

DESIGN AND CONSTRUCTION OF AN AUTOMATED LIQUID DISPENSER

Arnaldo Villalon, Jacob Godino* and Noel Pacayra

College of Engineering, Eastern Samar State University, Borongan City, Eastern Samar.

Article Received on 07/07/2021

Article Revised on 27/07/2021

Article Accepted on 17/08/2021

*Corresponding Author

Jacob Godino

College of Engineering,
Eastern Samar State
University, Borongan City,
Eastern Samar.

ABSTRACT

This study centers on the design and fabrication of an Automated Liquid Dispenser which can help prevent spreading of the virus. This device is useful especially in hand washing. The user of this device will limit the contact while using this device. In order to construct the Automated Liquid Dispenser, it would be appropriate to study the

material and to determine the design suited for the device. Automated Liquid Dispenser uses IR transmitter and IR Receiver or Photodiode as a sensor switch. It has Op Amp integrated circuit for switching and amplifying the input current and voltage. DC motor is used to dispense liquid in the Automated Liquid Dispenser.

KEYWORDS: Automated, Dispenser, infrared, Sensor, Photodiode, Transmitter, Receiver, Operational Amplifier.

1.INTRODUCTION

We are in a period that we call the new normal. We wear facemask or face shield all the time. Mass gathering is not allowed and we always maintained a one meter physical distance. We step on foot bath and wash our hands before entering a building or a room, office and even in our own houses. This disturbance is a preventive measures made by our government to prevent spreading of the virus. The virus that hit our country is called COVID19.

As a citizen of this world, I would like to contribute a little help in prevention of spreading the virus. Every building has hand disinfectant for anyone who will enter.

Disinfecting hand using bottled alcohol is a one way to stop the virus. This problem made the researcher to come up an idea in creating an Automated Liquid Dispenser. Automation is popular in our time, many gadget, invention are automated. C D. Nwoye had study of Construction of an Automatic Power Switch Using Infrared (IR) Sensor. As stated in Global.com, infrared radiation exists in the electromagnetic spectrum at a wave length that is longer than visible light. It cannot be seen but it can be detected. Objects that generate heat also generate infrared radiation and those objects include animals and human bodies.

This work was supported by the Research and Development Services Office of the Eastern Samar State University, Borongan City, Eastern Samar, Philippines.

Automated Liquid Dispenser will lessen the contact of using alcohol disinfectant it can also be used as soap dispenser or any liquid that is needed to be used in preventing virus. It will lessen the hustle of using disinfectant especially in crowded places that will enter a building or other vicinity. According to Wiki, Automation or Labor Saving Technology is a Technology by which a process or procedure is performed with minimal human assistance. This will be cheap, low cost in constructing the device.

2. OBJECTIVES OF THE STUDY

The purpose of this study is to design, construct and evaluate an Automated Liquid Dispenser.

3. METHODOLOGY

Automated technology is common in this era. Some technologies are operated by internet, WIFI and wireless. Fahmy, Hossam Mahmoud Ahmad, write a book about wireless sensor networks. It explains the different types of networks the use of wireless devices like internet and WIFI and sensors.

To determine the design of the sensor switch we must able to learn the different types of sensor. Passive Infrared (PIR) is a motion sensor that can detect any movement. It can detect movement from Humans, Animals and Vehicles. It is also called Anti – theft sensor. Samuel Bango invented the first Motion Detector it is called Burglar Alarm. PIR sensors, measures the Infrared (IR) Light Radiating from object in field of view.

Infrared (IR) transmitter contains a LED that emits Infrared Lights. Infrared (IR) Receiver is a Photodiode or Phototransistor. Photodiode is a semiconductor diode that generates potential

difference or change in electrical resistance when exposed to light. Suha Al – Nassar, uses infrared (IR) wireless communication to transmit voice over a certain distance in laboratory. Integrated Circuit (IC) was invented by Werner Jacobi (1858 – 1859). IC is a small chip that can be function as amplifier, timer, microprocessor and more. Min-Gyu Jung used IC as switch in battery charger for mobile devices. It helps to operate as a boost dc-dc converter and smoothly switched the mode of charging the battery from its natural process of charging to adopting a diode based mode of charging.

To construct the sensor switch it is necessary to collect all the components that will be needed in assembling sensor switch. The main components of the circuit diagram are IR transmitter and receiver and the Integrated Circuit (IC). To determine what type of IC to be used will be based on the type of IC. Since this will operate as a switch, an op amp IC will be appropriate to be used for this project. An operational Amplifier or Op Amp is a DC coupled high gain electronic voltage amplifier with a differential input and, usually, a single ended output (wiki). If an Op Amp senses a signal from IR Receiver, it will run through IR Transmitter and serve as the input in op Amp IC and the output will be triggered.

Testing the device would be appropriate before we disseminate to the end users. To test the device it would need some trials to regulate if the integrated circuit will last depend on the trial that will be performed, hence in our development we will test the device up to twenty times to define the consistency of the project. Sensor and integrated circuit are sensitive components. It has low voltage and current. Plugging inappropriate supply can damage the sensors and the integrated circuit. Therefore it is highly recommended to test to maximum capacity of the voltage and current to be supplied in the device. Using tester, multi tester and digital tester, we can conclude the voltage and current necessary to operate the device in safe circumstance.

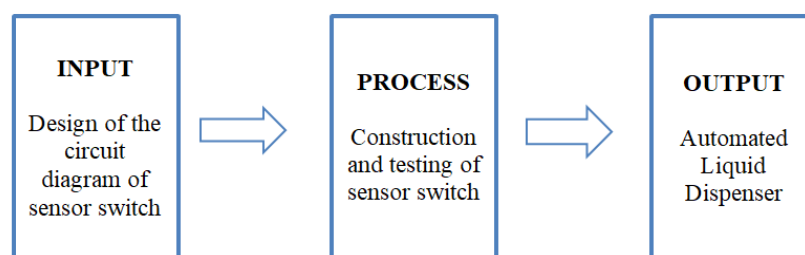


Figure 1: IPO of the study.

4. RESULTS AND DISCUSSION

4.1 The Sensor

Automated equipment's are apparatus's that are programmed or mechanisms without requiring human assistance. Programed means they are fixed or intended to do so. The common automated components used are sensor switch. Sensor switch can be used in lighting, doors and Automated Liquid Dispenser. Automated Liquid Dispenser dispensed liquid automatically.

Circuit diagrams are important in constructing automated equipment's. The main components or the brain of this circuit is the Integrated Circuit called Operation Amplifier or Op Amp. It has eight (8) pins with Inputs and Outputs. The components used by the researcher are Infrared LED, Infrared Transmitter and Receiver, IC Op Amp, Resistor, Capacitor and Potentiometer. The Mechanical Parts are DC motor and the Relay.

In the figure shown below, the Infrared Transmitter (D2) and Infrared Receiver or Photodiode (D3) serves as the switch for the Automated Liquid Dispenser. If an object blocked the Infrared Receiver it will throw a signal to the Infrared Transmitter, from the Infrared Transmitter, a signal will travel to the Op Amp (OA1). One of the characteristics of Op Amp is a differential amplifier, because the output is proportional to the difference in voltage between the two inputs. Two common inputs of the Op Amp are the Inverting and Non Inverting inputs. The Non – Inverting Input mark as “+” and the Inverting Inputs mark as “-“. The two inputs will determined the Output if it has positive voltage applied in the inputs. If the Non – inverting inputs supplied by a positive voltage, a positive swing of the output will be produced hence, if the Inverting inputs will be supplied by a positive voltage, a negative output will be developed. The resistors in the circuit, limits the flow of the current going to the Op Amp. The potentiometer (RV) in the circuit controls the range of the sensor. RV ranges from 0 ohm – 10k ohm, the higher the value of the RV the shorter the range can detect by the sensor.

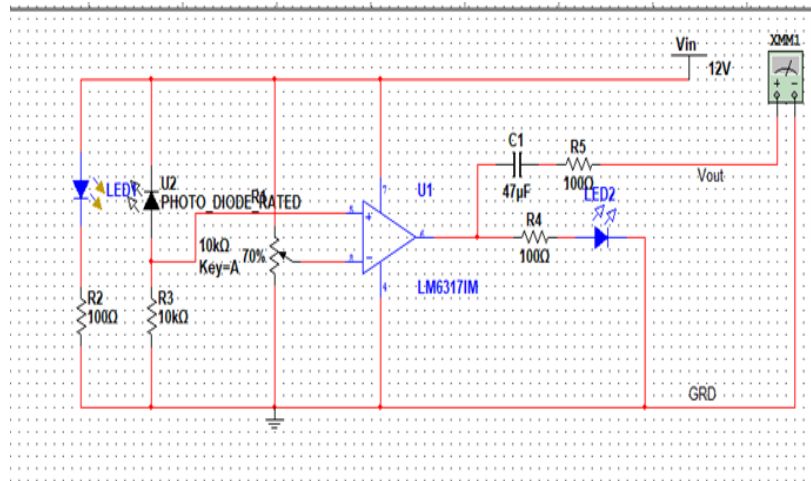


Figure 2: Sensor Electrical wiring Setup.

4.2 The Operation

Operational Amplifier or Op Amp is a DC-coupled high-gain electronic voltage amplifier with a differential input and, usually a single ended output. The amplifier's differential inputs consist of a non-inverting input (+) with voltage V_+ and an inverting input (–) with voltage V_- ; ideally the op amp amplifies only the difference in voltage between the two, which is called the differential input voltage.

4.2.1 Open Loop Amplifier

The magnitude of AOL is typically very large and therefore even a quite small difference between V_+ and V_- drives the amplifier output nearly to the supply voltage. Without negative feedback, and perhaps with positive feedback for regeneration, an op amp acts as a comparator. If the inverting input is held at ground (0 V) directly or by a resistor R_g , and the input voltage V_{in} applied to the non-inverting input is positive, the output will be maximum positive; if V_{in} is negative, the output will be maximum negative. Since there is no feedback from the output to either input, this is an open-loop circuit acting as a comparator.

4.2.2 Cross Loop Amplifier

The closed-loop feedback greatly reduces the gain of the circuit. When negative feedback is used, the circuit's overall gain and response becomes determined mostly by the feedback network, rather than by the op-amp characteristics. If the feedback network is made of components with values small relative to the op amp's input impedance, the value of the op amp's open-loop response AOL does not seriously affect the circuit's performance. The response of the op-amp circuit with its input, output, and feedback circuits to an input is

characterized mathematically by a transfer function; designing an op-amp circuit to have a desired transfer function is in the realm of electrical engineering.

4.3 The Process

Relay is an electrically operated switch. It has Normally Open (NO) and Normally Close (NC) pins, two common and coil pins. These are the terminal terminate the connection from the sensor through the Relay down to the DC motor. A relay is a switch operated by a small electric current.

Current from the output from the Op Amp will pass in series through the capacitor straight to the coil pin of the relay. The pin of Normally Open (NO) is connected in series to the DC Motor. The common pin of the Relay is connected in series to the negative terminal of the sensor as well as the other terminal of the DC motor. If the relay sense current the pin of Normally Open (NO) will close and it will create a circuit. The DC motor normally in standby mode, the circuit from the sensor down to the motor is in open circuit possession. In electrical field, once the circuit is in open condition, there will be no current circulating in the circuit. It means that no operation will be executed.

In the figure below the circuit for the DC motor to pump the liquid from the fabricated case is displayed. The researcher indicated descriptions in the sad circuit diagram. As we notice in the circuit diagram, a three small circle in the left side, these circles are the pin of the circuit specified as Vcc, Vout, GND. The sensor will be terminated in these pins, from the sensor a current will pass through in this pins. Each pins has its own designation or duty to perform so that the motor will run.

The circuit diagram has LED, Resistor, Relay, Transistor and a DC motor. Each component's has also duty to perform for the liquid dispenser. The LED is the indicator that the device is running. It will turn ON if the Automated Liquid Dispenser is being used.

If the device is supplied by 12v, the circuit will be in standby mode. Once the sensor detect object, the current will pass through Vout down to 1K ohms resistor and it pass through the base section of the transistor. Hence, transistor are used to control the flow of electric current in which a small amount of current in the Base lead controls a larger current between the Collector and the Emitter. Therefore, the small amount of current from the Vout will be amplify as it will pass through the Base of the transistor and will goes out in the Emitter.

As we see in the fig below, the relay is connected by Vcc and GND, from the relay the DC motor is connected in Normally Open (NO), means that no current is passing through therefore, the DC motor in in OFF state. Since there is a transistor in the circuit, a larger current can travel towards the relay. When current is present in the relay, the coil in the relay will be energized and the electromagnet will be developed in the relay causing the Normally Open (NO) pin to close. Hence the relay will close a complete circuit is formed in the diagram and current will pass towards the DC motor causing it to run.

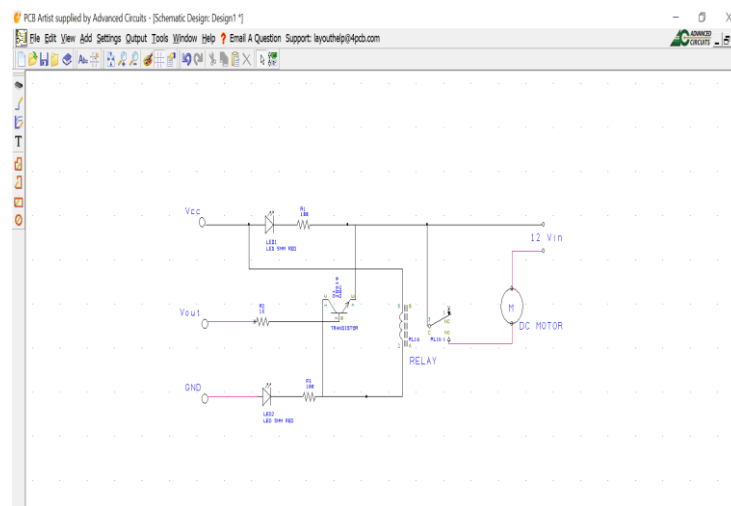


Figure 3: Process Electrical wiring Setup.

4.4 The Output

Multisim is an electronic schematic capture and simulation program which is part of a suite of circuit design programs. This software provides analysis and printed circuit board tools to help designers quickly iterate through designs and improve prototype performance.

Figure 4 show the circuit diagram of the sensor, instead of using a photodiode a switch is place in the circuit. It's only temporary and the purpose is to test if the circuit has no problem. There is also a Multimeter in the circuit to determine the value of the voltage output of the circuit. Hence the switch in is open position, it indicates that no contact has been made in the sensor. The LED 2 in the circuit has red color indicating that the device is in standby mode and the Multimeter has reading of 8.6v. Since there is an output voltage in the circuit and it is not negative voltage, it means that the circuit has no problem encountered.

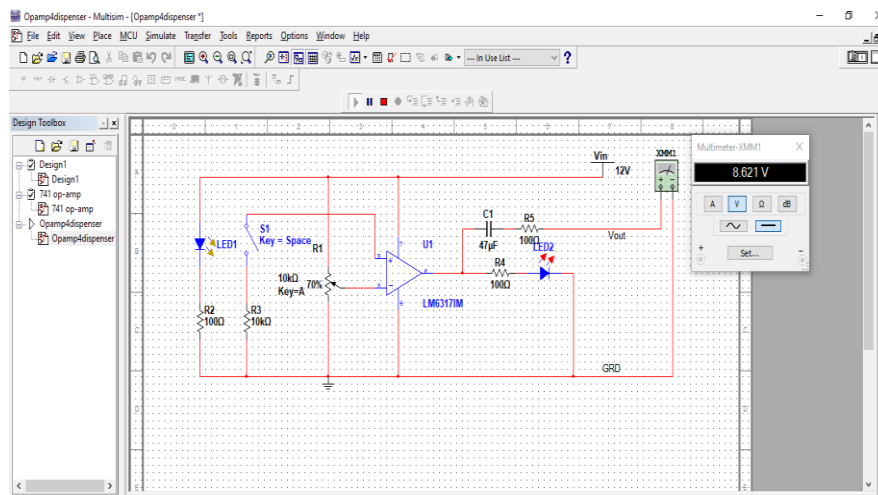


Figure 4: Circuit Diagram of the Sensor.

Figure 5 shows that the sensor detected object and it turned ON. As we noticed the switch in this figure it is in close state. Referring to the photodiode, it has detected object. The LED 2 in the circuit became null, means that it is running.

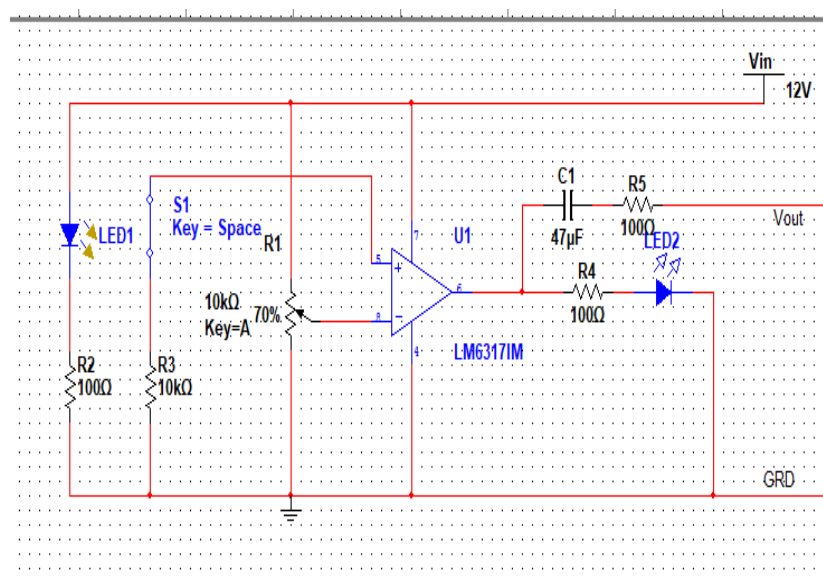


Figure 5: Circuit Diagram when turned On.

When the photodiode is disturbed or detect something, a close circuit will be formed. Using 12v supply a current will flow in the circuit and it will pass through to the Op Amp. The Op Amp will send voltage at the Vout that will supply the DC motor to dispense liquid. The current that will flow towards the Vout is the same current that will trigger the relay to contact in the normally open (NO) pin. Once the normally open (NO) pin closes, a current will pass toward the DC motor to help the device run.

The screenshot displays a Proteus simulation environment. The main window shows a circuit diagram with a 12V DC source (Vin) connected to a network of resistors (R1, R2, R3), a switch (S1), an LED (LED1), a capacitor (C1), another LED (LED2), and a resistor (R4). The circuit is grounded (GRD). Two multimeters are present: Multimeter-XMM1, which is configured to measure current (mA) and shows a reading of 1.776 uA; and Multimeter-XMM2, which is configured to measure voltage (V) and shows a reading of 8.634 V. The simulation interface includes a top menu bar (Simulate, Transfer, Tools, Reports, Options, Window, Help) and a toolbar with various simulation and editing tools.

In the figure above, the circuit diagram is in standby mode, the photodiode was not disturbed. No contact from the sensor and the current circulating in the circuit is very low. Low current cannot trigger our DC motor to dispense liquid. Even there is transistor connected in the diagram for the motor, still, it's not enough to supply the DC motor to run.

5. CONCLUSION

This result is what the researchers need in their data to continue in constructing the automated liquid dispenser.

No conflicts of interest exist during the conduct of this research.

REFERENCES

1. Product Specification for PR150-1L/PR180-1L. Leviton. Retrieved, 6 September 2014.
2. "How Infrared motion detector components work". Non commercial research page. Glolab Corporation.
3. "PIR sensor technology". ecosirius.com. Retrieved, 1 February 2014.
4. "PIR Sensor Output Pulse Generation".
5. D., Hallee. Retrieved 6 May. "Passive Infrared Sensors: A Brief Overview". InHomeSafetyGuide.org. In Home Safety Guide, 2016.
6. C. F. Tsai and M. S. Young (December). "Pyroelectric infrared sensor-based thermometer for monitoring indoor objects". Review of Scientific Instruments, 2003; 74(12): 5267–5273. doi:10.1063/1.1626005.
7. C.D. Nwoye, M.R. Usikalu*, I.O. Babarimisa, J.A. Achuka and W.A. Ayara July. Construction of An Automatic Power Switch using Infrared Motion Sensor, 2017.
8. S Kadam, S Prakash, P Mitesh - International Journal of ICT Research and Technology. Automatic room light controller with bidirectional visitor counter, 2016.