A Literature Review on Improving Error Accuracy and Range based on RFID for Smart Shopping

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Abstract— IoT is referred as "Internet of Things". This paper provides information about the implementing the technologies based on sensors, protocols and application problems; with the IoT we can emphasis latest developments in RFID, smart sensors, communication technologies and protocols. These technologies can directly enable application without any human interference. IoT enables developments of new technologies. In this research survey we have included all the current scenarios based on product identification and presented RFID based smart cart analysis apart from other survey papers we have provided more collective summery of available technologies and research of smart product identification to deliver standard information about emerging field and we have also discussed the pros and cons of all methods and issues regarding the research. We have also explained relationship between IoT and smart product based identification methodology; also we have included the RFID range and accuracy problems to fulfilment of the issue about product identification.

Key words: IoT, RFID, Wireless Sensors, Smart Cart, Smart Shopping

I. INTRODUCTION

In today's world Internet of Things (IoT) is being adopted as the most actively pursued research topics by many technical communities. The Internet of Things is the network of physical objects or "things" embedded with electronics, software, sensors and network connectivity which enables these objects to collect and exchange data[7]. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit[7]. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure[7]. Experts estimate that the IoT will consist of almost 50 billion objects by 2020[7].

Radio Frequency Identification (RFID) involves a tag affixed to a product which identifies and tracks the product via radio waves[6]. These tags can carry from 1000 to 2000 bytes of data. This technology has three parts: a scanning antenna, a transceiver with a decoder to interpret the data and a transponder (RFID tag) pre-set with information about the product[6]. RFID tag will be scanned by the scanning antenna through the means of radio frequency signal that interacts with the tags[6].

When the RFID tag is within the field of the scanning antenna, it detects the activation signal and can transfer the information data in holds to be picked up by the scanning antenna[6].

This paper mainly focuses on the concept of smart shopping using RFID to improve the error accuracy and the range for product identification.

II. LITERATURE SURVEY

A. Smart Shopping Cart with Automatic Billing System through RFID and ZigBee[1]

In this paper the authors has proposed the problems faced by the customers at the supermarkets and thus to prevent it has developed a Central Automated Billing System.

Supermarket is the place where customers come to purchase their daily using products and pay for that. So there is need to calculate how many products are sold and to generate the bill for the customer. Cashier's desks are placed in a position to promote circulation. At present, many supermarket chains are attempting to further reduce labour costs by shifting to self-service check-out machines, where a single employee can oversee a group of four or five machines at once, assisting multiple customers at a time. Thus the authors had proposed a Central Automated Billing System which access the product database and calculates the total amount of purchasing for that particular cart.

The figure shows the concept of Central Automated Billing System. Since each cart is attached with product identification device (PID), through ZigBee communication PID sends its information to central automated billing system, there it calculates net price for the purchased products. Customer can get their billing information at the packing section according to their Cart Identification Number. Even there is no need for a cash collector, in case customer uses their debit/credit for bill payment. The Automated central billing system consists of a ZigBee transceiver and a server/system connected to access product database.

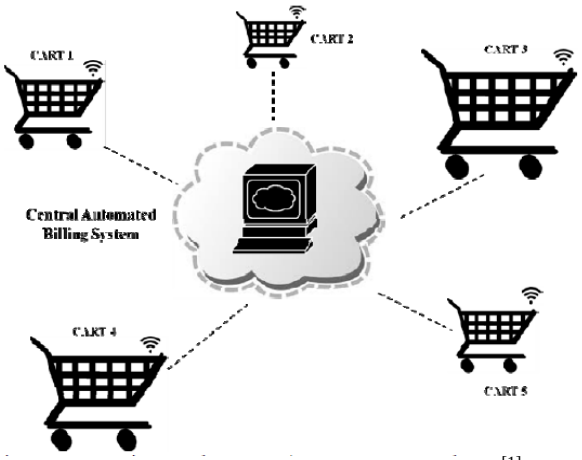

Fig. 1: Central Automated Billing System[1]

This automated billing system is developed using visual basic.

B. An Automatic Smart Shopping Cart Deployment Framework Based On Pattern Design[2]

An automatic embedded software generation framework that can create and evolve Zigbee applications is proposed by the authors. The framework consists of two major modules, pattern extraction and code generation. Pattern extraction and development are designed to provide Zigbee application with model reuse and modification. SysML serves as a medium between pattern development and code generation.

The research method developed by the authors integrated SysML, requirement modeling editor, Zigbee application design pattern, automatic code generation, and architecture model mapping, to aim at required tools for automated layout of Zigbee embedded software. The integration process is as shown in figure.

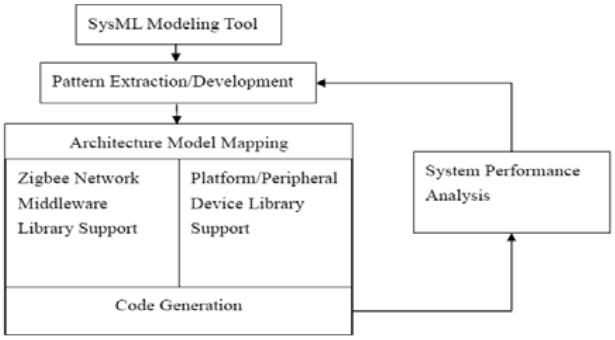

Fig. 2: Pattern based Zigbee embedded software automatic generation framework[2]

Applying design patterns always makes the system easy to maintain, extend or resolve certain design issues. If the developer does not understand the purpose or usage of a pattern clearly, it may cause design errors or inconsistency. In order to specify a pattern formally and apply a pattern by model transformation, we divide a pattern into six parts as presented in figure.

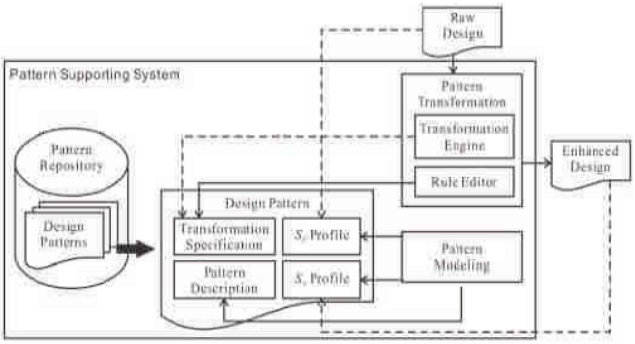

Fig 3: ZigBee Design Pattern Architecture[2]

An intelligent shopping cart was implemented by the authors using the above framework which consists of a Zigbee localization test grid site and an actual shopping cart equipped with a PXA255 board. The board is connected with a Zigbee sensor serving the role of communication with other reader tags. These localization grid uses 10 ~ 15 Zigbee sensors to construct rudiment of wireless localization of backbone network.

C. On Object Identification Reliability Using RFID[3]

In this paper the authors has discussed object identification reliability by first listing the factors that results in false readings and thus lead to unreliable object identification and then then has developed a general framework for a guaranteed object identification reliability.

Radio Frequency Identification (RFID) is a technique which identifies objects through radio communications. An RFID system includes the following important components: 1) RFID Tags (or Transponders): Tags could be classified into active semi active, and passive tags depending on whether they have embedded power or not and what the embedded powered is used for; 2) RFID Readers (or Interrogators): An RFID reader usually has more than one separate antenna and is responsible to read potential tags in its proximity. The communications between the reader and tags are stipulated by an air-interface protocol; 3) Database: Each record of RFID raw data could contain information such as reading time, location, and tag EPC. RFID readers usually store some raw data at the front-end and a cleaned and pre-processed RFID database exists at the back-end.

A general RFID architecture is depicted in figure which comprises of Back-end software subsystem and frond-end communication subsystem.

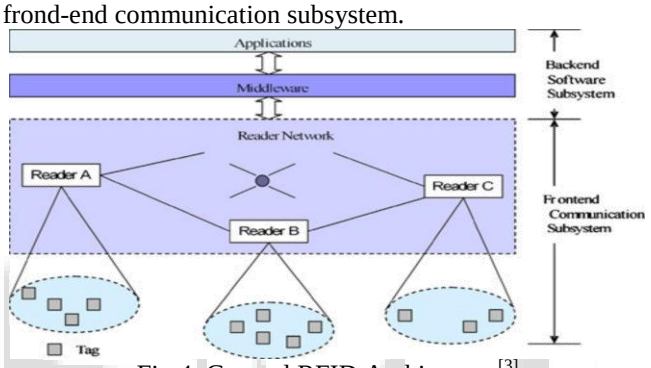

Fig 4: General RFID Architecture[3]

Without an accurate database, it is hard to create useful value-added applications. Therefore, RFID systems must guarantee reliable object identification or provide high object identification reliability, which implies each object/tag should be correctly identified by the right readers.

The main factors leading to incorrect or unreliable object identification reliability are 1) some tags are not identified by the readers and /or 2) some tags are identified by a reader are incorrect or unexpected by the reader.

Since reliability problem is due to false readings in RFID systems, the authors has proposed two general approaches to solve this problem: Reading Error Prevention (REP) and Reading Error Correction (REC). REP means to prevent the occurrence of false readings or reduce the number of them, while REC is to detect and correct/eliminate them from raw dataset. Some possible approaches for REC and REP are described in the figure.

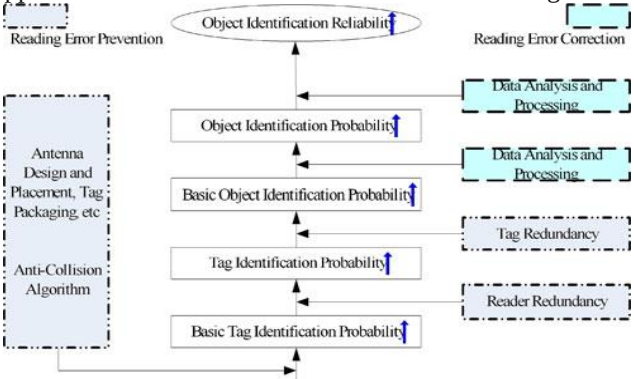

Fig. 5: Approaches to improve object identification Reliability[3]

D. RFID based Smart Shopping: An Overview[4]

RFID technology is amongst the most revolutionary technologies that will shape tomorrow's pervasive retail sales. This technology offers an important set of opportunities which improve the shopping experience of customers when visiting any self-service store. Indeed, this technology is increasingly promising to the extent of a potential replacement the barcode system as new low cost RFID tag manufacturing procedures have emerged.

In this paper the author has developed a model for RFID based smart shopping and billing which comprises of Cart Location Detection Unit (CLDU), Server Communication Unit (SCU), User Interface Display Unit (UIDU) and Billing and Inventory Management Unit (BIMU). CLDU is used to smartly locate the position of shopping cart inside the shopping market to help in obtaining relevant product information. SCU will help in establishing and maintaining the connection of the shopping cart with the main server. UIDU will provide the customer with user interface and BIMU deals with the billing and inventory management in collaboration with the SCU.

E. Comparative study of Barcode, QR-code and RFID System[5]

The Barcode is an optical machine-readable representation of data relating to the object to which it is attached. On the other hand the RFID is the use of wireless non-contact system that uses radio frequency electromagnetic field to transfer data from a tag attached to an object, for the purpose of automatic identification and tracking. Quick Response (QR) codes are a very convenient way to display a small bit of information that is easily scanned and processed typically by mobile devices allowing physical items to almost become interactive, by providing information that is easily scanned like a website URL.

Also the author has compared the all three technologies using various parameters.

Attribute	Barcode	QR Code	RFID
Line of Sight	Required	Required	Not Required
Accessibility Range	Up to few inches	Up to few inches	Up to few meters
Content Updating	Cannot be updated	Cannot be updated	Can be updated
Reliability	Damaged tags won't work	Up to 30% damaged tags can work	Damaged tags can work flawlessly
Read/Write	Read Only	Read Only	Read and Write
Information Capacity	Very Less	Less	More than QR code and Barcode

Table 1: Comparison of Barcode, QR Code and RFID[5]

Thus, RFID proves to be a promising technology compared to other in use.

III. CONCLUSION

We can conclude that the IOT is emerging field of research and can make human life more confortable by providing ease for users by using the sensors, protocols and hardware. Though there are many issues in this technologies, as we have discussed we find this domain as researchable and it requires improvement so we decided to find out more challenges so we can improve and make it for some use.

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