A Survey on Smart Toolbox Using Rfid

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Abstract:

The manufacturing of automated machines is done by skilled engineers with the required tools in reach at time & place of easy reach. Tool misplacing is a phenomenon that is leading to efficiency loss of 20-25% of working hours which is indirectly related to cost to company. Toolbox & tool chest have a definite position and slot for each size and type of tool.Employee time-in and time-out details and proximity to determine a tool's position and its allotted user. Due to day-to-day increasing non track-ability of tools, a RFID- Arduino circuit which checks the employee details and grants tool chest/ toolbox access.This methodology can be used for service engineer SPC tracking. A integrated system can reduce toolbox replacement from every 3-4 months to more than once a year. System can be installed and customised to industrial standards and customer requirements.This is a survey of such early tracking methods which is been researched recently.

Keywords — *Toolbox, RFID , asset management, tool tracking, industrial manufacturing*

I. INTRODUCTION

Tool control/Tool Accountability has become a must for the industries not only to prevent misplace of tools in the industry but also to boost the effectiveness of the work. As maintenance is influenced by the labor time in the industry, time taken by an engineer or a technician in finding tools can be reduced, further aiding the employees accelerate the overall maintenance time. Issues regarding the tool quality and maintenance costs the industry over £500 million every year which is the result of lost tools, broken tools, misplaced tools, etc.

Control of tools is a way to assure that the work is done with the right tools and no tool is misplaced. Tool Control can be achieved in a number of ways such as tool shadow boards, tool dual layer foam inlays, RFID control.

While using other methods for tracking the tools can be a provident and fairly constructive method, tracking the tools using RFID can maximize the effectiveness to more than 99%. RFID may a little pricy when compared to other methods, but it prevents multiple challenges accomplished in the workplace. A few important researches on RFID technology for tool management have been listed and discussed here in this paper.

II. LITERATURE SURVEY

An embedded system for practical security using contact less smart cards which uses RFID technology is briefly explained in a paper written by Timo Kasper and others. [1] A flexible low level reader and ISO 14443 tags have been successfully tested. It allows for flexible usage and characteristics such as behavior, timing, etc., of contactless interface. An operational principle of the equivalent to the reader, is addressed as FAKE TAG. A fake tag unlike a normal tag has its own power supply which is used for communication using radio module with reader. This is a cost effective embedded implementation of arbitrarily programmable RFID reader and fake tag for various applications. This tool design is built using electronic hobbyist equipment. Its design is simple and cost effective (approx. 40€), it can be reproduced by low skilled attackers also.

The classification of RFID devices into different categories is explained in a paper proposed by Roy Want (Intel research) [2].The classification of RFID devices into two base categories as active and passive is explained. These categorization is based on power supply infrastructure or integrated battery environment. The tags life time is determined by the energy source or storage capacity. Due to power requirement for active they are not widely used compared to passive tags. The paper also classifies RFID into many basic design approaches for transmission of power from reader to tag using magnetic induction and electro-magnetic wave capture methods. RFID scanning is further sub divided into two modulation techniques such as near field and far field RFID. The paper gives us insight on power/communication mechanisms for RFID tags operating at various frequencies.

An idea about advancement in the field of RFID systems that involves anti- tamper technology constructed using capacitor and conductive materials is given in a paper proposed by INTERMEC, INC., Lynnwood, WA(US).[3] It explains RFID tags with a new anti-tamperable system which is constructed using capacitors and conductive members. The paper addresses mis-usage of RFID devices by using a breakaway structure with coupled housing. When a tampering occurs, the breakaway structure remains attached to the surface and the housing gets decoupled with the capacitor. This leads to a change in

capacitance value and when it exceeds a predetermined threshold, a microcontroller provided on the substrate is scrambled thereby disabling the transponder. The microcontroller remains in a scrambled state until it is reprogrammed hence providing secure and tamper proof RFID transponders.

Methods on how the parameters can be detected by a RFID reader from the tag and its authentication is briefed in the paper proposed by Impinj, Inc., Seattle, WA (US) (Matthew Robshaw, Seattle, WA (US); Christopher J. Diorio, Shoreline, WA (US)). [4] Two methods of how the parameters are detected by the reader from the tags are explained. In the first method, the RFID tag sends the first parameter to reader, which receives and decodes the encrypted data. Once the first parameter is decoded, only then the second parameter is sent to the reader.The second method tells how the second parameter is derived from the first parameter sent to the receiver in the reader. The parameter that is sent contains least portions of the second parameter. The reader decodes the first parameter and hence derives the second from it.For the authentication to be done on a particular item to which the RFID tag is linked, the RFID reader challenges the tag to prove if the tag is genuine. The data from the tag is read and verified. If the tag is genuine, the item to which the tag is attached is also assumed to be genuine.

Unclonable environmentally sensitive chipless RFID tags with a plurality of slot resonator system is explained in the University of Florida Research Foundation, Incorporated, Gainesville, FL (US) (Mark M. Tehranipoor, Gainesville, FL (US);and others). [5] It embodies and provides information on using unclonable chipless RFID which are a more secure way of accessing data or permission granting applications. Each RFID tag is capable of generating a unique and unclonable identifier from a new algorithm which generates from its intrinsically random manufacturing process.The UCR (unclonable chipless RFID) devices can have added features such as temperature measurement and other small parameters. The tags are very user friendly as they can be integrated with or printed on to the product itself which allows for smaller size tags and more cost efficient also .UCR allows for monitoring of security and access limitation for a certain group and in various forms of identification, enabling of non-electronic products and is a very important method of integrating systems into the scope of expansion of IOT.

RFID system for lock control is explained in a paper written by Joseph M. Kulinets, Melrose, MA (US); Peter R. Nuytkens, Melrose, MA (US); Arvind K. Venkatesh (US).[6] The lock system consists of a detection unit positioned proximate to a lock system. This system consists of a microcontroller which is used for identifying information gathered and access granting to a specified restricted RFID tag. An area secured by the lock is operated by an actuator to unlock and this action is controlled by the microcontrollers output. Depending on the size of the antenna used by the RFID reading system the range of scanning can be altered according to the application. The detection unit for the system can be a touch sensor or a motion processing module consisting of passive infrared sensors. The lock system application can be further enhanced by using a secondary microcontroller for communication via infrared or RF wireless communication techniques. The RFID tag in this application can be of two types-

- Contact based RFID cards
- non-contact RFID range devices

Portable container inventory system that uses RFID technology for automatic monitoring the taking and returning of items is explained in the paper proposed by Rafael-Guillermo Ramos-Elizondo, Monterrey (MX); Jose-Adalberto Terán-Matus, Nuevo León (MX).[7]Inventory control system uses RFID technology for automatic monitoring the taking and returning of items such as tools, weapons, jewellery, surgical instruments, etc., from one or more container and to maintain a status of each item as well as to keep a record of each item. The system registers which item has been taken from or stored from which toolbox by which user and when it was taken and returned. It compiles the information of all tool movement in one database which can be accessed anytime and also gives a detailed record of the tool used, tool missing, tool user, in-out time, etc.A designated spot is designed for every item or tool and this allows for improper placing of tools and tool identification.

Smart box application principles based on the location of asset is explained in the paper proposed by Matthias Lampe and Christian Flörkemeier. [8] It explains the asset box application based on the position of object and used to represent various items or persons related to the box for various applications The system uses an automated asset monitoring application using Automatic-ID technology such as RFID. Compared to existing applications which do not reuse majority of the development process again and again. The paper proposes a use of software specialised framework based on smart box applications. This blueprint gives a reuse concept of design, architecture and predetermined software structures for the smart box application oriented domain to reduce the time required for development, testing and maintenance costs of future smart box application. Depending on the application, the settings are clearly defined and these are configured based on the behavior of an application system.

Location and positioning of stored asset using RFID tags are briefed in a research paper pro-

posed by Abdul Malik Shaaria and Nur Safwati Mohd Norb. [9] RFID system uses radio waves for sending energy to respective tags which in succession emit a unique code which is used for unique identification. This code is sent back to the readering device and attached to a asset data base. Employing of RFID technology for detecting the objects has reached a certain level of maturity. The information management data base is based on the idea of intelligent space. It allows the system to extend its applications such as home cleaning robot, searching and automatic object restoring. This system works on four main tasks such as sensing collecting identifying displaying.This research demonstrates various applications using RFID tags, RFID readers, real time clock, Arduino IDE software, Arduino boards for processing tasks and data base is stored in Microsoft Excel. So using these, the system can be configured according to application requirements.

Development of a method for mobile integration for hospital patients' movement tracking is put forth Kamran AHSAN, Hanifa SHAH and Paul KINGSTON. [10]In this research, the main aim is to develop a method for mobile integration for hospital patients' movement trackability. It emphasis on exploring components of a RFID system such as tag, antenna and reader. RFID is used as a tool of identification based on remotely retrieving information and storing of data. The readers decode and encode the data using their propriety software running on a designated ROM. Each unique tag has its own "read-only" or "rewrite" internal memory on the type and application. RFID uses HF electromagnetic energy and query signal for triggering the tags. The range of RFID tags depend on their independent frequency such as microwave,ultra high frequency,high frequency,low frequency.RFID readers operate as a central hub for a RFID based system. Readers are meant to write or collect data onto tags or pass them to computer systems. Usually, readers are integrated using RS-232, RS-485, USB and other wireless options.

RFID identification that couples to a shopping cart is demonstrated in the paper written by Javier Ferrer Alós Modelos Informáticos and others[11].RFID identification that couples to a shopping cart is configured to detect objects that approach the window. It is based on horizontally crossing of light trays from a light curtain. A RFID reader is used to detect and identify the objects that enter or exit the basket. Depending on the size of antenna, the space of the window can be determined. The research gives an insight to the first aspects of the invention which comprises of a window (400X400 mm) and light curtain such that it covers the entire surface of the window. The information gathered is related and linked to an automatic payment point comprised of connected computer, LCD screen, receipt printer and a means of electronic payment.

Smart Box Concept for ubiquitous Computing Environments is proposed by Thomas Scotch and others[12]. A smart object application is described that shows how daily problems related with monitoring can be eliminated without any change in the way the users interact. Smart box method here is based on automatic and unobtrusive asset monitoring technique and the comparison made of actual assets to required configurations. The indicator is a green or red LED which shows the state of the box whether it is complete or not complete. The functionality associated with this box can be given as Keeping a history of the tool inside the box showing for how long a particular tool had been placed inside the box.Making the tools of the box available for remotely accessing.Identifying of who has been interacting with the smart box and tool area.

RFID monitoring and tracking of tools is explained by John K Stevens.[13]A mechanism for identifying, monitoring and tracking of tools is described. A basepad is used for placement of tools .LF radio tags are placed in the pad positions and coupled with the sensor for reading. LF radio tag is configured to transmit and receive signals within a peer-to-peer type of network with combined transceiver. This method enables area read or touch less communicate to and from a tool box area without any contact or process change in control by personnel.Four security indicative levels being used with the tool tracking system are-

- Level 1->*Existence Detection*
- Level 2->*Tool Identity*
- *Level 3->Tool Authentication*
- *Level 4->Lost and found Visibility*

The prospective of RFID for moveable property management proposed by Matthias Lampe and Martin Strassner.[14]It clearly shows the prospects of RFID based material management solutions using the example of asset management in maintenance tasks which includes the tool box and tool inventory applications as an integrated solution. In the smart tool box, misplaced tools are indicated by empty areas and tools that belong to a other tool box are mentioned with a different indicator signal .Implementation of the system consists of a RFID user application that handles the recognition of the tools and method that manages the timeout and returning process and a application that allows the operator to gain information about the timeout condition of tools. The data to and from the user application are XML messages.Activity of the system is to identify the right assets,locating of missing tools ,monitor of the quality,keep a track of the history of assets.

CONCLUSIONS

The technology in paper [7] a designated spot is designed for every item or tool and this allows for improper placing of tools and tool identification which is essential in tool management. Absence of proximity sensor does not allow for tool authentication.

Paper [8] has proposed an innovative way of reusing the scheme, architecture and software elements for the development of smart tool box application which in turn reduces the cost of the application. But this application is not befitted for general location based operations.

Paper [9] has proposed a various applications that uses RFID tags, RFID readers, real time clock, Arduino IDE software, Arduino boards for processing tasks and data bases. The basic Arduino board used for processing power is not sufficient for industrial applications.

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