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Quick Response (QR) Code Image Pattern Recognition: Time Utilization Tracking Application

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Abstract *- Time utilization is an essential number for firms that charge the maximization of productivity of employees' efficiency. QR code store the identity of mobile employees/students of whereabouts. QR code recognition is a pattern identification presence in image orientation. Automating the time tracking method holds employees/students responsible for their locations, does eliminate time and error estimation, and ensures its accuracy. The goal is to develop an application using the technology of QR code for the time utilization tracking process. Some companies today still using Bundy clock or Radio Frequency Identification (RFID) for time tracking, and due to the restricted transaction and access mobility, the problems encountered are time recording, monitoring, and manual computing. The methodology is the V-model agility process in the System Analysis, Design, and Development (SADD) phases. Quantitative data analysis was resulted in a significant level and qualitative on the Reliability Test of the system functionality. Twenty-five respondents perceive significant, and five IT experts calibrated, tested, and evaluated, which resulted in a mean of 3.10 as "Average." The coefficient of variation of <10 is "Very Good" shows the precise estimate proves that QR code provides efficiency in record management, accurate computational arithmetic, and accessibility of the mobile app.*

INTRODUCTION

According to Masalha, Fadi, and Nael Hirzallah (2014), smartphones are becoming more acquainted with customers than desktops or laptops. Knowing that smartphones are most familiar with consumers around the age of 26, using smartphones to speed up employee/student attendance would save time. This paper proposed a system based on a QR code that will track the employees/students of their places. To verify their whereabouts, the employees/students will need to scan the code. The document describes the details of the suggested system's high-level execution. It also explains how the scheme verifies the identity of the employee/student to remove fake registrations.

A monitoring scheme is an exclusive software solution, and by using QR code, which is now gaining in significance and popularity, many companies are now adopting this code as a means device. The use of QR codes for everything and anything does benefit both customers and businesses. For instance, by distributing a QR code to your website or Uniform Resource Locator (URL), a company saves money and marketing costs. A client can scan this QR code, allowing them to store future reference data.

Through the use of technology such as QR code prevent the employees from doing cheating and padding or any malicious in their working places. It's going to reduce the number of errors that occur when processing information requests, improve the use of working hours by increasing the quality of employee attitude to job responsibilities and discourage unjustifiably claiming overtime. Access module will help restrict people from entering individuals to enable accessibility of authorized personnel.

Based on the assessment and data gathered from the survey and interview, the problems of the

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existing time log monitoring of the company system are the following: *(a) miscalculation and time-consuming due to manual data intervention, (b) errors on posting data, (c) cheating in attendance due to anyone can time in with the use of timecards.* Because of the following issue faced by the Management and Finance Officer, they come up with the solution of stopping the problem. The experienced in log tracking they model and developing a scheme that can secure the information application employing a QR code algorithm for log mapping that links to the system that provides precise computing and periodic creation.

OBJECTIVES OF THE STUDY

Is to design and develop the Quick Response (QR) code Image Pattern Recognition Time Utilization Tracking Application, which will help the Human Resources Department (HRD) and the Finance Officer to improve the system in the logging of employees in their local time monitoring. Implementing a quicker, more comfortable, and more reliable way of applying information, changing the present attendance practice through Bundy Clock or RFID, generating wage and periodic reporting for the staff, eliminating manual information input, the technological innovation can attain.

QR code time utilization provide cost-saving benefits in *(a) Accuracy* – eliminate timesheet factual errors that falsify time logs with automated data capture; *(b) Simplicity* - record with just a swipe or card scan all pertinent information; *(c) Efficiency* – reduce the time and enrollment data needed for processing; *(d) Productivity* – manage the time and efficiency of the employee to maximize their capacity.

MATERIALS AND METHODS

Materials Analyzed

QR code recognizes by the system; *Step 1*: Gray conversion–A QR code symbol captured by an embedded system with Charged Coupling Devices (CCD) or Complementary Metal Oxide Semiconductor (CMOS) (http://www.steves-digicams.com/) and is a colorful image. The QR Code symbol is a dark collection, light pixels. Fortunately, the color and gray picture of the data quickly calculated with a small room. *Step 2*: Binary–Greyscale image binary in the re-processing system. *Step 3*: Determine location and orientation–Location of locator patterns is the premise of acquiring a version, direction, and distortion of the QR code - similar location detection patterns across the three out of the four corners of the QR.

Three dark-light-dark squares overlap each finder pattern, with a dark-light proportion 1:1:3:1:1. Determine the orientation of the symbol after you get the location of the finder patterns. The QR code can be sure to read from any direction. *Step 4*: Locate the position of the central alignment pattern. The symbol includes several patterns of alignment to correct the contorted QR code symbol. The increased QR code version will result in the number of patterns applied to the alignment. A small sampling grid created to connect the center point alignment patterns, and the three pattern positions were detected. A small sampling grid overcomes distortion. *Step 5*: Decode–decoding is just the other side of the encoding method.

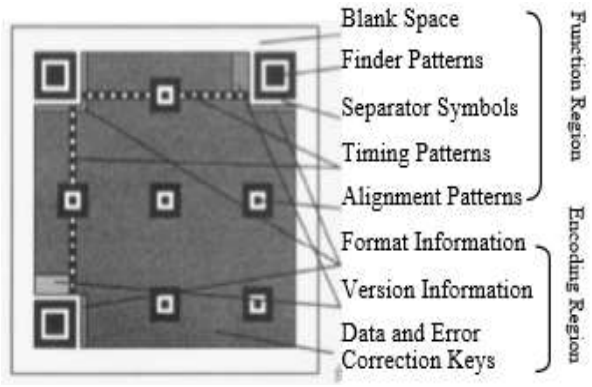

Figure 1. QR code

Identifying Marks / Masking shown in Figure 1, that the QR code is the square range of some modules. It involves function and region of encoding (such as search patterns, separator symbols, timing patterns, alignment patterns), and some portion of not be used to encode information. The region around the symbol of the QR code is empty.

The finder patterns at the symbols' three corners intend to assist in the natural positioning of their position, height, and leaning.

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According to Chris Schnabel, "Globe launches GoPay mobile QR payment system" August 06, 2017, there is a length of the same separator symbols module between the sample pattern and the encoding region, both light modules. Timing pattern characteristics are the density of the QR code symbol, and the limitation of the reference position can determine the coordinates of the modules, as stated in (www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 2, February 2014).

. The structural features of the QR code symbol should appropriately use in the decoder technique (*https://en.wikipedia.org/wiki/QR_code*). It consists primarily of the following steps:

- Binarization
- Obtain the approximate QR code region and execute the rough placement of the image according to the finder pattern ;
- Implement accurate positioning according to alignment patterns
- calculate the angle of inclination to be rotated the QR image, and implement rectification;
- Obtain the number of versions and perform self-adaptive sampling;
- Decode and join the regular 2D matrix based on the corrected image (https://www.tec-it.com/).

The QR code's structure

The four parts, as shown in Figure 2: *(a) Finder patterns:* these are the big black /white/black squares in the three corners of the QR code (https://blog.naver.com/). It indicates the existence and orientation of the QR code in the picture that produced identification very rapidly; *(b) Alignment patterns:* they are smaller than the finder models and help to form the QR code drawn on the curved surface. The larger the code, the more alignment patterns it has. (https://mafiadoc.com/); *(c) Timing pattern:* They are alternating black/white QR code modules. The concept is to assist you in exactly figure out the data grid; *(d) Actual data*: The blacks and whites are bits. Groups of 8 such modules would be up to one byte. You might want to combine 16 modules for Unicode information.

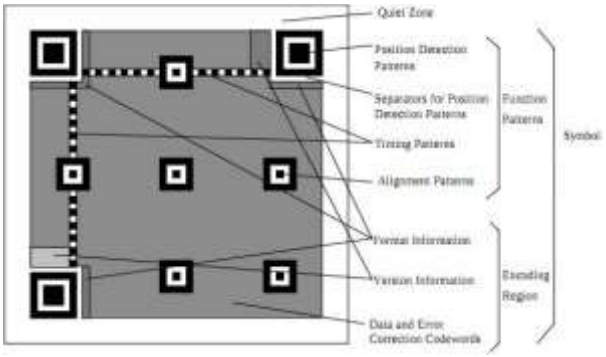
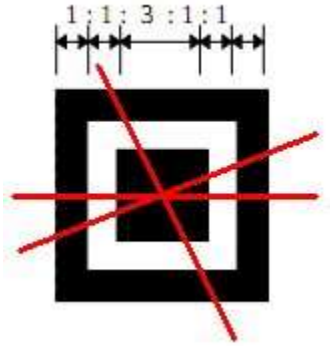


Figure 2. QR code Unicode information

Detection of the QR code

It is about finding patterns to classify the QR code. The idea is that there is a combination of the amount of black/white/black/white/ black. No matter what angle it looks still ratio remains the same.



The QR error correction code can be artistic. They can't sacrifice some pieces of information to create a better look. It stores redundant copies of bits to compensate for the lost bits. It decreases the overall capacity, of course, but it makes the code look good, and all the scanners are still readable. SmarQR utilizes the Reed-Solomon error correction code to do this. It encourages different error correction rates (7%, 15%, 25%, and 30%). The 30% of the bits are damaged (soiled, washed, faded, and replaced by art), the QR can still be read.

Image-based recognition of QR code

The image-based recognition algorithm shows the problem of QR code recognition caused by ordinary camera collection. The entire process, including image binarization, image tilt correction, image orientation, geometric image correction, and image normalization, allows identifying images

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collected under different illumination conditions quickly. Some improvements were present in image tilt correction, image orientation, image normalization, and so on based on the algorithm to speed up image processing and make it easier to achieve. Experiments show that the enhanced method can increase the speed and accuracy of two-dimensional code recognition.

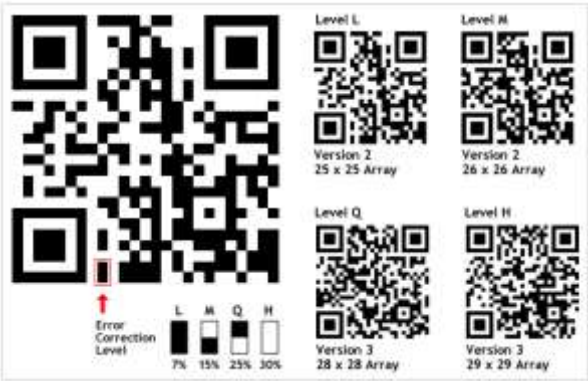
Errors Code and Validity

Several factors affect the capacity of the QR code. The uncertainty level in the code version defines the volume (number of components), and type of the data encoded affect functionality (https://mafiadoc.com/).

- Version: There are 40 different versions of QR codes available primarily in the number of modules. It is possible to store up to 133 sets of data with 21x21 modules. Version 40 contains 177x177 modules that save enough as 23,648 data.
- Error Correction: The detailed form of Bose–Chaudhuri–Hocquenghem (BCH) codes for error correction depends on the Reed-Solomon code. Table 1 shows the four stages. Users can choose to correct the error at the time of creation.

Table 1. QR error level determination

Error Level	Error Correction Capacity
L	7% damage
M	15% damage
Q	25% damage
H	30% damage



Source:https://blog.qrstuff.com/2011/12/14/qr-code-error-correction

Increase percent of codewords used to correct errors when using higher error correction rates to generate QR code. Reduces the number of data that can store in the code, according to P. Kieseberg et al., (2010).

- Encoded data: QR code is convenient to use; their complexity influences the number of actual characters within the code that can be stored. Version 2, for example, with the lowest level of error correction in the QR code.
- Only 10 Kanji characters, but 77 numerical characters can use according to J. Shieh, J. Zhang, et al., (2011).

Methods

According to the book of Ian Sommerville Software Engineering 9th Edition (2011), the developmental approach, which is an agile method that focuses on the iterative process rather than specific technical criteria to agile software engineering.

The methodology allows the proponents to (i) efficiently develop the proposed system with no holdup progress caused by unstable requirements, (ii) enabling them to deliver the software on time for evaluation and (iii) ensuring the ideal software to obtain.

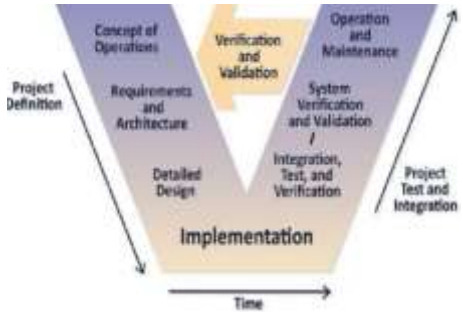


Figure 3. V-model Methodology

V-model methods illustrate how verification and validation actions are associated with software engineering actions

QR code procedure

The QR code is a 2D barcode for easy access to information via a camera and smartphones (https://searchmobilecomputing.techtarget.com/)

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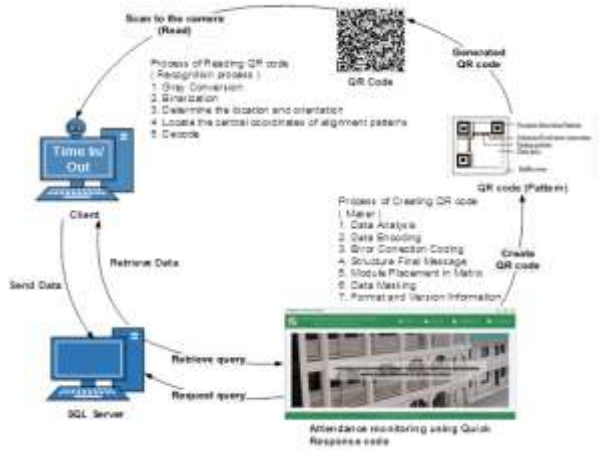

Figure 4. QR code procedure

Shows the QR code created by the system; *Step 1: Data Analysis* – determine whether it is possible to encode text in a numerical, alphanumeric, byte, or kanji mode[4] then choose the most appropriate version. *Step 2: Data Encoding* – this step is a string of Bits broken down into 8-bit data code words. *Step 3: Error correction code* – after creating the series of data Bits, those Bits used to generate error correction codewords utilizing a method according to Reed-Solomon error correction (https://www.thonky.com/). *Step 4: Structure Final Message* – codewords produced for information and correction of a mistake in past activities will arrange in the right order. (https://www.thonky.com/) stated the codewords for information and correction of error provided by big QR code in blocks. Those blocks will interleave according to the specification of the QR code. In neighborhoods, these blocks will interleave according to the specification of the QR code. *Step 5: Module Placement in Matrix* - Codewords has been arranging in the matrix. *Step 6: Data Masking* - some Patterns of the QR code matrix may make scanning difficult. To counteract the QR code configuration defines eight mask patterns that alter the QR code according to a specific model. *Step 7: Format and Version Information* – add a pixel to particular areas of the system which have been left blank in the previous actions. The format pixels identify the level in Error correction and masking pattern used. The QR code version of the pixels encodes the volume of the QR matrix and only used in the QR matrix.

The technicality of the Project

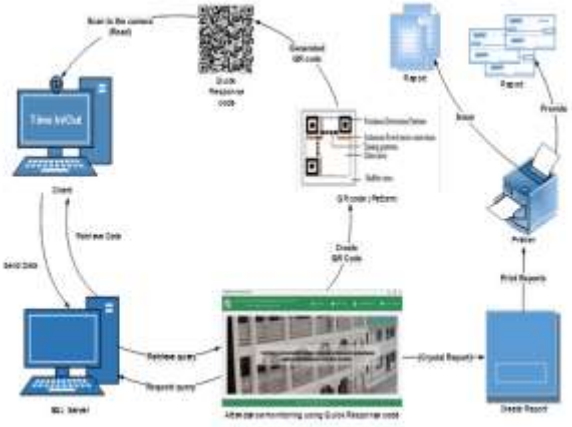

Figure 5. Technical Diagram of System

Shows the QR code image recognition patter for the time utilization tracking program will use MySQL Workbench 6.3 to store every employee's time log and data transaction process in the database. And we use Visual Studio. Net and also Crystal report to generate a report to create the design interface.

Screen Design

Module Name	Sub-Module Name	Object Conventional Name	Functional Validation
Administrator	Generate QR Code	Generate QRC_Btn	Generate QR Code
		SaveQRCode_Btn	Save the QR Code to the gallery

Figure 6. Generate Quick Response Code and Design Interface of the system

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Platform Used

Table 2. Software Tools used in the System

Software	Specification	Technology Capability
Visual Studio.Net 2012	• Windows 8 • 32-bit (x86) or 64-bit (x64) • Dual-core, 2.66-GHz • USB 2.0 • 2 GB of RAM • Graphics card	Visual Studio.Net for programming and design interface of the project
MySQL Workbench 6.3	• CPU - 32 or 64-bit Single-Core 3GHz, Dual Core 2GHz • RAM - 4 GB or higher • Display - 1920×1200	Used for a database of the system

Instruments Used

Three (3) Indicators; *(1) Reliability Testing/Calibration (Measurement), (2) Evaluation,* and (3) *Review of the Users*: (i) *Frequency Distribution-Percentage* for Demographic Profiling; (ii) *Mean-Measurement* of Central Tendency of variable; (iii) *Chi-square-Inference* (Perceptive Survey) of the (Significance Level); (iv) *Reliability Test* (Functionality). Coefficient result of the variation

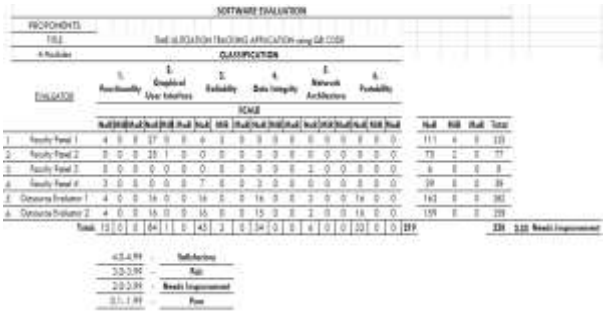
RESULTS AND DISCUSSION

The testing, measurement, evaluation, and review of the developed system conformed to the objectives. The proponents conducted a series of tests, evaluate, and review the users to attain the affirmative results.

Table 4. System Testing

Shows System Testing of 5 IT professors of Infotech Development System Colleges on the scale used are: *(1) Object functionality, (2) Arithmetic Computation, (3) Reports Parameter, (4) Relationship Integrity and (5) IPO* that acquire an overall mean of 2.99 which interpreted as "Needs Improvement."

Table 5. Software Evaluation



Shows Software Evaluation of 4 IT professors of Infotech Development System Colleges on the scale used are *(1) Functionality, (2) Portability, (3) Reliability, (4) Data Integrity, (5) Network Architecture and (6) Portability* that acquire an overall mean of 2.55 which interpret as "Needs Improvement."

Validity and reliability

Research safety was tested through a pilot study test by evaluating and re-testing the findings using a sample size of participants following software called SPSS (Statistical Social Science Package).

Data quality checks the correct data and relies on some experts to verify accurate data and tests. The questionnaire is still in service, and some experts were sent to the survey to test questions

Using eight different effects to illustrate the QR code symbol's ability to read the QR code image quality via mobile device or iPad. The software platform used by Visual Studio 2012 to code the generator of QR code and improve the quality of QR code symbols.

As shown in Table 1, the encoder program will produce the original QR code script. Users can use a different version of sizes, and error detection rates, the L, M, Q, and H generate the QR code file. To determine the quality of images using QR code, 80 QR code images sample collection will evaluate for each approached image. A mobile phone with an embedded camera acquires all QR code images. The mobile device used to test images with QR code has 8.0 MEGA Pixels resolution.

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The experiment tested different methods of techniques in a realistic setting for QR code images. Evaluation of the output of five groups QR code images:

First group, Histogram Equalization condition; *Second group*, Salt-Pepper and Noise Generation Additive; *Third group*, Filter Blobs; *Fourth group*, Bayer Filter-GRBG (Color Filter Array) and Baroda Rajasthan Gramin Bank (BRGB); *Last group*, (Blobs Processing) BP-Quadrilateral Transformation and Perlin Noise (Visual Effects/Computer Graphics) condition.

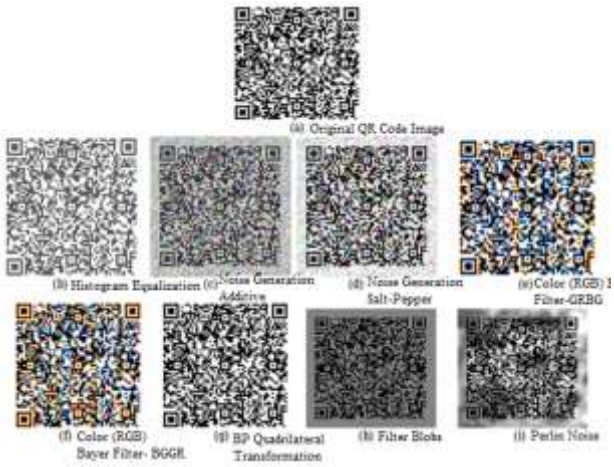

Figure 7. QR code images

Shows covered QR code version to all aspects of technical conditions. According to Abdullah et al., (2014), the study shows that the images of the QR code can scan under different circumstances; *(a) 1st* QR code image; *(b) 2nd* Histogram Equalization *(c) 3rd* Noise Generation Additive *(d) 4th* Noise Generation Salt-Pepper *(e) 5th* Color (RGB) Bayer Filter-GRBG *(f) 6th* Color (RGB) Bayer Filter- BGGR *(g) 7th* Blobs Processing (BP) Quadrilateral Switch *(h) 8th Filter* Blobs *(i) 9th* Perlin Noise.

Table 6. Average Recognition Time and Rate

Techniques	Average Response Time on Decoding (ms)
Histogram Equalization	900
Noise Generation Additive	3100
Noise Generation Salt-Pepper	600
Filter Blobs	800
Color (RGB) Bayer Filter-GRBG	400
Color (RGB) Bayer Filter- BRGB	200
BP Quadrilateral Transformation	700
Perlin Noise	1100

It shows the effects of all similar techniques used in the complete QR code image. The recognition time for QR code is higher than the average noise generation additive technique (3100ms) and the time clutter recognition time for Color (RGB) Bayer Filter (200ms).

The five groups are the Quadrilateral Transformation Blobs Processing (binarization) techniques that cost, on average, the slowest QR image deciphered (700ms).

The study eventually showed that under various conditions, mobile devices were able to check the image of the QR code, and all information stored in the image could properly check and retrieved.

CONCLUSION AND RECOMMENDATION

Based on findings, most businesses have an existing manual logging monitoring system that is not effective and efficient enough to accommodate the number of employees and reports requirements, specifically the periodical reporting of records. The current time utilization tracking system is manual or paper-based. Its speed, accuracy, and storage are inefficient. The existing attendance monitoring system could not track down correct data application information. The outdated device used in the attendance monitoring system is subject to anomalies in time log usage. Thus, this study entitled *Quick Response (QR) Code Image Pattern Recognition: Time Utilization Tracking Application* is somehow able to provide efficient management of records, accurate computational arithmetic, security, and generated reports. The results and finding in the conducted on the three (3) indicators, *testing/calibration (measurement), evaluation*, and *review of the users* conclude that the proposed system is implementable and a need for budget allocation.

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