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SMART WASTE MONITORING AND CONTROLLING FOR SWACH BARATH USING IOT

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Abstract:- This project manages the garbage collection done by Municipal Corporation with the help of an IOT based embedded device attached to dustbin of each area, this device continuously update the status of dustbins in each area to the website designed for this management. This device continuously detect the level of dustbin using ultrasonic sensor and as the dustbin gets full it will update its status of getting full on the website designed for garbage management along with date and time and will go to waiting state and remain in this state till dustbin gets empty. A timer is also set simultaneously in this state for a fixed duration within which dustbin must be cleaned by the Municipal Corporation. If this timer gets expired and dustbin is not cleaned by their employees on given time then device will sent a message to the higher authority using GSM that dustbin not cleaned on time and again set the timer for the same duration and remain in waiting state. Once the dustbin is cleaned by the employees the device will comes out of waiting state and will update its status of getting cleaned on the website along with date and time. Thus a record is maintained regarding dustbin status for each area in the website in tabular form using IOT technology along with embedded system which will efficiently manage the garbage collection by the Municipal Corporation and will resolve the major environmental issue of inefficient garbage collection leads to a clean and healthy environment and data uploaded to web page using ESP8266.

Keywords— ESP8266, GSM, IOT, garbage management.

I. INTRODUCTION

IOT based Embedded system is the technology in which an embedded developer connects multiple embedded devices to the internet. IOT for embedded systems consist of many things like collecting and analyzing large amount of data from different perspectives and summarizing them into useful information to improve the way services and devices are used today and making the embedded devices more smarter than before. Major players in embedded hardware and software development are aiming to bring these transformations into their products to take advantage of growing IT market. Smart embedded systems need architecture and design elements to suit real time operations. With billions of devices expected to join in the coming years, analysts expect that IOT will have significant impact on device design [11]. In today's era as the population is growing day by day, in most of the cities the overflowed garbage bins results in unhygienic environment which will further leads to rise of different types of unknown diseases degrades the standard of living[9].

As solid waste management is one of the major issues in the urban cities hence introduction of smart dustbins is one of the major requirements to eradicate this problem or at least reduce it to the minimum level. Our present Prime Minister of India, Sri Narendra Modi has recently introduced the concept of implementing 100 smart cities in India and "Swachh Bharat Abhiyan" to ensure a clean environment is one of the major initiatives included in this implementation [6]. So in this paper we are going to propose a smart garbage management system based on IOT for urban areas acts as one of the innovative system to keep the cities clean. This system monitors the dustbins in different areas and update about their status on a website. For this, the system uses ultra sonic sensor placed over the bins to detect the garbage level, Advanced Virtual Reduced (AVR) instruction set microcontroller ATmega16 for controlling the whole system working, Global system for mobile communication (GSM) to send message to higher authority, GPRS (General Purpose Radio Service) for updating status on designed website. The website designed for this purpose gives a tabular view of the status of dustbin along with date and time and the 16X2 LCD display equipped with system will show the changing status of dustbin.

Fig 1. Smart waste collection control unit

II. LITERATURE SURVEY

The employees of Municipal Corporation often shows irregularity in inspection of dustbins of different areas as it made them to do a lot of manual effort. Hence to reduce their manual effort technology of IOT based embedded devices is used to introduce the smart garbage collection systems is that majorly have two units one is master unit to undertake allocation of work to available truck drivers for respective area and slave unit that keep record of all the garbage collection in different areas [2]. However the task of allocation of work and keeping records is done with the help of a device equipped with these dustbins. These devices generally consist of sensors like weight sensor for getting level of dustbin, Arduino UNO board for controlling device functioning, and Wi-Fi module so that status of dustbin can be updated on government's web server [3].Further advancement is done in the system where the GSM module is used in addition, to above proposed system to introduce a feature according to which the device will send the message to the respective truck drivers when dustbin is full for collecting garbage from respective area as well as ultrasonic sensor used in place of weight sensor for level detection [4].

At some systems dustbin is equipped with RF transmitter which will send information regarding status of dustbin to central level having RF receiver at central level from where data is sent to cloud used further for presenting status of dustbin on respective server [5]. To show the status of device, LCD is also used [6] [7] [8] [9].The use of ATMega 16 is also possible as controller instead of Arduino [7]. Further advancement is done within system by interfacing more sensors with the dustbin like fire sensors used to detect fire in dustbin or nearby so that this information can also be reached to respective authority on time to prevent hazardous activities [9]. As per latest trend apps are also be used instead of web page for updating status of dustbin [10]. To make this device more efficient and smarter, dustbins are also be equipped with other type of sensors like using photoelectric sensors along with ultrasonic sensor in order to get the clear information regarding type of garbage inside the dustbin like presence of some electrical or electronic component inside it.[11].

III. RELATED WORK

This system makes use of general purpose board of cortex M3 microcontroller, SIM800 (GPRS/GSM) module and IR sensor. It is powered by a 12V DC adapter via 7805 regulator IC. A 16X2 LCD display is used to show the mode in which device working. An ultrasonic sensor used to detect level of dustbin. Along with this a website is built to show the status to the user monitoring it.

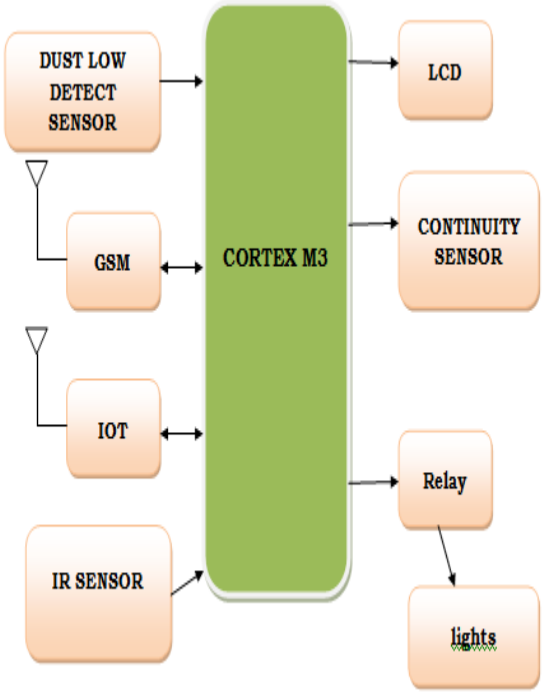

Fig 2. Proposed Block Diagram

A. CORTEX M3

The Cortex-M3 processor is specifically developed to enable partners to develop high performance low-cost platforms for a broad range of devices including microcontrollers, automotive body systems, industrial control systems and wireless networking and sensors. Arm Design Start provides

the fastest, simplest, no-risk route to custom silicon success.

- ✓ Design the most optimal System-On-Chip with a processor that has the perfect balance between area, performance and power with comprehensive system interfaces and integrated debug and trace components.
- ✓ Develop solutions for a large variety of markets with a full-featured Armv7-M instruction set that has been proven across a broad set of embedded applications.
- ✓ Capture a worldwide experienced developer base to accelerate adoption of new Cortex-M3 powered products and leverage the available extensive knowledge base to reduce support costs.
- ✓ Achieve exceptional 32-bit performance with low dynamic power, delivering leading system energy efficiency due to integrated software controlled sleep modes, extensive clock gating and optional state retention.

Powerful debug and non-intrusive real-time trace

Comprehensive debug and trace features dramatically improve developer productivity. It is extremely efficient to develop embedded software with proper debug.

Memory Protection Unit (MPU)

Software reliability improves when each module is allowed access only to specific areas of Memory required for it to operate. This protection prevents unexpected access that may overwrite critical data.

Integrated nested vectored interrupt controller (NVIC)

There is no need for a standalone external interrupt controller. Interrupt handling is taken care of by the NVIC removing the complexity of managing interrupts manually via the processor.

Thumb-2 code density

On average, the mix between 16bit and 32bit instructions yields a better code density when compared to 8bit and 16bit architectures. This has significant advantages in terms of reduced memory requirements and maximizing the usage of precious on-chip Flash memory.

B. GSM

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. GSM supports voice calls and data transfer speeds of up to 9.6 kbit/s, together with the transmission of SMS (Short Message Service). GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. The 850MHz band is also used for GSM and 3G in Australia, Canada and many South American countries. By having harmonized spectrum across most of the globe, GSM's international roaming capability allows users to access the same services when travelling abroad as at home. This gives consumers seamless and same number connectivity in more than 218 countries.

GSM is mainly built on 3 building blocks as shown in below figure

- GSM Radio Network – This is concerned with the signaling of the system. Hand-overs occur in the radio network. Each BTS is allocated a set of frequency channels.
- GSM Mobile switching Network – This network is concerned with the storage of data required for routing and service provision.
- GSM Operation and Maintenance – The task carried out by it include Administration and commercial operation , Security management, Network configuration, operation, performance management and maintenance tasks.

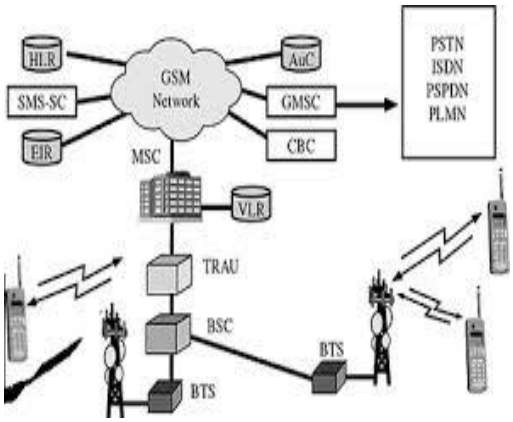

Fig 3. Building blocks of GSM

C. SPDT

A relay is an electrically operated switch used to isolate one electrical circuit from another. In its simplest form, a relay consists of a coil used as an electromagnet to open and close switches contacts. Since the two circuits are isolated from one another, a lower voltage circuit can be used to trip a relay, which will control a separate circuit that requires a higher voltage or amperage. Relays can be found in early telephone exchange equipment, in industrial

control circuits, in car audio systems, in automobiles, on water pumps, in high-power audio amplifiers and as protection devices.

The switch contacts on a relay can be "normally open" (NO) or "normally closed" (NC)--that is, when the coil is at rest and not energized (no current flowing through it), the switch contacts are given the designation of being NO or NC. In an open circuit, no current flows, such as a wall light switch in your home in a position that the light is off. In a closed circuit, metal switch contacts touch each other to complete a circuit, and current flows, similar to turning a light switch to the "on" position. In the accompanying schematic diagram, points A and B connect to the coil. Points C and D connect to the switch.

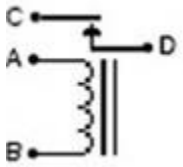

Fig . Relay connection

IV. INTERNET OF THINGS

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

Fig . Internet of things Interfacing

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the *Documents* section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IoT (Internet of Things) solution.

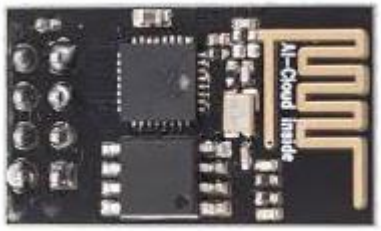

Fig6. ESP8266 IOT module

There seems to be three ways of using this module, in order of increasing complexity:

1. Sending it AT commands from a computer via an USB to serial adapter. This is mostly useful for testing and setup.
2. Interfacing with cortex M3 or any other micro controller and using this board as a peripheral.
3. Programming the module directly and use its GPIO pins to talk to your sensors, eliminating the need for a second controller.

IV. RESULT ANALYSIS

The Internet of Things provides access to a broad range of embedded devices and web services. Thing Speak is an open data platform and API for the internet of Things that enables you to collect, store, analyze, visualize, and act on data from sensors or actuators, such as Cortex M3, Beagle Bone Black, and other hardware. For example, with Thing Speak you can create sensor-logging applications, location tracking applications, and a social network of things with status updates, so that you could have your home thermostat control itself based on your current location. The primary element of Thing Speak activity is the channel, which contains data fields, location fields, and a status field. After you create a

Thing Speak channel, you can write data to the channel, process and view the data with MATLAB® code, and react to the data with tweets and other alerts. The typical Thing Speak workflow lets you:

1. Create a Channel and collect data
2. Analyze and visualize the data
3. Act on the data using any of several Apps.

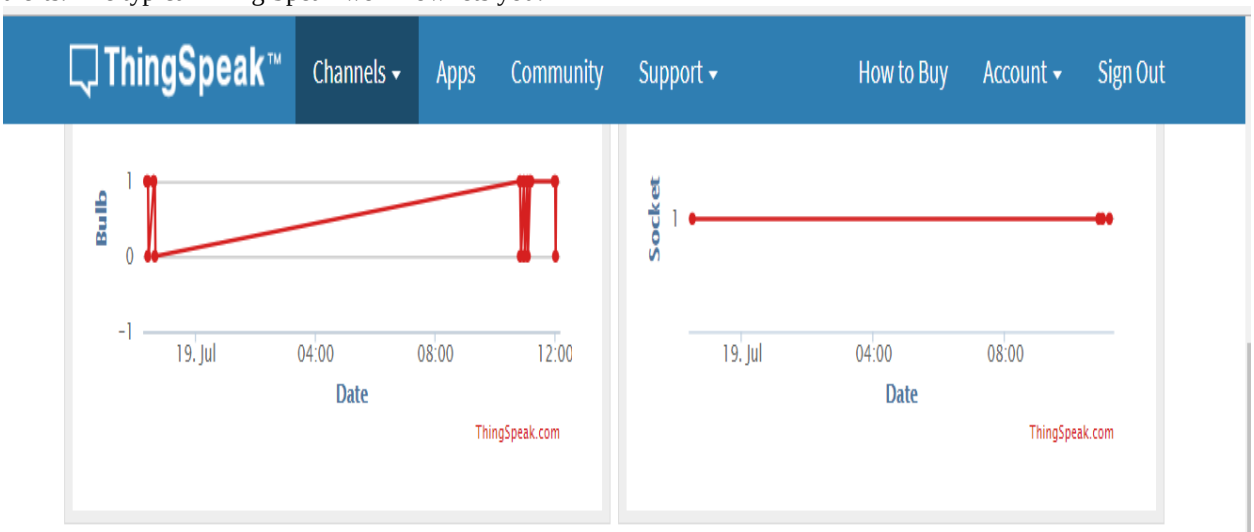

Fig 7. Graphical representation of output

VI. CONCLUSION

Hence overall we conclude that the main objective is to maintain the level of cleanliness in the city and form an environment which is better for living. By using this system we can constantly check the level of the garbage in the dustbins which are placed in various parts of the city. If a particular dustbin has reached the maximum level then the employees can be informed and they can immediately take certain actions to empty it as soon as possible. The employees can check the status of these bins anytime on their mobile phones by visiting corresponding website. This can prove to be a very useful system if used properly. The system can be used as a benchmark by the people who are willing to take one step further for increasing the cleanliness in their respected areas. Ultrasonic sensor is being used in this system to check the level of garbage in the dustbins but in future various other types of sensors can be used with the ultrasonic sensor to get more precise output and to take this system to another level. One of important advantage of this system is it is really helpful in improving the quality of environment and is a step towards fulfilling goal of SWACH BHARAT ABHIYAN a government initiative for environment cleanliness.

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