WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Implementation and Development of Smart Refrigeration System

[1]Vaishanavi Andhale, [2]Shraddha Bhand, [3]Sakshi Shahane, [4]Pratik Sankpal, [5]Prof. Vaibhav Phule*

[1-4],BE Student, Department of Mechanical Engineering, Dr. D.Y. Patil College Of Engineering , Akurdi, Pune. Affiliated Under Savitribai Phule Pune University, Pune,(MH) India,

Assistant Proffessor, Department of Mechanical Engineering, Dr. D. Y. Patil College Of Engineering, Akurdi.

Affiliated Under Savitribai Phule Pune University, Pune,(MH) India.

A B S T R A C T

We still struggle with hunger and poverty in the world we live in. People are on the edge of hunger in Sub-Saharan Africa and other countries, including India. Contrarily, there is increased worry about food waste. Our project's goal is to suggest a new type of smart refrigerator featuring sensors, a camera, and an image recognition system. Food preservation and storage for a long time are frequently done in refrigerators. People's attention on their jobs has increased as a result of the modern lifestyle, leaving them with less time to think about what they eat every day. They eventually lose awareness of the quantity and quality of food kept in their refrigerators. As a result, food kept in refrigerators is frequently wasted and left unattended. Food insecurity, especially in poor nations, and rising greenhouse gas emissions are both caused by food waste. Through this project, we are developing the concept of a smart refrigerator that can gauge the number and quality of food items kept inside of it. Using an Android application on a mobile device, it is intended to alert users of food shortages, food rotting, and the present status of food items. The user has the ability to identify food items that are beginning to spoil. As a result, it will offer the user a convenient and controlled method of food preservation. The development of the smart refrigerator system integrates the Internet of Things and the expansion of the smart kitchen. The sensor module, control module, and gearbox module are the system's three key components. The transmission module is made up of an LCD module and a Wi-Fi module. The sensing module includes a load cell, an odor sensor, and a camera. The control module includes an Raspberry Pi and a power supply unit. Together, these modules assess the contents of the refrigerator and send an SMS or email to the user informing them of the quantity and condition of the food. In this article, we suggest an automated strategy for classifying refrigerator images that is based on a novel Convolutional Neural Network (CNN) architecture. By applying a data-driven approach and jointly optimizing both classification and similarity constraints, it overcomes the challenges associated with classifying refrigerator images.

Keyword: Machine Learning, Artificial Intelligence, CNN Algorithm, Deep Learning, Refrigeration,:IOT, Smart Appliances, RFID

1. INTRODUCTION

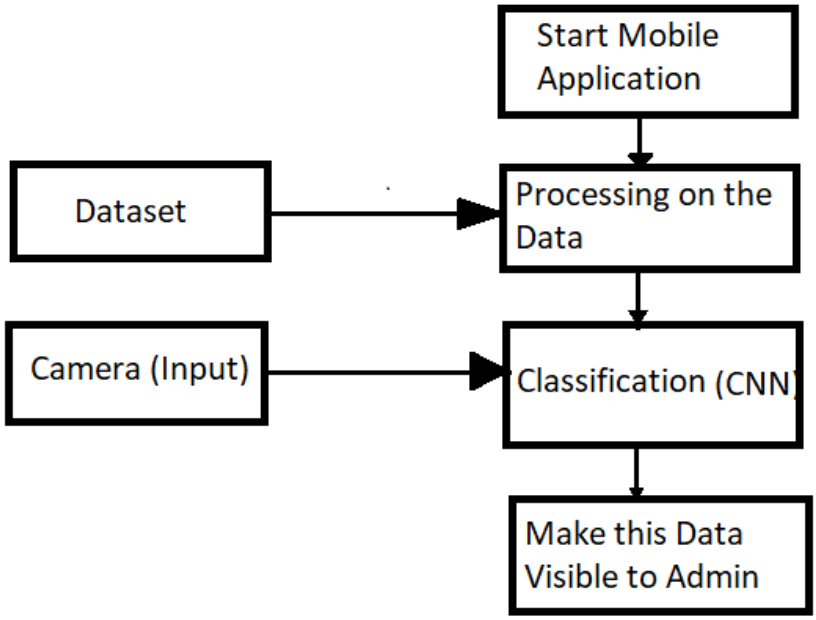
One of the most popular domestic appliances and a key component of industrial production, the refrigerator is an essential part of our daily life. A refrigerator makes these tasks easier, from preserving the freshness of our food to big industrial applications. By eliminating heat, refrigeration creates a cooling environment. It is mostly used to preserve food and other perishable things, reducing the risk of illnesses brought on by consuming perishable foods. In essence, it prevents bacteria from growing in food items, which happens at low temperatures. These food preservation techniques have been practiced for countless years, but the modern refrigerator is a relatively new development. Around 1000 B.C., the Chinese discovered how to cut and store ice, and 500 years later, the Egyptians and Indians discovered how to manufacture ice by leaving clay pots outside on chilly nights[3]. The Greeks, Romans, and Hebrews, among others, used snow pits to store snow and covered them with various insulating materials. During the 17th century, saltpeter dissolved in water was discovered to provide cooling conditions and was used to make ice in numerous locations around Europe. Europeans began gathering ice in the 18th century, salted it, wrapped it with flannel, and buried it where it could be kept for months. According to a 2004 study in the journal of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)[5], ice was even delivered to other places in the world. Nearly 20% of the energy consumed globally today is going towards refrigeration and air conditioning[2]. China has been producing the most refrigerators in recent years, and this industry has significantly boosted China's economy. Along with the advancement of industrial automation,

particularly with the advent of industry 4.0 standardization, a number of vision-based applications in the manufacturing of refrigerators have been developed. For industrial automation, automatic classification is one possible asset. It assists in addressing a number of drawbacks of manual inspection, which is extensively used on the production line but has drawbacks such as high labor costs and inter/intra-observer variances. People's attention on their jobs has increased as a result of the modern lifestyle, leaving them with less time to think about what they eat every day. They eventually lose awareness of the quantity and quality of food kept in their refrigerators. As a result, food kept in refrigerators is frequently wasted and left unattended. Food insecurity, especially in poor nations, and rising greenhouse gas emissions are both caused by food waste. This essay explores the concept of a smart refrigerator that can measure the number and quality of food items kept inside. Using an Android application on a mobile device, it is intended to alert users of food shortages, food rotting, and the present status of food items. The user has the ability to identify food items that are beginning to spoil. As a result, it will offer the user a handy and manageable method of food storage. In order to improve the quality of life at home, this project aims to develop Smart Home concepts using Internet of Things (IoT) technology. In this project, we first go over the general layout of a cheap Raspberry Pi-powered Smart Refrigerator. Our solution may easily help a family reduce food waste thanks to this Smart Home and Internet of Things technology, a user-friendly graphical user interface, prompt data synchronization among numerous devices, and real-time actual photographs captured from the refrigerator. Due to the Internet's and technology's rapid development, several businesses have put forth concepts for "smart home" technologies, including home automation systems, pet care systems, and smart refrigerators [4,5,6] that can manage a food supply. These intelligent refrigerators were nonetheless too expensive for middle-class families to afford.The network of physical objects—"things"—that are integrated with sensors, software, and other technologies for the purpose of communicating and sharing data with other devices and systems over the internet is referred to as the Internet of Things (IoT). These gadgets include anything from common domestic items to high-tech industrial gear. The Internet of Things (IoT) develops a network fabric that is intelligent, invisible, and programmable. The technology used by IoT-enabled items enables their embedded communication, either directly or indirectly, with other IoT-enabled products or the Internet. Recently, anytime we discuss the Internet of Things or Cloud of Things, smart kitchen immediately comes to mind. The kitchen is the home's biggest garbage producer and second-largest energy consumer, so that explains it. As a result, producers are constantly looking for ways to create smart kitchen goods that use less energy and waste while increasing convenience. For instance, a Samsung Smart house promotes a "total home solution" with the tagline "Enrich Your Life" with the intention of reestablishing balance in your life. It offers a means to handle housework remotely while also enhancing activities done at home. As a result, the consumer has less to worry about and more free time to spend with loved ones. A refrigerator, also known as a "fridge," is a common household appliance that consists of a thermally insulated compartment and a heat pump (mechanical, electronic, or chemical), which transfers heat from the refrigerator's interior to the environment outside the refrigerator so that the interior of the refrigerator is cooled to a temperature lower than the room's ambient temperature. In developed nations, refrigeration is a crucial method of food storage. The refrigerator slows down food spoiling because the lower temperature slows down bacterial reproduction. However, no matter how costly and well-known the refrigerator is, it may not be able to keep the food fresh for an extended period of time, which may result in food rotting. Unfortunately, consumers also have less time to inspect the state of their food every 11 days that it is kept in the refrigerator. Additionally, they can forget what kinds of food and how long they kept it in the refrigerator. As a result, anytime they try to use the food for cooking, they may discover that it has already gone bad and must be thrown away. It's a complete waste. As a result, a smart refrigerator system that can notify the user of the status of their food in the refrigerator has been designed. Users will receive a notification from the system informing them of how long specific foods have been kept in the refrigerator. The system will issue a warning when the limit (the time period selected by the user) is reached.

Nomenclature

CNN Convolutional Neural Network
RFID: Radio Frequency Identification
Raspberry Pi 3B
HX711

1.1. Structure Table :



1.2. Literature Review

PROJECT NAME	AUTHOR	KEYWORD	OUTCOME
1. A smart domestic refrigerator with energy efficiency improvement	Athiwat Phuchamniphatthanan nun	Refrigerators, Temperature sensor, Compressors,WSN,Wireless Communication	In this Paper, A simple learning algorithm is also implemented on the microcontroller to maximize system efficiency to maintain the temperature at food safety limit or user temperature.
2. IoT Based Novel Smart Refrigerator to Curb Food Wastage	Gaurav Annand, Lucky Prakash	IOT , Smart refrigerator , Temperature sensor, Mobile device	In this paper , The objective is to propose a next generation Smart Refrigerator enriched with sensors, camera and image recognition mechanism. Refrigerators are commonly used for storing and preserving food for an extended period of time.

3.Low-Cost Smart Refrigerator	Hsin-Han Wu,Yung-Ting Cuang	IOT,GUI, Smart Refrigerator , Rasberry Pi board , Devices	In This paper, To present the Smart Home concepts for Internet of Things (IOT) technologies that will make life at the home more convenient. We are firstly describe the overall design of a low-cost Smart Refrigerator built with Raspberry Pi
4. IoT based Grocery Management System: Smart Refrigerator and Smart Cabinet	Muhammad Asad Khan Hassan Mansoor Uzair Shafique Asim ur Rehman Khan	internet of things, grocery management, smart cabinet, smart refrigerator	This paper presents the Internet of Things (IoT) based Grocery Management System consisting of Smart Refrigerator and Smart Cabinet.
5. The Implementation of IoT based Smart Refrigerator System	Haidawati Nasir, Wan Basyar Wan Aziz, Fuead Ali Kushsairy Kadir	— Internet of Things (IoT), Smart Kitchen, Home Automation System, Arduino, Sensors	This paper combines the idea of IoT and smart kitchen evolution, the smart refrigerator system is developed. The system consists of three main parts which are sensing module, control module and transmission module. Sensing module consists of load cell and odour sensor while control module consists of Arduino UNO and power supply unit and last but not least, the transmission module consists of LCD module and Wi-Fi module. These modules work together to determine contents status inside the refrigerator and notify the user about the condition and quantity of the food
6. A novel refrigerator for smart city	Niketan Patil Devarshi Pathak	Peltier effect; liquid coolant; compressor; Air conditioner	This paper proposes the complete overhaul of the refrigerator with replacing the compression-based model to Peltier effect-basedrefrigerator. This is novelapproach in the field of refrigeration.

1.3. Methodology:

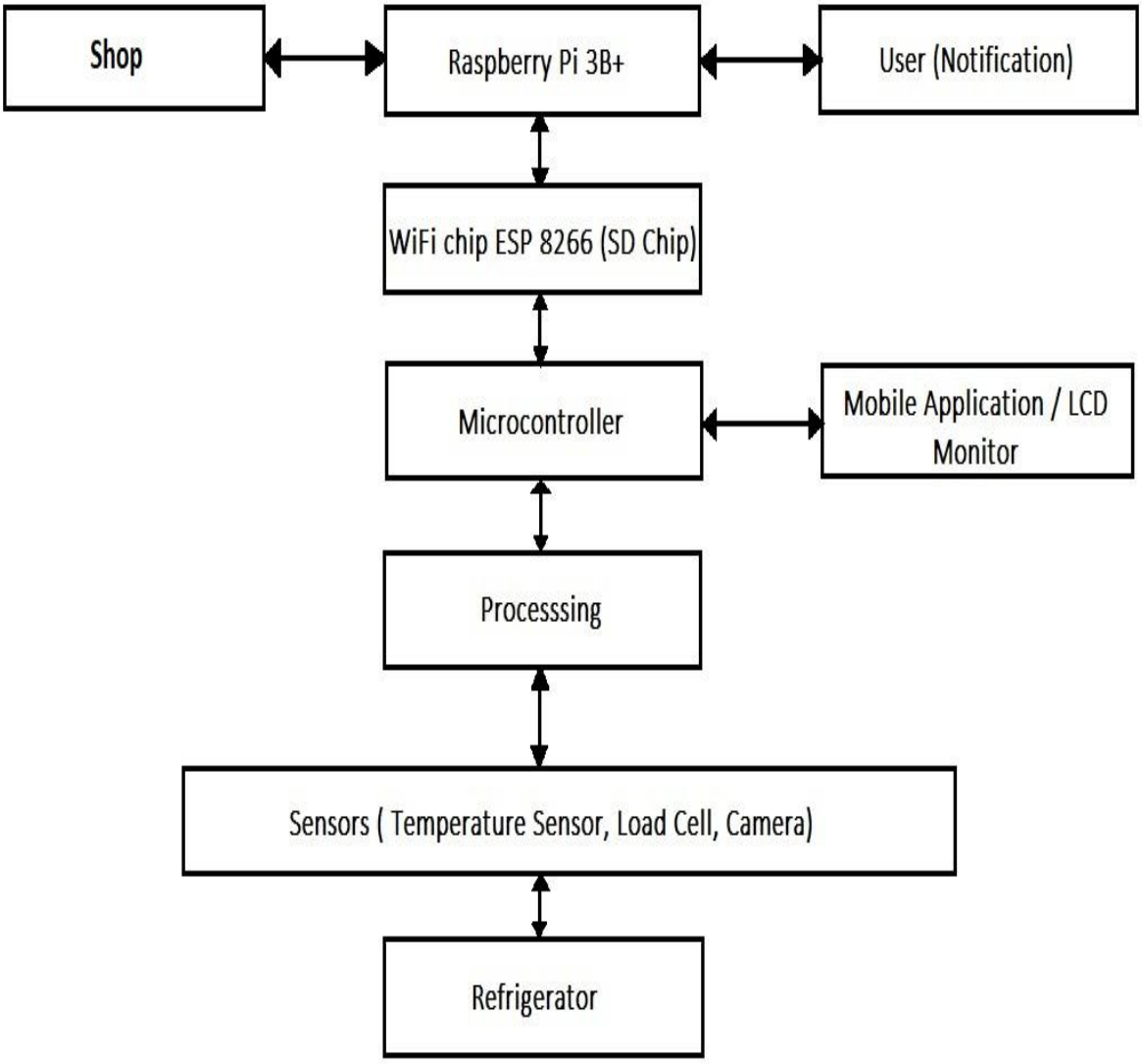


Fig2: Block Diagram of Methodology

With the help of an android app that downloads data from the cloud, the user will be able to monitor content and operate the refrigerator online. Since this system is built on the Internet of Things, all of the sensor data is supplied to the microcontroller, which then uploads it to the cloud using a Wi-Fi chip interface.

1) **Smart Refrigerator Sensors:**

a) Temperature Sensor: This gadget gauges the interior and outside temperatures of the refrigerator. Use this to contrast the temperature of the room with the refrigerator's auto-off functions.

b) Load Cell: To determine whether the refrigerator part is overly heavy, use a load cell.

Figure displays the block diagram for the smart refrigerator using a Raspberry Pi B+. The whole sensor used for its functionality is shown in block schematic form. We employed a raspberry pi as a controller to oversee the project's workflow, as seen in the above figure.

To help the user understand refrigerator warnings, output devices such LCDs and buzzers are available. The buzzer will also blow. The Android app can be used by both customers and store owners. The user's app will warn them when something dips below the threshold, and if necessary, they can place an order. The shopkeeper receives notification of the order through the user's app, and he then delivers the requested item to the consumer.

Results: Because of their hectic schedules, people today often forget to check the refrigerator for the daily ingredients they require. Our technology gives consumers the option to place orders with local shopkeepers to have certain products delivered whenever fresh produce or everyday necessities like milk, eggs and so forth fall below a set threshold.

When a vegetable, like a tomato, goes bad, it will cause other veggies to go bad as well. If a consumer consumes such food without realizing it and has negative health effects, then we can decide whether or not vegetables are beneficial. Vegetables that are starting to deteriorate will be reported to the user.

Additionally, we provided a mobile app with an on/off button. Let's imagine a user is away from the station for more than three to four days and forgets to turn off the refrigerator. He can remotely turn off the refrigerator by turning off the switch on your app.

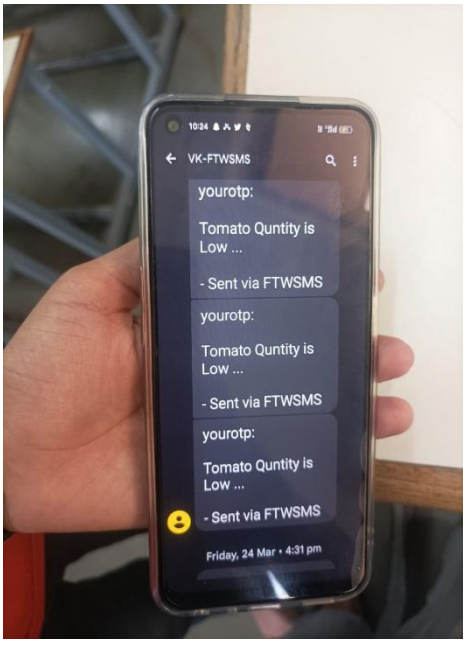


Fig. Notification received after getting quantity of food items below certain threshold.

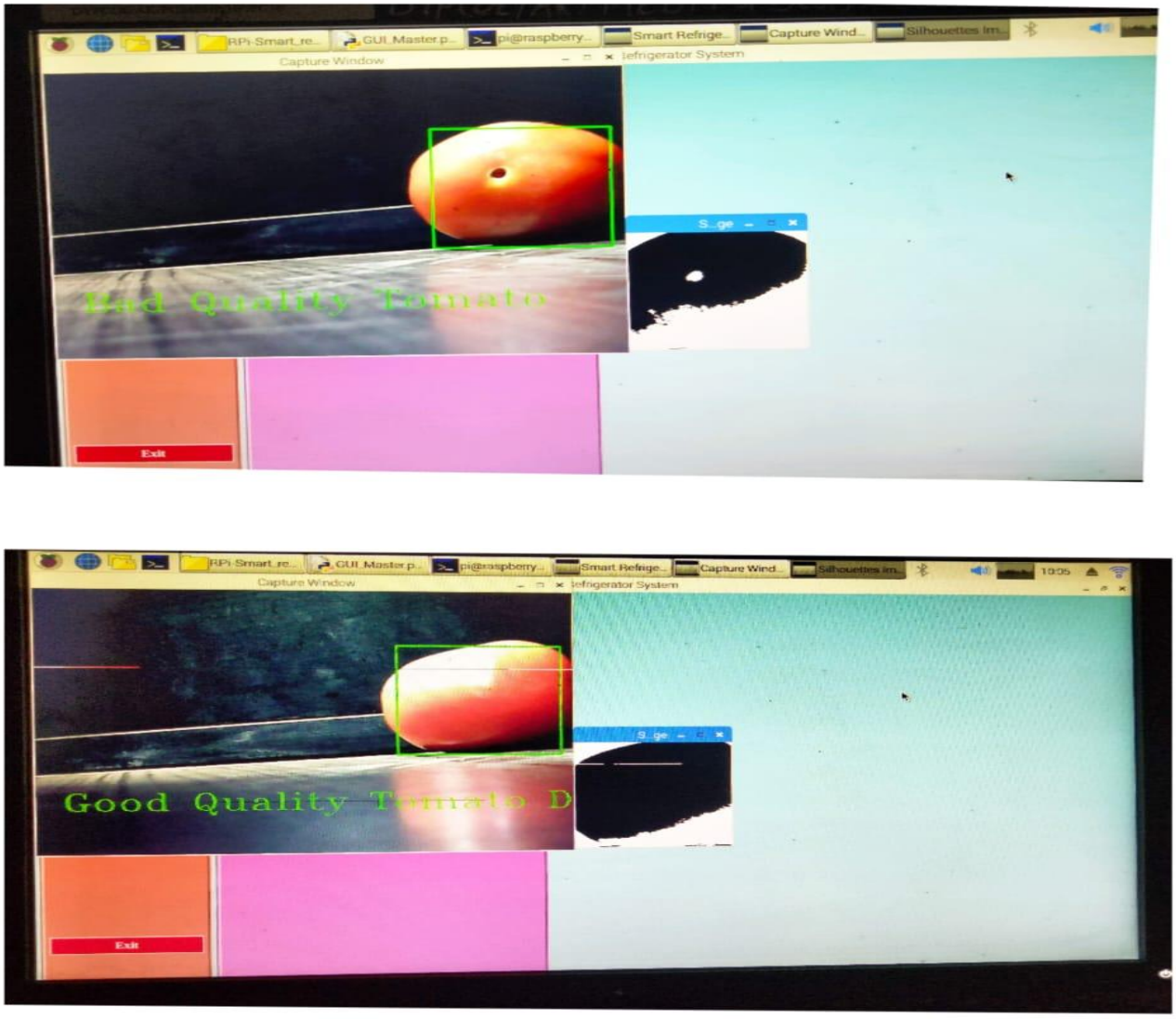


Fig. Algorithm showing whether the quality of food is good or bad.

Conclusion: The Smart refrigerator module had the ability to alert the user and manage refrigerator operations from a distance. Additionally, it makes it easier to buy the in-demand food items online. The user receives notifications and information from the programmes via an Android app. With the help of other modules, on user can announce a placed order and the other can accept it.

Reference:

1. https://www.sciencedirect.com/science/article/pii/S0140700715001759
2. Sustainable cold chains can address climate, food crises: UNEP and FAO Report https://www.downtoearth.org.in/news/food/sustainable-cold-chains-can-address-climatefood-crises-unep-fao-report-85966
3. Images Processing: Segmentation and Objects Counting with Python and OpenCV https://medium.com/analytics-vidhya/images-processing-segmentation-and-objectscounting-in-an-image-with-python-and-opencv-216cd38aca8e
4. National Restaurant Association (2017). Food waste Retrieved March 27, 2017, from http://www.restaurant.org/advocacy/Food-Wast
5. Rouillard, J. (2012). The pervasive fridge. A smart computer system against uneaten food loss. In Seventh International Conference on Systems (ICONS2012) (pp. pp-135), February 2012.
6. Shadangi, V., & Jain, N. (2015, December). Medical internet refrigerator. In Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2015 International Conference on (pp. 363-366). IEEE.
7. Types of load cells. https://www.omega.com/en-us/resources/load-cells
8. Athiwat Phuchamniphatthananun, Wanchalerm Pora. A smart domestic refrigerator with energy efficiency improvement

9. Matthew Edward1 , Kanisius Karyono2 , H Meidia. Smart Fridge Design using NodeMCU and Home Server based on Raspberry Pi 3
10. How an IoT-Enabled “Smart Refrigerator” Can Play a Clandestine Role in Perpetuating Cyber-Crime
11. IoT based Grocery Management System: Smart Refrigerator and Smart Cabinet 12. The Implementation of IoT based Smart Refrigerator System 13. IoT Based Novel Smart Refrigerator to Curb Food Wastage
12. A novel refrigerator for smart city
13. Low-Cost Smart Refrigerator
14. Design of an Interactive Smart Refrigerator Based on Embedded System