System for reliable identification and localization of overlying metallic objects using RFID

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This technology (antenna array and algorithm) enables the precise identification of metallic objects and reduces electromagnetic reflection effects. It allows for further optimization of many processes and reliable work flows in a wide range of areas such as asset management in hospitals, production processes, transport & logistics, industry 4.0 and IoT.

- High detection rate of metallic objects
- Precise localization
- Low noise system, high signal-to-noise ratio
- Process optimization, increase of reliability

Fields of application

Contactless 100% acquisition of information/localization of reflective objects without visual contact is useful in many areas. A possible application of the invention presented here is the identification of metallic objects such as surgical instruments. However, other applications are also conceivable in which many (metallic) objects are identified simultaneously (bulk detection), especially in cases where objects are located in cluttered environments, e.g. in logistics or in production processes.

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Service
Technologie-Lizenz-Büro GmbH has been entrusted with exploiting this technology and assisting companies in obtaining licenses.

Background

Contactless identification of closely adjacent or overlying metal objects via RFID is a great challenge, since the objects to be identified are close to the antenna, which has a negative impact on the antenna properties and the detection system. In addition, in many cases, the objects are located in cluttered environments, so that the transponders of certain objects are either in "dead spots" or are shielded by other objects.

Problem

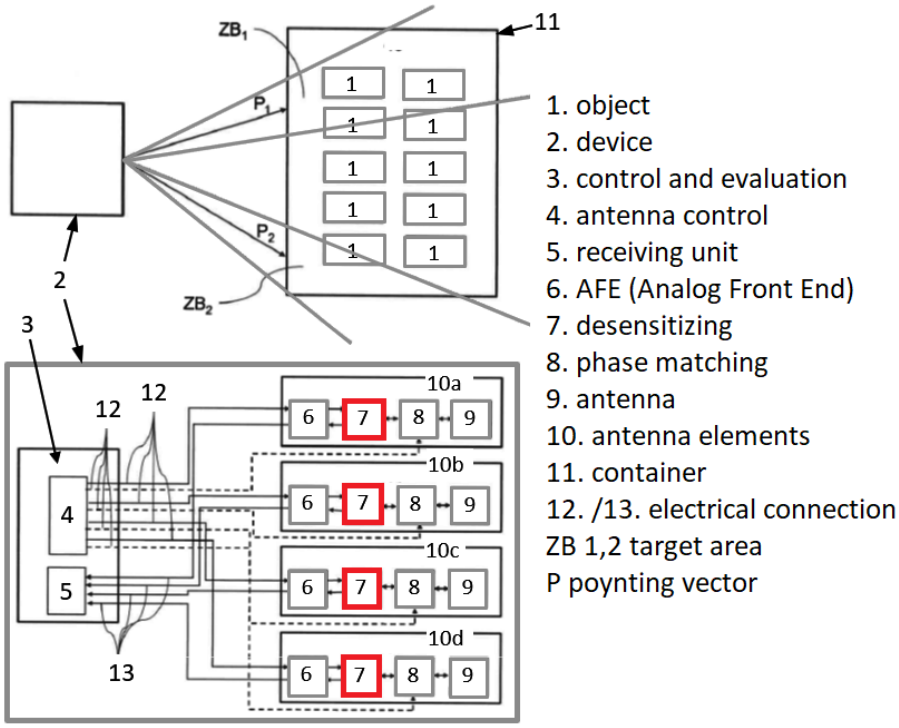
The following partial solutions are considered state of the art: Methods and circuits for carrier leakage suppression (CLS), antenna arrays and beam steering technology (the individual antennas are controlled via phase-shifted and amplitude-adjusted signals). While these solutions can contribute to an improved detection of metallic objects via RFID, they cannot guarantee a 100% detection rate as required by the industry. Even precise localization of objects could not yet be achieved using these conventional methods.

Solution

The invention improves the identification of tagged metallic objects and reduces electromagnetic reflection effects. It is based on two major innovations:

a) Antenna array with individual carrier leakage suppression (7, see fig.) and phase matching (8). For each antenna (10) the occurring reflection is individually taken into account and compensated for by a CLS circuit (7). This results in a significant increase in the signal-to-noise ratio and thus a significantly higher detection rate.

b) A newly developed algorithm for recognition and localization of objects. Beam steering (synchronous control of all AFEs or antennas with individual phase and CLS) is used to scan the detection area. At the same time, a dynamic CLS control is run to obtain a minimum reflection at the receiver input. The procedure is repeated several times according to a newly developed algorithm until either no more objects are found or alternatively a given time limit has been reached.



1. object
2. device
3. control and evaluation
4. antenna control
5. receiving unit
6. AFE (Analog Front End)
7. desensitizing
8. phase matching
9. antenna
10. antenna elements
11. container
12. /13. electrical connection

ZB 1,2 target area

P poynting vector

Schematic representation of the system according to the invention.

Publication and links

Bourouah, M., Goridko, V., Schumacher, D., Scheithauer, H., Knappmann, S., & Nommensen, P. (2015). „Identification of surgical instruments using UHF-RFID technology, Current Directions in Biomedical Engineering", 1(1), 318-321; doi: https://doi.org/10.1515/cdbme-2015-0079