

# Robotic Arm with Real Time Human Arm Motion Replication Using IoT

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**Abstract:** The paper describes about Robotic Arm controlled by using the hand motion done at one place and that motion will be replicated in any part of the world using Internet of Things (IoT). Different position sensors for sensing human arm motion are placed at different joints to know the positions and send them to the cloud so the other Robotic Arm, which is at other place reads the data in the cloud and positions accordingly to that data received using Internet of Things (IoT). The application of Robotic Arm can be seen at the places where the humans cannot enter like coal mines, gas mines, radiation places etc... Where human interaction directly can be harmful. This can also be used for disabled to impersonate their hand motions.  
**Keywords:** Robotic Arm, IoT, Cloud, Python, Flask, Raspberry Pi, Web based manufacturing.

## 1. Introduction

In the history of robotics Leonardo da Vinci created many robot-like sketches and designs in the 1500's. The word robot first appeared in print in the 1920 play R.U.R. (Rossum's Universal Robots) by Karl Kapek, a Czechoslovakian playwright. Robota is Czechoslovakian for worker or serf (peasant). Typical of early science fiction, the robots take over and exterminate the human race (1-3).

When science fiction author Isaac Asimov devised his Three Laws of Robotics he was thinking about androids. He envisioned a world where these human-like robots would act like servants and would need a set of programming rules to prevent them from causing harm. Isaac Asimov's "Three Laws of Robotics" are:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

The Robotic Arm with Real time human Arm motion duplication is truly a reliable operation, fast and works accurately from any place with better internet connectivity (4-5). This would act as the beneficial device for humans (6-7).



## 2. Methodology :Working principle

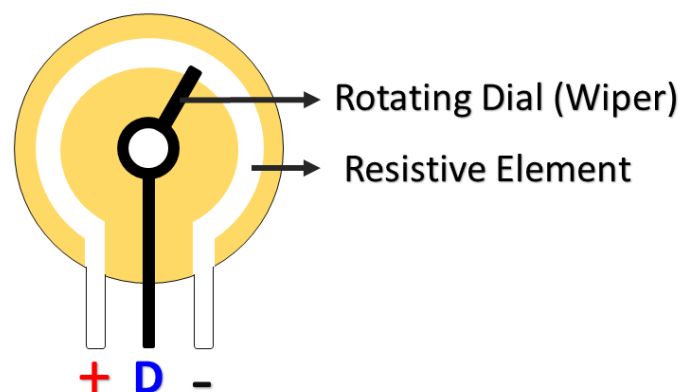
The Robotic Arm in this project is operated by using the hand motion which is done at one place and that motion will be replicated in any part of the world using Internet of Things (IoT). For this different position sensors are placed for sensing human arm motion at different joints to know the positions and send its positions to the cloud so the other Robotic Arm, which is at other place reads the data in the cloud and positions accordingly to that data received using Internet of Things (IoT). The application of Robotic Arm can be used where humans cannot enter like coal mines, gas mines, radiation places etc... Where human interaction directly can be harmful. This is used for human arm movement's replication in manufacturing plants using internet and this can also be used for disabled to replicate their hand motions.

### 2.1. IoT Devices

The Internet of Things (IoT) is a system where the transfer of data takes place between physical things embedded with sensors, software, and electronics using Internet. The sensing devices that are either passive (sensing) or active (actuating). Here the passive sensing devices are Potentiometers and the active devices are Servo motors. Here the IoT device, which connects, is Raspberry Pi.

### 2.2. Position sensor

Potentiometers are used as position sensors in this project. So, when the potentiometer which is attached to the hand suite is moved according to the hand position then there will be change of resistance will occur. The change of the value at different places is sent to the cloud using the internet connection.

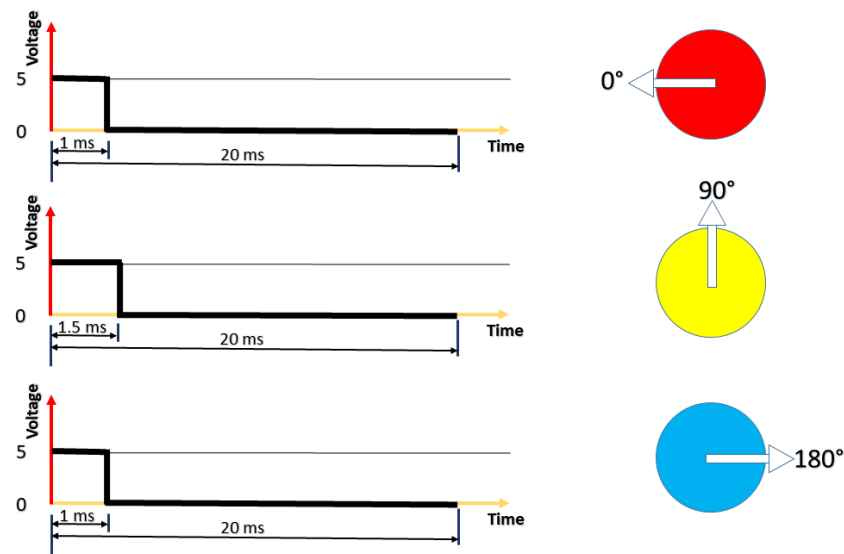


**Figure1:** Potentiometer

As we see in the figure we can see the internal of potentiometer this has resistive element and rotating element. When the knob of the potentiometer is moved, the wiper or rotating dial is also moved on the Resistive element so the resistance of it changes like the variable resistance.

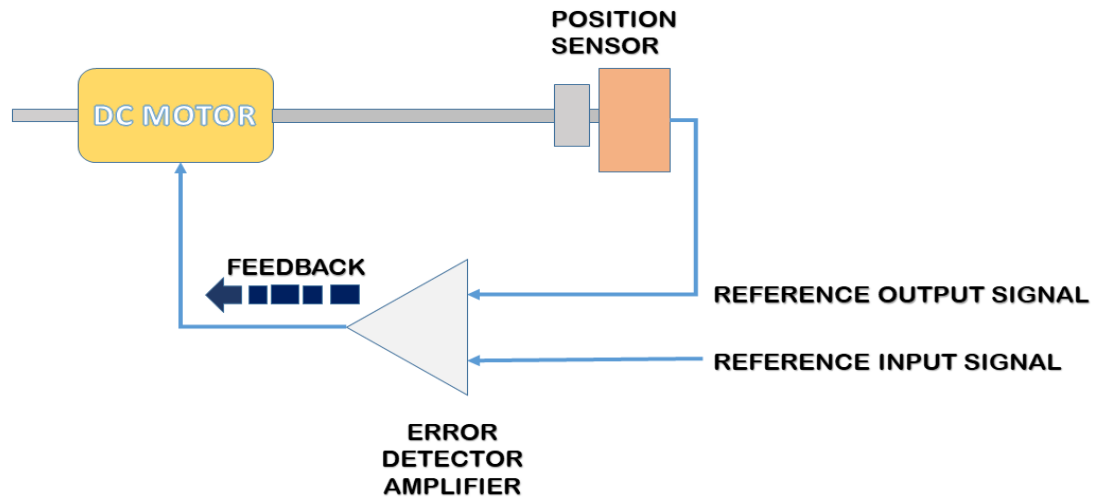
### 2.3. Servo Motor

The servomotor moves is an actuator which moves in rotatory motion with precise position according to the width of the signal length, which is called as the Pulse Width Modulation as shown in Fig.2. The Servomotor manipulates the Pulse width modulation into angle as rotary actuator with précised angle.



**Figure2:** Pulse Width Modulation

The Servomotor internally has the position feedback sensors as shown in the Fig.3. The position feedback sensor sends the position of the shaft as the reference output to the controller so the controller controls the motor operations and thus the position of the servo motor is controlled.



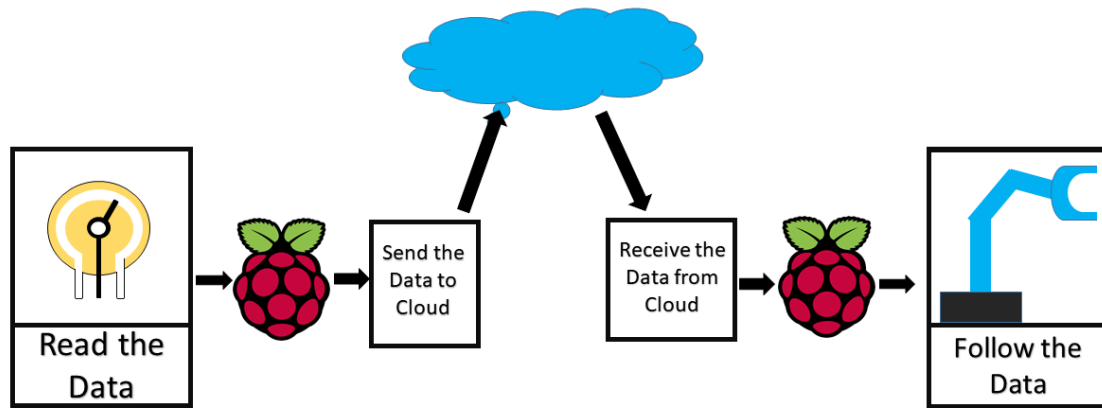
**Figure3:** Servo motor position control system

The data from the cloud is frequently checked and the data checked. Then the controller controls the servomotor according to the data in the cloud.

#### 2.4. Raspberry Pi

Raspberry is the mini size CPU that acts as the controllers in this project. The Raspberry Pi Foundation created it in February 2012. The Raspberry Pi Foundation is a charity founded in 2009. It enables people of all ages to explore computing, and to program in simple language like Python. It is free and open source. The Raspberry Pi has inbuilt Wi-Fi and 1GB RAM. Raspbian is the operating system used for this Raspberry pi where the word Raspbian is the mixture of two words Raspberry and

Debian. Debian is one of the popular Linux version. The Raspberry Pi has some GPIO pins so to operate the sensors and actuators. This features makes Raspberry Pi comfortable for IoT projects. The flow of working for Raspberry Pi is shown in Fig.4



**Figure4:** Raspberry Pi flow diagram

Raspberry Pi reads the data from the sensor and sends that data to cloud and another Raspberry Pi reads the data from the cloud and controls the actuators. Raspberry Pi can be programmed in many languages like Python, C, C++, Java, Scratch, and Ruby as all comes installed on default in the Raspbian operating system. The Python language is widely used for Raspberry Pi.

### 2.5. Python

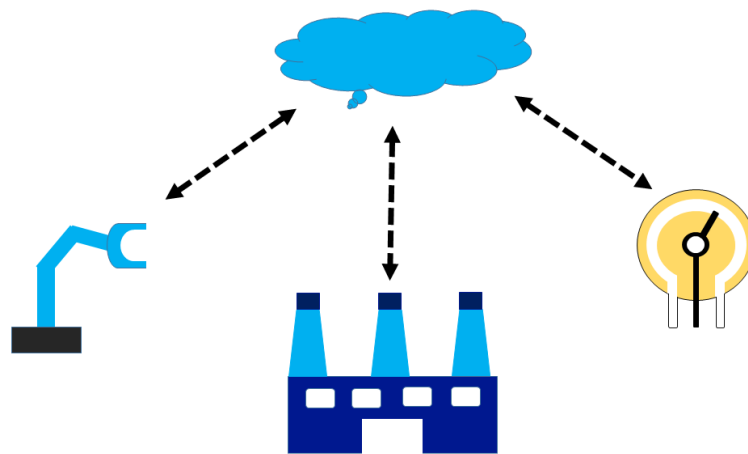
Python is a powerful interpreted object-oriented, high-level, interactive, general-purpose programming language created by Guido van Rossum. It has simple and easy-to-use syntax and Python source code is also available under the GNU General Public License (GPL). As Python is widely used in many different applications and can be written in few lines of code to complete task, here in this project we are using Flask Python package.

### 2.6. Flask

Flask is a micro web framework built and written in Python with easy-to-extend and small core philosophy. It is based on Werkzeug toolkit and Jinja2 template engine. Using Flask, we can host websites, on which we can send and receive data using Uniform Resource Locator (URL). The process of sending and receive data from an electronic device to another electronic device is called web service.

### 2.7. IoT

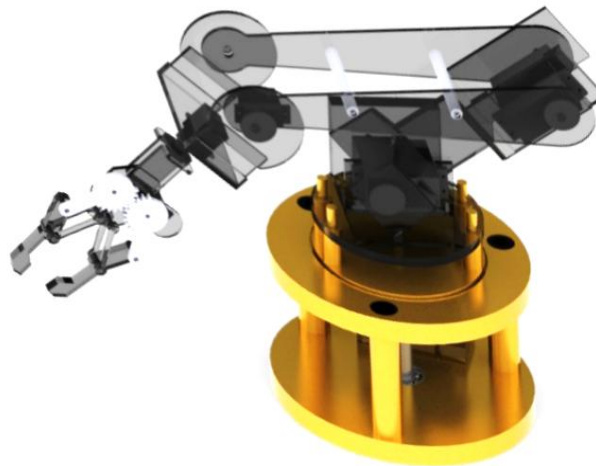
Internet of Things (IoT) is a network of electronic devices, physical devices, home appliances, sensors connected to devices, actuators, medical devices, etc... Which enables these devices and sensors send and receive data with each other. The devices are connected to Internet access data via web services to perform specific tasks. Here devices receive the data generated from the motion of human arm via sensors and send that data to the cloud through web services. As soon as data is changed it triggers the Robotic Arm motion in order to synchronize with the moment caused by human arm. This whole operation involves Python, Flask, Web Services, Internet of Things, Raspberry Pi, Sensors in performing the replication of Human Arm moments to Robotic Arm.



**Figure5:** IoT Network

### **2.8. Robotic Arm**

The Robotic Arm used here has five Servo motors as five degrees of freedom. The Servo motors of the Robotic Arm are connected to the Raspberry Pi. The Raspberry Pi takes the data from the cloud and then it controls the Servo motors accordingly.



**Figure 6:** Robotic Arm

### **3. Abbreviations and Acronyms**

IoT–Internet of things, PWM–Pulse Width Modulation, CPU–Central Processing Unit, RAM–Random Access Memory, GPIO–General Purpose input and output, URL– Uniform Resource Locator.

### **4. Results and discussions**

This Robotic Arm with five degrees of freedom is working accurately by replicating the human arm movements very quickly using Servo motors. This project can be used in the places where the human arm motions should be done quickly instead of joysticks, control panels etc...So the need for skilled operator is reduced.

## 5. Conclusions

The Robotic Arm with Real time hand movement replication using IoT is the future Technology where we operate movements of Robotic Arm easily. This Robotic Arm is very quick in action and works accurately. The further improvements of this project would be with the brain and computer interference technology for disabled people to control the Robotic Arm mechanism with their mind.

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