IOT Based Robotic Arm for the Pick and Place Operation

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Abstract - The advancement of multimodal interfaces aims to provide an intuitive user interface to improve the performance of various tasks. Teleoperated robotics in Explosive Ordnance Disposal (EOD) tasks require the operator to perform complex maneuvering tasks to control a robotic arm. Problems such as loss of depth perception, degradation of visual perception, system delay, and a high mental workload in the control of the robotic elements make these tasks require extensive training periods, extensive knowledge of the robot operation and demand a great effort from the operator to perform a task efficiently and avoid catastrophic situations in handling explosive packages. To solve this, a multimodal interface is proposed based on the creation of a virtual operating environment, where the operator uses a combination of three interfaces: a visual interface through a Virtual Reality Head Mounted Display (VRHMD), a natural user interface (NUI) and a predictive display based interface. The proposed system is evaluated with the participation of thirteen agents with experience in explosive ordnance disposal tasks; the results obtained are divided into objective and subjective results through time measurements of task completion, success rate, usability through System Usability Scale questionnaire (SUS), mental workload through NASA Task Load Index questionnaire (NASA TLX) in Pick and Place tasks, which constitute the master task type in EOD robotics tasks. The proposed multimodal interface is proven to have a considerably higher efficiency than the conventional keyboard and monitor-based control interface, specifically achieving an improvement in task completion times of 67%. 14%, an improvement in task completion rate of 11.54%, a decrease in overall mental workload of 65.18%, and an improvement in usability of 198.12%.[1]

***Key Words*: - Robotic Arm, Pick-and-Place Operations, Small-Scale Industries, Servo Motors, Inverse Kinematics, Industrial Automation, PLA Material, Microcontroller Programming, Real-Time Adjustments, Cost-Effective Design**

1.INTRODUCTION

Robot is a type of automated machine that can execute specific tasks with little or no human intervention and with speed and precision. A robotic system can be customized according to needs and budgets. Pick and place systems are used to complete manufacturing tasks in Industrial automation. At present scenario with technology, computers and engineering, industrial automation is turning significantly important in the assembly production and manufacturing process because computerized or robotic machines are able of handling repetitive tasks rapidly an defficiently. Many robot systems rely on local accuracy which is generally possible even with a marginally-accurate system. Vision systems sync on a group of datum features and within the small volume of the group (e.g. 300 x 300 x 100 mm) the robot can maintain reasonable accuracy.

A. Specific Field of Work Here idea is to innovate and provide advanced robotic solutions tailored for the Design and Manufacturing industry, with a specific focus on the 3D printing applications. Aims is to introduce a robotic system dedicated to 3D printing processes, and elevate production capabilities, improve the quality of 3D printed products, and uphold stringent standards for human safety within this dynamic manufacturing environment.

B. Specific Topic of Work

The project encompasses a structured approach, starting with an in-depth examination of articulated robotic arm mechanisms for pick and place operations, focusing on 3D printed models. Design specifications are established, leading to the generation of multiple concepts for the articulated robotic arm. Through rigorous evaluation and design calculations, the most optimal concept is selected. Subsequently, a 3D model is developed and subjected to simulation to assess its performance. The chosen design is then translated into a physical form through fabrication, culminating in the creation of the articulated robotic arm. The final phase involves meticulous testing of the fabricated model to ensure it meets the predefined specifications and functions effectively in its intended task.[2]

2. Body of Paper

The development of 5 degree bowler arms for Pick-and-Place Operations deals with the growing need for cheap automation in small industries. Industrial automation has become essentially important in order to improve efficiency, accuracy, productivity, reduce manual work and maintain consistent quality. The proposed robot arm is constructed with PLA material. This means it is easily and affordable and is equipped with a servo motor and coder to allow for accurate control. The arm works based on inverse motion calculations that determine the joint angle required for accurate positioning of the gripper. AMicrocontroller manages the movement of the arm and allows real-time adjustments in position, speed and acceleration via IDE software. This design handles parallel movement light objects with two garments, and includes a payload capacity of 100 grams with a raw area of 600 mm, 500 mm work area.

Kinematic simulations using Adams software validated the performance of the arms and confirmed the ability to efficiently execute tasks with 5.995 mm reproducibility and 3.506 mm accuracy. Tests showed that the pick-and-place task on the robot arm can be performed smoothly and reliably. The simplicity and low cost of the system make it an attractive solution for manufacturers who want to automate processes without much investment. However, current designs are limited by its payload capacity and the lack of an ai-based vision system for increased object recognition and adaptability. Future improvements may be focused on increasing payloads, AI integration for intelligent automation, and enabling wireless control for remote operation. In summary, the developed robotics arms provide a practical and scalable automation solution for small industries with a very high chance of further upgrades to improve their skills.[3]

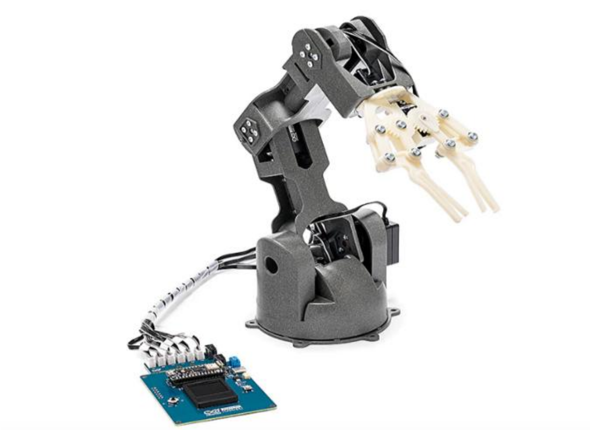

Fig-1: Robotic Arm

3. CONCLUSIONS

The Memory-Driven Robotic Arm with WiFi-Enabled Control presents a promising prototype for applications in diverse industries. The successful integration of precise motor control, intuitive mobile interface, and recording/playback functionalities positions the robotic arm as a versatile tool for pickand- place tasks. Its potential applications range from assembly line automation in manufacturing to warehouse logistics, showcasing the adaptability and efficiency of the prototype. The innovative features of real-time control and automated task repetition make it a valuable asset for industries seeking flexible and efficient robotic solutions. Further exploration of scalability and optimization will contribute to its broader adoption in practical settings, marking a significant step towards enhancing automation in various industries.[4]

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