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UTILIZATION OF VISUAL MARKERS IN IMAGE

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ABSTRACT
This paper deals with the data extraction from markers in the image using short-range communication technologies and with subsequent implementation of experimental software solution. Other short-range communication options are considered and described as well. The proposed solution is designed as universal mark-up tool for everyday use in various situations. Presented application represents reliable solution for storing of data in various forms. The developed approach allows user to simplify many situations during day, such as planning everyday household chores, shopping or keeping the track various projects.

KEYWORDS: barcode, markup object, web application.

1.   INTRODUCTION
Mark-up object is a physical object that can store data in different forms for a long period of time and enables to get the data using appropriate methods for data extraction. With the advanced developments in IT, such objects are being improved and used in many areas of business all over the world. The main challenge of mark-up object is to provide specific space-related data, it represents comfortable and simple way of providing data to consumers on a specific place [1]. According to Wang [2], great advantage of these objects is low or no power consumption which makes it ideal for long term usage anywhere, for example in offices, on the streets, means of transport, etc. Development of data extraction from mark-up objects is closely connected with development of short-range communication which has made significant progress in recent years. While the use of mark-up objects in business and industry worldwide has been very high, the usage in households and everyday life is very low.

2.   OVERVIEW OF TECHNOLOGY
Two main approaches are considered, short range communication and visual extraction using real-world markers. Short range communication includes various types of technologies, namely NFC, RFID and Bluetooth. Table 1 shows comparison of these three. Later in the research, only the NFC was considered to be used, due to its ability of two-way communication and availability of NFC chips.
In terms of ease of use, the major consideration was for visual extraction utilizing markers. Advantages of both, the NFC and image-based methods are described next.

Table 1. Comparison of some wireless technologies [3]

Parameters	NFC	RFID	Bluetooth
Information transmission	Coupling of magnetic field	Magnetic field	Electromagnetic field
Operating frequency	13.56 MHz	13.56 MHz	2.4 GHz
Modes	Active-Active-Passive	Active-Passive	Active-Active
Network type	Point-to-point	Point-to-point	Point-to-multipoint
Communication	Two-way	One-way	Two-way
Maximum data rate	424kbps	128kbps	2.1Mbps
Setup time	<0.1 msec	<0.1 mesc	6 sec
Range	Up to 10 cm	Up to 3 cm	Up to 10 m
Consumer experience	Touch wave, simply connect	Get information	Configuration Needed

NFC

Near Field Communication (NFC) is a wireless short-range communication technology which is based on standards and principles of the Radio Frequency Identification (RFID) infrastructure [3]. NFC operates over a distance of a few centimeters, maximum limit of 10 cm, and connects the functions of a contactless reader, a contactless card or chip and peer-to-peer functionality on a device. Currently many manufacturers have integrated NFC technology within their handsets.

Advantages of NFC by Dhar [3]:
- easy to use: quick and easy setup,
- versatile: suitable for a wide range of industries,
- open and standards-based: based on ISO, ECMA and ETSI standards,
- technology-enabling: a simple and fast setup of other technologies like Bluetooth or Wi-Fi,
- secure: NFC data transmissions are short range,
- inter-operable: can be used with existing contactless, card technologies,
- security-enabled: can support secure applications.

Disadvantages of NFC:
- short range communication,
- slow data transfer,
- costly in initial phases.

Image-based methods

Image-based methods use optical device, the camera, to scan mark-up objects. These objects are represented by images with certain coded or decoded data. In recent years, image-based data extraction methods are being used in many areas and they replace older technology.

The most used image-based mark-up objects are various forms of barcodes. According to Reischach et al. [4], barcodes are mostly the black-and-white striped codes that can be found on most consumer products and they can be divided into two main categories: one-dimensional and two-dimensional barcodes (see Fig. 1). They consist of many different geometrical shapes like stripes, rectangles, circles, etc.

Advantages of barcodes:
- easy to use: quick and easy setup,
- universal: suitable for a wide range of situations,
- availability: easy initial setup, easy extension,
- accessibility: camera is standard accessory of many devices.

Disadvantages of barcodes:
- quality of image: outside conditions, light, damaged barcodes,
- longer scanning: needs readable image.

Fig 1. Barcodes (left: one-dimensional, right: two-dimensional)

3.   EXPERIMENTAL IMPLEMENTATION

For our implemented application we choose image-based method of data extraction from mark-up objects. This means that mark-up objects consist of various types of barcodes. Designed solution should represent universal solution for different fields of use. It consists of an experimental client-server web application, which will include many useful features such as calendar. Current applications are usually limited to only read-write functionality and so they require other applications to work further with the data. Proposed application consists of two parts: client and server. Server part stores the data in a database and communicates with client part. Client part is used to scan mark-up objects and communicate with client-user. In implementation process, we have tested several modules able to scan barcodes and have decided for ZXing module due to its reliability. In the Fig. 2 we can see results of a study [4] of the reliability of recognition of popular barcode scanner modules.
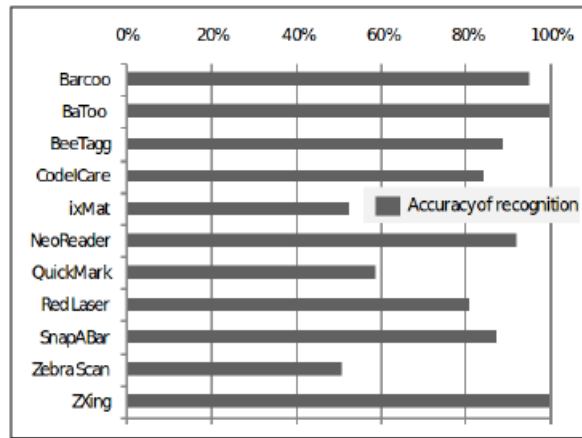
Fig 2. Comparison of reliability of popular scanners [4]

After scanning mark-up object, user can create or edit a data object which consists of:

- ID – identification of mark-up object,
- mark string – string containing decoded data,
- title – title string,
- main image,
- description - text field with text formatting,
- images – voluntary image gallery,
- events.

    ID is automatically generated and filled by the system to uniquely identify a mark-up object. Data scanned by camera of device are written to Mark string. Separating scanned data and ID allows different users to save the same mark-up object. Rest of properties can be filled by the user.

4.   SYSTEM DEMONSTRATION

Final experimental prototype of application was tested. It may be used is various fields, e.g. Fig. 2 represents its utilization in the construction area, where the application was used for tracking of construction projects and its progress. Further, application supports multiple users with separate access to a SQL database. Designed application is universal in many ways. It is optimized for various resolutions including common desktop and handheld devices resolutions.
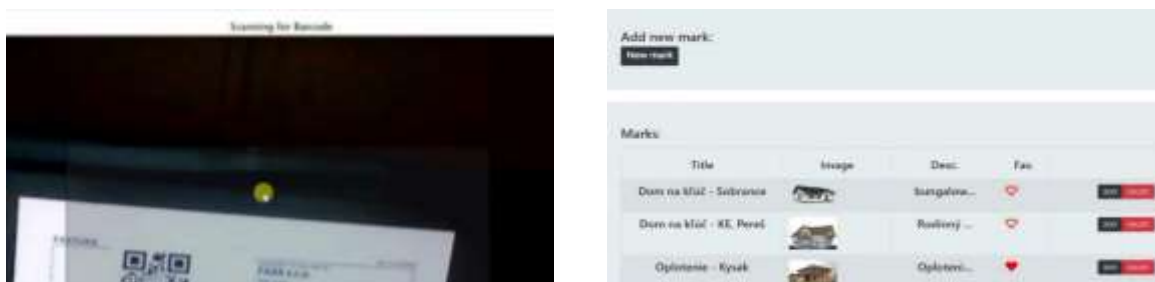

Fig 2. Final experimental application

5.   CONCLUSION

Research presented in this paper was focused on the development of the universal experimental application for the extraction of the data from mark-up objects using appropriate extraction methods, mainly two were considered, i.e. NFC and image-based methods. Initially, mark-up objects were developed and used as item tracking objects, but as information technology rapidly changes, they found applications in a lot of new areas such as marketing, advertising, secure payment systems, education industries, etc.

Adoption of the mark-up objects grows fast in recent period of time and the number of users increases quickly over the time, because of its advantages like higher data storage capacity, fast connection and ease of use.

6.   ACKNOWLEDGEMENTS

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