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Penulis : Intan Nayla

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Lampiran 3 Source Code Arduino ESP32

```
1.  #include <WiFi.h>
2.  #include <WebServer.h>
3.  #include <WebSocketsServer.h>
4.  #include <ArduinoJson.h>
5.  #include <HX711.h>
6.  #include <ESP32Servo.h>
7.  #include <NTPClient.h>
8.  #include <Fuzzy.h>

9.  // Konfigurasi WiFi
10. const char* ssid = "EspIntan";
11. const char* password = "1234567890";

12. WebServer server(80);
13. WebSocketsServer webSocket(81);
14. WiFiUDP ntpUDP;
15. NTPClient timeClient(ntpUDP, "pool.ntp.org", 25200, 60000);

16. // Pin Sensor
17. #define LOAD1_DT 32, LOAD1_SCK 33 // Berat Awal
18. #define LOAD2_DT 25, LOAD2_SCK 26 // Beras Bersih
19. #define LOAD3_DT 27, LOAD3_SCK 14 // Beras Patah
20. #define TRIG 18, ECHO 19 // Ultrasonic
21. #define SERVO_KATUP 21
22. #define SERVO_AYAK1 22, SERVO_AYAK2 23
23. #define MOISTURE_PIN 34 // Kelembaban
24. #define RELAY_FAN 13, RELAY_DINAMO 17, BUZZER 15

25. // Kalibrasi
26. #define CAL_LC1 447000.0, CAL_LC2 -447000.0, CAL_LC3 -
    447000.0
27. #define MOIST_DRY 4095, MOIST_WET 1700
28. #define BATAS_LEMBAB 65, MIN_BERAT_MULAI 1.0

29. HX711 lc1, lc2, lc3;
30. Servo servoKatup, servoAyak1, servoAyak2;

31. enum Mode { STANDBY, PENGERINGAN, AYAK, SELESAI };
32. Mode mode = STANDBY;

33. float beratAwal = 0, beratAwalSnapshot = 0;
34. float beratBersih = 0, beratPatah = 0;
35. int kelembabanPersen = 0;
36. bool prosesDimulai = false;
37. String waktuMulai = "", waktuSelesai = "";

38. // Fuzzy Logic
39. Fuzzy *fuzzy;
40. FuzzyInput *patah, *lembab;
41. FuzzyOutput *kualitas;
42. String statusKualitas = "Belum Dihitung";
43. float nilaiKualitas = 0.0;

44. void setup() {
45.   Serial.begin(115200);
46.   pinMode(TRIG, OUTPUT); pinMode(ECHO, INPUT);
```

```

47. pinMode(RELAY_FAN, OUTPUT); pinMode(RELAY_DINAMO, OUTPUT);
48. digitalWrite(RELAY_FAN, HIGH); digitalWrite(RELAY_DINAMO,
    HIGH);

49. servoKatup.attach(SERVO_KATUP); servoKatup.write(0);
50. servoAyak1.attach(SERVO_AYAK1);
    servoAyak2.attach(SERVO_AYAK2);
51. servoAyak1.write(90); servoAyak2.write(90);

52. lc1.begin(Load1_DT, Load1_SCK); lc2.begin(Load2_DT,
    Load2_SCK); lc3.begin(Load3_DT, Load3_SCK);
53. lc1.set_scale(CAL_LC1); lc2.set_scale(CAL_LC2);
    lc3.set_scale(CAL_LC3);
54. lc1.tare(20); lc2.tare(20); lc3.tare(20);

55. inisialisasiFuzzy();
56. WiFi.begin(ssid, password);
57. int c = 0; while (WiFi.status() != WL_CONNECTED && c < 30) {
    delay(500); c++; }

58. timeClient.begin();
59. server.on("/status", HTTP_GET, handleStatus);
60. server.on("/start", HTTP_POST, handleStart);
61. server.on("/stop", HTTP_GET, handleStop);
62. server.begin();
63. websocket.begin();
64. websocket.onEvent(websocketEvent);
65. }

66. void loop() {
67. server.handleClient();
68. websocket.loop();
69. timeClient.update();
70. bacaSensor();
71. if (prosesDimulai) jalankanProses();
72. if (millis() - lastBroadcast > 200) { kirimStatus();
    lastBroadcast = millis(); }
73. delay(10);
74. }

75. void inisialisasiFuzzy() {
76. fuzzy = new Fuzzy();
77. patah = new FuzzyInput(1);
78. patah->addFuzzySet(new FuzzySet(0,0,0,15)); // Rendah
79. patah->addFuzzySet(new FuzzySet(10,20,20,30)); // Sedang
80. patah->addFuzzySet(new FuzzySet(25,40,40,40)); // Tinggi
81. fuzzy->addFuzzyInput(patah);

82. lembab = new FuzzyInput(2);
83. lembab->addFuzzySet(new FuzzySet(0,0,0,30)); // Rendah
84. lembab->addFuzzySet(new FuzzySet(25,40,40,55)); // Sedang
85. lembab->addFuzzySet(new FuzzySet(50,75,100,100)); // Tinggi
86. fuzzy->addFuzzyInput(lembab);
87. kualitas = new FuzzyOutput(1);
88. kualitas->addFuzzySet(new FuzzySet(0,0,15,30)); // Sangat
    Baik
89. kualitas->addFuzzySet(new FuzzySet(25,35,45,55)); // Baik
90. kualitas->addFuzzySet(new FuzzySet(50,60,60,70)); // Sedang
91. kualitas->addFuzzySet(new FuzzySet(65,75,75,85)); // Kurang

```

```

92. kualitas->addFuzzySet(new FuzzySet(80,90,100,100)); // Buruk
93. fuzzy->addFuzzyOutput(kualitas);
94. // 9 Aturan Fuzzy
95. FuzzyRuleAntecedent* a1 = new FuzzyRuleAntecedent(); a1-
    >joinWithAND(patah->getFuzzySet(0), lembab->getFuzzySet(0));
96. FuzzyRuleConsequent* c1 = new FuzzyRuleConsequent(); c1-
    >addOutput(kualitas->getFuzzySet(0));
97. fuzzy->addFuzzyRule(new FuzzyRule(1, a1, c1));
98. // ... 8 aturan lainnya
99. }

100. void bacaSensor() {
101. static unsigned long last = 0;
102. if (millis() - last < 300) return; last = millis();
103. if (lc1.is_ready()) { float b = lc1.get_units(3); if (b>=0 &&
    b<50) beratAwal = b; }
104. if (lc2.is_ready()) { float b = lc2.get_units(3); if (b>=0 &&
    b<50) beratBersih = b; }
105. if (lc3.is_ready()) { float b = lc3.get_units(3); if (b>=0 &&
    b<50) beratPatah = b; }
106. long t=0; for(int i=0;i<10;i++) {
    t+=analogRead(MOISTURE_PIN); delay(1); }
107. kelembabanPersen = constrain(map(t/10, MOIST_WET, MOIST_DRY,
    100, 0), 0, 100);
108. }

109. void selesaikanProses() {
110. mode = SELESAI; prosesDimulai = false;
111. servoKatup.write(0); servoAyak1.write(90);
    servoAyak2.write(90);
112. digitalWrite(RELAY_FAN, HIGH); digitalWrite(RELAY_DINAMO,
    HIGH);
113. delay(2000);
114. waktuSelesai = getWaktuDatabase();
115. float persenPatah =
    (beratPatah/(beratBersih+beratPatah+0.001))*100;
116. fuzzy->setInput(1, persenPatah);
117. fuzzy->setInput(2, (float)kelembabanPersen);
118. fuzzy->fuzzify();
119. nilaiKualitas = fuzzy->defuzzify(1);
120. if(nilaiKualitas < 30) statusKualitas = "Sangat Baik";
121. else if(nilaiKualitas < 55) statusKualitas = "Baik";
122. else if(nilaiKualitas < 70) statusKualitas = "Sedang";
123. else if(nilaiKualitas < 85) statusKualitas = "Kurang";
124. else statusKualitas = "Buruk";
125. }

126. void kirimStatus() {
127. StaticJsonDocument<512> doc;
128. doc["awal"] = beratAwal; doc["awal_snapshot"] =
    beratAwalSnapshot;
129. doc["bersih"] = beratBersih; doc["patah"] = beratPatah;
130. doc["moist"] = kelembabanPersen; doc["proses_berjalan"] =
    prosesDimulai;
131. doc["waktu_mulai"] = waktuMulai; doc["waktu_selesai"] =
    waktuSelesai;
132. doc["nilai_kualitas"] = nilaiKualitas; doc["status_kualitas"]
    = statusKualitas;
133. String json; serializeJson(doc, json);

```

```

134. websocket.broadcastTXT(json);
135. }
136. void handleStatus() {
137. StaticJsonDocument<256> doc;
138. doc["awal"] = beratAwal; doc["bersih"] = beratBersih;
    doc["patah"] = beratPatah;
139. doc["moist"] = kelembabanPersen; doc["proses_berjalan"] =
    prosesDimulai;
140. doc["status_kualitas"] = statusKualitas;
    doc["nilai_kualitas"] = nilaiKualitas;
141. String res; serializeJson(doc, res);
142. server.send(200, "application/json", res);
143. }

144. void handleStart() {
145. if (!prosesDimulai && beratAwal >= MIN_BERAT_MULAI) {
146. prosesDimulai = true; waktuMulai = getWaktuDatabase();
147. mode = (kelembabanPersen > BATAS_LEMBAB) ? PENDING :
    AYAK;
148. server.send(200, "text/plain", "OK");
149. } else server.send(400, "text/plain", "Gagal");
150. }
151. void handleStop() { if(prosesDimulai) selesaikanProses();
    server.send(200, "text/plain", "Stop"); }
152. String getWaktuDatabase() { timeClient.update(); return
    String(timeClient.getEpochTime()); }

```

Lampiran 4 Source Code ESP32 ke Database

```

1.  <?php
2.  // send_command.php - Kirim perintah ke ESP32
3.  $ip =
    json_decode(file_get_contents('php://input'),true)['ip']??'10
    .29.107.230';
4.  $url = "http://$ip".($_POST['endpoint']??'/status');
5.  $ch = curl_init($url); curl_setopt($ch,
    CURLOPT_RETURNTRANSFER,1);
6.  curl_setopt($ch, CURLOPT_TIMEOUT,2); $res = curl_exec($ch);
7.  echo curl_getinfo($ch,CURLINFO_HTTP_CODE)==200 ? ($res?:'OK')
    : 'ESP32 offline';
8.  curl_close($ch);
9.  ?>

10. <?php
11. // save_log.php - Simpan ke database
12. $db = new mysqli("localhost","root","","rice_db");
13. $s = $db->prepare("INSERT INTO log_proses VALUES
    (null,?,?,?,?,?,?,?,?)");
14. $s->bind_param("ssddiids",
    $_POST['mulai'],$_POST['selesai'],$_POST['awal'],
15.
    $_POST['bersih'],$_POST['patah'],$_POST['lembab'],
16.
    $_POST['skor'],$_POST['kualitas']);
17. $s->execute(); echo json_encode(['success'=>$db-
    >affected_rows>0]);
18. ?>

```

```

19. <?php
20. // get_esp_data.php - Ambil data dari ESP32 via proxy
21. $ip =
    json_decode(file_get_contents('php://input'),true)['ip']??'10
    .29.107.230';
22. echo file_get_contents("http://$ip/status");
23. ?>

```

Lampiran 5 Source Code Konek PHP Database

```

1. <?php
2. // history.php - Tampilkan riwayat proses
3. $db = new mysqli("localhost","root","","rice_db");
4. $q = $db->query("SELECT * FROM log_proses ORDER BY id DESC
    LIMIT 50");
5. while($d=$q->fetch_assoc()): ?>
6. <tr>
7. <td><?=date('d/m/Y
    H:i',strtotime($d['waktu_selesai']))?></td>
8. <td><?=$d['berat_bersih']?> kg</td>
9. <td><?=$d['berat_patah']?> kg
    (<?=round(($d['berat_patah']/($d['berat_bersih']+$d['berat_pa
    tah']+0.001))*100,1)?>%)</td>
10. <td><?=$d['kelembaban']?>%</td>
11. <td><span class="badge bg-
    <?=$d['nilai_kualitas']<30?'success':($d['nilai_kualitas']<55
    ?'info':($d['nilai_kualitas']<70?'warning':'danger'))?>>">
12. <?=$d['status_kualitas']?>
    (<?=$d['nilai_kualitas']?>)</span></td>
13. </tr>
14. <?php endwhile; ?>

15. <?php
16. // get_stats.php - Statistik hari ini
17. $db = new mysqli("localhost","root","","rice_db");
18. $q = $db->query("SELECT COUNT(*) t, SUM(berat_awal) r FROM
    log_proses WHERE DATE(waktu_selesai)=CURDATE()");
19. $d = $q->fetch_assoc();
20. echo
    json_encode(['success'=>true,'total'=>$d['t']??0,'rice'=>roun
    d($d['r']??0,2));
21. ?>

22. <?php
23. // hapus_log.php - Hapus data
24. $db = new mysqli("localhost","root","","rice_db");
25. $db->query("DELETE FROM log_proses WHERE
    id=".($_GET['id']??0));
26. header("Location: dashboard.php");
27. ?>

```