

RFID Technology in Bank Services

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Abstract— In recent years, progress of micro chip technology has led to create changes in various industries. One of these technologies is automation identification that its famous example is RFID. Nowadays, RFID technology is used in a variety of industries and application due to its advantages. One of these important applications can be in banking system. Banks are tried to give better services to their customers by using of modern technologies. Our aim in this paper is utilization of this technology in order to make electronic banking system more useful.

In the application, cards attached to the RFID tag give to customer and information related to customers and their bank account store in these cards. Customer is identified by readers when entering the branch and processing on his information is performed in order to give more desirable services such as reduction of waiting time for special customers.

Keywords—RFID, E-Banking, Reader, Tag, Contactless.

I. INTRODUCTION

Nowadays, necessity of automatic identification of elements and data collection related to them without human interference is felt in many industrial, scientific, services and social areas. In response to this need, several technologies have been designed and performed. These technologies are called briefly Auto ID. Barcodes, sound recognition, some biometric technologies, OCR and RFID are examples in this field [7], [13].

RFID is a wireless identification system which is able to data exchange by communication establishment between a tag that is connected to one goods or object and a reader. Basically, RFID systems are used electronic and electromagnetic signals in order to read and write the data without contact. Readers are tools which are recognized the presence of the tag connected to the goods and are recovered stored information in them. According to the fact that these systems are worked based on changes of electromagnetic waves and or radio frequencies, sometimes, antenna (signal amplifier) is used in environment in order to amplify the present signal [1], [3], [12].

These days, the number of banks has created a sense of intense competition in them and each of them tries to use

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modern technologies to give better services to their customers. In advanced country, because there is sufficient knowledge about bank and banking and necessary confidence to virtual and electronic banking, their physical presence to the bank is very low. But in developing country, this matter is not true and despite there has been good progresses in this field in recent years; customer's tendency to physical presence in banks is much more than their virtual presence via internet. The purpose of this paper is to establish a system in banks which is used RFID technology properties such as automated identification system and its contactless specifications and provide more appropriate physical space for them by give particular services to particular customers and prepare the background in order to establishment of virtual and electronic banking. In the following discussion, we will examine modern banking and challenges which there are in their path. Then, we will inspect RFID technology and its application in electronic banking in order to removal of these challenges. After these stages, the proposed method is produced and the circumstance of its simulation is described. Then, we will analyze the proposed method and evaluate the results. Finally future works are explained.

II. MODERN BANKING AND CHALLENGES

Current status of electronic exchanges in the world and tendency of organizations and institutions to take advantage of virtual spaces and development of new commercial methods and economic activities such as electronic commerce has led to take into consideration the electronic banking as a necessity. But electronic banking is not comprehensive in third world countries. Perhaps, providing software and hardware infrastructure and paying attention to the technical problems in order to reach electronic banking is necessary. But cultural conditions of society are an important matter in order to acceptance of this system. Therefore, need feeling and tendency to take advantage of new methods should be motivated by introducing the achievements to customers in transferring from traditional banking to electronic banking. In this direction, physical places should not be eliminated once, and in the initial step, combination of electronic banking and traditional banking should be used (dual banking) which in this method, customers perform their bank activities with physical presence and by using of electronic services. In the first step, this method can be caused that traditional customers of banks rely on this new method and this situation prepares the conditions for entry into new banking field. But acceleration of giving services and customer satisfaction in this method is very important. Because in case of customer dissatisfaction, acceptance of electronic bank will be subjected to new challenges [11]. RFID technology is one of the technical and scientific progresses of the world which can be effective in this regard.

RFID have this ability that accelerate most of the banking works by using of present electronic infrastructures and without inconvenience for customers and bring security, accuracy and integrity for banking system of country and provide customers satisfaction [6], [10].

III. APPLICATION OF RFID TECHNOLOGY IN ELECTRONIC BANKING

Identification is the first application of RFID, and better relationship with customers in bank branches can be established by putting RFID label on bank cards and checkbooks, and identifies them in the next time that customers return to the branch. RFID technology help them in various fields such as check confirmation by putting RFID labels into the check, availability control, filing system and security in offices and buildings of banks and financial institutions [4], [5], [6].

IV. PROPOSED METHOD

Fig. 1 indicates the flowchart of proposed method in this paper. Card is allocated to each customer who open an account in the bank, and RFID tag is connected to the card and all information about customer such as his priority based on his account balance are stored in it. Customers' prioritization is assumed in four levels:

- Level 1: costumers who their account balances are more than \$1 million.
- Level 2: costumers who their account balances are between \$500 thousand and \$ 1 million.
- Level 3: costumers who their account balances are between \$100 thousand and \$ 500 thousand.
- Level 4: costumers who their account balances are less than \$100 thousand.

This prioritization is parametric. Given values are examples and can be changed.

With customer arrival, stored information in his card is read by reader system in the branch and this person is identified for branch personnel.

Two counters are assumed to give services to customers. With customer arrival, in case that one of the counter is empty, the person is called to counter regardless of priority and his work is performed. Otherwise in the case that 2 counters are full, the person must be waited until his turn come based on priority. Finally, if customer's balance is changed, new priority will be allocated to him and his information will be updated. Also, in order to prevent excessive waiting of customers with low priority, the period as threshold time is considered that if their waiting time is more than this period, customers can receive their desired service, otherwise, it is possible that customer cannot receive service by the end of the working day. This time is assumed 30 minutes in this paper that can be changed.

Also, other advantages of bank customer are performed according to the same leveling. For example, number of any facilities in one year for each level is: level 1= 100 item, level 2= 80 items, level3= 60 items, level 4= 40 items.

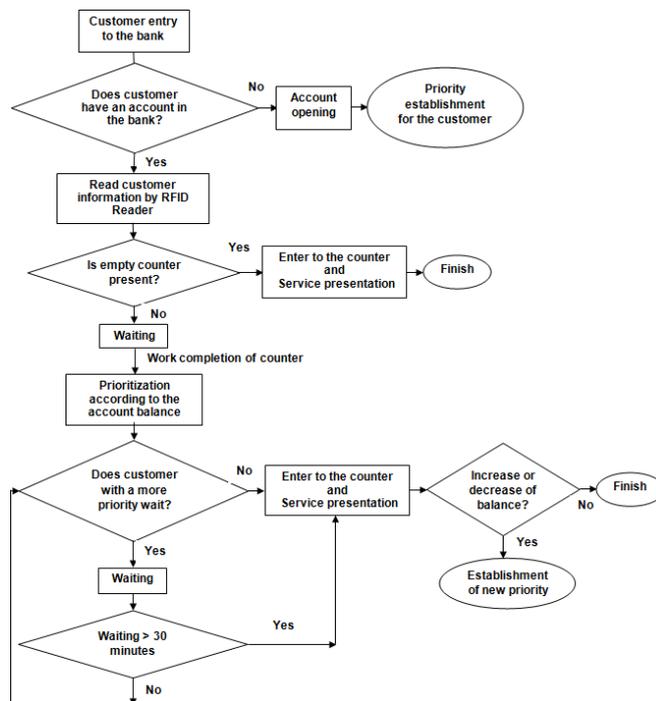


Fig. 1 Flowchart of proposed method.

In the beginning of the customer entry, this issue is notified to them that waiting time may be increased to half-hour according to the calculation of priority system. In situation where customer reference with high priorities is too high, bank will notify them at the time of customer acceptance that customers are high in this time and may be waited more than maximum time (30minute). In this case, customer can plan for next visit and or they accept that they must be waited in bank more than threshold time. In this situation, for customers who want to refer again afterwards, this issue is suggested that when their turn is close, SMS system should be used for notify them.

Following flowchart indicate the stages of more detailed prioritization algorithm:

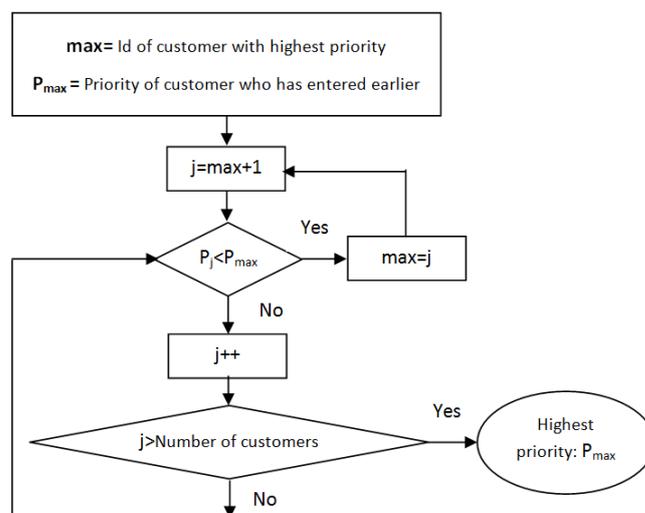


Fig. 2 Flowchart of stages of prioritization algorithm.

After finishing the counter work, for calling the next customer, priority system is assumed that customer who enters the bank earlier than other persons in the branch is the

highest priority customer (max). Variable j is considered equal to max+1 (person after the highest priority customer) and his priority is compared with highest priority (Pmax). If j had a higher priority (the numerical value of Pj was lower than Pmax), the j-th customer is highest priority customer. (max=j) otherwise, next customers are compared with max. Finally, the highest priority is Pmax and max customer is called to the counter.

V. SIMULATION

Proposed simulation method performed in visual studio 2010 and with C# programming language. Furthermore, SQL Server 2008 is used as database in order to store customer information of assumed bank containing name and last name, account number, account balance and other specifications. Fig. 3 is indicated the sample of stored information in database which is called during program execution.

ID	CustomerNo	Name	AccountNo	cash	priority
1	10001	Sana Azari	10.23123.1	80000.0...	4
2	10002	Farshid Yousefi	10.45646.4	450000....	3
3	10003	Asal Yazdi	15.78978.1	300000....	3
4	10004	Reza Azadi	11.91515.9	50000.0...	4
5	10005	Hosein Shakiba	19.51951.5	3000000...	1
6	10006	Sara Azin	10.57375.3	700000....	2
7	10007	Sara Salehi	11.85285.5	6000000...	1
8	10008	Nasrin Faridi	14.23423.2	650000....	2
9	10009	Ali Ghorbani	15.93517.3	90000.0...	4

Fig. 3 Calling of customers information from database

Fig. 4 shows that with the arrival of customer, his name and account information is revealed:

Fig. 4 Customer information reading by reader at the time of arrival to the branch.

Fig. 5 indicate the messages that notify to customers at their arrival time. For example, at arrival time of customer namely "Farshid Yousefi", second counter (counter 2) is empty and system is called the customer by message regardless of priority of this person, but by entry of next customer, because 2 present counters are busy, system request from customer to wait by another message.

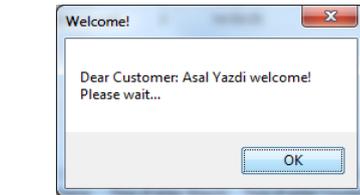
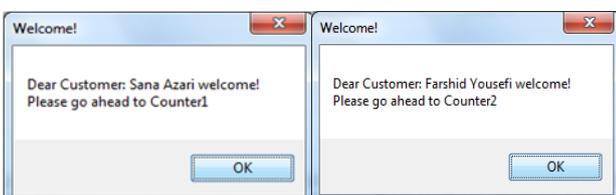


Fig. 5 Customer calling to counter or waiting.

Calling time of next customer, system set customers automatically according to their priorities and next customer is called based on his priority. In fact, if a person with priority 3 is entered in branch and another person with higher priority (1 or 2) is entered after his arrival, second person who has higher priority is called to counter sooner and his waiting time is lower although this person entered to branch later. As indicated in figure 6 at inserted time, after completion of work of first and second customers in counter 1 and 2, customers with higher priority are called to counter, and this process will continue for other customers. And latest customers who are called to the counter are customers with the least priority (priority 4).

Full Name	Priority	Time of enter Branch	Time of enter Counter	Waiting Time	Finish Time	ALL Waiting Time
Sana Azari	4	08:37:53	08:37:53	00:00:00	08:45:53	00:08:00
Farshid Yousefi	3	08:37:58	08:37:58	00:00:00	08:45:58	00:08:00
Asal Yazdi	3	08:38:03	09:01:53	00:23:50	09:09:53	00:31:50
Reza Azadi	4	08:38:07	09:01:58	00:23:51		
Hosein Shakiba	1	08:38:12	08:45:53	00:07:41	08:53:53	00:15:41
Sara Azin	2	08:38:16	08:53:53	00:15:37	09:01:53	00:23:37
Sara Salehi	1	08:38:20	08:45:58	00:07:38	08:53:58	00:15:38
Nasrin Faridi	2	08:38:25	08:53:58	00:15:33	09:01:58	00:23:33
Ali Ghorbani	4	08:38:28	09:09:53	00:31:25		

Fig. 6 Customers' reference according to their priorities.

Other advantages for customers are displayed in table during program execution (table of customers advantages), and customers at every level and priority can be aware of advantages related to them.

CustomerNo	FullName	Numbers of Facilities	Ceiling for exemption from fees	Ceiling for Insurance services	Safe deposit boxes Assign	Gifts
level 1: more than \$ 1 million						
10005	Hosein Shakiba	100 items	\$1,000	\$1,000,000	Yes	Yes
10007	Sara Salehi	100 items	\$1,000	\$1,000,000	Yes	Yes
level 2: between \$ 500 thousand and \$ 1 million						
10006	Sara Azin	80 items	\$800	\$800,000	Yes	Yes
10008	Nasrin Faridi	80 items	\$800	\$800,000	Yes	Yes
level 3: between \$ 100 thousand and \$ 500 thousand						
10002	Farshid Yousefi	60 items	\$600	\$600,000	No	Yes
10003	Asal Yazdi	60 items	\$600	\$600,000	No	Yes
level 4: less than \$ 100 thousand						
10001	Sana Azari	40 items	\$400	\$400,000	No	No
10004	Reza Azadi	40 items	\$400	\$400,000	No	No
10009	Ali Ghorbani	40 items	\$400	\$400,000	No	No

Fig. 7 Customers' advantages table.

VI. ANALYSIS

We must be addressed queue management in order to give better services to waiting queue. Customers have always expressed dissatisfaction because of staying in long waiting queues and reduction of waiting time is very important matter that banks and other large service companies and institutions

pay attention to it. Give priority to customers is one of the methods that cause more equity in providing services to customers and create more satisfaction. The usual method in giving priority style in such human queues is "First In First Out ". But one must be careful that this method will be appropriate when conditions of everyone in queue are the same from all points of view. Here, this method does not present acceptable waiting time for particular customers whose accounts are more profitable and expect more from bank and does not create motivation to increase capital and customer attraction with high account balance. In order to absorb and distinct such customers, giving priority method is presented according to volume of account balance in this paper. This means that in the beginning, highest profit customer receive services. Of course, this issue must be noted that humans are accustomed to special methods and will resist against changes [9], [14].

VII. RESULTS EVALUATION

In this section, in order to evaluate the results, we compare usual method of giving priority FIFO with proposed method in this paper.

Upper table in figure 8 show the times of customers arrival to branch until the time of their work completion and finally their total waiting time in branch by using of proposed method in this paper. As the arrival of first and second person, empty counter is present and they enter into counter regardless of priority and receive required services. But third person and afterwards persons rest in waiting list until one of the counters become empty. With emptying each counter, next person is selected among present persons according to priorities:

Full Name	Priority	Time of enter Branch	Time of enter Counter	Waiting Time	Finish Time	ALL Waiting Time
Sana Azari	4	09:05:39	09:05:39	00:00:00	09:13:39	00:08:00
Fahid Yousefi	3	09:05:45	09:05:45	00:00:00	09:13:45	00:08:00
Asal Yazdi	3	09:05:50	09:29:39	00:23:49	09:37:39	00:31:49
Raza Azadi	4	09:05:54	09:29:45	00:23:51	09:37:45	00:31:51
Hossein Shakiba	4	09:06:00	09:13:39	00:07:39	09:21:39	00:15:39
Sara Azini	2	09:06:06	09:21:39	00:15:33	09:29:39	00:23:33
Sara Salehi	1	09:06:12	09:13:45	00:07:33	09:21:45	00:15:33
Nasrin Fandi	1	09:06:17	09:21:45	00:15:28	09:29:45	00:23:28
Ali Ghorbani	4	09:06:23	09:37:39	00:31:16	09:45:39	00:39:16

Full Name	Time of enter Branch	Time of enter Counter	Waiting Time	Finish Time	ALL Waiting Time	Time Difference
Sana Azari	09:05:39	09:05:39	00:00:00	09:13:39	00:08:00	00:00:00
Fahid Yousefi	09:05:45	09:05:45	00:00:00	09:13:45	00:08:00	00:00:00
Asal Yazdi	09:05:50	09:13:39	00:07:49	09:21:39	00:15:49	00:16:00
Raza Azadi	09:05:54	09:13:45	00:07:51	09:21:45	00:15:51	00:16:00
Hossein Shakiba	09:06:00	09:21:39	00:15:39	09:29:39	00:23:39	00:08:00
Sara Azini	09:06:06	09:21:45	00:15:39	09:29:45	00:23:39	00:00:06
Sara Salehi	09:06:12	09:29:39	00:23:27	09:37:39	00:31:27	00:15:54
Nasrin Fandi	09:06:17	09:29:45	00:23:28	09:37:45	00:31:28	00:08:00
Ali Ghorbani	09:06:23	09:37:39	00:31:16	09:45:39	00:39:16	00:00:00

Fig. 8 Comparison of proposed method (Highest Profit Customer First) with FIFO method.

The table at the bottom of this figure shows enter and exit times of same customers in FIFO method. In this method, account balance or other customers' advantages are unimportant and customers who are present in branch simultaneously are entered to branches according to entry and received services.

"Time Difference" column is derived from difference between All Waiting Time in 2 tables. Values which are inserted in this column show reduction of waiting time for each customer. The customers who have came later but have higher priority; their waiting time is significantly red circle in top table.

To get a more accurate result, it is assumed that: 1- all customers that are present simultaneously in branch at a

specific time and prioritization should be done, are entered with intervals of about 3seconds. And 2- duration of work on counter (arrival time to counter until work completion time) is averagely eight minutes for all customers.

VIII. FUTURE WORKS

For future works, further inspection of prioritization algorithm should be done. For example, it is true that customers with higher account balance receive services sooner, but customers who have fewer account balances but entered sooner, are subjected to large delay in receiving services and this delay may become more by increasing bank crowding.

It may be suggested that the number of counters and servers are increased, but bank expenditure must be considered and perform this task with least expenditure. If solution of this problem is required, the better formulation of combination of time entry and priority must be done and or additional parameter is considered. Another issue that can be effective on customer satisfaction is knowledge of waiting time duration at the time of entry. For this purpose, more appropriate methods must be used for prediction of waiting time. However, because of occurring of unpredictable events such as server stop and exit of persons from bank, very accurate prediction is not possible, but prediction accuracy can increase to acceptable limit.

In addition to above cases, another proposal that can be effective for future research is utilization of newer technology NFC in development of banking system which is based on combination of RFID technology and cell phones. High level security can be attained by combination of this technology with existing SIM card in mobile phone and utilization of coder algorithms on RFID signals [2], [8].

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