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Affordable Smart Humidifier for Indoor Application

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Abstract - *Proper humidity ensures comfort and creates a healthy indoor environment. Traditional humidifiers lack the efficiency and intelligence to change dynamically with fluctuating environmental conditions. This paper presents an affordable smart humidifier system that makes use of advanced technology in managing room humidity. The controlling unit is an Arduino microcontroller that continuously monitors parameters like humidity, temperature, and air quality. It monitors in real time the moisture provided by a humidity sensor and the data is processed by Arduino. When the humidity goes below the threshold value, it triggers a relay module that, in turn, activates the spray module, injecting moisture into the air from an external water container. The proposed work aims to develop an affordable smart humidifier for indoor applications.*

Key Words: **Arduino UNO, Humidity Sensor DHT11, OLED display, Relay, Spray Module**

1. INTRODUCTION

A smart humidifier is an intelligent device that is responsible for regulating and maintaining the highest possible humidity in a room or space to provide comfort and healthy living conditions. Humidity is among the most pertinent factors in indoor air quality that relates directly to health and comfortable living. Indoor heating can drastically reduce the humidity levels in dry climates or during winter months, leading to dry skin, respiratory issues, and overall discomfort. A smart humidifier resolves these issues with its automatic adjustment of humidity within a desirable range and is thus considered to be a very important tool in improving indoor air quality. The backbone of the smart humidifier is an Arduino microcontroller. The Arduino is programmed to command the different sensors and components that make up the smart humidifier.

2. LITERATURE SURVEY

The Arduino microcontroller board is highlighted for its versatility and efficiency in various applications, with particular emphasis on its ease of use, open-source nature, and ability to seamlessly integrate with sensors and actuators. These features make it ideal for projects requiring precise control and automation [1]. The Arduino is highly suitable for developing a smart humidifier, as it effectively manages the humidity levels by controlling the humidification process based on real-time sensor data.

The Arduino plays a significant role in prototyping across various domains, emphasizing its widespread use driven by cost-effectiveness, ease of programming, and strong community support. Despite challenges like limited processing power and memory, which may pose constraints for complex projects, the review highlights Arduino's suitability for applications such as a smart humidifier. Its advantages, including rapid prototyping and the flexibility to integrate sensors, make it a practical choice for developing efficient and responsive control systems [2].

The Arduino-based microcontrollers along with suitable sensors have been used for monitoring environmental parameters, specifically humidity and temperature. Arduino is highly effective in integrating with sensors to provide accurate and real-time data. The work supports the use of Arduino in developing responsive and efficient systems for observing environmental changes [3]. The integration of Arduino microcontrollers within IoT-based smart home applications, highlighting Arduino's capability to connect with various IoT devices for remote monitoring and control via the internet is explored. The work underscores the Arduino's potential in creating interconnected smart systems that can be easily monitored and adjusted through the IoT platforms [4].

In sensitive applications, a compact weather station is desired, which is cost effective and small size, so as to provide critical information about temperature and humidity. The study highlights the crucial role of precise sensor integration in achieving optimal humidity control system [5]. The control of electrical equipment using relay modules using Arduino is considered. Arduino can efficiently manage devices by using relays to switch circuits on and off [6].

Fuzzy logic-based IoT system has been introduced for controlling temperature and humidity in smart buildings, highlighting the use of fuzzy logic to manage uncertainties in environmental conditions, thereby creating a more adaptive and efficient control system [7]. A framework

based on Arduino aims at connecting devices, sensors and solar cells to build a smart home application. The objective is to lessen the energy consumption by controlling the devices remotely [8].

Power modules are highly relevant to the smart humidifier and efficient power management is needed. Non-isolated step-down modules are crucial for providing the stable, lower supply voltages required by the ICs and sensors in the humidifier. Their integration into a compact package saves space and reduces design complexity. Furthermore, the use of these modules streamlines the development process, allowing engineers to concentrate on other aspects of the humidifier while ensuring stable operation and efficiency [9]. It is observed that humidity and temperature monitors are highly needed in industrial applications. The paper proposed the inclusion of features that can identify, record and control the humidity in an industrial setup [10].

The paper describes the implementation of real time control algorithms using cost effective, simple and powerful platform consisting of Arduino board along with a Raspberry Pi running the REX control system. The interaction with the physical world is done using the input and outputs of Arduino board [11]. A comprehensive review and survey of articles related to smart home IoT applications, smart home technology, frameworks for design, development and operation of applications is done [12]. A similar work related to integration of Smart home system with cloud based IoT platform is discussed using the natural language interface [13]. A microcontroller-based system using an automatic ultrasonic humidifier is developed to primarily identify and eliminate the low humidity problems. A control system is implemented to generate air humidity based on the rooms relative humidity and temperature [14].

3. METHODOLOGY

The block diagram of the proposed affordable smart humidifier is illustrated in Figure 1. The system begins with a temperature and humidity sensor placed in a discreet location, where it continuously monitors the environmental conditions, specifically humidity and temperature. The sensor transmits this data to an Arduino UNO, which acts as the central controller of the system. The Arduino UNO processes the data to determine if the humidity needs to be adjusted. If the humidity falls below a predefined threshold, the Arduino activates a relay module to switch on the spray system. The relay module functions as a controlled switch, managed by the Arduino. When the humidity level drops below the set point, the Arduino turns on the relay, supplying power to the spray module.

A. **Block Diagram**

The entirety of the smart humidifier system is built around an Arduino UNO, used as the central controller to manage all the operations. Temperature and humidity were measured using the DHT11 sensor. This sensor continuously supplied real-time data to the Arduino UNO for it to monitor the ambient environmental conditions.

The Arduino UNO receives the sensor data and controls the activity of the system: in case of low humidity below the level required, the Arduino UNO turns on the spray module connected via a relay. Relay is a kind of switch and operates in a way in which the way Arduino can control the power supply to the spray module. The spray module blows tiny water droplets into the air, increasing the ambient humidity. An OLED display is connected to Arduino UNO for displaying real-time updates. This would show the present readings of temperature and humidity.

The smart humidifier is designed to have a separate power module to feed the required amount of electrical energy to the Arduino UNO and other connected components. This in turn will enable the Arduino to drive the spray module continuously according to the inputs from sensors and also continuously update the current environmental data on the OLED.

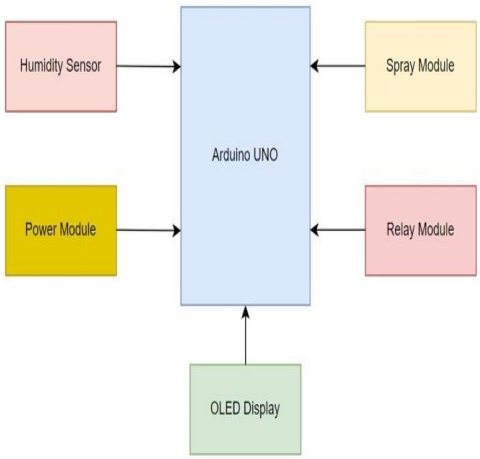

Fig -1: Block Diagram

The spray module releases water vapor into the room's atmosphere to increase humidity as required. An OLED display provides real-time readouts of humidity levels and other relevant information for the user. Additionally, a power module supplies the necessary power to the Arduino and other connected components, ensuring the entire system operates smoothly and efficiently. This comprehensive setup allows for automated and precise humidity control, enhancing the overall effectiveness of the system.

B. Flow chart

The flowchart for the operating of the smart humidifier is shown in Figure 2. The flowchart represents a process that initiates its operation with the initialization of Arduino and the sensors connected to it. Once the system has been initialized, then it goes forward to read inputs from the sensors. The data gathered through the sensors is then be displayed on an OLED screen for real-time monitoring. Then, advanced processing of sensor data is engaged to see if pre-set conditions are met. The system continues looping from reading the inputs from sensors again for a situation when that condition is not met.

If the desired condition is satisfied, the relay will turn on and further control the external device. In this way, the relay switches on/off the spray control device. Lastly, the process, after controlling the external device, gets to an end, and thus the system halts. This flowchart describes the general control system that uses Arduino; the input taken from sensors undergoes processing to switch the external devices on or off based on predefined conditions.

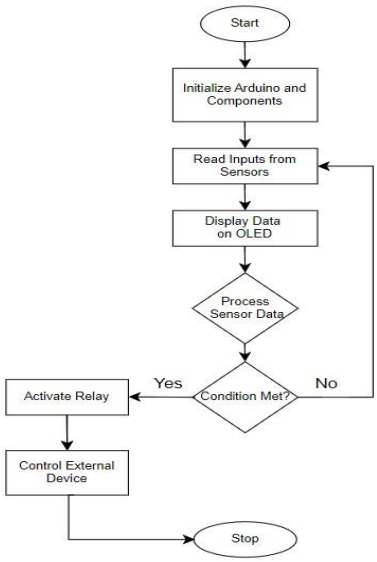

Fig - 2: Flowchart

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4. Hardware implementation

A smart humidifier using Arduino is a sophisticated device that helps maintain optimal humidity levels in any closed space by using the Arduino microcontroller to measure and control humidity levels. The device is made up of various components, including a humidity sensor, an output device (such as a humidifier), an Arduino board, and programming code.

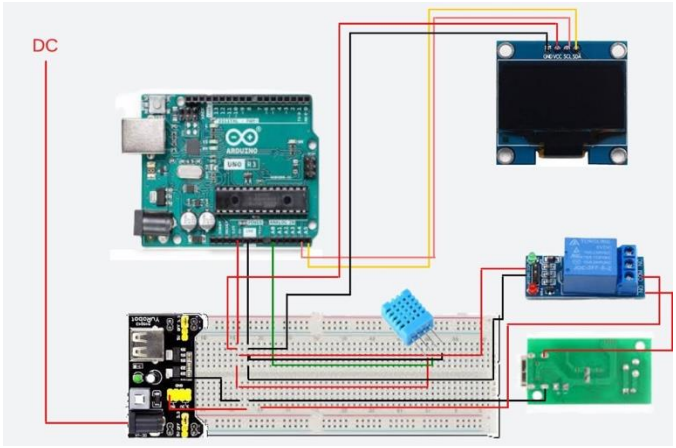

Fig -3: Circuit Diagram

The humidity sensor is a critical component of the smart humidifier system as it measures the humidity level in any closed space. It provides information on whether the humidity level is too high, too low, or within the ideal range. Once the humidity level is measured, the information is sent to the Arduino board. It uses the data provided by the humidity sensor to control the output device, which is a humidifier in this case. The board is programmed to adjust the humidifier output based on the current humidity level in the room. For instance, if the humidity level is too low, the Arduino board turns on the humidifier to add moisture to the air, and if the humidity level is too high, it turns off the humidifier to reduce moisture levels.

5. Results and Discussion

The DHT11 sensor, when interfaced with Arduino UNO, is always monitoring temperature and humidity during the operation of the smart humidifier system. In this system, a target relative humidity was set to be 80% so that when it detected the humidity in the room was below the target

value, the system automatically turned on the spray module via the jiashi pin. For example, when the humidity fell to about 70%, the spray module was switched on, and on for around 3 minutes, increasing the relative humidity up to the required mark of 80%.

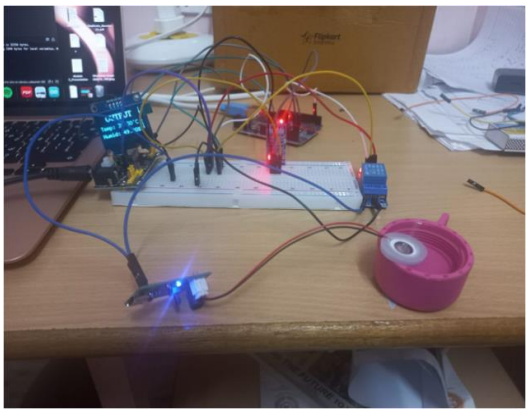

Fig -4: Implemented Smart Humidifier.

The further actions went as follows: every time the humidity dropped below 80%, at about 75%, Arduino UNO switched the spray module on again. In its turn, every time this happened, the spray worked for about 2 minutes until the level of humidity got back to normal. Such a working cycle made sure the system would not be a waste while keeping the target value of humidity and promptly reacts to changes in the environment. Both temperature and humidity were reflected in real time on the OLED screen, thus providing an easily readable interface to the users.

The values are updated continuously, and users can easily monitor the performance of the humidifier with screen display. Arduino controlled the spray module accurately to hold the indoor humidity level inside the comfort zone with the minimum human intervention. The smart humidifier works effectively with low power consumption.

6. CONCLUSIONS

A smart humidifier offers a perfect blend of convenience, health benefits, and advanced technology, making it an ideal addition to any application. By maintaining optimal humidity levels, it helps improve air quality, reduce allergens, and protect your respiratory health, especially in dry or winter conditions. Its smart features,such as app control, scheduling, and real-time monitoring, add unparalleled ease and efficiency to maintaining your environment. Whether for personal comfort or protecting delicate items like furniture and electronics, a smart humidifier is a valuable investment in enhancing your living space.

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