PLASTIC WASTE MANAGEMENT

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Abstract

A trend of significant increase in plastic waste generation has been recorded worldwide. This has been found due to over population growth rate, industrialization, urbanization and economic growth which have ultimately resulted in increased plastic accumulation. In India 70 percent of total plastic consumption is discarded as waste. Around 5.6 million tons annum (TPA) of plastic waste is generated in country, which is about 15,342 tons per day (TPD). An efficacious management needs to be materialized for better planet to live in. The proposed work implements an automated waste segregator household level using microcontroller to control the entire process with ease and simplicity. The sensing unit consists of a capacitive proximity sensor to detect and segregate plastic wastes. The proposed systems would be best applied in industries that handle plastic shipped in from many sources including multiple numbers of municipal recycling facilities. Each of the sorting methods currently being researched would show a great promise in the future.

Keywords*: Automated waste segregator, a capacitive proximity sensor, industrialization, urbanization, recycling.*

INTRODUCTION

In this 21st century, an amalgam of technologies is quite essential for the development of the current system of waste management. The design automatically detects the plastic material and segregates it from other wastes.

The work requires some hardware and software tools working together to bring about the innovation which based on embedded systems. Embedded systems are designed to do some specific task, rather than being a general purpose computer for multiple tasks. The program instructions written for embedded systems are referred to as firmware. Data are stored in read-only memory or flash memory.

Related Work

Literature shows many analysis done on the effect of the plastics on aquatic organisms and the

different remedial measures for the same. The filter-feeder organisms ingest micro plastics (MP) while feeding. The impact of polystyrene microspheres (micro-PS) on the physiology of the Pacific oyster, adult oysters was experimentally exposed to virgin micro-PS for 2 months during a reproductive cycle. The effects were investigated on eco-physiological parameters in [1]. The actual environmental risks of different plastics and their associated chemicals needs a systematic assessment of adverse outcome pathways based on relevant metrics for exposure [2]. Author of [3] makes an attempt to use flexible dual-mode capacitive sensor for robot applications which has tactile and proximity sensing capability where the sensor consists of a mechanical structure based on PDMS (Polydimethylsiloxane) and a meshwork of multiple copper electrode strips. The mesh is composed of 16 top and 16 bottom copper strips crossed each other to form a 16 times 16 capacitor array. The proposed sensor is able to switch its function from tactile sensing to proximity sensing or vice versa by reconfiguring the connection of electrodes. [4] is the design of Soft fingers, which are made of macromolecular and have large elastic deformation. These fingers have a peculiarity that high friction force, which stabilizes a grasping condition, which helps in expansion of contact area between tip of soft finger and grasping object. The design of autonomous robot to pick and place objects has been done in [5] which definitely would improve the efficacy. Recycling technique is emphasized in [6] against other waste-reduction strategies, like the reduction in material use through product reuse, the use of alternative biodegradable materials and energy recovery as fuel. The work of [7] uses a system for performing minimally invasive cardiac procedures with a pair of surgical instruments tied up to a pair of robotic arms with end adjustable setup that can be manipulated to hold and suture tissue. The design can be used for the purpose of the waste management system robot as well. The work of [8] is a study that gives the monitoring of northern fulmar a sea bird to identify the effect of biological monitor for plastic pollution. [9] The effects of toxic chemicals present in plastic debris on bird physiology was analyzed and the mean mass of plastics found in the stomach was 0.23 g per bird. The waste management by using electronic system utilizes radio frequency identification of bin level. [10] proposes a smart recycle bin application based on information in the smart card to automatically calculate the weight of waste and convert the weight into point then store it into the card. Work of [11-14] also gives the brief idea of waste management, recycling methods etc.

Existing System

The existing system uses 8051 microcontroller which is the heart of the system. Inductive proximity sensor is used to detect if the waste is a metal or of any other kind. Also the wet or dry waste can be distinguished based on their weight. A high speed blower system is used to blow dry waste off the belt while most of the wet waste remains. It then falls off as the belt rotates and is collected separately. This system is particularly suitable for installation in apartments and colonies to maintain a hygienic waste management process.

Flow Diagram

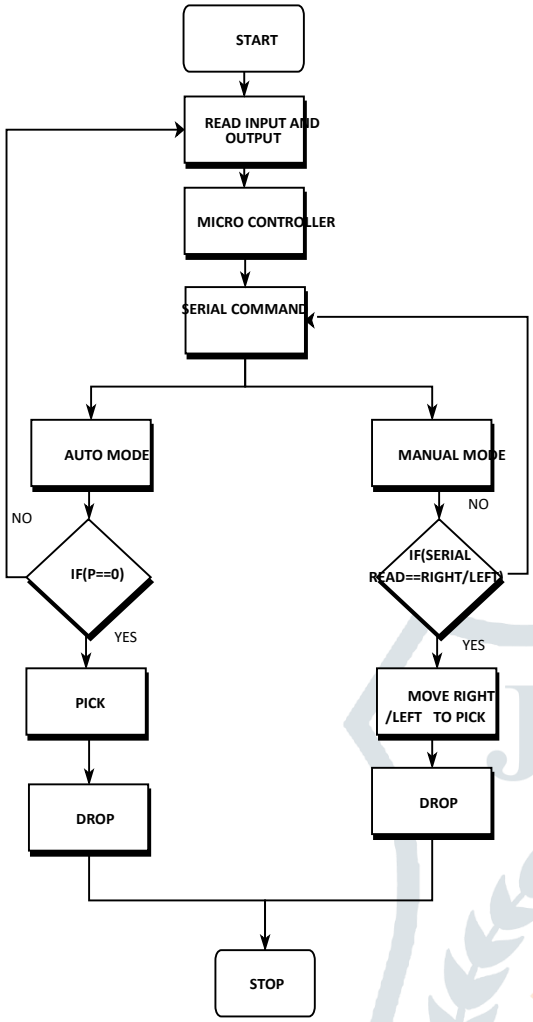

Fig 1. Work Flow Diagram

Proposed System

The sensing unit consists of a capacitive proximity sensor and soil conductivity sensor to detect plastic and solid waste respectively. The main architecture of the segregator comprises of two prominent stages consisting of 30 degree and 60 degree for segregation bins. Identification and separation of waste is done by sensors. The proposed work implements an automated waste segregator at household level using microcontroller, to control the entire process with ease and simplicity. The microcontroller controls all the activity of sensors. The objective of the proposed work is to effectively segregate plastics from the other wastes.

The sensing unit consists of a capacitive proximity sensor used to detect and identify plastic waste respectively. Once the plastics are detected the values are fed into the microcontroller. The controller runs the necessary software for the up down movement and 360 degree rotation of 2 axis robotic arm and thus the waste is placed in the respective bins and the status is displayed in the LCD.

The hardware part consists of capacitive proximity sensor used to detect and identify plastic waste respectively. When the plastic is detected the values are fed into the microcontroller then the servo motor and the stepper motor are operated accordingly for the up down movement and 360 degree rotation of the 2 axis robotic arm. Once the plastic is picked and placed in the allocated bin and then the display is made using the LCD. Thus the segregation makes it possible to reuse and recycle the plastic waste effectively. Fig 1 shows the work flow diagram.

Hardware Block Diagram

The hardware requirements are

- LCD display
- Capacitive proximity sensor
- Power supply
- Servomotor
- Stepper motor
- 2 axis robotic arm
- Arduino microcontroller
- Series voltage regulator[LM78XX]

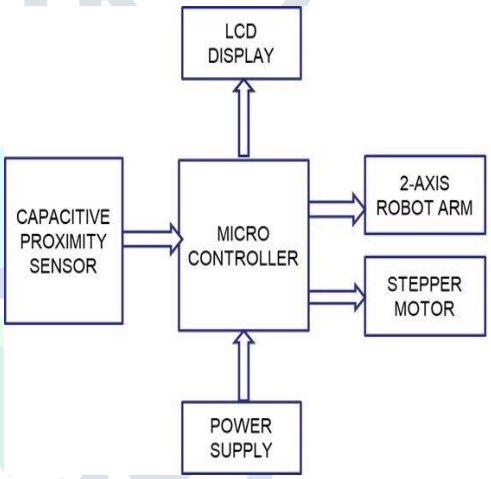

Fig 2. Hardware block

The fig 2 gives the hardware block diagram as explained previously.

Results and Discussion

Based on the design explained earlier the system has been designed and the snapshots of the implementation are as shown in Fig [3, 4] which shows the robotic arm picking up the waste and the display indicating the type of wastes. Further the different wastes are dropped into different bins. The number of trials was made and almost 80% of the time the result shows the positive results. Further there are two modes of operation where the first mode is the auto mode and the second one is the manually controlled mode through blue tooth.

Fig 3. Robotic Arm

Fig 4. LCD Display

Conclusion and Future Work

Industrialization, modernization, rapid advancements and increase in population have led to large generation of plastic waste. Segregation makes it possible to reuse and recycle the plastic waste effectively. The current systems would be best applied to industrial waste management, municipal recycling, apartments etc. These sorting methods currently being analyzed will definitely be a blessing to the society enabling a hygienic environment. This may be a trick to avoid direct involvement of the workers in segregation of wastes thereby reducing many threatening diseases.

Further research on the economics of the available technology like feasibility studies involving finding the amount of plastic intake that serves as the warning bell to the usage of plastic. As the government is now in an attempt to ban the usage of plastics the same system with minor modification can also be used for segregation of metallic, dry and wet wastes effectively. The studies are being done on improving the efficiencies and in building large scale systems

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