School of Aerospace
& Automotive Engineering
COLLEGE OF ENGINEERING & ARCHITECTURE

54th Virtual UNISEC-Global Meeting

IoT constellation mission for a safer desert roads

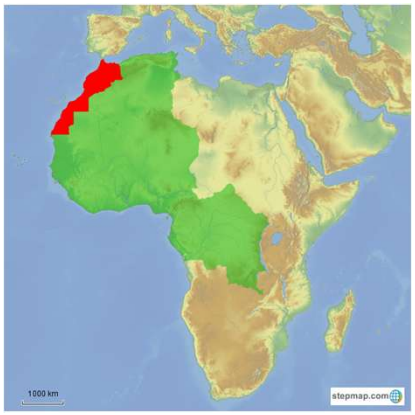
Project team: Intenational University of Rabat- Morocco

IoT constellation mission for a safer desert roads

- School of Aerospace engineering started in 2011.
- Offers training in Aerospace and Automotive engineering.
- Number of Alumni: around 550
- Partnerships with international universities (GIT,MSU,Strasbourg, Lorraine)
- First time participating in UNISEC global meeting.

Project team

IoT constellation mission for a safer desert roads



IoT constellation mission for a safer desert roads

- The number of camels recorded in southern Morocco is 171,956, mainly found in the southern regions.
- The construction of the main Agadir–Laâyoune road has led to an increase in accidents involving dromedaries, as they often wander onto the roads and cause collisions.
- Sand accumulation on roads can seriously disrupt traffic and cause accidents and damage infrastructures.
- Moroccan authorities conduct regular maintenance operations, such as clearing sand with specialized equipment and stabilizing dunes with fixing barriers to ensure the continuity of road traffic, particularly in the regions of Laâyoune and Tarfaya.

Camel movement monitoring

Objectives

- Prevent collision
- Support research
- Manage herds

Users

- Authorities managing desert traffic.
- Camel owners and herders.
- Researchers studying animal movement patterns.
- Transport and logistics companies operating in the region of sahara.

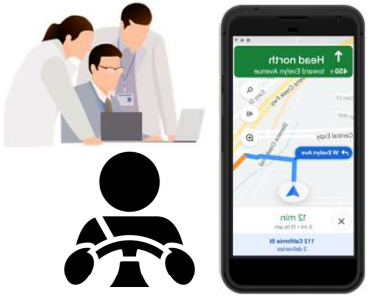
Benefits

- Reducing road accidents and improving safety in desert areas.
- Enhancing data-driven decision-making for desert transport.
- Preserving cultural and economic significance of camels in Morocco.

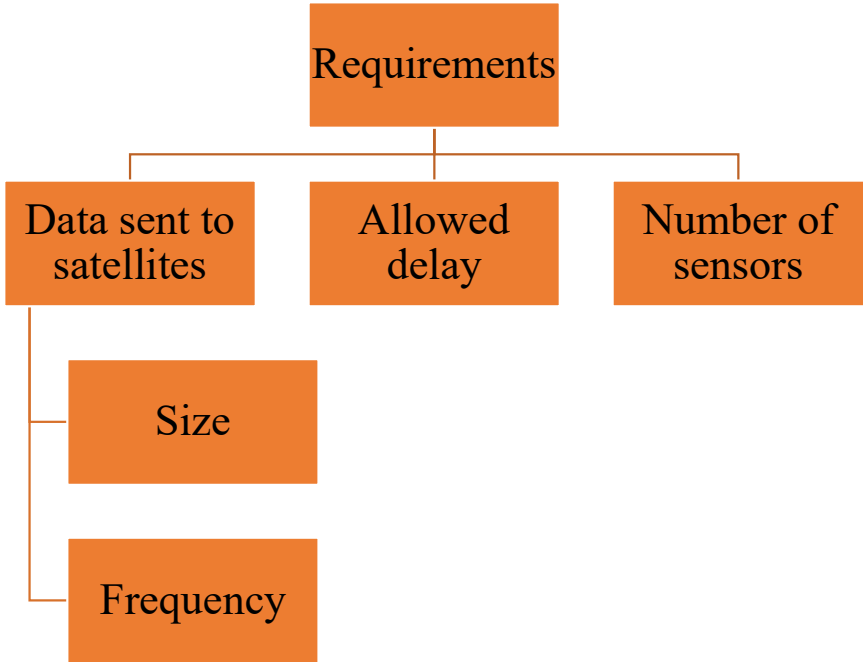
Camel movement monitoring: How IoT mission works

GPS location, motion patterns, activity, temperature and proximity alerts

GPS location, motion patterns, activity, temperature and proximity alerts



Camel movement monitoring: Requirements



- **Data size**
  - Each GPS fix (latitude, longitude, timestamp, and additional metadata) is typically 50–100 bytes per transmission.
  - If motion/activity data (accelerometer, temperature, battery status, etc.) is included, the data packet size can range from 200–500 bytes.
- **Data frequency**
  - Every 10–30 minutes under normal conditions.
  - Every 1–5 minutes if a camel approaches a road.
- **Allowed delay**
  - Regular GPS updates: Up to 1–3 hours delay is acceptable for periodic monitoring.
  - Urgent alerts (e.g., unusual movement patterns): Should be transmitted within minutes to 30 minutes
- **Number of sensors**
  - A reasonable estimate for camel tracking could be 10–30 GPS collars per 10km² to provide sufficient movement data.

Sand presence detection

Objectives

- Prevent accidents and improve safety
- Optimize road maintenance scheduling for clearing sand obstructions.
- Enhance emergency response by guiding rescue teams to safe paths.
- Assist autonomous vehicle navigation

Users

- Road safety & maintenance teams
- Emergency response teams (for rerouting rescue operations).
- Satellite agencies (integrating IoT-based road monitoring).
- Drivers
- Autonomous vehicle navigation systems for desert roads.

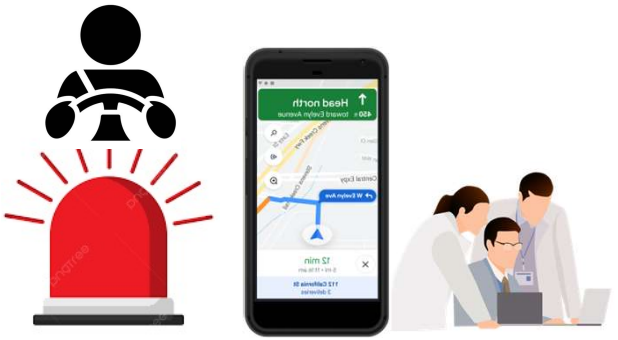
Benefits

- Enhances road safety for travelers
- Reduces economic losses due to blocked transport routes.
- Improves emergency response efficiency
- Contributes to research on desertification and climate change effects.
- Supports self-driving vehicle adaptation in extreme desert conditions

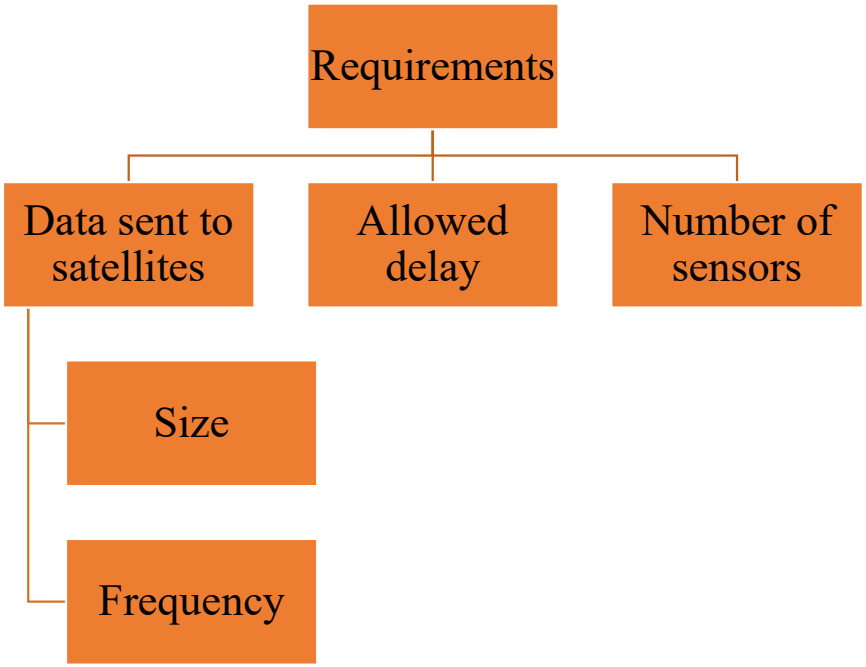
Sand presence detection

Optical data from Lidar sensor measuring surface reflection and sand height to detect road coverage

Road state



Sand presence detection: Requirements



- **Data size**
  - Image-based AI detection: 10 - 50 KB per image (if compressed).
  - Lidar point cloud data: 500 KB - 1 MB (if detailed mapping is required).
- **Data frequency**
  - Real-time (every 1-5 minutes) if sand buildup is detected.
  - Every 30 minutes for routine monitoring of road conditions.
  - Event-based transmission (only when sand accumulation reaches a critical level).
- **Allowed delay**
  - For emergency alerts: <1 minute (low latency).
  - For routine updates: Up to 5-10 minutes delay is acceptable.
- **Number of sensors**
  - If using fixed roadside sensors: 10 - 50 sensors per 10 km (depending on road density).
  - If mounted on vehicles (desert transport/trucks): 5 - 10 sensor-equipped vehicles per 10 km².
  - If using aerial drone-based monitoring: 1 - 3 drones covering 10 km².