SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)
DEPARTMENT OF
ELECTRONICS AND INSTRUMENTATION ENGINEERING

EI6811- PROJECT WORK

DITTO – THE ADVANCED LEAD THROUGH ROBOT

FIRST REVIEW
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Abstract

- The main objective of this project is to design a lead through robot for point to point robot programming using dimensional scaling of a real-time robot to a scaled down model.
- This robot, we can record, save and playback the robot motion with accuracy and precision. This root the workers to not strain to program the robot by moving the nose of huge real-time robot but through the scale downed duplicate. This ensures the method of programing much easier to use.
- On the actual scenario of programing, the real-time robot offers resistance to motion which causes the operator to strain to move it to required positions. This issue can be overcome through this scale down method with greater reduction in latency of relocating the nose trajectory.

Existing system

Simulation/Offline Programming

- Programming offline does not interfere with production too much. Offline programming allows the robot to be programmed using a virtual mockup of the robot and task. If the simulation software is intuitive to use, this can be a quick way to test an idea before moving it to the robot.

Teaching Pendant/Drive Through

- over 90% of robots are programmed using this method. Often consists of a giant handheld calculator. To program the robot, the operator moves it from point-to-point, using the buttons on the pendant to move it around and save each position individually. When the whole program has been learned, the robot can play back the points at full speed.

Teaching by Demonstration/Lead Through

- These methods involve moving the robot around, either by manipulation a force sensor or a joystick attached to the robot wrist just above the end effector. As with the teach pendant, the operator stores each position in the robot computer as it is easy for operators to get started immediately using the robot with their applications.

Proposed system

- **An update on Teaching by Demonstration / Lead through method of programming.**
- Rather than moving a real time robot's end effector with our muscular efforts, we can make a scaled down model in order to achieve the same motion in a simple way.
- This method will be much easy, convenient and highly flexible to program a robot with non purposeful, wide application oriented situations.
- Through this method, we can reduce the halted time of the industrial robot.
- It will not require skilled craftspeople who are unfamiliar with programming.
- Quicker than traditional teach pendants. We can reduce the end up wasting time sorting out by the old simulator issues instead of solving production challenges.
- It reduces the need for multiple button pressing, allowing the operator to simply move the robot to the desired position.
- Very good for detailed tasks which would require many lines of code to achieve the same effect, such as welding or painting of intricate shapes.

Objective

- The main objective of this project is to build a robot that will be embedded with a robotic arm and can be controlled using new lead through method.

- The robot can move to remote places and do the pick & place action of objects that are dangerous and harmful. The applications of this project is vast and can be implemented in a lot of industries.

- To create a pick and place robot with lead through method for point to point robot programming using angular and dimensional scaling of an real-time robot to a scaled down model.

- To increase the pick-and-package global performance in terms of flexibility, dependability and error reduction.

- Improvement of the working conditions of operators by a proper layout design and task allocation between worker and robot.

Base Paper

- "**Sensorless kinesthetic teaching of robotic manipulators assisted by observer-based force control**" by Martino Capurso, M. Mahdi Ghazaei Ardakani, Rolf Johansson, Anders Robertsson and Paolo Rocco.

- This paper let us to know the programing strategy that is needed for industrial robots with the revolution of automation.
- In this paper they mentioned, it is vital to be able to reprogram robots quickly. Kinesthetic teaching, also known as lead-through programming (LTP), provides a fast approach for teaching a trajectory.
- In this approach, a trajectory is demonstrated by physical interaction with the robot, i.e., the user manually guides the manipulator. This paper presents a sensor less approach to LTP for redundant robots that eliminates the need for expensive force/torque sensors.

- **Through this paper, we thought that "why don't a robot can be controlled through a scale down model in spite of fixing sensors to the arm?" so that it will be much more reliable and fast... Thereby we can do the same recording the motion, play and resetting path.**

LITERATURE SURVEY

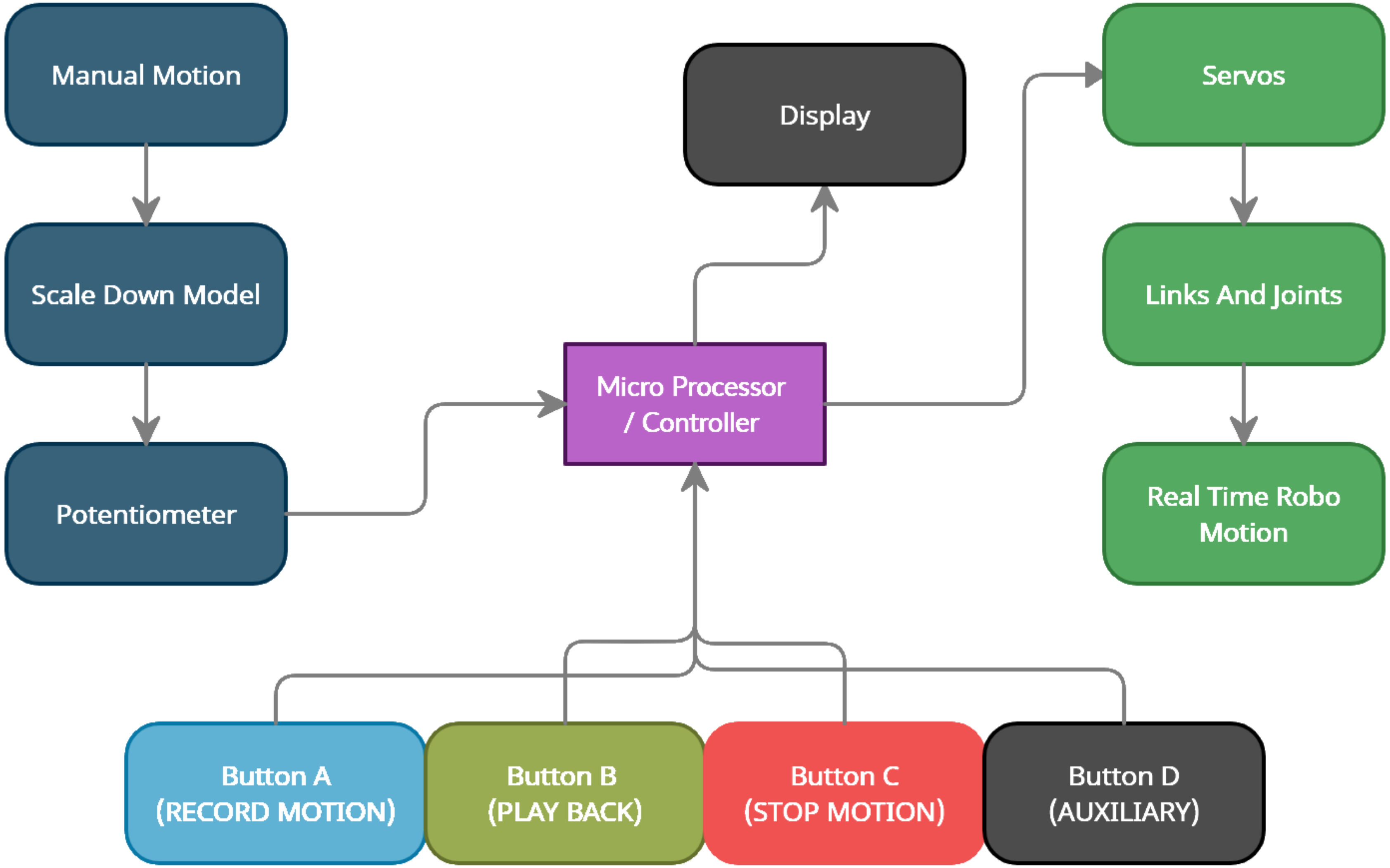
- “A REVIEW ON DESIGN AND DEVELOPMENT OF PICK AND PLACE ROBOTIC ARM” by Prof. S.D Rajgure1 , Aakash D Chougale, Ajit N Bhatkande, Suraj A Bhamare, Swaroop S Chougale. This paper let us to know the forward and inverse kinematics of robot arm motion. It is helpful to calculate the load carried by arm during its work time. shows the method for reducing the total energy consumption of pick and placed robotic arm.

- “DEVELPOMENT OF PICK AND PLACE ROBOT FOR INDUSTRIAL APPLICATIONS” by Vishakha Borkar, Prof G.K.Andurkar. This paper let us to know the Law of robotics, Key components of a robot, Model for mechanical gripper.

- “ROBOTIC ARM FOR PICK AND PLACE APPLICATION” by Kaustubh Ghadge, Saurabh More, Pravin Gaikwad, Shrenik Chillal. This paper let us to know the Robot types, Problems faced, Robotic arm and base development , Microcontroller and Servo motors.

- BEEE book by j b gupta for learning electronics and implementing them in project.

Block Diagram



Work Flow

- **Step-1 :** We going to move the scale down model.
- **Step-2 :** The potentiometer is attached to the model will gives the output voltage with reference to the power supply and the angle of the scale down model.
- **Step-3 :** These output voltages from each joints of the scale down model are then converted to angles through micro controller.
- **Step-4 :** In the real-time robot, we will have servo motors for angular twist of the arm. So we will control the servo through the angles obtained from the microcontroller with data from the potentiometer of the scale down model.

- So through programing, we can lively control the real-time robot with a small scale down model.
- Later, when we need to record some required motion, we have switches for saving the angles, replay the position and to reset the program memory.
- Through display device like computer, we can lively monitor the actions performed by the robot with clear data that can be saved and documented for future references.

Hardware Used :

- **Arduino UNO**
- **High Torque Servo Motors**
- **Rotary Potentiometers**
- **USB to TTL Converter**
- **5V Adopter**
- **PCB Board**
- **Male Pin Connectors**
- **Female to Female Jumper Cable**
- **Resistors and Push Buttons**
- **Pick and place robot frame**
- **Laptop for display**

Software Used :

- **Arduino IDE 1.8.13**

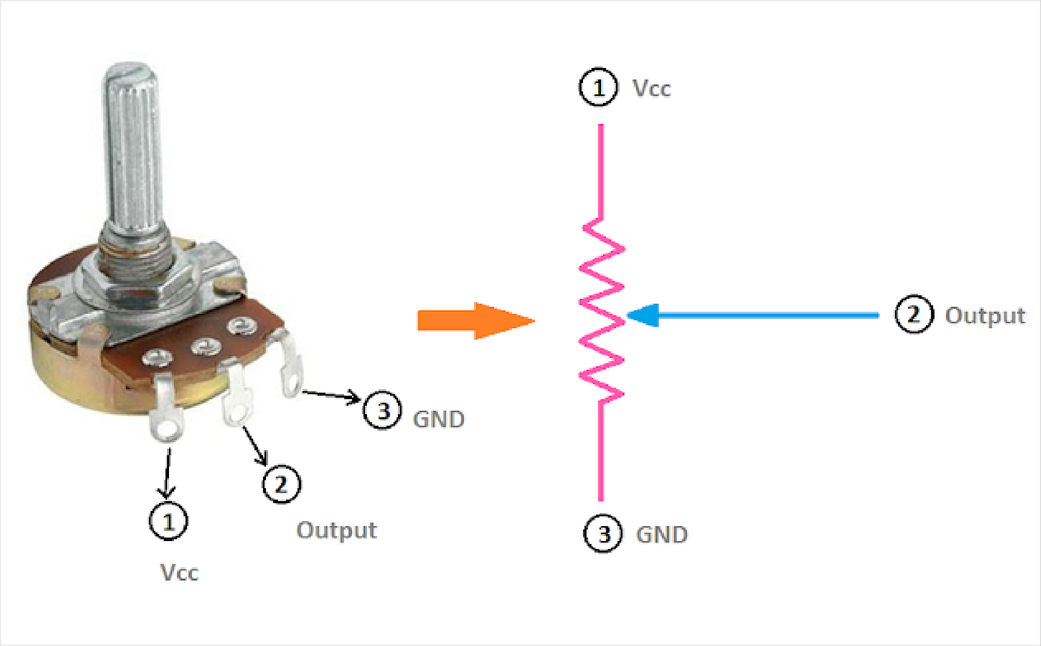
Arduino UNO

- An open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external supply.

High Torque Servo Motors

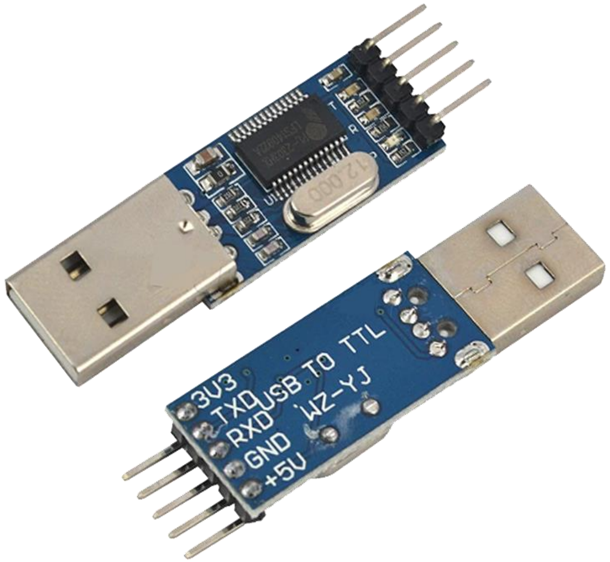
- A rotary actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.
- 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.

Rotary Potentiometer



- A three-terminal resistor with a rotating contact that forms an adjustable voltage divider. Potentiometers consist of a resistive element, a sliding contact (wiper) that moves along the element, If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat. The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage). Potentiometers operated by a mechanism can be used as position transducers.

USB to TTL Converter

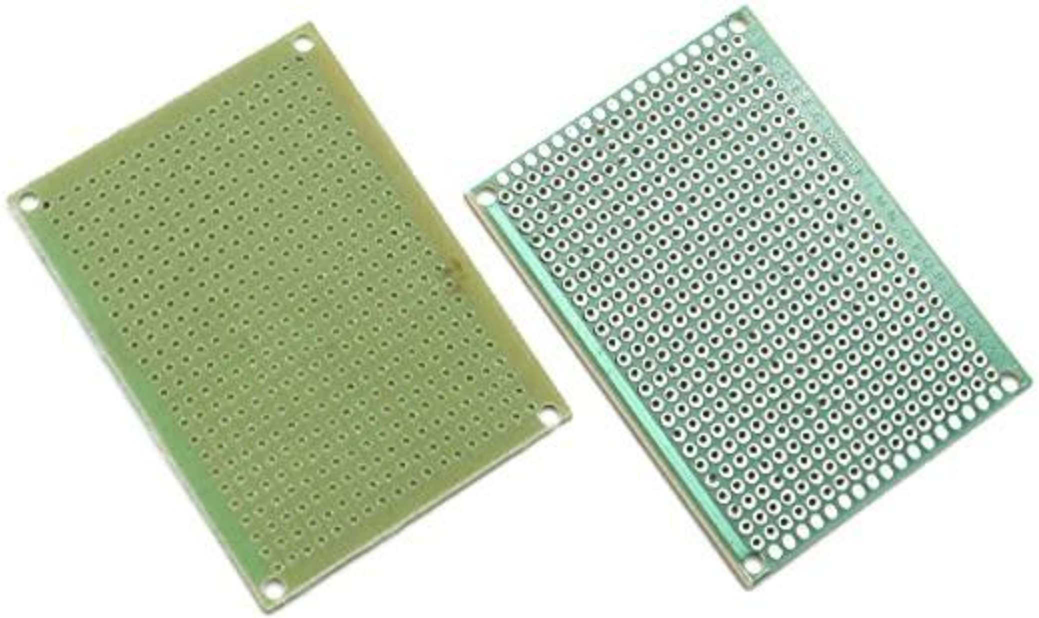


- A TTL-USB converter is essentially required for the direct interfacing of modules to the PC, without an intermediate microcontroller or similar platform. We generally use TX and RX pins for communication.
- We using a Type-2 RS232 TTL signal converter (Tx, Rx, +5V, Gnd). It is a serial with 2-pin connectors for mounting on a microcontroller board. where, 2-pin connector for power and another 2-pin connector for data.

5V Adapter

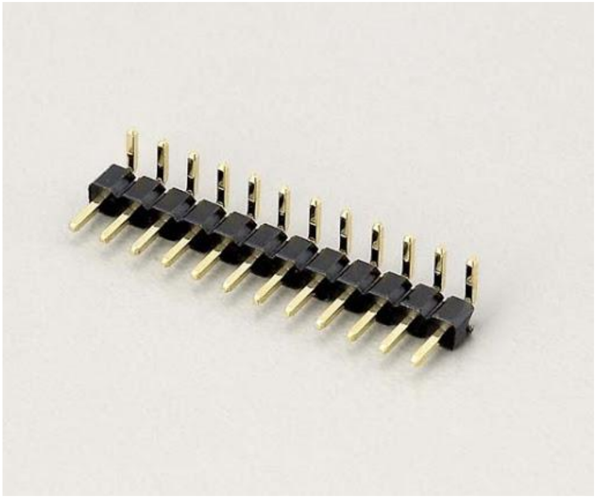
- 5 Volt 1 Amp Power Adapter takes an AC INPUT of 100-240V and gives 5V 1A DC output.
- This has the following features - Short Circuit, Over Voltage & Over Current Protection, Incredibly Low Fault Rates It's plug design is for Indian power socket so, no plug converter is required, Compact size & light weight, Regulated Stable Voltage Stabilized Output, low ripple & low interference, High Efficiency & low energy consumption.

Printed Circuit Board



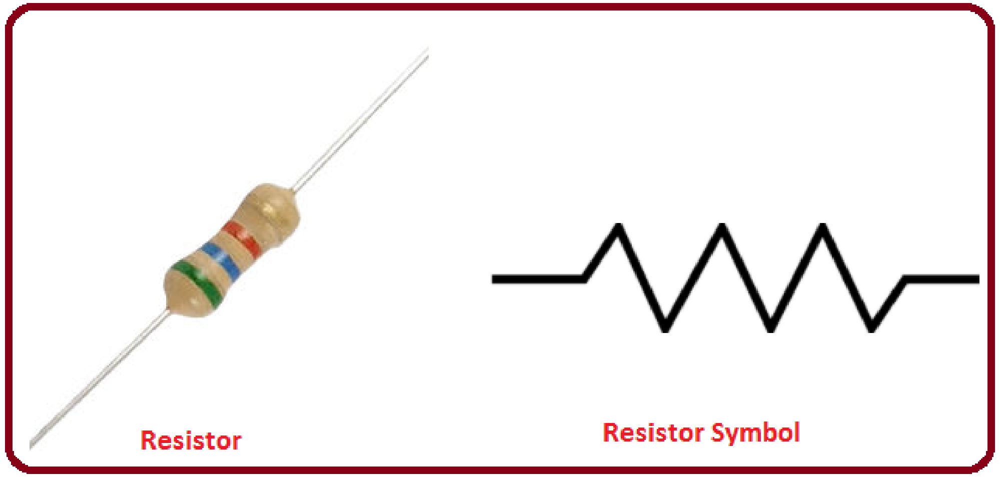
- A printed circuit board (PCB) mechanically supports and electrically connects electrical or electronic components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate. Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it.

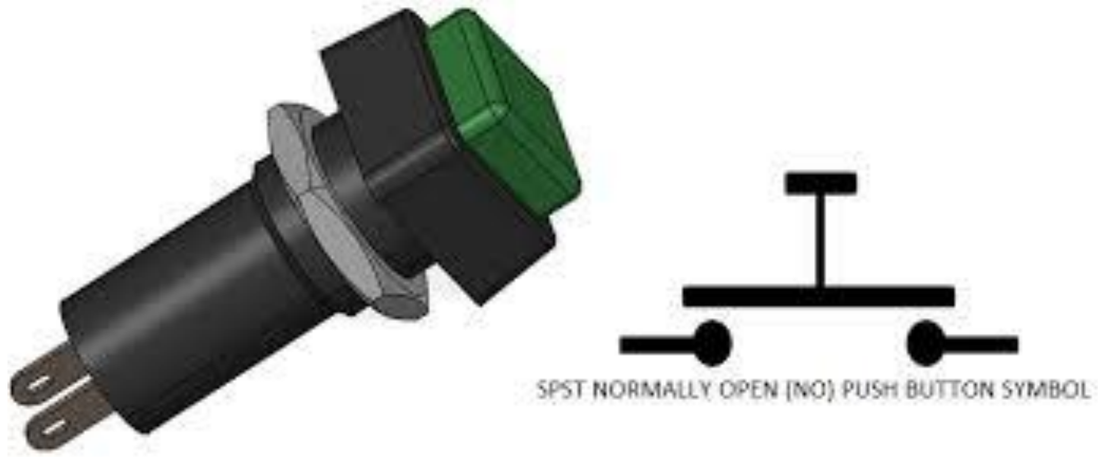
Connectors



- **Male Pin Header -** A male pin header consists of one or more rows of metal pins molded into a plastic base, many spacing. can be either straight (vertical) or right-angle, the latter form is sometimes used to connect two PCBs together horizontally
- **Female to Female Jumper Cable -** With this specially designed conversion cables, we can connect easily with a breadboard or other micro-controllers. They are used for connecting a Base Shield to a Grove sensor, actuator, or device.

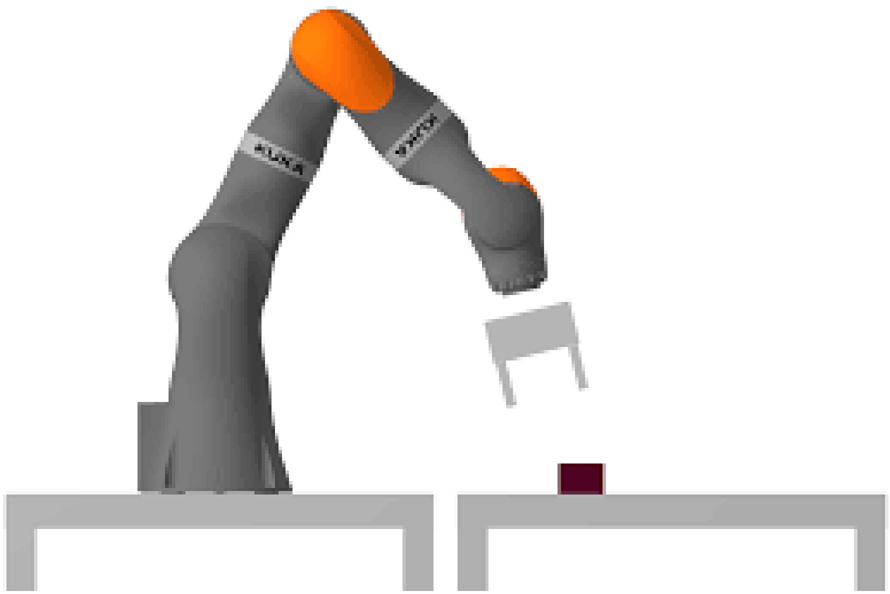
Resistor & Push Button





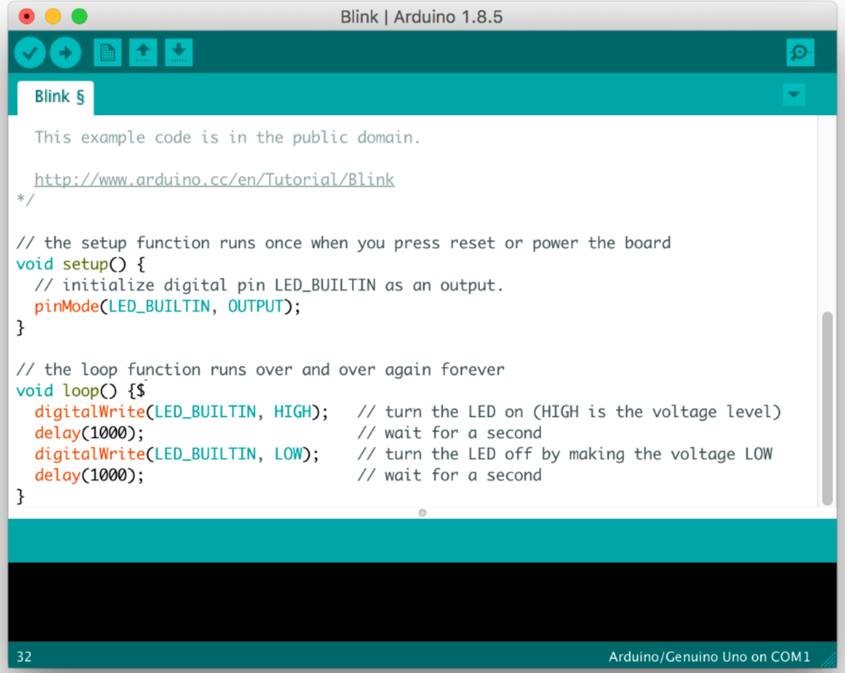
- **Resistors -** A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements.
- **Push Buttons -** A Push Button is a type of switch work on a simple mechanism called "Push-to-make". Initially, it remains in off state or normally open state but when it is pressed, it allows the current to pass through it or we can say it makes the circuit when pressed.

Pick and Place Robot Frame



- A frame of a robot will carry the motors, electronics, mounting supports, and more. All of these components and parts are added to the weight of the chassis itself, which will count towards the total carrying capacity of the electrical motors. This enhances the best strength/weight ratio for a robot.
- It provides a structural stability and dimensional clarity of a robot that helps us to determine the motion path and work volume of the robot.

Software - Arduino IDE 1.8.13



- The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, The Arduino IDE supports the languages C and C++ using special rules of code structuring.
- User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.

Work Status

Program used to obtain angular data from potentiometer of the scale down model

- int Read_Pin1 = A1;
- int Read_Pin2 = A2;
- int Read_Pin3 = A3;
- int Read_Pin4 = A4;
- int Read_Pin5 = A5;
- void setup()
- {
- pinMode(Read_Pin1, INPUT);
- pinMode(Read_Pin2, INPUT);
- pinMode(Read_Pin3, INPUT);
- pinMode(Read_Pin4, INPUT);
- pinMode(Read_Pin5, INPUT);
- Serial.begin(9600);
- }

- void loop()
- {
- Analog_Read();
- // Mapping();
- }

- void Analog_Read()
- {
- int Pin_Value1 = analogRead(Read_Pin1);
- int Pin_Value2 = analogRead(Read_Pin2);
- int Pin_Value3 = analogRead(Read_Pin3);
- int Pin_Value4 = analogRead(Read_Pin4);
- int Pin_Value5 = analogRead(Read_Pin5);
- Serial.print("Pin_Value1 ");
- Serial.print(Pin_Value1);
- Serial.print("   ");
- Serial.print("Pin_Value2 ");
- Serial.print(Pin_Value2);
- Serial.print("   ");
- Serial.print("Pin_Value3 ");
- Serial.print(Pin_Value3);
- Serial.print("   ");
- Serial.print("Pin_Value4 ");
- Serial.print(Pin_Value4);
- Serial.print("   ");

- Serial.print("Pin_Value5 ");
- Serial.print(Pin_Value5);
- Serial.println("");
- }

- void Mapping()
- {
- int Pin_Value1 = analogRead(Read_Pin1);
- int Map_Value1 = map(Pin_Value1, 0, 1023, 0, 180);
- Serial.print("Pin_Value1   ");
- Serial.print(Pin_Value1);
- Serial.print("   ");
- Serial.print("Map_Value1   ");
- Serial.println(Map_Value1);
- }

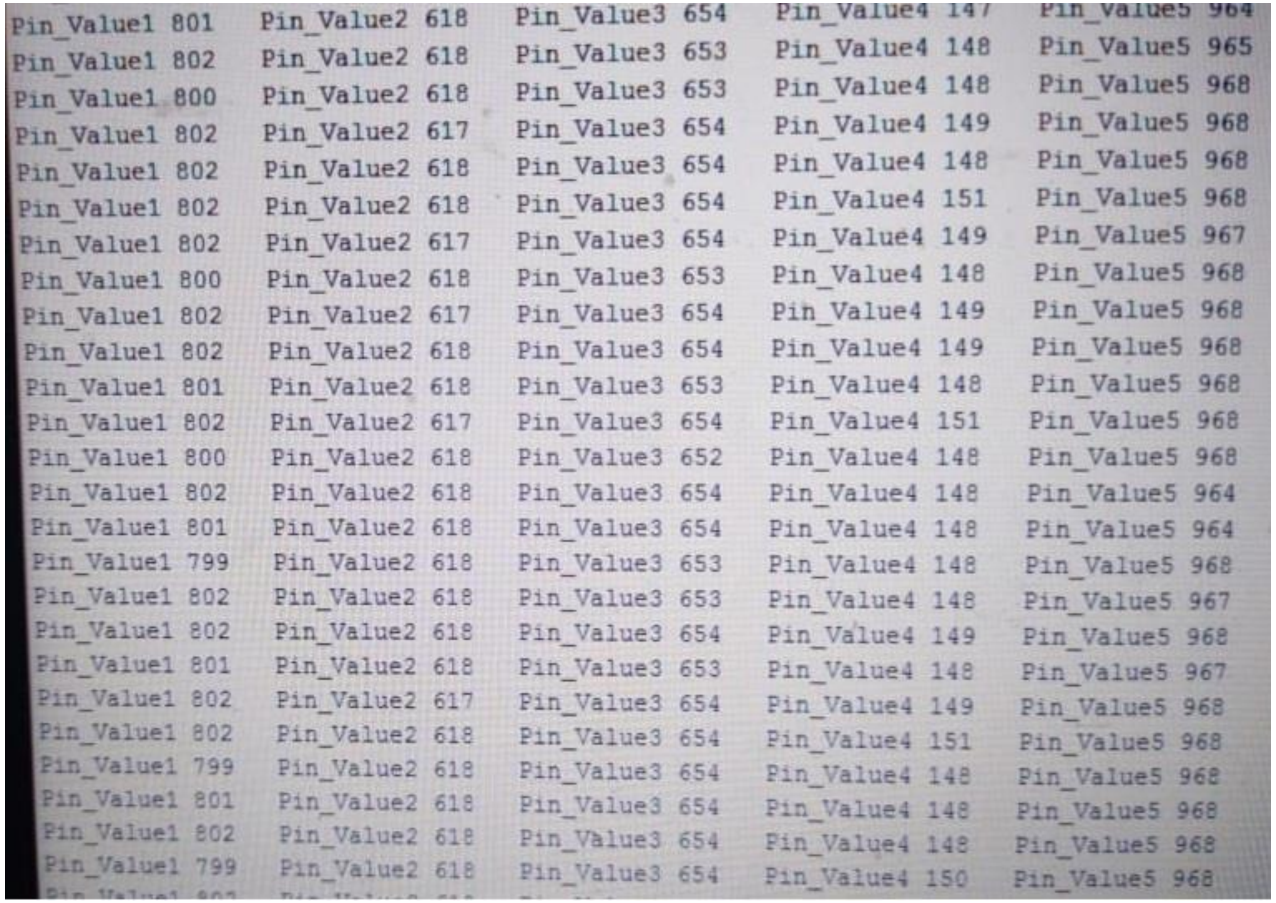
- **From the above program we can take the link angles of a miniature model of pick and place robot.**
- **In the next step, we going to operate the real-time robot with the angle data obtained from the above. So that we can control a real-time robot in live remote control method.**

Program description

- Our current work status is we can read all the Potentiometer of the scale down model. so we can take readings from the scale down model and can display it in computer monitor.
- In the program, we assign analog pins with integer datatype.
- Then it moves to void setup which will perform the operation just once and skip to the void loop. In the void setup we will assign what type of pins that actually and they are input or output and also the serial monitor also can be executed right here.
- Void loop will consist of set of program which will loop continuously. We used a function call technique so it will has a set of programs belongs to it.
- In this call, the pin values are read through analogue read function and it is stored in assigned variables. These are then called and printed through serial monitor from the system.
- there is also another type of function called mapping. It converts 0 to 1023 value to 0 to 180 degrees of angle. this angle can be obtained as a output in system monitor.

- In future, the values of the pot of small scale on model will be duplicated to the original robot.

- We can take the pot values from the miniature model that controls the real-time robot.
- **Working on the progress of creating the real-time robot.**



Pin_Value1 801	Pin_Value2 618	Pin_Value3 654	Pin_Value4 147	Pin_Value5 964
Pin_Value1 802	Pin_Value2 618	Pin_Value3 653	Pin_Value4 148	Pin_Value5 965
Pin_Value1 800	Pin_Value2 618	Pin_Value3 653	Pin_Value4 148	Pin_Value5 968
Pin_Value1 802	Pin_Value2 617	Pin_Value3 654	Pin_Value4 149	Pin_Value5 968
Pin_Value1 802	Pin_Value2 618	Pin_Value3 654	Pin_Value4 148	Pin_Value5 968
Pin_Value1 802	Pin_Value2 618	Pin_Value3 654	Pin_Value4 151	Pin_Value5 968
Pin_Value1 802	Pin_Value2 617	Pin_Value3 654	Pin_Value4 149	Pin_Value5 967
Pin_Value1 800	Pin_Value2 618	Pin_Value3 653	Pin_Value4 148	Pin_Value5 968
Pin_Value1 802	Pin_Value2 617	Pin_Value3 654	Pin_Value4 149	Pin_Value5 968
Pin_Value1 802	Pin_Value2 618	Pin_Value3 654	Pin_Value4 149	Pin_Value5 968
Pin_Value1 801	Pin_Value2 618	Pin_Value3 653	Pin_Value4 148	Pin_Value5 968
Pin_Value1 802	Pin_Value2 617	Pin_Value3 654	Pin_Value4 151	Pin_Value5 968
Pin_Value1 800	Pin_Value2 618	Pin_Value3 652	Pin_Value4 148	Pin_Value5 968
Pin_Value1 802	Pin_Value2 618	Pin_Value3 654	Pin_Value4 148	Pin_Value5 964
Pin_Value1 801	Pin_Value2 618	Pin_Value3 654	Pin_Value4 148	Pin_Value5 964
Pin_Value1 799	Pin_Value2 618	Pin_Value3 653	Pin_Value4 148	Pin_Value5 968
Pin_Value1 802	Pin_Value2 618	Pin_Value3 653	Pin_Value4 148	Pin_Value5 967
Pin_Value1 802	Pin_Value2 618	Pin_Value3 654	Pin_Value4 149	Pin_Value5 968
Pin_Value1 801	Pin_Value2 618	Pin_Value3 653	Pin_Value4 148	Pin_Value5 967
Pin_Value1 802	Pin_Value2 617	Pin_Value3 654	Pin_Value4 149	Pin_Value5 968
Pin_Value1 802	Pin_Value2 618	Pin_Value3 654	Pin_Value4 151	Pin_Value5 968
Pin_Value1 799	Pin_Value2 618	Pin_Value3 654	Pin_Value4 148	Pin_Value5 968
Pin_Value1 801	Pin_Value2 618	Pin_Value3 654	Pin_Value4 148	Pin_Value5 968
Pin_Value1 802	Pin_Value2 618	Pin_Value3 654	Pin_Value4 148	Pin_Value5 968
Pin_Value1 799	Pin_Value2 618	Pin_Value3 654	Pin_Value4 150	Pin_Value5 968

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Thank You