

Arduino Based: Smart Light Control System

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Abstract— This world is full of different kind of light sources some are natural ones while others are man-made light sources. The man-made light sources have only two modes of operation that is switch on and switch off there is no intermediate level that can be set according to the surrounding lighting condition and at the end everything needs to be controlled manually. These lead to wastage of electricity and at the same time a manual control is not effective in the modern era. In this paper, we purpose an advanced light control system which is capable of replacing the old generation light control system. The system is implemented on an embedded platform & is equipped with a photo sensitive detector (LDR) which gives the required input for operation .The working of our light control system is based on the amount of luminous energy in the environment at that moment of time. Depending upon the light intensity at that instant the lighting of the lighting system is adjusted. The embedded main board including the Microcontroller chip, memory (flash), and communication port are used as a processing module for the input that we get from peripheral devices (LDR).Application of such a system can be implemented in workstations, park lights, street lighting system, head lights of automobiles and much more.

Keywords—Arduino Uno, LDR, Relay, Lighting Units Arduino Programming, Automatic Control, Energy Efficient

INTRODUCTION

We are living in the world where everything goes to be automatic from your washing machine to your ceiling fan. The world revolves around the word automation and the ones that are automated are said to be of next generation because they limit the involvement of humans. They are self-sufficient to operate on their own and thereby, saving time and cost by being more efficient than the manual ones. But lighting systems have yet to make its move in these automated crusade. We have just started the crusade in our attempt here.

The main objective of this project is to implement an auto-intensity control of LED-based on LDR which is interfaced to an Arduino board. As the surrounding light decreases slowly from evening to night, the light intensity gradually increases and then gets gradually decreased from night to early dawn hence saves energy .Thus, the lights switch on at the dusk and light intensity increases till midnight and regressively decrease till dawn and then finally switch off automatically. The process repeats every day. As stated earlier, application includes: park lights, street lights, head light in automobile and many unexplored options. Relay is used to provide isolation between Arduino and 220 volt AC supply.

The goal is to reduce the amount of energy consumed and thereby reducing the cost incurred due to energy loss thus proving to be a cost-effective strategy.

LITERATURE REVIEW

Controlling lighting system by means of LDR and Arduino together is relatively a new concept. After going through many research papers which were related to field of lighting system, I found that there are papers only about street light system and that too most of them are Passive Infrared receiver based and few are LDR based but they are controlled by means of timers and analog circuits. Some were controlled by wireless GSM/GUI networks .That being said they are no papers which coin all the lighting system under one umbrella and use LDR and Arduino system as their fundamental architecture to control it.

Ancient Lighting system have been confined to two options on and off, due to it had their own share of disadvantage. This kind of operation meant energy loss due to continuous operation at maximum voltage though actual requirement might be less depending upon the outside lighting condition. The simplest solution to it is by calibrating the lights according to the outside lighting condition. This is what we are aiming for in our smart lighting system.

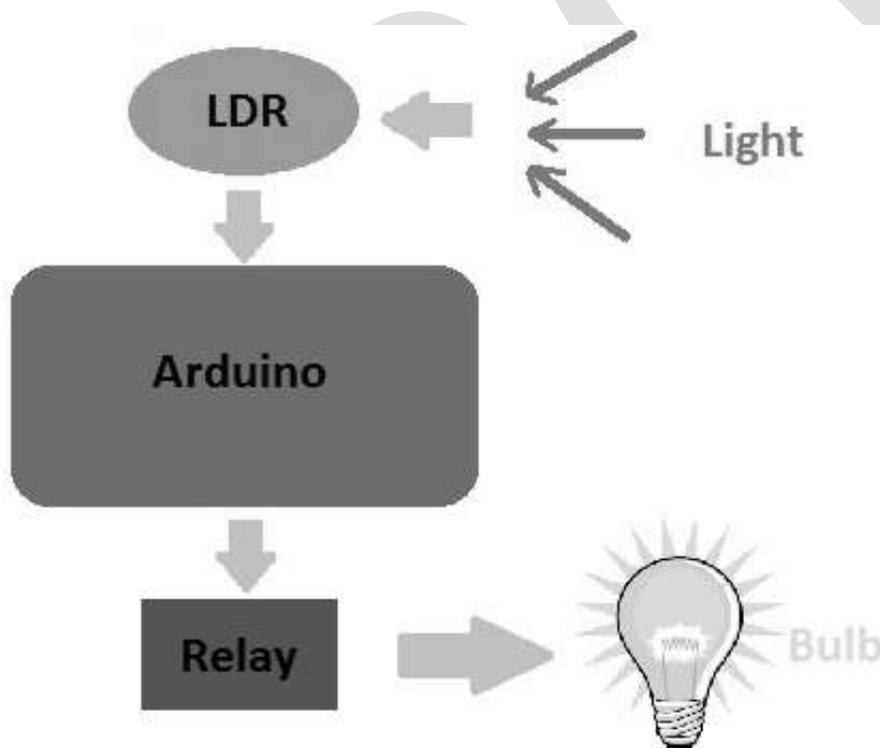
PROPOSED SYSTEM

As stated earlier our main objective is to provide an efficient & energy saving lighting system by evaluating the outside lighting condition and then adjusting the lights accordingly. The circuit mainly consists of a sensing element known as LDR, which is followed by processing unit Arduino which takes input for sensing element and gives its output to the LEDs (lighting units). Though other units like relays, transistors are also be used for higher voltage supply.

The LDR senses the light and sends the data to Arduino. The Arduino analyse the data and gives its response to the LEDs through the relay mechanism. The Arduino is programmed in such a way it automatically adjusts the lights to give most accurate result possible.

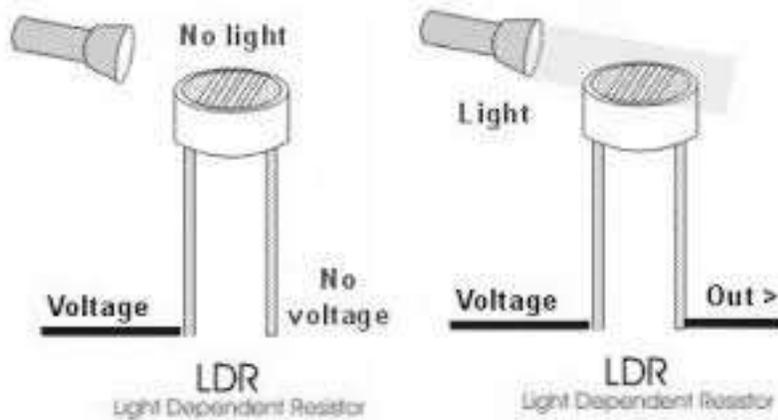
ARCHITECHTURE DESIGN

The pictorial representation of our model is given below:



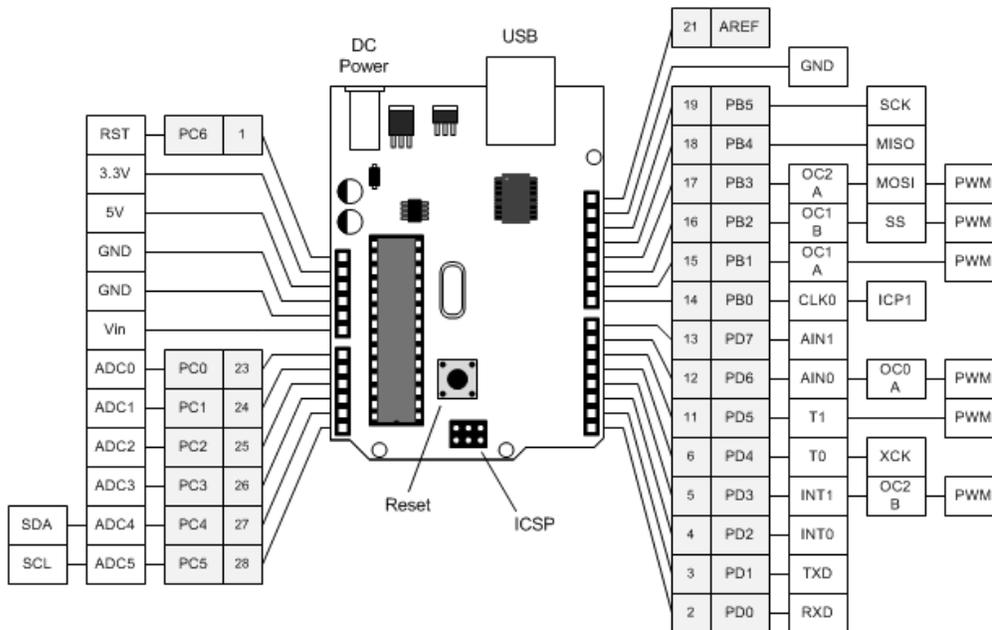
CIRCUIT COMPONENTS:

- 1) LIGHT DEPENDENT RESISTOR (LDR) SENSOR



Light Dependent Resistor as the name suggest the resistance is dependent upon the light incident on it. The light dependent resistor resistance changes with intensity of light, with increase in light intensity the resistance offered by the sensor decreases and with decrease in light intensity the resistance offered by the sensor increases. Hence it acts as variable resistor with change in light intensity. These helps in finding the amount of light intensity at that instant of time and thus helping in regulating the lighting of our lighting system accordingly.

2) ARDUINO UNO



Arduino is an open-source physical platform based on microcontroller board having the ATmega32 series controllers and Integrated Development Environment for writing and uploading codes to the microcontroller. It has input and output pins for interaction with the outside world such as with sensors, switches, motors and so on. To be precise it has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller .It can take supply through USB or we can power it with an AC-to-DC adapter or a battery Arduino acts as the processing module of the

system. It takes input from the LDR, process the data and gives the output to LEDS directly or through a relay and a transistor mechanism

3) LEDS

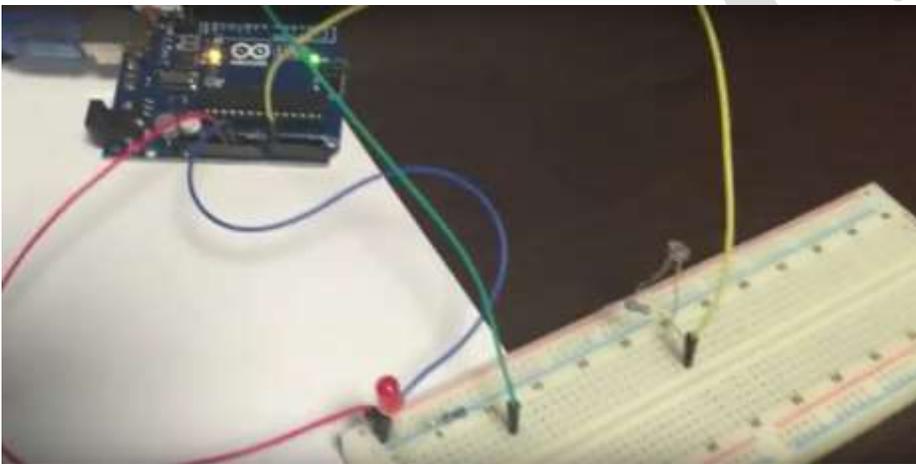
A light-emitting diode (LED) is a pn junction diode, which emits light when activated. When we apply voltage across its leads, electrons are able to recombine with holes within the LED, releasing energy in the form of photons which gives the light. Hence, it is a two-lead semiconductor light source

Light emitting diodes represents our lighting system and the amount of light emitted by it is directly related to the amount of light in the environment that is when outside light is less than the light given by LEDS is more and visa-versa.

RELAY

In this project whenever high voltage supply has to be used then relay is used to provide isolation between low voltage circuitry and high voltage circuitry. Arduino is also used to provide control signal to relay whenever intensity of light falls below a certain level. Control signal generated from pin 13 of Arduino which is used as an output pin was given to relay which is finally given to the lights.

WORKING PRINCIPLE

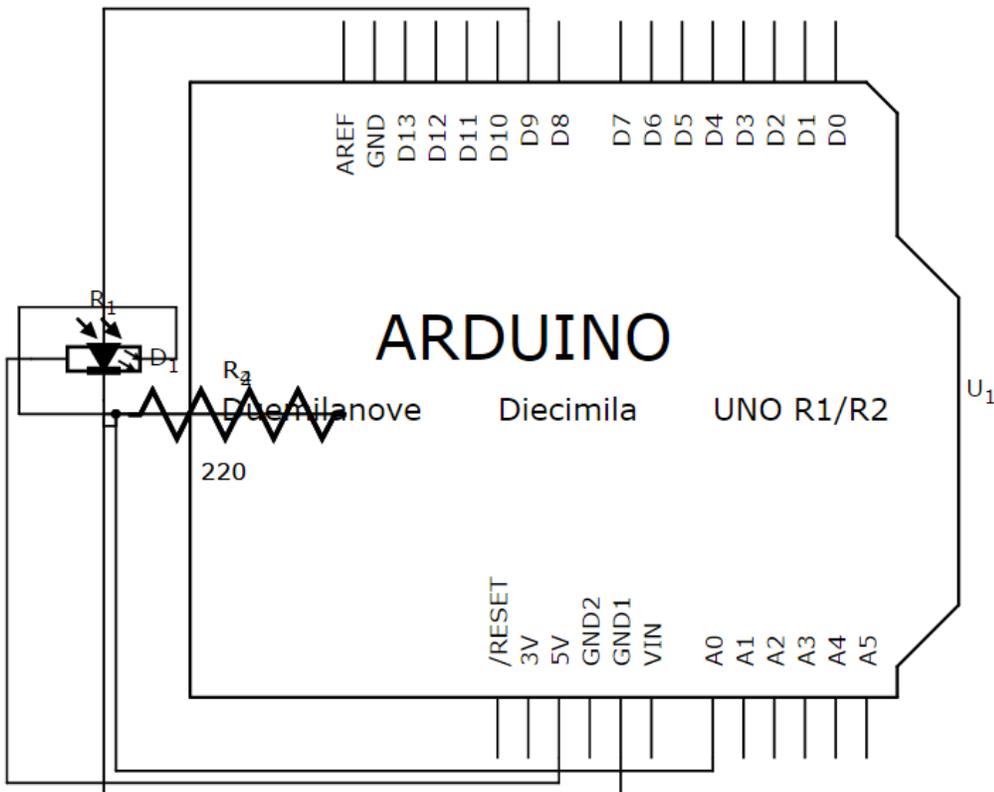


The working of our model is very simple. The supply is given through the power jack. From the Arduino we take 5v supply and connect it to one of the terminal of photo resistor and other end is connected to a resistor of 10k which acts as a voltage divider and then final connected to ground. The output is given by output pin 13 of the Arduino which is connected to the led through a 220ohm resistor. The other end of LED is perfectly grounded. As this is a working porotype here, we haven't shown the usage of relays but if required they can be connected just before the lights (LEDS) for isolation purposes.

The LDR senses the amount of light in the atmosphere at that moment of time and accordingly sends the data is to Arduino .The Arduino converts the data received into various discrete levels .For example from 0 to 1023 discrete levels for a given data then 0 represents maximum darkness and 1023 represents maximum brightest so light is received is converted into one of the discrete value from 0 to 1023.Now depending upon the discrete value that we get (0 to 1023) we adjust the output voltage accordingly from 0 to 5v.So,when complete darkness (night time)that is discrete level 0 than the output is 5v as a result LED is brightest or when partially dark(dawn/evening) that is discrete level of 512 then the output is 2.5 v as a result LED is half of the maximum brightest or when completely bright that is discrete level 1023 then the output voltage is 0v as a result LED switched off. Thus, the LED not only just automatically switches on and off but also adjust the amount of light emitted according to the outside condition. The usage of such kind of application in the headlights of cars, park lights, street lights is very useful.

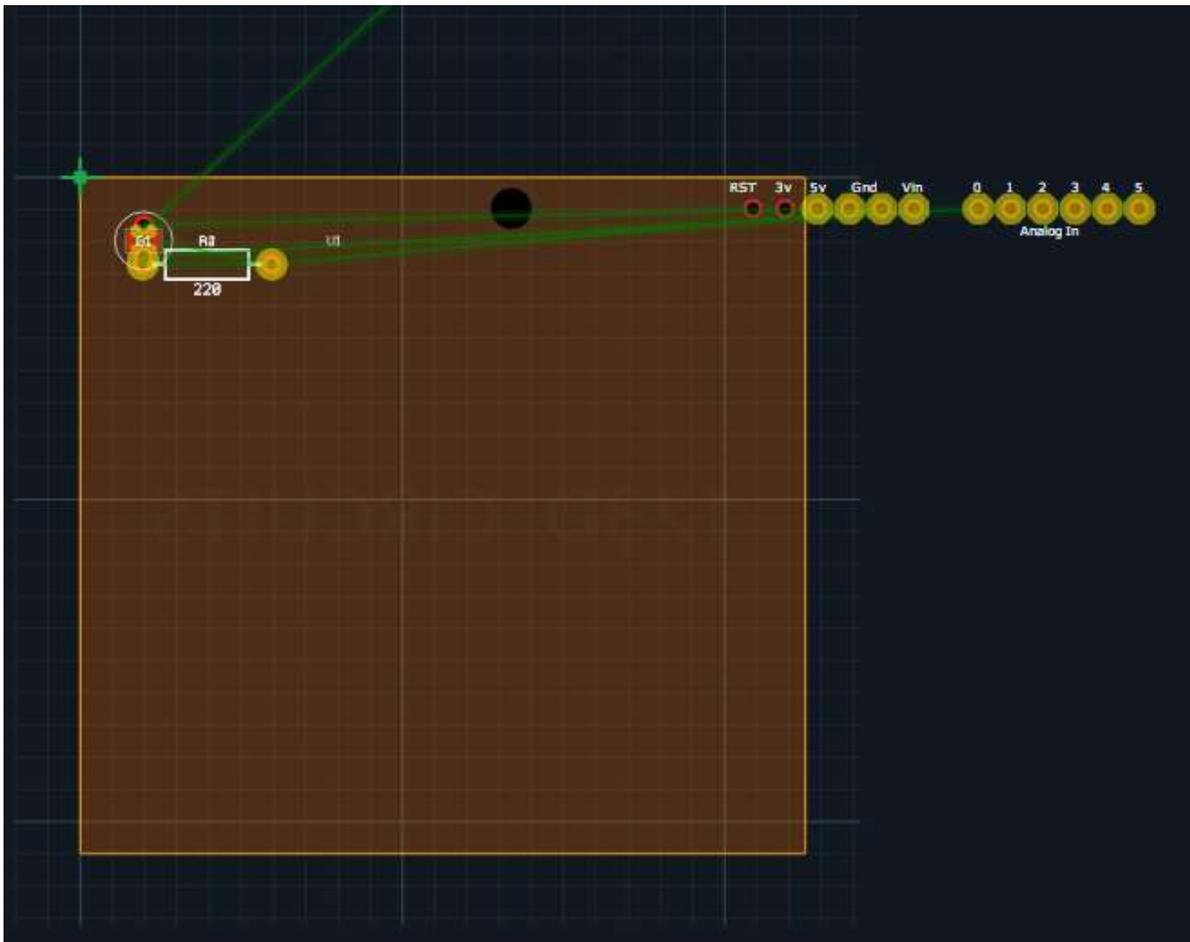
SCHEMATICS VIEW:

The schematic diagram of the smart lighting system is given below:



PCB VIEW:

The PCB diagram of the smart lighting system is given below:



The relays and transistors are externally connected and are not given in the above views as it is only required when with a higher AC voltage supply is used as a supply. These can be used in the case of street lighting and park lighting system where isolation is important for safety.

CONCLUSION

This Arduino based project will provide a competent method for lighting systems and make the whole process of energy saving easier and efficient. With a capability to change the amount of light emitted depending upon the outside condition is no doubt an innovation with many future application apart from the fact that it can also be used in many present day tech such as head lights, street light, park lights, industrial lights and many more. The usage of the smart lighting system will undoubtedly change the world that we see today.

REFERENCES:

- [1] Wang Xiao-Yuan, Andrew L. Fitch, Herbert H. C. Iu, Victor Sreeram and Qi Wei-Gui "Implementation of an analogue model of a memristor based on a light-dependent resistor" 2012 Chinese Physical Society and IOP Publishing Ltd Chinese Physics B, Volume 21, Number 10

- [2] A.A.Nippun Kumaar, Kiran.G, Sudarshan TSB, " Intelligent Lighting System Using Wireless Sensor Networks", International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC) Vol.1, No.4, December 2010, pp 17-27
- [3] Y. K. Tan; T. P. Huynh; Z. Wang, " Smart Personal Sensor Network Control for Energy Saving in DC Grid Powered LED Lighting System", IEEE Trans. Smart Grid
- [4] O'Reilly, Fergus, and Joe Buckley. "Use of wireless sensor networks for fluorescent lighting control with daylight substitution." Proceedings of the Workshop on Real-World Wireless Sensor Networks (REANWSN). 2005.
- [5] Divya, Guddeti, et al. "Design and Implement of Wireless Sensor Street Light Control and Monitoring Strategy along with GUI." IJITR (2016): 78-81.
- [6] Prasetyo, William Tandy, Petrus Santoso, and Resmana Lim. "Adaptive Cars Headlamps System with Image Processing and Lighting Angle Control." Proceedings of Second International Conference on Electrical Systems, Technology and Information 2015 (ICESTI 2015). Springer Singapore, 2016.
- [7] Qi, Liang, MengChu Zhou, and WenJing Luan. "Emergency Traffic-Light Control System Design for Intersections Subject to Accidents." (2016).
- [8] Huynh, T. P., Y. K. Tan, and K. J. Tseng. "Energy-aware wireless sensor network with ambient intelligence for smart LED lighting system control." IECON 2011-37th Annual Conference on IEEE Industrial Electronics Society. IEEE, 2011.
- [9] Subramanyam, B. K., K. Bhaskar Reddy, and P. Ajay Kumar Reddy. "Design and development of intelligent Wireless Street light control and monitoring system along with GUI." International Journal of Engineering Research and Applications (IJERA) Vol 3 (2013): 2115-2119.
- [10] Fitch, Andrew Lewis, et al. "Realization of an analog model of memristor based on light dependent resistor." Circuits and Systems (ISCAS), 2012 IEEE International Symposium on. IEEE, 2012.
- [11] Tran, Duong, and Yen Kheng Tan. "Sensorless illumination control of a networked LED-lighting system using feedforward neural network." Industrial Electronics, IEEE Transactions on 61.4 (2014): 2113-2121.
- [12] Kim, Sangil, et al. "Design of lighting Fluorescent lamp and AC LED control board using MCU." Journal of the The Korean Institute of Power Electronics (2010): 252-253.
- [13] Song, Sang-bin, Woo-young Cheon, and Young-^ㄹ. Yu. "Design of a LED lighting bar replacement neon sign." Journal of the Korean Institute of Electrical Engineers (2006): 1671-1672.
- [14] Tran, Duong, and Yen Kheng Tan. "Sensorless illumination control of a networked LED-lighting system using feedforward neural network." Industrial Electronics, IEEE Transactions on 61.4 (2014): 2113-2121.