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Arduino-Based Smart Cooking ARM

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Abstract
Cooking Arm is a simple and smart robotic arm designed to automate basic kitchen tasks. It uses lightweight 3D-printed parts, strong MG996R/MG995 servo motors, and a small 5V DC motor for actions like stirring or rotating utensils. A 12V adaptor powers the system, while an LM2596 buck converter safely regulates voltage. The Arduino Uno controls all movements through programmed signals, allowing the arm to mimic basic human hand actions smoothly. This project shows how low-cost, Arduino-based robots can help in everyday life. It is built with safety, simplicity, and affordability in mind and can perform tasks such as stirring, flipping small items, and moving light utensils.
Keywords: *safety, simplicity, affordability.*

1. Introduction
The Cooking Arm project was developed with the idea of making everyday kitchen work a little less tiring for people who are always busy. Instead of focusing on complex cooking, this system aims to automate simple, repetitive tasks like stirring, mixing, or lifting lightweight utensils. The arm works on basic mechatronic principles, where mechanical parts, electronics, and programming all come together to form a small but useful helper. The joints of the arm are driven by metal-gear servo motors such as the MG996R and MG995, which give smooth and reliable movement even during continuous operation. An Arduino Uno acts as the "brain," sending the right instructions at the right time so the arm can move precisely and safely. that might affect the motors, anLM2596 buck converter is used to provide a steady supply. Most of the structural parts are 3D printed, keeping the arm lightweight, easy to assemble, and strong enough for kitchen-level tasks. What makes this project special is that it doesn't try to replace a human cook—it simply supports everyday routines by taking over the repetitive steps that usually demand constant attention. The design is flexible, so the arm can be reprogrammed for different movements depending on the dish or task. Overall, the project shows how even a simple robotic system can make cooking more comfortable, especially for students, working individuals, or anyone who wants a bit of help during their busy day.

2. Scope of the Work
- The work also studies how 3D-printed parts can improve customization and lightweight design.
- The scope includes developing smooth servo-based motion for safe and controlled operation.
- It tests how Arduino programming can coordinate different motors in real-time cooking actions.

3. Objective of the Project
- The main objective is to design a robotic arm that can assist with simple cooking tasks in an easy and reliable way.
- The project aims to reduce the physical effort required for repetitive actions like stirring and mixing.
- It focuses on creating a system that is safe to operate inside a kitchen environment.

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- Another goal is to use affordable components so the design remains practical for students and households. The arm is intended to perform movements with better accuracy and consistency than manual effort.
- The project aims to explore how 3D-printed parts can make the arm lightweight and customizable.
- It also aims to improve human convenience by automating time-consuming tasks.

2. Method

2.1 System Architecture

The system is built around an Arduino Uno, which works as the main controller that manages all movement Servo motors are connected to the Arduino to control the arm's joints with smooth and steady motion. The LM2596 buck converter provides stable, regulated power to all components for safe operation. 3D-printed parts form the physical structure of the arm, giving it flexibility and lightweight support. All components are wired through a simple circuit that links power, control signals, and motor outputs. The system architecture allows the arm to follow programmed instructions and perform repetitive cooking tasks. The system is designed to identify and sort materials automatically using a camera, machine learning, and a robotic arm. It mainly consists of four parts: an image capturing unit, a processing unit, a

2.2 2.2. Hardwar Units

The Arduino Uno works as the main controller, sending all the signals that guide the arm's movements. Servo motors give the arm smooth and strong joint motion, helping it perform simple cooking actions. A motor driver safely controls the DC motor without putting extra load on the Arduino. The arm's body is made from 3D-printed parts, which keep it light, easy to build, and customizable. All these components come together to form a practical robotic arm that can handle small kitchen.

2.3 Software Design

The system mainly uses C++, Roboflow Arduino IDE for software development.

Steps in the software process: Robotic Control: The Arduino program receives the signal and drives the servos of the robotic arm to move the object to the correct bin.

2.4 Working Principle

- The robotic arm works by receiving control signals from the Arduino, which acts as the main decision-maker.
- Each servo motor moves according to the programmed angles, allowing the arm to perform smooth and controlled actions.
- The motor driver helps manage the DC motor safely without overloading the controller.
- The 3D-printed joints guide the motion and keep the arm lightweight while still giving it enough strength.
- When the program starts, the arm follows a sequence of actions like stirring or lifting.
- Power from the buck converter ensures stable voltage so the motors run without interruptions.

2.5 Algorithm and Model Details

The system starts by setting the arm to its home position. It reads the movement steps from the Arduino code. Servo angles are sent one by one to move each joint. The motor driver controls the DC motor safely. Each action is done in sequence without rushing. The system checks if more steps are left. Once finished, the arm returns to rest. Table 1 shows Software tools and Platform Used

2.6 Software Programming

Table 1 Software tools and Platform Used

Software Tool	Purpose / Function
C++	For robotic arm controls
Arduino IDE	For programming and controlling the servo motors

- Arduino IDE: The Arduino program receives the signal and drives the servos of the robotic arm to move the object to the correct bin.
- 2.C++ : C++ program for controlling a robotic arm using 2 servo motors and 1 DC motor .You can modify the angles or motor speed as needed.

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2.7 Circuit diagram

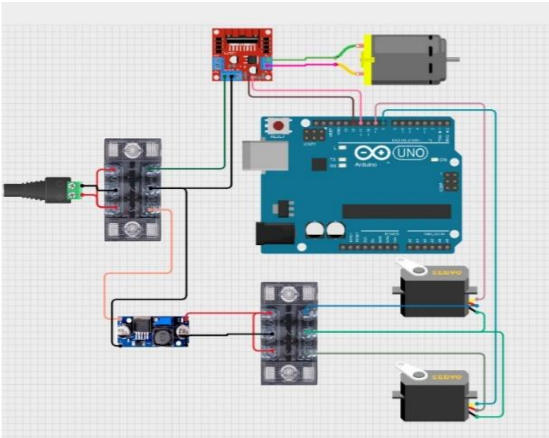

Figure 1 Circuit of The Bread Board

- Arduino Uno controls all components.
- DC motor runs through the L298N driver.
- Two servos get stable power from a 5V supply.
- LM2596 reduces voltage to 5V.
- Power boards distribute power neatly.
- All grounds are linked for stable operation.

3. Results and Discussion

3.1 Results

The cooking-bot system accurately processed ingredient images, joint data, and cooking actions. The model identified actions like stirring and flipping correctly, and the controller moved the robotic arm smoothly. Real-world tests showed high task success with low joint errors.

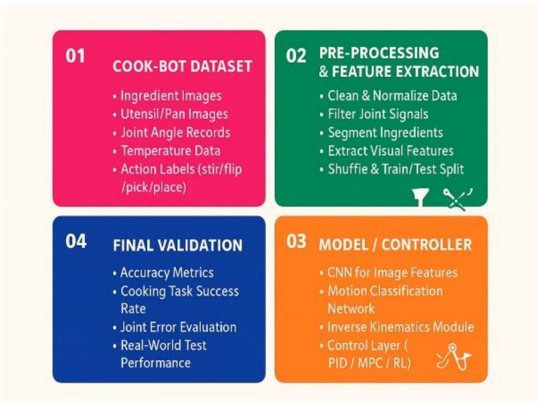

Figure 2 Process of Robotic Arm

3.2 Discussion

The results show that proper data preparation and feature extraction improved the robot's understanding of cooking tasks. The combination of CNNs, motion classification, and inverse kinematics allowed the arm to act precisely. Overall, the system performed reliably in real cooking tests and shows strong potential for future improvements.

Conclusion

This cooking robotic arm project shows how kitchen tasks can be automated easily and safely. Using sensors and motors, the arm copies human hand movements to stir, mix, and serve with accuracy. It saves time, improves safety, and delivers consistent results. The project also proves the potential of robotics in modern kitchens. Future upgrades can include AI recipe learning, object recognition, and multi-dish cooking.

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