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Utilization of IP LM393 Sensor Module as an Automation System for a Portable Gallon Pump

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ABSTRACT

Research has been conducted on developing an automatic gallon pump based on the IP LM393 sensor. This research aims to provide alternative solutions to avoid direct contact as the cause of COVID-19 transmission. The research method used includes the stages of designing, manufacturing, and testing the automatic gallon pump based on the IP LM393 sensor. The results showed that installing IP LM393 in a portable gallon pump can help people avoid direct contact when pouring water. This research proves that some materials can be sensor barriers at specific distances with an effective light intensity range of 19-23 lux.

Introduction

Since the beginning of 2020, the world has been shocked by the discovery of the coronavirus as the cause of severe infections of 44 pneumonia patients in Wuhan, Hubei province, China (Handayani et al., 2020). The coronavirus, known by the scientific name SARS-CoV-2, can infect the human respiratory tract. (Guan et al., 2020). Symptoms caused by exposure to the SARS-CoV-2 virus include fever, cough, shortness of breath, and complications in the form of pneumonia, severe acute respiratory disease, and even death. (Fitriani, 2020; Huang et al., 2020; Lapostolle et al., 2020). The COVID-19 disease is disturbing for the world's citizens because it can spread easily and quickly through respiratory droplets (Xiao et al., 2020). The SARS-CoV-2 virus can also be transmitted to humans due to contact with objects contaminated with the virus and then accidentally touching the face, making it easier to infect the respiratory tract (Hoffmann et al., 2020; World Health Organization, 2020).

COVID-19 is a disease pandemic caused by SARS-CoV-2, which is difficult to cure (Vollono et al., 2020). Experts must first research this virus so that medical personnel can provide the best treatment for COVID-19 victims. WHO officially declared COVID-19 a global pandemic on March 11, 2020, because its spread covers most of the world (World Health Organization, 2020). Indonesia, through Presidential Degree Number 11 of 2020 on March 31, 2020, declared that COVID-19 had been an emergency condition status in public health (Fitri, 2020; Indonesia, 2020).

Each country has implemented various efforts to overcome the rapid spread of COVID-19. Health protocols and strict regulations limiting residents' activities are implemented to minimize the number of

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victims of the COVID-19 virus (Sembiring & Suryani, 2020). General anticipation that is often carried out is the implementation of health protocols with recommendations for wearing masks, maintaining distance, living a healthy lifestyle, sterilizing hands and clothes with disinfectant or hand sanitizer, as well as implementing Large-Scale Social Restrictions and locking access to enter a region or country (Fitri, 2020; Pradasari et al., 2020; Valerisha & Putra, 2020).

Technology has a massive role in preventing COVID-19 (Hasyim et al., 2020). Researchers are trying to create tools to help implement health protocols properly. This tool is designed with various sensors and is assisted by the Internet of Things (IoT) to minimize touching, especially in public facilities. Examples of technological innovations that are most useful during the current pandemic are thermometer guns for detecting human body temperature, automatic elevator doors with light sensors (Setyawan et al., 2020), and COVID-19 mask detectors (Lambacing & Ferdiansyah, 2020).

Technological innovation is needed to help overcome the spread of COVID-19. The tools that will be made refer to several automatic tools that can be used without needing to touch them, such as auto hand washing machines used in plazas, restaurants, etc. (Prilyanto, 2020; Sukri, 2019). Researchers are well aware that direct contact with others poses a significant potential for the spread of COVID-19. Therefore, researchers utilize an IP (Infrared Proximity) LM393 sensor to assist an automatic water pump in dispensing water from a water gallon without pressing or touching the pump activation button.

IP LM393, the Infrared proximity sensor, detects obstacles or objects in front of it (Pramana, 2019). This sensor is suitable for use as portable gallon automation. When the sensor detects an obstacle in the form of glass with various materials, the sensor will activate the gallon pump module without requiring direct contact. The IP LM393 sensor is commonly used to meet the needs of a line-following robot (Suryana, 2021). Using the IP LM393 sensor in an automatic gallon pump is a unique and different approach compared to previous usage.

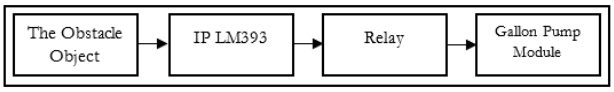
Method

The research methodology includes designing, processing, and testing an automatic water gallon pump.

Designing

The design of the automatic water gallon pump can be seen in Figure 1. The circuit in the IP LM393 sensor uses two LEDs: the Infrared LED as the transmitter of infrared waves to detect obstacles in front of it, and the photodiode LED as the receiver of reflected waves from the emitted Infrared LED that hits obstacles in front of the water gallon pump. The obstacle (glass) is placed before the IP LM393 sensor. The obstacle detected by the IP LM393 sensor will be forwarded to the relay to activate the gallon's electric water pump automatically without pressing the On/Off switch button.

Figure 1
Block Diagram for an Automated Water Pump System



The results of this design serve as the basis for determining the components, tools, and materials needed for one unit of a water gallon pump based on the IP LM393 sensor. The components, tools, and materials needed to create a water gallon pump based on the IP LM393 sensor can be seen in Table 1.

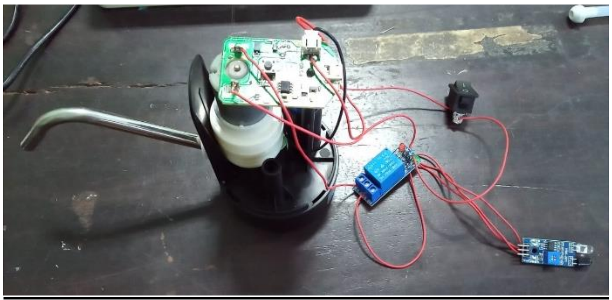
Table 1
Tools and Materials

Tools and Materials	Amount
Electric Gallon Pump	1
IP LM393	1
Relay	1
Switch Button	1
Solder	1
Cable	1 meter
Solder Tin	1
Glue Gun	1

Processing

After the design phase, the next step is manufacturing the automatic water gallon pump. The creation of the automatic water gallon pump based on the IP LM393 sensor begins by opening the electric water gallon pump. The electric water gallon pump circuit is modified by adding a relay circuit and IP LM393 sensor so that the automation process can be carried out. A switch is added as an on/off button to activate and deactivate the automatic water gallon pump. In Figure 2, the circuit of the electric water gallon pump that has been created can be seen.

Figure 2
The Circuit of The Electric Water Gallon Pump that has Been Assembled



Testing

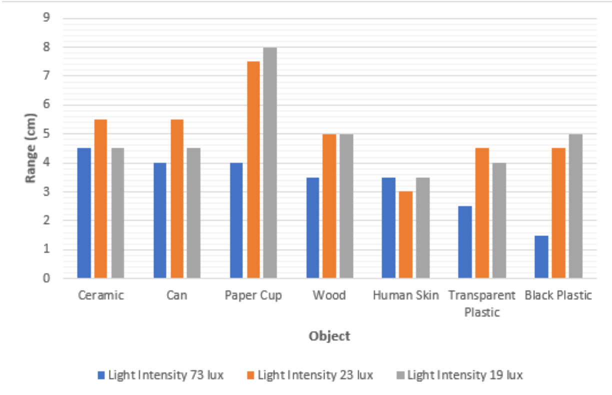
The automatic gallon pump that has been created will be tested first. The testing process is used to determine the functionality of IP LM393 as an automatic gallon pump. The testing stage was carried out to find how the sensor's sensitivity can work when used on various types of materials and room light intensity. Figure 3 shows us how the water gallon pump automation testing process can work using an obstacle in the form of a can at a certain distance. The testing stage was carried out using three variations of room light intensity: dark, regular, and bright.

Figure 3
The Testing of the Automatic Water Gallon Pump

Result and Discussions

This development process is carried out by modifying the circuit module of the electric water gallon pump. In the circuit module of the water gallon pump, a relay circuit and IP LM393 are connected to enable automation when there is an obstacle in front of the sensor. The IP LM393 plays a crucial role in controlling the automation of the automatic water gallon pump based on obstacles detected in front of the sensor. In the circuit, a switch is also added so that when not used for an extended period, the water gallon pump can be temporarily deactivated to conserve battery usage. Figure 4 shows the results of the testing of the automatic water gallon pump based on the IP LM393 sensor at three light intensities: 19 lux (dark light), 23 lux (normal light), and 73 lux (bright light) using various materials.

Figure 4
The Result of the Automatic Water Gallon Pump Based on The IP LM393 Testing



Sensitivity Testing

A specific test is conducted to assess the functionality of the automatic water gallon pump based on the IP LM393 sensor. The functionality being examined is the sensitivity to obstacles in front of the sensor. The testing is conducted to ensure whether the IP LM393 sensor is suitable, allowing the device to operate according to the plan. The sensitivity tests conducted include the materials with maximum distance and lightroom intensity testing.

Material testing is conducted to determine the materials that can be used to create a functioning sensor, thus activating the automatic water gallon pump. Several materials tested include ceramic, cans, paper cups, wood, human skin, transparent plastic, and black plastic. Look at Figure 4; when these materials are placed in front of the sensor, it can be observed that the sensor functions and activates the automatic water gallon pump at a certain distance. This indicates the difference in sensor sensitivity to different materials.

The distance test conducted on seven materials produced varying distances based on sensor sensitivity, with the farthest distance being 8 cm. Distance testing is conducted to assess the effectiveness of each material in relation to the maximum distance within the tolerance range detected by the IP LM393 sensor, enabling automatic signaling for the gallon pump.

Based on the distance test that has been conducted (see Figure 4), it can be observed that the maximum distance for each material varies based on certain factors. The distance test in this study indicates that materials with low light scattering levels, such as paper cups, are more effective when used as obstacles than ceramic, metal cans, plastic, and other materials.

Materials and distances were tested with three variations of light intensity: 73 lux, 23 lux, and 19 lux. Room light intensity measurement was carried out using a lux meter. The difference in light intensity is intended to determine the effectiveness of the sensor's performance under a specific room intensity.

The data obtained (see Figure 4) indicates a difference in sensor sensitivity under different light intensity conditions. This research shows us that low room light intensity causes higher sensor sensitivity to obstacles in front of it. This aligns with previous LDR (Light Dependent Resistor) sensor research (Kumar, 2011; Suoth et al., 2018). The conducted tests indicate that the IP LM393 sensor is suitable for controlling the automation of an electric gallon pump system.

Conclusions

The IP LM393-based gallon pump is more effective when encountering obstacles made of materials such as paper cups, ceramics, and metal cans. The average effective distance for the automation of the IP LM393-based gallon pump to function is 3-4 cm. The IP LM303-based gallon pump is more effective at low room light intensities between 19-23 lux. This leads to the conclusion that the IP LM393 sensor effectively automates a gallon pump, enabling non-touch operation and avoiding direct contact.

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