e-ISSN:2582-7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 1, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.521

International Journal Of Multidisciplinary Research In Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| | Monthly Peer Reviewed & Refereed Journal |

|| Volume 7, Issue 1, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

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Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India

Smart Food Waste Management System to Prevent Food Waste in Corporate Environments

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ABSTRACT: This project introduces a Smart Food Waste Management System designed to mitigate food waste in corporate settings. Employing a combination of Arduino technology, RFID readers, load cells, and alarms, the system enhances waste disposal processes and cultivates responsible consumption habits among employees. The system operates by requiring employees to use their RFID cards to access waste disposal bins. Only after swiping the RFID card does the bin unlock, allowing the employee to deposit food waste. Simultaneously, the employee's name is displayed on a 16x2 LCD screen, confirming the transaction. To quantify individual contributions, a load cell measures the weight of the food waste deposited by each person. In case of excessive disposal, a penalty is automatically deducted from the employee's RFID balance. This monetary disincentive encourages individuals to be mindful of their food waste, fostering a culture of responsible consumption. The implementation of this system aims to reduce unnecessary food disposal by promoting self-awareness and accountability. Employees are encouraged to take only what they need, as the penalty mechanism underscores the value of minimizing food waste. The recorded data on food waste weights for each employee provides valuable insights for targeted awareness campaigns and ongoing waste reduction initiatives.

KEYWORDS: Reader, Arduino Technology, Load cell, Microcontroller, Buzzer.

I. INTRODUCTION

Food waste poses a significant challenge in today's corporate environments, where large numbers of employees contribute to the disposal of edible items daily. Recognizing the urgency to address this issue, our project introduces a **Smart Food Waste Management System** that leverages cutting-edge technologies to revolutionize waste disposal practices within corporate settings. By integrating **Arduino, RFID (Radio-Frequency Identification)** readers, load cells, and alarms, our system not only streamlines the waste disposal process but also incorporates a novel approach to encourage responsible consumption habits among employees. Traditionally, waste disposal has been a typical task with minimal accountability, leading to an alarming increase in food waste. In an effort to tackle this problem head-on, our Smart Food Waste Management System requires employees to use RFID cards for accessing waste disposal bins. The system ensures that the bin only opens after a successful RFID card swipe, subsequently displaying the employee's name on a 16x2 LCD screen. This not only ensures secure and traceable waste disposal but also acts as an immediate confirmation of the transaction. [1-2]

INTRODUCTION TO ARDUINO TECHNOLOGY: Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog input/output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages, C and C++.[3-4]

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INTRODUCTION TO IOT: The Internet of Things (IoT) heralds a new era of connectivity, seamlessly intertwining the digital realm with the physical world. At its core, IoT encompasses a network of interconnected devices, equipped with sensors, actuators, and communication technologies, enabling them to collect, transmit, and exchange data. From smart thermostats that adjust room temperatures based on occupancy to industrial machinery optimizing production processes in real-time, IoT has permeated various facets of our lives, promising greater efficiency, convenience, and insight. However, this proliferation of interconnected devices also raises concerns about security, privacy, and interoperability, underscoring the need for robust frameworks and standards. As IoT continues to evolve, its transformative potential across industries becomes increasingly evident, driving innovation, enhancing productivity, and reshaping the way we interact with technology and our environment. [5-6]

INTRODUCTION TO EMBEDDED SYSTEM: An embedded system is a special-purpose computer system, which is completely encapsulated by the device it controls. An embedded system has 11 specific requirements and performs pre-defined tasks, unlike a general-purpose personal computer. An embedded system is a programmed hardware device. A programmable hardware chip is the 'raw material' and it is programmed with particular applications. This is to be understood in comparison to older system with full functional hardware or system with general purpose hardware and externally loaded software. Embedded system is a combination of hardware and software which facilitates mass production and variety of application. A combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform dedicated functions.

INTRODUCTION TO RFID READER: The RFID Reader additional board is used to read identification cards (RFID Cards) using radio waves. This additional board features a receiver/transmitter module with antenna and a 2x5 male connector that enables connection with development systems. The operation of the RFID Reader board is based on amplitude modulation of radio waves and electromagnetic induction. The RFID card is not provided with the RFID Reader, but you can buy it separately.

INTRODUCTION TO LOAD CELL: A load cell is a transducer that is used to create an electrical signal whose Magnitude is directly proportional to the force being measured. This electronic signal can be a voltage change, current change or frequency change depending on the type of load cell and circuitry used. The electrical signal output Is typically in the order of a few milli-volts and requires amplification by an instrumentation amplifier before it can be used. The various types of load cells include hydraulic load cells, pneumatic load cells and strain gauge load cells. Here, we are using string gauge load cells. [7-8]

II. PROPOSED METHODOLOGY

As the users tap their RFID cards on the RFID reader for identification. Arduino reads the RFID tag information. If the RFID tag is authorized, the system proceeds; otherwise, it denies access .As users dispose of food waste, the load cell measures the weight. Arduino processes the load cell data to determine the amount of waste Arduino stores data on the waste amount and user details. It may calculate statistics on waste generation. Display unit shows real-time waste weight, user details, and possibly other information. Users receive feedback on their waste contribution. Arduino communicates with external systems, e.g., a central server or a mobile app, via a connectivity module. System logs data for future analysis or reporting. Implementing a food waste management system using RFID (Radio-Frequency Identification) reader and Arduino can be an efficient way to track and manage food waste. Here's a basic outline of how such a system could work:

1. RFID Tags: Everyone will be provided by RFID tag containing their information . These tags contain unique identifiers that can be read by RFID readers.

2. RFID Readers: RFID readers are installed at various points in the food management system, such as at the entrance of a kitchen, near waste disposal areas, or inside refrigerators and storage areas. These readers communicate with the RFID tags to read the information stored on them.

3. Arduino: Arduino microcontrollers can be used to interface with the RFID readers, collect data, and control other components of the system.

4. Data Processing: The Arduino processes the data obtained from the RFID readers, including information about when items are placed in storage, when they expire, and when they are disposed of as waste.

5. Alerts and Notifications: The system can be programmed to send alerts and notifications when food items are disposed in the bin. This can help prevent unnecessary waste and ensure effective production.

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6. Analytics and Reporting: Over time, the system can collect data on food usage and waste generation, which can be used to identify trends, optimize inventory management, and improve overall efficiency.
7. Feedback Loop: By analyzing data collected by the system, adjustments can be made to purchasing, storage, and preparation practices to minimize waste and maximize efficiency.
8. User Interface: A user interface can be developed to allow kitchen staff to interact with the system, view real-time data, generate reports, and make adjustments as needed.

By implementing a food waste management system using RFID reader and Arduino, organizations can effectively track and manage their food inventory, reduce waste, and optimize their operations for greater efficiency and sustainability.
The "Smart food waste management system to prevent food waste in corporate environments" project introduces a comprehensive system designed to reduce the food waste by implementing an smart disposal way which can effectively reduce the wastage of food and enhance responsible consumption amoung employees. [9-10]
1. System Design: Begin by designing the overall system architecture. Identify the components needed, such as an RFID reader, Arduino board, sensors load cell, and any additional hardware like a display,buzzer, transformer, bin open/close,ac main, voltage regulator, capacitive filter.
2. RFID Tagging: Every employee will be provided with an RFID tag. Each tag should have a unique identifier associated with employee's name and other information's.
3. RFID Reader Integration: Connect the RFID reader to the Arduino board. Utilize appropriate libraries to interface with the RFID reader and read tag data.
4. Data Processing: Develop code on the Arduino to process the RFID tag data. Extract relevant information such as the weight of the food disposed in the bin and employee's information.
5. Database Management: Set up a database to store the information collected from RFID tags. This database will be used to track disposed food and their weight.
6. User Interface: Creating a user interface to interact with the system. This could be a simple LCD display connected with the system.
7. **Assessment of Current Situation**: Understand the current food waste generation and disposal practices within the corporate environment. This includes analyzing the type of food wasted and reasons for wastage.
8. Identification of Key Stakeholders: Identify the key stakeholders involved in food procurement, preparation, consumption, and disposal within the corporate environment. This may include kitchen staff, catering services, facilities management, and employees.
9. Data Collection and Analysis: Implement sensors or other data collection methods to gather real-time data on waste generation. Analyze this data to identify patterns, trends, and areas for improvement.
10. Development of Smart Technologies: Develop or implement smart technologies such as IoT sensors, RFID tags, load cell, piezoelectric buzzer for alerting staff when food wasted in bins is filled.
11. Employee Engagement and Education: Conduct awareness campaigns and educational programs to engage employees in reducing food waste.
12. Implementation of Waste Reduction Strategies: Implement strategies to reduce food waste at its source, such as adjusting procurement practices, optimizing portion sizes and responsible consumption.
13. Continuous Improvement: Foster a culture of continuous improvement by regularly reviewing and updating the food waste management system to incorporate new technologies, practices, and feedback from stakeholders.

A smart food waste management system offers several merits such as it optimizes waste collection routes and schedules, reducing fuel consumption and emissions while maximizing resource utilization. By accurately monitoring and managing food waste, businesses can save on disposal costs and potentially generate revenue through recycling or composting initiatives. By diverting food waste from landfills, where it emits harmful greenhouse gases, such as methane, smart systems contribute to mitigating climate change and preserving natural resources. These systems provide valuable data analytics on waste generation patterns, enabling businesses to identify opportunities for waste reduction and process improvement. Through transparency and education, smart food waste management systems can encourage consumer awareness and behavior change, fostering a culture of sustainability. By ensuring compliance with waste management regulations and standards, businesses mitigate the risk of fines and reputational damage. Overall, implementing a smart food waste management system promotes economic, environmental, and social benefits, making it a worthwhile investment for businesses and communities alike.It provides real-time data on waste generation patterns, allowing for better decision-making and resource allocation. It decreases the need for landfill space and reduces soil and water contamination associated with food waste decomposition. It fosters awareness and encourages

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behavior change through educational campaigns and feedback mechanisms. It encourages the development of new technologies and solutions to address food waste challenges effectively. [10-12]

EXPLANATION

The "Smart food waste management system to prevent food waste in corporate environments" project introduces a comprehensive system designed to reduce the food waste by implementing an smart disposal way which can effectively reduce the wastage of food and enhance responsible consumption amoung employees.A smart food waste management system offers several merits such as it optimizes waste collection routes and schedules, reducing fuel consumption and emissions while maximizing resource utilization. By accurately monitoring and managing food waste, businesses can save on disposal costs and potentially generate revenue through recycling or composting initiatives. By diverting food waste from landfills, where it emits harmful greenhouse gases, such as methane, smart systems contribute to mitigating climate change and preserving natural resources. These systems provide valuable data analytics on waste generation patterns, enabling businesses to identify opportunities for waste reduction and process improvement. Through transparency and education, smart food waste management systems can encourage consumer awareness and behavior change, fostering a culture of sustainability. [13].

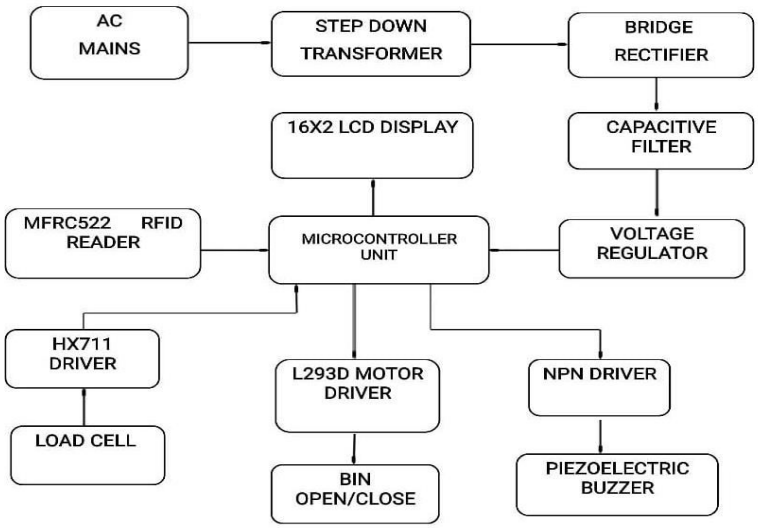

Fig.1 Block diagram for RFID

LCD:LCD stands for liquid crystal display.It is a 16 character, 2-linealphanumeric LCD display connected to a single 9-way D-type connector.It display's the employees name and the weight of the food wasted in the dustbin.

Fig.1 LCD display

POWER SUPPLY: The power supply can be provided by the AC main. A rectifier is an electrical device that converts alternating current (AC) to direct current (DC). A voltage regulator is an electronic device or circuit that maintains a constant output voltage irrespective of changes in input voltage or load conditions.

CAPACITIVE FILTER: A capacitive filter is a type of electronic filter that uses capacitors to pass certain frequencies while blocking others.

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ARDUINO: Arduino is an open-source project that created microcontroller-based kitsfor building digital devices and interactive objects that can sense and control physical devices.

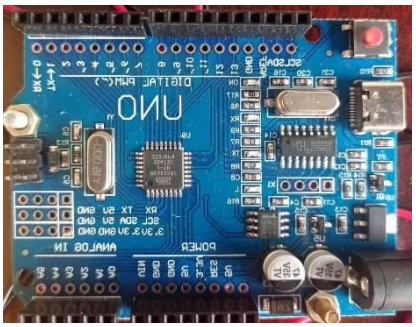

Fig.no.2 ARDUINO

RFID READER:RFID Reader is powered via a development system it is connected to the microcontroller. The presence of the power supply is indicated by a LED marked POWER.It can read the RFID tag and provide the information.

Fig.no.3 RFID Reader

LOAD CELL: A load cell is a transducer that is used to create an electrical signal whosemagnitude is directly proportional to the force being measured.

Fig.no.4 Load cell

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PIEZOELECTRIC BUZZZER: A piezoelectric buzzer is a small electronic component commonly used for generating audible alerts or tones in various devices.It gives alerts to the employees

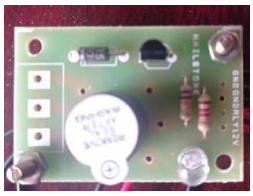

Fig.no.5 Buzzer

III. SIMULATION RESULTS

In our proposed system, project we had designed Smart Food waste management system which consist of RFID Reader, Arduino and Load cell for detecting the Amount of Food wasted by the individuals inorder to create responsible consumption habit and thereby reducing the food waste .
The following model shows our proposed system,

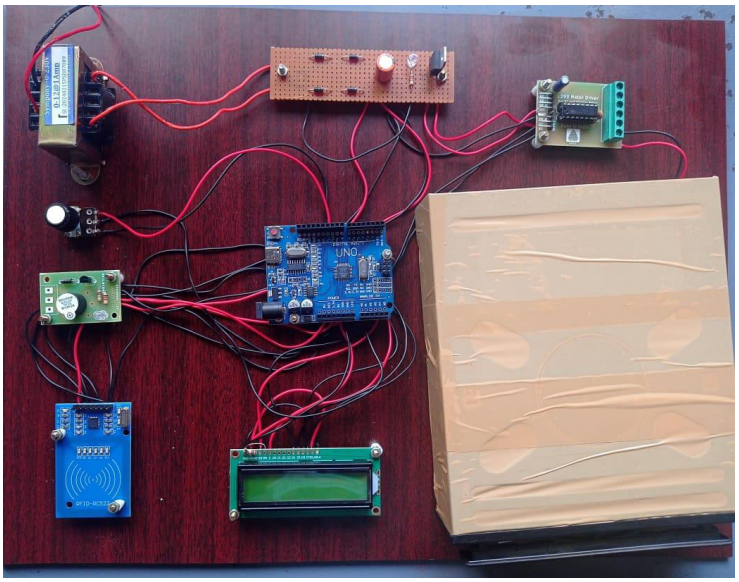

Fig.no.6 Proposed system

Fig.no.7

Fig.no.8

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Fig.no.9

Fig.no.10

Fig.no.11

Fig.no.12

Fig.no.13

Fig.no.14

IV. CONCLUSION AND FUTURE WORK

1. Integration with IoT Devices: Implementing sensors in refrigerators, food storage areas, and waste bins to track food consumption, expiration dates, and disposal patterns in real-time.
2. Data Analytics: Utilizing AI and data analytics to analyze consumption patterns, identify areas of waste, and optimize food procurement and allocation.
3. Predictive Modeling: Developing predictive models to forecast food demand, enabling better planning and reducing overstocking, which often leads to waste.
4. Automated Inventory Management: Implementing automated inventory systems that track food items, notify staff of approaching expiration dates
5. Employee Engagement: Creating apps or platforms that engage employees in reducing food waste through education, incentives for responsible consumption, and feedback mechanisms.
6. Composting Solutions: Introducing on-site composting solutions to divert organic waste from landfills and promote sustainability.

In conclusion, the implementation of the Smart Food Waste Management System in corporate environments marks a pivotal step toward fostering responsible consumption and minimizing the ecological footprint associated with food waste. By combining RFID technology, Arduino, load cells, and alarms, this innovative system not only streamlines waste disposal processes but also introduces an element of accountability through individualized tracking and penalties. The project envisions a cultural shift in corporate spaces, where employees actively engage in conscious decision-making regarding their food consumption, thereby contributing to a more sustainable and environmentally responsible workplace. The system's data-driven insights and technological interventions not only enhance waste management practices but also serve as a model for corporate entities striving to align their operations with broader sustainability

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objectives. Ultimately, the Smart Food Waste Management System signifies a holistic and effective approach towards building a greener, more responsible future within corporate settings.

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