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A Survey on Intelligent Refrigerator Using Artificial Intelligence

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ABSTRACT

The task to discover useful systems (electronic home appliances) to simplify our live, is one of the main purpose of intelligent systems. Intelligent appliances with multimedia capability have been emerging into our daily life. Thanks to the fast advance of computing technology. Kitchen is one of the places where such intelligent appliances have used. At the same time it has been a practice for all of us to use the junk foods, or too old vegetables and fruits in our daily life due to the busy scheduled life that we lead. Or some possibilities where we do not remember the vegetables/fruits we have not been eating for a long time. This in turn leads to lack of nutrition or, some hazardous infections or might disturb the power in each of us. Why don't we come across an attempt to have a device to indicate what we have (food/vegetables/fruits) and how old is it. Of course it is not possible for us to determine the exact age of the vegetable, since it is to be calculated from the day it is grown, but yet we could come across one small effort to at-least have an eye on how old is the vegetable from the day it was fetched from the vendor. Existing systems used barcode or RFID(Radio Frequency Identifier) scanning to keep track of the stock. The Intelligent Refrigerator module is designed to convert any existing refrigerator into an intelligent cost effective appliance using ARTIFICIAL INTELLIGENCE. The intelligent refrigerator is capable of sensing and monitoring its contents and counts the age of the contents. The smart refrigerator is also able to remotely notify the user about old products via SMS (Short Message Service).Additional functionality includes indication of items we have not been eating for long time.

Keywords : Intelligent Refrigerator Using Artificial Intelligence, Nutritious Value

I. INTRODUCTION

The growth of the number and variety of devices that are connected to the internet and are collecting data is incredibly rapid. In [1], Cisco conducted a study in which it estimates that in 2010 the number of devices connected to the internet overcomes the human population and that there will be over 50 billion devices connected to the internet by 2020. The technology lOT is too complicated or complex for a simple household user who have little knowledge of how all the mechanism behind the intelligent refrigerator with lOT works. The internet connectivity at most of the places is still poor and there is limited network connectivity i.e. either low internet speeds or low support. The barcode is not uniform to record the essentials of the product that includes the expiration date. The smart home environment or the networked home doesn't have enough security to protect the outflow of data from the house. The privacy of user and the house can be compromised by attackers. There is no unique operating system for remote device use to control the smart system. There is no area, resulting products conforming to different specifications by different producers.

The intelligent refrigerator as it is called is used to monitor the count of the vegetables and indicate the user about the count and the age of the vegetabl along with the vegetables that were not used by the user for last 30 days.

II. METHODS AND MATERIAL

The idea of connecting home appliances to the internet had been popularized and was seen as the next big thing. In June 2000, LG launched the world's first internet refrigerator, the Internet Digital DIOS. Smart refrigerator is a refrigerator which has been programmed to sense the product and find what kinds of products are being stored inside the refrigerator it and keep a track of the stock through barcode or RFID scanning. For example, many juice bottles are transparent.

III. RELATED WORKS

A cost-effective space sensing prototype for an intelligent refrigerator was described in [7]. The proposed system was cost-effective and automatically monitored the amount of space, and indirectly the usage, in a refrigerator compartment. An extension to the proposed design allowed the system to automatically alert the homeowner of the refrigerator's status through short message service (SMS). This added dimension of automatic detection and communication provides an attractive enhancement to available commercial models of "smart" refrigerators.
Another intelligent refrigerator was patented in 2007 and refers to a refrigerator system to be used in the pharmaceutical environment. Its main use was storing pharmaceutical product containers. RFID was use for

IV. CONCEPT

The proposed system revolves around the core concept of product identification based on RFID technology. We have considered in this paper a use case that in the nearby future, all or most products bought from the store will have a tracking RFID tag, with information stored in a global level database by all or most manufacturers, that will serve two purposes: • Firstly, the manufacturers will easily track their products from the assembly line, transportation route and finally to the store shelf, giving them more information about assembly and transportation costs along with information about product visibility in the store itself • Secondly, the consumer will be able to easily access the above information, in time, for himself, information that is not easily or at all accessible to this day. The concept itself is built on a set of well-defined functionalities. Below we give an overview of them.

V. ARCHITECTURE

As stated above, in our system we focus on two main quotidian activities related to any refrigerator: adding and removing products. Figure 1 provides a functional block diagram of the proposed system. The monitoring system consists of 5 main components, 4 of which are hardware components and the fifth is a Smart Refrigerator P-21 software component: the RFID kit which can be broken down into the RFID reader and the RFID antenna, the Arduino Breakout Kit, the Intel Edison and finally the remote IoT platform used to aggregate the data received from the local system.

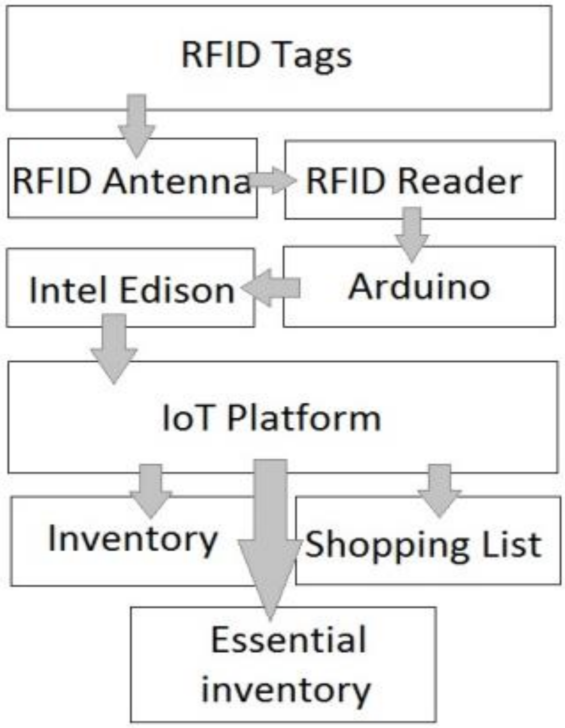

Figure 1. The proposed system architecture

VI. IMPLEMENTATION

The system presented has been implemented at a proof of concept level, meaning that a refrigerator was not actually used in the process and the system was built and assembled on working bench, partly because of the necessary funds required but also because in this case, it would not bring an added value to this paper. However, the full implementation was part of the design process and was thought of. In order to have the widest coverage inside the refrigerator the antenna was to be placed and the top or bottom of the refrigerator. Using a vertical implementation will result in not requiring multiple antennas, one for each level compartment, thus reducing the costs and the entire system complexity. Figure 5 better describes the hardware implementation inside the refrigerator.

VII. THE IOT PLATFORM

An IoT application platform, the backbone of any IoT system, is centered on connectivity. All devices that are components of an IoT system and are connected to the Internet and each other share a connection with an IoT application platform as it provides a common link between those devices and their data [12]. Nowadays, many companies offer IoT Platforms and all of them offer some level of analytics reports but the similarities end there as they are entirely different software applications. For someone new in this field it may not be easy to understand that this term refers to a complete and mature IoT cloud platform. More so, there are some software applications that have been stretched to the point of being called IoT platforms even when they describe just an element of a platform or even something completely different [13]. There are 4 main types of platforms that are often referred to as "IoT Platform" and are not because they serve some other purpose:

- ✓ Connectivity / M2M platforms: as the name suggests, these platforms focus on connected IoT devices via telecommunication networks but do not offer processing of data.
- ✓ IaaS (Infrastructure-as-a-service) backends: they are more an interface to a platform than a platform; they offer controls to configure the hosting space provided and processing power for different kinds of applications.
- ✓ Hardware-specific software platforms: they are proprietary software applications that come along with some devices.
- ✓ Consumer/Enterprise software extensions: they are usually enterprise software programs of packages that offer some functionalities of an IoT platform such as Microsoft Windows 10. As stated above, the main goal of an IoT platform is enabling and facilitating device communication. Besides this main feature, an IoT complete platform may feature a lot of other important functionalities that are meant to improve either the IoT system performance and capabilities, or the quality of life of the platform consumer or client. A complete IoT platform consists of the following eight features:
- ✓ Connectivity & normalization: unifies multiple protocols and data formats under a software interface ensuring continuous and accurate data streaming and communication. Device management: monitors the connected devices and ensures proper connectivity between devices.
- ✓ Database: usually consists of scalable storage of device data, implementing data volume, variety, velocity and veracity requirements.
- ✓ Processing & action management: consists of event or rule based triggers enabling execution of specific actions based on sensor data.
- ✓ Analytics: generates reports based on data clustering extracting the essence out of the data-stream from the IoT devices.
- ✓ Visualization: offers a human readable graphical representation of patterns and trends through different kind charts. Additional tools: consists of implementation examples, tests and prototypes.
- ✓ External interfaces: offers ways to integrate with 3rd-party systems via application programming interfaces; also can consist in software development kits in order to expand the IoT implementation. For the proposed system described in this paper, Google Cloud Platform was used because it offers tools to scale connections, gather and make sense of data, and provide the reliable customer experiences that hardware devices require.

VIII. CONCLUSION

The dynamic rapidly changing and technology-rich digital environment enables the provision of added value applications that exploit a multitude of devices contributing services and information. As IoT techniques mature and become ubiquitous, emphasis is put upon approaches that allow things to become smarter, more reliable and more autonomous. This paper presented the concept, architecture, building process and functionality of a smart refrigerator, a future IoT component. The ideas presented in this paper can be further developed in several directions. First of all, further research is needed to effectively overcome one of the RFID's biggest weakness which represents the radio waves propagation through metal and liquids. Secondly, the proposed solution did not touch any of the security and privacy concerns that currently affect the IoT paradigm development

Lastly, the proposed solution does not cover the products stored in a refrigerator that are not container in a RFID-equipped packaging like fruits of vegetables. Although the solution presented in this paper works well in the context of a smart refrigerator, the concept can be adapted and implemented in all contexts that require managing and tracking storage items or inventories in enclosed small and medium sized areas. The added value of this paper is represented by more than the technical solution and context that were chosen, the concept itself being new and bringing new opportunities and ideas to the IoT industry. As a short example, a similar solution can be implemented inside a wardrobe in order to assess what clothes are available and what are the optimal matches that can be wore in a specific day, based on what was removed from the wardrobe the day before, outside weather forecast, desired color scheme and other situational parameters. Many more implementations can be found even outside of a home. This is why the concept adopted in this paper is part of the added value. Realizing the vision of sustainable IoT applications requires the enhancement of IoT technologies with new ways that will enable things and objects to become more reliable, more resilient, more autonomous and smarter.

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