Arduino Based Trainable Robotic Arm

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***Abstract*—The popular concept of a robot is of a machine that looks and works like a human being. The industry is moving from current state of automation to robotization, to increase productivity and to deliver uniform quality. A trainable robotic arm is proposed in this paper. The robotic arm is implemented based on the teach function of the arduino. The proposed robotic arm is capable of learning different movements and reproduces them as required. The industrial robots of today may need this type of capabilities to meet the increasing needs of the current trends.**

IndexTerms*—Arduino, trainable robotic-arm, teach function.(keywords)*

I. INTRODUCTION

A robotic arm is a robot manipulator, usually programmable, with similar functions to a human arm. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The business end of the kinematic chain of the manipulator is called the end effectors and it is analogous to the human hand. The end effectors can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application. The robot arms can be autonomous or controlled manually and can be used to perform a variety of tasks with great accuracy. The trainable robot can be easily trained to perform actions by simply moving his arms and grippers with your own hands while he records the motions. Analog feedback servos provide a way around the complicated kinematics necessary to make robotic arms operate efficiently. Interacting with a robotic arm is lots of fun and being able to actual teach it to carry out tasks futuristic-tool. Extra dials, buttons, and controls are available on arm for more precision and features. Any regular worker could program and it only takes a few minutes, unlike usual industrial robots that take extensive programs and coding in order to be used. His work aims to design a trainable robotic arm to perform material handling operations using human teach function at minimum cost with better efficiency.

II. RELATED WORK

There are various ways in which a robotic arm may be controlled. In the past there have been many researchers working to control robotic arm through computer terminals, Joysticks, even interfacing them with the internet so they can be controlled from anywhere in the world. [1][2] Usually most of the robotic arms are controlled by a central controller which makes uses of Human Arm Movement Sensors (Accelerometers) Atmega32 Microcontroller Processing Unit Atmega640 Microcontroller Robotic Arm Actuators (Servo Motor Controller) 4 values taken in from the terminal that are entered by the user at the terminal to move the arm to a particular coordinates in space. This makes the control very difficult as the control values of the motors are very difficult to predict to achieve a particular movement.

D. Katagami [3] presents an Active Teaching for an Interactive Learning Robot. In this paper introduces Interactive Classifier System‟ a fast learning method that enables a mobile robot to acquire autonomous behaviours from interaction between human and robot. A mobile robot is able to quickly learn rules by directly teaching from an operator. They have proposed a fast learning method that enables mobile robot to acquire autonomous behaviour from interaction between human and robot. In this research they develop a behaviour learning method ICs (Interactive Classifier System) using interactive evolutionary computation. As a result, a mobile robot is able to quickly learn rules by directly teaching from an operator. ICs are a novel evolutionary robotics approach using classifier system. In this paper, they investigate teacher’s physical and mental load and proposed a teaching method based on timing of instruction using ICs. They proposed an Active Teaching method regarding for teacher's cognitive load when a teacher instruct a mobile robot to perform a simulation task.

Chanhun Park [4] has created dual arm robot controller which combination of two mechanical 6-DOF arms and one 2-DOF middle body is presented. This dual arm robot manipulator is designed for the assembly automation of the automotive parts in automobile and other industries. Each mechanical 6- DOF arm can be utilized as a stand-alone kind of modern 6-DOF robot arm and as a piece of double arm controller at a same time. These structures help the robot creator which is get more accomplishment in aggressive business sector of double arm robot have the high rivalry for the current mechanical robot market and developing business of double arm robot at same time.

Anthony Cowley [5] has worked on Perception and Motion Planning for Pick-and-Place robot of Dynamic Objects. “Mobile manipulators have brought a new level of flexibility to traditional automation tasks such as table top manipulation, but are not yet capable of the same speed and reliability as industrial automation.

Ayokunle A. Awelewa [6] has work on development of a 3 DOF revolute robot manipulator amenable to pick-and-place operations in the industry. Appropriate kinematic equations of the manipulator are obtained, and to achieve predetermined positions of a small object in a customized workspace using developed algorithms.

III. SYSTEM DESIGN

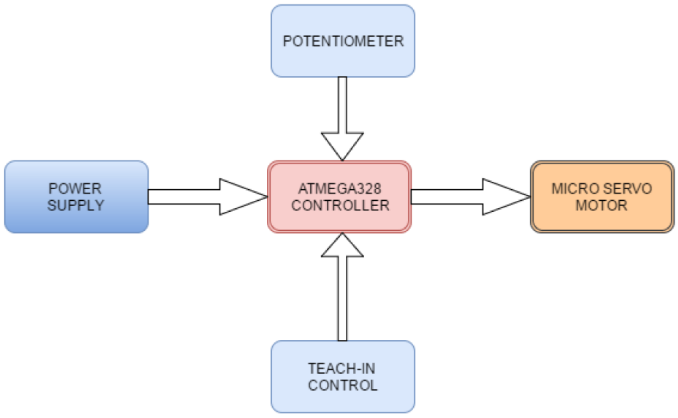

Fig. 1 Block diagram of Arduino based trainable robotic arm

Fig. 1 shows the block diagram of Arduino based trainable robotic arm. Micros Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. A servo motor can usually turn 180° in either direction. Robot Arm has 4 degrees of freedom which includes: Shoulder rotation, Elbow rotation, Wrist pitch and roll. Using just one input pin, servos receive the position from the Arduino and they go there. Internally, they have a motor driver and a feedback circuit that makes sure that the servo arm reaches the desired position. It is a square wave similar to PWM. Each cycle in the signal lasts for 20 milliseconds and for most of the time, the value is LOW. At the beginning of each cycle, the signal is HIGH for a time between 1 and 2 milliseconds. At 1 millisecond it represents 0 degrees and at 2 milliseconds it represents 180 degrees. In between, it represents the value from 0–180. This is a very good and reliable method. A potentiometer is used to measure angular position. The varying voltage is directly proportional to the angular position of the shaft connected to the center of the potentiometer. This allows in obtaining an analog measurement of an angular position slide. A potentiometer is connected to the central axis of the servo motor. The potentiometer allows the control circuitry; monitor the current angle of the servo motor. If the shaft of the servo is at the correct angle, then the engine is off. If the circuit checks that the angle is not correct, the motor will turn in the right direction until the correct angle. Push buttons are used to store the value of the potentiometer which is used during teach mode, and the other is used during play mode that is which performs the continuous action until the next movement of the arm is changed.

IV. RESULTS

The snapshots of the robotic arm are presented here. The actions involved in an object pick & place operations are shown here.

Fig. 2 Arduino based trainable robotic arm

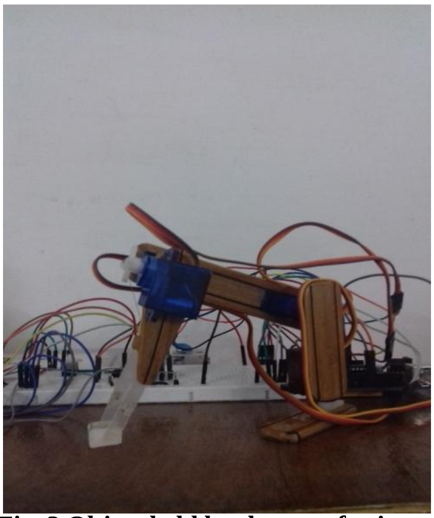

Fig. 3 Object held by the use of gripper

Fig. 4 Arm movement with the object held

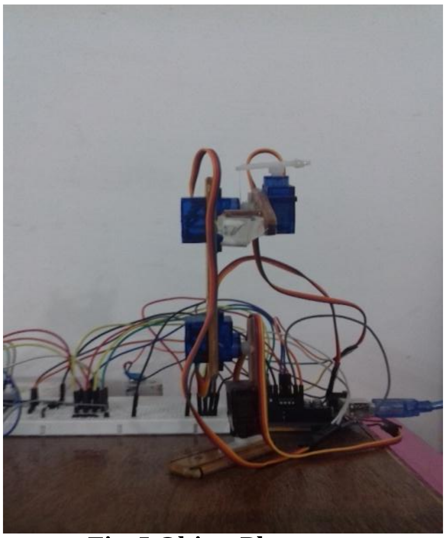

Fig. 5 Object Placement

V. CONCLUSION

From observations, it can be shown that the robotic arm's movement is precise, accurate, and is easy to control. The robotic arm can be developed successfully as the movement of the robot can be controlled precisely. This robotic arm control method is expected to overcome the problem such as placing or picking hazardous object in a very fast and easy manner.

Advantages include:

1. The arm is Trained; Not Programmed. No traditional programming is required. Instead, it is manually trainable by in house staff, reducing the time and cost of third party programmers
2. Humans could get exemption from very tedious and lengthy tasks.
3. The arm is flexible for range of applications and re-trainable for different tasks.

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