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INTELLIGENT MOVING SERVICE ROBOT NAVIGATION TECHNIQUE USING RFID TECHNOLOGY FOR TRANSPORTATION INSIDE SMEs

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Radio Frequency Identification (RFID) is a revolution in industrial control, because it has the potential to simplify and make more robust tracking of parts or part carriers through manufacture, storage, distribution, and at the end of the supply chain. [1] We try to present intelligent mobile robot navigation technique using radio frequency identification (RFID) technology. RFID systems use radio waves to transfer data from electronic devices (TAG) to the reader, and then the reader forwards the received data to the control unit further processing. In today's digitized world, radio frequency identification (RFID) is becoming a major way of digital identification for people, animals, objects, buildings, etc. A navigation processing of the characteristics of the analog signal RFID is a very good alternative to the different types of navigations. Mobile robot has to navigate in unknown areas without a system vision and planned map of the robot -workspace. We setting up RFID in 3-D space, so that the lines connecting their projections in the field define free time along robot can (or wants to) move. This algorithm is able to find the target in an unknown work space, and also track the desired trajectory with high accuracy. The proposed solution provides a modular, computationally efficient, and cost-effective alternative to other navigation techniques for service robots, such as, for example somewhere in industry.

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1.0 Introduction

[2], [7] Bar code technology is currently the most for the labeling of products that allows unique identification of products and accelerates their flow from the manufacturer to the end customer. This technology has only one flaw, and that is the necessity for access product to its bar code could be read. Radio frequency identification (RFID) was conceived as a simple replacement of bar codes where the product identification carried out wirelessly via radio waves. Using such a system removes certain limitations that exist when using bar codes, such as need for immediate visibility of the code by the reader, a small distance at which it can be read, problems with wear and tear or damage the label with barcode labels, slow at reading larger quantities of products, and the like.

RFID stands for radio frequency identification. It is a technology that uses radio frequency waves or changing magnetic field for exchanging information between the portable device / memory and computers. The basic components of an RFID system are the transponder and reader / writer. Transponder chip that is transferable in its memory contains data, and the reader device at a distance can read data stored in the memory transponder. Usually it's a unique identification number, in addition may contain some other data. The reader can read forwarded to other systems, usually to a microcontroller or computer.

Universal Biochip would replace all existing cards that people use today (ID card, driving license, passport, health insurance card, credit cards, etc...). Existing biochips to store small amounts of information in length from 10 to 15 characters. In the future we expect the development of technologies that will enable the storage of larger amounts of information. Opponents point out that our technology this technology too leads to a situation where "big brother" can have absolute control over us and to all personal information.

2.0 RFID systems

[3], [4] Radio frequency identification (RFID) the technology of wireless transmission of information that is used to identify individual objects using radio waves.

An RFID system consists of three basic components, shown in Figure 1.0:

1. *Tag* (*Transponder*), which consists of a semiconductor integrated circuit, an antenna, and sometimes the battery.

2. Second reader, which consists of an antenna, a radio frequency (RF) hardware and other control electronic modules.

3. Third controller or control, whose role often takes personal computer or workstation that does the job and database management through software.

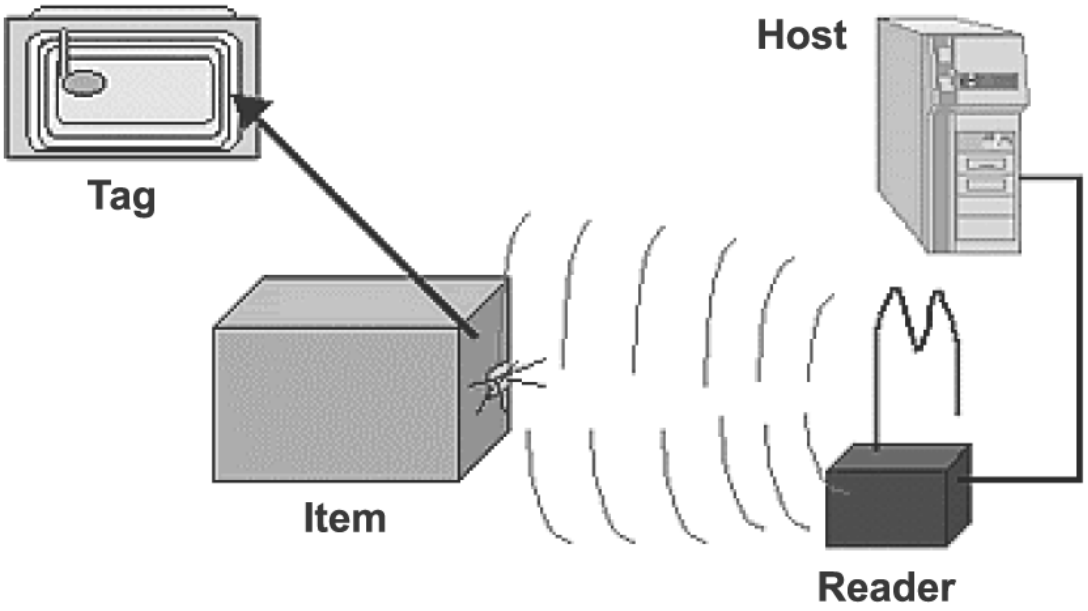

Figure 1.0 RFID system

2.1 RFID Tag (Transponder)

[7] Each tag is principally a provider of information on which can be written a whole range of information (related to the origin, composition, quantity, etc...) That the same product is uniquely identified and distinguished from the other. RFID tags or transponders allow these "read" and "write" data.

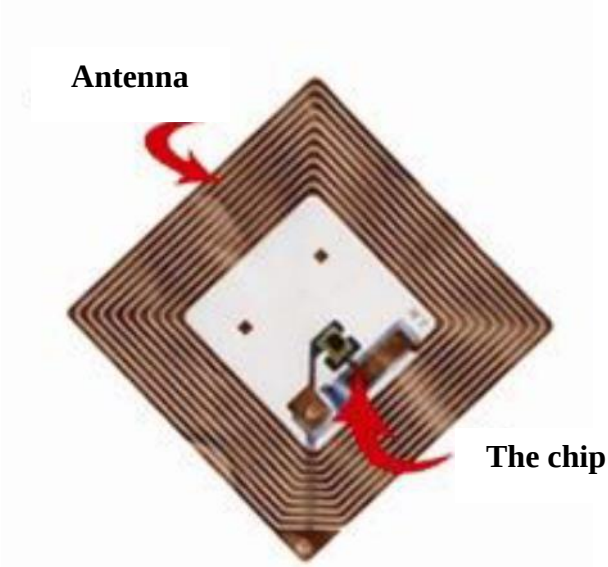

Figure 1.1: Display of the antenna and the chip with a passive RFID transponder

Passive tag - Do not contain internal power supply, but their power from the current electronic stimulation of the antenna arriving input radio frequency signal sent by the reader.

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Figure 1.2: Passive RFID transponder label

Contain a battery that is used for their own power supply (which results in a finite useful life of up to several years), which enables them to reach up to several kilometers.

Figure 1.3: Active RFID transponder

2.2 The physical design tag (transponder)

Physically, generally three types of RFID tags:

- tag (transponder)
- "Smart" labels
- RFID circuit board (PCB).

Figure 1.4: Different types of RFID transponder

[1], [5] Generally, RFID readers consisted of three parts: Antennas, RF modules (which are responsible for communication with the RFID tag included) and the controller, which is

responsible for communication with the controller. In Figure 1.6 shows some of the structures of RFID reader.

Figure 1.5: Examples of RFID readers

Antennas readers are most complicated part of RFID, when it comes to designing the antenna. For shorter frequency band (less than 10 cm) antenna are integrated in the reader for longer range eg. 3 to 5 m, antennas are generally external, and are related to a distance to the reader.

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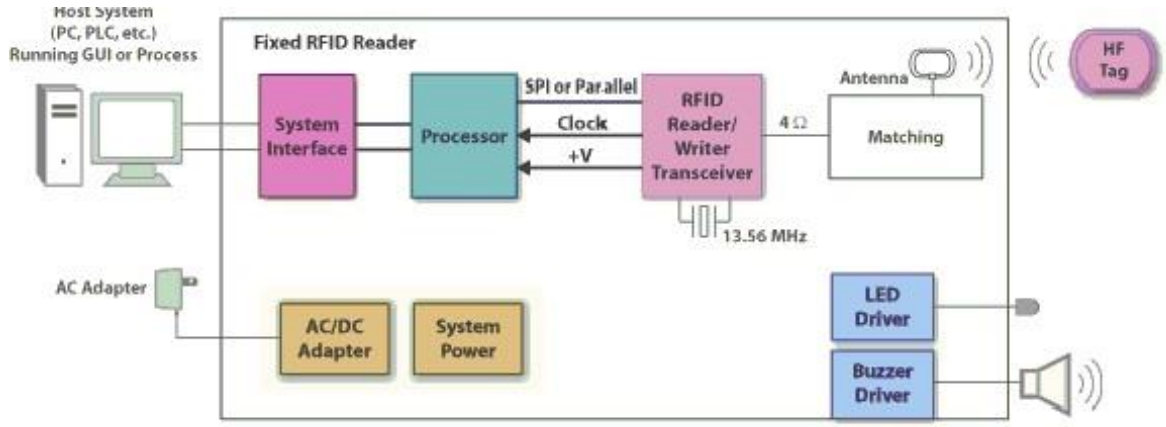


Figure 1.6: Examples of RFID reader with external antenna

Characteristics of RFID readers are:

- Operating Frequency (HF or UF)
- Support for different protocols tags (ISO, EPC),
- Different regulatory regions of the world,
- Networking multiple readers,
- The ability to manage multiple antennas etc...

2.3 RFID computer or controller

[6], [7], [8] A necessary part of any RFID system is a computer system. It consists of computer hardware, and the software for data processing associated with the reader computer system. This software is also called RFID middleware, or application that operates between applications and networks.

Therefore, the RFID controller is the "brain" of the entire RFID system. They have the task of networking a large number of RFID readers and the central information processing. The controller in a network is usually a personal computer, PLC, a workstation or a micro controller. It uses the information provided by the reader to:

a) stocks tracked and informed about the state procurement of goods in the warehouse and the need for new supply,
b) monitor the movement of objects through the system and directed to specific production processes,
c) Determined the identity of the authorized users with access to the system contactless (RFID *tag's* in the form of a card), etc...

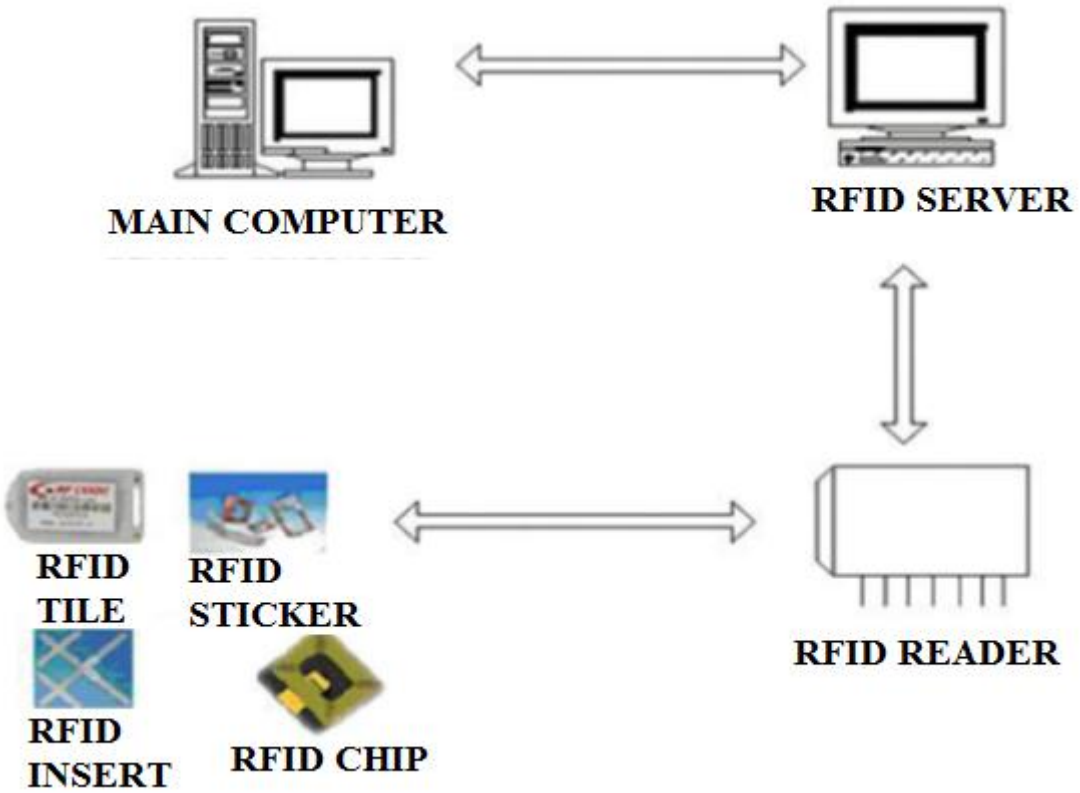


Figure 1.7: Structure of the RFID system to the controller

3.0 Working principle of rfid systems

[8] The goal of any RFID system is simpler and faster to compile information about each unique product in a digital format that allows the fastest further processing thereof. In Figure 2.2 shows a simplified model of the functioning of the RFID system, its elements and the

relationships between them. RFID tag, which is located on or in the product, is being irradiated radio waves emitted by the reader and its antenna.

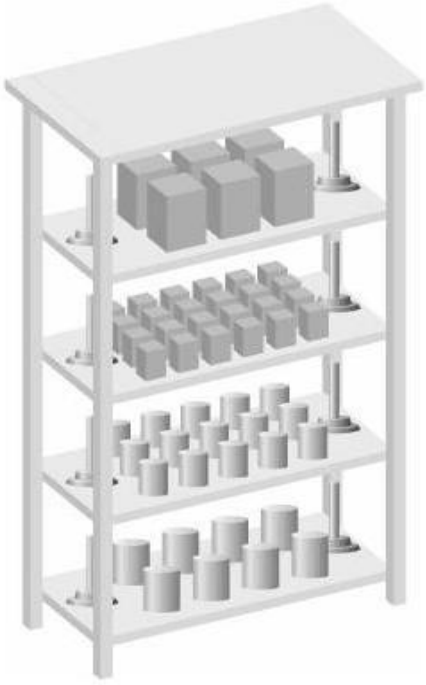
3.1 Handhelds

Handhelds with integrated antennas and controllers allow you to scan tagged items do in situations when it is expensive or impossible to relocate them to the reader. The use of handheld RFID reader is similar to the use of conventional bar code reader.

Figure 1.8: Motorola handheld RFID reader and the use of RFID handheld reader

3.2 Smart shelves

The application of which says a lot, which is very little applied in practice as RFID "smart" (smart) shelves. These policies represent a system in which the built-in antennas to recognize the placing and taking items from the shelves and read all the items off the shelf, at the request of the user. In this way, real-time monitoring allows items on shelving in the shop.



3.3 The use of RFID technology in library

[9] The warehouse can be set fixed RFID reader that will control the complete entry and exit of books in library. Each passage of book through the warehouse door activates the reader who reads the goods leaving and entering the warehouse. In this way it is possible to automatically read the traffic of goods and maintain updated records of storage conditions.

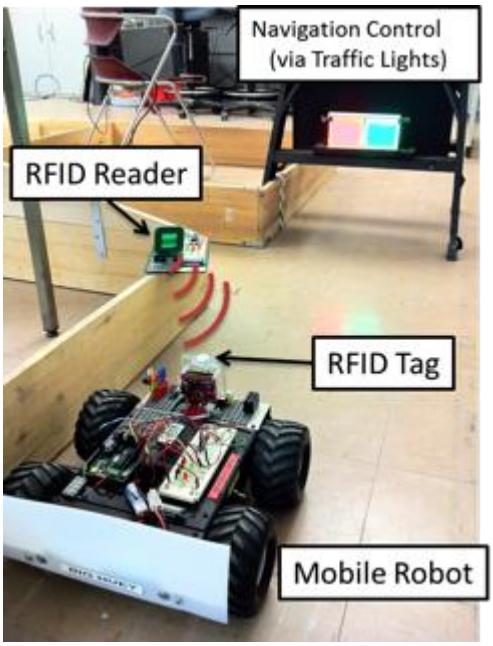
Figure 1.9: Using RFID technology in library

3.4 Application of RFID technology in the process of assembly and disassembly of equipment

[10], [7], and [11] Example assembly is shown in Figure 1.10 is conducted as follows: a conveyor belt parts that come to carry an RFID tag. RFID tag with UID (Unique Identifier) is the unique identifier upon arrival at the first job reads through the RFID reader. Perceiving the UID is compared with a UID from the database, and then the database "pulls" the set of instructions technological assembly process in terms of visual presentation on the monitor in front of the workers. Accessories are then deposited on the bar, where I am on one of the following posts by reading the signal from the RFID tag performs identification (recognition) accessories.

Figure 1.10 RFID system for supply chain management

3.5 RFID robot localization setup



The ability to know the real time location of a robot itself is the pre-condition for other tasks that are commanded such as navigation [12]. Not every localisation problem has the same difficulty. Problems are characterized by different factors. The main factor is the type of knowledge that is given at the beginning and during the operating procedure [13]. The initial robot pose is supposed to be known in *position tracking*, and approaches for it are always connected with presumption of small error exists. This type of problem is a local problem because of the locality of uncertainty. In contrast, the initial robot pose is unknown in *global localisation*. The robot has little or no information concerning its primary environment. Position tracking is included in global localisation. The global localisation problem has a variant, *kidnapped robot problem*. It is more difficult than the former. The kidnapped robot is a place recognition problem triggered when robots are in an unknown environment [14]. Static environments are environments where the only variable quantity (state) is the robot's

pose. In other words, except for the position of mobile robot, all objects keep fixed in such an environment. Location estimation can be effective.

Single-robot localisation deals with only one robot. It is the most widely applied method to robot localisation. All data is gathered together in a single robot platform and interaction event is not required. It is more of convenience than multi-robot localisation [13]. A multi-robot localisation problem can be tackled by localising each robot independently. However, there is an opportunity to obtain better results if robots have the ability to detect each other. Once a robot identifies the relative position of another one, internal beliefs of both of them can be refined based on the estimation of the other one. As a result, both of the robots harvest improvement of precision. This approach is especially attractive for global localisation so as to diminish the uncertainty [14]. Those dimensions represent the four most essential traits of the robot localisation problem. Also there are many representatives that have the effect on the hardness of the problem such as data lost during motion.

3.6 Advantages and disadvantages RFID technology

Advantages:

- ✓ No visibility, empty space between the reader and the transponder;
- ✓ It is possible to read and write data without any contact with the object;
- ✓ Traceability of products by type, model, etc.;
- ✓ Monitoring the production process through time;
- ✓ Monitoring information to control;
- ✓ The shape of the transponder can be varied, adapted to the application;
- ✓ The transponder can fit on the smallest space;
- ✓ The transponder is resistant to the reflection of light, and it does not interfere with either a complete lack of light;
- ✓ The transponder has a very long life, there is the possibility of reusing the same
- ✓ transponders (type for multiple uses) reduce costs, and requires no maintenance;
- ✓ Transponder can be read and / or write information to it at any time;
- ✓ Materials that are not made of metal, paper, wood, plastic, etc...
- ✓ The transponder can have a large capacity memory to store data.
- ✓ Etc...

Disadvantages:

- ☒ The introduction of a fully functional RFID system is not easy
- ☒ The number of companies that use RFID tags is relatively small and limited to the major retail chains
- ☒ Bar code technology in the mass implementation for 40 years
- ☒ Complete design philosophy is based on the possibilities and advantages of bar code Technology
- ☒ It is necessary to completely change the philosophy of design and construction information system, in particular the specialized logistics distribution and trade system, which will be based on the use of RFID technology
- ☒ The problems of harmonization of standards / frequency of work in various countries
- ☒ Etc...

4.0 Conclusion

One of the futures of RFID systems is the concept called the Internet of Things. This concept refers to the unique identification of the object and their virtual representation on the Internet. Radio frequency identification here is seen as a great solution in the identification of objects, and the Internet of things, and is the basis of this concept is based on RFID technology.

Development of Industry fourth generation also is largely based on RFID technology. The leading role in the industry takes it upon so-called fourth generation. Smart Factory where RFID technology is used to identify objects, egg. One of the futures of RFID systems is the concept called the Internet of Things. This concept refers to the unique identification of the object and their virtual representation on the Internet. Radio frequency identification here is seen as a great solution in the identification of objects, and the Internet of things, and is the basis of this concept is based on RFID technology.

Smart Factory where RFID technology is used to identify objects, eg. Along linear strips directs further process control facility or by completing over him further proceedings, etc.. In the future will become inevitable use of RFID technology in a variety of industrial systems, Internet et al.

This paper is considered one of the mechatronic system for automatic identification of objects or objects. Identification was used RFID technology that is technically the latest technology of identifying objects or structures. Design of RFID systems requires knowledge of the functioning of the hardware parts, or components or devices that are used (communication module, reader / writer, tag, control, network interfaces, etc..).

This issue refers to the capability of RFID technology to support a product throughout its complete life cycle. It is easy to imagine that for all the stages that a product goes through, and for its potentially long lifetime, a single tag may not be capable to support all upcoming interaction needs. However, the “upgrading” of RFID tags is a somewhat neglected feature of RFID-enabled products. To have the technology and processes available to support it could have a high impact on industry, but we are certainly far from having them readily available, and creating them would require a significant effort.

Many of the open problems listed are correlated, for example reading reliability and operation in harsh environments, and many of them could withstand a solution due to fundamental physical or economic reasons. To maximize the benefits, this should certainly be taken into consideration when selecting research topics.

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