

Tracking of Pallets in Manufacturing Environment Using RFID System

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Abstract Pallets are the common form of material transport equipment together with forklift conveyer or transport vehicles in a factory. In supply chain, the importance of pallet usage is significant, allowing efficient handling of items. The movements of pallets on a factory floor, however, are manually tracked. Thus, they are difficult to be closely monitored. This results in loss of time, energy, and efficiency. To improve the efficiency and accuracy of pallet movements and to eliminate the loss of time and energy of parts movement in or out of the factory, this work introduced the application of a radio frequency identification (RFID) based automatic tracking system. In this paper, we demonstrate the technique of using the RFID technology as a platform to improve the efficiency in the pallet movements.

Keywords: material handling, RFID, efficiency in the movement

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1. Introduction

Manual track of movement of pallet on the factory floor is still the choice for the workers monitored. However, carelessness of human that not able to closely monitor the movement pallet. As a result, the right pallets are not available at the time of request; therefore resulting in loss of time, energy and cost. This is because human incapable of focusing on the repeating work. An efficient system that identifies and automatically tracks the movements of these pallets are desired in order to improve efficiency. A technique using Radio Frequency Identification (RFID) technology could be applied as a solution to improve efficiency in the movement of pallets.

RFID technology has become essential for the efficiency and effectiveness improvement in production, logistic and supply chain management. RFID can identify, classify and manage the flow of materials and information throughout the supply chain wireless without human intervention in order to avoid human error. Information about an object's current location, condition and history can be stored and retrieved on real-time basis, given better visibility for decision making [1].

RFID is about the technology of Automatic identification and data capture (AIDC). AIDC is only beginning to see practical application because reliability, flexibility, and cost savings have not yet been completely addressed [2]. Benefits include accuracy of data, availability of timely data, improved register checkout productivity, increased levels of controls, customer service, reduced physical inventory time, and increased system flexibility [3].

Recently, RFID technology application is becoming popular in the industry sectors. The mostly used to make supply chain be more efficient, as to control the inventory management and to optimized the process. RFID finds its use in areas including asset tracking, real time supply chain management and telemetry based remote monitoring [4].

A transponder or tag is an essential component in RFID that carried all the data information of pallet so that they can be tracked wherever it goes. Basically, there are two types of RFID that can only communicate with certain types of transponder. The two ends of an RFID system are: 1) A reader which is typically a stationary system that communicates with the Tag, and 2) An RFID Tag, or transponder, which stores information about an object. These tags are attached to the objects to be identified or tracked [5]. The fixed type RFID is for RFID reader to communicate with stationary tags. On the other hand, the mobile type RFID is either for mobile RFID reader to communicate with stationary tag or for stationary RFID reader to communicate with mobile tags [6]. The transponder can be classified by two main types: active transponder, passive transponder and semi-passive transponder.

The purpose of this work is to identify material and the material flow path to be automatically monitored from one location to another. Furthermore this work also to design automatic identification and tracking system for material handling based on the problem occurs. Then, the automatic tracking system will be validated either the system will be functional or otherwise. A material handling has been limited only for pallet with special features. The idea is to track and identify the movement of

the pallet using RFID technology. These pallets are tracked in the real time movement and be analyzed on the efficiency of the automatic system.

2. Methods

This work carries out the following sequence of activities development of the system; integrate and simulate the system; and analysis the system.

2.1. System Development

Pallet tracking system carried out by monitoring the movement of pallet from one location to another. The system is developed by using RFID technology application. RFID, as a non-contact automatic identification technology, can discern the target automatically through radio frequency signal and obtain the relevant data [7]. Data in tags attached to pallets captured by the antenna. Wave signal read by a reader and then the user interface will record the data and find the data on the computer. The computer will collect all the data and record it. Data is then processed, the data required on the computer indicated (see Figure 1).

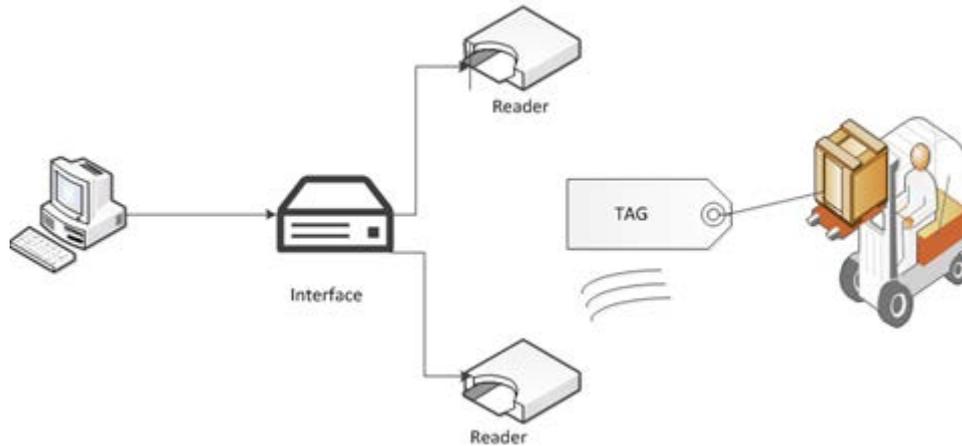


Figure 1. Overview pallet tracking system design

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Private Sub BindingNavigatorAddNewItem_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles BindingNavigatorAddNewItem.Click
    Me.PalletLotBindingSource.AddNew()
    i = 1
End Sub

Private Sub BindingNavigatorDeleteItem_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles BindingNavigatorDeleteItem.Click
    If Me.PalletLotBindingSource.Count > 0 Then
        If i = 1 Then
            Me.PalletLotBindingSource.RemoveCurrent()
            i = 0
        Else
            Dim msg As String
            Dim style As MsgBoxStyle
            Dim action As MsgBoxResult

            msg = "Are you sure to delete this current record?"
            style = MsgBoxStyle.YesNo
            action = MsgBox(msg, style)
            If MsgBoxResult.Yes Then
                Me.PalletLotBindingSource.RemoveCurrent()
                Me.PalletLotBindingSource.EndEdit()

                Me.Pallet_LotTableAdapter.update(Me.Database1DataSet1.Pallet_Lot)
                MsgBox("Record successfully delete")
            Else
                MsgBox("perform another action ")
            End If
        End If
    End If
End Sub

Private Sub ToolStripButton1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles ToolStripButton1.Click
    Try
        Me.PalletLotBindingSource.EndEdit()
        If Me.Validate() Then
            updateDatabase()
        End If
    Catch ex As Exception
        MessageBox.Show(ex.Message, "Save Data", MessageBoxButtons.OK, MessageBoxIcon.Stop)
    End Try
End Sub
    
```

Figure 2. Commands used in the interface

2.2. System Integration and Simulation

The complete components link together into a system. Therefore, the combination of RFID component consists of a functional system. It's included with the software application into the system.

A database was developed to store data and information that can be accessed by the user. The codes create to add, delete and save all data from interface linking to the

database that used to fill and recorded all information of pallet that go through the RFID gate. Figure 2 shows several command languages that had been used in the interface.

2.3. System Analysis

Analysis is constructed to evaluate the capability and reliability of the RFID system. Distance analysis is constructed to measure read range of the RFID with the

transponder. The analysis can determine the suitable range between the RFID and transponder. It conducted by attaching the transponder on the pallet and then is brought in through the RFID gate. The read range will be influence database to store the data as it might be affecting the recording of data in a database system.

3. Results and Discussion

Project setup determine as an assemble all RFID components which are PC, RFID reader, LAN cable, antennas, coaxial cable, power supply, adapter and gate frame is shown in Figure 3. PC used for the interface and

the database of the system. In addition, PC will link the reader through a LAN cable connection using the net mode. The reader is used to deliver the information from a PC to an antenna. The signal is arriving from the reader, then the antenna will capture data from tags as tags are used to store complete information and easy to use. On the other hand, the power supply used to generate a current to the reader.

For software setup, the main thing needs to be set up is a connection between the reader and antenna. Since the RFID Reader linked to a PC through LAN cable, user has to choose a Net mode button to activate the signal of the antenna.



Figure 3. Experimental setup showing the RFID gate with three antennas

A database was developed to store data and information that can be accessed by the user. Regarding to the simple features they have, Microsoft Office Access 2010 was the right software to be chosen. It's easy to record data and can do modification such as replace, add, remove, update data and more. Microsoft Office Access 2010 was linked to the VB Express 2010 to view the connection between the database and the interface used to record all data information. This software use as medium transfer

interface for all data into database. In order to connect the reader within the PC for the activation of RFID, the Software Development Kit (SDK) used. The complete SDK was provided (see Figure 4). Figure 5 shows an overall system process flow of the RFID system. The *station.exe* program will be executed when the system confirms that the number of pallets on the display box is equal to the actual number of pallets. The present state is updated once the counted numbers agree.

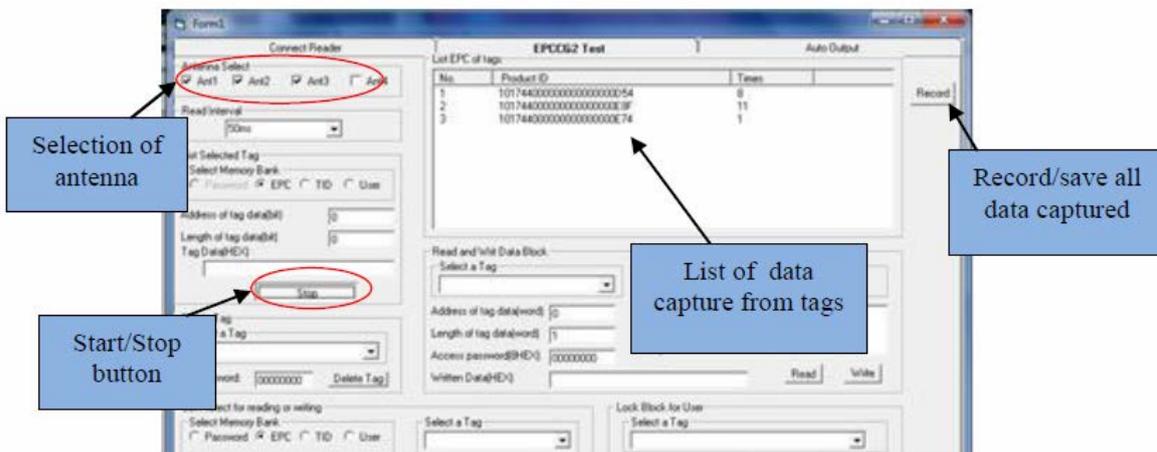


Figure 4. Snapshot of the main interface

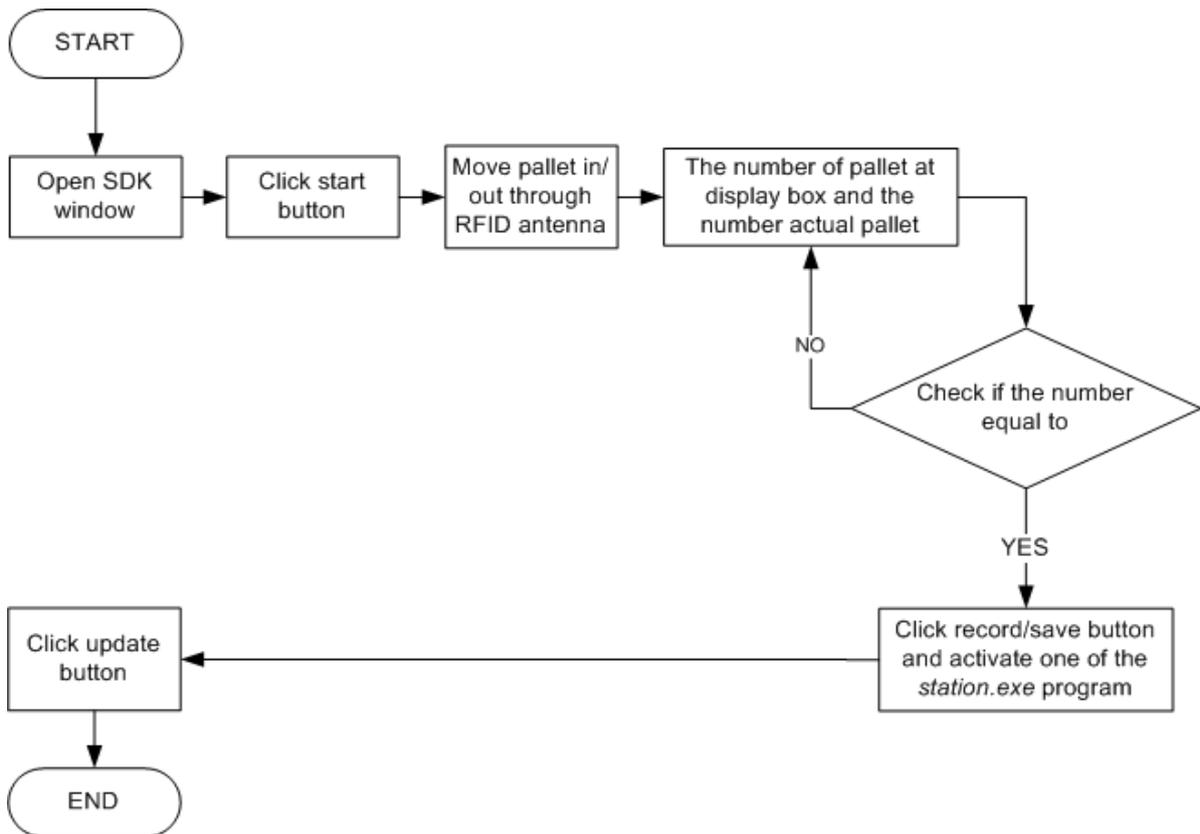


Figure 5. Overall system process flow for RFID system

ID	Pallet No	Pallet Type	Pallet In Qty	Location	Click to Add
1	SP1	Special Pallet	2	Assembly area	
2	SP2	Special Pallet	2	Assembly area	
*	(New)				

Figure 6. Snapshot of all information on pallet filled in the database

ID	Pallet No	Pallet Type	In Qty	Click to Add
1	SP1	Special Pallet	2	
2	SP2	Special Pallet	2	
*	(New)			

Figure 7. Snapshot of the system recorded numbers of pallet that enter the factory

ID	Pallet No	Pallet Type	In Qty	Time In	Click to Add
1	SP1	Special Pallet	2	15/4/2013	
2	SP2	Special Pallet	2	22/4/2013	
	(New)				

Figure 8. Snapshot of system recorded date-in of the pallet enter the factory

ID	Pallet No	In Qty	Out Qty	Time In	Time Out	Click to Add
3	SP2	2		14/4/2013		
4	SP1	2		14/4/2013		
5	SP1		2		15/4/2013	
6	SP2		2		16/4/2013	
	(New)					

Figure 9. Snapshot of the system recorded all information on pallet in and out from the factory

User was generally set the background of pallet in order to facilitate them to conduct pallet into the factory (see Figure 6). This is to ensure the monitoring of the movement of pallets guarded. The pallet lot table will record the quantity of pallet that go through the RFID gate (see Figure 7), whereas all the information will filled before the pallet allowed into the factory. The transaction of time incoming pallet-in at the first station and the last station that used the pallet was recorded in the pallet transaction table (see Figure 8). Then, number of pallets used in the factory will be updated once more before the pallet taken out from the factory. The table recorded all the history of the transaction; therefore the user can trace back the movement of pallet-in or pallet-out in detail (Figure 9).

4. Conclusions

If properly designed, an RFID system can improve the efficiency movement of inventory in the industry compared to other tracking technology. Most of the biggest industry is already using this application for their supply chain management storage is used to monitor real-time movement of pallet. All information stored on pallets

in a database that is easily accessible by the user. It can be modified anytime based on data collection made. RFID technology has an ability to read in a long distance, able to read various types of transponder (tag) and cheap. It can track the movement of pallet easier and accurate.

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