**IJIRAE::**International Journal of Innovative Research in Advanced Engineering ISSN:2349-2163
Volume 13, Issue 03, March 2026 https://www.ijirae.com/archives
https://doi.org/10.26562/ijirae.2026.v1303.29

# IoT-Based Digital Scoreboard Monitoring System

**V.Nanthakumar**
Assistant Professor, Department of Electrical and Electronics Engineering
Sengunthar Engineering College (Autonomous), Tiruchengode, India
vnanthakumar.eee@scteng.co.in
https://orcid.org/0009-0008-1516-5058
**Rajkumar R, Vinnarasan S, Vigneswaran J**
UG Students, Department of Electrical and Electronics Engineering
Sengunthar Engineering College (Autonomous), Tiruchengode, India
rajkumar805680@gmail.com,vinsiva05@gmail.com, jvigneshwaran402@gmail.com

**Publication History**
Manuscript Reference No: IJIRAE/RS/Vol.13/Issue03/AEMR26.MRAE10108
Research Article | Open Access | Double-Blind Peer-Reviewed |Article ID:IJIRAE/RS/Vol.13/Issue03/AEMR26.MRAE10108
Received:22,February 2026, Revised: 01, March 2026, Accepted: 16,March 2026,Published Online: 25, March 2026.
https://www.ijirae.com/volumes/Vol13/iss-03/28.AEMR26.MRAE10108.pdf
**ArticleCitation:Nanthakumar,Rajkumar,Vinnarasan,Vigneswaran(2026)**,IoT-BasedDigital Scoreboard Monitoring System, IJIRAE: International Journal of Innovative Research in Advanced Engineering, Volume 13, Issue 03 of 2026 pages 239-243 **Doi:>** https://doi.org/10.26562/ijirae.2026.v1303.29
**BibTeX Key: Nanthakumar@2026IoT-Based**
IJIRAE papers should be cited as IJIRAE (International Journal of Innovative Research in Advanced Engineering, AM Publications, India 2025, ISSN 2349-2163, https://doi.org/10.26562/ijirae.2026.v1303.29 The journal's official abbreviation is IJIRAE. Orcid: https://orcid.org/0009-0004-9398-7488


**Abstract:** The increasing demand for automation and real-time data accessibility in sports management has led to the development of intelligent scoreboard systems. Traditional manual scoreboards are time-consuming, prone to human errors, and lack remote accessibility. This paper presents an IoT-Based Digital Scoreboard Monitoring System designed to provide real-time, accurate, and remotely accessible score updates. The system utilizes a Wi-Fi-enabled ESP32 microcontroller integrated with cloud-based communication using MQTT protocols. Authorized users can update scores through a web or mobile interface, and the data is instantly transmitted to a digital display using LED matrix modules driven by MAX7219 driver ICs. The proposed system ensures low-latency communication, secure data handling, and efficient synchronization across connected devices. Experimental results demonstrate improved operational efficiency, reduced update delay, and enhanced user convenience compared to conventional systems. This solution is cost-effective, scalable, and suitable for educational institutions, tournaments, and sports environments.
**Keywords:** IoT, Digital Scoreboard, ESP32, MQTT Protocol, Cloud Computing, Real-Time Monitoring, LED Matrix Display, Wireless Communication

## INTRODUCTION

In recent years, the rapid advancement of Internet of Things (IoT) technology has enabled the transformation of traditional systems into intelligent, automated, and connected solutions. In the field of sports management, conventional scoreboards are still widely used, which rely on manual operations. These systems are often inefficient, time-consuming, and prone to human errors, while also lacking real-time accessibility for remote users. The need for an efficient and reliable score monitoring system has increased significantly, especially in schools, colleges, and sports tournaments. Traditional methods do not provide synchronization between the score input and display systems, resulting in delays and inconsistencies. Furthermore, the absence of remote monitoring capabilities limits audience engagement and transparency. To overcome these limitations, this paper proposes an IoT-Based Digital Scoreboard Monitoring System that enables real-time score updates through wireless communication. The system integrates a Wi-Fi-enabled microcontroller with cloud-based communication protocols such as MQTT, allowing seamless data transmission between users and the display unit. Authorized users can update scores using a web or mobile interface, and the updated information is instantly reflected on the digital scoreboard. By leveraging IoT technology, the proposed system enhances operational efficiency, accuracy, and accessibility. It provides a scalable and cost-effective solution suitable for various sports environments, ensuring improved user experience and real-time visibility of match scores.

## EXISTING SYSTEM

Existing scoreboard systems are primarily based on manual or semi-automated approaches for updating and displaying scores during sports events. In traditional systems, score updates are performed by an operator using physical switches, buttons, or mechanical boards. These methods are highly dependent on human intervention, making them slow, error-prone, and inefficient. In recent developments, some digital scoreboards have incorporated embedded systems and short-range wireless communication technologies such as Bluetooth and RF modules. These systems allow limited automation and reduce manual effort to some extent. However, they still suffer from significant drawbacks, including restricted communication range, lack of real-time remote access, and dependency on a single control unit. Most existing systems do not utilize cloud-based communication, which limits their ability to synchronize data across multiple devices or provide live updates to remote users.

Additionally, these systems lack proper authentication mechanisms, making them vulnerable to unauthorized access and data manipulation. The absence of centralized data storage also prevents the maintenance of score history and performance analysis.

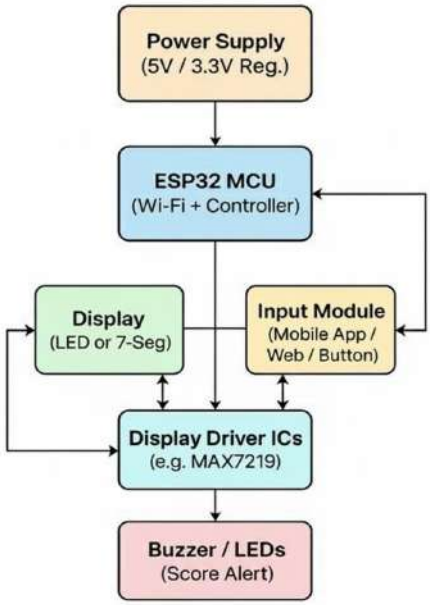


**Figure1 -** Block diagram for Existing system

## PROBLEM IDENTIFICATION

The major challenge in existing scoreboard systems is the heavy dependence on manual operation, which leads to delays, inaccuracies, and inefficient score management. In traditional systems, the score must be updated by an operator physically present near the scoreboard, increasing the chances of human error and miscommunication during fast-paced sports events. Another significant issue is the lack of real-time remote accessibility. Existing systems do not provide live score updates to users who are not physically present at the venue. This limits audience engagement and prevents coaches, organizers, and spectators from monitoring match progress remotely. Short-range wireless technologies such as Bluetooth and RF modules have been introduced in some systems to reduce manual effort. However, these solutions suffer from limited communication range, lack of scalability, and unreliable data transmission. They are also restricted to single-user control and do not support multi-device synchronization. Security is also a major concern, as most existing systems do not implement authentication or access control mechanisms. This makes them vulnerable to unauthorized access and data manipulation. Additionally, there is no provision for centralized data storage, which prevents maintaining score history and performing performance analysis. Furthermore, existing systems lack flexibility and adaptability, as they are often designed for specific sports and require hardware modifications for different applications. These limitations highlight the need for a modern, IoT-based scoreboard system that provides real-time, secure, and scalable score management.

## PROPOSED SYSTEM

The proposed system introduces an advanced IoT-Based Digital Scoreboard Monitoring System designed to provide real-time, accurate, and remotely accessible score updates during sports events. The system eliminates the limitations of traditional manual and semi-automated scoreboards by integrating wireless communication, cloud connectivity, and embedded control. The system utilizes an ESP32 microcontroller equipped with built-in Wi-Fi capability, which acts as the central processing and communication unit. Score updates are performed through a secure web or mobile interface by authorized users. The updated data is transmitted to the cloud platform using MQTT protocol, ensuring low-latency and reliable communication. The architecture of the proposed system consists of four major components: the input interface, cloud communication layer, processing unit, and display system. The input interface allows users to update scores remotely, while the cloud platform manages data transmission and synchronization. The ESP32 receives real-time data from the cloud and processes it to control the display output. The display system is implemented using LED matrix modules driven by MAX7219 display driver ICs, which provide efficient multiplexing, brightness control, and clear visualization. Additionally, a buzzer is integrated to provide audio alerts for score updates or important events. The proposed system ensures secure access through authentication mechanisms, supports multi-user operation, and enables real-time synchronization across multiple devices. It also provides scalability, allowing the system to be adapted for different sports without hardware modification. In addition to visual output, the system incorporates a buzzer module to provide audible alerts during score updates or key events. The system also supports data logging functionality, enabling storage of match history and performance analysis for future reference. Security and scalability are key features of the proposed system. Authentication mechanisms ensure that only authorized users can modify scores, while cloud-based architecture enables multi-user access and real-time synchronization across multiple display units and remote devices.

The system is highly flexible and can be adapted to different sports applications without requiring hardware modifications. Overall, the proposed system offers a cost-effective, reliable, and efficient solution for modern sports score management, improving accuracy, accessibility, and user experience.

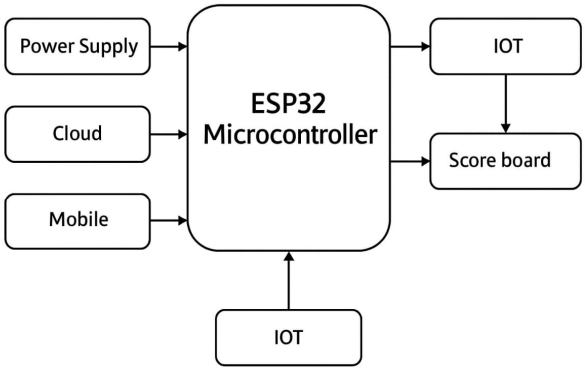


**Figure 2-** Block diagram for proposed system

## SIMULATION AND RESULT

Simulation plays a crucial role in validating the performance and functionality of the proposed IoT-Based Digital Scoreboard Monitoring System before hardware implementation. In this project, simulation is carried out using tools such as Proteus Design Suite to model the system components, including the ESP32 microcontroller, MAX7219 display driver IC, LED matrix display, and power supply unit. The virtual environment replicates real-time operation, allowing verification of circuit connections, data flow, and communication between modules. Input signals representing score updates are processed by the microcontroller and transmitted to the display driver, which controls the LED matrix output through efficient multiplexing. The simulation results demonstrate that the system successfully performs real-time score updates with high accuracy and minimal delay. The LED matrix display produces stable and clear output without flickering, and communication between components remains reliable under different conditions. The system shows efficient performance in handling continuous data updates, ensuring proper synchronization between input and display. Overall, the simulation validates the proposed system as a reliable, low-latency, and efficient solution suitable for real-world sports score monitoring applications.

## SIMULINK

Proteus Design Suite is a widely used simulation and design software developed by Labcenter Electronics for electronic circuit design, microcontroller simulation, and PCB development. It provides a comprehensive virtual environment that enables engineers, students, and researchers to design, test, and validate electronic systems before implementing them in real hardware. Proteus supports a wide range of microcontrollers such as Arduino, PIC, AVR, ARM, 8051, and ESP32, making it highly suitable for embedded systems and IoT-based applications. In this project, Proteus is utilized to simulate the interaction between the ESP32 microcontroller, MAX7219 display driver IC, LED matrix display, and supporting components, ensuring proper system functionality and connectivity.

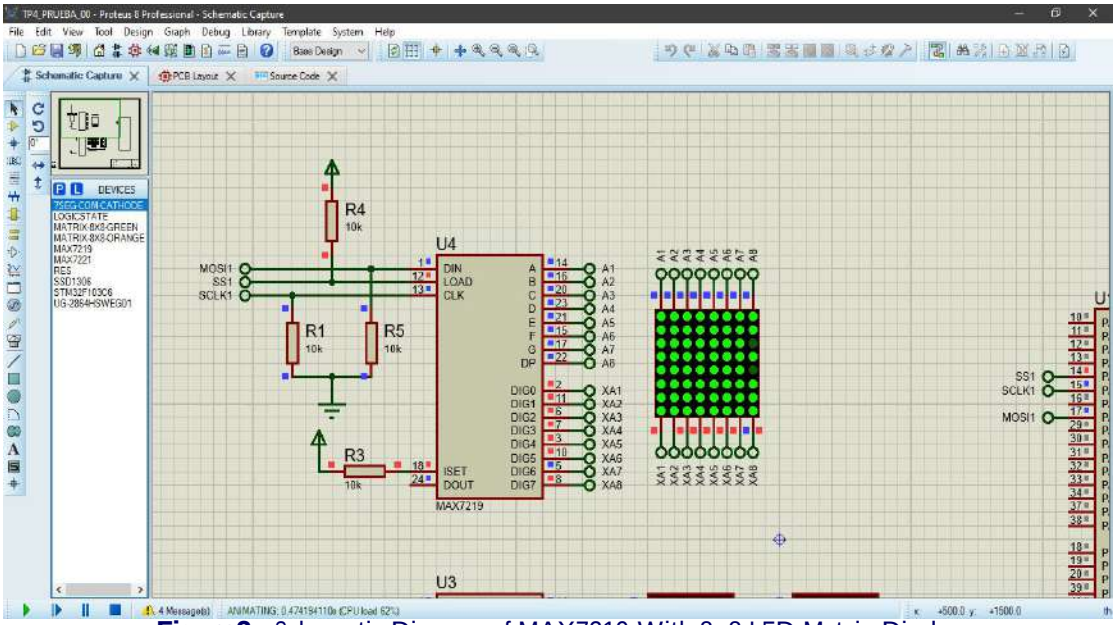


**Figure3 -** Schematic Diagram of MAX7219 With 8×8 LED Matrix Display

The software integrates schematic capture, real-time circuit simulation, and PCB layout into a single platform, allowing users to analyze the dynamic behavior of electronic components under different operating conditions. It enables simultaneous simulation of hardware and embedded firmware, which helps in identifying design errors, communication delays, and synchronization issues at an early stage. Proteus also provides virtual instruments such as oscilloscopes, logic analyzers, and signal generators, which are used to monitor signal flow, verify data transmission, and evaluate system performance. The simulation results confirm that the proposed system operates with high accuracy, stable communication, and efficient real-time response, thereby reducing development cost and improving overall system reliability. The schematic diagram of the MAX7219 with an 8×8 LED matrix display illustrates the interfacing between the microcontroller, the MAX7219 display driver IC, and the LED matrix module. The MAX7219 acts as an intermediary device that simplifies the control of the LED matrix by utilizing only three communication lines—DIN (Data Input), CLK (Clock), and LOAD/CS (Chip Select)—from the microcontroller. These lines are used to transmit serial data, which is decoded and stored in the internal registers of the MAX7219 for controlling the display output. The MAX7219 efficiently drives the LED matrix through its multiplexing mechanism. The DIG0 to DIG7 pins function as row drivers, while the SEG A to SEG DP pins act as column drivers, enabling control of all 64 LEDs in the matrix. This internal multiplexing reduces the number of required microcontroller pins and ensures stable, flicker-free display operation. Overall, the schematic demonstrates an efficient and compact design for real-time display control in embedded and IoT-based applications.

## RESULT

The The developed IoT-Based Digital Scoreboard Monitoring System demonstrates efficient real-time performance in updating and displaying scores with high accuracy and minimal latency. The system successfully integrates the user interface, cloud communication, and embedded hardware to ensure seamless data flow. Score inputs provided through the web or mobile interface are transmitted via MQTT protocol to the ESP32 microcontroller, which processes the data and updates the LED matrix display through the MAX7219 driver IC. The communication between modules is stable and reliable, ensuring continuous synchronization without data loss. The results show that the system minimizes human errors, improves response time, and provides clear and flicker-free display output under different operating conditions. Additionally, the system supports remote access, allowing users to monitor and update scores from any location. Overall, the proposed system proves to be efficient, cost-effective, and suitable for real-world sports applications.

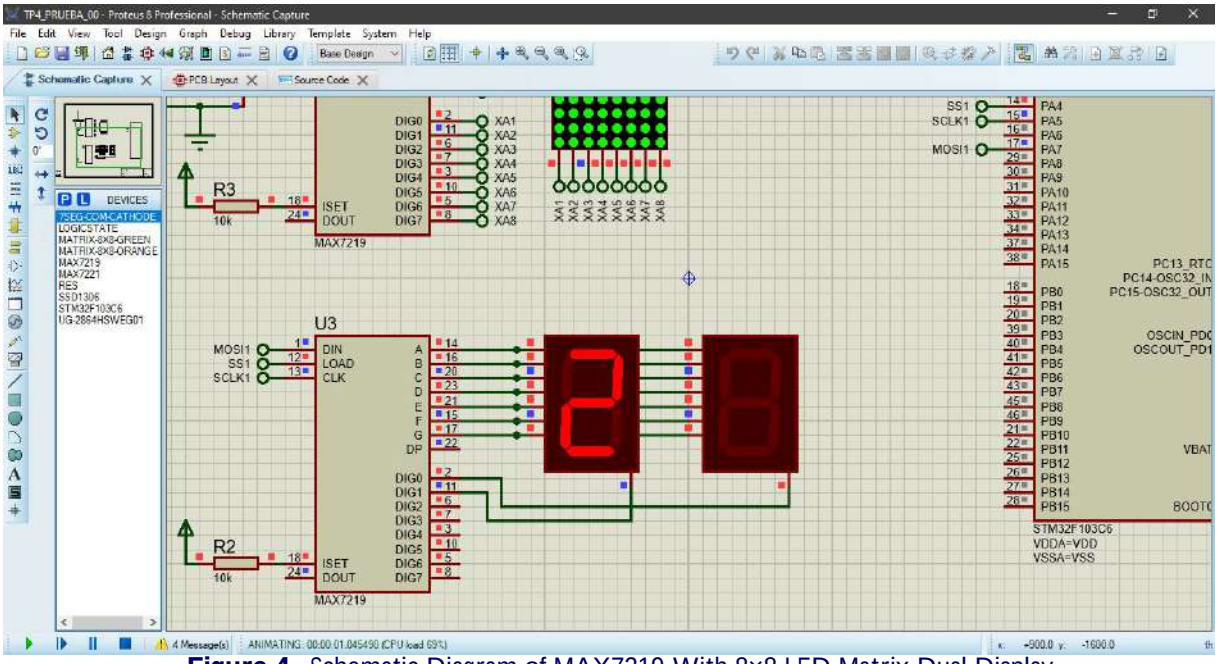


**Figure 4–** Schematic Diagram of MAX7219 With 8×8 LED Matrix Dual Display

The schematic diagram of the MAX7219 with an 8×8 LED matrix dual display demonstrates how two MAX7219 display driver ICs can be cascaded to control multiple display units using a single microcontroller. This configuration is highly suitable for applications such as digital scoreboards, scrolling text displays, and multi-digit numeric systems where a larger number of LEDs are required. By cascading multiple driver ICs, the system achieves scalability without increasing the complexity of microcontroller connections. The display output using the MAX7219 driver IC is achieved through an efficient process of serial communication, internal data decoding, and multiplexed LED control. The MAX7219 acts as an interface between the microcontroller and the display module, such as a seven-segment display or an 8×8 LED matrix, enabling the presentation of numeric, alphanumeric, or graphical data with minimal microcontroller involvement. This significantly reduces the number of required I/O pins and simplifies the overall circuit design. The microcontroller transmits data serially through the DIN (Data Input) pin, it is synchronized by the CLK (Clock) signal and latched using the LOAD/CS (Chip Select) line.

**IJIRAE::**International Journal of Innovative Research in Advanced Engineering ISSN:2349-2163
Volume 13, Issue 03, March 2026 https://www.ijirae.com/archives
https://doi.org/10.26562/ijirae.2026.v1303.29

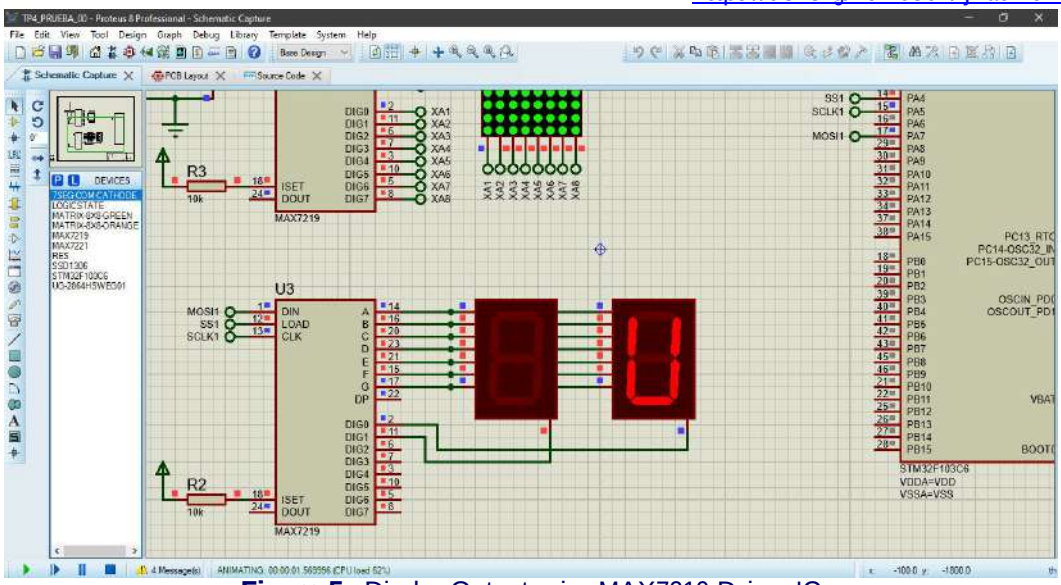


**Figure 5–** Display Output using MAX7219 Driver IC

The received data is stored in the internal 8×8 static RAM of the MAX7219, where each bit corresponds to a specific LED or display segment. The driver IC continuously refreshes the display by scanning rows (DIG0–DIG7) and columns (SEG A–SEG DP) at a high frequency using multiplexing techniques.

## CONCLUSION

The IoT-Based Digital Scoreboard Monitoring System successfully addresses the limitations of conventional scoreboard systems by providing a real-time, automated, and remotely accessible solution for sports score management. By integrating embedded systems, wireless communication, and cloud-based technologies, the proposed system ensures accurate and synchronized score updates with minimal delay.

## REFERENCES

1. S.K.Kanaugia, S.Kumar, V.Goyal, V.Dadheech, A. Pandey, and V. Shrivastava, “Digital Scoreboard Using ESP32,” Computer Research and Development, vol. 25, no. 6, pp. 1–5, 2025.
2. N.Markandwar and N.Nasreen, “Cricket Score Board,” Journal of Emerging Technologies and Innovative Research (JETIR), vol. 11, no. 6, pp. 201–206, Jun. 2024.
3. K.Verma,“Enhancing Sports Event Experience Through IoT and Cloud Synchronization Technologies,” International Journal of Innovative Research in Computer and Communication Engineering, vol. 11, no. 2, pp. 88–95, 2023.
4. E.Dwipriyoko, W.Widjajani, W.P.Sari, and Mujiarto, “Wireless Scoreboard Technology Architecture for Athlete Performance Data Warehouse at Multiple Table Sports Games,” Journal of Physics: Conference Series, vol. 1764, no. 1, p. 012058, 2021, https://doi.org/10.1088/1742-6596/1764/1/012058.
5. Z.Ismail and M.F.A.Zakaria, “Display/Scoreboard Using LED Dot Matrix,” Politeknik & Kolej Komuniti Journal of Engineering Technology, vol. 6, no. 1, pp. 1–9, 2021.
6. J.Pak, D.Spasic, M. Srbinovski, and A. Stoica, “Multi-Sport Scoreboard: An FPGA-Based Design for Multi-Game Scoring Systems,” School of Engineering and Computer Science, Oakland University, Rochester, MI, Technical Report, 2020.
7. M.Rusli and H.Sutopo, “Development of Visualization Scoreboard for Four Disciplines Execution of Journal Publication on Mobile Devices,” International Journal of Computer Theory and Engineering, vol. 11, no. 6, pp. 97–102, Dec. 2019, https://doi.org/10.7763/IJCTE.2019.V11.1250.
8. D.R.More and V.S.Jahagirdar, “Electronic Multipurpose Scoreboard with Synchronous Clock,” International Research Journal of Engineering and Technology (IRJET), vol. 5, no. 8, pp. 70–73, Aug. 2018.
9. D.R.More and V.S.Jahagirdar, “A Survey on Electronic Multipurpose Scoreboard,” International Research Journal of Engineering and Technology (IRJET), vol. 5, no. 7, pp. 2423–2425, Jul. 2018.
10. S.Hutauruk, P.Siagian, and L. Sianturi, “Scoreboard Wireless Universal Based on Microcontroller,” IOP Conference Series: Materials Science and Engineering, vol. 420, no. 1, p. 012052, 2018, https://doi.org/10.1088/1757-899X/420/1/012052.