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DESIGN OF AUTOMATIC HAND WASHING SYSTEM USING SOLENOID VALVE BASED ON MICROCONTROLLER

Muhammad Furqon Siregar[1], Chairul Imam[2]
Department Of Informatics, Department Of Information Technology
Universitas Battuta, Medan, Indonesia
muhammad.furqon.srg@gmail.com

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Abstrak

Nowadays, technology is evolving with the times. Technology is applied and makes it easier for humans to carry out all activities. Researchers take the initiative to see and use technology in daily life, supporting our health. From the research of the results in the field, researchers find problems with washing hands. Everyone is still interacting directly by holding the faucet and soap bottle. From this habit, the virus can be reattached to the hands through the faucet that people have held before. From the research analysis, researchers will make designs to prevent the spread of viruses and bacteria by washing hands. This is an intelligent system design, where is the system integrated with a microcontroller. The prototype system uses a fully automated sensor implementation. It is hoped that this prototype can be applied by segments of the wider community..

Keywords: Technology for Health, Prototype, Innovation Smart System Design

1. Introduction

Technological developments are increasingly playing a role in making it easier for humans to carry out various roles and daily activities. This is supported by the development of the industrial revolution 4.0 era. Where all activities can be done easily, which is integrated with a system that has been designed by the developer, as well as a distributed system built by a programmer [1]. The world is currently faced with the problem of viruses that attack human health. The preventive solution that can be done as early as possible is to wear a mask, keep a distance, maintain health and diligently wash hands. In washing hands, we must use hand sanitizer or soap that must be rinsed with water. This is done so that the virus that is in the palm of our hand will die instantly and not spread anywhere when the hand is holding something [2].

Based on research in the field, everyone who wants to wash their hands always presses the bottle containing liquid soap, then holds the faucet to turn it. However, there are several places that have innovated that place for hand washing without being touched, namely pressing the soap bottle using the footrest lever [3]. According to the view that occurs in the field, the author wants to do research in the form of an Arduino Uno-based automatic prototype system for hand washing [4].

2. Method

In system design, the author uses the prototype method, but the programming system that has been made in Arduino uses the FIFO (First In First Out) system. This FIFO method is a method that carries out the system of arranging the goods that are first entered, then the goods are also the first to be processed for sale (first entered, and first issued) [5]. This purpose is done so that the first goods that enter are sold before the expiration period, and maintain the quality of the product so that it is guaranteed to be fresh and good.

2.1.Microcontroller

Microcontroller is an electronic device in the form of an IC (Integrated Circuit) that can manage input and output data or can manipulate data based on instructions (programs) made by developers and

programmers. Microcontroller is a functional computer system on a chip. Inside the chip contains a processor core, RAM (Random Access Memory), program memory, and input-output processes. How the microcontroller works to read and write data [6].

2.2. Arduino Uno

Arduino is an electronic device that is open source and has hardware and software that is very easy to use. On Arduino Uno, there are input/output ports as input commands or data transmission commands. Arduino has many models and functions according to user needs. The Arduino board that is often used by beginner programmers and professional programmers is the Arduino Uno R3 type [7]. This is because the port used is sufficient for a project.

Figure 1. Arduino Uno R3 (SMD)

In the picture above is the Arduino board used, namely the Arduino Uno R3 SMD type. Arduino is divided into 2 types, Arduino type SMD and Arduino type DIP, the difference is only in the chip and the number of additional VCC - Ground pins. In terms of use, it's the same, but on the DIP Arduino, there is an advantage in the microprocessor chip, on this Arduino, the ATMEGA 328P chip can be replaced if there is damage, the user only plugs in the leg, then the chip can be taken. This advantage is not found in the SMD type Arduino, because the SMD has a built-in IC, the replacement must be done with extra care and the component legs can be removed only by using steam solder. Arduino is designed to facilitate the use of electronics in various fields, in the hardware section it has an Atmel AVR processor, while the software has its own programming language (Siregar, 2017). Arduino Uno type R3 has 20 input-output pins, which consist of 6 analog pins and 14 digital pins.

2.3. Arduino Inputs and Outputs

On Arduino Uno with R3 model, has 14 digital pins, these pins can be used as input or output. Its coding function uses pin Mode(), digital Write(), and digital Read() functions. Input/Output can be operated with a voltage of 3.3Volt-5 Volt, if you want to read or drive a 12 Volt motor, we have to change the mechanics by adding a relay contactor [2]. Each pin can generate or receive a maximum of 40mA and has an internal pull-up resistor of 20-50K Ohms.

There are several pins with specific functions, described as follows:

Table 1. Port Function Specifications On Arduino

Arduino Pins	Port	Function Pin
Serial	0 & 1	RX & TX: This pin can be used as two-way communication, RX is the Receiver (receive), while TX is the Transmitter (sender)
External Interrupt	2 & 3	This pin can be configured to trigger a low value interrupt, a rising, or an uncertain value change.
PWM (Pulse Width Modulation)	3, 5, 6, 9, 10, 11 with “~” logo	This pin supports 8 bit PWM output which can be used as analogWrite().
SPI, MOSI, MISO, SCK	10, 11, 12, 13	This particular pin supports SPI communication, which is supported by other hardware that does not include Arduino.

2.4. Arduino Software

On Arduino, there is an Atmel CPU processor IC type ATMega328, which IC can function with Arduino as a bootloader that allows users to upload new program code without other external hardware. To program an Arduino, users can use a support application to the Arduino, namely the Arduino IDE. Arduino IDE is very good and flexible software, in which there is already a Program Editor, Compiler, and Uploader [8]. The program editor is a window or desktop that provides a new worksheet for users to write and edit programs in Processing Language [9]. The compiler is the action of checking the coding that has been conceptualized by the programmer. While the uploader is the process of uploading a program to the ATMega328 memory chip contained in the Arduino Uno [10].

For programming, Arduino uses the complex C language, which Arduino applications are derived from the low-level C language, to the intermediate level, up to user-friendly.

2.5. Research Stages

For this research to be directed and structured, several stages must be made to get a good result, these stages include:

1. Describing the Problem
   Describing the problem clearly will help in designing and making a design that will be used in everyday life. The design to be made must be based on field research and described in detail. Because this can help to achieve the best solution to overcome the problem.
2. Problem Analysis
   The second step, the thing to do is to analyze the existing problems. This is a step to understanding the problem that has determined the scope and boundaries of the problem. By analyzing the problems that have been determined, it is hoped that these problems can be understood properly.
3. Setting Goals
   Based on the results of understanding the problems of the problems obtained, the authors can determine the objectives to be achieved in this study. In this goal, targets to be achieved will be determined, especially those that can overcome existing problems.
4. Studying the Literature Related to the Title
   To conceptualize and achieve research objectives, it is necessary to study some of the literature that is expected to be used, which refers to the research concept that will be made. Then the literature studied is selected to determine which literature will be used in this study.
5. Data collection
   The data collection needed is data contained in the field based on research. The data is conceptualized from several public opinions and also inputs received from the community segment
6. System Analysis
   System analysis is very important for the design process because on this occasion, the author must look for where the lack of innovations that already exist in the wider community, and must find out whether there are system weaknesses, obstacles that occur, or obstacles in the existing system. will be made, this is so that it is on target to get alternative solutions to the problem
7. System planning
   In designing the system, the author uses a design system using the FIFO (First In First Out) method. This is chosen because users can alternate without a limit on the number of users.
8. Program Structure
   The program structure is something that needs to be considered so that the tool system can communicate with the programmer using serial communication. The program structure design is a description of the communication relationship between the module and other components.
9. Program Results
   For the implementation of the system, the author makes an intelligent system in the form of a prototype. Which prototype can be used in the wider community with an infinite number of limitations.

3. Results and Discussion

3.1. Tool Design

In designing this tool, the author uses several components, including:

1. Arduino Uno, as a tool system microcontroller.
2. Step Down Motor, as a current reducer from 12Volt to 5Volt.
3. Sensor HC-SR04, as input distance is received, then sent to Arduino Uno.
4. Sound sensor, to receive spoken sound
5. *buzzer*, as a sound indicator for device standby, and functions in each of these sounds.
6. 2 servos, to pull the soap bottle lever.
7. *Relay* 12Volt contactor, as a circuit breaker from Arduino to 12 Volt current which is connected directly to the solenoid valve.
8. *solenoid*12Volt, as an automatic faucet, which is commanded from the contactor relay.
9. Iron Buffer, as the foundation of the tool.
10. Acrylic, as the base of the Arduino components, as well as the base of the bucket and soap holder.
11. Soap Bottle (per), as a place to fill liquid soap.

3.3. Flow chart System

So that researchers and readers can understand from this design, then a flowchart concept is made using the tool system. Which is the attached image below:

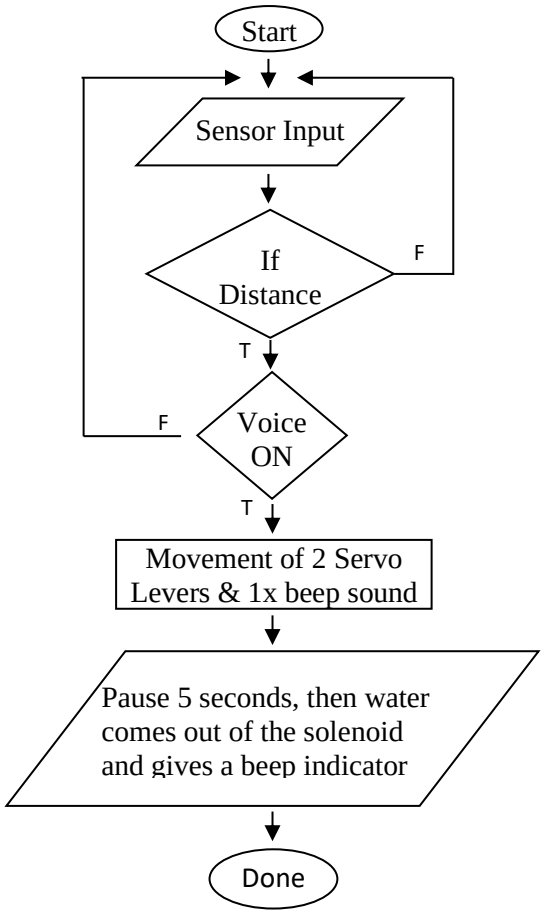

Figure 2. Flowchart of Tool Work System

From the flowchart, the researcher made a tool system that without any human assistance, namely by connecting to an electrical adapter, the device was on standby to be used. The stage begins with input from the sensor, and is given the condition of a distance of 60 cm. if it is detected as smaller

than 60 cm, then the servo and solenoid are working. However, before the solenoid works, there is an additional sensor that must be inputted, namely with the notation "On", if a distance of >60 cm is detected and there is no sound input notation, then the device is only on standby and does not do any work.

3.4. System Test

As for the results of the design and the steps taken, researchers can build based on the results of research and input from several people who have been interviewed. The tool has been built to have a base width of 40cm * 30cm, with a height of 25cm. Due to research, a mini prototype was made and researchers used a piping model, with the aim of replacing water reservoirs or gallon bottles. From the results obtained, users can take advantage of the automatic system by taking turns to wash their hands by standing in front of the prototype and reaching out in front of the soap bottle. If the sensor is read at a distance of <60 cm, then it beeps once, then the user must provide a voice notation with the sound condition "On", it will sound 2x beeps, then the servo pulls the soap lever, and the soap liquid comes out . Users can wash their hands with the liquid soap in 5 seconds. After 5 seconds of running, the water comes out automatically from the solenoid valve. As long as the sensor still detects a distance below 60cm, the water coming out of the solenoid has no limit. The indicator beeps every 5 seconds, indicating the standby tool is still in use (still detected at a distance of <60 cm). Attached are the results of the prototype that has been made for this research.

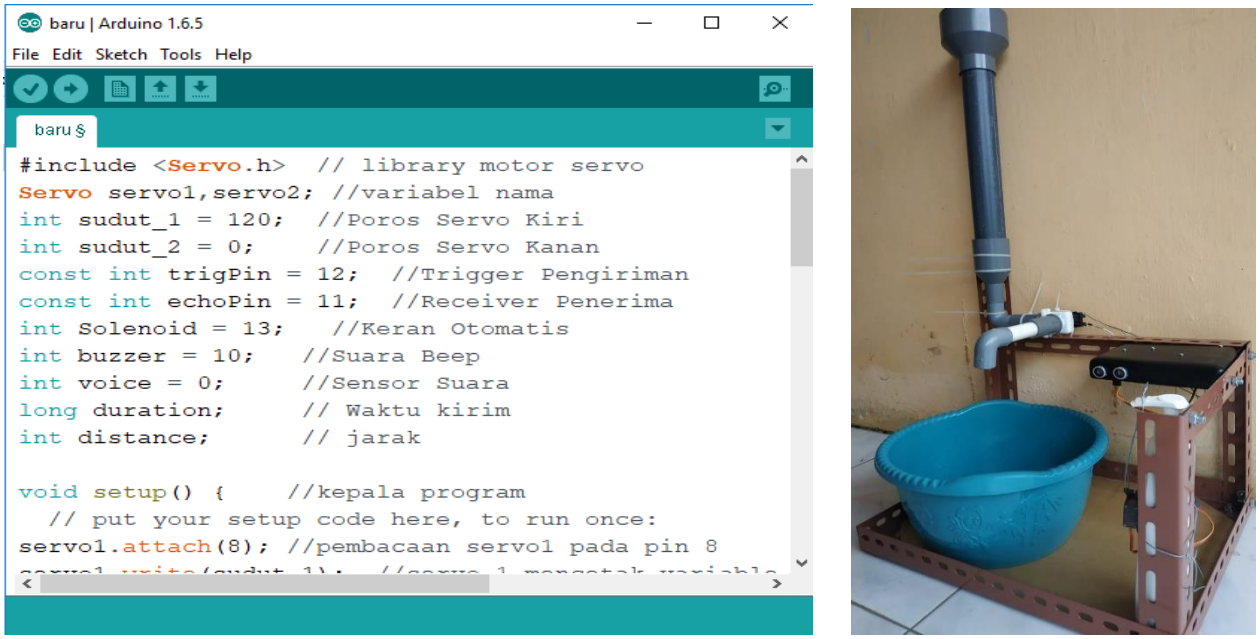

Figure 3. Program Snippets and Prototype Design Results

Results of the tool testing were carried out 100 times, with different interrupts, and the tool was running well without experiencing any problems. This prototype can be applied directly in home installations using water tanks, with the aim that it can be used at the entrance of the house, or at the entrance of the office.

4. Conclusions

After the tests that have been carried out by researchers, starting from research to making prototypes, with the research title Utilizing Solenoid Valves and HC-SR04 Sensors as Arduino Uno-Based Automatic Hand Washers, the following conclusions can be drawn: Has found a solution to the community in washing hands without hesitation every time they touch a faucet or soap bottle that has been touched by someone before. Utilize component modules in daily life that are more beneficial for yourself. This intelligent system is a motivation for students and students to be able to think more

creatively in developing technological knowledge in their daily lives, especially dealing with the problem of the Covid-19 virus which is being widely discussed by the general public. The results of this research, can be dedicated to the community on behalf of the lecturers who are researching and the ranks of students who can be invited to work together as a team.

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