IOT BASED SMART SUPER MARKET SYSTEM

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Abstract—The internet of Things is a concept that not only has the potential to impact how we live but also how we work. The new rule for the future is going to be, ”Anything that can be connected, will be connected.” The reality is that the IoT allows virtually endless opportunities and connections to take place, many of which we can’t even think of or fully understand the impact of today. In this paper we propose a smarter way to ease and automate the way supermarkets work today. The proposed architecture focuses more on the RFID based tracking of customer location in the supermarket and smarter scanning and billing options for the customer. We also discuss the feasibility of the proposed system. Keywords—RFID, IOT, RFID Tags, RFID Reader, GPS, Inventory Management. I. INTRODUCTION The ”Internet of things” (IoT) is becoming an increasingly growing topic of conversation both in the workplace and outside of it. The Internet of things (IoT) is the internetworking of physical devices, vehicles (also referred to as ”connected devices” and ”smart devices”), buildings, and other itemsembedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the

Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as ”the infrastructure of the information society.” The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. Today, there are a number of challenges in the operation of supermarket and its automation. The existing supermarket system needs a huge deal of manual work in billing, check-outs, inventory management involving sales person. Also it doesnt have an integrated billing system for various departments. Also the amount of difficulty in locating goods increases with the size of the supermarket, practically adversely affecting their shopping experience. On the other hand the operational cost of employing technical and non-technical staffs, managing supply chains, surveillance and tracking of customers in the supermarket becomes difficult. Thus better customer support and automated operational support can be seen as a challenge in the existing system. In this paper we focus on building a smart IoT based supermarket system and visit few of the details of its implementation. The proposed system will be completely wireless and serves its purpose of easing both the operational and consumer experience. We will discuss in detail about the application modules and tracking systems for locating the customers within the supermarket. A. Existing Techniques of Location Tracking in Supermarket:- GPS technology has moved to one step forward which tells about the habits of a person. Gps helped the researches to gather a lot more important which is helpful to mankind. The modern day researchers are constantly using this technology to get information. Shopping Carts are very new source of getting information. Its not that only one supermarket is using this GPS technology, but in several other parts in the world, and for various other reasons. Pathfinder is the very first device which has been used in New Zealand. Shoppers Habit or its related activities has been monitored by a supermarket in Auckland to increase the quality of service, what they are is that they are attaching the GPS device in their shopping carts. This GPS device which has been installed in there cart gives the data such as how much they spend, what departments the customer shops in and how they select groceries. Generally, Most GPS

tracking studies and projects inform the person they are being tracked. The whole unit contains three majo be always 100 1-GPS satellites are not visible:- The GPS tracking device contains the GPS chip which uses 3 or more satellites for receiving the signals related to time and identification and then calculates its position on earth. But suppose if there is less than 3 signals because the line of sight between the GPS device and the GPS satellites is being blocked due to some obstruction, then the position cant be calculated accurately. 2-Other environmental condition:-Solar flares can also cause distortion in the signal, thus causing in error in the calculation of location of any person present. 3-No power: - If the GPS unit doesnt have the power then obviously our instrument cant work hence it will not able to give any location of any object. 4-Service:-If we consider as a customer service tool then this is invaluable for customers. False complaints regarding to overcharges cannot be lodged . Also, a fleet tracking system allows your business to respond more quickly to customer needs, resulting in happier clients and additional business. 5-Poor mobile network coverage:-Due to weak or nonexistent of mobile cellular signals, sometimes, the GPS unit were not able to send the data. Mobile network has been used to send data by GPS so if there is no signal, then the location can be sent. As the mobile networks typically prioritize voice over data, you might be showing a strong signal on your phone, but if there is a lot of traffic then the signal might not get through from the unit C. RFID Based Tracking:- Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. a RFID system consists mainly of three components; the transponder/tag, reader, and RFID middleware. This automatic data capture technology that relies on radio-frequency electromagnetic fields. Hence the name, Radio-Frequency IDentification or RFID. This technology can be used in our daily lives and objects so that they transit from manufacture to storage and finally the point of sale. The difference between objects and ourselves is that they dont voluntarily present their RFID tag or card when asked. The data in these cards can be sensed by the localised tag readers. These tags are therefore read in very different conditions and often require greater detection distances. Tags: These are basically two categories of tags: Passive Tags: battery needed, the tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active Tags: no battery needed, Active tags have a local power source such as a battery and may operate at hundreds of meters from the RFID reader. RFID tags contain at least two parts: an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, collecting DC power from the incident reader signal, and other specialized functions; and an antenna for receiving and transmitting the signal. The tag information is stored in a non-volatile memory. The RFID tag includes either fixed or programmable logic for processing the transmission and sensor data, respectively. Fig. 1. Tracking Using RFID Reader: An RFID reader transmits an encoded radio signal to interrogate the tag. The RFID tag receives the message and then responds with its identification and other information. This may be only a unique tag serial number, or may be product-related information such as a stock number, lot or batch number, production date, or other specific information. Since tags have individual serial numbers, the RFID system design can discriminate among several tags that might be within the range of the RFID reader and read them simultaneously. D. Advantages of using RFID based identification and tracking system in supermarket:- 1-RFID technology can be used for tracking products or product identification. 2-Does not require line of sight to read the tag. 3-has a longer read range than bar code reader. 4-Tags can store more data than bar codes. 5-Readers can simultaneously communicate with multiple tags 6-This feature could allow customers to breeze through grocery store checkout counters while a reader identifies all. 7-Items in a shopping cart can be scanned at the same time, instead of scanning each bar code individually. II. PROPOSED ARCHITECTURE In this paper we mainly focus on an IoT based automated supermarket system with the support of a mobile application that will help in tracking and

surveillance of the customer by the market staffs and also improve customer experience by helping them to efficiently locate the desired goods in their shopping list. This requires tracking of the customers location and guides them to the desired product department. For this we use RFID based tracking system for customer tracking. This has two in one benefits- firstly, helps the customer for navigation in the supermarket and secondly helps the manager to keep track of the customers. Here, we propose an idea to embed RFID tags in the customer cards pertaining to that supermarket. RFID Tags On Cards:Many of us might have noticed people bring their membership cards when they visit the malls just to get the advantage that those cards provide them, let it be discount or some prize. These cards can make your shopping easier too with a little bit of change? This is where the cards with RFID tags can be used, we suggest installing those cards with an RFID tag, this way we can track our customers movement and their frequently visited sections in the supermarket. This wont cost a fortune but with the tracking of customer can help in various ways. To do so we Fig. 2. Proposed Architecture could get the cards by getting them manufactured like others smart cards. Not so costly and can benefit the customers and the Supermarket sales at the same time. To avoid multiple cards for same family it is suggested that the card be issued to the person who shops often in the family and the name of family members can be also registered on the same card. The option of the getting a personal card is available to everyone on demand. The RFID reader will be responsible to track the customer based on the radio-frequency waves generated.RFID tag readers must be installed at different locations inside the market for sensing the tags. Because RFID tags can be read from any orientation, it can speed up the scanning process and reduce the labour associated with repositioning boxes for scanning. Also, scanners can read multiple tags at the same time, so an entire pallet-load of items can be scanned simultaneously. A. Features of proposed IoT based supermarket system:- 1-Tracking each customer using a unique identification. 2-Enable customers to upload digital shopping list. 3-Interactive floor maps and guiding the customers to reach the desired product department in the supermarket with respect to customer location. 4-Barcode scanning of the product to get product details and digitally add to cart(like readymade garments) 5-Integrated billing based on customer identification via smart customer cards. 6-Automated check-out 7-Storing customer details on cloud based storage for retrieval across multiple branches of the supermarket B. Detailed description of the architecture:- Any new customer enters the shopping centre; they have to scan their customer card with the help of a card scanner placed near the entrance. The RFID tag installed in the card gives a unique identification code to the customer. Then they can login to the mobile application pertaining to the market with that code and enter their shopping list over there. The code uniquely identifies the customer through their mobile app and connects it to its RFID code. Now as the customer moves across the market, the data of the location traced by the tag can be efficiently read by RFID readers installed across the market. This data is sent to the RFID management console. Now this data is sent to the local server. From the local server, data is fetched by the mobile application in order to track the customer location. This can be integrated with customized floor maps of the market in the mobile application, thereby helping the customers to find out location of the desired products as per the customers shopping list. It can also be used to find the nearest product in their proximity by scanning the shopping list. This can be an efficient move to improve the customer experience. On the other hand it can help the manager sitting on the management console to monitor their staff and customers. Another feature of the proposed architecture is to reduce the man-power involved in billing counters and avoid the crowd and inconvenience caused in manual billing by digitally adding product details to the bill. For this we use barcode scanners for line of sight scanning of the products by the Smartphone to add it to the cart. Once the billing is done, payment can be made online either by using the payment gateway in their mobile application, or by using the shopping card where they can use advance payment option for a regular interval (like monthly

basis), then the billing amount can be reduced each time a bill is generated. The latter method of transaction has a benefit to ease the authentication requirements in the payment gateway each ti tracking based on the data fed to the mobile application. For temporary data within a session, local servers can be used. For storing personalised customer data like login credentials, internet or mobile banking details, the whole system has to be integrated with the help of a cloud based infrastructure. Also operational data from various branches of the supermarket can be stored and retried from a centralised cloud based database system. For this purpose we may use dynamoDB database of AWS. Mobile application can be built using android platform. D. Proposed techniques and details on tracking:- We all know how it is hard to go through the sections of the items you require sometimes. Wastes time and effort. A solution to this will be the RFID tracking system that we propose here. The idea is that we will install the RFID Reader throughout the supermarket. The reader will help in reading the tagged cards and we will use this read data related to location and come to know the location of the customers in the market. As the reader will send the signal from time to time and the tags on cards will respond to them, this will help us determine the real-time location by using the RFID arrangement for RTLS. This location data is then retrieved by our systems and then can be used for navigation purpose E. Modules of the mobile application along with cloud based storage solution:- 1-RFID Tag on Entrance:- The mobile RFID reader is built around a PDA, tags, an OEM flash card module reader, and a database. These are described in the following:- Tags, Reader Module:- This tag has a 32-bit unique serial ID or SID code that is factory-programmed and 256-bits nonvolatile user memory that is organized in 8 blocks of 32-bits each. The ISO version tag has a similar organization, except for the fact that the SID code is 64-bits long. This SID is similar to the information that is stored on a bar code label. When the SID is linked to a database, additional information may be accessed through the reader such as item stock number, current location, status, selling price, etc. The Syscan RFID reader module is a contact less read write device for a broad range of 13.56 MHz tags. The reader comes with an integrated compact flash interface, so it can be plugged into standard CF slots of a PDA. The reader has a reading distance of 10 cm and works with all operating systems versions of Windows. Communication Interface Reader-PDA:- The Syscan reader module was plugged into the PDAs CF slot, with the following communication parameters: COM7, 9600, N, 8, 1. The readers commands can be issued using an ASCII communications protocol. This protocol was used for its simplicity. Commands and data are transmitted as ASCII hexadecimal characters from the PDA to the reader, and the results showed on the PDA. Database:- Due to the fact that the hp-PDA does not include a built-in database application, we decided to install a database from Syware [5]. This product has the advantage of synchronizing in real-time, with any ODBC-enabled database server wirelessly using Bluetooth or Wi-Fi. We can also use Cloud Based Database like amazons DynamoDB or google cloud database such that if a person gets registered at some place and then if he goes to some other his details can be loaded using that cloud database. Fig. 3. Sample of Interactive Supermarket Navigation 2-Update Digital Shopping List:- Mobile Apps like Big Oven and All Recipes Recipe Spinner, deliver all of the functionality right down to organizing the shopping list by department to make shopping faster. Both are user-oriented services that start with access to thousands of recipes and clearly demonstrate the power of connecting meal planning and digital shopping lists anywhere, anytime. So in our proposed architecture we will use a mobile app which contains the list of all the items that particular person wants to buy. That list is further get divided into departments. The is designed in such a way that it will notify him that from his current location which is the nearest department and will give the directions to reach towards that department location. So as soon as the person gets the desired item, according to list, he will have to scan the barcode of that item from the mobile. As soon as he scans the barcode the item will be automatically removed from the list and at the same time the cost of that item will be added. 3-Tracking customer location using mobile

application:- Pre-loaded maps would be present in the supermarkets app. These maps would be used for navigation by the users. Their location tracked by our RFID arrangement would be used for the systems to give the location of the user/customer to his map, then the customer can use this to reach the desired department of accordingly to the list of items they have uploaded in the supermarkets cloud. The department of the items on the list will be marked on the map, making it easier for the customer to go to that site and get the product that he wanted to buy rather than roaming here and there to finally get what he wanted all this time. 4- Barcode scanning of products in mobile application:- A barcode scanner is composed of three parts: the illuminator, the decoder, and the sensor/convertor. The barcode scanner illuminates the barcode with red light using the illuminator system. The sensor/convertor part of the scanner then detects the reflected light. Once the light is detected, an analog signal is generated. This signal contains varying voltage based on the intensities of the light reflection. The analog signal is converted by the sensor into a digital signal. The digital signal is then interpreted by the decoder. The decoder then sends the information to the internal storage area and then it is being displayed to screen. 5- Digital billing using mobile application:- Thing with billing in supermarket is that nobody wants to wait in a line because everyone wants to save their time and take back home all their purchases as soon as possible. The tradition billing strategy of wait for your turn makes it annoying for majority of people. But now that the RFID uniquely identifies the customers with their cards, the billing can be made easy and we can avoid those big lines on holidays and sales. Apps role in billing:- With the session running on App for the shopping in the super market. We plan to use the same session to help in billing and thus helping the customers to avoid the long lines to pay for their goods. The idea is that the RFID will uniquely identify the customers and an independent session will run on each customers mobile device, we plan to equip the apps with billing feature, where all the products that they have scanned with their barcode/QR code scanner while picking up the product will be added to their bill automatically and thus the bill is always ready for payment. All that needs to be done is to pay the bill using a payment option which could be via credit/debit cards or via net banking, this will depend on what customer chooses. Although we do not completely remove the idea of traditional billing, but we do change it by giving the option to the customer, they can still go to counter to pay the bill F. Advantages of proposed architecture:- There are many advantages of the proposed architecture based on the usage on RFID tracking. This will also automate billing and checkout. This also reduces time required to scan each and every product while billing and check-out. The whole shopping cart can be scanned in one go. Barcode labels can fade or fall off when they are exposed to the weather, sunlight, or other harsh conditions. RFID tags now exist that are not only weatherproof, but that can also survive harsh chemical baths or even multiple autoclave and sterilization cycles. They have a larger range of tracking compared to barcode scanners. III. FUTURE WORK There is a lot of opportunities in the field of IOT and hence if we take into consideration regarding Smart Supermarket then also we can go upto an extent. A. Inventory management:- The concept of RFID can also be used in inventory management. This may be implemented by adding additional tags. RFID also improves visibility of inventory by providing realtime updates and faster scanning. With RFID readers placed at each portal or doorway, you can know exactly when inventory enters or leaves a location; with barcodes, employees could potentially move an item without scanning it, which erodes data accuracy. That visibility can also improve the tracking of returns or recalled items by providing real-time updates as the goods reenter the facility. The manager can keep track of this and also send updates based on it to the operational manager. B. Smart mirrors:- Installation of smart shelves in store to give a virtual view to the customers to try out outfits. C. Smart shelves:- Installation of smart shelves will help in detecting when the inventory is low. This concept may be further expanded to send notification to the market manager about the unavailable stocks. Future works may also include automated scanning of products on check-out and use of smart robots for stock replenishment and customer care and

assistance. Further, inventory tracking may help in automating supply chains. IV. CONCLUSION The demand of the ease of operational management and better customer experience has led to the need for smarter solutions for retail. The proposed architecture can be an effective solution in tracking the location of the customer using RFID technology and also provide operational benefits such as reducing the man-power for scanning and billing of the products. Also the advantages of using RFID technology in the system and its feasibility are discussed. This system is proposed to give a hustle free and smooth shopping experience. Our future work will include the implementation of the proposed system and study on the feasibility of complete automation of the supermarket system. REFERENCES [1] S. Sandoval-Reyes,J.L. Soberanes Perez,Mobile RFID reader with database wireless synchronization,2016 [2] http://www.brickmeetsclick.com/taking-digital-grocery-shopping-liststo-the-next-level [3] https://www.syware.com/company/casestudy/smbmobilemanufacturingcaprturingcritical.php [4] http://www.qrcodestickers.org/about-qr-codes/how-barcode-scannerswork.html [5] https://www.ibm.com/support/knowledgecenter/en/SSMKHH9.0.0/com.ibm.etools.mft.doc/ah14440.htm [6] http://www.impinj.com/resources/about-rfid/how-do-rfid-systems-work/ [7] A. R. Al-Ali, Fadi A. Aloul, Nada R. Aji, Amin A. Al-Zarouni, Nassar H. Fakhro,Mobile RFID Tracking System,Computer Engineering Department American University of Sharjah, UAE [8] https://www.forbes.com/sites/jacobmorgan/2014/05/13/simpleexplanation-internet-things-that-anyone-can-understand/ef66a731d091 [9] https://en.wikipedia.org/wiki/Internetofthings [10] http://www.centrenational-rfid.com/introduction-to-the-rfid-article-gbruid-202.html [11] http://questsolution.com/blog/item/34-pros-and-cons-the-use-of-rfidfor-inventory-management [12] https://docs.oracile.com/cd/E19486-01/819-4686/EM-intro.html [13] https://www.google.co.in/search?q=architecture+of+rfid+based+card+readersclient=firefoxbtbm=ischimgil=BQzEMKmbn4v2LM [14] https://www.intechopen.com/books/designing-and-deploying-rfidapplications/rfid-middleware-design-and-architecture [15] http://www.corerfid.com/rfid-technology/rfid-tracking/rfid-tags/ [16] https://www.ieee.org/about/technologies/emerging/rfid.pdf [17] http://retailsmanagement.geo-viz.com/blog/top-challenges-faced-bygrocery-stores-focus-retail-software/ [18] https://en.wikipedia.org/wiki/Radio-frequencyidentification [19] Mehdia Ajana El Khaddar, Mohammed Boulmalf, Hamid Harroud and Mohammed Elkoutbi (2011). RFID Middleware Design and Architecture, Designing and Deploying RFID Applications, Dr. Cristina Turcu (Ed.), ISBN: 978-953-307-265-4, [20] Ravi Kishore Kodali, Vishal Jain, Suvadeep Bose and Lakshmi Boppana Department of Electronics and Communications Engineering, IoT Based Smart Security and Home Automation System, International Conference on Computing, Communication and Automation (ICCCA2016) [21] T.S. Lim, S.C. Sim and M.M. Mansor Faculty of Engineering and Technology, Multimedia University, Jalan Ayer Keroh Lama, 75450 Melaka, RFID Based Attendance System, IEEE Symposium on Industrial Electronics and Applications (ISIEA 2009), October 4-6, 2009, Kuala Lumpur, Malaysia, 2009 [22] Lu Ning1, a, Yanli Xing1,b* 1 Library, Beijing University of Agriculture, Beijing, 102206, China ,a ninglu@mx.study.org.cn, b xingyl@mx.study.org.cn (corresponding author), The application of RFID technology in the university library, Applied Mechanics and Materials Vols 263-266 (2013) pp 3279-3283 (2013) Trans Tech Publicati