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AUTOMATIC CHICKEN EGGS HATCHER USING DHT 22 SENSOR and DC MOTOR GEARBOX BASED ON ARDUINO

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ABSTRACT

The hatching machine is one of the technological developments in the field of animal husbandry in increasing livestock productivity. Hatching eggs using an incubator is much more effective than natural/conventional breeding. The incubator is an incubator that has controlled temperature and humidity. Instruments used in the manufacture of hatching machines include a DHT 22 sensor which is used as a controller of temperature and humidity values, incandescent lamps are used as a heat source from the hatching machine, ultrasonic mist maker acts as a steam mist generator, DC motor is used as an egg turning rack driver, motor driver L298N acts as a DC motor movement controller, and Arduino Uno as a microcontroller that regulates all system work. This research was conducted with the aim of producing a hatching machine that is more complex and efficient. Based on data analysis carried out from the accuracy and thoroughness. The measurement accuracy ranges from 99.64% to 100%, while the measurement accuracy ranges from 99.64% to 100%, with an average measurement error of 0.178572%.

Keywords : Egg,temperature and humidity,Incubator,Arduino,Sensor DHT 22

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I. INTRODUCTION

The development of chickens is mostly found in rural areas, generally reared naturally, namely the eggs are incubated by the mother directly so that chicken breeding is relatively slow. The natural egg hatching system is less effective because one parent is only able to incubate a maximum of 13 eggs. For hatching eggs that are relatively large, it is less effective because the hen takes time to lay eggs again. This does not consider economic factors because it can only produce a small amount of production [1].

An incubator is an enclosed space that is heated with an electric current that is used to incubate and incubate eggs. The power source functions so that the heating system can function as it should, which usually uses incandescent lamps for reasons that are more economical in making egg incubators. In the manufacture of incubators, coolant is a component that.

Which is very important in lowering the air temperature in the incubator room. In the process of incubating eggs, if the temperature and humidity are not suitable, the eggs will automatically fail to hatch. To produce good hatchability, the hatching process is carried out more effectively and efficiently, usually equipped with heaters, humidity regulators, egg breaker, and temperature sensors. To be able to control the whole system efficiently, Arduino Uno is used to control the work of each system [2].

Arduino Uno is a microcontroller-based board consisting of 14 digital input/output pins, Arduino is a board/mini computer equipped with 6 pins that can be used as PWM outputs, 6 analog inputs equipped with a USB connector, an electrical DC jack and a reset button. . Analog pins consisting of pins A0 to pins with pins A5 provide 10 bits of resolution consisting of 1024 different values. On each Arduino digital pin operates a voltage of 5 volts which can send or receive a maximum current of 40 mA.

Please note that a computer-based device experiences a delay event during the computing process. In the event of a delay it is known that different oscillators including timer oscillator, external oscillator, Crystal oscillator, low frequency Crystal oscillator and RC calibration oscillator drive the AVR control unit, while the

AVR control unit drives the subsystem which includes asynchronous timer/counter, common I/O module, ADC, CPU core, RAM and Flash and EEFPROM. The Arduino Uno image can be seen in Figure 1 [3].

Fig 1. Arduino Uno.

The DHT 22 sensor is a tool that is able to monitor and can be a control system for the temperature and humidity of a room. The DHT 22 sensor has excellent reading quality, fast response to the data acquisition process and a minimalist size and relatively low price. The DHT 22 sensor is a temperature and humidity measuring sensor with an output in the form of a digital signal. The DHT 22 sensor has 4 pins consisting of the power supply pin, the data signal pin, the null pin, and the ground pin. The DHT 22 sensor has better accuracy than the DHT 11 sensor with a relative error of 4% temperature measurement and 18% humidity. The following form of the DHT 22 sensor can be seen in Figure 2 [4].

Fig 2. DHT sensor 22.

A DC motor is a system that is used to convert electrical voltage into mechanical power. DC motors are often also referred to as direct current motors whose movement produces rotation which results in the rotation being used as the desired mechanical drive. The working principle of electromagnetism on a DC motor will produce rotation. When a voltage source is applied to the motor, a stationary magnetic field will be formed. If the magnetic field has been formed, the rotor will rotate which will later be used to rotate the desired object, such as a wheel. At the rotation of the rotor the greater the applied voltage, the greater the rotational speed produced by the motor, but if it exceeds the maximum limit of the applied voltage, the motor will burn. The following in Figure 3 can be seen in the parts of a DC motor [5].

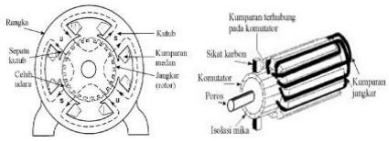

Fig 3. Contruction of direct current motor part stator (a) dan rotor (b) [6]

Inverter is a set of electronics that is used to convert DC voltage into AC voltage. To produce an AC output voltage, the input source used can use a battery, solar voltage, or other DC voltage. The output of the inverter output voltage can be a sine wave, square wave, or modified wave. To produce AC output voltage, the general working principle of the inverter uses 4 switches that work alternately [7].

ATS stands for Automatic Transfer Switch, which is the process of moving feeders from one power source to another alternately according to programming commands, AMF is an abbreviation for Automatic Main Failure which means to explain how the automation of the system works against the backup electrical system in case of an accident. interference with the main power source/feeder. The work system of ATS and AMF panels that we often find is a combination for exchanging sources from the generator to PLN or vice versa, if one day the electricity source from PLN suddenly goes out, the AMF is tasked with running the diesel generator set while providing protection to the generator system, both protection of the engine unit in the form of security against low oil pressure disturbances as well as engine temperature conditions and cooling media, and also provides protection for the generator unit in the form of security against excessive usage loads and protection against other electrical characteristics such as voltage and generator frequency, if the secured parameters exceed the normal/setting limits, the task of the ATS is to disconnect the electric current to the load while the AMF is in charge of stopping the engine from working. If PLN returns to normal, then ATS is tasked with returning the line by moving the switch back to the main side and then followed by the AMF task to stop the diesel engine from

working, and so on, all control systems are controlled automatically and run automatically. The form of ATS/AMF can be seen in Figure 4.

Fig 4. ATS/AMF.

An ultrasonic mist maker is a device that can produce very small mists or water droplets (in the micro order) of a number of liquids. This ultrasonic mist maker transducer is an electronic component or layer that can convert electrical signals into mechanical energy in the form of ultrasonic waves (frequency above 20 KHz) with a working system by vibrating a membrane or thin layer. The physical form of the ultrasonic mist maker can be seen in Figure 5.

Fig 5. Ultrasonic mist maker

Ultrasonic mist maker is a humidifier that converts water into steam with a range of 5 meters. To operate this ultrasonic mist maker requires a power supply of 24 VDC. To produce water mist, this tool uses a metal diaphragm that can vibrate at ultrasonic frequencies to create a mist of water drops that come out of the humidifier machine. This tool uses a piezoelectric transducer to create high-frequency mechanical oscillations that will produce a very fine mist that can quickly evaporate in the air [8].

AC Light Dimmer Module is a Dimmer that can be controlled by Microcontrollers such as Arduino Raspberry Pi and others. In this module there is a pin with a zero crossing detector feature that allows the microcontroller to know when is the right time to send a PWM signal. For more details about the AC light dimmer module, see Figure 6.

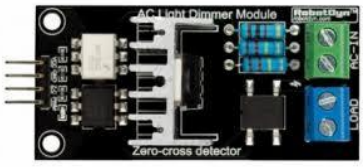

Fig 6. *AC light dimmer module*

Pulse Width Modulation (PWM) is a method used to manipulate a pulse signal width of a wave that will get an average voltage over a certain period. PWM is widely applied to modulate telecommunication data, control incoming power to loads, voltage regulators, audio effects and amplification, as well as other applications. In the digital signal method, every change in the PWM signal is influenced by the resolution of the PWM signal itself, for example an 8-bit digital PWM signal has a value variation of 28 = 256, which means that the output of the PWM signal has 256 variations starting from 0 - 256.

The AC Light Dimmer Module is a circuit equipped with a TRIAC that can control the amount of AC voltage and current supplied to the device. TRIAC is an electronic component that can be used to control 2-way current, so it can be used to control AC (alternating current) electricity. TRIAC is used to control the brightness of the lamp in an electronic circuit. TRIAC is a thyristor that has bidirectional characteristics. The TRIAC structure is built like 2 SCRs in opposite directions with gate pins joined together [9].

Incandescent lamps are artificial light sources that are produced by passing an electric current through a filament which then heats up and produces light. The glass that envelops the hot filament prevents air from coming into contact with it so that the filament will not be directly damaged by oxidation This incandescent lamp is used as a room heater in the incubator. The use of incandescent lamps here is because I consider the glow of incandescent lamps to be more evenly distributed than using a heater, and if calculated economically, incandescent lamps are easier to obtain and cheaper than heaters [10].

A liquid crystal display (LCD) is a device that can display numbers, letters and even certain symbols. An LCD is composed of two stacks of glass arranged in a thin layer with tightly closed edges. On the surface of each plate of glass is embedded a translucent conducting layer such as tin oxide or oxide of indium, while between the two sheets of glass is given a transparent liquid crystal material.

In an LCD component there is a controller and driver. The LCD circuit has two registers consisting of an instruction register (IR) and a date register (DR) which have many advantages over a 7-segment light emitting diode. To meet the needs of consumers there are so many variations and sizes of an LCD starting with the number of lines 1 to 4 with the number of characters 8, 16, 20, 24 etc. in characters per line. Figure 7 shows an Image from a Liquid Crystal Display (LCD) [11].

Fig 7. *Liquid Crystal Display* (LCD).

Most LCD modules meet a certain interface standard. There are 14-pins that can be accessed, including 8 data lines, 3 control lines and 3 power lines. LCD pin position can be known by reading the number which is usually printed on the PCB (Printed Circuit Board).

Relay is a mechanically operated component that functions to control an electrical circuit communication system. Relays often also act as remote controllers, both high voltage and high current controllers with relatively low current and voltage control signals. To be able to control a communication system in a circuit, the relay has a very simple working system, namely when an electric current flows in a coil contained in the relay, the magnetic field will pull the iron arm from the anchor causing the frame and anchor to be connected. In operation, a relay has a contact mechanism of NO (normally open) and NC (normally close). Figure 8 describes the shape of the Relay module.

Fig 8. Relay Module

In the operation so that the relay life is longer, the relay should only be used at 80% of the maximum limit capability. In the use of relays, it is necessary to pay close attention to the controller voltage and the power of the relay to operate the current/voltage to be controlled. In operation the relay arm is driven by DC current. A relay is equipped with a diode that is installed in parallel with the winding and places the anode on a negative voltage and the cathode on a positive voltage with the aim of anticipating damage to surrounding components due to electric shocks [12].

A power supply is a device or system that supplies electricity to the output of a load or group of materials. Electronic devices are usually supplied by a stable DC direct current will work well. Batteries are the best single source of power, but for applications that require a large power supply the battery source is not sufficient, a large source of power supply is AC alternating current from the power plant. For that we need a device that converts AC alternating current into DC direct current. The power supply circuit schematic can be seen in Figure 9.

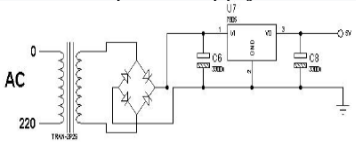

Fig 9. *Power supply*.

Based on the power supply picture above, it is known that when the 220 Volt AC current enters the transformer whose function is to lower the 220 Volt AC voltage to 6 Volt AC and then enters the bright diode, the diode will rectify the voltage from 6 Volt AC voltage to a 6 volt voltage. DC and then proceed to the capacitor for a voltage stabilizer then enter the regulator to change the voltage to 5 volts and will be stabilized again with the second capacitor [13].

II. METHOD

This research was conducted at the Electronics and Instrumentation Laboratory, Department of Physics, Faculty of Mathematics and Natural Sciences (FMIPA), Padang State University. This research began in December 2019 with several stages, including the preparation stage, literature review, data collection stage, data processing stage and final report preparation which will be completed according to a predetermined schedule.

This research is classified as engineering research. Engineering research is a non-routine design activity, so that in it there are new contributions, both in the form of processes and in the form of products/prototypes. In engineering research, the discussion of design activities involves things that are relatively new. If the design activity refers to certain design standards or codes, then the activity is not an engineering research activity.

Engineering research has six main procedures that are carried out. First, clarify ideas and clarity of tasks. Second, designing a conceptual control system. Third, explain the functions of the design arrangement. Fourth, design in detail and as a whole. Fifth, make a prototype and sixth, test the prototype.

The equipment used in this study consisted of a personal computer (PC), thermometer, hygrometer, and multimeter. The PC is used in making the microcontroller program, the thermometer is used to measure the temperature of the egg incubator room, the hygrometer is used to measure the humidity value of the egg incubator room, the multimeter is used to measure the sensor output voltage value at the time of the research. Meanwhile, in the manufacture of this egg incubator using several electronic components such as an AC light dimmer which functions as a controller on or off incandescent lamps, a DHT 22 sensor is used as a tool to detect the temperature and humidity of the incubator room, Ultrasonic mist maker functions to increase humidity and lower humidity. by creating a mist of steam in the incubator room, a 12 volt fan that functions to even out the temperature in the incubator, incandescent lamps that function as heaters for the incubator, Liquid Crystal Display (LCD) which functions as a display of temperature and humidity values, relay modules and connecting cables.

The concept of the design of an automatic chicken egg incubator using a DHT 22 sensor and an Arduino-based DC motor is in the form of a prototype. The resulting prototype has several specific stages. First, the system measures the temperature and humidity values in the incubator space. Second, the measurement value will be analyzed whether the temperature and humidity values are above a predetermined threshold or below a predetermined threshold. If the temperature measurement results are below a predetermined threshold, the microcontroller will turn on the heating lamp to a predetermined upper limit, and if the humidity is in the lower limit range that has been determined, the cooler will be turned on until the upper limit range has been determined. Third, if the temperature value is in the upper limit range that has been determined, the microcontroller will turn off the heating lamp to a predetermined lower limit range, and if the humidity value is at a predetermined upper limit, the incubator cooler will be turned off until the lower limit has been determined. . Fourth, on day 4 to day 18, the egg-turning motor will rotate once in a period of 6 hours. Fifth, the measurement results of temperature and humidity values as well as RTC time readings will be displayed on an LCD screen.
The components of this automatic chicken egg incubator are arranged geometrically according to their respective functions. The following components are combined to form a unified Arduino-based automatic chicken egg incubator, which can be seen in Figure 9.

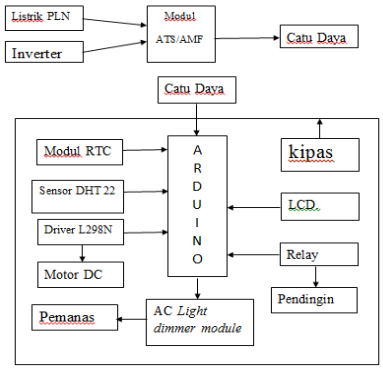

Fig 9. The arrangement of the automatic chicken egg control system

The arrangement of this automatic chicken egg incubator consists of several electronic components, namely inverter, ATS/AMF module, power supply, arduino, DHT 22 sensor, heater, cooler, RTC module, DC motor, LCD screen, L298N motor driver, AC light dimmer module, fan and relay. The following in Figure 10 can be seen the design of this research software.

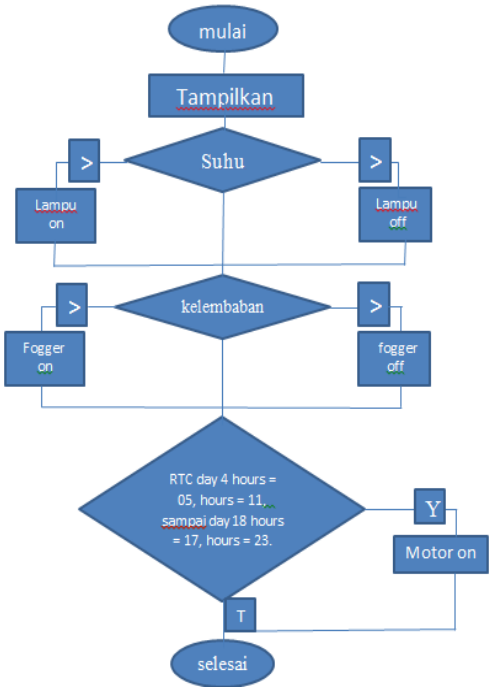

Fig 10. Research software design.

In Figure 10 it can be seen clearly the flow of the software. The first step of the Arduino programming language will send a command to turn on the LCD screen to read the DHT sensor data and read the RTC module data and the data will be displayed on the LCD screen. After all the data appears on the LCD screen, Arduino checks the temperature, humidity and time values, if the temperature and humidity values exceed the desired limit, Arduino sends a command to the incandescent lamp to OFF. If the temperature and humidity values are less/smaller than the specified limits, the Arduino will send a command to the incandescent lamp to turn ON. While checking the time, if the time is on the 4th day which is at 06.00, 12.00, 18.00 the difference is 6 hours until the 18th day which is at 18.00, 24.00 then Arduino will send a command to activate the DC Motor, then the temperature, humidity and RTC time values will be displayed again on the LCD display.

III. RESULTS AND DISCUSSION

Based on the analysis carried out both graphically and statistically, the results are in accordance with the research objectives. The results obtained include design specifications and performance specifications for automatic chicken egg incubators. The performance specifications are known through the identification stage of the function of the system part. Design specifications are known from the results of measurement and data analysis.

This automatic chicken egg incubator is an incubator that uses controlled temperature and humidity so that the eggs can hatch properly. Controlling the temperature and humidity values aims to ensure that the temperature and humidity values in the hatchery are the same as the temperature and humidity values for conventional hatching eggs using hen. To get the temperature and humidity values in accordance with the conventional temperature and humidity values. The temperature and humidity in this incubator are controlled using a DHT 22 sensor. The DHT 22 sensor is a component that can determine the temperature and humidity values of the surrounding air. The DHT 22 sensor will control the temperature and humidity values of the incubator programmed using Arduino. Arduino will control when the heater will turn on and when the heater will turn off. Arduino will control the heater through the reading of the DHT 22 sensor value. The heater will turn off if the temperature exceeds the hatching temperature threshold and will turn on again if it is less than the hatching temperature threshold.

The characteristics of the DHT 22 sensor is a capacitive type digital sensor that has high precision in measuring temperature and humidity values. The DHT 22 sensor has a good level of stability and features accurate calibration. The calibration coefficients are stored in the OTP memory program, so if the internal sensor detects a temperature or humidity value, the module includes the coefficient in the calculation. In this study, the LCD is used to display the temperature and humidity values that have been programmed on the Arduino Uno.

This automatic chicken egg incubator is equipped with automatic backup electricity which if the PLN electricity goes out, the backup electricity will automatically turn on. This incubator can hold 120 eggs with an automatic egg turning system. In the process of hatching eggs that the author did, the authors conducted research 4 times the hatching process with the results of the first and second trials failing and the third and fourth experiments were successful, however, the eggs that hatched had not reached 100%. During the third experiment, the authors hatched 10 chicken eggs and managed to hatch 6 eggs, while in the fourth experiment, the authors incubated 87 eggs. Of the 87 eggs that were hatched, 78 hatched into chickens with a success percentage of 89.65%.

IV. CONCLUSION

Based on the results of testing and analysis as well as a discussion of the automatic chicken egg incubator using a DHT 22 sensor and an Arduino-based DC gearbox motor, the following conclusions can be drawn:

- The results of the performance specifications of the automatic chicken egg incubator using a DHT 22 sensor and an Arduino-based DC gearbox motor consisting of an incubator box measuring 90x64x60 cm equipped with a controlled heating and cooling system consisting of several components including Arduino Uno, DHT 22 sensor , DC gearbox motor, ultrasonic mist maker, AC light dimmer module, LN298N driver, incandescent lamp, and controlled LCD to suit the desired function.
- The results of the analysis of the automatic chicken egg incubator using a DHT 22 sensor and an Arduino-based DC gearbox motor consist of precision and accuracy. The measurement accuracy ranges from 99.64% to 100%, while the measurement accuracy ranges from 99.64% to 100%, with an average measurement error of 0.178572%.

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