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# Measure Device of Water Content On Food Materials Based On Internet of Things

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***Abstract***

*Water content is the amount of water contained in an object, such as soil, agricultural materials, and others. Determination of the water content of a food is very important so that the processing and distribution process gets the right handling. Because if there is improper handling in the processing and determination of the wrong water content there will be damage to food that can be harmful to health. Therefore measuring the amount of water content in food is important. Android-based water level measurement is a tool that provides information on water content in food based on the Internet of Things. This tool is controlled by the Wemos D1 Mini microcontroller by using a Soil Moisture sensor whose output is displayed on the LCD and the android application "Blynk". Using an internet connection. The amount of water content will be displayed in the LCD and android application "Blynk" by producing temperature in the form of celsius and humidity in the form of numbers with percent from 0% to 100%, so we can see how much the level of water content is good.*

***Keywords:*** *Water Content, Microcontroller Wemos D1 Mini, Sensor Soil Moisture, LCD, Blynk, Android*

## 1. Introduction

The development of technology is something that we cannot avoid in this life, because technological progress will go according to the progress of science. The current technology is very influential in the industrial field that can not be separated from a measurement. Measurement is comparing the value of a quantity that is measured by using a similar quantity and determined as a unit. The measurement activities such as in markets, gas stations, hospitals and in industry and so on. One of the measuring tools that is and continues to grow is a water content meter that can be useful for humans, especially the actors in the agricultural industry [1]. Measuring the moisture content can basically be done using measuring tools and measurements using the oven method. Measurement by oven or drying method is one of the methods used to measure water content in a food with the principle that the water contained in a material will evaporate if the material is heated at 105oC for a certain time and the difference between the weight before and after heating is the moisture content of the material[2]. The accuracy and accuracy of determining the value of water content using the oven method has become a reference to the Indonesian National Standard, however determining the water content using the oven method is relatively rather complicated and requires a long time. Therefore, now there are water content gauges using digital technology that is faster and easier to operate than analog devices. Thus the food that will be used will be known more quickly the water content and consumers or industry players can decide on the next process without making the risk of food quality will soon decrease in quality or even rot. Because all food ingredients contain water, and consumers or industry players must know the amount of water content which is one of the important elements in food, although it is not a source of nutrition, but

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its existence is essential in the survival of the biochemical processes of living organisms [3].

Water content is the amount of water contained in an object, such as soil (also called soil moisture), rocks, agricultural materials, and so on. Water content is widely used in the scientific and engineering fields and is expressed in ratios, from 0 (total dry) to the saturated value of water in which all pores are filled with water. The value can be volumetric or gravimetric (mass), wet or dry basis [4]. About 60-95% of the total weight of food is water, this component is the most dominant component compared to other food components such as fats, oils, proteins, carbohydrates, minerals, salt, and acids. In food, water can act as a continuous phase where other substances are dispersed in the form of molecular, colloidal or emulsified [5]. The presence of water in food is always associated with the quality of food and as a measure of dry matter or solids. Water in materials can be used as an index of stability during storage and determinants of organoleptic quality, especially taste and tenderness[6]. Water content in food greatly affects the quality and shelf life of the food. Determination of the water content of a food is very important so that the processing and distribution process gets the right handling. Because if there is improper handling in the processing and determination of the wrong water content there will be damage to food that can be harmful to health. In Law No. 18 of 2002 concerning Food, Food Safety is a condition and effort needed to prevent food from possible biological, chemical, and other contaminants that can disturb, harm and endanger human health and do not conflict with the religion, beliefs and culture of the community so that it is safe for consumption[7].

An Android-based water level measurement tool is a tool that provides information on water content obtained during the drying process so that the amount of water content can be known and the water content to be ideal. This tool is controlled by the Wemos D1 Mini microcontroller by using a humidity sensor whose output is displayed on the LCD and the android application "Blynk". Using an internet connection that uses an internet connection. The amount of water content will be displayed in the LCD and the android application "Blynk" by producing temperature in the form of centigrade and humidity in the form of numbers with percent from 0% to 100%, so we can see how much the level of water content is good. The tool made in this study is expected to detect the amount of water content properly and can help improve the quality of food ingredients because it prevents substances or materials from decaying in moist places caused by mold and bacteria that develop in them.these components, incorporating the applicable criteria that follow.

## 2. Research Methodology

### 2.1. Measurement

Measurement is the determination of quantities, dimensions, or capacities, usually against a standard or unit of measure. Measurement can also be interpreted as giving a number of certain attributes or characteristics possessed by a person, thing, or certain object according to the rules or formulations that are clear and agreed upon. Measurements can be made in anything imagined, but with different levels of complexity. For example, to measure height, one can measure easily because the object measured is an invisible object with internationally agreed-upon units. But this will be different if the object measured is more abstract, such as intelligence, maturity, honesty, personality, and so on so that certain measurements and skills are needed [8].

### 2.2. Water

Water or (Dihydrogen monoxide) is a compound that is important for all life forms known to date on earth, but not on other planets. Water covers almost 71% of the earth's surface. There are 1.4 trillion cubic kilometers (330 million miles) available on earth [9].

### 2.3. Water content

Water content is the amount of water contained in an object, such as soil (also called soil moisture), rocks, agricultural materials, and so on. Water content is widely used in the scientific and engineering fields and is expressed in ratios, from 0 (total dry) to the saturated value of water in which all pores are filled with water. The value can be volumetric or gravimetric (mass), wet or dry basis [4].

### 2.4. IoT (Internet of Things)

Internet for Everything (English: Internet of Things, also known by the abbreviation IoT) is a concept that aims to expand the benefits of continuously connected internet connectivity. As for capabilities such as data sharing, remote control, and so on, including real objects. For example food, electronics, collections, any equipment, including living things that are all connected to the local and global network through embedded sensors and always active [10].

### 2.5. Android

Android is an operating system for mobile devices that includes an operating system, middleware and applications. Android provides an open platform for developers to create their applications. Initially, Google Inc. buy Android Inc. which is a newcomer to software makers for cellphones / smartphones by forming the Open Handset Alliance (OHA) at the inaugural release of Android, November 5, 2007, Android and OHA said they supported the development of open source on mobile devices [11].

### 2.6. Foodstuffs

Food is a basic requirement for every human being, because it contains compounds that are needed to restore and repair damaged body tissue, breeding and producing energy for the benefit of various activities in life [12].

### 2.7. Robotic

The word "ROBOT" first appeared in 1921 in a drama called R.U.R. (Rossum's Universal Robots). Karel Tired (read chop'ek). The word "ROBOT" comes from the Czech language "ROBOTA" which means Forced Labor. The word "ROBOTICS" also originates from a science fiction short story written by Issac Asimov in 1942 entitled "Runaround". The short story was later included by Isaac Asimov in his well-known book, "I, Robot". A robot is a unit in the form of mechanical or physical or virtual that has intelligence. In general, robots are electromechanical circuits that can move and have reason. However, until now, the definition of a machine or tool can be categorized as a robot is still being debated and standardized [13]

### 2.8. Field Research

In this method the researchers conducted directly by collecting data related to the problem of the amount of water content in food. These data the researchers collected by:

**a) Observation**

Researchers make direct observations to the object of discussion that you want to obtain the most important parts, namely on how to measure the amount of water content in food.

**b) Interview**

Interview to get an explanation of the problems that were previously unclear and to ensure that the data obtained or collected is really accurate, then an interview is conducted

### 2.9. Library Research

In this method the researcher quotes from several readings related to the implementation of the final project. With this library method has been taken from several related journals about measuring the amount of water content that has been discussed in the previous description to be a reference in conducting this research. Besides that from the related journals, also citing several theories about everything related to this research both from books or literature available in the library, both in the form of lecture materials and books that are related to this thesis research. And data collection using internet facilities through a search engine [14].

# 3. Results and Discussion

## 3.1. Gap Analysis

All food ingredients contain different amounts of water, both animal and vegetable food. Water acts as a carrier of food substances and metabolic remnants, as a reaction medium that stabilizes the formation of boiopolymers, and so on. Moisture content contained in food varies. To determine the water content of these foods, it must be done with a water content analysis test which is carried out by a certain method. The physical form of foodstuff cannot be used as a benchmark to determine the water content of ingredients. Water content in food ingredients can be determined in various ways one of which is the drying method, the distillation method, chemical methods and physical methods [15]. However, the results of previous studies obtained through testing the drying method using an oven are not always the same, with a general standard according to F.G Winarno, but rather having different amounts of water content. This can be seen as the following example:

a) Research conducted by Prima Bagus. S in 2013 concerning the analysis of water content found that the water content in tomatoes is 93% which is done using the method of drying through an oven while according to F.G Winarno usually tomatoes have a water content of 94%.
b) Arifa, olin and yanni research with the title of Practicum Analysis Report of Food Water Content Test in 2014 showed the same thing, the watermelon obtained 90% water content by drying method through oven while according to FG Winarno usually has 93% water content in watermelon.
c) Research on determining the water content (oven drying method) conducted by Wulaniriky shows the water content in mung beans is 4% while according to F.G Winarno is 90%.
d) Research The analysis of rice quality by Sarastuti, Usman and Sutrisno has the result of a water content of 12% which has similarities with F.G Winarno The water content of rice is usually 12%.
e) Zunggaval R research in 2017 has the results of the water content in bananas by 60% different from F.G Winarno bananas usually have a 75% moisture content.

**Table 1. Comparison of yields of water content**

| No | Foodstuffs | Water Content (According to F.G Winarno) | Water Content (Drying method) | Results Expected experiments |
|---|---|---|---|---|
| 1 | Tomato | 94% | 93% | 94% |
| 2 | Water Melon | 93% | 90% | 93% |
| 3 | Green Beans | 90% | 4% | 90% |
| 4 | Rice | 12% | 12% | 12% |
| 5 | Banana | 75% | 60% | 75% |

## 3.2. Analysis of the Proposed System

The proposed system is to create a hardware and software system that is able to measure water content in real time through an android application with an internet connection that can be monitored anywhere. then if the food quality deteriorates it can be seen the water content. Not only business owners can see the quality of the water content but employees / farmers can also see it through the LCD printed on the moisture meter. Following is the proposed system analysis flowmap [16].

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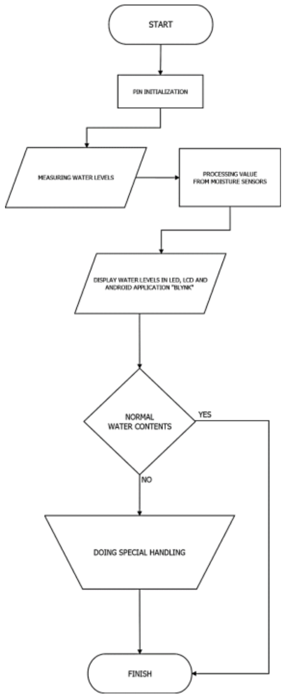


**Figure 1. Proposed System Analysis Flowmap**

Based on the above explanation, then the Internet of Things-based Moisture Meter requires analysis. Mainly user analysis and hardware requirements analysis.

### 3.3. Analysis of Current Systems

The current system is interpreted as a system that is being used, while the analysis of the current system is interpreted as a way to first understand the problems faced by the system, such as defining the functional needs of the system so that it can be known what user needs are not met by the current system walk. The aim is to determine the form of the system design to be applied. The analysis can also determine the design steps to be made so that the system design according to user needs and the system has an effective and efficient performance. Flowmap of the current water content detection system for farmers is as follows:

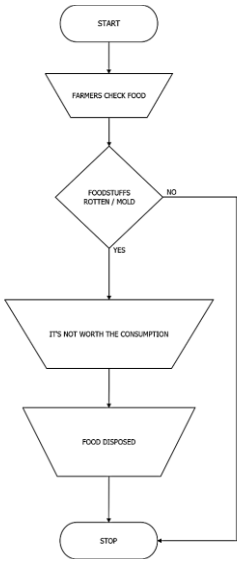


**Figure 2. Flowmap of the Running System**

### 3.4. Research Framework

The research framework is used to facilitate the understanding of the stages that researchers do in this thesis research. A more detailed explanation of these stages can be seen from the research framework in Figure 3 below.

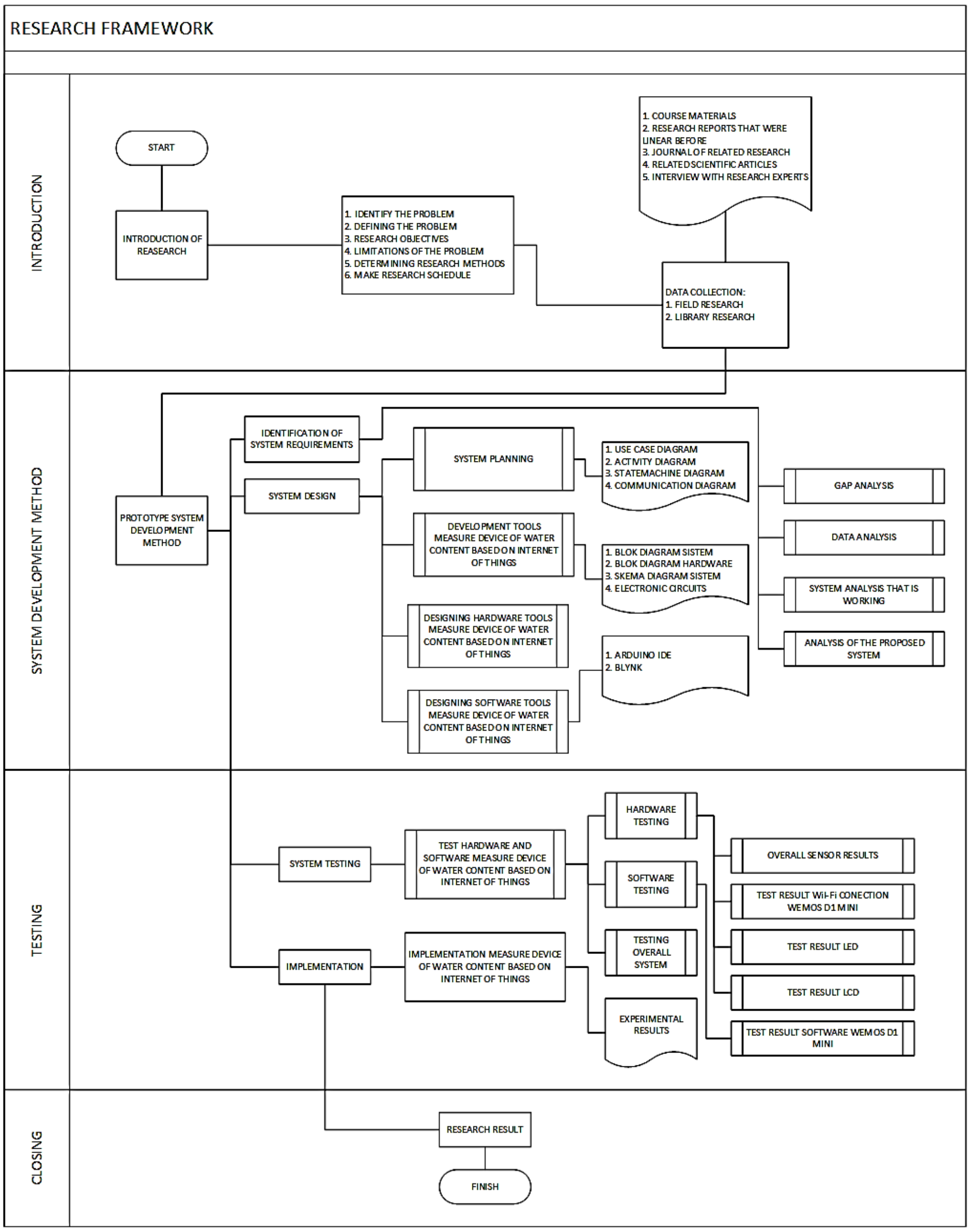


**Figure 3. Research Framework**

### 3.5. System Design

The design of the system has two objectives namely to meet the needs of the user and to provide a clear picture and complete design to the programmer and other engineers involved in making the system. Based on the current water detection system and based on other related analyzes, the system for measuring the amount of water content in the proposed food is as shown in Figure 4, which is the Overall System Flowchart.

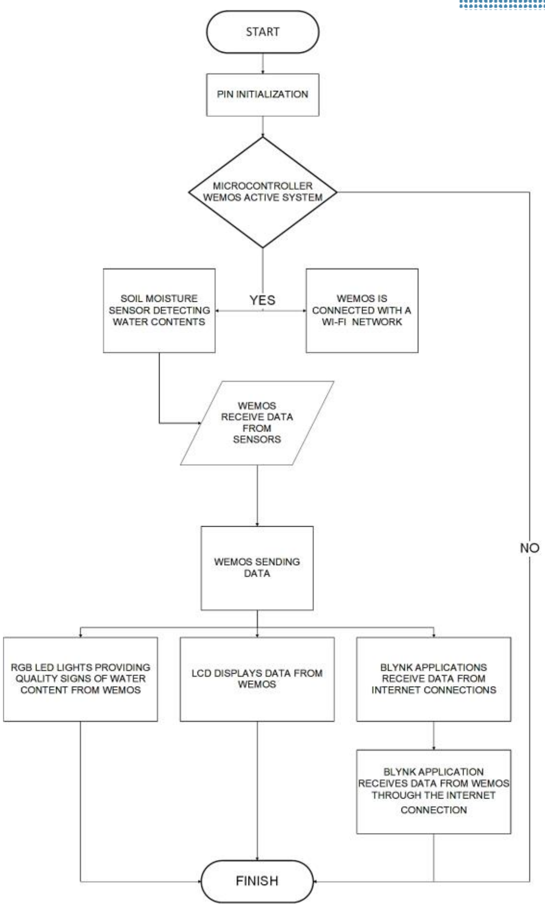


**Figure 4. Overall System Flowchart**

Soil Moisture sensor that detects the amount of water content, then the input will be processed on the Wemos D1 Mini Microcontroller so that the output is as follows:

Measuring the moisture content in accordance with the input received;

Display the measurement of water content in the RGB LED

Displaying the measurement of water content on the LCD

Displays the results of measurements of water content in the Blynk Application.

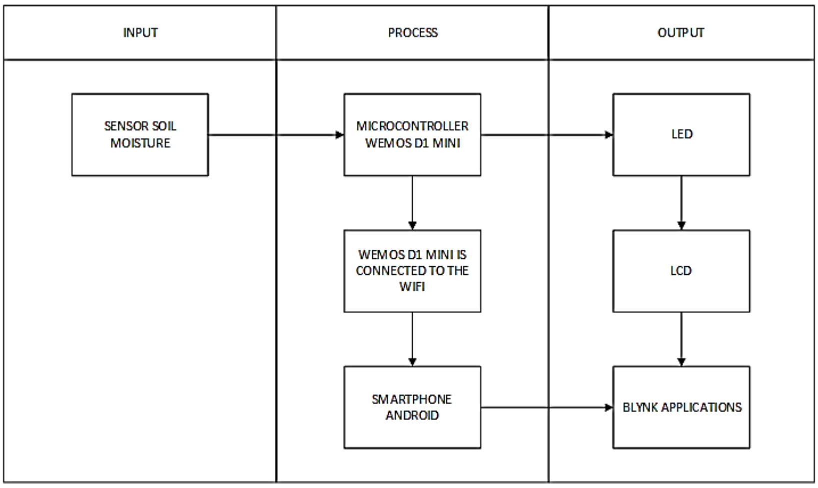


**Figure 5. Block Diagram of Whole System**

### 3.6. Hardware Design

In the hardware circuit contains a hardware block diagram used on the Internet-Based Moisture Estimator. This block is the initial stage in system design, this stage is carried out in order to facilitate the integration of hardware devices both as input and output. The hard role connected to the pins (input / output) on the Wemos D1 Mini Microcontroller which will then be initialized to the control program created on the Wemos D1 Mini by using the Soil Moisture Sensor.

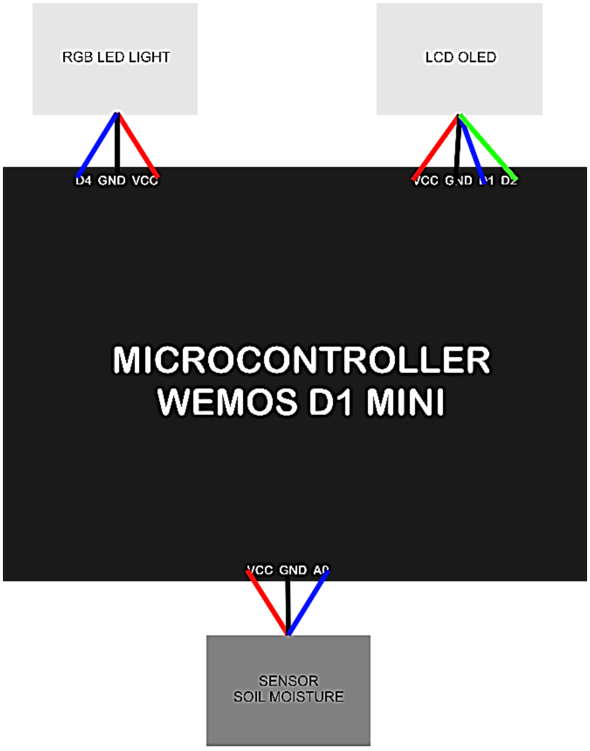


**Figure 6. Hardware Diagram Block (Wemos Pin)**

**Table 2. Wemos D1 Mini I/O Pins Used**

| No | Hardware Name | Pins on Arduino UNO R3 |
|---|---|---|
| 1 | Sensor *Soil Moisture* | Analog 0 |
| 2 | LED RGB | Digital 4 |
| 3 | LCD OLED | Digital 1 & Digital 2 |

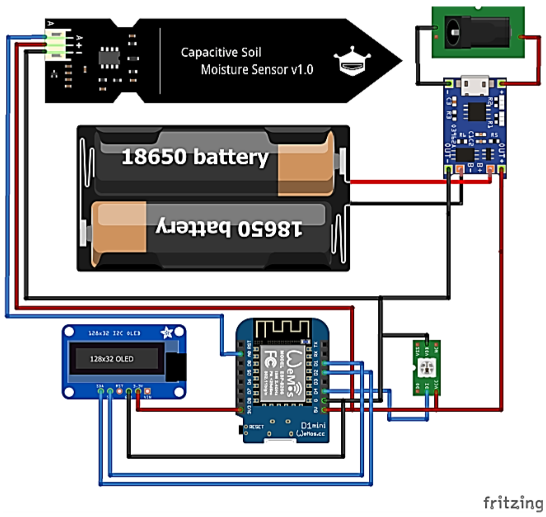


**Figure 7. System Diagram**

### 3.7. Designing Software on Wemos D1 Mini

In designing the software on this Mini D1 Wemos will be discussed about the software that will be built to support the performance of measure device of water content based on internet of things.

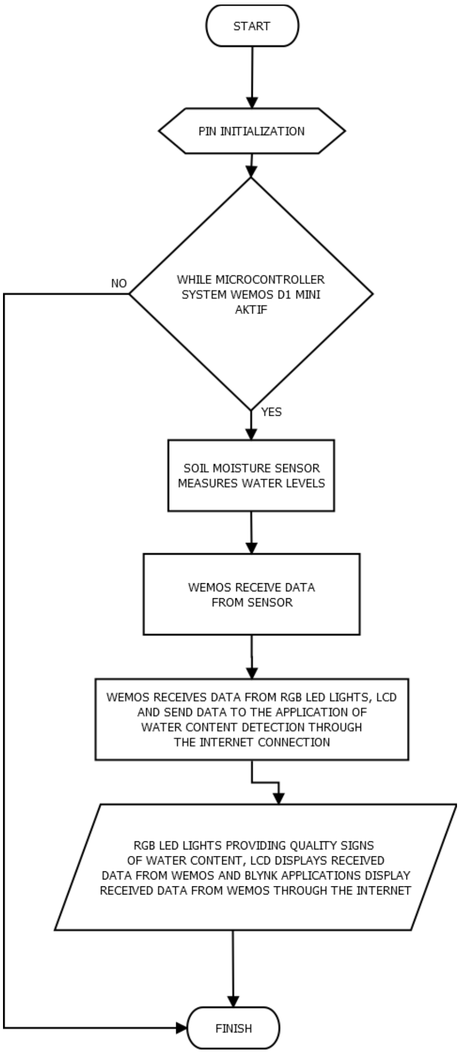


**Figure 8. Software Flowchart On Wemos D1 Mini**

### 3.9. Testing the Soil Moisture Sensor

The purpose of testing and analysis or discussion carried out on the Soil Moisture Sensor is to obtain parameters about the accuracy of the water content detected by the Soil Moisture Sensor. This is done to get maximum results from the detected water content. So that the results of the Soil Moisture Sensor test are as follows, Based on the results of the Soil Moisture Sensor test, it can be seen that by jabbing a tool into a fruit or place containing grains of water content in food, the results can be known by increasing and decreasing the sensor's detected water content, as in tomatoes which have a water content of 73%, watermelons 78%, green beans 7%, rice 13% and bananas 77% and require an average time of 1.3 seconds. The accuracy owned by this tool is 86.7% which is calculated by means of the results of the examination (observation) divided by the calculation results (expected) multiplied by one hundred percent which is then averaged. And the average error that is owned by this moisture meter by reducing the desired value of t by the actual value and divided by the actual value and then divided by one hundred percent has a yield of 4.81%.

### 3.10. Testing of LED RGB Lights, LCD dan Blynk

Testing of LED Lights, LCD, LCD and Blynk Application aims to determine the indicator when the water quality is good or bad. This test is devoted to knowing the function of the LCD and Blynk. applications as indicators. This test can be seen in the table as follows:

**Tablel 3. Testing of LED Lights, LCD, LCD and Blynk Applications**

| No. | Foodstuffs | Soil Moisture Sensor | |
|---|---|---|---|
| 1 | Tomato | Water Content: 73 | |
| 2 | Water Melon | Water Content: 78 | |
| 3 | Green Beans | Water Content: 7 | |
| 4 | Rice | Water Content: 13 | |
| 5 | Banana | Water Content: 79 | |
| 6 | Papaya | Water Content: 77 | |
| **No** | **Foodstuffs** | **Water Content** | **LED RGB** |
| 1 | Tomato | High | Green |
| 2 | Water Melon | High | Green |
| 3 | Green Beans | Low | Red |
| 4 | Rice | Low | Red |
| 5 | Banana | High | Green |
| 6 | Papaya | High | Green |
| **No.** | **Foodstuffs** | **LCD** | **Blynk Applicatios** |
| 1 | Tomato | 73 | 73 |
| 2 | Water Melon | 78 | 78 |
| 3 | Green Beans | 7 | 7 |
| 4 | Rice | 13 | 13 |
| 5 | Banana | 79 | 79 |
| 6 | Papaya | 77 | 77 |

Based on black box testing can be seen how the performance of tools and application, the following results from black box testing that has been done.

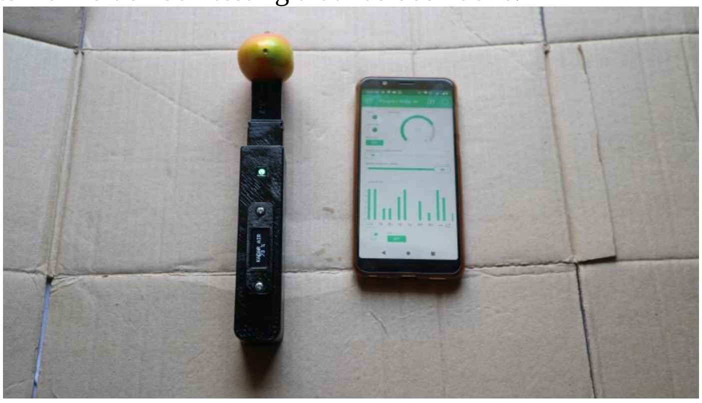

**Figure 9. Output Measuring Moisture Content in Tolls and Aplication**

## 4. Conclusion

Based on the results of research and discussion that has been done, the conclusion of the Final Project with the title "Measure Device of Water Content on Food Materials Based on Internet of Things" is as follows:

a) This water content measurement tool uses the Soil Moisture Sensor as input which will be processed by Wemos D1 Mini then uses RGB LED Lights, OLED LCD and Blynk applications that are connected using internet access as output so that the detection process is easier and efficient;
b) The Soil Moisture sensor will read the amount of water content using two probes to pass current through the soil or foodstuff, and read that resistance to get the level of humidity. Furthermore, the Soil Moisture Sensor detects the water content of the sensor which will be integrated with the Wemos D1 `Mini microcontroller using the C programming language, then if the water content in the food has been obtained the actor can determine the next process, if the water content does not match what is expected then he must do sorting of foodstuffs to match the quality that has been determined and can be used to determine the estimated time to store foodstuffs.
c) The results of testing in a measuring device for the amount of water content in food have the results of an average accuracy of 86.7% which has an average error of 0.75%. And the results of the comparison of this study with previous research can be seen in the following matrix:

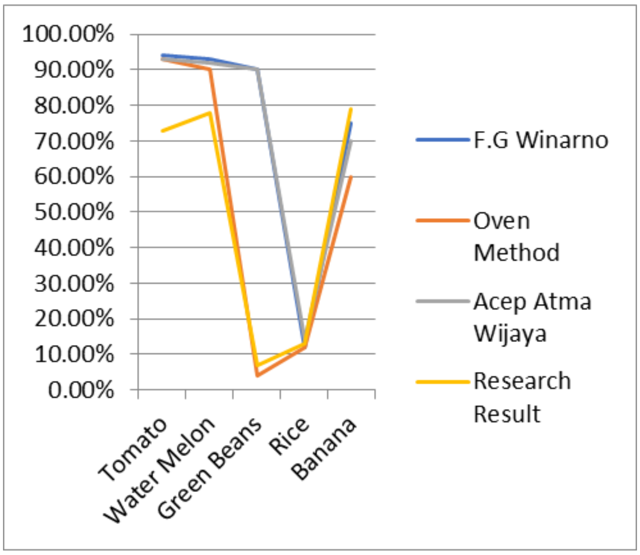


**Figure 10. Comparison of Research Results Graph**

Based on the graph above it can be seen that the average research results of water content in the foodstuff studied have the closeness of the results despite the comparison or differences in each of these studies. In tomatoes can be seen in the graph according to the three previous studies have similar results but the results of this study are quite different, according to FG Winarno tomatoes have a water content of 94% and not much different from the research using the drying method and Majalengka University lecturer Mr. Acep Atma Wijaya, SP ., MP that tomatoes have a moisture content of 93% but different from the results of this study that is equal to 73%. In watermelon according to F.G Winarno has a water content of 94%, and in the method of drying 90%, according to Acep Atma Wijaya, SP., MP 92% and the results of research on this tool by 78%. The water content in mung beans can be seen to have quite significant differences between studies, such as F.G Winarno and according to Acep Atma Wijaya, SP., MP which has a 90% moisture content while the drying method is 4% and the current study is 7%. In rice grains, water content tends to be the same, according to F.G Winarno 12%, the drying method is 12%, according to Acep Atma Wijaya, SP., MP 14% and the results of this research tool are 13%. And bananas have water content according to F.G Winarno 75%, 60% drying method, according to Acep Atma Wijaya, SP., MP 70% and the results of this study are

79%. From the description of the graph, it can be seen that there are differences and similarities between previous research and current research, this can occur because of differences in water content in each food item at harvest and related to the condition of the foodstuff studied.

## References

[1] A. F. Isdiana, "Prototype Pendeteksi Ph Air Menggunakan Microcontroller Dengan Sensor Ph Dan Sensor Dallas Berbasis Android ( Studi Kasus Kolam Budidaya Ikan di PD. QIDUL MAS )," 2018.

[2] A. Arafat and N. Alamsyah, "Alat Pengukur Kadar Air Pada Media Campuran Pembuatan Baglog Jamur Tiram Berbasis Internet Of Things (IOT)," *Technol. J. Ilm.*, 2018, doi: 10.31602/tji.v9i2.1376.

[3] N. A. Ahmad, "Kajian Terhadap Kadar Air Tepung Jagung Dan Tepung Karaginan Sebagai Bahan Baku Puding Jagung," *Univ. Negeri Gorontalo, Gorontalo.*, 2014.

[4] M. Kristina, "Alat Pengatur Kelembaban Tanah secara Otomatis Berbasis Mikrokontroler Atmega8535," 2018.

[5] H. Kumalasari, R. Syarif, and F. M. Taqi, "Validasi metoda pengukuran kadar air perisa bubuk menggunakan moisture analyzer halogen Hb43-S, sebagai alternatif metoda oven dan karl fischer," 2013.

[6] F. G Winarno, "Analisis Kadar Air – Agroindustry Virtual Laboratory," 2004. .

[7] T. F. Prasetyo, E. A. Frastya, and Enceng Enda S, "Sistem Pendeteksi Kesuburan Tanah Pada Desa Cihaur Kelompok Tani Bina Mandiri," *Pros. SINERGI*, pp. 191–198, 2017.

[8] Syekhudin, "Pengertian Pengukuran, Penilaian dan Evaluasi – Blog Pendidikan," 2013. .

[9] A. A. Wijaya, "Pengertian Kadar Air dan Manfaat Dari Kadar Air," *Majalengka*, 2019. .

[10] H. Sujadi, T. F. Prasetyo, and P. Paisal, "Pengembangan Sistem Monitoring Keamanan Sepeda Motor Berbasis Internet Of Things," *J-ENSITEC*, 2018, doi: 10.31949/j-ensitec.v5i01.1209.

[11] A. Zainudin, "Pengenalan Android. Forum Android Indonesia," 2010. .

[12] Aventi, "Penelitian Pengukuran Kadar Air Buah Proses Pengeringan (Drying)," *Semin. Nas. Cendekiawan 2015*, 2015.

[13] H. D. Siswaja, "Prinsip Kerja dan Klasifikasi Robot," *Media Inform.*, vol. 7(3), pp. 147–157, 2008.

[14] A. M. H. Pardede, "Algoritma dan Pemrograman BAB I," pp. 1–125, 2017.

[15] H. Isnianto and N. Lastrada, "Rancang Bangun Alat Ukur Kadar Air Dalam Biji Kakao Berbasis Mikrokontroler Atmega-8," *J. Rekayasa Elektr.*, 2011.

[16] Haviluddin, "Memahami Penggunaan UML ( Unified Modelling Language )," *Memahami Pengguna. UML (Unified Model. Lang.*, 2011.

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