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BINTERNET: Smart Waste Management System

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Abstract: ***To make the cities greener, safer, and more efficient, Internet of Things (IoT) can play an important role. Improvement in safety and quality of life can be achieved by connecting devices, vehicles and infrastructure all around in a city. We present a waste collection management solution based on providing intelligence to waste bins, using an IOT prototype with sensors. It can read, collect, and transmit huge volume of data over the Internet. Such data, when put into a spatial-temporal context and processed by intelligent and optimized algorithms, can be used to dynamically manage waste collection mechanism. Simulations for several cases are carried out to investigate the benefits of such system over a traditional system.***

I. INTRODUCTION

The Internet of Things (IOT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect, collect and exchange data, creating opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions. The number of IOT devices increased 31% year-over-year. The Internet of Things (IOT) is a technological advancement that enables everyday objects to have Wi-Fi connectivity and be able to communicate with each other making them 'SMART THINGS'. This technology, suddenly allows objects that were once not connected, to be able to convey data in real time. It is the basis of optimizing not just our physical homes but the everyday processes that happen around us in the places we work and the cities we live in. This new development allows our old methods of predictive maintenance to suddenly be shifted to smarter systems. Waste management is a growing problem for companies and cities all around the world. Costing millions of dollars to collect, manage and remove. It's time to use IOT and to bring waste management into the 21st century. When modeling an IOT based waste management system, aims is to provide a few services defined below:

1) Waste collection planning and implementation.
2) Creation and visualization of SMART DATA produced by intelligent hardware software systems.

II. REVIEW OF LITERATURE

A. *Theodoro's Anagnostopoulos, ArkadyZaslavsky, Alexey Medvedev, Sergei Khoruzhnicov, Topk Query based Dynamic Scheduling for IOT-enabled Smart City Waste Collection.*

In this paper author introduce IOT-enabled system architecture to achieve e client dynamic waste collection. They also propose a top-K query based dynamic scheduling model to face the demanding nature of scheduling timing. Finally, an Android app along with a user-friendly GUI is presented in order to evaluate a waste collection scenario on synthetic and real experimental data. Author discuss about Smart Cities, are being designed and built for comfortable human habitation. These paper 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. The Internet of Things (IOT) enables dynamic solutions aimed at optimizing the garbage truck set size, collection routes and query based prioritized waste pick-up. It gave us the concept of dynamic scheduling required for the cleaning of dustbin and the Top-k query led us to priority based cleaning of dustbins.

B. *Kanchan Mahajan, Prof.J.S.Chitode, Waste Bin Monitoring System Using Integrated Technologies*

The author proposed in this paper a new, quick and easy way of garbage collection. It uses the ZigBee, GSM (Global System for Mobile Communication) and ARM7 is used to form the integrated system to monitor the waste bins remotely. 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. The controller will give indication to the driver of garbage collection truck as to which garbage bin is completely lied and needs urgent attention. ARM 7 will give indication by sending SMS using GSM technology.

C. Narayan Sharma, Smart Bin Implemented for Smart City

The paper enhances describes the application of model of Smart Bin in managing the waste collection system of an entire city. The network of sensors enabled smart bins connected through the cellular network generates a large amount of data, which is further analyzed and visualized at real time to gain insights about the status of waste around the city. The IR sensor is act as level detector. The assures a low budget by changing all light traffic servers into Raspberry Pi. The sensor senses the content of the dustbin and sends the signals or the data to the ARM microcontroller then the microcontroller reads the data from the sensor and process the data received from sensor, and the same data will send to Dashboard section and this section send mail/message to respective Municipal / Government authority person or collection vehicle.

III. METHODOLOGY DETAILING THE ACTIVITIES AND SUBACTIVITIES

By 2050, the vast amount of earth's population will move to urban areas, thus, forming vast cities. Such cities require a smart sustainable infrastructure to manage citizens' needs and offer fundamental and more advanced services. The adoption of Future Internet technologies enhanced by the by the use of the Internet Protocol (IP) on numerous wireless sensors enables the Internet of Things (IOT) paradigm. Numerous sensors have the opportunity to be part of Wireless Sensor Networks (WSNs). This definition incorporates the fundamental component of a smart environment which is mainly adopted for systems dealing with environmental pollution. In our project, we focus on a specific application domain, waste management. The efficient management of waste has a significant impact on the quality of life of citizens. The reason is that waste disposal has a clear connection with negative impacts in the environment and thus on citizens' health. Today, very few IOT products and solutions are being integrated into our lives. The problem is that IOT solutions are expensive, risky and difficult to integrate. Some of these IOT products require a complete infrastructure overhaul from the business/home and this can be time consuming and resource depleting. Even though successfully integrated IOT solutions provide substantial cost savings, it has proven to be hard for companies to take the step forward.

A. Step By Step Activity

In this system, a 24x7 monitoring system is designed for monitoring dumpsters. Here a smart and organized system is designed for selective clearing. The ultrasonic sensor is used for measuring the level of waste in the dumpster. The employee will first login and the employee will be redirected to the IOT platform. Them the employee will check the level of waste. Then If the container reaches 100% or above 80% the gauge pointer will point to the red zone. In turn, employees can clear the corresponding dumpster. The LCD will be showing the current fill level 24x7. All these sensors are connected to an Arduino Uno board/Node MCU board on bread board. It can be used for controlling all mechanical setup based on current conditions.

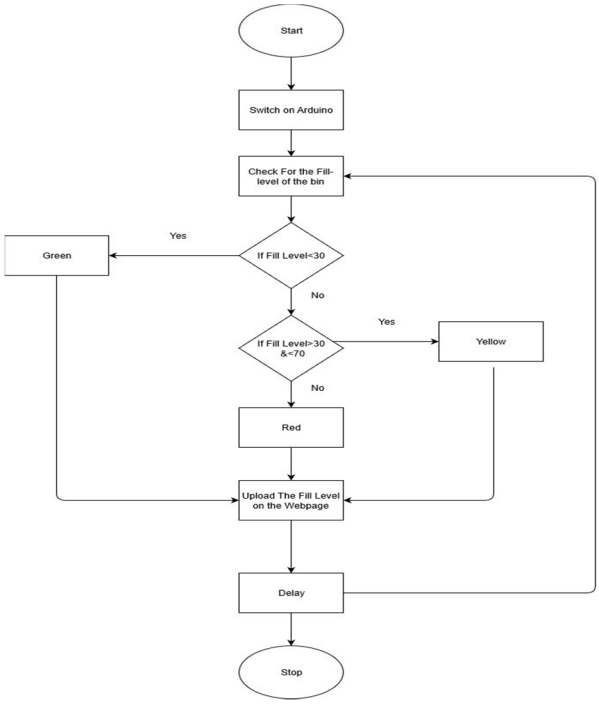

Fig 1: Flow chart of the Operation

B. Component Description and used Softwares

1) Arduino UNO: The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.

2) Ultra Sonic Distance Sensor: The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. It comes complete with ultrasonic transmitter and receiver modules. Wears using Ultra Sonic Distance Sensor for up to the millimetre accuracy to strengthen the truth of your data.

3) NODE MCU: NodeMCU is a Wi-Fi SOC (system on a chip) produced by Espressif Systems. It is based ESP8266 -12E Wi-Fi module. It is a highly integrated chip designed to provide full internet connectivity in a small package. It can be programmed directly through USB port using LUA programming or Arduino IDE. By simple programming we can establish a Wi-Fi connection and define input/output pins according to your needs exactly like Arduino, turning into a web server and a lot more.

*4) 16*2 LCD Display:* LCD stands for liquid crystal display. Character and graphical LCD's are most common among hobbyist and diy electronic circuit/project makers. Since their interface serial/parallel pins are defined so it's easy to interface them with many microcontrollers. They are used to show status of the product or provide interface for inputting or selecting some process. Character LCD come in many sizes 8x1, 8x2, 10x2, 16x1, 16x2, 16x4, 20x2, 20x4, 24x2, 30x2, 32x2, 40x2 etc. We have used 16x2 LCD for our project

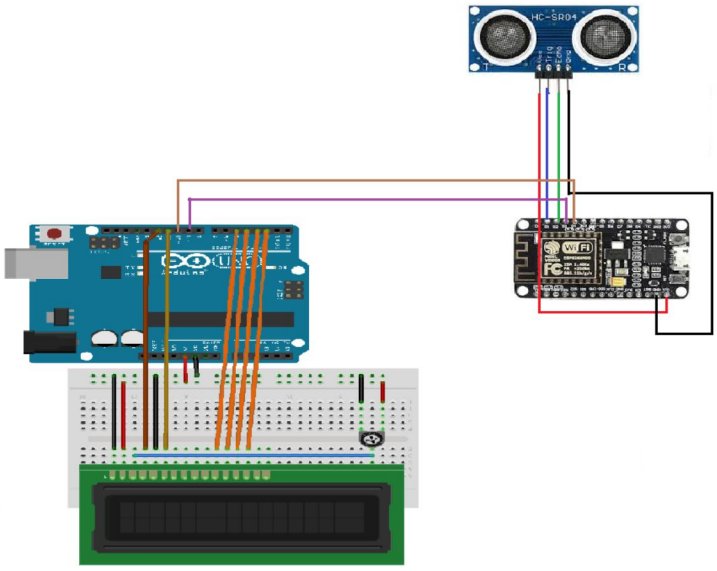

Figure 2: Hardware connection of all the components

IV. RESULT AND DISCUSSION

After all the components are connected properly, the system is put into a dustbin on the proposed location. The device will start scanning the dustbin and the output will be displayed on the website accordingly. If the garbage present in the bin is less than 30% filled, this indicates that the bin can collect more garbage.

If the garbage collected by the bin is less than or equal to 70%, then the clean up authority will get a warning message that the bin is partially full. If the garbage collected by the bin is almost full or at 100%, then the clean up authority will get a warning message to clear the garbage as soon as possible.

Figure 3: On-time Example of the device.

The website provides the details about the clean-up authority and the services they provide, it also shows the monthly garbage collected by each of the dustbins and also displays the current garbage level of the dustbin. Using our system, The clean up authority can get the on time garbage level so that they can take the precise measures for the cleaning process accordingly. The system also helps them to save time as they will just need to collect the garbage when it is about to be full.

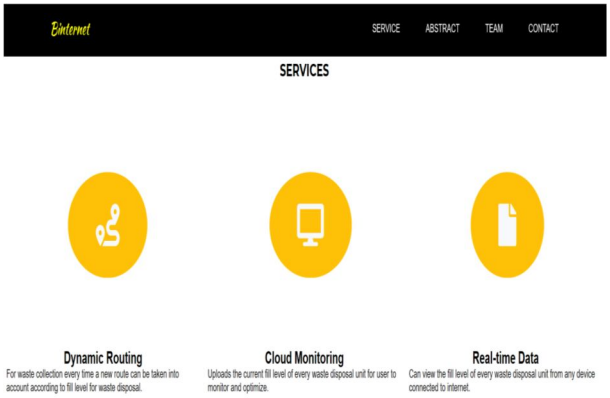

Figure 4: Binternet Website

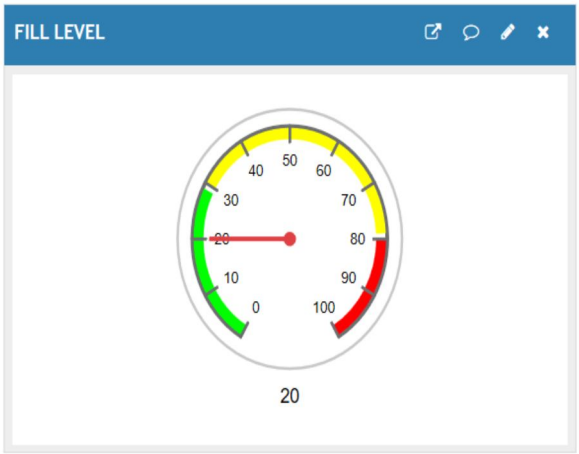

Figure 5: Garbage level of a dustbin

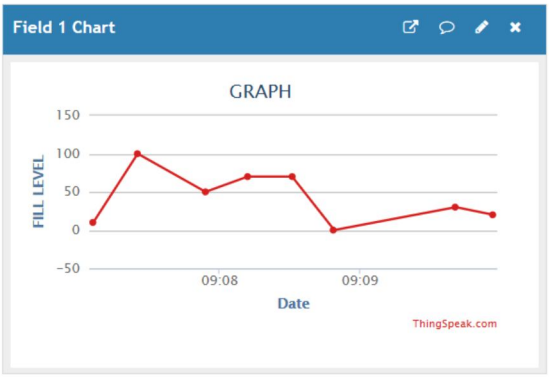

Figure 6: Monthly Garbage Collection

V. CONCLUTION

By implementing this project, we will avoid over flowing of garbage from the container in residential area which is previously either loaded manually or with the help of loaders in traditional trucks. Manual loading takes time and reduces the productivity of the vehicles and manpower deployed. Besides, manual handling of waste poses a threat to the health of the sanitation workers as the waste is highly contaminated

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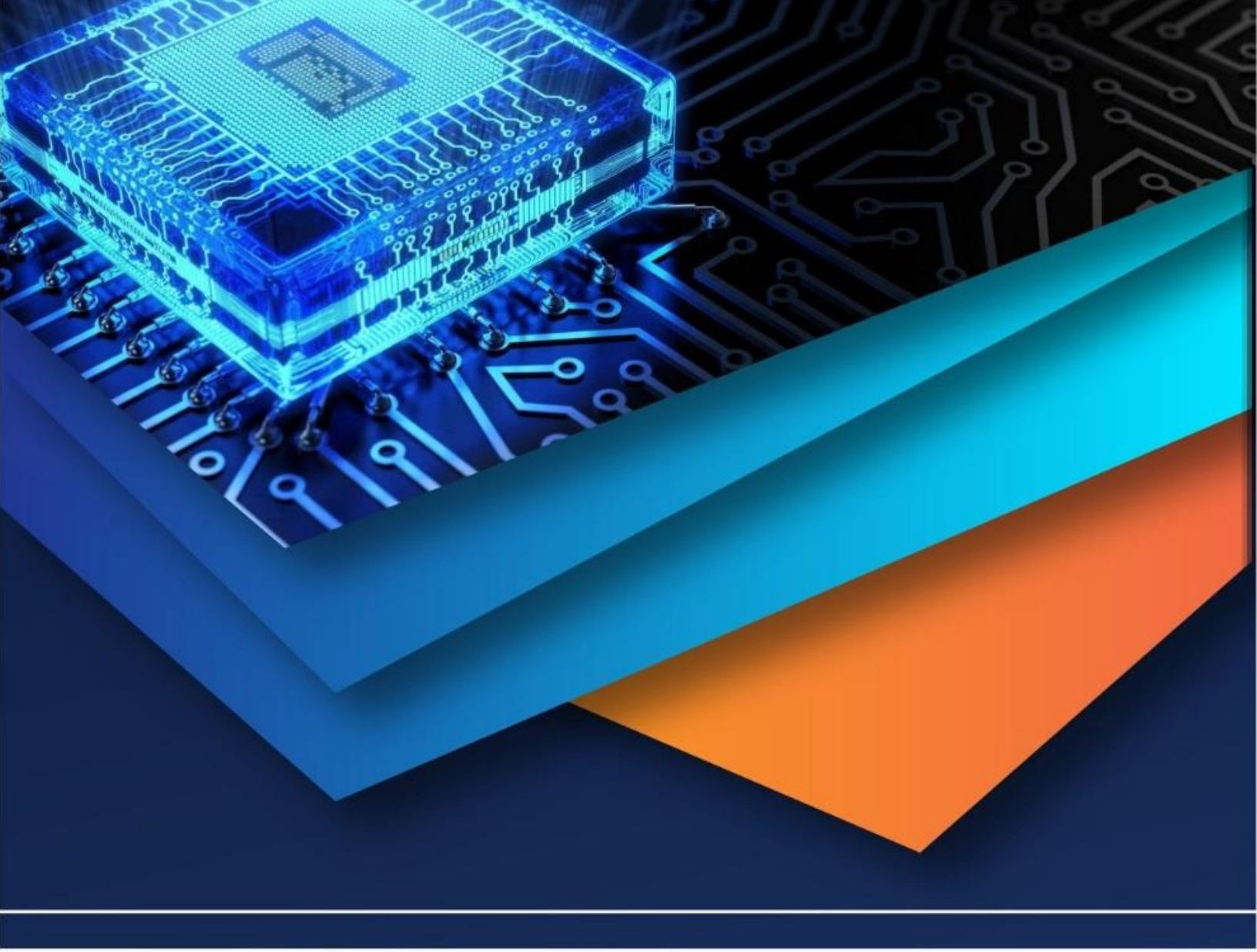

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