Concept and Design of a Deep-Functioning Robotic Arm Driven by an Android App to Transport Hazardous Goods

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Abstract.

This research paper is based on robotic arm and its expansion and enlargement. Basically, it tells us about the technical aspects to some of the recent investigation in this area of activity. In this analysis of investigation there are numerous of exclusive questionable problems and field of exploration. Currently, various types of robotic arm are economically accessible. Many of the robotic arms are outstanding in precision and remarkable. In this paper, we will know about advancement of robotic arm, servo motors and mark out various specification of a robotic arm. A mobile robot that's effective to do pick and place behavior and can be controlled by Smartphone via Bluetooth. In android application, data packets are sent to Bluetooth module. It can be widely used in the automobile industries. Finally, this illustration of the robot is anticipated to get over of the problems like picking and placing the hazardous substances without touching it and this robot prototype is supposed to solve problems such as placing or choosing objects as well as picking and placing dangerous objects in the quickest and easiest method possible.

Keywords: *Robotic arm, Accuracy, Bluetooth, Data packets, Servo motors, Arduino, Automobile Industry.*

1 INTRODUCTION

These days there is an increase demand of robotic into working tasks to make work easier for tomorrow. Specially the work that have repetitive task. Basically, robotics is of two types industrial and service robot. According to IFR, an automatically controlled, multipurpose manipulator, reprogrammable which can be either fixed in place or movable. it does not include inventing operations. Movable robots are being used in variety of fields such as hospital operations, military tasks, office, hotels and agriculture. Depending on the application, it can be constructed to accomplish necessary functions like grabbing, moving, and even more.[1] Apart from worker who must pick and place something must be difficult for example, in chemistry the chemicals cannot be picked by bare hands of humans as well as in case of military such as to defuse bomb that requires a robot to pick and place it to the required space. Consequently, the work of human can be replaced by a locomotor's robot.

[2] The robot is a wirelessly operated that can ensures that the work from a long distance as well. Bluetooth is also a platform other than wireless controller that control robot without the use of any type of cables. The robotic motion and movement can be controlled by smart phone via Bluetooth. As per this project we will be able to move the arm of robot in all directions (left, right upward and downward) as per requirement. There are more than thousands of robotic arms which are made by different companies. Bluetooth, in addition to being wirelessly operated, is also a platform for controlling robots without the use of a cable. The robot's motions are controlled remotely through Bluetooth technology. The actuation of robotic arm is operated by producing PWM from a pin on the Arduino Mega board. Robotic arm may be operated autonomously or by human intervention and can be utilized to conduct a range of jobs with high precision. Analytical prediction of the behaviour of physical systems in many critical situations is either exceedingly difficult or impossible. Motivated by the limits of prototyping a physical system, modelling discovers significant reasons to analyse and investigate a system's performance. The robotic arm can be stationary or movable (wheeled), and it can be built for industrial or domestic use. The most often used robotic arm for the application i.e. pick and place is segmented. Wireless mobile robots have also been evolving in recent years. The robotic arm is currently used all around the world is more in industries rather than the domestic as robots are not much used for normal purpose. Robotic arm is also very useful in places that requires high accuracy, where there is no place for errors. Industrial arm may differ in size, types of joint, the joint sequence that are connected and motion range accepted at each joint. There are various parameters to manufacture and develops a robotic arm. The parameters are number of axis, freedom degree, working envelops, speed and acceleration, motion control and iterative.[3]

2. DESIGNING OF ROBOTIC ARM

In this section, we will talk about robotic arm this include the basic components like types of robots, servo motor, HC05BT module, Arduino uno etc. these have also covered kinematics in the development of robotic arm.

2.1 ***Types of Robotic Arm:*** It is of many types depends on the parameters and kinematics properties. Based on parameters, robotic arm is defined by multiple parameters i.e., no. of axis, degree of freedom, drive system, speed and acceleration of actuators, accuracy & repeatability and motion control. The research is focused on the creation and construction of a robotic arm control for a 5 Degree of Freedom movable robot arm for pick and place applications, allowing the robotic arm to be utilized as a lab-based model for learning and education as well as an autonomous model as needed.

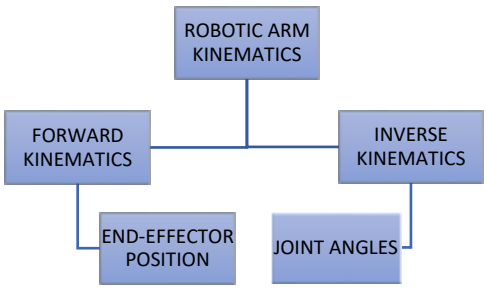

Figure 1: Types of robotic kinematics

2.2 Need for Robot Kinematics: Kinematics is the research of the movement of bodies without regard for the cause. Similarly, Robot kinematics is a relationship between position,

velocity and acceleration of links and joints. Kinematics is a need from robotic arm to do required work. Robot kinematic modelling enhances industrial automation processes by allowing them to be semi-autonomous or even completely autonomous. Because of the nature of the work and the operating environment, industrial robots are often made up of a series of stiff links set on a base. By kinematics robotic arm can pick and place objects like pick any object from location A and drop or place to the second location B accurately. Forward kinematics is simple and straightforward whereas inverse kinematics is very complex and much more difficult. [4] 3D based animated software that is Robo-analyser is used to study kinematics, DH (Denavit–Hartenberg) parameters and robot dynamics and it authorize animation and graph as an outcome.

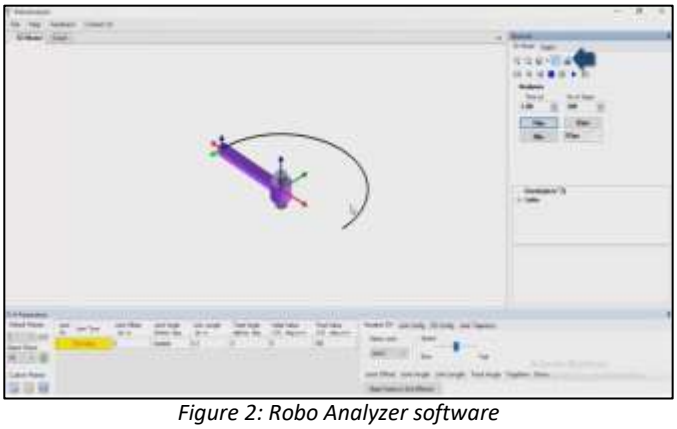

Figure 2: Robo Analyzer software

2.3 Hardware and software Implementation

2.3.1 Servo Motor: A servo motor, which functions as a rotary actuator, allows for accurate regulation of angular and linear position. The functions of the servomotor are to turn over a sequence of speed and to perform the control speed of the motor given by the instruction through PWM pulse width modulation pin in Arduino uno. Servo motor can control speed, position and torque of the motor simultaneously. [5]

2.3.2 Bluetooth Module (HC05 BT): Bluetooth is required to make our robotic arm more advanced and can be controlled wirelessly by smartphone through Bluetooth. Bluetooth is a standard short-range wireless interconnected tool; its repeating range is 1 to 100 meter and frequency of communication is 2.45 GHz. It can send 1600 data packs per second; each packet of data is sent on different channel. Speed of data transfer of transceiver is 3Mbps. [6]

2*.3.3 Servo Control App* This application is designed for IoT which can control the hardware remotely. In android application, data packets are send to Bluetooth module (HC05 BT). The Arduino uno receives the data from Bluetooth module through serial communication. Control signals are generated by Arduino uno for servo motor based on the value of the data packets [7]. Figure 4 represents the flowchart for better understanding. It has easy to use widgets which can be set with no additional training required. There is no need of any code required for the implementation. [8]

2*.3.4 Arduino uno Microcontroller* The ATmega328P-based Arduino Uno is a microcontroller board. It contains 14 digital I/O pins (six of which are PWM outputs),

analogue inputs, a 16 MHz quartz crystal, a USB connection, a power connector, and a reset button. It comes with everything you need to support the microcontroller; simply link it to a computer via USB or power it using an AC-to-DC connector or battery to get started.

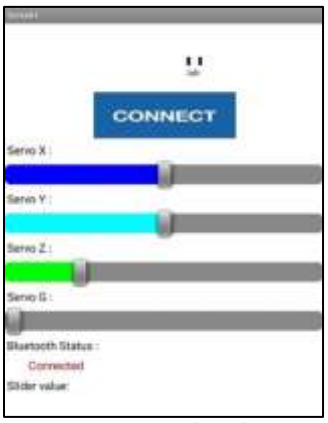

Figure 3: Servo control application

2.3.5 End Effector of the Robot The end effector is one feature that enables the robot to deliver adaptive solutions. This device is designed to interact with its environment, and the end effector's functionality is fully reliant on the robotics research. Essentially, an end effector is nothing more than a gripper or a device that functions according to the many applications generated in it and when it comes to robotic awareness. They are classified as Impactive, Ingressive, Astrictive, and Constitutive. Different end effectors respond differently to these.

- **Impactive:** This functions as a jaw or fingernail that physically grasps by colliding with the thing to be operated upon.
- **Ingressive:** The use of pins and needles to physically penetrate the surface of an item.
- **Astrictive:** It is just the suction established on the item's surface, which is generated by vacuum cups as an outsourced and by electromagnetic devices if applied.
- **Contiguous:** Close communication is necessary for the object's holding mechanism, such as surface tension produced at a precise point.

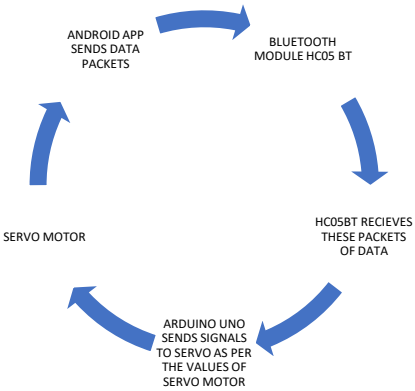

Figure 4: Servo control application flowchart

3. APPLICATION OF WORK

There are many applications of Robotic Arm in different industries i.e. Medical industry, Automotive industry, Agriculture industry, Education Industry, Chemical industry, and Food industry. When we talk about Medical industry, these autonomously robotic arms aid surgeons in the performance of less invasive surgeries. Healthcare mobility robots bring supplies, drugs, and food to patients and personnel, allows experts, hospital workers, and patients to communicate more effectively. For the oil and gas business, there are inspection robots that can move through a pipeline, as well as undersea robots for checking oil sites and rescue operations.

4. RESULTS AND DISCUSSION

Robotic arm using IOT, all servo motors and modules are working properly.[9] It is able pick any object less than 100 gm from location A and place it to location B with high accuracy.

3.1 General Homogeneous Transformation: In robotic arm, HTM is known as Homogeneous Transformation Matrices. It is used as a tool for exploring both the position and orientation. General homogeneous transformation equation used for this robotic arm is as follows: [10].

$$T=\begin{bmatrix} \cos\emptyset i & -sin\theta i cos\alpha i & sin\theta i sin\alpha i & a i cos\theta i \\ sin\emptyset i & cos\theta i cos\alpha i & -cos\theta i sin\alpha i & a i sin\theta i \\ 0 & sin\alpha i & cos\alpha i & ai \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

3.2 Robotic Arm Gripper for Picking And Placing Constructs: Gripper is the component of robotic arm which is used to hold the object. Below is the snapshot of the gripper position one is in closed state and another is in open state. It is used for grabbing any object to pick and place. It is also called the head of the robotic arm. [11][12] The great variety of gripper types is owing to the broad range of objects that robots may grasp, which includes textiles, electronics, and automobile parts. A tiny, soft gripper, for example, is likely to be the ideal choice for direct handling of sensitive goods.[13]

Figure 5: Robotic arm, gripper

Figure 6: Robotic arm, gripper

3.3 Sideview of Robotic Arm: This is the picture of the whole robotic arm connected via jumper wire, Arduino uno, HC05 BT, 5V DC supply, and Arduino uno is programmed by Arduino IDE.[14]

Figure 7: Side view 1

Figure 8: Side view 2

5. CONCLUSION

This paper is illustrated a robotic arm and its components using IOT based services. The proposed design or the development is easily configurable and maintainable. These types of solution or machinery can be used in various industries where humans cannot operate or it is too dangerous for human beings on these sites. For this application embedded technologies like Bluetooth, Arduino MCU, advanced servo motors. Unique and homogeneous transformation matrices are computed, providing information on the location and direction of a robotic arm side. By comparing it to a human arm, the number of parts in this specific robotic arm is calculated. This is how the number of parts is calculated. In this article, we

evaluated the robotic arm in every way imaginable, including core strength capabilities, motion ranges, joints, and so on. The figures depict the robot's kinematic test. The proposed improvement is reusable, cost effective, and accurate. Overall, the goals of designing the software and hardware components for a wireless mobile robotic arm, establishing the pick and place system operation, and testing the robot that fulfils the requirements of purpose research have been met. Based on the examination, it is obvious that its action is exact, accurate, easy to regulate, and user pleasant.

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