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Intelligent Monitoring System for Smart City Using Arduino and Android App

Vinitha Shree.P, Vimalaa.V, Rajagiri.R[1]
IV UGStudents, Dept. of ECE
Sri Shakthi Institute of Engineering and Technology
Coimbatore, Tamilnadu, India

A.Senthilkumar[3]
Assistant Professor, Dept. of ECE
Sri Shakthi Institute of Engineering and Technology
Coimbatore, Tamilnadu, India
Email:a.senthilkumar@siet.ac.in

Mr.S.Raja[2]
Assistant Professor, Dept. of ECE
Sri Shakthi Institute of Engineering and Technology
Coimbatore, Tamilnadu, India
Email:raja.s@siet.ac.in

Abstract—today we see the garbage waste bins are overflowing and all garbage is split out from dust bins, which results into unhygienic condition, illness and bad smell for all people near that area. Hence, we are designing the system based on Arduino for monitoring garbage from particular area to avoid pollution, unhygienic condition, bad smell, etc. The dustbin is interfaced with microcontroller based system having ultrasonic sensor and gas sensor monitoring the status of garbage. When garbage reaches the level of sensor, then that indication will be given to the microcontroller unit and microcontroller sends signal to the user through GSM. So continuous monitoring of garbage bins will keep the environment clean. The app helps the public to get directly connected to the authorities and to know about the current status of facilities in their area. The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision.

Keywords-*garbage ,gas sensor, ultrasonic sensor,smart city,microcontroller.*

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I. INTRODUCTION

In present day, many times we see that garbage bins or dustbins placed at public places are overflowing due to increase in solid waste every day. It creates unhygienic conditions for all people and creates bad smell around the surroundings this leads in spreading some diseases and human illness, to avoid such situation we are designing “Intelligent monitoring system for smart city using Arduino and android app”. In this proposed system there are multiple dust bins are located throughout the city, this dust bins are provided with low cost embedded devices. Global system for mobile communication is the latest tread used now a days can be used for our project. Sensors are placed above the dust bin. It will detect whether the garbage is at low, middle or highest level.

The main control unit consist of Arduino it will receive the output signal of sensor, process it and according to that it will send the message and long ring notification to particular municipal worker in that area through GSM.

After send the message, if dustbin remains the same stage in some amount of time, it will send the information to the higher officer and the PC will display the status of garbage by using LABVIEW.Along with detection of depth of garbage simultaneously Gas sensor will detect the presence of flame or smoke. The work consists of an experimental approach towards waste management and finding an alternative to conventional materials in flexible pavements.

Embedded System

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. 98 percent of all microprocessors are manufactured as components of embedded systems. Examples of properties of typically embedded computers when compared with general-purpose counterparts are low power consumption, small size, rugged operating ranges, and low per-unit cost. This comes at the price of limited processing resources, which make them significantly more difficult to program and to interact with. However, by building intelligence mechanisms on top of the hardware, taking advantage of possible existing sensors.

Arduino

The Arduino project started at the Interaction Design Institute Ivrea (IDII) in Ivrea, Italy. In 2003 Hernando Barragán created the development platform wiring as a Master's thesis project at IDII, under the supervision of Massimo Banzi and Casey Reas, who are known for work on the Processing language. The project goal was to create simple, low cost tools for creating digital projects by non-engineers. Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's

products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone.

Figure 1: Arduino model

GSM

GSM is a second-generation (2G) standard employing time-division multiple-Access (TDMA) spectrum-sharing, issued by the European Telecommunications Standards Institute (ETSI). The GSM standard does not include the 3G Universal Mobile Telecommunications System (UMTS) code division multiple access (CDMA) technology nor the 4G LTE orthogonal frequency-division multiple access (OFDMA) technology standards issued by the 3GPP.GSM, for the first time, set a common standard for Europe for wireless networks. It was also adopted by many countries outside Europe. This allowed subscribers to use other GSM networks that have roaming agreements with each other. The common standard reduced research and development costs, since hardware and software could be sold with only minor adaptations for the local market.

II. LITERATRURE SURVEY

[1] Smart Cities are being designed and built for comfortable human habitation. Among services that Smart Cities will offer is the environmentally-friendly waste/garbage collection and processing. In this paper, we motivate and propose an Internet of Things (IoT) enabled system architecture to achieve dynamic waste collection and delivery to processing plants or special garbage tips. In the past, waste collection was treated in a rather static manner using classical operations research approach. As proposed in this paper, nowadays, with the proliferation of sensors and actuators, as well as reliable and ubiquitous mobile communications, the Internet of Things (IoT) enables dynamic solutions aimed at optimizing the garbage truck fleet size, collection routes and prioritized waste pick-up. We propose a top -- k query based dynamic scheduling model to address the challenges of near real-time scheduling driven by sensor data streams.[2]There are a number of techniques which are purposefully used and are being build up for well management of garbage or solid waste. ZigBee and Global System for Mobile Communication (GSM) are the latest trends and are one of the best combinations to be used in the project. Hence, a combination of both of these technologies is used in the project. To give a brief description of the project, the sensors are placed in the common garbage bins placed at the public places. When the garbage reaches the level of the sensor, then that indication will be given to ARM 7 Controller. [3] Solid waste generation, Classes of waste, Quantity generated, Method of management. The work reported in this paper involves the characterization of residential solid waste in Amassoma for the determination of household solid waste management option in Amassoma, Bayelsa state in Nigeria. A site-specific study was carried out in order to determine the components and estimate the quantity of residential solid waste generation in the town. Structured questionnaires were applied to collect primary information such as size of households, educational level, monthly income etc. from households. [4] IoT or Internet Things refers to the network of connected physical objects that can communicate and exchange data among themselves without the desideratum of any human intervention. It has been formally defined as an “Infrastructure of Information Society” because IoT sanctions us to amass information from all kind of mediums such as humans, animals, conveyances, kitchen appliances. Thus, any object in the physical world which can be provided with an IP address to enable data transmission over a network can be made part of IoT system by embedding them with electronic hardware such as sensors, software and networking gear.

III. PROPOSED SYSTEM

It below figure shows how the status of garbage dust bins is received by the user on mobile. Sensor unit consist of IR sensor or ultrasonic sensor or flame detection sensor. The main control unit consists of Arduino; signal passes through Arduino and reaches the user mobile through GSM. The user friendly android app provides necessary platform for the public to connect with Municipal Corporation.

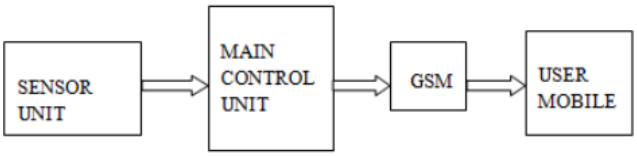

Figure 2: Methodology

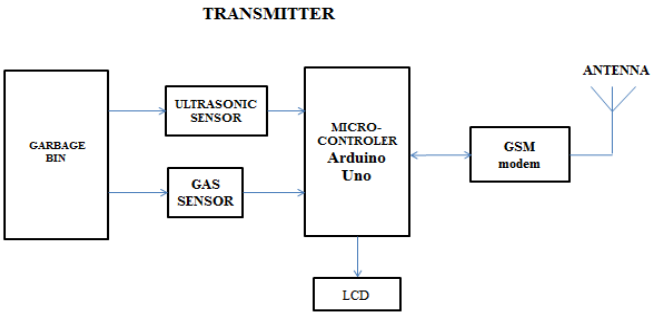

Figure 3: Transmitter

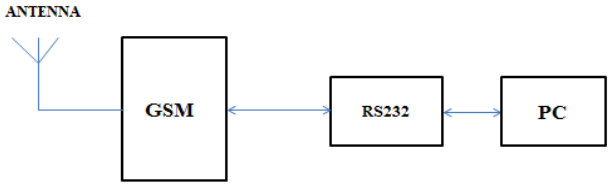

Figure 4: Receiver

ARDUINO UNO

Arduino/Genuine Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Figure 5: Arduino UNO

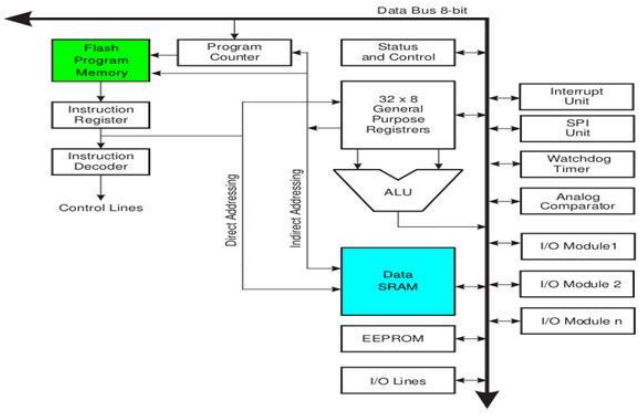

Figure 6: Arduino architecture

Ultrasonic sensors

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. This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water.

Figure 7: ultrasonic distance sensor

Gas Sensor (MQ135)

The MQ-135 gas sensor module consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current. Through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it.

Figure 8: Gas Sensor (MQ135)

Sensitive for benzene, alcohol, smoke. Output voltage boosts along with the concentration of the measured gases increases. Fast response and recovery. Adjustable sensitivity. Signal output indicators are the features of MQ135 gas sensor.

LCD Display

A liquid crystal display is special thin flat panels that can let light go through it or can block the light. (Unlike an LED it does not produce its own light). The panel is made up of several blocks, and each block can be in any shape. Each block is filled with liquid crystals that can be made clear or solid, by changing the electric current to that block. Liquid crystal displays are often abbreviated LCDs. Liquid crystal displays are often used in battery powered devices, such as digital watches, because they use very little electricity. They are also used for flat screen TV's. They work well by themselves when there is other light around (like a lit room, or outside in daylight). The LCD uses technology called electro-optical modulation. This means it uses electricity to change how much light passes through it.

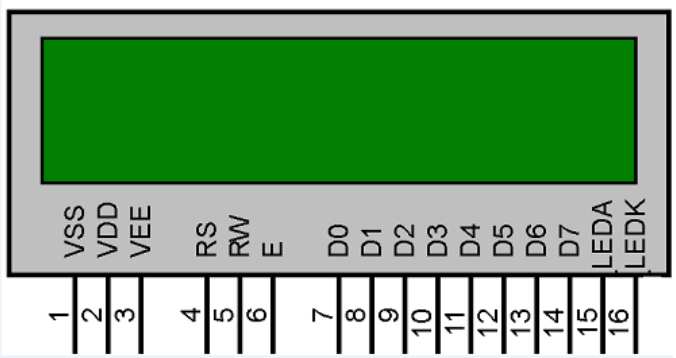

Figure 9: LCD Display

On a character LCD, a character is generated in a matrix of 5x8 or 5x7. Where 5 represents number of columns and 7/8 represents number of rows. Maximum size of the matrix is 5x8. You cannot display character greater than 5x8 dimension matrix. Normally we display a character in 5x7 matrices and left the 8th row for the cursor. If we use the 8th row of the matrix for the character display, then there will be no room for cursor.

ADC (Analog to Digital Convertor)

It is a device that converts a continuous quantity to a discrete digital number. Typically, an ADC is an electronic device that converts an input analog voltage (or current) to a digital number proportional to the magnitude of the voltage or current. This functionality is done by the ADC interface block of the IOT board.

Power Supply

Digital Power Supply ESP8266EX has two digital pins for power supply, Pin11 and Pin17. For digital power supply, there is no need to add additional filter capacitors. The operating voltage range of digital power supply pins is 1.8V ~ 3.3V.

IV. SOFTWARE DESCRIPTION

LAB VIEW

Laboratory Virtual Instrument Engineering Workbench (Lab VIEW) is a system-design platform and development environment for a visual programming language from National Instruments.

The graphical language is named "G"; not to be confused with G-code. Originally released for the Apple Macintosh in 1986, Lab VIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of operating systems (OSs), including Microsoft Windows, various versions of Unix, Linux, and macOS. The latest versions of Lab VIEW are Lab VIEW 2017 SP1 and Lab VIEW NXG 2.0, released in January 2018.

Dataflow programming

The programming paradigm used in Lab VIEW, sometimes called G, is based on data availability. If there is enough data available to a sub VI or function that sub VI or function will execute. Execution flow is determined by the structure of a graphical block diagram (the Lab VIEW-source code) on which the programmer connects different function-nodes by drawing wires. These wires propagate variables and any node can execute as soon as all its input data become available. Since this might be the case for multiple nodes simultaneously, Lab VIEW can execute inherently in parallel.1–2 Multi-processing and multi-threading hardware is exploited automatically by the built-in scheduler, which multiplexes multiple OS threads over the nodes ready for execution**.**

Graphical programming

Lab VIEW integrates the creation of user interfaces (termed front panels) into the development cycle. Lab VIEW programs-subroutines are termed virtual instruments (VIs). Each VI has three components: a block diagram, a front panel, and a connector panel. The last is used to represent the VI in the block diagrams of other, calling VIs. The front panel is built using controls and indicators. Controls are inputs: they allow a user to supply information to the VI. Indicators are outputs: they indicate, or display, the results based on the inputs given to the VI. The back panel, which is a block diagram, contains the graphical source code.

ANDROID APPLICATION

Android is a mobile operating system developed by Google, based on a modified version of the Linux kernel and other open source software and designed primarily for touchscreen mobile devices such as smartphones and tablets. In addition, Google has further developed Android TV for televisions, Android Auto for cars and Android Wear for wrist watches, each with a specialized user interface. Variants of Android are also used on game consoles, digital cameras, PCs and other electronics.

Applications ("apps"), which extend the functionality of devices, are written using the Android software development kit (SDK) and, often, the Java programming language. Java may be combined with C/C++, together with a choice of non-default runtimes that allow better C++ support. The Go programming language is also supported, although with a limited set of application programming interfaces (API). In May 2017, Google announced support for Android app development in the Kotlin programming language.

The SDK includes a comprehensive set of development tools, including a debugger, software libraries, a handset emulator based on QEMU, documentation, sample code, and tutorials. Initially, Google's supported integrated development environment (IDE) was Eclipse using the Android Development Tools (ADT) plugin; in December 2014, Google

released Android Studio, based on IntelliJ IDEA, as its primary IDE for Android application development. Other development tools are available, including a native development kit (NDK) for applications or extensions in C or C++, Google App Inventor, a visual environment for novice programmers, and various cross platform mobile web applications frameworks. In January 2014, Google unveiled a framework based on Apache Cordova for porting Chrome HTML 5 web applications to Android, wrapped in a native application shell.

Android has a growing selection of third-party applications, which can be acquired by users by downloading and installing the application's APK (Android application package) file, or by downloading them using an application store program that allows users to install, update, and remove applications from their devices. Google Play Store is the primary application store installed on Android devices that comply with Google's compatibility requirements and license the Google Mobile Services software. Google Play Store allows users to browse, download and update applications published by Google and third-party developers; as of July 2013, there are more than one million applications available for Android in Play Store. As of July 2013, 50 billion applications have been installed. Some carriers offer direct carrier billing for Google Play application purchases, where the cost of the application is added to the user's monthly bill. As of May 2017, there are over one billion active users a month for Gmail, Android, Chrome, Google Play and Maps.

V. RESULTS AND DISCUSSIONS

Figure 10: output of GSM initialization

Figure 11: output of Garbage empty

Figure 12: output of Garbage full

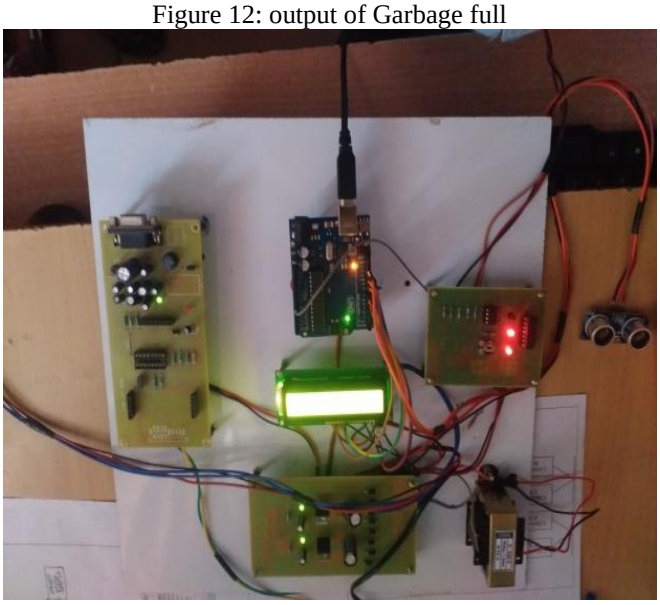

Figure 13: Project proposed model

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Software Output

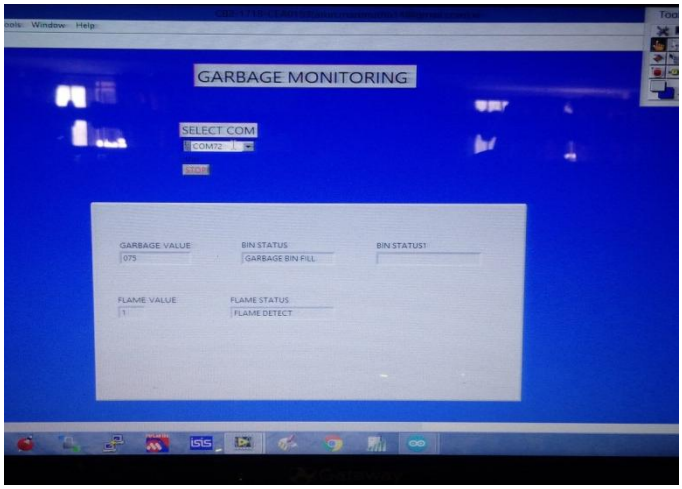

Figure 14: output of Garbage full and flame detect in LAB VIEW

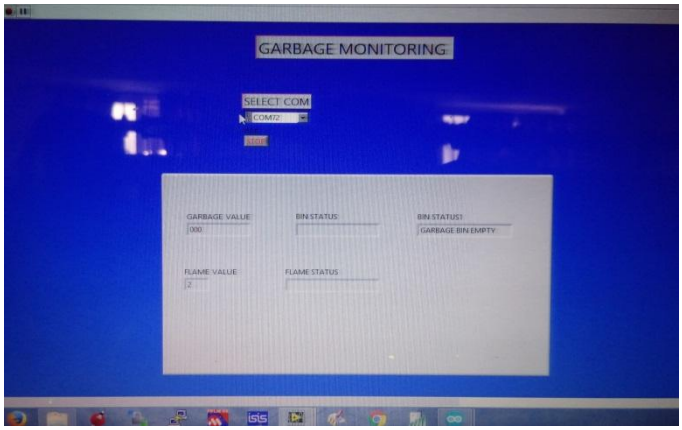

Figure 15: output of Garbage empty in LAB VIEW

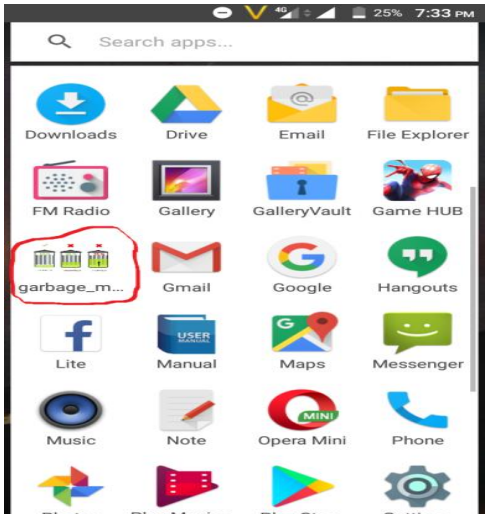

Figure 16: Android application

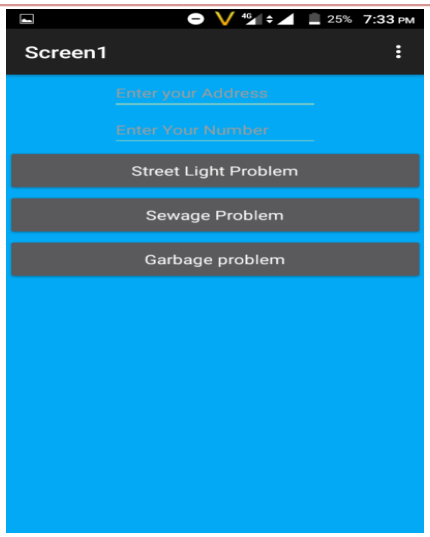

Figure 17: starting page

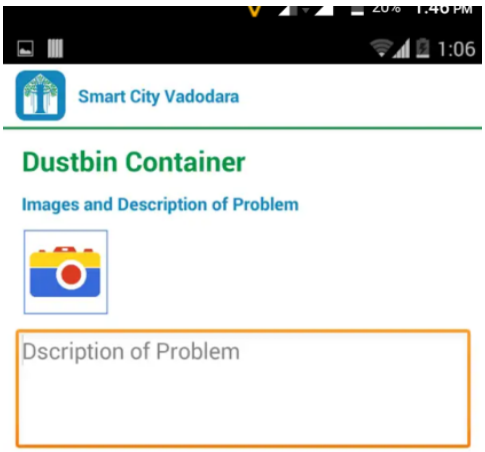

Figure 18: problem register page

VI. CONCLUSION

By implementing this project we can able to monitor the level of garbage in the dust bins placed at public places, according to that we can collect garbage of particular which will avoid overflow conditions and helps to reduce pollution as well as different hazards of health. This system will reduce the wastage of fuel by reducing number of trips of garbage collection vehicle. The disposal of garbage is done efficiently in this system. The ultrasonic sensor measures the level of the garbage. Once the threshold level is reached it will immediately send message to the authorized person. Once the waste is thrown it is immediately send message that the dustbin is started to collect the waste. The message started message is sent to the person through GSM.In this each garbage can will be allocated with the mobile number such that the message will be sent to the authorized person via GSM. Once the threshold level is reached it will immediately send message to the

authorized person that the garbage level is overloaded. The user friendly android app provides necessary platform for the public to connect with Municipal Corporation.

While dealing with more number of dustbins in city level we can use video processing, which will improve the reliability of circuit. Also we can add GPS modem to this project hence; it will help to track the position of dust bin. We can create new application also for garbage monitoring which will show overview of dustbin. Apart from this, differentiation can be made between dry trash bin and wet trash bin collecting plastic dry waste and biodegradable waste respectively. To implement this methane and smell sensors can be used. This helps in distinguishing the waste at the source and hence reducing the requirement of manpower.

VII. ACKNOWLEDGMENT

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