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Milestone # 1

Robotics (Edpt1009) W’21 course project

Robotics (EDPT1009) Word Document Template

Project Milestone: MS# 1

Team Number: # 10

**Research & Design of 4 DOF Desktop robotic arm**

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**Abstract- a brief description on what you did throughout this milestone, how did you perform the analysis including simulations, SW design and visualization and finally state the comments of your results.**

**Keywords: state the keywords used in this report (Ex. DH Convention, Trajectory Planning, Fuzzy Logic Control (FLC) …)**

1. INTRODUCTION

The development and use of robotic arms have evolved significantly, driven by the need for automation in various fields, including manufacturing, education, and research. Desktop robotic arms, in particular, have gained attention for their compact size, versatility, and accessibility. These devices offer precision in tasks such as small-scale manufacturing, 3D printing, and educational demonstrations, making them invaluable tools for students, researchers, and hobbyists. As advancements in technology continue, desktop robotic arms are becoming more functional and affordable, providing a bridge between theoretical learning and practical application.

Recent studies have shown a growing trend toward the adoption of desktop robotic arms in both educational and industrial settings. For instance, Madiha Farman et al. (2018) noted the increasing preference for robotic arms over human labor in tasks that demand precision and accuracy. Their study focused on the design and kinematic analysis of a three-degree-of-freedom (DOF) robotic arm, highlighting the importance of servomotors, microcontrollers, and proper simulation to achieve efficient performance. These studies underline the significance of forward and inverse kinematics in determining the position and orientation of a robotic arm's end-effector, critical for tasks such as pick-and-place operations.

The educational value of robotic arms has also been emphasized in research. Tanzila Younas et al. (2019) highlighted the use of manipulator-based robotic arms in schools and universities worldwide, particularly for teaching kinematics and control theory. They explored the integration of robotic arms with open-source platforms like Arduino and LABVIEW, enabling students to interact with real-time data and gain hands-on experience in error analysis and system control. This interactivity enriches robotics education, making complex concepts more accessible.

Further developments in affordable, educational robotic arms were made by Zhou Dongxu et al. (2022), who introduced Mirobot, a low-cost, six-DOF desktop robotic arm. This system combines 3D-printed components with a user-friendly control interface, making it an ideal tool for teaching kinematics and motion control. The integration of forward and inverse kinematics with a simple user interface ensures a smooth experience for students and hobbyists alike.

Building on these studies, this project aims to design and implement a desktop robotic arm for an industrial pick-and-place application. The arm will assist in the handling and positioning of parts during a drilling process, improving overall efficiency and precision. The project will begin with the selection and simulation of a robotic arm design from CADGrab, followed by detailed kinematic analysis. This will ensure that the arm's movements are optimized for the desired tasks. The hardware development phase will involve the use of servomotors and a microcontroller, such as Arduino or STM32, to control the robotic arm’s movements. Finally, the arm will be integrated into an industrial drilling system, with extensive testing conducted to ensure reliability, precision, and speed.

This paper reviews the current advancements in desktop robotic arms, identifies gaps in their application for industrial automation, and proposes a solution that leverages existing knowledge to develop a highly functional system tailored to industrial needs. Through simulation, kinematic optimization, and hardware development, the project aims to contribute to the growing body of knowledge surrounding robotic automation in small-scale industrial settings.

1. TOPIC 01 (EX. Hardware Components and Circuit Design)

To build the robot, you need to state the components used and the circuit diagram designed as the first step in the project.

Table 1: Hardware Components Table

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1. TOPIC 02 (EX. ROBOT’S FRAME ASSIGNMENT)

This section should present the first topic in the methodology you are introducing in this work including figures, tables (if any).

1. TOPIC 03 (EX. DH CONVENTION)

This section should present the second topic in the methodology you are introducing in this work including figures, tables as in Table 2 (if any).

Table 2: DH- Parameters Table

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1. SIMULATION RESULTS

This section should include the simulation environment used to simulate the robot’s motion (Ex. MATLAB/Simulink), the robot’s parameters used (length, width, thickness of each link) and finally the simulation results with the figures and visualization response as well as the comments on each response.

1. CONCLUSINS AND FUTURE RECOMMENDATIONS

This section should include the conclusions of your work, a summary of what you have done and the comments of the results.

Followed by the future recommendation in order to enhance your analysis or future steps to build a full functioning robotic system that you are going to implement in the upcoming milestone.

1. APPENDIX

For any further or detailed analysis (if any).