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Design and build a timekeeping device on RFID-based fast roller skating sports

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Abstract

Sports that require speed for the Athlete to reach the finish line with the fastest time will be the winner in a speed skating race. With the demand to recap the speed of the alet entering the finish line, it is necessary to calculate the time that can be used in a speed skate race. Tools such as stopwatches have been used without weaknesses in the device, but weaknesses often arise from human error and result in many athletes being harmed. So we need a tool that can record athletes' speed without any errors so that athletes' speed can be recorded. This research aims to develop a speed-measuring instrument by utilizing radio signals or RFID to minimize human error in the race. This research uses research development methods (Research and Development). The timekeeper uses an identity tag attached to the skate and a sensor reader (Tag Reader) to detect the time. The study results show that RFID for recording time in roller skates is already valid and feasible. The development of this tool RFID, RFID, can detect the identity of the time between the Tag and Tag Reader with a maximum distance of 3m. Using this tool can improve the ability to record time in roller skating to record the time produced by athletes when reaching the finish. The use of this tool is practical and easy, so it is in accordance with the regulations in roller skating and as needed in the sport. The timing system will work when the Tag passes the Tag Reader attached to the start/finish line in a speed skating race.

Keywords: Design, timekeeper, roller skates, RFID

Authors' contribution: a – Preparing concepts; b – Formulating methods; c – Conducting research; d – Processing results; e – Interpretation and conclusions; f - Editing the final version

INTRODUCTION

Fast skating, or inline skating, is a discipline in roller skating competitions. The winner in the race is speed. A speed-measuring instrument often used is a stopwatch (Syarif, 2022). A stopwatch is a tool with little risk, but the accuracy of the referee in using the stopwatch makes the speed gauge less accurate. Therefore, a tool is needed to

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record the Athlete's speed time more accurately. CuTheres a more accurate roller skate speed timer and transponder (Suryawati et al., 2022). To excel, several factors must be possessed by an athlete, including good technical, tactical, physical, and psychological abilities. Practicing techniques and tactics takes a long time to make the movement perfect and become the correct reflex when performed during training and competing (Kardiyono & Rohidi, 2019). The speed of roller skating athletes must be supported by a coach or committee in roller skating to determine the speed of roller skates produced by athletes (Saputra & Indra, 2019).

This research is entitled "Design and Build a Timekeeping Device in RFID-Based Speed Roller Skate Sports" to develop a faster, more accurate, precise speed measuring instrument that roller skaters can use during the race. This was adapted due to many problems of some coaches and timekeepers in recording athletes' speed when conducting matches (Zhang et al., 2022). Time recording is needed and known by athletes and coaches in order to plan strategies and further developments in the future so that skills in roller skating can increase (Saputra & Indra, 2019). RFID design is a radio frequency identification system using tags or labels attached to objects for identification (Fescioglu-Unver et al., 2015). RFID is included in the Auto-ID (Automatic Identification) technology group, which includes barcode techniques, optical character readers, and biometric technology (Fernandez & Wiyata Mandala, 2022). But other groups of AutoIDs still require limited human intervention to capture that identity data, but RFID is not the case (Rezaiesarlak & Manteghi, 2015).

Measuring instruments will be developed by utilizing radio signals (RFID). RFID, or Radio Frequency Identification, is a wireless technology used to communicate (Hunt et al., 2006). RFID has a working system, such as a sensor system, that will work when the TAG and Reader are in a close enough position (Rezaiesarlak & Manteghi, 2015).

There are many types of RFID technology, so proper consideration is needed to choose one type that suits the application to be built (Olaby et al., 2022). This is important so that the RFID-based system can be

effective and efficient, reducing operational costs and increasing efficiency (Yao et al., 2010). Transmitter-receiver two-way radios, called checkers or readers, send signals to the Tag and read the response. Generally, the reader sends the observations to a computer system running RFID center software or software. RFID labels can be affixed to an object and used to track and manage inventory, assets, people, etc. For example, RFID labels can be affixed to cars, computer equipment, books, mobile phones, etc. How an RFID tag works if it passes through the electromagnetic zone of the tag reading equipment, the RFID tag will detect the activation signal from the tag reading equipment and send a return signal according to what is stored in the tag memory in response. The tag reader equipment then translates the data transmitted by the RFID tag as needed (Maryono, 2005).

(Orbia et al., 2020) has conducted a study entitled "Design an Automatic Locker Lock Based on Raspberry Pi and RFID to Improve Time Efficiency," inoving that RFID systems arcanerform tasks well. Similar research was also conducted by (Valentino et al., 2020). This study used the RFID system to measure sprint running speed on the same test. The study was conducted by attaching a TAG to the body of the prospective soldier, and the receiver was placed at the finish line to measure the time or speed of the prospective soldier's sprint. The results found that the RFID system can read TAGS up to 40km/h at 70 cm from the receiver.

In this active RFID system, RFID tag cards have their power source and a transmitter (Nugraha et al., 2021). The power source used can come from batteries or solar power. Because it has its power source, this type of RFID has a wider range, which is between 20 meters to 100 meters (Valentino et al., 2020). Researchers will utilize RFID to calculate the time of roller skaters when reaching the finish line; RFID systems will replace stopwatches. The study was conducted by attaching a TAG with a specific identity to the Athlete's shoes before starting the race. The receiver will be placed at the finish line. After the skate crosses the finish

https://doi.org/10.29407/js_unpgri.v8i3.20061
8 (3) 2022 | 186-206

line, the tag reader will detect the tag id, and the detection results are sent to the data processing device (computer), which will record the finish time.

METHOD

This research uses Research and Development method. The subjects in this study were all futsal goalkeeper athletes. This research was conducted in April 2022. In product trials in this study, the author involved roller skate athlete Kediri. Data was collected by recording the Athlete's speed in a full track lap with a track distance of 200 meters and recording scores three times.

To produce specific products, research is used, which is a needs analysis, and to test the product's effectiveness so that it can function in the broader community, research is needed to test the product's effectiveness (Sugiyono, 2010). The product developed in this study is an RFID-based speed-measuring instrument. The research instrument this researcher aims to determine the results of detecting the accuracy of the Tag on the sensor and installing the sensor tag on the Athlete's wheel spats. The steps for the development of measuring instruments refer to the following diagram.

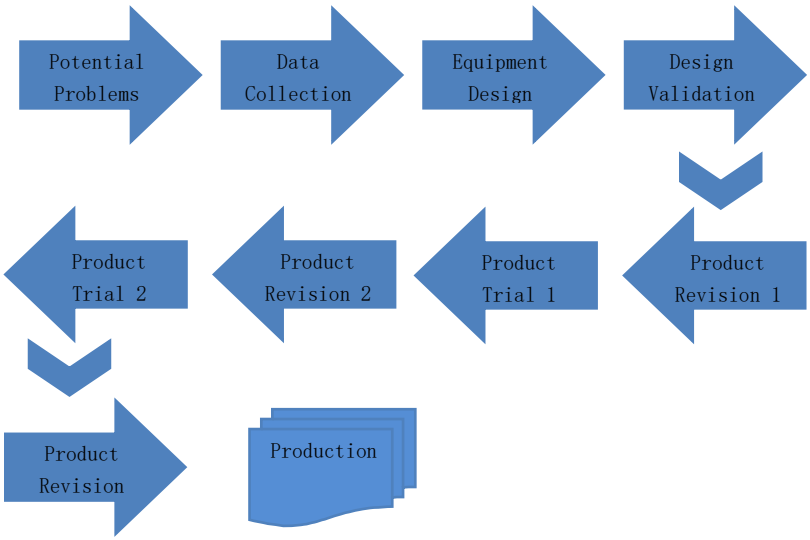

Figure 1. Measuring instrument development steps Sumber : (Sugiyono, 2010)

Data was collected by recording athletes' speed in a full track lap with a track distance of 200 meters and recording scores three times. Data

analysis uses descriptive statistics to describe data acquisition and inference statistics to test hypotheses and draw conclusions. DaThe SPSS program will assist in data analysis with an error rate of 5%. The hypothesis test used is a one-track anava to conclude whether the product needs to be revised or has met the criteria and is mass-produced.

Equation and formula

A. Tools Assembly

The RFID-based timekeeping device that can be made utilizes RFID working principles and systems to calculate the time of the roller skater when it reaches the finish line. This system will replace manual timekeeping by using a stopwatch. TAG will be affixed to the Athlete's shoes before the start of the race. The receiver is placed on the finish line. When the Athlete reaches the finish line, the receiver will receive data on the time taken by the Athlete to reach the finish line. The RFID system will read the time the Athlete requires accurately and in real time. The design of using an RFID system on roller skates is as follows.

1. The code or tag number is identified and recorded before roller skating begins. WhEachag has a unique electromagnetic identity, which differs from one Tag to another. This is the nani that will be used as the identity of roller skates.
2. Tags are mounted on roller skates, and sensor readers are placed at the start and finish lines.
3. When the skate crosses the starting line, the tag reader detects and reads the Tag's identity. The readings are sent to a data processing device (computer) to record them at the start time.
4. Moreover, when the skate crosses the finish line, the tag reader will detect and read the identity of the Tag. The readings are sent to a data processing device (computer) to record them at the finish time.

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8 (3) 2022 | 186-206

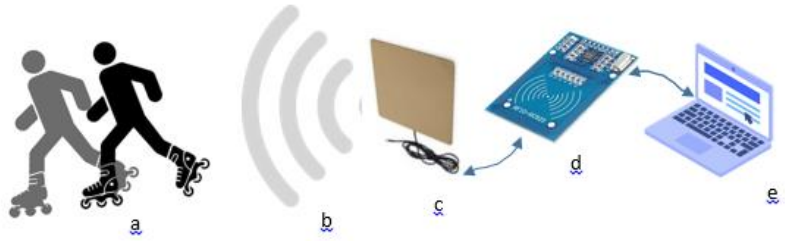


Figure 2. Illustration of the use of RFID systems on roller skates

Image caption:

a. Tagged / chip Athletes and Skates
b. RFID Signal
c. Antenna
d. Reader circuit or circuit components (RFID reader)
e. Computer/laptop to process data

B. System Workflow

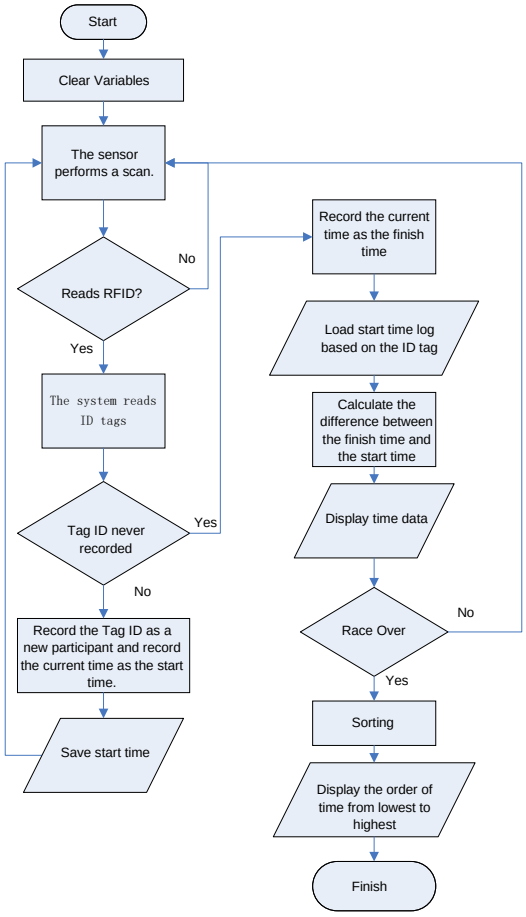


Figure 3. Planned system workflow

The picture above can be explained as follows.

1. After the device/system is turned on, the records or logs on the system will be cleaned, and the sensor (reader) condition will be on standby.
2. If RFID is detected/read, the system will check the ID of the detected Tag. If the ID has never been recorded in the variable/log, then the system will record that ID and the current time as the start time. If the ID is ever recorded, the system records the current time and saves it as the finish time of the read ID.
3. On the ID that has been recorded, after the finish time is recorded, the system will calculate the difference between the start
4. and tid these times. When a race or an operational cycle is completed, the system sorts by lowest time to highest time.

C. Required equipment

1. Transponder

A transponder, which can also be referred to as Tag is a device to store information for object identification. This design uses UHF RFID Tag production of Electrons with type EL-MT04, WZ-G16, and WZ-Y258.

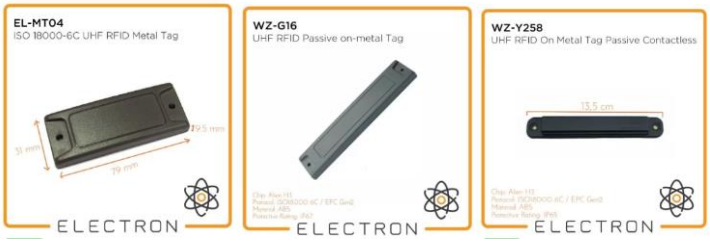


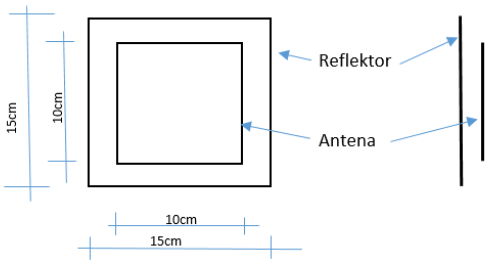
Figure 4. Tag or Transponder

2. Antennas and Reflectors

The antenna is one of the components of the orthatransmit radio frequency signals between the RFID reader and the Tag. Reflectors are used to reflect the emitted signal. This design uses antennas and reflectors made of aluminum plates with a thickness

https://doi.org/10.29407/js_unpgri.v8i3.20061
8 (3) 2022 | 186-206

of 1.2mm. The antenna and reflector are boxy, with 10cmx10cm for antennas and 15cmx15cm for reflectors, respectively. Here is the design of the antenna and reflector.



(a) Front View (b) Side View

Figure 5. Tag or Transponder

3. RFID Reader

RFID Reader is a device used to read RFID Tags. This design uses the HW-VX Main Board or the 6330K series of products from Electron. The circuit has a range specification of 6 to 8 meters.

4. Host Computer

The host computer in RFID is a personal computer (PC) used to process further information. The information comes from an RFID reader sent via serial USB port communication. Furthermore, special software or applications are needed to process the data. The processing software in question is built using the Delphi programming language.

5. Power Supply Unit

The power supply unit is an electronic circuit that provides power to the RFID reader. This device can be in finished form (kit) with specification input voltage 220V AC and output 12V DC.

6. Delphi Development Tools

Delphi is a previsualization language, just like the Visual Basic (VB) programming language. Code Gear developed the Delphi programming language as Embarcadero's software development division. The division initially belonged to Borland, so

the language has a Borland Delphi version. Borland Delphi 7, commonly referred to as Delphi 7, is a programming language located and works within the scope of the Windows operating system. Another ability of Delphi 7 is that it can provide components that you can later use to create an application that is the same as the appearance and workings of the Windows operating system. Delphi 7 has provided visual application creation as in Visual Basic. This programming language has also made it easy for us to use program codes, compile programs quickly, develop attractive designs, and develop software. It has been supported by object Pascal programming language. Delphi 7 also has a special appearance that can support the performance of the Delphi programming language to build an application with the help of VCL or Visual Component Library. Here is how to install Delphi 7 on Windows 10.

a. Klik file setup.exe
b. Then comes the initial display of the Delphi installation wizard 7.
c. Click **Next** to continue.

Figure 6. The initial view of the Delphi 7 installation wizard

d. Next, you will be asked to fill in the serial number. Type in the serial number column as shown below. If so, then click **Next**.

https://doi.org/10.29407/js_unpgri.v8i3.20061
8 (3) 2022 | 186-206

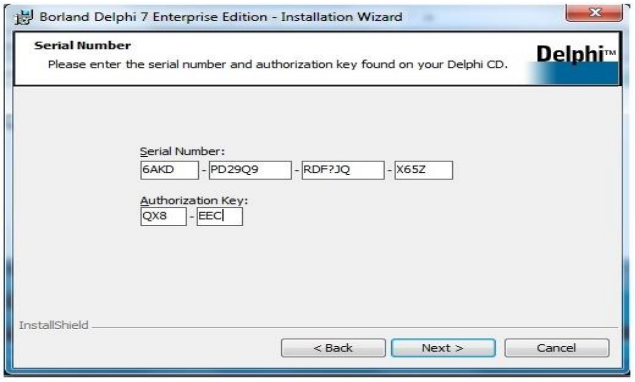


Figure 7. Serial Number Display

e. Then in the License Agreement section, select the option I accept the terms in the license agreement. After that, click Next.

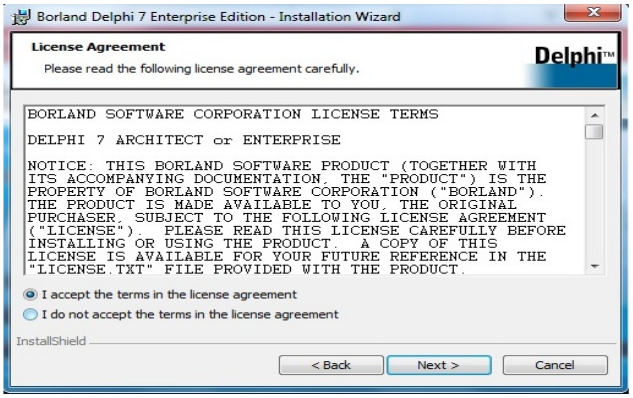


Figure 8. License Agreement Display

f. Next, choose the type of setup for this Delphi 7 application. And choose the **Typical** type. Then click the **Next** button.

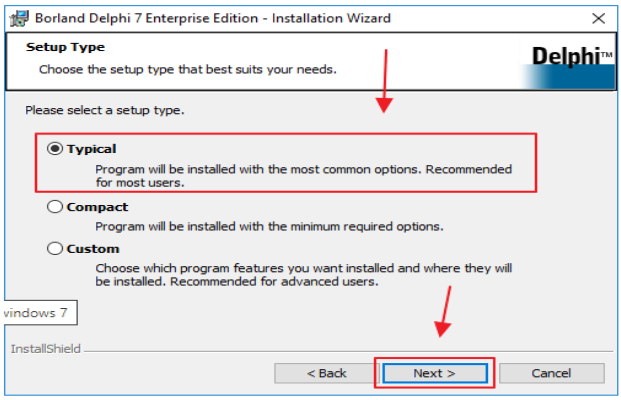


Figure 9. Display Setup Type

g. In the Choose VisiBroker section, click the **Use VisiBroker/COBRA Support check**. After that, click **Next**.

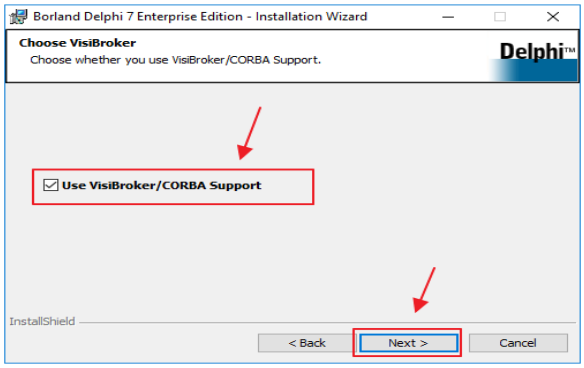


Figure 10. Choose VisiBroker Display

h. The next step is that you will be asked to select the version of Office you will be using for the Delphi 7 app. Choose the **Office 2000** option. Then click the **Next** button.

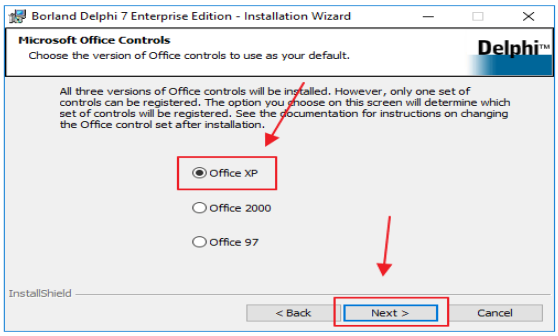


Figure 11. Microsoft office Controls the view

https://doi.org/10.29407/js_unpgri.v8i3.20061
8 (3) 2022 | 186-206

i. In Delphi 7, you can install Additional Components. But for this step, you must uncheck the entire selection of options. Then click the Next button.

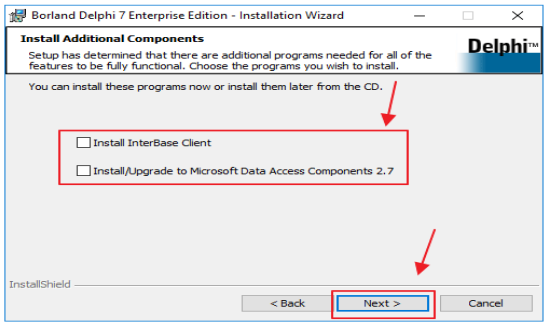


Figure 12. Display Install Additional Components

j. This next step is the folder locations for the Delphi 7 application settings. Just click the Next button to continue the installation.

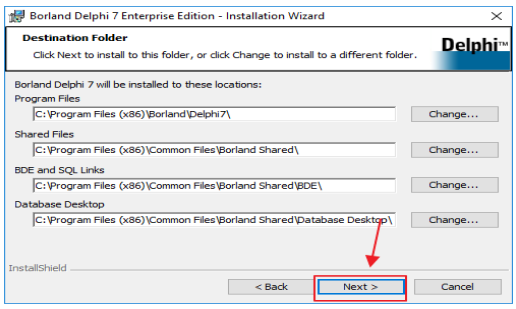


Figure 13. Install Destination Folder view

k. Then, you can check the Save **installation database to hard drive (recommended) section** at the Save installation database stage. After that, click **Next**.

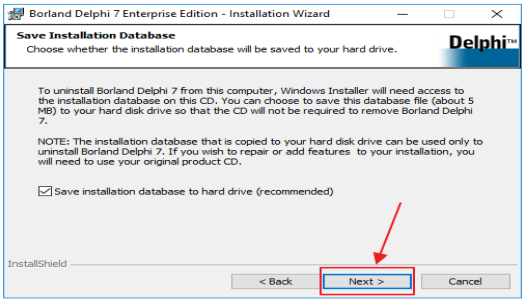


Figure 14. Save Installation Database view

l. After completing all the initial configurations to install the Delphi 7 application, you can immediately install this application. Click the Install button.

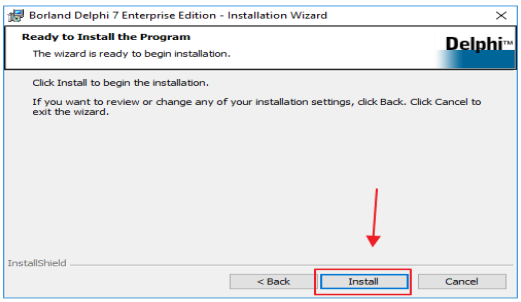


Figure 15. Display Ready to Install The Program

m. Wait a few moments for the Delphi 7 app to finish installing. Then click the **Finish** button to complete the installation of the Delphi 7 application.

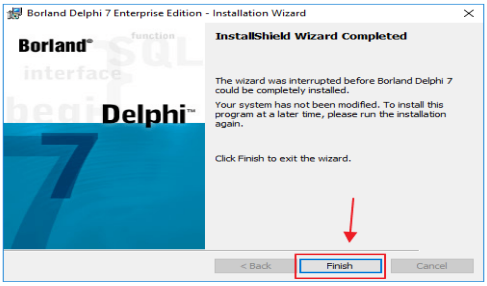


Figure 16. Display Installshield Wizard Completed

7. Software Interface Design

Several modules or parts are required in software used to process data from an RFID reader through a USB port serial connection. The parts are as follows.

1. Front Interface

https://doi.org/10.29407/js_unpgri.v8i3.20061
8 (3) 2022 | 186-206

The front interface manages communication to the Reader device through serial communication, and the menu tab displays the results of tag reading.

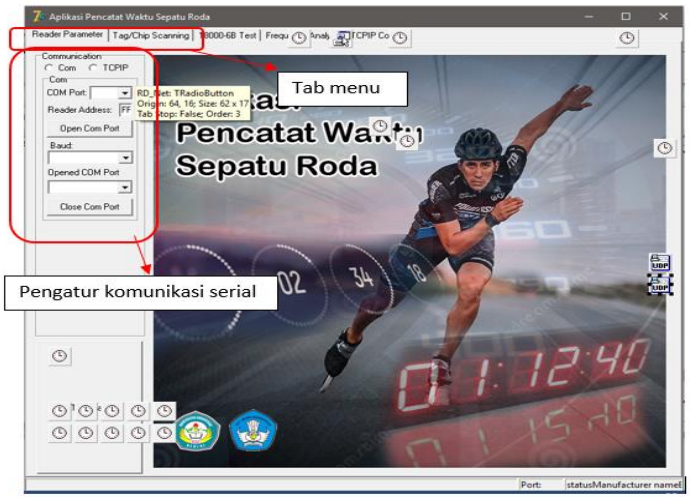


Figure 17. Front Interface Display

2. Serial Communication Connection

Serial communication connection via USB port. Set up a new project using the Delphi 7.0 IDE. Add radio button, combo box, edit, and button components.

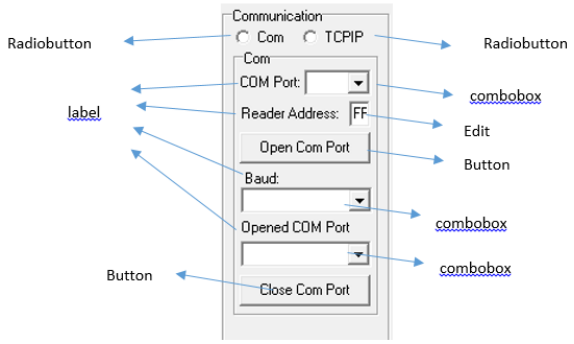


Figure 18. Serial connection module display

3. Data Processor

To display the detected tags, add a listview component, increase the number of columns to 7, and set the column headings as shown below.

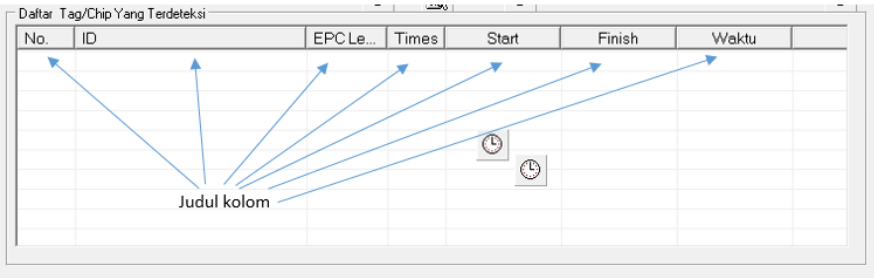


Figure 19. Listview Component View

Column captions:

a. No: used to mark the order and index.
b. ID: used to hold ID data from read or detected tags.
c. EPC Length: used to display the data length of a readable tag.
d. Times displays the number of times the reader reads the data.
e. Start: used to display the first time the reader read Dali.
f. Finish: used to display the second time, considering the finish time.
g. Time: used to display the difference in start and finish times.

8. Tool Trial

After the reader consisting of the HW-VX 6330K circuit along with the antenna and reflector has been assembled and functioning, proceed to try the tool's functionality. Connect the serial cable of the HW-VX6330K circuit to a PC or laptop. Run applications or software that have been created using Delphi before. The roller skate track's layout and the RFID reader's position are illustrated in the following figure.

https://doi.org/10.29407/js_unpgri.v8i3.20061
8 (3) 2022 | 186-206

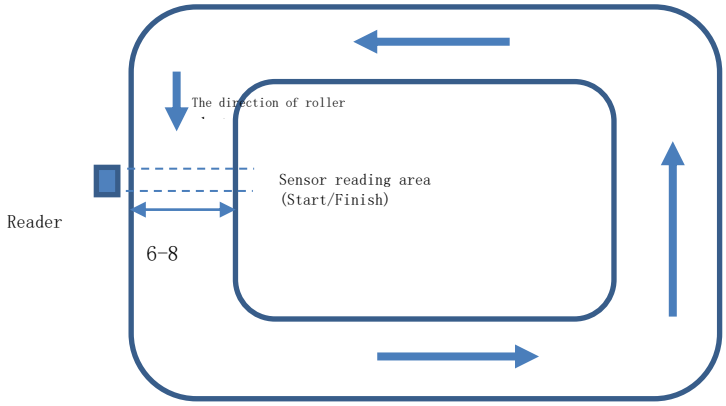


Figure 20. Test Layout Illustration

Put tag types EL-MT04, WZ-G16, and WZ-Y258 on the skates. The installation of tags on shoes can be on the right foot or the left foot, adjusting to the habits of athletes because each Athlete has different habits, especially when approaching the finish line, which foot is used as a mainstay for assessment to reach the finish line.

Figure 21. RFID Tag On Roller Skates

RESULT

This research produced measuring instruments in the form of Tag and Tag Readers. This research results in the creation of Tag and Reader Tag as a tool for measuring roller skate speed. Tag and Reader This Tag is a tool that aims as an auxiliary facility in creating speed monitoring aids appropriately in roller skating. This Tag and Tag Reader can be used so that with the help of these tools, it is expected to improve the performance of athletes in mastering roller skating to achieve the highest achievement.

This study used two types of sizes on the Tag (large and small). After testing on roller skaters, this RFID-based timekeeping measuring instrument has several areas for improvement. The first drawback is that tags with small sizes can only be detected by a distance of 120cm, which causes tag readers to be less accurate in detecting sensor id tags that cross the finish line. The second weakness, tags with large sizes require much space when mounting on roller skates, which causes athletes less freedom in moving.

The working system of Tag and Reader Tag, in essence, is that it can record the speed time of roller skates as needed on the Athlete's roller skate so that when the Athlete runs with roller skates on the track can be known, the speed produced, predicted in detail, the speed of the Athlete's roller skate when the Athlete is needed to predict his speed. Roller skating requires recording the speed of the Athlete's results when doing speed races. Therefore, to find out the speed, a tool in the form of a Tag and Reader Tag is needed to determine the speed of roller skaters.

DISCUSSION

From the results of making a timekeeping device design in RFID-based fast roller skates, it has run well in terms of software (application). This is proven when the tag reader trial can detect the id tag affixed to roller skaters, after that the results of the ID tag detection will be sent to a data processing device (computer) and will record the time when the roller skater enters the finish line, in accordance with the data receipt process described by (Yao et al., 2010).

The main components of an RFID system include hardware (tags, readers, and antennas) and System software. RFID tags can be passive or active, depending on the powering technique. Passive tags can only communicate with readers when they sit in the reader's electromagnetic field because they do not have battery power. At the same time, active RFID tags can power integrated circuits and Broadcast response signals to readers (Orbia et al., 2020). The results recorded are in the form of seconds or minutes. After testing, it is known that there are weaknesses in

https://doi.org/10.29407/js_unpgri.v8i3.20061
8 (3) 2022 | 186-206

tags where two types of small and large form tags have different levels of sensor detection. Small tags can only detect a distance that is not too far, and the sensor is less accurate, while tag readers with large forms can detect long distances, and for sensors, it is more accurate than small tag readers. This weakness is also experienced in the study results (Yao et al., 2010). Technical problem: The limitation of RFID technology is that RFID systems are only sometimes reliable. RFID read accuracy depends on various factors such as tagged objects, tag placement, rotation angle, and read distance (Yoandhita, 2020). Penerimaan RFID kurangnya secara umum standar industri melarang penyebaran RFID dalam skala besar, termasuk standar struktur data RFID, antarmuka udara, dan antarmuka lokal

General industry standards prohibiting large-scale deployment of RFID need to improve RFID acceptance, including RFID data structure standards, air interfaces, and local interfaces (Wijayanto & Sasmoko, 2015). Besides knowing the weaknesses of these two types of tag readers, they also have weaknesses in shape. This large tag reader has a better sensor level than small tag readers, but this will be an obstacle to installing tag readers in roller skaters. If installed on the Athlete's shoes, it will interfere with the Athlete when sliding because it has a large shape. And it should be good to install on the Athlete's shoe with a small shape so that it will not interfere with the Athlete when gliding, but this small tag reader has a weakness in the detection sensor.

Based on its function, the design of a timekeeping device in RFID-based fast roller skating sports can later make it easier for roller skating competition committees who used to use stopwatches to find out the time results of athletes and will later be facilitated by this tool, in line with the explanation of the benefits of RFID by (Meng & Li, 2016) RFID is already considered a very useful electromagnetic sensing solution. It can be easily integrated with sensing materials and electronic systems for conventional RFID readers and antenna applications. Using RFID tags as electromagnetic sensors or media for power and data transmission

sensors, both can utilize RFID in low-cost remote sensing, without batteries, miniature, and easy fabrication (Rozy & Fahruzi, 2022).

This study created a design for timekeeping devices in RFID-based fast roller skates. Because with this tool, roller skaters at the start and finish times will be automatically recorded on each Athlete's computer. This research in the future has been created to design a timekeeping device in RFID-based speed skates for roller skate athletes. The design tool for timing in RFID-based fast skates uses this tag reader programming software to make roller skaters more accomplished. Some suggestions from researchers for the next research are that it can be developed even better and add to the design of timekeeping devices in RFID-based fast skates with different media or tools that can improve the system or how it works more optimally than the tools currently designed. To make the design of a timekeeping device in RFID-based fast skates more sophisticated so that speed recordings can be adequately detected.

CONCLUSION

This study concludes that this RFID-based timekeeping measuring instrument is very helpful for measuring speed in speed skate races. However, this RFID-based timekeeping measuring instrument has several areas for improvement. The first drawback is that tags with small sizes can only be detected by a distance of 120cm, which causes tag readers to be less accurate in detecting sensor id tags that cross the finish line. The second weakness, tags with large sizes require much space when mounting on roller skates, which causes athletes less freedom in moving. The next research is that it can be developed even better and add to the design of timekeeping devices in RFID-based speed skates with different media or tools that can improve the system or how it works more optimally than the tools currently designed.

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8 (3) 2022 | 186-206

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