QR Code as an Element of Educational Activity

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Abstract: Educational activity is one of the directions, which in its development uses various advanced technologies. This makes it possible to increase the attractiveness of the learning process, various professions, attract potential applicants, and develop the necessary skills of students. Advanced technologies also make it possible to improve the learning process, to present the material being studied in a new way. Among such new technologies, the use of QR codes in educational activities should be noted. Based on this, the paper considers: types of codes, levels of error correction in QR codes, the main directions for using QR codes. The paper also provides some examples of QR codes in the form of separate figures. This allows you to better understand the material presented.

Keywords—education; educational activities; QR code; error levels; 2D symbolism

1. INTRODUCTION

A QR code (Quick Response translates as "quick response") is a type of barcode that carries over 4,000 characters of data. This data is encoded using special programs or services in the form of white and black squares (this encoding can be in other colors). Such a code can transmit – links to Internet resources, e-mail address, geographical data, telephone numbers, text, pictures, video and audio information, contact information. For this, various algorithms, methods, and approaches that have found application in other areas of research can be used [1]-[15].

At present, the competitiveness and profitability of educational institutions increasingly depend on how quickly and fully data on educational processes are received by students and applicants. Only those educational institutions are able to achieve the greatest popularity, where the most modern information technologies are used and the data transmission cycle is organized through all information channels. Such educational institutions stand out from the competition.

The introduction of information technology means not only the availability of a computer control system, but also the ability to speed up, for example, the acceptance of documents for admission of applicants.

QR codes are a good way to take students from offline to online. For participants in the educational process, it is easier to point the smartphone camera at the code than to drive in the link manually. You can place codes on any surface or promotional materials. You can generate a QR code in a few seconds in a special application or constructor [16], [17].

There are a number of technical points that should also be taken into account when working with QR. For example, the size of the printed code, which must be at least 2 * 2 cm.

It is worth taking care of the location. It is important that the banner is at eye level.

2. TYPES OF CODES

The most widespread are QR codes and DataMatrix codes. The QR code is the oldest representative of matrix codes, its concept was created back in 1994 in Japan, where they are currently very common. In Japan, QR codes are everywhere, on business cards, magazines, newspapers, flyers, posters, stickers, food, websites, bulletin boards, even on graves. DataMatrix appeared later, other codes even later [18]-[22].

The following international ISO/IEC standards for 2D symbology are currently accepted [23]: ISO/IEC 16022:2000 Data Matrix; ISO/IEC 15438:2001 PDF417; ISO/IEC 16023: 2000 MAXI CODE; ISO/IEC 18004:2000 QR Code.

3. BRIEF DESCRIPTION OF THE MAIN 2D SYMBOLS

Fig. 1 shows some examples of 2D symbology [18], [20], [23].

a) Data Matrix   b) PDF417
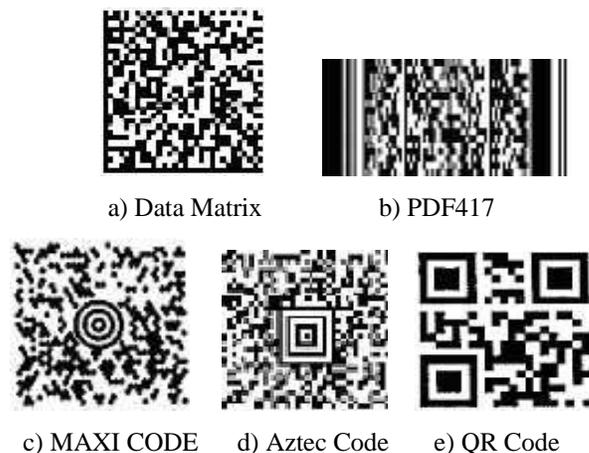
c) MAXI CODE   d) Aztec Code   e) QR Code

Figure 1: Examples of 2D symbologies for implementing codes

The Data Matrix is a two-dimensional code designed to accommodate a large amount of information in a limited area and can store up to 2000 alphabetic characters or 3000 digits [18].

PDF417 consists of 17 modules, each containing 4 dashes and spaces.

QR code. To form the code, a matrix of rectangular data elements and three orientation patterns at the corners of the symbol is used [20], [23].

MAXI CODE image. A two-dimensional fixed-size matrix symbology consisting of hexagonal elements gathered around a search pattern. The pattern is several concentric circles [20], [23].

Aztec Code is designed for fast printing and easy decoding. It is a square matrix with concentric squares in the center, which serve to determine the position of the code relative to the scanner and a measuring ruler along the edge of the code [23].

4. ERROR CORRECTION LEVELS IN QR CODES

A QR code has a special mechanism for increasing the reliability of storing encrypted information. For codes created with the highest level of reliability, up to 30% of the surface can be damaged or overwritten, but they will retain information and be correctly read. The Reed-Solomon algorithm is used to correct errors. When creating a QR code, you can use one of 4 levels of error correction. An increase in the level contributes to an increase in the reliability of information storage, but leads to an increase in the size of the matrix code [24].

Permissible percentage of violations [25], [26]: L – about 7%; M – about 15%; Q – about 25%; H - about 30%.

5. WHAT CAN QR CODES BE USED FOR?

Among the main areas of use of QR codes should be highlighted (fig. 2) [27]:

Postcards, posters, outdoor advertising, with an encrypted message or wish; when organizing project activities, you can create collections of links, information blocks, comments, etc. QR codes can be published on the pages of project support sites, posters, etc.

Figure 2: Application of QR codes

In the educational process, QR codes should be used for the following purposes [18], [28]:

1) as an additional material with QR codes providing students with handouts for lectures in the form of links to multimedia sources and resources: videos, applications, websites, drawings, animations, electronic educational publications. You can place QR codes on the presentation slides themselves;

2) for placing reference material on the covers of educational and methodological literature;

Figure 3: QR code that leads to sample student work

3) for use in the educational institution's library catalog system;

4) to place the schedule of classes, schedules of consultations. At the same time, a complex QR code (with a large amount of data) may not be recognized by a low-resolution camera, and it is necessary to figure out how to reduce the data;

5) for students to enter the virtual classroom of the distance course. For example, the Moodle system allows you to generate a QR for a course, and you can also create a QR code for Classroom;

6) as an attachment to a learning object - QR codes can be placed on printing equipment, color palettes and other objects;

7) for a thematic survey, control of students' knowledge on a specific topic, made in the form of cards with various options for tasks. There is a special service ClassTools.NET that allows you to create such tasks in the form of QR codes. Direct link to the service http://www.classtools.net/QR/;

8) in an educational game-quest with tasks in QR codes; can be effectively used when holding events, when at one of the stages (in any subject or in circles of departments) the task will be offered in the form of a QR code;

9) students can create their portfolios or annotations on the books they have read and educational literature on the topic under study and post them on the website in QR codes;

10) to place contact information on the business card of the teacher, the administration of the educational institution, on the badges of participants in conferences, seminars, exhibitions. As a description for exhibition works.

All students, applicants and their parents have smartphones, which makes it possible to widely use the possibilities of modern technologies in practical activities.

The University of Bath is a precursor to the use of QR codes in education. Some educational applications using QR codes are described below [18], [19], [28]:

1. With every catalog search in the university library, a QR code will also be automatically displayed to summarize the key information, title, author, and shelf location

2. A title page with the corresponding QR code must be attached to the student's assignment for the Faculty of Engineering and Design

3. QR codes are automatically added to the bottom of Moodle printouts. The QR code contains the URL of the page for that particular Moodle course.

4. QR codes can also be found on campus posters, bookmarking websites and service blogs, event guides, and departmental marketing materials.

6. HOW TO POST QR CODES

QR codes are widely used by many famous companies and brands. The use of codes in educational institutions is also gaining momentum. The dynamics of the popularity of the term "QR code" can be traced on Google Trends (see fig. 4, www.google.com/trends/explore#q=QR code).
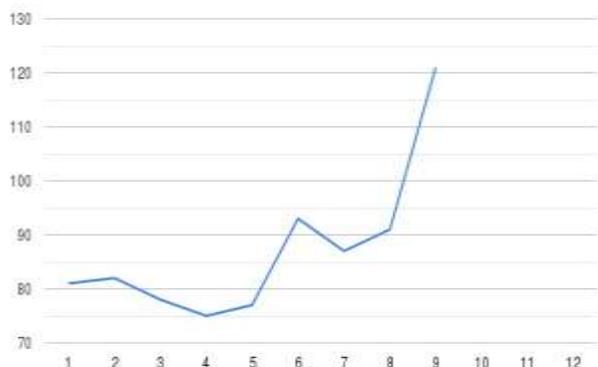

Figure 4: Popularity of the term "QR code" over the past year in Ukraine

7. HOW TO CREATE A QR CODE

Creating a regular QR code is not difficult, as there are currently a large number of services for creating it. It is possible to save codes as a graphic image using JPEG, PNG or TIFF formats. Then they can be printed or published on the Internet.

QR codes have gained such popularity that just white and black squares are no longer enough.

Brian Benchoff, the author of the Hack A Day blog, figured out the algorithm for generating QR codes (ISO 18004

standard) and compiled instructions on how to embed an arbitrary image in a QR code. For example, the company logo [29].

For work, Brian Benchoff used a standard QR code generator and Microsoft Paint for pixel-by-pixel editing.

When generating a QR, one rule must be taken into account: black pixels must always be black, and white pixels must always be white.

The gray space is divided into 172 eight-pixel areas. Some of them are divided into two parts and spaced apart in space, connected by black lines.

The QR code technology was developed taking into account the fact that they will be read by cameras of not the best quality or in not very good conditions. Therefore, in order to improve the quality of recognition, redundant coding technology is used. And if some part of the QR code is damaged, then it can still be read and decrypted.

As experience shows, about 30% of the zones can be filled with random information, and the phone can decode the information [30]. Thus, out of 172 sections, about 51 can be used, giving any shape and color.

The simplest change that can be made to the code to improve aesthetics is to change its color. As mentioned earlier, a QR code consists of only two colors - black and white. You can replace one color or both. It is necessary that the black color after staining remains darker than white. And the contrast was large enough otherwise the smartphone's camera or software would not be able to decode the QR code.

New services for working with QR codes make it possible to complicate the coloring algorithm using a gradient fill. Using the right gradient can significantly improve visual perception compared to a linear color fill (fig. 5 [30]).

Figure 5: QR code with gradient fill

The use of rounded corners of code segments will also improve the perception of QR codes. Another way to improve aesthetics can be to rotate the QR code around its axis by 45 degrees (fig. 6 [30]).

Figure 6: QR code rotated around its axis by 45 degrees

Having a QR code with increased noise immunity, we can embed any images in it that do not overlap the code by more than 30%. Often such a highlight in the form of small pictures on the code greatly changes the perception of such code and increases interest in it.

To make truly beautiful logos, you can take a larger QR code. For example, the 14th version with a square side of 73 pixels (fig. 7).

Figure 7: QR code with embedded logo

Pixels can be made in any color: white, black, red or purple, only the contrast between them is important. Consider an example with the letters of the MCT department logo. Since the letters MCT are relatively dark in this example logo, the algorithm will perceive them as black. Using color is a handy technique that allows you to get rid of the contrasting border.

If the MCT department logo had a white border, it would cover more than 30% of the image area. And with the use of color, it covers less than 30% and this QR code is perfectly readable.

It is not necessary to limit yourself to the per-pixel resolution of a QR code, you can always insert a simple image (fig. 8).

Figure 8: QR code with a pixel-by-pixel logo

In addition to a pixel-by-pixel logo and a logo insert, you can make a QR code with a background image. You can insert background images in place of the black segments, while the picture must be of low quality so that there is a high contrast with the white segments. Or use a background for white code segments. In this case, on the contrary, the brightness of the image should be high in contrast with the black segments. Using this approach, you can get quite interesting visual effects on a QR code (fig. 9).

Figure 9: QR code with background images

For example, a phone number that is encrypted in it can be applied to the code so that people who cannot scan and recognize it can enter this number manually. Therefore, branded QR codes with logos are becoming more common. The inscription or logo is usually inserted into the central part of the code.

8. CONCLUSION

The use of unusual QR codes will help departments and universities become more popular. Such QRs will help you stand out against the background of the same type of QR codes - make the code work more efficiently. For example, you can print booklets for university applicants, but at the same time

use not a regular QR code, but make it colored, round the corners, add a shadow, a logo, etc. Adding some text to or next to the code itself, which can be read by the human eye, even before using the smartphone's camera, will help to interest and urge to scan the QR code.

Focus on the brand. Since QR codes are a very attractive element in advertising, it is natural that if you harmoniously fit it into the corporate identity of an organization, you can reinforce and strengthen the power of the brand in the minds of consumers. For example, coloring in corporate colors, embedding a logo in the code, decorating segments with elements typical for the industry.

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