Autonomous IoT Pet Tracker with Energy Harvesting System

***Abstract*—Thousands of pets are lost or abandoned by their owners every day. To tackle this issue, our aim is to find a way to track them at any given moment. Building such a tracking system has one big challenge: battery life. Nobody wants another "smart" device that needs to be charged every few days.**

We will use IoT and energy harvesting techniques to build an extremely low power consumption tracking system that harvests (recovers) energy from the pet's movements. This will significantly increase battery duration, ideally making the device autonomous.

I. Proposal

A. What is the problem to be solved?

Pet owners need a reliable way of finding their pet when it gets lost. Many pets' lives are lost every day because their owners never manage to track them after they go missing.

B. Business case

This project has an enormous potential: if feasible, this could potentially substitute the actual generation of pet microchips.

Only in the UK, there are estimated [1] to be 8.5 million dogs and 7.5 million cats. A recent study [2] showed that 15% of owners had lost their pet at least once, and a further 15% of them never found it back. Thus, just in the UK, a potential 360,000 dogs and cats could have been saved with this product.

C. Competitor analysis

There are already several GPS pet trackers in the market. However, none of them offers a battery duration superior to 7 days (average is 2-3 days). This is highly impractical; nobody wants to be have to charge their dog's collar every week.

Our product proposes a combination of different solutions to bring battery duration up to months or even years:

- Firstly, we will use an emerging yet widely available IoT protocol called Sigfox, which features extremely low power consumption (~50 μW) (see Table I).
- Secondly, our product will feature an energy harvesting system. This will convert energy from vibrations and animal's movements into electrical energy, which will be used to continuously charge up the battery of the device (see Fig. 1 and 2).

II. Project Development

A. What expertise is needed?

This project relates Power Engineering and Communications.

Group members should be IoT enthusiasts, critical thinkers and have a desire to make an impact in the world they live in.

B. Project Planning

The project will consist of 3 different parts:

1. IoT Tracking device with GPS
2. Energy harvesting and battery charging circuits
3. Put everything together in the shape of a pet collar

The goal is to have a working prototype by the end of the project. The team will initially be split into two sub-teams, each working on one of the first two parts, until January/February. Then, we will all come together for the third and last part.

Protocol	Typical Power Consumption	Range	Max. Data Transfer Speed
Bluetooth	2mW	50-150m	1 Mbps
Wi-Fi	80mW	50 m	600 Mbps
Cellular/3G	5mW	35 km	10 Mbps
Sigfox	0.05mW	3-50 km	1000 bps

Table I. Comparison between Sigfox and typical protocols used by other GPS pet trackers. [3]

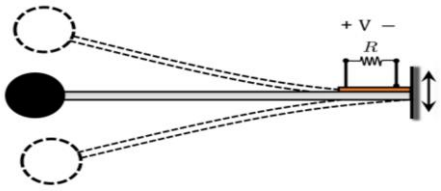

Fig. 1. Schematic of the movement of a typical piezoelectric harvester. [4]

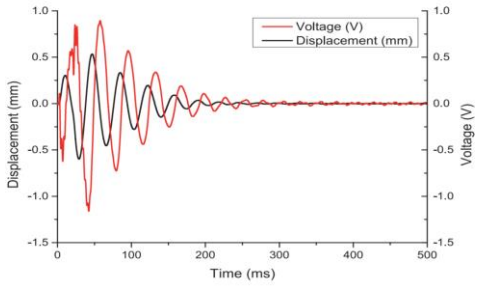

Fig. 2. Impulse response displacement and voltage generated by a typical piezoelectric energy harvester with a 97 kΩ load. [5]

References

[1] http://www.pfma.org.uk/pet-population-2016

[2] http://www.aspca.org/about-us/press-releases/how-many-pets-are-lost-how-many-find-their-way-home-aspca-survey-has-answers

[3] https://www.rs-online.com/designspark/eleven-internet-of-things-iot-protocols-you-need-to-know-about

[4] http://vibrationacoustics.asmedigitalcollection.asme.org/article.aspx?articleID=2092024

[5] http://www.npl.co.uk/publications/science-posters/efficiency-measurement-in-piezoelectric-vibration-energy-harvesters