

PetTracker – Pet Tracking System Using Motes

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ABSTRACT

We describe the design and implementation of “PetTracker”, a networked location aware pet tracking and logging application implemented using motes and sensors. We see this as a novel application of context aware systems that deals with a much-simplified notion of context due to its application to pets. We hope this application can be adopted for pet owners in the future.

Keywords

Location, context, pet, interaction, activities, sensors, motes, visualization

INTRODUCTION

Growth in wireless technology, improved microprocessors, and enhanced power support have all worked to make the dream of pervasive, interconnected “smart” devices a real possibility, and it is clear that the realm of the computer has now expanded far beyond the office and the desktop. With the new capabilities come new challenges for Ubicomp. Context-aware computing must grapple with the subtlety in human interactions. In most cases, physical context is inadequate to represent what humans truly perceive in our environment in order to interact with or within it. Much information exists that cannot be captured with sensors. Even the data that is currently collected by sensors can carry different meanings based on the activities engaged in.

However, one usage that has not been much explored by context aware systems is application to pets. Context-aware pet tracking applications hold great potential. First, the range of activities that pets engage in is much more limited than it is for humans. Many of the low-level activities that are recognized in existing Ubicomp applications [1] are also perfectly suitable for application to pets. An indoor dog or cat interacts with fewer objects, and the objects it interacts with are often stationary (especially when the owners are away, which is when pet tracking becomes most useful). By dealing with a simplified notion of context, a system built for pets can be much more successful in deducing the pet’s status and activities. Second, deploying systems on pets bypasses many of the privacy concerns that have to be dealt with by systems deployed on humans. Lastly, there is a significant portion of the pet-owning population that deeply cares about the pet’s welfare. We see this application as a solution for those pet owners who would like to be aware of their pet’s activities when they are away from home. This system can also be used by pet owners to gain insights to the type of environment preferred by their pets.

Prototypes for networking people and pets have been proposed in the past [4]. Commercial systems for pets also exist such as automatic feeders and RFID identification tags, as well as pure location tracking of pets using GPS [3] (which neglects activity and environment information, and operates poorly indoors). We employed the notion of context for pets and implemented a working system, the PetTracker, to deliver a more sophisticated and rich interaction paradigm for pet owners and their pets. Going beyond GPS coordinates, PetTracker tracks the pet’s activity and environment as well as its location. Instead of simply knowing that the pet is still at a known place, PetTracker aims to tell you what and how your pet is doing while there.

OVERVIEW OF SYSTEM

The PetTracker system allows pet owners to log and track their pets throughout an indoor environment such as a house or apartment. Our current system uses motes with



Figure 1. Mote on cat

environment sensor boards attached to them. One of these motes is attached to the pet (Figure 1) and used to track its location, activity and surrounding

environment. The other motes are stationary and installed in different areas of the apartment (Figure 2). These stationary motes act as tracking nodes as well as report their own environmental conditions. One of the stationary motes is attached to a serial programming board so that it can forward all the sensor data coming in from the motes to a PC for analysis and visualization. The application (Figure 3) can be networked and accessed from anywhere with an Internet connection.

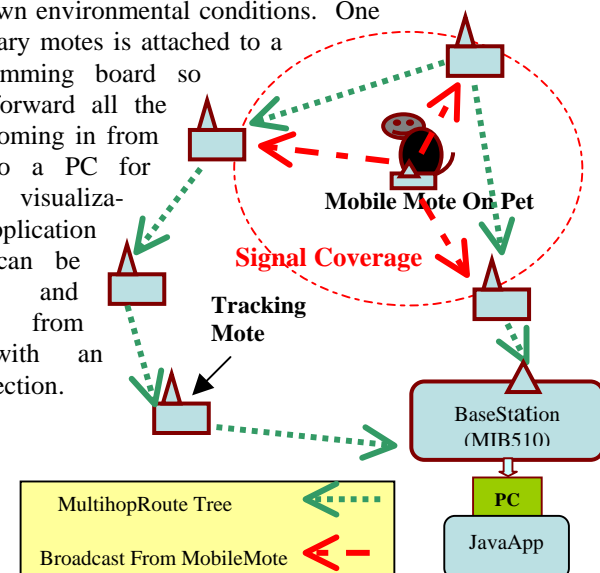


Figure 2. System layout



Figure 3. Location tab of PetTracker application

The hardware - Motes, Sensors, and Interface Boards

The hardware platform mainly consists of Processor Radio boards commonly referred to as motes. These battery-powered devices run TinyOS software [5] and support two-way mesh radio networks. We used a kit from Crossbow [2] that included these motes (MICA2), sensor acquisition cards that are designed to plug into the motes (to detect light, temperature, acceleration, sound), and a gateway and interface board (MIB510) that provides the interface between the motes and the PC.

The TinyOS Applications

We have two different TinyOS applications: one running on the stationary tracking motes and the other running on the single mobile mote. A stationary tracking mote sends a packet with its sensor data every 2 minutes. The mobile mote on the pet sends its sensor data every second. Each neighbor in range of the mobile mote will relay messages from the mobile mote to the base station using a multihop ad-hoc routing protocol. These packets sent by the neighbors are used for location tracking. At the base station, the PC processes all the packets from the mobile mote. We use a simple localization scheme based on the mobile mote's proximity to the stationary motes. Since signal strength is not entirely reliable for positioning, we also take advantage of the acceleration data from the sensors. During periods of inactivity, we presume the location cannot change and filter out false fluctuations in location.

The Java Application and the Database

We wrote a Java application that serves as the interface to pet owners, and it provides the following functionalities:

- Stores sensor data packets to a local persistent database (we used HSQL for its simplicity). This database is completely contained within PetTracker and requires no set up from the user.
- Processes the data from the database and provides visualizations of the pet's past activities, environment,

and locations (right panel in Figure 3), given a specific date range or the last x hours. Also performs intelligent filtering of data to improve accuracy.

- Shows the current status of the pet based on real-time live packets (left panel in Figure 3).

FUTURE WORK

From the initial deployment on a cat, which spanned a period of 72 hours, we discovered many improvements that can be made to the system. First, the MICA2 mote is too large for a small animal. We had to attach it to a harness, and then strap the harness to the cat. Crossbow manufactures a quarter size mote (the MICA2DOT) that should easily fit on a collar and be better suited for a pet. Second, the simple routing protocol currently used in the system can be improved so the mobile mote can more reliably transmit its packets. Third, current activity is deduced from location and some sensor data (such as acceleration); more sensor data that are currently collected can be utilized (such as light and sound) to deduce more types of activities. In addition, richer sensor boards and higher sample rates could provide more opportunities for activity recognition.

Eventually, PetTracker should be smart enough to deduce such activity patterns as hunting, scratching, watching birds outside or sleeping in bed, as well as when and where these activities took place. It will also allow pet owners themselves to identify certain behavior patterns in the application that are tailored to the uniqueness of their pets. It is also our hope that eventually, lessons learned from pet tracking applications can be utilized for application to people (i.e. the elderly) to better serve them and their families' needs.

CONCLUSION

This poster presents an application of context-aware computing focused on pets. Given the predicted decreasing prices on the hardware used in PetTracker, we hope that someday pet owners everywhere can utilize a PetTracker system to be aware of their pet's activities while they are away at work or travelling.

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