PROTOTYPE OF WATERING AND MONITORING SYSTEM FOR BEAN SPROUTS PRODUCTION BASED ON INTERNET OF THINGS (STUDY CASE BLOK BEAN SPROUTS CIMAHI CITY)

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ABSTRACT

Taoge Block is an area where the average community grows sprouts, in this area the community has its own place to produce beans sprouts and become the main income of society. With many communities producing tougher, the area has met the needs of society and market needs. Based on the results of interviews with Cucu as farmer sprouts, there is a problem in sprouting sprouts. For the moment sprouts farmers still use manual way to do watering resulting in a time-consuming process of watering the sprouts. This poses a new problem that is not the result of watering watering because the watering is still done manually. Then the next problem is that farmers can not go out of town due to the adjacent watering time. Based on this, it can be concluded that sprouts farmer needs a system that can be watering at once, leveling watering and monitor production remotely. The Design of Watering and Monitoring System of Taoge Production Based on the Internet of Things (IoT) is a device that serves to water the sprouts as well as flatten the results of its spray as well as to monitor and control the watering from a distance, this tool can help the taoge farmer for watering as well as automatic flushing So it can ease the taoge farmers. Based on the black box testing of the tool, it can be concluded that the Design of Watering System and Monitoring of Internet-Based Taoge Production (IoT) can help the sprouts farmers in the process of watering and equity of watering automatically and assist farmers in monitoring from a distance.

Kata kunci **:** Monitoring Application, Internet of Things, Watering Bean Sprouts Automatio , Equalization Watering Bean Sprouts Automation, Watering System.

1. INTRODUCTION

The Taoge Block is an area where the average community cultivates sprouts sprouts, in which the community has its own place to produce touge and become the main income of the community. With many communities producing tougher, the area has met the needs of society and market needs. For marketing, the bean sprout directly sells directly to buyers or collectors who come to the production site or directly sell it to the market.

In the production of sprouts takes up to 5 days to harvest, usually starting with washing, sorting the damaged seeds and finally soaked by warm water for 24 hours. In addition, sprouts must be flushed 5 times a day or interval of 4-5 hours, using clean water to grow maximally and produce a high quality sprouts that are clean white.

From the observation, microcontroller can be used to handle the problem of farmer sprouts. With advances in technology in the field of information and electronics can be the basis of designing software systems and hardware that communicate with each other. With microcontroller as main component and sensor as input size so that can be solution to fulfill requirement of technology. One is for watering automation, watering settings, remote watering control and monitoring sprouts production.

The objectives to be achieved from the design of the system of irrigation and internet-based monitoring of things is:

1. The absence of sprinkling system of automatic sprouts and shifting period of watering when there is delay watering in block sprouts Cimahi
2. The absence of sprinkling system of sprouts to cope with unevenness and water savings in the process of watering in Cimahi sprouts block.
3. The attachment time of the sprouts farmers because they can not go out of town due to the adjacent watering time.

2. CONTENTS OF RESEARCH

2.1.1 Bean sprouts

Taoge is a sprout from seeds aged between 4-5 days, usually sprouts of green beans are often used for making sprouts. Taoge is long with head on end. The head is a split green bean.

Vitamins that can be found in sprouts are vitamins A, C, E, Kd an B6, thiamin, riboflavin, niacin, pantothen, folate, choline and β-carotene. Minerals found in sprouts are calcium (Ca), iron (Fe), magnesium (Mg), phosphorus (P), potassium (K),

sodium (Na), zinc (Zn), copper (Cu), manganese (Mn) And selenium (Se). Aminoesensial acids present in the sprouts include tryptophan, threonine, phenylalanine, methionine, lysine, leucine, isoleucine sertavalin) [7]. In sprouts contain some antioxidants and antioxidant-related substances namely phytosterols, vitamin E (α-tocopherol), fenol and some minerals (selenium, manganese, copper, zinc and iron) [8]. Vitamin E acts as an antioxidant that protects unsaturated fatty acids from oxidizing and maintaining an intracellular balance. [1]

2.1.2 Cultivation of bean sprouts

Plant cultivation technique is the process of producing food and agro-industry products by utilizing plant resources. Coverage of cultivation objects include food crops, horticulture, and plantations [2]. As an example is the cultivation of sprouts sprouts. Here's how the sprouts cultivation sprouts**:**

1. Cleaning Seeds

   Beginning with the process of cleaning the seeds, for the green bean seed itself there are two countries that are well known for good quality of green beans namely Thailand and China. Green beans imported from the country has a very good quality, although for the price is more expensive than the green beans obtained from local farmers. Choosing local green beans from farmers should be selective, to choose green beans of good quality make sure the whole green beans are evenly distributed, do not look brownish or black because it is a feature that indicates the quality of the green beans is bad [3].



Figure 1. One of the bean sprouts production

2. Soaking Seed

   After the green beans seed looks clean the next process is soaking the seeds with warm water as for the immersion time depends on the quality of the seed, wait until the seed is expanding for good quality seeds usually only takes less than 24 hours. It will be much longer if the seeds of green beans have poor quality. After the green bean seeds expands it is time to drain it into a bamboo-made basket, the selection of bamboo baskets so that in the next process there is no puddle under the surface of the container. Do not forget to side the basket is given a layer to resist grow sprouts so as not to get out of the basket. Here is an example of Figure 2 immersion of green beans [3]



Figure 2. Soaking Seed

3. Watering.

   soaking a few hours and then drained the next stage is to water the seeds terebut during the period of 4-5 hours, like plants that require irrigation to keep it grow well. Watering is done for 3-4 days. The following watering activities in Figure 3 immersion of green beans [3].



Figure 3. Watering Beans Sprout

4. separation

After waiting for 3-4 days finally the seeds of green beans have become sprouts / sprouts, this indicates the sprouts are ready to be marketed but before marketing it's good first in separating the peanut skin in his head sprouts, this is so that the resulting sprouts look clean. The way is just by sifting it slowly as in the process of sifting the rice in a sifted way then automatically the green skin will be wasted. After all that is done then the sprouts are ready to be marketed [3]

2.2 Internet of Things

Internet of Things (IoT) Is a concept that aims to expand the benefits of Internet connectivity that is connected continuously. As for capabilities such as remote data sharing control, and included also on real world objects. Foodstuffs, electronics, any equipment, collections, including living things, all connected to local and global networks through embedded sensors and always "on" [4].

The interaction between man and man has been very common since ancient times. The interaction between man and machine is also common, since the invention of technology such as computers or other gadget devices. However, according to McKinsey Global Institute analysis, internet of things is a technology that allows us to connect machines, equipment and other physical objects with network sensors and actuators to obtain data and manage their own performance, enabling machines to collaborate and even act on information Newly acquired independently. A publication of the Internet of things in 2020 explains that the internet of things is a state where objects have identities, can operate intelligently, and can communicate with the social, the environment, and the user [5].

2.3 Wemos D1

Wemos D1 Wifi Arduino ESP8266 is a microcontoler board created by Wemos and is designed to be similar to the arduino uno board. The uniqueness of Wemos D1 Wifi Arduino ESP8266 board is its compatibility with Arduino IDE, so can use Arduino IDE to create / compile program and download it to this board. With Wifi Module ESP8266EX has 32bit / 80-160MHZ processor, flash / memory program 4MB, 32KB SRAM & DRAM 80KB of course with Wifi 2.4GHZ feature make Wemos D1 Wifi Arduino ESP826 as a very powerful board and suitable for internet of things. With the emb 8266 WiFi Wireless embedded module This is the ESP8266 SoC series transceiver wifi module. SOC has an Integrated TCP / IP protocol stack, so it is widely used in networking, project control when connected to a wifi router. This module 8282 WiFi can be used for remote monitoring of home appliances, room temperature and humidity, and remote control of electronic appliance with hanpdhone.

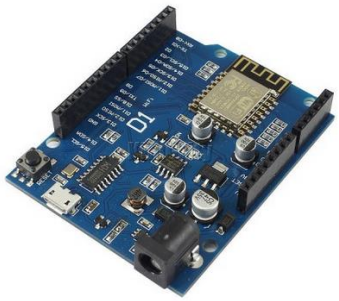


Figure 4. Board Wemos D1

2.2 Analysis and Design

Analysis can be defined as the decomposition of a whole system into its parts in order to identify and evaluate the problems of problems and constraints that occur and the expected needs so that proposed improvements can be proposed.Sedangkan design can be defined system design is a problem-solving technique by completing the components into small Unified components of the system back system. This technique is expected to produce a better system.

2.2.1 Problem analysis

Problem analysis is an assumption of the problem to be described in the procedure. From the results of research conducted got the problem consisting of:

1. The absence of sprinkling system of automatic sprouts and shifting period of watering when there is delay watering in block sprouts Cimahi.
2. The absence of sprinkling system of sprouts to cope with unevenness and water savings in the process of watering in Cimahi sprouts block.
3. The attachment time of the sprouts farmers because they can not go out of town due to the adjacent watering time..

2.2.1 Analysis of Current System

Analysis of a running system is defined as a way to learn, evaluate and understand in advance the problems faced by the system. While the current system is defined as one way to understand the problems faced by the system currently in use, such as defining the functional requirements of the system then it can be known what needs to be fulfilled by the current system.

Analysis of a running system is defined as a way to learn, evaluate and understand in advance the problems faced by the system. While the current system is defined as one way to understand the problems faced by the system that is being used today, such as defining requirements - functional requirements of the system, it can be known what are the needs that have not been fulfilled by the current system is.

1. The procedure of watering and equity of watering manually.

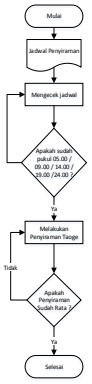


Figure 5. Watering procedure

2. The procedure of the watering place custody.

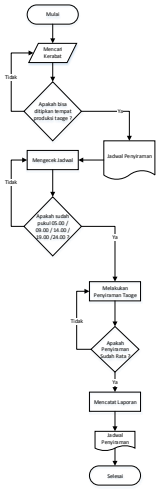
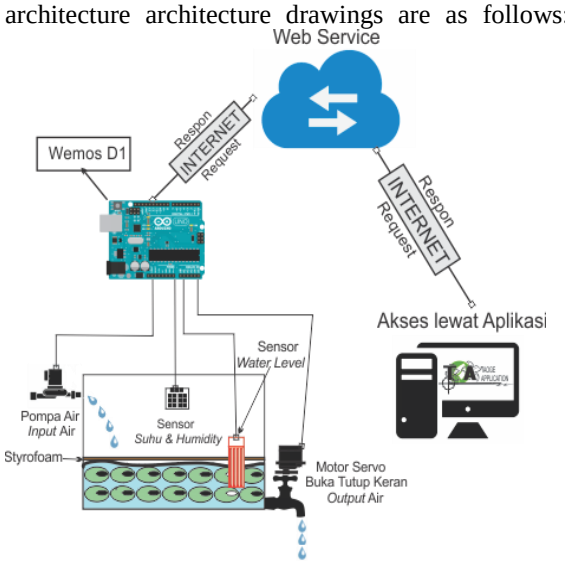


Figure 6. Custody Procedures

2.2.2 Architectural Design Analysis

Architecture Analysis System is a system to be built, this internet-based application will communicate with microcontroller tools that are bridged by web service, In general, architecture design can be seen in Figure 1.7 explanation of each architecture architecture drawings are as follows:



Gambar 1. System Design Architecture

Figure 7 System Design Architecture describes the system to be built, can monitoring and control watering from a distance via an internet network that is connected to a microcontroller through a computer or smartphone device. The application will request data to the web service as a liaison with the microcontroller, a web service that stores a register that existatabase that communicate through the Internet network, the microcontroller will control the sprouts of sprouts and monitoring the production of sprouts.

The following is an explanation of the system architecture as shown in 7 System Design Architecture:

1. Wemos D1, serves as the main control center for collecting data that is detected by the sensor and sending the data that has been generated by the sensor into the server. Arduino has Input Output which generally classified into 2 ie I / O digital and I / O analog. Arduino digital pin serves to read the input and output output in the form of a digital voltage. The digital voltage is divided into 2 ie for the voltage 0 - 2.5 V will be read as 0 and for the voltage of 2.6 - 5V will be read 1. For the digital output, the Arduino pin will output 0V voltage for signal 0 and 5V tension for signal 1. Some Arduino digital pins can function as pulse width and pulse width (Pulse Width Modulation) pulse generators. Arduino analog pin serves to read analog voltage input. The readable analog voltage is at the interval 0-5V. The analog voltage that goes into the analog pin will go into ADC (Analog Digital Converter). The Arduino Uno ADC has a 10bit resolution so that when the voltage is 0V the ADC will read 0 and when 5V ADC will read 1024. The Tx and Rx pins are used for serial communication lines, Tx as transmitter data pins, and Rx as receiver data pins. Meanwhile ESP8266 will automatically connect internet via wifi modem.Sensor, berfungsi sebagai pengumpul data-data yang diperlukan. Dalam hal ini data-data tersebut adalah data-data tentang informasi yang ada didalam tempat produksi taoge. Sensor tersebut adalah DHT22 dan *water level*. Data *water level* akan dapat dibaca oleh Wemos D1 melalui pin *analog output* pada Wemos D1. Setelah sensor *water level* disimpan di atas permukaan kacang hijau / kecambah taoge. Kemudian sensor DHT22 dipasang pada Wemos digital pin dan akan akan memperoleh data kelembaban dan suhu yang nantinya digunakan untuk keperluan untuk memutuskan kondisi yang akan di eksekusi oleh sistem pengairan dan data dikirim ke *web service*.
2. Micro servo, serves as an opening and closing tap. To open the faucet then the servo will rotate by 110 degrees and to reupload the sole or 0 degrees.Relay, berfungsi untuk menghidupkan dan mematikan pompa yang sebelumnya sudah dihubungkan ke relay. Relay akan menyala jiga kita mengirimkan nilai HIGH ke pin digital secara otomatis pompa akan nyala dan mengisi air ditempat pertumbuhan kecambah dan LOW untuk mematikan relay dan pompa akan secara otomatis mati.
3. Wifi modem, serves to perform the process of data lagging on the information signal to the carrier signal in order to be sent to the user through certain media, this process is usually called the modulation process. Modem-generated signal will deliver detail data on the situation where the sprouts grow sprouts to the server.Komputer, berfungsi untuk mengakses data dari server

melalui web *browser* dimana komputer sudah terhubung dengan koneksi internet.

Taoge of application, is an application that serves to monitor and perform remote monitoring and setup for irrigation will be used by farmers sprouts.

2.2.3 Data Communication Analysis

Data communication is a very important thing, because without any data communication, a built application will not be able to run properly or optimally. Data communications used in the application of drainage and monitoring system design for the production of internet-based sprouts of things Cimahi City spawning block case is to use TCP / IP and the method used to send the data packet is using the post method.

Here is the flow of data communication architecture on the device in Figure 8 Data Communication Architecture Flow:

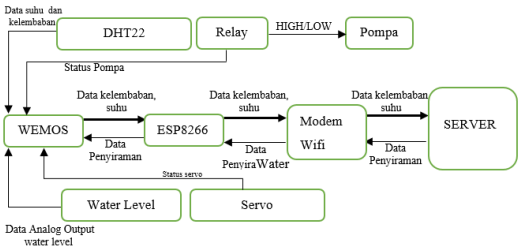


Figure 8 Data Communication Architecture Flow**.**

The following is a description or explanation of the figure 8 The flow of data communication architecture include:

1. Wemos provide power as well as request data to each sensor (Water level and DHT22)
2. Water level sensor provides response in the form of AO data (analog output) value that will be used to detect water which will be followed by other procedures.
3. he DHT22 sensor provides response in the form of air humidity and temperature data to be used for regulatory reference in watering .
4. Wemos will send data to ESP8266 already connected internet via wifi hostpost / mifi modem.
5. Data from ES8266 will be sent to internet via internet network.
6. Moisture data, high data sprouts and high water data sent to the server.
7. For sprinkling data sprouts ESP8266 will request data from server through internet network.

Here are the details of the inter-device communication used in moisture and high-capacity detection prototypes as indicators for watering and harvesting on the production of sprouts based on the internet of things:

1. Sensor Water Level - Wemos

   Soil sensor water detection then send it to pin AO (Analog Output) then read by Wemos. The following is a fragment of the syntax for reading the analog output of a water level sensor,

```
liquid_level= analogRead(sensorPin);
```

   Then the value will be used to detect the presence of water and followed by another procedure that serves to turn off the relay connected into the water pump and servo to open the faucet,

```
if(liquid_level >= lvlair){
 digitalWrite(rly, LOW);
 Serial.println("POMPA OFF");
 Serial.println("BUKA KERAN");
 Servo1.write(0);
```

2. DHT22 Sensor - Wemos

   The DHT22 sensor will be connected to a digital pin on Wemos and will read the humidity and the following temperature is a syntax for reading air humidity and temperature,

```
sensors_event_t event;
dht.temperature().getEvent(&event);
if (isnan(event.temperature)) {
  Serial.println("Error reading temperature!");
}
else {
  Serial.print("Temperature: ");
  Serial.print(event.temperature);
  Serial.println(" *C");
}

dht.humidity().getEvent(&event);
if (isnan(event.relative_humidity)) {
  Serial.println("Error reading humidity!");
}
else {
  Serial.print("Humidity: ");
  Serial.print(event.relative_humidity);
  Serial.println("%");
}
```

At this stage, the design of irrigation system and monitoring in the form of design. The designs built are tailored to a predefined system of problems faced by the sprouts farmers.

2.2.4 Non-Functional Needs Analysis

System requirement analysis is done to find the outside requirement of system needed to make system to be built. The non-functional requirements for running the system include hardware analysis, software analysis. There are also software recommendations from digital library applications are as follows:

Tabel 1. Software recommendations

Software Requirements	**Specification**
Operating system	Windows XP SP3

Hardware	Specification
RAM	32 GB
Hardisk	2x2T Enterprise SATA
Prosessor	Intel® Xeon® E3-120
Motherboard	Super Micro E3-1230v2

Time	Temperature (°C)	Humidity (%)	Locatiom
07:18:53	26	76	In place of production
09:08:35	30	54	Outdoor
09:45:38	28	63	Indoor

Browser	Mozilla Firefox, Google Chrome

Tabel 2. Recommended Hardware Tools

Hardware	Name
Microcontroller	Wemos D1
Wifi	ESP8266
Humidity and Temperature Sensors	DHT22
Water Detection Sensor	Water Level
Servo	SG90
Relay	Relay 1 Channel

Tabel 3. Recommended Server

2.3 Implementation and Testing

2.3.1 Testing Wemos D1

Wemos D1 is supplied with a 12VDC power supply that is routed through a switching regulator to produce 5VDC. Testing Wemos D1 aims to determine whether Wemos D1 can perform commands that have been uploaded via the serial port by turning the led on Pin 8 so it can be stated that Wemos D1 can be used and running properly. The tools used in testing Wemos D1 are as follows::

1. Wemos D1
2. 1 Led
3. Power Supply
4. PC / Laptop
5. Arduino IDE
6. USB board Cable

Here are the results of testing Wemos D1 can be seen in table 4 Testing Wemos D1.

Tabel 4. Testing Wemos D1

Testing	Condition	Results
1	digitalWrite(20,LOW)	Led OFF
2	digitalWrite(20,HIGH)	Led ON

Based on the above test results, Wemos D1 can turn on the led by giving the condition HIGH in accordance with the given command.

2.3.2 DHT22 Sensor Testing

DHT22 sensor testing performed in several different places with the aim to determine the level of sensitivity and respone sensors. Before performing the test, the sensor is connected to the wemos which will read the sensor output already calibrated in degrees Celsius (° C). The following test results performed on the DHT22 sensor are described in Table 5. DHT22 Sensor Testing:

Tabel 5. Pengujian Sensor DHT22

2.3.3 Pengujian Sensor *Water Level*

Water level sensor testing is done with the aim to determine the level of sensor stability. Before performing the test, the sensor is connected to wemos which will read the output via analog pin. The following test results performed on the water level sensor are described in Table 6. Water Level Sensor Testing:

Tabel 6. Water Level Sensor Testing

Lowest Value	The highest Value	Time required To get back to normal
3	874	5 Minute

3.2.4 Water Level Sensor Testing

Relay sensor testing is done in order to know the logic and the amount of electric current on the relay. Relay sensor testing is done by connecting pins, vcc and gnd on wemos to relay. Then from the relay connected to the outlet connected to the pump so it can burn. Here is the test on the relays described in Table 7. Relay Testing

Tabel 7. Relay Testing

No	Logic Input on Relay	Exit Out
1	LOW(0)	0V
2	HIGH(1)	220V

2.3.5 Servo Test MG995

Testing servo mg995 in order to know the voltage that can turn on the servo. Testing servo mg995 is done by connecting pin, vcc and gnd on wemos to servo. Then the servo is connected to the water tap used to open and close according to the condition. The following is the test on the relays described in Table 8 Servo MG955 Testing

Tabel 8. Servo MG955 Testing

Electrical voltage	Servo MG955	
	Function	Not function
3.1V		☑
4.8V	☑	

5.5V	☑	
5.8V	☑	
6.3V	☑	
6.7V	☑	
7.2V	☑	

2.3.6 Testing Wireless Modem Connection

Testing a wireless modem connection with the purpose to determine the maximum distance that can be detected by ESP8266 Testing a wireless modem connection is done by connecting ESP8266 with a modem via wireless so that ESP8266 can be connected to the Internet and can perform activities of sending and receiving data from the server. The following is a test of the relays described in Table 9 of the Wireless Modem Connection

Tabel 9. Wireless Modem Connection

Wireless Modem Distance	Modem Wifi	
	Connects with modem	Internet connection
1 meter	☑	☑
2 meter	☑	☑
3 meter	☑	☑
4 meter	☑	☑
5 meter	☑	☑
6 meter	☑	☑
7 meter	☑	☑
8 meter	☑	☑
10 meter	☑	☑
11 meter	☒	☒

2.3.7 Watering Testing

The sprinkling watering test on the design of irrigation and monitoring system for the production of sprouts based on internet of things can be seen in Table 10 Watering Tests.

Tabel 10. Watering Tests

No	Time	Range	Information
1	05:00:00 – 05:01:00	1 minute	Watering Taoge
2	09:00:00 – 09:01:00	1 minute	Watering Taoge
3	13:00:00 – 13:01:00	1 minute	Watering Taoge
4	17:00:00 – 17:01:00	1 minute	Watering Taoge
5	21:00:00 – 21:01:00	1 minute	Watering Taoge

2.3.8 Watering Tests by Time

Testing for overcome the sprinkling delay of sprouts in the design of irrigation and monitoring systems for the production of internet-based sprouts of things can be seen in Table 11 Testing of Watering.

Tabel 11. Testing of Watering by time

No	Waktu	Waktu yang ditentukan	Keterangan
1	05:01:00 – 09:00:00	4 hour	The 1th time pours watering sprouts
2	09:01:00 – 13:00:00	4 hour	The 2th time pours watering sprouts
3	13:01:00 – 17:00:00	4 hour	The 3th time pours watering sprouts
4	17:01:00 – 21:00:00	4 hour	The 4th time pours watering sprouts
5	21:01:00 – 01:00:00	4 hour	The 5th time pours watering sprouts

3. CONCLUDING

4.1 Concluding of research

Based on the results of testing and discussion that has been made then can be drawn conclusion as follows:

1. This system can help farmers sprouts in the process of watering automatically and avoid the delay and shifting time sprinkling sprouts.
2. This system can help farmers sprouts in leveling the process of watering.
3. This system can help farmers sprouts for monitoring and controlling watering sprouts through the internet. So that can beraktifitas outside the production house.

4.1 Suggestions

Suggestions that can be given to the development of systems that have been made for further system development can be explained as follows :

1. This system does not have a system to detect the damage to each component used. We recommend adding a feature that can detect if the component or sensor is damaged.
2. This system does not have a system to cope if the power goes out. We recommend adding an electrical system that can cope with power outages.

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