Decision Analysis Model for Cloud Based Grass Surveillance Systems

Irfan Syamsuddin[*1,2], Anton Satria Prabuwono[2,3], Ahmad Hoirul Basori[2], Arif Bramantoro[2], Arda Yunianta[2,4] and Alaa Omran Almagrabi[5]

[1]Department of Computer and Networking Engineering, Politeknik Negeri Ujung Pandang, Makassar, Indonesia
[2]Faculty of Computing and Information Technology Rabigh, King Abdulaziz University, Rabigh 2191, Saudi Arabia
[3]Master in Computer Science Program, Budi Luhur University, Jakarta 12260, Indonesia
[4]Faculty of Computer Science and Information Technology, Mulawarman University, Indonesia
[5]Department of Information Systems, Faculty of Computing and Information Technology (FCIT) King Abdul Aziz University (KAU) Jeddah Saudi Arabia

Summary
Advancing grass development and maintenances is a novel research area in Indonesia. Among many areas of grass research, real time monitoring with low cost energy usage is underlined within this paper. In order to support cloud based grass surveillance systems, appropriate video streaming technique is considered be applied according to real time monitoring requirements. This study proposes a new decision analysis model for guiding decision makers to perform selection among existing video streaming algorithms to enhance grass surveillance systems on the cloud. A novel decision analysis model is developed and the guidance for using it properly is also presented.

Key words:
decision analysis, AHP, grass, surveillance, streaming algorithm.

1. Introduction

Grass research and development has been extensively conducted in several countries such as the United States and South Korea. Commonly, the results can be easily seen such as in football stadiums or golf fields. In South Korea, research on grass technology has been extensively researched to achieve twofold objectives. Firstly, creating high quality grass that is environmentally friendly with advanced low pollution grass management and secondly to achieve a variety with minimum environmental harms [1].
Following advanced grass reseach in South Korea, a similar approach to explore Indonesian local grass has been started within the Department of Soil Science, Sebelas Maret University, Surakarta, Indonesia. At the time, there are four main areas of research activities namely ecology, soil, pathology, insects, and breeding. Its main aims are to establish Indonesian local turfgrass with eco-friendly grass management systems and applicable to be applied within the country [2]. In the future, the results of this long term and multidisciplinary research will yield the best grass varieties that will meet the needs of grass stadiums throughout Indonesia.

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Video surveilance systems for grass monitoring is among collaborative research topics within the scope of the multidisciplinary research in order to support countinuous monitoring for data collections purpose. Currently, grass current surveillance technology is still a client server based on Linux that strongly depends on server capacity to accommodate growing collections of data that has long been collected.

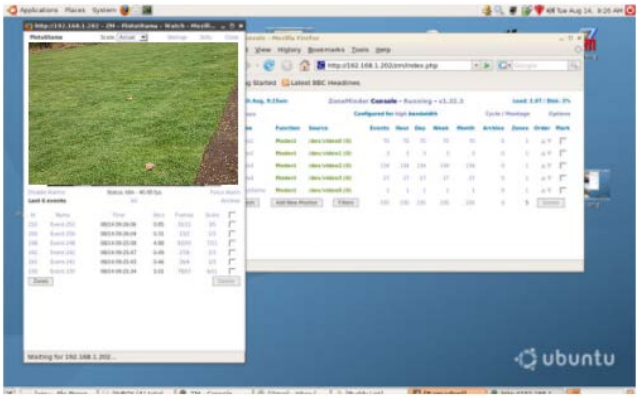

Fig. 1 Traditional grass surveillance systems – client server model.

The issue of limited storage capacity has been realized and searching a more flexible media becomes open research. In order to deal with the issue, an advanced monitoring system for grass development based on cloud computing technology was proposed and implemented.
However, the new cloud based video surveillance systems still questioned in terms of which video streaming technology is capable and approariate enough for handling vast amount and real time video data of grass monitoring on the cloud (see figure 2).

Fig. 2 Cloud based grass surveillance systems.

Previous studies have shown several video streaming techniques that currently well developed and maintained both in laboratory environment as well as in real implementations that might be taken into consideration [13][14]. In choosing a specific video streaming technology, it is important to take many considerations, looking at from different angles and use various criteria in order to minimize possible risks and at the same time to maximize benefits of the project in the future.

This study aims to deal with the issue by proposing a decision analysis model based on Multi Criteria Decision Making (MCDM) methodology for guiding the selection of video sreaming techniques suitable for application of cloud based grass surveillance systems.

The paper is structured into seven parts. After brief introduction in the first section, section 2 presents literature review on cloud computing technology. Then, section 4 presents the methodology of Multi Criteria Decision Making with an emphasis on the Analytic Hierarchy Process approach. This section also describes advancement in video streaming technology. Furthermore, the decision analysis model for cloud based grass surveillance systems is presented and explained in section 5. Finally, conclusion and future research direction are presented in the final section.

2. Literature Review

According to the NIST, Cloud Computing is defined as ‘‘Model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.’’[4]

Cloud computing has been a widely discussed, studied and observed topic by academicians and IT professionals both in universities and industries. Various technical approaches to improve efficiency and quality of cloud computing services are being proposed as seen in current literature [5]. Besides, in order to obtain the most optimum benefits from business perspectives, many economic models have been tested and introduced by experts [6].

All of benefits offered by cloud computing are basically coming from three main concept of Cloud computing called cloud characteristics, cloud service model, and cloud deployment type.

2.1. Cloud Characteristics

Cloud Computing enables a feature called on-demand self-service. With this feature, a consumer who demands particular need of computing resources such as storage, CPU, network, software, and others, may automatically obtain it self-service way without the need to get help from cloud service providers [4][7].

Resource pooling is the next characteristic of cloud computing that enables various hardware and software resources to be pooled together by cloud service provider and then dynamically assigned according to consumers’ needs. This can be performed both in virtualization as well as in multi-tenancy model [7].

Rapid elasticity is a unique facilities for consumers. In this scheme, computing resources become immediate rather than persistent, without upfront commitment or contract as usual. In addition, users can use them to scale up any services whenever they want and then release or scale them down once they finish. Moreover, resources provisioning appears to be infinite to them, the consumption can rapidly rise in order to meet peak requirement at any time [7].

Measured service is a special feature that helps users to appropriately use particular mechanisms to measure the usage of resources for every single usage. Although computing resources are pooled and shared by multiple consumers, through this feature cloud computing providers able to measure every single usage of its services by applying its metering capabilities [7].

2.2. Cloud Service Model

According to NIST, cloud computing provides three basic models of service delivery. They are well known as Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) [4][7].

In SaaS model, a user may accessed any cloud based application runs on a hosting environment, through networks from various clients (e.g. web browser, PDA, etc.) [7].

Then, by using PaaS model, cloud consumers do not need to own any platform for development. Instead, they can make or develop cloud services and applications directly on the PaaS cloud. PaaS offers a development platform that hosts both completed and in-progress cloud applications [7].

Finally, through IaaS model, various IT infrastructures such as storage, networks, and other fundamental

computing resources might be enjoyed by users by using virtualization mechanisms [7].

2.3. Cloud Deployment Model

In terms of Cloud deployment, there are three major types of Cloud Computing implementation called Public Cloud, Private Cloud, and Hybrid Cloud [4][7].

Public cloud is a term where all Cloud infrastructure, platform and application (software) are developed and owned by Cloud providers. Users who need particular application, platform or even infrastructure do not need to spend money to have them all; instead they only rent as they need from cloud providers [7].

Private cloud is the contrary of Public Cloud. In this type, users develop and operate the whole cloud computing infrastructure within the organization and have full control of the system [7].

Hybrid cloud, on the other hand is the combination of both types mentioned above. For specific reasons, users need to develop particular Private Cloud, but in other case users need Public cloud since it is more efficient in terms of management. This is positioned as a mixture between Private Cloud and Public Cloud [7].

Users from small business usually prefer public cloud considering its low cost in implementation while government is advised to deploy private cloud in order to keep their sensitive data away from public access.

3. Methodology

This study applies Multiple criteria decision making (MCDM), a specific methodology for guiding decision making processes in which multiple, usually conflicting, criteria are existing as well as alternatives. MCDA is "a discipline that encompasses mathematics, management, informatics, psychology, social science and economics" [8]. MCDM approaches the problems by structuring and solving decision and planning problems involving multiple criteria. As a result, by using MCDM methodology decision makers will be clearly guided in handling such kind of problems. MCDM might be applied adequately to any fields which have multiple criteria problem where a significant decision needs to be made such as in business, government, health, science and technology [8].

Among many approaches in dealing MCDM problems, AHP which stands for Analytic Hierarchy Process is considered as the most widely used one. Since its introduction in 1975 by Saaty [9], AHP has been applied to solve many MCDM cases in business, government, health, science and technology to name a few [3].

AHP is an eigen value approach to the pair-wise comparisons in representing any multiple criteria decision making problems both in the numeric scale for the measurement of quantitative as well as qualitative performances according to decision maker's needs[10].

AHP also offers a group consensus feature. Using this feature, a number of decision makers may make group decision and uses geometric mean to combine all results into a single group decision [10]. AHP proposes the following basic steps to approach any MCDM problems [10] :

a. Define the problem goal
b. Consider all actors, objectives and its possible outcome.
c. Find any possible criteria that influence the behavior.
d. Organize the problem in the form of a four level of hierarchy (goal, criteria, sub-criteria and alternatives).
e. Compare each element in the corresponding level and calibrate them using the numerical scale.
f. The maximum eigen value, consistency index (CI), consistency ratio (CR), and normalized values for each criteria or alternative are calculated.
g. Ranking the results to obtain final decision

The issue to be tackled in this study falls into MCDM problem, where there are many criteria must be considered carefully in order to establish video surveilance systems for grass monitoring over cloud computing infrastructure. Besides, there are also a number of video streaming technology are available as candidate for the systems which are considered as alternatived from MCDM point of view.

Cloud based grass surveillance systems strongly relies on quality of video streaming. Since the media transmission quality varies, commonly video transmission rate will be degradated due to some factors such as bandwidth limit, loss of data and jitter [11] [12] [13].

To maintain quality of service of streamed video data, a number of techniques are introduced using different logical algorithm approaches to make video packets intelligent enough and adaptive with the unfriendly network conditions [13].

In general, intelligent video streaming techniques are grouped into four main categories, namely Adaptation Streaming, Scalable Streaming, Summarization Streaming, and Secure Streaming techniques which are briefly described as follows.

First of all, Adaptation Streaming technique is considered as the basic technique used for video streaming to keep the quality of video being transmitted according to the capability of data sender to deal with instable network condition. Flexible media streaming employed by this adaptive scheme develops to address the problem of serving heterogeneous clients with adaptive video quality. Simulcast [14] [15], Video Transcoding [16], Wireless Transcoding [17] and intelligent Prioritized Adaptive

Scheme (iPAS) [18] are few examples of advanced video streaming algoritms that employs Adaptive Streaming technique.

Secondly, Scalable Streaming technique is another way to maintain quality of streamed video data in a broadcast or multicast environment, since there are large variations in adaptation need among receivers. The technique is employed in a number of algorithms such as Fine Granularity Scalability [19], Motion Compensated Temporal Filtering (MCTF) [20], Self-tuning Neuro-Fuzzy (SNF) [21] to name a few.

Thirdly, Summarization Streaming technique is specifically developed to maintain large quantity of video streaming data particularly in network environment. Video summarization scheme applies intelligent smart algorithm for analysis, structuring, and summarizing video content according to various user preferences in viewing the video [22]. The pictorial summary is considered as the most fundamental example of this technique [23]. Another approach is personalized summarization to archive browsing by adding an indexing subsystem according to user preferences [24]. Algorithm to enhance multi-user video communication solution [25] is also a example of summarization streaming [26].

Finally, Secure Streaming is technique for streaming video by adding security parameters to enhance smart video streaming [27]. Secure scalable streaming (SSS Framework) is considered as the first security algoritm in this category [28].

4. Result and Discussion

The decision analysis model in this study is developed according to the Analytic Hierarchy Process approach which is a triad hierarchy of goal, criteria and alternative. The hierarchy is then properly structured in such a way that multi-criteria decision clearly reflects the problems being faced. Description of the decision analysis model, including the goal, criteria, and alternative are described as follows.

First of all, the goal is defined as the research objective to be achieved. It is to select the best one among many video streaming technologies to enhance the cloud based grass surveillance systems.

Secondly, the next level consists of criteria which contains various perspectives or different point of views to address, assess and evaluate the given problem. Criteria act as reflective insight to analyze the given problem.

In this case, we argue that the criteria must reflects various perspectives that commonly incorporated in software engineering field of study in terms of technology evaluation. There are several approaches in literature that supportive to this study such as the ISO 9126 for Software Quality [29], Evaluation Framework for OS [30], ERP Systems Selection [31], open-source EMR software packages [32], asset inventory information system [33], and many others.

Considering the nature of problem being discussed which is video streaming technology selection for cloud based surveillace systems, criteria proposed in Wei's AHP model [31] is adopted with some changes. There are five criteria to be applied in our decision analysis model namely functionality, flexibility, implementation time, reliability, and user friendliness.

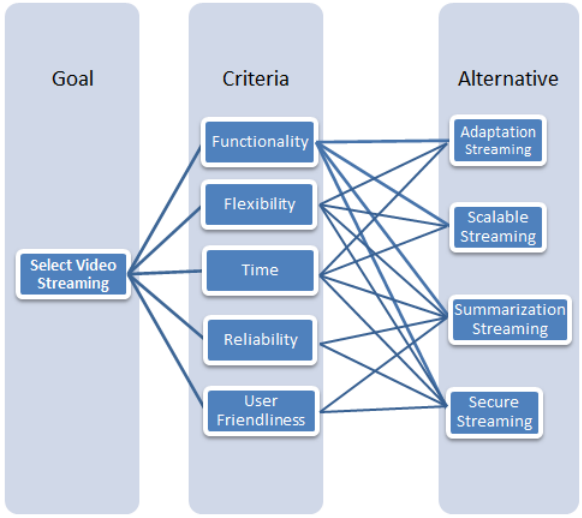

Fig. 3 The Decision Analysis Model.

The criteria adequately meet the requirement for software engineering evaluation in particular video streaming techniques. Readers may refer to [31] for more details explanation for these criteria.

Finally, the last level of the decision analysis model is called alternatives. In this study, the alternatives are four categories of video streaming technologies mentioned in our previous study [3]. They are Adaptation Streaming, Scalable Streaming, Summarization Streaming, and Secure Streaming. The best one will be selected according to AHP approach to fulfill the objective or the goal of the decision making [31].

To assist decision analysis, the following six steps of data analysis procedures are proposed to be followed by decision makers both individual or in group [31][32].

1) Establish the decision survey: The survey is created according to AHP technique which is pairwise comparison by using 1-9 scale of every criteria with respect to the goal as well as for every alternative with respect to the criteria. The complete survey is provided in Appendix section.

2) Collect the survey results : In this stage survey collected in step 2 are organised into a square matrix. The diagonal elements of the matrix are 1. If the value of element (i, j) is

more than 1, then criterion in the ith row is better than criterion in the jth column; otherwise the criterion in the jth column is considered as better than that in the ith row. Then value of (j, i) element of the matrix is calculated as the reciprocal of the (i, j) element. The four steps survey are presented is from Table 1 to Table 5.

Table 1: AHP Survey (Goal)

	9	7	5	3	1	3	5	7	9	
Functionality										Flexibility
Functionality										Time
Functionality										Reliability
Functionality										User Friendly
Flexibility										Time
Flexibility										Reliability
Flexibility										User Friendly
Time										Reliability
Time										User Friendly
Reliability										User Friendly

Table 2: AHP Survey (Criteria: Functionality)

	9	7	5	3	1	3	5	7	9	
Adaptation Streaming										Scalable Streaming
Adaptation Streaming										Summarization Streaming
Adaptation Streaming										Secure Streaming
Scalable Streaming										Summarization Streaming
Scalable Streaming										Secure Streaming
Summarization Streaming										Secure Streaming

Table 3: AHP Survey (Criteria: Flexibility)

	9	7	5	3	1	3	5	7	9	
Adaptation Streaming										Scalable Streaming
Adaptation Streaming										Summarization Streaming
Adaptation Streaming										Secure Streaming
Scalable Streaming										Summarization Streaming
Scalable Streaming										Secure Streaming
Summarization Streaming										Secure Streaming

Table 4: AHP Survey (Criteria: Time)

	9	7	5	3	1	3	5	7	9	
Adaptation Streaming										Scalable Streaming
Adaptation Streaming										Summarization Streaming
Adaptation Streaming										Secure Streaming
Scalable Streaming										Summarization Streaming
Scalable Streaming										Secure Streaming
Summarization Streaming										Secure Streaming

Table 5: AHP Survey (Criteria: Reliability)

	9	7	5	3	1	3	5	7	9	
Adaptation Streaming										Scalable Streaming
Adaptation Streaming										Summarization Streaming
Adaptation Streaming										Secure Streaming
Scalable Streaming										Summarization Streaming
Scalable Streaming										Secure Streaming
Summarization Streaming										Secure Streaming

3) Calculate Principal Eigenvalue and the corresponsing Eigenvector : In this step, the principal eigenvalue and the corresponding normalised right eigenvector of the comparison matrix give the relative importance of the various criteria being compared. The elements of the normalised eigenvector are termed weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives.

4). Evaluate Inconsistency rate: In this stage, consistency of the decision maker in filling the survey will be assessed based on AHP rule. If this consistency index fails to reach a required level of consistency ratio (CR) then answers to comparisons may be re-examined. Saaty suggests the value of CR should be less than 0.1.

5) Final judgment : Once all requirements in step 4 satisfied, the final judgment can be obtained as follows. The rating of each alternative is multiplied by the weights of the sub-criteria and aggregated to get local ratings with respect to each criterion. The local ratings are then multiplied by the weights of the criteria and aggregated to get global ratings. List of the global ratings from the highest value to to lowest one represnt the final judgment.

6) Documentation : The objective of the last step is to provide clear and reasonable decision analysis both in

technical and managerial perspective to apply the chosen video sreaminng technique for cloud based grass surveillance systems.

The main contributions of this study is a new MCDM model as guidance to assist decision makers in the area of streaming video in cloud for grass management which is a specific part in advancing agricultural information systems [34]. This study also would pave the path of using intelligent video streaming that could enhance efficiency in analyzing video data in the cloud environment [35].

In the future, the study might be extended by applying Fuzzy Analytic Hierarchy Process to deal with uncertainty and fagueness in particular decision environment as seen in several previous study [36][37].

5. Conclusion

A decision analysis model for selecting video streaming technique of cloud based grass surveillance systems is presented. The model is structured according to Analytic Hierarchy Process approach which consists of three levels of goal, criteria and alternative.

The objective is to develop a well-organized decision analysis model to aid policy makers in determining the best video streaming technique to be implemented in new grass surveillance systems which is based on cloud computing technology. Several criteria for approaching the problem are used namely, functionality, flexibility, time, reliability and user friendliness. In addition, as alternative, there are four video streaming techniques are selected according to the given criteria nemely Adaptive Streaming, Scalable Streaming, Summarization Streaming and Secure Streaming.

In addition, the decision analysis model is equipped with guidance on how to use it to reach the final decision both in person or in group. The guidance includes the six steps of data analysis which is started by establishing decision survey and ended by documenting final decision.

References

[1] G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955.

[2] Rahayu, Mujiyo, J.Syamsiyah, E.J.Bae, S.M.Choi, G.M.Yang and J.S.Choi, “Survey on native Zoysiagrass in Indonesia: Its spread and characteristics”, ARPN Journal of Engineering and Applied Sciences vol. 11, no. 21, pp. 354-360, 2016.

[3] Rahayu, G.M.Yang, J.S.Choi, Effects of Salinity Level and Irrigation Rate on Kentucky Bluegrass (Poa pratensis L.) Growth and Salt Accumulation in Sand Growing Media Established Over the Reclaimed Saline Soil, Asian Journal of Turfgrass Science, vol.25, no. 1, pp.79-88, 2011.

[4] L.S. Budi, “Development of Agro-Horticultural Commodity Approach and Institutional Models in The District Of Madiun, Indonesia”, International Journal on Advanced Science, Engineering and Information Technology, vol. 3, no. 6, pp. 363-367, 2013.

[5] P. Mell, and T. Grance, T., "The NIST definition of cloud computing." , 2011.

[6] I. Syamsuddin, "Problem Based Learning on Cloud Economics Analysis Using Open Source Simulation." International Journal of Online Engineering vol. 12, no.6 , pp. 4-9 2016.

[7] I. Syamsuddin "Novel Gap Analysis Framework for Cloud Health Information Systems." Journal of Theoretical and Applied Information Technology, vol. 87. no3, pp. 415-421, 2016.

[8] M. Rani, D. Kanimozhi, and S. Sakthivel. "Analytical Hierarchy Process–Study on its Applicability on Web Based Environment." International Journal of Software Engineering and Its Applications vol 9.no 4, pp. 37-46, 2015.

[9] P. Nemery, A. Ishizaka, Multi-criteria Decision Analysis. Wiley, 2013

[10] T.L. Saaty, The Analytic Hierarchy Process, McGrawHill, 1980.

[11] M.A.Marhraoui and A. El Manouar, “An AHP Model towards an Agile Enterprise” International Journal of Advanced Computer Science and Applications, vol 8, no 11, pp. 151-156 , 2017.

[12] C.Huang, J. Li, Shi, “An intelligent streaming media video service system, in the Proc. of IEEE Conference on Computers, Communications, Control and Power Engineering, pp. 1-5, 2002.

[13] I, Syamsuddin "A Novel Framework to Select Intelligent Video Streaming Scheme for Learning Software as a Service." Proceeding of the Electrical Engineering Computer Science and Informatics, pp: 91-95: 2014

[14] J. G.Apostolopoulos, W.T.Tan, and S. J.Wee. Video streaming: Concepts, Algorithms, and Systems. HP Technical Report, 2002.

[15] B.Furht, R.Westwater, and J.Ice, “Multimedia Broadcasting Over the Internet”, PartII–Video Compression, IEEE Multimedia, vol. 6, no 1, pp. 85–89, 1999.

[16] A.Lippman,A., “Video Coding for Multiple Target Audiences”, in Proc.SPIE Visual Communications and Image Processing, pp. 780–782 , 1999.

[17] A.Vetro, C.Christopoulos, and H. Sun, “Video Transcoding Architectures and Techniques: An Overview, IEEE Signal Processing Magazine, vol. 20, no 2, pp. 18–29, 2003.

[18] Z.Li, A.K. Katsaggelos, G. Schuster, and B. Gandhi, “Rate-Distortion Optimal Video Summary Generation”. IEEE Trans. on Image Processing, vol. 14, no.10, pp. 1550-1560, 2005.

[19] Z.Yuan, H.Venkataraman, G.Muntean, “iPAS: An User Perceived Quality-Based Intelligent Prioritized Adaptive Scheme for IPTV in Wireless Home Networks”, IEEE International Symposium on Broadband Multimedia Systems and Broadcasting, 2010.

[20] F.Wu, S. Li, and Y.Q. Zhang, “DCT-Prediction Based Progressive Fine Granularity Scalable Coding,” in Proc.of

IEEE Int. Conference on Image Processing, pp. 1903-1906 , 2000.
[21] J.R. Ohm, “Advances in Scalable Video Coding”, in Proc. Of IEEE, vol. 93, no 1, pp. 42-56, 2005.
[22] H.B. Kazemian, L. Meng, “A fuzzy control scheme for video transmission in Bluetooth wireless," Information Sciences, vol. 176, no 9, pp. 1266-1289, 2006.
[23] C. Cotsaces, N. Nikolaidis, and L. Pitas, “Video Shot Detection And Condensed Representation”, IEEE Signal Processing Magazine, vol.23, no. 2, pp. 28-37, 2006.
[24] H.Karray, M.Ellouze, and A. Alimi, “Indexing Video Summaries for Quick Video Browsing”, Computer Communications and Networks, pp. 77-95, 2010.
[25] F.Chen, D. Delannay, and C.D.Vleeschouwer, “An Autonomous Framework To Produce And Distribute Personalized Team-Sport Video Summaries: A Basket-Ball Case Study”, IEEE Transcations on Multimedia, vol. 13, no 6, pp. 1381-1394, 2011.
[26] Z. Li, J. Huang, A.K.Katsaggelos, and M.Chiang, “Intelligent Wireless Video Communication: Source Adaptation and Multi-User Collaboration”, China Communications, October, pp. 21-29, 2006.
[27] S.J.Wee, and J.G. Apostolopoulos, “Secure scalable video streaming for wireless networks”, in Proc. of the IEEE International Conference on Acoustics, Speech, and Signal Processing, 2001.
[28] C.Venkatramani, P.Westerink, O.Verscheure, and P.Frossard, “Securing Media for Adaptive Streaming”, in Proc ACM Conference on Multimedia (2003).
[29] S.K. Sehra, Y.S.Brar, and N, Kaur, “Applications of multi-criteria decision making in software engineering”, International Journal of Advanced Computer Science and Applications, vol.7, no.7, pp. 472-477, 2016.
[30] C.A.Ardagna, E.Damiani, and F.Frati, “FOCSE: An OWA-based Evaluation Framework for OS Adoption in Critical Environments”. In: Proc. Third IFIP WG 2.13 International Conference on Open Source Systems, Limerick, Ireland, pp. 3–16, 2007.
[31] C.C.Wei, C.F. Chien, and M.J. Wang, "An AHP-based approach to ERP system selection." International journal of production economics vol. 96., no. 1, pp. 47-62, 2005.
[32] A.A. Zaidan, B. B. Zaidan,. A. Al-Haiqi, M. L. M. Kiah, M.Hussain, and M. Abdulnabi, “Evaluation and selection of open-source EMR software packages based on integrated AHP and TOPSIS”. Journal of biomedical informatics, 53, pp. 390-404. 2015
[33] Y.Fitrisia, and B.Hendradjaya. "Implementation of ISO 9126-1 quality model for asset inventory information system by utilizing object oriented metrics." International Conference on Electrical Engineering and Computer Science (ICEECS), pp. 229-234, 2014
[34] P.Mishra, S.D. Samantaray, and A.S. Bist. "An effective approach for finding periodicity of a subject in video data." International Conference on Parallel, Distributed and Grid Computing (PDGC), IEEE, pp. 223-229, 2014.
[35] J.S, Yoo,K.J.Min, S.H.Jeong, and D.B.Shin, "Inter-ministerial collaboration to utilize CCTV video service operated by U-City center of South Korea." Spatial Information Research vol 24.no.4, pp. 389-400, 2016..
[36] L.Abdullah, S.Jaafar and I.Taib. “A New Analytic Hierarchy Process in Multi-Attribute Group Decision Making”. International Journal of Soft Computing, vol 4, pp. 208-214, 2009.
[37] R.Kohli, and S.K.Sehra. "Fuzzy Multi Criteria Approach for Selecting Software Quality Model." International Journal of Computer Applications, vol.98, no.11, pp.11-15, 2014.