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Real-Time Constraints for Activities of Daily Living Recognition

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Introduction

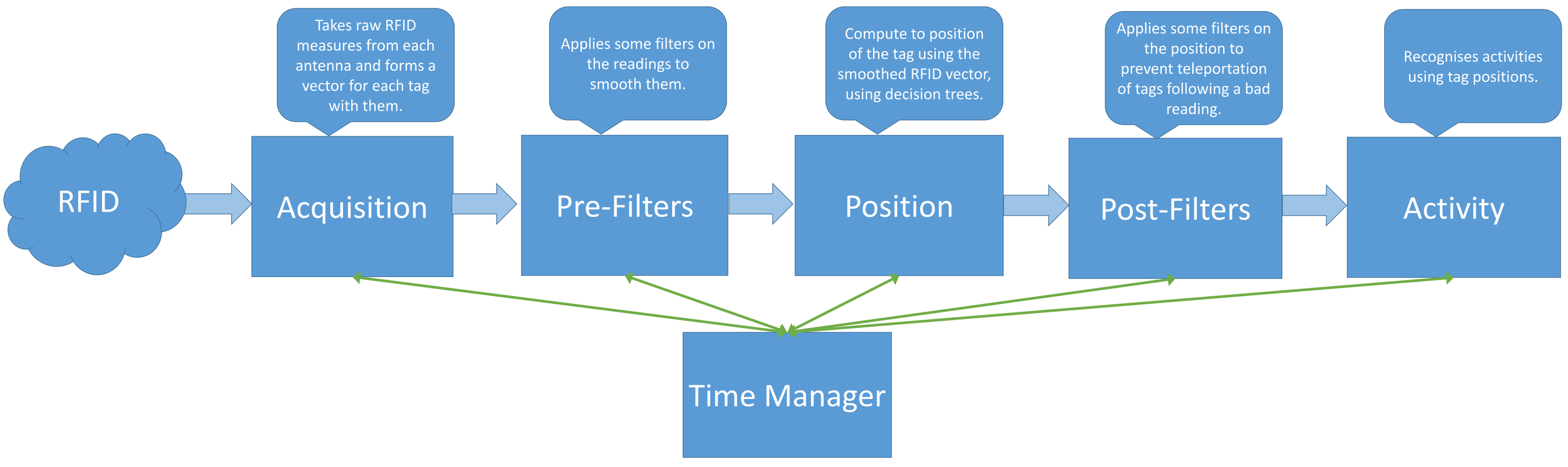
In recent years, we assisted a growing interest in smart homes as a way to allow elder to age in place [1]. Houses equipped with a large range of sensors are seen as a way to reduce the pressure on healthcare systems by delaying institutionalization [2]. Smart homes rely on many technologies for different tasks. One common task is to recognize activities performed in the home. This can be achieve in many different ways. A common way is to use Radio Frequency IDentification (RFID) signals by placing tags then try to infer activities by tracking the tags [3]. We chose to use RFID over other similar technologies because passive RFID tags are cheap, small and have a long lifespan [4].
Here, we present the constraints we need to address to develop a real time activity recognition system. We also present IPADL, the system we built in regard to those constraints.

Real-Time Constraint

IPADL is designed to provide real-time activity recognition inside a smart home. To do so, it must convert RFID readings to recognized activities faster than the delay between two consecutive readings on a given antenna. If it takes more time, then the system will fall behind. For example purpose, let us say that there are 20ms between two RFID readings. Then, IPADL will calculate new activity probabilities every 20ms, but with a 120ms delay. This comes from the modular structure of IPADL. Since activity recognition requires some computational power, the pipeline structure allow good parallelization of distinct tasks. This is also how we can cheat the 20ms delay. In fact, all modules have to respect their own constraint. As there are 5 modules, it can take up to 120ms to compute activities from RFID readings. Still, activities are computed every 20ms.

Time Manager

We can see in the graph below that there is a module called Time Manager (TM). As its name suggests, this is where the constraint is enforced. To do so, each module is responsible to measure its own time, and to report any timeout to the TM. The TM records all timeouts and when the failure rate of a module reaches a given threshold, the TM decreases the frequency of the RFID antennas, giving more time to each module. This mechanism ensures the system never falls behind. The TM also notify an administrator each time the frequency is decreased, so the administrator can make some changes should the system become to slow for its purpose.



Conclusion

In conclusion, IPADL is a system that recognises activities from RFID readings. Its modular structure allows it to do it in real-time. Moreover, a time manager makes sure activities are always recognised at a constant rate, the one used by the RFID antennas.

References

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