IT UNIVERSITY OF COPENHAGEN

Internet Of Things Report

Master of Science in Computer Science

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Contents

Question 1

We need a sensor device to track assets (vehicles and animals) in two wildlife parks:

- **Knuthenborg Safari Park**, Denmark

- **Mpala Research Center**, Kenya

The parks are large, and the devices must be able to track the location of the assets with a high degree of accuracy. The devices will be used to monitor the animals' movements and behavior, as well as to track the vehicles used for research and conservation efforts. The parks are located in different parts of the world, and the devices must be able to operate in different environments. The devices must be able to withstand harsh weather conditions, including extreme temperatures, rain, and dust. The devices must also be able to operate in remote areas with limited access to power and communication networks.

Functional requirements

- Location tracking (GPS)

- Measure acceleration (motion state)

- Measure particulate matter concentration

- Record data every hour (preferably real-time reporting)

Non-functional requirements

The devices must have an accuracy of at least 500 meters. Apart from that we need to consider environmental conditions, battery life, size, and cost.

Given that the devices will be used in wildlife parks, they must be able to withstand extreme temperatures, rain, and dust. Knuthenborg Safari Park is located in Denmark, where temperatures in worst case can drop to -20

degrees Celsius in winter and have hot humid summers. Mpala Research Center is located in Kenya, where temperatures can reach close to 40 degrees Celsius in summer.

Because the device needs to be able to track animals as many types of animals are present in the parks, the size of the device must be small enough to be attached to the animals without causing discomfort.

- Accuracy: ≥500 m or more

- Withstand extreme temperatures (e.g., -20 to 40 degrees Celsius)

- Withstand rain and dust (IP67 or better)

- Battery life: 0.5 years or more

- Track animals and vehicles

- Size has to be Small

- Cost: $100 or less

Device selection

Acceleration For the acceleration we can would want to use a accelerometer. An accelerometer is small and does not consume much power. It can measure the acceleration of the device in three dimensions so vertical movement of birds can be detected too if needed. An example of a sensor could be the ADXL345, which measures at 3mm x 5mm x 1mm, has an Ultra-low power consumption down to 2 μAm, can measure acceleration in three dimensions. It has a range of up to +/-16g and can operate in temperatures from -40 to +85 degrees Celsius.

Particulate matter concentration For the particulate matter concentration we can use a laser particle counter. The laser particle counter is a small device that can measure the concentration of particulate matter in the air. It uses a laser to detect particles in the air and can provide real-time data on the concentration of particulate matter.

Location tracking For the location tracking we can use a GPS module. The GPS module is a small device that can provide real-time location data. It uses satellite signals to determine the location of the device and can provide accurate location data even in remote areas. An example of a GPS module is the u-blox NEO-6M

Question 2

Question 3