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Automatic Switching System for Streetlights

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Abstract: Street lighting systems contribute significantly to the power consumption by public systems in urban and semi-urban localities. The current paper examines various switching schemes to optimally switch on and switch off street lights according to the level of ambient darkness in a locality. The paper proposes a simple, cost-optimal automatic switching scheme for street lights using LDRs and 555 timer ICs. The scheme implements smart switching of street lights without investing in expensive controllers.

Keywords: Street Lighting, Automatic Switching, Cost-Optimal, LDR, 555 Timer, Smart Switching

I. INTRODUCTION

The automatic control of street lighting systems is a current area of research for scholars of diverse fields, from urban planning to electronics and computing. The topic has gained relevance during the past few years due to the thrust on research into the planning and development of smart cities. Automatic control allows for near-optimal use of street lights in a manner that decreases energy consumption and prolongs the active lifetime of the streetlights.

The current paper deals with the proposal of an efficient and cost-effective method of switching control of street lights. Section II surveys some of the recent and relevant literature in the domain of automatic control of street lights. Section III describes the control scheme proposed in this paper. Section IV concludes the paper with a discussion on the scope for further research in this domain.

II. LITERATURE SURVEY

Automatic street light controls have been tested for distributed systems connected by wireless networks, to allow remote monitoring and switching [1]. Researchers have also proposed intelligent system based schemes for similar purposes [2]. Cloud based systems for higher speed and more reliable connectivity have also been investigated by researchers [3]. Hybrid systems powered by solar photovoltaics have also been proposed by some researchers to further the end of renewable energy generation and consumption [4]. Energy efficiency has been the goal of multiple researchers investigating in this particular domain [5][6]. Real-time control has also been proposed as a solution to optimize the duration for which street lights remain on in a particular area [7]. It has also been suggested by researchers that the level of artificial intelligence possessed by the controllers may determine the efficacy of the proposed solutions [8][9]. Other researchers have recognized the fact that smart street lights would require more expensive processors to b more optimally effective, and hence have tried to implement solutions using FPGAs [10].

The essential problem in the solutions proposed by various researchers is the high cost involved in the implementation of their proposed solutions, which the current paper aims to address through the proposed system discussed in the following section.

III. PROPOSED SYSTEM

Darkness Detector or Dark Detector is a circuit that detects darkness or absence of light. In this paper, the researchers have proposed a simple Darkness Detector Circuit using the simplest of all light sensors: the LDR (Light Dependent Resistor). The system consists of LDR, 555 timer, voltage regulator and some passive components. The proposed system is shown below. The knob of the pot is to be adjusted so that the LED stops glowing at normal surrounding light intensity. We have designed a voltage divider using the LDR and 10 K resistor given in the diagram. When light falls on the LDR then its resistance decreases which results in increase of the voltage at pin 2 of the IC 555. IC 555 has got comparator inbuilt, which compares between the input voltage from pin2 and 1/3rd of the power supply voltage. When input falls below 1/3rd then output is set high otherwise it is set low.

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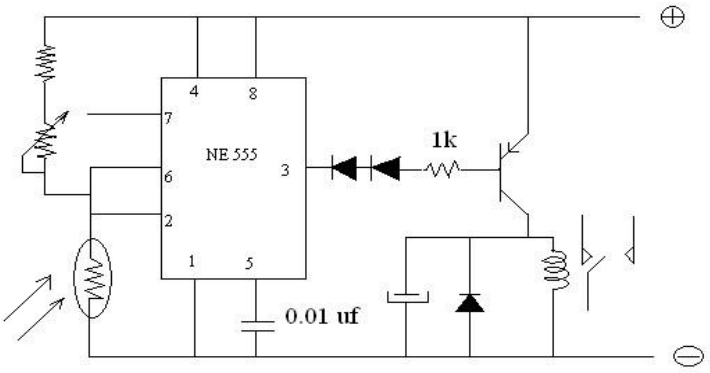

Figure 1: Proposed primary sensor circuit

Since in brightness, input voltage rises so we obtain no positive voltage at output of pin 3 to drive relay or LED, besides in poor light condition we get output to energize. This circuit needs to be connected to a regulated power supply designed using a step-down transformer and voltage regulator IC. The corresponding circuit is shown in figure 2 below.

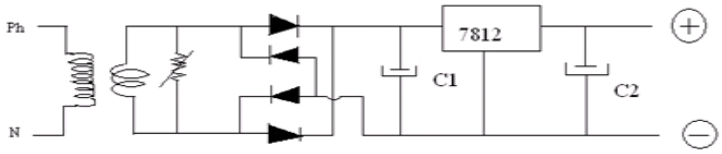

Figure 2: Regulator circuit

The advantage of the proposed system is its simplicity and low cost. Additionally, it is easier to repair or replace the required components of the system in the advent of a failure or burnout, and the low cost of such a circuit makes it a good alternative to more expensive smart systems.

IV. CONCLUSION

The current work accomplished in this paper comprised of the review of existing automatic switching systems for street lights and the proposal of a cheap, simple and robust alternative to typical controller-based automatic control systems. A future work in this direction may be the connectivity of such systems using microwave relays and a central controller circuit. The presence of a central controller is bound to enhance the capacity of the system and can allow the designers to implement basic machine learning for distributed control through learning of typical patterns as well as prediction of variations from such patterns, allowing lights to be turned off or switched on in a semi-intuitive fashion, further lowering the power consumption of the proposed system.

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