Human/Animal Footprints Monitoring Using Internet Of Things

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Project Summary

Footprints monitoring can be one of the most effective and least expensive ways to detect many human/animals activity. However, it is difficult in boreal areas due to the harsh environment and the uncertainty of human/animal movement patterns. Furthermore, due to the cost, it's difficult to deploy the traditional wireless sensor networks(WSNs) widely. Also, sending the sensed information promptly is costly and impractical. Is that possible to use the open source hardware, software, and open standard to develop an accurate, practical, inexpensive WSN to monitor human/Animal footprint?

The objective of our project is to build an accurate and cost-effective tool to detect the impact of human footprint and monitor the habit of the wild animal through open hardware, software, and interoperable IoT standard.

We build three types of trail counter which is a low-cost, open-source measurement device that counts pedestrian, bikes, ATVs(All terrain vehicle) and cars on trails, paths, and sidewalks.

The first one is based on ultrasonic ranger; the second one is based on passive infrared motion(PIR) sensor; the last one is based on the differential pressure sensor.

To let device send data in a remote area, we build a private LoRaWAN network and test the network coverage. For allowing device run longer in the field, we also make a solar system to supply power.

Progress To Date

We deployed the ultrasonic-based solution and PIR based solution on Steve's backyard and monitored for a week. Based on the data we collected, PIR based solution can provide relevant, accurate results, whereas the ultrasonic-based solution is not credible right now. Due to the safety reason, the differential pressure sensor based solution wasn't tested and will be verified in the next field session

Fig 1. PIR Motion Sensor

Fig 2. Differential Pressure Sensor

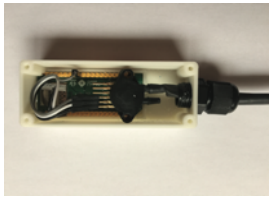

Fig 3. Ultrasonic Ranger Sensor

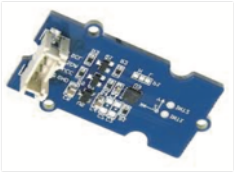

Fig 4. Acceleration sensor

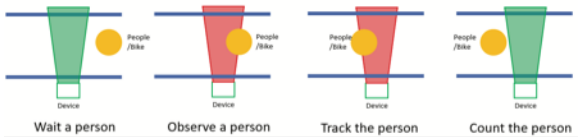

Fig 5. Principle of Ultrasonic Ranger Counter

Our LoRaWAN network can receive sensed information from the client, and upload to SensorThings API cloud. The most extended communication range of this network can reach to 5 KM in the condition of no high obstacles. For the solar system, it can provide consistent power to the device under sufficient sunlight, but it will only offer three days power to the device if there is no sunlight.

We are at the stage of prototype verification. Our next important task is deploying the prototype in the field and build a LoRaWAN network to support device communication in the following summer.

Fig 6. LoRaWAN Network

Fig 7. Power Supply

Management Implications

The trail counter we try to build compares to the commercial trail counters, should be a cost-effective solution to detect the impact of human footprint and monitor the habit of them.

Thanks to open hardware and IoT standard, we're able to build a functional, cheap trail counter, and it's possible to large-scale deployment of this trail counter.

The solar power system can extend the lifetime of the device from several days to several weeks, so that they can sustain themselves with reducing human participation .

LoRaWAN network can help us build a low-cost, mobile, and secure bi-directional communication system in the remote area with increasing the monitoring area.

Future Work

Our future work will focus on the firmware upgrades which will let the application run as stable as possible. Extending the running time of the platform is also our priority. We're waiting for the new LoRaWAN hardware to deploy a practicable LoRa network. We will test our application in Calgary during the winter to prepare the next year field experiment.

Boreal Ecosystem Recovery & Assessment

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