International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

DESIGN AND FABRICATION OF SMART SORT TRASH CAN.

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Abstract - *The present work proposes a smart system for sorting common trash items, controlled by the microcontroller. The system differentiates between three common types of trash: paper, plastic, and metal. Based on the material of the article, the system is to use actuators to deposit trash to the appropriate trash bin for purpose of recycling. The recognition of the type of material is made using a capacitive sensor. Specifically, the sensor consists of air-filled capacitance plates arranged parallelly. The capacitance will change based on the dielectric constant of the material presented as trash. Since the dielectric constants for the three materials are different, the system can make the appropriate decision. The microcontroller will determine the type of trash based on capacitance readings. Standard servo motors will then be used to push the trash into an appropriate bin. The microcontroller will determine the type of trash based on capacitance readings. Standard servo motors will then be used to push the trash into an appropriate bin. Moreover, when one or more trash bins are full, information is conveyed to the user by means of lighting an LED for the respective bin by utilizing ultrasonic sensor.*

***Key Words*: Microcontroller, capacitive plates, servo motor, ultrasonic sensor.**

1. INTRODUCTION

From the beginning of the human civilization, people used various methods of waste disposal to get rid of unwanted material. Sometimes it was buried in the land, thrown in the sea, fed to animals or burnt. Getting rid of unwanted material is always a major concern for the modern society. Trash has played a tremendous role in history. Proper management of waste plays a vital role in global environment. That is why a waste sorting system is designed which can be used in houses, offices, industries as a part of smart waste management system. Waste sorting is the process by which waste is separated into different elements.

2. Hardware Components:

Arduino UNO: The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced with various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable It can be powered by the USB cable or by an external 9volt battery, though it accepts voltages between 7 and 20 volts.

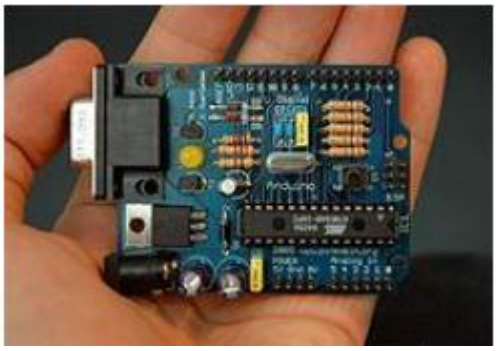

Fig1:Arduino UNO Microcontroller.

Capacitive Plates:

The capacitor is a component which has the ability or capacity to store energy in the form of an electrical charge producing a potential difference (Static Voltage) across its plates, much like a small rechargeable battery. Its basic form, a capacitor consists of two or more parallel conductive (metal) plates which are not connected or touching each other, but are electrically separated either by air or by some form of a good insulating material such as waxed paper, mica, ceramic, plastic or some form of a liquid gel as used in electrolytic capacitors. The insulating layer between a capacitors plates is commonly called the Dielectric.

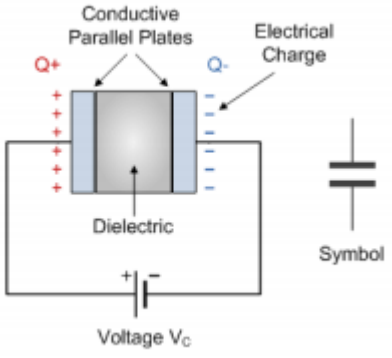

Fig2: working of capacitive plates.

Capacitive sensing is a growing technology to replace optical detection methods and mechanical designs for applications namely proximity /gesture detection, material analysis and liquid level sensing and some other applications. One of the

main advantages of capacitive sensing, and the one we are concentrating on in our paper proposal, is the use of it in sensing different kind of materials (plastic, liquid, metal etc.). It has the ability to sense up to a larger distance with greater accuracy. The sensor is cost-efficient and has a low power consumption which is an added advantage to meet the power constraints. Measure of capacitance is the ability of a capacitor to store electric charge. A parallel plate capacitor is widely used and its capacitance is calculated by C=Q/V where C is the capacitance of the charge stored at a voltage V. The parallel plate capacitor as in Fig consists of two conductor plates and the capacitance is calculated by:

$C = (\varepsilon_r * \varepsilon_o * A)/d$ (1)

Equation 1 is characterised by:

• A is the area of the two plates

• Ɛr is the relative dielectric constant of the material between the plates.

• Ɛo is the absolute permittivity of free space (8.854 x 10-12 F/m)

• d is the separation between the plates (in meters).

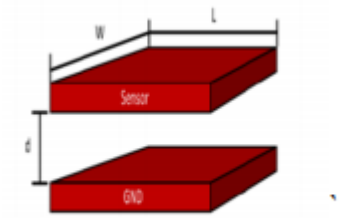

Fig3: parallel plate capacitor.

The parallel plate capacitor carries equal and opposite charges spread evenly over the surface. The field lines (electric field) start from the plate having higher potential and ends at the plate having low potential. The field lines sketch is shown in Fig

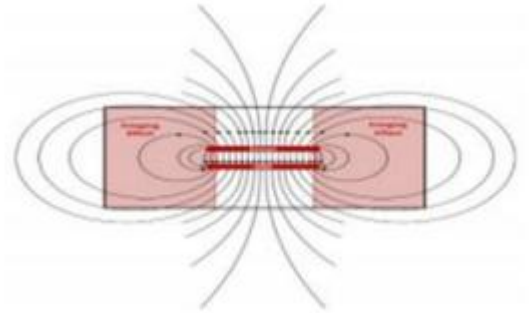

Fig4: ElectricField lines.

3. Servomotor:

A servomotor is a rotary actuator or linear actuatorthat allows for precise control of angular or linear 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.

Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system.

Fig5: ServoMotor

4. ULTRASONIC SENSOR:

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact.

Ultrasonic proximity sensors are a common type of proximity sensor used in many manufacturing and automation applications. Mainly for object detection and distance measurement, they're commonly used in food and beverage processing and various packaging applications. Ultrasonic sensors work by using sound frequencies higher than the audible limit of human hearing (around 20 kHz), which is typically in the range of 25 to 50 KHZ.

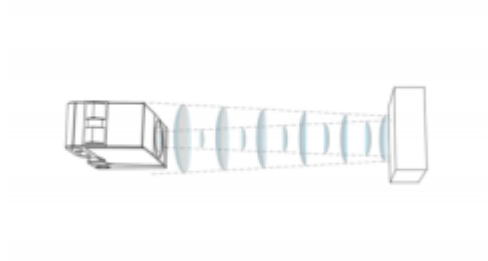

Fig6: Working of Ultrasonic sensor.

Working:

We begin with two conductive plates, which have a space between them, which respond differently when a voltage is applied to them. When we apply a voltage to the conductors, an electric field is between the positive and negative charges. Materials such as plastic, aluminium, paper cups will all have dielectric constants that are different from air. When a non-conducting/ conducting material is inserted between the plates, we obtain a capacitance. Capacitance of a material will also depend on the thickness and density of a material as well.

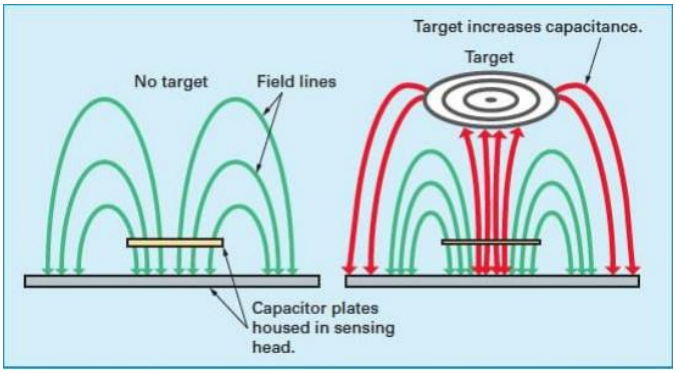

Fig7: Capacitive Sensing.

When air is between the two plates, the capacitance is close to 1; however, when an object is placed between the plates, the capacitance increase. When metal or plastic is placed between the sensors, the capacitance will increase. When paper is placed between the two plates, the capacitance does not change by much because the capacitance is close to that of air.

Having metal between the two plates changes the capacitance because the metal is charged in such as a way that the negative charge on the metal will attract to the positive plate on the capacitor and the positive charge on the metal will attract to the negative charge on the plate. Thus, with metal we create to capacitors that are hooked up in series. Then, the formula that we use follows the equation below. The formula that would be used for non-conductive materials such as paper or plastic would be the equation below, because in this case there would only be one capacitor and not two hooked up in series.

C = (€0€rA)/(w-d)

We can see the theoritical values of change in capacitance due to different materials in figure 4.3. This is due to the fact that these materials have different dielectric constant values. This difference in capacitance is divided into ranges and for the microcontroller so that it can differentiate between metal, plastic and paper.

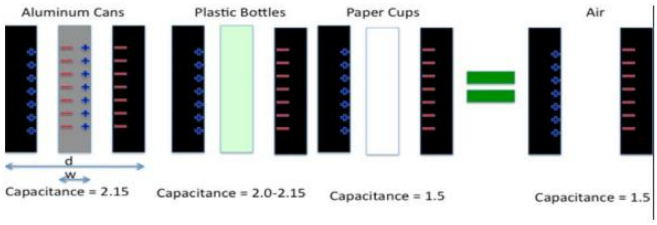

Fig8: Theorectical Capacitance values of different materials.

Circuit Diagram:

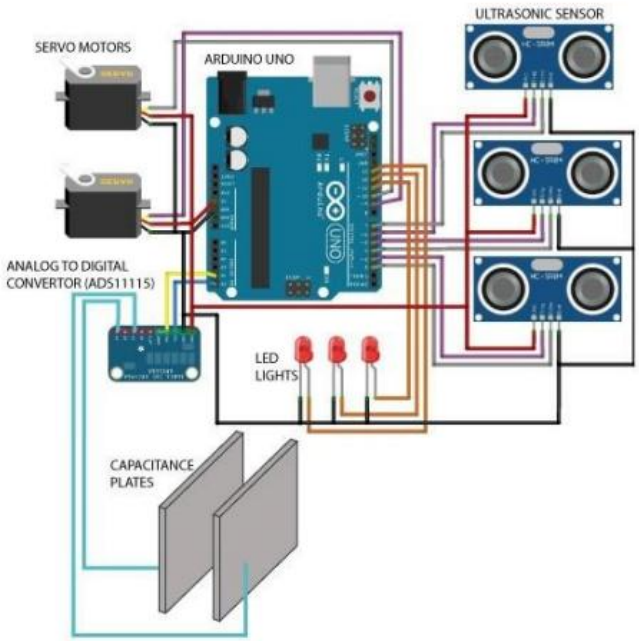

Fig9: Circuit Diagram.

Advantages:

- Minimizes Pollution.
- Protects the environment.
- Minimizes global warming.
- Conserves natural resources.

Conclusion:

The Paper mainly focues on Smart Sort Trash Can for Smart Waste Management System which is an excellent example of proper waste management. It will also ensure effective recycling system. Hence, the improvement of waste sorter will ensure economic and ecological development.

• Based on the material of the article, the system is to use actuators to deposit trash to the appropriate trash bin for purpose of recycling. This system of sorting can be used for a long time.

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