

# University of Tehran

School of Engineering, Faculty of Mechanical Engineering  
Mechatronics Course Project

## Project Report

### Project Title:

Four-Legged Walking Robot

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## 1. Introduction

This report presents the development of a four-legged robot with a specific walking mechanism. The project started with selecting an appropriate mechanism, calculating its dimensions, and designing it in **SolidWorks**. The mechanical components were then manufactured and assembled, while the necessary electronic parts were selected and purchased. The electronic components include an **Arduino board, sensors, and motors**. The entire system was programmed and synchronized to ensure seamless operation between the mechanical and electronic components. Additionally, the robot's dynamic performance was simulated in **Simulink**.

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## 2. Selection and Design of the Walking Mechanism

The first step in the robot design was to determine the walking mechanism. Various four-legged walking mechanisms were considered, and the **Klann mechanism** was selected for implementation. The mechanism was designed using **SolidWorks**, and its movement was simulated in the motion analysis section of the software. The rendered image of the mechanism is shown below.

To further validate the design, dynamic simulations of the robot's movement were conducted using **Simulink**. The walking trajectory of a single leg was analyzed, and the corresponding movement graphs were obtained. The robot's mechanism was implemented in the simulation software **SAM**, and its output is shown below.

For manufacturing the robot's structure, the design was exported in **DXF** format and sent for laser cutting on **2 mm thick MDF** sheets. Once received, the mechanical components were assembled using nuts and bolts.

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## 3. Electronics Design

In this section, the electronic components used in the project are detailed:

### 1. **Arduino UNO Board:**

- The central control unit of the robot.
- Chosen due to its ease of use, multiple available modules, and affordability.

### 2. **DC Motors:**

- Two DC motors manufactured by **Zheng** with the following specifications:
  - Voltage: 12V
  - Current: 0.5A
  - Speed: 150 RPM

### 3. **Ultrasonic Sensor:**

- **SRR05** module used for obstacle detection and distance measurement.

### 4. **Gyroscope Sensor:**

- **MPU-6050 GY521** sensor used to measure 3-axis linear acceleration and rotational acceleration.

### 5. **Motor Driver Module:**

- The motors were connected to the Arduino via an **L298 motor driver** to control movement using a joystick.

#### 6. Joystick Module:

- Used as the primary robot controller to send movement commands.
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## 4. Circuit Design

The complete electronic circuit design of the robot includes all necessary connections between the sensors, motors, and the Arduino board.

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## 5. Robot Operation

The robot is controlled via a joystick. It continuously measures distance using the ultrasonic sensor. If the distance falls below **5 cm**, the motors stop, and the robot ceases movement to avoid collisions.

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## 6. Appendices

The report includes the following appendices:

- SolidWorks model files
  - Arduino source code
  - Simulink simulation files
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