Arduino Robotic Arm

Developed by Ludor Engineering

A Trainers Toolkit To Foster STEM Skills Using Microcontroller Applications

Co-funded by the Erasmus+ Programme of the European Union

Project No. 2019-1-RO01-KA202-063965

This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Arduino Robotic Arm

Aim
Description
Learning Goals
Learning Methodologies
Target group
Learning Schema
Solution
Scientific areas covered
Assessment
Bibliography

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Aim

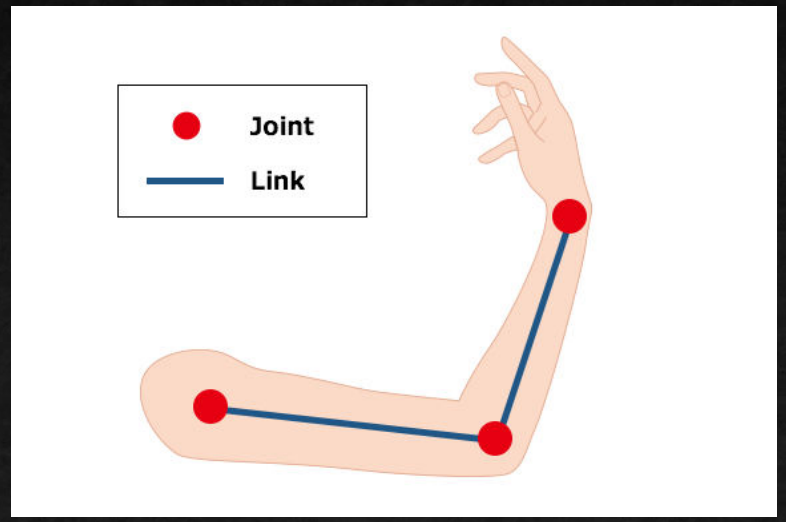
Use an Arduino robotic arm to help students to explore how a human arm works.

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Description

- The Arduino robotic arm includes a series of joints and links that work together to closely resemble the motion and functionality of a human arm. The joints are the movable components that allow relative motion between adjacent rigid parts, called links.
- From a mechanical perspective, the joints are similar to human elbow and shoulder while the links play the same role as the human bones. Human and robotic arms use the same principle of moving joints and transmitting power through the links.



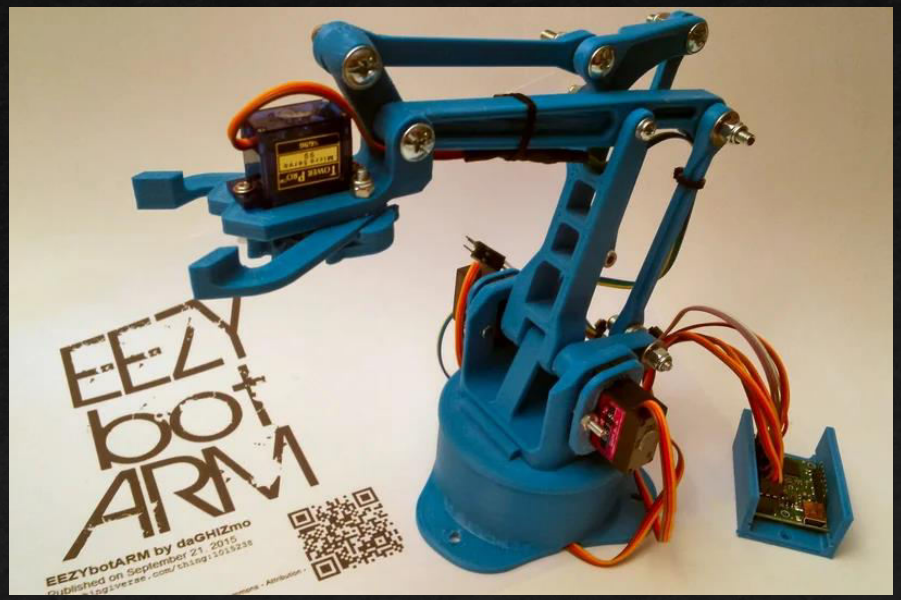
Human elbow and shoulder are joints and the bones connecting them are links. Image courtesy of Kawasaki

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Description

- Robotic arms are used in a wide variety of industrial applications, ranging from painting, welding, assembling to bomb disposal and repairs in space. They are increasingly used in medical applications, such as surgery and disinfection.
- The Arduino robotic arm can be used in teaching Biology / Anatomy in order to demonstrate the human arm functioning and to explain the roles of joints and bones.



EEZYbotARM robotic arm. Image courtesy of theGHIZmo

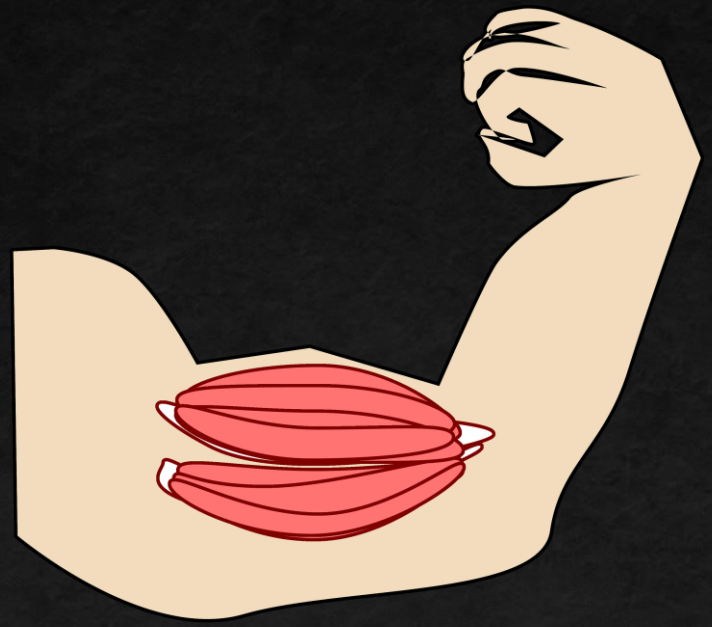
Medical robot arm. Copyright ©[2021] Intuitive Surgical, Inc.

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Learning Goals

- Students understand the principle of human arm movement
- Students understand the roles of joints, bones and muscles
- Students understand how simple principles can be used in complex applications



Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Learning Methodologies

Photo by Possessed Photography on Unsplash

- Research findings show that mathematical principles similar to those used in robotics are very useful for a good understanding of the human body.
- Teacher explains the principle of human arm movement with the help of Arduino robotic arm. Various movements can be demonstrated by selecting appropriate commands.
- Students explore the similarities between humans and robots way of moving, so they come to see the human body as a system from an engineering point-of-view.

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Learning Methodologies

- Students work with the robot to replicate the process of movements and learn about the various human parts involved in the arm motion.
- To help students engage, teacher can ask questions to help students relate the robotic arms to their own human arms. The students could rotate their joints to see how these rotate.

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

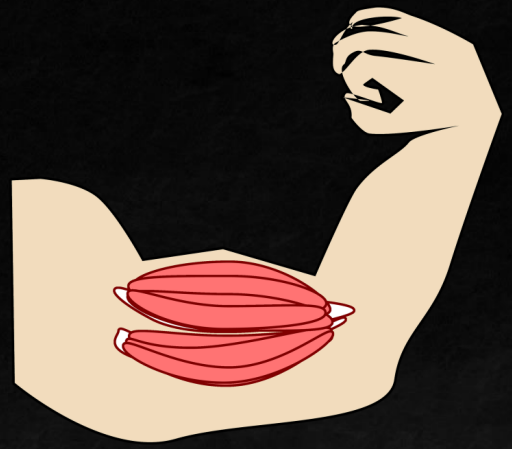
Target Group

Primary and secondary school students

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Learning Schema



- Compare the movements of the robotic and human arms
- Identify the links and joints
- Find the common functioning principle

Image courtesy of theGHIZmo

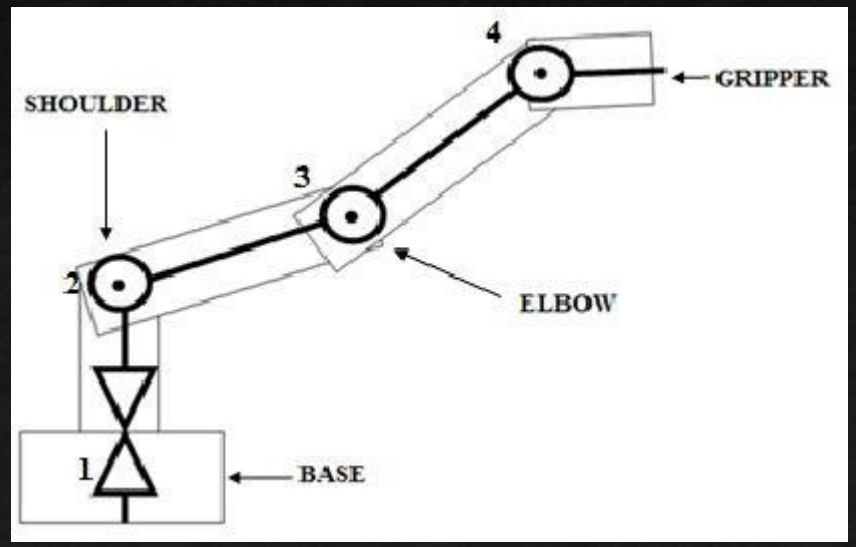


Image courtesy of Adeline Neo Wei QI

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Solution

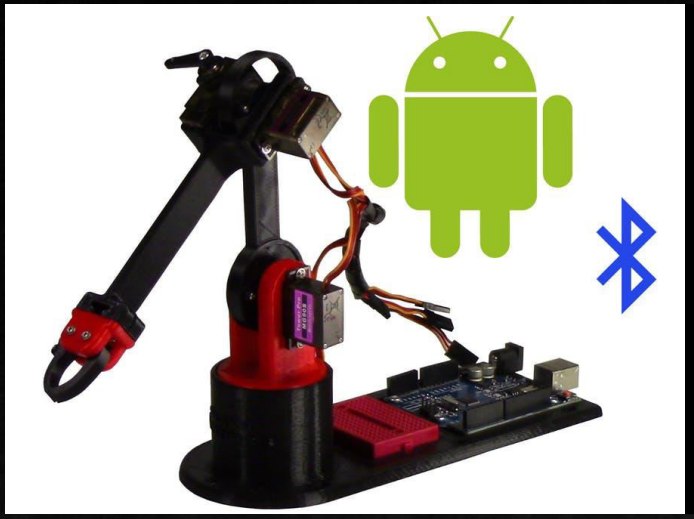
Image courtesy of mearm.com

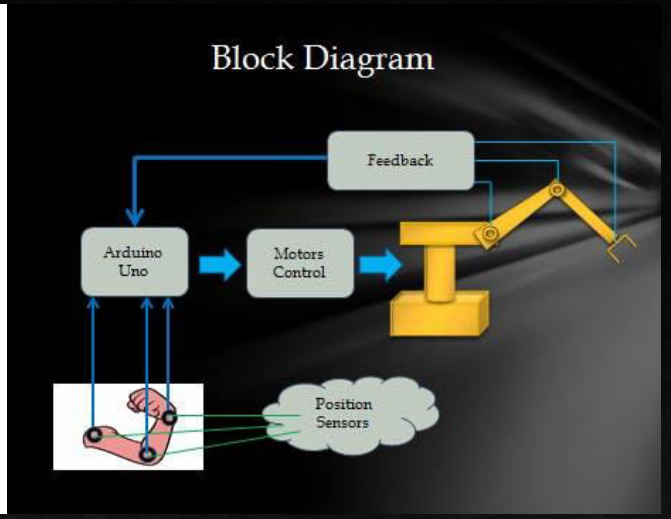
- A very affordable Arduino robotic arm can be build using widely available open-source design and documentation. Some of the necessary parts can be 3D printed, laser cutted or even hand cutted from plywood or cardboard. The servomotors and the Arduino board are easily available, at reasonable prices.
- The software for programming the robotic arm is free and there are many freely-available already made programmes.
- Reasonably-priced Arduino robotic arms are also widely available in online shops
- Some useful links are given at the end of this presentation.

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

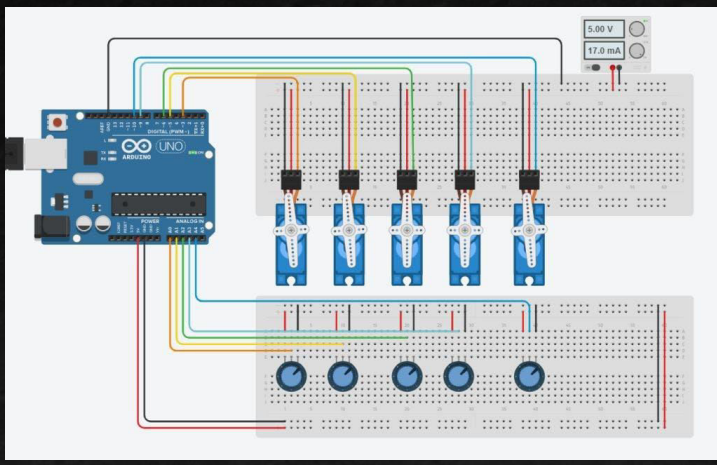
Co-funded by the Erasmus+ Programme of the European Union

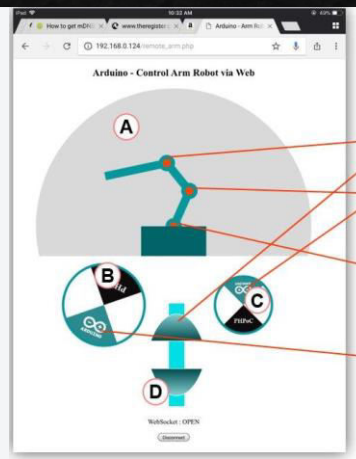
Solution

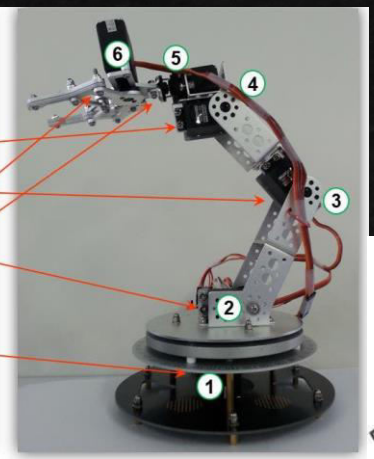




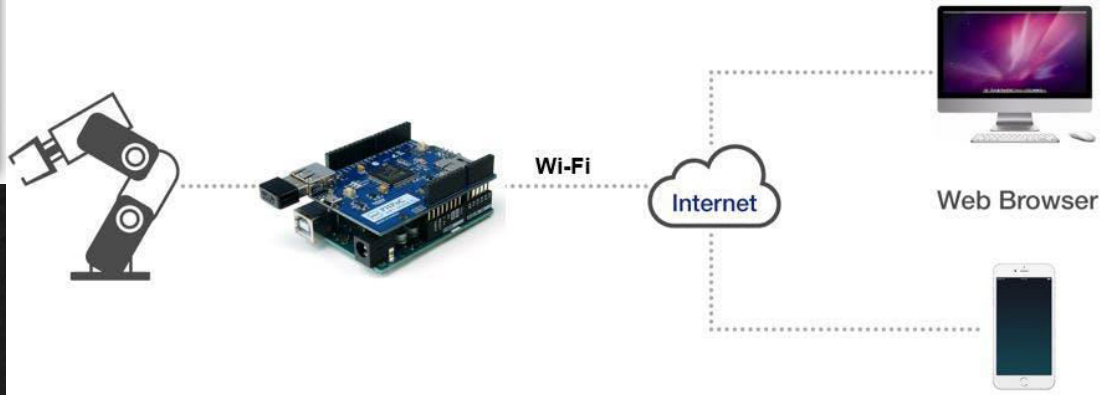
- There are various solutions available for controlling the robot arm using Arduino:
  - simple control with potentiometers
  - based on Android apps
  - using sensors attached to the arm of the user
  - gesture controlled via Bluetooth
  - control via web
- Documentation, instructions, schemes, list of materials, etc. are available on https://create.arduino.cc/ and other places.







Images courtesy of arduino.cc



Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Scientific Areas Covered

Biology / Anatomy

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Assessment

- The students understanding can be assessed during the class discussions.
- Individual students can be questioned to check knowledge of key terms.
- The students should be able to explain the movement mechanism.

Photo by Glenn Carstens-Peters on Unsplash

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Bibliography

1. Best Open Source Robot Arm Projects, https://pinouts.net/best-open-source-robot-arm-projects/
2. How to Make a Robotic Arm, https://create.arduino.cc/projecthub/MisterBotBreak/how-to-make-a-robotic-arm-783525
3. Arduino 3D-Printed Robotic Arm, https://www.hackster.io/mircemk/arduino-3d-printed-robotic-arm-e824d8
4. Tutorial on building the open-source robot arm EEZYbotARM, https://www.instructables.com/EEZYbotARM/
5. How Are Industrial Robots Built? A Guide on the Components and the Movement of Robot Arms, https://robotics.kawasaki.com/ja1/xyz/en/1804-03/
6. uArm Ⅰ : An open source robot arm project, https://www.robotshop.com/community/robots/show/uarmi-an-open-source-robot-arm-project
7. MeArm Robot Arm Version 3.0, laser cut file, https://www.thingiverse.com/thing:3420797
8. MeArm 3D Printing files, https://www.thingiverse.com/thing:616239
9. Simple and Smart Robotic Arm Using Arduino, https://create.arduino.cc/projecthub/WolfxPac/simple-and-smart-robotic-arm-using-arduino-1ceda6

Project No. 2019-1-RO01-KA202-063965
This project has been funded with support from the European Commission. The content reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union