# Monitoring System for Temperature and Humidity Measurement with DHT11 Sensor Using NodeMCU

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**Abstract:- Temperature and humidity are important variables to determine changes in the state of a substance or object. By knowing the change in temperature, we can know the direction of the physical change. Therefore, it is very important to monitor changes in temperature and humidity in a system. To fulfill various needs, various sensors were developed. Therefore, it is very important to monitor changes in temperature and humidity in a system. To fulfill various needs, various sensors were developed. In this study, the authors use the NodeMCU microcontroller development board as a control center that connects to wifi communication. DHT11 temperature and humidity sensor which functions as a temperature gauge of 4 objects in turn, namely the temperature of the ice cubes, temperature of water heated by electric water heater and temperature of electric solder neck. Measurements are made in contact with a maximum distance of 0.4 cm from the object. The results of the DHT11 temperature sensor readings will be continued by sending real time information every second with units of $°$ C which can be seen using the visual basic net application, which is desktop-based for monitoring data with communication via wifi that is running well and stable. Temperature and humidity measurement data can be stored through an online database, namely firebase. Because sensor data is stored by NodeMCU to the Firebase Real-time Database, the VB Application can access it anytime and anywhere.**

*Keywords;- Sensor DHT11, NodeMCU, Visual Basic Net, Firebase, Wiifi.*

## I. INTRODUCTION

Temperature and humidity are important variables to determine changes in the state of a substance or object. By knowing changes in temperature and humidity, we can know the direction of physical change. Therefore, it is very important to monitor changes in temperature and humidity in a system. Monitoring temperature and humidity is very important, especially in the industrial sector, therefore there are several ways to monitor temperature and humidity.[4]

One way to monitor changes in temperature and humidity requires a DHT11 device or sensor. By using this sensor, users can monitor the temperature and humidity of an object remotely. So that users can monitor a dangerous object without having to be close together. The advantage of this sensor is that it is sensitive to changes in temperature and humidity every second that can be seen in real time. [4]

Based on this, the author wants to create a monitoring system for measuring temperature and humidity remotely using temperature and humidity sensors to make it easier for users to monitor the temperature of an object remotely. This tool system is based on the NodeMCU microcontroller development board as a control center as well as a DHT11 sensor as a tool for measuring temperature and humidity as well as data. The results of DHT11 temperature and humidity sensor readings will be continued by sending real time information every second with $°$ C units which can be seen using a visual application. basic net which is desktop-based for monitoring data with communication via wifi that is running well and stable. Temperature and humidity measurement data can be stored through an online database, namely firebase. Because the sensor data is stored by NodeMCU to the Firebase Real-time Database, then the VB application can access it anytime and anywhere. [6].

## II. LITERATURE REVIEW

### A. Monitoring

Monitoring (Indonesian: monitoring) is monitoring which can be described as awareness of what one wants to know, high-level monitoring is undertaken in order to make measurements over time that indicate movement toward or away from it. Monitoring will provide information about the status and the tendency that the completed measurements and evaluations are repeated over time, monitoring is generally carried out for a specific purpose, to check against the following process objects or to evaluate conditions or progress towards management outcomes objectives for the effects of actions of some type including actions to maintain ongoing management.[2]

### B. Modul NodeMCU ESP8266

NodeMCU is an electronic board based on the ESP8266 chip with the ability to carry out microcontroller functions and also an internet connection (WiFi). There are several I / O pins so that they can be developed into a monitoring and controlling application for the IOT project. The ESP8266 NodeMCU can be programmed with the Arduino compiler, using the Arduino IDE. The physical form of NodeMCU ESP8266, there is a USB port (mini USB) so that it will make programming easier. NodeMCU ESP8266 is a development derivative module of the ESP8266 family of IoT (Internet of Things) platform modules of type ESP-12. In function, this

module is almost similar to the Arduino platform module, but what makes it different is that it is devoted to "Connected to the Internet ".[6]

*C. Sensor*

Sensor is a tool for detecting / measuring something, which is used to change mechanical, magnetic, and thermal variations, rays and chemistry become voltage and electric current. In the environment of control systems and robotics, sensors provide similarities that resemble eyes, hearing, nose, tongue which will then be processed by the controller as the brain.[5]

*D. Sensor DHT11*

Sensor DHT11 is a sensor with digital signal calibration that is able to provide temperature and humidity information. This sensor is classified as a component that has a very good level of stability, especially when coupled with the ATmega8 microcontroller capability. Highest quality product, fast reading response, and anti-interference capability, at an affordable price. DHT11 has a very accurate calibration feature. This calibration coefficient is stored in the OTP program memory, so that when the internal sensor detects something temperature or humidity, this module reads the sensor coefficient. Small size, with signal transmission up to 20 meters, making this product suitable for many applications. Air humidity describes the moisture content in the air which can be expressed as absolute humidity, relative humidity and water vapor pressure deficit. Relative humidity is the comparison between the actual water vapor content or pressure with the saturation state or the air capacity to accommodate water vapor. Electronic equipment can also rust easily if the air around it is high enough humidity. Therefore, Information about the humidity in a certain area becomes something important to know because of the effects it causes. Information about the humidity value obtained from the measurement process. The tool usually used to measure air humidity is a hygrometer. DHT11 is a digital sensor that can measure the temperature and humidity of the surrounding air. This sensor is very easy to use with Raspberries. Has a very good level of stability and features a very accurate calibration. The calibration coefficient is stored in the OTP program memory, so that when the internal sensor detects something, then this module balances the coefficients in its calculations.[4]

*E. Firebase*

Firebase is a realtime database service provider and backend as a service. An application that allows developers to create APIs to be synced for different clients and stored in the Firebase cloud. Firebase has many libraries that make it possible to integrate this service with Android, Ios, Javacript, Java, Objective-C and Node.JS. Firebase databases are also accessible via the REST API. The REST API uses the Server-Sent Event protocol by establishing an HTTP connection to receive push notifications from the server. Developers use the REST API for subsequent data posts Firebase client library that has been implemented in an application that is built which will retrieve data in realtime. Developers can also use this database to secure data using the Firebase server with existing rules. For hosting files, Firebase provides hosting for static files with CND and SNL facilities.[8]

## III.  METHODOLOGY

*A. Research Stages*

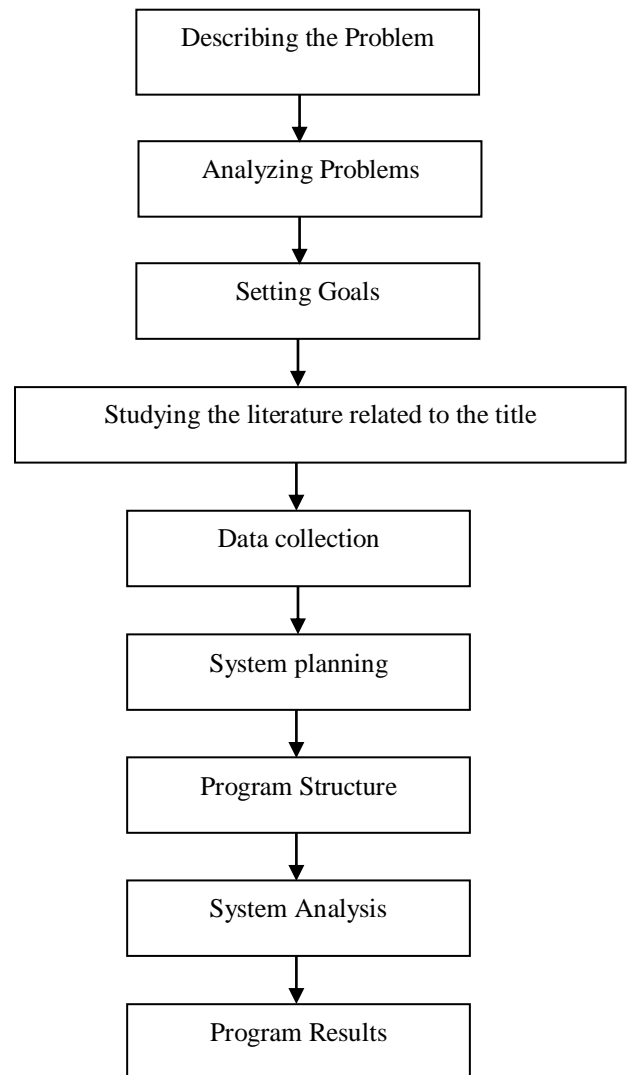In general, the stages of the entire study are as follows:



Fig 1:- Research Stages

> *Describe the Problem*

Describing the problem clearly will help in designing and making a temperature and humidity monitoring system tool that will be studied must be described in advance, because without being able to describe the problem, determine and define the boundaries of the problem to be studied, then there will never be a single best solution of the problem. So this step is the most important first step in this research.

> *Problem Analysis*

The problem analysis step is a step to understand a problem whose scope or boundaries have been determined. By analyzing the predetermined problem, it is hoped that the problem can be understood well.

> *Setting Goals*
>   Based on the understanding of the problem, the objectives to be achieved in this study were determined. This goal determines targets to be achieved, especially those that can overcome existing problems.

> *System planning*
>   This stage is the stage of the design of the tool being made, at this stage the design of the tool and the design of a series of heart rate monitoring tools is made.

> *System creation*
>   This stage is the stage for creating a temperature and humidity monitoring device, making the tool based on the design and design of the tool that was made in the previous stage.

> *System Testing*
>   Tool testing is done by monitoring the humidity temperature in a controlled room with the NodeMCU microcontroller development board as a control center and connected and equipped with a wifi network.

> *System Accuracy Level Analysis*
>   This stage is the stage where the analysis of taking wifi communication is carried out properly if there are obstacles.

B.  *Measurement and Observation Parameters*
The parameters measured in this study are the distance between the tools and the existing obstructions. Furthermore, observations will be made whether there is unstable wifi communication in sending data to computer networks or Android smartphones.

C.  *Research Design*
In this research, a block diagram design of the system is made. The block diagram design can be seen in the following figure:
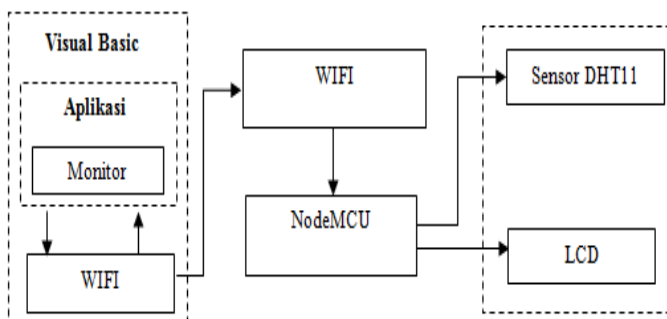
Fig 2:- Circuit Block Diagram

In addition, there is also a structure for the program that is described in the form of a flowchat.
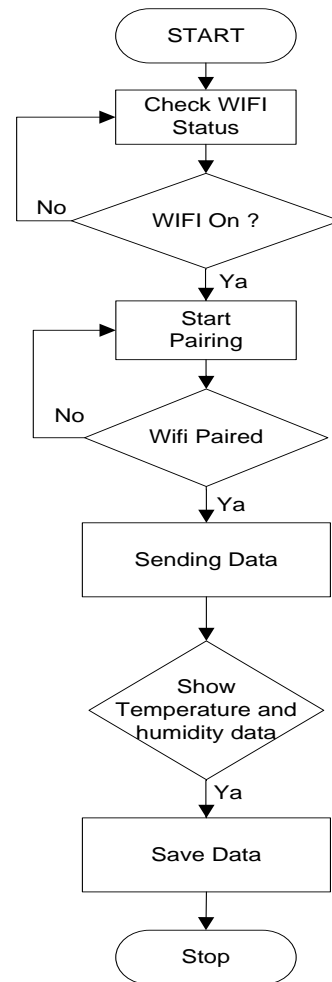
Fig 3:- Flowchart

The flowchart above can explain how the series of tools to be made works. The flowchart that starts from Start is by running the wifi on the NodeMCU module then the wifi will start pairing or it is also called by starting the installation or connecting between the wifi on NodeMCU to the wifi on the computer. After the two wifi are connected, the DHT11 sensor or temperature and humidity sensor reads or then the data that has been read will be automatically sent to the monitor or in the Visual Basic.Net application. Then the temperature and humidity value data will appear on the interface [1]

D.  *Circuit Design Tool (Hardware)*
Hardware design is a very important stage in making a tool, because by analyzing the components used, the tools to be made can work as expected. To get optimal results, first make a good design. Namely by paying attention to the properties and characteristics of each component used so as to avoid damage to the components used and make it easier to work on.

*E.  NodeMCU circuit schematic with DHT11*

In this design the use of DHT11 is a temperature and humidity sensor which has an analog voltage output which can be further processed using the NodeMCU module microcontroller development board.. [7] DHT11 temperature and humidity sensors generally feature a fairly accurate calibration of temperature and humidity readings. The NodeMCU circuit with DHT11 can be seen in the following figure.
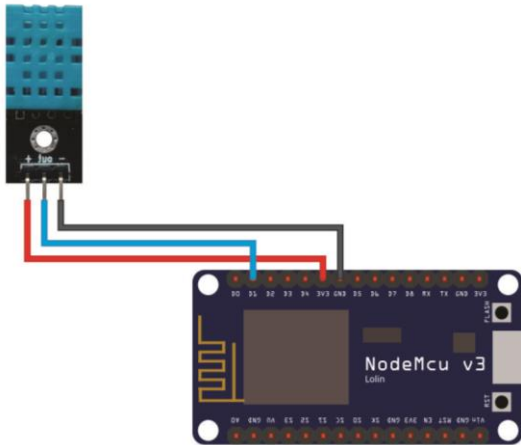


Fig 4:- NodeMCU circuit schematic with DHT11

## IV.  RESULT AND DISCUSSION

In this study, it will be explained and shown how the results of testing the design of the tool are made along with a discussion of the interface application. The results of the tests carried out are a software interface, which is a desktop application designed using the Visual Basic.Net application and tools created or designed and programmed using the Arduino IDE application. Each program display will be explained.
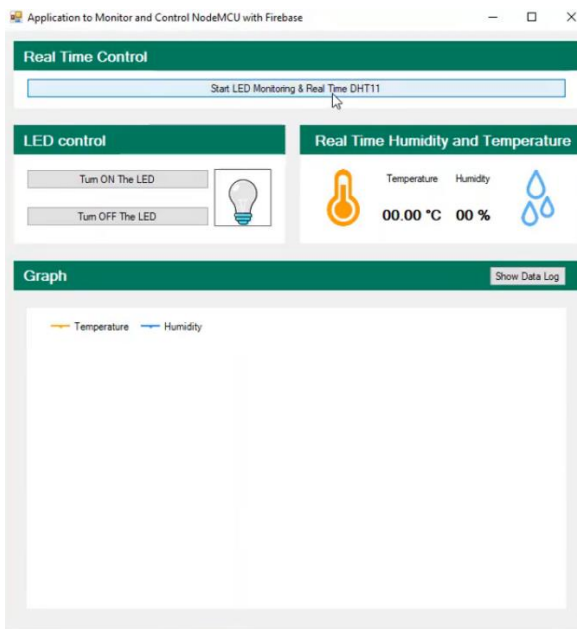


Fig 5:-Temperature and Humidity Monitoring Display

In the picture above shows the display of the temperature and humidity monitoring program designed using the visual studio.net application, in this display there is no process of temperature and humidity. For that in testing the program work system, users must bring hot objects closer to the DHT11 sensor so that the working system can be seen from the temperature and humidity monitoring application.
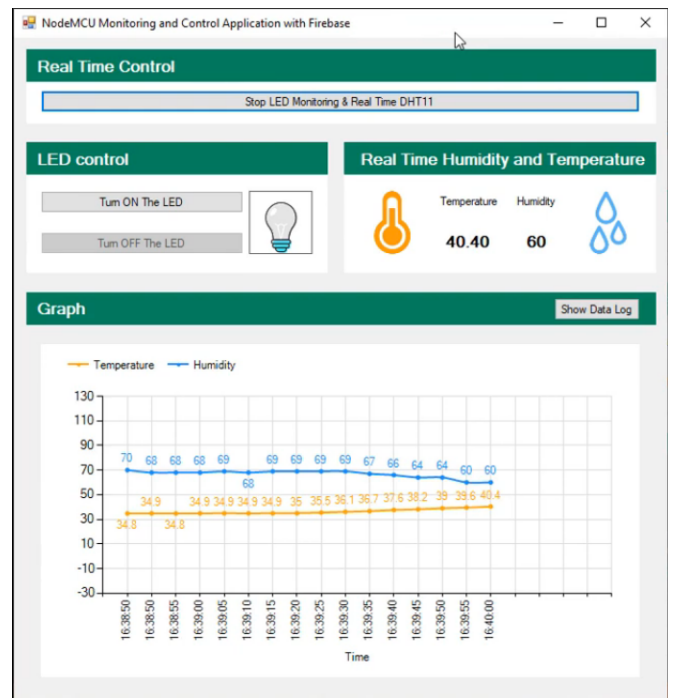


Fig 6:- Display of Temperature and Humidity Monitoring Process

In the picture above, you can see the working system of the temperature and humidity monitoring application in progress, Initially normal temperature and humidity and when there is a hot object brought closer to the DHT11 sensor the work system moves fast. It can be seen that the temperature reaches 40 Celsius and humidity decreases to 60%. To see the overall hardware working system can be seen in the image below.
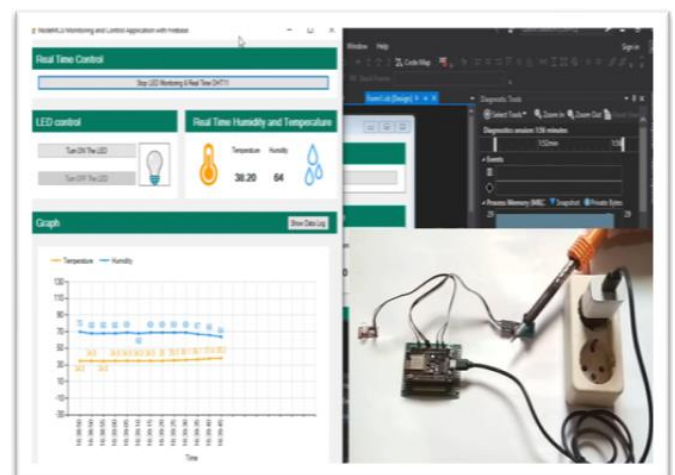


Fig 7:- Overall Hardware View and Temperature and Humidity Monitoring

The picture above shows how the system work process and the temperature monitoring circuit using the NodeMCU module and the Desktop application. The function of a desktop application that has been designed using Visual Basic.Net software is to monitor temperature. Aplikasi desktop yang di rancang sebagai alat monitoring di komunikasikan melalui Desktop application designed as a monitoring tool communicated via wifi. As for testing of temperature sensors and digital thermometers. Testing tools can be seen in the table below:

| No | Second | DHT11 $^0$C | Thermometer$^0$C | Score difference |
|---|---|---|---|---|
| 1 | 0 | 28,5 | 31,4 | 2,9 |
| 2 | 5 | 31,1 | 33,9 | 2,8 |
| 3 | 10 | 34 | 36,2 | 2,2 |
| 4 | 15 | 36,6 | 37,7 | 1,1 |
| 5 | 20 | 38,3 | 38,6 | 0,3 |
| 6 | 30 | 39,2 | 39,7 | 0,5 |
| 7 | 40 | 40,2 | 40,3 | 0,1 |
| 8 | 50 | 41,2 | 40,8 | 0,4 |
| 9 | 60 | 41,7 | 41 | 0,7 |
| 10 | 70 | 41,8 | 41,4 | 0,4 |
| 11 | 80 | 42 | 41,7 | 0,3 |
| 12 | 90 | 42,4 | 41,9 | 0,5 |
| 13 | 100 | 42,6 | 41,9 | 0,7 |
| 14 | 110 | 42,6 | 42 | 0,6 |
| 15 | 120 | 42,8 | 43,9 | 1,1 |
| **Average temperature values** | | | | **0,97** |

Table 1:- Temperature Measurement Table and Digital Thermometer

From the table above, it can be seen that the difference in temperature measurement with a DHT11 sensor and a thermometer is 0.94. DHT11 sensor and thermometer are given for 5 minutes of hot temperature. Then the test is carried out with the humidity in the room. The tool was tested by giving it 5 minutes using hot air. Hot air humidity testing can be seen in the table below.

| No | Second | DHT11 % | Thermometer % | Score difference |
|---|---|---|---|---|
| 1 | 0 | 68,5 | 70 | 1,5 |
| 2 | 5 | 68,5 | 69 | 0,5 |
| 3 | 10 | 66,5 | 67 | 0,5 |
| 4 | 15 | 62,5 | 64 | 1,5 |
| 5 | 20 | 55,6 | 57 | 1,4 |
| 6 | 30 | 55,6 | 57 | 1,4 |
| 7 | 40 | 50,5 | 53 | 2,5 |
| 8 | 50 | 47,4 | 49 | 1,6 |
| 9 | 60 | 44,9 | 46 | 1,1 |
| 10 | 70 | 42,8 | 54 | 11,2 |
| 11 | 80 | 41.7 | 52 | 10,3 |
| 12 | 90 | 39,8 | 51 | 11,2 |
| 13 | 100 | 39,8 | 51 | 11,2 |
| 14 | 110 | 38,6 | 50 | 11,4 |
| 15 | 120 | 36,8 | 58 | 21,2 |
| **Average temperature values** | | | | **5,9** |

Table 2:- Humidity Measurement Table and Digital Thermometer

After testing the humidity with a thermometer, the average value is 5.9 of the difference in value. So it can be seen that each working system for measuring temperature and humidity has a difference in the value tested with a digital thermometer.

## V. CONCLUSIONS

1. From the tests carried out, the measurement results of the DHT11 temperature sensor have a significant deviation and vary when compared to the reference, namely the digital thermometer..

2. Through the indoor temperature measurement monitoring system, we can see information about temperature quality

by looking at the information on the interface that has been designed using the Visual Basic application..

3. The results of the data obtained by the DHT11 temperature sensor can be accessed anywhere online because the data system is stored automatically, namely using the Firebase database which stores real time.

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