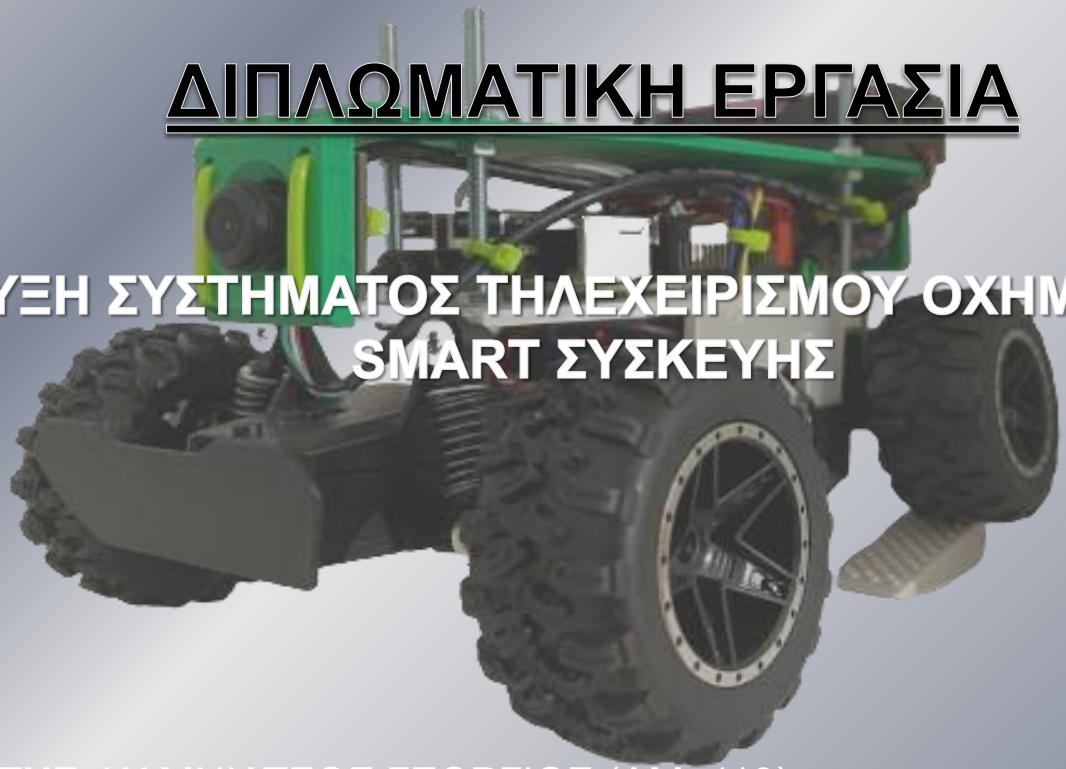
ΔΙΕΘΝΕΣ ΠΑΝΕΠΙΣΤΗΜΙΟ ΤΗΣ ΕΛΛΑΔΟΣ
ΣΧΟΛΗ ΜΗΧΑΝΙΚΩΝ
ΤΜΗΜΑ ΜΗΧΑΝΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ
ΠΑΝΕΠΙΣΤΗΜΙΟΥΠΟΛΗ ΣΕΡΡΩΝ

MSc in ROBOTICS ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ ΣΤΗ ΡΟΜΠΟΤΙΚΗ
ΔΙΕΘΝΕΣ ΠΑΝΕΠΙΣΤΗΜΙΟ ΤΗΣ ΕΛΛΑΔΟΣ - ΣΕΡΡΕΣ
ΣΧΟΛΗ ΜΗΧΑΝΙΚΩΝ
ΤΜΗΜΑ ΜΗΧΑΝΙΚΩΝ ΠΛΗΡΟΦΟΡΙΚΗΣ, ΥΠΟΛΟΓΙΣΤΩΝ ΚΑΙ ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ

ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ



ΑΝΑΠΤΥΞΗ ΣΥΣΤΗΜΑΤΟΣ ΤΗΛΕΧΕΙΡΙΣΜΟΥ ΟΧΗΜΑΤΟΣ ΜΕΣΩ SMART ΣΥΣΚΕΥΗΣ

ΕΚΠΟΝΗΤΗΣ: ΚΑΜΝΙΑΤΣΟΣ ΓΕΩΡΓΙΟΣ (ΑΜ: 113)
ΕΠΙΒΛΕΠΩΝ: ΣΑΓΡΗΣ ΔΗΜΗΤΡΙΟΣ (Αναπληρωτής Καθηγητής)

ΣΕΡΡΕΣ
ΑΠΡΙΛΙΟΣ 2024

Σκοπός εργασίας

- Σχεδίαση & Ανάπτυξη συστήματος τηλεχειρισμού οχήματος με χρήση smart συσκευής.
- Καταγραφή ιστορία χειρισμών.
- Καταγραφή εικόνας & Video.
- Εκτέλεση μακροεντολών.
- Δυνατότητα κίνησης σε περιορισμένους χώρους, σε διάφορα εδάφη.
- Μεταφορά ωφέλιμου φορτίου 1kg.
- Σχεδιασμός σε κατάλληλο 3D λογισμικό

Χρησιμοποιηθέντα λογισμικά

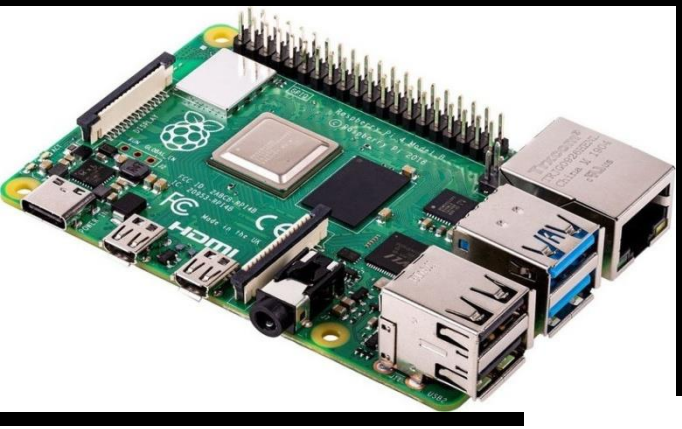
- Solidworks
- Python
- JavaScript
- HTML
- Creality Slicer

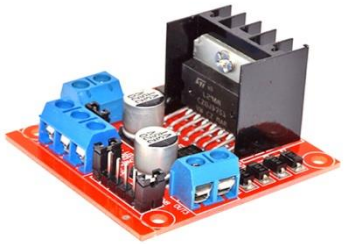
Σχεδιασμός Hardware οχήματος

- Κατασκευή οχήματος – 6 στάδια

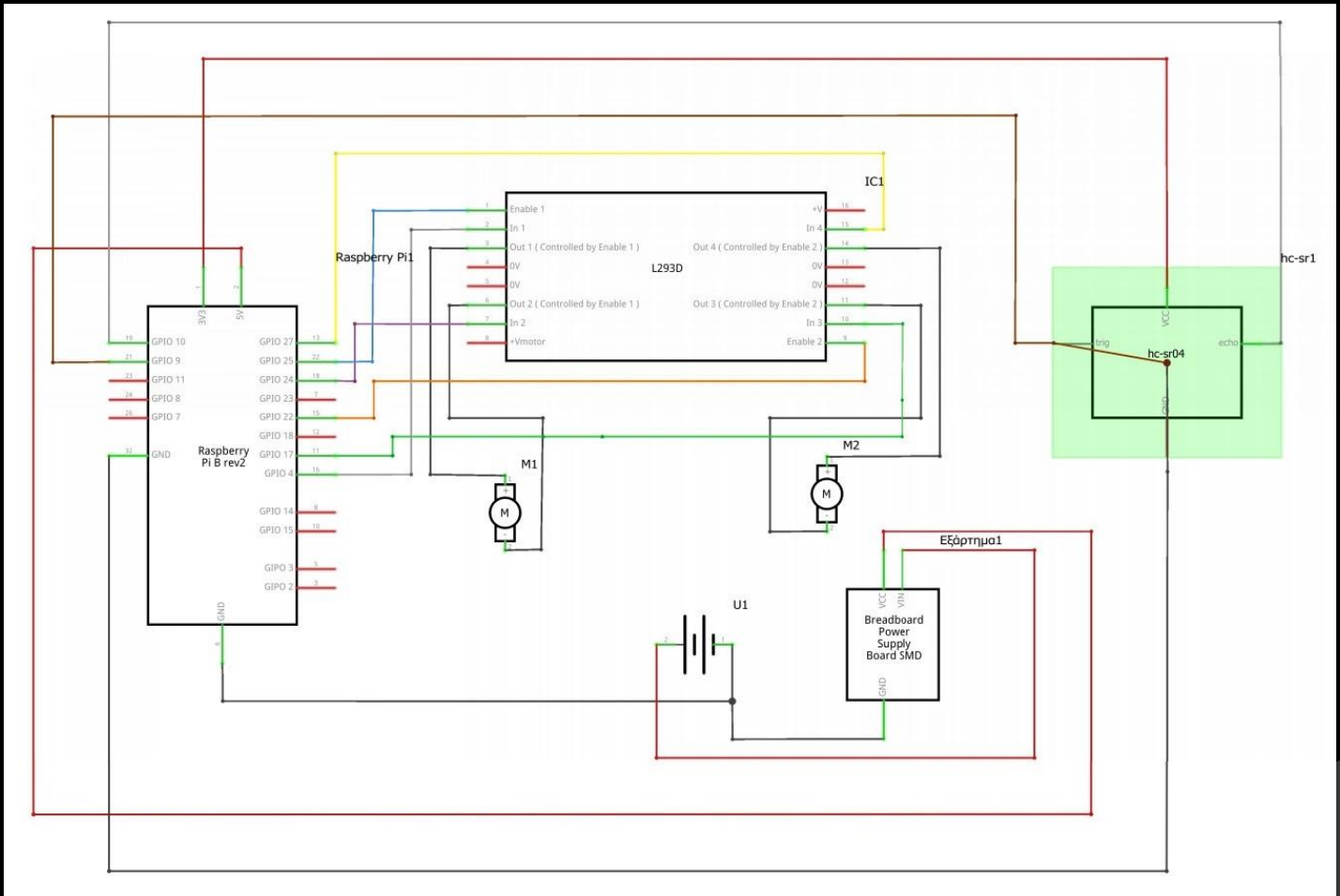
1. Εύρεση – αγορά κατάλληλου οχήματος.
2. Αρχή τροποποίησης – προσωρινή τοποθέτηση hardware.
3. Δημιουργία προσωρινής κατασκευής. (έλεγχος συμπεριφοράς)
4. Βελτιστοποίηση κατασκευής.
5. 3D σχεδιασμός και εκτύπωση απαραίτητων εξαρτημάτων.
6. Τελειοποίηση της κατασκευής – τελικές παραμετροποιήσεις.

Απαιτούμενος εξοπλισμός - Hardware



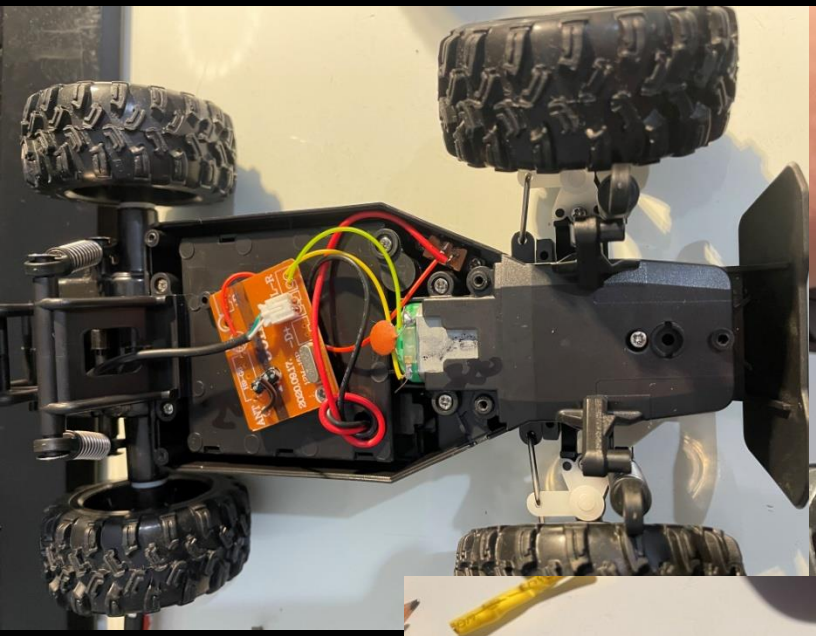


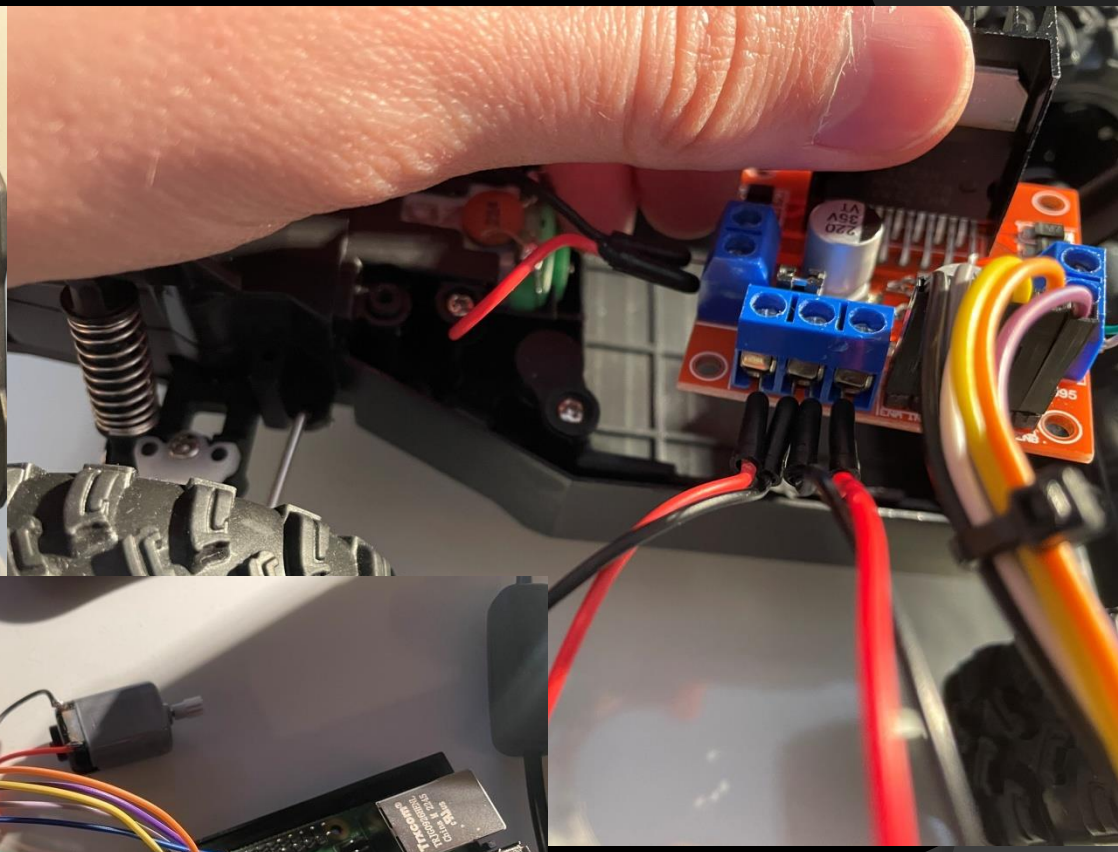
Ηλεκτρικό διάγραμμα

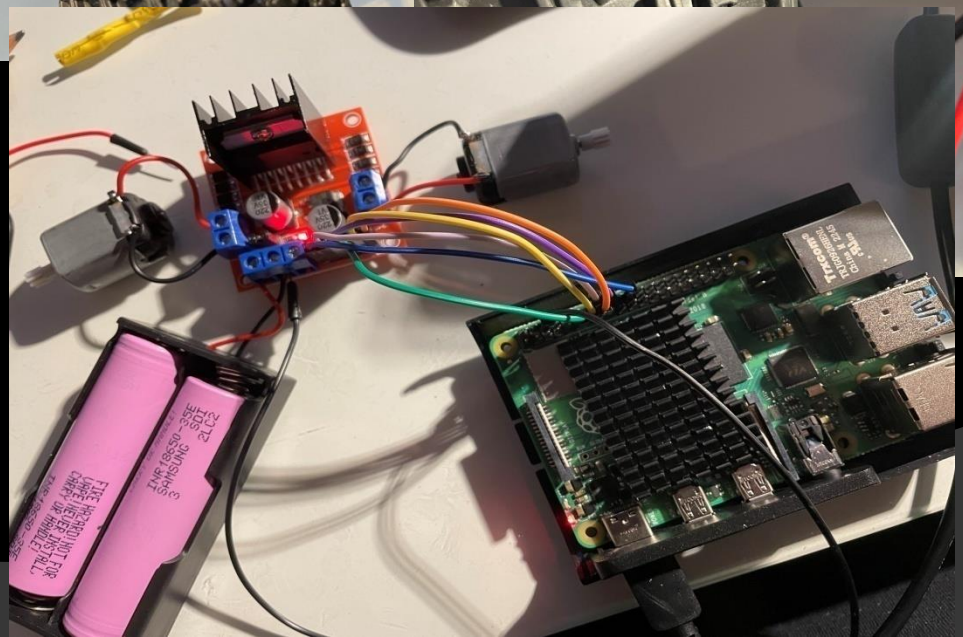


Στάδιο 1

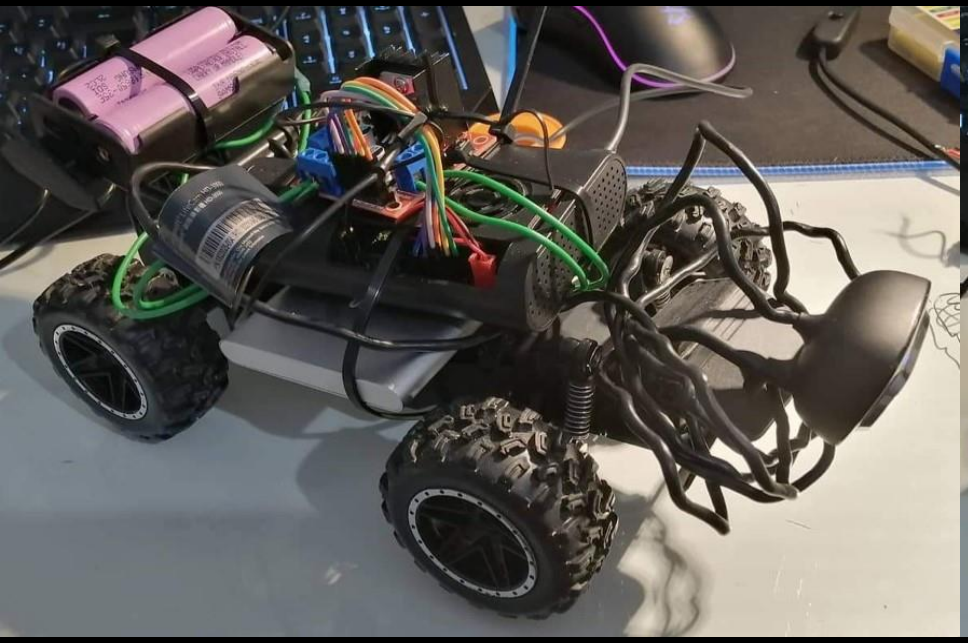
Στάδιο 2

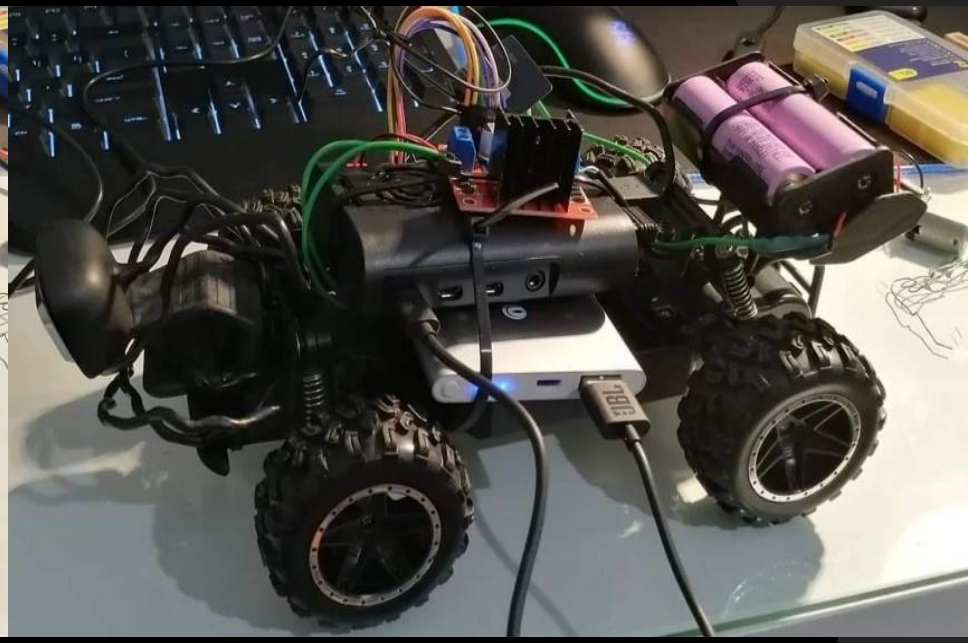






Στάδιο 3





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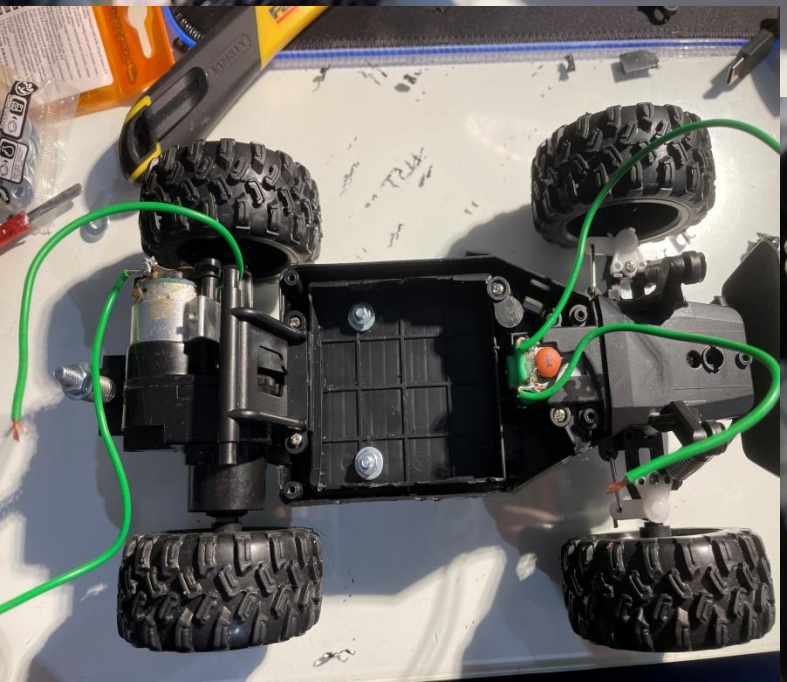
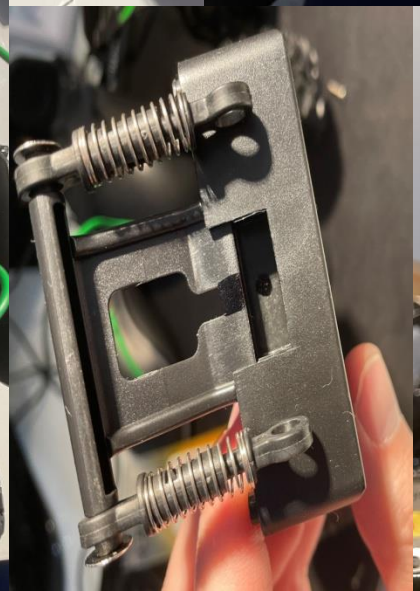
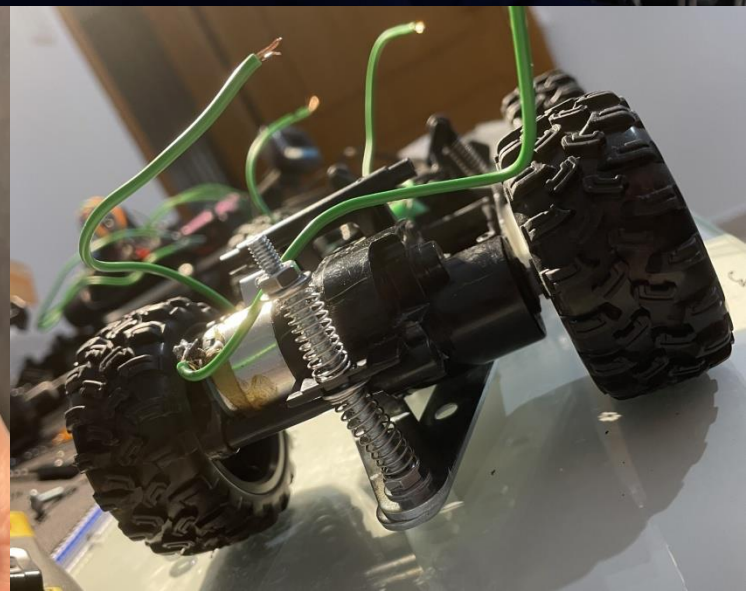
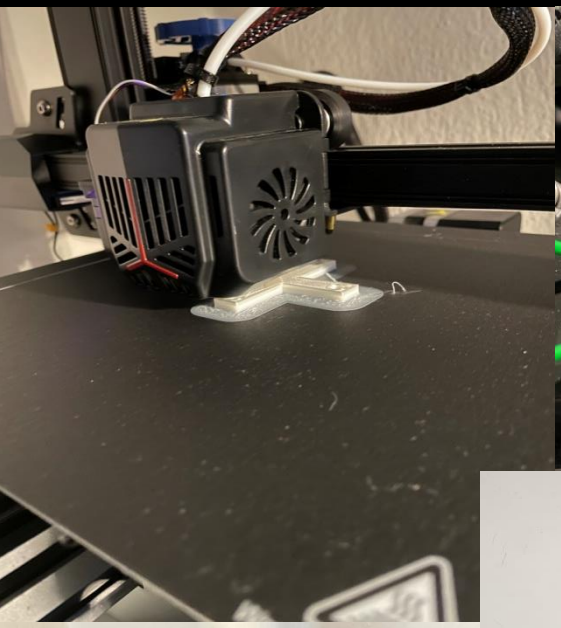
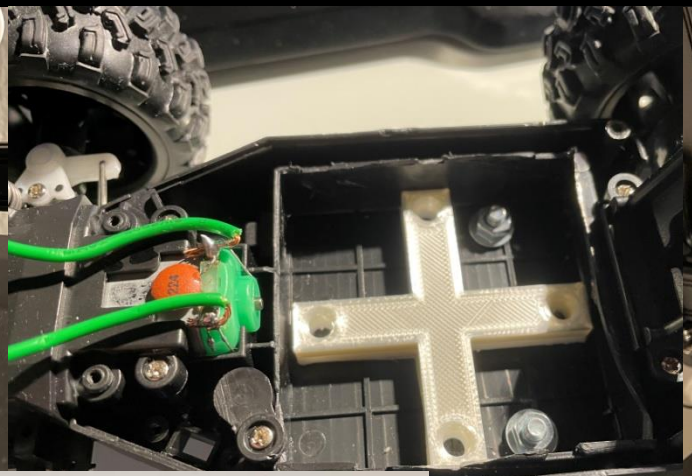


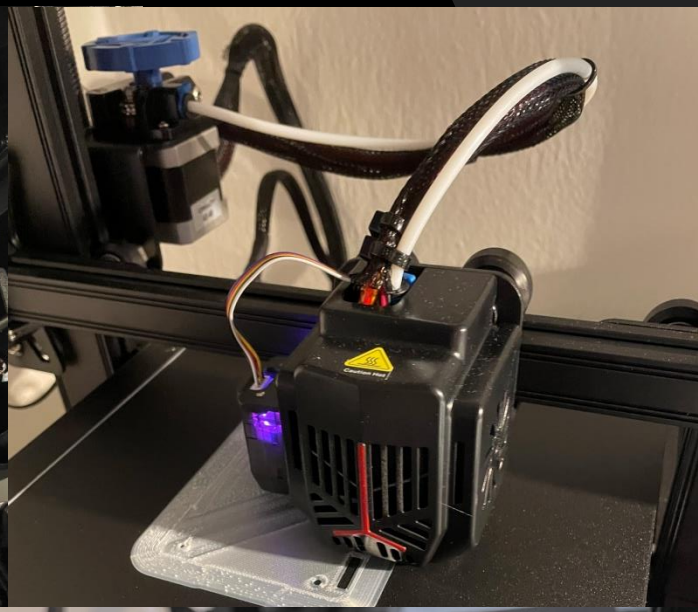


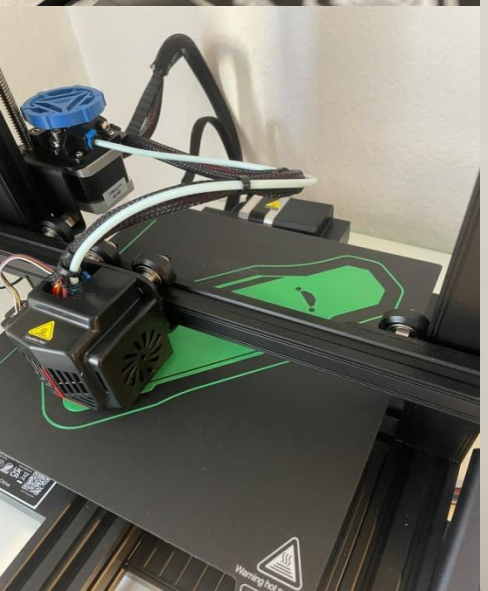


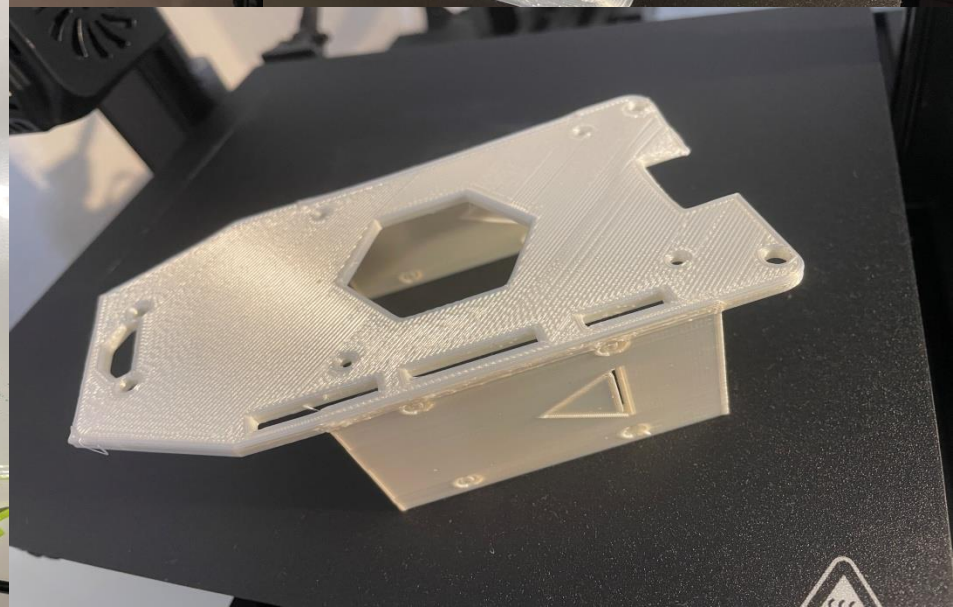
Στάδιο 5



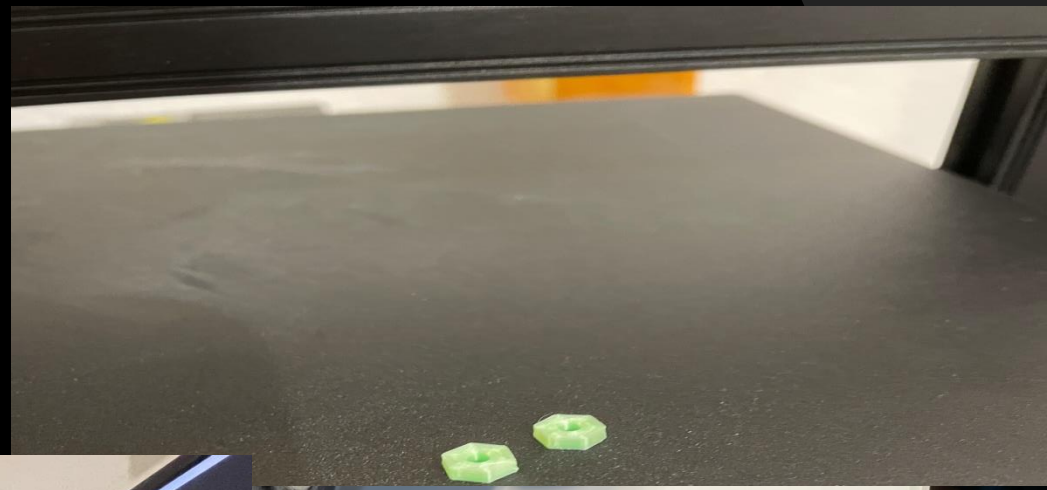


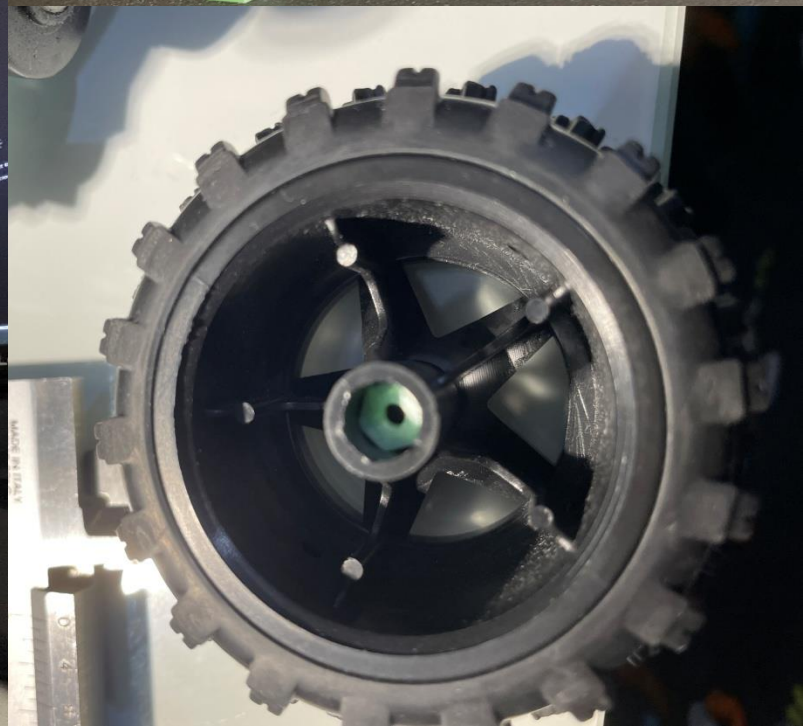






Στάδιο 6





Σχεδιασμός Software επικοινωνίας & χειρισμού

- Αρχικό πλάνο (Rpi + Arduino)
- Δημιουργία python αρχείου. (εντολές σε Rpi)
- Δημιουργία HTML αρχείου. (απομακρυσμένη σύνδεση για χειρισμό.
- Δημιουργία JS αρχείου (Joystick)
- Δημιουργία CSS αρχείου (μορφοποίηση joystick).

2,45M/s 71% 9:57

Combined App

192.168.1.209:5000

Combined App

Video Feed

Motor Control

Forwards | Left | Stop | Right

Backwards

Emergency Stop

Clean up

Αγγλικά Ελληνικά

Κώδικας Python

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app.py 3

C: > Users > kamni > Desktop > Διπλωματική > GK-Robot 1 > robotapp1 > app.py > ...

```python
from flask import Flask, render_template, request, Response, make_response, se
from io import BytesIO
import cv2
import RPi.GPIO as GPIO
import threading
import time
import sched

app = Flask(__name__)

Motor1A = 16
Motor1B = 18
Motor1E = 22

Motor2A = 11
Motor2B = 13
Motor2E = 15

#TRIG = 37
#ECHO = 35

CAMERA_SHRINK_RATIO = 0.25
CAMERA_FPS = 8
CAMERA_FRAME_RATE = 8
CAMERA_WIDTH = 640
CAMERA_HEIGHT = 480

GPIO.setmode(GPIO.BOARD)

GPIO.setup(Motor1A, GPIO.OUT)
GPIO.setup(Motor1B, GPIO.OUT)
GPIO.setup(Motor1E, GPIO.OUT)

GPIO.setup(Motor2A, GPIO.OUT)
GPIO.setup(Motor2B, GPIO.OUT)
GPIO.setup(Motor2E, GPIO.OUT)

#GPIO.setup(TRIG, GPIO.OUT)
#GPIO.setup(ECHO, GPIO.IN)

pwm1 = GPIO.PWM(Motor1E, 5000)
pwm2 = GPIO.PWM(Motor2E, 1000)

camera = cv2.VideoCapture(0)
camera.set(cv2.CAP_PROP_FRAME_WIDTH, CAMERA_WIDTH)
camera.set(cv2.CAP_PROP_FRAME_HEIGHT, CAMERA_HEIGHT)
#camera.set(cv2.CAP_PROP_FPS, CAMERA_FPS)
```

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app.py 3

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```python

def move_backwards(speed):
    pwm1.start(speed)
    #distance = get_distance(TRIG, ECHO)
    #if distance > 10:
    GPIO.output(Motor1A, GPIO.LOW)
    GPIO.output(Motor1B, GPIO.HIGH)
    GPIO.output(Motor1E, GPIO.HIGH)
    #else:
        #GPIO.output(Motor1A, GPIO.LOW)
        #GPIO.output(Motor1B, GPIO.LOW)
        #GPIO.output(Motor1E, GPIO.LOW)

def move_left(speed):
    pwm2.start(speed)
    GPIO.output(Motor2A, GPIO.HIGH)
    GPIO.output(Motor2B, GPIO.LOW)
    GPIO.output(Motor2E, GPIO.HIGH)

def move_right(speed):
    pwm2.start(speed)
    GPIO.output(Motor2A, GPIO.LOW)
    GPIO.output(Motor2B, GPIO.HIGH)
    GPIO.output(Motor2E, GPIO.HIGH)

def move_forwardsleft(speed):
    pwm1.start(speed)
    pwm2.start(speed)
    GPIO.output(Motor1A, GPIO.HIGH)
    GPIO.output(Motor1B, GPIO.LOW)
    GPIO.output(Motor1E, GPIO.HIGH)
    GPIO.output(Motor2A, GPIO.HIGH)
    GPIO.output(Motor2B, GPIO.LOW)
    GPIO.output(Motor2E, GPIO.HIGH)

def move_forwardsright(speed):
    pwm1.start(speed)
    pwm2.start(speed)
    GPIO.output(Motor1A, GPIO.HIGH)
    GPIO.output(Motor1B, GPIO.LOW)
    GPIO.output(Motor1E, GPIO.HIGH)
    GPIO.output(Motor2A, GPIO.LOW)
    GPIO.output(Motor2B, GPIO.HIGH)
    GPIO.output(Motor2E, GPIO.HIGH)

def move_backwardsleft(speed):
    pwm1.start(speed)
```

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app.py 3

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```
177     GPIO.output(Motor2E, GPIO.LOW)
178
179 def cleanup():
180     GPIO.cleanup()
181
182 @app.route('/')
183 def index():
184     return render_template('index_combined.html')
185
186 @app.route('/video_feed')
187 def video_feed():
188     return Response(gen(camera), mimetype='multipart/x-mixed-replace; boundary=frame')
189
190 @app.route('/start-streaming', methods=["POST"])
191 def startStreaming():
192     global isStreaming
193     isStreaming = True
194     return "Streaming started"
195
196 @app.route('/stop-streaming', methods=["POST"])
197 def stopStreaming():
198     global currentFrameBytes, availableFrames, isRecording, isStreaming
199     isRecording = False
200     isStreaming = False
201     currentFrameBytes = None
202     availableFrames = []
203     return "Streaming stopped"
204
205 @app.route('/start-recording', methods=["POST"])
206 def startRecording():
207     global isRecording
208
209     if isRecording == True:
210         return "Already recording"
211
212     isRecording = True
213     return "Recording started"
214
215 @app.route('/stop-recording', methods=["POST"])
216 def stopRecording():
217     global availableFrames, isRecording
218
219     if isRecording == False:
220         return "Camera is not recording"
221
```

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app.py 3

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```
246     return make_response("Camera is not currently operating",
247
248 @app.route("/move", methods=["POST"])
249 def move_route():
250     move_stop()
251     direction = request.form["direction"]
252     speed = int(request.form["speed"])
253
254     if direction == "forwards":
255         move_forwards(speed)
256     elif direction == "backwards":
257         move_backwards(speed)
258     elif direction == "left":
259         move_left(speed)
260     elif direction == "right":
261         move_right(speed)
262     elif direction == "forwardsleft":
263         move_forwardsleft(speed)
264     elif direction == "forwardsright":
265         move_forwardsright(speed)
266     elif direction == "backwardsleft":
267         move_backwardsleft(speed)
268     elif direction == "backwardsright":
269         move_backwardsright(speed)
270
271     return "Moving " + direction
272
273 @app.route("/macro-commands", methods=["POST"])
274 def executeMacrocommands():
275     move_stop()
276
277     command = request.form["command"]
278     duration = request.form["duration"]
279     print(duration)
280
281     if not duration.isnumeric():
282         return make_response("Invalid duration", 400)
283
284     duration = int(duration)
285
286     if command == "forwards":
287         move_forwards(100)
288     elif command == "backwards":
289         move_backwards(100)
290     elif command == "stop":
291         move_stop(100)
292     elif command == "left":
```

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Κώδικας HTML

```html
<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <script src="https://code.createjs.com/1.0.0/createjs.min.js"></script>
    <script src="/static/js/easytimer.min.js"></script>
    <script src="/static/js/hammer.min.js"></script>
    <script src="/static/js/js-file-download.js"></script>
    <script src="/static/js/main.js"></script>
    <link rel="stylesheet" href="/static/css/main.css">
    <title>Robot Control</title>
</head>

<body>
    <h1>Robot Control</h1>
    <div class="container">
        <div class="joystick-wrapper">
            <canvas id="joystick" height="300" width="300"></canvas>
        </div>
        <div class="stream-content">
            <img id="stream-view" src="/static/images/no-camera.png" alt="Robot Camera">
            <span id="stream-timer" class="timer"></span>
            <div class="camera-controls">
                <label class="switch">
                    <input type="checkbox" onclick="toggleStreaming(this, event)">
                    <span class="slider round"></span>
                </label>
                <div class="camera-buttons">
                    <button type="button" class="photo-btn" disabled onclick="capturePhoto(event)">
                        <img src="/static/images/camera.png" alt="camera">
                    </button>
                    <button type="button" class="video-btn" disabled onclick="toggleVideoRecording(event)">
                        <img id="video-recording-img" src="/static/images/video-start.png" alt="camera">
                    </button>
                </div>
            </div>
        </div>
        <div class="macro-command-container">
            <table class="command-table">
                <thead>
                    <tr>
                        <td>
                            <span style="font-weight: bold;">Commands</span>
                        </td>
                    </tr>
```

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Search

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index_combined.html

C: > Users > kamni > Desktop > Διπλωματική > GK-Robot 1 > robotapp1 > templates > index_combined.html > ...

```
<html lang="en">
<body>
    <div class="container">
        <div class="macro-command-container">
            <table class="command-table">
                                right
                            </td>
                        </tr>
                        <tr>
                            <td>
                                forwardsleft
                            </td>
                        </tr>
                        <tr>
                            <td>
                                forwardsright
                            </td>
                        </tr>
                        <tr>
                            <td>
                                backwardsleft
                            </td>
                        </tr>
                        <tr>
                            <td>
                                backwardsright
                            </td>
                        </tr>
                    </tbody>
                </table>
                <form onsubmit="sendMacroCommands(this, event)">
                    <label class="label" for="macro-commands">Usage: command,duration</label>
                    <textarea id="macro-commands" name="macro-commands" rows="20" required></textarea>
                    <br>
                    <button id="macro-command-submit" class="macro-command-submit-btn" type="submit">Send commands</button>
                </form>
            </div>
        </div>

        <script>
            initialize();
        </script>
    </body>

    </html>
```

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Κώδικας JS

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main.js

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```
const BASE_URL = "";

// See https://hammerjs.github.io/api/
const DIRECTION = {
    NONE: 1,
    LEFT: 2,
    RIGHT: 4,
    UP: 8,
    DOWN: 16,
    HORIZONTAL: 6,
    VERTICAL: 24,
    ALL: 30,
    // Sums
    UP_LEFT: 10,
    UP_RIGHT: 12,
    DOWN_LEFT: 18,
    DOWN_RIGHT: 20
};

const MIN_SPEED = 40;
// Maximum speed: maxacceleration + minspeed
const MAX_ACCELERATION = 60;

var currentJoyStickDirection = DIRECTION.NONE;
var currentDistance = 0;
var isStreaming = false;
var isRecording = false;
var streamTimer;

function initialize() {
    initializeJoyStick();
    initializeVideoRecordingTimer();
}

// See: https://codepen.io/jiffy/pen/zrqwON
function initializeJoyStick() {
    // easal stuff goes hur
    var xCenter = 150;
    var yCenter = 150;
    var stage = new createjs.Stage('joystick');

    var psp = new createjs.Shape();
    psp.graphics.beginFill('#333333').drawCircle(xCenter, yCenter, 50);

    psp.alpha = 0.25;

    var vertical = new createjs.Shape();
```

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```
function getDirectionByAngle(angle) {
    var direction;

    if (angle < 112.5 && angle > 67.5) {
        direction = DIRECTION.DOWN;
    } else if (angle <= -112.5 && angle >= -157.5) {
        direction = DIRECTION.UP_LEFT;
    } else if (angle >= -67.5 && angle <= -22.5) {
        direction = DIRECTION.UP_RIGHT;
    } else if (angle < -157.5 && angle >= -179.9 || angle <= 180 && angle > 15
        direction = DIRECTION.LEFT;
    } else if (angle > -22.5 && angle < 0 || angle >= 0 && angle < 22.5) {
        direction = DIRECTION.RIGHT;
    } else if (angle <= 157.5 && angle >= 112.5) {
        direction = DIRECTION.DOWN_LEFT;
    } else if (angle >= 22.5 && angle <= 67.5) {
        direction = DIRECTION.DOWN_RIGHT;
    } else {
        direction = DIRECTION.UP;
    }

    return direction;
}
```

```
    // Multiply distance diff with acceleration value, then add minimum speed valu
    let speed = parseInt(((distance / 100) * MAX_ACCELERATION) + MIN_SPEED);

    let piDirection;
    switch (direction) {
        case DIRECTION.DOWN:
            piDirection = "backwards";
            break;
        case DIRECTION.LEFT:
            piDirection = "left";
            break;
        case DIRECTION.RIGHT:
            piDirection = "right";
            break;
        case DIRECTION.UP_LEFT:
            piDirection = "forwardsleft";
            break;
        case DIRECTION.UP_RIGHT:
            piDirection = "forwardsright";
            break;
        case DIRECTION.DOWN_LEFT:
            piDirection = "backwardsleft";
            break;
        case DIRECTION.DOWN_RIGHT:
            piDirection = "backwardsright";
            break;
        default:
            piDirection = "forwards";
            break;
    }

    let response = await fetch(BASE_URL + "/move", {
        method: "POST",
        headers: {
            "Content-Type": "application/x-www-form-urlencoded",
        },
        body: `direction=${piDirection}&speed=${speed}`,
    });
    let text = await response.text();
    console.log(text);
}
```

```
async function toggleVideoRecording(event) {
    var streamTimerEl = document.getElementById("stream-timer");

    if (isRecording) {
        if (streamTimerEl) {
            streamTimerEl.innerText = "stopping...";
        }

        let response = await fetch(BASE_URL + "/stop-recording", {
            method: "POST",
        });

        let blob = await response.blob();
        download(blob, Date.now() + ".mp4");

        let videoButtonImage = document.getElementById("video-recording-img");
        if (videoButtonImage) {
            videoButtonImage.src = "/static/images/video-start.png";
        }

        streamTimer.reset();
        streamTimer.stop();
    } else {
        if (streamTimerEl) {
            streamTimerEl.innerText = "starting...";
        }

        await fetch(BASE_URL + "/start-recording", {
            method: "POST",
        });

        let videoButtonImage = document.getElementById("video-recording-img");
        if (videoButtonImage) {
            videoButtonImage.src = "/static/images/video-stop.png";
        }

        streamTimer.start();
    }
```

Κώδικας CSS

```css
#joystick {
    height: 300px;
    width: 300px;
    border-radius: 300px;
    text-align: center;
    background-color: #80d5ff;
    cursor: all-scroll;
    user-select: none;
}

.camera-controls {
    display: flex;
    justify-content: space-between;
    align-items: end;
    position: absolute;
    bottom: 0;
    width: 100%;
}

.camera-buttons {
    margin-right: 8px;
}

.camera-buttons button {
    border-radius: 50%;
    padding: 16px;
    width: 80px;
    height: 80px;
}

.camera-buttons button img {
    height: 44px;
    width: 44px;
}

#macro-commands {
    width: 150px;
}
```

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main.css

C: > Users > kamni > Desktop > Διπλωματική > GK-Robot 1 > robotapp1 > static > css > # main.css

```css
body {
    background-image: url("/static/images/bg.jpg");
    background-repeat: no-repeat;
    background-size: cover;
    background-attachment: fixed;
    color: #FBFAF5;
    text-align: center;
    font-family: Arial, sans-serif;
}

.container {
    display: flex;
    justify-content: space-around;
    align-items: center;
    margin-top: 20px;
}

.stream-content {
    width: 640px;
    height: 480px;
    position: relative;
}

.stream-content .timer {
    font-size: 36px;
    top: 16px;
    left: 16px;
    position: absolute;
}

.stream-content #stream-view {
    border: 1px solid #FBFAF5;
    border-radius: 24px;
    width: 100%;
    height: 100%;
}

.camera-buttons button {
    font-size: 26px;
    padding: 20px 30px;
    margin: 0 8px 8px 0;
}

.macro-command-container {
    display: flex;
}
```

Ευχαριστώ πολύ για την προσοχή σας!