# Self Replicating Robotic System for Advanced Industrial Applications

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***Abstract:***

**For some time, based on the Arduino platform, we have been interested in making some sort of robots. This project is the first phase of this long-term desired effort. Anything is obviously possible with the mighty power of Arduino. It's compact, makes embedding electronics into the world-at-large fun and easy.**

**Taking the current situation of robot's importance in the work field, which increases the economic growth of the country. An idea to make a simplified robot to use in industries has attracted me in developing this project. The project idea came to us after watching of animatronic hand controller that uses mechatronics to create machines. The created machines seem animate rather than robotic. This project has been developed with an idea of reducing the complexity and cost and easy process of performing the weight liftings in an industry by robots. The project is developed using very low-cost electronics, achieving the results very precise and accurate. We decided to make realistic hand using potentiometers to achieve realistic motions. Approximating the kinematics of the human hand using potentiometers was our top priority. Each joint of this hand has a movement range again the same or very close to that of human hand.**

**Keywords- Arduino, servo motors, potentiometers, programming of the Arduino, battery to power the Arduino, mechatronics, robot,humanoid.**

## I. INTRODUCTION

The basic components of this project are the potentiometers, servomotors, Arduino, and the power supply. The potentiometers are mounted with the plastic material that actually allows to bend such that the bend is length of the bend is sensed and given to the Arduino. On the other hand, the servo motors are connected the Arduino, that in turn rotates in the desired angle counting the length of the bend done by the potentiometers. Voltage dividers are placed so that to avoid voltage regulations[1]. The servo pulls the strings that act as tendons, allowing the hands of the robot to move to lift the objects that are unsafe to touch.

This paper mainly analysis about different topologies and design regarding the construction of this Arduino based like human hand with the use of potentiometers. This project has many industrial applications and fun as well. Interactive robot control of this level, has many uses in industrial manufacturing, medical research and anything with precision and that is unsafe to touch. This project is completed successfully, and goal has been achieved by integrating of all the underlying technologies [2]. The programming code used in this project is developed such that the results are achieved very accurate and a long-term result. We shall discuss the design and overview of this project below.

## II. RELATED WORKS AND HARDWARE USED

This project deals with a microcontroller board known as Arduino mega2560. This is based on the ATmega2560. There are 54 digital input/output pins, 4 UART's and a 16MHz crystal oscillator[3]. There's an USB connection, a power jack, an ICSP e Arduino header and a reset button for a better access control. It is a recommended board for 3D printers and robotic projects. It contains everything need or support microcontroller. To get started, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery. The mega 2560 board is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

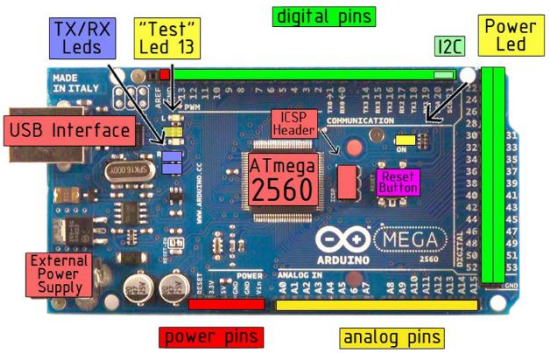


***Figure1:Picture of Arduino mega***

The figure shown above describes the physical look of Arduino mega2560 board and the pin configuration in it. The power of Arduino is not shown by its ability to crunch code, but rather shown by its ability to interact with the outside world through its input/output pins. The Arduino mega2560 has 54 digital I/O pins labelled 0-53 that can be used to turn motors, lights and other controllable devices on and off. It is also to read the state of the switches. The

features of mega2560 is more than enough for interfacing to most of the devices. But for controlling devices other than LED's, interface circuits are not needed. In other words, the motor can't run directly using the current available from an Arduino pin, but must rather have a pin drive [4]. It is an interface circuit that in turn drives the motor. The program sets digital pins to a high or low value using C code instructions, which corresponds to +5 V or 0 V at the pin. The pin is connected to the external interface electronics and then to the device being switched on and off. The below figure illustrate the sequence of events that actually happen.

The following is the procedure to get input from a pin.

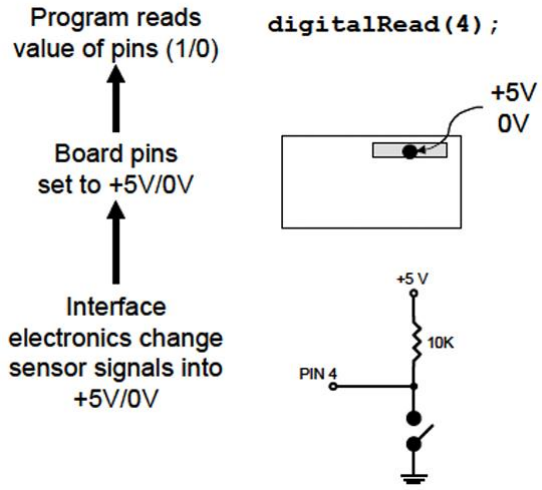


***Figure 2: Flow of events***

By using the control signal with servo motors, the shaft can be positioned at a specific angle. As long as the control signal is unaltered, the motor shaft will be holding at its position. This can be used to control robot arms, unmanned airplanes control surface and so on. This is very helpful for any kind of object that you want it to move at specific angle and used to stay at a desired position [5]. There are three types of servo motors based on the torque. They are mini, standard and giant servos. In this, mini and standard size servo motors needs no external power supply or driver and can be powered by Arduino directly.

The servo has three probes:

BLACK wire : GND(ground)

RED wire : +5 V

COLORED wire : Control signal

The connection and the three pins configuration of servo motor is illustrated in the figure shown below figure 3. The control signal is accepted by the third pin. This is also known as pulse-width modulation signal [6]. All the microcontrollers can easily generate the control signal.

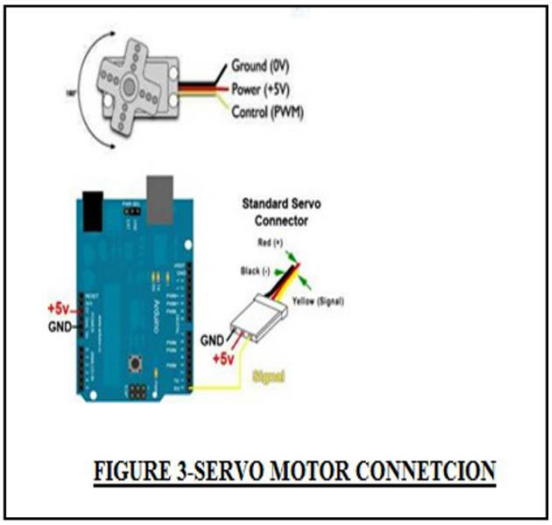


***Figure 3: Servo motor configuration***

The control signal and the stepper motor signal are fairly compared with each other. It is just about a pulse of varying lengths. The angle the motor turns to corresponds to the length of the pulse.

The pulse width sent to servo ranges as follows:

Minimum:1ms(millisecond) corresponds to 0 rotation angle.

Maximum:2ms(millisecond) corresponds to 180 rotation angle.

Any random length of pulse in between will rotate the servo shaft to its corresponding angle [7]. For example: 1.5millisecond corresponds to the rotation angle of 90 degree. The below figure illustrates the above concept in detail.

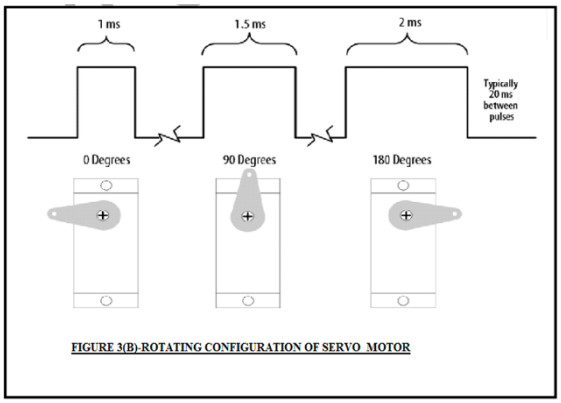


***Figure 4: Rotor connection***

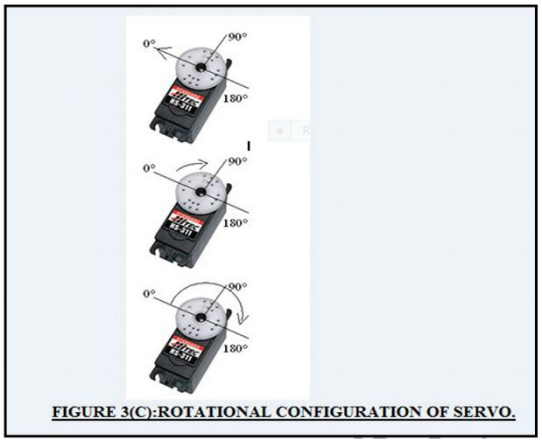

FIGURE 3(C):ROTATIONAL CONFIGURATION OF SERVO.

***Figure 5: Rotational configuration of servo***

## III. PROPOSED METHODOLOGY

Arduino can be used to control standard servo motors which is an easy process. This is because the Arduino software comes with a simple servo sketch and servo library. This makes the process easier and it'll get you up.

1. Connect the ground pin(GND) with the black wire from the servo on Arduino.
2. Connect the +5 V pin with the red wire from servo on the Arduino.
3. Connect the digital pin with the third wire on Arduino.

The ground of the external power source connected to Arduino ground.

A potentiometer informally, a pot, is a three-terminal resistor with a sliding or rotating contact. This forms an adjustable voltage divider [8]. It acts as a variable resistor, if only two terminals are used, one end and the wiper. The measuring instrument called a potentiometer is essentially a voltage divider. It is used for measuring electrical potential. The component is an implementation of the same principle, hence its name. Potentiometers are commonly used in controlling electrical devices such as volume controllers and also as position controllers [9]. For example: joystick

## IV. SYSTEM ALGORITHM:

### A. ARDUINO PROGRAMMING CODE STYLE-

A simplified version of the C programming language is used by Arduino with some extensions for the purpose of accessing hardware. All the Arduino instructions are made in one line. The Arduino board can hold a program with hundreds of lines along. It has a space about 1,000 two-byte variables. 3,00,000 source code lines per second can be executed by Arduino [10]. Programs are created in the Arduino development environment at first and then downloaded to the Arduino board. Code must be entered in the proper syntax. The code should use valid command names and a valid grammar for each line of code. The complier catches the syntax errors and flags them. The error message can be cryptic at times. For that, you have to do a bit of hunting because the actual error occurred before what was flagged. Codes can be written in our own particular style. This includes layouts, conventions for using case, headers, and use of comments. All codes must follow the correct syntax. But there are so many different styles we can use. Here are some few suggestions:

- Starting of every program is with a comment header that has the program name and perhaps a brief description of what the program does.
- Using indentation things can be lined up. Function name and braces are gathered in column one. Mark major sections or functions with a comment line header or two.
- Having just the right number of comments can make the code clear. It should not be too few and not too many as well. Make sure that the reader knows the programming language very well so that the comment be can be more instructive.

## V. RESULTS AND DISCUSSION

A servo motor based robotic hand was first tested with a single robot arm alone. After bending the single potentiometer at the transmitter side, the corresponding robotic finger moved in the same manner and same angle. The movement of a robotic finger is due to the servo motor. All the four servo motors are moved or controlled by four potentiometers on a single control board.

## VI. CONCLUSION:

The human and robot communication has been achieved successfully in this manner. So, now it is proved that a man can control a robotic hand from a distance wirelessly. This project presents a servo based robotic hand. This is implemented by using potentiometers, Arduino board etc. It can be widely used in places where there are restrictions or a hazard to human hand. It is basically a futuristic project which will be used to make humanoid . These humanoids are known as human like robots. Future efforts will be made to make this hand movable from one place to another. The efforts will be made to make the humanoid more flexible and more precise if possible.

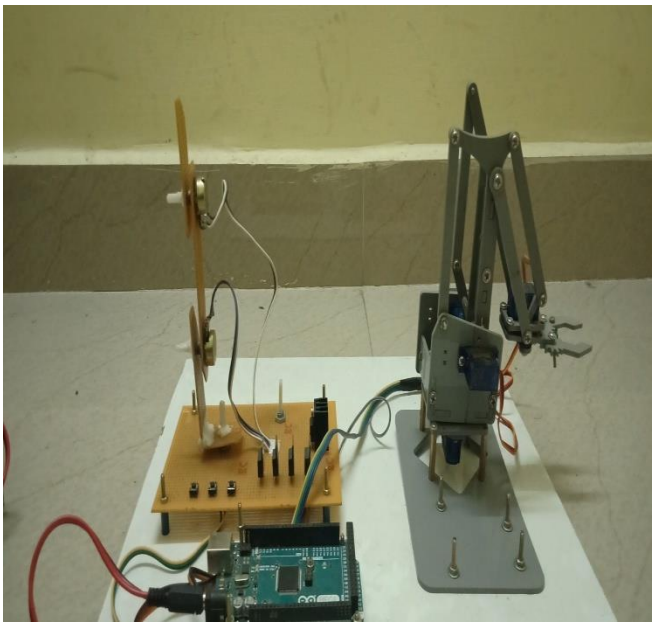

*Figure 6: Potentiometer raised at straight angle*

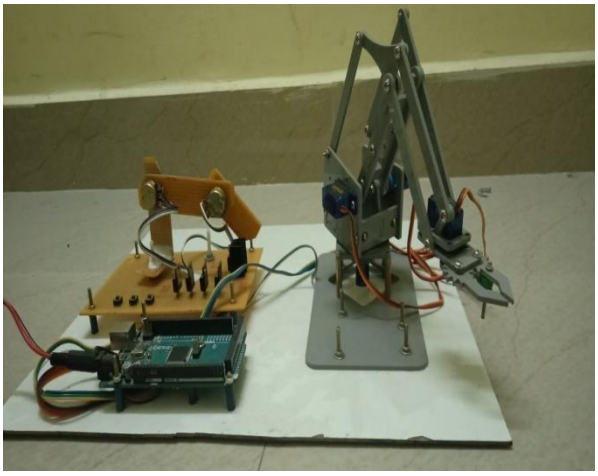

*Figure 7: Potentiometer with right bend*

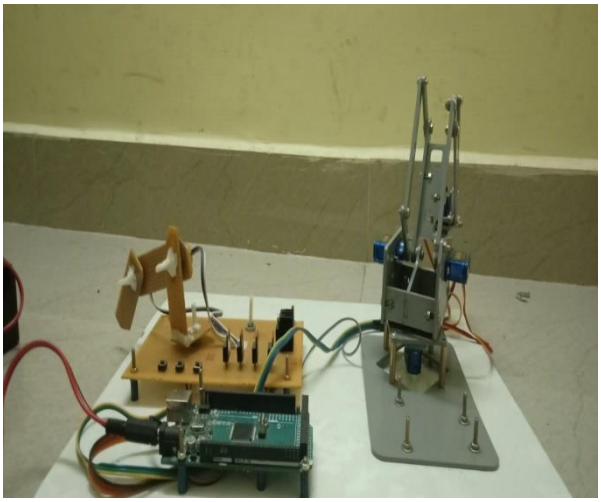

*Figure 8: Potentiometer with left bend*

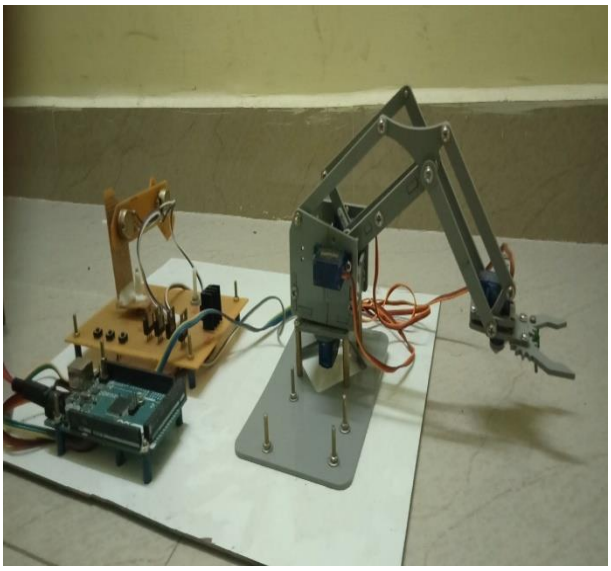

*Figure 9: Potentiometer with straight bend*

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