ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

FPGA Implementation of Solid Waste Bin Monitoring and Collection system

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Abstracts

Solid waste management is anunavoidableissue in city areas for almost all the countries in the world. To maintain a safe and green environment for people, it is necessary to adopt an effective waste management system because disposal of wastes are drastically increasing day by day. Nowadays, many technologies are being proposed for waste collection and recycling. In this paper, we have proposed an integrated system consisting of 4 pair of remote sensor,2 modules of Global System for Mobile communication (GSM) and General Packet Radio Service (GPRS) The FPGA module would automatically retrieve all levels of Remote sensors information from the bin. with the help of modules, mounted with each bin. GPS/GSM would give the location information of the collection truck.The GPRS communication system will help the center server to update all the information immediately and automatically. The performance of the proposed system has been implemented in such a way that it is much better than the existing system in every aspect such as precision, real time and reliability and high speed data transmission.

Keywords GSM, GPRS, GPS, IR sensors, FPGA, Solid waste bin monitoring and collection.

Introduction

Solid waste is the unwanted or useless solid materials created from all industrial and commercial works in a particular area. Solid waste has become a challenging issue that isdue tofast increasing urbanization andeconomicdevelopmentwhich is witnessed by the amount of municipal solid waste.If proper steps are not taken and proper management is not proposed, it will highly create impact on human health. Some primary methods wereadopted previously such as incineration, open burning, dumping, landfills, but it will work only if handled properly The overall generation rate in rural areas is very low which is 0.15 kg/cap/day, while 1.0 kg/cap/day in the urban areas. Cities are more affected by wastes compared to rural areas Thegrowing amount and complexity of waste associated with the modern economy is contributing a dangerous risk to our ecosystems and health of human. An overall figure of 11.2 billion tons of solid waste gets collected throughout the world every year and decaying of organic part of solid waste is above 5 per cent of the gas emission of global greenhouse which is a serious problem to be considered. The solid wastes which contains new and contaminated hazardous andharmful substances provides with the fastest-growing challenge in developing and developed countries as well

Inefficient waste management from poor collection systems to unmanaged disposal -createswater, soil and air pollution. Drinking water also gets contaminated due to open and improperly handled sanitary landfills and which eventually spread diseases and infect public health.Ecosystems gets polluted due to dispersal of debris and harmful toxins from waste or garbageof industrial elements affect the health of inhabitant of urban areas and the environment too..

The first and foremost solution is to minimizethe waste materials. Practically,we cannot avoid the waste but we can recover materials and energy from it and also can remanufacture and recycle waste into products which can be used as usable products further by people. This would be the second option and solution. Resources are saved to substantial amount due to recycling. 50 per cent of water and 17 trees can be saved per ton of paper which is recycled. Over and above, recycling gives jobs where 12 million people are employed by this sector in Brazil, United States and china alone.

China is the country where municipal solid waste is grown the fastestwhich in 2004 even surpassed the United States where the waste generation is largest and also other parts of Eastern Europe and East Asia.The United States generated about 250 million tons of trash which was recycled and composted almost 87 million tons in 2011 where the recycling rate was 34.7 percent.1.53 pounds of waste are recycled and composted on average where 4.40 pounds per person per day is the individual waste generation

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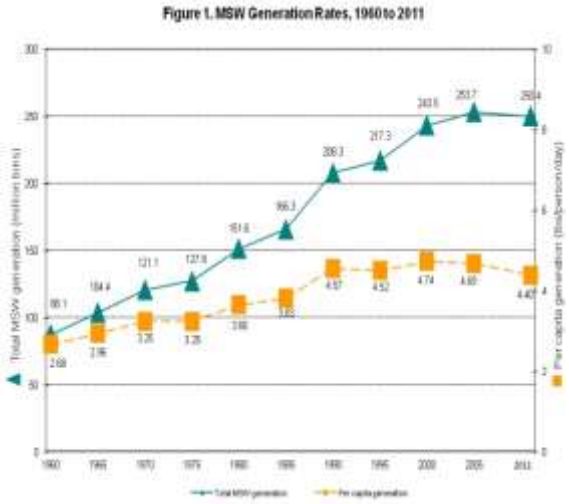

Fig 1. MSW Generation Rates in America in 1960-2011

Fig 1 shows the municipal solid waste generation in America from 1960 to 2011.Each and every country is trying its level best to make the environment pollution free. There are some hopes which can be implemented in our project. Manual collection of solid waste will not be done as in existing system. Using sensors in the bin will make the technology easier to manage the solid waste. Here the main work to create a network using IR sensors for solid waste bin monitoring and collection system.

Proposed system

Basically,the project is focused on the hygienic environment of our surrounding. Solid waste without proper management in the urban area causes many challenges .Due to improper management,it affects the human health of the particular surrounding. Exposure to hazardous solid waste can affect human health, children being more vulnerable to the pollutants.Improperly operated incineration plants cause air pollution and improperly managed and designed landfills attract all types of insects and rodents that spread disease.Waste workers andthe rag pickers are risked withchronic diseases which is the most vulnerable one which occur due to direct handling of solid waste

In our proposed system the sensing unit, consisting of 4 sensors which are mounted on the bin, will be automatically updating the status of the bin continuously. So, we can easily identify the over flowing bin status and also suddenly arrange the truck service for cleaning through SMS service. We are going to use 4 infrared sensors in our project.IR Sensors use a specific light to detecta selected light wavelength in the Infra-Red (IR) spectrum. LED produces light at the same wavelength as the sensor does. When an object comes closer to thesensor, the light from the LED falls on the object and reflects back to the light sensor. This results in a large jump in the intensity, which can be detected using a threshold.The sensors give 4 levels of status in the bin FPGA gets all the sensor status of the bin and enables the GPS system. For real time application,we need very fast and speedy response. So, we are going to use FPGA in our project. The information of the bin will be communicated through the GSM network. The information for the truck location will be updated in the system of the server section. Through this project, we are trying to make the system easy for the people who are in authority of the waste management.Once the truck gets located,the person-on- duty will be informed by sms service through the GSM network. It will be very easy for the senior authority people to check whether the person on-duty is a responsible one or not which is eventually helpful to the government.

The main aim of the project is to make an innovative and very effective system for those who deals with the waste authority management The main ambition of the project is to make the environment pure and hygienic for the safety of general public In this case, the details of the on-duty person for waste collection will be sent to the senior authority through the system. If in case, the on duty person fails to do his duty for any reason will be caught in no time

Block diagram

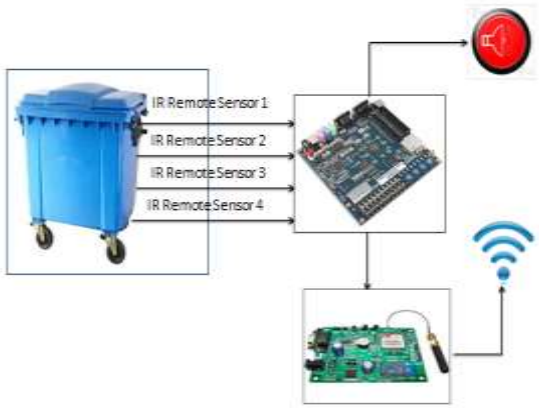

Fig 1 block diagram of bin section

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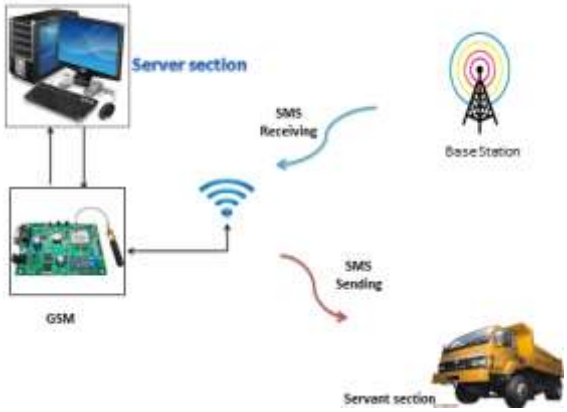

Fig 2 block diagram of Server section

Block diagram description

Fig 1 shows the bin section of the proposed system.In the bin,4 IR sensors are mounted for giving the solid waste status Instead of using 4 sensors, we can use 3 sensors also.In case,the 4 levels in the bin are overfilled with solid waste,it will show a overflowing status i.e the buzzer will be on.Theretreived information in the FPGA will be communicated through the GSM module enabling the GPS system which is located in the server section.

Fig 2 shows the server section of the proposed system.GPS provides accurate location and time information of the person on dutyi.e the collection truck.GPS satellites broadcast signals from space that are picked up and identified by GPS receivers. GPS receiver then provides three-dimensional location (latitude, longitude, and altitude) plus the time which will be updated immediately in the system of server section.The person on duty will get the sms for collecting the waste through the network by the higher authority person.

Conclusion

In this paper, an integrated system of FPGA,GSM, GPS and GPRS is introduced for efficient and economic solid waste collection. The developed system provides improved database for waste collection time and waste amount at each location. The system is also contributed to reallocate the location of the bin, new collection route using the data are saved in center server. GPS data would help to select the dumping point or relocation by giving the collection truck monitoring facilities.and gives the scope of identification as per system requirements. GSM communication system has provided a high data transmission rate for real time monitoring.

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