

Digitisation and Development of a Tracking System for Small Rental Equipment

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1. Introduction and Challenges

The company 'Alpha', which was a collaborative partner in the project, provides rental services of small and large scale equipment. Tracking of large-scale equipment is currently being integrated, however, it has proven difficult to ensure the same degree of control for smaller equipment, due to the number of individual pieces. This project has investigated the capabilities of UHF RFID, for the purpose of tracking small scale equipment.

Small equipment is tracked as pools using barcodes without unique IDs. Hence, a single barcode is shared between items of the same type.

When a rental period is over, the equipment is repackaged by the customer, before being picked up by Alpha. This leads to loss of control over the repackaged equipment, which has to be recounted manually for it to be inventoried. At best, this is a time consuming process. At worst, during busy periods, recounting equipment is not feasible due to tight delivery schedules between renting periods.

Alpha faces the following logistical challenges:

- Difficulty to know the location or state of equipment when it is rented out.
- Manual recounting of equipment.
- Imprecision due to lack of unique IDs.
- Implausible to teach customers to repackage correctly

2. Technology selection

To determine the best technology for the solution, several, relevant, technologies were analysed. These Technologies were then rated based on their performances in six parameters: Automation, Cost, Lifetime, Reliability, Accuracy and Integration. The ratings can be seen in the table below.

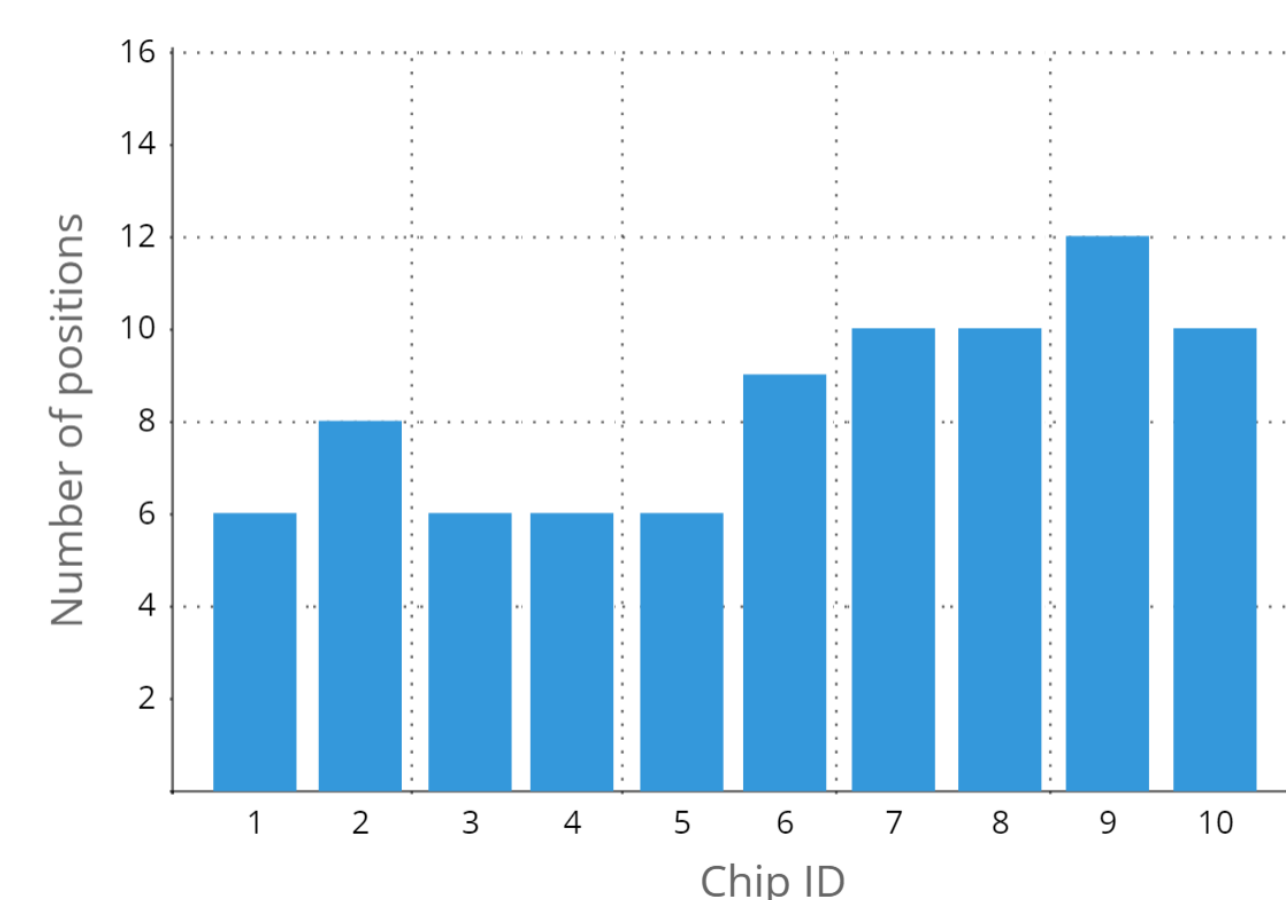
Parameters	Technologies							
	Bar-code	Vision	Z-wave	GPS	BLE	Active RFID	Passive RFID	UHF RFID
Automation	2.5	3.5	5.0	5.0	5.0	4.0	3.5	4.0
Cost	4.5	5.0	1.0	2.0	2.5	2.5	4.5	4.0
Lifetime	4.0	5.0	3.0	1.0	4.0	3.0	5.0	5.0
Reliability	2.0	2.0	5.0	2.5	4.0	5.0	3.5	3.0
Precision	1.0	5.0	3.0	2.0	4.5	4.5	3.0	5.0
Integration	4.0	1.0	2.0	5.0	3.5	3.5	3.5	3.5
Sum score	18.0	21.5	19	17.5	23.5	22.5	23	24.5

The parameters were then weighted, based on input from relevant "Alpha"-employees, which solidified UHF RFID as the most suitable technology

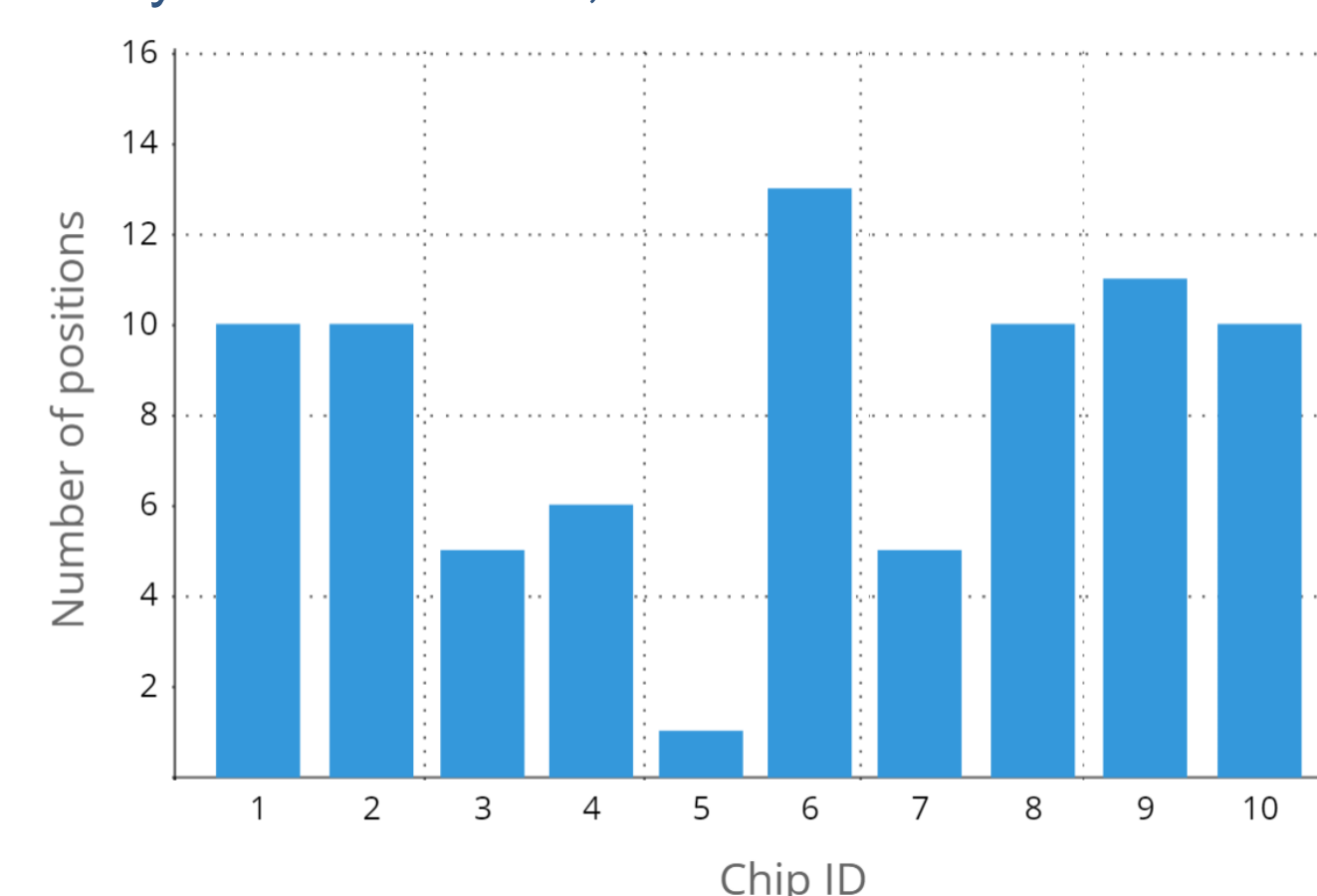
3. UHF RFID tests

Tests were conducted wrt. range, angle, interference, methods for mounting RFID tags to objects etc. before final use case tests. The tests were meant to test the performance of static positions for the potential of a scanning-zone, and natural movement scanning to test what to expect when done manually. Among these, objects were packed within crates, as they would be during regular service. Tests were conducted with objects packed in an orderly fashion, or messily, then scanned from one of a number of positions around or above the crate.

1		8		7
	10		13	
2		9		6
	11		12	
3		4		5



Number of positions each object was successfully scanned from, in an **ordered** crate



Number of positions each object was successfully scanned from, in a messy crate

Examples of tests

- Overall, 16 tests were made, with 500 repetitions, and 5600 overall reads with RFID scanners.
- Tests were made to identify range, and the angle of the scanner wrt. RFID tags.
- Mounting different types of tags in different ways to objects.
- Interference of metal and water.
- Natural movements, such as sweeping or waving the RFID scanner, generally, improved acquisition rates to a point where all objects were found.
- Similar, short-term feasibility tests were made to check viability in other scenarios. RFID was much more capable in these instances, as there was less interference, making implementation cheaper and easier for most objects at Alpha.

4. Conclusions

Based the test results, it was concluded that UHF RFID would be a suitable technology for tracking small scale equipment in interference heavy environments.

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