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Data Stream Event Weighting for the Efficient Context Awareness of the Smart Distribution Panel

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ABSTRACT : *The insulation portion of the electrical equipment may become poor and deterioration due to various factors that may proceed. Most of the events that cause this problem are characterized by repetition. If the insulation coating on the inside or outside of the switchboard is hardened and leakage current or heat is generated, it is not a single event. Repetitive events continue to accumulate, causing such problems. Therefore, context awareness in smart switchboards requires general analysis and weighting of specific events included in other data streams. In this study, we propose and assign frequency-based weighting to important events and related events that should be recognized in Smart Switchboard.*

KEYWORDS *IOT, Smart Distribution Panel, Data Stream, Context Awareness, Event*

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I. INTRODUCTION

Most electrical installations inevitably experience fatigue over time. Electrical equipment that is aging and fatigued over time may cause various serious hazards such as overheating due to resistance, electric shock caused by the ground faults. Among them, a switchboard is a place where the public electricity supply network and the user's electric circuit are connected and it is necessary to monitor the status of the switchboard.

In the smart switchboard, the network connecting the sensor and the host is conceptually a connection-oriented communication network that stands for the Internet of things. The data transmitted in such communication has a data stream form. The goal of analyzing the data sensed and reported by the smart switchboard is to recognize various situations related to the switchboard. At this time, it is necessary to give weight in analyzing the data stream generated by the sensor continuously reporting. There are various situations in the real world. To recognize the situation, the sensing activity of the sensor is performed. For the event information obtained as a result of the sensing activity of the sensor, the value of the information cannot be uniform.

In particular, the goal of the situation recognition perceived by the smart switchboard is to detect the fatigue of the electric equipment and detect the abnormal occurrence of the electric equipment beforehand to prevent the fatal risks such as fire and electric shock in advance. Therefore, weights should be given to situations that directly relate to or are directly related to these risks. However, since the smart switchboard is intelligently aware of the situation without any human intervention, there is a restriction to use only the activity of the sensor and the data obtained as a result.

In this paper, we propose a method to identify the data related to electrical safety among the event data detected and reported in analyzing the data stream generated from the smart switchboard and to assign a weight to the data. This can contribute to the smart switchboard system to obtain and judge the situation information about the safety of the electric equipment itself without human intervention or management.

In this paper, we propose an efficient weighting scheme for specific events in the environment where data streams are input and provide a clue to estimate the state of the switchboard and the electrical equipment using it.

This paper is organized as follows. Chapter 2 summarizes related research and Chapter 3 presents a weighting scheme for notable events among data streams in Smart Switchboard. In Section 4, we conduct experiments and evaluations, and in Section 5 we conclude our study

II. RELEVANT STUDIES

2.1 Real time data stream processing

The data stream requires real-time processing, and there is a problem that it takes a long time to retrieve data because the amount of data continuously and continuously generated is large and difficult to store. Efficient query processing of sensor data is required. There are SenDB and TinyDB in the query processing system of the sensor network. SenDB implements illumination, temperature and wireless data transmission based on SenOS. SenDB distinguishes between Host-PC and Mote and uses a Callback function. And TinyDB can efficiently process the distributed query of real-time sensor data. Using Tiny-SQL, we can efficiently increase the usage of TinyDB query language and it is provided like a bible to users [1].

Jang, Yoo, and three others filter the stream data through the query sent from the user at each sensor node. The data of the sensor nodes do not reach all users. This saves the energy consumed in transmitting the data and optimizes the transmitted data [2]. Park, Eun - ji, et al. Convert heterogeneous streams from sensors into situational awareness data and store them in the repository. A stream processing system for combining sensor stream information and situation information manages information between sensor streams. Define a continuous query as a boolean function and provide a continuous query with the operator. The situation stream processing system consists of a sensor stream catalog manager, a sensor stream analyzer, a sensor stream continuous query manager, and a sensor stream converter. We have implemented a stream data management system that stores the data read from the sensor network, efficiently processes the query requested by the user, and outputs it to the upper application or the web [3]. To interoperate with the value of sensor data in the internet environment of objects, the integration with web technology is being studied. Semantic transformation of data for convergence of sensor data and service domain knowledge is required. The technique of converting static metadata to semantic data (RDF) cannot handle real-time, large-volume data properly in the Internet environment of objects [4] [5].

Kwon, Soon - Hyun, and three others converted the semantic data through real-time and parallel processing of large - scale stream sensor data generated in the Internet environment of objects. Define sensor, event, and context ontology models and transformation rules. It builds a translation knowledge base (Translation KB) and constructs Translation Topology based on Apache Storm real-time and parallel framework. Performs collection, conversion, and storage of real-time sensor data regarding the conversion knowledge base. To improve performance, each conversion task is processed in parallel using Apache Storm, a big data real-time analysis framework [6].

2.2 Distribution Panel manager

It is very important to inspect and monitor switchboards because the damage caused by fire or power outage is very large due to electrical equipment accidents. Equipment accidents in switchboards are caused by various stresses during the short and long term. Insulation failure, natural deterioration, and overload. Ko and two others performed the phase discrimination (PD) measurement and the temperature measurement at the same time to determine the failure of the electrical equipment in the switchboard. Transformer failure is detected by a local temperature rise and PD test. Since the series reactor capacity is designed to be smaller than the capacity of the condenser, the overcurrent flows to overheat the condenser. Therefore, only the noise that does not have a special pattern in the signal in the PD test is detected. The cracks in the support of the BUS-Bar are hard to distinguish by the naked eye. In the PD test, a certain pattern of the signal can be detected and the failure can be detected [7].

Kim diagnosed various electrical safety conditions such as deterioration state, defects, and electrical connection status of terminals by measuring the temperature distribution signal generated from the electrical equipment in real time. The number of electrical equipment for hospital medical equipment, electrical equipment disturbance condition was diagnosed after telescopic measurement of surface temperature distribution image by using high-performance infrared thermography camera of incoming cable, breaker, insulator, power cable of substation equipment [8]. Chang - Wan and three others monitored the switchboard using a non-contact infrared temperature sensor. The infrared temperature sensor can measure -20 ~ 300 ℃, and the characteristics are different according to the surface material of the object to be measured and the measurement distance. After the characteristic test of the booth inside the switchboard, the conversion formula using the characteristic results of the busbar is calculated and applied to the DAU (Data Acquisition Unit) to compensate for the error. DS ratio is 15: 1 and the power device is measured above the insulation distance. It can monitor the temperature change of the measurement object according to the ambient temperature and observe an abnormal symptom [9] [10].

Control and communication functions were added to the switchboard technology. The current and voltage sensors were optimized for the high-voltage switchboard, integrated with digital relays and open communication. Protect the load from electrical accidents and smooth power supply. There are digital filter system and digital protection relay system in the high voltage switchboard, and the basic wave components are extracted for the digital filter and the function of the switchboard is summarized. The fundamental wave components were extracted from the 1 - period sample data of input voltage, current, and reference fundamental functions. It shows the operating characteristics and adjustment range of the protection relay function of an electronic switchboard and shows the structure of a control device [11].

III. DATA STREAM EVENT WEIGHTING FOR THE EFFICIENT CONTEXT AWARENESS OF THE SMART DISTRIBUTION PANEL

Electricity equipment inevitably accumulates equipment fatigue. The insulation portion of the electrical equipment may become poor and deterioration due to various factors that may proceed. Most of the events that cause this problem are characterized by repetition. If the insulation coating on the inside or outside of the switchboard is hardened and leakage current or heat is generated, it is not a single event. Repetitive events continue to accumulate, causing such problems. Therefore, context awareness in smart switchboards requires general analysis and weighting of specific events included in other data streams. In this paper, we propose and apply frequency-based weighting to important events and related events that should be recognized by Smart Switchboard.

Smart switchboards are aimed at recognizing the status of the switchboard, recognizing the power status, and recognizing the status of all electrical equipment. A variety of sensors can be installed and operated to intelligently execute them without human intervention or management.

If a temperature sensor and a vibration sensor are installed in the smart switchboard to detect the condition of the switchboard, it is meaningful that the same event as the one-time increase in temperature is continuously performed. It is reasonable that weights should be given to duplicate and continuous occurrences of events. Likewise, if the events generated by the vibration sensor are generated with a very large time difference, or if they occur frequently, they can not be processed like other events.

Secondary problems arising from the problems of electrical installations are very serious. Insulation weakening, heat generation, etc. may cause a fire. Leakage currents are often associated with electric shocks in people and livestock. These problems may occur in a short period time, but they are often slow. Therefore, to prevent such secondary disasters in advance, it is necessary to pay special attention to related events in the process of recognizing the status of the smart switchboard.

Therefore, in this study, we propose to assign a weight to events included in the data stream that the sensor detects and transmits in the smart switchboard.

The following figure is an illustration of the algorithm proposed in this study. Figure 1 shows the recognition of the power state and the status of the distribution board based on the events from each sensor.

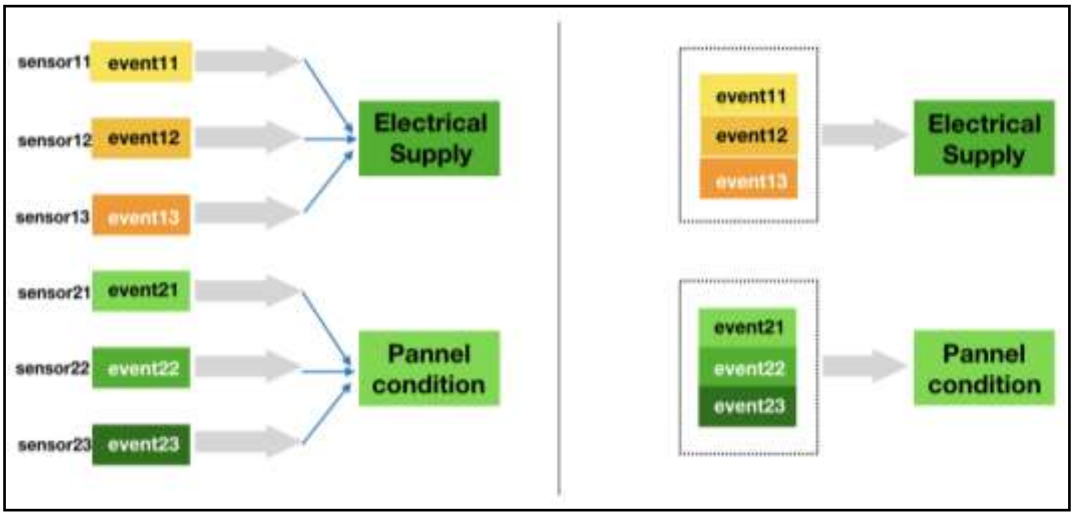

Fig. 1. Situation recognition using sensor event data

Figure 1 shows the power status and the status of the switchboard using the event information of each sensor. To detect the power state, it uses events to detect and transmit the related sensors. To detect the switchboard to deduce the state of the switchboard, it analyzes and uses the events sensed by the sensors installed to infer the state of the switchboard.

The event of the figure is contained in the data stream transmitted by the sensor, and the data processing device extracts the situation information through analysis and processing of the received data stream. The problem is that sensor activity continues to be transmitted over a network that is continuously connected. In the data processing device, it is necessary to distinguish between meaningful and meaningless data streams transmitted by the sensor, and it is necessary to be able to perform differential processing for what should be observed with particular emphasis and what is not. The following figure shows the data stream transmitted from the sensor and the events included in it.

Fig. 2. Data streams and events

1. S11, S12, and S13 are the sensors installed on the smart switchboard. S21, S22 and S23 are the sensors installed in the electrical equipment of the customer connected to the switchboard.
2. Each sensor reports the sensing activity inside the switchgear and all electrical installations. The data set detected and reported by sensor S11 is DS11, and the data set detected and reported by sensor S12 is DS12. In this way, DS13, DS21, DS22, DS23 are reported to the host as a detection result by the sensors.
3. DS1n (n = 1 ~ 3) and DS2n (n = 1 ~ 3) are data sets continuously flowing with time.
4. ev11m is an event that appears in DS11. ev12m is an event that appears in DS12. Ev1nm (n = 1 ~ 3, m = 1 ~) and ev2n (n = 1 ~ 3, m = 1 ~) are the events included in the data stream of each sensor. All events have a weight (w: weight) equal to one.
5. When ev1nm and ev1n (m + 1) are successively reported in the data stream DS1n, the weight w is incremented by one. Likewise, in the data stream DS2n, a weight is added by 1 when the event is consecutive.
6. The data stream analysis program is called F (t), and if f is a mass function,
   If ev1nm and ev1n (m + 1) are consecutive, we add w to 1 to calculate F (t), where F (t) = f (ev1nm · w · t). If ev2nm and ev2n (m + 1) are continuous in F (t) = f (ev2nm · w · t)
7. Continue applying these operations to the data stream that is continuously available for computation.

The algorithm proposed in this study is valid because it considers the increase in fatigue due to the characteristics of the electrical equipment affecting the condition of the electrical equipment and the switchboard. In the next section, experiments are conducted using the proposed algorithm and evaluated.

IV. EXPERIMENT AND EVALUATION

The sensor used for the experiment was a temperature sensor and a humidity sensor. The raspberry pie was used as the Internet platform for objects, and the sensor values flowed in the form of data streams. The data obtained by the experiment are as follows.

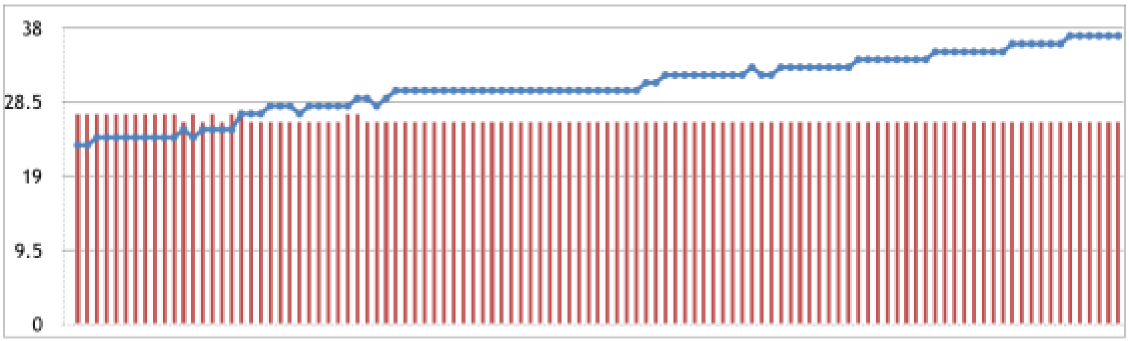

Fig. 3. Data set from temperature sensor and humidity sensor

The red bars on the graph show the values detected by the humidity sensor. The blue line shows the data set detected by the temperature sensor.

Because the leakage current causes thermal hardening of the insulator and the temperature of the part is increased, the temperature rise is repeated. Therefore, we want to reflect the frequency based weight for the repetition of event data. The reason why the weight should be reflected is shown in the following figure.

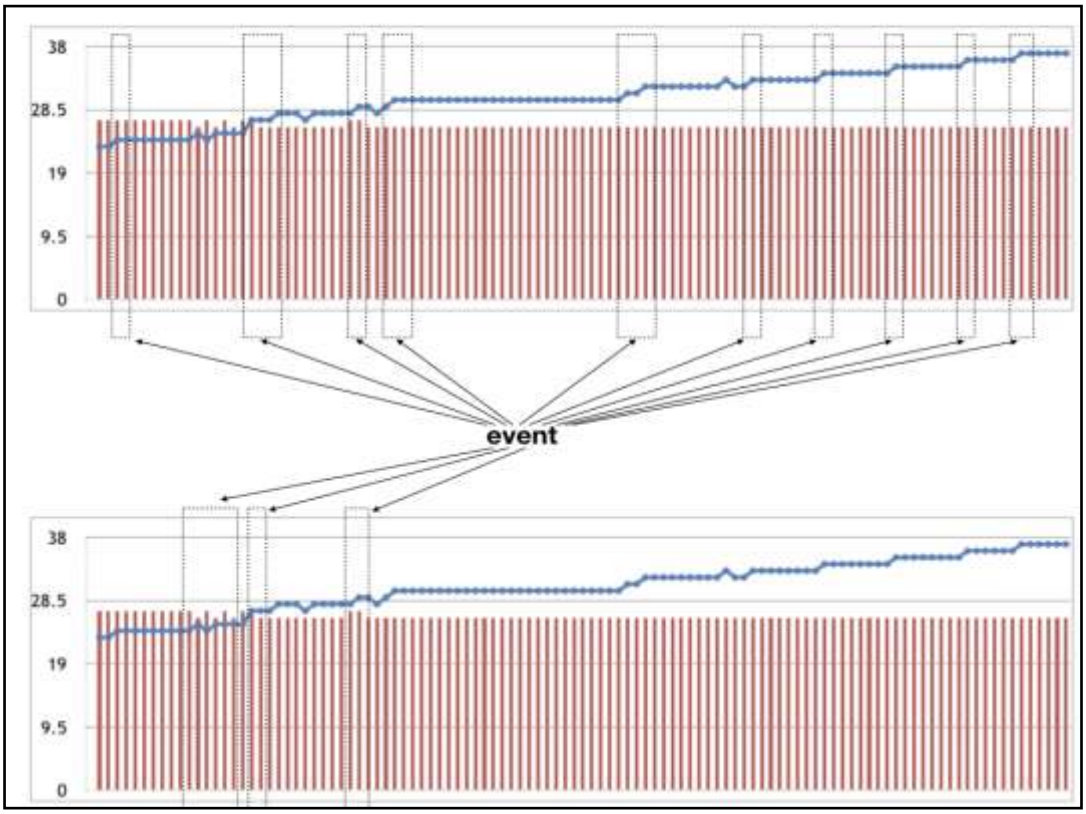

Fig. 4. Event occurrence by sensor

At the top of the picture, the event along the line connecting the blue dots is 10. This is the value sensed by the temperature sensor, which is a factor affecting the stress of the electrical equipment. There were 10 events affects the fatigue of the electric equipment, whereas the event occurred 3 times in the detection value of the humidity sensor indicated by the following bar graph. The figure above shows that the temperature sensor and the humidity sensor cannot handle the same values we have detected.

Therefore, t = 55 seconds for the temperature sensor and w = 10 for the temperature sensor

If we apply F (t) = f (ev1nm · w · t), F (t) = f (ev1nm · 10 · 55)

T = 55 seconds for the humidity sensor and w = 3 for the humidity sensor

Applying F (t) = f (ev2nm · w · t) yields F (t) = f (ev2nm · 3 · 55).

If F (t) is called contribution analysis for context recognition and the mass function f is given by the expert 20,

The context contribution of the temperature sensor can be expressed as ev1nm = F (t) / 11000, The context contribution of the humidity sensor can be expressed as ev2nm = F (t) / 3300.

There are various factors increase the fatigue of electric equipment. Problems that cause electrical equipment malfunctions are not happening at once, but they are evolving into serious problems as the events are repeated. As shown through the experiment, the weight of the events included in the data stream can be weighted to further enhance the perception of the electric equipment fatigue

V. CONCLUSION

Situation awareness in Smart Switchboard is based on sensor event data transmitted over the network where the connection is maintained. The smart switchboard analyzes the data that the sensors that detect the factors affecting the increase in the fatigue of the switchboard and the electric equipment detect and report the data. In this study, we propose to apply to weight to event data included in the data stream processed by the smart switchboard and propose to apply frequency-based weighting to elements affecting the fatigue of all electrical equipment as a specific weighting scheme. The problems of the switchboard and the electrical equipment to be grasped in the smart switchboard are often caused by the accumulation of problems that seem to be weak rather than sudden in a short period time. In data stream analysis, the weighting of the factors related to the targeted contextual recognition is reasonable and is useful for detecting and responding to the risks in advance.

REFERENCES

[1]. Krizanovi, K., Gali, Z., and Baranovi,M.,: Spatio-temporal data streams: an approach to managing moving objects, in Proceedings of the 33rd International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO '10), 744–749(2010)

[2]. Jang,Y.H., Lee,S.H., Kim, Y.S., and Oh,R.D.,: Query Processing System for Incomplete Sensor Stream Data of in Real-time Sensor Network, Proceedings of the Korean Society of Computer Information Conference, vol. 22,no.1,123-124(2014)

[3]. Park,E.J., Byeon,J.W., Choi,d.S., Kim, J.H., and Oh, R.D.,: An Effective Stream Data Management System for the Incomplete Stream Data on Sensor Network, Proceedings of the Korean Society of Computer Information Conference, vol. 22,no.1, 125-126(2014)

[4]. Lee,H.K., Kim, M., Bang, H.C.,: IoT Techno-logy Trend and Development Direction, Korea information processing society review, vol. 21,no.2,14-21(2014)

[5]. Berners-Lee, T. , Hendler, J. , and Lassila, O. ,: The semantic web, Scientific American, vol. 284, no. 5, 32-43(2001)

[6]. Kwon,S.H., Park,D.W., Bang,H.C., and Park,Y.T.,: Real-time and Parallel Semantic Translation Technique for Large-Scale Streaming Sensor Data in an IoT Environment, Journal of Korea Information Science Society, vol. 42,no.1,54-67(2015)

[7]. Ko,M.S., Choi,H.K., Park,J.Y., Park,I.C., and An,J.U.,: A Study on effective diagnostic equipment of switchgear, Proceedings of The Korean Institute of Illuminating and electrical Installation Engineers Annual Conference,25-26(2013)

[8]. Kim,S.G.,: Thermal Image Diagnosis of Power Supply for University Hospitals using infrared Thermography, Proceedings of The Korean Institute of Illuminating and electrical Installation Engineers Annual Conference, 129-129(2015)

[9]. Jin,C.H., Choi,J.U., Park,S.W., and Kim,Y.G.,: Monitoring and Diagnosis technique in Metal-clad switchgear by using the infrared temperature sensor, The Korean Institute of Electrical Engineers, 1663-1664(2016)

[10]. Zhang, L., Li, Q., and Wang, G.,: Development of a Digital Algorithm Based on Instantaneous Power Transform for On-line Monitoring of the Dielectric Loss Factor. vol. 27.35-42(2007)

[11]. Byun,Y.B., Joe,K.Y., and Jyung,J.W.,: A Development of the Digital Switchboard for the High Voltage Customer, The Korean Institute of Electrical Engineers, 803-805(1993)

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