Intelligent Refrigerator based on Internet of Things

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Abstract—**Based on the technology of radio frequency identification (RFID), combined with Internet and information processing technology, intelligent refrigerator for food management is developed, food records the within the refrigerator is achieved. These data will be automatically uploaded to the production of intelligent refrigerator cloud data service platform, easy to be viewed by the user. And according to the food inside the refrigerator it can provide recipes. Wireless communication module is used to achieve the reception of Internet information. A week before shelf life of the food, a warning will be sent to the user. When the food over the shelf life, there will be usage warning to the user. When the food is reduced or not available through the information on the Internet, different businesses will be compared to choose the best food. At the same time the wireless communication module can also be used to connect intelligent terminal and the refrigerator, the situation inside the refrigerator is checked.**

Keywords- RFID; Internet of Things; Intelligent refrigerator; Wireless control

I. INTRODUCTION

With the improvement of people's living standards and the accelerating pace of people's life. The refrigerator is playing a increasing important role in our daily life, it has brought great convenience to people's live as more and more food are put into the refrigerator. However, it also bring some issues with the food in the refrigerator continues to increase, first of all if you can't eat these foods in time, then the food is very easy to expire, followed by the traditional refrigerator is difficult to figure out which food are surplus, which food has been used up. So it is important to produce a smart refrigerator.

Most of the refrigerators currently in the domestic market are also manually controlled, and did not achieve remote wireless control [1]. With the development of Internet of Things technology as well as improvement of people's living standards, smart home is no longer out of reach and it is gradually becoming a reality. The smart fridge arises at the moment under the fast pace of life and plays a critical role. With the variety of fresh food stored in the refrigerators, it has brought great convenience to people's daily life. The emergence of intelligent refrigerators allows people to fully appreciate the convenience of the refrigerator and give full play to the use of intelligent refrigerators. At the same time bring the convenience of people, it can not only reduce the waste but also can be supple the food timely. Connect the

sensor, controller and other equipment through the wireless network connection, people can use a computer or mobile phone and other intelligent terminal connected to the network to remote control intelligent refrigerator and upload the real-time information to the cloud storage, the user will know the storage of food timely and can be achieved Remote control of intelligent refrigerators [2]. The application of intelligent refrigerators will give the busy people a very convenient life, so that those people can put more time and energy into the work and study, let the life can be in an orderly way.

II. BACKGROUND

Over the past few years, the rapid development and growing maturity for the WEB service intelligent home technology [3] and embedded wireless module technology, speed up the rapid development of their smart home. At the same time, the Internet is developing rapidly since entering the 21st century, which is associated with China's e-commerce has entered a golden period of development. Compared with most of the foreign market , China is facing many problems, such as the higher cost of entrepreneurship, the greater risk of investment, the fierce and imperfect competition of market, therefore, the electronic commerce put forward by Alibaba are developing quite rapid and towards maturity, resulting in the traditional retailers suffered a huge blow, Wal-Mart, Paul Long warehouse and other large retailers' turnover declined dramatically and market share decreased rapidly in the last few years. Domestic and foreign well-known management consulting firm Bain released the latest analysis report of the retail industry. According to the report can be drawn, China's online retail sales continue to grow by a large margin each year [4]. So, looking for a new business model to transform is very important. However, although most of the goods can be purchased online now, online shopping like some fresh food may not be particularly convenient, because these fresh food is not easy to save and their retention period is shorter. But now, the rhythm of people's lives getting faster and faster, so that many people are lacking of time to buy things on the store, in this case, the realization of fresh food online shopping can make people's lives more convenient. So to produce a smart refrigerator with this function is imminent, it has a huge practical value and it will be greatly facilitate people to live.

Smart home as a product of rapid development of high technology, can fully meet the modern busy people's needs on the convenience of life management, so that people can temporarily slow down in the fast-paced life to enjoy the convenience of daily life which brought by the smart home. What's more, it can manage the daily life through many ways like remote control, wireless remote control and so on [5]. The main purpose of smart home is to let the intelligent system make a set of control programs to manage family daily life, so that life is more efficient, living management is more intelligent [6] and the control of life is more accurate and effective. Now people are gradually pay more attention to the green environmental protection, energy conservation and emissions reduction. Intelligent home is also able to meet this demand suitably, it achieves the function of people's needs intelligently through the small electronic chips, intelligent control of the air humidity, temperature, and can detect the formaldehyde and other harmful gases in the room whether are excessive, so the life will more healthy and environmentally friendly, the living environment will more reliable and reliable [7]. Under the environment of smart home, the emergence of intelligent refrigerators is the inevitable result, and we can say that the intelligent refrigerator is the product of the wave of smart home, it is an integral part of the realization of smart home, and its emergence will make people's daily Life more convenient undoubtedly.

III. PURPOSE AND SIGNIFICANCE OF RESEARCH

Since the first refrigerator in the world appeared in 1923, people are increasingly inseparable from the refrigerator, especially in recent decades, the refrigerator is developing faster and faster[8].For now, it is the era of updating household appliances, refrigerator product classification will be more detailed in the future, so different people can choose different refrigerator to meet their own needs, and it will personalize and modernize your refrigerator. However, there are still many shortcomings of the current refrigerator. For example, refrigerators control temperature depends on a series of ways like mechanical, electronic and computer. However the temperature, frost control are set in advance, so that it will lead to lacking of flexibility as well as wasting energy.

Although the smart refrigerator is constantly evolving, most of the functions of intelligent refrigerators is only limited to the original traditional refrigerator, but with the development of information technology, if the smart refrigerator and information technology can be combined, then Smart refrigerator will make people's lives more convenient undoutly.

People's living standards are improving now, at the same time, people's requirements living quality are also increasing. In order to make people adapt to the fast-paced life more easily and to ensure people's living quality,the research of intelligent refrigerator can just meet people's demand for high quality of life. The intelligent refrigerator has function of managing the food, controlling the temperature inside the refrigerator, browsing the recipe and shopping online.So

users can arrange daily diet life orderly and easily through the intelligent refrigerator [9].

Although this design of the smart refrigerator is not particularly mature,it also can meet people's requestments of refrigerator more appropriate when campared with the taditional refiegerator.Because this section of the refrigerator is not expensive and have many relatively high-end technology, providing people a more convenient and efficient way of life, so it will occupy a larger market share after develpoing to mature and accepted by most people.

IV. SYSTEM TOTAL PROGRAM DESIGN

Intelligent refrigerator is composed of food management module, temperature control module, online shopping module, wireless control module and user management module. Respectively,have the function which must be achieved by intelligent refrigerator, the specific implementation of the function shown in Figure 1 below.
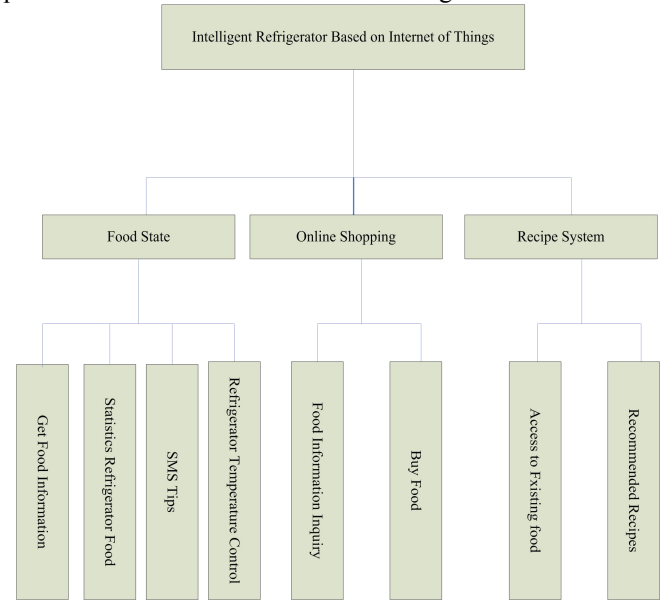

Figure 1 intelligent refrigerator function
The smart refrigerator has the following components:

A. Food Management Module

When the user puts the food into the refrigerator or takes out the food form the refrigerator, the pressure value of the pressure sensor at the bottom of the refrigerator will change, and then the function of the refrigerator wireless device and the RFID reader will be enabled, so the type, weight, shelter life, origin of food and other information will be obtained through the RFID reader, then the wireless devices will upload the information to the refrigerator cloud data desk to update the data. Furthermore, the information will be sent to the user, so the user can also view the cloud data through the intelligent terminal. The cloud data platform will give users tips when the food runs out, then users can buy the corresponding food online. When the food has a week of shelf life, the cloud data platform will remind user to eat

them as soon as possible, if the food has been exceed shelf life, cloud data platform will give users warn not to eat.

B. Temperature Control Module

Temperature control module collect the temperature inside the refrigerator through the temperature sensor DS18B20, DS18B20 is relatively new intelligent digital temperature sensor which adapt microprocessor, it can integrate temperature sensing, signal conversion, A / D conversion into a chip, use TO-92 package, and its temperature measurement range of - 55 ~ +125 ℃ .It can satisfy the measurement of the temperature inside the refrigerator [10]. Programmable for 9 to 12-bit conversion accuracy, temperature measurement resolution can reach 0.0625 ℃ . So it is not too different between the detective temperature difference and the actual temperature difference, the user can view the refrigerator's temperature through the LCD display screen or the remote terminal connected with the temperature sensor. In addition, users can also use remote terminal to control the temperature, in order to achieve the desired results.

C. Online Shopping Module

Users can check the food themselves needs online after check the type and quantity of food through the intelligent terminal. When searching for food, you can compare the food price, origin, quality and other comprehensive factors in the same kind of food. According to their own needs, choose the best food online to buy among the several commodities, so this will save time shopping in the supermarket. Furthermore, online shopping data will be automatically updated to database connected to the cloud. And the smart refrigerator will display their own recipes in the user shopping interface when shopping. Of course, users can also check the recipe online, download to the smart refrigerator's database. So that users can purchase food according to the needs of recipes.

D. Wireless Control Module

Refrigerator connects intelligent terminal by Wi-Fi, so the user can check the type and quantity of food through the terminal in spare time to arrange the daily diet better. Also, you can check the remaining amount of food in the refrigerator and purchase food which are run up online automatically. In addition, if the user think the refrigerator temperature is too low or too high, they can also adjust the temperature through the intelligent terminal to meet their own control of the refrigerator temperature.

E. User Management Module

Users can view the temperature of the refrigerator through the intelligent terminal, and manually manage the temperature of the refrigerator. And also, users can view the type or amount of food within the refrigerator through the intelligent terminal, facilitating the management of food. The user management module can also view, add or delete the existing recipes in the refrigerator.

V. CONCLUSIONS

With the rapid development of Internet of things, intelligent refrigerator has developed rapidly and has already become the main products which the major enterprises competing to develop, but there are still a long period of time before the smart refrigerator really come into the ordinary family. At present, there are still many bottlenecks in the development of intelligent refrigerators.

The food inside the refrigerator are scanned by the RFID tag, but the supermarket did not fully use RFID tags, so users have to labeling on each food, the operation not only troublesome, but also the cost is relatively high, it is the big problem of using RFID in a smart refrigerator. But with the popularity of RFID technology, electronic tag prices are gradually declining, the RFID technology will undouble become an indispensable part of achieving intelligent refrigerator.

Even if the RFID fully used on smart refrigerators, sensitive scanners can't be less in the refrigerator. Otherwise the user will intentionally scan the food in front of the scanner every time when putting food into refrigerator. Can not be free to throw. If the scanner was full of the refrigerator or the scanner is sensitive enough, users do not need to deliberately scan the food FRID. Intelligent refrigerator is also more intelligent.

Intelligent refrigerators can't judge the quality of food whether are good or bad by the smell of the refrigerator, some food may be in the shelf life, but in fact it already has been damaged because of this or that reason. In this case, through the smell of the refrigerator to identify the food is a required function.

Intelligent terminal which connect by wireless network may be useful among a family range, but concerning the follow situation, when user control smart refrigerator which was installed in the home by company's network, intelligent terminal may have beyond the scope of control. So it is not easy to achieve control intelligent refrigerator through Wi-Fi connection.

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