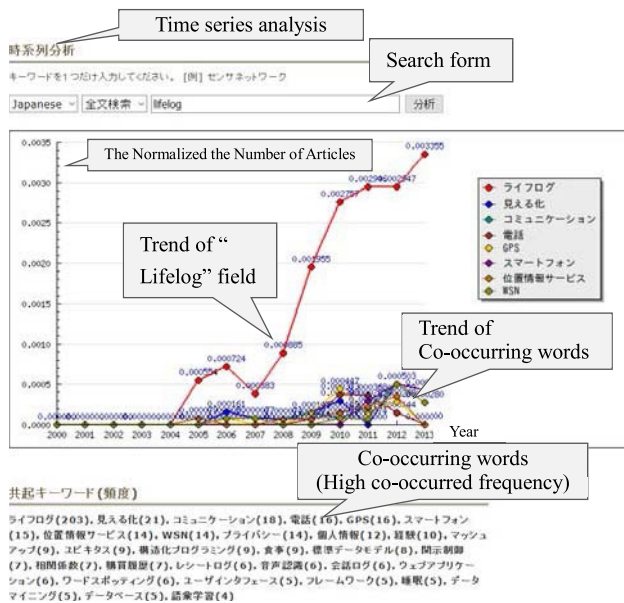
is used as a Web server and the programming language is PHP5. JpGraph [11] is used as a graph library.

3.2   Trend Analysis of LOIS Technical Committee

By using this system, the time series trends of the technical papers of the LOIS Technical Committee, the Society Conference, General Conference and the FIT (Forum on Information Technology), papers from the International Conference, and IEICE Transactions on the Information and Systems Society were extracted and analyzed by the inputted keywords [12]. Figure 2 shows the results of time series analysis of the keyword "Lifelog" in the interval 2000 to 2013 in the LOIS TC literature. (The name of the TC had been changed from OIS to LOIS in 2009.) The results are normalized with the total volume of literature and has still greatly increased during that period. Then time series trends of other keywords co-occurring with "Lifelog" are also shown in this figure. These keywords include "GPS", "API", "Mashup", etc.

The time series analysis for the special keywords, "Lifelog" and "Web application", from 2000 to 2013 is shown in Fig. 3. This figure shows the co-occurring fre-
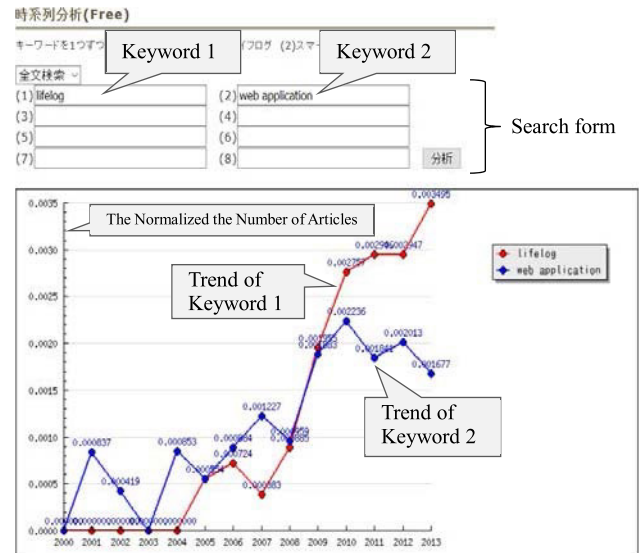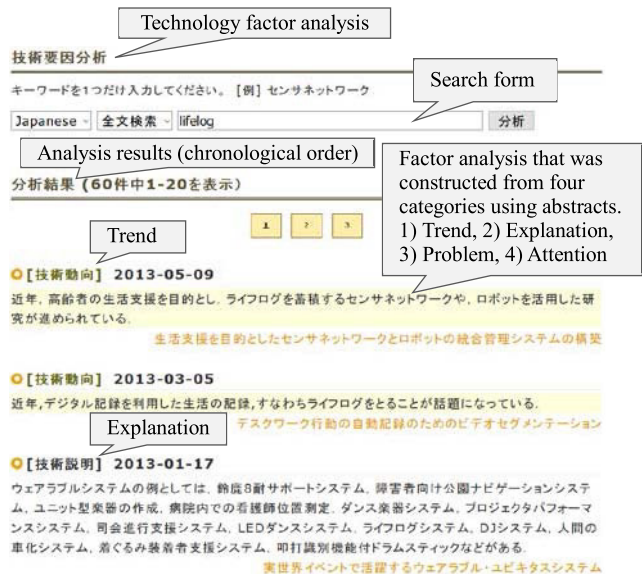
quency characteristics of the two keywords. Although the frequency of the keyword "Lifelog" increases from about 2005, the keyword "Web application" doesn't display a similar trend to the increase in "Lifelog". It is presumed that the various lifelog services are increasing year by year, but web application technology is in use from about 2000 and this well-established and saturated in 2010 era.

The technology factor analysis (技術要因分析) is shown in Fig. 4. This shows the examples of the analysis results from the abstracts of the papers.

The results are classified into 4 categories, namely, the technological Trend, Explanation, Problem and Attention. The trend of technological factor can be estimated or at least a hints of solutions may be obtained from the article abstract.

Table 6　Keywords ranked top 10 in the LOIS TC paper.

2009	2010	2011	2012	2013
Lifelog	Lifelog	Lifelog	Lifelog	Lifelog
Home network	GPS	Knapsack encryption	Sensor network	Smart phone
e-Learning	Sensor Network	Location information	Security	Management
GPS	Mashup	GPS	Smart phone	Image processing
Encryption	Security	QR code	Authentication	QR code
Recommend	User support	Mobile terminal	Location information	GPS date
Pulse rate	Scheduler	Encryption code	Cloud	Vocabulary learning
Elliptic curve	Firefox	Security	Electronic watermark	Food log
Pairing	Community	Low density attack	No-contact IC card	Communication
QR code	Standard date model	Formal verification	Word spotting	Home network

Then the keywords registered in the paper are very important. Table 6 shows the top 10 ranked keywords in the papers of the LOIS TC for past 5 years as obtained through the new literature analysis system. From this table, it is evident that the keyword "Lifelog" appears most frequently and can be considered the most important in LOIS TC. After the change of the name of the TC, "Lifelog" and related keywords, "GPS", "Location information", "Mashup", "Smart phone", "Mobile phone", "Food log" etc., are frequently utilized in the presented literature.

Then the recent time series analysis of the literature and number of authors per year are shown in Fig. 5.

From this figure, the numbers of articles and authors have been increasing after 2009 and it can be said that research activities have been invigorated since 2009.

The LOIS TC is ordinarily held every two months and cooperated with other TCs or other such as Document Communication (DC) TC of the Information Processing of Japan (IPSJ).

Figure 6 shows the number of articles per two month interval. Before 2009, the number of articles was typically 10 or less. But the number of articles has increased, especially in March. This is because the venue had been moved from Tokyo to Okinawa and the conference became popular destination as a graduation trip for students.

Table 7 shows the topics and keywords which are discussed in the LOIS TC. This is shown in the Web page of LOIS TC. The topics are composed of 8 topics, namely, "Lifelog", "Office model", "Communication", "Data mining", "System architecture", "Network", "Security" and "Human interface". The top 10 ranking keywords in the period of between 2009 and 2013 are shown in Table 6. These keywords are obtained from the system and useful for researchers to select the presenting conference.

Figure 7 shows the number of articles in each field for approximately ten years. In this figure, because there are various systems and services in the "System architecture" field, these make up the largest in total articles. The second largest category is "Network". Thus the literatures covering "Lifelog" field is the third largest. We can assume
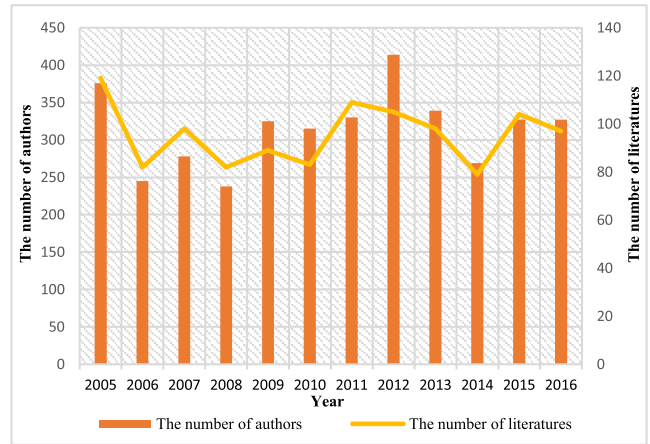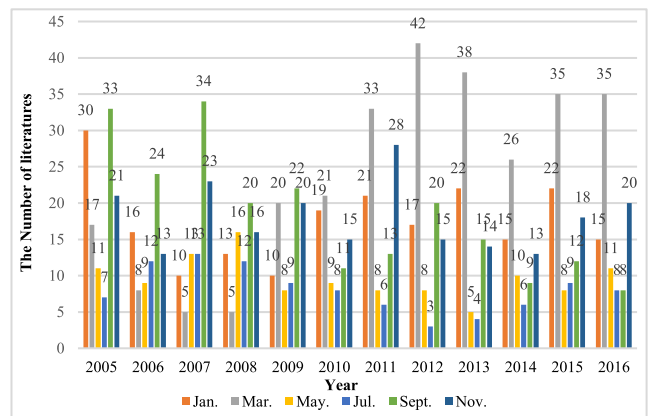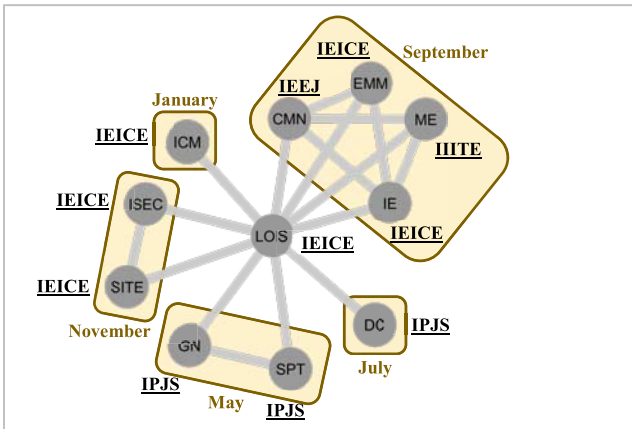

Fig. 5　Time series analysis of LOIS TC.

Fig. 6　Time series literature number of the LOIS TC.

Table 7　Topics and major keywords handled by LOIS TC.

Topics	Major Keywords
Lifelog	Lifelog, Life intelligence, Log
Office model	Office Bussiness, Cocument
Communication	Communication, Weblog, SNS
Data mining	Mining, Recommend, Intelligence
System architecture	System, Service, Mashup
Network	Network, Cloud, P2P
Security	Security, Spam, Privacy
Human interface	Device, Operation, Visualizatiomn

that the explanatin is that there are many services, such as food logging services, telephone logging services, receipt logging services, etc., which have been proposed and their experimental results are often reported. The big challenges, however, are privacy and security protection issues around the use of private personal information. Therefore the literatures covering lifelogs has been decreasing. Three figures (Fig. 5, 6 and 7) are presented as generated by an ordinary spreadsheet software from the dataset of the retrieval system.

The relation among the keywords are shown as a Key-

word Network Map as persented in Fig. 8. In this figure, "Lifelog" is located around the center and this is related to other keywords, such as "Conversation log", "Telephony", "Multimedia", "Database", "Word spotting", and so on. Then the keyword "Office" is also linked to the keywords, such as "Business", "Office Information system", "Secretary", "Telephony", and so on.

This figure is drawn by the principle that the co-occurring keywords with "Lifelog" are linked by the edge with each other. Figure 9 shows the numbers of literatures in each LOIS TC per month. It has held in January, March, May, July, September and November. In January, the Information Management Network (IMN) TC is co-located and so as Groupware and Network Service (GN) TC and Security Psychology and Trust (SPT) TC in May. This TC is co-located with Document Communication (DC) TC in

Fig. 7　Time series literature per topics.

Fig. 9　Article count per month

Fig. 8　Keyword network in the LOIS TC

ICM: Information and Communication Management, ISEC Information SECurity,
SITE: Social Implications of Technology and Information Ethics, ME: Media Engineering,
CMN: Communication, EMM: Enriched Multi Media, IE: Image Engineering,
DC: Document Communication, SPT: Security Psychology and Trust, GN: Groupware and Network Service
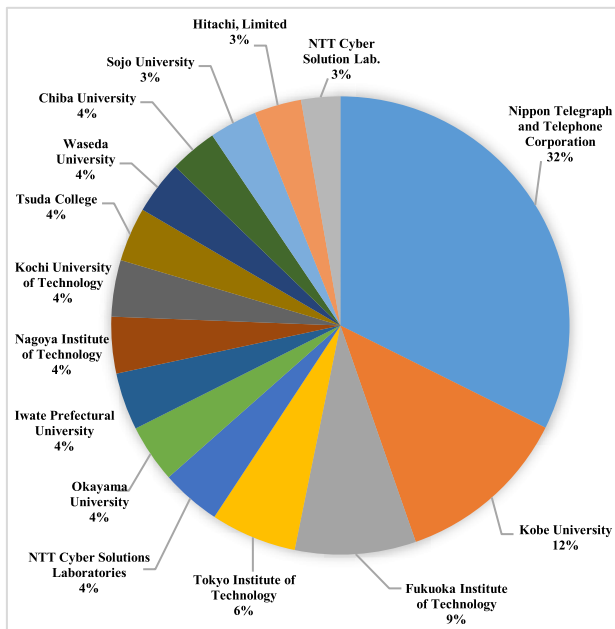
Fig. 10 Joint conference relation with other TCs

Fig. 11 Main contributors in the LOIS TC.

Fig. 12 Keyword network connected to Lifelog in 2004.
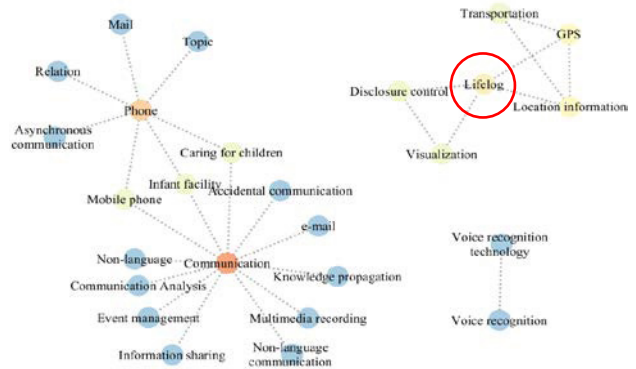
Fig. 13 Keyword network connected to Lifelog in 2008.
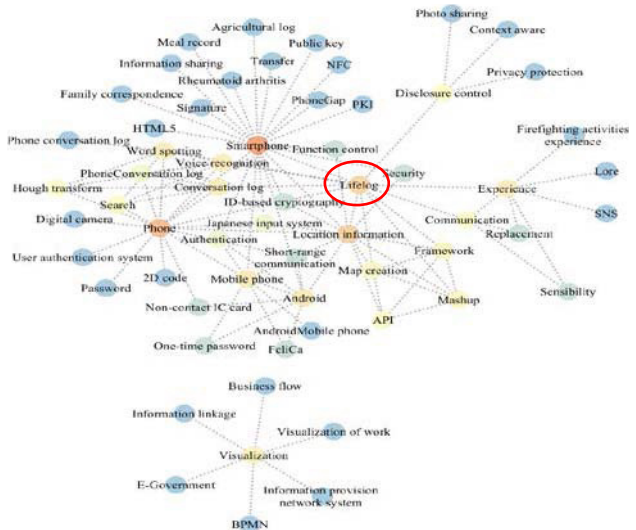
Fig. 14 Keyword network connected to Lifelog in 2012.

July. These cooperating TCs are shown in Fig. 10. Since the number of articles in July is rather small, the joint conference with Mobile Network and Application (MONA) TC in Communication Society is scheduled to start from 2017.

The main contributors of the LOIS TC are from NTT Laboratories, Kobe Univ., Kochi Univ. of Tech., Fukuoka Inst. of Tech. and so on. The top 15 contributors are shown in Fig. 11.

The keyword network graph linked with keyword "Lifelog" in 2004 is shown in Fig. 12. In this figure, there are no keywords related to "Lifelog". Then the similar keyword graph in 2008 is also shown in Fig. 13. In this figure, the keyword appears in the upper right area. The graph in 2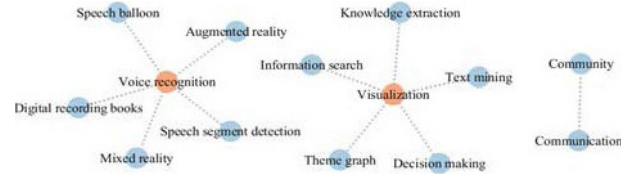014 is shown in Fig. 14. Comparing these graphs from Fig. 12 to Fig. 14, the number of the keyword links with "Lifelog" has gradually increased and spread. This corresponds to the increase in the quantity of literature and cross-referencing with each other. It can be said that the research related to "Lifelog" has develops gradually and is in the development phase.

Figure 2 to Fig. 4 were drawn with the new literature analysis system. Other figures were drawn by using ordinary software such as, Excel and Cytoscape [13] with the datasets of I-Scover system.

4. Conclusions

It has been about 30 years since the OS Technical Committee was founded. During this period, technologies for office systems have developed significantly and the name of the technical committee was changed from OS to OFS, OIS and LOIS.

- Examining the activity trends of the LOIS TC with the new literature analysis system using the I-Scover system, it is found that the TC was on a gradual decline until 2008. After the name was changed from OIS to LOIS in April 2009, it has become very active. After that, more than 70 presentations were observed over the next five years, and it can be said that the change contributed greatly to revitalization.
- Since the venue was changed from Tokyo (Machine Promotion Center) to Okinawa in March 2009, the number of presentations has increased by more than 20 and is still continuing. The conferences in March are hosted by LOIS TC alone. It seems that the March conference has become established as an event for graduation presentation for university students and researchers.
- The conference in July is held jointly with the Document Communication (DC) TC of Information Processing Society of Japan, but the number of research presentations has been small. Therefore, new strategies, such as inviting tutorials, encouraging lectures and panel discussions, will be introduced.

The LOIS TC will continue to regularly hold 6 conferences a year (in the odd months) and semi-annual FIT (Forum on Information Technology) and general conferences. It will also further invigorate research presentations by choosing the timely topics across wider society. The joint conference with Mobile Network and Applications (MONA) TC is expected to start from July 2017 as the first of its expansion strategies. Special issues of the ISS Journal (in Japanese) have been published 5 times over the past 15 years and the first one in English is being published with this volume. Finally, the authors hope further development of office related systems and technologies via LOIS TC.

Acknowledgements

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