

SENSOR BASED INTELLIGENT WASTE MANAGEMENT SYSTEM FOR SMART CITY

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Abstract— Globally, most waste is currently dumped or disposed of in some form of a landfill. The idea of intelligent waste management system for smart city is for smart buildings, colleges, hospitals and bus stand. The smart dustbin thus thought is an improvement of normal dustbin by elevating it to be smart using sensors and logics. Smart dustbins is a new idea of implementation which makes a normal dustbin smart using ultrasonic sensors for garbage level detection and sending message to the user updating the status of bin using GSM module. As soon as the dustbin is full a smart solid waste collecting system. It is a common sight to witness garbage spilled out in and around the dustbins. The area around an improperly maintained dustbin can house disease spreading insects like mosquitoes, flies, bees and driver ants. The environment around a dustbin is also conducive for increasing the pollution level in air. Air pollution due to dustbin can produce bacteria and virus which can produce life threatening disease in human beings.

Keywords—*Theory of waste management, Waste, non- waste, waste management.*

I. INTRODUCTION

Waste management is all the activities and actions required to manage waste from its inception to its final disposal. This includes collection, transportation and disposal of waste together with monitoring and regulation. Waste collection methods vary widely among different countries and regions. Curbside collection is the most common method of disposal in most countries, in which waste is collected at regular intervals by specialized trucks. Waste collected is then transported to an appropriate disposal area.

Now days, cities with developing economies experience exhausted waste collection services, inadequately managed and uncontrolled dumpsites and the problems are worsening. Waste collection method in such countries is an on-going challenge and many struggle due to weak institutions and rapid urbanization.

A. Need for Improvement in waste management system

Efficient and energy saving waste management system, reducing Co₂, air pollution and vehicle exhaust emissions – these are just a examples for the demands of future cities. In views of that, the efficient use and responsible handling of resources become more important.

The system prevents harm to human health and the environment by reducing the volume and hazardous character of residential and industrial waste. Improving proper waste management will reduce pollution, recycle useful materials and create more green energy.

B. Features of smart waste management system

The smart sensor based dustbin will judge the level of waste in it and send the message directly to the municipal corporation. It emphasizes on “Digital India”. If there is any problem with any equipment in the future, that part is easily replaceable with new one without any difficulty and delay.

II. BACKGROUND

The system of waste management is lacking of information about collecting time and area. Lack of proper system for monitoring, tracking the trucks and dustbin have been collected in real time.

A. IoT based garbage and dustbin detection system

This system is to reduce amount of food waste. The battery based system exchange information with each other using wireless mesh networks, and a router and server collect and analyze the information for a service provisioning and include various IoT techniques for user convenience. The proposed system has been operated for a one year period, it shows that the average amount of 30 percent of food waste reduced.

B. Integrating different sensing and communication technologies

The system consists of bins with sensor nodes, gateways and base station. Sensor nodes measure and transmit waste conditions inside bin at every access, gateways forward data to base station after receiving and base station stores data for further use. The system helped to minimize collection route and fuel cost.

C. Reducing cost of Waste Management system

This system reduce cost of the system and to facilitate automating the waste identification and weight quantity processes, radio frequency identification and load sensor is used for designing smart waste management system.

It is the basic essential of healthy environment for above two hundred municipalities in Australia, the highest waste generators in the world. Waste disposal is a key environment concern, principally in urban centers in Australia.

D. Sensor Unit Waste Management System

This system is proposed to give a solution for improper waste disposal system. It comprises the use of biosensor and weight sensor along with height sensor to sense the run over of the waste in the dustbin and the intensity of pollution caused by undesirable poisonous gases from the dustbins. Afterwards, these sensors are fed to the controller to help the GSM module to send the notification to the respective authority about the status of dustbin. The main aim to provide solution for proper disposal of waste. Effective management system is achieved through the use of sensors in this paper where sensors units are used for sensing, microcontroller for controlling and GSM module for communication and solar energy is used for the power necessary in operating system.

III. PROPOSED WORK

The proposed system is to have a green and clean environment. The proposed system is focused on the over filling of waste in the dustbin and proper intimation to the respective authorities. The operation of dustbin is controlled by electronic circuits. The sensors used in the smart dustbin are employed for various control and monitoring operations. The ultrasonic sensors are used in front of the dustbin to dispose the waste.

The dustbin cap is closed during normal operating condition that is during no person are present to dispose the waste. The cap opens for any person are present in front of dustbin to dispose the waste. The dustbin remains open till the person in front of it, is closed when the person leave from the position. The system of operation of dustbin is achieved by using stepper motor.

There is leveling sensors used inside the dustbin to monitor the level of filled waste in it. The sensor once the waste inside the bin reached the sensor, permanently closed the top of bin. If any person in front of dustbin, it never opens since it is filled up to its maximum level. On the same instant a message is passed to the truck driver and respective authority to intimate the particular dustbin is filled at particular location for the identification of dustbin each bin are numbered. The passing of message is achieved by using GSM. It is programmed to send message to the respective authority when a signal from level sensor is received. After clearing the waste in the filled bin, the bin operated normally that is during the present of person in front of it, its cap open to dispose the waste in it. It helps to avoid the overflow of dustbin because breeding of mosquitoes and houseflies occur mainly in garbage which are major because for various disease like malaria, dengue, etc., it also causes headache and increase in stress level. The system will give the real time information about the dustbin. The resources are available easily and improve environment quality. By using the system, waste collection would become efficient and also reduction in transportation costs can be witnessed. The system has no individual use, but can be used by city, state or country.

IV. HARDWARE IMPLEMENTATION

A. Power Supply

The electrical power is almost exclusively generated, transmitted and distributed in the form of AC because of economical consideration but for operation of most of the electronic devices and circuits, DC supply is required.

The basic power supply is constituted by four elements: transformer, a rectifier, a filter and regulator put together. The output of the dc power supply is used to provide a constant dc voltage across the load. Transformer is used to step – up or step – down the supply voltage as per need of the solid state electronic devices and circuits to be supplied by the dc power supply. It can provide isolation from the supply line an important safety consideration. It may also include internal shielding to prevent unwanted electrical noise signal on the power line from getting in to the power supply and possibly distributing the load.

B. Filter

A capacitor is added in parallel with the load resistor of a rectifier to form a simple filter circuit; the output of the rectifier will be transformed in to a more stable DC voltage. The capacitor is charged to the peak value of the rectified waveform. Beyond the peak value, the capacitor is discharged through the load resistor until the time at which the rectified voltage exceeds the capacitor voltage. Then the capacitor is charged again and the process repeats itself.

C. IC Voltage Regulator

The voltage regulator comprises a class of widely used IC's. Regulator IC units contain the circuitry for reference sources, comparator amplifier, control device and overload protection all in a single IC. It provides regulation of a fixed positive voltage, a fixed negative voltage or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of mill amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

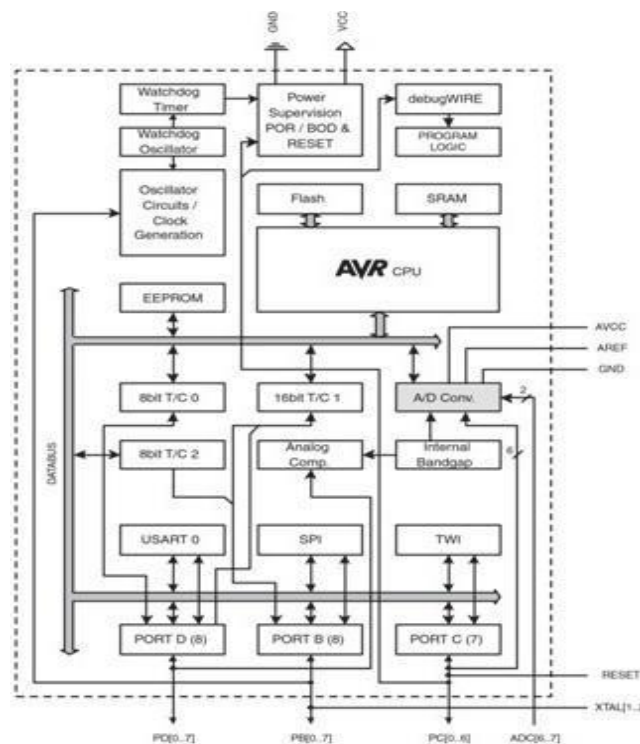
A fixed three-terminal voltage regulator has an unregulated dc input voltage, applied to one input terminal, a regulated dc

output voltage, from a second terminal, with the third terminal connected to ground. The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts. This is a regulated power supply circuit using the 78xx IC series. These regulators can deliver current around 1A to 1.5A at a fix voltage levels. The common regulated voltages are 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, and 24V.

D. Microcontroller ATmega328/P

The atmega328/P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the atmega328/P achieves throughputs approaching 1 MIPS per mhz allowing the system designed to optimize power consumption versus processing speed. The device which enhances power – on reset and programmable brown out detection, Internal calibrated oscillator and external and internal interrupt sources. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

Fig. 4.1 Block diagram for Atmega32/P



The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption.

The device is manufactured using Atmel’s high density non-volatile memory technology. The On-chip ISP flash allows the program memory to be reprogrammed. The System through an SPI serial interface by a conventional nonvolatile memory programmer or by an On-chip Boot program running on the AVR core. The Boot program can

use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In- System Self-Programmable Flash on a monolithic chip, the Atmel atmega48a/PA/88A/PA/168A/PA/328/P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

E. GSM Module

SIM800C is a SMT package with 42 pads, and provides all hardware interfaces between the module and Customer’s boards. One 3 lines serial port and one full modem serial port. One USB interface for download software. A audio channel which include a microphone input and a speaker output. It has a programmable general purpose input and output. SIM800C is designed with power saving technique so that the current consumption is as low as 0.6ma in sleep mode.

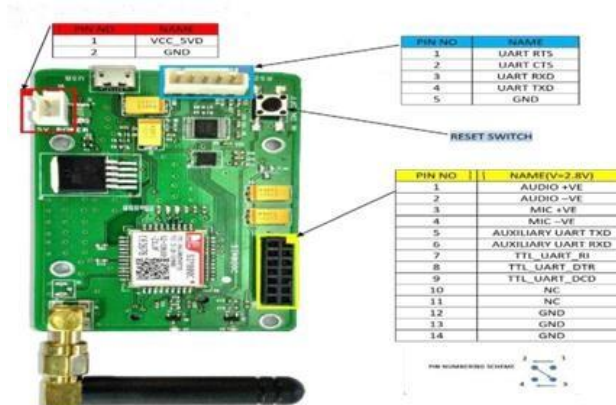


Fig 4.2 GSM Module

F. Ultrasonic Sensor

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The module includes ultrasonic transmitters, receiver and control circuit. This sensor using IO trigger for at least 10us high level signal. The module automatically send eight 40 KHz and detect whether there is a pulse signal back. IF the signal back, through high level, time of high output IO duration is the timefrom sending ultrasonic to returning.



Fig 4.3 Ultrasonic Sensor

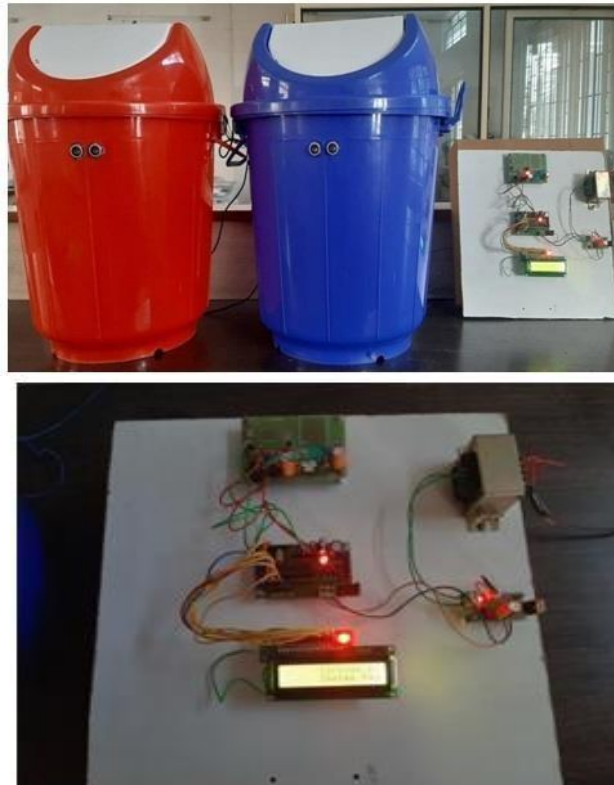
G. Micro Servo Motor

The SG90 mini servo is lightweight, high-quality and lightning-fast. The servo is designed to work with almost all the radio control systems. It is with excellent performance and high torque of 1.5kg cm gives you the freedom to use it for a variety of projects. The SG90 miniservo with accessories is perfect for R/C helicopter, plane, car, boat and truck use.



Fig 4.4 Micro Servomotor

V. EXPERIMENTAL SET UP



VI. CONCLUSION AND FUTURE SCOPE

The Proposed work has been performed for collecting the details of smart garbage management methods and to find out effective methods which are useful for providing hygiene environment in cities. As the level of garbage in the bins crossed the threshold, it will be informed to the corresponding authority, if it was found ignored then the details will be forwarded to the higher authority to take necessary actions. Thus a hygiene and clean environment can be provided. Our project helps to identifying all possible smart garbage management methods that can be implemented to make city clean.

This Smart Dustbin can contribute a lot towards clean and hygienic environment in building a smart city. But since the technology to give proper awareness should be created among the public before it is implemented on a largescale. Otherwise, sensitive devices like sensors might be damaged due to rough action of the users.

In future the dustbin will be supplied with solar power. Also it is fixed with a vibrator, which is used to fill the waste inside the bin in an even manner, and thus improves proper and maximum filling of the waste.

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