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INTELLIGENT ILLUMINATION SYSTEM TO PREVAIL OVER POSSIBLE DISEASES DUE TO OVER- AND UNDER-ILLUMINATION

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Abstract:

Researches have shown that lightening is responsible for one fourth of the energy consumption worldwide and case studies have shown that several forms of over illumination constitutes energy wastage, which is non-beneficial and increases during night. [1] Medical research on the effects of excessive light on the human body suggests that a variety of adverse health effects may be caused by light pollution or excessive light exposure, and some lighting design textbooks use human health as an explicit criterion for proper interior lighting [2] The Intelligent Illumination System (IIS) is the futuristic and most economic solution to come out of the predicament situation of the improper illumination. The present

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title manages the interior lightening actively considering all possibilities of weather changes, time shift and etc. The IIS system is flexible and is suitable for offices, malls, visiting centers, public or private libraries etc.

Index Terms:

Glare, Interior Lightening, Illumination Systems, IIS-Intelligent, Light Pollution

I. Introduction:

Specifically under illumination occurs when indoor light intensity falls below minimum threshold level. The minimum threshold level for indoor lightening system is around 320 lux. Over illumination is the concept where light intensity is available is more than the maximum threshold level. The maximum threshold level is around 700 lux. For comparison, mid day sun provides around 32,000 to 1, 00,000 lux, this assessment differs according to the latitude, time of the year and cloud cover. [3]

The terms: Light, health and energy conservation are interlinked. Production of Glare because of over illumination causes optical processing conflicts and confusion to the brain in processing optical inputs. A Glare is difficulty in seeing the bright light source which may be direct or even reflected from the source. [4] [5]

Over lightening causes light pollution-a term that describes inept, disagreeable and unnecessary use of artificial light. Scientific researches in the field of effect of excessive light on the human body suggest that numerous health problems are possible due to the light

pollution. And hence human health now becomes unambiguous criterion for interior lightening. Improper luminance causes headache, fatigue, stress, decrease in medical function, and increase in anxiety. [6][7][8]

Further, several published studies have interlinked the exposure to light at night and breast cancer, which is possible due to suppression of the normal production of melatonin. [9][10][11]

To come out of such shortcomings and to manage the power actively, the IIS system proposes a new way to operate the light sources so that luminance level can be maintained within the maximum and the minimum threshold level.

System is build around high speed, low power consumption devices, Programmable Gate Arrays. IIS considers different parameters as input to calculate the intensity required for the close room arena. It promises to consider internal and external temperature as well as internal and external light intensity to manage the threshold, and accordingly the lights are operated.

II. Atrophic Muscular Disease:

Atrophic Muscular disease is one of the eye diseases possible due to an improper illumination level. Over or under illumination level is the leading cause of the Atrophic Muscular Disease (AMD). Improper illumination level causes the degradation of the macula. Macula is the central part of the retina. It is responsible for fine and detailed central-visual task.

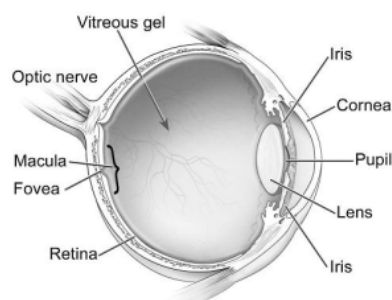


Fig.1: Eye/ Macula Details

Fig.1 depicts the details about the macula and other important sections of the eyes. In early stages of this disease it is difficult to diagnose. Fig.3 shows the vision after the AMD disease. When either of the eyes get this disease, it becomes more difficult to diagnose the AMD, because from the second eye, fine details of the incoming data can be easily decoded. [15]

III. IIS Implementation:

Fig.2 shows possible implementation of the IIS, considering the Library view. IIS consist of internal and external temperature sensor along with the internal and external light level sensor. Present view describes the entrance and separate exit between which different shells are arranged to create a view of Library, this implementation is equivalent to museum and bigger visiting center.

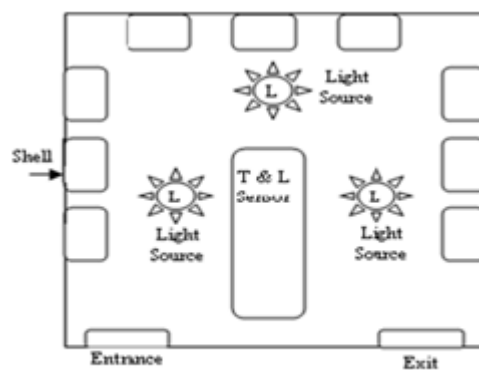


Fig.2: Library/ Museum View

The data produced from internal and external temperature sensor is used to uphold the essential speed of the fan. Light sensor is used to maintain the appropriate illumination inside the room or over certain prescribed area. Light source is basically array of white LEDs that can be operated, array by array, as per the level of intensity required.

IV. IIS Building blocks:

IIS can be best implemented around the High Computing Programmable Gate Arrays. Fig.3 shows projected building blocks for IIS around PGA. System can be realized using different platforms like Fuzzy Logic, Neural Network, advanced Computing and so on, out of this

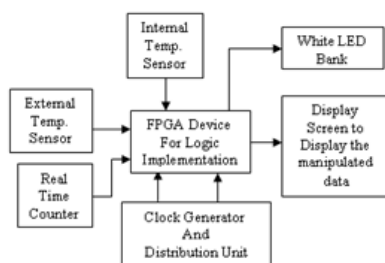


Fig.3: IIS Building Blocks

possibilities best suitable means is the VLSI platform. Because of startling features of this new trend that makes it most suitable for the said application.

VLSI platform supports range of devices that can be used but out of the supported range XC2S200 becomes best means because of the exceptional features like 16-bit LUT RAM, In-System Programming (ISP),

Boundary scan and Read back ability Fully 3.3V PCI compliant to 64 bits at 66 MHz and Card Bus compliant, Low-power segmented routing architecture, Dedicated carry logic for high-speed arithmetic, etc. [12]

V. Field Programmable Gate Arrays:

Field Programmable Gate Arrays (FPGA) is basically a collection of Configurable Logic Blocks also abbreviated as CLBs. It is programmable combinational structure which is use to implement any Sum of Product (SOP) or product of sum (POS) logical equations. FPGA is collection of CLBs. Each of the CLBs are configured according to the specific program

created by the user. For configuring the CLBs, special parallel programming techniques are used, like **Hardware Description Languages (HDL)**. Key element of the CLB is the Look-Up Table (LUT).

A. Look-Up Table:

Look-Up Table is the concept that is realized from the assembly Language Programming (ALP). In this concept the logic values that must be produced as a result, for specific combination of the inputs are determined and are stored. Whenever the predetermined input combination occurs respective output is produced.

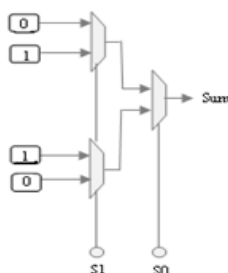


Fig.4: SUM output

This can be best implemented using universal device i.e. Multiplexer (Mux). Using Mux it is possible to realize any combinational circuit as well as any sequential circuit. Different device

vendors uses different platform to realize the LUT. 2:1 is the best choice for realizing any hardware. Fig.4 shows the possible LUT design for sum output of the half adder. [13]

For the first combination of $S1 = '0'$ and $S0 = '0'$. Upper mux of the first layer is selected ($S0 = '0'$) and first input of the upper mux is selected ($S1 = '0'$). As the first input is already tied to logic '0', sum output 0 is produced. Similarly remaining combinations are performed. Above example executes simple equation of XOR Gate. Similarly different SOP/POS expressions can be realized using LUTs.

B. Configurable Logic Blocks:

Using Look-Up Table concept it is possible to realize any logical expression. Whenever the application is to be realized using the concepts of Digital Logic Designs, the circuit may be purely combinational or it may be purely sequential or even combination of both. Using

concepts of LUTs, it is possible to realize any combinational circuit, but it is quite difficult to realize sequential circuit for that it is best suggested to use inbuilt flops. By using LUTs in combination with the flop it is possible to build any sequential circuit. [12][13]

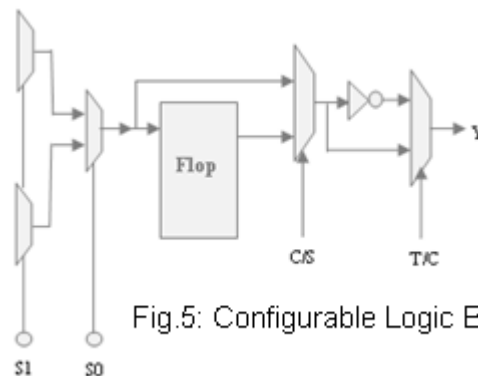


Fig.5: Configurable Logic Blocks

Fig.5 depicts the fundamental details about the configurable Logic Blocks. First part is of LUT and the second part is for flip-flop, both in conjunction constitute a CLB. Addition of further circuitry gives option for selection between pure combinational or sequential circuitry. This can be selected by adjusting bias at the pin C/S. when C/S = '0', circuit performs like pure combinational circuit else it will be use for sequential circuit. Similarly next flip-flop is used to have option to produce true or complement circuit. When T/C = '0', output is produced in complemented form else true output is produced.

VI. Sensor Unit:

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Sensor section is comprised of three sensors that are light sensor, temperature sensor and PIR sensor. All of these sensors are used in proper combination so as to produce appropriate controlling signals for internal light and the internal fan.

IIS uses temperature sensor in pair, one is placed outside of the room where luminance is to be maintain at apposite level. The second one is positioned inside the room. Based on the output of both the temperature sensors cooling level inside the room can be managed. For IIS placement of temperature sensor is optional, it is used for operating cooling system appropriately.

LM35 is the best option as compared to the other sensors available like thermocouple and etc. it provides output voltage in linear proportional to the input temperature in Celsius. Apart from this, it doesn't require any external calibration or trimming circuitry and it maintains accuracy of ± 0.4 °C.

Similar to the temperature sensor, light sensors are also arranged, one outside of the room and second one inside the room to manage the light intensity. Outer light sensor is used to detect the outer luminance. This is also required to find day or night time. For the internal light sensor different threshold levels are predetermined based on the values of inner and outer threshold levels lights are operated in parts.

Unit of PIR sensors are used to create an arena under surveillance. This is a responsive area where PIR sensor tracks even a small movement of the human being. Passive Infra-Red sensors are infrared transmitter and receiver, which continuously transmits infrared frequency around and receiver section monitors for any response.

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PIR GH-718 is the best option, in which, amount of infrared striking the receiver element change the voltage generated, which can be measured by an on-board available amplifier. This sensor is equipped with the Fresnel lens, which focuses the infrared signals onto the receiver element. As the ambient infrared signal changes rapidly, the output amplifier trips the output to indicate motion.

VII. Luminance Control Section:

While working with aspire of generating luminance between maximum and minimum threshold to avoid over and under illumination and for increasing system performance with minimum power utilization white LED is the best choice. White LEDs require less operating current and voltage levels and becomes better light source when they are operated in group. [14]

White LEDs are used in groups. To increase efficiency they are operated in array. According to the output of the internal and external light sensor output LED arrays are operated.

Very initially, output of external Light sensors is considered to determine the light intensity level available outside of the arena under surveillance. In conjunction with this output of the inner sensor is evaluated. If light natural light is enough, all five arrays remains off. As the darkness increases, one by one, array is operated and in case of full darkness all five LED arrays are operated.

VII. IIS Operation:

Considering an arena under surveillance as library or museum, three white LED array panels are arranged as shown in figure 3. Number of white LED array panels to be use can be increased or decreased as per the illumination level required. Each of the white LED array

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panel is equipped with PIR sensor module, which detects movement under the specific arena under its coverage.

Whenever, IIS come to operating end as a default, one array from each of the panels remains on to maintain minimum visibility inside the room. When person enters the surveillance arena first depending upon the output of the internal and external light sensors number of array of the first white LED panel is operated. As individual moves towards the next panel PIR sensor of that respective panel detects the movement and number of arrays of the middle panel operated, at the same moment the previous panel status comes to a default state with only one array being operated.

Similarly number of white LED panels is operated inside the considered arena. IIS system is also fully suitable for companies, workstations, houses, etc.

Number of white LED panels to be used depends upon the important factors like: arena under surveillance, level of illumination to be maintain, average group of the visitors to the considered arena, climatic conditions, etc.

VIII. Observations:

```
case state is
when 0 =>
if"00000000"<left_adcandleft_adc<"00100000" then
    ldr_left <= "0000";
    state <= 0;
else
```

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```
state <= 1;
end if;
when 1 =>
if"00100000"<left_adcand left_adc< "01000000"      then
    ldr_left <= "1000";
    state <= 0;
else
    state <= 2;
end if;
when 2 =>
if"01000000"<left_adcandleft_adc < "10000000"  then
    ldr_left <= "1100";
    state <= 0;
else
    state <= 3;
end if;
when 3 =>
if"10000000"<left_adcandleft_adc<"11000000"  then
    ldr_left <= "1110";
    state <= 0;
else
    ldr_left <= "1111";
    state <= 0;
end if;
end case;
```

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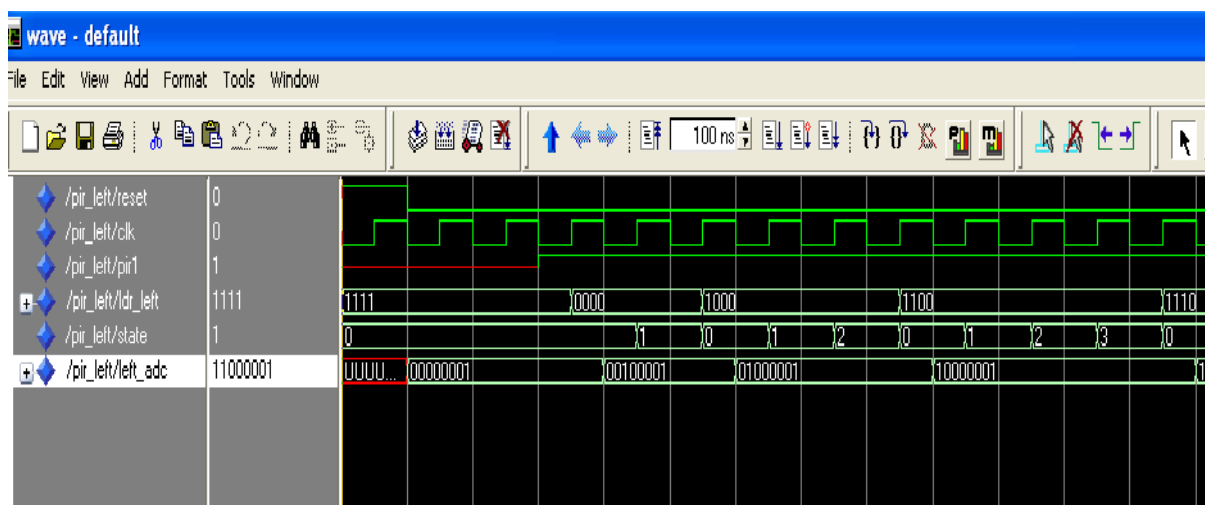


Fig.6: White Panel Operation.

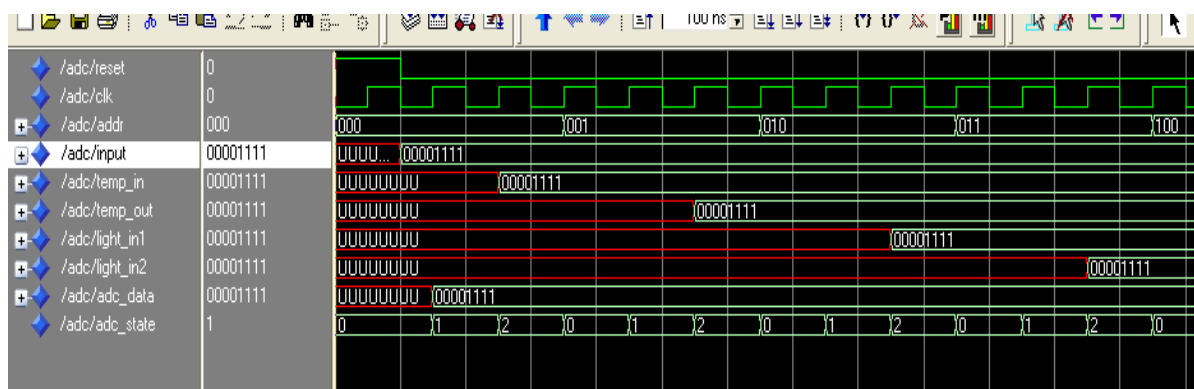


Fig.7: Device Selection Using ADC

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IX. Conclusion:

Intelligent Illumination System to Prevail over Possible Diseases Due to Over- and Under-Illumination is the innovative concept that actively operates bank of white LED panels to maintain illumination level, inside the arena under surveillance, within maximum and minimum threshold level to steer clear of over or under illumination.

From the discussion it is clear that there are many possible diseases which may occur due usual day to day improper or unadjusted lightening systems. The proposed system is the solution to the loop-hole. IIS promises to adjust the light intensity automatically according to possible age group of the visitors, climatic conditions, illumination level to be maintained and type of the arena under surveillance.

As the proposed IIS system considers all the possibilities to maintain proper illumination level it is possible to prevail over the possible diseases due to over and under illumination.

Further it can be stated that, IIS operates one panel at a time, and even array by array by considering different possibilities and hence it is also a solution to green computing techniques. IIS promises to save at least 35% of total energy.

X. Acknowledgement:

We are appreciative to **Dr. Mrs. Anuradha Totey, Ophthalmologist, Amravati** for her valuable guidance and practical inputs on effects of improper luminance on human body.

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XII. Author Information:

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