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SPLIT DUCT AC LEAKAGE MONITORING SYSTEM VIA GOOGLE SHEETS

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ABSTRACT

General Background: Split duct air conditioners are prone to leaks, often resulting from corrosion in water catchment systems, which can lead to significant operational hazards such as electrical fires. **Specific Background:** Given the prevalence of these issues, there is an urgent need for effective monitoring solutions to maintain optimal air conditioner performance and prevent leaks. **Knowledge Gap:** Current monitoring systems lack integration with real-time data reporting mechanisms that can alert users promptly to potential issues. **Aims:** This research aims to develop a monitoring device utilizing NodeMCU ESP8266, water level sensors, and Google Sheets to enable real-time monitoring and management of water levels in split duct air conditioners. **Results:** The device successfully operates by turning on the fan when water levels are below 2 cm and activating the pump when levels exceed this threshold. The data is continuously sent to Google Sheets, allowing for easy monitoring and management. **Novelty:** This study presents a novel approach to air conditioner leak monitoring by integrating IoT technology, offering an efficient and user-friendly solution for residents. **Implications:** The developed monitoring tool significantly enhances the ability to detect and manage potential leaks in real time, thereby improving safety and operational efficiency. Future research should focus on enhancing sensor accuracy through specialized equipment and exploring alternative IoT platforms for improved data visualization, thereby providing users with an even more effective monitoring experience.

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INTRODUCTION

Utilization of air conditioning devices (Air Conditioner/AC) in maintaining the temperature of residential spaces has become a common practice in various types of buildings such as residential houses, hotels, educational institutions, and office spaces.

This phenomenon is closely related to Indonesia's tropical climate conditions which significantly affect people's daily lives [1].

Choosing the right air conditioning device has various benefits, especially related to energy efficiency which can help reduce carbon dioxide (CO2) gas emissions thereby minimizing air pollution, as well as reducing costs during long-term use. In addition, the ideal room temperature can maintain the comfort of residents so that they avoid stress and maintain productivity levels at the desired level [2].

One type of air conditioner that meets the above factors is Split Duct. AC split duct is often referred to as air handling system, where the room temperature setting is controlled at one central point and the temperature distribution is carried out with a ducting system that brings air conditioning to be evenly distributed in each room with minimal indoor installations [3] [4].

To achieve optimal performance in its operation, air conditioners require proper and planned maintenance [5]. Dirty and unmaintained air conditioning components can cause blockages in the air conditioning ducts and less than optimal air conditioning in producing cold air [6]. There are several main components in a split duct air conditioner, namely a compressor, condenser, blower, air filter, and evaporator. In simple terms, air conditioners use evaporators to absorb heat (heat) and then convert the heat into cold air and be distributed by fans. This process produces used water for heat absorption that is stored in the sewer gutter. The longer it is left unchecked, the water can cause corrosion that forms holes so that water can flow to the place where the AC fan dynamo is located and cause the dynamo to catch fire. The condition of these shelter gutters is often found by field technicians and has a negative impact on users because the air conditioner has to experience down-time so that it cannot be used and the repair cost is relatively expensive.

Therefore, it is necessary to have a periodic monitoring system to avoid the possibility of leaks in the air conditioning gutter shelter. With the advancement of today's internet of things technology, checking the condition of the air conditioner can be done anytime and anywhere.

Previous research from Gohi Diori (2019) shows that monitoring the condition of air conditioners can be done easily. The system uses Arduino as a microcontroller combined with several sensors such as water level sensor, hall effect sensor, ds18b20, and PIR sensor. The results of the study show that the air conditioner will turn on automatically when there are people in the room, then the ds18b20 sensor to regulate the room temperature, and finally the water level sensor and hall effect sensor to detect damage to the air conditioner. Reading data can be monitored through the Thingspeak platform [7].

Research from Hendro Widiarto (2022) uses Arduino UNO, DHT22 sensors, PIR sensors, and relays applied in multipurpose seminar rooms. The system can automate the turn on and off of the air conditioner and optimize the temperature based on the number of people in the room by utilizing a relay to switch between half pk and one pk [8].

Research from Eka Afdi Septiyono Aji (2023) regarding a leak monitoring system in split duct air conditioners using NodeMCU ESP8266 and water level sensors, the results of which are then sent to the Blynk application through a protocol internet of things. The system uses a relay to regulate the fan flame and a pump to discharge water when the water in the gutters reaches a certain limit [9].

The current research develops several sectors from previous research. The current system uses a NodeMCU ESP8266 microcontroller equipped with a relay and a 16x2 I2C

LCD as an output device. The main update given is the implementation of Google Sheets for the automatic monitoring process of air conditioning gutter conditions [10]. Google Sheets makes it easy for users to have a transparent recap system that is easy to modify as they see fit. [11] [12] [13]

With the creation of this system, users can minimize damage to the split duct air conditioner churder with a periodic monitoring system so that users can quickly identify and overcome obstacles that arise during the operation of the air conditioner [14] [15].

METHODS

This study uses the research and development method, where researchers test the effectiveness of the tool by conducting experiments, revisions, and finalizing designs and components in one complete tool to achieve research objectives [16] [17]. The stages of research in the R&D method include:

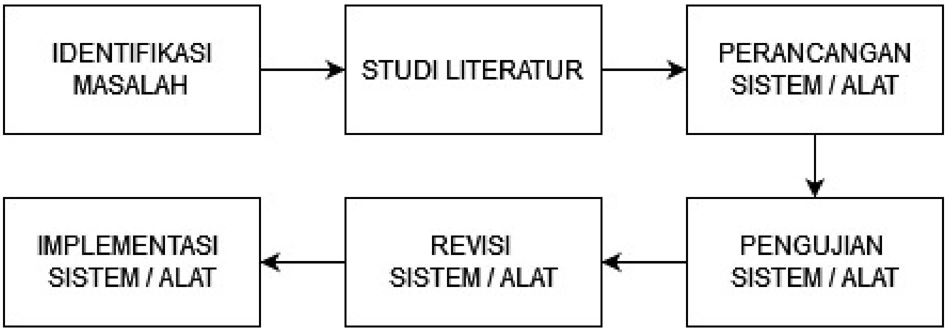


Figure 1. Flow of research methods

The stages of the research can be explained as follows:

1. Problem Identification: Make observations on the condition and operation of the split duct air conditioner.
2. Literature Studies: Gathering sources of information relevant to current research through books, journals, scientific papers and other sources of related research to examine the components and how tools work such as water level sensors, NodeMCU ESP8266, Internet of Things, water pumps, relays, and Google Sheets.
3. Design: Design is carried out by determining how the device works and designs, by combining components in the form of sensors, microcontrollers, and other supporting components in one complete system.
4. Testing: Reliability and accuracy testing is carried out to ensure that the tool functions in accordance with the research objectives. Testing is carried out several times with the same variables so that consistent results are obtained. The test results were then analyzed and discussed in more depth.
5. Revision: After going through various tests, conclusions can be drawn regarding the performance of the tool in accordance with the research objectives, the

weaknesses found after the test are then collected and recommendations are designed for better future research.

6. Implementation: A tool that has gone through a testing and revision process and then implemented in accordance with the original purpose of the research.

A. Block diagram

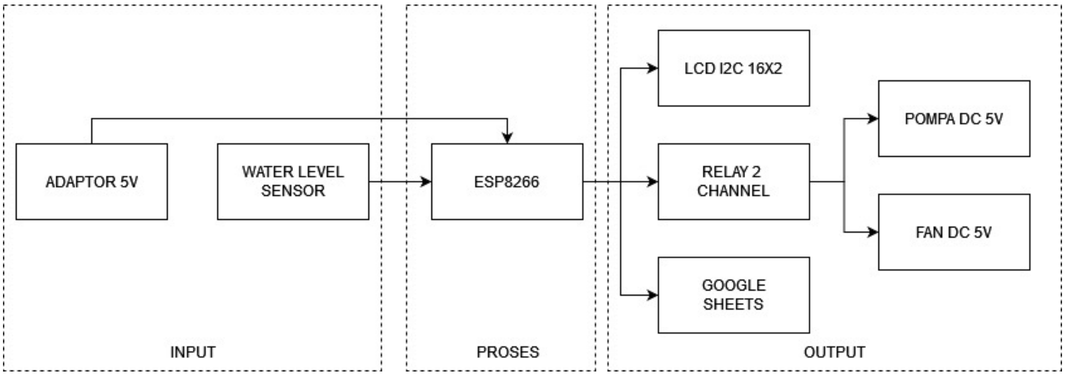


Figure 2. Block Diagram

The system is powered by a 5V adapter and a water level sensor that functions as an input component, after which the data from the water level sensor readings is processed by the NodeMCU ESP8266. Then, the reading data is displayed by a 16x2 I2C LCD then a 2-channel relay will control the turn on and off of the fan or pump according to the logic in the NodeMCU program ESP8266. Finally, the data from sensor readings and the condition of the fan or pump is sent to Google Sheets for *monitoring* by the user.

B. Wiring diagram

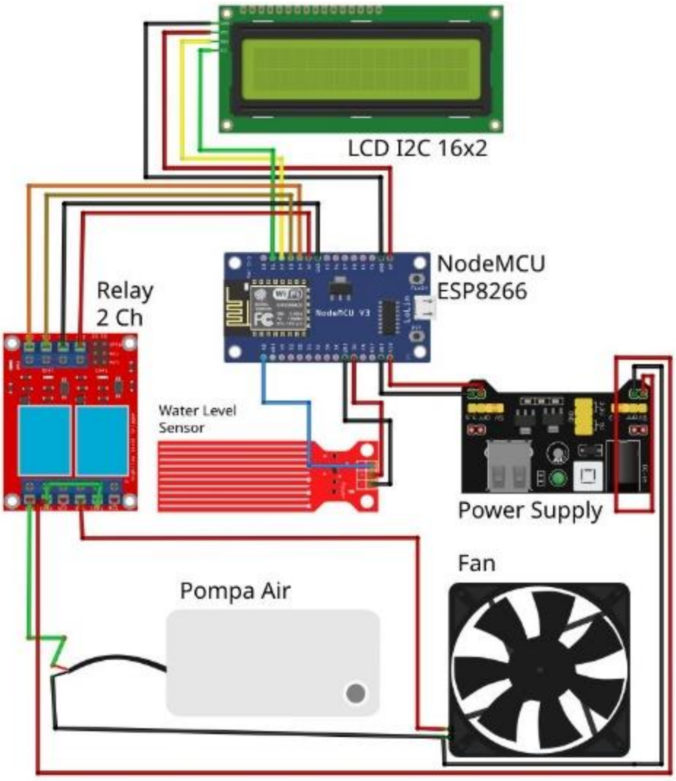


Figure 3. Wiring Diagram

The wiring diagram starts with the positive wire of the adapter connected with the VIN pin and the negative wire of the adapter with the GND pin of the ESP8266. After that, the water level sensor is connected to pin A0 as an analog input to obtain sensor reading data. Then, the SDA pin with pin D2 and the SCL pin with pin D1 ESP8266. Then connect pins D5 and D6 of the ESP8266 as IN1 and IN2 on the 2 channel relay. The positive wire of the fan and pump is connected NO (Normally Open) with a relay.

C. Flowchart

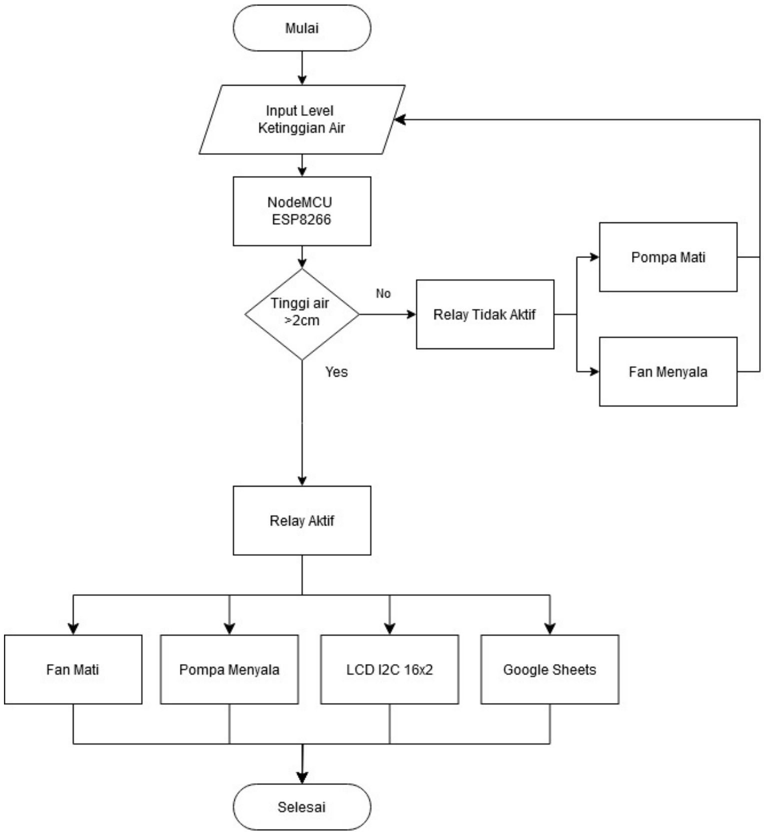


Figure 4. Flowchart Tools

The flowchart starts with the input of the water level obtained from the water level reading data of the sensor which is then processed by the NodeMCU ESP8266. Then there is a *decision* where the main parameter is whether the condition of the water catchment gutter is above 2cm? If NO, the water level is below 2cm, then the relay will be in an inactive condition so that the fan turns on normally and the water pump is off. If YES, the water level is above 2cm, then *the relay* will turn off the fan and the water pump will turn on to suck the water out of the reservoir. The reading data is then sent to the 16x2 I2C LCD as a *display* to the user and Google Sheets through the *internet of things* protocol for automated *monitoring* of the condition of the shelter.

RESULT AND DISSCUSION

A. Water level sensor testing

The water level sensor test is intended to determine the maximum *analog value* of the sensor used as a reference in program making. The test was carried out by submerging the sensor until the entire plate was wet with water. The test results are shown in the following table:

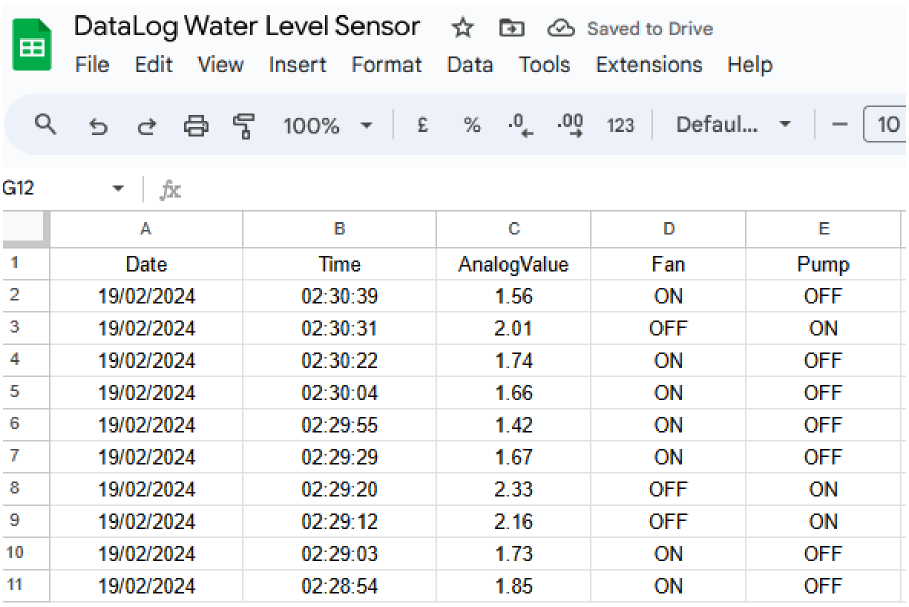
Table 1. Analog Value *Test Results* of Water Level Sensor

It	Water Level (cm)	Analog Value of Sensors
1	0	0
2	1	180
3	2	363
4	3	554
5	4	706

The table above shows the results of the *analog value* readings obtained from the sensor viewed through the serial monitor. *The analog values* above are then applied to the program to determine the water level detected by the sensor.

B. Sensor reading data conformance testing with Google Sheets

This test is aimed at ensuring that the data transmission from the sensor to Google Sheets runs according to the logic given in the program.



Date	Time	AnalogValue	Fan	Pump
19/02/2024	02:30:39	1.56	ON	OFF
19/02/2024	02:30:31	2.01	OFF	ON
19/02/2024	02:30:22	1.74	ON	OFF
19/02/2024	02:30:04	1.66	ON	OFF
19/02/2024	02:29:55	1.42	ON	OFF
19/02/2024	02:29:29	1.67	ON	OFF
19/02/2024	02:29:20	2.33	OFF	ON
19/02/2024	02:29:12	2.16	OFF	ON
19/02/2024	02:29:03	1.73	ON	OFF
19/02/2024	02:28:54	1.85	ON	OFF

Figure 5. Data View in Google Sheets

The image above shows a Google Sheets display filled with four main data, namely, "Date" which contains the date, "Time" which contains the time of sending the data, "AnalogValue" which is the altitude data detected by the water level sensor, "FAN" is the condition of the fan, and finally "PUMP" which means the condition of the pump.

Table 2. Data Fit Testing Results from the Tool with Google Sheets

No	Water Level Sensor Reading (cm)	Sensor Reading Data Display on Google Sheets (cm)	Delivery Status to Google Sheets
1	1.56	1.56	Succeed
2	2.01	2.01	Succeed
3	1.74	1.74	Succeed
4	1.66	1.66	Succeed
5	1.42	1.42	Succeed
6	1.67	1.67	Succeed
7	2.33	2.33	Succeed
8	2.16	2.16	Succeed
9	1.73	1.73	Succeed
10	1.85	1.85	Succeed

Based on the table above, it can be concluded that the data transmission to Google Sheets is running optimally and the data sent corresponds to the sensor reading data displayed on the 16x2 I2C LCD.

C. 16x2 I2C LCD Testing

The 16x2 I2C LCD test is intended to ensure the LCD components can display sensor readings and relay condition data on the tool. The data text displayed on the LCD is "WLevel" which represents the level of water level detected by the sensor, then "F" means fan and then "P" means pump. The test is shown in the following image:

Figure 6. 16x2 I2C LCD Display when the Tool is Working

The image above shows that the 16x2 I2C LCD can display water level data and fan and pump conditions clearly.

D. Overall tool testing

This overall test is aimed at testing the suitability of the tool with the program's logic and the initial objectives of the research. The test was carried out ten times and then presented in the table below:

Table 3. Overall Tool Testing Results

No	Water Level Sensor Reading (cm)	Sensor Reading Data Display on Google Sheets (cm)	Condition Pump	Condition Fan	Delivery Status to Google Sheets
1	1.56	1.56	OFF	ON	Succeed
2	2.01	2.01	ON	OFF	Succeed
3	1.74	1.74	OFF	ON	Succeed
4	1.66	1.66	OFF	ON	Succeed
5	1.42	1.42	OFF	ON	Succeed
6	1.67	1.67	OFF	ON	Succeed
7	2.33	2.33	ON	OFF	Succeed
8	2.16	2.16	ON	OFF	Succeed
9	1.73	1.73	OFF	ON	Succeed
10	1.85	1.85	OFF	ON	Succeed

The table above shows that the tool can work according to the given program logic, namely when the water level sensor reading is below 2cm, the fan turns on and the pump turns off, while if the water level sensor is above 2cm, the fan turns off and the pump turns on, sucking water so that the churrah is clean of water that causes corrosion.

Sending data to Google Sheets displays optimal results with compatibility with sensor reading data as the tool works for easy monitoring by the user.

CONCLUSION

In conclusion, this study successfully developed a monitoring device for split duct air conditioners that effectively prevents leaks by utilizing the NodeMCU ESP8266, water level sensors, and Google Sheets for real-time data monitoring. The **Fundamental** Finding is that the system operates efficiently, with the relay logic ensuring the fan activates when water levels fall below 2 cm and the pump engages when levels exceed this threshold, facilitating prompt action to prevent damage. The **Implication** of this research is significant, as it provides residents with an automated solution for monitoring air conditioner conditions, thus enhancing safety and operational efficiency. However, the **Limitation** of the current system lies in its reliance on specific sensor accuracy, which can impact the reliability of monitoring. **Future research** should focus on improving sensor accuracy by exploring specialized water level detection technologies and investigating alternative IoT platforms that offer more compact and user-friendly displays for enhanced data visualization.

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