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Robotic Plastic Separator

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Abstract: *Plastic bags are one of the few new chemical materials which pose environmental problem. Plastic bags are used because they are simple and economical to make and they can last a long time. Unfortunately, these same useful qualities can make plastic a huge cleanliness problem. Because the plastic is most economical it gets discarded easily and its persistence in the environment can do great harm. We propose robotic plastic bags separator for separating plastic bags from mixtures, of waste such as paper, fibers, aluminium foil, copper wire chips, sand, and glass. The robotic arm is fitted with an IR sensor and flex sensor to identify the plastic material. The combined output from the IR sensor and flex sensor are processed by the microcontroller and issues commands to sort out the plastic from other materials. Here we use IR sensors and flex sensors to sense the materials for separation. The reflected signal from the IR transmitter can be used to separate the plastic from the waste. The Robot applies some angular displacement to the plastic to confirm before placing in the plastic waste box. This Robot can be used to pick up plastic bags lying by the roadside, playground and all around us. Humans and robots can work alongside to make our planet safe from plastic pollution.*

Keywords*:* Plastic Bags, IR Sensor, Flex Sensor

INTRODUCTION

The purpose of our paper is to present a generalized approach towards a green environment. It describes the development of microcontroller base Robotic separation of non-degradable waste such as plastics from degradable waste. The trend towards economical, miniaturization and high efficiency is by using Infrared sensor and a flex sensor. Here we use an infrared sensor. The Infrared sensor fitted on the robotic arm to sense the materials such as plastic, wood, glass, metal and other materials present in the trash barrel. If the voltage ranges within the limit, the Infrared sensor sends a control signal to the robotic arm through the pre-programmed microcontroller; the robotic arm picks up the plastic material. Now the pre-programmed microcontroller activates the flex sensor and the control signal is sent from the microcontroller to the robotic arm to crush the material, based on the measurements of angular displacement the materials are classified. Finally the non-degradable wastes such as plastics are segregated.

ROBOTIC ARM

In the field of robotics the robotic arm can solve many human limitations. A typical robotic arm is made up of seven metal segments,connected by six joints.The microcontroller controls the movement of stepper motors connected to each joint. The robotic arm uses motion sensor to make sure it moves just the right amount. A robotic arm with six joints closely resembles a human arm, it has equivalent of a shoulder, an elbow and a wrist. The shoulder is mounted to a stationary base. Here we used this robotic arm to pick up the waste materials from the trash barrel.

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BLOCK DIAGRAM

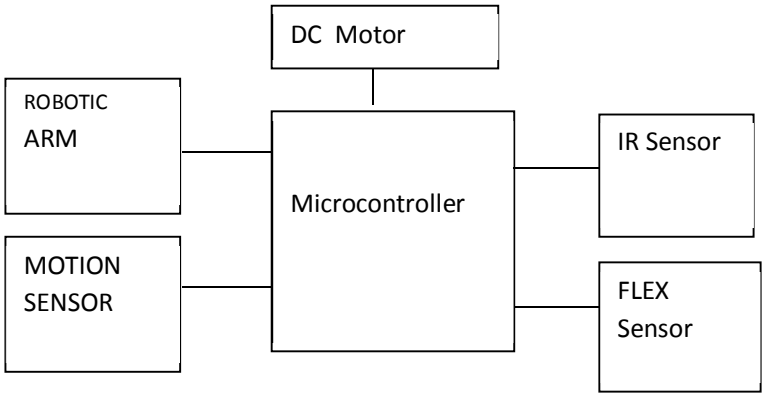

Fig. 1 Block diagram of Plastic Separator

MICROCONTROLLER

A microcontroller is a programmable digital processor with necessary peripherals. It is also known as a small computer on a single integrated circuit containing a processor core, memory and programmable input/output peripherals. It is a complex sequential digital circuit meant to carry out its job, according to the program.It is designed for embedded systems.Analog to digital converter is used to convert the physical quantities like pressure, temperature, etc into the electrical signal (i.e) voltage. A 8-bit ADC has a range of 0-255. The signals which we are getting from our sensor is of analog signal, so the analog signal must be converted to digital signal using analog to digital converter. By converting from analog to the digital, we can begin to use electronics to interface with the analog signal around us. The process flow of analog to digital converter is given below

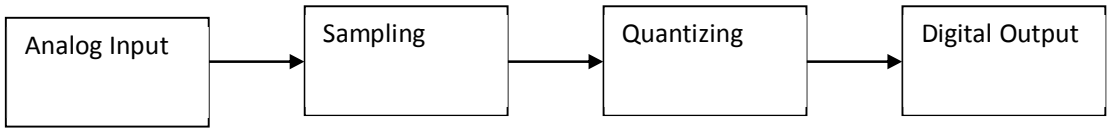

Fig. 2 Block diagram of analog to the digital converter

Infrared sensor

An Infrared sensor is an electronic device. IR sensor consists of an IR transmitter or an IR emitter and an IR detector. The emitter is simply an IR LED and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength. When IR light falls on the photodiode, the resistances and hence the output voltage change in proportion to the magnitude of the IR light received. Thus the light energy is converted to electrical energy. The IR detector is used in the feedback path of an inverting operational amplifier as shown in Fig.1 below. The output voltage of the op amp is given by

$$vo = \frac{Rf}{Ri}\ vi$$

where vi is negative reference voltage at the input, Rf is the variable resistance of photodiode, the gain of the op amp is gain=$-\frac{Rf}{Ri}$

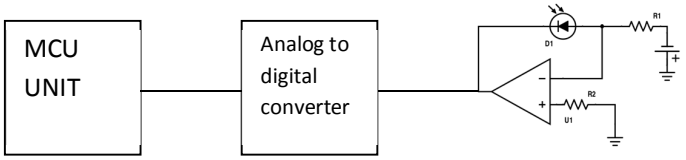

Fig 3. Infrared sensor

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The output of the op-amp is an analog voltage that varies acording to the light reflected from the plastic materials. The analog output of the op-amp is provided to analog to digital converter whose result is fed to the microcontroller. If the output voltage falls in the range of pre-programmed voltages for plastic, then microcontroller controls the movement of a robotic arm to pick up that material. Here we did a sample experiment to verify the behavior of the voltage for different thickness of plastics in microns.

TABLE I

THICKNESS OF PLASTIC VS VOLTAGE

Microns	Voltage (V)
40	0.2
30	0.4

FLEX SENSOR

Flex sensor has variable resistance that change its resistance depending on the amount of bend on the sensor. They convert meachanical pressure to electrical resistance, the more bend the more the resistance value. The Flat Resistance of flex sensor is 25K Ohms and Bend Resistance ranges fron 45K to 125K Ohms. They are usually in the form of a thin strip from 1"-5" long that vary in resistance.

The output of Infrared sensor is processed by the microcontroller and sends a control signal to the robotic arm to pickup the material. The robotic arm fitted with flex sensor crush the material, depending upon the bend applied to crush the material we can segregate non-degradable waste such as plastics from other metals, wood, glass. The bend radius needed to crush a plastic is high as compared to other materials like metals, wood and glass. The high resistance of the flex senor can be used easily separate plastic from other waste. The basic flex sensor circuit is given below

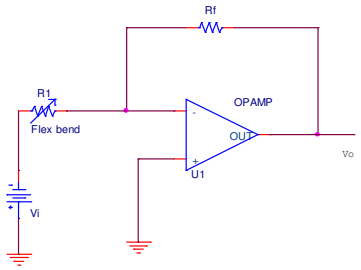

Fig 4. Basic Flex sensor circuit

The flex sensor is connected to an inverting op amp as shown in fig 4. The output voltage is given as

$$vo = \frac{Rf}{Ri}\ vi$$

where Ri is the variable resistance of the flex sensor.

A negative reference voltage vi will give a positive output. The output of Flex sensor circuit is converted to digital before fed to the microcontroller. The microcontroller compares the output voltage with the reference voltages for different grade of plastics stored in the memory to separate plastic from other waste.

CONCLUSION

The awareness of keeping our planet pollution free is increasing rapidly. Engineering always has been a part of development and fulfillment of all needs of Humanity. So here we have just one of the basic experimental solutions for saving our planet from plastic. Further enchancement of this concept can be made by the usage of capacitive proximity sensor instead IR sensors which can reduce time consumption and provide greater accuracy. So, in the future if this may becomes more effective solution to provide green environment and save us from non-degradable plastics. Betterment in cleaning process leads to betterment in life and society which further extends to a better planet to live.

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