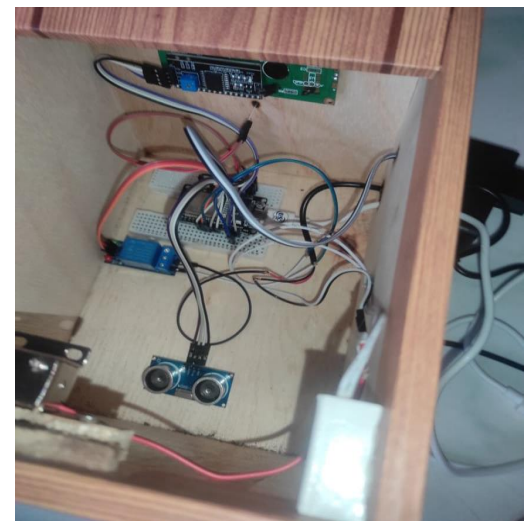


LAMPIRAN

Dokumentasi Penelitian



Code Program Arduino IDE

```

1 #include <WiFi.h>
2 #include <HTTPClient.h>
3 #include <WiFiClientSecure.h>
4 #include <ArduinoJson.h>
5 #include <Wire.h>
6 #include <LiquidCrystal_I2C.h>
7 #include <math.h>
8
9 const char* WIFI_SSID = "ABCDE";
10 const char* WIFI_PASSWORD = "abc12345";
11 const char* API_BASE_URL = "https://smart-package-box-api.vercel.app/api";
12 const char* DEVICE_API_KEY = "db17ea7498b82239d2c72be7ad97af895609413287f7a9a270acd05c518b537";
13 const char* DEVICE_ID = "BOX-001";
14
15 // KONFIGURASI PIN ESP32
16 constexpr uint8_t PIN_TRIG = 27;
17 constexpr uint8_t PIN_ECHO = 26;
18 constexpr uint8_t PIN_REED = 25;
19 constexpr uint8_t PIN_RELAY = 33;
20 constexpr uint8_t PIN_LED = 2;
21 constexpr uint8_t PIN_BUTTON = 32;
22
23 // LCD yang umum menggunakan alamat 0x27.
24 // Ubah menjadi 0x40 apabila LCD tidak tampil.
25 LiquidCrystal_I2C lcd(0x27, 16, 2);
26
27 // LOGIKA LEVEL PIN
28 // Kebanyakan relay module bersifat active LOW.
29 constexpr uint8_t RELAY_UNLOCK_LEVEL = LOW;
30 constexpr uint8_t RELAY_LOCK_LEVEL = HIGH;
31
32 // MODUL PUSH BUTTON 3 PIN:
33 // GND -> GND ESP32
34 // VCC -> 3.3V ESP32
35 // OUT -> GPIO 32
36
37 // sudah tersedia pada modul. Umumnya: ditekan = LOW.
38 // Jika hasil pengujian modul anda terbalik, ubah LOW menjadi HIGH.
39 constexpr uint8_t BUTTON_PRESSED_LEVEL = LOW;
40
41 // Read switch dengan INPUT_PULLUP; pintu tertutup biasanya LOW
42 // ketika magnet berada dekat sensor. Balik ke HIGH bila berbeda.
43 constexpr uint8_t REED_CLOSED_LEVEL = LOW;
44
45 // KONFIGURASI SENSOR DAN WAKTU
46 // Sesuaikan dengan ukuran kotak setelah kalibrasi.
47 // Paket dianggap ADA saat jarak <= nilai ini.
48 constexpr float PACKAGE_ENTER_DISTANCE_CM = 5.0f;
49
50 // Histeresis: paket dianggap HILANG saat jarak > nilai ini.
51 constexpr float PACKAGE_EXIT_DISTANCE_CM = 10.0f;
52
53 constexpr unsigned long BUTTON_DEBOUNCE_MS = 60;
54 constexpr unsigned long DOOR_DEBOUNCE_MS = 100;
55 constexpr unsigned long SENSOR_INTERVAL_MS = 700;
56 constexpr unsigned long HEARTBEAT_INTERVAL_MS = 60000;
57 constexpr unsigned long RELAY_POLL_INTERVAL_MS = 2000;
58 constexpr unsigned long WIFI_RETRY_INTERVAL_MS = 10000;
59 constexpr unsigned long UNLOCK_TIMEOUT_MS = 10000;
60 constexpr unsigned long LCD_REFRESH_MS = 500;
61 constexpr unsigned long LED_BLINK_INTERVAL_MS = 400;
62 constexpr unsigned long TOTP_MESSAGE_MS = 2500;
63 constexpr unsigned long DOOR_OPEN_SENSOR_GRACE_MS = 2000;
64 constexpr unsigned long DOOR_OPEN_WARNING_DELAY_MS = 30000;
65 constexpr unsigned long WARNING_RETRY_INTERVAL_MS = 10000;
66
67 // Event yang menghasilkan notifikasi WhatsApp dijadwalkan 1 menit setelah kejadian.
68 // Queue bersifat non-blocking, sehingga sensor, tombol, relay, dan LCD tetap berjalan.
69 constexpr unsigned long WHATSAPP_NOTIFICATION_DELAY_MS = 60000;
70 constexpr unsigned long NOTIFICATION_RETRY_INTERVAL_MS = 10000;
71 constexpr uint8_t NOTIFICATION_QUEUE_CAPACITY = 10;
72
73 constexpr uint8_t PACKAGE_CONFIRMATION_COUNT = 3;
74 constexpr uint8_t PACKAGE_OPEN_CONFIRMATION_COUNT = 5;
75
76 // STATUS SISTEM
77 bool doorClosed = true;
78 bool packageDetected = false;
79 bool lockIsLocked = true;
80 bool unlockAuthorized = false;
81 bool doorOpenedAfterUnlock = false;
82 bool doorOpenWarningSent = false;
83 bool tamperDetectedThisCycle = false;
84
85 float lastDistanceCm = NAN;
86
87 // Nilai variabel ini menyatakan kondisi "sedang ditekan", bukan level GPIO.
88 bool buttonStableState = false;
89 bool buttonLastRawState = false;
90 unsigned long buttonLastChangeMs = 0;
91
92 bool doorStableState = true;
93 bool doorLastRawState = true;
94 unsigned long doorLastChangeMs = 0;
95
96 uint8_t packageCandidateCount = 0;
97 bool packageCandidateState = false;
98
99 unsigned long unlockStartedMs = 0;
100 unsigned long doorOpenedMs = 0;
101 unsigned long packageDetectedUntilDoorOpensMs = 0;
102 unsigned long lastDoorWarningAttemptMs = 0;
103 unsigned long lastSensorMs = 0;
104 unsigned long lastHeartbeatMs = 0;
105 unsigned long lastRelayPollMs = 0;
106 unsigned long lastWifiRetryMs = 0;
107 unsigned long lastCdnRefreshMs = 0;
108 unsigned long lastTotpToggleMs = 0;
109
110 bool ledState = false;
111 String temporaryLine1 = "";
112 String temporaryLine2 = "";

```