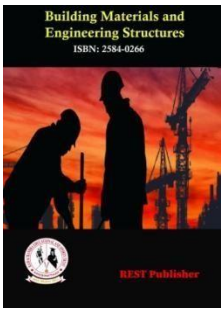
Building Materials and Engineering Structures

Vol: 2(1), March 2024

REST Publisher; ISSN: 2584-0266 (Online)

Website: https://restpublisher.com/journals/bmes/

DOI: https://doi.org/10.46632/bmes/2/1/1



Exploring IoT Integration for Innovative Advancements in Civil Engineering

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Abstract: *Civil engineering developments have allocation with the recent trends of integration with IoT technologies and devices. This technology significantly improves automation and remote monitoring for various tasks in the construction process, building maintenance and safety, allowing operators to remain remote free ever than before. IoT is simply the connection of several devices to the internet as per the need. The real implication of IoT is beyond and complex than this. The IoT is meant to signify the establishment of entire networks of devices which are connected to the internet and with each other. Various sensors and monitors recognize the conditions, communicate them to online network or app, and transmit relevant information to your phone automatically. Internet of Things (IoT) is the technology that transforming construction industries, automate processes, and improves construction area and other relevant fields in civil like Global Positioning System (GPS), Water Resources Management and Water Supply, Smart Construction, Water & Waste Water Treatment, Traffic Management and Control, Waste Management, Concrete Technology, Environmental Impact Assessment & Monitoring and Smart Lighting System. This research paper covers implementation of IoT in all these fields of civil engineering and updating the current scenario. IoT is potentially used to increase the productivity, on-site safety, and operational efficiency. Through the placement of low-power sensors, managers can improve worksite visibility at every stage of a project in real-time, from planning to construction, and even task post-construction. The construction industry is bringing real-time information into processes that are long-standing. Internet of Things (IoT) devices and sensors are collecting job site data in a more affordable, efficient and effective way than can ever previously imagined. This latest technology represents exciting hikes forward in the civil engineering world. Foremost principles among these are integrated in this study for Internet of Things with the world of civil engineering.*

Keywords: *Internet of Things, Smart city, Sensor, Devices, Automation*

I. INTRODUCTION

Internet of thing is very latest subject for research today. It is related and most important topic in computer science engineering and communication engineering. IoT has an important role in civil engineering also. Now a day's Internet of things (IoT) has been in demand in smart construction. Internet of things is based on the sensors and internet technologies. IoT technology can generates intelligent machines that can communicate and taking smart actions based on situations without human help. It can be used in automation in home, traffic control, monitoring and management in railway, smart cities, river monitoring and all kinds of water resources management. There are different types of smart sensors are making for the security purpose. Smart water management that includes monitoring of flow of water, valves management, faults in valves and data analysis from different water meters is only possible with the help of IoT. In conventional method man power required but in case of IoT, it can be possible by automation without any human help. At present government working on smart city projects. We have seen that the application of IoT grow very fast across civil engineering field also, it will make more advanced to the industry. The IoT tools and sensors collect all the real time information required for the execution of work and then report to the system. That system finds the error and communicates the required information to the parties. Real time solution

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also provides in very short duration. Decision makers can realize the situation decides immediately how to control and improve the situations. IoT tools can reduce the paper work in the project because of its automation process we can generates the reports easily. The robotic systems can be used to execution of construction works. In the designing, planning and alignment of new pavement, possible locations and numbers of bridges and tunnels IoT helps with GIS. The major objective of IoT is decision making in selecting an appropriate action for a defected pavement. Flood and tidal forecasting is an important factor in construction activity at the site presents at river bank and marine areas. The integration of IoT technologies and tools improves the automation and remotely monitoring for many works. As we know that the sensors used in IoT tools can also monitor development of any project and as well as it can be monitor consolidation and degradation of soil. Environmental impact assessment can be done by the sensors used in IoT. Advancement of the IoT tools and sensors used in the construction will make positive change to the construction industry. Smart construction increases work productivity, control over the workers and resource allocation. Sensors provides safety working environment at the construction site. Maintenance and operation cost of any project can be reduced by using the IoT tools and sensors (H. Gopi Reddy, V.Kone).

2. SMART CONSTRUCTION

Growing population density in the cities needs the infrastructure and provisions of services to the residents, visitors and workers. Sensors and network supports to the data management and cloud based system. IoT also helps in the noise monitoring in the smart city concept (J. Jin, 2014). Advancement of digital technology and metering system based on IoT tools where various real time devices smartly interconnected to a centralized network for better engineering solution, smart cities can be progress fast (R. Palaniappan). An advanced computerized technique reduces cost and enhances the profit and sustainability. Application of Smart sensor assets in home provides more satisfaction and making effective for the residents (Construction leadership council). In the smart city projects IoT tools may be used for waste management of city, energy management, smart lighting and smart transportation.

Global Positioning System (GPS): Global Positioning system is used in many ways in the construction industry. GPS is a satellite based radio navigator system. It consists of space segment i.e. satellite, the control segment i.e. ground control station and users segment i.e. receiver equipments. It has been broadly used in surveying, photogrammetric surveying, marine surveying and mapping (M. Zhang, T. Cao, 2017). In any project by using GPS can save time and improve the accuracy of surveying. GPS surveying can give a position (latitude, longitude and level) directly, without the need to measure angles and distance between intermediate points. GPS can be used in mapping and measuring various measures on the earth surface and underwater. It is used in determining land boundaries, mapping sea floors. It provides surveying and mapping data with greatest accuracy. GPS based data collection is much faster than the conventional surveying and mapping method. It also reduces the amount and numbers of equipment and labor required.GPS system connected in a vehicle easy in tracking and location of that vehicle. It also helps to drivers to find the location of site where material to be delivering.

Water Resources Management and Water Supply: Water is the vital element for all the living beings, at the other side a huge amount of water being wasted by uncontrolled flooding and exploitation of water resource. Overflowing of water tanks in residential, commercial and institutional buildings causes water wastage. By controlling this we can save large amount of water. Conventional water tanks can neither control nor monitor the water level in the tank. But nowadays we can solve the above problem with automatic water level detection system with the help of Internet of Things. A smart water management system consists of pipes, valves and reservoir in built with sensors that can sense the leakage and quantity of water required to be supply. It reduces the operational cost in conventional water management system (P. Gurnani, 2019). The laser sensor can continuously monitors the water level in real time. Based on this data we can analyze the amount of water. According to the water level in the tank the motor functioning automatically controlled. As the water level goes down the threshold level the motor will be started automatically (J. Joseph, K M Manju 2018). The application of IoT has many advantages to overcome the challenges for sustainable water management (D. Koo, K. Piratla, 2015). Sensors and communication technologies provide useful insights into the sustainable water management approaches. Novel technologies can be connected to that system for forecasting the water cycle and resources, it also helps to understand the connection between quantity of water and land use. Advanced sensing technology reflects the need of water use, its quality and quantity sensing. It is worked on the baseline conditions (T. Robles, R. Alcarria, 2014). Water resources management by using IoT tools can be useful for monitoring, managing and tracing of remotely located meters and valves. Traditionally a person is employed for management of such remote location meters and valves but it can be easy to maintain by IoT tools without any man power. IoT tools can develop a better water management and monitoring system by using internet, datasets and GIS software (S.deshmukh, 2017).

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Water and Waste Water Treatment: The IoT device monitoring the (physical, chemical and biological) properties of different types of water potentially and gives the optimum treatment solution (U.S. Department, 2013). It is also useful for large scale data collection of contaminated water and provides useful insights for deciding limit for the analytical model development for contaminant. Therefore, We can install the IoT tools for monitoring to various water bodies such as river, sea, estuaries, etc (L. Backer & S. Moore,2010). IoT has the potential to develop underground infrastructure monitoring, storm water and wastewater overflow monitoring system through integration of subsurface sensing and wireless underground communication (S. Salam, A. Shah, 2019). This helps to community managers for taking preventive actions on time for control rising water levels. The LiDAR has beneficial to monitor the post treatment quality of the water to ensure it is safe for human health (T. Asano, & J. Cotruvo, 2004). The ground water is present in the soil pores underground. The groundwater remediation process contains the conversion the water pollutants into safe drinking water. There are various techniques are used for groundwater treatment. the nanotechnology is good for remediation of groundwater (A. Dhasmana & S. Uniyal, 2019).

Traffic controlling: As the population growing traffic crowd also increases, it is really unavoidable in a busy schedule. IoT provides a smart solution to solve this problem. Intelligent traffic lights play an important role to control traffic in an appropriate manner (P. Gurnani, 2019). Traffic light has inbuilt sensors and systems. The IoT based traffic light works on the real time situation. The smart traffic lights are collects the real time vehicular data by using sensors and camera that sense speed and traffic volume, as per the collected data system analyze the traffic pattern and traffic lights will respond accordingly (L. Shrivastava, 2004). The smart traffic lights can also be detect with sensor the level of Carbon –dioxide and Nitrous oxide in the atmosphere to monitor the level of pollution at any junction.

Waste Management: Waste management in a metro city is a big problem because of its disposal, dumping and transportation cost, as most of lands in city occupied by buildings (P. Gurnani, 2019). Application of IoT supplies intelligent waste containers, they can sense the load level in the container and before overflow, it will intimate to the controller to take action.

Concrete Technology: In the field of civil engineering automation and robotics system helpful in case of smart construction materials and ready mix concrete plant. It is best for quality control and construction and based on the computer programming. Concrete mix design is very difficult and sensible. It is based on the workability, durability and strength. The concrete strength is calculated by the properties of cement, fine aggregate, coarse aggregate and water cement ratio. The system provided with a sensor can respond according to changes occurs in environment (Jeng and Cha 2003).

Environmental Impact Assessment and Monitoring: Hazardous gases releases from the vehicles and industries are affects the environment badly. Many people residing in such area suffers by respiratory problems due to polluted air. We can install IoT based monitoring system to keep the level of hazardous gases in air. It has suitable methods to determine the quality of air in the public places and in crowded areas (P. Gurnani, 2019). The sensors for monitor air pollution in can be used for indoor and outdoor environments. The most of sensors concentrates on ozone, particulate matter, carbon monoxide and nitrous oxide in the air. The data collected by the sensors are then provided to the main server and at the main server analyzed that data by the various data science methods and machine learning models to interferences by it. These outcomes about the air quality are the accessible to the citizen's mobile app, so they can find the quality of their areas.

Smart Lighting System: Conventional lighting system consumes more energy. The manual lighting system is also very expensive and consumes more energy due to wastage of power. Automation system can overcome this wastage problem and save the power consumption by 30%. Sensor based lights can automatically cut the power during day time or in the presence of natural light. This automation process is based on the sensors and IoT can be provided a better alternative to conventional system (Giroux and Sylvain, 2005).

3. CONCLUSION

Advancement of technology and engineering works introduce the sensor based new techniques "IoT". Above literature review concluded that the application of IoT tools and sensors are very helpful in smart city development. Digitalization of the work makes it easy and efficient than the conventional methods. IoT has been successfully used in smart construction. We can apply IoT sensors and tools in GPS for data collection, water resources management and water supply, treatment of water and waste water, traffic controlling and traffic study, waste management, concrete technology for quality control, monitoring of environment and air quality and in smart lighting systems. IoT based on sensors that collect the data and send it to main web server then based on the real time data decisions

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will be implemented by the server automatically. It is an automation process that gives quickly the optimum solution of any problems based on the real time data. Application of IoT in water management, environmental impact assessment and smart lighting systems makes it best for the sustainable development and construction.

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