A modern approach to civil engineering drawing access through QR code integration

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Abstract—**The adoption of QR code technology in construction site management addresses challenges associated with traditional methods such as paper-based documentation, verbal instructions, and limited access to critical information. By leveraging QR codes, site teams can quickly retrieve digital resources, including blueprints, safety protocols, and task assignments, through smart phones and tablets. This approach streamlines workflows, reduces dependence on physical paperwork, and minimizes errors caused by miscommunication. Furthermore, QR codes facilitate real-time updates, improve collaboration, and enhance overall efficiency on-site. This study evaluates the practical application of QR codes as a cost-effective and accessible solution for modernizing construction management processes and improving task execution. Innovative applications that can enhance efficiency, productivity, and safety on construction sites. The idea is to use QR codes to share architectural plans, providing easy access to critical information for worker, contractor, and stakeholder. As the industry advances, integrating QR codes with technologies like augmented reality or AI can unlock even greater potential. By embracing this approach, construction projects can become faster, safer, and more efficient, ultimately benefiting everyone involved, from workers to project managers.**

Index Terms—**QR code, Design and construction information, physical to digital, Progress monitoring, communication.**

I. INTRODUCTION

Construction projects often require workers to rely on large paper-based drawings and plans to understand building designs and execute tasks on-site. These drawings, which show dimensions, layouts, and other critical details, are essential for guiding the construction process. However, in large commercial projects, the number of paper-based drawings can be overwhelming. Workers frequently need to refer to multiple sheets to find the information they need, cross-checking details and instructions. This process is not only time-consuming but also increases the chances of miscommunication and errors.

Paper drawings also present practical challenges. They are difficult to manage on busy construction sites, prone to wear and tear, and can be easily lost or damaged. If any updates or changes are made to the design, distributing revised documents adds to the workload and delays. Workers may struggle to access the latest instructions, leading to mistakes and inefficiencies. These issues are a major bottleneck in construction workflows, as they slow down progress and increase mental and physical effort for workers.

To overcome these challenges, the construction industry is turning to technology-based solutions to improve the way information is delivered and managed on-site. One innovative approach is the use of Quick Response (QR) codes. QR codes are small, scannable codes that link directly to digital content. By scanning a QR code with a Smartphone or tablet, workers can quickly access blueprints, specifications, task instructions, or safety guidelines. This makes QR codes an efficient and reliable alternative to paper-based methods.

QR codes have several benefits. Firstly, they allow workers to instantly access relevant information without searching through piles of paper documents. For example, scanning a QR code on a specific section of the site can bring up the exact blueprint or task list for that area. This saves time and reduces the chances of errors caused by misinterpreting outdated or incomplete drawings. Secondly, QR codes are easy to update. If a design or instruction changes, the linked digital document can be modified, and the QR code will automatically direct users to the latest version. This ensures that everyone on-site is

working with the most accurate and up-to-date information.

Another advantage of QR codes is their ability to improve teamwork and communication. QR codes can be used to assign specific tasks or materials to workers, with each code linking to instructions, deadlines, or progress updates. Supervisors can also use QR codes to monitor task completion and provide real-time feedback. This helps streamline workflows and ensures that all team members are on the same page.

Additionally, QR codes can improve safety on construction sites. Codes placed in high-risk areas can link to safety instructions, emergency procedures, or training videos. Workers can access this information instantly, reducing the risk of accidents and ensuring compliance with safety standards. This makes QR codes a practical tool for enhancing both efficiency and safety in construction projects.

II. LITERATURE

Foroughi M. et. al. (2023) [1]
The literature review of the research paper highlights the challenges faced in construction due to traditional, paper-based methods of accessing design and construction information. These methods often lead to errors, inefficiencies, and increased costs, as workers rely on shop drawings and verbal instructions that are prone to misinterpretation. The paper addresses these issues by proposing the integration of Augmented Reality (AR) and QR Codes, allowing workers to quickly access accurate, digital construction data on-site. By utilizing both paper-based and digital tools, this hybrid approach aims to reduce errors, improve communication, and enhance productivity on construction sites.

Vasilyev R. et. al (2020):[2]
In that Quick Response Code (QR) implementation and improve the routine construction site for task management. In that mobile integration for data exchange system via QR codes, using smart phones to scan and upload data above construction process. As a result, the statics and advantages of working with smart phones over computers were considered.

Lorenzo T. et. al. (2014):
BIM and QR code use at a construction sector for allow demonstrating the practical use of tool, enhancing communication between client technical structure, contractor and workers. It more useful and applicable in the construction sites under the organization of structured construction companies. It helpful to maintain the data for regarding construction site like, workers details, wages and material.

Sachin P. R. et. al. (2019):
This study examines the possibility of integrating BIM into a project management framework to monitor construction progress and thus, improving the current method of progress monitoring on site. A workflow involving collection of as-built data is implemented in a live construction project and this data is stored on a BIM-based platform. The project progress is monitored with the help of a project management application which utilises sensing technology (QR code) for data collection.

III. METHODOLOGY
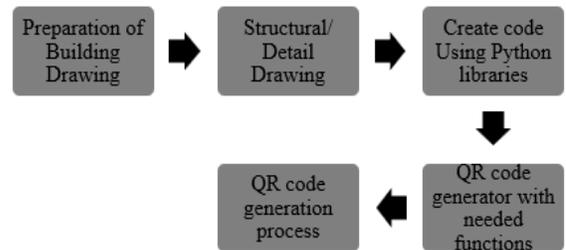
Building drawings involves a systematic approach to design and documentation. Gather details about the client's needs, site conditions and building regulations. Create detailed drawing including floor plans, elevation, sections and site plan. Structural drawing details including information on foundations, beams, columns, electrical wiring, plumbing and HVAC system. Python is used for creating a code of generator and some of the libraries are used like. SQLite3, Tkinter, Filedialog, Message box, etc. The QR code generator allows users to create a QR code by uploading a file or providing a link. Once generated, the QR code image and its associated data are stored in the database. The system includes functionality to update or replace the data linked to the QR code without altering its image. This is achieved by uploading the QR code into the generator, enabling seamless access to the updated data while maintaining the same QR code appearance.
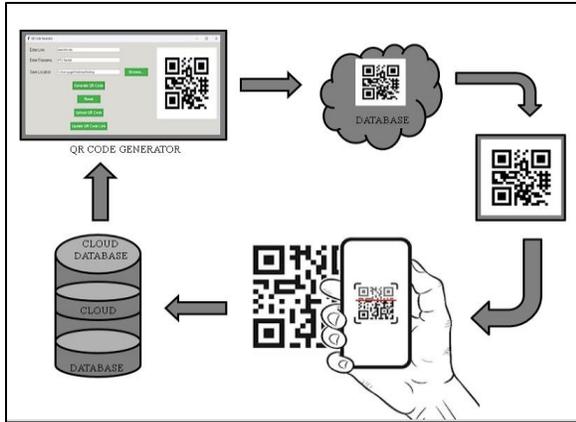
Fig. Working flow chart.

For QR code generator we used some kind of python libraries:

- SQLite3: Used to interacting SQlite data base.
- Tkinter: For creating GUI application in python.
- Filedialog: A module of tkinter for file and directory selection dialogs.
- Message box: Module of tkinter for showing pop-up message.
- json: Handles JSON data for API request response's
- qr code: Library for generating QR code.
- Pillow: Python imaging library (PIL) fork image processing used for handling and displaying QR code image.
- Pyzbar: Used to decode QR code from image.
- OpenCV (CV2): Used for reading QR code image for decodeing.

IV. RESULT

QR codes are changing how construction projects are managed. Imagine that employees can instantly access all the information they need, such as blueprints and safety guidelines, by simply scanning a code on their phone this eliminates the hassle of sifting through stacks of documents, preventing them from getting them more time and reduces the risk of error.

Communication and teamwork are greatly improved. Project updates, security alerts, and any system changes can be shared instantly with everyone on the team via a QR code. This ensures that everyone is always in the loop and working from the same information. Managers can easily track progress and

provide feedback, while teams can easily access shared documents and work more effectively together.

But that not all. QR codes play an important role in improving safety on construction sites. A quick scan can easily identify safety codes, emergency communications, and even where hazards may occur. This keeps everyone safe and reduces the risk of accidents. In addition, by reducing the need for paper documents, QR codes are more environmentally friendly and can save money on printing and storage costs.

V. CONCLUSION

Using QR codes on construction sites offers a simple yet powerful way to address challenges like inefficient information access, errors, and delays. By linking QR codes to essential resources such as design plans, material specifications, and safety instructions, workers can easily access the information they need through their mobile devices. This shift from paper-based methods to digital systems helps reduce confusion, saves time, and ensures that everyone is working with accurate and up-to-date data. It also minimizes errors and rework, making the entire process more streamlined and efficient.

In addition to improving workflow, QR codes enhance safety on construction sites. Workers can quickly scan codes to access safety guidelines, emergency procedures, and equipment instructions, ensuring they follow proper protocols without delay. The data stored behind these QR codes can be securely managed in a cloud-based system, allowing real-time updates and easy accessibility for everyone involved. This eliminates the problems associated with paper documents, such as misplacement or outdated information.

Overall, the adoption of QR codes can transform how construction sites function by improving coordination, reducing errors, and enhancing safety. As the industry advances, integrating QR codes with technologies like augmented reality or AI can unlock even greater potential. By embracing this approach, construction projects can become faster, safer, and more efficient, ultimately benefiting everyone involved, from workers to project managers.

VI. ACKNOWLEDGMENT

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