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An Improved Rain Activated Automatic Window

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Abstract

Meteorological conditions like temperature, wind, clouds and precipitation (rainfall) influence the condition of comfort inside a house especially through entrances such as windows; hence the need for proper control (either to close or open) of windows in a building. This work, an improved automatic window with rain activator is aimed at having window control made convenient to home owners by the use of a switch to open or close the window. The design was conceived after observing the stress mechanical windows give us in our control of it to let air and light come into the house; therefore, advancement in electronics technology was used to design this automatic window. However, unlike existing automatic windows, a rain sensor has been included in this work to help shut the window automatically when raining is falling. To achieve this, a moisture sensor is incorporated in the design to sense rainfall, a forward and reversing DC Motor to move the window pane back and forth, a bistable circuit to control the movement of the DC Motor and a power supply to power the system. The design was tested and was found to work effectively in convenient control of window for the comfort of the homes and in protecting the homes from rainfall.

Keywords: Automatic window, rain activator, mechanical window, electronics, DC motor.

1. Introduction

Windows are openings normally designed on the walls of a building to allow light and air access into the building and also to control the temperature of the rooms in a building. Recently however, windows have been designed in buildings to add aesthetics values to the buildings. The word window is derived from the Scandinavian words "vindr and auga", which translate literally as 'winds eye'.

In the early civilization of man, man made little holes in his building to maintain warmth and keep out cold, for example, early Norse builders made sure that their houses were tightly sealed, limiting free movement of air and allowing smoke and stale air to escape through a hole in the roof called an 'eye'(Tokheim, 2009). Wind often whistled through the eye, leading them to call it the 'winds eye'. Builders in Britain borrowed the Norse term

and changed it to 'window'; however, the British 'window' is an advancement of the Norse 'winds eye', because windows have glass to cover the hole.

Surprisingly however, the development of windows is closely linked to glass and its manufacture. Glass was actually invented by the Romans way back in 400 BC; however because the Mediterranean was warm, they did not waste their new found knowledge on windows, preferring to use their new found invention for more pleasurable uses such as wine glasses.

In medieval time, prior to the development of electric power industry in the 19th century, natural ventilation through manually operable windows was the only means of ventilating building. However when electricity was discovered in the 19th century it led to the automation of homes.

Home automation is a field within building automation specialized in the specific automation requirements of private homes and in the application of automation techniques for the comfort of residents.

When home automation is design for a building, usually control wires are added before the drywall is installed during construction of the home. These control wires run to a controller, which will then be used to control the environment. With advancement in wireless technology home automation can now be done wirelessly using remote controller (Rosslin and Taihoon, 2010).

In this work, automation was achieved using control wires and a switch on the wall of the building to control the opening and closing of the window to forestall inconveniences in the event of loss of remote controller, also automation in this work does not prevent manual operation of the window in the event of power outages. In addition, the window closes automatically when moisture (rainfall) touches the rain sensor strategically placed on the roof of the building (Musa, 2012).

1. Materials and Methods

Modular approach was used in the circuit design of the automatic window and it consists of four main parts namely (a) The Power Supply Unit (b) The Water Sensing Unit (c) Bistable Circuit and (d) Driver and Reversing circuit/output unit, Figure 1.1 shows the block diagram of the automatic window design.

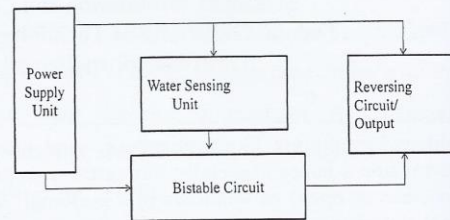


Fig. 1.1 Block diagram of automatic window with rain activator

2.1 Power Supply Unit

Power supply units of most electronics devices are similar because most electronics devices utilize DC supply for their operation, like in most electronic devices, the power supply unit in this work consist of the transformer, a bridge rectifier, a filter and a voltage regulator which all function together to transform the alternating current (AC) mains voltage supply to a regulated direct current (DC) voltage supply; as the output of the power supply unit. The diagram of the power supply unit is shown in Figure 1.2

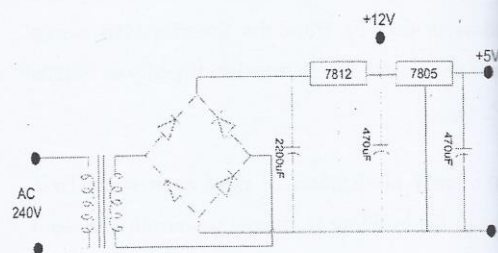


Fig.1. 2 Power supply unit

2.2 The Water Sensing Unit (Rain Activator)

The rain activator consists of closely arranged conductors represented as C and D on an insulated surface in an open circuit mode as shown in Figure 1.3, the presence of rain water bridges the

conductors and closes the circuit. The contact distance is made adjustable so that the user can adjust to the level of moisture sensitivity needs. One of the terminals of the rain activator connects to the positive of the power supply and the other to two transistors Q1, BC108 and Q2, BC141 connected as a high gain compound pair in common collector to get a current gain signal product of each transistor needed by the switch S2 to drive DC motor for a 'close window' movement when the rain water passes a minimum of 4µA across the contacts else 'leave the window open' position is maintained. The circuit connection to achieve this control is shown in Figure 1.3.

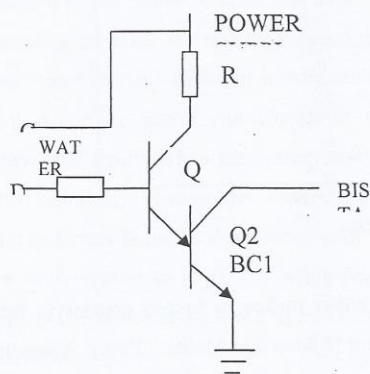


Figure 1.3 Circuit Component for Sensing the rain.

2.3 The Bistable Circuit Unit

Figure 1.4 shows the Bistable Circuit used in the design of the automatic window with rain activator.

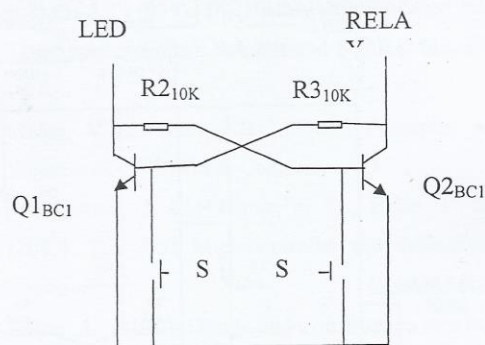


Fig. 1.4: Bistable circuit

The bistable circuit or flip-flop is a resistor coupled two stage common collector amplifier (Jansen, 1999, Electronics circuits and Applications, 2012). In this respect, it is a DC amplifier with 100% positive feedback. It has no self triggering action but has to be externally triggered with positive pulses that are switch S1 and S2 as can be seen in Figure 1.4. It makes use of two chosen transistors Q1 and Q2 which are BC107 each. At any time power is supplied to any switch, one transistor is ON while the other is OFF. At a point, Q₁ is conducting and Q₂ is cut off. The rising positive edge of the trigger pulse, S2 switches Q₂ into conduction (zero collector voltage) and it will continue conducting until the next rising positive edge comes to switch it OFF (V_{CC} collector voltage) by switch S1 (Mohammed *et al*, 2005).

2.4 The Driver and Reversing Circuit/Output Unit

This unit consists of a (a) Relay, (b) Motor and (c) LED indicators which display the desired output.

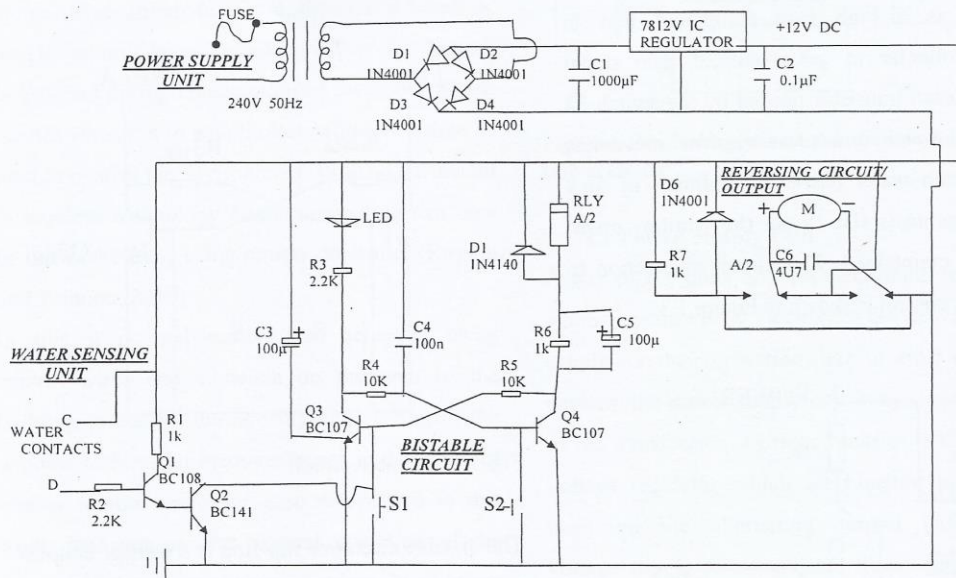


Fig 1.5 Complete Circuit diagram

2.4.1 Relay Switch

A relay switch is normally used for switching heavy load in AC; the load rating depends on the current specification of the devices [Mehta and Mehta, (2006)]. The type chosen in this work is rated 6V; of the five terminals of the relay, three of them serve the switching connection. The other two are used for inductive switching of the relay. A diode was connected across its terminal to dissipate energy of collapsing contact. The relay is incorporated into the circuit for switching (made to open and close under the control of a driver current). When current flows through the coils, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The

movement either makes or breaks contact to turn the DC motor [Mehta and Mehta, (2006)]. When the current to the coil is switched OFF, the armature is returned with a force, half as strong as the magnetic force to relax position (Theraja and Theraja, 2008). It is controlled by two BC107 transistors which response to the pressing of the switch S1 and S2.

2.4.2 Motor and Led (Lead Emitting Diodes)

The motor used is in this work is a 6V DC motor (Nelkon, 1975). It has two polarity terminals which reverse its direction if the current input to the same leg is changed to enable the window to OPEN and CLOSE by the switches S1 and S2. The LED display is used to display the output of the control

whether window is OPENED or CLOSED. Figure 1.5 is the complete circuit diagram of rain activated automatic window.

3. Results and Discussion

Each module of the automatic window with rain activator as shown in the block diagram was executed one after the other and tested to observe if they give the expected results. After which the units were joined together as a single working system. Testing started with the Power supply unit to ensure it could supply the required power to the circuit; the power supply unit gave the required output of 12V. Bistable circuit unit test was confirmed by the movement of the motor to open and close window by pressing switches S1 and S2 respectively, The rain activator circuit was tested with bistable circuit and it made the motor run clockwise to close window, and finally when the system was coupled it was tested by placing the water sensor with terminals C and D inside a container with water to make water spread to it surface while power was supplied. The motor is observed to move in closing the window.

4. Conclusion

This work has presents an improved rain activated automatic window, an electronic and convenient means of controlling (opening and closing) our windows by pressing a switch, a rain sensor is also included to prevent rain water from entering the homes through the windows and consequently damaging properties.

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