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Design of an Automatic Water Faucet System Using the IOT Based HC-SR04 Sensor

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Abstract

Water is a vital element for humans, many activities are related to water. In everyday life, the use of water becomes very important and necessary in various fields, such as households, industry and agriculture**.** But their use is often inefficient and has the potential to waste valuable resources. In this context, the concept of the Internet of Things (IoT) emerges as a potential solution by connecting physical objects via the internet. This research designs and builds an IoT-based automatic water faucet system using the HC-SR04 sensor to measure the water level in a container. Hardware components such as Node mcu Esp8266, Infrared Sensor, 2 channel 5v Relay, and others are used to control the system automatically. The software used includes the Arduino IDE. This system aims to intelligently monitor and control water flow, prevent water wastage, and incorporate the advantages of IoT technology to create an automatic water faucet system that is responsive to water levels and the presence of objects in front of it.

Keywords: *Sensor_HC-SR04, Nodemcu_Esp8266, Arduino_IDE, IOT.*

1. Introduction

Many activities related to water. In everyday life, the use of water is very important and necessary in various fields, such as households, industry and agriculture. One important aspect of water management is avoiding wastage. Many people often forget or accidentally leave the water tap open after use, which can result in significant water wastage. Along with the development of science and technology, it is now increasingly providing convenience in everyday life. Where all things that are widely applied to science and technology with machines or electronics, so that human work can be done easily. Internet of Things (IoT) is a concept whereby physical objects around us, such as electronic devices, vehicles, household appliances and many more, are connected to each other via the internet network. IoT enables these objects to collect and exchange data autonomously, as well as interact with other users or systems. In the previous research, namely, researched by Muhammad Amin 2020 entitled "Intelligent Water Faucet Control System Using Arduino Microcontroller and Ultrasonic Sensors" which concluded that the Intelligent Water Faucet Control System using Arduino and ultrasonic sensors will close the faucet valve automatically when the water level reaches a distance of 5cm and the distance of the water user or the user has reached a distance of 5cm from the ultrasonic sensor which is located in the water faucet section [1] .

2. Research Methods

2.1. Tap water

The water faucet functions to control the amount of water that is released. Despite its small size, the presence of a water faucet is very important in everyday life. None other than everything related to water such as hoses and rooms bath will be easier to operate with this tool. The design of a water faucet can also affect the beauty of a room or certain elements. Currently there are many selling water faucets in the market, both in terms of design and color [2] .

2.2. Microcontroller

Microcontroller is a complete microprocessor system contained on a chip. Microcontrollers are different from multipurpose microprocessors used in a PC, because a microcontroller generally contains components that support a minimal microprocessor system,

namely memory and Input-Output programming. Microcontrollers can be programmed to perform calculations, receive input and produce output. Microcontrollers are used in automatically controlled products and devices, such as machine control systems, remote controls, office machines, household appliances, heavy equipment, and toys. [3] .

2.3. NodeMCU ESP8266

NodeMCU is an Internet of Things (IoT) product development board based on eLua and y (SoC) ESP8266-12E Firmware. ESP8266 itself is a WiFi chip with a complete TCP/IP protocol stack. NodeMCU can be analogous to the ESP8266 ardu ino board. The ESP8266 program is a little difficult because it requires several wiring techniques and an additional USB to serial module to download the program. However, NodeMCU has packaged the ESP8266 into a compact board with various features such as a microcontroller with access capability to Wifi as well as a USB to serial communication chip. So to program it, you only need a USB data cable extension exactly the one used for charging smartphones [4] .

2.4. Arduino IDE

Arduino uno can be programmed with Arduino software. The Arduino IDE was developed from Processing software which was overhauled into an Arduino IDE specifically for programming with Arduino. Programs written using Arduino Software (IDE) are called sketches. Sketches are written in a text editor and saved in files with the extension IDE stands for Integrated Development Environment or in simple language is an integrated environment used for development. It is called an environment because it is through this software that Arduino is programmed as a built-in function with programming syntax. Arduino uses its own programming language, which is similar to C language. The Arduino programming language (sketch) has been changed to make it easier for beginners to program from the original language. Before being sold to the market, the Arduino microcontroller IC has been embedded into software called the bootloader , which acts as an intermediary between the Arduino compiler and the microcontroller [5] .

2.5. Blynk App

The Blynk App is an application designed for the Internet of Things. This application is able to control hardware remotely. Blynk functions to create application projects using various variations of the widgets that have been provided. However, the limit for using widgets in one account is only 2000 energy. This energy can be added by buying it through the playstore.

2.6. HC-SR04 Ultrasonic Sensor

Ultrasonic sensor is a sensor that functions to convert physical quantities (sound) into electrical quantities and vice versa. The way this sensor works is based on the principle of the reflection of a sound wave so that it can be used to interpret the existence (distance) of an object with a certain frequency. Called an ultrasonic sensor because this sensor uses ultrasonic waves (ultrasound sound). Ultrasonic waves are sound waves that have a very high frequency of 20,000 Hz. Ultrasonic sound cannot be heard by the human ear. Ultrasound can be heard by dogs, cats, bats and dolphins. Ultrasonic sound can travel through solids, liquids and gases. The reflectivity of ultrasonic sound on a solid surface is almost the same as the reflectivity of ultrasonic sound on a liquid surface. However, ultrasonic sound waves will be absorbed by textiles and foams [6] .

2.7. Definition of Water Pump

The pump is one of the fluid machines that are included in the working machine class. The function of the pump is to convert mechanical energy (work rotating the shaft) into fluid energy and pressure. A centrifugal pump basically consists of one or more impellers equipped with blades, which are mounted on a rotating shaft and enclosed by a casing. The fluid enters the impeller axially near the shaft and has potential energy, which is imparted to it by the blades. As the fluid leaves the impeller at a relatively high velocity, it is collected in a 'volute' or a series of diffusers which transform kinetic energy into pressure. This is of course followed by a reduction in speed. Once the conversion is complete, the fluid is then removed from the machine. Same for pumps with the exception that the volume of gases is reduced as they pass through the blower, while the volume of fluid is practically constant as it passes through the pump. Centrifugal pumps are essentially high-speed machines (compared to reciprocating, rotary, or displacement types [7].

2.8. Censorship Theory

Sensors are transducers that function to process variations of motion, heat, light or light, magnetic and chemical into voltages and electric currents. The sensor itself is an important component in the equipment section, the sensor also functions as a tool to detect and also to determine the magnitude [5] .

2.9. Infrared Sensors

The infrared sensor circuit uses photo transistors and infrared LEDs. The photo transistor will activate when exposed to light from the infrared LED. The distance between the obstacle or object is far away, which affects the intensity of light received by the phototransistor. The light emitted by the infrared LED will be read by the photodiode if there is an object in front of it.

2.10. Internet of Things

The internet of things basically connects all devices that have an on and off button to the internet. These devices can be cell phones, coffee grinders, washing machines, lamps, smartwatches, and almost anything imaginable. Parts of a system can also be controlled, such as doors

on housings, drills on oil rigs. The term Internet of Things 1 is often referred to as today's technology, namely technology that utilizes mini-sized computer devices and can be connected to local networks or the internet. The device used is designed to use small power, so that the device can only execute simple commands. Internet of Things has been widely applied to Smart Home today [8] .

3. Results and Discussion

This study uses the prototype method. Which uses the concept of direct monitoring and allows iterative changes to be made until the desired result is achieved. So this prototype method makes it possible to display the view directly.

3.1. Research Equipment and Materials

The materials used to design an automatic water faucet that uses the HC-SR04 sensor are as follows:

1. The hardware used in this study is as follows:
   a) Nodemcu Esp8266
   b) HC-SR04 Sensors
   c) Infrared Sensors
   d) Relays 2 channels 5v
   e) Mini water pump
   f) Water hose
   g) Breadboards
   h) Acrylic
   i) Jumper Cable
   j) Wifi/internet network
   k) Smartphones
   l) Water
   m) Some Glue and insulation
   n) Solder and Solder Tin

2. The software used in this study is as follows:
   a) Arduino IDE
   b) Microsoft Word

3.2. System Block Diagram

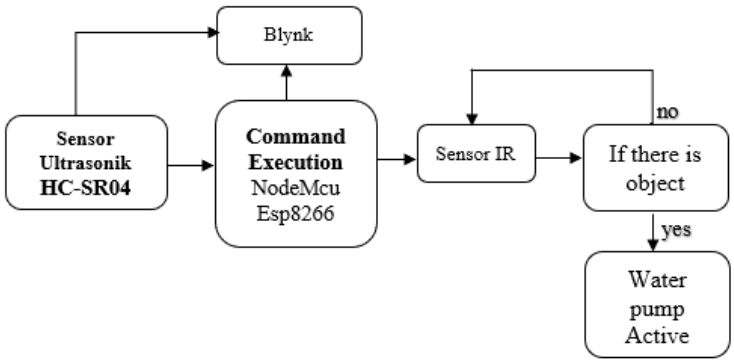

Fig.1: Diagrams System Block on Nodemcu Esp8266

The description of the Flowchart above is as follows:

1. Nodemcu Esp8266 functions as the brain and controller function in the electronic system.
2. The HC-SR04 sensor sends a message via Nodemcu Esp8266 to blynk, the HC-SR04 sensor functions to measure the water level in the container.
3. The 2Chan 5v relay functions as a switch for the water pump valve.
4. Infrared sensors function as object detectors that are in front of the tool. If an object is in front of the sensor, the water pump will turn on.

3.3. Overall Tool System Range

This circuit is composed of the components needed to design the tool so that the data tool works as desired, which can be seen in the image below:

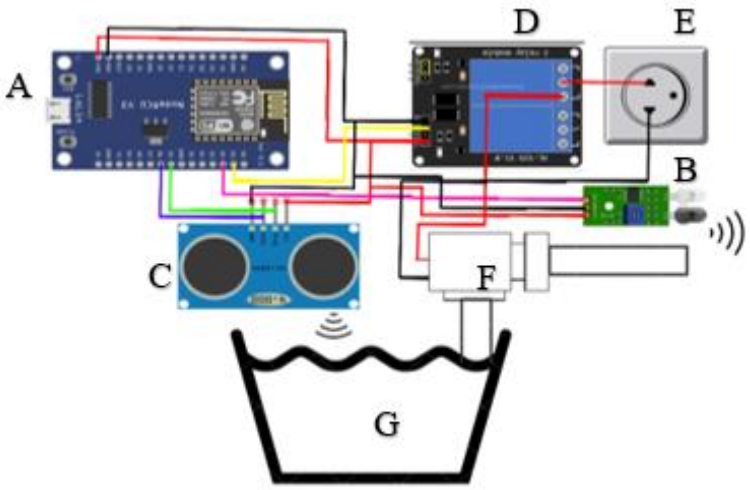

Fig. 2: Overall Series of Tools

The explanation of Figure 2 is as follows:

a. Nodemcu Esp8266 functions as the brain and controller function in the electronic system.
b. Infrared sensors function as object detectors that are in front of the tool. If an object is in front of the sensor, the water pump will turn on.
c. The HC-SR04 sensor sends a message via Nodemcu Esp8266 to blynk, the HC-SR04 sensor functions to measure the water level in the container.
d. The 2Chan 5v relay functions as a switch for the water pump valve.
e. Electric Current serves as the power supply of the device
f. The water pump functions as a water faucet
g. Tap water container

3.4. Flow chart

Software planning starts from making flowcharts (flow diagrams) to facilitate planning and programming on the microcontroller. Making a flowchart (flow chart) also aims to make it easier to understand the work process of this tool. The program flowchart of this Final Project includes tool control systems and work systems. This program can be seen in Figure 3 and Figure 4.

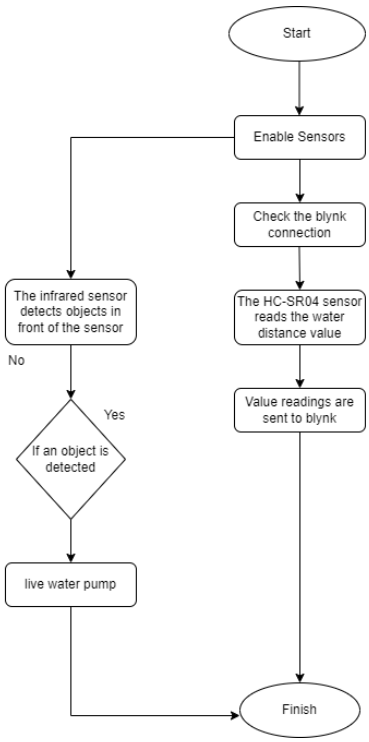

Fig. 3: Flowchart of Automatic Water Tap System

Information :

From the flowchart above it can be explained if the design of this toolconsists from a number of channel.

1. Start the program
2. Perform ON mode on both sensors
3. Do a connection check on b lynk
4. The HC-SR04 sensor reads the value of the water level distance in the container
5. Then the distance value will be sent to the blynk application
6. Infrared sensor detects objects that are in front
7. If Detected The water pump will start and if not, it will detect again
8. And done.

4. Conclusion

After carrying out the design stage and which is then followed by the testing and analysis stage, the conclusions can be drawn:

1. In designing this automatic water faucet, the HC-SR04 sensor is used to measure the water level in the container. Hardware components such as Nodemcu Esp8266, Infrared Sensor, 2 channel 5v Relay, and others are used to control the system automatically. The software used includes the Arduino IDE.
2. The toolkit describes how the components are connected in the system. Sensors detect environmental conditions, Nodemcu makes decisions based on the data received, and the water pump is controlled via a relay.
3. This design combines hardware and software to create an automatic faucet system that is responsive to the water level and the presence of objects in front of it. The prototype method allows iteration and repeated improvement until the desired result is achieved.

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