A Research on Construction Industry - Technologies used for Construction Monitoring

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Abstract

The industrial sector of production and trade concerned with creating, restoring, updating, and maintaining infrastructure is known as the construction industry. Buildings and other constructed infrastructure, including roads, bridges, and other structures, are constructed by the construction industry. These sectors' offers will vary depending on the level of expertise, the emphasis on residential, industrial, and water constructions, etc. The study work from the construction business will briefly focus on construction monitoring utilising several technologies to monitor. This research work will describe construction monitoring, the technologies utilised at the site to monitor, and briefly explain one of the monitoring technologies which is used effectively in construction monitoring, their applications, and upcoming works.

Keywords: Construction Monitoring, IoT, Sensors, Technologies.

1. Introduction

Roads, bridges, buildings, and other built works are all included in the construction sector. They will examine the building suggestions and provide the services in accordance with the agreed-upon pricing and timeline while keeping the client's needs in mind. The business sector will have specialists functioning in various capacities to bring construction to life in order to satisfy consumers. To ensure that the construction job goes successfully, the contractor will come up with a plan that includes all the procedures, labor, and supplies [3].

With a history spanning more than 150 years, Shapoorji Pallonji and Company Limited (SPCL) is the oldest and most recognised construction firm in India. Construction, real estate, and infrastructure development are all part of SPCL's wide portfolio because it is one of the major infrastructure sectors. The SPCL has the most important infrastructure, including the Taj Intercontinental Hotel, Bombay Stock Exchange, and TEC. Tata Projects Limited, Larsen & Toubro Limited, Hindustan Company Construction Limited, Reliance Infrastructure Limited, and others are among the various construction companies [4].

After assessing the needs of the clients, the construction industry will concentrate more on full design-build services. It is aware of every part of new initiatives, planning, and execution necessary to make them successful. This approach will be used for all structures, including buildings, roads, bridges, and other infrastructure. The use of technology in recent years has altered the quantity and distribution of materials used on construction sites. Innovative actions like recycling concrete are made possible by new technology; freshly discovered carbon fiber has a novel strength in a building component [5].

Virtual and augmented worlds are other technologies that have gained attention. Virtual reality serves as an example of how technology is transforming the building industry. To display the construction plan in a way that would satisfy the customer and give them a clear understanding of the building's construction using 2D drawings or 3D models. The construction sector also does self-funded projects like smart buildings, smart roads, and other innovations.
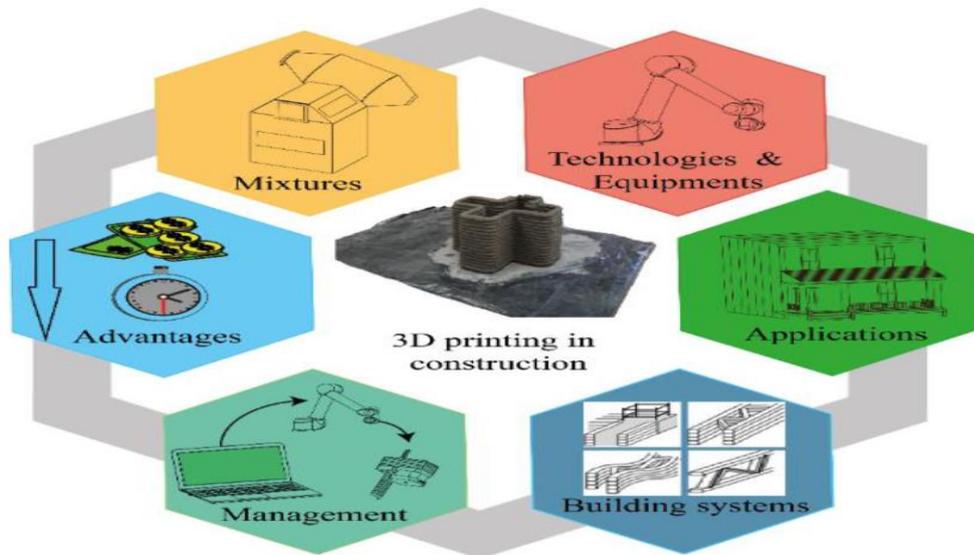

Figure 1. Uses of 3D Printing in Construction [1]

2. Construction Monitoring

Construction monitoring is to identify the problems and mistakes before and during the work in order to prevent the occurrence of errors and non-compliance with the design and technical requirements. Additionally, the expert overseeing the site or construction monitoring team is responsible for coordinating all responsibilities and actions, including those of decision-makers, developers, contractors, and suppliers.

Construction monitoring is a crucial area in the construction industry where the contractors must keep an eye on the equipment, tools, and workers' safety as well as monitor the structure to avoid exceeding budgeted costs and timelines. Therefore, the contractors employ several technologies that may be employed to eliminate the aforementioned dangers and save time and money. All the demands of the client and the contractor will be satisfied by using technology in theconstruction field. Different technologies are applied in every building under development to make them smart buildings. Constructing high-risk structures with the use of automation and robotics technologies will become standard practise in the future.

3. Technologies used in Construction Monitoring

Today, a variety of technologies are employed in the construction industry. The use of technology will facilitate work in a quicker, more efficient manner. The construction industry uses certain technologies that are covered here for construction monitoring reasons. A Few of them are explained below [6]: -

3.1 3D Printing

In 2017, caught the building of two bridges with the use of 3D printing. This was a significant turning point in the tool's development. Many people are now proposing 3D printing as the future technique for building homes. Constructing a new home utilising 3D printing for large-scale tasks. Early limitations imposed by the government and requirements for construction permits were the main obstacles to the sale of homes made with 3D printers. Governments, non-governmental groups, and private companies will all heavily utilise 3D printing in the next few years. Employing cloud-based, mobile technologies by the construction industry might alter the structure of the buildings.

3.2 Site Sensors

To protect the safety and comfort of the workers on the site, contractors may install several sensors all over the construction site to monitor various factors, including noise levels, temperatures, and dust particles. The sensors instantly send out notifications if any personnel are in danger of exposure. These sensors also gather information that constructors may use to check that exposure levels in the construction zone are suitable and in line with local, state, and federal requirements.

3.3 Drones & Robots

On a building site, drones may do a variety of duties. In order to update builders on projects, they often hover over the drones and capture photos or videos of the development. To make sure crews stick to building site regulations, remain efficient, and stay safe, leadership personnel may routinely review recordings made by these drones at a site. Additionally, drones may do potentially hazardous tasks like inspections of bridges or buildings. People who work on construction sites could undergo considerable training on how to operate these drones to record the footage of the location.

3.4 Autonomous Heavy Equipment

These are huge pieces of machinery and equipment that can be utilised on construction sites to finish excavation, grading, and site work. Because autonomous heavy machinery is self-driving, no one needs to control it from the driver's seat. Instead, the equipment is often guided to the building site using GPS, drones, and sensors. For the equipment to follow as it grades and excavates the ground onsite, construction teams create 3D models. These monitoring devices can also be operated by employees using a computer or tablet.

3.5 Predictive Analysis

Predictive analytics use large data sets to create forecasts about the supply and other costs incurred by a construction business. It can examine a company's past expenditures on particular goods and contrast them with the frequency and volume of usage of such products by personnel. This enables the system to calculate the quantity of goods to order for upcoming projects in order to save costs and prevent costly overstocks on certain supplies.

As many teams utilise tools like smart gear and site sensors to be more aware of the environment and to safeguard their bodies from unforeseen trash or other potential damages, there are still a few more technologies employed in the construction industry that make construction sites safer. Numerous software and mobile solutions also make it simpler to connect with coworkers efficiently, which improves cooperation throughout the workplace.
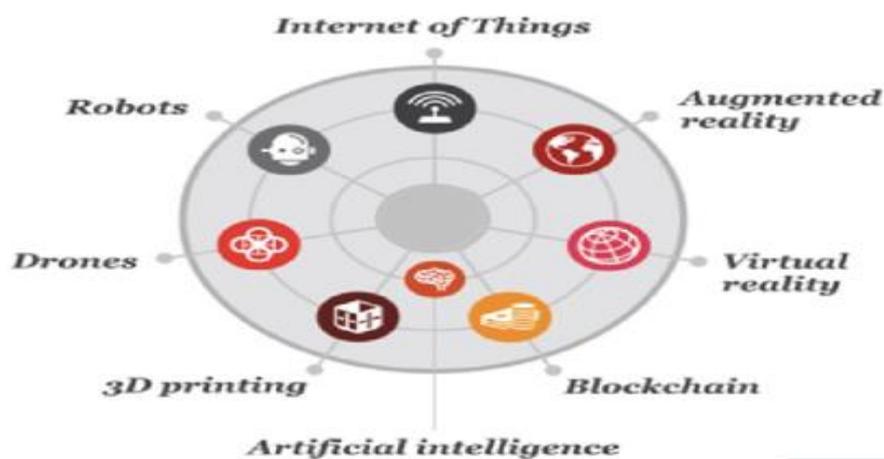

Figure 2. Technologies used in Construction Monitoring [7]

4. IoT Application used in Construction Monitoring

There are several applications for the Internet of Things (IoT). The IoT is widely employed in the construction industry. The builders can keep an eye on the job site and the workers by using a variety of sensors. The use of various sensors on construction sites makes it possible to keep track of the quality of the job, the prices, how the equipment is handled, and the general condition of the workers. Several sensors used on construction sites for monitoring are covered here. Those are:

4.1 GPS Tracking Sensor

In the past, managing a fleet of construction vehicles required an enormous number of papers and phone calls. Fleet managers used to have to manually compute details like fuel consumption, mileage, and more. The responsibilities and position of a fleet manager have evolved significantly with the development of technology. The assigning of drivers to tasks, the tracking of cars, and fleet management in general have all been made easier by GPS tracking technology for construction monitoring [8].

By utilising a GPS tracker with IoTenabled sensors, it may pick the quickest routes, which uses less gasoline and saves us a lot of money and time. By analysing data stored in the GPS tracking system, the contractors obtain information to help them decide how to save money. Utilising information from the GPS system, the distance, fuel usage, speed, and battery health of the automobiles are tracked, which aids in the analysis of the condition of the items that the vehicle is carrying.

4.2 Environmental Sensor

Environmental sensors are used to provide real-time information on the environmental circumstances at the building site. Temperature, humidity, wind speed, and air quality are among the parameters that will be monitored. Environmental sensors make the workplace safer and make sure that construction operations are not negatively affecting the environment. For instance, airborne dust and contaminants can be found using particulate matter sensors [9].

The temperature sensor will forecast the weather at the building site based on the environmental monitoring sensors, including whether it will be sunny, wet, or cloudy. The monitoring crew will receive a warning if it is raining, and they may take precautions as a result. To provide information about the wind speed that impacts the building site or not, a wind speed prediction sensor is utilised. By employing the various environmental monitoring sensors, the contractors may prevent significant time and expense overruns.

4.3 Structural Health Monitoring Sensor

For the purpose of identifying changes in the physical state of buildings, including skyscrapers and bridges, structural monitoring sensors are important. They keep an eye on strains, deformations, and vibrations, giving crucial information for proactive maintenance. For instance, fibre optic sensors provide precise strain measurements, whereas piezoelectric sensors may sense dynamic pressure changes [9].

This sensor is commonly used in high-rise buildings and on bridges. Vibration sensors will be employed as structural monitoring sensors to monitor buildings that are shaking while they are being constructed, and the contractors will also keep an eye on whether the structure is vibrating or not after the work has been completed. Crack sensors are used to track the

development of cracks in buildings and bridges and stop significant time, life and financial losses. The contractors will guarantee public safety by using this sensor.

4.4 Safety Sensors

On construction sites, safety sensors are intended to reduce accidents and injuries. By using sensors like wearable sensors to track workers' health, proximity sensors that warn workers if they are near hazardous areas or equipment, and gas sensors that identify harmful gases, it will protect the workers who are all employed on the construction site.

Wearable sensors will be used to track the employees' heart rates and overall health, alerting them to any potential risks and sending a notification to the contractor for follow-up. Employees are warned if they're near unsafe equipment or places using fall detection sensors. As a result, the employee will avoid the risky circumstance.
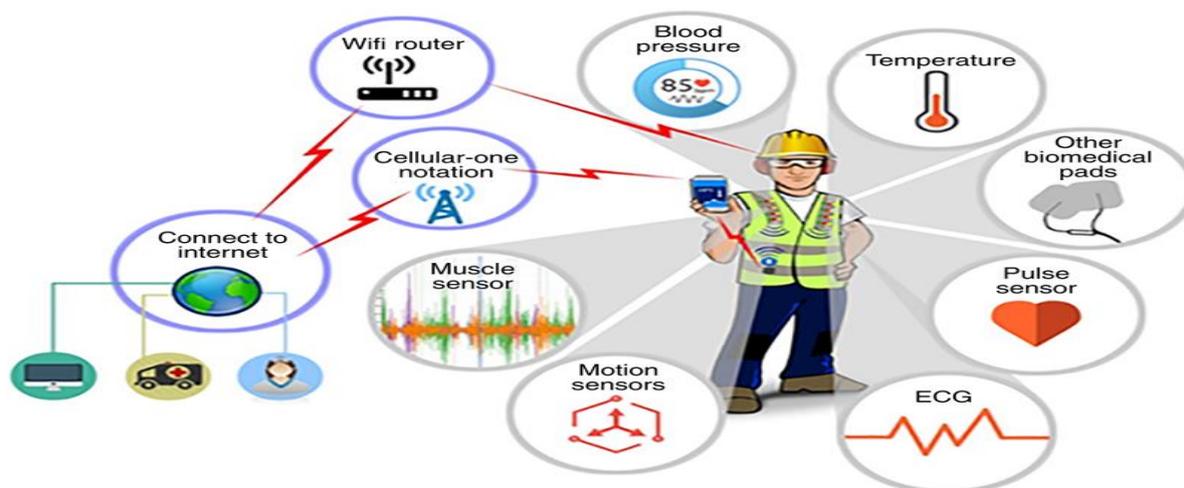

Figure 3. Safety Sensors used for The Construction Site Employees [2]

5. Benefits and Outcomes

The advantages of IoT in construction monitoring, such as increased productivity, improved safety outcomes, optimised resource allocation, and decreased project delays, are explored. It also covers the difficulties that come with putting IoT solutions into practice, such as data security, interoperability, scalability, and the requirement for qualified employees.

In order to prevent significant risks to the building and the employees, several IoT sensors are used in construction site monitoring. Contractors may assess if a building is constructed according to design by employing drones on its roof. The cost and completion time of the building will be shortened, satisfying both the client and the contractors. All of this will result in the creation of smart buildings that are automated and hospitable to the environment.

6. Future Scope

Experts predict that in 2023, construction industries will become more interested in automation technologies like drones, 3D printing, and autonomous cars. Construction companies will be able to speed up work and save costs by using this technology. Also, experts anticipate a big push towards sustainability and green-focused development due to worries about global warming and environmental sustainability. An increase in the use of energy-efficient materials and a general focus on renewable energy sources will emerge from this trend. Construction organisations will have a competitive advantage in the market if they use data analytics to produce insights and enhance decision-making [10].

7. Conclusion

This study shows that there are many technologies used by the construction sector for monitoring construction. Particularly, the sensors are going to be widely utilised on building sites to monitor the on-site activities as well as the jobs, safety, etc. of the employees. The study work provided a brief explanation of the technologies employed in the construction business, in particular the many sensors employed in the construction monitoring field, their advantages, and the potential applications of these technologies in the next few years.

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