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Internet of Things based Smart Refrigerator

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Abstract - In this growing world, the Internet of things plays a very vital role in making human life much simpler and more convenient. Automatic smart appliances have overtaken conventional appliances by improving its efficiency, power consumption, connectivity and robustness. The term 'Smart' is associated with applications that can be interfaced with web. Smart appliances include Television, Washing Machine, Refrigerator etc. In this paper we have proposed a methodology which can convert a traditional refrigerator into a Smart refrigerator[1]. The Smart refrigerator helps in food management by summing computational intelligence which uses micro controllers and simple sensors to increase the functionality. Using this simple mechanism, cost effective intelligent refrigerator can be developed. The Smart refrigerator is user friendly and enhances human life.

Key Words **:** Renesas microcontroller, Internet of Things, Android application, Smart refrigerator, Temperature and humidity sensors.

1. INTRODUCTION

Home automation makes our daily life much more easy and simpler. Refrigerator has made human daily life more convenient keeping food fresh and preventing spoilage of food items. The research and industry have focused on development of the Smart Home Environment. Kitchen is the most important place for a Smart home as it consists of various appliances which provides better services to the household. And the main focus of our project is on smart Refrigerator. In this modern lifestyle, it doesn't allow the user to keep a track of the food items inside the refrigerator. Even though researches have been done by the industry to develop the smart refrigerator, the existing technology is still not cost effective or energy efficient.

The technology used in past was too complicated or complex for a simple household user who have less knowledge of how all the mechanism behind the smart refrigerator works. The Smart refrigerator proposed in the paper provides the user with a message about the shortage of food amount present in the refrigerator via a mobile application and it also senses temperature, humidity and displays them to the user by using simplest techniques. The proposal of connecting house appliances to the internet or the smart home surroundings has been the future of IOT.

2. METHODOLOGY

This section provides a brief information about the technologies used in the implementation of the refrigerator. The system consists of a three sub-module which are control module, sensing module and GSM module.

2.1 Sensing Module

The sensing module is equipped with variety of sensor such as temperature sensor, humidity sensor, smoke sensor and force sensor to measure the variation in the environment of the refrigerator. After sensing, the sensed data gets updated to the control module.

2.2 Control Module

In the control module, the analog input received from the sensing module is been processed into digital form for displaying it on the LCD screen. When the sensed values are above threshold, it triggers the GSM module for message passing.

2.3 GSM Module

In the GSM module, the received information from the control module is sent to the user's mobile number and the Android application to notify the user about the changes happening in the refrigerator.

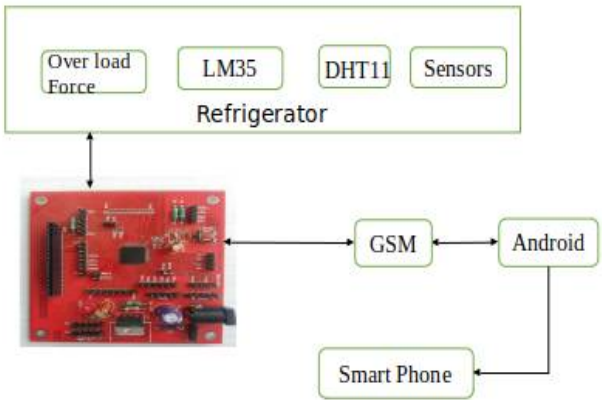

Fig-1 : Methodology

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3. MODELLING

3.1 System Design

When the system is set ON, the GSM module gets Initialised and a text message is sent to the user mobile number. IR sensor senses the shortage of food items, if there is a shortage a message is sent to the user stating that there is no stock[4]. Magnetic door sensor is used to monitor the opening and closing of the door, if the door is left open then the user gets notified. Temperature and humidity sensors are used to monitor the environment inside the refrigerator. If the odour exceeds the threshold,the smoke sensor gets activated and simultaneously an alert message is sent to the user.

An overload sensor is equipped in order to monitor the overloading of the refrigerator and same will be updated to the application. An LCD is incorporated on the Renesas microcontroller board in order to display the conditional changes inside the refrigerator.

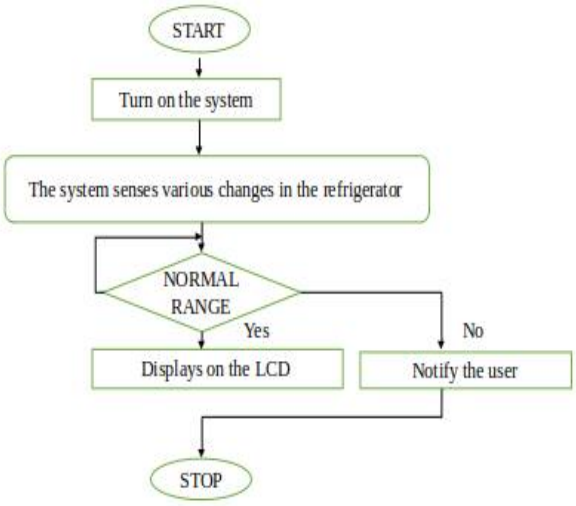

Fig-3 : Flow Chart of the system

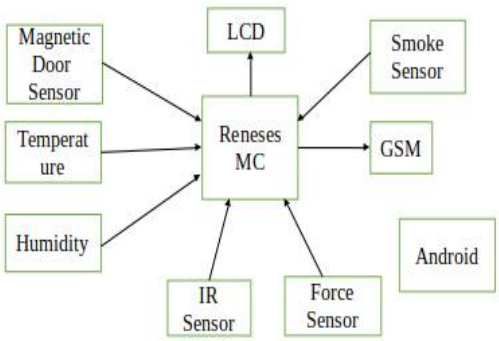

Fig-3 : Block diagram of the system

3.2 Hardware Requirements

3.2.1: Renesas Microcontroller:

Renesas microcontroller belongs to 8051 family of microcontrollers, with various in-built features. A features are, Renesas is a 16 bit microcontroller minimum instruction time can be changed from ultra- low speed(30.5 us) to high speed (0.03125 us). 16 to 512KB of ROM and 2 to 32KB of RAM are available depending upon the series and number of pins. On-chip high speed (32 MHz to 1 MHz) as well a low-speed (15KHz) oscillator is present. 10 bit resolution A/D converter. Totally 3 UART for Serial Interface and totally 0-7 channels for timer with built in features. Most of the pins of Renesas have multi-task features. Cost of Renesas microcontroller is comparatively less in price. Rigid body of microcontroller hence less prone to damages due to electrostatic charge and it operates with 5V power supply.

Fig-4 : Renesas MIcrocontroller

3.2.2: LM35 Temperature Sensor:

LM35 series are precision integrated circuit temperature sensors, which are used to sense the temperature and whose output voltage is linearly proportional to the Celsius temperature. The LM35 has an advantage , that is the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.The LM35 sensor will operate over a −55˚ to +150˚C temperature range.

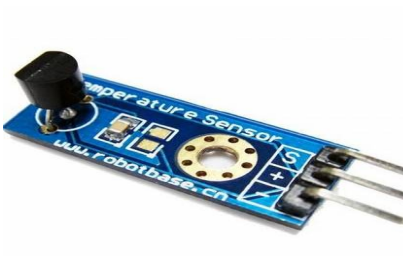

Fig-5 : Temperature Sensor

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3.2.3: DHT11 Humidity Sensor

The DHT11 sensor is a low-cost humidity sensor which is used to sense humidity. This sensor uses a thermistor for measuring the surrounding air, and it gives a digital signal on the data pin. It is simple to use, but requires appropriate timing to get the data. You can get new data from the sensor once every 2 seconds. This sensor can be used with any microcontroller like Arduino, Raspberry pi and so on to measure humidity instantaneously. DHT11 humidity sensor is small in size with an operating voltage of 3 to 5 volts.

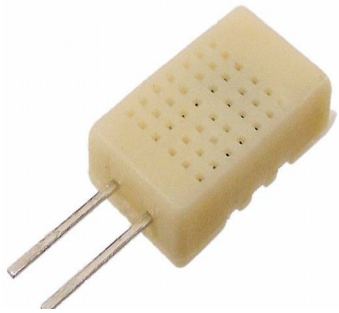

Fig-6 : Humidity Sensor

3.2.4: MQ2 Smoke Sensor

The MQ-2 Gas sensor is used to detect or measure gases like LPG, Alcohol, Hydrogen, CO and even methane. It comes with a Digital Pin which makes this sensor to operate even without a microcontroller. When it comes to measuring the gas in ppm the analog pin has to be used, the analog pin also works on 5V and hence can be used with most common microcontrollers.

Fig-7 : Smoke Sensor

3.2.5: IR Sensor

IR sensor is an electronic device, it will emit the light in order to sense object of the surroundings.IR sensors can be passive/active. Passive IR sensors do not use any infrared source and detects energy emitted by obstacles in the field of view.[2] Active IR sensors consist of two elements: infrared source and infrared detector. The energy emitted by the IR source is reflected by an object and falls on the infrared detector.

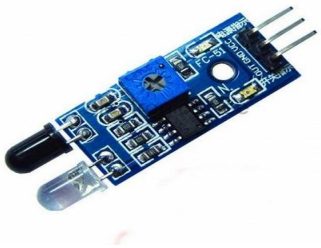

Fig-8 : IR Sensor

3.2.6: Force Sensor

Force Sensors is a polymer thick film device which exhibits decrease in resistance with an increase in force applied to the active surface. The force sensitivity is optimised for the use for human touch control of electronic devices. Force sensor are not a load cell, though they have similar properties. Force sensor are not suitable for precision measurement.

Fig-9 : Force Sensor

3.2.7: GSM Module

GSM Module is one of the most commonly used communication module in embedded systems. A GSM Module are used to enable communication between a microcontroller and the GSM Network, GSM stands fo Global System for Mobile Communication. A GSM comprises of a GSM Module along with some other components like communication interface, power supply and few indicators. With the help of this communication interface, we can connect the GSM Module on the GSM MODEM with an external a microcontroller.

Fig-10 : GSM Module

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3.3 Software Requirements

3.3.1: CubeSuite+

The CS+integrated development environment provides simplicity, security, and ease of use in developing software through iterative cycles of editing, building, and debugging. You can use the basic software tools for developing software for Renesas MCUs immediately after the initial installation. CS+ is also compatible with Renesas hardware tools including the E2 and E1 debugging emulators which facilitates advanced debugging. Abundant extensions and functions for user support ensure a dependable environment for all users.

3.3.2: Renesas Flash Programmer

The Renesas Flash Programmer V2 provides usable and functional support for programming the on-chip flash memory of Renesas microcontrollers in each phase of development and mass production.

4. Result

4.1: Hardware Result

The proposed smart refrigerator Sytem is able to test all the conditions inside the refrigerator and notify the user whenever there is a shortage of items inside the refrigerator and about the changes in temperature and humidity. Whenever there is odour, user is notified with an alert message.

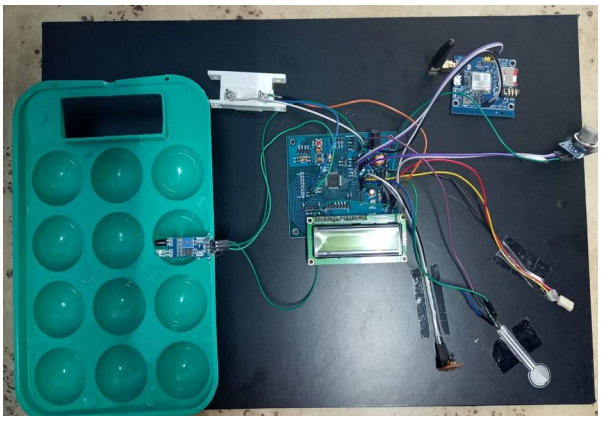

FIG-10 : Final Product

4.2: Android Application

An Android Application is developed in order to check about the conditions inside the regrigerator. It is designed in such a way that displays all the parameters like date, time, temperature, humidity, load, shortage of food items and odour.

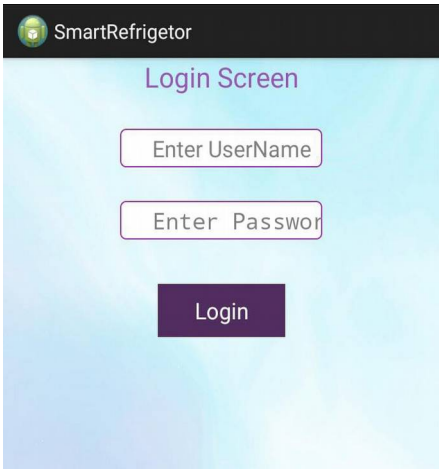

Fig-11 : Login page

Fig-12 : Admin page

4.3: Message Receiving

Text message sent to the user mobile number about the conditions inside the Refrigerator.

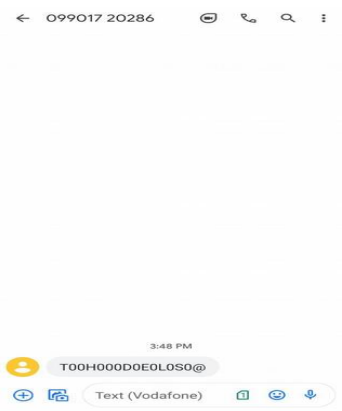

Fig-13 : Message Received

5. CONCLUSION

The conversion of traditional refrigerator to a smart and intelligent is done using Renesas Microcontroller and mobile app, and the module detects the shortage of food items and notifies the user and uploads the data to GSM service along with data of refrigerator temperature, humidity, load, odour and opening and closing of the door. This system is cost-effective and can be used for any Refrigerator just consuming some space in the fridge. The future work can be implementation like image recognition software to detect what's inside the fridge been mounting camera and using image processing algorithms and other features. Use of Google API for speech recognition which uses natural language processing algorithms and recognises commands by strong neural networks and give response.

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