# Automatic Lighting Control System and Architecture Using Ambient Light Sensor

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***Abstract* — In this paper, we propose an automatic lighting control system and architecture using ambient light sensor, which is built in a lighting device. The proposed method can predict user preference lux value on the floor by referencing measured lux value on the ceiling surface with ambient light sensor. We also implement real time lighting automatic lighting control system using the ambient light sensor. An optimized lighting control service can be provided to users in the home network environments.**

***Keywords- automatic , lighting control, ambient light sensor.***

## I. INTRODUCTION

According to the spread of LED (Light Emitting Diode) lighting devices, there have been many researches of lighting control system using various sensors for energy saving in office or home environments. Nowadays, it is possible to design and realize the intelligent lighting control system along with the increasing maturity of computer technology, network technology, control technology and embedded system [1]. The lighting system is one of the largest single consuming units, which accounts up to 26% of the total energy consumption of an inefficient building [2].

Also, it is not easy to adjust the optimal illumination environment for the office worker. The lighting control system, which provides most suitable brightness for each office worker is necessary by using ceiling lighting fixtures [3]. This paper proposes automatic lighting control mechanism with ambient light sensor built-in a lighting device for the efficiency of user-oriented home environment. Section II presents the automatic lighting control system architecture for lighting control using ambient light sensor. Section III describes the simulation result of data analysis and mechanism of the automatic lighting control system. Section IV provides some concluding remarks regarding our proposal and future work.

## II. AUTOMATIC LIGHTING CONTROL SYSTEM ARCHITECTURE

The automatic lighting control system architecture includes seven blocks. Figure 1 shows automation lighting system architecture for the optimized lighting control. External interface block performs function of communication with the application server or terminal.

The sampling block collects the initial sampling data of ambient light sensor when the dimming level of the lighting is changed from 1 to 100%.

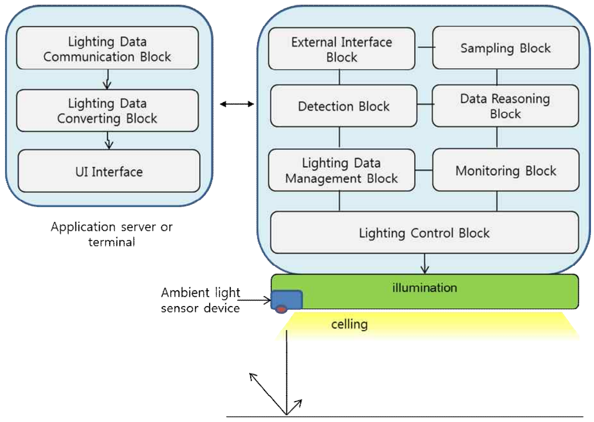



Fig. 1. Automatic lighting control system architecture

The sampling data is used as the basis data of the self-control mechanism. The data detection block collects raw sensor data and converts the extracted sensor information into valid ambient light sensor data. The data reasoning block can infer the floor surface data based on the ceiling surface data of the built-in ambient light sensor in the lighting fixture. The lighting data management block performs flow management of lighting data through application server or terminal. The monitoring block performs ambient light sensor data monitoring periodically. The lighting control block performs the optimization of illumination and controls the lighting device according to the service environment. The position of the ambient light sensor device is attached to the illumination.

## III. AMBIENTL LIGHT SENSOR DATA ANALYSIS AND AUTOMATION LIGHTING CONTROL MECHANISM

In the simulation, the ambient light sensor is connected to the processor board (Micro Controller Unit) through I2C (Inter-Integrated Circuit) communication. The 10W~50W lighting device is implemented and ambient light sensor is embedded in the lighting device. The simulation environment of illumination is shown in Figure 2. The size of the lighting space is about 60cm * 60cm * 60cm. The illumination value is measured and analyzed by comparing the luminance data of the illuminometer (CL-200A Chroma Meter) and ambient light sensor. A 1 point method is used for the illumination measurements. In the simulation, dimming level of illumination increases from 0% to 100% stepwise.

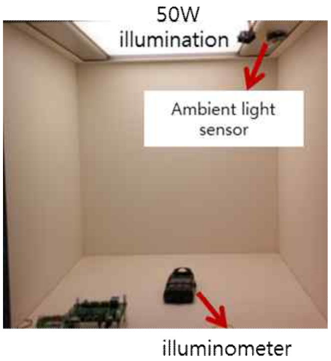
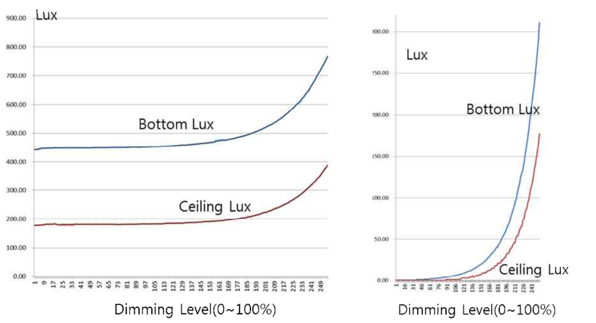



Fig. 2. The Illumination simulation environment.

At the same time, the floor surface data is measured through the illuminometer and the ceiling surface data is collected by ambient light sensor. Equation (1) can be obtained by linear regression analysis through the simulation.

In Figure 3, we see a comparison of the floor surface data with ceiling surface data from the simulation.




(a) When there is some external light source. (b) In the dark room.

Fig. 3. Simmulation results.

$$Y= 1.5599\chi + 169.12. \qquad (1)$$

Y : The floor surface data (Bottom lux)
X : The ceiling surface data (Ceiling lux)

Equation (1) is possible to obtain a formula, such as (2):

$$Y= A\chi + B \qquad (2)$$

Y: The reasoning floor surface data
X: The measured ceiling surface data
A (weight) = (y1-y2)/(s1-s2)
y1: The floor surface data at the time of the minimum dimming level of lighting
y2: The floor surface data at the time of the maximum dimming level of lighting
s1: The ceiling surface sampling data at the time of the minimum dimming level of lighting
s2: the ceiling surface sampling data at the time of the maximum dimming level of lighting
B (Constant) = ((y2-y1) * s2)/ (s1-s2)) + y2

Equation (2) predicts user preference (target) lux value on the floor by referencing measured lux value on the ceiling surface. In Figure 4 shows automation lighting control mechanism and architecture using ambient light sensors.

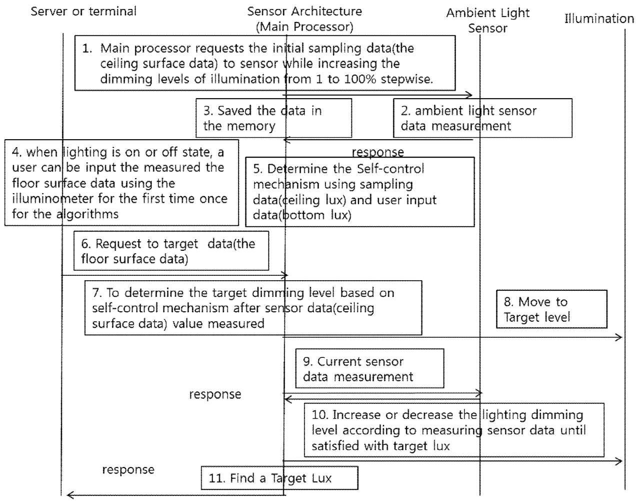



Fig. 4. The mechanism of the automatic lighting control system.

The user is able to maintain the lighting environment in real time through automation lighting control mechanism.

## IV. Conclusion and Future Work

We propose automation lighting control system and architecture using ambient light sensors in the home environments. In this paper, the ceiling lux data can be converted to the floor surface lux data, which is set by user automatically. Also, the dimming level of illumination can be switched to the target dimming level quickly by using an automatic lighting control algorithm. In the future, we will need to study the simulation and light data analysis of algorithms in the various spaces.

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