IoT Based Teach-Play mode for Robo Arm

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Abstract— Industry 4.0 is a name for the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, internet of things, cloud computing and cognitive computing. Industry 4.0 is commonly referred to as the fourth industrial revolution. Industry 4.0 refers to a new phase in the Industrial Revolution that focuses heavily on interconnectivity, automation, machine learning, and real-time data. This Paper presents a Robo Arm, which perform various tasks according to industrial requirements using industry 4.0. Some significant task such as industrial automation, painting, welding, package loading and unloading, cutting and application specific tasks can be performed using this arm. There are two sections in this paper, one is wireless section and another one is control section. Wireless section consists of WIFI module and two channel relays for switch action. Control section consists of microcontroller and servomotors. The controlling of robo arm can be done in two modes. Teach mode (mapping): Teaching a robo arm can be done using blynk web server. And it maps analog input for every 25ms in microcontroller. By pressing the button, it stores each servo position in a array. Play mode (mapping retrieve). It switches to play mode. When the play button is double tapped. Now the mapped data is retrieved and reads the array step by step and moves the robot arm according to the given input. This idea can be extended in a bigger industrial robo arm, which can handle large number of application.

Key words: Robo Arm, Servo Motor Control, Teach and Play Mode

I. INTRODUCTION

The earliest known industrial robot, conforming to the ISO definition was completed by "Bill" Griffith P.Taylor in 1937 and published in Meccano Magazine, March 1938. The crane-like device was built almost entirely using Meccano parts, and powered by a single electric motor. Five axes of movement were possible, including grab and grab rotation. Automation was achieved using punched paper tape to energize solenoids, which would facilitate the movement of the crane's control levers. The robot could stack wooden blocks in pre-programmed patterns. The number of motor revolutions required for each desired movement was first plotted on graph paper. This information was then transferred to the paper tape, which was also driven by robot's single motor.

George Devol applied for the first robotics patents in 1954. The first company to produce a robot was Unimation, founded by Devol and Joseph F. Engelberger in 1956. Unimation robots were also called programmable transfer machines since their main use at first was to transfer objects from one point to another, less than a dozen feet or so apart. They used hydraulic actuators and were programmed in joint coordinates, i.e. the angles of the various joints were stored during a teaching phase and replayed in operation. Unimation later licensed their technology to Kawasaki Heavy Industries and GKN, manufacturing Unmutes in Japan and England respectively. For some time Animation’s only competitor was Cincinnati Milacron Inc. of Ohio. This changed radically in the late 1970s when several big Japanese conglomerates began producing similar industrial robots. Bringing robots to the market in 1973. ABB Robotics (formerly ASEA) introduced IRB 6, among the world's first commercially available all electric micro-processor controlled robot.

The most common manufacturing robot is the robotic arm. A typical robotic arm is made up of seven metal segments, joined by six joints. The computer controls the robot by rotating individual step motors connected to each joint (some larger arms use hydraulics or pneumatics). Unlike ordinary motors, step motors move in exact increments. This allows the computer to move the arm very precisely, repeating exactly the same movement over and over again. The robot uses motion sensors to make sure it moves just the right amount.

II. DESIGN AND DEVELOPMENT OF MECHANICAL FRAME

An industrial robot with six joints closely resembles a humans, it has the equivalent of a shoulder, an elbow and a wrist. Typically, the shoulder is mounted to a stationary base structure rather than to a movable body. This type of robot has six degrees of freedom, meaning it can pivot in six different ways. A human arm, by comparison, has seven degrees of freedom. The arm's job is to move hands from place to place. Similarly, the robotic arm's job is to move an end effectors from place to place. The user can outfit robotic arms with all sorts of end effectors, which are suited to a particular application.

One common end effectors are a simplified version of the hand, which can grasp and carry different objects. Robotic hands often have built-in pressure sensors that tell the computer how hard the robot is gripping a particular object. This keeps the robot from dropping or breaking whatever it's carrying. Other end effectors include blowtorches, drills and spray painters.

III. PROPOSED BLOCK DIAGRAM OF THE IDEA

In this Paper, we propose a system a teach play mode robo arm for package loading and unloading processes.

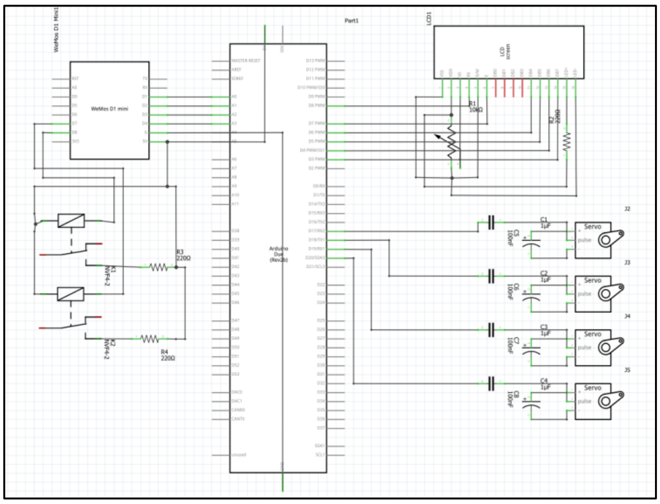

Fig.1: Block Diagram

A. Power USB

Arduino board can be powered by using the USB cable from the computer. All the user needed to do is connect the USB cable to the USB connections .

B. Power (Barrel Jack)

Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack

C. Voltage Regulator

The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.

D. Crystal Oscillator

The crystal oscillator helps Arduino in dealing with time issues. The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz.

E. Arduino Reset

The user can reset your Arduino board, i.e., starts your program from the beginning. It can be reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, which can connect an external reset button to the Arduino pin labelled RESET. 6,7,8,9. Pins (3.3, 5, GND, Vin), 3.3V (6) − Supply 3.3 output volt, 5V (7) − Supply 5 output volt. Most of the components used with Arduino board works fine with 3.3 volt and 5 volt. GND − There are several GND pins on the Arduino, any of which can be used to ground your circuit. Vin − This pin also can be used to power the Arduino board from an external power source, like AC mains power supply.

F. Analog Pins

The Arduino UNO board has five analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

G. Main Microcontroller

Each Arduino board has its own micro controller. The user can assume it as the brain of the board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. The user must know what IC your board has before loading up a new program from the Arduino IDE. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet.

H. ICSP Pin

Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output. Actually, which are slaving the output device to the master of the SPI bus.

I. Power LED Indicator

This LED should light up when plug the Arduino into a power source to indicate that the board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.

J. TX and RX LEDs

On the board, the user will find two labels: TX (transmit) and RX (receiver). There appear in two places on the Arduino UNO board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led. The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. RX flashes during the receiving process.

K. Digital I/O

The Arduino UNO board has 14 digital I/O pins (15) (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labelled "~" can be used to generate PWM.

L. AREF

AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

M. NODE MCU12E

Node MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Systems, and hardware which is based on the ESP-12 module. The term Node MCU by default refers to the firmware rather than the dev kits. The firmware uses the scripting language. It is based on the project, and built on the Non-OS SDK for ESP8266. It uses many open source projects. Node MCU was created shortly after the ESP8266 came out. On December 30, 2013, node mcu-firmware to GitHub. Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9. Later that month, Tuan PM ported MQTT client library from Contiki to the ESP8266 SoC platform, and committed to Node MCU project, then Node MCU was able to support the MQTT IoT protocol, using to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devsaurus ported the to Node MCU project, enabling Node MCU to easily drive LCD, Screen, OLED, even VGA displays. In summer 2015 the creators abandoned the firmware project and a group of independent but dedicated contributors took over. By summer 2016 the Node MCU included more than 40 different modules. Due to resource constraints users need to select the modules relevant for their project and build a firmware tailored to their needs.

N. SERVO MOTOR

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft. The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops. The very simplest servomotors use position-only sensing via a potentiometer and bang-bang control of their motor; the motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models.

O. TWOCHANNEL RELAY MODULE

This is a 5V, 10A 2-Channel Relay interface board. It can be used to control various appliances, and other equipment with large current. It can be controlled directly with 3.3V or 5V logic signals from a microcontroller (Arduino, 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic).It has a 1x4 (2.54mm pitch) pin header for connecting power (5V and 0V), and for controlling the 2 relays. The pins are marked on the PCB.

GND - Connect 0V to this pin.

IN1 - Controls relay 1, active Low Relay will turn on when this input goes below about 2.0V

IN2 - Controls relay 2, active Low Relay will turn on when this input goes below about 2.0V

VCC - Connect 5V to this pin. Is used to power the opto couplers

There is a second 1x3 (2.54mm pitch) pin header for supplying the "relay side" of the board with 5V. At delivery, a jumper is present on this header selecting the 5V signal from the 1x4 pin header to power the relays.

IV. RESULT AND CONCLUSION

Here robotic arm was to the designed records the initial motion or command and stores in the memory and play it again in the continuous or infinite loop based on the input command. This input commandis nothing but the particular industrial application. The Figure shows the hardware implementation of this design project.

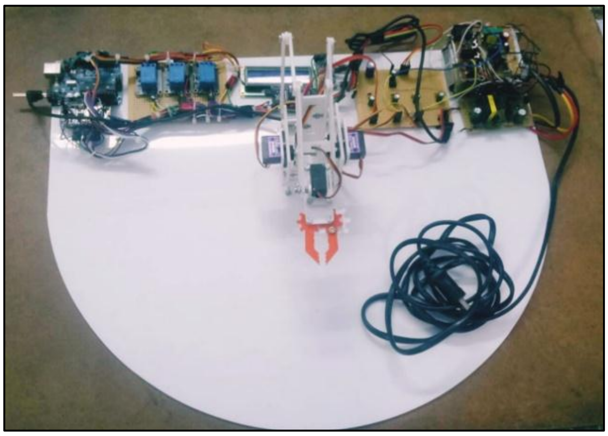

Fig. 2: Hardware implementation

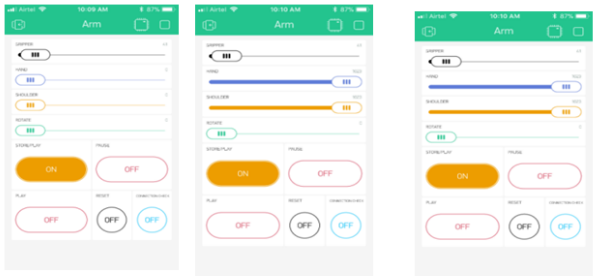

Fig. 3: teach play mode

V. CONCLUSION

The most important feature in this project is to record the motion and play it again in infinite loop unless and until pressing reset or pause button. After pressing reset all the old recorded moves get erased and robot is ready. By this way, the man power in the industry can be reduced and production may be increased.

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