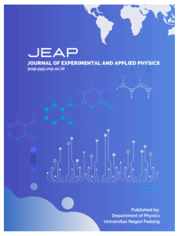
Journal of Experimental and Applied Physics
Journal Homepage: jeap.ppj.unp.ac.id
Vol. 1, No. 2, September 2023.
ISSN (Print): 2988-0378 ISSN (Online): 2987-9256




# Electronic Pad to Paragliding Landing Score System Based Internet of Things (IoT)

**Venezia Ferly Wiranda[1], Yohandri[1,*]**

[1] *Department of Physics, Universitas Negeri Padang, Padang 25131, Indonesia*

**Article History**
Received : September, 14th 2023
Revised : September, 24th 2023
Accepted : September, 26th 2023
Published : September, 30th 2023

**DOI:**
https://doi.org/10.24036/jeap.v1i2.11

**Corresponding Author**
*Author Name: Yohandri
Email: yohandri@fmipa.unp.ac.id

**Abstract:** Advances in technology allow sports equipment to become more efficient, easier to use, and have more use value. One of the technological advancements in the field of paragliding is the existence of a tool that can measure paragliding accuracy scores without having to measure them manually. However, this tool is still difficult to obtain because the price is expensive and the diameter is still 22 cm, so if a paragliding athlete lands outside the tool it is still measured manually. Therefore, an Internet of Things (IoT) based electronic pad with a diameter of 100 cm was developed. This electronic pad is designed to use a push button as a detector to get a paragliding screening accuracy score and a Radio Frequency Identification (RFID) sensor is used to detect the identity code of the intended athlete. The output of the tool appears on Google Sheets and in the Android application to make it easier to record scores for the superior accuracy of paragliding athletes. The type of research used is engineered research, namely research that applies knowledge in the form of tool design or design. The direct result of the research is the measurement of the heart rate score and the identity code of the paragliding athlete and for the indirect measurement results in the form of the accuracy of the electronic pad device is 1 and the accuracy of the tool is 1. Based on the results of its accuracy and precision, this electronic pad tool is suitable for measuring landing accuracy scores and paragliding athlete identity codes.

**Keywords:** Landing Accuracy Score, Microcontroller ESP32, Pad Electronic



## 1. Introduction

Aerospace sports began to develop in Indonesia after the proclamation of independence of the republic of Indonesia on august 17, 1945, namely with the existence of aeromodelling, kite flying, and motorized aircraft associations [1]. One of the aerospace sports that is very beneficial for the strong mental development for Indonesia's young generation is paragliding [2]. Paragliding appeared in Indonesia in 1990 which was marked by the establishment of the Mount Merapi plunge

**How to cite:**
V. F. Wiranda and Yohandri, 2023, Electronic Pad to Paragliding Landing Score System Based Internet of Things (IoT), *Journal of Experimental and Applied Physics,* Vol. 1, No. 2, page 16-25. https://doi.org/10.24036/jeap.v1i2.11 

group in Yogyakarta in January 1990. at that time, paragliding was better known as mountain waterfall [3]. Paragliding is a sport that already has achievements at both national and international levels [4]. Paragliding sports with competitive objectives include landing accuracy (ktm), xc (cross country) and rtg (rice to goal) [5]. The tool used to measure the accuracy score of paragliding landing in the competition is an electronic pad. this electronic pad has a dead center which is a 0 m coordinate point as a reference for the accuracy score for landing paragliding athletes [6]. The calculation the accuracy of landing is calculated from the first footstep that steps on the pad on the ground. The best value is the closest distance to the zero point [7].

Advances in technology and growing digitization have changed the role of technology in sports in the last two decades. Due to the limitations of human performance to reach the limits of the future it will be increasingly dependent on technology [8]. Advances in technology will have an impact on sports in the future [9]. These technological advances have given rise to many new ideas in the world of sports. Technological advances allow exercise equipment to be more efficient, easier to use, and have more use value [10]. Technology in sports is able to support the hard work of athletes from an early age. Athletes will be able to prepare themselves early and be able to face various forms of competitive challenges, through a combination of athlete talent and scientific technology [11].

The tool used to measure landing accuracy scores in competitions is an electronic pad. This electronic pad has a dead center which is a coordinate point of 0 m as a reference for paragliding athletes' landing accuracy scores. The calculation for landing accuracy is calculated from the first foot that steps on the pad on the ground. The best value is the closest distance to the zero point (Mega Pinayung, 2019). However, this tool still has shortcomings. First, this tool still uses a cable as a connection between the paragliding landing platform and the scoreboard. Second, this tool still has a diameter of 22 cm, where if the paragliding athlete lands at a distance of >22 cm from the dead center, measurements will be taken manually, namely using a meter, thereby reducing the accuracy in the measurement. For this reason, in this research a tool will be created that can detect the athlete's identity code and the athlete's landing accuracy score and increase the diameter of the tool to 100 cm.

By utilizing this technological advancement, an electronic pad will be designed using a push button as a detector. A push button is a simple switch that functions to connect or disconnect an electric current [12]. The push button work system is a device that connects the flow of electric current when the button is pressed and when the button is not pressed the switch will return to normal conditions [13]. Push buttons will be installed in parallel in the device to detect the paragliding athlete's first step on the electronic pad. Meanwhile, in this study the sensor used is a Radio Frequency Identification (RFID) sensor. RFID technology consists of a reader and a tag to identify objects emitted by radio waves [14]. The tag receives information from an object and then sends it to the reader [15]. This RFID will be installed outside the electronic pad circle and on the athlete's shoes will be installed an ID card containing the athlete's identity code. Thus, the jury can see the accuracy score of paragliding landing along with the athlete's identity code on the website page easily. The advanced technological advances nowadays, the display of measurement results from the tool is not only a display on the Liquid Cristal Display (LCD) but can already be based on a smartphone, namely by utilizing Internet of Thinks (IoT) technology [16]. One of the advancements in connectivity technology is the Internet of Things (IoT). IoT has gained popularity in many fields over the last decade [17]. IoT technology can display measurement results on a website. Website-based displays can make it easier for people to see the data from the measurement results of a tool, namely the user does not have to come to the location of the tool to see the results of the measurements. Based on the description that has been explained previously, a research has been conducted with the title "Design Pad Electronic to Measure the Accuracy Score of Paragliding Landing Based on the Internet of Things (IoT)". As the title implies, the measurement results will be displayed on the website page and then the data is stored in a database.

## 2. Materials and Method

This research includes engineering research. Engineering research is research that applies science in the form of design or tool design. Engineering research is directed at designs that meet predetermined specifications [18]. The data obtained in this study are the accuracy scores of landing paragliding athletes and the identity code (ID) of the paragliding athletes who landed. The accuracy score for landing paragliding athletes is obtained from the paragliding athlete's first footing on the push button while the athlete's identity code (ID) is obtained from the RFID sensor. The geometric arrangement of the electronic pad system can seen in Figure 1.

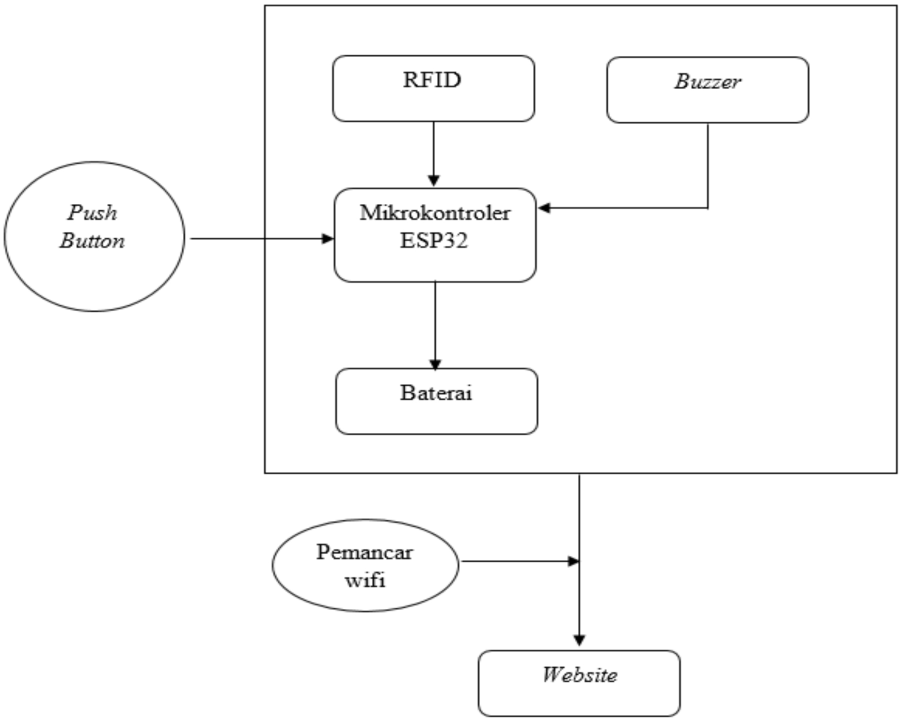



Figure 1. Block Diagram Electronic Pad Design

Based on Figure 1 RFID is used to determine the ID of the paragliding athlete who landed and the push button is the sensor used to get the landing accuracy score obtained by the paragliding athlete. These two sensors will be connected to the ESP32 microcontroller. With the help of WiFi, the data that is read by the sensor and has been processed by the ESP32 microcontroller will be sent to a website that is already connected to the database. Furthermore, the paragliding athlete ID data and the accuracy score of paragliding landing will be displayed on the google sheet.

The process of measuring the score along with the athlete's identity code begins by pressing the on/off button on the switch. The next step is to connect the device to a WiFi network. The function of WiFi here is as a means for sending measurement data to the website. After connecting to the WiFi network, it will be checked whether the connection process is successful or not, if successful, the buzzer will sound once and if it fails, the device will continue to try to connect to the WiFi network. Furthermore, the tool will be pressured or stepped on so that one of the push buttons is in a high condition. When detected, the buzzer will sound until the ID card is scanned on the black box of the tool. After the ID card scan is successful, the buzzer will turn off and the measurement data will be sent directly to the website and appear on the Android application.

## 3. Results and Discussion

Performance specifications are specifications related to the performance of a tool. The performance of a tool is related to the basic capabilities of the tool. The basic capabilities of this electronic pad are the ability to read the landing accuracy scores of paragliding athletes, the ability to read the identity codes of the athletes who landed, and the ability of the website to display data.

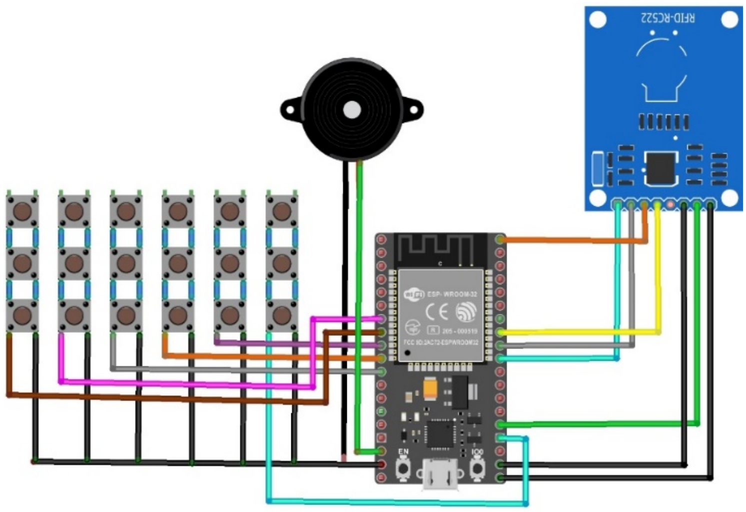


Figure 2. System circuit pad electronic

The design in Figure 2 is to determine the performance of the system so that the tool can work properly. RFID has 7 pins connected to the ESP32 microcontroller, the first Vcc pin as a +3.3 volt voltage source is connected to the ESP32 microcontroller 3V3 pin, the second GND pin is connected to the ESP32 microcontroller GND pin, the third RST (reset) pin is connected to the ESP32 microcontroller GPIO4/D4 pin. , the four MISO pins are connected to the GPIO19/D19 pins of the ESP32 microcontroller, the five MOSI pins are connected to the GPIO23/D23 pins of the ESP32 microcontroller, the six SCK pins are connected to the GPIO18/D18 pins of the ESP32 microcontroller, and the seven SDA pins are connected to the GPIO5 pins of the ESP32 microcontroller. The buzzer can be directly connected to the ESP32 microcontroller, the positive pin on the buzzer (which is green) is connected to the GPIO13/D13 pin of the ESP32 microcontroller and the negative pin on the buzzer (which is black) is connected to the GND pin of the ESP32 microcontroller. The push button also has two legs, namely the positive leg and the negative leg. The negative pins of all push buttons are connected to the GND pin of the ESP32 microcontroller, while the positive pins of each push button are connected to pins GPIO15, GPIO25, GPIO26, GPIO27, GPIO32, and GPIO33.

The pad electronic tool consists of several electronic components. The pads are made using a plywood board as a basis for assembling components and as a cover for a series of equipment components so that the athlete's footing does not directly touch the push button. The plywood board for assembling the components is made into a square with a length of 1 meter and for the tool cover it is made like a circle with a diameter of 1 meter. The circle with a diameter of 1 meter will be divided into 5 parts, with a diameter of 20 cm per circle. On a 1 meter circular pad there are 85 push buttons which are divided into several parts. The arrangement of the push button installation is shown in Figure 3.

Figure 3. Circuit push button

The other components are placed in a black acrylic box measuring 15 cm x 10 cm. In the black box there is a series of ESP32 Microcontroller, RFID, switch, buzzer, battery and battery charging module. The ESP32 microcontroller serves as a place to enter a program that will send data via a WiFi connection to Google Sheets. The circuit in the black box can be seen in Figure 4.

Figure 4. Circuit RFID and buzzer

The performance specifications of this electronic pad device consist of all the output parts of the IoT-based electronic pad device. The results of this tool are connected to a google sheet which is then connected to the android application. The data read by the google sheet will also be linked to the android application, so that it can see the results of the landing accuracy score and the athlete's identity code remotely using the internet network. The Android used must be connected to the internet with a stable connection and this is what is called the Internet of Things (IoT) system. The results of the development of the electronic pad can be seen in Figure 5.


Figure 5. Pad electronic Development

The design specification starts from testing the push button and the push button output voltage. When the push button is footed, the output status is High, while when there is no footing, the push button status is Low [19]. The status of High and Low push buttons indicates that each paragliding athlete does not have to hit all the push buttons to be able to calculate the score, the most important thing is that if someone is hit, a landing accuracy score will be obtained. The push button output voltage can be seen in Figures 6.

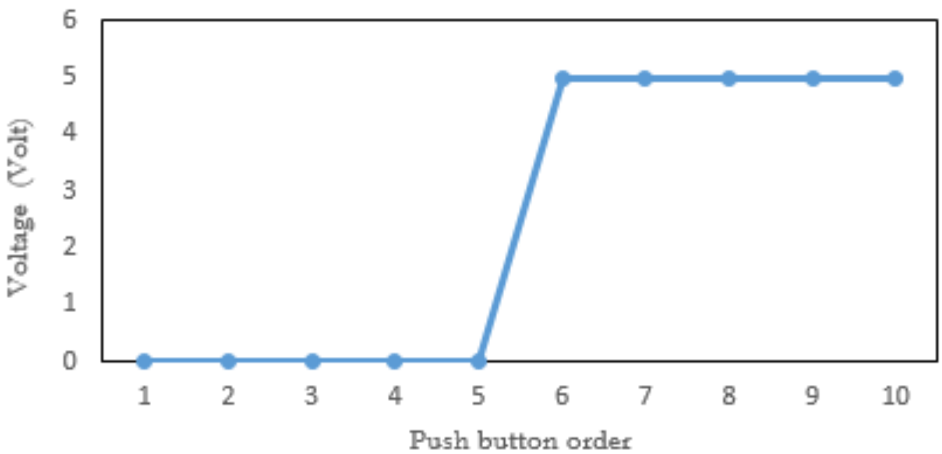



Figure 6. Output Voltage when push button low and high

When the push button is pressed by the paragliding athlete's shoes, it will produce a high status with the output voltage equal to the input voltage and when it is not pressed the push button will return to a low condition with zero output voltage. Furthermore, the accuracy of the electronic pad tool can be seen in Table 1.

Table 1. Accuracy data

| Footing Position | Score on *pad electronic* | | | | | | | Accuracy |
|---|---|---|---|---|---|---|---|---|
| | Score 0 | Score 1 | Score 2 | Score 3 | Score 4 | Score 5 | Score 6 | |
| 0° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 30° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 60° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 90° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 120° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 150° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 180° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 210° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 240° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 270° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 300° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |
| 330° | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 100% |

In Table 1, it can be seen that the accuracy score data for paragliding landings obtained using an electronic pad with several variations of footing positions has very good accuracy. The results of the measurements carried out have an accuracy that is close to the results in theory. The accuracy of the electronic pad tool can be seen in Table 2.

Table 2. Precision data pad electronic

| Measurement Order- | Score on *pad electronic* | Score according to theory | Precision |
|---|---|---|---|
| 1 | 5 | 5 | 100% |
| 2 | 5 | 5 | 100% |
| 3 | 5 | 5 | 100% |
| 4 | 5 | 5 | 100% |
| 5 | 5 | 5 | 100% |
| 6 | 5 | 5 | 100% |
| 7 | 5 | 5 | 100% |
| 8 | 5 | 5 | 100% |
| 9 | 5 | 5 | 100% |
| 10 | 5 | 5 | 100% |

Table 2 shows that the data on the accuracy of the measurement of the accuracy of the paragliding landing score using the designed tool was obtained by taking measurements repeatedly 10 times in the same place. So that the accuracy of the electronic pad is obtained, which is 100%. Experiments of RFID can be seen in Table 3.

Table 3. RFID input test

| RFID detection | Detected Distance | | | | | Code ID tag |
|---|---|---|---|---|---|---|
| | 1 cm | 2 cm | 3 cm | 4 cm | 5 cm | |
| Tag 1 | Read | Read | Read | Not Read | Not Read | 43131223400 |
| Tag 2 | Read | Read | Read | Not Read | Not Read | 67184362300 |
| Tag 3 | Read | Read | Read | Not Read | Not Read | 99732152300 |
| Tag 4 | Read | Read | Read | Not Read | Not Read | 171851313400 |
| Tag 5 | Read | Read | Read | Not Read | Not Read | 581129417300 |
| Tag 6 | Read | Read | Read | Not Read | Not Read | 1541868418900 |
| Tag 7 | Read | Read | Read | Not Read | Not Read | 1863813718900 |
| Tag 8 | Read | Read | Read | Not Read | Not Read | 2182215819000 |
| Tag 9 | Read | Read | Read | Not Read | Not Read | 25017412318900 |
| Tag 10 | Read | Read | Read | Not Read | Not Read | 2501946317400 |

Testing the reading of the ID tag by the RFID reader by knowing at what distance the ID tag can be read by the RFID reader. This test is done by bringing the RFID tag closer slowly starting from a distance of 1 cm – 10 cm. The test was carried out with a simple ruler. An RFID reader must complete two tasks, namely receiving commands from the application software and communicating with the RFID tag. The RFID reader is the link between the application software and the antenna that will radiate radio waves to the RFID tag. Radio waves emitted by the antenna propagate in the surrounding space. As a result, data can be transferred wirelessly to an RFID tag located adjacent to the antenna [20].

Based on the analysis that has been done, it can provide research results that are in accordance with the research objectives. The results obtained are the electronic pad performance specification to measure the accuracy score of Internet of Things (IoT)-based paragliding landing and the electronic pad design specification to measure the Internet of Things (IoT)-based paragliding landing accuracy score. Performance specifications consist of the function of each component contained in the electronic pad tool. The components contained in the electronic pad are push buttons, ESP32 microcontroller, RFID, buzzer, battery and battery charging module. The push button functions as a detector to generate the accuracy score for landing paragliding athletes. The ESP32 microcontroller serves as a place to enter a program that will send data via a WiFi connection to Google Sheets. RFID is used to retrieve ID numbers from paragliding athletes who land. Batteries and battery charge modules are used as power supplies for the appliance. The switch is used as the tool's Off/On button, the buzzer serves to signal that the device is connected to the WiFi network and also to warn athletes who land to immediately scan the ID card on the black box. From the measurement results that appear on the google sheet and on the android application, it can make it easier for the judges to get the accuracy score of paragliding landing and there is no need to record the score manually.

The second result is an electronic pad design specification to measure the accuracy score of paragliding landing based on the Internet of Things (IoT). The output status of the push button is seen when the push button is given a footing, then the status is HIGH and when it is not given a footing, the output status will be LOW. The value of precision and accuracy is obtained from the comparison of the readings of the instrument with the existing theory. According to the theory, to get a paragliding landing accuracy score, use a landing spot with parts of each circle. The highest score is located at the midpoint of the landing spot, which is a score of 0. Each section of the circle is spaced 10 cm apart, the first 10 cm section for a score of 1, the second 10 cm section for a score of 2, the third 10 cm section for a score of 3, the fourth 10 cm section for score 4, and so on (6). Through the measurement results of the electronic pad tool are the same as the theory, so that the value of the precision and accuracy of the electronic pad tool is 100%. From the results of the accuracy and precision of the electronic pad, it can be concluded that the electronic pad can be used to measure the accuracy score of landing paragliding athletes. The accuracy of the instrument is obtained from the results of repeated measurements 10 times. For the accuracy of the electronic pad, the percentage of accuracy is 100%.

## 4. Conclusion

The results of the electronic pad design specifications to measure the accuracy score of the Internet of Things (IoT) based paragliding landing were obtained from the status of the push button output, tool accuracy, tool accuracy and tool testing. The output status of the push button can be seen when the push button is given a foothold, the status is HIGH and if it is not given a foothold, the output status will be LOW. The accuracy of the tool is obtained from the comparison of measurements made by the tool with the actual theory. The accuracy of this electronic pad has a 100% accuracy percentage. The accuracy of the tool is obtained from the results of repeated measurements 10 times. For electronic pad accuracy, the accuracy percentage is 100%. In testing the RFID sensor, it is known that the RC522 can only read ID tags at a distance of <4 cm. In testing the tool as a whole, it can be seen from whether the tool runs according to the input program.

## References


[1] R. R. Lukman and E. Sepdanius, "Profil Pembinaan Olahraga Dirgantara Paralayang dan Gantole Di Bukit Tambun Kabupaten Dharmasraya," *J. Stamina*, vol. 3, no. 4, pp. 207–217, 2020.

[2] P. Accuracy, "FAI Sporting Code Section 7C – Class O Paragliding Accuracy," no. May, 2020.

[3] A. S. Faturochman, Said Junaidi, "Journal of Sport Sciences and Fitness DI SEMARANG," vol. 5, no. 2, p. 104, 2020.

[4] R. A. Ayazlar, "Flow Phenomenon as a Tourist Experience in Paragliding: A Qualitative Research," *Procedia Econ. Financ.*, vol. 26, no. 2013, pp. 792–799, 2015, doi: 10.1016/s2212-5671(15)00845-x.

[5] M. Wilkes, R. Charles, G. Long, H. Massey, C. Eglin, and M. Tipton, "Ergonomics of paragliding reserve parachute deployment in linear acceleration," *Appl. Ergon.*, vol. 90, no. September 2020, p. 103229, 2021, doi: 10.1016/j.apergo.2020.103229.

[6] A. E. Dika and A. Finandhita, "Riani Lubis Program Studi Teknik Informatika Universitas Komputer Indonesia," 2018.

[7] S. Siswi, L. Biasa, and S. Kabupaten, "Jurusan ilmu keolahragaan fakultas ilmu keolahragaan universitas negeri semarang 2020," 2020.

[8] W. Luo and Y. He, "Influence of sports applications on college students' exercise behaviors and habits: A thematic analysis," *Alexandria Eng. J.*, vol. 60, no. 6, pp. 5095–5104, 2021, doi:

10.1016/j.aej.2021.03.059.
[9] M. Bäckström *et al.*, "Sports technology education at Mid Sweden University," *Procedia Eng.*, vol. 60, pp. 214–219, 2013, doi: 10.1016/j.proeng.2013.07.037.
[10] V. Ratten, "Sport technology: A commentary," *J. High Technol. Manag. Res.*, vol. 31, no. 1, 2020, doi: 10.1016/j.hitech.2020.100383.
[11] A. Malik, S. Sunardi, and D. T. Ardianto, "Pengembangan Panduan Identifikasi Bakat Olahraga Berbasis Teknologi Sport Search," *J. Curric. Indones.*, vol. 3, no. 2, p. 54, 2020, doi: 10.46680/jci.v3i2.30.
[12] E. Duchêne, M. Heinrich, U. Larsson, and A. Parreau, "The switch operators and push-the-button games: A sequential compound over rulesets," *Theor. Comput. Sci.*, vol. 715, pp. 71–85, 2018, doi: 10.1016/j.tcs.2018.01.003.
[13] M. D. Riski, "Rancang Alat Lampu Otomatis Di Cargo Compartment Pesawat Berbasis Arduino Menggunakan Push Button Switch Sebagai Pembelajaran Di Politeknik Penerbangan Surabaya," *Pros. SNITP (Seminar Nas. Inov. Teknol. Penerbangan*, pp. 1–9, 2019.
[14] B. Unhelkar, S. Joshi, M. Sharma, S. Prakash, A. K. Mani, and M. Prasad, "Enhancing supply chain performance using RFID technology and decision support systems in the industry 4.0–A systematic literature review," *Int. J. Inf. Manag. Data Insights*, vol. 2, no. 2, p. 100084, 2022, doi: 10.1016/j.jjimei.2022.100084.
[15] W. C. Tan and M. S. Sidhu, "Review of RFID and IoT integration in supply chain management," *Oper. Res. Perspect.*, vol. 9, p. 100229, 2022, doi: 10.1016/j.orp.2022.100229.
[16] J. Kaur, N. Santhoshkumar, M. Z. M. Nomani, D. Kumar Sharma, J. Pai Maroor, and V. Dhiman, "Impact of Internets of Things (IOT) in retail sector," *Mater. Today Proc.*, vol. 51, no. xxxx, pp. 26–30, 2021, doi: 10.1016/j.matpr.2021.04.246.
[17] J. Mihelj, A. Kos, and U. Sedlar, "Source reputation assessment in an IoT-based vehicular traffic monitoring system," *Procedia Comput. Sci.*, vol. 147, pp. 295–299, 2019, doi: 10.1016/j.procs.2019.01.267.
[18] T. Journal and K. Society, "발명영재의 생애목표 특성* 1) 2)," vol. 14, no. 1, pp. 163–180, 2015.
[19] Suryani, "Sistem Pengontrolan Mi3F Dengan Tiga Kecepatan Berbasis PLC," *Tek. Elektro Fak. Tek. Univ. Muhammadiyah Makassar*, vol. 12, no. 01, pp. 37–47, 2020.
[20] G. Casella, B. Bigliardi, and E. Bottani, "The evolution of RFID technology in the logistics field: A review," *Procedia Comput. Sci.*, vol. 200, no. 2019, pp. 1582–1592, 2022, doi: 10.1016/j.procs.2022.01.359.