

Robotics & AI Advanced Category

(18 – 25 Years Old)



(Smart Surveillance Solutions)

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Summary for Safe Cities: Robotics Advanced Category Competition

This document outlines the competition **Game Rules** for the STEM Festival Robotics Advanced Category, focusing on "**Smart Surveillance Solutions.**" You have **2 to 3 months** to design, program, and test your robot until the day of traveling to the host city of the competition, Port Harcourt, Nigeria.

Key Points:

- ✓ These game rules serve as guidelines for the STEM Festival competitions.
- ✓ The missions can be adapted for different skill levels, making it suitable for both beginners and experienced teams.
- ✓ Focus on completing missions that showcase your robot's capabilities in:
 - Utilizing networked camera systems
 - Utilizing AI for video analysis and suspicious activity detection
 - Performing autonomous response tasks based on detected activity
 - Adaptability to different environments
- ✓ While completing all missions is not mandatory, strive for creativity and innovation in your solution.
- ✓ Be prepared to present your robot's functionalities clearly to the judges.

Ethics Code for Teams:

- Participating and learning are more important than winning the prizes.
- Teams are encouraged to learn and master new skills while having fun together.
- It is not whether you win or lose, but how much you learn that counts.
- Join the global community of inventors and practical problem-solvers across Africa and the globe at STEM Festival.

STEM Festival Team

Safe Cities

Robotics - Advanced Category (18 -25 years old)

Category Focus: **Smart Surveillance Solutions**

Introduction:

Welcome to Port Harcourt City, a bustling metropolis on the cutting edge of technology. However, with innovation comes new safety and security challenges. As a team of robotics enthusiasts or engineers, you've been tasked with developing a next-generation smart surveillance solution.

Mission:

Design and build a robot that utilizes a network of interconnected cameras and AI software to autonomously detect suspicious activity in a designated area. Your robot should then initiate appropriate responses based on the situation.

Tasks:

1. **Networked Camera System:** Design and build a robot that incorporates a network of interconnected cameras. This network could be a combination of fixed cameras mounted on the robot and mobile cameras.
2. **AI-Powered Video Analytics:** Develop or integrate AI software that analyzes video feeds from the camera network in real-time. This software should be able to detect suspicious activity such as loitering, unauthorized access, or potential threats.
3. **Autonomous Response:** Program your robot to initiate pre-defined responses based on the type of suspicious activity detected. Responses could include:
 - Sending alerts with video evidence to a central security command center.
 - Deploying smaller robots for further investigation.
 - Triggering alarms or activating deterrents.
4. **Adaptability:** Design your system to be adaptable to different environments. Consider factors like lighting conditions, weather variations, and potential obstacles.

Sample Image



This is just an example. Your robot does not need to look like this or have the same design to be successful in the competition. Use it as a source of inspiration!

Design Tools (Your Free Choice):

- 3D modeling software (e.g., SolidWorks, Fusion 360, FreeCAD) for designing robot parts and camera housings.
- CAD (Computer-Aided Design) software for designing the overall robot structure and camera network layout.
- Simulation software (e.g., Gazebo, V-REP) for testing robot behavior and camera placement virtually.
- Etc.

Programming Software (Your Free Choice):

- Python: Popular language for AI development and image processing.
- C++: Powerful language for real-time video analysis and robot control.
- Etc.

Scoring/Earning Points:

Section 1: Robot Design (25 points)

NB: Teams may opt to focus their efforts on the software aspect of the tasks if they encounter any constraints with their hardware design. This allows them to concentrate on the remaining 75% of the points allocated for the competition.

Criteria	Description	Points Awarded (Max: 25)
Mechanical Design	Innovation and effectiveness of the robot's mechanical structure and components.	5
Electronics and Sensors	Integration and functionality of electronic components and sensors.	5
Build Quality	Durability and craftsmanship of the robot.	5
Power Management	Efficiency and reliability of the power system for sustained operation.	5
Adaptability	Ability to modify and improve the robot for different tasks and environments.	5

Section 2: Networked Camera System Design (25 points)

Criteria	Description	Points Awarded (Max: 25)
Camera Coverage and Resolution	Effectiveness of camera placement and video quality for comprehensive surveillance (wide-angle, high-definition, night vision capabilities).	5
System Reliability	Consistent and accurate performance of the networked camera system.	5
Scalability and Expandability	Ability to integrate additional cameras or adapt to larger surveillance areas.	5
Data Security	Measures in place to ensure secure data transmission and storage of captured footage.	5
User Interface Design	Clarity and ease of use of the interface for monitoring and controlling the camera system.	5

Section 3: AI-Powered Software for Video Analysis (25 points)

Criteria	Description	Points Awarded (Max: 25)
Object Recognition Accuracy	Effectiveness of AI algorithms in accurately identifying people, vehicles, and other objects of interest.	5
Anomaly Detection	Ability of the software to detect suspicious activity, unusual movement patterns, or potential threats.	5
False Alarm Reduction	Minimization of false alarms triggered by the software.	5
Real-time Processing	Ability to analyze video feeds in real-time for timely response to security threats.	5
Algorithm Transparency	Clarity and explainability of the AI algorithms used for analysis.	5

Section 4: Autonomous Response System (25 points)

Criteria	Description	Points Awarded (Max: 25)
Automated Response Triggers	Effectiveness of AI in triggering appropriate responses based on detected activity (e.g., alarms, notifications, escalation protocols).	5
Response Action Flexibility	Ability of the system to tailor its response based on the severity and nature of the threat.	5
Integration with Security Systems	Seamless integration with existing security measures (e.g., lights, sirens, communication with security personnel).	5
Remote Control Override	Ability for human operators to override automated responses and take manual control if necessary.	5
System Reliability	Consistent and reliable performance of the autonomous response system.	5

Section 5: Adaptability to Different Environments (25 points)

Criteria	Description	Points Awarded (Max: 25)
Weather Resistance	Ability of the robot and camera system to operate effectively in various weather conditions (rain, sun, extreme temperatures).	5
Lighting Conditions	Effectiveness of the system in capturing clear video footage in both bright and low-light environments.	5
Terrain Adaptation	Ability of the robot (if applicable) to navigate uneven terrain or obstacles within the surveillance area.	5
Power Management	Efficiency and reliability of the robot's (if applicable) power management system for sustained operation.	5
Security Measures	Physical security features to protect the robot (if applicable) and camera system from theft, tampering, or vandalism.	5

Overall Comments:

Please Note: Judges may award bonus points for exceptional performance, unique functionalities, or innovative solutions beyond the core requirements.

Remember:

- Prioritize safety in your robot design and operation.
- Focus on real-world application by considering the needs of human first responders during emergencies.
- Be prepared to competitively demonstrate your robot's capabilities and explain its design decisions to the judges.

We wish you the best of luck in creating a life-saving Smart Surveillance Solution robot for Port Harcourt City and Nigeria!