Intelligent Museum Protection System

Árpád Fiai

Artists create it,
we protect it.

Balogh Bence
Hutyánszki Áron
Szenykov Alexander Igor

Coach: Farkas István

Who are we?

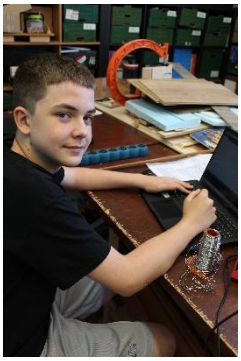
We are Team Árpád Fiai from Hungary, a group of students brought together by our passion for robotics, engineering and innovation.

By combining our different skills, we designed and built an intelligent museum that improves security, sustainability and automation while protecting valuable works of art.

Balogh Bence

Lead Electronics Engineer

- Electronic systems
- Sensors
- Wiring
- Testing



Hutyánszki Áron

Lead Software Engineer

- Programming
- Arduino communication
- Automation
- System integration

Szenykov Alexander Igor

Lead Construction Engineer

- Museum structure
- Mechanical systems
- Assembly
- Design

Our Team Motto: Artists create it, we protect it.

The Problem

Protecting Art in a Changing World.

Picture generated using Artifical Intelligent

Museums preserve history, culture and art for future generations.

However, protecting valuable collections is becoming increasingly difficult due to security risks, environmental changes and rising energy costs.

1. Security

Museums must protect valuable artwork from theft and unauthorised access.

2. Environment

Temperature and humidity changes can damage historical objects and paintings.

3. Energy Consumption

Maintaining a stable environment often requires large amounts of energy.

4. Sustainability

Modern buildings should reduce their environmental impact while remaining efficient.

How can technology help protect art while creating a smarter and more sustainable future?

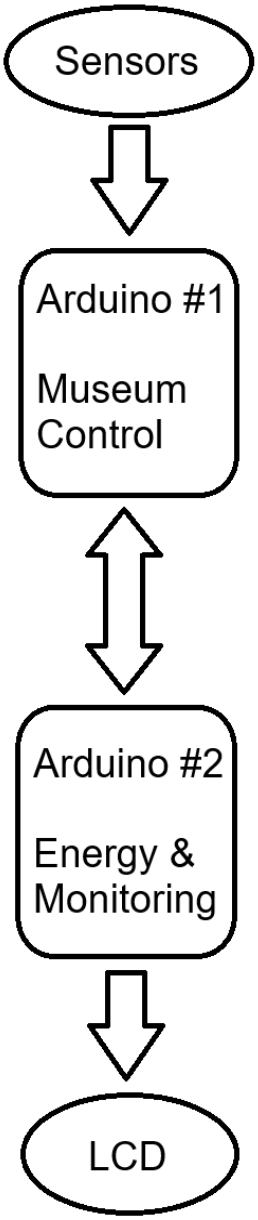
Our Solution

An intelligent museum that protects artwork while reducing energy consumption.

To address the challenges faced by modern museums, we developed an intelligent museum protection system.

Our project combines automation, security and sustainability into one integrated solution.

Using multiple sensors, two Arduino Uno controllers and intelligent automation, the museum can automatically respond to changing environmental conditions and potential threats.



Why Two Arduino Boards?

To improve reliability and organisation, our project is divided into two independent control systems.

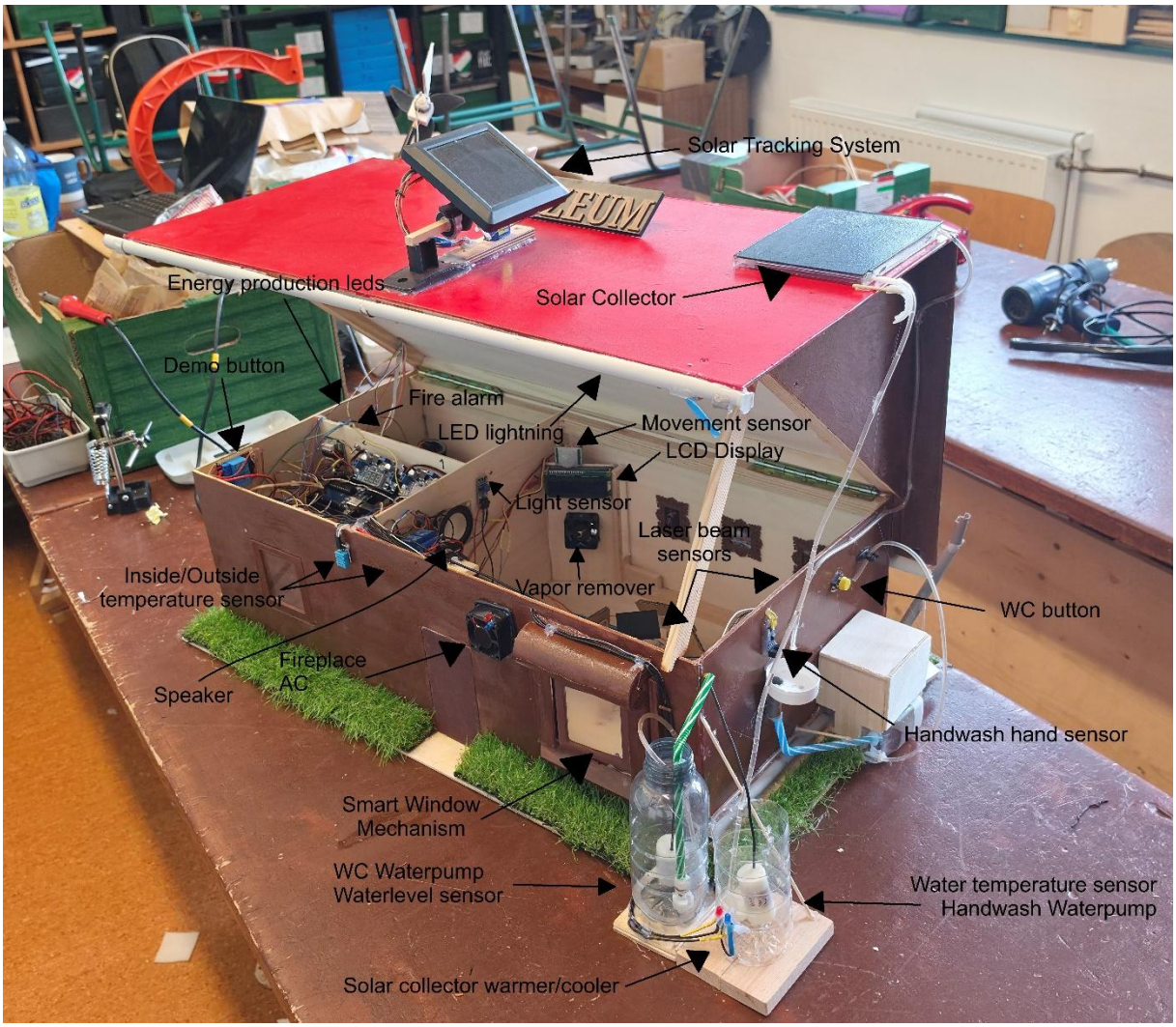
The first Arduino is responsible for the museum's protection and environmental control, while the second manages energy-related functions and the information display.

This modular design makes the system easier to maintain, expand and troubleshoot in the future.

Our Goals

- ✓ Protect artwork.
- ✓ Improve safety.
- ✓ Save energy.
- ✓ Support sustainability.
- ✓ Smart automation.

Project Overview



Smart Protection

- Laser security
- Smoke detection
- Climate monitoring
- Smart lighting

Sustainable Solutions

- Solar Tracking System
- Wind energy
- Smart temperature control
- Water management

Every component of our museum has a specific purpose. Together, these independent systems create an intelligent environment that improves safety, energy efficiency and the protection of valuable artwork.

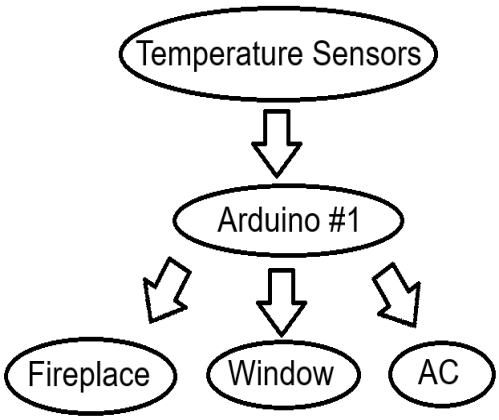
Smart Temperature Control

Museums require stable environmental conditions to preserve valuable artwork and historical objects. Traditional heating and cooling systems can consume large amounts of energy, especially when they operate continuously.

How Does It Work?

The system continuously monitors the museum's temperature using environmental sensors.

Instead of activating a single heating or cooling method, the Arduino analyses the situation and automatically selects the most energy-efficient option.



Depending on the conditions, it can:

• open the smart window,

• activate the fireplace,

• or turn on the air conditioning system.

Advantages

- Reduces unnecessary energy consumption.
- Protects sensitive artwork.
- Fully automatic operation.
- Improves museum sustainability.
- Combines multiple climate control methods.

Why Is It Innovative?

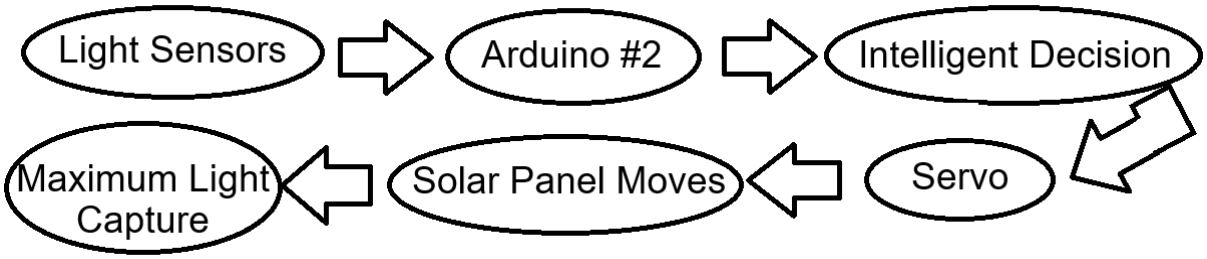
Unlike traditional systems that rely on a single heating or cooling solution, our project evaluates multiple possibilities before taking action.

By choosing the most efficient option, the system helps maintain a stable museum environment while reducing energy consumption.

Solar Tracking System

Renewable energy is becoming increasingly important for modern buildings and smart cities. However, fixed solar panels cannot always collect the maximum amount of sunlight throughout the day.

Our Solar Tracking System automatically follows the strongest light source, improving energy efficiency and supporting a more sustainable museum.



How Does It Work?

Two light sensors continuously measure the surrounding light intensity. The Arduino compares their values and determines which direction receives more sunlight. A servo motor then rotates the solar panel towards the brighter side, allowing it to collect more energy automatically.

Advantages

- Increases solar energy efficiency.
- Fully automatic operation.
- Supports sustainable energy use.
- Demonstrates intelligent automation.
- Easy to expand and improve.

Why Is It Innovative?

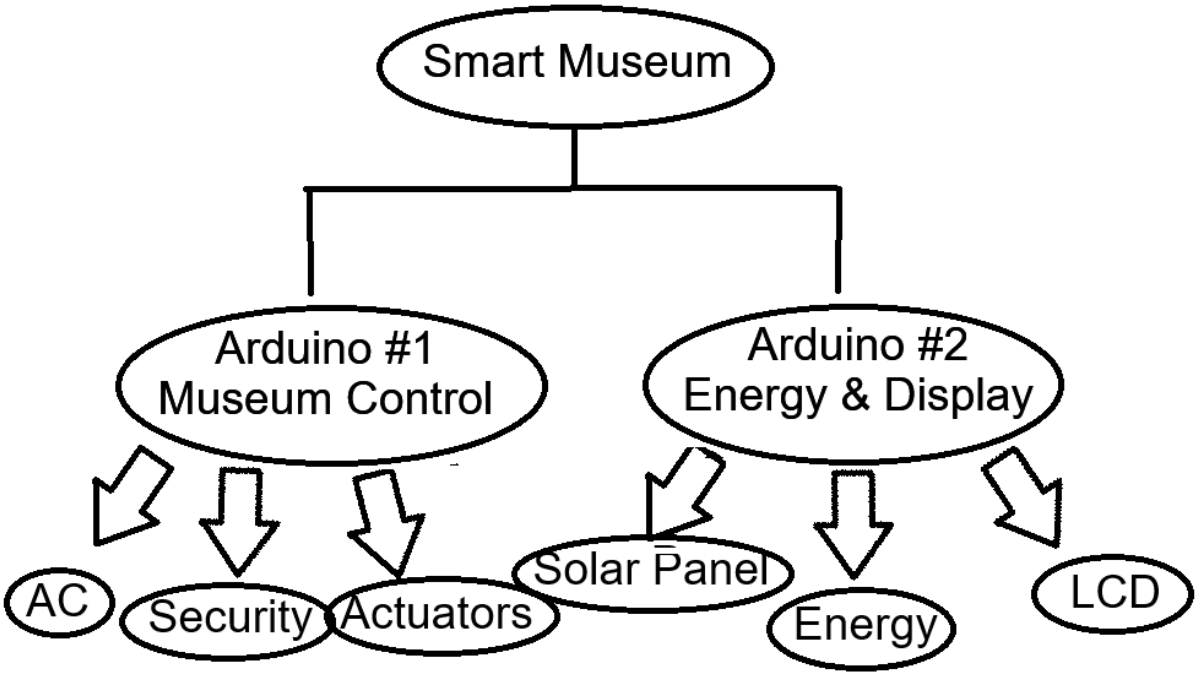
Traditional solar panels remain in a fixed position throughout the day.

Our system actively follows the strongest light source, improving efficiency through intelligent automation while demonstrating a practical application of renewable energy technology.

Hardware Architecture

To improve reliability, organisation and future expandability, our museum is controlled by two Arduino Uno boards working together.

By dividing the project into separate control systems, we reduced complexity and made the entire system easier to maintain and develop.



Arduino #1

- Temperature Control
- WC water management
- Smart lighting
- Speaker
- Security
- Vapor remover
- Fire alarm

Arduino #2

- LCD display
- Hand wash water manager
- Solar tracking system
- Energy manager system

Sensors and Actuators

Our intelligent museum relies on a combination of sensors and actuators to monitor its surroundings and respond automatically to different situations.

These components work together to improve security, sustainability and the protection of valuable artwork.

Sensor	Function
Waterlevel sensor	Detects when water level is low.
WC button	Detects when someone presses the toilet button.
Movement sensor	Detects movement, lightning system needs it.
Fire alarm	Detects fires.
Inside temperature sensor	Temperature sensor.
Outside temperature sensor	Temperature sensor.
Light sensor	Alerts when its too dark.
Demo button	Detects when someone presses the demo button.
Laser beam sensors	Detects if someone is reaching towards the paintings.
Solar tracking Right light sensor	Solar tracking system needs it.
Solar tracking Left light sensor	Solar tracking system needs it.
Handwash hand sensor	Detects when someone puts their hand inside the sink to wash it.
Water temperature sensor	Alerts when water temperature is too low.

Actuators	Function
Window opener	Opens the window if needed.
LED lightning	Light source.
Waterpump WC	Pumps water to the toilet.
Waterpump Handwash	Pumps water to the handwash.
AC	Turns on when its too hot.
Fireplace	Turns on when its too cold.
Speaker	Plays songs in the morning.
Vapor remover	Removes vapor from the air.
LCD Display	Displays temperatures.
Solar panel servo	Moves the solar panel towards light.
Solar collector water warmer/cooler	Warms and cools the handwashing water.
Energy production leds	The LEDs turn on when energy is being produced.

Sustainability

Sustainability is an important challenge for modern buildings and public institutions.
Our intelligent museum incorporates multiple technologies that reduce energy consumption and support environmentally friendly operation.

1. Solar Tracking System

Provides renewable energy by following the strongest light source throughout the day.

2. Wind Energy

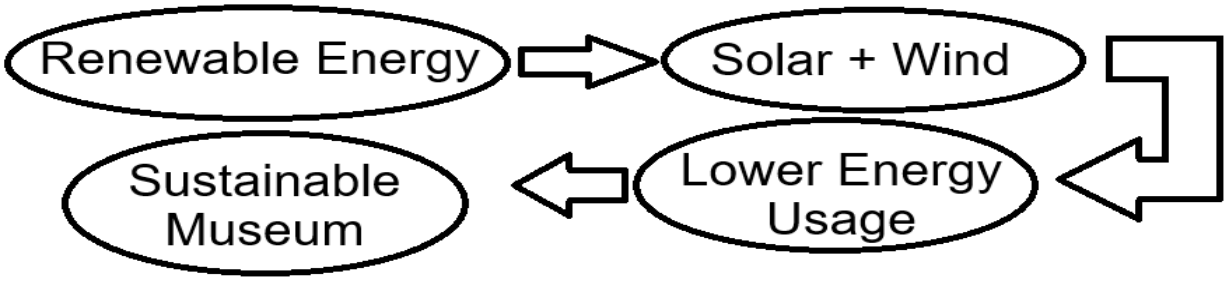
Demonstrates the use of renewable energy sources and supports sustainable operation.

3. Smart Temperature Control

Reduces unnecessary heating and cooling by selecting the most efficient climate control method.

4. Smart Window

Uses natural ventilation whenever possible, reducing dependence on air conditioning.



Advantages

- Reduced energy consumption.
- Increased use of renewable energy.
- Lower enviromental impact.
- More efficient resource managment

Why Is It Innovative?

Museums protect history and culture for future generations.

We believe they should also help protect the future itself by operating in a more sustainable and environmentally responsible way.

Business Plan – Market need

The Problem

Traditional museums often consume large amounts of energy due to climate control, lighting and building management systems.

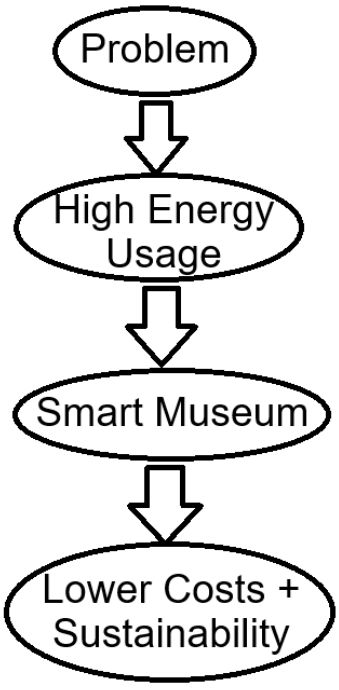
At the same time, visitors increasingly expect interactive and environmentally friendly experiences.

Cultural institutions are also looking for new ways to demonstrate sustainable technologies while protecting valuable collections.

Our Solution

The Smart Museum combines several technologies into one integrated system:

- Solar Tracking System
- Wind Energy Generation
- Water Management System
- Motion-Controlled Lighting
- Laser Security System
- Intelligent Climate Control



Benefits

- Reduced energy consumption
- Increased sustainability
- Improved security
- Educational value
- Modern visitor experience

Why Is This Important?

Our project demonstrates how museums can become more sustainable while maintaining the highest standards of artwork protection and visitor experience.

Business Plan – Customers & Value

Target customers

- National and Regional Museums
- Banks and Secure Facilities
- Art Galleries
- Art Preservation Organisations
- Environmentally Conscious Companies

Secondary Customers

Private Collectors and Smart Home Owners

Although museums are our primary target audience, some individual systems can also be adapted for private use.

By serving a wider market, production volumes could increase, reducing manufacturing costs and making the technology more affordable for museums and cultural institutions.

Value Proposition

Museums often operate with limited budgets, making it difficult to invest in advanced technologies.

Our business model aims to support cultural institutions by making smart museum technologies more affordable.

By offering selected systems to additional customer groups, production costs can be reduced through larger manufacturing volumes, allowing museums to access innovative solutions at lower prices.

Business Plan – Future Development

Value Proposition

- Mobile Application
- VR and AR Exhibitions
- AI Information Assistant
- EV Charging Stations
- Advanced Water Recycling

Future Expansion

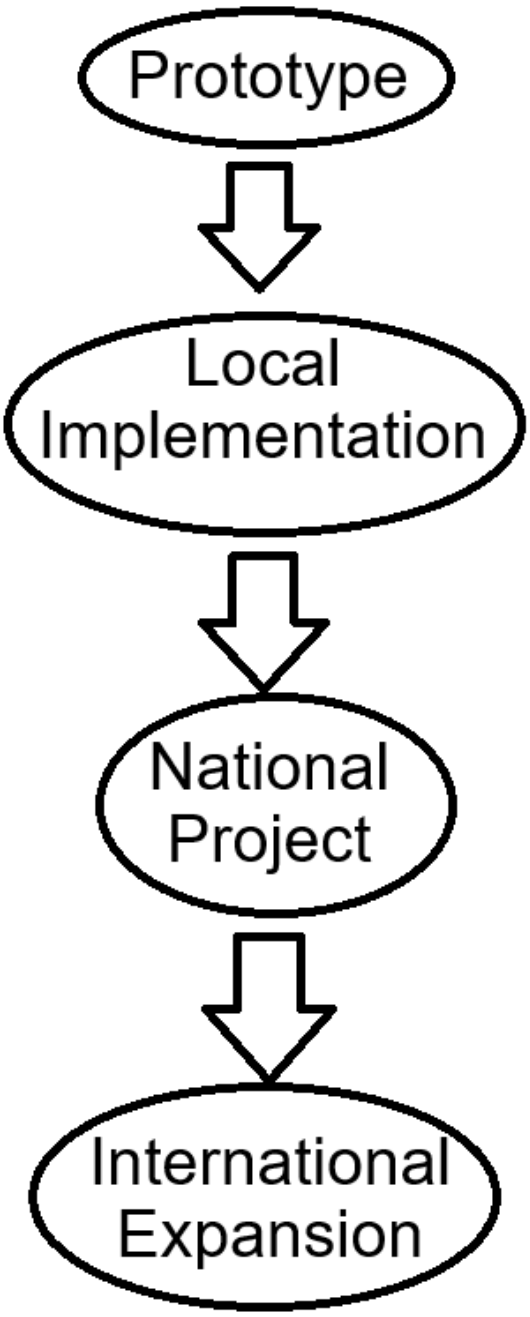
- Cooperation with Schools
- Cooperation with Universities
- International Programs
- Partnerships with Museums

Future Potential

- Educational use
- Commercial applications
- International adoption
- Sustainable innovation

Long-Term Vision

Our goal is to transform the Smart Museum from a prototype into a scalable concept that can inspire future museums and smart buildings worldwide.



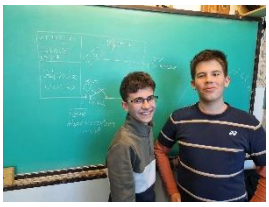
Development Process

Developing our intelligent museum was a long process that required planning, construction, programming and continuous testing.

Throughout the project, we improved both the hardware and software while learning from each challenge we encountered.

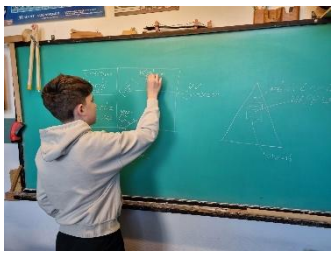
Idea & Research

- Studied museum challenges
- Identified security and sustainability issues
- Brainstormed solutions



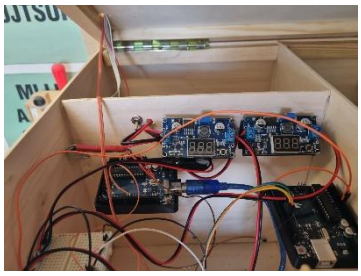
Design & Planning

- Designed the museum structure
- Planned electronic systems
- Defined team responsibilities



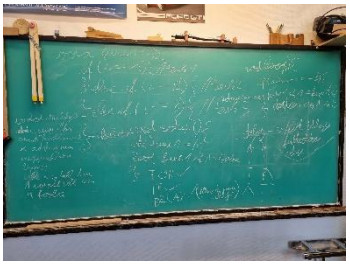
Construction

- Built the museum model
- Installed sensors and actuators
- Assembled renewable energy systems



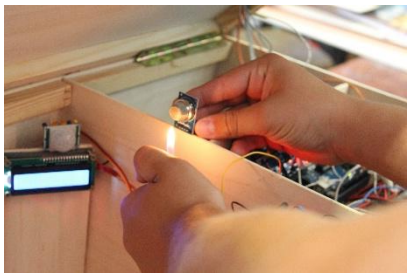
Programming

- Developed Arduino software
- Implemented automation logic
- Integrated multiple subsystems



Testing & Improvements

- Tested all systems
- Fixed hardware and software issues
- Improved reliability and performance



Challenges We Faced

During the development of our intelligent museum, we encountered several technical and mechanical challenges.

Solving these problems helped us improve both the reliability and overall quality of our project.

Mechanical Challenges

Smart Window System

Designing a reliable automatic window mechanism proved to be more difficult than expected.

During testing, parts of the mechanism occasionally broke or became misaligned, requiring multiple redesigns before achieving a stable solution.

Electronics Challenges

System Integration

Connecting multiple sensors and actuators while maintaining stable operation required careful wiring and troubleshooting.

Several tests were necessary to eliminate connection and communication issues.

Programming Challenges

Coordinating Multiple Systems

One of the biggest software challenges was ensuring that all automated systems worked together without conflicts.

The program had to process information from multiple sensors and make appropriate decisions in real time.

How We Solved Them

Window reliability – Redesigned mechanism

Wiring complexity – Improved cable managment

System coordination – Optimised software logic

What We Learned

- Persistence
- Problem solving
- Testing methods
- Engineering thinking
- Teamwork

Testing and Reliability

Testing was an essential part of our development process.

Every subsystem was tested individually before being integrated into the complete museum. This approach helped us identify problems early and improve overall reliability.

Solar Tracking Test

Goal:

Check whether the solar panel follows the strongest light source.

Result:

The panel consistently adjusted its position toward the brighter light source.

Security System Test

Goal:

Test laser-based protection and monitoring systems.

Result:

The system reliably detected interruptions and reacted appropriately.

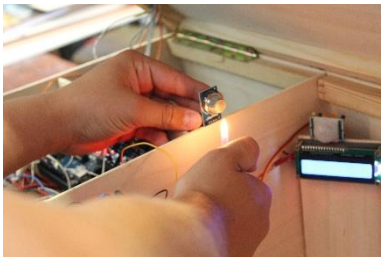
Smoke Detection Test

Goal:

Verify fire hazard detection.

Result:

The sensor detected smoke and activated the warning system.



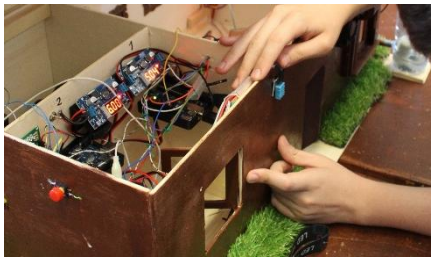
Temperature Control Test

Goal:

Verify that the system selects the correct heating or cooling method.

Result:

The system successfully switched between the window, fireplace and air conditioning based on temperature conditions.



Future Improvements

Although our intelligent museum already combines automation, security and sustainability, we believe there are many opportunities for further development.

Future improvements could increase efficiency, expand functionality and provide even better protection for valuable artwork.

Planned Improvements

1. AI-Based Monitoring

Artificial intelligence could analyse sensor data and predict potential problems before they occur.

2. Mobile Application

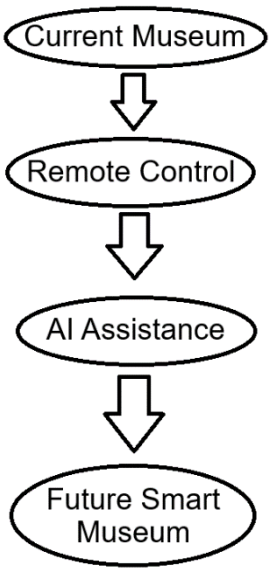
Museum staff could monitor and control the system remotely using a dedicated smartphone application.

3. Cloud Connectivity

Sensor data could be stored online, allowing long-term monitoring and analysis.

4. Larger-Scale Implementation

The system could be adapted for real museums, galleries and cultural institutions.



Expansion Opportunities

- More sensors
- More safety devices
- Additional renewable energy sources

Planned Improvements

Our goal is not only to create a museum model, but also to demonstrate technologies that could inspire future smart buildings and cultural institutions.

Project Impact

Our intelligent museum demonstrates how automation, renewable energy and smart decision-making can work together to solve real-world challenges.

While our project is a prototype, the concepts behind it could be applied in many different environments.

Areas of Impact

1. Cultural Protection

Museums preserve history and culture. Our project helps protect valuable artwork through automated monitoring and environmental control.

2. Sustainability

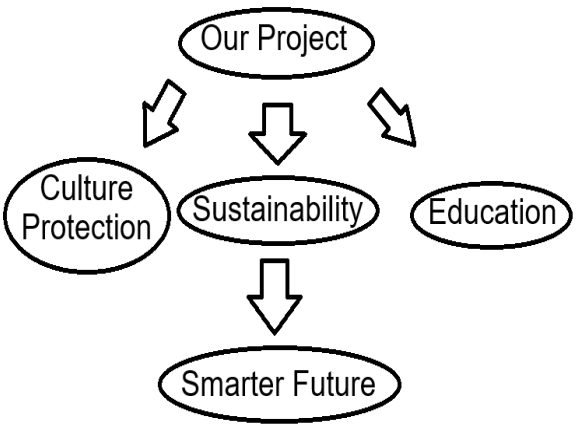
By reducing unnecessary energy consumption and integrating renewable energy sources, the museum operates in a more environmentally friendly way.

3. Smart Automation

The project demonstrates how intelligent systems can make decisions automatically without constant human intervention.

4. Education

The museum can also serve as an educational example of robotics, engineering and sustainability for future students.



Why Does It Matter?

Technology should not only make life easier, but also help preserve important cultural and historical values.
Our project combines innovation with responsibility, creating solutions that benefit both people and the environment.

Why Is Our Project Special?

Many projects focus on a single problem. Our museum combines multiple intelligent systems into one integrated solution that improves security, sustainability and automation simultaneously.

The project reflects our team's creativity, technical skills and commitment to protecting cultural heritage.

What Makes Us Different?

Intelligent Temperature Decisions

Instead of simply heating or cooling the environment, our system chooses the most efficient solution between the smart window, fireplace and air conditioning.

Renewable Energy Integration

The solar tracking system automatically follows the strongest light source, increasing efficiency and demonstrating sustainable energy use.

Automated Protection

Security systems continuously monitor the museum and react automatically when necessary.

Two Arduino Architecture

Dividing responsibilities between two Arduino Uno controllers improves reliability, organisation and expandability.

Our Strengths

- Combines multiple technologies.
- Fully functional prototype.
- Sustainability-focused design.
- Real-world inspiration.
- Expandable architecture.

What Are We Most Proud Of?

We are proud that every part of the museum was designed, built and programmed by our team.

The project is not only a technical achievement, but also a demonstration of teamwork, creativity and perseverance.

Conclusion

Our intelligent museum combines automation, sustainability and security into a single integrated system.

Through smart decision-making, renewable energy and automated protection, the project demonstrates how technology can help preserve valuable cultural heritage while reducing environmental impact.

Throughout this journey, we developed not only a working prototype, but also our engineering, programming and teamwork skills.

Project Highlights

Smart Temperature Control

Intelligent climate management for artwork protection.

Solar Tracking System

Improved renewable energy efficiency.

Automated Security

Continuous monitoring and protection.

Intelligent Automation

Real-time decisions without human intervention.

Thank You!

Thank you for taking the time to learn about our project!

We hope our intelligent museum demonstrates how technology can be used not only to create the future, but also to protect the past.

Team Árpád Fiai

Artists create it,
we protect it.