IoT APPLICATIONS ON SECURE SMART SHOPPING SYSTEM

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Abstract - *In today's life going to supermarkets for shopping is increasing rapidly. People take the item and put it into trolley. After done with shopping they go for billing at the Billing counter but as there are many people standing in Queue for billing purpose, So lots of time is required for the individuals for billing because of existing barcode technology. To reduce this time we are proposed a system based on RFID technology. The system contains the items attached with RFID tag, RFID reader which reads the tag information when put into the trolley. Then this information is send to main billing server which calculates the total amount of purchased items and sends the calculated bill to the device attached to trolley for displaying it on LCD. Along with this system we are implementing an Android application for controlling the trolley movements. The application is based on the Trolley number and total amount of purchased items.*

***Key Words*: Internet of Things (IoT), Radio Frequency Identification (RFID), Zigbee Technology, android**

1. INTRODUCTION

INTERNET of Things (IOT) is the network of physical objects embedded with radio frequency identification (RFID), embedded systems, sensors, network, and software that enable physical objects to collect and exchange data for a common goal.

Everyday objects can now be equipped with computing power and communication functionalities, allowing objects everywhere to be connected. This has brought a new revolution in industrial, financial, and environmental systems, and triggered great challenges in data management, wireless communications, and real-time decision making. Additionally, many security and privacy issues have emerged and lightweight cryptographic methods are in high demand to fit in with IoT applications. There has been a great deal of IoT research on different applications, such as smart homes, e-health systems, wearable devices.

In this paper, we focus on a smart shopping system based on Radio Frequency Identification (RFID) technology, which has not been well-studied in the past. In such a system all items for sale are attached with an RFID tag, so that they can be tracked by any device equipped with an RFID reader in the store –for example, a smart shelf. It becomes easy for the store to do inventory management as all items can be automatically read and easily logged. We propose the use of ultra high frequency (UHF) RFID technology in the smart shopping systems, as UHF passive tags have a longer range, from 1 to 12 meters.

1.1 Existing System

Previous research on the design of smart shopping systems mainly focused on low/high frequency RFID which have inadequate ranges, and leave customers to manually scan items with RFID scanner. In the existing system, humans are used for monitoring the product quality and quantity in supermarket, so the manual faults may occur.

1.2 Proposed System

In our proposed system, each smart cart is equipped with a UHF RFID reader, a micro controller, an LCD touch screen, a Zigbee adapter, and a weight sensor. The smart cart is able to automatically read the items put into a cart via the RFID reader. A micro controller is installed on the cart for data processing and a LCD touch screen is equipped as the user interface. In order for the smart cart to communicate with the server, we have chosen Zigbee technology (data exchange purpose) as it is low-power and inexpensive.

We have a weight scanner installed on the smart cart for weighing items. We also set a RFID reader before the exit door to check that all items in the cart have been paid for. We consider security and privacy issues related to smart shopping systems as no previous research has tackled it. This system is automatic monitoring the product quality and quantity so the customer satisfaction is achieved by using this concept.

2. Architectural Design

2.1. System Architecture

Each trolley is attached with Product Identification Device (PID). Through ZigBee communication, PID device sends its information to automated central billing system, where the net price of all the purchased products is calculated. Customer can get their billing information at the billing or packing section according to their trolley Identification Number. Even there is no need for a cash collector, if in case a customer uses their debit/credit for the net bill payment. The automated central billing system consists of a ZigBee transceiver and a server/system connected to access product database.

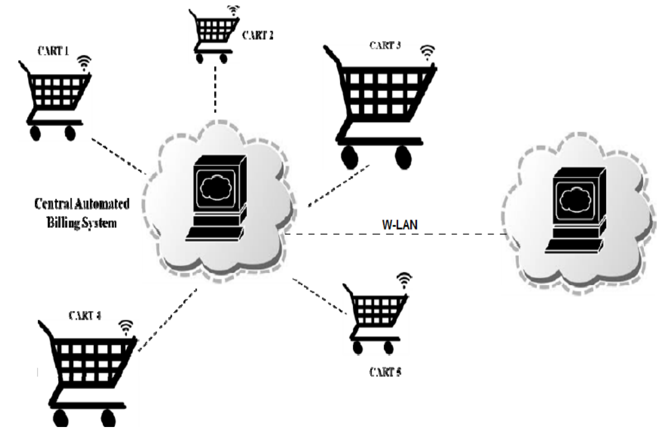


Fig.1. Central Automated Billing System product database

2.2 Hardware Architecture

Each trolley in supermarkets or malls is attached with One device which consists of hardware components such as RFID reader, micro-controller, EEPROM memory and Liquid crystal display (LCD).

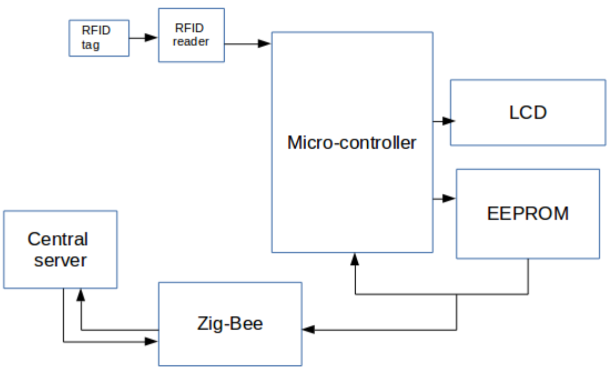


Fig. 2. Hardware architecture of system

3. SYSTEM WORKING

All trolleys in the supermarket are attached with the device which contains the RFID reader, microcontroller, Zigbee. So each trolley will send the item information to the main billing server for calculating the final bill of purchased items.

To send information of each trolley we are using Zigbee as it has some advantages over Bluetooth and Wi-Fi. Working is started when the customer enters to the supermarket and takes the trolley. The RFID reader in the trolley is paired to android app for bill generation. When the customer puts the items the RFID reader reads the data, then it is send to the EPROM through the microcontroller. By using Zigbee this data is get sent to main server for fetching cost of the item, so that cost details are displayed on the LCD attached to the trolley. If the customer wants to remove the item from the trolley, then cost of that item gets subtracted from the total bill during the process. At last the bill gets calculated in the main server.

The android application is divided into two parts which includes trolley movement controller and outline map display. The android app is first paired with the trolley to control the movements. The map shows the outline of the shop which shows the customers where the particular items are present. This sets the purchase in ease. It becomes easy for the store to do inventory management as all items can be automatically read and easily logged on to.

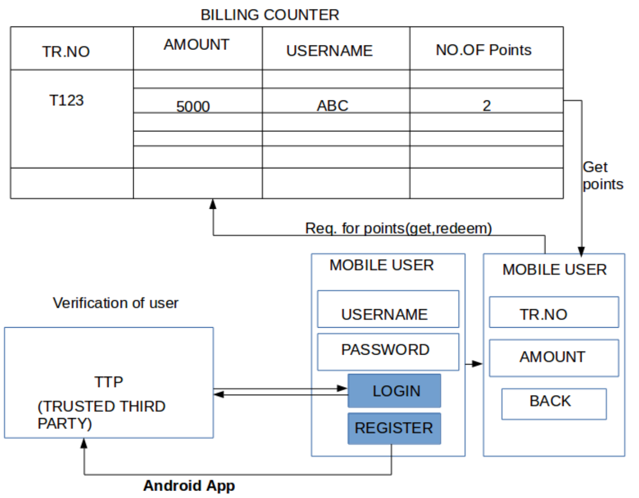


Fig.3. Android application interface

3.1. ALGORITHM

Step1: Start

Step2: Initialize System

Step3: Put the item attached with RFID tag into trolley

Step4: RFID reader reads the tag information

Step5: Reader sends the data to the microcontroller

Step6: Microcontroller send the data to the sever using ZigBee

Step7: Server calculate the bill and send back to trolley

Step8: Final Bill get displayed on LCD

Step9: If customer wants proceed then go to

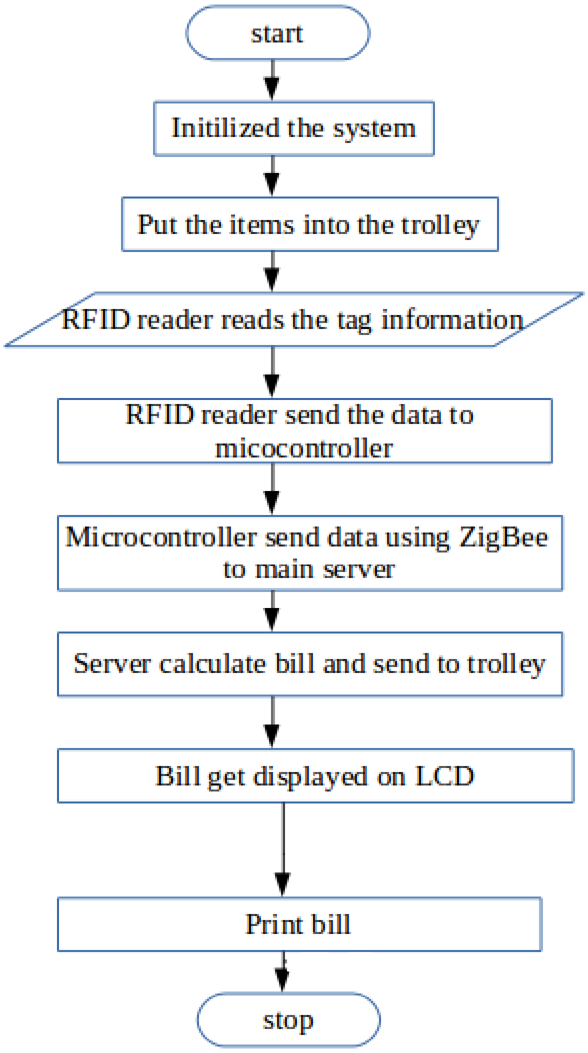
Step10 else go to Step12

Step10: Create account on Android application

Step11: Server generates the bill and prints the bill

Step12: Stop

3.2. FLOW DIAGRAM



4. CASE STUDY

This section develops a prototype for IoT-enabled smart job-shop production and discusses a Demonstrative case to verify the feasibility and efficiency of the proposed data analysis method. We have configured an IoT-enabled smart job-shop in our Lab, together with a smart warehouse. There are three workstations in the job-shop, i.e., EMCO Mill 55, MANIX 360, and Xian Dao C56A. Each workstation is deployed with RFID readers, RFID antennas, sensors, and other IoT facilities according to the proposed configuration scheme. A Web-based system is developed by using Java/-JavaScript, MySQL, and Jquery. Besides, the network and database are configured in the job-shop. The parts need to be produced are A-type and B-type shafts from an outsourced order, and each of them is attached with a unique active RFID tag because they need to be separately monitored during their production processes. There are more than 30 types of collected heterogeneous production data. To better understand the production status in this smart job-shop, we take the proposed methods to analyze the collected data.

Firstly, when smart WIPs enter the smart job-shop, they communicate and interact with machine tools and other physical assets according to the process commands stored in the active RFID tags. If all the required physical assets are right and ready, the first process will be executed and then the next. Secondly, during the production processes, RFID readers and antennas collect the real-time data of position changes of smart WIPs, vehicles, operators, cutting-tools, and other flowing physical assets. Other IoT facilities collect real-time data from ambient environment and machining status. These real-time production data are stored in the manufacturing database according to the proposed production data model. Thirdly, by applying the proposed data analysis method, the collected real-time production data are merged into the real-time production statuses, such as progress, current process, workload of machine tool and operator, and material flow. Besides, the collected historical RFID-based production data are excavated to generate production-related information, knowledge, and rules, which can be utilized for production control and decision-makings. Fig. 6 illustrates four snapshots of the prototype system for the demonstrative case. From the case, it can be seen that there are total six processes for shaft #A1. The production progress of #A1 reaches the fourth process, and this process has finished 40% (achieved by comparing the finished process time and the undone process time).Based on that, the total production progress of #A1 has reached 63%. The production information of other A-type shafts can be achieved too. From the view of workload, the detailed profile of operator #R021 is listed and his workload is 8 h-12 min-7 s on that day, which is achieved by calculating the duration time of processes he undertakes (these data are derived from the RFID production data). The current task for him is No. 3 process (key seat milling) of the Btype shaft. Another kind of workload is the machine tool's workload. The profile of EMCO Mill 55 is listed and its workload is 10 h-35 min-21 s on that day. The current task of it is No. 16 process (end milling) of the B-type shaft. This also can be used for process monitoring. Except for the above managerial implications, the real time production control can be realized. For example, a data record in the database implies that #A2 shaft arrives at the wrong workstation, and the machine tool at this workstation cannot undertake its next process. Thus, an alert with detailed log pops up instantly in the system, which reminds the managers of unexpected events. Then, the smart WIP starts communicating with other machine tools in the smart job shop to find a proper one according to the preset rules and incidence relationship matrix. After that, the process command is updated in the smart WIPs active RFID tag. Note that this kind of production control is real-time, autonomous, and transparent. Finally, through big data analysis, some hidden rules and knowledge are achieved. As the dispatching of different production processes can be exploited. For example, No. 1 processes (end face rough turning) of A-type shafts are all taken by Xian Dao C56A. No. 2¡No. 4 processes (excircle rough-turning, excircle semi-finishing-turning, and grooving) are taken by Xian Dao C56A and MANIX 360. The dispatching of these processes reveals the workload balance and the capability difference between these two machine tools. The mined information can be used for dynamic production plan and scheduling, which will lead to a harmonious production orchestration. From the view of transportation, the workload of vehicles and the transportation trajectories can be excavated from the transportation processes data. Vehicle #1 undertakes the external transportation tasks between warehouse and smart job-shop, while vehicle #2 and #3 undertake the internal transportation tasks among machine tools. It can be seen that vehicle #2 has bigger workload than vehicle #3, which causes disequilibrium between them. Thus, their work dispatching rules must be optimized to avoid transportation blocking. Except for that, some other knowledge and rules can be exploited from the historical data to assist production control. For example, by calculating the residence time of smart WIPs in the in-buffer and out-buffer of workstations, the production blocking in different workstations can be revealed. By establishing a deep neural network (DNN)-based processing time evaluation model, the standard machining time for different features with different machining parameters on different machine tools can be predicted. By calculating the workload of different cutting-tools, the cutting tool lifetime prediction model can be built to remind the tool changing.

5. CONCLUSION

This work aims to provide an insight into the RFID –based production data analysis for production control in the IoT enabled smart job-shops. Thus the system creates the automatic bill of the purchased items from the trolley using trolley number. This process saves the time of customer and also reduced the man power in the malls. So ultimately it becomes a easiest way of the shopping. Also with this system the reward point system gets implemented using Android application. The objective behind the application is that to replacing the existing cards based system by android application. So the intended objectives were successfully achieved in given system.

REFERENCES

[1] ITU. Internet of Things Global Standards Initiative, 2015. [Online]. Available: http://www.itu.int/en/ITU-T/gsi/iot/Pages/default.aspx

[2] K. Ding, P. Y. Jiang, P. L. Sun, and C. Wang, “RFID-enabled physical object tracking in process flow based on an enhanced graphical deduction modeling method,” IEEE Trans. Syst. Man Cybern. Syst., vol. 47, no. 11, pp. 3006¡3018, 2017. doi:10.1109/TSMC.2016.2558104

[3] P. Y. Jiang and W. Cao, “An RFID-driven graphical formalized deduction for describing the time-sensitive state and position changes of work-inprogress material flows in a job-shop floor,” J. Manuf. Sci. Eng., 135, 3, pp. 031009, May 2013.

[4] R. Y. Zhong, Q. Y. Dai, T. Qu, G. J. Hu, and G. R. Huang, “RFID-enabled real-time manufacturing execution system for mass customization production,” Robot. Comput.-Integr. Manuf., vol. 29, no. 2, pp. 283¡292, Apr. 2013.

[5] T. Qu, H. D. Yang, G. Q. Huang, Y. F. Zhang, H. Luo, and W. Qin, “A case of implementing RFID-based real-time shop-floor material management for household electrical appliance manufacturers,” J. Intell. Manuf., vol. 23, no. 6, pp. 2343¡2356, Dec. 2012.

[6] F. Q. Zhang, P. Y. Jiang, M. Zheng, and W. Cao, “A performance evaluation method for radio frequency identification-based tracking network of job-shop-type work-in-process material flows,” Proc. Inst. Mech. Eng. Part B: J. Eng. Manuf., vol. 227, no. 10, pp. 1541¡1557, Sep. 2013

[7] THE SEVENTH INTERNATIONAL CONFERENCE ON SENSOR TECHNOLOGIES &APPLICATIONS Smart Shopping Cart For Automated Billing Purpose Using Wireless Sensor Networks, SANCHITA ROY,UDITA GANGWAL,JYOTSNA BAPATRobert Bakker, Edwin Keijsers, and Hans van der Beak “Alternativ

[8] Swati Zope, Prof. .Maruti Limkar, “RFID based Bill Generation and Payment through Mobile”, International Journal of Computer Science and Network (IJCSN), Volume 1, Issue 3, June 2012

[9] G. Roussos and B. College, “Enabling RFID in Retail”, Computer, IEEE, vol. 39, no. 3, 2006, pp. 25-30

[10] Mazidi, Mazidi, McKinlay- “The 8051 microcontroller and Embedded Systems”.

[11] IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, VOL. 25, NO. 2, FEBRUARY 2014. LocaWard: A Security and Privacy Aware Location-Based Rewarding System Ming Li, Student Member, IEEE, Sergio Salinas

[12] W. Luo and U. Hengartner, “Proving Your Location Without Giving up Your Privacy,” Proc. 11th Workshop Mobile Computing Systems Applications, Feb. 2010.

[13] K. Finkenzeller RFID Handbook: Fundamentals and Applications in Contactless Smart Cards and Identification, 2003 :Wiley

[14] H. B. Cai, A. R. Andoh, X. Su, and S. Li, “A boundary condition basedNalgorithm for locating construction site objects using RFID and GPS,”Adv. Eng. Inform., vol. 28 no. 4, pp. 455¡468, Oct. 2014.

[15] C. Wang, P. Y. Jiang, and K. Ding, “A hybrid-data-on-tag-enabled decentralized control system for flexible smart workpiece manufacturing shop floors,” Proc. Inst. Mech. Eng. Part C: J. Mech. Eng. Sci., to be published. doi: 10.1177/0954406215620452

[16] C. C. Aggarwal and J. W. Han. A survey of RFID data processing," in Managing and Mining Sensor Data, C. C. Aggarwal, Ed. New York: Springer, 2013, pp. 349¡382.

[17] G. Larkou, C. Costa, P. G. Andreou, A. Konstantinidis, and D. Zeinalipour-Yazti. Managing smartphone testbeds with smartlab. In Proceedings of the 27th Intl. Conference on Large Installation System Administration, LISA '13, pages 115–132, 2013.

[18] B. Li, J. Salter, A. G. Dempster, and C. Rizos. Indoor positioning techniques based on wireless lan. In Proceedings of the 1st Intl. Conference on Wireless Broadband and Ultra Wideband Communications, pages 13–16, June 2006.

[19] N. Li, T. Li, and S. Venkatasubramanian. t-closeness: Privacy beyond k-anonymity and l-diversity. In Proceedings of the 23rd IEEE Intl. Conference on Data Engineering, ICDE '07, pages 106–115, April 2007.

[20] H. Liu, H. Darabi, P. Banerjee, and J. Liu. Survey of wireless indoor positioning techniques and systems. IEEE Trans. on Systems, Man, and Cybernetics, Part C: Applications and Reviews, 37(6):1067–1080, Nov 2007.

[21] D. Lymberopoulos, J. Liu, X. Yang, R. R. Choudhury, V. Handziski, and S. Sen. A realistic evaluation and comparison of indoor location technologies: Experiences and lessons learned. In Proceedings of the 14th International Conference on Information Processing in Sensor Networks, IPSN '15, pages 178–189, New York, NY, USA, 2015. ACM.

[22] A. Machanavajjhala, D. Kifer, J. Gehrke, and M. Venkitasubramaniam. L-diversity: Privacy beyond k-anonymity. ACM Trans. Knowl. Discov. Data, 1(1):25–36, Mar. 2007.