Software Requirement Analysis
for Electronic Door Lock System

Project Team

Team 5

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Team Information

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Table of Contents

1 Introduction

1.1 Purpose

Electronic door lock system (이하, 도어락) 에서 사용하기 위한 SW를 개발한다.

1.2 Scope

1.2.1 개발팀

Team 5(강민우, 서동현, 임동현, 함진아)

1.2.2 제한사항

HW (전자장치)와 연동까지 고려하지 않고, SW로만 구동할 수 있도록 개발한다.

1.2.3 제품의 활용도

개발이 완료된 후 실제 도어락에서 사용 가능한 SW를 개발하기 위한 프로토타입으로 삼을 수 있다.

1.2.4 개발환경

IDE: Eclipse
Compiler: MinGW

1.3 Definitions, acronyms, and abbreviations

SW: Software
HW: Hardware
EDLS: Electronic Door Lock System
PW: Password
SOUND_END: 소리를 내는 시간이 종료됨.
LS: Lock State Data (TRUE / FALSE)
NBC: Number Button Clicked Data (TRUE / FALSE)
NB: Number Button Data (TRUE / FALSE)
CO: Cover Opened Data (TRUE / FALSE)
CC: Cover Closed Data (TRUE / FALSE)
DO: Door Opened Data (TRUE / FALSE)
DC: Door Closed Data (TRUE / FALSE)

KS: Key Sensor Data (TRUE / FALSE)

PW_CLK: PW Clicked Data (TRUE / FALSE)

PW_CRT: PW Correct Data (TRUE / FALSE)

Return: 작업을 종료한다.

Tick: 10ms 주기로 보내지는 신호

Count: 10ms 단위의 시간.

FULL: 배열의 모든 요소가 입력 됨.

NULL : 포인터의 의미 없는 초기화된 값

NIL : 의미 없는 값. 입력되지 않은 값의 초기화된 값으로 쓰임

1.4 Reference

IEEE Std. 830-1998

Lab. introduction #1 (SASD)

(http://dslab.konkuk.ac.kr/Class/2013/13SE/ClassB/lecturenotes/Introduction%20to%20SASD.pdf)

실습 수업 주제(SRS)

(http://dslab.konkuk.ac.kr/Class/2013/13SE/ClassB/lab/DS-2013.EDLS.SRS-0.9.docx)

2 Overall Description

2.1 Product perspective

대상 SW는 실제 도어락에 사용될 수 있는 SW가 될 수 있다. 해당 SW는 HW (버튼)에 의한 동작을 처리한다.

2.2 Product functions

2.2.1 잠금장치

2.2.1.1 수동 잠금

사용자가 버튼을 이용해 문의 잠금장치를 수동으로 잠금 상태로 전환한다.

2.2.1.2 자동 잠금

문이 닫힌 상태가 3초간 지속되면 문의 잠금장치를 잠금 상태로 전환한다.

2.2.1.3 저장된 비밀번호를 이용한 잠금 해제

미리 저장된 4자리 숫자와 동일한 숫자를 입력 받으면 문의 잠금장치를 열림 상태로 전환한다.

2.2.1.4 열쇠를 이용한 잠금 해제

도어락이 열쇠를 감지하면 문의 잠금장치를 열림 상태로 전환한다.

2.2.2 문 닫힘 감지

문이 닫혔는지 여부를 판단하는 기능이다.

2.2.3 백라이트

디지털 도어락의 커버가 열리면 10초간 백라이트를 켠다. 사용자가 10초 이내에 숫자키를 누르면 백라이트가 다시 10초간 켜진다. 10초 후 백라이트를 끈다.

2.2.4 경보음

사용자가 저장된 비밀번호와 같은 번호를 누를 시 경보음을 출력한다.

사용자가 저장된 비밀번호와 다른 번호를 누를 시 경보음을 출력한다.

2.3 User characteristics

사용자는 본인이 설정한 비밀번호를 기억하고 동일한 번호를 입력하여 잠금장치를 해제시킬 수 있다. 또한, 비밀번호가 아닌 열쇠를 이용해서 문을 열 수도 있다. 비밀번호를 모르고 열쇠가 없는 사용자의 경우에는 문을 열 수 없다.

2.4 Constraints

본 SW는 여러 입력을 동시에 처리할 수 없다. 동시에 여러 개의 입력이 들어왔을 때는 특정 우선순위에 따라 동작하도록 한다.

2.5 Assumptions and dependencies

도어락의 비밀번호는 한 번 설정하면 시스템의 전원이 나가기 전까지 유지되는 것으로 가정한다.

경보음은 PC에서 소리 출력이 가능한 장치를 이용하여 대신한다.

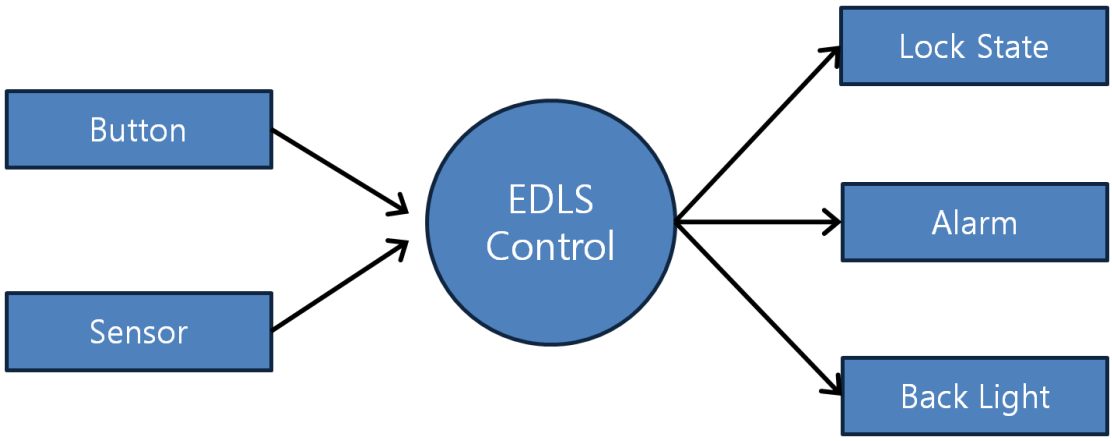
문의 잠금을 표현하기 위해 PC에서 확인 가능한 수단을 이용한다.

각종 입력은 PC에서 사용 가능한 입력(키보드 또는 마우스 등)으로 대체한다.

3 Structured Analysis

3.1 System Context Diagram

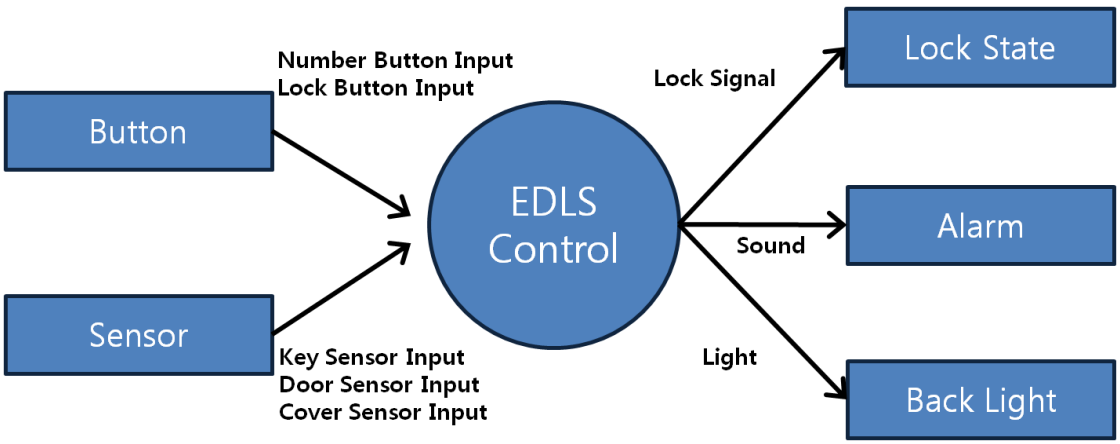
3.1.1 Basic System Context Diagram



3.1.2 Event List

Input/Output Event	Description
Number Button Input	Detects click of the number buttons from 0 to 9
Lock Button Input	Detects click of the lock button
Key Sensor Input	Detects key that user touches to it
Door Sensor Input	Detects open/close state of the door
Cover Sensor Input	Detects open/close state of the cover
Light	Turn the light on / off
Sound	Makes a sound (Sound 1 / Sound 2 / Sound 3)
Lock Signal	Controls the door's unlock/lock state

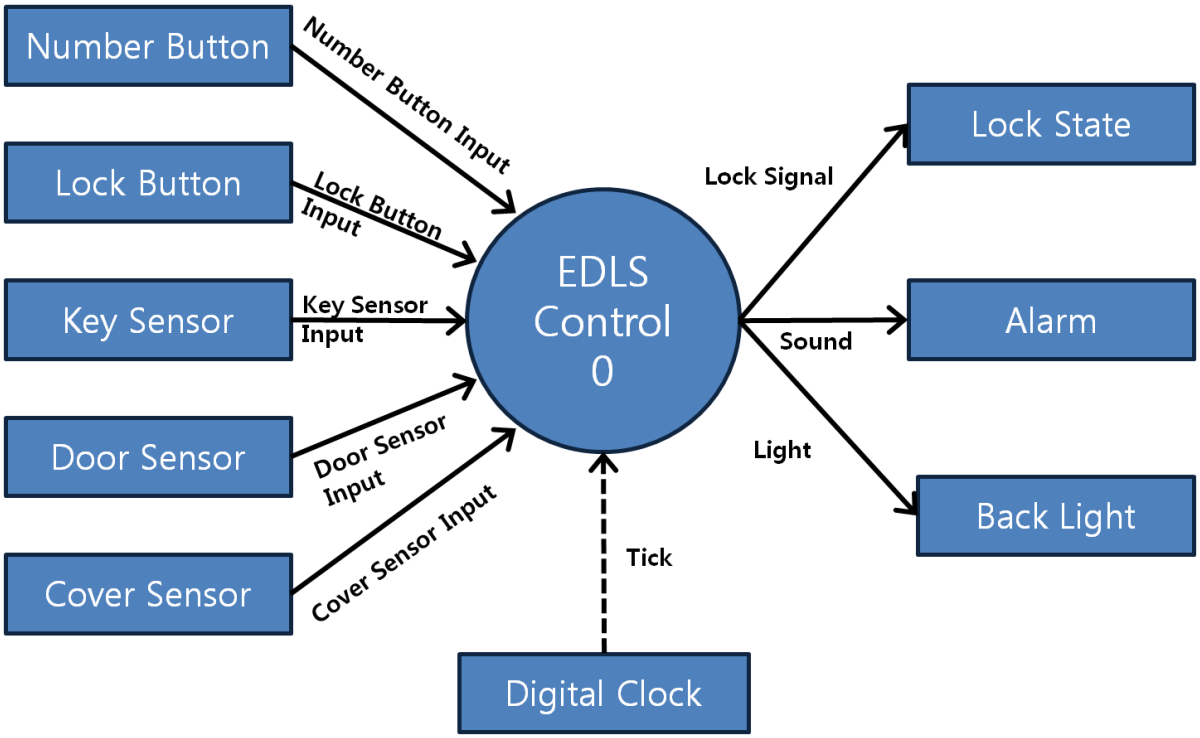
3.1.3 The System Context Diagram



3.2 Data Flow Diagram

3.2.1 DFD Level 0

3.2.1.1 DFD



3.2.1.2 Process Specification

3.2.1.2.1 Process 0

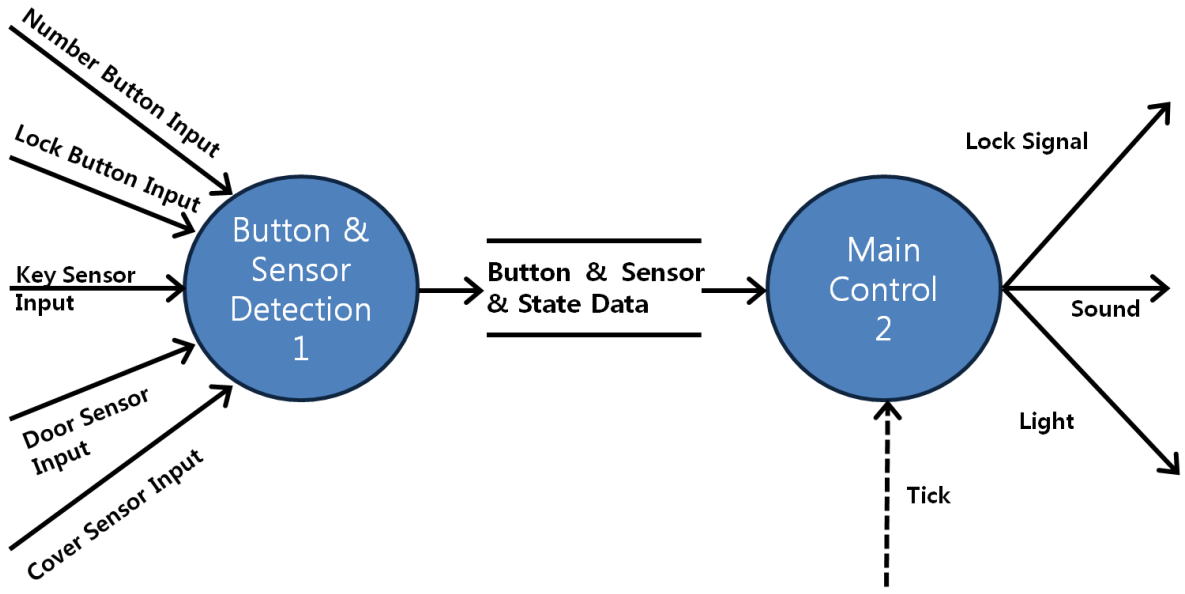
Reference No.	0
Name	EDLS Control
Input	Number Button Input, Lock Button Input, Key Sensor Input, Door Sensor Input, Cover Sensor Input, Tick
Output	Lock Signal, Light, Sound
Process Description	It is main control of Electronic Door Lock System. If there is any Button Input or Sensor Input, it reads values of the inputs and sends Lock Signal / Light / Sound Data to Lock State, Back Light and Alarm.

3.2.1.3 Data Dictionary

Input/Output Event	Description	Format / Type
Number Button Input	Detects click of the number buttons from 0 to 9	Decimal number from 0 to 9, Interrupt
Lock Button Input	Detects click of the lock button	Analog Value, Interrupt
Key Sensor Input	Detects key that user touches to it	Analog Value, Interrupt
Door Sensor Input	Detects open/close state of the door	Analog Value, Interrupt
Cover Sensor Input	Detects open/close state of the cover	Analog Value, Interrupt
Light	Turn the light on / off	On / Off
Sound	Makes a sound (Sound 1 / Sound 2 / Sound 3)	Sound 1 / Sound 2 / Sound 3
Lock Signal	Controls the door's unlock/lock state	Unlock / Lock
Tick	The signal which is entered per 10ms.	

3.2.2 DFD Level 1

3.2.2.1 DFD



3.2.2.2 Process Specification

3.2.2.2.1 Process 1

Reference No.	1
Name	Button & Sensor Detection
Input	Number Button Input, Lock Button Input, Key Sensor Input, Door Sensor Input, Cover Sensor Input
Output	Button & Sensor Data
Process Description	It detects selected button or activated sensor. If two or more button signals come in this process, it chooses the signal which has the highest priority.

3.2.2.2.2 Process 2

Reference No.	2
Name	Main Control
Input	Button & Sensor & State Data, Tick
Output	Lock Signal, Light, Sound
Process Description	This is the main control of the EDLS system. It reads the button & sensor & state data and commands for display and lock state changing.

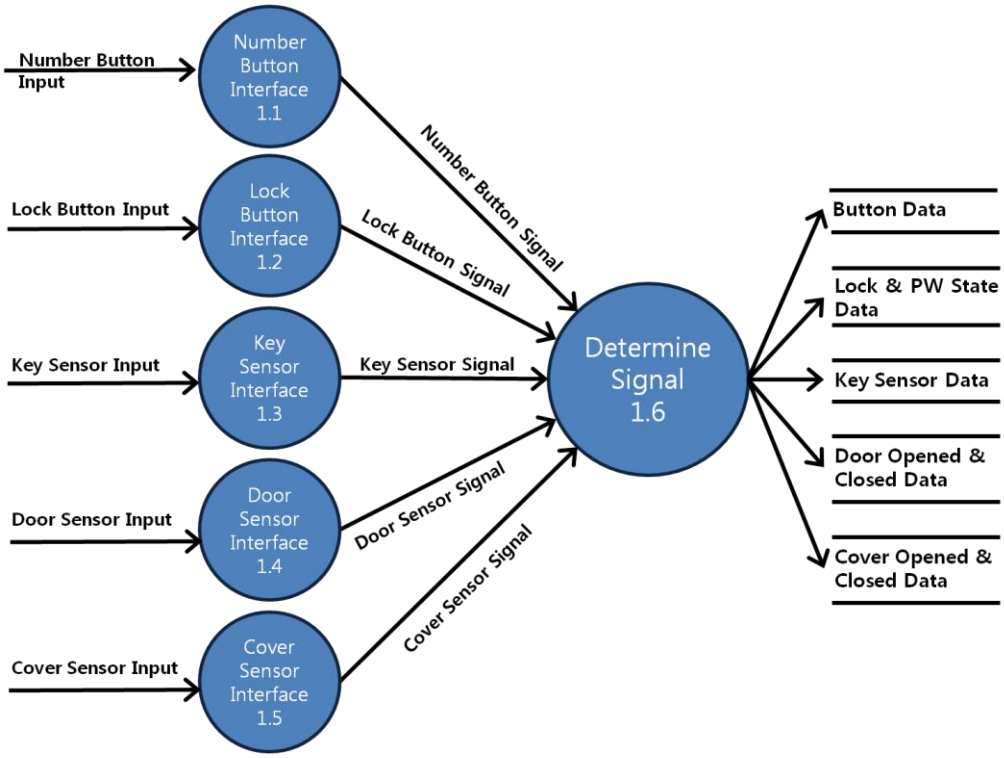
3.2.2.3 Data Dictionary

Input/Output Event	Description	Format / Type
Button & Sensor & State Data	It saves button data, sensor data, and state data of the system. State Data includes Lock and PW Data	Structure

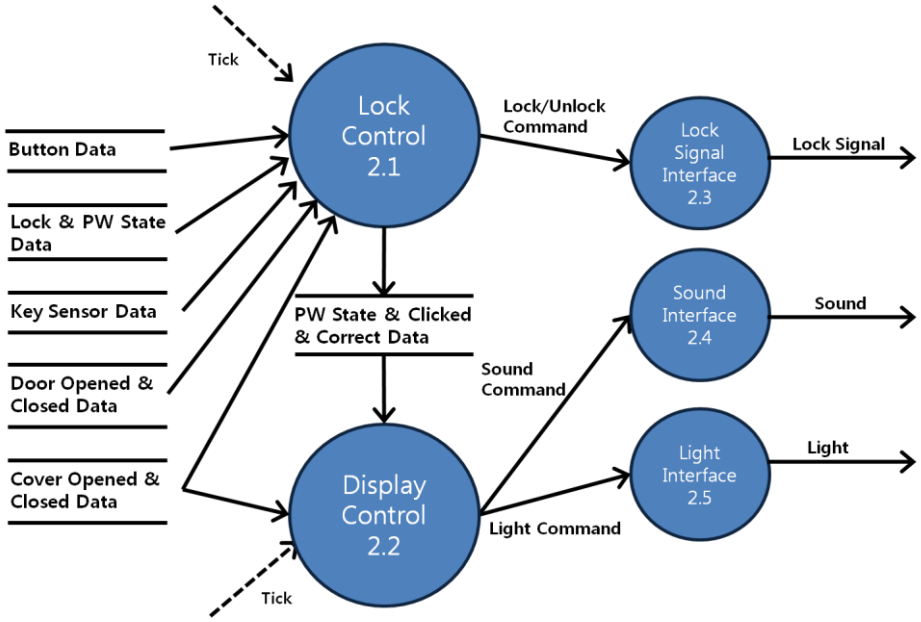
3.2.3 DFD Level 2

3.2.3.1 DFD

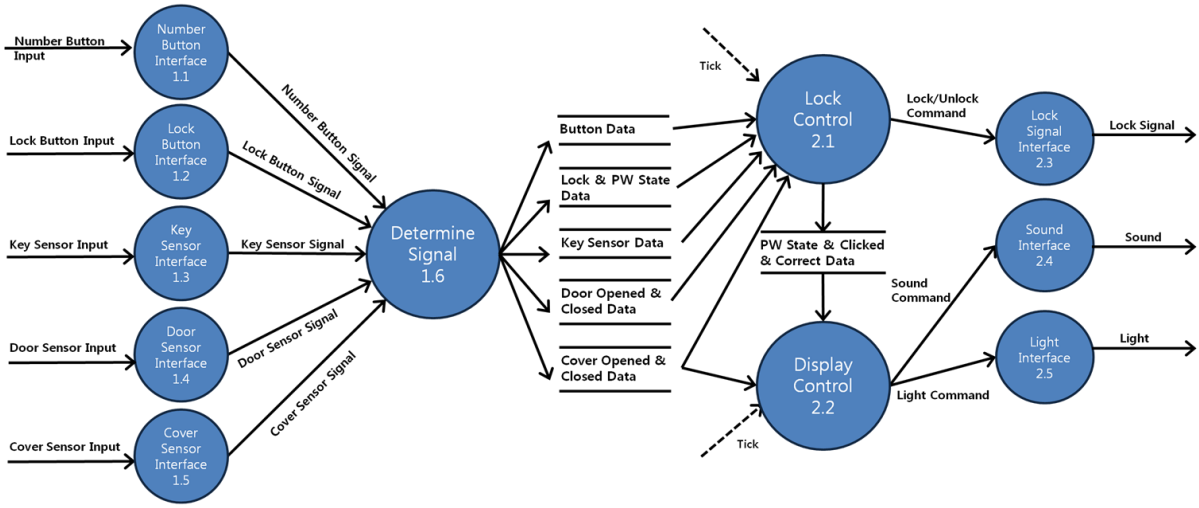
3.2.3.1.1 DFD enlarge for Input Interfaces 1.1 ~ 1.5 & Determine Signal



3.2.3.1.2 DFD enlarge for Lock / Display Control & Output Interfaces 2.3 ~ 2.5



3.2.3.1.3 DFD overall for Level 2



3.2.3.2 Process Specification

3.2.3.2.1 Process 1.1

Reference No.	1.1
Name	Number Button Interface
Input	Number Button Input
Output	Number Button Signal
Process Description	Checks the value of the Number Button input, and changes it as a digital signal that could be read by Determine Button process. It makes decimal number to binary number. If the cover is detected as 'closed', the interface doesn't send number button signal.

3.2.3.2.2 Process 1.2

Reference No.	1.2
Name	Lock Button Interface
Input	Lock Button Input
Output	Lock Button Signal
Process Description	Checks the value of the Lock Button input, and changes it as a digital signal that could be read by Determine Button process. It makes a boolean type value(true→1 / false→0).

3.2.3.2.3 Process 1.3

Reference No.	1.3
Name	Key Sensor Interface
Input	Key Sensor Input
Output	Key Sensor Signal
Process Description	Checks the value of the Key Sensor Input, and changes it as a digital signal that could be read by Determine Button process. It makes a boolean type value(true→1 / false→0).

3.2.3.2.4 Process 1.4

Reference No.	1.4
Name	Door Sensor Interface
Input	Door Sensor Input
Output	Door Sensor Signal
Process Description	Checks the value of the Door Sensor Input, and changes it as a digital signal that could be read by Determine Button process. It makes a boolean type value(true→1 / false→0). If the door is locked, it doesn't detect any door sensor input. (When the door is opened and locked, it can't be closed and when the door is closed and locked, it can't be opened.)

3.2.3.2.5 Process 1.5

Reference No.	1.5
Name	Cover Sensor Interface
Input	Cover Sensor Input
Output	Cover Sensor Signal
Process Description	Checks the value of the Cover Sensor Input, and changes it as a digital signal that could be read by Determine Button process. It makes a boolean type value(true→1 / false→0). If the cover is not fully opened, the interface doesn't sends signal about open state.

3.2.3.2.6 Process 1.6

Reference No.	1.6
Name	Determine Signal
Input	Number Button Signal, Lock Button Signal, Key Sensor Signal, Door Sensor Signal, Cover Sensor Signal
Output	Button Data, Lock & PW State Data, Door Opened & Closed Data, Cover Opened & Closed Data, Key Sensor Data
Process Description	It detects signal value. If two or more signals come in this process, it chooses the signal which has the highest priority and send it to the data storages. (Lock Button > Door Sensor > Key Sensor > Cover Sensor > Number Button). The Lock State Data, PW State Data are generated and initialized. It also sends Number Button Clicked Data(boolean type) when sends Number Button Data. When detects door sensor or cover sensor, it makes and sends Door Opened & Closed Data and Cover Opened & Closed Data. It changes the detected data to TRUE.

3.2.3.2.7 Process 2.1

Reference No.	2.1
Name	Lock Control
Input	Button Data, Lock & PW State Data, Door Opened & Closed Data, Cover Opened & Closed Data, Key Sensor Data, Tick
Output	PW State & Clicked & Correct Data, Lock/Unlock Command
Process Description	This is the main control of lock process. It receives Button Data, PW State Data and Door & Cover Opened & Closed Data, Key Sensor Data then it makes a decision to Lock or Unlock the door. It sends PW State & Clicked & Correct Data to Display Control.

3.2.3.2.8 Process 2.2

Reference No.	2.2
Name	Display Control
Input	Cover Opened & Closed Data, PW State & PW Clicked & Correct Data, Tick
Output	Sound Command, Light Command
Process Description	This is the main control of display process. It receives Cover Opened & Closed Data and PW State & PW Clicked & Correct data, checks those data and sends the proper display commands such as sound and light commands to Sound and Light Interface.

3.2.3.2.9 Process 2.3

Reference No.	2.3
Name	Lock Signal Interface
Input	Lock/Unlock Command
Output	Lock Signal
Process Description	If there is lock command from Lock Control, the Interface reads it and sends a lock signal for change the lock state(lock/unlock) to a lock device.

3.2.3.2.10 Process 2.4

Reference No.	2.4
Name	Sound Interface
Input	Sound Command
Output	Sound
Process Description	If there is sound command from Display Control, the Interface reads it and sends a sound signal to make sounds.

3.2.3.2.11 Process 2.5

Reference No.	2.5
Name	Light Interface
Input	Light Command
Output	Light
Process Description	If there is light command from Display Control, the Interface reads it and sends a light signal to turn on or off the back light.

3.2.3.3 Data Dictionary

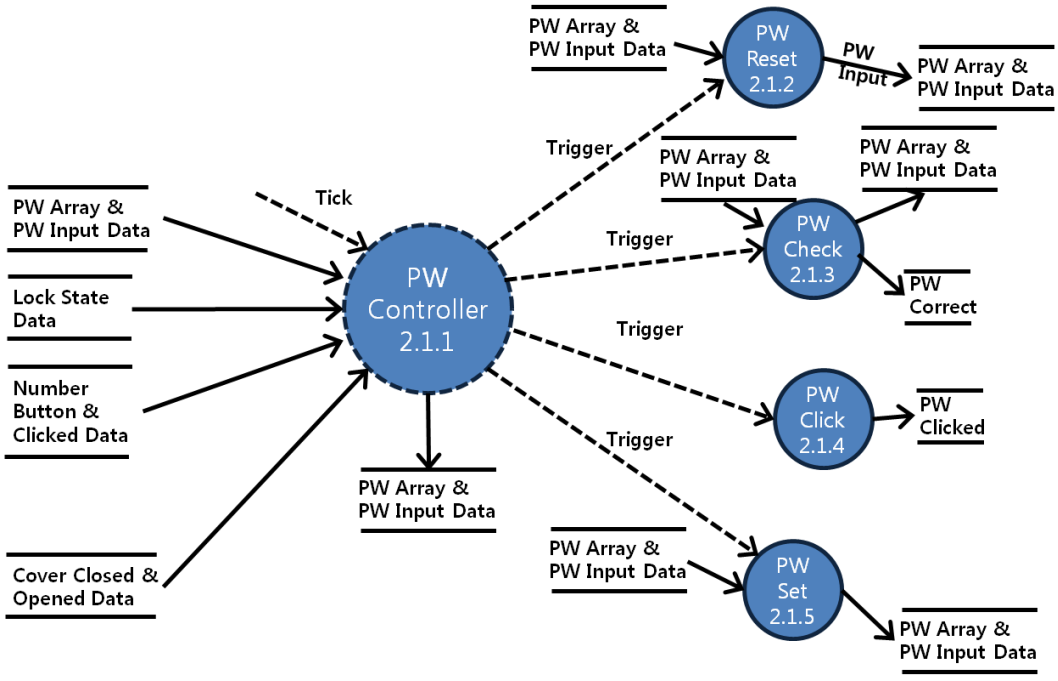
Input/Output Event	Description	Format / Type
Number Button Signal	Binary number that is changed from decimal number.	Integer, Interrupt
Lock Button Signal	Boolean type data that is true if the Lock Button is clicked.	True / False, Interrupt
Key Sensor Signal	Boolean type data that is true if the key is the right key to unlock door.	True / False, Interrupt
Door Sensor Signal	Boolean type data that is true if the Door is closed. If no input come in, it saves insignificant data.	NIL / True / False, Interrupt
Cover Sensor Signal	Boolean type data that is true if the cover is closed. If no input come in, it saves insignificant data.	NIL / True / False, Interrupt

PW State Data	It saves Integer Array Data used to check password. It also has data about the Integer Array Data that is made up with user's input data, and the size of the array. Actually it means PW Array & PW Input Data.	Structure
Lock/Unlock Command	Commands to make a Lock Signal	Structure
Sound Command	Commands to make a Sound Signal	True/False
Light Command	Commands to make a Light Signal	
Button Data	It includes Number Button Data and Lock Button Data generated by Determine Signal.	Structure
Lock State Data	It saves Boolean data. If Door Lock State is unlock, saves false, and if Door Lock State is lock, saves true.	True, False/ Interrupt
Key Sensor Data	It saves Boolean data used to check Key Sensor detects right key.	True/False , Interrupt
Door Opened & Closed	It saves Boolean data used to check Door Sensor detects the door is closed. (If door is opened Door Opened is True, or Door Closed is True).	True/False , Interrupt
Cover Opened & Closed	It saves Boolean data used to check that the cover is closed or opened(If cover is opened Cover Opened is True, or Cover Closed it True).	True/False, Interrupt

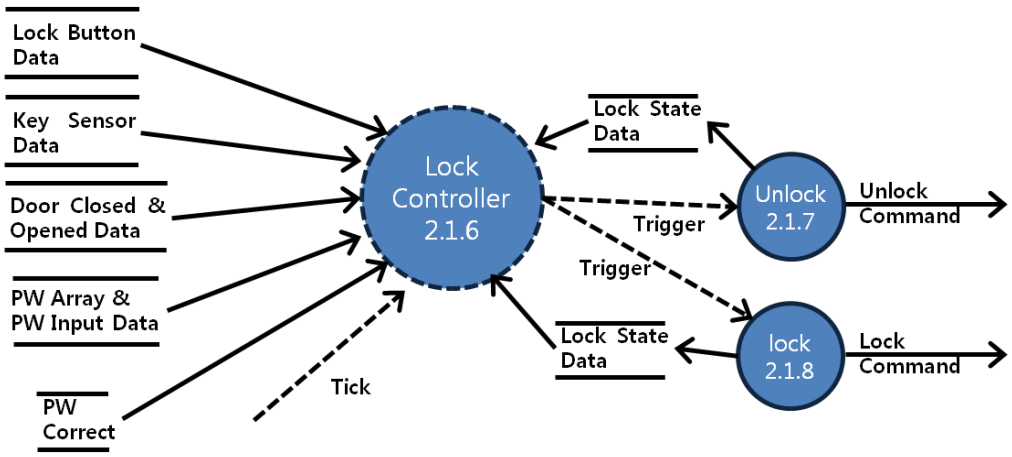
3.2.4 DFD Level 3

3.2.4.1 DFD

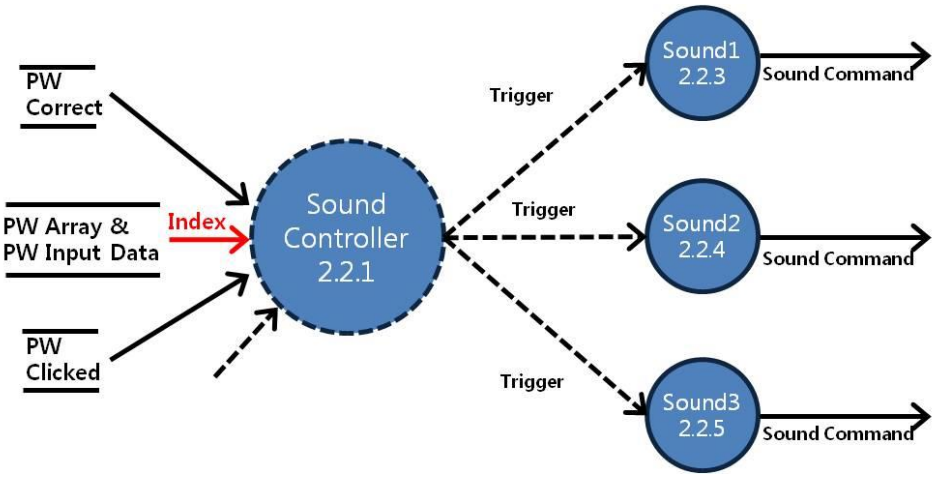
3.2.4.1.1 DFD enlarge for PW Controller & process 2.1.2 ~ 2.1.5



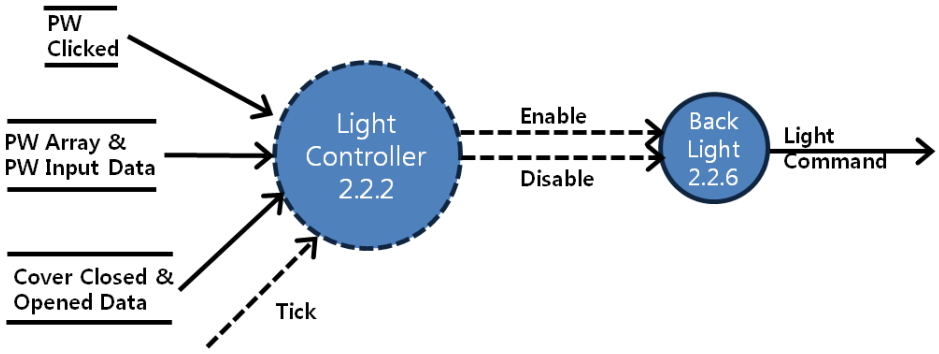
3.2.4.1.2 DFD enlarge for Lock Controller & process 2.1.7 and 2.1.8



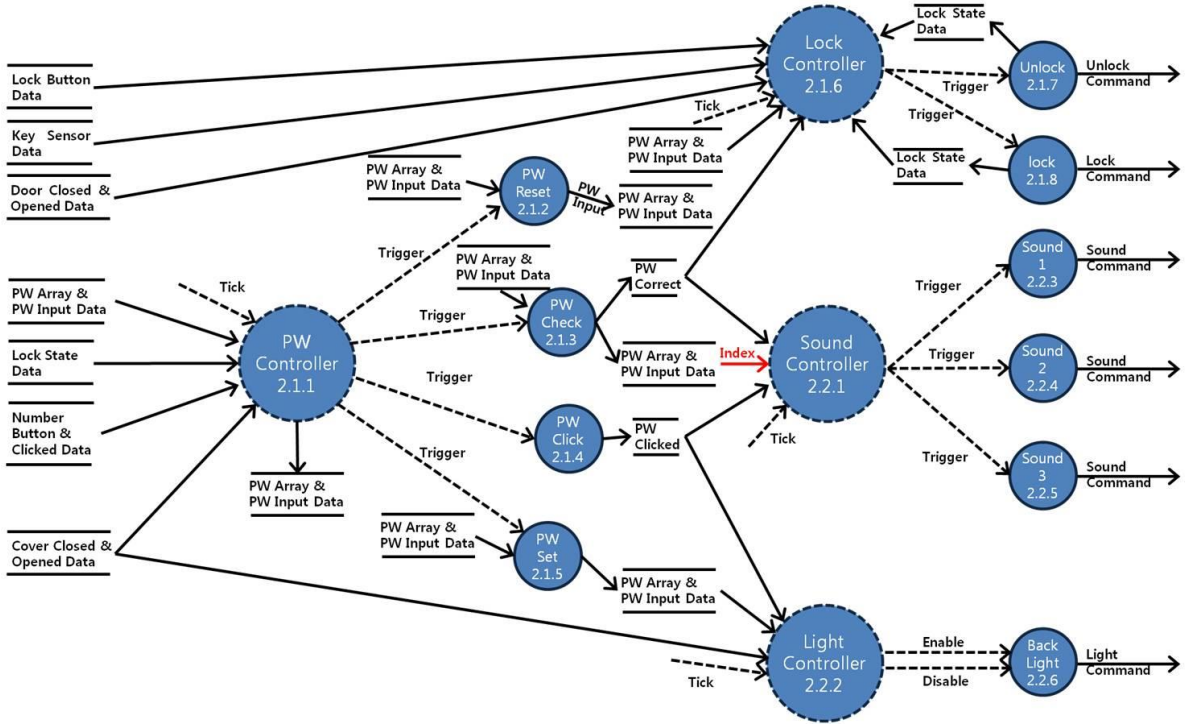
3.2.4.1.3 DFD enlarge for Sound Controller & process 2.2.3 ~ 2.2.5



3.2.4.1.4 DFD enlarge for Light Controller & process 2.2.6



3.2.4.1.5 DFD overall for Level 3



3.2.4.2 Process Specification

3.2.4.2.1 Process 2.1.1

Reference No.	2.1.1
Name	PW Controller
Input	PW Input & PW Array Data, Cover Opened & Closed Data , Lock State Data, Number Button & Clicked Data, Tick
Output	Trigger, PW Input & PW Array Data
Process Description	If Lock State Data is false, it doesn't operate below processes exept when there is no PW Array. (Before the PW Array is set, when PW Input is full, this controller sends a trigger to PW Set.) If Number Button Clicked is True, it sends a trigger to the PW Click, saves Number Button Data in PW Input Data, increases Index, and initializes counting time and starts counting time. If there is no input of Number Button Data for 10 seconds, it sends a trigger to PW Reset. When PW Input is full, it sends a trigger to PW Set if PW Array Data is null, or PW Check. If the Cover Closed Data is input as True, it sends a trigger to PW Reset and stop counting. After sending triggers to the processes, it triggers PW Reset to initialize PW Input.

3.2.4.2.2 Process 2.1.2

Reference No.	2.1.2
Name	PW Reset
Input	PW Input & PW Array Data, Trigger
Output	PW Input, Index
Process Description	If Trigger is input, It initializes Index to 0.

3.2.4.2.3 Process 2.1.3

Reference No.	2.1.3
Name	PW Check
Input	PW Input & PW Array Data, Trigger
Output	PW Input & PW Array Data, PW Correct
Process Description	If Trigger is input, compare PW Input with PW Array. If they are equal it sends PW Correct Data as True, or sends PW Correct Data as False. Then it initializes PW Input.

3.2.4.2.4 Process 2.1.4

Reference No.	2.1.4
Name	PW Click
Input	Trigger
Output	PW Clicked
Process Description	If Trigger input, it sends PW Clicked as True.

3.2.4.2.5 Process 2.1.5

Reference No.	2.1.5
Name	PW Set
Input	PW Input & PW Array Data, Trigger
Output	PW Input & PW Array Data
Process Description	If Trigger is input, It copies PW Input into PW Array Data. Then it initializes PW Input Data.

3.2.4.2.6 Process 2.1.6

Reference No.	2.1.6
Name	Lock Controller
Input	Lock Button Data, Key Sensor Data, Door Closed & Opened Data, Lock State Data, PW Correct Data, PW Input & PW Array Data, Tick
Output	Trigger
Process Description	If Lock State Data is True and PW Array Data is not null, When Lock Button Data or Key sensor Data or PW Correct Data is input as True, sends a Trigger to Unlock. If Lock State Data is False and PW Array Data is not null, When Lock Button Data is input as True or when Door Closed is in, and Door Opened Data is not received within 3 seconds , it sends a Trigger to Lock.

3.2.4.2.7 Process 2.1.7

Reference No.	2.1.7
Name	Unlock
Input	Trigger
Output	Lock State Data , Unlock Command
Process Description	If Trigger is input, it changes the Lock State Data to False and sends the Unlock Command to Lock Interface.

3.2.4.2.8 Process 2.1.8

Reference No.	2.1.8
Name	Lock
Input	Trigger
Output	Lock State Data , Lock Command
Process Description	If Trigger is input, it changes the Lock State Data to True and sends the Lock Command to Lock Interface.

3.2.4.2.9 Process 2.2.1

Reference No.	2.2.1
Name	Sound Controller
Input	PW Correct Data, PW Clicked, Index, Tick
Output	Trigger
Process Description	It can be input Boolean type data. If PW Correct Data is input as TRUE, sends Trigger to Sound 1, as FALSE, sends Trigger to Sound 2. When PW Clicked is input as True, it initializes counting time and starts time counting. If counting time is 10 seconds or more it sends Trigger to Sound3. If the input data 'Index' is 0(When the PW Input is reset), it stops counting and initialize count.

3.2.4.2.10 Process 2.2.2

Reference No.	2.2.2
Name	Light Controller
Input	PW Clicked, Cover Closed & Opened Data, PW Input & PW Array Data, Tick
Output	Enable, Disable
Process Description	When Cover Opened or PW Clicked is input as True, it sends Enable to Back Light and it initializes counting time and starts time counting(but, if PW Array is null it doesn't count). Then if counting time is 10 seconds or more, it sends Disable to Back Light and stop counting time. When Cover Closed is input as True it sends Disable to Back Light and stop counting time.

3.2.4.2.11 Process 2.2.3

Reference No.	2.2.3
Name	Sound 1
Input	Trigger
Output	Sound 1 Command
Process Description	It sends sound 1 command when Trigger input.

3.2.4.2.12 Process 2.2.4

Reference No.	2.2.4
Name	Sound 2
Input	Trigger
Output	Sound 2 Command
Process Description	It sends sound 2 command when Trigger input.

3.2.4.2.13 Process 2.2.5

Reference No.	2.2.5
Name	Sound 3
Input	Trigger
Output	Sound 3 Command
Process Description	It sends sound 3 command when Trigger input.

3.2.4.2.14 Process 2.2.6

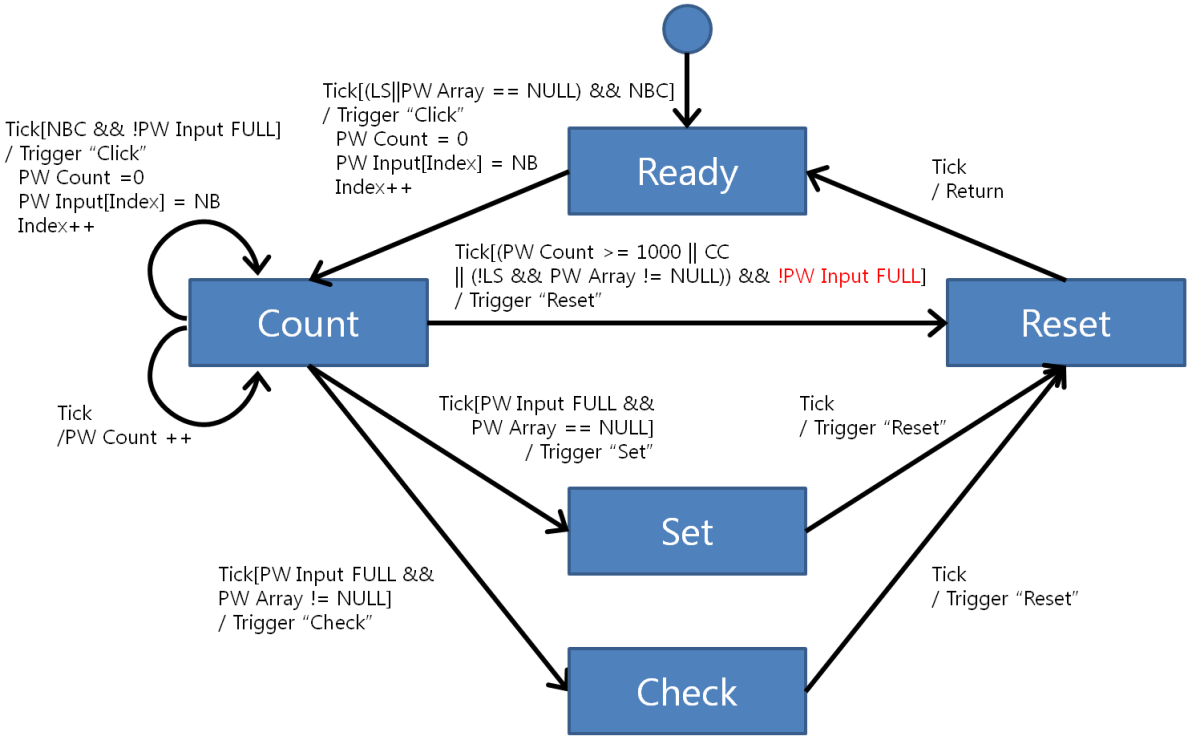
Reference No.	2.2.6
Name	Back Light
Input	Enable, Disable
Output	Light Command
Process Description	It sends Light Command to turn on the Back Light when it received Enable. It sends Light Command to turn off the Back Light when it received Disable.

3.2.4.3 Data Dictionary

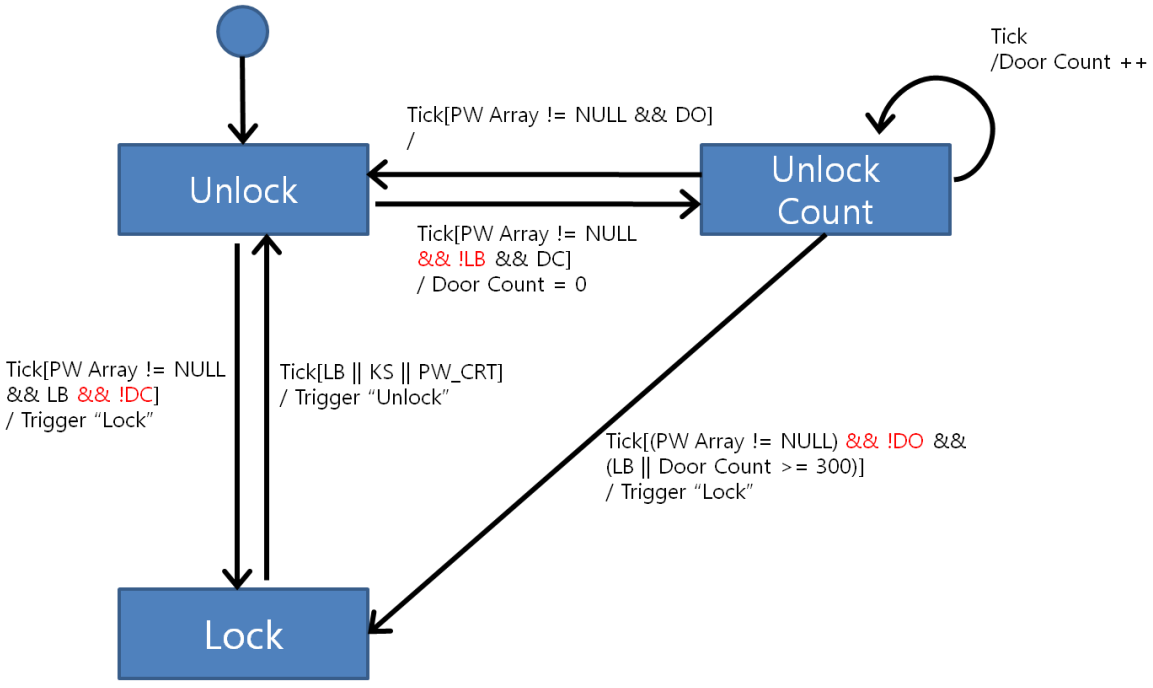
Input/output Event	Description	Format / Type
Number Button Data	It saves Integer type data used to make password data.	Integer (0~9), Interrupt
Number Button Clicked Data	It saves Boolean type data used to check whether Number Button is clicked or not. When Number Button is clicked, it is True.	True/False, Interrupt
Lock Button Data	It saves Boolean data used to check whether Lock Button is clicked or not. When Lock Button is clicked, it is True.	True/False, Interrupt
PW Array & PW Input Data	These data are included in PW State. PW Input Data has PW Input and Index. PW Input is made up four Number Button Data in incoming order and Index with a range of 0-4 is the size of PW Input. PW Array Data also saves integer array data used to checks PW Input Data. If PW Array saves NULL then Password hasn't set yet.	Structure
PW Correct Data	Using information generated by PW Check Process, it saves Boolean data whether the password is correct or not. It saves NIL as init state.	NIL /True / False, Interrupt
PW Clicked	The data generated by PW Clicked. It sends Boolean data. (It sends true when PW Click.)	True / False, Interrupt

3.2.4.4 State Transition Diagram

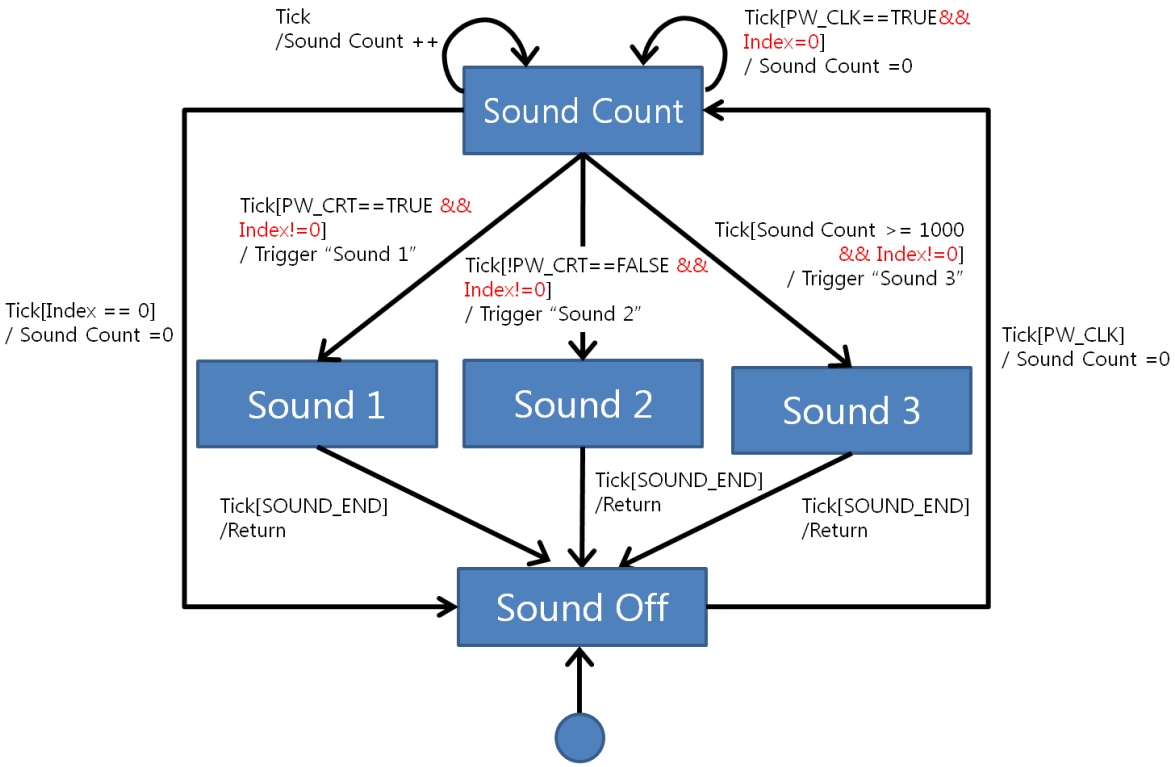
3.2.4.4.1 State Transition Diagram for PW Controller(2.1.1)



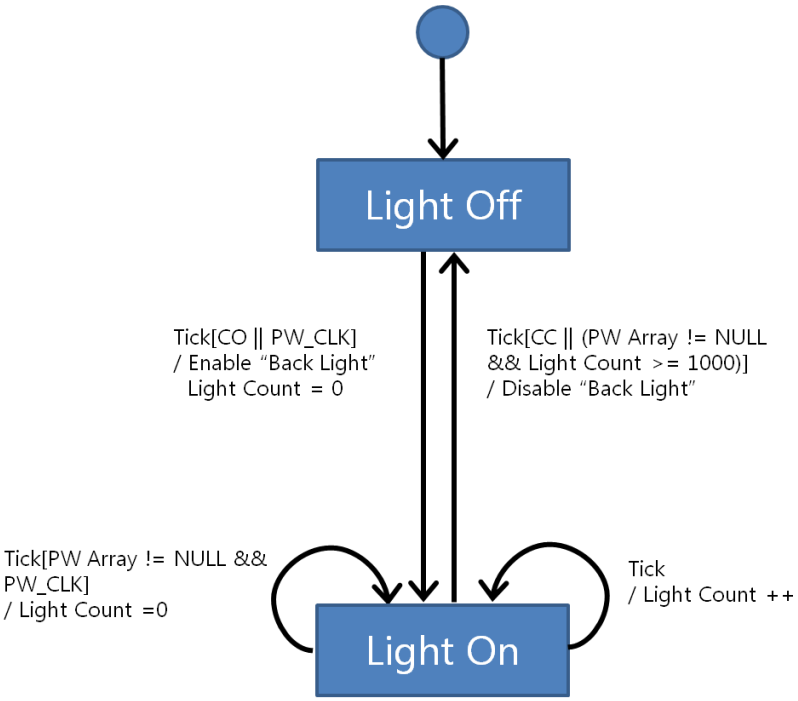
3.2.4.4.2 State Transition Diagram for Lock Controller(2.1.6)



3.2.4.4.3 State Transition Diagram for Sound Controller(2.2.1)



3.2.4.4.4 State Transition Diagram for Light Controller(2.2.2)



3.2.5 Overall DFD