PRAKTIKUM INTERNET OF THINGS
Mobile Robot ESP-CAM

Nama Kelompok :

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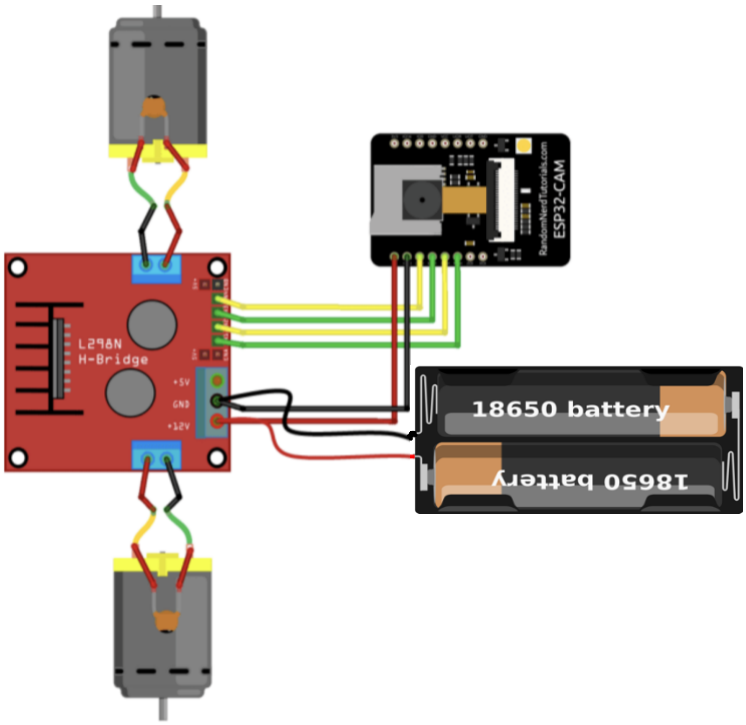
A. RANGKAIAN



L298N Motor Driver	ESP32-CAM
IN1	GPIO 14
IN2	GPIO 15
IN3	GPIO 13
IN4	GPIO 12

B. SOURCE CODE

```
#include "esp_camera.h"
#include <WiFi.h>
#include "esp_timer.h"
#include "img_converters.h"
#include "Arduino.h"
#include "fb_gfx.h"
#include "soc/soc.h"           // disable brownout problems
#include "soc/rtc_cntl_reg.h"  // disable brownout problems
#include "esp_http_server.h"

// Replace with your network credentials
const char* ssid = ".....";
const char* password = ".....";

#define PART_BOUNDARY "123456789000000000000987654321"
```

```
#define CAMERA_MODEL_AI_THINKER
//#define CAMERA_MODEL_M5STACK_PSRAM
//#define CAMERA_MODEL_M5STACK_WITHOUT_PSRAM
//#define CAMERA_MODEL_M5STACK_PSRAM_B
//#define CAMERA_MODEL_WROVER_KIT

#if defined(CAMERA_MODEL_WROVER_KIT)
  #define PWDN_GPIO_NUM    -1
  #define RESET_GPIO_NUM   -1
  #define XCLK_GPIO_NUM    21
  #define SIOD_GPIO_NUM    26
  #define SIOC_GPIO_NUM    27

  #define Y9_GPIO_NUM      35
  #define Y8_GPIO_NUM      34
  #define Y7_GPIO_NUM      39
  #define Y6_GPIO_NUM      36
  #define Y5_GPIO_NUM      19
  #define Y4_GPIO_NUM      18
  #define Y3_GPIO_NUM       5
  #define Y2_GPIO_NUM       4
  #define VSYNC_GPIO_NUM   25
  #define HREF_GPIO_NUM    23
  #define PCLK_GPIO_NUM    22

#elif defined(CAMERA_MODEL_M5STACK_PSRAM)
  #define PWDN_GPIO_NUM     -1
  #define RESET_GPIO_NUM    15
  #define XCLK_GPIO_NUM     27
  #define SIOD_GPIO_NUM     25
  #define SIOC_GPIO_NUM     23

  #define Y9_GPIO_NUM       19
  #define Y8_GPIO_NUM       36
  #define Y7_GPIO_NUM       18
  #define Y6_GPIO_NUM       39
  #define Y5_GPIO_NUM        5
  #define Y4_GPIO_NUM       34
  #define Y3_GPIO_NUM       35
  #define Y2_GPIO_NUM       32
  #define VSYNC_GPIO_NUM    22
  #define HREF_GPIO_NUM     26
  #define PCLK_GPIO_NUM     21

#elif defined(CAMERA_MODEL_M5STACK_WITHOUT_PSRAM)
  #define PWDN_GPIO_NUM     -1
  #define RESET_GPIO_NUM    15
  #define XCLK_GPIO_NUM     27
  #define SIOD_GPIO_NUM     25
  #define SIOC_GPIO_NUM     23

  #define Y9_GPIO_NUM       19
  #define Y8_GPIO_NUM       36
  #define Y7_GPIO_NUM       18
  #define Y6_GPIO_NUM       39
  #define Y5_GPIO_NUM        5
  #define Y4_GPIO_NUM       34
  #define Y3_GPIO_NUM       35
  #define Y2_GPIO_NUM       17
  #define VSYNC_GPIO_NUM    22
  #define HREF_GPIO_NUM     26
```

```
  #define PCLK_GPIO_NUM     21

#elif defined(CAMERA_MODEL_AI_THINKER)
  #define PWDN_GPIO_NUM     32
  #define RESET_GPIO_NUM    -1
  #define XCLK_GPIO_NUM      0
  #define SIOD_GPIO_NUM     26
  #define SIOC_GPIO_NUM     27

  #define Y9_GPIO_NUM       35
  #define Y8_GPIO_NUM       34
  #define Y7_GPIO_NUM       39
  #define Y6_GPIO_NUM       36
  #define Y5_GPIO_NUM       21
  #define Y4_GPIO_NUM       19
  #define Y3_GPIO_NUM       18
  #define Y2_GPIO_NUM        5
  #define VSYNC_GPIO_NUM    25
  #define HREF_GPIO_NUM     23
  #define PCLK_GPIO_NUM     22

#elif defined(CAMERA_MODEL_M5STACK_PSRAM_B)
  #define PWDN_GPIO_NUM     -1
  #define RESET_GPIO_NUM    15
  #define XCLK_GPIO_NUM     27
  #define SIOD_GPIO_NUM     22
  #define SIOC_GPIO_NUM     23

  #define Y9_GPIO_NUM       19
  #define Y8_GPIO_NUM       36
  #define Y7_GPIO_NUM       18
  #define Y6_GPIO_NUM       39
  #define Y5_GPIO_NUM        5
  #define Y4_GPIO_NUM       34
  #define Y3_GPIO_NUM       35
  #define Y2_GPIO_NUM       32
  #define VSYNC_GPIO_NUM    25
  #define HREF_GPIO_NUM     26
  #define PCLK_GPIO_NUM     21

#else
  #error "Camera model not selected"
#endif

#define MOTOR_1_PIN_1    14
#define MOTOR_1_PIN_2    15
#define MOTOR_2_PIN_1    13
#define MOTOR_2_PIN_2    12

static const char* _STREAM_CONTENT_TYPE = "multipart/x-mixed-replace;boundary=" PART_BOUNDARY;
static const char* _STREAM_BOUNDARY = "\r\n--" PART_BOUNDARY "\r\n";
static const char* _STREAM_PART = "Content-Type: image/jpeg\r\nContent-Length: %u\r\n\r\n";

httpd_handle_t camera_httpd = NULL;
httpd_handle_t stream_httpd = NULL;

static const char PROGMEM INDEX_HTML[] = R"rawliteral(
<html>
  <head>
    <title>ESP32-CAM Robot</title>
    <meta name="viewport" content="width=device-width, initial-scale=1">
    <style>
```

```
    body { font-family: Arial; text-align: center; margin:0px auto; padding-top: 30px;}
    table { margin-left: auto; margin-right: auto; }
    td { padding: 8 px; }
    .button {
      background-color: #2f4468;
      border: none;
      color: white;
      padding: 10px 20px;
      text-align: center;
      text-decoration: none;
      display: inline-block;
      font-size: 18px;
      margin: 6px 3px;
      cursor: pointer;
      -webkit-touch-callout: none;
      -webkit-user-select: none;
      -khtml-user-select: none;
      -moz-user-select: none;
      -ms-user-select: none;
      user-select: none;
      -webkit-tap-highlight-color: rgba(0,0,0,0);
    }
    img {  width: auto ;
      max-width: 100% ;
      height: auto ;
    }
   </style>
  </head>
  <body>
    <h1>ESP32-CAM Robot</h1>
    <img src="" id="photo" >
    <table>
      <tr><td colspan="3" align="center"><button class="button" onmousedown="toggleCheckbox('forward');"
ontouchstart="toggleCheckbox('forward');" onmouseup="toggleCheckbox('stop');"
ontouchend="toggleCheckbox('stop');">Forward</button></td></tr>
      <tr><td align="center"><button class="button" onmousedown="toggleCheckbox('left');"
ontouchstart="toggleCheckbox('left');" onmouseup="toggleCheckbox('stop');"
ontouchend="toggleCheckbox('stop');">Left</button></td><td align="center"><button class="button"
onmousedown="toggleCheckbox('stop');" ontouchstart="toggleCheckbox('stop');">Stop</button></td><td
align="center"><button class="button" onmousedown="toggleCheckbox('right');"
ontouchstart="toggleCheckbox('right');" onmouseup="toggleCheckbox('stop');"
ontouchend="toggleCheckbox('stop');">Right</button></td></tr>
      <tr><td colspan="3" align="center"><button class="button" onmousedown="toggleCheckbox('backward');"
ontouchstart="toggleCheckbox('backward');" onmouseup="toggleCheckbox('stop');"
ontouchend="toggleCheckbox('stop');">Backward</button></td></tr>
    </table>
   <script>
   function toggleCheckbox(x) {
     var xhr = new XMLHttpRequest();
     xhr.open("GET", "/action?go=" + x, true);
     xhr.send();
   }
   window.onload = document.getElementById("photo").src = window.location.href.slice(0, -1) + ":81/stream";
  </script>
  </body>
</html>
)rawliteral";

static esp_err_t index_handler(httpd_req_t *req){
  httpd_resp_set_type(req, "text/html");
  return httpd_resp_send(req, (const char *)INDEX_HTML, strlen(INDEX_HTML));
}
```

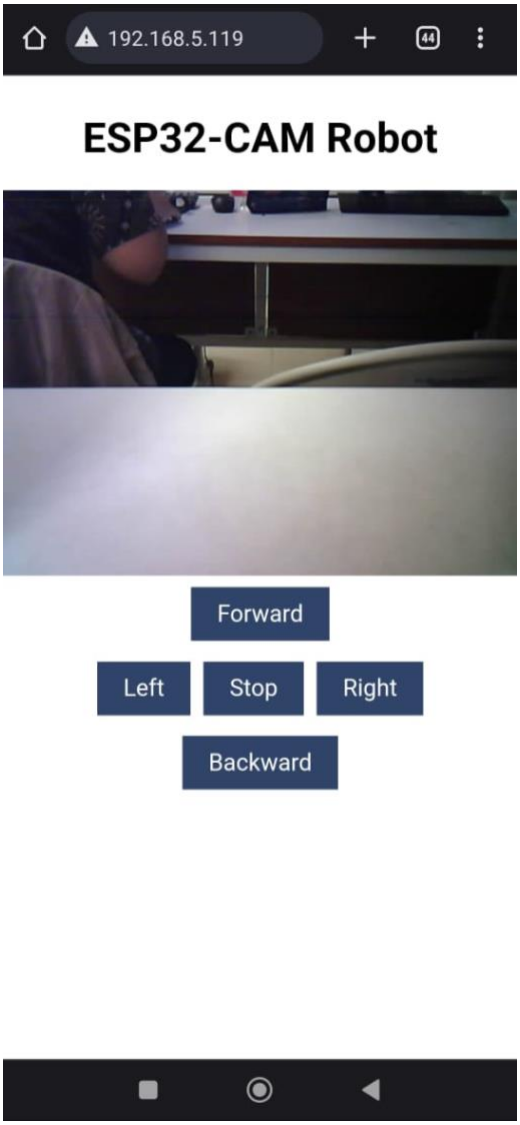
```
static esp_err_t stream_handler(httpd_req_t *req){
  camera_fb_t * fb = NULL;
  esp_err_t res = ESP_OK;
  size_t _jpg_buf_len = 0;
  uint8_t * _jpg_buf = NULL;
  char * part_buf[64];

  res = httpd_resp_set_type(req, _STREAM_CONTENT_TYPE);
  if(res != ESP_OK){
    return res;
  }

  while(true){
    fb = esp_camera_fb_get();
    if (!fb) {
      Serial.println("Camera capture failed");
      res = ESP_FAIL;
    } else {
      if(fb->width > 400){
        if(fb->format != PIXFORMAT_JPEG){
          bool jpeg_converted = frame2jpg(fb, 80, &_jpg_buf, &_jpg_buf_len);
          esp_camera_fb_return(fb);
          fb = NULL;
          if(!jpeg_converted){
            Serial.println("JPEG compression failed");
            res = ESP_FAIL;
          }
        } else {
          _jpg_buf_len = fb->len;
          _jpg_buf = fb->buf;
        }
      }
    }
    if(res == ESP_OK){
      size_t hlen = snprintf((char *)part_buf, 64, _STREAM_PART, _jpg_buf_len);
      res = httpd_resp_send_chunk(req, (const char *)part_buf, hlen);
    }
    if(res == ESP_OK){
      res = httpd_resp_send_chunk(req, (const char *)_jpg_buf, _jpg_buf_len);
    }
    if(res == ESP_OK){
      res = httpd_resp_send_chunk(req, _STREAM_BOUNDARY, strlen(_STREAM_BOUNDARY));
    }
    if(fb){
      esp_camera_fb_return(fb);
      fb = NULL;
      _jpg_buf = NULL;
    } else if(_jpg_buf){
      free(_jpg_buf);
      _jpg_buf = NULL;
    }
    if(res != ESP_OK){
      break;
    }
    //Serial.printf("MJPG: %uB\n",(uint32_t)(_jpg_buf_len));
  }
  return res;
}

static esp_err_t cmd_handler(httpd_req_t *req){
  char*  buf;
```

```
size_t buf_len;
char variable[32] = {0,};

buf_len = httpd_req_get_url_query_len(req) + 1;
if (buf_len > 1) {
  buf = (char*)malloc(buf_len);
  if(!buf){
    httpd_resp_send_500(req);
    return ESP_FAIL;
  }
  if (httpd_req_get_url_query_str(req, buf, buf_len) == ESP_OK) {
    if (httpd_query_key_value(buf, "go", variable, sizeof(variable)) == ESP_OK) {
    } else {
      free(buf);
      httpd_resp_send_404(req);
      return ESP_FAIL;
    }
  } else {
    free(buf);
    httpd_resp_send_404(req);
    return ESP_FAIL;
  }
  free(buf);
} else {
  httpd_resp_send_404(req);
  return ESP_FAIL;
}

sensor_t * s = esp_camera_sensor_get();
int res = 0;

if(!strcmp(variable, "forward")) {
  Serial.println("Forward");
  digitalWrite(MOTOR_1_PIN_1, 1);
  digitalWrite(MOTOR_1_PIN_2, 0);
  digitalWrite(MOTOR_2_PIN_1, 1);
  digitalWrite(MOTOR_2_PIN_2, 0);
}
else if(!strcmp(variable, "left")) {
  Serial.println("Left");
  digitalWrite(MOTOR_1_PIN_1, 0);
  digitalWrite(MOTOR_1_PIN_2, 1);
  digitalWrite(MOTOR_2_PIN_1, 1);
  digitalWrite(MOTOR_2_PIN_2, 0);
}
else if(!strcmp(variable, "right")) {
  Serial.println("Right");
  digitalWrite(MOTOR_1_PIN_1, 1);
  digitalWrite(MOTOR_1_PIN_2, 0);
  digitalWrite(MOTOR_2_PIN_1, 0);
  digitalWrite(MOTOR_2_PIN_2, 1);
}
else if(!strcmp(variable, "backward")) {
  Serial.println("Backward");
  digitalWrite(MOTOR_1_PIN_1, 0);
  digitalWrite(MOTOR_1_PIN_2, 1);
  digitalWrite(MOTOR_2_PIN_1, 0);
  digitalWrite(MOTOR_2_PIN_2, 1);
}
else if(!strcmp(variable, "stop")) {
  Serial.println("Stop");
  digitalWrite(MOTOR_1_PIN_1, 0);
```

```
    digitalWrite(MOTOR_1_PIN_2, 0);
    digitalWrite(MOTOR_2_PIN_1, 0);
    digitalWrite(MOTOR_2_PIN_2, 0);
  }
  else {
    res = -1;
  }

  if(res){
    return httpd_resp_send_500(req);
  }

  httpd_resp_set_hdr(req, "Access-Control-Allow-Origin", "*");
  return httpd_resp_send(req, NULL, 0);
}

void startCameraServer(){
  httpd_config_t config = HTTPD_DEFAULT_CONFIG();
  config.server_port = 80;
  httpd_uri_t index_uri = {
    .uri       = "/",
    .method    = HTTP_GET,
    .handler   = index_handler,
    .user_ctx  = NULL
  };

  httpd_uri_t cmd_uri = {
    .uri       = "/action",
    .method    = HTTP_GET,
    .handler   = cmd_handler,
    .user_ctx  = NULL
  };
  httpd_uri_t stream_uri = {
    .uri       = "/stream",
    .method    = HTTP_GET,
    .handler   = stream_handler,
    .user_ctx  = NULL
  };
  if (httpd_start(&camera_httpd, &config) == ESP_OK) {
    httpd_register_uri_handler(camera_httpd, &index_uri);
    httpd_register_uri_handler(camera_httpd, &cmd_uri);
  }
  config.server_port += 1;
  config.ctrl_port += 1;
  if (httpd_start(&stream_httpd, &config) == ESP_OK) {
    httpd_register_uri_handler(stream_httpd, &stream_uri);
  }
}

void setup() {
  WRITE_PERI_REG(RTC_CNTL_BROWN_OUT_REG, 0); //disable brownout detector

  pinMode(MOTOR_1_PIN_1, OUTPUT);
  pinMode(MOTOR_1_PIN_2, OUTPUT);
  pinMode(MOTOR_2_PIN_1, OUTPUT);
  pinMode(MOTOR_2_PIN_2, OUTPUT);

  Serial.begin(115200);
  Serial.setDebugOutput(false);

  camera_config_t config;
  config.ledc_channel = LEDC_CHANNEL_0;
```

```
  config.ledc_timer = LEDC_TIMER_0;
  config.pin_d0 = Y2_GPIO_NUM;
  config.pin_d1 = Y3_GPIO_NUM;
  config.pin_d2 = Y4_GPIO_NUM;
  config.pin_d3 = Y5_GPIO_NUM;
  config.pin_d4 = Y6_GPIO_NUM;
  config.pin_d5 = Y7_GPIO_NUM;
  config.pin_d6 = Y8_GPIO_NUM;
  config.pin_d7 = Y9_GPIO_NUM;
  config.pin_xclk = XCLK_GPIO_NUM;
  config.pin_pclk = PCLK_GPIO_NUM;
  config.pin_vsync = VSYNC_GPIO_NUM;
  config.pin_href = HREF_GPIO_NUM;
  config.pin_sscb_sda = SIOD_GPIO_NUM;
  config.pin_sscb_scl = SIOC_GPIO_NUM;
  config.pin_pwdn = PWDN_GPIO_NUM;
  config.pin_reset = RESET_GPIO_NUM;
  config.xclk_freq_hz = 20000000;
  config.pixel_format = PIXFORMAT_JPEG;

  if(psramFound()){
    config.frame_size = FRAMESIZE_VGA;
    config.jpeg_quality = 10;
    config.fb_count = 2;
  } else {
    config.frame_size = FRAMESIZE_SVGA;
    config.jpeg_quality = 12;
    config.fb_count = 1;
  }

  // Camera init
  esp_err_t err = esp_camera_init(&config);
  if (err != ESP_OK) {
    Serial.printf("Camera init failed with error 0x%x", err);
    return;
  }
  // Wi-Fi connection
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");

  Serial.print("Camera Stream Ready! Go to: http://");
  Serial.println(WiFi.localIP());

  // Start streaming web server
  startCameraServer();
}

void loop() {

}
```

C. UI WEB



D. ROBOT