Signal and Image Processing Letters
Vol. 5., No. 1, 2023, pp. 40-47
ISSN 2714-6677
https://simple.ascee.org/

Smart fan using room temperature sensor and human movement

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ARTICLE INFO

Keywords
Fan
Ultrasonic Sensors
LM35 Sensors
PIR Sensors
2 Channel Relay

ABSTRACT

Fans are electrical equipment that people often need in their daily lives. Fans that are available in the market generally use a manual button to turn it on and off. It is necessary to develop a system so that the fan can be turned on automatically without the need to press a button on the fan. The system designed in this study has PIR, LM35 and Ultrasonic sensor devices, while the control uses an Arduino Uno microcontroller. PIR testing is done by measuring the sensor output for each input object movement. The LM35 sensor was tested by comparing the temperature measurement results obtained with the measurement results using a standardized digital thermometer. The ultrasonic sensor is tested by comparing the detected distance reading to the actual distance using a ruler placed under the sensor. Overall system testing is done by observing the fan rotation for each given input parameters. The criteria used are if there is human movement and the room temperature is above 28 0C and the object distance is less than 16 cm, then fan 1 and fan 2 rotate simultaneously. Another criterion, if the temperature is below 28 0C, then fan 1 turns off even though there is human movement and fan 2 remains on because the object distance is limited to less than 16 cm. The results showed that the system had worked well, namely fan 1 and fan 2 had behaved according to the specified criteria. This system is expected to be used to assist humans in operating the fan automatically based on room temperature, human movement, and human distance.

1. Introduction

Against the development of innovation now, a group of researchers' minds are so creative. Advanced digital framework is applied to microcontroller technology [1]. This system works on the framework from tool to programmatic. The formation of this tool is planned to see the use of the microcontroller as a fan controller [2]. Usually the fan turns on in the house is directed by a switch, so turn on and turn off the fan by adjusting the fan speed by pressing the fan button. The presence of an automatic fan control system that can turn on and accelerate the speed of the fan can make it easier for humans because there is no need to press a manual button [3].

Utilization of electrical energy is carried out periodically due to human needs, for example, the lights are on without being turned off, the fan is on but no one is in the room [4]. It is believed that community groups that utilize power can minimize the cost of using electrical energy at home or in their respective workspaces [5]. In order to save energy, it must be possible with controlled electronic systems to reduce continuous electricity usage [6]. Therefore, planning a programmed control framework for the device in order to save electricity [7].

People nowadays need improvement to move their life. For example, a fan is a tool used to reduce heat in a room [8]. From the beginning the fan was only in the form of woven bamboo which was moved manually and gradually the fan changed to an electric fan which involved a dynamo as a wind generator [9]. Its use is also very simple, the user only needs to press the speed control button (speed 1, 2 or 3). Not only that, fan makers are now growing by having clocks that can be used to determine how long the fan will work [10].

In regular daily life, a person needs a comfortable place or room so they can focus on the field they are doing. Hot conditions can cause discomfort when in the room for activities. Room temperature and humidity can affect work [11]. Working with a room temperature that is hot enough definitely reduces the body's capacity to create weakness [12].

This increase in earth's temperature will obviously affect the comfort of humans who are in the room. The room conditions were too high after that, plus being in a closed room. Of course, we will need a tool that can cool the room temperature, especially fans [13]. However, the drawback with this fan is that we are a bit bothered by pressing the on button to turn on or turn off the fan if it is not in use anymore [14].

The increase in the foundation was followed by an expansion of the office by cooling the room using air conditioning (refrigeration) and fans so that in the end the electricity bill would be higher [15]. One of the techniques that is currently being carried out with the aim of saving funds is using a computerized system on the cooling system and lighting system in the office, while the use of fans is still mostly using the usual system, to turn on and off still using the buttons on the fan [16].

2. Method

2.1. System Design

In designing this system, a system design is used with two design stages, namely hardware design and software design. The first step in designing this system is to make a hardware block diagram, then proceed with making sensor circuits such as ultrasonic sensors, LM35 sensors, and PIR sensors [17]. The second step is to create software/commands used to operate the monitoring system [18].

2.2. Hardware Design

To simplify the design of the tool, block diagrams are used as the first step in making the tool. This block diagram describes in general how the circuit works as a whole. Shown in Fig. 1.

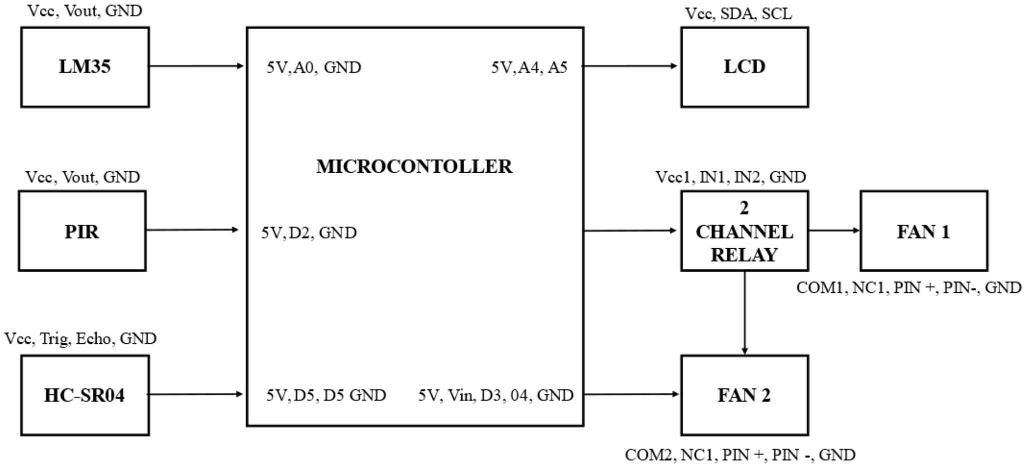

Fig. 1. Tool design block diagram

The picture above is a Tool Design Block Diagram with several explanations of the component parts and their functions in this tool design system:

1. PIR sensors are used to read human movements and also as input.
2. The LM35 sensor is used to detect the temperature in the room and is also used as data input.
3. Ultrasonic sensors are used to determine the distance to a human movement and also as input.

4. The microcontroller is used to control the PIR sensor, LM35 sensor and ultrasonic sensor.
5. The 2 channels relay is used to activate the relay with commands according to the detection conditions of the PIR, LM35 and ultrasonic sensors so that the fan will turn on.
6. The fan is the most important part of the design system which has the function of producing air, so that it can be circulated to the human body when indoors.

The circuit shown in Fig. 2 is a circuit in a fan system where the voltage source comes from a 12 V adapter that connects to the Arduino then on the ultrasonic sensor there is a VCC connected to the 2 channel relay to VCC 1 then the TRIG on the ultrasonic sensor will connect to pin 5 Arduino then the ECHO pin on the ultrasonic sensor will be connected to Arduino pin 6.

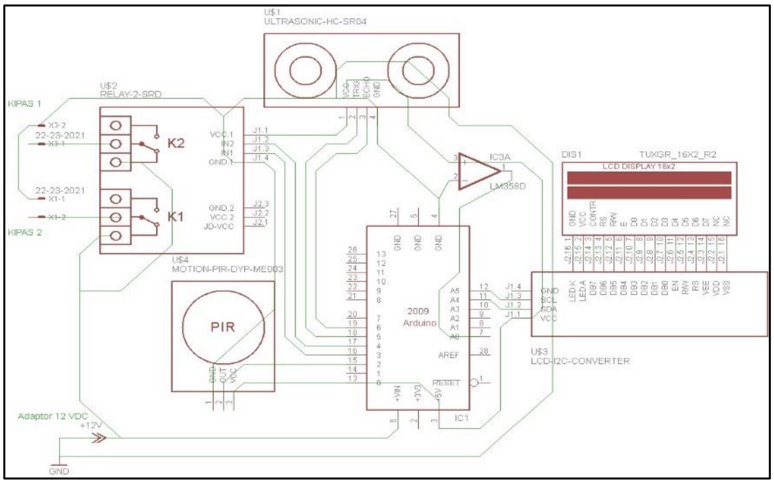

Fig. 2. Circuit diagram of the entire system

For the LM35 sensor there is pin 1 input voltage (+) connected to VCC on ultrasonic and also connected to VCC LCD converter for pin 3 (–) will be connected to GND while pin 2 output will be connected to A0 Arduino, then the PIR sensor on VCC will be connected to 5V Arduino for output will be connected to pin 2 Arduino. While the 2 channel relay on VCC 1 is connected to VCC ultrasonic on IN 2 it is connected to pin 4 Arduino and IN 1 is connected to pin 3 Arduino for common pin K1 will be connected to fan 2 while common pin K2 will be connected to fan 1, to monitor the fan Wind uses a 16x2 LCD where VCC is connected to 5 V Arduino then SDA is connected to Arduino A4 pin and SCL is connected to A5 pin. Input and output on Arduino can be seen in Table 1.

Table 1. Input output table

Arduino Uno	Sensors/Actuators
A4, A5, 5V	LCD
A0	LM35
Pin 2, 5V	PIR
Pin 3, Pin 4	Relay 2 Channel
Pin 5, Pin 6	Ultrasonic

2.3. Software Design

Fig. 3 is an explanation of the flowchart of the fan that is made. This flowchart explains the working system of the fan, in which the first step is the input process from the LM35, PIR, and ultrasonic sensors. The three inputs will be controlled by the same microcontroller to control the fan.

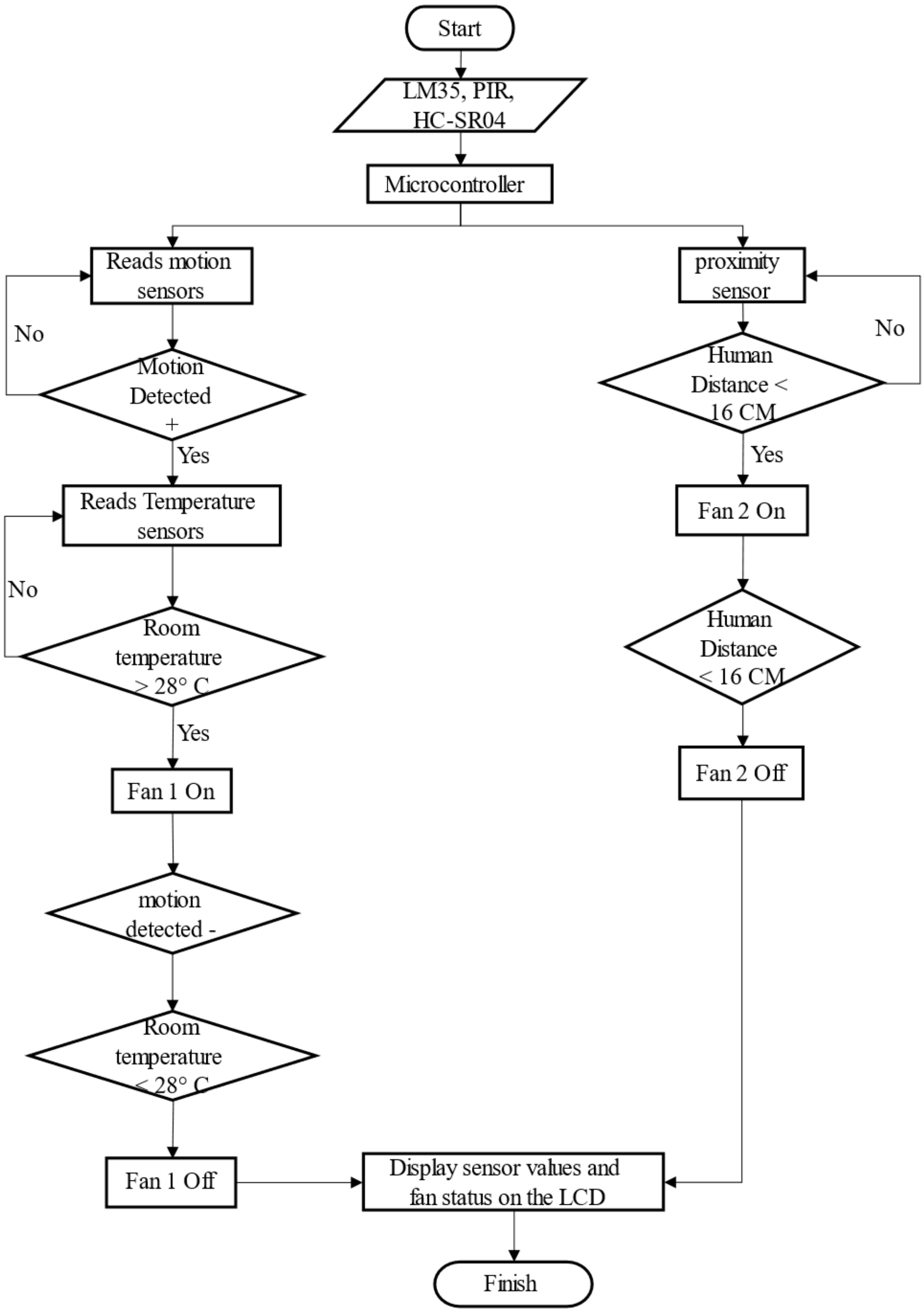

Fig. 3. Flowchart of the process of reading and sending data

When the process from the PIR sensor detects human movement in the room (There is movement +) then proceed to the process from the LM35 sensor to detect room temperature, if the room temperature is more than 28° C then fan 1 will turn on automatically and when fan 1 turns off automatically if the PIR sensor detects human movement in the room (There is movement -) then the LM35 sensor detects a room temperature of less than 28° C. For fan 2, namely the process of detecting human distance using an ultrasonic sensor, when the human distance is limited in the room less than 16 cm, fan 2 will turn on automatically and if the human distance in the room is more than 16 cm then fan 2 will automatically turn off. From the fan 1 and fan 2 testing process for the display of LM35, PIR, and Ultrasonic sensor values, the fan status will be displayed on the LCD screen. Fan 1 and fan 2 turn on simultaneously when the PIR sensor detects human movement (There is movement +) then the LM35 sensor detects a room temperature of more than 28° C and an Ultrasonic sensor detects that human distance is limited in a room of less than 16 cm. Fan 1 and fan 2 will turn off when the PIR sensor detects human movement in the room (There is movement -) then the LM35 sensor detects a room temperature of less than 28° C and a distance to humans of more than 16 cm [19].

2.4. Research Flowchart

In this study, the process of identifying problems with smart fans was carried out using room temperature sensors and human motion. The factor that becomes a problem is the measurement at the distance of the object when it is in front of the ultrasonic sensor [20]. Then a supporting literacy study was carried out to design the appropriate hardware. After the hardware design is complete, software is created to read data from the three sensors. Furthermore, testing data measurements of distance, temperature and human movement after the sensor is working properly, the fan will work. The following research flowchart is in Fig. 4.

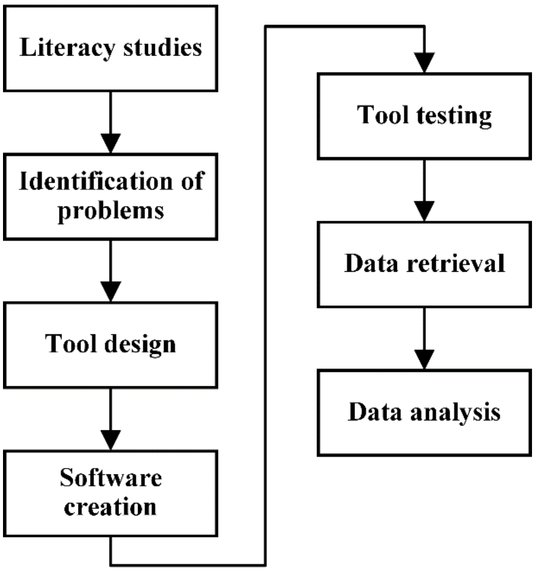

Fig. 4. Research flowchart

3. Results and Discussion

3.1. Ultrasonic Sensor Testing

Data testing is done by bringing an object closer to the front of the ultrasonic sensor with a distance of <16 cm. When the object is less than < 16 cm away, the ultrasonic sensor will work. To see a comparison of the ultrasonic sensor with a ruler can be seen in Table 2.

Table 2. Testing of ultrasonic sensors with a ruler

Num	Ruler (cm)	Ultrasonic(cm)	Difference (cm)
1	7	7	0
2	10	9	1
3	10	10	0
4	11	11	0
5	13	13	0
6	16	15	1
7	17	17	0
8	19	19	0
9	20	20	0
10	23	22	1

3.2. LM35 Sensor Testing

The results for testing the LM35 sensor can work properly without any problems when measuring room temperature in the morning, afternoon and evening as shown in Table 3. The error value obtained when testing the LM35 sensor is 1.9%.

Table 3. Testing the LM35 sensor with a thermometer

Morning 09.15	Thermometer	Sensors	Error %	Difference
1	29,6	29	2,0	0,6
2	29,9	29	3,1	0,9
3	31,5	30	5,0	1,5
Afternoon 12.05	**Thermometer**	**Sensors**	**Error %**	**Difference**
1	29,9	29	2,0	0,9
2	29,8	30	0,7	0,2
3	29,7	30	1,0	0,3
Evening 15.25	**Thermometer**	**Sensors**	**Error %**	**Difference**
1	30,6	30	2,0	0,6
2	29,3	29	1,0	0,3
3	28,9	29	0,3	0,1
Average Error Value			1,9	

3.3. PIR Sensor Testing

Testing the PIR sensor can be carried out using a human movement detection method covering three positions, namely left, right and in front of the sensor. From these three movements the PIR sensor will emit infrared through Fresnel and then it will hit the pyroelectric part because infrared light can have heat so that the pyroelectric will produce an electric voltage source. The PIR sensor can issue logic values 0 and 1, logic 0 values when the sensor does not respond to human movement while logic 1 values when the sensor detects human movement. Shown in Table 4.

Table 4. PIR sensor testing

Num	Left Position	Front Position	Right Position	Human Movement
1	3 cm	2 cm	3 cm	Detected
2	5 cm	4 cm	4 cm	Detected
3	6 cm	5 cm	6 cm	Detected
4	8 cm	9 cm	7 cm	Detected
5	10 cm	10 cm	10 cm	Detected

From Table 4 the results of testing the PIR sensor can work properly. In the three testing positions for human movement, namely the left, front and right positions, it can be performed well when tested at a distance as shown in Table 4 without any interference, while the maximum detection distance on the PIR sensor for human movement or other objects is approximately 4 meters.

3.4. 2 Channel Relay Testing

In testing this 2 channel relay based on 3 sensors namely ultrasonic sensor, lm35 sensor and PIR sensor, these three sensors work in a different way where ultrasonic sensors are used to measure distances to humans <16 cm so fan 2 will turn on while the lm35 sensor is used to detect room temperature > 28 o C then the PIR sensor is used to detect human movement so that fan 1 will turn on. In Table 5, a test is carried out using 2 sensors on fan 1 while fan 2 uses 1 sensor.

Table 5. 2 channel relay testing

Channel Relay	Fan
Channel 1	Fan 1 turns on according to temperature > 28^o C And there is a movement towards humans
Channel 2	Fan 2 turns on when human distance < 16 Cm

3.5. Set of Tools

In this fan circuit, it is a series with a whole that has been assembled into one part where the adapter is the voltage source for the fan, then an ultrasonic sensor is used to determine a distance to humans, then a PIR sensor is used to detect a movement in humans, and an lm35 sensor is used to detect room temperature, by stringing them together, it is called a fan using room temperature sensors and human motion which can be seen in Fig. 5.

Fig. 5. Series of fan tools

4. Conclusion

Research and design of smart fans based on room temperature variables and human motion has resulted in a fan that can rotate automatically based on variable conditions, implemented a microcontroller based on 3 inputs, and tested with room temperature conditions. In morning conditions at 09.15 with a temperature of 29 0C, afternoon at 12.05 with a temperature of 30 0C, and in the evening at 15.25 with a temperature of 29 0C, then the condition of the PIR sensor detects human movement and Ultrasonic sensor detects that human distance is limited to less than 16 cm so fan one and fan two can live together.

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