Design of Portable Attendance Monitoring System with RFID Technology

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Architecture and flowchart analysis of RFID-based attendance monitoring system

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1. System Architercutre

1) Components Used

Arduino Uno R3
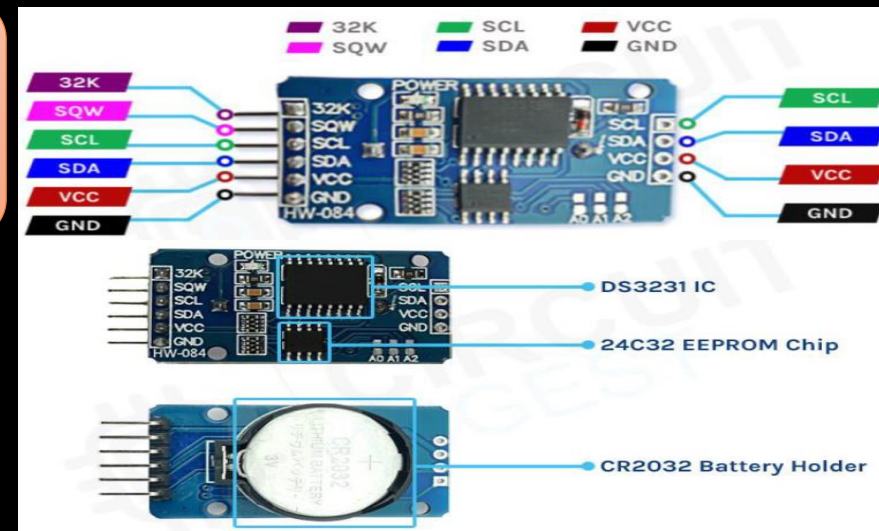
Micro SD card module

RFID Tag and MFRC522 RFID reader module
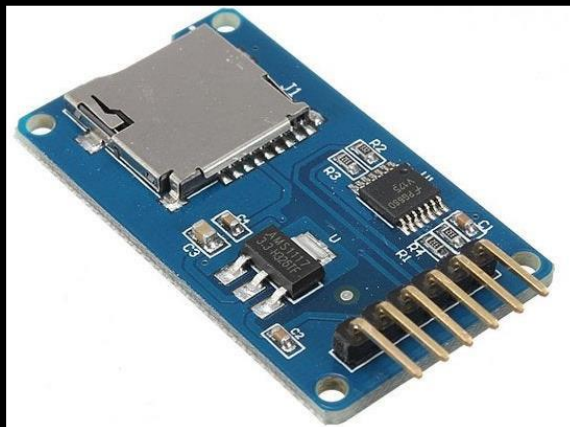
DS3231 RTC module

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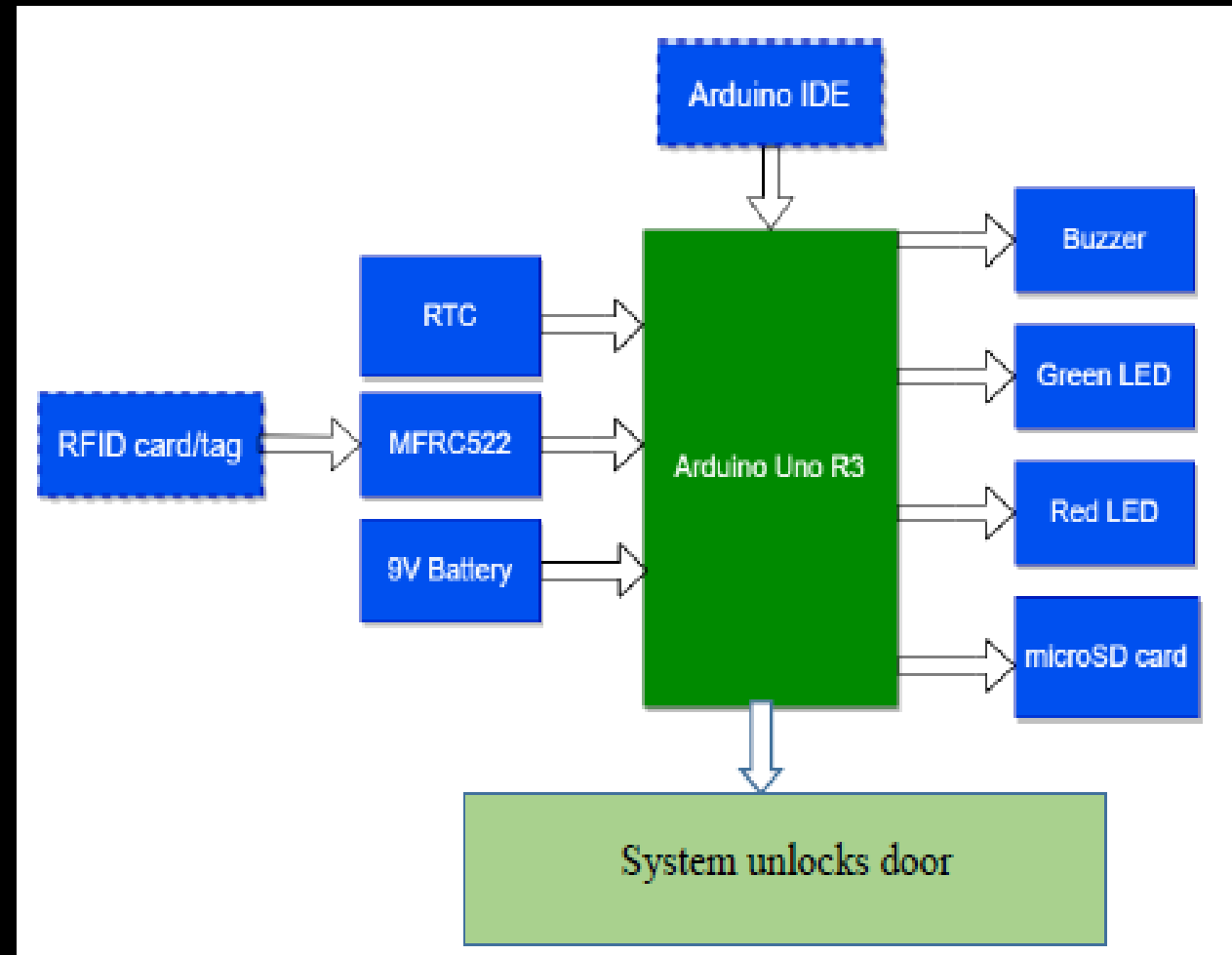
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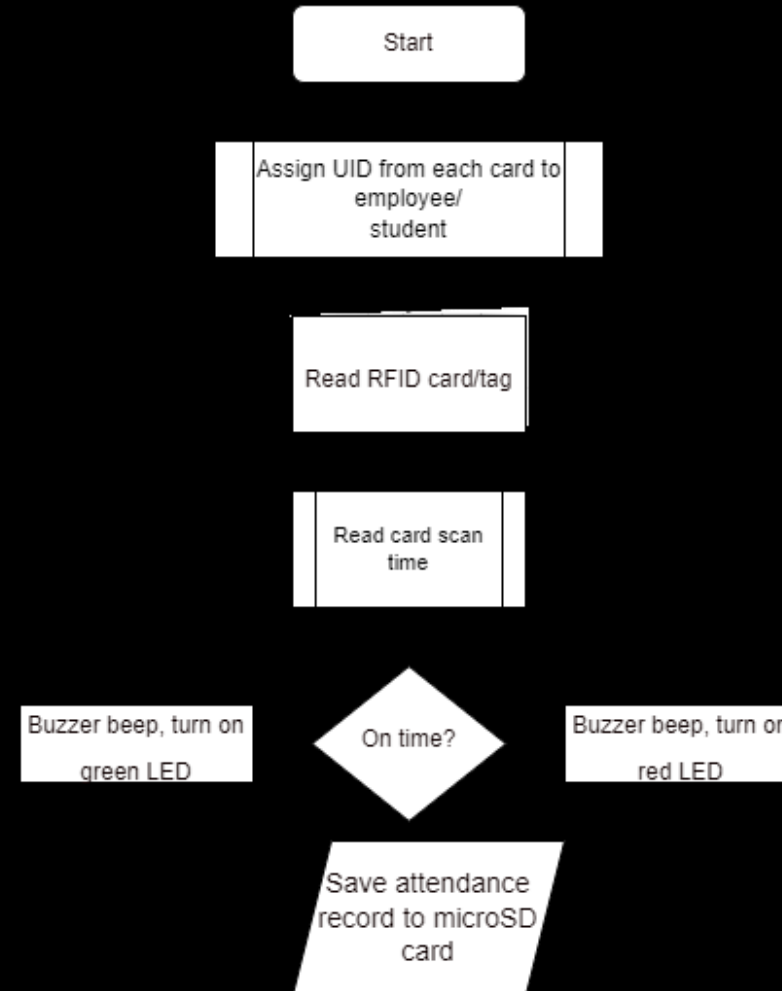# Architecture and flowchart analysis of RFID-based attendance monitoring system

2) Block Diagram

a. Radio frequency Identification (RFID)
b. Arduino Uno R3 microcontroller
c. Real time clock (RTC module)
d. output devices; green and red LEDs, active buzzer and microSD card

Architecture and flowchart analysis of RFID-based attendance monitoring system

3) Process Flow Diagram

**The system's flow process involved these steps-**

Start

Assign UID from each card to employee/ student

Read RFID card/tag

Read card scan time

Buzzer beep, turn on green LED

On time?

Buzzer beep, turn on red LED

Save attendance record to microSD card

Design of battery-powered RFID-based attendance monitoring system

- **Battery Powered attendence monitoring system**

1. The 9V battery was used to power the Arduino and RFID-based attendance system.
2. The battery was connected to the power input jack of the Arduino board.
3. The Arduino board regulated the voltage and distributed the power to other components of the system.
4. Other components included the RFID module, sensors, and other peripherals.
5. The modules that used a 5V supply, such as the RTC module and the active buzzer, worked seamlessly with the 9V supply from the battery.
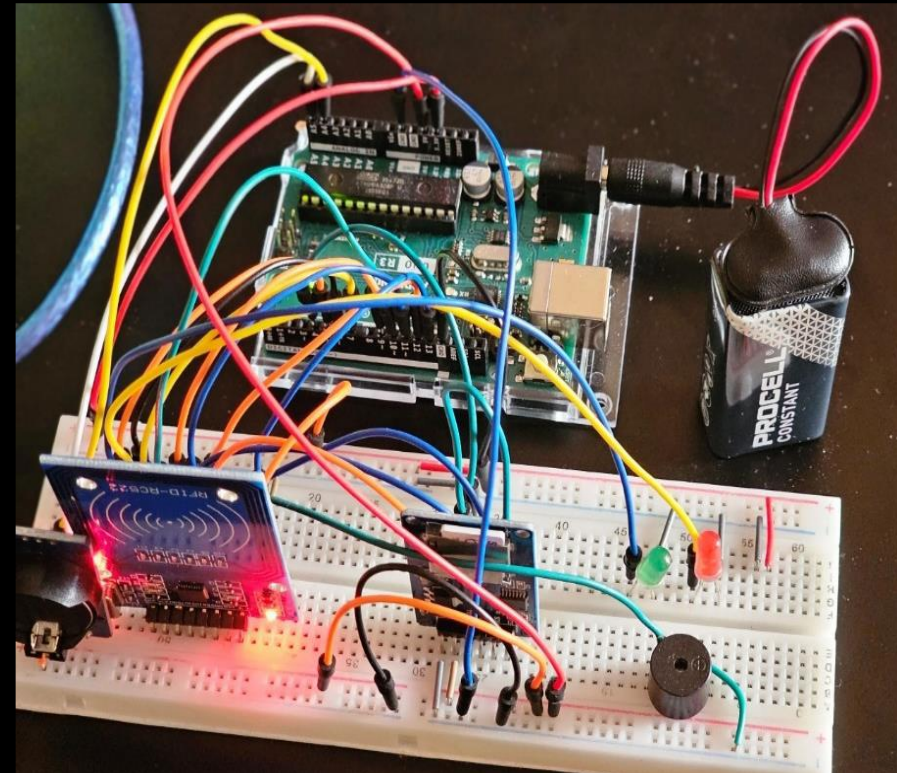
Experiments evaluating the performance of the designed monitoring system.

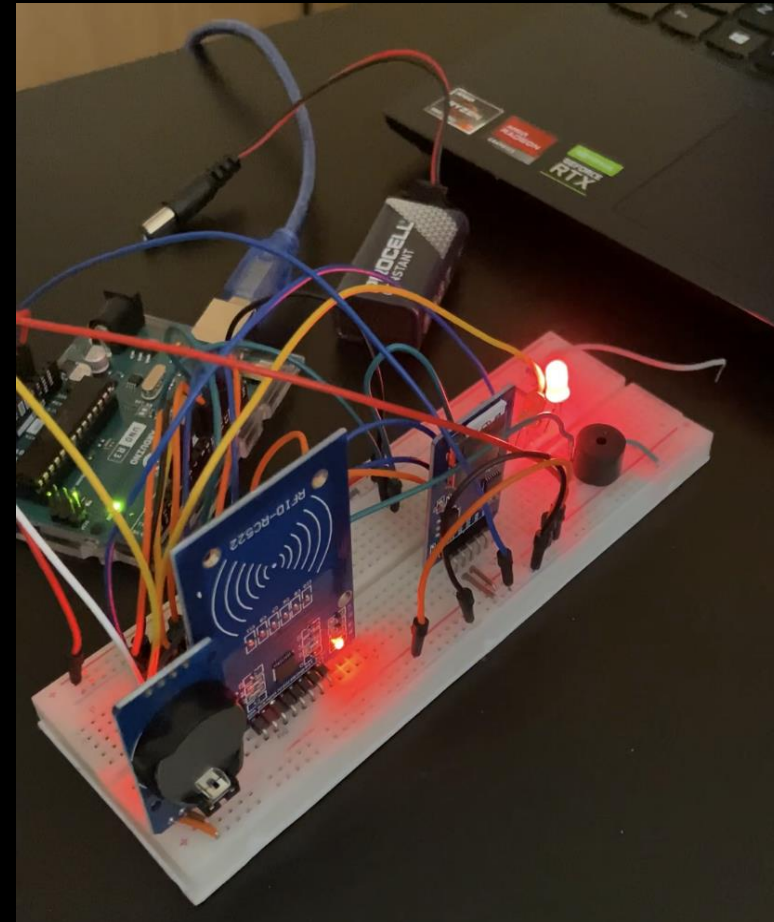• **Testing the attendance tracking system**

1. The designed attendance monitoring system can record the check-in time of students and teachers.
2. If a card is scanned before or on the designated check-in time, the green LED and the buzzer are activated, indicating arrival on time.
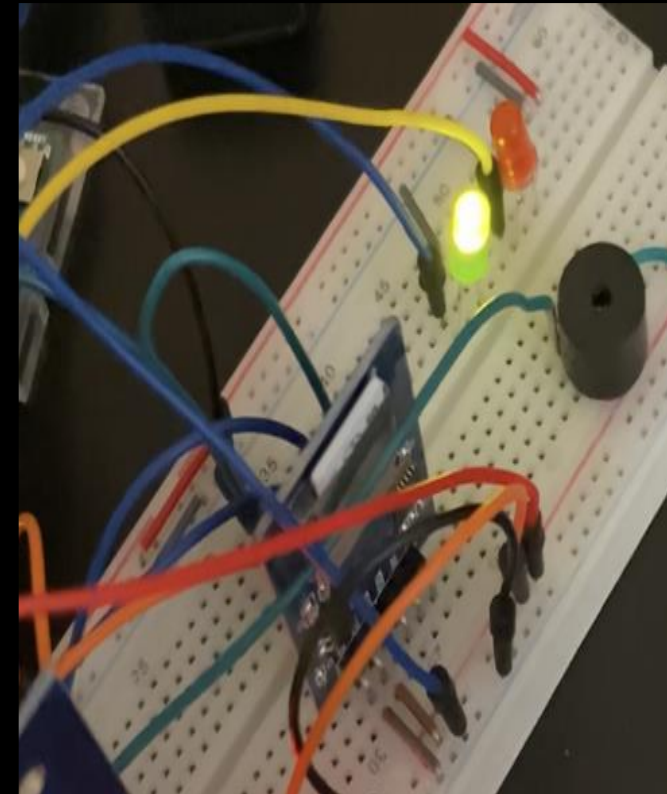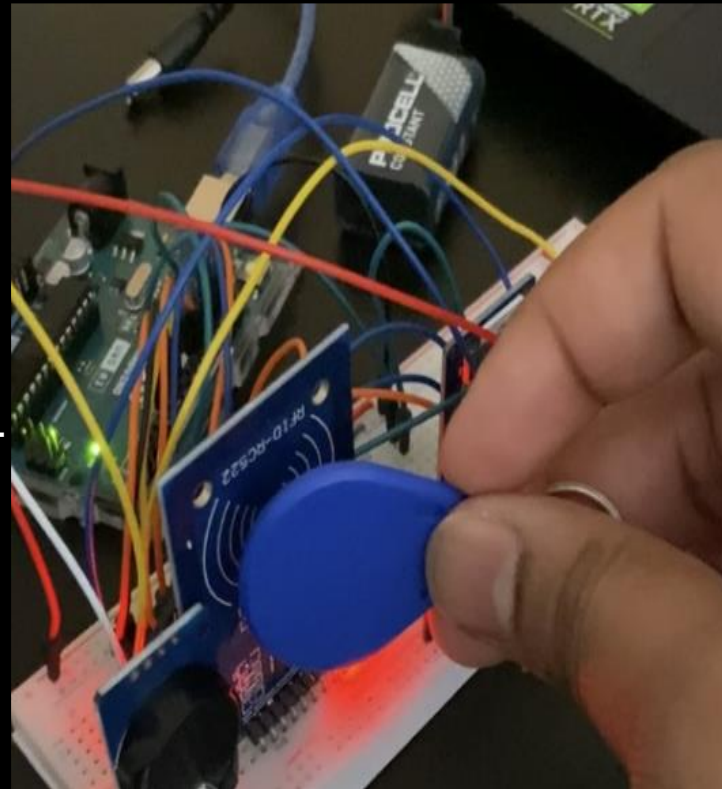
Experiments evaluating the performance of the designed monitoring system.

- **Testing the attendence tracking system**

1. If a card is scanned after the designated check-in time, the red LED and the buzzer are activated, indicating a late entry.

Experiments evaluating the performance of the designed monitoring system.

- **Testing the attendance tracking system- videos**

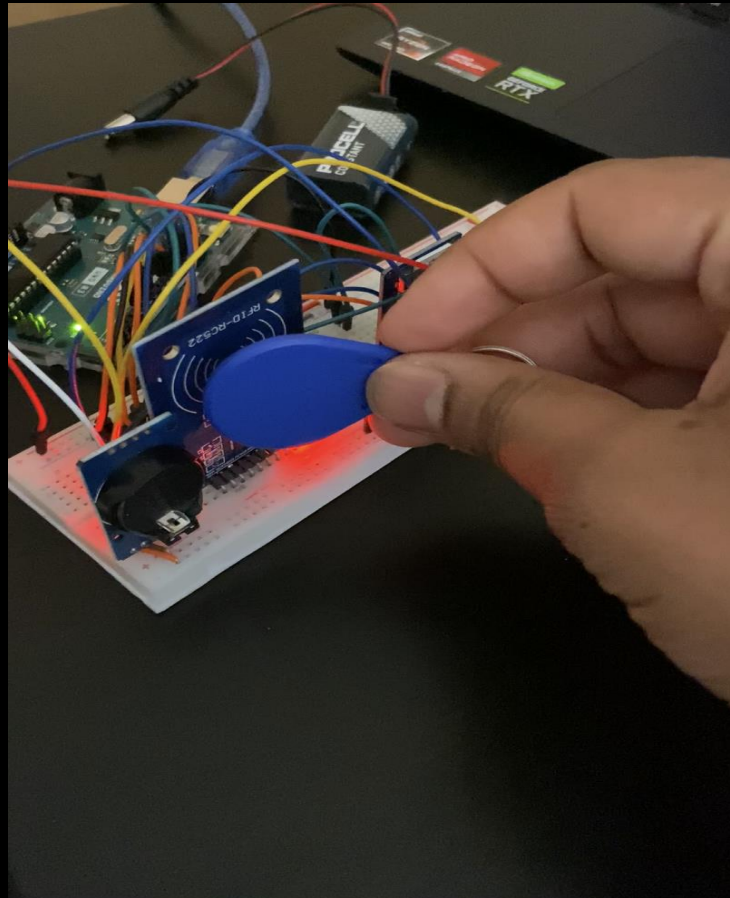On-time [5]   Late [6]

Experiments evaluating the performance of the designed monitoring system.

- **Testing the attendence tracking system**

1. The data from the scanned card is read and saved into the microSD card.
2. The microSD card provides a secure and reliable backup of the attendance records.

Production costs of designed portable attendance monitoring system

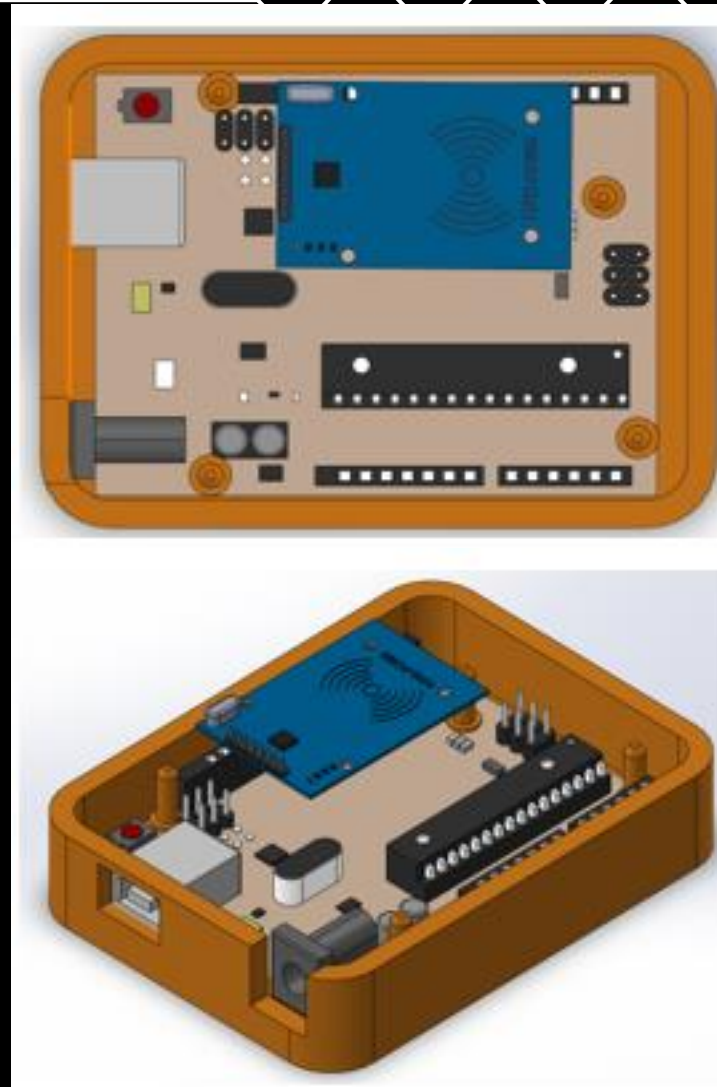- **Total cost of portable attendence monitoring kit was 84 EUR.**

- If the proposed product is made in bulk, the cost per piece can be significantly reduced.
- Components can be sourced from cheaper-cost countries like China to further reduce the cost.
- The whole device can be prepared under €50 per piece if ordered in bulk.
- This would make the product more cost-effective and affordable for small-scale organizations or businesses.

Serial number	Component	Quantity	Price per piece (€)	Total Price (€)
1.	Arduino Uno R3	1	29.00	29.00
2.	MFRC522 RFID reader	1	5.00	5.00
3.	RFID tag/card (13.56 MHz)	2	1.10	2.20
4.	Micro-SD card reader	1	3.00	3.00
5.	DS3231 RTC module	1	4.85	4.85
6.	CR2032 3v button cell/battery	1	1.50	1.50
7.	Active buzzer with generator 5V 12mm - THT	1	1.20	1.20
8.	Green LED	1	0.15	0.15
9.	Red LED	1	0.15	0.15
10.	Battery 9V 6LR61 DURACELL PROCELL	1	3.70	3.70
11.	9V Battery DC Jack	1	2.00	2.00
12.	Jumper wires	Up to usage	~ 3.00	3.00
13.	Maxi Breadboard	1	3.50	3.50
14.	Micro-SD card 16 GB	1	~ 8.00	8.00
15.	AWS S3 Free Tier	1	0.00	0.00
16.	3D printed enclosure	1	~12.00	12.00
17.	Labor cost	1 hr.	~ 5.00	5.00
	Total items	~ 17	**Total cost**	~ € 84

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Enclosure for the portable attendance monitoring system

3D enclosure design for portability

- To protect system from environmental factors (dust, humidity, temperature, etc.)
- Material- ABS due to low cost and durability, may be customized based on use-case, for example, glass for corrosive environments.
- The modules can be fixed using silicon glue or further customizing the design to occupy grooves to fit modules.
- The Arduino can fit snugly because of the presence of mounting pegs and stand-offs

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Enclosure for the portable attendance monitoring system

3D enclosure design for portability

- The Arduino can fit snugly because of the presence of mounting pegs and stand-offs
- Box shape- Rectangular
- Dimension of the box- 76mm x 56 mm x 22 mm
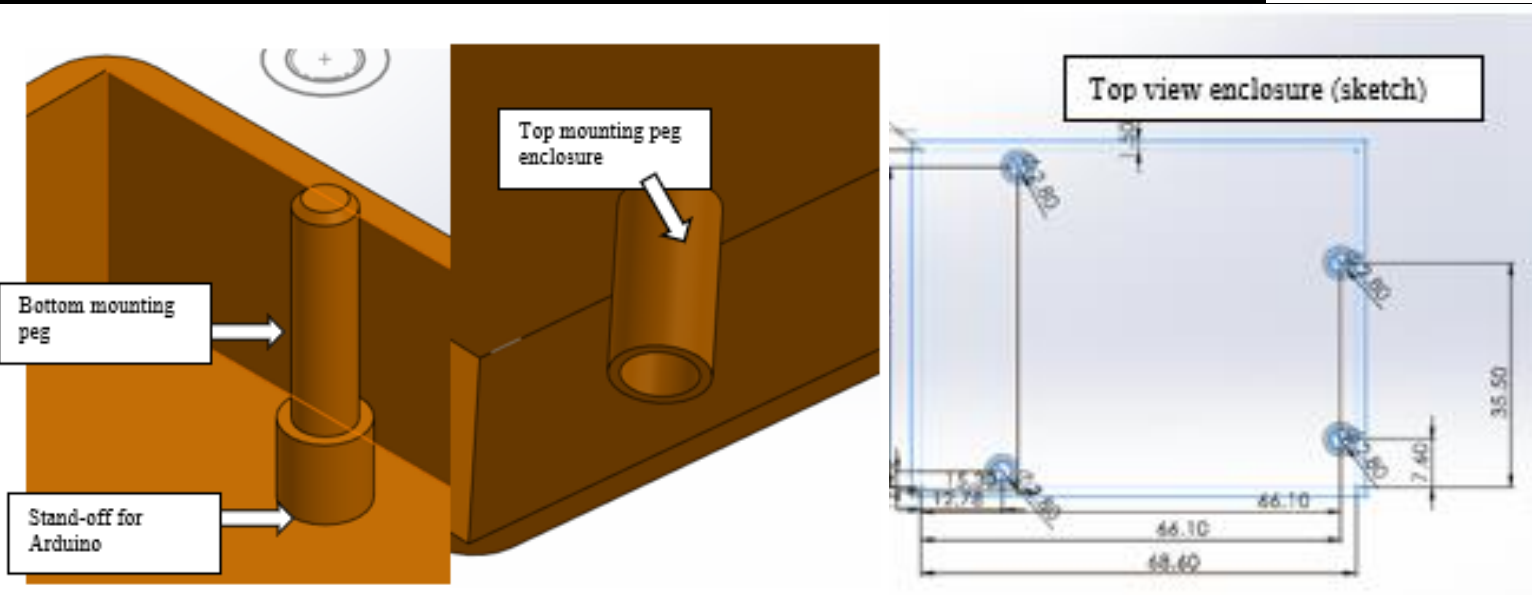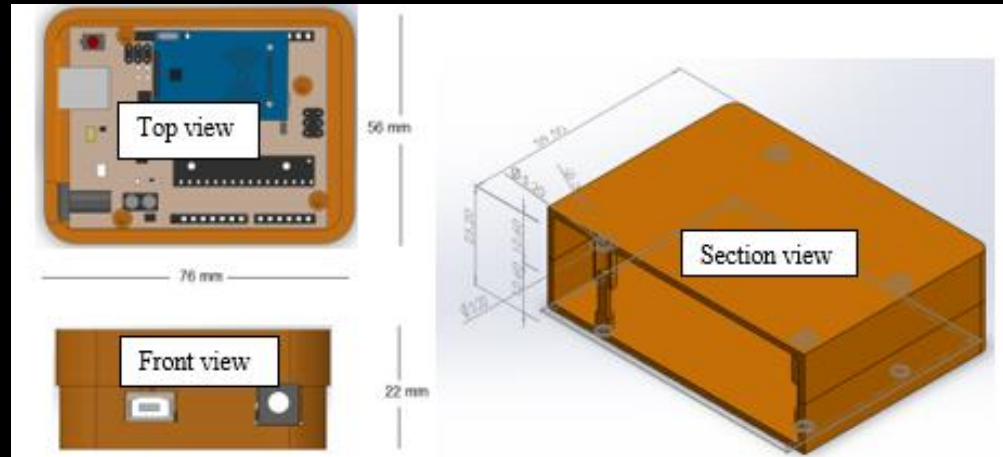
Evaluation of the design. Application areas

- **Accuracy**- The system was accurate in recording the attendance correctly and instantaneously.
- Ease of use- minimalistic interface, just tap the RFID card/tag and await response.
- **Efficiency**- system could perform the tasks efficiently and with rare errors. All tasks were automated, such as RFID scanning, LED illumination & buzzer beeps, and data saving task.
- **Security**- role based access control ensures the person enters only designated areas. All data inside microSD and on cloud could be encrypted by design, within the Arduino program/ cloud provider console.

- **Portability**- battery usage made system portable. Any 9V standard battery works with the system, making is modular and easy to carry. Non-rechargeable batteries are cheaper option, rechargeable batteries will save the environment and wastage.
- **Physical safety**- The 3d enclosure could be designed to be dust and splash-proof, (IP44/IP65).
- The enclosure could be made water-proof by adding gaskets and water-seals in the gaps of the design.
- **Cost**- Modules used were moderately or low priced and available in the market abundantly.
- Overall cost ~84 EUR, could be reduced to less than ~50 EUR if components are sourced from China and ordered in bulk.
- Cloud service is cheap and use-based (pay-as-you-go pricing model)

Evaluation of the design. Application areas

Application Areas-

• Remote area construction sites [1]
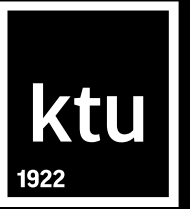

• University [2]

• Healthcare [3]

• Inventory control at remote locaitions [4]

Conclusions

1. A literature review was conducted to understand the currently available technologies and devices that could be used to improve attendance monitoring systems.
2. The research methodology explained how the proposed attendance monitoring system was customized and tested for reliability and durability. The system was found to be easily customizable to meet different requirements of organizations.
3. The experimental results showed that the proposed attendance monitoring system was reliable, accurate, and easy-to-use. Future research could focus on developing more user-friendly customization tools and exploring integration with other IoT devices or technologies.
4. The cost estimation of the proposed attendance monitoring system was discussed, and it was found that the system could be reproduced on a minimal budget and sourced from cheaper countries if ordered in bulk.
5. With the integration of cloud and IoT technology, the proposed attendance monitoring system can track attendance in real-time and provide access to attendance data from anywhere in the world using a phone or computer. This could be useful for parents, teachers, and employers in keeping track of attendance or work hours, even in the absence of a power supply or internet.

References

1. Construction Projects in Remote Locations Present Unique Problems and Solutions -, 2019. Construction Projects in Remote Locations Present Unique Problems and Solutions - [online]. Available from: https://www.nationwideconsultingllc.com/construction-projects-in-remote-locations/

2. We stand for ambition, 2023. University of Kent - University of Kent [online]. Available from: https://www.kent.ac.uk

3. How Can Simple Patient ID Tools Improve Front-Line Healthcare? | Zebra Blog, [no date]. Zebra Technologies [online]. Available from: https://www.zebra.com/ap/en/blog/posts/2019/how-simple-patient-identification-tools-drive-better-frontline-care.html

4. Pros & Cons of Using RFID Tracking for Inventory Management, [no date]. Asset Infinity [online]. Available from: https://www.assetinfinity.com/blog/rfid-inventory-tracking-pros-cons

5. On time- https://www.youtube.com/shorts/d1mFdGO6_Bo

6. Late- https://www.youtube.com/shorts/V8Xl4YBa7TM

Thank You!

Questions are welcome