AUTOMATIC CLOTHESLINE WITH ARDUINO AND MOBILE CONTROL

EMBEDDED SYSTEM

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INFORMATICS ENGINEERING

INSTITUT TEKNOLOGI SUMATERA

2019

Automatic Clothesline With Arduino and Mobile Control

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***Abstract*— This paper is made to describe howArduino in embedded systems working in the form of automatic clothesline. Background of this paper is to better understand how embedded systems works on Arduino UNO, Servo motors, light resistors, rain sensors, LEDs, and relays. Things to do are creating a C language program to run Arduino, using the Arduino IDE, and applying it to automatic clothesline. The expected result is to understand and understand the concept of embedded systems using Arduino in automatic clothesline and be able to apply it in daily life.**

***Keywords*—Arduino, Resistor, LED, Servo, Resistor, IDE Arduino, Rain sensor, LDR, Relay.**

I. INTRODUCTION

This paper is a result of research in embedded systems courses. While doing research, there are several things to do, such as prepare a tool that will be used to make automatic clothesline, and apply it as a concept that was designed before. The purpose of this research is to be able to create and apply the concept of embedded systems in automatic clothesline in daily life. The results obtained from this practicum are the application of the Embedded System in Arduino, using the Rain Sensor, Soil Moisture Sensor, and Servo

II. BASICS THEORY

A. Arduino

Arduino is an electronic opensource platform which easy to use both in terms of hardware and software. An Arduino (board) device is hardware that has electronic components made from a Semi-Conductor material called an Integrated Circuit. Arduino Software is an IDE Tools to run Arduino in the form of hardware. Arduino IDE uses a programming language that resembles the C language.

Arduino UNO is Arduino which has 14 input pins from digital output, and 6 of them can be used as PMW output, and 6 other pins are used for analogue input. Arduino UNO also has a crystal oscillator, USB connection, power input, ICSP header, and a reset button.

B. Servo Motor

Servo Motor is a motor that has a feedback system to the user. In DC motors, the only parameters that can be activated are the speed and direction of rotation. But on a Servo motor, the angle magnitude can be adjusted too. This happens because the servo motor has a potentiometer that is useful as a feedback value to be processed.

The servo motor on the automatic clothesline also can be used as a clothesline drive to open and close. The potentiometer on the servo motor will be set with an angle of 0° for initial conditions and 90° for current conditions.

C. Light Dependent Resistor

LDR (Light Dependent Resistor) is a resistor that has sensitivity with light. While the intensity of light increases, LDR will decrease, if while the light intensity decreases, the resistance will increase.

LDR usually used as an input, that accepts light parameters on automatic clothesline. While light intensity is high, the servo motor will accept parameters so the clothesline is open (in the active condition), and vice versa.

D. Rain Sensor

Rain sensor is a sensor that sensitive to water. While the rain sensor affects the air, no voltage will occur, so the rain sensor's port and ground will be connected so there is no voltage, transmits the signal when it rains.

Automatic clothesline uses a rain sensor to receive input on the servo motor while there is rain, the servo motor will be in the initial position. While it doesn't rain then the servo motor will be active.

E. LED

Light Emitting Diode (LED) is a diode that collected and arranged to emit light. LED lights themselves have a better lifetime than incandescent lamps and more efficient to use than fluorescent lamps.

In automatic clothesline, LED lights are used as lights that will give signals to the user of the current clothesline condition. While the light on, that means the day is sunny, while the lamp is not on, so the clothesline is in the shade (day isn't sunny).

F. Relay

Relay is an automatic switch, and the connector between the electricity in the house to turn on the clothesline and Arduino servo. Relay is used to connect the Arduino and electricity in the house, so when it's applied to the actual condition in the house, there is no damage caused to the device.

G. NodeMCU (ESP8266)

NodeMCU is an opensource IoT Platform. NodeMCU is also used as a microcontroller. NodeMCU in automathic clotheline is used for access the clotheline with wifi. So users don’t have to wait until it’s raining or cloudy to pick up the laundry.

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III. METHODS

A. *Problem Space*

Problem space is created to restrict the research, as follows:

- Limited time, make people unable to keep their eyes to the clothesline every time.
- Limited costs, make people unable to use laundry services often.

B. *Components*

These following components are used to make automatic clothesline:

1) Arduino UNO
2) Relay
3) LDR
4) Servo Motor
5) Rain Sensor
6) LED lights and resistors
7) Wifi (ESP8266)

C. *Design*

To make the project clearer, a device design has been made. The design of this project consists of:

1) Flowchart

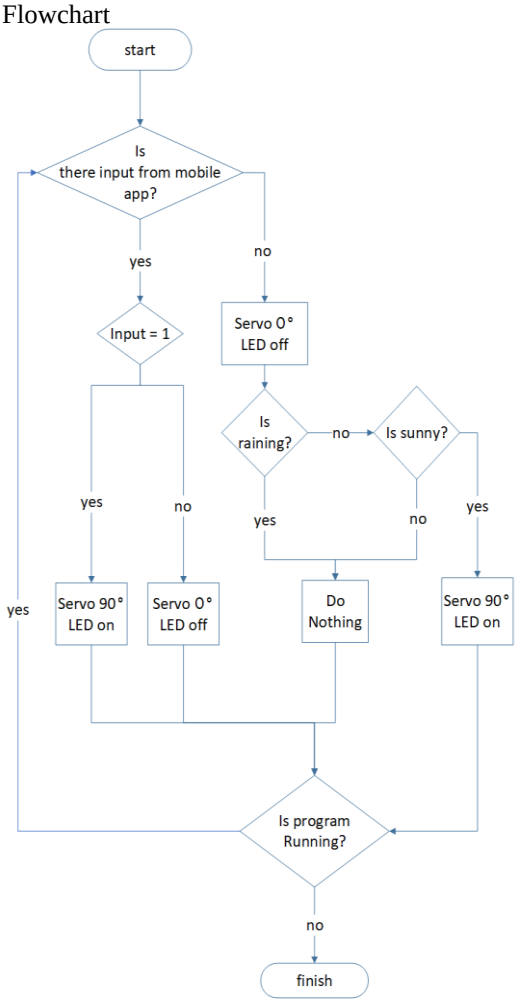

Fig. 1. Flowchart diagram how automatic clothesline work.

2) Schematic diagram

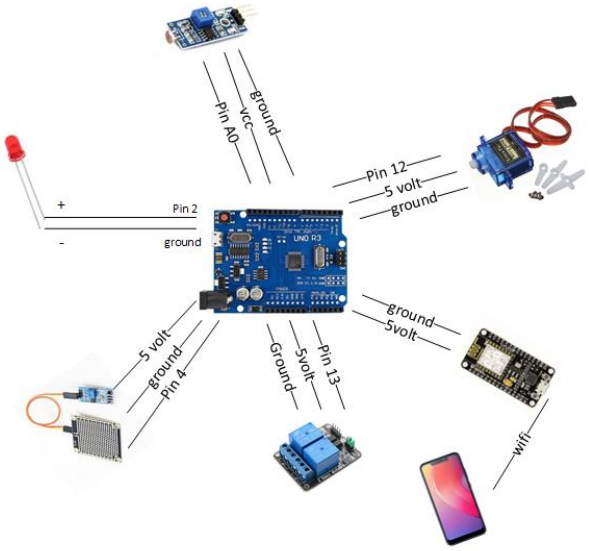

Fig. 2. Schematics diagram of components in automatic clothesline.

3) Block Diagram

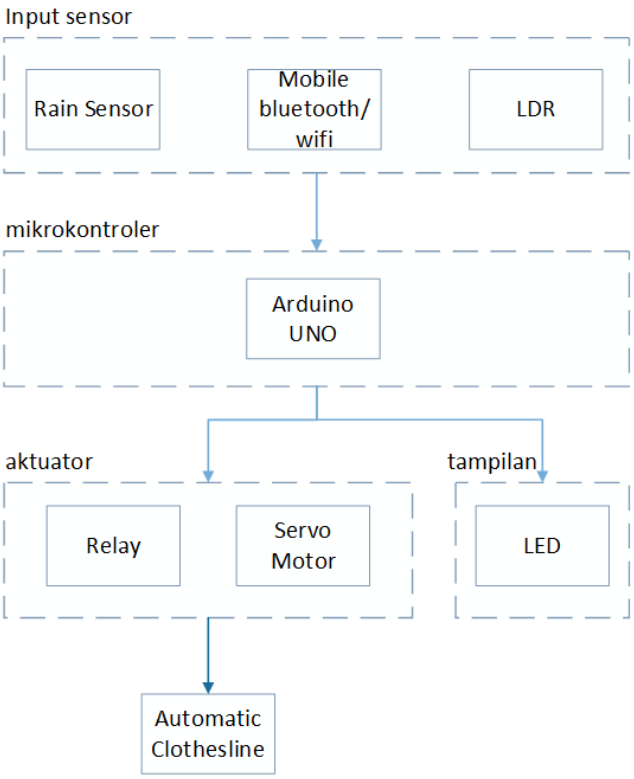

Fig. 3. Block diagram of automatic clothesline.

4) Interface Design

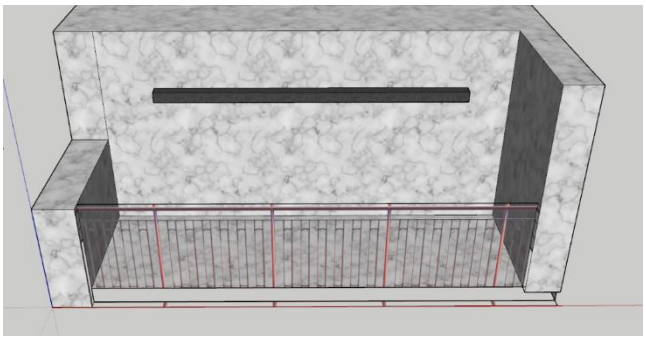

Fig. 4. Automatic clothesline while rainy days.

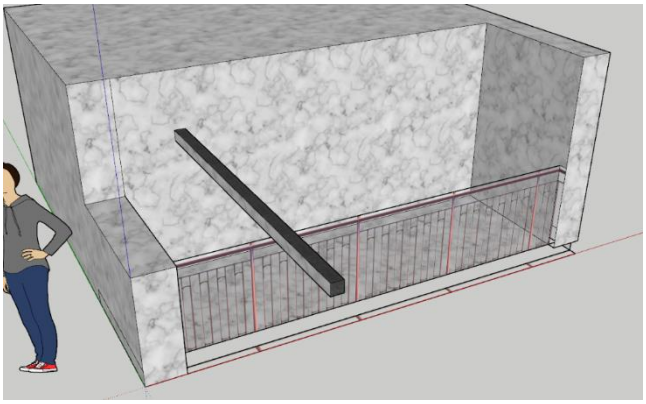

Fig. 5. Automatic clothesline while sunny days.

IV. Result and Analysis

A. *Program Explanation*

There are two programs used in this project. One for the arduino (Figure 6), the other one for NodeMCU (Figure 7). Software Serial Library is used for allows serial communication on other digital pins of the arduino. Servo library for control the servo.

```
#include <Servo.h>
#include <SoftwareSerial.h>
SoftwareSerial s(5,6);
const int LDR_PIN = A0;
const int led = 2;
const int rain = 4;
const int relay = 13;
int nyala = 0;
Servo servo;
```

Fig. 6. Arduino program header.

These are codes used for this project. In figure 7. There are dictionary for Servo and ESP8266 which is for wifi module. Port 80 is used for the wifi server, because port 80 is a default port for web server (HTTP). Then some variable is defined to named port used in arduino, to specific sensor.

```
#include <ESP8266WiFi.h>
#include <SoftwareSerial.h>
SoftwareSerial s;
String  i;
WiFiServer server(80);
int data;
```

Fig. 7. NodeMCU program header.

In void setup() function , s.begin() is used for output 9600 bits per second. Then servo attached at pin, with function attach(), and written by the function of write(). pinMode() is used for define whether a pin is input or output.

```
void setup() {
    s.begin(9600);

    servo.attach(12);
    servo.write(0);

    pinMode(LDR_PIN, INPUT);
    pinMode(led,OUTPUT);
    pinMode(rain,INPUT);
    pinMode(relay,OUTPUT);

    Serial.begin(9600);
}
```

Fig. 8. Arduino program setup.

In void setup() for NodeMCU function, there are, Serial.begin() and s.begin(). First, disconnect() the wifi, then delay 3000 millisecond. Wifi.begin() is used for input the wifi password. While wifi status is connected, it will print ".." with 300 milliseconds delay, it will loop until wifi is connected, and show a connected status in serial monitor with IP.

```
void setup(){
    Serial.begin(9600);
    i = "";

    s.begin(9600,D6,D5);
    WiFi.disconnect();
    delay(3000);

    Serial.println("START");
    WiFi.begin("123");

    while ((!(WiFi.status() == WL_CONNECTED))){
        delay(300);
        Serial.print("..");
    }
    Serial.println("Connected");
    Serial.println((WiFi.localIP().toString()));
    server.begin();
}
```

Fig. 9. NodeMCU program setup.

In void loop() function for arduino, check the availability for s(5,6) first, if it has any data ready to read it will turn the "nyala" parameter to s.read() which read the input form s(5,6). Then declared rain sensor, and light dependant resistor. Program also turn condition of relay, and led, to Low condition or High condition, and Servo condition to 0 degree or 90 degrees, based on variable parameters.

```
void loop() {
    if(s.available()>0){
        nyala  = s.read();
    }

    int water = digitalRead(rain);
    int intensity = analogRead(LDR_PIN);

    if (nyala == 1){
        digitalWrite (relay,LOW);
    }else{
        digitalWrite (relay,HIGH);
    }

    if (intensity > 800 || water == 0 ||  nyala == 0){
        servo.write(0);
        digitalWrite(led,LOW);
    }else if (water == 1 && intensity < 800 && nyala == 1){
        servo.write(90);
        digitalWrite(led,HIGH);
    }
}
```

Fig. 10. Arduino program loop.

In void loop() function of NodeMCU, we check the client server first, if server does not has any data ready to read it will return, if it has data ready to read, it will read the command until the ennd of file, and get the function "ON" or "OFF" for turn the data to 1 or 0. Last, the program will do s.write() with the value of data.

```
void loop(){
    WiFiClient client = server.available();

    if (!client) {
        return;
    }

    i = (client.readStringUntil('\r'));
    i.remove(0, 5);
    i.remove(i.length()-9,9);

    if (i == "ON"){
        data = 1;
    }else if (i == "OFF"){
        data = 0;
    }
    s.write(data);
}
```

Fig. 11. NodeMCU program loop.

B. *Device Explanation*

Figure 9. is the device used for automathic clothesline, from number 1 to 7 is the following devices:

1) Arduino UNO
   Used as microcontroller for access input, from sensors or users
2) Relay
   Used for connector between the electricity in the house to turn on the clothesline and Arduino servo. Relay is used to connect the Arduino and electricity in the house, so when it's applied to the actual condition in the house, there is no damage caused to the device
3) LDR
   LDR used as an input, that accepts light parameters on automatic clothesline. While light intensity is high, the servo motor will accept parameters so the clothesline is open (in the active condition), and vice versa
4) Servo Motor
   used as a clothesline drive to open and close. The potentiometer on the servo motor will be set with an angle of 0° for initial conditions and 90° for current conditions
5) Rain Sensor
   Used for receive input on the servo motor while there is rain, the servo motor will be in the initial position. While it doesn't rain then the servo motor will be active.
6) LED lights and resistors
   give signals to the user of the current clothesline condition. While the light on, that means the day is sunny, while the lamp is not on, so the clothesline is in the shade (day isn't sunny).
7) Wifi (ESP8266)
   used for access the clotheline with wifi. So users don't have to wait until it's raining or cloudy to pick up the laundry.

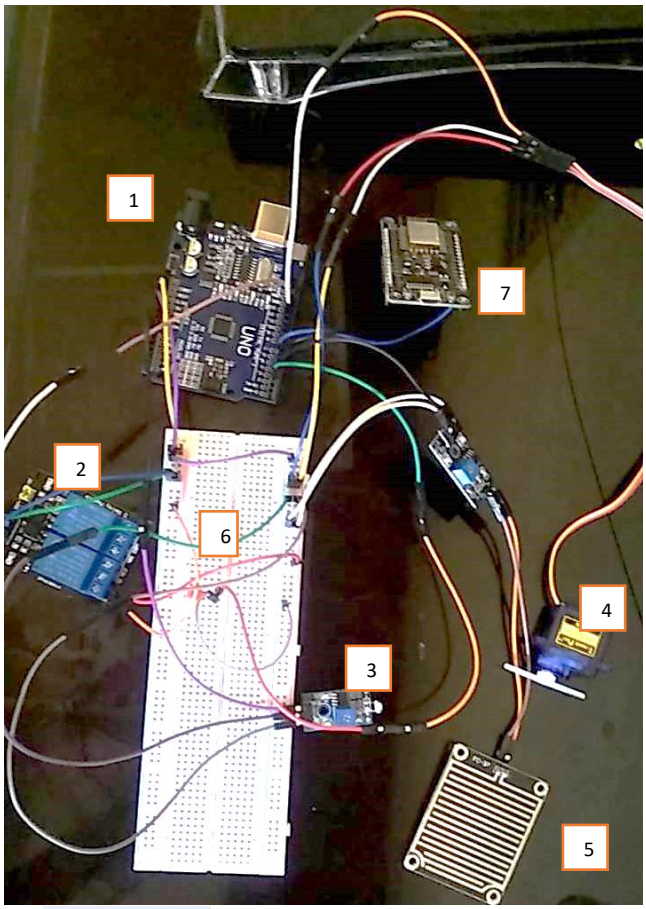

Fig. 12. Devices design.

C. Prototype

Figure 10. is the devices, already attach to the house (as prototype). Rain sensor and LDR is placed on the roof of the house, so it receive input well. Servo is placed on the wall of the house under the roof for the place of the clothesline. The other devices is placed in the house, so devices did not get wet while raining, which can cause a damages.

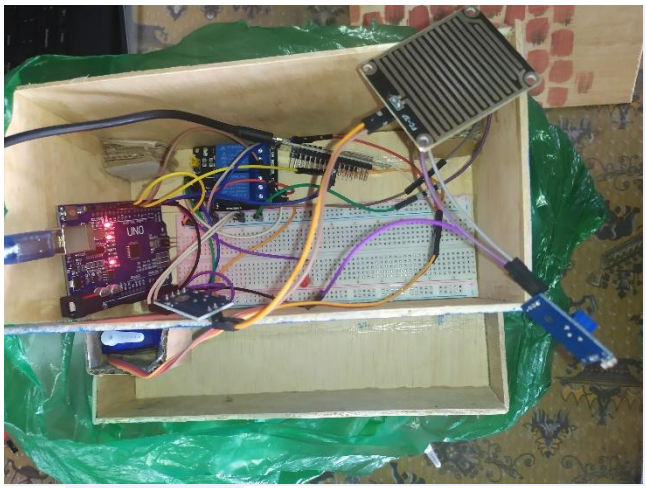
Fig. 13. Inside of prototype.

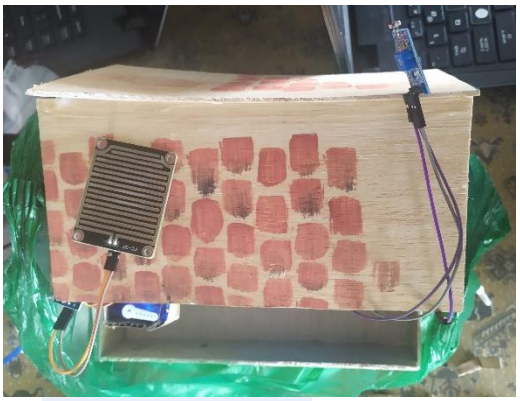
Fig. 14. Outside of prototype (roof).

D. Deficiency and advantages

Automathic clotheline has several Advantages and Deficiency. The advantage of this automathic clothesline is:

- Can easily access with wifi.
- No need to wait for clothesline until the clothes are dry.
- Save money, save electricity.

The Deficiency of this automathic clothesline is:

- Can only access with wifi (no offline access)

Lampiran:

A. Source code Arduino

```
#include <Servo.h>
#include <SoftwareSerial.h>
SoftwareSerial s(5,6);
const int LDR_PIN = A0;
const int led = 2;
const int rain = 4;
const int relay = 13;
int nyala = 0;
Servo servo;

void setup() {
    s.begin(9600);

    servo.attach(12);
    servo.write(0);

    pinMode(LDR_PIN, INPUT);
    pinMode(led,OUTPUT);
    pinMode(rain,INPUT);
    pinMode(relay,OUTPUT);

    Serial.begin(9600);
}

void loop() {
    if(s.available()>0){
          nyala  = s.read();
    }

    int water = digitalRead(rain);
    int intensity = analogRead(LDR_PIN);

    if (nyala == 1){
          digitalWrite (relay,LOW);
    }else{
          digitalWrite (relay,HIGH);
    }

    if (intensity > 800 || water == 0 ||
nyala == 0){
          servo.write(0);
          digitalWrite(led,LOW);
    }else if (water == 1 && intensity <
800 && nyala == 1){
          servo.write(90);
          digitalWrite(led,HIGH);
    }
}
```

B. Source code NodeMCU

```
#include <ESP8266WiFi.h>
#include <SoftwareSerial.h>
SoftwareSerial s;
String  i;
WiFiServer server(80);
int data;

void setup(){
    Serial.begin(9600);
    i = "";

    s.begin(9600,D6,D5);
    WiFi.disconnect();
    delay(3000);

    Serial.println("START");
    WiFi.begin("123");

    while ((!(WiFi.status() ==
WL_CONNECTED))){
          delay(300);
          Serial.print("..");
    }
    Serial.println("Connected");
    Serial.println((WiFi.localIP().toStri
ng()));
    server.begin();
}

void loop(){
    WiFiClient client =
server.available();

    if (!client) {
          return;
    }

    i = (client.readStringUntil('\r'));
    i.remove(0, 5);
    i.remove(i.length()-9,9);

    if (i == "ON"){
          data = 1;
    }else if (i == "OFF"){
          data = 0;
    }
    s.write(data);
}
```

C. Documentation
https://bit.ly/tubesES2019

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