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Utilization of the Color Temperature in Smart Lighting using Zigbee Wireless Module

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Abstract : ***Light based technologies are widely used in the field of medicine, health, offices and automated houses. They are the fastest growing segment and improve the life style of people. Zigbee wireless technology can be used to control the ambient light modules regarding the color temperature and intensity.***

Keywords: Intensity, Moods, Zigbee, Lighting.

1. INTRODUCTION: Light has a deep impact in our daily life. If we maintain the exact intensity and temperature of light many of its advantages can be utilized. The light that we get from light sources consists of a specific temperature along with its intensity. A 2000K light is warmer and a 6000K is cooler. If we maintain the intensity of light along with its color temperature various functions of light can be extracted from it. Smart lighting using Zigbee modules can improve the comfort and convenience of living.

1.1 Zigbee Wireless Module: Zigbee is used for high level communication protocols, which is less expensive compared to other protocols like Wi-Fi or Bluetooth. It has a line of sight transmission distance up to 100 meters. Long distance transmission is also possible by using network of intermediate devices.

The Zigbee networks are secured by 128 bit symmetric encryption keys and it supports star, tree and mesh networks. Zigbee networks can be simulated using NetSim or Opnet which allows it to be verified before hardware implementation. A Zigbee module consumes very less power. By using this module one can change lighting to reflect season, ambiance or specific task remotely. It is an innovative technology which provides new ways to use light, improve convenience, comfort and energy savings. Dimming the lights when the maximum output is not required can reduce the energy draw.

Zigbee can help in power saving by automatic dimming based on ambient light conditions. It is an emerging wireless networking technology which meets easy installation, cost effective, reliability and flexible deployment requirements.

A Zigbee sensor consists of a radio transceiver that transmits a unique ID number. When sensor used is more than one, then each sensor serves as a node on a network, sending the data to and receiving it from the other nodes within the range of communication. A mesh network is formed by these nodes. Zigbee ensures that hardware and software from multiple vendors to be interoperable.

2. SCOPE OF APPROACH: By controlling the color temperature and intensity, the way in which we consume light can be changed. Every person has different moods at different times. If the light intensity and temperature is adjusted according to ones mood then controlling and variance of the mood will be possible. This can help to increase the appetite at dining room, exact concentration at study room or relaxation at bed room.

3. METHOD: When light sources are selected for a specific task, three important factors are considered. They are Color Rendering Index, lumen output and color temperature. These all factors are independent of each other. Color Rendering Index rates the color rendering ability of light in comparison with natural sun light, which has a Color Rendering Index of 100. It shows how the color appears compared to natural outdoor sunlight. Lumen is the SI unit of luminous flux which represents the time rate of transferring brightness.

Color temperature has an important application in lighting. It describes color characteristics of light in which warm white is yellowish in nature and cool white is bluish in nature. It is denoted in Kelvin. The color temperature of light describes how light will appear when one looks to it. It is a numeric value which represents the chroma.

When the color temperature rises, the bluer will be the appearance and it will become cool light. When the color temperature fall the redder will be the appearance and it will become a warm light. Two different lamps can have the same temperature but different color rendering index and lumen output.

Controlling the intensity of light along with the color temperature has a great application for the easiness in life. A smart lighting can be made by using the Zigbee wireless module. Figure 1 shows the smart lighting with Zigbee module. This module can be programmed such that the light changes its color, temperature or intensity according the surrounding or the mood.

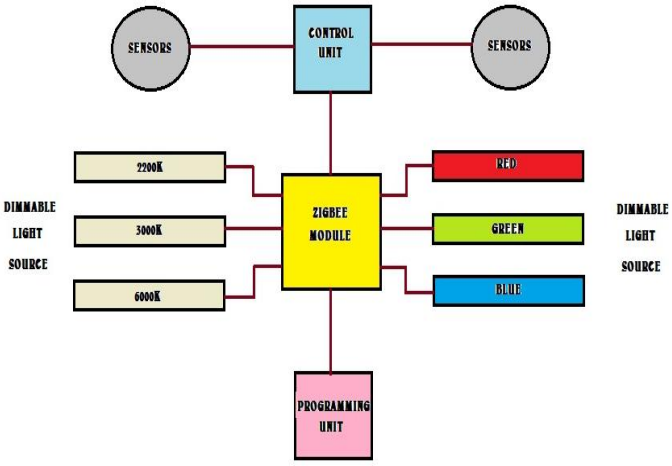

Figure 1: Smart Lighting

In the medical the same can be used to cure or recover a patient quickly from serious illness. Since daylight is a combination of sunlight and skylight, it is also possible to program the module to keep the lighting condition in the same way as in the nature outside. Thus it will provide a great easiness and comfort in the life style of people.

The color temperature of light is used in various applications like aqua culture, plant growth simulation, home automation etc. Cool color which has high color temperature is best for business atmosphere for increasing the concentration in work areas. A warmer light which have low color temperature is best for social atmosphere for promoting relaxation. The combination of cool and warm can be used to feel the warmth for a nice social working environment. Figure 2 shows the relation of color temperature and color effects. At those places where the temperature is cold, warm light is the best because it creates a feeling of warmth when coming indoors from outdoor. For hot temperature areas cool light will be best to create a feeling of cold.

Zigbee wireless technology uses the industrial protocol for controlling the lighting. The light can be dimmed for the required intensity and varied for required color temperature. More ever the color lights can be mixed up to create a combination of light color that looks both attractive and according to the mood required.

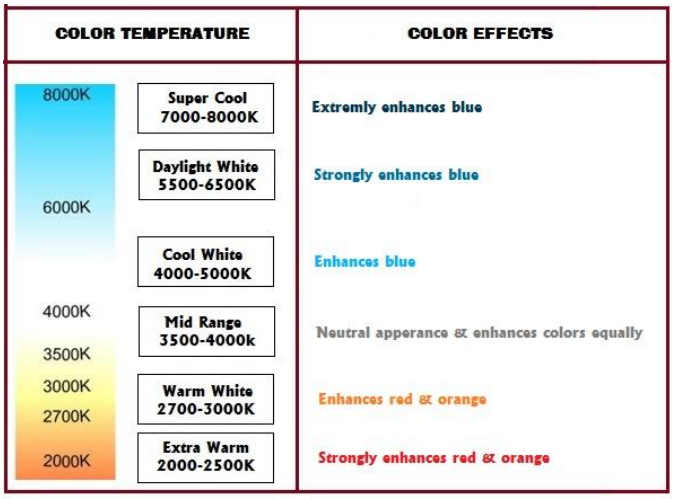

Figure 2: Color temperature and color effects

Lighting which is used normally doesn't deliver more efficient light and is comparably poor. The essential components of the lighting are the light quality, controlling method, sensing and color temperature combinations. To create an appropriate environment high quality light output is required. Smart lighting enables the light emitted to be of uniform quality in every aspect. A smart lighting technology involves

1) Light source with different colors and temperature.

2) Sensors and drivers.

3) Zigbee wireless modules

To determine proper lighting the things to be considered are the application, area size, intended use, height of ceiling or wall and type of fixtures. The right light is very necessary to boost up work and home environments. It will reduce eye strain, glare and increase productivity.

Smart lighting is formed when the lights connected are able to communicate with sensors and controlling units. The Kruithof curve shows the region of luminance levels and color temperature. It is used as a guide for designing lighting for living or working areas. Figure 3 shows the Kruithof curve.

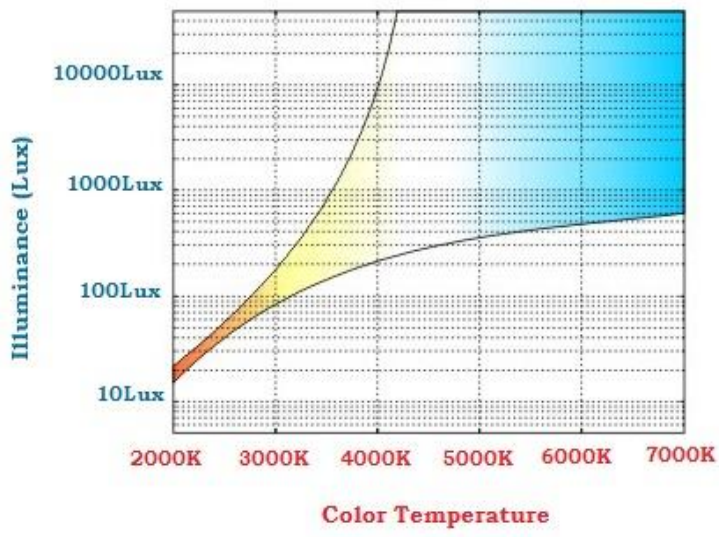

Figure 3: Kruithof Curve

Zigbee enabled sensors help to sense the amount of natural ambient light and adjust the light fixtures automatically. When there is enough ambient light from outer environment, the sensor activates the dimmer to dim the lighting down accordingly as needed. They can monitor the amount of incoming natural light and controls the lighting to be raised or lowered.

Lightings installed with Zigbee enabled motion detectors can be programmed automatically to turn on or off as the people enter or exit a building. Zigbee mesh network allows the network range to be extended to gain additional control of outdoor lighting systems. Zigbee sensors go to sleep mode when not being used to conserve energy, but can still respond within 15 milliseconds on receiving a signal to become active.

3. CONCLUSION: Smart lighting based technologies are the future of lighting. Controlling the light by using Zigbee wireless module to dim, change intensity or color temperature will automate a person's life. It can be used in medical or personal life to make an ease of living the life. When light is enabled by smart module, the sensing capability and combination of color temperature can be achieved easily. A real and natural lighting environment can be formed in the indoor, which increases the productivity, satisfaction and quality of life.

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