Auto Luminance Control System for Airports

Bhavya S Parekh, Sejal A Jadhav, Priti A Mane
Electronics and Telecommunication
Shree L.R. Tiwari College of Engineering
Thane, India

***Abstract*—Global warming and its effects have gained wide attention all over the world. One of the major contributors of global warming are industries and power plants. The fuels used by power plants for generation of electricity gives rise to greenhouse gases. With few available options to combat the problems of greenhouse effect, they may vary from either changing the fuel used by power plant or reducing the power consumption. None of them being practically feasible except one of them, which is to variably control the power consumption by the output devices. The proposed idea is an attempt in managing power resources on airports by smartly switching the luminance level of the light emitting devices, where the required luminance level meets the pre-defined standards for saving power factor on a large scale. Since the airports are laid on acres of lands there power consumptions values in kilowatts and the main power consuming devices are the light emitting devices. Keeping in mind the minimum visibility range of a human eye the luminance level of these devices can be controlled which can help in reducing the power consumption by the devices drastically. The concerns about global warming and the meager availability of the conventional resources are rising continuously. Implementation of this idea might be the answer!**

Keywords—Global warming, Power Plants, Fuels, Power Consumption, Airports, Luminance Level, Visibility Range.

I. INTRODUCTION

Energy conservation is the most concerned topic. Consumption of conventional resources is increasing day by day leading to global warming. It directly or indirectly affects the living beings. To overcome this problem, there is a need of an technology which can reduce the use of these resources. This paper gives broad idea on an embedded system for power saving on airports. The airport covers the largest area that consumes power in kilowatts. The idea implements auto brightness control, which switches the voltage level of the device according to the required brightness level using light dependent register and ATMEGA16 controller resulting in power conservation.

There is a chance that the electronic devices used in the airport system may get damaged due to overloading, surges, lightning. The idea also has overload and short circuit protection circuit which will switch off the power supply in case of faulty condition. On the airport the brightness level of runway is controlled manually. Sometime there is requirement of low brightness level but due to manual handling if the voltage level is set to high level, it will result in loss of power. In order to overcome this problem automation of luminance level is implemented.

II. BLOCK DAIGRAM

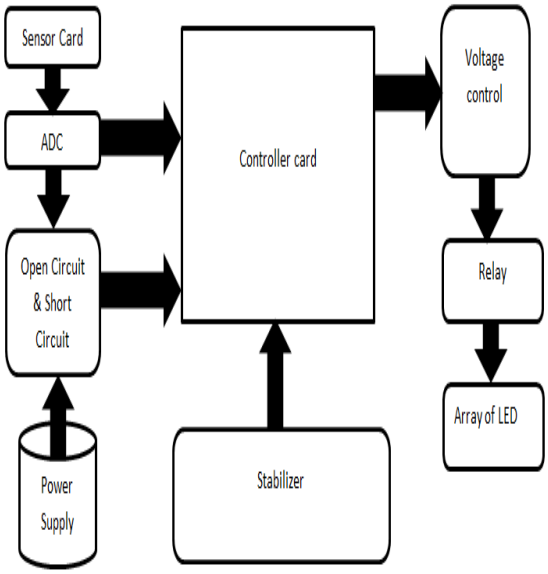

Fig. 1

The block diagram consists of the following blocks:

- Sensor card
- ADC (Analog to digital converter)
- Open circuit and Short circuit card
- Power supply
- Controller card
- Stabilizer
- Voltage control card
- Relays
- Array of LEDs

1) Sensor Card

The sensor card comprises of LDRs connected in series that helps to sense the environmental brightness. It not only helps in sensing the environmental brightness but also converts the brightness into an equivalent electronic signal which can further used by other blocks for processing.

2) ADC

ADC means analog to digital converter, that is it helps in digitization of analog signal. The signal gets digitized into a digital signal having its amplitude equivalent to the baseband

analog signal where the level of the digital signal depends on the +Vref and –Vref supplied to the IC

3) Open circuit and Short circuit card

The open circuit card and the short circuit card helps protect the circuit from over voltage short circuiting and loading effect.

4) Power Supply card

Power supply card acts as the main power source to the circuitry. It helps convert the AC supply into regulated controlled supply. It also acts as an isolator between the power source and the main circuitry.

5) Controller card

The controller card is the main heart of the circuit. It controls all the processes and decides the working of the circuitry. This card takes in the digital signal processes it as programmed by the programmer and gives it as output on the output port.

6) Relays and Array of LEDs

Relays are controlled switch which stays turned on until an excitation is available on its coil. The main purpose of relays being used in circuit is as a latching device [1] that latches the potential divider bias circuit with the array of LEDs on the command from processor.

The array of LEDs acts as an output device in the circuitry which helps in achieving the main goal of the design. The array of LEDs are used as light emitting device whose luminance level is controlled by the processor by controlling the power supplied to the array which is indirectly achieved by varying the voltage across the array using relays.

III. FLOW CHART

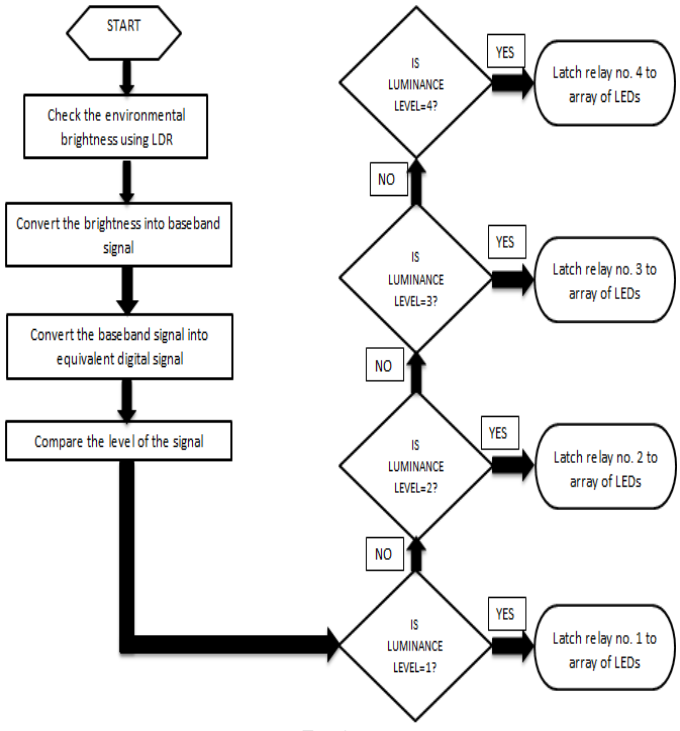

Fig. 2

Figure 2 depicts the flow chart where the flow graph starts with LDRs, which act as the sensors and helps in converting brightness into baseband signal. It is followed by ADC where the measured brightness is converted into digital signal. ADC is followed by processor which is the main decision taker. Here the processor compares the level of the brightness with predefined standards and accordingly latches the relays connected at the output port.

IV. WORKING PRINCIPLE

The main working principle of the circuit is based on comparison, conversion, and switching. In the very first stage the circuit senses the environmental brightness using LDR. As soon as it senses environmental brightness it converts the brightness into an electronic signal [2] using LDR. Since the resistivity of LDR is inversely proportional to the brightness, the voltage across LDR is directly proportional to the intensity of light focused on it. Keeping in mind the same fact the complete designing of the circuit is achieved. So as soon as the light is focused on the LDRs an equivalent signal is generated. The equivalent signal is then digitized using the inbuilt ADC. The signal is digitized since the processor can process data only in digital format.

Digitization of signal not only helps the processor to access the data easily but also helps in knowing the light intensity of the environment directly. After the signal is digitized, the level of the digital signal [3] is compared with values 2, 3 and 4 which consist of pre-defined brightness levels [4]. Depending on the comparison the level of the signal is decided and accordingly the corresponding relay is latched. There are 4 relays connected to 4 different voltage levels. The relay that is being latched provides a voltage value that is directly proportional to the intensity level of the light measured, because the visibility of the light emitted by device detoriates as the environmental light being focused on it increases, that is if the level of the environmental brightness is maximum then the brightness level of the device should also be set to the maximum level. This is achieved by the implementation of the described design. So for example say the brightness intensity measured is equal to 3.5 after the analog signal measured using LDR is digitized, then on comparing it with 5, 4, 3, 2 it is concluded by the processor that the value compared is equal to 4 and accordingly relay number 3 is latched on. This process keeps on repeating at a specified interval. Thus the luminance level of the output device is set according to environmental brightness [6] and the optimization of power consumption is achieved.

V. ADVANTAGES

- Reduces human error in selection of luminance level
- Makes optimum use of power supply.

VI. APPLICATIONS

- Runway indicator luminance automation.
- Airport`s luminance automation.
- Street light control.
- Home automation.
- Auto brightness control systems in mobile phones.

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