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Devising Total Analysis Algorithm for Managing Safely LPG Facilities

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Abstract.. The traditional LPG distribution system has been summarized as four level structures such as LPG base, LPG station, LPG store and user. However, LPG station, LPG store and user less than medium-size have showed frequently diverse accidents, because they are seemed to satisfy only institutional requirements. In LPG accidents, human is damaged directly. Therefore, an advanced safety process is required for enforcing safety management of LPG. Although correct progress direction in advances safety process is necessary for many devices, methods and system, it is to require analysis method that many different data are analyzed in parallel but each measuring data is analyzed in individual. This paper aims to devise method using artificial intelligent algorithm in order to manage total safety analysis that can analyze simultaneously many different data. So, this research develops total risk analysis algorithm with a combination method between classification and clustering algorithm. This method is to mark the beginning of analysis method for detecting cause and increasing safety about LPG facilities.

Keywords: noxious material, dispersion system, intelligent algorithm,

1 Introduction

The traditional LPG distribution system has been summarized as four level structures such as LPG base, LPG station, LPG store and user. According to purpose of each level, various facilities have been existed for storing, packing, transferring and using LPG. A LPG base has been carried out exhaustively institutional regular inspection in long cycle as well as itself check and inspection in short cycle, measured status of facility through safety devices, and loaded safety management system with various function on online or offline.

However, LPG station, LPG store and user less than medium-size have showed frequently diverse accidents, because they are seemed to satisfy only institutional requirements. In LPG accidents, human is damaged directly because most cause is careless handling and inadequate safety equipment, and most type is explosion, fire and rupture [7, 8]. Therefore, an advanced safety process is required for enforcing safety management of LPG. Although correct progress direction in advances safety process is necessary for many devices, methods and system, it is to require analysis

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method that many different data are analyzed in parallel but each measuring data is analyzed in individual.

In preceding paper [5, 6, 9], we checked the feasibility about applying artificial intelligence algorithm to gas domain, and suggest methodology for enhancing accuracy. This paper aims to devise method using artificial intelligent algorithm in order to manage total safety analysis that can analyze simultaneously many different data. So, this research develops total risk analysis algorithm with a combination method between classification and clustering algorithm. This method is to mark the beginning of analysis method for detecting cause and increasing safety about LPG facilities.

2 Applying Algorithm with Clustering Aspect

The algorithm, which is necessary to generate total analysis model in LPG supply facilities under medium-size, should be realized through improving itself and combining among various algorithm. Decision tree and clustering method is considered that t may be appropriate to algorithm for total risk analysis [1, 2, 3, 4]. Therefore, our research will modify and use EM (expectation-maximization) algorithm as clustering method. The EM algorithm is classified roughly into expectation procedure and maximization procedure. The expectation procedure calculates expected value of log likelihood as estimated values at parameter. The maximization procedure generates variable value by maximizing expected value of the former procedure.

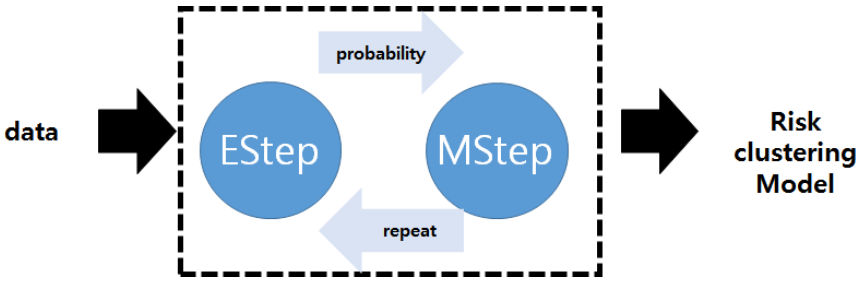

Fig. 1 The clustering flow with EM algorithm

· Expectation procedure: deciding cluster of the highest probability that should belong to clustering by comparing previous selected log likelihood and current computed likelihood

(1 step) Calculating cluster density through normal distribution density function

$$F(x, m, \sigma) = \left\{ \frac{(x - m)^2}{2 \times \sigma^2} \right\} - \log\left(\sqrt{2\pi}\right) - \log(\sigma) \quad (1)$$

(2 step) Getting weighted value between instance and cluster

$$W(j) = \sum_{c=0}^{l} F\left(x(c), m(c), \sigma(c)\right) \tag{2}$$

(3-step) Finding linking density about instance units

$$W(j) = \sum_{c=0}^{l} F\left(x(c), m(c), \sigma(c)\right) \tag{3}$$

(4-step) Working out density about whole instances

$$l(\sigma) = d(l) + \exp \sum_{\alpha=0-}^{l} d(\alpha) - d(l) \tag{4}$$

(5-step) Calculating log likelihood at E procedure

$$Loglk = \frac{\sum_{c=0}^{l} lW(c) \times l(c)}{\sum_{c=0}^{l} lW(c)} \tag{5}$$

· Maximization procedure:
(1-step) Initializing instances
(2-step) changing priors: reflecting next expectation procedure

$$Loglk = \frac{\sum_{c=0}^{l} lW(c) \times l(c)}{\sum_{c=0}^{l} lW(c)} \tag{6}$$

(3-step) Weighting instance by changing mean and standard deviation estimated value about whole instance
Mean:

$$\sum_{c=0}^{k} m(c) = \sum_{a=0}^{m} m(c) \times lW(c) \times lWA(c, a) \tag{7}$$

Standard deviation

$$\sum_{c=0}^{k} \sigma(c) = \sum_{a=0}^{m} \sigma(c)^2 \times lW(c) \times lWA(c, a) \tag{8}$$

Instance weight

$$\sum_{c=0}^{k} \sigma(c) = \sum_{a=0}^{m} \sigma(c)^2 \times lW(c) \times lWA(c, a) \tag{9}$$

(4-step) Reflecting estimated value and recalculating

$$\sigma^2(i,j) = \frac{\left(\frac{\sigma(i,j) - m(i,j)^2}{W(i,j)} \right)}{W(i,j)} \tag{10}$$

$$\sigma = \sqrt{\sigma^2(i,j)} \tag{11}$$

(5-step) Deriving maximization value

$$m(i,j) = \frac{m(i,j)}{/W(i,j)} \tag{12}$$

3 Applying Algorithm with Classification Aspect

Also, our research selects decision tree for classifying status. A decision tree ramifies nodes by finding the best break point per each node in tree, and then branching node is repeated until node does not ramify any more to bottom nodes. Our algorithm use decision tree as prediction model linking between observed value and predictive value. A very critical matter in this tree structure should decide leaf nodes with no more of branching. In our research, classification procedures are shown fig 2, and then deciding leaf node steps are followings;

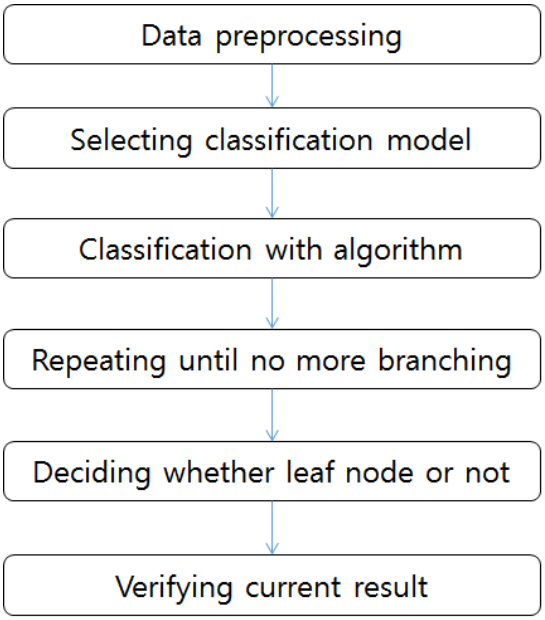

Fig. 2 The classification flow with J48 algorithm

1-step) Calculating entropy when nodes are ramified

$$E(x) = \sum_{i=1}^{n} (W(i)) \div \log (W(i)) \tag{13}$$

Where, x: data set, n: the number of class, W(i): i^{th} value of n classes

(2-step) Calculating entropy before classification

$$E^{old} = (T(x) \times \log(T(x)) - E(x)) - \log(2) \tag{14}$$

Where, T(x): the total number of given data set

(3-step) Calculating new entropy after classification

$$E^{old}(x) = -\left(\frac{\sum_{i=1}^{n} (E(x_i) - T(x_i) \times \log(T(x_i)))}{\log(2)} \right) \tag{15}$$

Where, x_d: data set with redistributing as the number of branch on a node in given data set, n: the number of branch

(4-step) Calculating information profit quantity per branch case

$$E^{old}(x) = -\left(\frac{\sum_{i=1}^{n} (E(x_i) - T(x_i) \times \log(T(x_i)))}{\log(2)} \right) \tag{16}$$

(5-step) Calculating information acquisition rate

$$E^{old}(x) = -\left(\frac{\sum_{i=1}^{n} (E(x_i) - T(x_i) \times \log(T(x_i)))}{\log(2)} \right) \tag{16}$$

4 Conclusions and Future works

In LPG accidents, human is damaged directly because most cause is careless handling and inadequate safety equipment, most type is explosion, fire and rupture. Therefore, an advanced safety process is required for enforcing safety management of LPG. Although correct progress direction in advances safety process is necessary for many devices, methods and system, it is to require analysis method that many different data are analyzed in parallel but each measuring data is analyzed in individual.

This paper aims to devise method using artificial intelligent algorithm in order to manage total safety analysis that can analyze simultaneously many different data. So,

this research develops total risk analysis algorithm with a combination method between classification and clustering algorithm. At First, This research applied and modified clustering EM algorithm, which is classified roughly into expectation procedure and maximization procedure, in order to generate efficiently risk class name. Secondly, this study customized decision tree algorithm, which create decision model through six procedures, for recommending autonomously facility status. This method is to mark the beginning of analysis method for detecting cause and increasing safety about LPG facilities

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References

1. Moussa, M. I. and Eid, T.: Risk Management for Chlorine Producing Factory in Egypt, Australian Journal of Basic and Applied Science, 1(3), 239-248 (2007)
2. Goeble, M. and Gnuenwald, L.: A Survey of Data Mining and Knowledge Discovery Software Tools, ACM SIGKDD Explorations, 1(1), 20-33 (1999)
3. Tsang, S. L., Clarke, S.: Mining User Models for Effective Adaption of Context aware Applications, In: International Journal of Security and Its Application, vol. 2, pp. 5--62 (2008)
4. Henrique V. da Silva, Celso K. Morooka, Ivan R. Guilherme, Tiago C. da Fonseca, José R. P. Mendes: Leak detection in petroleum pipelines using a fuzzy system, Journal of Petroleum Science and Engineering. vol. 49, issues 3-4, Pages 223--238. (2005)
5. Oh, J. S., Sung, J.G., Kwon, J.R.: A Study on Autonomic Decision Method for Smart Gas Environment in Korea. In: Advances in Intelligent and Soft Computing, vol 72, pp. 1--9, Springer-verlag (2010)
6. Oh, J. S., Yeo, J. H., Ko, I. J.: SSOMs Applied with Bayesian Inference Considering Plasticity and Stability Factors Depending on Data Characteristics. In: International Conference on Security-enriched Urban Computing and Smart Grid (Sucoms), SERSC, Jeju(2012)
7. Oh, J. S., Bang, H. J., Ko, H.: An Empirical Study on Smart Safety Management Architecture for Gas Facilities in Korea. In: INFORMATION-An International Interdisciplinary Journal., vol. 15, no.3, pp. 1107--1122, International Information Institute (2012)
8. Oh, J. S.: An Analysis Intelligent Methodology for Finding Gas Leak Location. In: INFORMATION-An International Interdisciplinary Journal., vol. 16, no.3(B), pp. 3297--3302, International Information Institute (2013)
9. Oh, J. S: Safety Monitoring System Design for LPG Supply Facilities. To appear The Asian International Journal of Life Sciences., vol. 26, No.1, pp 1-11 (2016)

