# IOT

*by* Abc Com

**Submission date:** 04-Apr-2023 08:31PM (UTC+0530)
**Submission ID:** 2055692088
**File name:** Industry_4.0_paper.docx (198.21K)
**Word count:** 3987
**Character count:** 21928

# An Illustration Of The Use Of Internet Of Things Technology In Stadiums

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## Abstract

The "Internet of Things" has emerged as a technology that is playing a significant part in our daily lives as a result of the new era's rapid economic growth and continual advancements in social science and technology. This is due to the "Internet of Things" technology's growing significance in our day-to-day lives. The use of technology based on the Internet of Things has the potential to significantly contribute to the intelligent processing of sports, as has been demonstrated via study of relevant literature and field research. This article provides a summary of how the Internet of Things (IoT) can be used in athletic venues, with an emphasis on both the advantages and disadvantages of such an application. In conclusion, the main areas of sports venues where technology based on the Internet of Things may be used to create intelligent sports venues are the competition area, spectator area, and backstage area. Some examples of these applications include the management of fitness centre equipment, intelligent temperature and humidity control, and intelligent security system management. It is advised that the national government and pertinent agencies raise their expenditures on research and technology, encourage the general use of IoT, and aid in the ongoing growth of intellectual and scientific sports.

*Keywords: Internet of Things, intelligent security system, economic, humidity management system.*

## 1. Introduction

The phrase "Internet of Things" (IoT) describes a collection of real-time physical items that must be tracked, connected, interacted with, and controlled using a variety of information sensors, radio frequency identification technology, global positioning system, infrared sensors, laser scanners, and other tools and processes that gather the necessary data from physical phenomena like sound, light, heat, electricity, mechanics, chemistry, and biology. Via a variety of potential network accesses, the ubiquitous link between objects and objects, as well as between objects and people, can be realised. A significant amount of labour investment can be saved by the intelligent perception, identification, control, and administration of objects and processes, which is consistent with the development trend of the current intelligent era. The Internet of Things (IoT) includes technology that enable applications including pervasive computing, cloud computing, knowledge discovery, and intelligent control. Transport layer technologies, such as RFID, sensor networks, and barcode technologies, are used**.** Device perception technologies include M2M communication networks, the Internet, local area networks, and wireless networks. technology based on layers [9]. The establishment of sports venues as professional locations for the training of athletes, the staging of sporting events, and the performance of physical exercises is an essential component in the growth of sports. In recent years, extensive research on the technology and intelligence of the Internet of Things, along with the rapid development of information technology, has greatly promoted the intelligentization process of sports venues, which has led to a significant increase in the number of intelligent sports venues. It is primarily reflected in the intelligent research of stadium safety, temperature and humidity, lighting, monitoring, ticketing system, and management of stadium equipment [10].

## 2. Intelligent Stadium Development

Based on modern building technology, modern communication technology for the Internet of Things, and modern remote monitoring and control technology, intelligent stadiums are designed with three primary modules that are

built in during the construction process. The primary structure is depicted in Fig. 1. In order to ensure that the stadium management can continue to function normally, it is necessary for the intelligent stadium system to have management functions that are in line with the actual application. This technology must be based on the modern Internet of Things. The intelligent application of sports knowledge.

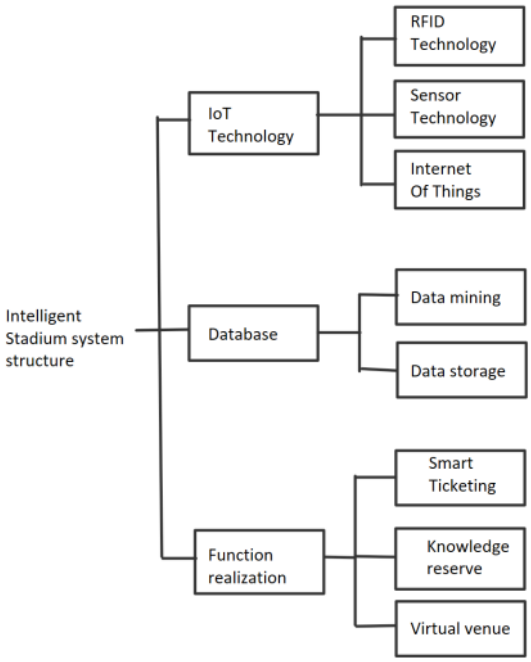


**Fig. 1** Structure of the overall system

Users are able to obtain game information on the network terminal thanks to the intelligent ticketing function, which also enables them to schedule their own time using the ticketing query function. In order to identify electronic bills and further strengthen the data protection provided by the system, the intelligent ticketing system makes use of both barcodes and RFID technology [2]. The RFID card readers and barcode scanners that are used in the ticket inspection service of the system are the primary tools that are utilised to recognise electronic ticketing information and intelligently manage stadium security.

Users will be able to gain access to stadium information and log in to the system through smart terminal devices if the virtual stadium management function makes use of the technology that is available through the Internet of This [3]. The function of the system known as virtual stadium management also keeps an eye on the information related to the smart stadiums' security.

The intelligent sports knowledge reserve system stores a significant amount of information pertaining to sports, including but not limited to physical education, information regarding athletes who participate in sports, experience training for sports, and other data. The system allows users to inquire about demand using the system Fig. 2. Because the system makes use of Internet of Things technology, it is able to connect a large number of devices within the stadium. This enables the system to perform identification, positioning, tracking, monitoring, and management functions. Additionally, it enables the system to facilitate the exchange of sporting information within the system.

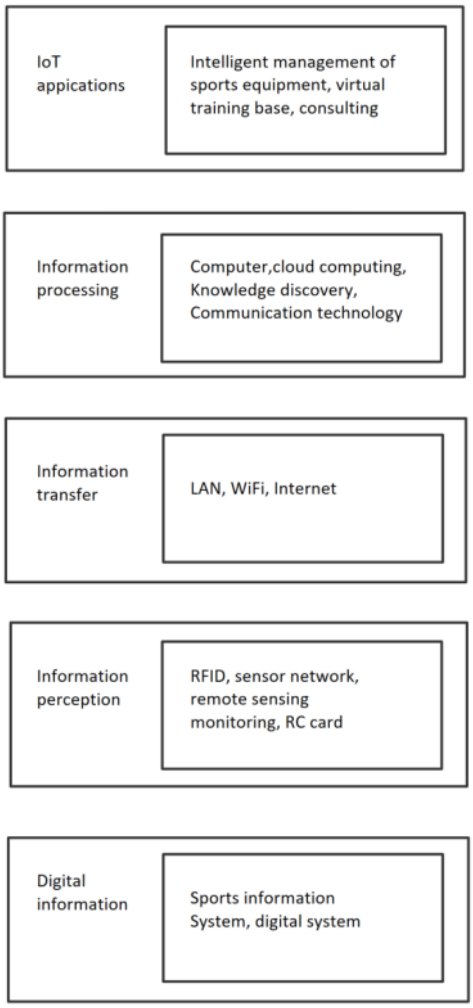


**Fig. 2**. IoT architecture system

## 3 Integrating IoT into a state-of-the-art stadium management system

The fields of science and technology have made consistent strides forward, which has led to an increase in the significance of Internet of Things (IoT) applications in the world of competitive sports. Such as the Gold Center No. 1 Arena, which is the first truly intelligent stadium to be built in the 21st century and is also the home of the NBA Sacramento Kings. accelerated the development of the sports business sector as well as the economy that is associated with it. It is abundantly clear that the technology behind the Internet of Things has a constructive influence on the expansion of both regional and societal life, just as it does on the growth of sports intelligence. Taking advantage of the inherent properties of the network is the most important step in developing a smart stadium for use with the Internet of Things. The characteristics of the Internet of Things can be broken down into three main tiers: processing, networking, and perception. These are the main tiers that make up the Internet of Things. Increasing your perceptual level means you will have a greater capacity to recognise new configurations. After the adjustments have been made, the data that was gathered from the sensors that were placed in each location is uploaded to the cloud over the internet. After being processed, analysed, and acted upon, the instructions for each IoT device are downloaded from the cloud and delivered to their respective devices. The cloud serves as the medium through which the terminals that make up the Internet of Things can communicate with one another. The commands are carried out at the appropriate times in order to optimise the venue from the inside [11]. The placement of Internet of Things terminals in stadiums typically focuses on the individuals who are actually competing in the sports or competitions. This is done with the intention of making sports

and competitions more accessible, safer, and more intelligent for spectators. Participation in sporting events can be broken down into two categories: spectators and actual players. The majority of spectators at sporting events congregate in a particular section of the venue, whereas the vast majority of athletes choose to train in a separate facility. This indicates that the primary focus of our Internet of Things infrastructure for smart stadiums should be placed on the stadium's main sports venue as well as its spectator seating areas. Every sensor in the Internet of Things stadium instantly transmits the data it collects to a cloud server located outside the stadium. The smart stadium cloud on the Internet of Things performs optimization analysis in order to make adjustments that are in line with the problems that are currently occurring within the stadium.

## 4. Integrating IoT into a state-of-the-art stadium management system

In the arena, where the competitions take place, an intelligent system that is connected to the Internet of Things (IoT) is utilised in a manner that is distinct from how it is utilised in the stands, where people watch the competitions. This is most obvious in the realms of competition and sports equipment and venues, where they are used to ensure a level playing field and consistent penalties. To give you an example, technology known as Virtual Assistant Referee (VAR) was utilised at the 2018 FIFA World Cup in Russia. With the help of dynamic scanners, this technology is able to determine with high accuracy whether or not a player is flopping. While wearing the helmet, the official has easier access to the heads-up display (HUD). You need to improve the accuracy of your evaluations. Even though it is very small and lightweight, the addition of an NFC tag to a football will not affect the football or the game itself when combined with the football; however, it does play a very important role, even in the typical offside problem that occurs in football. a significant effect On the field, there are a number of intelligent scanning devices that can scan the location of the football quickly and precisely. This helps the referee make the right call in the split second that it takes for the ball to suddenly leave the playing area or enter the goal. It is beneficial for all parties involved, and it maintains the integrity of the game for the audience. In the past, spectators who were not physically present at the games had to rely on television broadcasts or live camera captures to experience the action. Because of the ball's incredible speed and the fixed position of the camera, some spectacular balls would reduce the enjoyment that the audience had to experience. The Internet of Things technology, which enables viewers to see the route the football is taking in real time, helps to foster a good, fair, and healthy sports environment, which allays the concerns of fans about the game's fairness and fosters a good, fair, and healthy sports environment. has, in a positive way, influenced the expansion of sporting events in a favourable way.

Integration with the internet of things may also be beneficial to older field technologies. Traditional eagle-eye technology, for example, is captured by a high-speed camera for precise scanning and is used for out-of-bounds identification in small-sized and fast-paced ball games such as badminton and tennis. The referees are only allowed to use Hawkeye for a limited amount of time because reviewing high-speed footage is time-consuming and can cause disruptions to the flow of the game. Additionally, because most judgement calls are still made by eye, there is still room for error in terms of judging what happened. Fortunately, this problem can be easily remedied by utilising technology that is connected to the Internet of Things. You can get immediate feedback after a play that went out of bounds if you first attach an NFC chip to the ball and then position a receiver at the boundary of the playing field. It not only helps reduce the number of errors in judgement, but it also speeds up the process, makes the game more enjoyable for spectators, and contributes to the overall efficiency of the operation.

## 5. Internet of Things technology implemented in stadium seating areas

Currently, sporting events have to be held in locations that are equipped with a sizable LED screen and the capability to connect to a wireless network. The application of Internet of Things (IoT) technology in sports will, to some extent, encourage the widespread use of Internet of Things sensors, as well as the development of comprehensive intelligence in sports venues over the course of time. Improving the experience that spectators have while watching a game is the primary objective of Internet of Things (IoT) smart stadiums that are installed in the audience section. This not only enhances the experience for the audience, but it also reduces the amount of money spent and the amount of energy used. The application of Internet of Things technology in the audience area is comprised of four primary components: a security system, a temperature and humidity system, a lighting system, and a ticketing system [12].

## 6. Intelligent Security System for Internet of Things

No matter where you are, protecting both yourself and your belongings should be your top priority. In places with a lot of people and a lot of moving parts, like sports venues, you absolutely need an all-encompassing security system. A thorough security monitoring system can offer "three defences" in one, which are the prevention of fires, thefts, and natural disasters respectively. The traditional sensing device for safety management systems can only be used to alert the operator, at which point the operator takes protective action. However, due to the rapid occurrence of a large number of unexpected dangers in a relatively short amount of time, the traditional security system is unable to effectively ensure the personnel's safety within the venue. After the intelligent security system of the Internet of Things has been put into place, the effectiveness with which crises are managed will see a significant boost. When a corresponding security sensing device detects a threat, it immediately sends the information to the cloud. The cloud then immediately analyses and processes the problem, after which it issues commands to the corresponding devices. Finally, each corresponding security device executes the commands that are issued by the cloud. The total running time of these episodes is approximately 23 seconds or less. And as a result of real-time monitoring of each device connected to the Internet of Things, re-analysis, reprocessing, and re-execution can be carried out at any time in order to respond to changes, thereby reducing the risk of injury to venue personnel and financial loss.

## 7. Intelligent temperature and humidity management system for the Internet of Things

The size of the stadium, along with a number of other factors, may cause the temperature and humidity levels in each section to be uneven. The Internet of Things intelligent temperature and humidity management system has the capability of installing corresponding temperature and humidity data collection devices in multiple locations, then transmitting the collected data to the temperature and humidity system devices in the corresponding locations, and finally controlling the temperature and humidity of the entire venue through the cooperation of the devices in each location. Stable, as well as capable of regulating the temperature and humidity levels in a particular location For instance, if the temperature and humidity sensing end detects that the ambient temperature in a particular area is higher than 30 degrees Fahrenheit and that the humidity is higher than 50%, the system will issue instructions to automatically start the functions of cooling and dehumidification in order to bring the temperature and humidity back to normal levels. This is done so that the temperature and humidity can be maintained at a level that is comfortable for the occupants of the area. When the ambient temperature and humidity are lower than the set normal threshold, the reason is the same. The aim is to keep the temperature and humidity level in the gymnasium at a constant level while also providing a comfortable and appropriate environment for working out [13]. In a large-scale sporting venue, the central air conditioning system and other pieces of equipment can be repurposed as execution unit equipment. It is not the conventional temperature and humidity system, which can only function autonomously in a limited space or in a single central location. This guarantees a good time for the audience while simultaneously lowering the amount of energy used.

## 8. Intelligent Lighting Management System for the Internet of Things

The conventional lighting system found in sports venues is typically controlled by a master switch. After the power is turned back on at the venue, the lights are typically all or nearly all turned back on as well. As a consequence of this, lights are sometimes turned on in areas that are vacant, which results in a significant amount of wasted energy. It's possible that the lamps will need to be crammed into a confined space when there are competitions on a large scale. Using the IoT intelligent lighting system, the number of personnel as well as their location can be monitored, and the lights themselves can be dimmed, turned off, or concentrated according to the requirements of the situation. Not only does it make it easier to light the stadium, but it also prevents the waste of energy inside the stadium and puts the country's initiative to save energy into action.

## 9. Smart IoT Ticketing System

Within the framework of the conventional ticketing system, fraud can occur. Even electronic tickets can be stolen by unauthorised individuals, and the process of checking tickets requires a large number of staff members, which leads to inefficient use of the venue's resources. The Internet of Things smart ticketing system incorporates NFC chips into the tickets, making each one completely unique and eliminating the need for human attendants. To get into the venue, you won't need a ticket because you'll be able to get in by going through the chip sensing device instead. It is

very similar to the turnstiles that are found in train stations and subway stations. Since the NFC function is now supported by a large number of mobile phones, you can enter the ticket information into your phone and then use your phone to enter the venue. It is practical, in addition to being safe.

## 10. The utilization of Internet of Things technology in stadium equipment and equipment management

With Internet of Things technology, real-time management of sports equipment is possible. This enables sports venues to automatically control sports equipment, real-time monitoring of storage and delivery of sports equipment, and recording of the application of equipment and equipment. In addition, uploading and sharing the records of sporting goods can help improve the effectiveness of their applications [14]. While this is happening, the utilisation of Internet of Things technology enables real-time tracking of equipment and the dynamics of equipment within the venue, in addition to the recording of damage and warranty information. The management of sporting goods has gone from being done manually to being done automatically thanks to technological advancements made possible by the Internet of Things [15]. The particular method of operation is as follows: First, affix NFC tags to the sporting goods and other equipment; then, use technology that is connected to the Internet of Things to scan the tags; finally, upload the scanned data to the cloud for real-time management and tracking. Information regarding storing, applying, and repairing the product is included on the label. The cloud will leave its mark on the apparatus after it has been utilised in a competition or a training session. After it has been used, the electronic label can be repurposed for future applications, and the Internet of Things project can be applied to change the label's name. The label may also be useful for other types of equipment and management of equipment. In addition, positioning tags can be installed on some expensive equipment and equipment, and in the IoT system, special settings can be made for the mobile area. In the event that either the equipment or the equipment leaves the restricted area, the system will immediately sound an alarm and begin monitoring it. It is important to perform positioning and moving routes for recording and feedback in order to guarantee that equipment can be retrieved on time [16]. Make certain that the premises of sporting events are secure.

## 10. Conclusion

Support from IoT technology is crucial to the continued growth and development of sports in the modern era. Technology like this is crucial to the evolution of modern sports because it encourages a more scientific and intelligent approach to designing and operating sporting facilities. The growth of sports naturally aids the growth of science and technology; in fact, the two fields are symbiotically intertwined and mutually beneficial. First, the use of IoT technology in the stadium's competition area; second, the use of IoT technology in the stadium's audience area, including Networking technology in intelligent security system, intelligent temperature and humidity management system, intelligent lighting management system, and intelligent audio management system; and third, the use of IoT technology in the stadium's infrastructure. The integration of Internet of Things technology and athletics will become more seamless as science and technology continue to advance, leading to a higher standard of sports intelligence in the United States.

## 10. Recommendations

The following recommendations are made in an effort to encourage the natural combination of Internet of Things technology and athletics, both of which blend and develop together: The national government is increasing its investment in science and technology, promoting the comprehensive construction of Internet of Things technology, and making it more widely covered and penetrated into the field of sports. Additionally, the government is intensifying its management of social sports public services to ensure the steady development of sports in order to realise the organic combination with Internet of Things. This is all being done in order to promote the intelligent and scientific development of sports in this new era.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7