

Internet of things (IoT) applications in orthopaedics

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Dear Editor,

The application of internet of things (IoT) is continuously increasing in industries, medical and dentistry to achieve evidence-based outcomes. Now a day this technology is also incorporated in orthopaedics to provide proper information for treatment. IoT uses sensors to improve the quality of treatment. These sensors provide the measurement of bone and fracture information quickly. This technology accurately provides information on blood pressure, bone pain and brain activity. During an injury, it guides patients for proper exercise for fast recovery. It efficiently improves patient satisfaction, efficiency and outcomes.¹

In orthopaedics field, IoT provides advancement in treatment, surgery, information, education, research and development. After orthopaedics surgery, there is effective communication between doctors and patient and with its help, there are better chances of recovery of the patient. It collects the data of exercise and daily routine of the patient and alerts them to follow up the recovery after surgery.² Different software applications are used to capture data from knee and hip replacement of patients. This data is shared easily to the doctors for the recovery of the patient.³

Orthopaedics surgery requires a lot of exercises and physical therapy at home. This technology monitors the patient without any requirement of health professionals. Surgeon and patient care team send message to remind and guides them step by step for better exercise to improve patient outcome. Patient and their family can quickly check recovery progress without any appointment of doctors. During the confusion of the patient, it solves the regarding issues.⁴

The main benefits of this technology are to decrease operational cost and errors during surgery. It appropriately manages all drugs to improve patient outcome through this virtual infrastructure. IoT connects all physical orthopaedics devices with internet to quickly receive or sent information. Through this digital health record system, medical devices can easily send information/data to doctors, surgeon, physicians, lab and associated entities. This innovative technology has an excellent capability to achieve quality results in orthopaedics with lesser involvement of doctors. During surgery, it performs better treatment of complicated cases to create

excellent service. It helps to achieve accuracy, dependency, reliability and proper medication for treatment.⁵

There are different technologies used in IoT, helpful in orthopaedics to provide proper information. These include big data, cloud computing, smart sensors, artificial intelligence, actuators and virtual reality/augmented reality.⁶ The process used in IoT for orthopaedics is shown in Fig. 1.

Different IoT technologies are used to store information in a server, and required related information are collected. This information is the best solutions to check, update and alert about the upcoming diseases, their sources and prevention for proper medication and treatment of the patient. With the help of proper instructions & information, it reduces the errors and detects mistakes during orthopaedics surgery. All history of illness, complain, progress is recorded and accessed in future for better treatment. It continuously monitors the system to provide the proper treatment of a critically ill patient.⁷ The major applications of IoT in orthopaedics are discussed briefly in Table 1.

Presently IoT is used in collaborative training and interaction

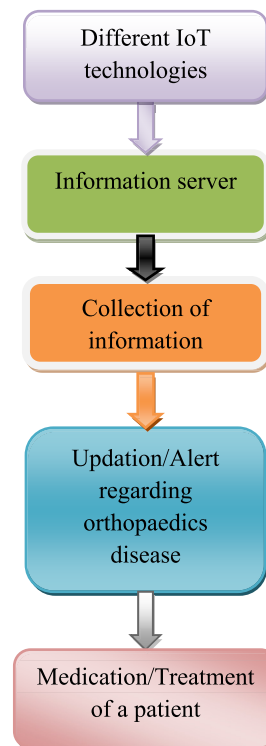


Fig. 1. Process chart of IoT in orthopaedics.

Table 1
Major applications of IoT in orthopaedics.

S No	Applications	Description
1	Information on the fractured bone & deformations	<ul style="list-style-type: none"> • IoT provides information regarding fracture bone using different sensing devices and visualization panel. • Provide proper information on bone pain, blood pressure and exercise
2	Health monitoring and report generation	<ul style="list-style-type: none"> • With the help of different sensors used in IoT, the information regarding the health status is provided to monitors all related activities and stored in servers for easy fetch • IoT creates a high impact on orthopaedics to meets personalized information solution in daily life
3	Improved communication	<ul style="list-style-type: none"> • This effective way of information provide better communication between doctors and patient • It collects data of routine exercise of the patient for better recovery after surgery • Also, alert to follow up the doctors and patient for certainly required precaution
4	Secure Digital storage of patient's data	<ul style="list-style-type: none"> • All information, clinical records are stored digitally and further used for data analytics and stored in secure servers • In emergency cases, digitally patient stored data can be share to make doctor job easy
5	Track orthopaedics devices	<ul style="list-style-type: none"> • Orthopaedics tools, devices and instruments are easily tracked to make the operation faster and successful with a head unit • It allows conducting virtual consultation of doctors to save time
6	Check and control all parameters	<ul style="list-style-type: none"> • It checks and controls the heat of the body for better treatment of the patient • Technology creates a smart hospital by which information is displayed accurately to reduce the waiting time of the patient
7	Knee replacement	<ul style="list-style-type: none"> • This technology is helpful in total knee replacement and guides for necessary exercise after performing surgery and can command for the 3D scan of the bone which even can be 3D printed • Sensors are helpful to speedy recovery as a result significantly improved patient outcomes
8	Reduce accident chances	<ul style="list-style-type: none"> • With the help of this proper validate information; it helps to reduce accident chances in the hospital and also establish security protocols • This technology helps decrease orthopaedics surgery time, cost and readmission rate
9	Provide accurate information regarding the motion of bones	<ul style="list-style-type: none"> • IoT use different types of applications to provide motion and related information of the bones • It provides daily progress of patients to the physiotherapists

among orthopaedics surgeon. It created a significant impact on medical education and clinical outcomes. IoT support to collects all information regarding orthopaedics surgery, which helps doctors to make surgery successful. It emphasized an expert surgeon to understand the target the surgical processes. By the implementation of this technology, there was a significant improvement in education, training, and performing orthopaedics surgery.¹

In future, this technology will support the management of all orthopaedics tools, instruments, implants and devices for proper and efficient working. It seems a better solution to analyze data, information and related activities of the patient. In future, it enables to take action during occurring of any error. IoT will help aware doctors the cause of the disease with the help of data stored digitally. It is the best technique to reduce waiting time and hospital stay time to make the patient comfortable.⁸ Contemporarily IoT is used in diverse applications like imaging, lab tests, drug delivery, clinical operations and medication management.

In orthopaedics, IoT is supposed to bring significant changes in facilities and information system. It opens a new application in proper management in hospitals. Especially during climate change, it alerts about public health and provides practical information for the future. IoT is helpful for different other purposes like fitness, health check-up, emergency, proper care, blood pressure and measurement system. It accurately monitors the doctor for the speedy recovery of the patient by providing a well-informed decision. Paperwork like admission form of the patient and other activities gets reduced by using this digital technology. Surgeon job becomes easy to perform complicated cases precisely. In future, the proper application of IoT will open a new door of innovation to provide a better solution in orthopaedics.

Conflicts of interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jcot.2019.07.003>.

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Abid Haleem

Department of Mechanical Engineering, Jamia Millia Islamia, New Delhi, India

E-mail address: ahaleem@jmi.ac.in.

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Mohd Javaid*

Department of Mechanical Engineering, Jamia Millia Islamia, New Delhi, India

Ibrahim Haleem Khan

College of Engineering, Northeastern University, USA

E-mail address: haleemkhan.i@northeastern.edu.

* Corresponding author.

E-mail address: mjavaid@jmi.ac.in (M. Javaid).

<https://scholar.google.co.in/citations?user=rifywvvsAAAAJ&hl=en> (M. Javaid)

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