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SYSTEMATIC UARM DESIGN OF CONSTRUCTIVE AND OPTIMAL SOLUTIONS IN ROBOT CONTROL AND SOFTWARE CONTROL

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Abstract
This article provides an overview of the uArm Swift, a robotic arm designed for various applications in industrial and home settings. The uArm Swift offers features such as programmability, repeatability, and flexibility, making it suitable for tasks such as prototyping, simulation, and recommended control algorithms. The article highlights the importance of repeatability in industrial robots and explains how the uArm Swift Pro model ensures high precision with a repeatability of 0.2mm. The article also discusses the modular design of the manipulator, including options such as a laser engraving module and a camera module, as well as the uArm Studio software for easy control and programming. The uArm Swift's user-friendly interface allows users to control the robot through block programming or by manually demonstrating desired movements. The article concludes by mentioning the advancements in the uArm Swift Pro model, which includes increased degrees of freedom, improved power button, offline learning mode, and interchangeable end-effectors.

Keywords: uArm robot, uArm Swift, industrial automation, repeatability, precision, modular design, programming, simulation, control algorithms, uArm Studio, block programming, manual control, final effects.

Introduction

Today, with the development of modern technologies, it is difficult to imagine in production, industry and other areas without robots, manipulators, automatic devices. If we look at the history of automatic devices. Designing effective control of a robot and, in general, any complex equipment, includes a number of tasks: theoretical development of the model, its solution, simulation and use in the proposed control algorithms with the help of appropriate hardware. Control systems should be user-friendly and accessible for the development of control algorithms, their performance testing, as well as for training purposes. Usually, industrial robots do not have this feature. This can be overcome by using a modified Hardware-In-Loop (HIL) simulator, which is well known in the field of electric drive control[1]. Analyzed in different types of HIL simulation of electric drives. HIL simulation is also used in robotics.

In 2002, the authors suggested that the next requirement for successfully solving a robot control system with 2 DOF by remote access to a HIL system for real-time simulation is easy implementation and user-friendly modification of the control algorithms. Authors present algorithm development for HIL simulator based on MATLAB/Simulink software. For the communication between the modules of the robot, the authors communicate with the central computer from the distributed control system and with the modules through the CAN (Controller Area Network) bus[2]. The design of algorithms for controlling the movement of the robot's working body is based on the knowledge of the mathematical model describing the inverse kinematic structure. This is a standard task faced by every manufacturer of robotic systems. The mathematical model of direct and inverse kinematics often presents a system of linear algebraic equations that do not have an analytical solution. The main components of industrial robots. The four main parts of an industrial robot are the manipulator, the controller, the human interface device, and the power supply. The manipulator is a hand and can move in different directions. The V5 Workcell is powered by the V5 Smart Motor, which acts as the actuator that provides the power to move the arm[3].
In an industrial robot, power can come from electric motors, air pressure in pneumatic cylinders, or fluid pressure in hydraulic cylinders. The hand has a controller that is the "brain" of the system. The controller holds the programming code and receives signals from the system (input), processes the signals, and then sends signals to the system (output) to control the robot. One type of input may come from a human interface device, such as a teaching pendant[4]. These devices can be used to program the arm and control its movement. The last component is the power source from which the industrial robot receives its energy for the controllers and actuators. This is usually in the form of electricity. While it's true that robots are becoming increasingly popular, some industries are being impacted more than others. Either way, it's nothing to worry about. Most knowledgeable industry commentators agree that robots aren't doing business. Indeed, robots to the company addition is likely to create new jobs[5]. If your industry is on this list, it's something to celebrate. Workers are even starting to trust robots more than in the past. According to a recent survey by the World Economic Forum, two-thirds of employees say they trust a robot boss more than they actually do. But it just shows that people don't trust their boss[6].
You can equip your home laboratory with a real robotic arm - uArm Swift. And if you spend a little more money, you can get a more accurate product - the uArm Swift Pro. Functionality is not too bad. A good tutorial, a base for demonstrating the principles of industrial robots, or a base for small scale manufacturing at home The first model is the uArm Swift. Its main parameters are working with a payload weighing up to 500 grams. Built-in bluetooth support[7].

Methods:

Repeatability is the ability of the manipulator to return to the same point over and over again, which is imparted to the robot during training. For industrial robots, repeatability is even more important than accuracy. Even expensive models, such as those designed for spray painting, can have an accuracy of +/- 3mm[8]. If you need higher accuracy, go for the more expensive UArm Swift Pro model, which provides 0.2mm repeatability - not bad for a variety of applications. The model is equipped with stepper motors. In this model, for example, laser engraving is possible, which requires sufficient positioning accuracy of the laser manipulator. The devices are equipped with open source software that provides several standard applications. For example, there's a "face-tracking" mode, where a fan-shaped arm sends a stream of fresh air to your face, no matter what position you take on your desk. A set of modules for manipulators, including a module with a digital camera, will be released, which will speed up and simplify the creation of your own projects[9]. You can use uArm Studio software developed by the company to control the manipulator. With this program, a user who does not know how to program can easily control it through "block" programming. There is a built-in GUI based on Blockly. An option such as non-contact training of the robot arm with the movements of the operator looks very effective. In this mode, the operator performs the necessary actions with his hand, shows them to the robot, and the manipulator repeats the actions. The robot supports human learning mode without connecting to a computer[10].

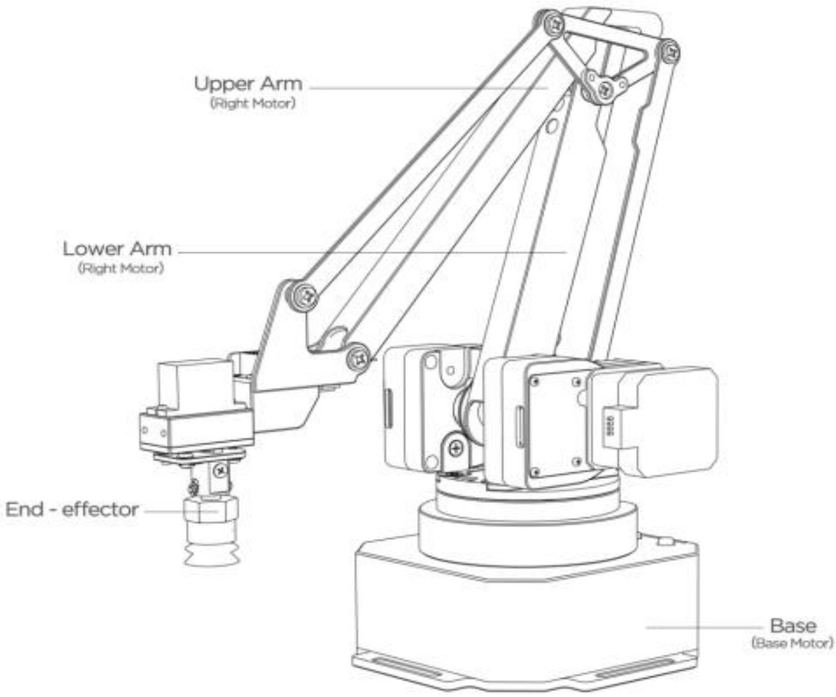

Figure-1. The component of the uArm swift pro robot.

Monitoring and Maintenance:

The above list is taken from the latest IFR World Robotics report. However, there are a few key areas where robotics will have a major impact: warehouse logistics and the pharmaceutical industry. Warehouse - According to a recent market report, the warehouse robotics industry is expected to grow by 11.7% and reach $6,471 million by 2025[11]. is predicted to reach. Warehouses are now operating without any human labor (except for robot maintenance). It's no surprise that warehouse robots are on the rise. The pharmaceutical industry is one of the top industries listed in McKinsey's 2019 Industrial Robot Report. one, invested in this area that allows companies to reduce costs, improve quality and increase efficiency[12].

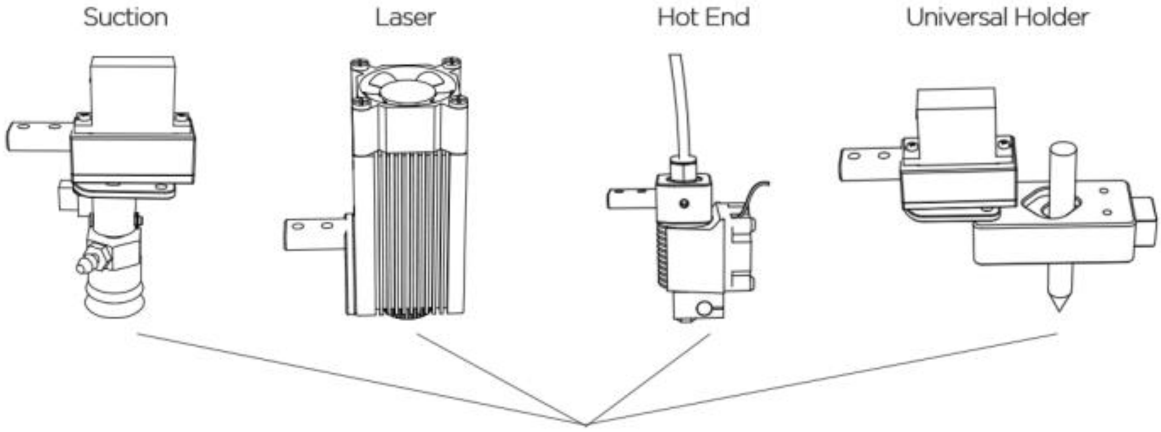

Figure-2. Introduction to the connector pins of the uArm robotUARM SWIFT PRO

Technical characteristics of the robot

➢ The full weight of Warm swift pro robot is 2.2 kg.

➢ The degree of freedom of our learning robot manipulator is 4.

➢ The repeatability of the UARM swift pro robot is 0.2 mm.

➢ Maximum load capacity is 500g.

➢ Working range is 50mm-320mm.

➢ Maximum speed of UARMswift pro robot is 100mm/sec.

➢ It is possible to connect the UARM swift pro robot to the technical setup via micro USB, and in the wireless case it is connected using Bluetooth.

➢ Dimensions of warm swft pto robot: 150x140x281 ➢ Weight, kg: 2.2 kg[13].

Conclusion:

The uArm robot is an easy-to-use, easy-to-programmable manipulator. Compared to other robots, it is easy to learn and can be used in laboratory applications and in the manufacturing sector. The model is designed to provide easy control of the control algorithm and accurate actions. Built around the Arduino Mega 2560, the uArm Swift Pro is an open source and DIY friendly robotic arm platform designed for makers and educational purposes. This little robot is very easy to use and anyone can learn how to use it in minutes. With 0.2mm resolution, the uArm can pick up and place objects up to 500g. It is one of the most highly configurable consumer-grade robotics platforms on the market. The metal holder enhances the uArm with 4 DOF, so you can use the uArm in any open source project or even standard lighting industry. UArm is the world's first open source robotics platform. You will have full access to our Github library and hardware. With a vision camera kit, uArm can track objects of different shapes or colors so you can conduct A.I. projects. The "teach-learn" mode allows anyone to get uArm up and running in minutes. GUI programming for beginner robotics learners helps them understand the logic of programming with robots. UArm Swift Pro, an open source robotic arm for STEAM and makers, has received mixed reviews from customers. While some found it useful for conceptual work and modeling, others had issues with its performance and quality. Several users have complained about the arm's fragility and poor accuracy, with one customer reporting that it broke within three months[14]. They also expressed dissatisfaction with the quality of the 3D print head and its limited capabilities. The inability to pick up objects without dropping them and the lack of control over the flow rate of the suction module were highlighted as the main drawbacks. Users also found the location of accessory connection pins awkward. Some customers recognized the arm's potential for specific projects and noted its ease of use, but the consensus was that the price was too high for the product's simplicity. In conclusion, the uArm Swift Pro has been criticized for its quality, limitations and value for money, despite its ease of use for certain tasks. uArm robots are produced by Ufactory. You can get more information about the robot at https://www.ufactory.cc/. Basic information is provided in English.

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