THE DIGITAL WEIGHT SCALE OF IoT SYSTEM USING LOAD CELL SENSOR IN UD. PANGRUKTI TANI

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ABSTRACT

Onion weight measurement recording in UD. Pangrukti Tani is still done using manual scales. Therefore, it prones to errors in recording of the measurement. Based on the explantion above, a prototype of digital scale is designed to measure the weight of onions using an ATMega2560 microcontroller which adopting Internet of Things (IoT) technology. To measure the weight, the device uses a load cell sensor which has a maximum weight capacity of 5 kg. ATMega2560 microcontroller is used for data management of the entire system. Sending weight data to the sensor, then to the web server using the Esp8266 wifi module. The results show that the device is able to measure the weight of onions with 5 kg of maximum capacity, 1.64% of measurement error, and of 98.36% of precision . The prototype of digital scales which uses IoT technology can help UD Pangrukti Tani owners in monitoring the results of the weight measurement.

Keywords : Esp 8266, Internet of Things, Load Cell, Microcontroller, Monitoring dan Controlling, Weight Scale.

1. PRELIMINARY

Shallots (Allium ascalonicum L.) shallots are one of the leading vegetable commodities. Shallots have good market prospects so they are included in national superior commodities. This vegetable commodity is included in the spice group which functions as a food seasoning and traditional medicinal ingredients. This commodity is also a source of income and employment opportunities that contribute quite high to the economic development of the region.

UD. Pangrukti Tani is one of the regional onion vegetable commodity businesses in Nganjuk Regency, East Java. Where has the onion post harvest plot, among them are extracting shallots, drying onions, cleaning shallots, cutting shallots, grading (onion) shallots, recording scales of shallots and packing onions

Based on the interview with Mr. AKAT as chairman UD. Pangrukti farmer and chairman Gapoktan (Farmers Group) Luru Luhur. Permasalahn occur at post-harvest groove recording section of onion scales that when local business owners will see record overall weight of the onion crop yields by grade. The process of weighing and weight recording onion harvest is done when the harvest season comes in August and November, and carried out after the sorting process shallots. The process of recording was still done manually and using paper media. Thus it can lead to errors in the calculation of weight of onion and loss of records at the time of checking back. As in August 2017 recording the results of onion scales lost when rechecking.

load sensors cell can measure mass (g), style weight (N), and the density (G / cm)[1], Load measurement sensor load cell can use stone[2], censorship Load cell can also measure weight maksimaltimbangan 200 Kg[3], Data from load cell sensor can sent to the database using modules wifi esp8266 [4], With esp8266 users can memonitoringdan control the data which are desired and data information displayed on computer in website form[5],

Based on the problems above description it needed a tool that could solve the problem, namely, digital scales using ATMEGA 2560 microcontroller as a control center system and pengelolahan the data, load sensors load cell as the load detection module wifi esp8266 as sensor data transmission using the internet / wifi and shown into website.

Based on the above results, it was taken topic thesis with the title "Digital Scales IOT System Sensor Using Load Cell at UD. Pangrukti Tani ".

1.1 Purpose

The following are the objectives of this study, as follows.

1. Knowing the overall weight of the onion crop yields by grade.
2. Having a record is the overall weight of the onion crop yields by grade.
3. Time efficiency in the process of weighing and weight recording onion.

2. RESEARCH CONTENT

2.1 Basis Theory

Base is the theory of This system development using the basic theories for the analysis process and to support the process system development of IOT system maintenance system using digital weighing load cell sensor at UD. Pangrukti Tani.

2.1.1 The Internet of Things

Internet of Things is a concept that aims to expand the benefits of connectivity internet connected continuously. Internet *of things is* a technology that allows for control, communication, cooperation with various hardware , various the data, virtualize anything real to in Internet forms and other - others through network Internet[6],

So the Internet of Things (IOT) in research This is used for send sensor data *load cell* into the database and web server to be stored and displayed in a web site through the Internet.

2.1.2 Microcontroller ATMEGA 2560

Microcontroller ATMEGA 2560 is a microcontroller based development board using the arduino chip ATMega 2560. This board has a pin I / O that is quite a lot, a number of 54 pieces of digital I / O pin (pin 15 of which are PWM), 16 pins analog inputs, 4 pin UART (serial port hardware). The microcontroller is equipped with a oscillator 16Mhz, a USB port, power jack DC, ICSP header, and a reset button. Usage is quite simple microcontroller with a 2560 ATMega connect the power USB to your PC / Laptop or through air conditioning / DC jack DC [7],

Picture 1. Microcontroller Board ATMega 2560

So ATMega 2560 microcontroller used in this study as the brain of the system and to manage analog data from the load cell sensor into digital data.

2.1.3 Sensor Load Cell

load cell is a device test electrical devices that may alter a energy into Other energy used to change a style into signal electricity [8],

Figure 2. Sensor Load Cell

So the load cell sensor used in this study to measure the weight of the onions are included.

2.1.4 LCD (Liquid Cristal Display)

LCD (Liquid *Crystal Display*) Is seuatu media types appear that using liquid crystal to produce visible image[9],

Figure 3. LCD 16x2

So LCD in this study is used to display the commands to be executed by the user such as showing heavy red onion. LCD is used is the type and size of 16x2.

2.1.5 Web Server

Web server is a software that provides services based data and function receives a request from HTTP or HTTPS on client known or web browser (Mozilla Firefox, Google Chrome) and to send back the results in the form some web pages and in general will take the form of document HTML [10],

2.1.6 ESP 8266

ESP 8266 is a embeded chip in communication design based wifi. chip It features TTL serial output and GPIO (General Purpose Input / *ourput*). Versatile wifi module is SOC (System *on chip*) the one that can do programing directly to the ESP 8266 which has capability to *networking* complete and united well as *client* nor *Access Point*, Having the ability to communicate with which uses port HTTPS [11],

Figure 4. ESP 8266

2.2 Analysis System

The analysis system can be defined as the decomposition of a system whole into its

parts component with a view to identifying and evaluate problems that No, barriers that occur and need expected.

2.2.1 System Architecture Analysis

The analysis system built that stage that provides an overview system built and aims to provide a more detailed picture of how the whole system is built. In any system there are hardware components such as sensors that read the weight of the onion that is connected to the microcontroller, LCD 16x2, buzzer, and transmit data from the sensor readings load cell through the ESP 8266 using Internet technology of things (IOT) and shown into the web ,

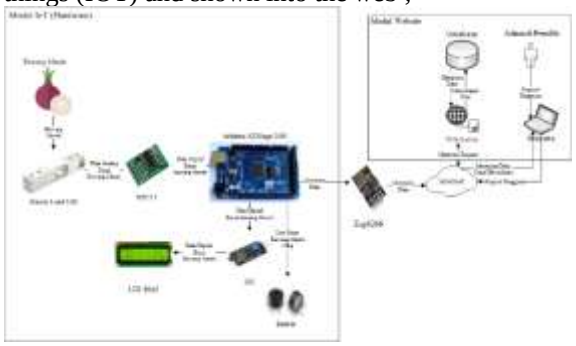

Figure 5. System Architecture To Be Built

2.2.1.1 Stages IOT module (Hardware)

1. Red onion as the object of the burden of load cell sensors.
2. Sensor Load Cell, red onion load data read and transmit that data to arduino ATMega 2560. Maximum weighing 5kg.
3. HX711 IC amplifier module output of the sensor load cel.
4. Microcontroller ATMEGA 2560 serves to take data from the sensor and load cell modules as well as the sending of data to the ESP 8266 wifi module and I2C module.
5. I2C modules as recipients of ATMega 2560 digital data and transmit digital data to the LCD.
6. Buzzer as notifiasi if the load exceeds the capacity of the scales of onion.

2.2.1.2Tahapan module website (Admin & Owner)

1. Admin and Owner of UD. Tani Pangrukti accessing websites via a browser and login.
2. Admin can manage data grade onion, the data weights, and adding data grade onion, the data weights, and add data manager system.
3. Owner UD. Pangrukti grade Tani can see the data, the data scales, scales graph, and export data onion scales in excel format.
4. *request* will be sent to the web server through the Internet.
5. *web server* processing the request to access the data in the database.
6. *web server* send the required data from the database to the manager in the delivery format HTTP GET with a system interface website.

2.3 Analysis of Data Communications

Data communication with regard to the data transmission system of electronic transmission of a terminal to another terminal. The data in question is an electronic signal that is generated by the source of data that can be captured and transmitted to the receiving terminal. Here are three key elements of section data communication system.

2.3.1 Data Sources

Existing data sources exist on this system can be described as follows.

1. Sensor Load Cell
   These sensors are used as a source of data to detect the weight of a red onion.
2. Microcontroller ATMEGA 2560
   Used as a control center that receives analog data from the load cell sensor and sends the digital data to the ESP 8266.

2.3.2 Transmission Media

The transmission medium is the path where the process of sending data from the source to the receiver. The following are the components of the transmission medium.

1. ESP 8266 Wifi
   Used as a liaison between the microcontroller ATMega 2560 with WIFI Router.
2. WIFI Router
   Wifi Router used are smartphone users as a hotspot tool that has an Internet connection to access the web server.
3. web Server
   Used as a liaison between the ESP 8266 to the database for data transmission in GET format.

2.3.3 Data Recipients

Devices that receive the data as follows.

1. website
   website receive data in the form of data scales and data grade onions from the database, can be accessed using a browser with Laptop or Smartphone device.

2.4 System Design

The system design aims to specify technical aspects the solution in planning.

2.4.1 Relation Scheme

Relationships between tables constitute The combined between files that have The main key together, so that files such as one that is connected by field key (primary key). Here is a schematic relationships.

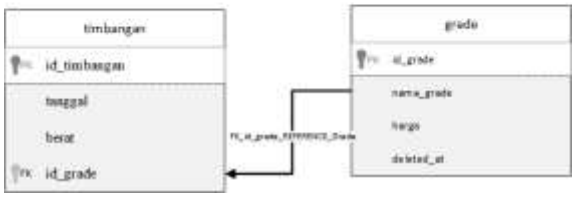

Figure 6. Relation scheme

2.4.2 Structure Table

The design of the table structure is the design of the tables that will be used on the database. The tables contained in the database used in this web-based application, ie.

Table 1. Users Table Structure

No.	name Field	Data types	Long	Ket
1	id_user	int	11	PK
2	nama_user	varchar	50	
3	e-mail	varchar	35	
4	password	text	-	
5	levels	tinytint	4	
6	deleted_at	datetime	-	

Table 2. Grade Table Structure

No.	name Field	Data types	Long	Ket
1	id_grade	int	11	PK
2	nama_grade	varchar	25	
3	price	int	11	
4	deleted_at	datetime	-	

Table 3. Scales Table Structure

No.	name Field	Data types	Long	Ket
1	id_timbangan	int	11	PK
2	id_grade	int	11	FK
3	date	date	-	
4	weight	int	11	

2.5 Implementation System

After the design stage that is done, then the steps being taken The next stages of the implementation of the design. At this stage of development of the system based on the results of the analysis, whether it either software or hardware.

2.5.1 Implementation Database

Implementation of the data base is a stage where implementing the database design, database creation software use XAMPP (phpMyAdmin). Implementation of the database can be seen in the sub-chapters below.

Table 2.5.1.1 Users

Users table used to store data manager. The contents of the user table can be seen in Table 4.

Table 4. users table

No.	field	Type	size	Key	Ket
1	id_user	int	11	PK	not_null, auto_increment
2	nama_user	varchar	50		not_null
3	E-mail	varchar	35		not_null
4	password	text			not_null
5	level	tinyint	4		not_null
6	deleted_at	datetime			null

Table 2.5.1.2 Grade

Tables are used to store data grade grade red onion. The contents of table grade is shown in Table 5.

Table 5. table grade

No.	field	Type	size	Key	Ket
1	id_grade	int	11	PK	not_null, auto_increment
2	nama_grade	varchar	25		not_null
3	Price	int	11		not_null
4	deleted_at	datetime			null

2.5.1.3 Table Scales

Table scales is a table that stores the data from the sensors. The contents of the scales table can be seen in Table 6.

Table 6. table scales

No.	field	Type	size	Key	Ket
1	id_timbangan	int	11	PK	not_null, auto_increment
2	id_grade	int	11	FK	not_null
3	date	date			not_null
4	weight	int	11		null

2.5.2 Implementation Interface Login

The following Figure 6 is a sample login menu interface into the admin menu.

Figure 6. Interface login

After a successful login admin, admin will go to the main menu, which will display information and manage user data, the data grade, the data weights, and reports. Which can be seen in Figure 7.

Figure 7. Main Page Admin Interface

2.6 Testing sisten

Testing of the system is the cornerstone that aims to find errors or deficiencies in the system is to determine the performance of the information system that has been tested. System testing is to determine the performance of the information system that has been made in accordance with the purpose of information system design.

2.6.1 Accuracy Testing Tool

For determine the accuracy of testing a necessary tool a calculation method specifically for know. The following have made the calculation method testing of accuracy tool has realized. After Data obtained of the test results and weight measurements onions red per gradenya by sensors load cell and Conventional scales, then the next step is to analyze the data for the calculation of the percentage value analysis (%) success and nlai percentage (%) Error (error). Formulas for calculating and seek the percentage of mistakes and successes measurement censorship load cell or conventional scales are 1-5 following berdasarkanxpersamaan[12],

1. The average percentage Load measurement results $Cell = \frac{\mathbf{S1+S2+S3}}{\mathbf{3}}$
2. The percentage of error measurements on Load Cell = $\frac{s-X}{s} \times \mathbf{100}\%$
3. Percentage Load measuring success *Cell* = $\frac{\mathbf{x}}{\mathbf{s}} \times \mathbf{100}\%$
4. The percentage measurement error on the Scales manual = $\frac{s-X}{s} \times \mathbf{100}\%$
5. The percentage of successful measurements on Scales manual = $\frac{\mathbf{x}}{\mathbf{s}} \times \mathbf{100}\%$

Where S1, S2, and S3 is the number of measurements and testing, S tends to value the results of measuring load cell and weighing manual and x is the value range or capacity limitations measurement.

2.6.2 Testing Sensor Load Cell

Testing load sensor *cell* done by entering the onion to in containers underneath by the load cell sensor. Tests carried out using three classes of onion that is class A, class B, and class C. Tests carried out 4 times with different capacities, namely 0,5kg, 1kg, 1.5 kg, and 2kg. after testing the load cell sensor test results displayed on the LCD. The test results and calculations can be seen in Table 7, 8, 9, and 10.

Table 7. Results of Testing and Measurement Onion Stage 1

No.	grade BM	Range (Kg)	Results 1 (Kg)	Results 2 (Kg)	Results 3 (Kg)	The average success		Error (%)
						(Kg)	(%)	
1	A	0.5	0.5	0.5	0.5	0.5	100	0
2	B	0.5	0.5	0.5	0.5	0.5	100	0
3	C	0.5	0.5	0.5	0.5	0.5	100	0

Table 8. Results of Testing and Measurement Onion Stage 2

No.	grade BM	Range (Kg)	Results 1 (Kg)	Results 2 (Kg)	Results 3 (Kg)	The average success		Error (%)
						(Kg)	(%)	
1	A	1	1	1	1.01	1.003	99.67	0.33
2	B	1	1	1	1	1	100	0

3	C	1	1	1.01	1.01	1,007	99.34	0.66

Table 9. Results of Testing and Measurement Onion Stage 3

No.	grade BM	Range (Kg)	Results 1 (Kg)	Results 2 (Kg)	Results 3 (Kg)	The average success		Error (%)
						(Kg)	(%)	
1	A	1.5	1.5	1.51	1.51	1,507	99.56	0.44
2	B	1.5	1.51	1.51	1.51	1.51	99.34	0.66
3	C	1.5	1.53	1.53	1.53	1.53	98.04	1.96

Table 10. Results of Testing and Measurement Onion Stage 4

No.	grade BM	Range (Kg)	Results 1 (Kg)	Results 2 (Kg)	Results 3 (Kg)	The average success		Error (%)
						(Kg)	(%)	
1	A	2	2.06	2.07	2.07	2.07	96.77	0.44
2	B	2	2.05	2.05	2.05	2.05	97.56	0.66
3	C	2	2.07	2.08	2.08	2.08	96.31	1.96

Table 11. Overall Results of Testing and Measurement Weight Shallots

No.	grade BM	total Range (Kg)	Results 1 (Kg)	Results 2 (Kg)	Results 3 (Kg)	Results 4 (Kg)	total Average	Success (%)	Error (%)
1	A	5	0.5	1.003	1,507	2.07	5.08	98.49	1.51
2	B	5	0.5	1	1.51	2.05	5.06	98.81	1.19
3	C	5	0.5	1,007	1.53	2.08	5.11	97.78	2,22

From Table 11 above show the overall results of test and measurement shallots weight per grade can use the sensor load cell where the first data onion grade A with a capacity of 5kg measurements obtained from the total number of first test measurement capacity 0,5kg, 1kg second testing, testing 1.5 kg third and fourth test 2kg, the value of the average measurement results of testing 1 0,5kg, the second test 1,003kg, 1,507kg and a third test fourth test 2,07kg. So the measurement and calculation is as follows.

Total measuring Average = S1 + S2 + S3 + S4
= 0.5 + 1.003 + 1.507 + 2.07
= 5.08 Kg

Average success = $\frac{X}{S} \times 100\%$

= = $\frac{5}{5,08} \times 100\%$

Average error = $\frac{S-X}{S} \times 100\%$

= $\frac{5,08-5}{5,08} \times 100\%$

Based on the results and the overall amount of the average obtained in the measurement and heavy testing shallots using sensors *load cell*, The obtained datazseperti Table 12 below.

Table 12. The average success and Error Rate Measurement In Sensor Load Cell

No.	grade BM	number Range (Kg)	Measure Results load Cell (Kg)	Success Measurement (%)	Error Measurement (%)
1	A	5	5.08	98.49	1.51
2	B	5	5.06	98.81	1,119
3	C	5	5.11	97.78	2,22

2.6.3 LCD Test

LCD (Liquid Crystal Display) receipts 16x2 types were used to show the value of weighing scales from the sensor load cell, stored in the front position of digital scales. LCD succeeded in showing the burden of red onion.

Figure 9. LCD testing

It can be seen from Figure 4.3 LCD can work well with heavy displays onions that have been identified by the load cell sensor.

2.6.4 Testing Module Wifi ESP 8266

ESP 8266 is wifi module that is used to transfer data from the load cell sensor to the database. ESP 8266 can work well.

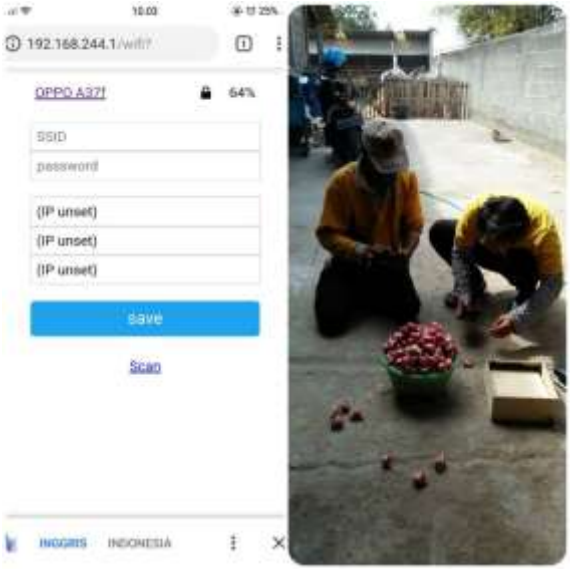

Figure 10. Wifi module testing ESP 8266

From Figure 10 it can be seen that the tool, connect to the network scales at around using wfi manager and the access point or address ip address of the scales.

3. CLOSING

3.1 Conclusion

Based on the results of testing of software and hardware that has been created as a digital scale IOT system using a load cell sensor at UD. Tani Pangrukti it could be concluded as follows.

1. A system that can determine the overall weight of the onion crop yields by grade.
2. A system that can have an overall weight data report onion yields by his grade.
3. Tools and systems are built have time efficiency in weighing and recording.

3.2 Suggestions

Suggestions from this study were drawn from interviews with Mr. AKAT as the owner of UD. Pangrukti Tani and taken from the test tool. Here are suggestions from the development of software and hardware of this system to become more optimal.

1. If you want to increase the capacity load cell, load cell should replace with a larger capacity.
2. If you want maximum capacity weighing 5 Kg, then use the maximum capacity of the scale is larger than the desired maximum capacity scales, if the weight exceeds the capacity of the scales the number displayed is not a minus.
3. The design of digital scales using better materials such as stainless steel, in order to strengthen the body scales.
4. Use a better wifi module that currently no data transmission delay or fail because of the signal.

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