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INTEREST TARGET OBJECT DETECTION USING RADIO FREQUENCY IDENTIFICATION (RFID) TECHNOLOGY

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Abstract: *RFID (radio frequency identification) is a technology that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency (RF) portion of the electromagnetic spectrum to uniquely identify an object, animal, or person. RFID is coming into increasing use in industry as an alternative to the bar code. The advantage of RFID is that it does not require direct contact or line-of-sight scanning. An RFID system consists of three components: an antenna and transceiver (often combined into one reader) and a transponder (the tag). The antenna uses radio frequency waves to transmit a signal that activates the transponder. When activated, the tag transmits data back to the antenna. The data is used to notify a programmable logic controller that an action should occur. In this paper we are discussing the Radio frequency identification RFID technology as a solution to a problem in industry and other fields. This problem is detecting the position of objects with respect to a reference point (Target detection). In this work, it is needed basic skills in programming using Visual basic at the beginning, then C#. It is also required to know how to deal with database and connect it with C# using SQL Server. We required to make user requirement analysis in making the graphical user interface of this project. We needed to learn about different types of motors and their different operations. We needed also basic knowledge about antennas. All these problems were discussed the solution and the results with all the applications has been given.*

Keywords: *Radio Frequency Identification, RFID, Object detection, motor, database.*

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1. INTRODUCTION

1.1. Radio Frequency Identification (RFID) technology

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source such as a battery and may operate at hundreds of meters from the RFID reader. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture (AIDC).

RFID tags are used in many industries, for example, an RFID tag attached to an automobile during production can be used to track its progress through the assembly line; RFID-tagged pharmaceuticals can be tracked through warehouses; and implanting RFID microchips in livestock and pets allows positive identification of animals.

1.2. Tags

A radio-frequency identification system uses *tags*, or *labels* attached to the objects to be identified. Two-way radio transmitter-receivers called *interrogators* or *readers* send a signal to the tag and read its response. RFID tags can be either passive, active or battery-assisted passive. An active tag has an on-board battery and periodically transmits its ID signal. A battery-assisted passive (BAP) has a small battery on board and is activated when in the presence of an RFID reader. A passive tag is cheaper and smaller because it has no battery; instead, the tag uses the radio energy transmitted by the reader. However, to operate a passive tag, it must be illuminated with a power level roughly a thousand times stronger than for signal transmission. That makes a difference in interference and in exposure to radiation.

Tags may either be read-only, having a factory-assigned serial number that is used as a key into a database, or may be read/write, where object-specific data can be written into the tag by the system user. Field programmable tags may be write-once, read-multiple; "blank" tags may be written with an electronic product code by the user.

RFID tags contain at least two parts: an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, collecting DC power from the incident reader signal, and other specialized functions; and an antenna for receiving and transmitting the signal. The tag information is stored in a non-volatile

memory. The RFID tag includes either fixed or programmable logic for processing the transmission and sensor data, respectively.

An RFID reader transmits an encoded radio signal to interrogate the tag. The RFID tag receives the message and then responds with its identification and other information. This may be only a unique tag serial number, or may be product-related information such as a stock number, lot or batch number, production date, or other specific information. Since tags have individual serial numbers, the RFID system design can discriminate among several tags that might be within the range of the RFID reader and read them simultaneously.

Since RFID tags can be attached to cash, clothing, and possessions, or implanted in animals and people, the possibility of reading personally-linked information without consent has raised serious privacy concerns. These concerns resulted in standard specifications development addressing privacy and security issues

1.3. Readers

RFID systems can be classified by the type of tag and reader. A Passive Reader Active Tag (PRAT) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only). The reception range of a PRAT system reader can be adjusted from 1–2,000 feet (0–600 m), allowing flexibility in applications such as asset protection and supervision.

An Active Reader Passive Tag (ARPT) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags.

An Active Reader Active Tag (ARAT) system uses active tags awoken with an interrogator signal from the active reader. A variation of this system could also use a Battery-Assisted Passive (BAP) tag which acts like a passive tag but has a small battery to power the tag's return reporting signal. Fixed readers are set up to create a specific interrogation zone which can be tightly controlled. This allows a highly defined reading area for when tags go in and out of the interrogation zone. Mobile readers may be hand-held or mounted on carts or vehicles.

2. RFID METHODOLOGY

2.1. Method

Radio Frequency Identification (RFID) is one of the most exciting technologies that revolutionize the working practices by increasing efficiencies, and improving profitability.

It is often presented as a replacement for today's barcodes, but the technology has much greater possibilities, such as the possibility to read the product information at a distance of several meters in addition to, RFID does not rely on the line- of-sight reading that bar code scanning requires to work. RFID system consists of ; Tag chips attached to products carrying identification information, Readers and Tags communicate information between one another via radio waves and finally the Controller connected to the reader can use that information for various purposes.

In this project, we are using the RFID technology in target detection. The target detection is needed in a lot of industrial applications. By making some changes on the readers and tags, the RFID technology can be used in the target detection.

The target detection will be detecting the location of the tag with respect to the reader. We can consider the two perpendicular axes, the abscissa and the ordinates. The reader will be in the origin and the tag is anywhere else. The location is defined by knowing the distance between the origin and the tag, and the angle between two lines: the ordinate, and the line passing between the reader and the tag. By knowing the distance and the angle, the location is detected accurately.

In order to make the RFID reader give us the capability of detecting the location of the tags, the reader antenna should be directional, with a very small beam angle. Since the farther the tag is, the weaker the field strength it receives, therefore, the field strength can be used in measuring the distance, after applying some calibrations to get the relation between the distance and the field strength practically.

To detect the angle, the reader with its antenna will be coupled on a rotating stepper motor with known number of steps. The initial position can be assumed with no constraints. The predicable case is that on the initial position, the reader won't be able to read the tag, as the beam is not directed towards the tag. The motor will be made to rotate until the reader reads the tag. When the reader reads the tag, the interface will display the position of the detected tag.

The angle will be detected by counting the steps that the motor took from the initial position until it stops, and by knowing the angle of the step, the required angle can be calculated. The distance can be known by knowing the field strength. In order to know the field strength, the reader should have a built-in field strength meter, or any later technology that makes the reader able to measure the distance.

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2.2. Block diagram of the system

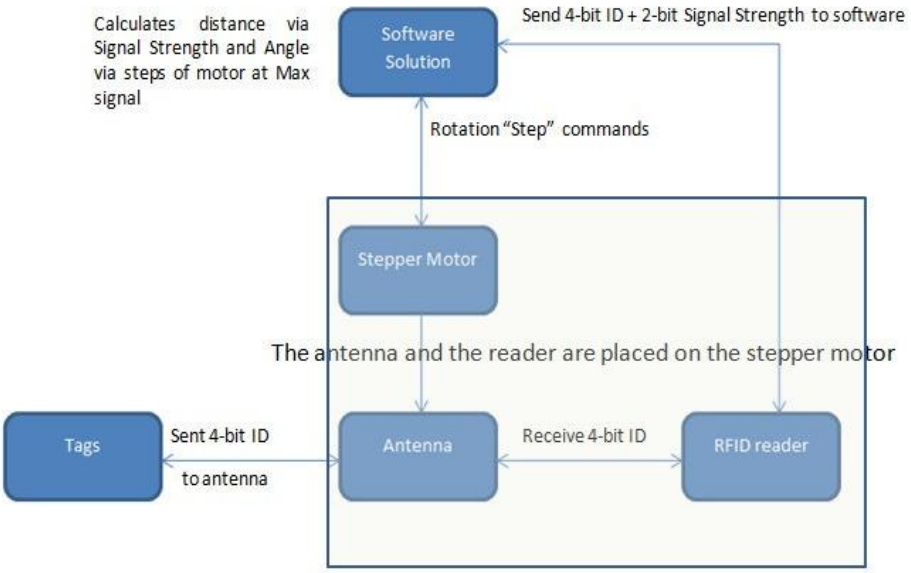

Figure 1: Block diagram of RFID

2.3. Working of RFID

Short for Radio Frequency Identification. The term RFID is used to describe various technologies that use radio waves to automatically identify people or objects. RFID technology is similar to the bar code identification systems we see in retail stores every day; however one big difference between RFID and bar code technology is that RFID does not rely on the line-of-sight reading that bar code scanning requires to work. Basically RFID is a wireless communication system which use RF signal to establish the communication between two ends. RFID system does this communication by using modulated RF signal which is sent between the two main components in the system; the reader and the tag.

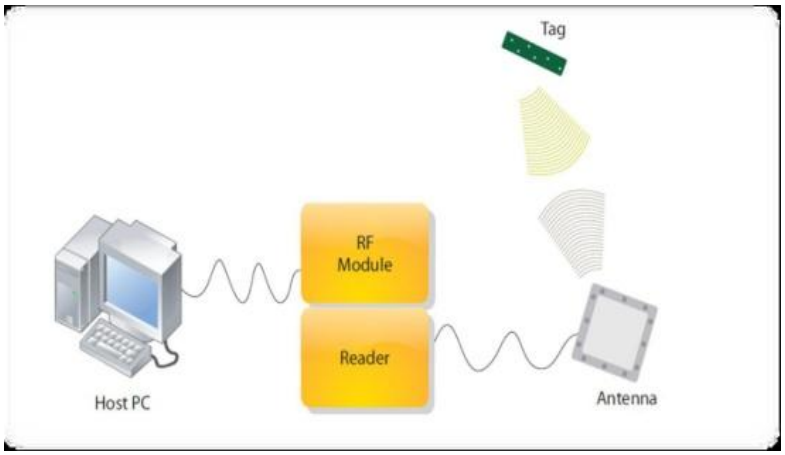

Figure 2: RFID working

2.4. Components of the RFID system

The main components are:

1- RFID Reader

2- RFID Tag or transceiver

Although that physically they are separated but the reader and the tag are inseparable for any applied application. The Reader main function is to read the ID stored in the tag this is done by receiving the modulated signal from the tag. Meanwhile the tag must be placed on the object which needs to be identified like book covers and cloth price tags that is why tags comes in different shapes and sizes in order to cope with the requirements of the application. Tags at least consists of a small antenna and a small silicon chip where data can be processed and stored in. one approach of RFID is that it was built to read one particular kind of tags but recently RFID systems are implemented to read different kinds of tags. RFID readers are also classified into two classes; the first class is the fixed RFID where the reader is fixed during the identification process while the tag is moving. The second class is the mobile RFID where the reader can be moving during the identification process while the tag can be in a stationary position or even moving as well. The two classes are successfully implemented in various numbers of applications by various major electronic manufactures.

2.5. Types of Tags

There are two differentiating factors between Tags

1. According to the on board Power Source
2. According to the Memory type

According to the on Board Power Source, there are three types of tags:

1- Active Tags

2- Passive Tags

3- Semi-Passive Tags

2.6. Advantages of RFID systems

- Reliable system and portable database Easy to use and tags can be simply installed
- Easy way to read tags therefore saving time and effort
- Line of sight is not needed between the reader & the tag unlike barcode system
- Wide reading range, the reader can be up to 10 meters away from the tag

- Anti-collision Identification (multiple access techniques - TDMA/SDMA/FDMA/CDMA)
- Implanted RFID tags
- RFID tags cannot be easily replicated
- RFID tags can stand to harsh environment
- RFID tags can store data up to 2KB
- RFID tags can be rewritable

2.7. Applications of RFID

- Access control in school and universities
- Airport baggage tracking
- Animal Identification and tracking
- Asset tracking
- Automatic vehicle location using RFID (AVL)
- Contactless payment (e-tolling)
- Libraries organization (replacing barcode) Race timing (used in Marathon)

CONCLUSION

An interface between the PC and the stepper motor, and a program that enables us to operate on the motor with the required rotating angle, and the required delay. Simulation to the rotation of the motor in both directions clockwise and anticlockwise. An interface between the RFID reader and the PC and recording the reading results in a database. Simulation of approximated results in detecting the target of the objects, which are the tags, according to the distance and the angle. A demo application of the readers and tags, besides target detection, which can be used in markets (Shopping carts) The RFID can be used as an indicator of objects and can be used in tracking, but not in a fully exact way, and needs development of up to date technology in order to reach full accurate results

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