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Implementation of Automated Waste Segregator at Household Level

Balaguan¹, Raja S², Maheswaran T³, Savitha S⁴

II Year P.G. Student, ME Embedded System Technologies, Sri Shakthi Institute of Engineering and Technology,
Coimbatore, Tamilnadu, India. ¹

Assistant Professor, Dept. of ECE, Sri Shakthi Institute of Engineering and Technology, Coimbatore, TN, India. ^{2,3}

ABSTRACT: Rapid increase in volume and types of solid and hazardous waste due to continuous economic growth, urbanization and industrialization, is becoming a burgeoning problem for national and local governments to ensure effective and sustainable management of waste. It is estimated that in 2006 the total amount of municipal solid waste generated globally reached 2.02 billion tones, representing a 7% annual increase since 2003 (Global Waste Management Market Report 2007). The segregation, handling, transport, and disposal of waste need to be properly managed to minimize the risk, health and safety of patients, the public, and the environment. The economic value of waste is best realized when it is segregated. Currently, there is no such system of segregation of dry, wet and metallic wastes at the household level. This paper proposes implementation of an automated waste segregator at household level using PIC16F877 microcontroller, to control the entire process with ease and simplicity. The sensing unit consists of an IR (Infrared) sensor, a moisture sensor and a metal sensor used to detect and identify various types of waste respectively. The main architecture of the segregator comprises of three prominent stages consisting of an IR sensor, a metal sensor, a moisture sensor and the segregation bins. The IR sensor detects the arrival of waste. Identification and separation of waste is done by sensors. The microcontroller controls all the activity of sensors. Results have presented segregation of waste into metal, wet and dry waste.

KEYWORDS: hazardous waste, automated waste segregator, moisture sensor, metal sensor, personal computer.

I. INTRODUCTION

Embedded system is a combination of hardware and software use to achieve a single task within a given time frame, repeatedly and endlessly, with or without human interactions. Embedded system of a computer system that monitor, respond to control an external environment. Environment connected to system through sensors, actuators and other input output interfaces. Embedded system must meet timing and other constraints imposed on it by environment. An embedded system in general, incorporates hardware, operating system and peripheral devices and communication software to enable to perform the predefined functions. In contrast to desktops that perform a variety of tasks, an embedded system performs a single, well-defined task. The system has a processor, associated peripherals and software for a specific purpose. An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is to be flexible and to meet a wide range of end-user needs.

Embedded systems control many devices in common use today. Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from

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economies of scale. On a continuum from "general purpose" to "embedded", large application systems will have subcomponents at most points even if the system as a whole is "designed to perform one or a few dedicated functions", and is thus appropriate to call "embedded".

In recent times, garbage disposal has become a huge cause for concern in the world. A voluminous amount of waste that is generated is disposed by means which have an adverse effect on the environment. The common method of disposal of the waste is by unplanned and uncontrolled open dumping at the landfill sites. This method is injurious to human health, plant and animal life. This harmful method of waste disposal can generate liquid leachate which contaminate surface and ground waters; can harbour disease vectors which spread harmful diseases; can degrade aesthetic value of the natural environment and it is an unavailing use of land resources. In India, rag pickers play an important role in the recycling of urban solid waste. Rag pickers and conservancy staff have higher morbidity due to infections of skin, respiratory, gastrointestinal tract and multisystem allergic disorders, in addition to a high prevalence of bites of rodents, dogs and other vermin. Dependency on the rag-pickers can be diminished if segregation takes place at the source of municipal waste generation. The economic value of the waste generated is not realized unless it is recycled completely. Several advancements in technology[3] has also allowed the refuse to be processed into useful entities such as Waste to Energy, where the waste can be used to generate synthetic gas (syngas) made up of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam; Waste to Fuel, where the waste can be utilized to generate bio fuels. When the waste is segregated into basic streams such as wet, dry and metallic, the waste has a higher potential of recovery, and consequently, recycled and reused. The wet waste fraction is often converted either into compost or methane-gas or both. Compost can replace demand for chemical fertilizers, and biogas can be used as a source of energy. The metallic waste could be reused or recycled. Even though there are large scale industrial waste segregators present, it is always much better to segregate the waste at the source itself. The benefits of doing so are that a higher quality of the material is retained for recycling which means that more value could be recovered from the waste[3]. The occupational hazard for waste workers is reduced. Also, the segregated waste could be directly sent to the recycling and processing plant instead of sending it to the segregation plant then to the recycling plant. Currently there is no system of segregation of dry, wet and metallic wastes at a household level.

II. RELATED WORK

Rapid increase in volume and types of solid and hazardous waste due to continuous economic growth, urbanization and industrialization, is becoming a burgeoning problem for national and local governments to ensure effective and sustainable management of waste. It is estimated that in 2006 the total amount of municipal solid waste generated globally reached 2.02 billion tones, representing a 7% annual increase since 2003 (Global Waste Management Market Report 2007). The segregation, handling, transport, and disposal of waste needs to be properly managed to minimize the risk to the health and safety of patients, the public, and the environment. The economic value of waste is best realized when it is segregated. Currently, there is no such system of segregation of dry, wet and metallic wastes at the household level. This paper proposes an Automated Waste Segregator (AWS) which is a cheap, easy to use solution for a segregation system for household use, so that it can be sent directly for processing. It is designed to sort the refuse into metallic waste, wet waste and dry waste. The AWS employs parallel resonant impedance sensing mechanism to identify metallic items, and capacitive sensors to distinguish between wet and dry waste. Experimental results show that the segregation of waste into metallic, wet and dry waste has been successfully implemented using the AWS.

Solid waste management is a challenge for the cities' authorities in developing countries mainly due to the increasing generation of waste, the burden posed on the municipal budget as a result of the high costs associated to its management, the lack of understanding over a diversity of factors that affect the different stages of waste management and linkages necessary to enable the entire handling system functioning. An analysis of literature on the work done and reported mainly in publications from 2005 to 2011, related to waste management in developing countries, showed that few articles give quantitative information. The analysis was conducted in two of the major scientific journals, Waste Management Journal and Waste Management and Research. The objective of this research was to determine

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Vol. 6, Issue 10, October 2017

the stakeholders' action/behaviour that have a role in the waste management process and to analyze influential factors on the system, in more than thirty urban areas in 22 developing countries in 4 continents. A combination of methods was used in this study in order to assess the stakeholders and the factors influencing the performance of waste management in the cities. Data was collected from scientific literature, existing data bases, observations made during visits to urban areas, structured interviews with relevant professionals, exercises provided to participants in workshops and a questionnaire applied to stakeholders. Descriptive and inferential statistic methods were used to draw conclusions. The outcomes of the research are a comprehensive list of stakeholders that are relevant in the waste management systems and a set of factors that reveal the most important causes for the systems' failure. The information provided is very useful when planning, changing or implementing waste management systems in cities.

Kolkata generates almost 5500 ton of municipal solid waste (MSW) per day. The waste of the city is maintained by Kolkata Municipal Corporation (KMC) and around 80% of this waste is collected by corporation waste management system KMC has introduced the Modern Scientific Waste Compacting Stations (MSWCS) under the Clean City initiative. The MSW thus collected were taken to the nearest compactor station which houses around two to five compactors depending upon the area, in total there are 90 compactors and 30 mobile compactors functioning till date. The number is expected to go up by the end of 2015 to 163 compactors at a cost of INR 152 crore. The previous method of dumping in open Vat was unhygienic and produced odor and vector borne diseases in the vicinity and the people living near were largely affected. Though the addition of compactor has enhanced the cleanliness of the city but the sustainability of these waste compactors is a major issue and which is needed to be addressed. The disposal of the compacted waste is still being carried out in traditional landfill site and the landfill site and city distance being smaller raise a question on transportation savings which may have been incurred due to the compactor thus the payback period and long-term sustainability of the compactor is in question. The sustainability issues and challenges were identified based on a preliminary field study in 15 of the compactor station in Kolkata. The waste quantity, waste characteristics, number of trip of the compactors, labours requirements and number of other sustainability factors were evaluated. The data collected were benchmarked based on the literature, with the practices of other countries. The study reveals that there is number of issues which are lacking and needed to be implemented within the waste compactor management system to make the project sustainable in long run. The analysis revealed the need for a sanitized landfill site for methane extraction and segregation of waste before compacting for increasing the sustainability of the system. The studies finding if implemented can led to a more sustainable, economical and environmentally sound waste management system for the city of Kolkata. There are number of literature specific to waste management practices but specific study for waste compactor in a city and for Kolkata is unavailable in literature.

III. EXISTING SYSTEM

Industrialization, modernization, rapid advancements and increase in population have led to large generation of waste. Lack of improper disposal scheme in the country has headed the problem of accumulation of wastes. Due to this waste lies littered in the surrounding, dumped on open lands and this becomes major home for various types of disease causing bacteria and viruses which is why waste management is of vital importance. Segregation makes it possible to reuse and recycle the waste effectively. As we move towards a more digitalized future, it is directly proportional to increase in urbanization and industrialization. This is the main cause of generation of large amount of waste. As per the report published by World Bank, approximately 1.3 billion tons of municipal waste is generated every year and it is expected to rise to approximately 2.2 billion tonnes per year by 2025. So the waste management becomes an important concern for the health and well-being of the society. Presently, the waste segregation is done manually by installing different bins for collecting different type of waste such as wet, dry and metal etc. But this method has lot of discrepancy, one being the unawareness of most people towards waste management. Due to lack of proper segregation methods, a large amount of untreated waste is dumped as landfills. Expenditure on waste disposal, manual effort required for waste segregation and the waste could be easily be recycled, reused and reduced.

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Vol. 6, Issue 10, October 2017

IV. PROPOSED SYSTEM

This paper proposes implementation of an automated waste segregator at household level using PIC16F877 microcontroller, to control the entire process with ease and simplicity. The sensing unit consists of an IR (Infrared) sensor, a moisture sensor and a metal sensor used to detect and identify various types of waste respectively. The main architecture of the segregator comprises of three prominent stages consisting of an IR sensor, a metal sensor, a moisture sensor and the segregation bins. The IR sensor detects the arrival of waste. Identification and separation of waste is done by sensors. The microcontroller controls all the activity of sensors. Results have presented segregation of waste into metal, wet and dry waste. An Automation of Waste material Segregation in scrap industry. This method is easy and simple solution of segregation of three types of wastes glass, metal and plastic. It is designed to sort the trash into metallic waste, plastic waste and glass waste ready to be processed separately for the next process of operation. The Method uses inductive sensors metallic items, and capacitive sensors to distinguish between and dry waste. Experimental results show that the segregation of waste into metallic, plastic and glass waste has been successfully implemented using the Automation of material segregation (AMS) method.

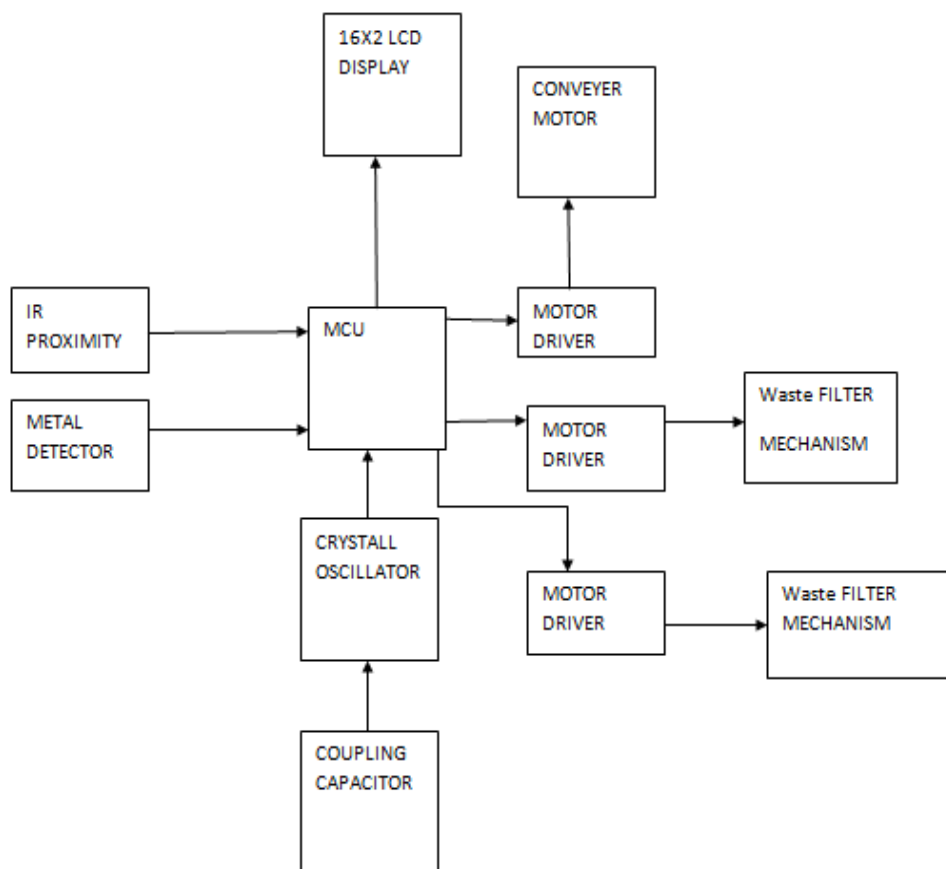


Fig 1: Proposed system block diagram

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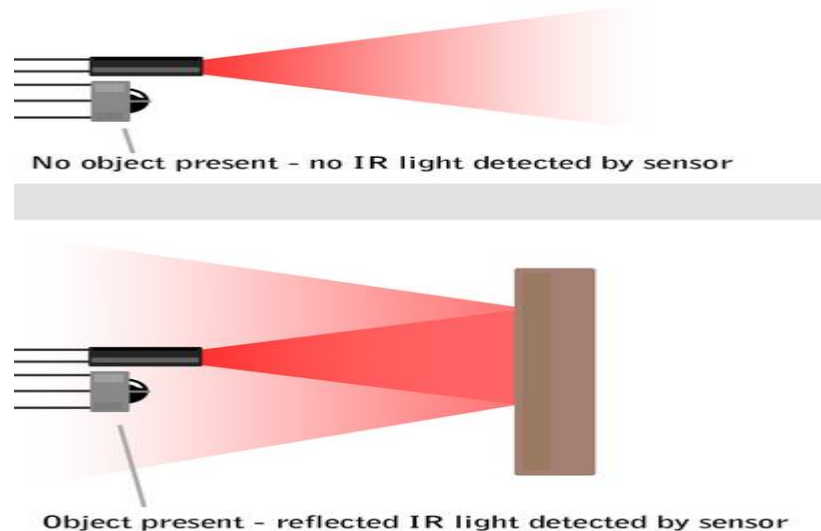


Fig 3: wavelength in the Infra-Red (IR) spectrum

Metal Sensor:

The object moves over the incline and falls over the metal sensor. The sensor is made up of inductive oscillator circuit which monitors high frequency current loss in coil. The circuit is intended for any metallic body detection by distinguishing the variations in the high frequency Eddy current losses. They act as oscillators with aid of external tuned circuits. Output signal level is changed by an approaching metallic object.

LCD – Liquid Crystal Display

Liquid Crystal Displays (LCDs) have materials, which combine the properties of both liquid and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material sandwiched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed. Polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. On each polarizer is pasted outside the two glass panels. This polarizer would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarizer and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating / highlighting the desired characters. LCDs are lightweight with only a few millimetres thickness. Since LCDs consume power, they are compatible with low power electronic circuits, and can be powered for long durations. LCDs do not generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. LCDs have long life and a wide operating temperature range. Changing the display size of the layout size is relatively simple which makes LCDs more customer friendly. LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in LCDs being extensively used in telecommunications and entertainment electronics. LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications.

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DC Motor

The direct current motor or the DC motor has a lot of application in today's field of engineering and technology. Starting from an electric shaver to parts of automobiles, in all small or medium sized motoring applications DC motors come handy. And because of its wide range of application different functional types of dc motor are available in the market for specific requirements.

V. RESULTS AND DISCUSSION

It consists of vertical arrangements with three subdivisions i.e. waste detection, metal sensing/moisture sensing section (for metal and dry/wet waste) and the segregation section. Foremost of all, IR sensor marks the introduction of waste when waste comes in proximity of it. After identifying the entry of waste, metal sensing section starts with a 'flap opening' through which garbage goes into the assembly. The waste to be segregated comes in contact with the inductive oscillator circuit mounted in metal sensing section which monitors high frequency current loss in the coil. The output signal is defined by changes in supply current. According to the presence or absence of a close metallic object, the output is high or low, but this variation in the output signal is independent of supply voltage. For performing simulation here Proteus tool is used. The simulation work of the waste segregator is shown below.

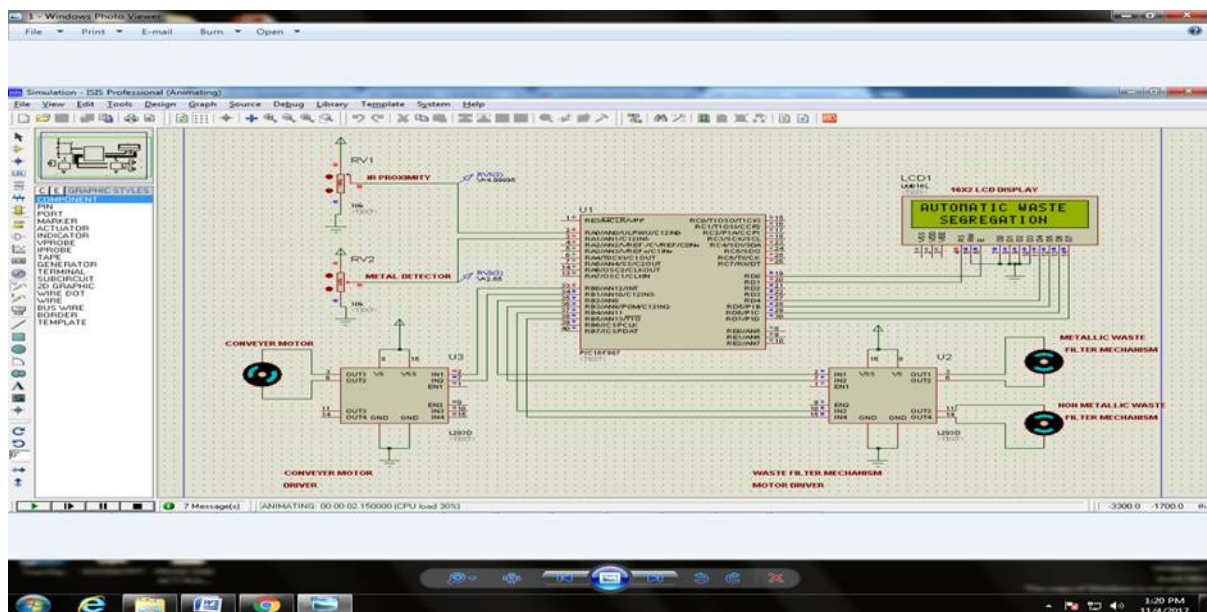


Fig 4: Simulation Result of an Automatic Waste Segregation Circuit.

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Visit: www.ijrset.com

Vol. 6, Issue 10, October 2017

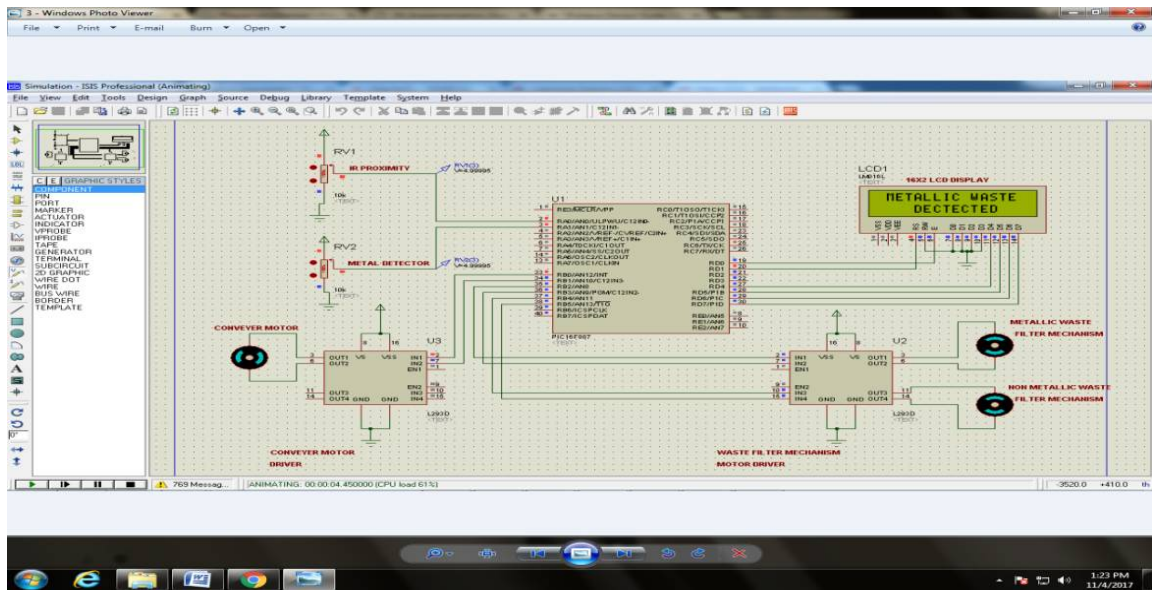


Fig 5: Simulation Result of Metallic Waste Detector Circuit.

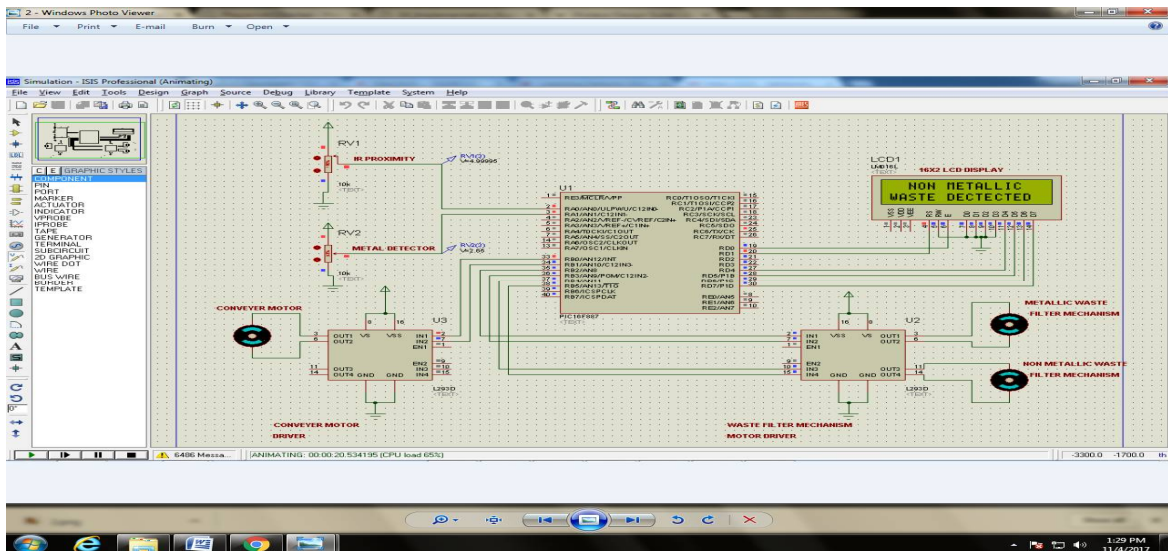


Fig 6: Simulation Result of Non Metallic Waste Detector Circuit.

The simulation of the project work has successfully been executed by using Proteus software. It is an economical and user-oriented waste segregation method at household level. The results can also be seen on the LCD display every time when a new waste arrives. The LCD shows the type of waste that comes into the segregator and displays (metal, non-metal) waste detected as the output.

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Vol. 6, Issue 10, October 2017

VI. CONCLUSION

Automated Waste Segregator has been successfully implemented for the segregation of waste into metallic, dry and wet waste at a domestic level. Noise can be eliminated in the sensing module to increase accuracy and overall efficiency. The system can segregate only one type of waste at a time with an assigned priority for metal, wet and dry waste. This project has been made using PIC controller and sensors such as metal, moisture and IR. The moisture sensor is not so efficient therefore we can make use capacitive plates to detect the wet and dry waste. Also the project can be done by using Arduino, MSP 430 or any other high end microcontroller. The project can further be implemented in industries on a bigger scale in order to make the correct choices for disposal of hazardous wastes and other types of harmless waste. With a designate primacy for metal, dry and wet waste, the system can isolate only one sort of waste at a time. Henceforth, advances can be made to separate the assorted type of waste by utilization of buffer spaces. Since, the time for sensing metal objects is low the entire sensing module can be placed along a single platform where the object is stable to ensure better results.

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