Demonstration of Robot for Industrial Application

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Abstract— in simpler terms, this paper describes how a robotic arm with five degrees of freedom was created to assist elderly or specially challenged individuals with tasks like feeding. The arm's movements are controlled by the user, and it's all managed through a combination of robotic principles, MATLAB programming, and a user-friendly interface. The design was tested and verified using stick diagrams, and a Graphical User Interface was developed to control the arm's joints. An Arduino MEGA2560 board acts as the brain of the system, connecting everything together including motors and sensors. Additionally, a virtual version of the arm was created in MATLAB to ensure the accuracy of the control algorithms.

Index Terms—Robotic arm, degrees of freedom, feeding, GUI, Arduino, MATLAB, forward and inverse kinematics

I. INTRODUCTION

This paper introduces the development of a safe robotic arm designed specifically for assisting specially challenged or elderly individuals with feeding tasks. The focus is on understanding the challenges related to gripper positioning and addressing them using kinematics In the existing literature, it's noted that for robotic arms to interact effectively with humans, they need to be easy to control and lightweight. Previous designs such as a 7-DOF robotic arm with cable-driven mechanisms and a slider-crank mechanism have been explored, but both had limitations like feasibility issues and vibrations.

The proposed solution is a 5-DOF articulated robotic arm comprising five axes. The position and orientation of the arm are determined using kinematics, solving from the base to the gripper. This kinematic model is implemented using MATLAB and simulated to ensure accuracy in reaching the desired destination point

II. LITERATURE SURVEY

Hardware description
Fig 2 shows the complete block diagram for the robotic arm control. The commands from the user are given through the Graphical user interface which communicates with Arduino I/O board serially. Arduino I/O board on receiving the commands from the GUI controls the position of the motor shaft which in turn controls the movement of the joints.
B. Arduino Mega and L298
C. The Arduino Mega2560 board is equipped with 54 digital I/O pins, 16 analog pins, 14 PWM (Pulse Width Modulation) outputs, and 4 serial pins. To facilitate serial communication between the Arduino board and the processing software used for developing the Graphical User Interface (GUI), COMPIM is employed.
D. Specifically, digital pins D2 to D16 are utilized for interfacing stepper motors, DC motors, and sensors. For motor interfacing, the L298 (H-bridge) is employed, where stepper motors typically consist of four wires (two for each coil), and DC motors require two wires connected to the H-bridge. The H-bridge operates with a 12V voltage supply to activate motors and provides +5V output to the Arduino I/O board.

The position of the motor shaft is detected using potentiometer which consists of 3 pins [4], one end of the potentiometer is connected to +5V supply, other end is connected to the ground, middle pin is connected to the analog pin on the Arduino board. Potentiometer are placed at the shoulder joint and the elbow joint. At the shoulder joint, gears are connected to the potentiometers shaft, these gears are connected to the gears placed on the stepper motor. Force sensors are placed at the gripper for detecting the amount of pressure applied on the object. Force sensor consists of 2 pins. A pulldown resistor of 10K [3,4] is used, one end of the sensor is connected to

+5V and other end to the ground as well as the analog pin on the Arduino board. Programming the force sensor is similar to that of the potentiometer.

III. OBJECTIVE

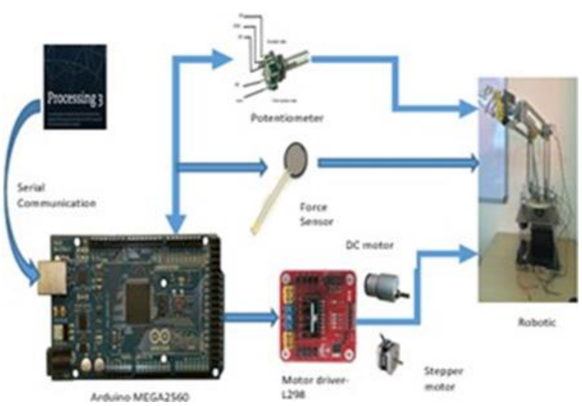
Advanced Applications of Industrial Robotics:
Research focuses on the hardware and software methods used to implement industrial robots in various applications.

The aim is to systematically classify the newest achievements in industrial robotics according to application fields without strong robotization traditions.

Programming Robots by Demonstration Using Augmented Reality:

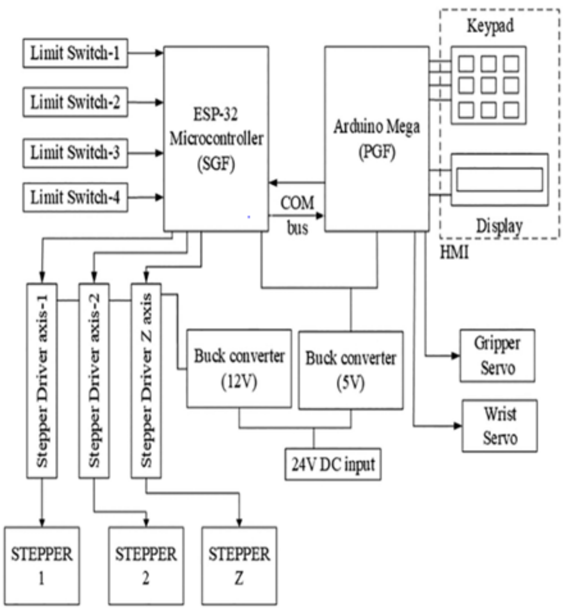
This work proposes an industrial prototype of a human–machine interaction system through Augmented Reality.

IV. METHODOLOGY



To test the functionality of the developed algorithm in Arduino IDE and processing, Proteus is used. Serial communication takes place between Proteus, Arduino IDE and Processing using COMPIM. Fig 5. shows the complete software setup in Proteus where serial communication takes place and the motors starts to rotate depending on the button pressed on the GUI Forward kinematics is implemented in Matlab and the results for the same is shown in the Fig 6. The frames are assigned for each link, the joint angles are assigned for each joint for finding the position and orientation of the gripper. The animation for the forward kinematics shows the movement of frames from home position to the position defined. Using the transformation matrix calculated in the forward kinematic modelling, inverse kinematics is derived using Jacobian matrix and pseudo inverse to find the joint angles for each joint, given the position of the target object.

V. A. CIRCUIT DIAGRAM



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B. RESULT AND MODEL

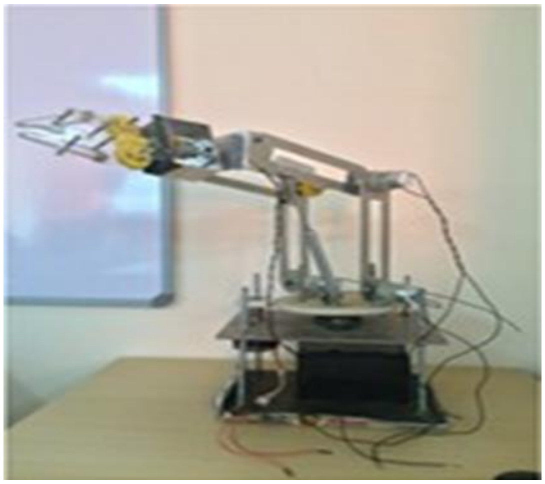

Fig 1. shows the exact model of the developed robotic arm built using Aluminum due to its characteristics such as light weight, do not wear out easily, cheaper and machining is easier. A stepper motor of 5 kg-cm torque is placed at the base which is used for rotating the entire arm clockwise or counter clockwise using pinon and gear mechanism. Other joints i,e., the shoulder, elbow, wrist and the gripper consists of DC geared motor of 3.5 rpm. DC motors and stepper motors are used as they are easy to control [9,10] giving HIGH or LOW pulses from the Arduino I/O board. To detect the position of the joint, potentiometers are placed, which acts as a sensor which feeds the output signal back to the Arduino I/O board for reducing the error signal. Force sensors are placed at the gripper for detecting the force applied on the object being held.

CONCLUSION

Assembly: Robots assemble products on assembly lines.
Welding: Robotic welding ensures precision and consistency.
Material Handling: Robots move heavy materials in warehouses and factories.
Painting: Automated painting improves efficiency and quality.
Inspection: Robots inspect products for defects.
Palletizing: Robots stack goods on pallets for shipping.
Packaging: Automated packaging speeds up production.

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