# Artificial Intelligence Based Trash and Recyclable Sorting Robot ARM

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## Abstract

Waste management and sorting are are crucial tasks to make the environment green and to ensure better (re)use of the resources. Some countries, because of their high density population, are facing enormous challenges to manage huge amounts of waste produced every day. The purpose of this paper is to use the advancement of Information and Communication technology (ICT) to improve the waste management system and make lives better by providing a smarter way for waste sorting and management. In this paper, an intelligent system was proposed and developed for automatically sorting the waste to be used in context. The aim of the project is to design a Robotic arm which will separate the valuable objects safely and throw the trash in a bin or a garbage can. This paper presents an AI (artificial intelligence) based sorting robotic arm that is used for automation processes.

**Keywords:** Raspberry pi3, pi camera, Hard disk (SD card), Servomotor, Artificial Intelligence

## 1. Introduction

Automation is the most frequently used term in the field of electronics. The hunger for automation brought many revolutions in the field of technology. This project makes use of an onboard computer, which is commonly termed as the **Raspberry Pi** processor. It acts as the heart of the project. This onboard computer can efficiently communicate with the output and input modules which are being used.

The portable system which captures the images is placed in front of the camera and the images can be detected and verified using the Raspberry Pi processor which is written in python using artificial intelligence techniques.

With the help of computer vision, Industrial Robots can do a great job of separating waste. There are **numerous sensors** which enable them to monitor the waste stream. The AI-powered robot identifies the waste materials and the robotic arm segregates them.

The proposed system consists of an AI model which is dumped into Raspberry Pi. When an object (garbage) is placed in front of the Pi camera it will determine if it is a valuable object or not. If the object is valuable like a cell phone, camera, etc., the robotic arm will put this item into the box safely. If it is not a valuable item like a plastic bottle, paper, etc., the arm will throw the item into the bin or garbage system. Servo motors is used to design a robotic arm with a 'pick and place' mechanism. To perform this task, **the Raspberry Pi3** processor is programmed using 'Raspbian OS'. These types of robots are used in commercial, industrial and medical fields.

## 2. LITERATURE SURVEY

In [1], the system implements waste segregation using a robot that picks up the waste from the conveyor belt. The waste is segregated into dry, wet, and metallic. Metal proximity, moisture and the limit switch are the sensors employed. The arm is used to drop the waste into the designated bin. The location of the bin is sent using a GSM module to the concerned authority once it is full. The conveyor belt used in this model is not portable and hence has very limited scope. It is most applicable for small scale usage.

In [2], the system segregates paper, glass, and metallic waste using an Automated Waste Sorter (AWS) and a Robotic Arm. To minimize human interference, the robotic system collects the waste and is later sorted by the AWS. An array of sensors is used in conjunction with the robotic arm to structure an automated waste sorter. To mechanically pick up the waste, a Mobile Robot Delivery System is employed to sort the waste and put it in their designated bins.

In [3], three pulleys are employed which run with the help of a DC motor on a conveyor belt. The sensor system segregates the waste using image processing. An actuator responds quickly using the sensor system to segregate the waste. Classifier techniques segregate them into dry, wet, and metallic waste. The model can be used for both domestic and industrial environments.

In [4], a municipal waste segregator is built using an Arduino Mega board. This system consists of three compartments, the first compartment is used to detect metal wastes, the second compartment detects if the waste is either wet or dry and the third compartment is the storage compartment which is further subdivided into three compartments as dry, wet, and metallic for storage purpose. Also, a NodeMCU is used to get feedback regarding the status of the bins and to send the information to their respective authorities.

In [5], a waste sorting system which uses the advances in information technology, has been built. The main objective of this system is to differentiate waste as organic, recyclable, and non-recyclable. Waste is picked up and dumped onto a conveyer belt using a robotic arm controlled by a mobile application. A rotating surface is placed at the end of the conveyer belt to collect the segregated waste. A database is developed to keep track of the number and type of waste collected, which is saved in text format.
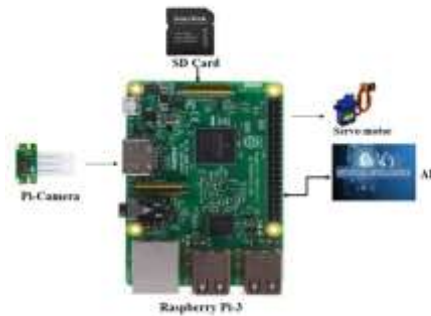
## 3. IMPLEMENTATION:



**Fig: Artificial Intelligence Based Trash and Recyclable Sorting Robot ARM**

**The objectives of the project are:**

- Using Raspberry Pi and AI to achieve the task.

- To pick up the useful object and place it safely.

- To pick up the waste material and put it into the garbage.

- Using PI CAMERA to capture and compare capability of objects.

- Using servo motors to design a robotic ARM with a 'pick and place' mechanism.

## 4. RELATED WORK:

Different modules used in this project are discussed below:

**a. Raspberry pi3 processer (ARM-11):**



*Figure. Raspberry Pi3 camera*

Raspberry Pi 3 featuring the ARM1176JZF-S Running at 1.2 GHz, with 1 GB of RAM.

The RASPBERRY Pi 3 is a credit card sized computer. The design is based around a Broadcom BCM2837 SoC, which includes an ARM1176JZF-S 1.2 GHz processor, Video Core IV GPU and 1 GB of RAM. The design does not include a built-in hard disk or solid-state drive, instead relying on a microSD card for booting and long-term storage. This board is intended to run Raspbian OS kernel based operating systems.

### b. Pi camera

The Raspberry Pi camera module can be used to take high-definition video, as well as still photographs. The module has a five-megapixel fixed-focus camera that supports 1080p30, 720p60 and VGA90 video modes, it is also captures still photos. It attaches a 15cm ribbon cable to the CSI port onto the Raspberry Pi Processor.

*Figure. Raspberry Pi camera*

### C. Servo motor:

*Figure. Servo Motor*

A servomotor is a rotary actuator that allows for precise control of angular 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.
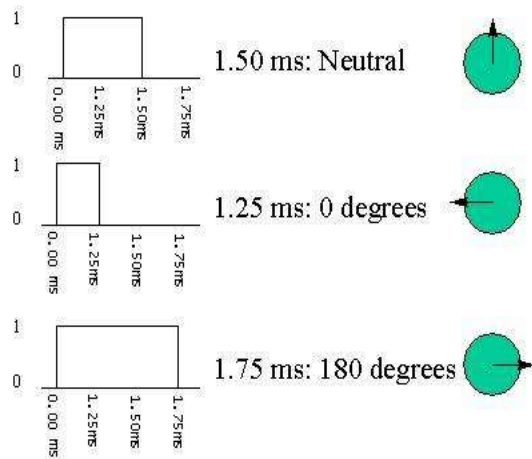
A servomotor is controlled by sending a pulse signal that is high for a brief time, generally 1 – 2 ms. There is no effect by connecting a battery as a power source - one must have a timer circuit that generates the pulsed signal. By varying the pulses ON time (or the pulse width) the motor will move to a certain position over its range of motion and then stop as long as the input pulse width remains the same. Depending on the pulse width, you'll get a different position.

## IV CONCLUSION:

The existing model presents an integration of all the hardware components which have been used and developed with the Arm-11 Raspberry pi processor. The position of each and every module has been placed very carefully. **Hence, contributing to the robust working of the model, Artificial Intelligence Based Trash and Recyclable Sorting Robot Arm.** Secondly, with the help of highly advanced IC's like ARM1176JZF-S 1.2 GHz processor, Raspbian OS operating system and artificial intelligence, the project has been successfully implemented with a unique approach. Thus, the project has been successfully designed and tested.

## 5. ACKNOWLEDGEMENT

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