

An Intelligent Appliance with Multimedia Capability

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Abstract— Smart refrigeration with the help of a smart fridge is a concept that finds its place in smart kitchens. The smart refrigerator is capable of sensing and monitoring its contents and is also able to remotely notify the user about scarce products via SMS (Short Message Service) and email using a GSM module. It also facilitates the purchase of scarce items by providing a link of the online website for purchase of that particular item. This assessment is done with the help of LDR and micro switches employed as pressure sensors (quantity management), odor sensor (quality management) and RFID (shelf life management). The overall food management is done based on coding done using Keil software for the same purpose.

Index Terms— GSM module, Keil software, LDR, RFID

INTRODUCTION

The Internet of Things (IoT) is the recent communication paradigm that envisions a near future, in which the objects of everyday life will become an integral part of the Internet. This project deals with the designing of a smart refrigerator which is able to sense the quantity and quality of the food items kept inside it. Expiration date and/or freshness of food products isn't readily known to consumers unless they individually examine and track each item. This leads to significant food spoilage, illness due to consumption of expired food, and resulting additional expenditure for the consumers. With smart sensing technology, this refrigerator will keep check on the expiry of food products. It will be smart enough to notify the current status of food items on our mobile phone, and will also remind us about the items are going to spoilage before they actually get rotten. The overall food management is done based on coding done using Keil software for the same purpose.

OBJECTIVES

Refrigerator food management and wastage prevention by:

1. **Quantity monitoring:** Assess the quantity and provide timely updates and reminders of immediate usage or restocking.
2. **Quality monitoring:** Quality of vegetables and fruits can be monitored and alerts can be generated on the onset of spoilage.

3. **Shelf life monitoring:** Packaged products can be monitored for expiry date.

The user can be alerted of the updates on his phone and can take steps to prevent food wastage or can place orders to restock the food in the fridge.

METHODOLOGY

The system comprises of sections where the sensors are placed. Light dependent Resistors (LDR) sensors, odor sensors and pressure sensors are placed along with a counter which can be used to sense the quality and quantity of contents. They can be used to detect the level of milk and soft drinks in the container and to sense the presence of vegetables in the refrigerator. ASIC RFID transmitter and receiver are used to monitor shelf life of contents. Whenever the contents inside the refrigerator goes below the predetermined threshold values or are degraded in quality, or if the product is on the verge of expiry, a trigger is generated which is being transmitted in the form of message to the user. **SENSORS:** These sensors are fitted in Refrigerator compartments. They sense objects, shelf life and quality of objects and if no object is found or if any quality degradation is sensed, they produce NO Object signal or NO Quality signal or NO shelf life signal which is fed to further stages. **INTERFACING STAGE:** As microprocessor needs TTL compatible level signals at its input port, interfacing stage must be introduced.

DESIGN AND CONSIDERATIONS

1. Design

The module could be seen to be composed of sub-modules namely:

1. *Sensing module:* LDR, MQ3 Sensor, Pressure Sensor, ASIC RFID Transmitter and Receiver
 2. *Control module:* ARM7 LPC 2148 Microcontroller, Power Supply Unit
 3. *Transmission module:* LCD Module, GSM Module
- These modules work together to determine contents status inside the refrigerator and notify the user about the products via an SMS or e-mail

2. Considerations

The following constraints must be kept in mind while developing the design.

- Power supply should be cut off when module not in use.
- Module has to be installed in a place where there is availability of strong network for notifications.
- The food items have to be placed in their respective slots.
- The design must be applicable any existing refrigerator.
- “Embedded C” was the effective option among others and is chosen as programming language.
- The output is shown on a circuit board which consists of the smart refrigeration module. LED’s are placed at various places to indicate the flow of execution.

The possible source of error include replacing of food items without using them leading false notification. To recover from such an error, the module could be reset or dedicated application could be developed.

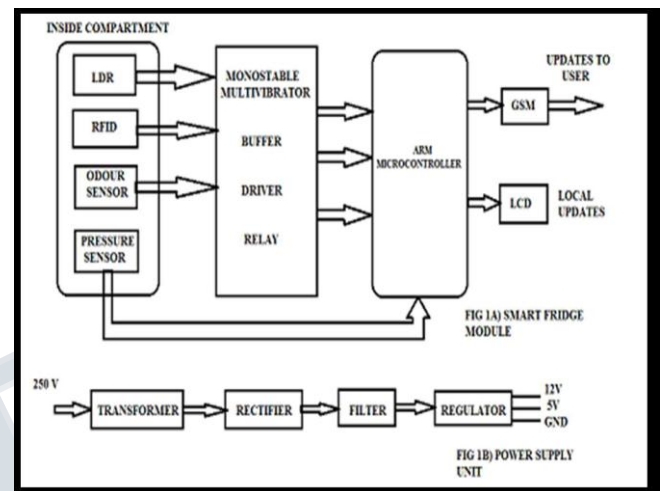
ALGORITHM

Steps:

1. Input from sensor is sent to the Monostable Multivibrator to convert Analog signals to Digital signal(high or low).
2. Digital signal from Multivibrator is complemented using Buffer and Driver Circuit.
3. The output of Buffer & Driver stage is given to Microcontroller for processing the input data and according display the status on LCD.
4. Initialize the GSM module which is connected to the MicroController.
5. Check Network status.
6. Send registered phone number to GSM module.
7. Send product information to GSM module.
8. Send temperature information to GSM module.
9. Set SMS mode to TEXT mode.
10. Add delay.
11. Send SMS text message to the registered phone number based on the information(i.e.,if the

input to the MicroController is high ,which means the items in fridge is less than prefixed or threshold limit).

MODULES



A. Power Supply Unit:

This section needs two voltages viz., +12 V & +5 V, as working voltages. Hence specially designed power supply is constructed to get regulated power supplies.

B. Monostable Multivibrator:

This Section converts the received RF IR signals into digital pulses to drive further circuits. The Received signals are fed to this Schmitt Trigger which produces the train of pulses with respect to the signals length. Now the Receiver Unit has digital pulses, which represents the Sensed Signals in remote area. These pulses are fed to next section for further processing.

Buffer and Driver: Buffers do not affect the logical state of a digital signal (i.e. a logic 1 input results in a logic 1 output whereas logic 0 input results in a logic 0 output). Buffers are normally used to provide extra current drive at the output but can also be used to regularize the logic present at an interface. **Driver** is used to drive the relay where the output is complement of input which is applied to the drive but current will be amplified. **Relay** is a electromagnetic device which is used to drive the load connected across the relay and the o/p of relay can be connected to controller or load for further processing.

Microcontroller:

The output of Buffer & Driver stage is given to this stage for further processing. The status of the Temperature and Light Sensors are fed to Microcontroller chip for display process. There are three status viz., Low, Medium and High. The chip processes the inputted data and accordingly displays the status on LCD Module.

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GSM (Global System for Mobile communication):

- **GSM** (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world
- The GSM module that is connected to the microcontroller is used to send updates to the user in the form of SMS or E-mail .
- The user is alerted about the status of the refrigerator contents on his mobile phone and is provided with appropriate links to access online sites to place orders for depleted or expired products.
- LCD module connected to microcontroller, is used for local alerts.

DESIGN CONSIDERATIONS

The following constraints must be kept in mind while developing the design.

- Power supply should be switched off when module not in use
- Module has to be installed such that there is availability of strong network in order to notify the user
 - The food items have to be placed in their respective slots.
 - The pressure sensor output has to be kept high.
 - The design must be applicable to any existing refrigerator .

GSM COMMANDS

The AT commands used to control models which are communicating through serial communication with a microcontroller or a PC .AT is the abbreviation for Attentions

- ATI: Modem product information
- ATE0: Disable echo so that characters typed by the user are not echoed back by the modem
- ATE1: Enable the echo mode
- AT+CMGF: Select SMS message format
- AT+CMGS: Send SMS message
- AT+CMGR: Read SMS message

ADVANTAGES

- Whenever the items in the refrigerator comes to empty stage, that will be monitored with the respective sensors like pressure sensor for egg, LDR (light dependent resistor) for drinks.
- The Odor Sensor is used to monitor the rotten groceries

- The user need not check the items in the fridge manually, so the notification about the status of items will be directly sent through the SMS or even through E-mail.
- Simple in design, low power consumption and compact size as hardware is considered
- Links will be sent along with the notification so that the owner will be able to place the order for the required item.

CONCLUSION

The Smart Refrigerator module is able to remotely notify the user about the low contents inside the refrigerator. It also facilitates purchase of the scarce food items from an online vendor. The link to the online vendor is incorporated inside the notification that is sent to the user via SMS (Short Message Service) and email. This module helps to prevent wastage of food as the user is constantly aware of the contents in the refrigerator and can proactively take measures to prevent wastage.

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