IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Vol. 12, Issue 3, March 2023

DOI: 10.17148/IJARCCE.2023.12363

SMART WASTE MANAGEMENT FOR METROPOLITAN CITIES USING IOT

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Abstract: In our city many times we see that the garbage bins or dustbins placed at public places are overflowing. It creates unhygienic conditions for people. Also it creates ugliness to that place. At the same time bad smell is also spread. To avoid all such situations, this system proposed Garbage collection bin overflow indicator using IOT technology and also segregate waste in separate compartments are metal, organic or wet, non biodegradable waste.

In this project, ultrasonic sensor is placed top of the dustbin, when the distance reaches to the minimum value, a alert will be sent to the respective Municipal & Government authority person. Microcontroller AT89S52 is used to perform a specific tasks. The UART is used for communication. Segregation details are display in LCD display. Generally, we see that they have a regular schedule of picking up these garbage bins or dustbins. This schedule varies as per the population of that place. It can be once in a day or twice in a day or in some cases once in two days. However we see that in case there is some festival or some function, lots of garbage material is generated by people in a particular area.

keywords: Bin overflow indicator, Segregate waste, Ultrasonic sensor, Microcontroller AT89S52, UART, LCD display, Internet of Things

I. INTRODUCTION

The total amount of waste that was dumped globally in the year 2007 was a whopping 2.12 billion tones increasing by 100 million tons from 2006 [1]. The segregation of the waste followed by the transportation and disposal of the waste needs to be very precise and managed properly so as to avoid the risk to the heal than safety of the public. Waste segregation is an absolutely necessary stage in waste management. Most of the waste is sent directly to the landfills without proper sorting and this has caused a huge loss for us. This project is useful for reduce our environmental pollution and avoid harmful diseases. Efficient way of waste disposal and of disposed garbage is essential for a sustainable and clean India.

This project is essential for Garbage level detection in waste bins and also segregate the waste in separate compartments are metal, organic or wet, non biodegradable waste. Properly distinguishing wet, dry and plastic waste lets us recycle it more efficiently and saves us a lot of money and resources. Smart bin can help dispose of the waste properly and efficiently without any problems. Also, the wet waste can be used as compost and some of the dry waste can be recycled. Smart bin identifies the type of waste and segregates it using the techniques mentioned. It is a filthy job as no human should touch such toxic and dirty waste thrown by us and also sometimes this segregation process is precise. The smart bin also tell the dustbins complete to take out the garbage.

Another important issue we face is we do not actually- count for what kind of garbage we throw. The smart bin gives us a weekly analysis through the app connected to the bin about the type of garbage thrown. Along with this, the smart bin will also provide solutions to what kind of garbage can be used as compost or which garbage can be recycled or reused. So The Smart Bin mainly focuses and helps in getting us a step closer to achieving the 3 Reduce, Reuse and Recycle. The level of waste is monitored in each compartment or waste bins using Ultrasonic sensor. Garbage bin level details is shown in web page using IOT technology. To Alerts the authorized person to empty the bin whenever the bins are full. It is useful to reduce the fuel consumption of truck. There are 3 types of segregation process involved metal (metal sensor), Wet or Bio degradable (humidity sensor) and non Bio degradable (proximity IR sensor). Segregation details are display in LCD display. IOT is enabled used to monitor bin status in web application. Smart waste management focuses

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DOI: 10.17148/IJARCCE.2023.12363

on solving the previously mentioned solid waste management problems using sensors, intelligent monitoring systems, and mobile applications. Smart waste management aims to optimize resource allocation, reduce running costs, and increase the sustainability of waste services.

II. PRELIMINARIES

The ineffective waste management affects the ecosystem. To make the cities more pollution-free, clean, green and healthy living, the effective method is used to the cycle of garbage collection and segregation. The people generates a lot of garbage and waste. There is some festival or some function. The main goal of this paper is to recycle and reuse the waste so as to separate the metallic, Bio degradable and non Bio degradable waste. So, by doing this, the metallic waste can be reused efficiently, and this technique can be used in some companies.

III. PROPOSED SYSTEM

In proposed system, the garbage dustbin in areas are monitored efficiently. The garbage bins overflows creates many problems. Here we have used ultrasonic sensors to identify wastage level in the dust-pin and also segregate the waste. The segregation process to conveyer to splitting individual bin waste using dc motor. They are 3 type of segregations process metal (metal sensor), Wet or Bio degradable (moisture sensor) and non Bio degradable (proximity IR sensor). This segregation is useful to reduce the manpower. The segregated waste materials are given by the recycling process of waste in some industries. Microcontroller AT89S52 is used to perform a specific tasks. The UART is used for communication. Segregation details are display in LCD display attached in the bin. If waste level is exceed the information sent to control station help of IOT and data is shown in webapp. All these information are sent to control station via IOT. The authority person to visit by user id and password.

IV. BLOCK DIAGRAM

This block diagram describes the components used for waste segregation and bin level detection.

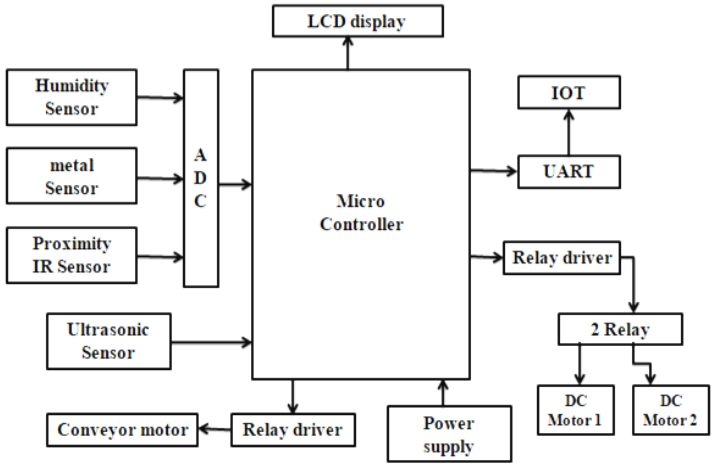

Fig.1. Block diagram

A. AT89S52 Microcontroller:

Fig.2. AT89S52 Microcontroller

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The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the Indus-try-standard 80C51 instruction set and pin out.

Features:

- Compatible with MCS®-51 Products.
- 8K Bytes of In-System Programmable (ISP) Flash Memory- Endurance: 1000 Write/Erase Cycles.
- 4.0V to 5.5V Operating Range.
- Fully Static Operation: 0 Hz to 33 MHz
- Three-level Program Memory Lock.
- 256 x 8-bit Internal RAM.
- 32 Programmable I/O Lines.
- Three 16-bit Timer/Counters.

Pin configuration:

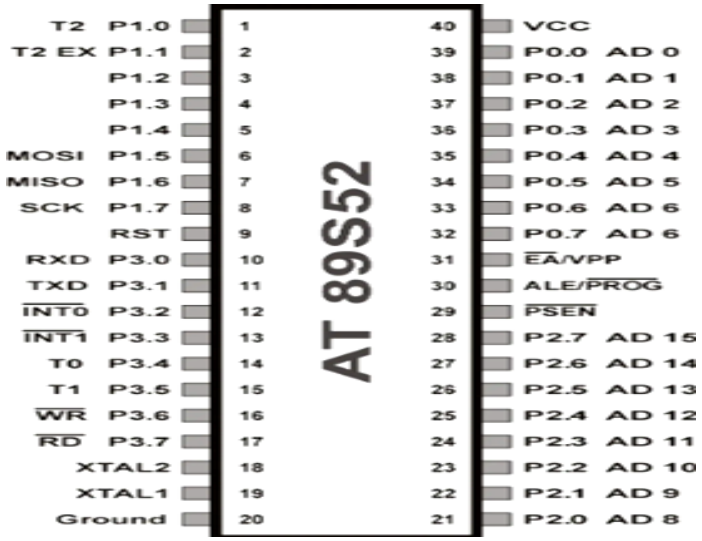

Fig.3. PIN DIAGRAM

B. INDUCTIVE PROXIMITY SENSOR:

Inductive proximity sensors or switches or also known as metal sensors contain high-frequency oscillation circuit, detection circuit, amplifier circuit, the solution circuit and the output circuit. When the power is supplied to the switch, the oscillator in the high frequency oscillation circuit generates an alternating electromagnetic field on the detection surface of the switch. When there is a metal close to the switch detection surface, the eddy current inside the metal absorbs the energy of the alternating electromagnetic field in the oscillator. The oscillator is weakened or stopped. Oscillator energy changes in the two states, the detection circuit is converted to a level signal, through the amplifier circuit to amplify the level signal after the trigger circuit to trigger the output transistor and the transistor circuit produces a switch signal. Thereby, this sensor detecting the presence or absence of the metal in order to achieve the purpose of metal detection.

Fig. 4. inductive proximity sensor

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Features:

- Model: LJ8A3-2-Z/BX-5V
- Type: 5VDC 3 Wire Type (Brown, Blue, Black)
- Brown = VCC (5VDC); Black = Output; Blue = GND.
- Output Type: NPN NO(Normal Open)
- When there is no metal detected the output is high to VCC voltage.
- When there is metal detected, the output is LOW to GND.
- Diameter of Head: 6.5mm/ 0.25"

C. HUMIDITY SENSOR:

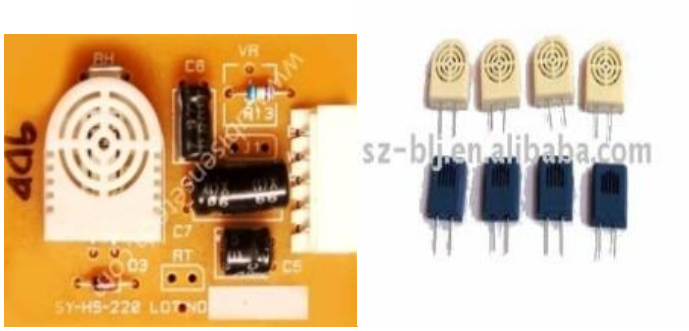

Fig.5. Humidity sensor

1. Principle

The polymer humidity sensor is made of a thermosetting resin based on AL2O3 ceramics, It's impendence can be changed with the related humidity because the H2O inside the polymer film can infect the inductivity of the sensor.

2. Feature

The Humidity sensors developed by our technology show excellent electrical properties for water resistance and long-term stability, excellent compared with other products.

D. PROXIMITY IR SENSOR:

An IR Sensor is an electronic device that performs IR signal scan in the specific frequency range defined by the standards and converts it to electric signals on its digital output pin (usually as a signal PIN as OUT PIN). Proximity sensors are used in touch screen phones, in other devices. IR sensor works similarly to ultrasonic sensors, though instead of using sonic waves, IR is transmitted. The remaining waste can segregated by using IR sensor.

The IR Sensor-Single is a general purpose proximity sensor. Here we use it for collision detection. The module consist of a IR emitter and IR receiver pair. The high precision IR receiver always detects a IR signal. The module consists of 358 comparator IC. The output of sensor is high whenever it IR frequency and low otherwise. The on-board LED indicator helps user to check status of the sensor without using any additional hardware.

Fig.6. Proximity IR sensor

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E. ULTRASONIC SENSOR:

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and non-destructive testing. The technology of non-contacted ultrasonic measurement, ultrasonic electric telemeter module can measure a distance within 0.03-3m effectively. An ultrasonic transducer is a device that converts energy into ultrasound, or sound waves above the normal range of human hearing. While technically a dog whistle is an ultrasonic transducer that converts mechanical energy in the form of air pressure into ultrasonic sound waves, the term is more apt to be used to refer to piezoelectric transducers that convert electrical energy into sound.

Fig.9.Ultrasonic Sensor

F. ADC 0808/0809:

Fig.7. ADC 0808/0809

The ADC0808, ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The 8-channel multiplexer can directly access any of 8-single-ended analog signals. The device eliminates the need for external zero and full-scale adjustments. The design of the ADC0808, ADC0809 has been optimized by incorporating the most desirable aspects of several A/D conversion techniques. The ADC0808, ADC0809 offers high speed, high accuracy, minimal temperature dependence, excellent long-term accuracy and repeatability, and consumes minimal power. These features make this device ideally suited to applications from process and machine control to consumer and automotive applications.

The quantization step in ADC0809/ADC0808 is given by,

$$Q_{step} = \frac{V_{REF}}{2^8} = \frac{V_{REF}(+) - V_{REF}(-)}{256_{10}}$$

The digital data corresponding to an analog input (V_{in}) is given by,

$$\text{Digital data} = \left(\frac{V_{in}}{Q_{step}} - 1\right)_{10}$$

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G. UART

A universal asynchronous receiver/transmitter is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. A UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers. A dual UART or DUART combines two UARTs into a single chip. Many modern ICs now come with a UART that can also communicate synchronously; these devices are called USARTs. The UART controller is the key component of the serial communications subsystem of a computer. The UART takes bytes of data and transmits the individual bits in a sequential fashion. At the destination, a second UART re-assembles the bits into complete bytes. Serial transmission of digital information (bits) through a single wire or other medium is much more cost effective than parallel transmission through multiple wires.

Pin Diagram:

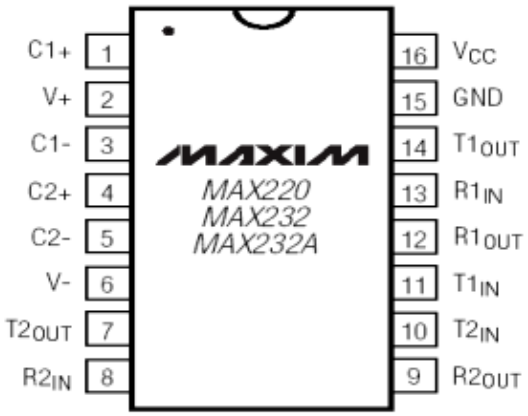

Fig.10. Pin Diagram

H. RELAY

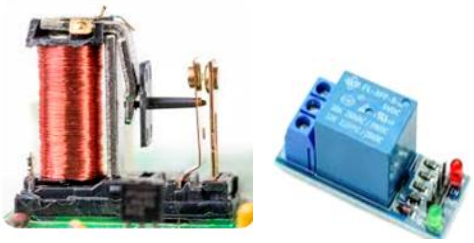

Fig.11. Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

I. LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. These modules are preferred over seven segments and other multi segment LEDs. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD.

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A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

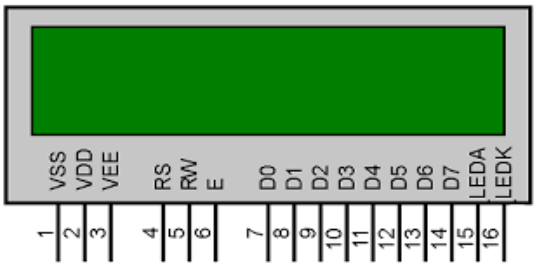

Fig.12. Pin diagram

J. Node MCU

Fig.13. Node MCU

The ESP8266 itself is a self-contained WiFi networking solution offering as a bridge from existing micro controller to WiFi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect NodeMCU devkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

1. Specification:

- Voltage: 3.3V.
- Wi-Fi Direct (P2P), soft-AP.
- Current consumption: 10uA~170mA.
- Flash memory attachable: 16MB max (512K normal).
- Integrated TCP/IP protocol stack.

- Processor: Tensilica L106 32-bit.
- Processor speed: 80~160MHz.
- RAM: 32K + 80K.
- GPIOs: 17 (multiplexed with other functions).
- 802.11 support: b/g/n.
- Maximum concurrent TCP connections: 5.

V. SOFTWARE UNIT

A. EMBEDDED C

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems.

In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.

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Embedded C uses most of the syntax and semantics of standard C, e.g., main() function, variable definition, data type declaration, conditional statements (if, switch, case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc.

A. EMBEDDED SYSTEMS PROGRAMMING

Embedded systems programming is different from developing applications on a desktop computers. Key characteristics of an embedded system, when compared to PCs, are as follows:

- Embedded devices have resource constraints(limited ROM, limited RAM, limited stack space, less processing power)
- Components used in embedded system and PCs are different; embedded systems typically uses smaller, less power consuming components. Embedded systems are more tied to the hardware.

Two salient features of Embedded Programming are code speed and code size. Code speed is governed by the processing power, timing constraints, whereas code size is governed by available program memory and use of programming language. Goal of embedded system programming is to get maximum features in minimum space and minimum time.

Embedded systems are programmed using different type of languages:

- Machine Code
- Low level language, i.e., assembly
- High level language like C, C++, Java, Ada, etc.
- Application level language like Visual Basic, scripts, Access, etc.

B. KEIL

8051- C51 C Compiler. The Keil C51 C Compiler for the 8051 microcontroller is the most popular 8051 C compiler in the world. It provides more features than any other 8051 C compiler available today. The C51 Compiler allows you to write 8051 microcontroller applications in C that, once compiled, have the efficiency and speed of assembly language. Language extensions in the C51 Compiler give you full access to all resources of the 8051.The C51 Compiler translates C source files into relocatable object modules which contain full symbolic information for debugging with the µVision Debugger or an in-circuit emulator.

FEATURE

- Nine basic data types, including 32-bit IEEE floating-point,
- Full use of the 8051 register banks,
- Bit-addressable data objects,
- Built-in interface for the RTX51 Real-Time Kernel,
- Support for dual data pointers on Atmel, AMD, Cypress, Dallas Semiconductor, Infineon, Philips, and Transcend microcontrollers,
- Support for the Philips 8*x*C750, 8*x*C751, and 8*x*C752 limited instruction sets,
- Support for the Infineon 80C517 arithmetic unit

VI. ADVANTAGES

- Online monitoring to reduce pollution.
- Efficient Waste disposal and segregation.
- Automatic segregation process.
- Create clean environment.
- Reduce fuel consumption of waste collecting trucks.

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VII. RESULT AND OUTPUT

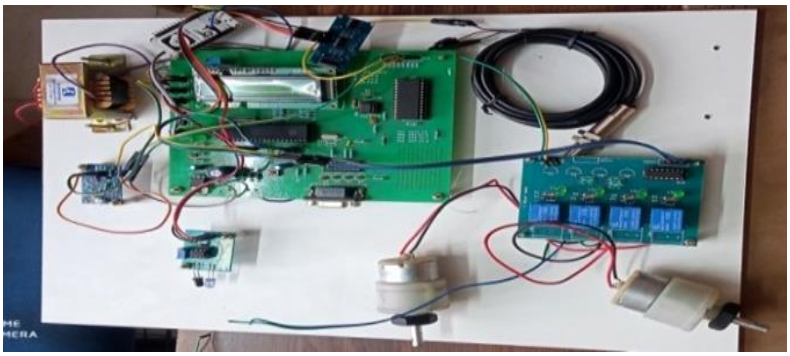

Fig.14. project kit

Waste segregation:

Our project is managing the waste using segregation method and bin level monitoring. In segregation part, the segregate can be done by using conveyor process. The sensors and motors are placed in conveyor setup. There are 3type of sensors are used. Sensor values shown in LCD. The types of segregation process involved metal, Wet and non Bio degradable. Segregation process can done successfully. Efficient way to reduce pollution.

Waste Bin level monitoring:

Bin level monitoring is done by using ultrasonic sensor. The waste level is shown in LCD display. The bin level is monitor in web page using IOT technology. the waste level reaches 50% and bin data is shown in web page. Once the level reaches above 90%, then the municipality person immediately empty that bin. The fill percentage is calculate using ultrasonic sensing range and the level monitoring is done successfully.

DataLogs

Click Here To Delete Logs CLEARLOG

LogID	DATA	Logdate	LogTime
4	U:0594	03/08/2023	14:51:57
12	U:5405	03/08/2023	14:53:00
20	U:5406	03/08/2023	14:54:04
30	U:0014	03/08/2023	14:59:28
35	U:0009	03/08/2023	15:00:31
40	U:0165	03/08/2023	15:01:34

VIII. CONCLUSION

The behaviour of generating garbage is too dangerous not only for today's generation, but also for future generations. It is critical to educate people and encourage them to practice Recycle, Reuse, and Reduce instead of producing waste. Waste disposal should be a priority for municipalities and governments. Monitoring the fullness of bins through the use of sensors, it is possible to achieve a more efficient system than the current existing. Our idea of “Smart waste management system”, mainly concentrates on Monitoring the waste management, segregate waste providing a smart technology for waste system, avoiding human intervention, reducing human time and effort and which results in healthy and waste ridden environment.

This idea cum product can be very compatible with the upcoming smart cities projects. We can have the garbage vehicles pick up just one category of waste and optimize the path in which they do it thus making the entire waste segregation and disposal method much more efficient.

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