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Main tracks of the conference are: Artificial Intelligence Technologies, Cyberspace Protection Technologies, Data Analytics, Digital Project Management Technologies, E-commerce, E-government and E-learning Technologies, Mathematical Foundations of Information Technology, Network and Internet Technologies.

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^{1,2,3} *Taras Shevchenko National University of Kyiv*³ *National University of Food Technologies***USING THE INTERNET OF THINGS WHEN INTRODUCING CRM SYSTEMS IN THE BANKING SECTOR**

Abstract. The Internet of Things (IoT) concept becomes more popular, in particular in the banking sector. Each customer needs special attention and an individual approach to service. Wireless communication between banking objects and the customer's mobile phone reduces the number of customer's actions and improves the protection of operations. Individual algorithms for interaction between customers and banking objects that work within modern customer relationship management (CRM) systems increase the loyalty of customers.

Keywords: Bank, customer, online banking, customer relationship management, Internet of Things, geolocation

1. Introduction

As the banking sector develops, the customers' requirements for its services increase. To attract and retain customers, banks must not only widen the range of services provided but also select which services should be offered to which customers. Introducing Customer relationship management (CRM) systems helps banks to analyze their interaction with each customer individually and to deliver efficient management based on this analysis [1].

One of the main areas of work with customers is using online banking that allows customers to work with their accounts from any point of the globe, given the availability of Internet connection [2]. Virtually all online banking customers use not only their PCs but also smartphones.

Internet of things (IoT) is a technology for wireless connection between devices via the Internet that allows them to exchange information and interact with minimal human intervention [3]. The development and use of IoT in the financial and banking sector for work with customers will allow increasing the quality and speed of service [4, 5].

2. Using the IoT for CRM Systems in Banking

2.1. Devices Interaction when Performing Banking Operations

All customer bank accounts are linked to a mobile phone number, which provides binding the IoT smartphone to the person who is the account user. When connecting to control devices, it is the smartphone that is identified by the personal number and, if necessary, by the password [6].

When a bank customer uses services of ATM, POS terminals, PC, etc., the authentication is possible through using the customer's smartphone geolocation [7]. The customer who uses an additional authentication for banking operations may use his smartphone that will function as a part of IoT and perform this action instead of the customer himself (figure 1).

To perform such actions, it is necessary to meet the next requirements: the customer permits to perform authentication by using a smartphone; the smartphone must have geolocation enabled [8]; the device and the object performing the operations must be within the strictly defined distance [9].

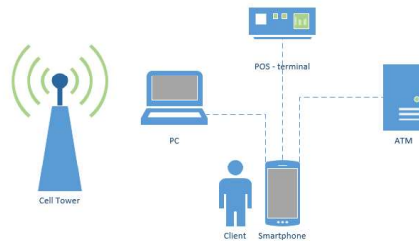


Figure 1 – IoT devices interaction for performing online banking operations

2.2. Determining the Distance for Interaction

We have all the needed conditions to determine the distance between objects: ATMs are installed at stationary positions that clearly define their geolocation; POS terminals have the functionality to determine their location; PCs and other devices are also able to show their location. Thus everything we need is to calculate and indicate the maximum allowable deviation distance between the action object and the customer's smartphone. Let the distance between objects be D . Then the allowable distance will be determined by the formula 1:

$$D \leq |(M \pm \Delta\beta) + (O \pm \Delta\gamma)|, \quad (1)$$

where M is the customer's smartphone location;

β is the accuracy of determining the smartphone location;

O is the location of the object performing banking operations;

γ is the accuracy of determining the location of the object performing banking operations.

It is worth noting that for different objects of interaction, the distance D may be defined individually, as each object has its features for work. Thus it is necessary to define the maximum allowable distance between objects when writing interaction algorithms in a CRM system. We should also consider the possible location error. Each scenario must take into account the features of work with each object (figure 2).

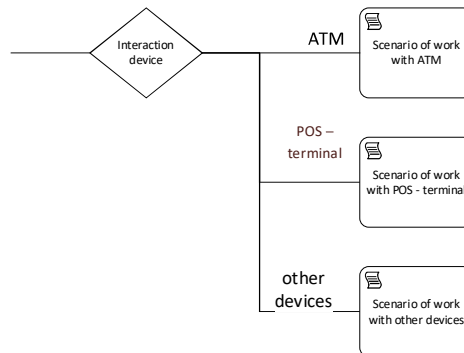


Figure 2 – Choosing a scenario for interaction between customers and objects in a CRM system

Due to using these functions at the device connection layer, a customer doesn't need to go through additional verifications for actions and operations.

2.3. Conclusions

Using modern IoT for work and customer support in banking helps to reduce the time for operations of two-factor authentication while providing an additional protection layer. However, there are some disadvantages. Not all bank customers are using modern smartphones, which is necessary to determine the customer's location accurately. Besides, the smartphone's geolocation must be on at all times for providing the functions needed.

But a smartphone with enabled geolocation can provide an additional access layer when performing operations. At this level, devices will exchange information without further actions by the customer. Additional actions for authorization are required from the customer only in case of lacking the listed conditions.

Introducing IoT in the banking sector of Ukraine will provide [10]:

- reducing human impact on operations;
- increasing protection of banking operations due to additional verification and authentication that are performed at the device level;

- optimizing and minimizing the message traffic of mobile network operators;
- gaining and maintaining leadership in the banking sector through the introduction of global trends in digitalization.

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