Design Automatic Dispenser for Blind People based on Arduino Mega using DS18B20 Temperature Sensor

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***Abstract*—People with visual disabilities, who have limited vision, will experience many obstacles in carrying out activities and social interaction. Equipment, in general, is not still user friendly for blind people. The purpose of this study was to create an automatic dispenser design that provides convenience and safety for visually impaired people when taking hot water to the dispenser. This study uses Arduino Mega microcontroller as the main control, proximity sensor to detect the presence of glass, and the HC-SR04 ultrasonic sensor as a determinant of high water levels and an SD Card Module to play sound. This research uses the Research and Development (RnD) method. The results of this study are an automatic dispenser that can fill glasses automatically with a glass height of 8 cm, 10 cm, and 12 cm. This dispenser can automatically tell blind people when the glass is full and turn off the tap when the water reaches 1-2 cm from the surface of the glass so that the water in the glass does not spill. Based on the test results, this automatic dispenser can detect glass of any color and make it from melamine, plastic ceramic, iron. However, this automatic dispenser cannot detect glass made of glass and transparent colored glass. When going to use hot water, blind people can choose a temperature with a setpoint of 50ºC, 70ºC, 80ºC. The results of testing the tool using hot water show that the temperature of the water in the glass has a difference of 1°C - 3° C with a setpoint.**

Keywords—water dispenser, Arduino mega, blind, sensor DS18B20

I. INTRODUCTION

According to WHO (World Health Organization) in the key facts of October 2018, it is estimated that around 253 million people suffer from visual impairment and 36 million people experience blindness in the world [1]. Eighty percent of all visual impairments global are considered avoidable with refraction errors and cataracts being the cause main [2]. Blindness is a form of disability that has limitations in vision. WHO held a meeting where the estimated number of blind children was revised to 1.4 million in 1997 [3].

All people with disabilities will experience many obstacles in carrying out social interactions in everyday life. Especially for blind people who have limited vision will have difficulty in carrying out their activities [4]. A simple example is taking water for drinking in a dispenser. If the water to be taken from the dispenser is cold water, then the risk is not dangerous too. But if the blind take hot water, of course, it will be very risky and the hot water may spill on the blind body members.

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Dispensers are a device that supplies water and allow users to take as much water as desired by controlling the power output from a heater induction that has a hot water module based on changes in the flow rate of water supplied or the temperature of the water released [5]. The dispenser as a man-made technology aims to help humans in the flexibility of the placement and taking of drinking water [6].

Some of the benefits obtained from the use of special dispensers for the visually impaired include: (1) It can reduce the risk of taking hot water in the dispenser; (2) It can train independence and help the activities of blind people in meeting their water intake; (3) dispensers can fill water with different glass variations so that the blind do not have to worry about using this type of glass; (4) It can choose the appropriate water temperature according to user needs; (5) It provides a sense of security and eases to use because there are sound indicators that tell blind people that the water has finished filling.

There been many types of dispensers in circulation with various advantages. However, dispensers for the visually impaired are not still much developed. For this reason, research will be carried out by making "Automatic Dispenser Building Design with People Blindness Based on Arduino Mega using DS18B20 Sensor". A dispenser that can automatically fill glasses with different size variations based on the level of the glass height (8 cm, 10 cm, and 12 cm) and it can choose the water temperature as needed with a setpoint of 50° C, the temperature of 70° C and 80° C and sound indicator as a warning that the glass is full.

II. MATERIALS AND METHODS

We used the research and development method Research and Development (R&D). Research and Development (R&D) methods are the research methods used to research a product to produce a new product and then test the effectiveness of the product, so it can function in the wider community [7]. The research and development method was chosen because it is longitudinal and it can still be developed further in the future and relevant to the purpose of the research which to produce certain products in the form of automatic dispensers.

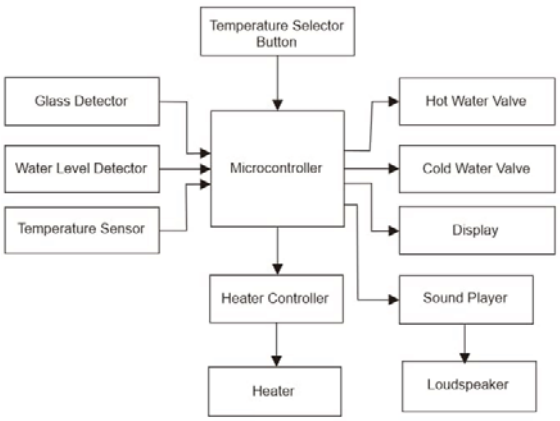

Fig. 1 Flowchart of Automatic Dispenser Design for Blind People

A. Collection Data and Information

The collected data in this study uses observation techniques. The observation technique in this study was used to determine the design and the level of accuracy before planning the manufacture of tools. The tool is designed based on observations about dispensers that have been circulating and then added an automatic system to help visually impaired people by adjusting the ergonomic values and visually impaired needs.

How to use a dispenser is quite easy, by placing the glass under the tap and then turning the water tap, then the water will come out of the dispenser. However, using a dispenser can be some troubles for the blind because they have to touch the glass and place it in the right position and have to estimate when the water is full. A technology is needed to help blind people, so use dispensers to reduce the risk of taking hot water to the dispenser. A dispenser special for the visually impaired that can be adapted to the need of the visually impaired.

B. Tool Manufacturing

In the design of automatic dispensers for blind people using a 220 volt AC voltage to power the dispenser. At the front of the dispenser is given a mat to make it easy blind in placing the glass to fit the position. There are two sides to put the glass, namely, the right side for cold or water fresh and the left side for hot water. A proximity sensor is placed at the front to detect the presence of the glass and the height of the glass. The HC-SR04 ultrasonic sensor is placed on the top of the glass to determine the height of the water when the water almost touches the surface of the glass which is about 1-2 cm.

The water heater system in the dispenser is given a choice of temperature with a setpoint of 50° C, 70° C and 80° C by pressing the button provided it will make a sound when the setpoint is selected. 16x2 LCD is used to monitor the temperature and status of the glass whether the glass can be read by a dispenser or not. The flowchart dispenser working system automatically a tool to help persons with alcohol in taking drinking water in the dispenser is as follows.

The main part of the automatic dispenser is Arduino Microcontroller as the main control which has a program to access data from the input [11] which consists of an ultrasonic sensor, DS18B20 sensor, and keypad/push button switch. The data from the sensor is processed by an Arduino microcontroller to control the Arduino output in the form of a relay module and an MP3 Shield Module. Glass height monitoring and detection of the presence of glass using a photodiode sensor, to monitor the height of water in the glass using the sensor HC-SR04 [9], a photodiode is used to detect glass, while the DS18B20 sensor is to monitor water temperature [10] [11]. The keypad uses a push-button switch for temperature selection. Relay module to control the AC voltage to turn on and turn off the heating element. The automatic dispenser design for visually impaired people is shown in Fig.2.

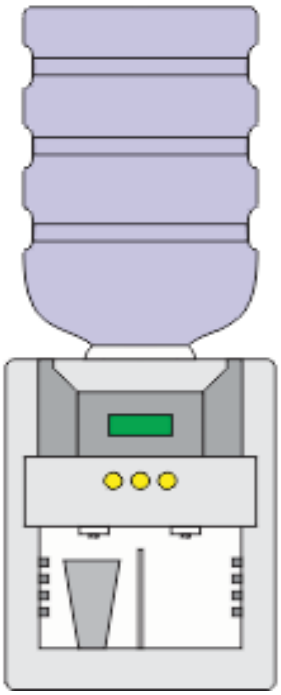

Fig. 2 Automatic Dispenser Design for Blind People

III. RESULT AND DISCUSSION

A. Result Tool

The tool produced in this study is an automatic dispenser used for blind people. This tool will be able to fill the glass with different size variations based on the high level of the glass (8, 10, and 12 cm) automatically. This dispenser can choose the water temperature as needed with a setpoint of 50° C, the temperature of 70° C and 80° C. Sound indicator as a warning that the glass is full.

Fig. 3 Automatic Dispenser Design Results

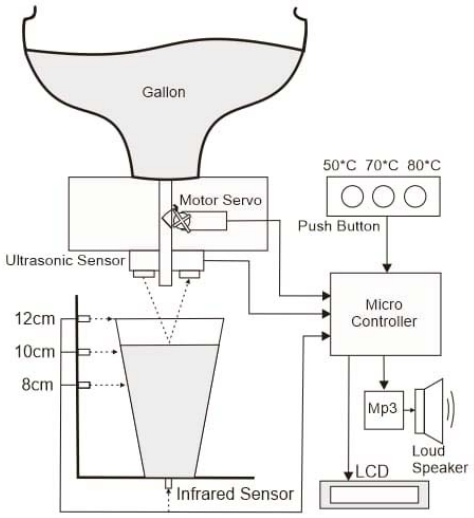

Fig. 4 The automatic water dispenser system

TABLE I. AUTOMATIC DISPENSER SPECIFICATION

No.	Characteristics	Specifications
1	Voltage	220 V
2	Power at Current ON	307 Watt
3	Power at Current OFF	7 Watt
4	Arduino Working Voltage	12 Volt
5	Box Dimension	31 cm x 35 cm x 46 cm
6	LCD Display	LCD x 2

Note:

A. Sound volume
B. 50° C button
C. 70° C button
D. 80° C button
E. LCD 16 x 2
F. Proximity sensor
G. Cold / neutral glass sensor
H. Hot glass sensor
I. Empty glass switch
J. Power switch
K. Heater switch
L. Emergency switch
M. Program probe
N. Reset button
O. Power cable

The specifications of the automatic dispenser as shown inTable.1

B. Automatic Dispenser Spesification

The main part of the dispenser Automatic is an Arduino Mega microcontroller which functions as the main controller in the dispenser automatic, which there is a program to access sensor data ultrasonic, DS18B20 sensor, and push-button. To determine the height of the glass and the sensor of the presence of glass using a photodiode, as well as temperature selection using a keypad. Data from the sensor is then processed and processed by a microcontroller. The sensor HC-SR04 ultrasonic functions as a monitor for the water level in the glass and the sensor is DS18B20 for monitoring the temperature of the water in the dispenser. Arduino gives

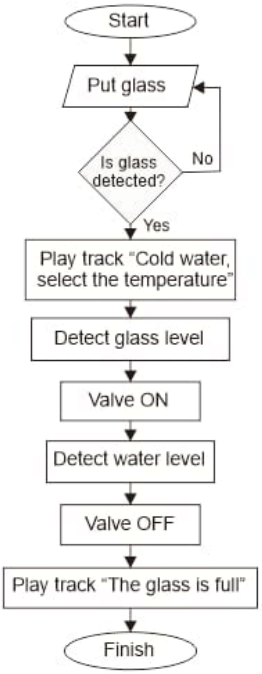

Fig 5. Coldwater system

commands to the AC relay/driver control to turn on the heating element, hot and water pump cold water pump, and the MP3 Module is an indicator when the water is full.

The automatic dispenser for visually impaired users uses 2 (two) systems work, namely cold/ neutral water working system and hot water working system. The working automatic dispenser system is as follows.

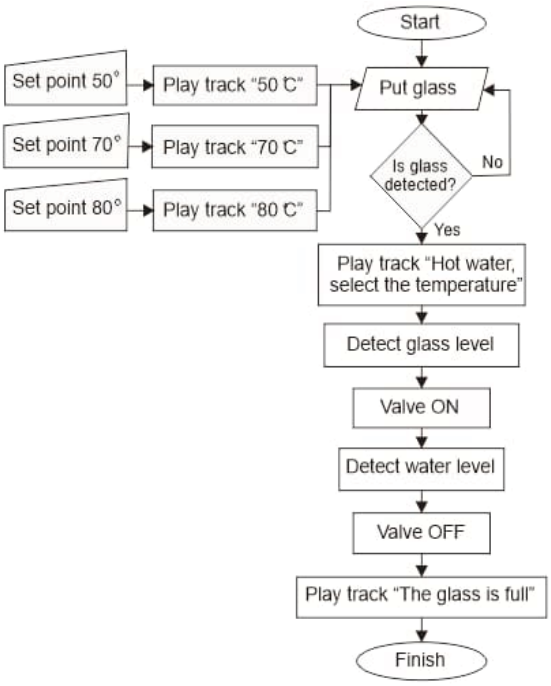

Fig. 6 Hot water system

Fig. 5 Glasses of various Types, Colors, and Sizes

C. *Results test*

Testing of automatic dispenser tools for blind people is done to test the performance of automatic dispensers. Test equipment is divided into 3 types, namely (1) testing the detection of the presence of glass; (2) cold water system testing; (3) hot water system testing. The automatic dispenser testing is as follows.

1. Testing for the Detection of the Existence of Glass

The component which serves to detect the presence of glass in his automatic dispenser is sensor proximity. Testing was done by using different types and colors of glass. The program is run on Arduino by giving a logic pull-up with a 5-volt range when the sensor is proximity neutral or does not detect objects, then the output has sensor logic HIGH and when the sensor proximity detects an object, the 5-volt voltage is connected to the ground and will give commands to Arduino program which has LOW logic [14].

TABLE II. RESULTS OF GLASS DETECTION TESTING

No.	Glass Materials	Glass Color	Output Voltage (volt)	Detection Results
1	Melamin	White	0.01	Detected
		Red	0.01	Detected
		Green	0.01	Detected
2	Plastik	Blue (transparent)	4.2	Not Detected
		Green (transparent)	4.2	Not Detected
		White (transparent)	4.2	Not Detected
3	Keramik	Green	0.1	Detected
		White	0.1	Detected
		Green	0.1	Detected
4	Besi	White	0.1	Detected
5	Kaca	(transparent)	4.2	Not Detected

The glass used in this study consists of various types of materials, sizes, and also varying colors. The glass used consisted of melamine, glass, plastic, ceramic, and iron. The color of the glass used is transparent/clear, white, green, red, blue. The size of the glass starts from a height of 8 cm, 10 cm, and 12 cm. The results of testing the detection of the presence of glass are as follows.

Table II above shows that the sensor proximity can identify all glass except for glass made of glass. It is because made from glass. The glass is transmitting infrared light and cannot reflect infrared light, so the proximity sensor cannot capture the reflection of infrared light and the output has sensor a HIGH logic. Besides, the proximity sensor cannot detect glass transparent/clear. Transparent glass / transparent can not reflect light infrared, so that the infrared light continues and makes the sensor output logic HIGH.

2. Coldwater system test

Testing This test is carried out to determine the level of success in the use of automatic dispensers for blind people. Coldwater testing has a water limit of 2 cm below the high surface of the glass. When the water reaches 2 cm height before touching the glass surface, the servo will close and the cold water tap stops flowing. The safe limit of the glass is expected in this study is 1-2 cm from the surface because when the glass touches a height of 1 cm below the surface of the glass it can be said to be reasonable because of improper ultrasonic sensor readings or when the servo closes there is still a small amount of water dripping.

Ultrasonic sensors are the sensors that have the most impact on the high success rate of water when touching the expected distance. It is because ultrasonic sensors can reflect signals or read objects even if they are tilted especially on glasses that have a slope on the base [12] [13]. The results of testing a cold/neutral water system are as follows.

TABLE I. THE RESULTS FROM A COLD/ NEUTRAL WATER SYSTEM

Glass Height (cm)	Testing					Limit (cm)
	1	2	3	4	5	
8 (small)	2	1	2	1	2	2
10 (medium)	2	2	1	1	2	2
12 (large)	1	1	2	1	2	2

1. Hot water system test

Testing is done by replacing the glass with a different height to determine the success rate of the automatic dispenser. The results of testing the water system work hot are as follows.

TABLE II. HOT WATER SYSTEM TEST RESULT

Glass Height (cm)	Testing-					Limit (cm)
	1	2	3	4	5	
8 (small)	2	1	2	2	2	2
10 (medium)	2	2	2	1	2	2
12 (large)	2	2	2	1	2	2

TABLE III. RESULTS OF DIFFERENCE FROM WATER TEMPERATURE IN GLASS WITH SETPOINT

SETPOINT (°C)	SUHU AIR PADA GELAS (°C)
50	52
70	73
80	81

Testing of hot water systems on automatic dispensers for blind people shows that the high limit water from the glass surface. Ultrasonic sensors have the biggest part in achieving the high expected water level to the glass surface because the glass width factor also affects. After that, the sensor can read on sloping surfaces. Readings ultrasonic sensors on the sloping surface do not always fix and always change, so the placement of the glass must be considered to make the water level as expected.

Tests on this heating system have obstacles that are heating the water because the water is not able to heat up to the expected highest point which is 90 ° C. It is only able to heat up to an average of 82 ° C. It is due to the limitations of the dispenser heating tube. The laying of the temperature sensor is not at the hottest point on the heater, it is because the sensor cannot be inserted in the tube heating. So, the researchers place the heat sensor at the exit point of the heating tube that goes to the heater. Besides that, if the sensor is placed in the hottest spot, the tube must be perforated. It can cause the sensor. It does not read more accurately because the sensor body also measures the plate on the heating tube. And addition, the heater cannot heat up to a temperature of 90 ° C because the tube is in a closed cycle on the dispenser.

IV. CONCLUSION

Based on the results of research on automatic dispenser design for the blind can be concluded that the automatic dispenser for the visually impaired can work filling the glass automatically with sizes different glass(8 cm, 10 cm, and 12 cm) and turn off the tap when the water reaches 1-2 cm from the height of the glass surface. So, it does not spill. Then, the dispenser can choose the temperature. According to the user, they need a choice of 50° C, 70° C, and 80° C.

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