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# Design of a Microcontroller Based Alarm Enabled Dark Activated Switch

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***Abstract:*** ***The aim of this work was to design an automatic Dark activated switch with an alarm. PIC16F1507 microcontroller was used as the main decision maker for the light and the alarm control of the system. However, the microcontroller was driven by the program code written in Mikro-C programming language. The dark activated switch activated an electrical device based on the level of light the switch is exposed to. The switch responds to the change of light level illuminated on a light dependent resistor (LDR) which triggers an onboard relay to activate the device.***

***Keywords:*** **Alarm, Dark Activated Switch, Light Dependent Resistor, Microcontroller, Relay**

## I. INTRODUCTION

Light consists of discrete packets of energy called photons thus the energy contained in a photon depends on the frequency of light. Essentially, optical detectors are devices used to convert optical energy or light into electrical energy [1]. The automatic light activated switch will use a photoconductive cell as its optical detector. Its resistance will decrease when light falls on it and increase with darkness. It is applicable in light night control, street light control etc [2]. Whenever the sun goes down, many people are gripped with fear. The fear of being robbed even in the early hours of the night will make people leave their work stations early just to save their lives and property. Thus in the major busy towns and other small trading centers, the need for security lights is crucial. Such security lights will be installed in residential areas for safety purposes [3]. Therefore vices and other incidents that occur at night are curbed completely from the society [4]. The automatic light activated switch refers to a circuit that employs a photo detector/Light Dependent Resistor that senses the amount of light intensity. It will automatically switch ON or OFF the lamps depending with the amount of light intensity [4]. The aim of this research is to design an Automatic light activated switch and alarm using PIC microcontroller as the controller within circuit.

- **Microcontroller**

A microcontroller is a single-chip microprocessor system that contains data and program Memory, serial and parallel input–output, timers, and external and internal interrupts, all Integrated into a single chip. Microcontroller applications are electronic calculators, remote controls, digital clocks, washing machines, security system etc. [5].

- **Light Emitting Diode (LED)**

Figure 1 displays the diagram of a Light Emitting Diode, the flat bottom surfaces of the anvil and post embedded inside the epoxy act as anchors, to prevent the conductors from being forcefully pulled out from mechanical strain. A modern retorting LED light "bulb" shape, complete with aluminum heat sink, light diffusing dome and E27 screw for using a built-in power supply working on phosphor coating to mix yellow down converted light with blue to produce light that appears white [6]. The development of LED technology has caused their efficiency and light output to rise, with a doubling occurring approximately every 36 months since the 1960s, in a way similar to Moore's law. This trend is generally attributed to the parallel development of other semiconductor technologies and advances in optics and material science [7].

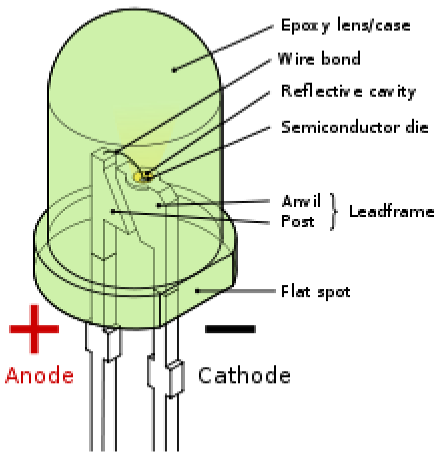


**Fig 1: LED**

- ***The System Clock***

System Clock to PIC16F1507 can be provided internally or externally to the Microcontroller. External Clock is often useful when a range of application is needed to be synchronized or real time timer is needed in the application. In this research, we consider using an internal system clock (PIC16F1507) as internal Flexible Oscillator Structure: 16MHz internal of Oscillator Block; software selectable frequency from 31 KHz to 16MHz [8].

- ***Alarm Device***

An alarm device or system of alarm devices gives an audible, visual or other form of alarm signal about a problem or condition. Alarm devices are often outfitted with a siren [9].

## II. SYSTEM DESIGN

The system design stage can be divided into three stages viz:

- The first circuit called The blind man sensor

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- The second circuit with increased sensitivity, and
- The third with higher sensitivity level.

### *The First Circuit: The Blind Man's Sensor*

The circuit is a simple transistor switch with the base of the transistor connected to a voltage divider. The voltage divider has two resistors. The first is the 100K potentiometer plus the protective 1K resistor, the second resistor is the LDR. Figure 2 shows the schematic diagram of the circuit:

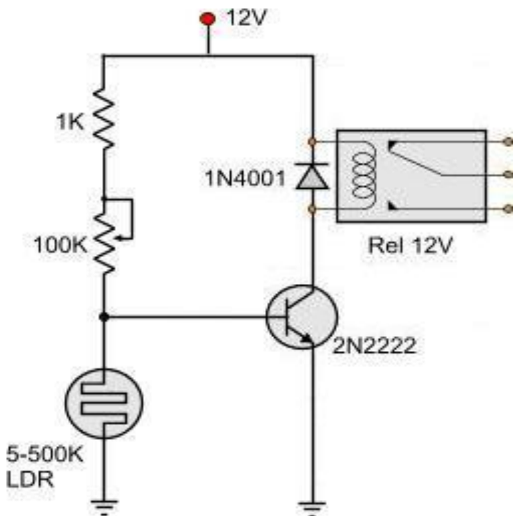


**Fig 2: the Blind's man Sensor**

As light falls on the surface of the LDR, the LDR changes it's resistance. The more the light, the less the resistance of the LDR, the less the resistance, the less the voltage drop across it. The less the light, the more the resistance and thus the more the voltage drop across it. As the voltage drop increases, so does the $V_B$ of the 2N2222 transistor and therefore the $I_{CE}$ increases accordingly, until the time that the current is enough to actuate the relay. The amount of light needed to actuate the relay can be changed by changing the 100K potentiometer. Basically, any change to the potentiometer will have an effect to the voltage drop of the LDR, as they are both members of the voltage divider described in Figure 2. The 1N4001 diode is used to eliminate any back voltage when the relay is disarmed. It is very important to have this diode because without it, the transistor may be damaged.

### *The Second Circuit "Increased Sensitivity"*

The circuit in Figure 2 works fine as far as the activation is concerned. There will be no problem to detect dark or light and actuate the relay, but there will be a problem when the relay needs to be released back again. At this point, the circuit has a big hysteresis. Therefore, there is a need to further amplify the signal before applying it to the switching transistor.

With this addition, the sensitivity of the circuit is further increased. The hysteresis window is significantly decreased, although there is still a region that when the relay is activated, it will not be deactivated with the same amount of light that existed just before its activation. BC517 NPN Darlington pair transistor is used. It is placed in between the 2N2222 and the LDR, as indicated in figure 3:

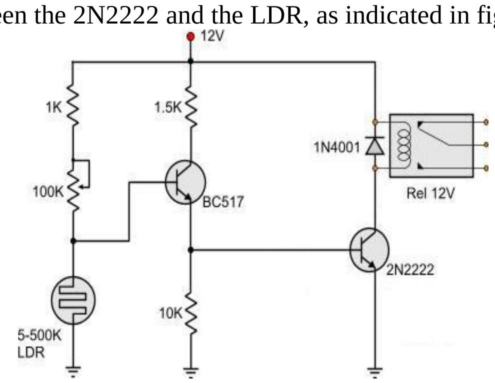


**Fig3: Increased Sensitivity Stage Circuit**

### The Third Circuit - Sensitivity To Higher Levels!

The next circuit has nothing to do with the above. It uses a 741 op-amp to achieve maximum sensitivity. This circuit can sense very slight light changes and can be really fine adjusted. The schematic diagram of the circuit is represented in figure 4.

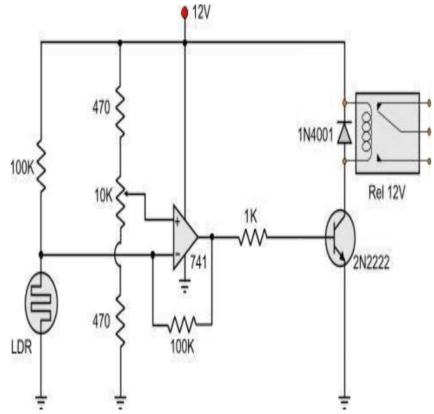


**Fig 4: Higher Level Stage Circuit**

This circuit has so much sensitivity and so low reaction time that is sometimes improper to be used. From figure 4, the 741 is connected as a voltage comparator. There are two voltage dividers in the circuit: The first one is the LDR and the 100K resistor. The second one is composed by the two 470 Ohms resistors and the potentiometer. Both the outputs of the dividers are connected as inputs to the voltage comparator. The second voltage divider will settle the reference voltage. The first voltage comparator that contains the LDR will change its voltage according to the light level. When the voltage across the negative input of the comparator is less than the voltage to the positive input of the comparator, the output is held low. When the voltage on the negative input rises, there will be a time that it becomes greater than or equal to the positive voltage, and then the output becomes high and the relay through the 2N2222 is actuated.

As long as the transistor is concerned, any NPN switching transistor capable to drive a relay will do. As for the LDR, it is important to make sure that it pairs with the 100K resistor. This means that the mid-value of the LDR is almost the same as this resistor. The circuit is designed to work with 12V, but

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it can operate in lower voltages as well, as long as you make sure you select the right relay for the circuit.

## III. CIRCUIT ANALYSIS

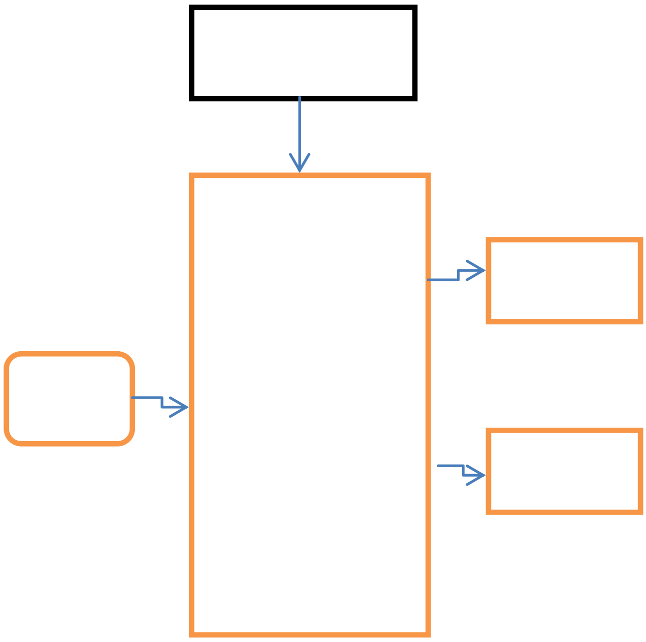

**Fig 5: Automatic Dark Activator Block Diagram**

Figure 5 shows the block diagram of the design which is concerned with the working principle of the circuit to illuminate a light source and at the same instant act as an alarm device in the dark. This system is design to meet the new technologies over the old systems by giving room for advancement in technology. The input analysis for the design is the LDR which senses darkness then having an effect on a buzzer and LED. The output is that the system automatically lights the LED and act an alarm device immediately it senses darkness.

***System Flow Chart***

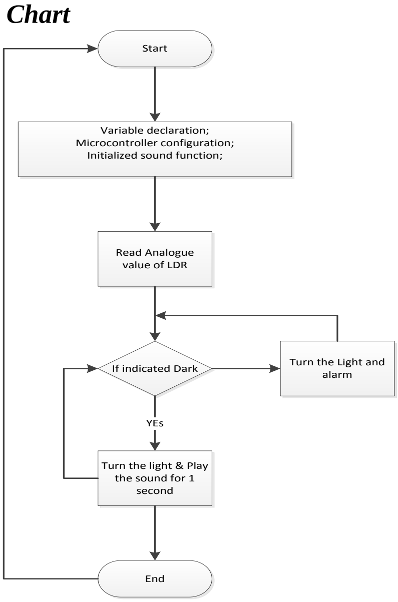


**Fig 6: System Flowchart**

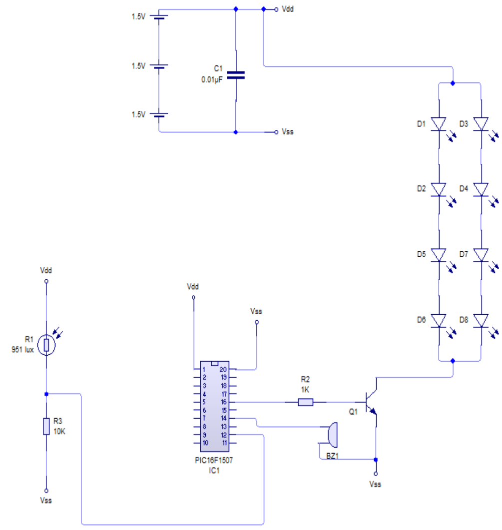

**Fig 7: Circuit Design**

From figure 7, the LDR R1 with Resistor R3 senses the light intensity, and generates voltage that corresponds to that intensity. The Voltage from LDR is fed into Microcontroller ADC module. The microcontroller ADC would then convert the Analogue voltage to Digital value that the microcontroller can understand. An array of LEDs is used as light in this design. The anode terminals of the LEDs are connected to positive terminal of the Batteries. The cathode terminals of the LEDs are connected to the collector terminal of transistor Q1 (BC108). The transistor actually acts as a switch to the light. When the base terminal is turned on, the transistor will allow current to flow the LEDs to ground. In this way, the light will turn on. Resistor R2 act as current limiter to the base of the transistor.

***Automatic Dark Activated Switch Algorithm***

1. Variable declaration
2. Microcontroller configuration
   i. Configure PORT B RB5 as analogue input channel 3
   ii. Enable ADC module of the microcontroller
   iii. Configure and select 16MHz internal oscillator of the Pic.
   iv. Configure PORTC as outputs.
   v. Configure PORTB as inputs
3. Initialized PORTC RC2 for alarm
4. Begin Endless Loop
   i. Read Analogue value of the LDR from ADC channel 3
   ii. If dark
   i. Tun the light on
   ii. Play sound for 1 second
   iii. If not dark
   i. OFF the light and Alarm
5. End of Enless Loop
6. End.

## IV. CONCLUSION AND RECOMMENDATION

Dark activated switch has become very important in our everyday activities because of its application in many useful devices that has been use to solve some societal problem. Helping those with disabilities to automatically switch on the light and other electrical devices whenever there is a sniff of darkness. It is also used in sensing devices e.g. water sprinkler that will automatically spin when it's dark [10]. As always, variations of this circuit can be done. Instead of using an LED, we can use any other type of lighting fixture. We may want to use a lamp or multiple lights so that different lights can be placed in parallel to one another. All that is needed to be done is just to adjust the power settings. Just because light seems like the most practical and useful component to place in a dark activated switch doesn't mean we have to use any lightning component at all. The components used will depend on the device we want the dark switch to control. Some of the other areas in which dark activated switch can be used are [11]:

- For automatic outdoor lighting or garden lighting at home
- For automatic switching of street lights
- For switching the hoardings on and off automatically
- For self-switching operation of displaying title hoardings of companies
- Useful as light detector circuit.

## REFERENCES

[1] Jean-Claude Bolay, Alexandre Schmid, Gabriela Tejada "Technologies and Innovations for Development: Scientific Cooperation for a Sustainable Future," Springer, 2012 ISBN 2-8178-0267-5, page 308.

[2] Moreno, I., Sun, C. C. (2008). "Modeling the radiation pattern of LEDs".Optics expresses 16 (3): 1808–1819.doi:10.1364/OE.16.001808.

[3] Dennis L. Noble "Lighthouses & Keepers: The U.S. Lighthouse Service and Its Legacy", Naval Institute Press, 2004. ISBN 1-59114-626-7, page 34.

[4] Lee, Thomas H. (2004). "The design of CMOS radio-frequency integrated circuits," Cambridge University Press, page. 20. ISBN 0-521-83539-9.

[5] Emilio Shepherd, Frank A. Perez, "Kerosene Lamps anpiod Cook stoves - the Hazards of Gasoline Contamination" 2007 retrieved 2015 Feb 12.

[6] Narasimha Desirazu Rao. "Distributional Impacts of Energy Policies in India: Implications for Equity" Stanford University, 2011 page 3.

[7] Nosov, Yu. R., O.B. jIoce, O.V., Losev (2005). "The Inventor of Crystodyne and Light-emitting diode" Электросвязь (in Russian) (5): page 63.

[8] Park, S. I., Xiong, Y., Kim, R. H., Elvikis, P., Meitl, M., Kim, D. H., Wu, J., Yoon, J. (2009). "Printed Assemblies of Inorganic Light-Emitting Diodes for Deformable and Semitransparent Displays". Science 325 (5943): 977–981.doi 10.1126/science.1175690.PMID 19696346.

[9] Pearsall, T. P., Miller, B. I., Capik, R. J., Bachmann, K. J. (1976). "Efficient, Lattice-matched, Double Hetero structure LEDs at 1.1 mm from GaxIn1-xAsyP1-y by Liquid-phase Epitaxy". Appl. Phys. Lett. 28499. Bibcode: 1976ApPhL..28..499p.doi:10.1063/1.88831.

[10] Schubert, E. Fred (2003). "Light-Emitting Diodes." Cambridge University Press. ISBN 0-8194-3956-8.

[11] Zayn Bilkadi (University of California, Berkeley), "The Oil Weapons" Saudi Aramco World, January–February 1995, pp. 20–22.