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Automatic Control System for Venetian Blind in Home Based on Fuzzy Sugeno Method

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Abstract. Smart home technology is evolving quickly, and numerous smart home devices associated with Artificial Intelligence (AI) have increased the quality of life for occupants. The purpose of making this tool is to design, build, and test the Internet of Things (IoT) using the Universal Board with the ATMega328 microcontroller to measure, record, and display data via a smartphone. The Sugeno fuzzy method is used to find the cryptic value of the system. The system design consists of a series of Universal Board modules with an ATMega328 microcontroller which acts as a controller for automatic drying monitoring, a series of light-dependent resistor sensors, raindrop, and DHT22 sensors, as well as a DC number and a micro switch that functions as the output of all these sensors. The data obtained is displayed on the mobile application. These tools and applications have worked well, it can be seen from the several tests that have been carried out there are no significant differences in system calculations and manual calculations.

1 Introduction

The definition of the Internet of Things is not widely agreed (also as IoT). The word IoT, used for the first time by Kevin Ashton in a 1998 lecture, defines the evolving global information service architecture focused on the Internet. About a decade earlier, late Mark Weiser created a seminal view of future technical ubiquity – one in which the growing “availability” of computing capacity will be followed by its diminishing “visibility” [16, 20]. The words “Internet” and “Things” mean an interconnected worldwide network based on sensory, communication, networking, and information processing technologies, which might be the new version of information and communications technology (ICT) [8]. The exponential growth of telecommunications has sparked new concepts

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that can be developed with the use of internet technology. The Internet of Things is one of the most common ideas. IoT or the Internet of Things is a term that seeks to extend the advantages of constant access to the Internet. The IoT application that is being built is a smart house. In recent years, the growth of smart home technology has led to the transition from a conventional home to a smart, wired Internet. Smart Home is a household filled with devices such as sensors, wired and wireless networks, actuators and intelligent systems [5].

The fields of use for IoT technologies are as vast as they are diverse, as IoT applications increasingly extended to nearly all aspects of daily life. The most important fields of implementation include, for example, the smart industry, where the implementation of intelligent production systems and linked production sites also was discussed under the heading of Industry 4.0. Intelligent thermostats and monitoring devices attract the most coverage in the smart house or construction market, while smarts energy solutions depend on smarts power, gas, and water meters [15, 20]. IoT can be considered as a global network infrastructure composed of numerous connected devices that rely on sensory, communication, networking, and information processing technologies [14, 20].

The smart home is a high-tech home that requires multiple systems and gadgets at home to interact with each other. Smart home systems can be used to monitor nearly all things in the home that can be remotely controlled (remote). Applying a smart home is simple and effective to overcome the many challenges and events at home, taking into account the different activities of any person outside the home [11, 20]. Smart home is a convergence of information technology and computer systems used in homes or buildings occupied by humans, depending on the performance, automation, convenience, protection and savings of home electronic devices. As a result of technical advances, the new supply of the smart home has been well developed with different ideas and systems in mind [4].

2 Related Works

In [2] the model of smart IoT was used for irrigation. It was presented how sensor readings can be used for precise irrigation in modern agriculture. IoT infrastructure for temperature monitoring and optimal control in retail refrigerated cabinets is one of the recent propositions [12]. This [1] research proposes a new solution based on multiple objective optimizers (MOO) to set a proper flow rate and water temperature minimizing the used amount of energy by the taps. [20] Note that, there is a large gap in this area when there are multiple users on different taps within a house. The future of the Internet will consist of heterogeneously connected devices that will further extend the borders of the world with physical entities and virtual components. The Internet of Things (IoT) will empower the connected things with new capabilities [6].

They present a modified Takagi–Sugeno method, one of Fuzzy Rule-Based Systems family, applied for prediction of forging dies wear [7]. A technological process, as well as acquired data are briefly discussed. The modified Takagi-Sugeno approach is introduced. Its main advantage, acquiring knowledge from experts instead of datasets, is emphasized [20]. They also defined the deployment status of artificial intelligence in smart home devices and how it is used in our home so that we can grasp how artificial intelligence is used to make smart homes [5]. This research describes the smart home management paradigm for the proposed system and the key tasks to be undertaken at each level. In addition, we address realistic architecture issues with focus on data transmission as well as smart home connectivity protocols and their interoperability [13].

The author [3] proposed to use a ball robot (BR) device control issue, where the BR has the ability to travel omni-directionally. [20] The suggested control system incorporates two fuzzy BR control methods. In this fuzzy control approach, the TS fuzzy paradigm for fuzzy BR modeling was introduced. The principle of parallel distributed compensation (PDC) was used to build a fuzzy control scheme for TS fuzzy models. Fuzzy language can be interpreted as vague, in other words, fuzzy logic is vague logic. Where in fuzzy logic a value can be 'true' and 'false' simultaneously. The rate of 'true' or 'false' value in fuzzy logic depends on the membership weights it has [19]. A new regression model is developed by [10] for the calculation of program effort based on the use case point model. In addition, the Sugeno Fuzzy Inference Method (FIS) approach to this model is used to improve estimation. The findings show that an increase of 11% could be made in the MMRE following the Sugeno fuzzy logic strategy [10].

Martin et al. [9] described the application whose effects are compared to those of multiple regression. A subset of 41 modules built from 10 programs is used as results [9]. The result indicates that the value of the MRE (aggregation of magnitude of relative error, MRE) applying fuzzy logic was marginally higher than that of the MRE applying multiple regression, while the value of Pred (20) applying fuzzy logic was slightly higher than that of Pred (20) applying multiple regression. In comparison, six of 41 MRE was equal to zero (without any deviation) when fuzzy logic was implemented (not any similar case was presented when multiple regression was applied) [9].

3 Methods

3.1 Research Approach

The methodology used is the planning approach. In Indriarti 1997, Thierauf and Klekamp 1975 suggest that the planning approach can be used to critically identify problems [20]. There are several steps in the planning approach method. Researchers developed a mobile-based automatic monitoring system using Arduino Nano to solve the current problems. It uses a Rain Drop Sensor (RD), Light Dependent Resistor (LDR) and DHT22 Sensor to construct this solution, as well as a mobile application for remote monitoring of venetian blind. The system design, hardware development and programming of mobile applications will be carried out using the Arduino Nano device and the ESP8266 module. After that, the hardware and application will be tested. If the test results are suitable, the hardware and applications will be implemented [20].

3.2 Research Stages

3.2.1 Data Flow Diagram

The data flow diagram illustrates that the input has an analog signal from the light-dependent resistor sensor (LDR), the raindrop sensor (RD) and the DHT22 sensor. The

Arduino Nano will process all of these inputs. After all data has been processed, the data transfer process will be carried with the server via the HTTP Protocol. ON/OFF is the output of the DC motor. The information will be transferred into a WEB API from the server and processed using a mobile application [20]. The data flow diagram is illustrated in Fig. 1 [20].

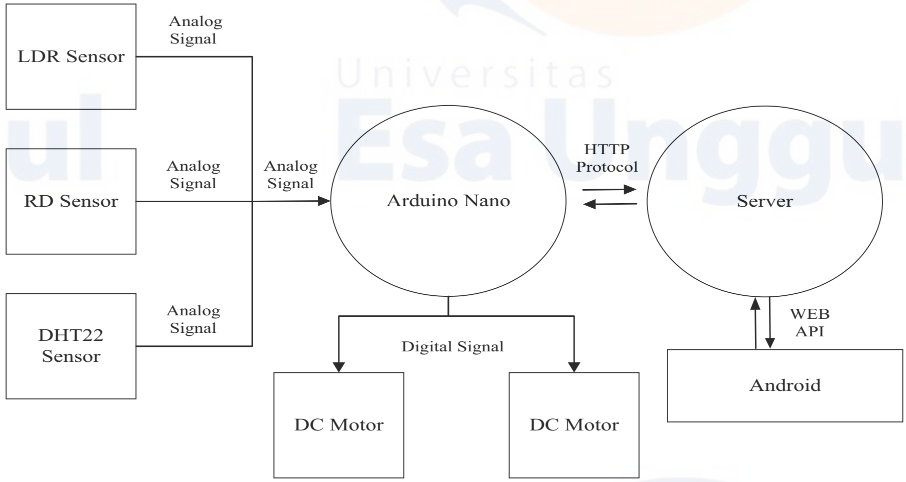

Fig. 1. Data flow diagram

3.2.2 Sensor's Variables

The DHT22 sensor will detect temperature and humidity, the LDR sensor will detect light, and the RD sensor will detect rain. On the Arduino Nano microcontroller, the results from each sensor will be processed and the data processing results will be sent to the server [20]. Each sensor's variables are as follows.

1. The values of variable for DHT22 Sensor (Humidity) are shown in Fig. 2.
2. The values of variable for RD Sensor (Rain) are shown in Fig. 3.
3. The values of variable for LDR Sensor (Light) are shown in Fig. 4.
4. The values of variable for DC Motor are shown in Fig. 5.

3.2.3 System Design

System design is carried out at this stage to read the value of the RD sensor, LDR sensor, and DHT22 sensor which the Arduino Nano microcontroller and ESP8266 module have already processed [20]. The data is sent to the server and processed to be shown in the mobile application. The system design is shown in Fig. 6.

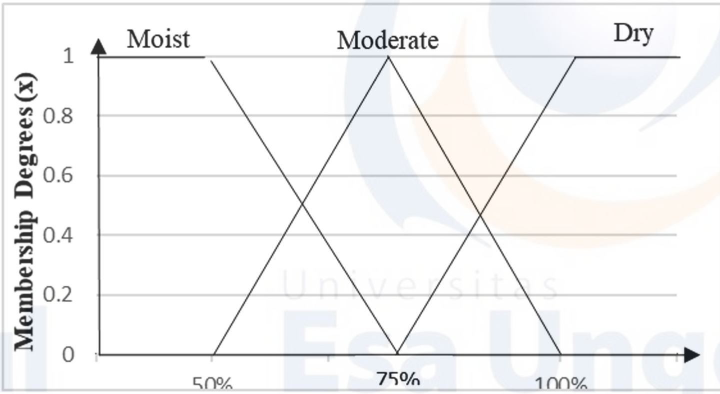

Fig. 2. DHT22 sensor graphics

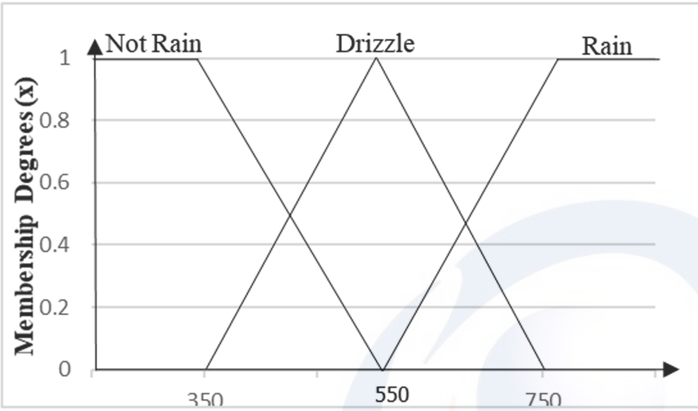

Fig. 3. RD sensor graphics

3.2.4 User Interface Design

Designing user interface to display data from RD sensors, LDR sensors, and DHT22 sensors. Figure 7 illustrates the user interface design [20].

3.2.5 Prototype Design

The venetian blind is made of aluminum with enamel finished flat sheets with the following characteristics: Blind dimensions: 1 m × 1.42 m, Sheet wide: 80 mm, Maximum distance between the sheets: 75 mm, Distance from the glass: 150 mm, Sheet colour: white [17]. It is shown in Fig. 8 for more details.

An Arduino Nano with an LDR sensor and an RD sensor is located on the roof. On the wall, 2 DC motors are installed which function to provide the venetian blind with output and there is also a DHT22 sensor to detect humidity and temperature. See Fig. 9 for more details [20].

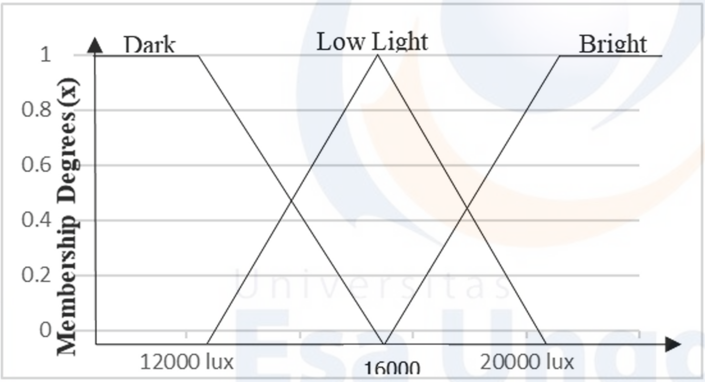

Fig. 4. LDR sensor graphics

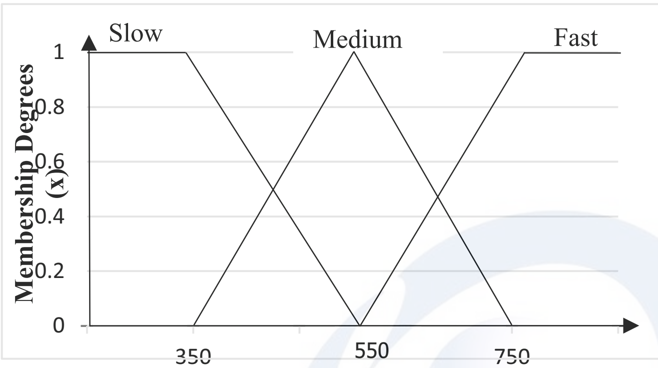

Fig. 5. DC motor graphics

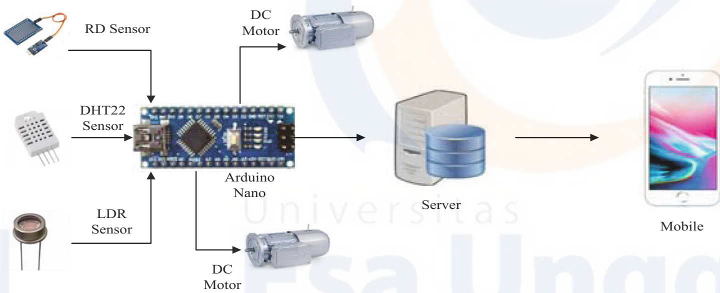

Fig. 6. System design

3.2.6 Database Design

[20] Database design to support the process of developing a mobile application. The database design is shown in Fig. 10.

Fig. 7. Mobile application interface design

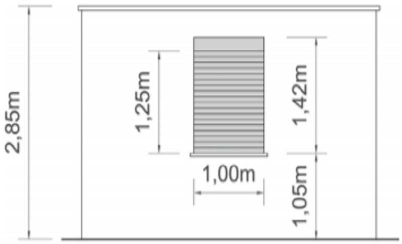

Fig. 8. Venetian blind

Fig. 9. Prototype design

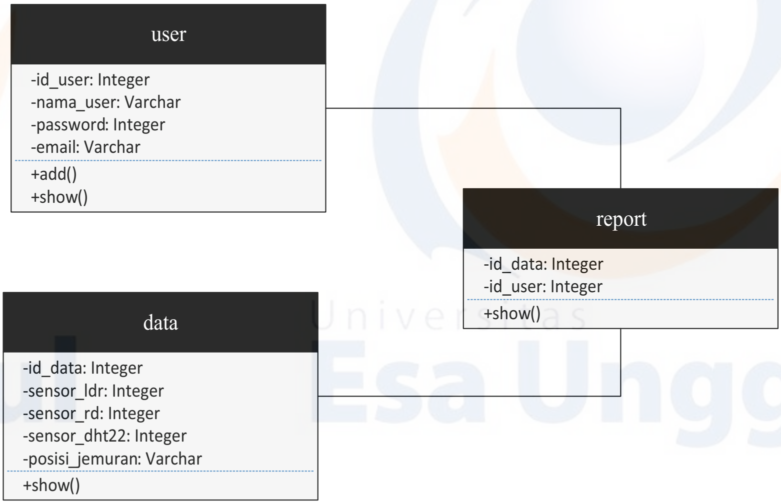

Fig. 10. Database design

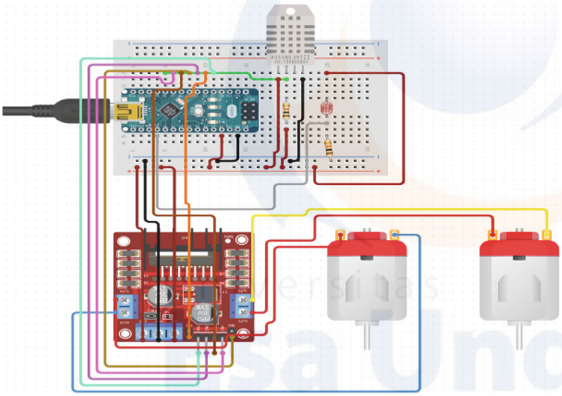

Fig. 11. Sensor data processing

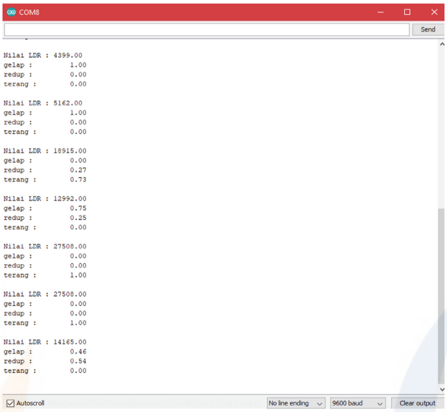

Fig. 12. Serial on the Arduino IDE (LDR Sensor)

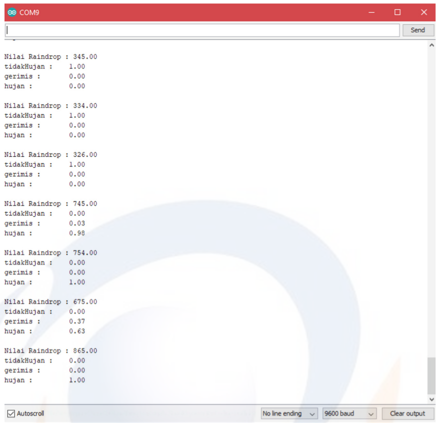

Fig. 13. Serial on the Arduino IDE (RD Sensor)

3.2.7 Sensor Data Processing

A DHT22 (Temperature and Humidity) sensor, an LDR (Light) sensor, and an RD sensor are the system input on the hardware [20]. Each sensor has analog input data (0–1023). All sensor inputs are processed in the Arduino Nano microcontroller and the ESP8266 module. The data will be transmitted to the DC motor if the sensor data matches the logic that has been made so that the DC motor can move the venetian blind.

3.2.8 Programming Stage

At this stage, mobile application programming and all hardware components are carried out [20]. The programming language used to program hardware is the C programming language and the Java programming language for mobile applications. The data sent to the mobile application is WEB API data. If the results of this programming are as expected, the testing process can be performed. To measure the effect of the independent variable on the dependent variable, a t-test or partial test was used to test the system. This t-test is used to ensure that the command moves in accordance with each variable.

4 Results and Discussion

4.1 Testing and Analysis of Light Dependent Resistor and Rain Drop Sensor

Both sensors require the Arduino IDE and installing the ESP8266 library [20]. Testing process is done by connecting the sensor pin to the Arduino Nano board pin. Light Dependent Resistor Sensor pin A0 is connected to pin A0 on the Arduino Nano, Rain Drop Sensor pin A0 is connected to pin A1 on the Arduino Nano, pin ground is connected to pin ground, and pin VCC is connected to pin 5 V. If the light-dependent resistor sensor does not have an error, the Serial Monitor display will contain the Arduino Nano data will appear as below.

The measurement method to find out the size of the error from testing the light-dependent resistor sensor is using Root Mean Square Error (RMSE) [20]. RMSE is not ambiguous in the results, and it is more appropriate to use [18].

$$\mathbf{RMSE} = \sqrt{\sum_{i=1}^{n} \frac{(\mathbf{yi} - \overline{\mathbf{y}})\mathbf{2}}{n}}$$

$$= \sqrt{\frac{1204266.90}{20}} == \sqrt{60213.34} = 245.38$$

5 Conclusion

From this research, it was concluded that the circuit designed based on the application of the fuzzy logic algorithm can be implemented to control the response of the servo motor DC that acts as an actuator [20]. The experiments included programming, testing, and comparing measurement variables were found to be statistically not significantly different with the reference system. The system that was designed was feasible to be used asΩ an IoT system development and contributed to the development of research towards the next IoT system. As a suggestion for further research, the alternative techniques of artificial e.g. Artificial Neural Networks (ANN), Genetic Algorithms and Gray Systems can be explored to increase system accuracy and reliability [20].

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Combining Pipeline Quality with Automation to CI/CD Process for Improving Quality and Efficiency of Software Maintenance

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Abstract. In Taiwan, the regular software maintenance is the essential procedure in general commercial banks. However, during system maintenance, the banking system must be suspended and stop related services. Maintenance period usually make many inconveniences for banking customer. Even affect the transaction efficiency and market competitive advantages of enterprises. How to improve the maintenance efficiency and quality for software system is a critical job to increase the banking service quality and reduce customer lost. In this paper, we redefine the software maintenance workflow and apply the automation tool for constructing automated CI/CD workflow, and propose the CPQM model. CPQM model combines the pipeline quantity factors and automation tool factors of CI/CD process for identifying process defects and assistant improving process quality and efficiency. CI/CD process with high quality and high automation can concretely enhance the maintenance efficiency and quality for software system.

1 Introduction

In the internet and information age, information system is a weapon for all walks of life to improve market competitiveness. However, information system is impacted by the technological evolution and continuous changes in the environment. In order to satisfy the needs of multi-faceted users, conform to the value of the enterprise, and enhance the market competitiveness of enterprises and organizations, information system must have the ability of adjustments, modifications, and expansions continuous. Taking online banking as an example, it provides a system that is not limited by time, area, and number

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