

工學碩士 學位論文

**A Study on Implementation of a Real-Time
Fault Diagnosis System for Marine Diesel Engines**

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A Study on Implementation of a Real-Time Fault Diagnosis System for Marine Diesel Engines

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Abstract

This paper presents an implementation of real-time fault diagnosis system for marine diesel engines using a multi-thread technique on Windows 98. Knowledge-base for the system is implemented using EE (Element Environment) shell. To reduce waiting time of resources, multi-buffers and an interprocess communication method are used.

Whenever an alarm occurs in monitoring system, alarm data are sent from the monitoring system to the real-time fault diagnosis system. And then, the data acquisition thread in the fault diagnosis system decodes and stores the received alarm data. The preprocessing thread calculates the diagnosis data using the alarm data. The inference thread drive OLE automation server of EE shell for inferring the causes of faults from diagnosis data.

1

가 가

(real-time)

(monitoring system)

(fault

diagnosis system)

가

EE(element

environment) 가

가

EE

OLE(object

linking and embedding)

(automation server)

(data

acquisition) , (preprocessing) , (inference)

, (multithread)

(interprocess communication)

(diagnosis data)

EE OLE

2

3

4

5

2

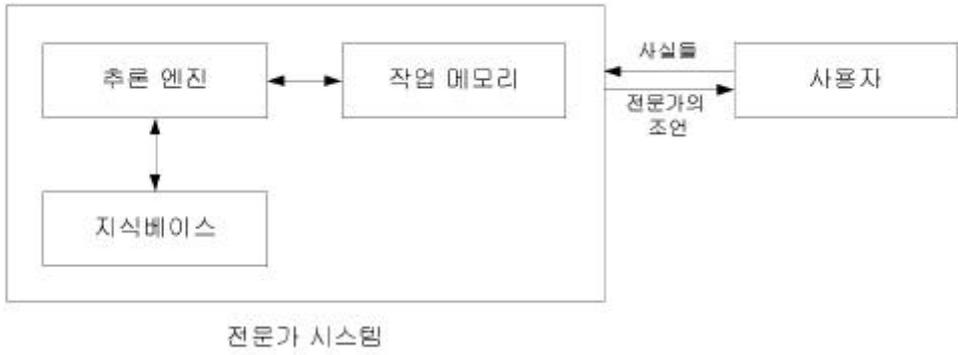
가 . 가 , 가 ,

2.1 가

가 Edward Feigenbaum
가 “ 가
.”
가 “ 가
가
.” [1]. 가
(knowledge-based system)

가 2.1 ,
가 (fact) 가
‘ 가 ’ . 가
가
가 ,

가



2.1 가

가

, 가

가

가

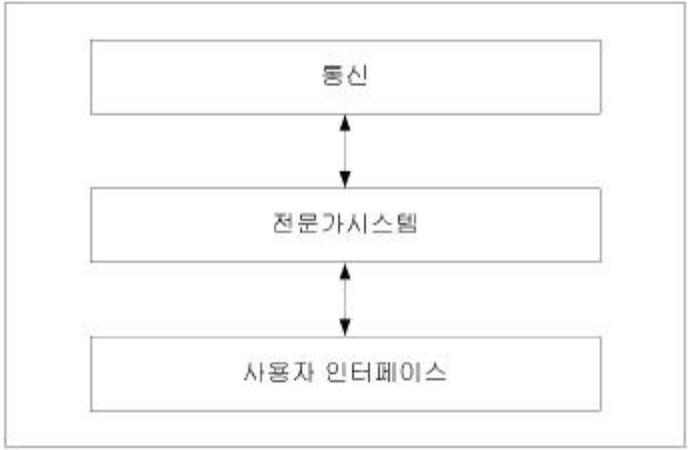
2.2

가

가 가 가

가

가



2.2 가

2.2

가 가

가

(backward reasoning) 가

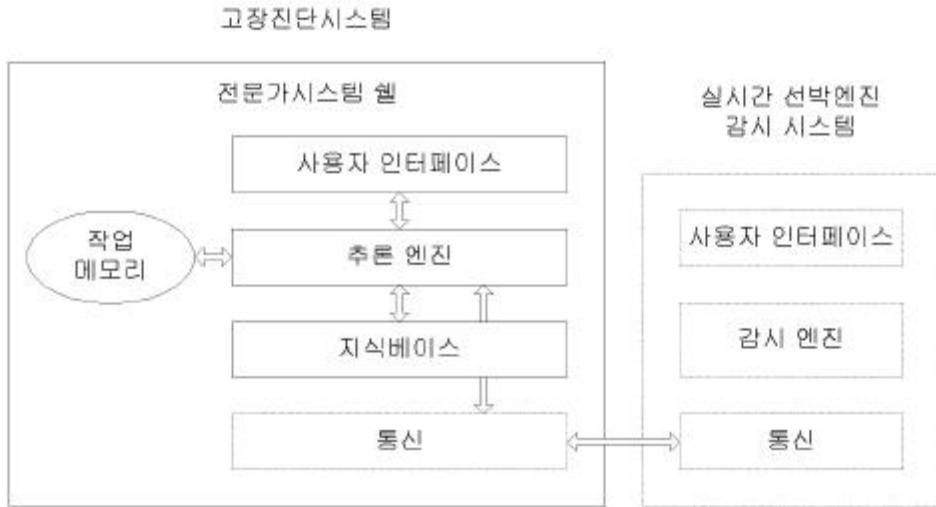
2.3

, EE 가

[2,3].

가

[2,4].



2.3

2.2.1 EE 가

EE 가 OLE 가 [5].

. GUI(graphic user interface)

[6]. OLE

가 가 [5].

2.2.2

가

가 가 . 가 가 가 가

(decision table)

[2,3,6].

AND/OR

2.4

(mapping database)

가

가

(conversion database)

가

2.1

2.5

가

Lubricating_Oil_Pressure.state

Lubricating_Oil_Pressure.state = HIGH가

Lubricating_Oil_Pressure.state = LOW가

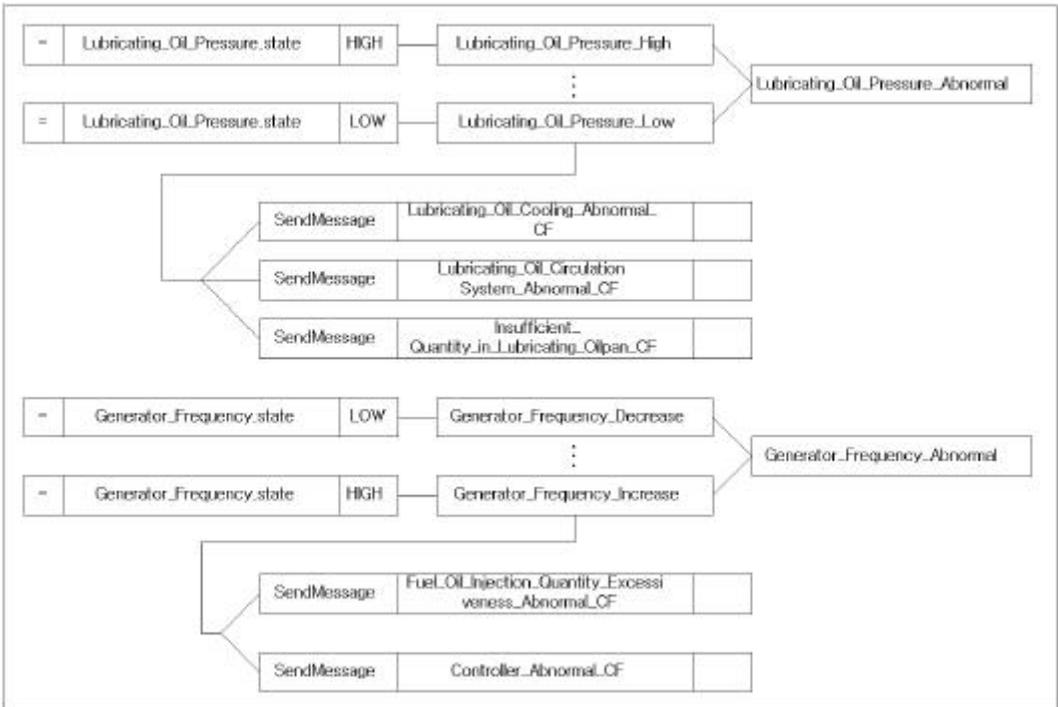
Lubricating_Oil_Pressure_Low 가

Lubricating_Oil_Pressure_Low

가 sendmessage

가 Lubrication_Oil_Cooling_Abnormal,

Lubricationg_Oil_Circulation, Insufficient_Quantity_in_Lubricating_Oilpan
sendmessage



2.6

2.2.4

MYCIN

Shortliffe Buchanan

[8].

가

가

(Degree of Confirmation) , (3.1)

. CF (certainty factor) E 가
 가 H , MB (Measure of Belief) E 가
 , MD (Measure of Disbelief) E 가

$$CF(H, E) = MB(H, E) - MD(H, E) \quad (3.1)$$

$$(3.1) \quad MD \quad 0 \quad .$$

(3.2) 가 H OR 가 가
 가 (Disjunction) .

$$(3.3) \quad \text{IF } E_1 \text{ OR } E_2 \text{ OR } \dots \text{ OR } E_n \text{ THEN } H$$

$$CF(H, E') = \max(CF(E_1 | E'), CF(E_2 | E'), \dots, CF(E_n | E'))$$

$$(3.4) \quad \text{IF } E_1 \text{ AND } E_2 \text{ AND } \dots \text{ AND } E_n \text{ THEN } H$$

$$CF(H, E') = \min(CF(E_1 | E'), CF(E_2 | E'), \dots, CF(E_n | E'))$$

$$(3.5) \quad \text{IF } E \text{ THEN } H$$

$$CF(H, e) = CF(E, e)$$

AND

$$(3.6) \quad \text{IF } E \text{ THEN } H$$

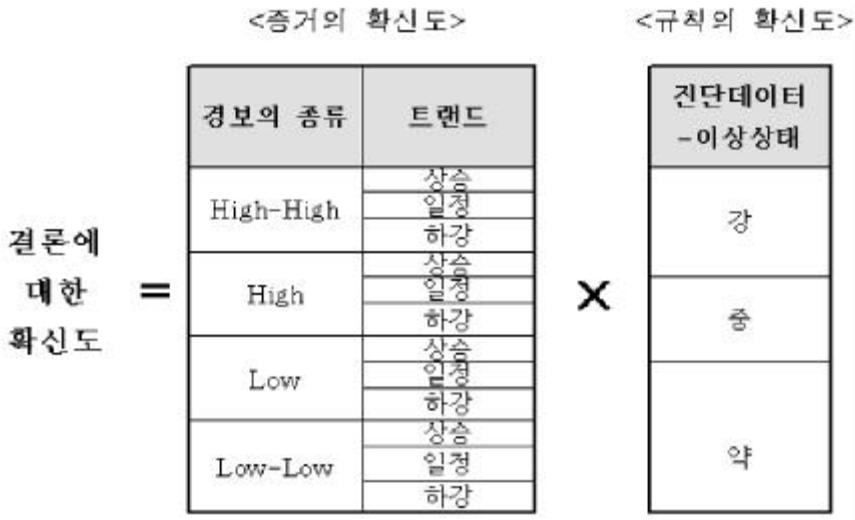
$$CF(H, e) = CF(E, e)$$

$$(3.7) \quad \text{IF } E \text{ THEN } H$$

$$CF(H, e) = CF(E, e)$$

E

$$CF(H, e) = CF(E, e) \times CF(H, E) \quad (3.6)$$



결론에
대한
확신도

=

2.7

가

2.7

· · ·

.

.

2.3

[2,3]

가

가

.

가

,

가

.

가

,

가

,

가

.

.

3

3.1

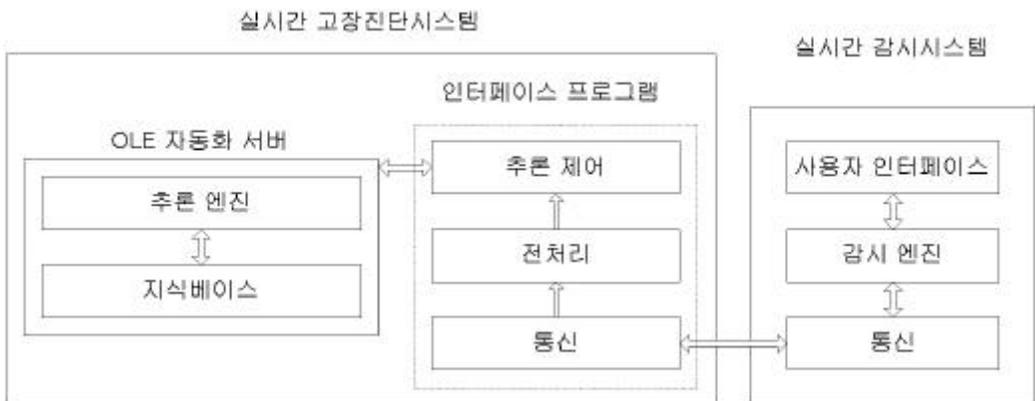
3.1

가

가

가

OLE



3.1

[9]

3.2

EE OLE

3.2.1 OLE

가

[10].

3.2 3.3

(Proxy), (Stub), LPC(local procedure call),
RPC(remote procedure call)

가 가

가

LPC RPC

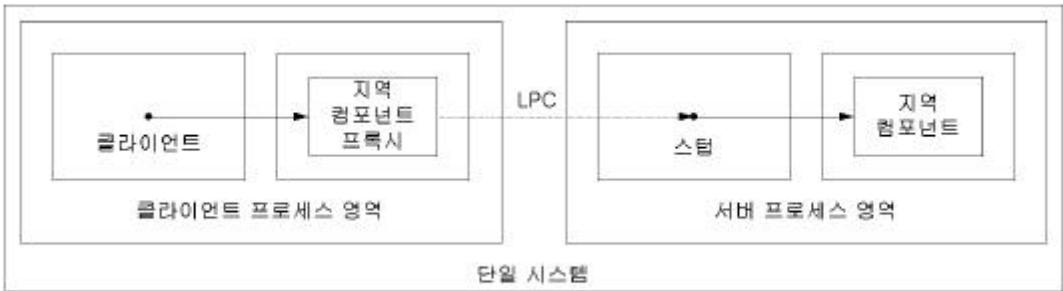
가

. LPC

, RPC

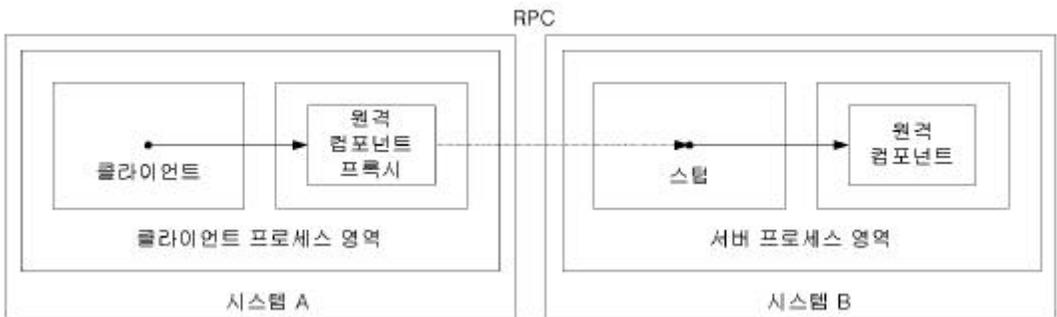
가

, , LPC, RPC



3.2

OLE



3.3

OLE

EE

OLE

3.2.2

[9].

3.4

가

가

가

가

OLE

OLE

가

가



3.4

가

가

3.2.3

가

가

가

[9].

가

가

Set

Reset

Set

Reset

3.5 2

가 Set

Reset

1

2

2

1

가 1 1 Set

1 Reset

가

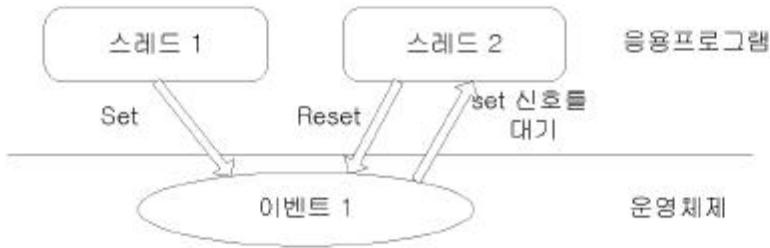
가

Set

가

Set

Reset



3.5

가

Lock

Unlock

가

가

3.6

1 Unlock

1 Lock

1 Lock

가

1 Lock

Lock

1 Unlock

가

1 Unlock

Lock

가

Lock

가

Lock

Lock

가

, 가 1 Unlock 가

Lock , Unlock

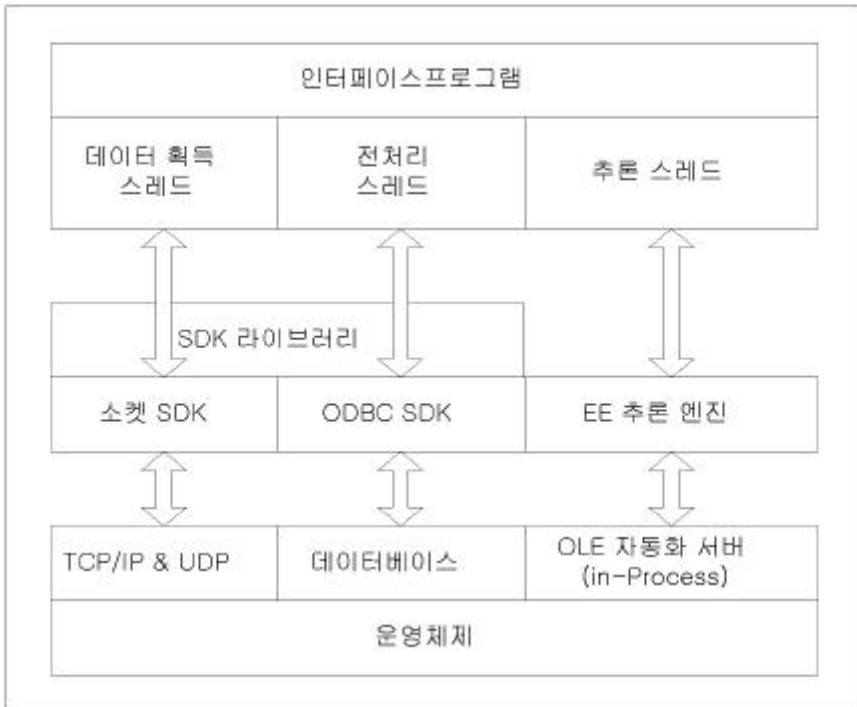


3.6

4

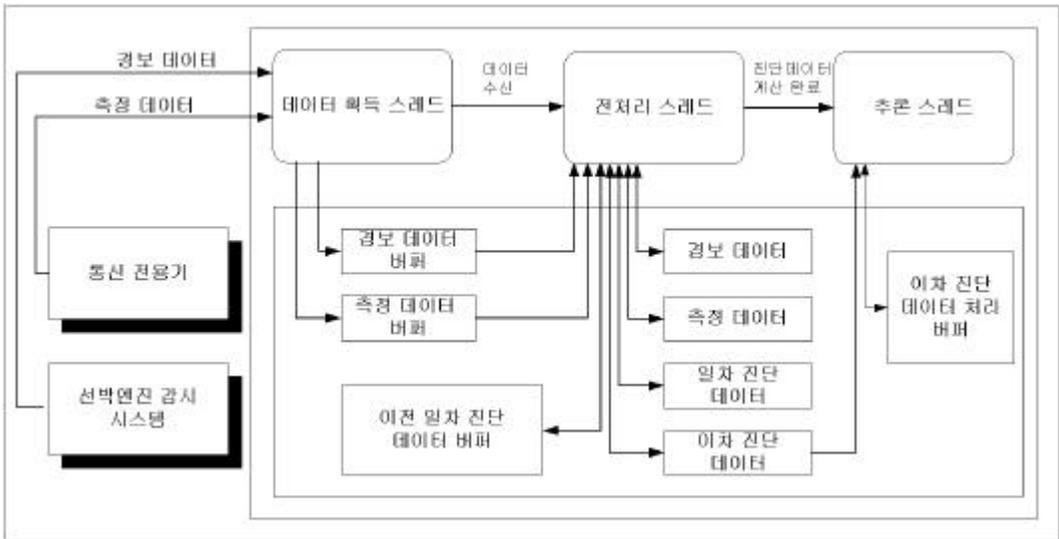
4.1

SDK(Software Development Kit),
ODBC(Open Database Connectivity) SDK,
EE OLE
Visual C++



4.1

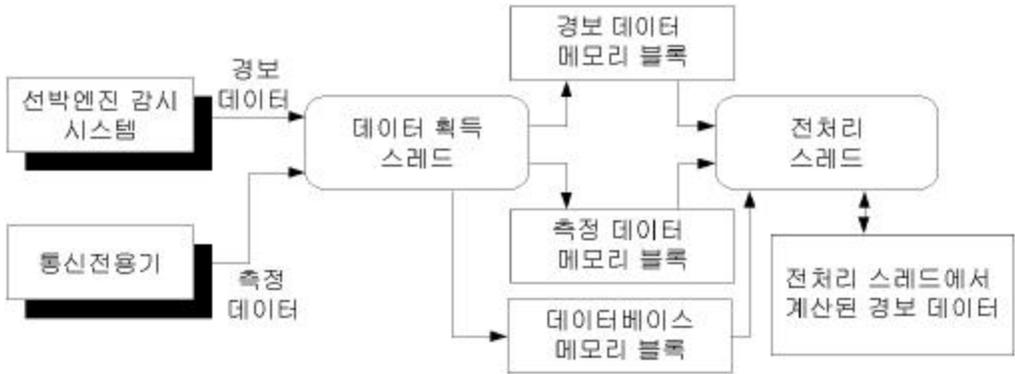
, OLE



4.2

4.3

가



4.3

4.1

[11]

4.4

UDP(user datagram protocol)

[11,12].

UDP

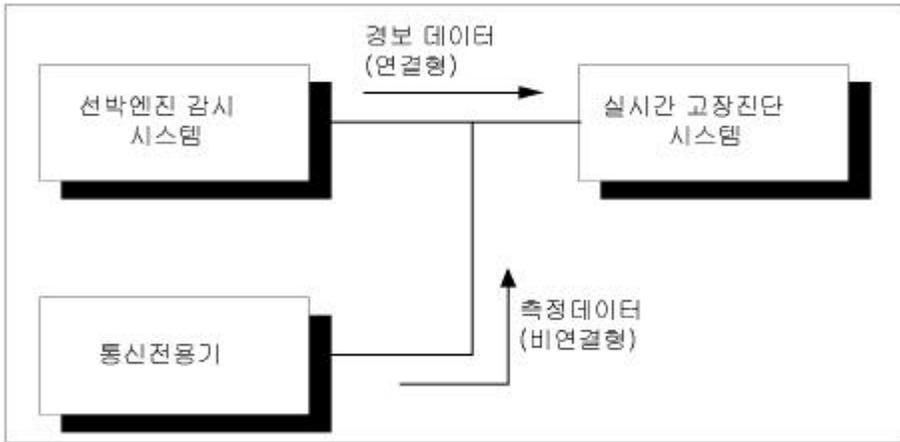
TCP(transmission control protocol)

가

가

가

TCP



4.4

(4.1)

ID,

ID,

가

30 LO019 2

158 GA045 50

(4.1)

(4.2)

ID,

ID,

30 LO019 M/E CAMSHAFT L.O INLET PRESS LOW

(4.2)

(4.3)

2 Low

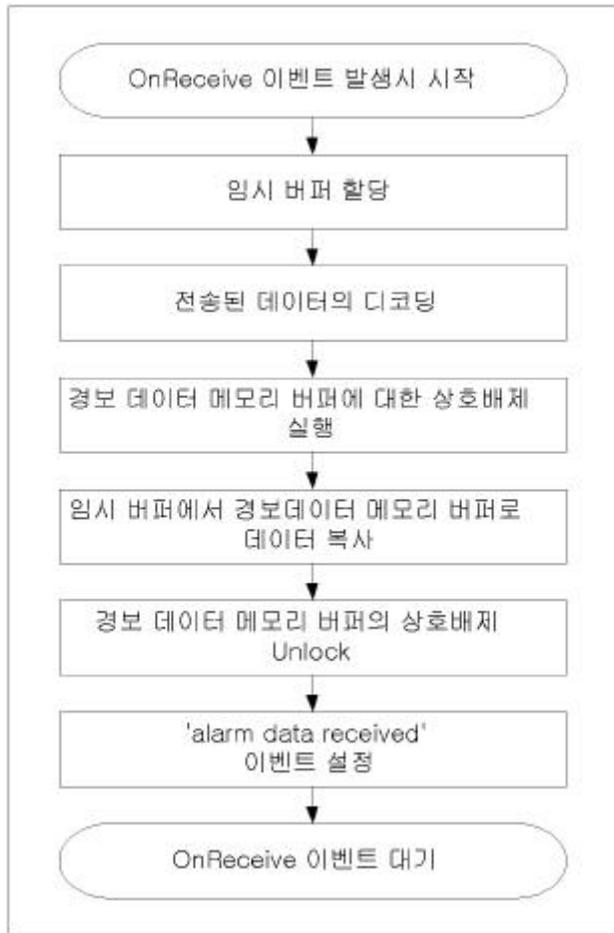
30 LO019 2

(4.3)

4.5

가
가

Unlock



4.5

4.2

가 "Measured Data Received", "Alarm Data Received", "Database Data Received" .

"Alarm Data Received"

가

4.6

ID

(4.5)

ID,

Description, Alarm

(4.4)

ID,

010 Lubricating_Oil_Pressure 30

011 Generator_Frequency 158

(4.4)

010 2 LOW DOWN 0.45

011 2000 NORMAL 0.1

(4.5)

가 ,
 가
 가 OR 가
 가 가 가
 , 가
 . (4.6)
 ID, , High-High ,
 High , Low , Low-Low ID,
 4.1 (4.7)

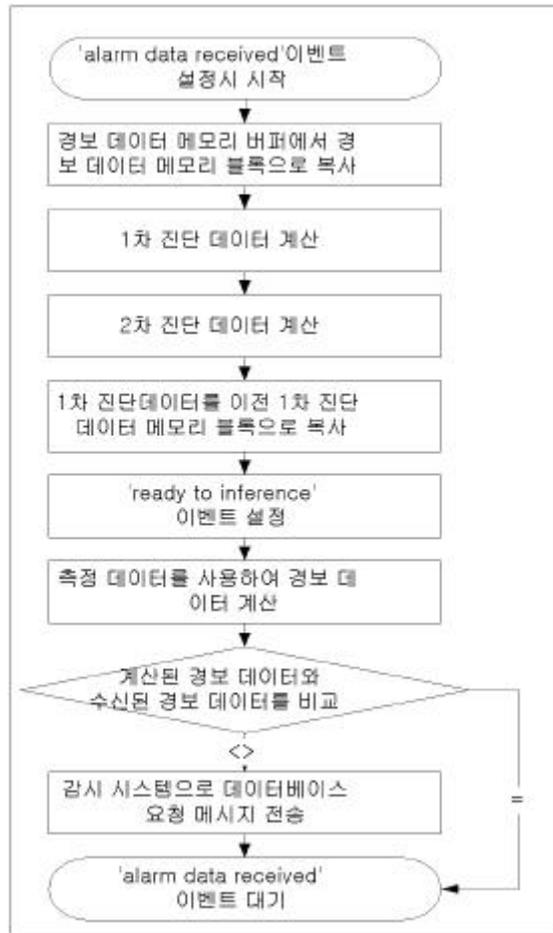
018 Generator_Frequency 65535 100 - 100 65535 011 TREND (4.6)

018 Generator_Frequency 500 HIGH UP 0.45 (4.7)

4.1.

0x00	Copy	
0x01	And	ID AND
0x02	Or	ID OR
0x03	Trend	
0x04	Difference	

“ready to inference”



4.6

4.3

OLE

OLE

가

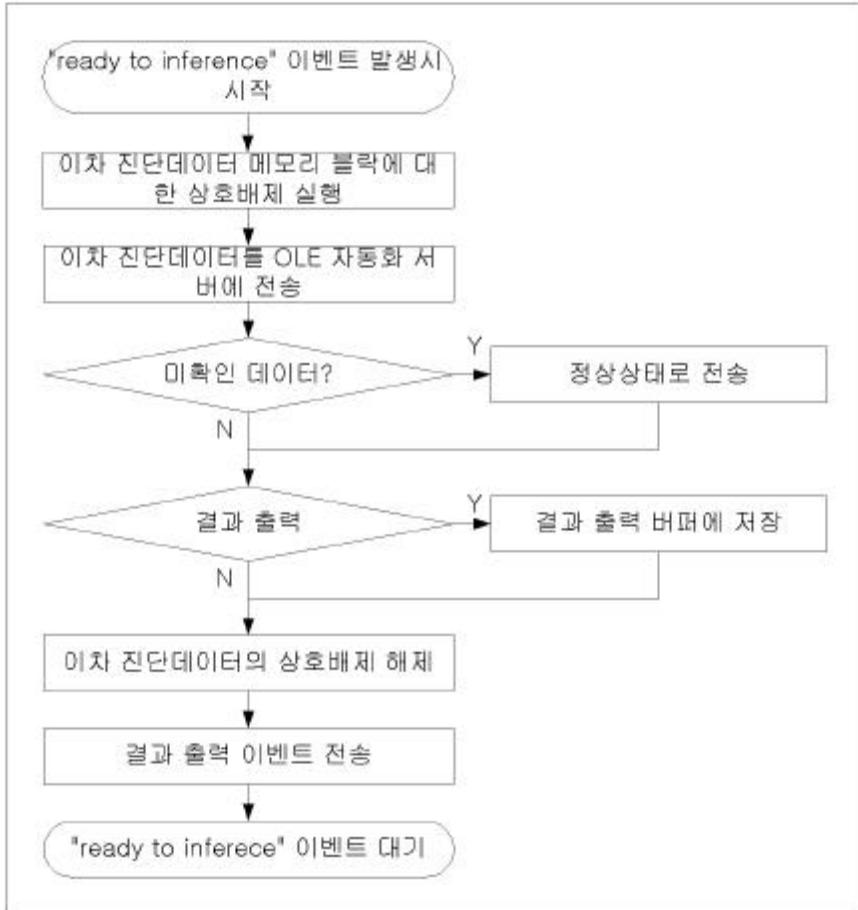
가
. OLE

4.7

“ready to inference” 가

. OLE

가



4.7

4.8 . Lubricating_Oil_Pressure
 Lubricating_Oil_Pressure.state
 . Lubricating_Oil_Pressure가 (4.1) Lubricating_Oil_Pressure_Low 가 가 .

가

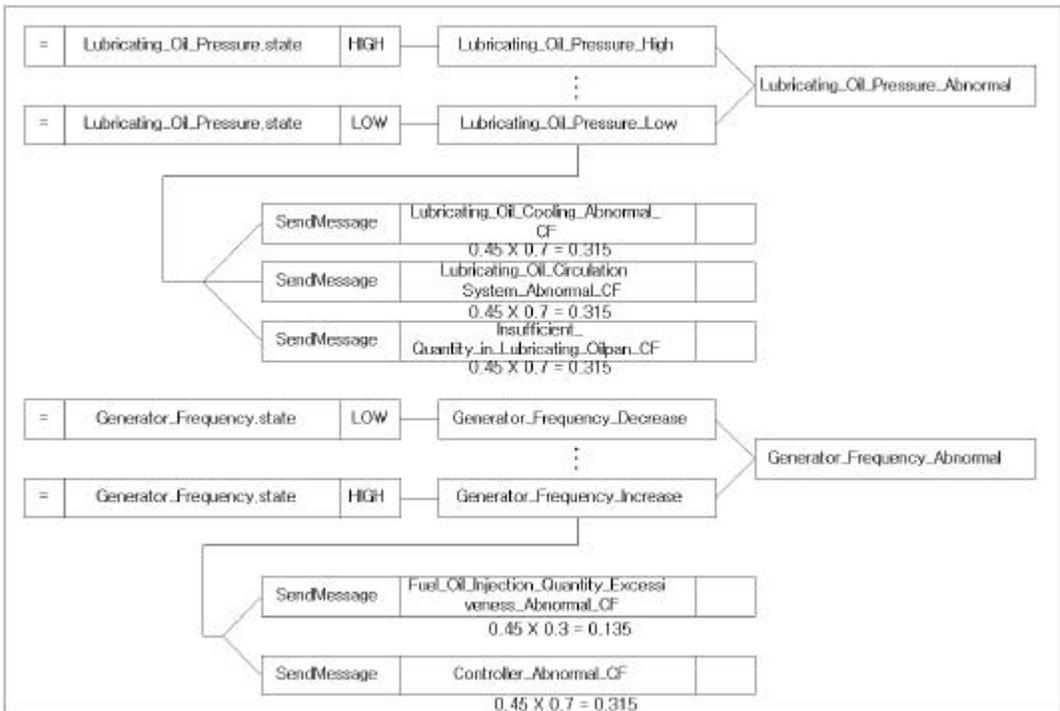
SendMessage

가

가

(4.1) (4.7)

4.8



4.8

4.4

4.9

가 가

가



4.9

가

가

가

11:3

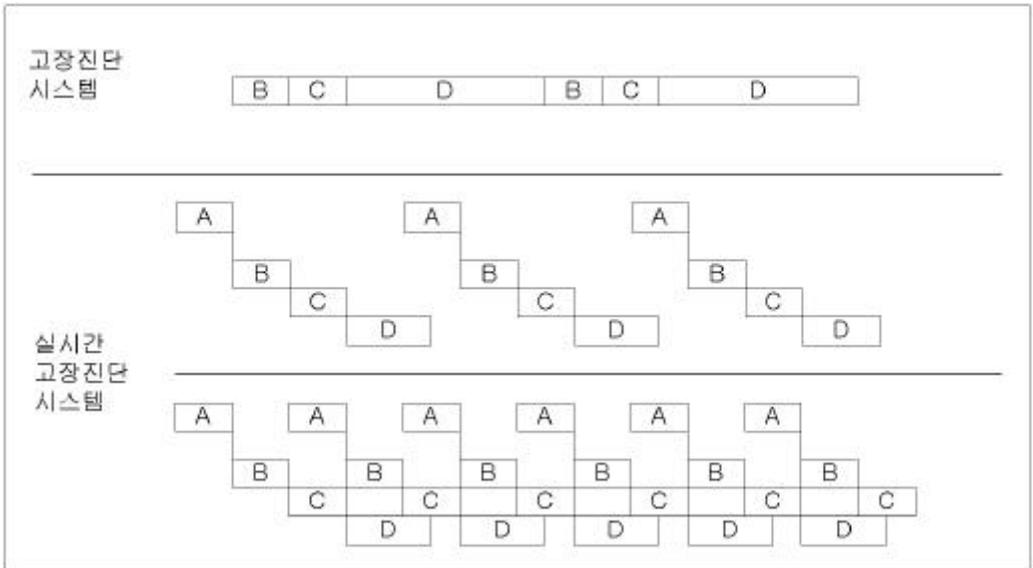
4.10

A

, B

, C

, D



4.10

5

가

가

가

ND

EE

OLE

가

EE

가

가

가

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가

7

가 가

가

가

가

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