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Design of Dynamic RFID System using 89C51 Microcontroller based Embedded System for Effective Supply Chain Management

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Abstract

Short for radio frequency identification, RFID is a dedicated short range communication technology. The term RFID is used to describe various technologies that use radio waves to automatically identify people or objects**.** RFID is a method of remotely storing and retrieving data using RFID tag. Radio Frequency Identification (RFID) technology has been attracting considerable attention with the expectation of improved supply chain visibility for consumer goods, apparel, and pharmaceutical manufacturers, as well as retailers and government procurement agencies. It is also expected to improve the consumer shopping experience by making it more likely that the products they want to purchase are available. Recent announcements from some key retailers have brought the interest in RFID to the forefront. This guide is an attempt to familiarize the reader with RFID technology so that they can be asking the right questions when considering the technology. RFID technology is used today in many applications, including access control, transportation and supply chain tracking. In this work, this study addresses the design and model the dynamic RFID System using 89C51 Microcontroller based Embedded System for effective and optimal supply chain management by applying Genetic algorithm integrated with Simulated Annealing.

Keywords
RFID, System security, embedded system, 89C51 Microcontroller, Supply Chain Management, GA-SA

1. Introduction
Radio Frequency Identification (RFID) technology has been attracting considerable attention with the expectation of improved supply chain visibility for consumer goods, apparel, and pharmaceutical manufacturers, as well as retailers and government procurement agencies. It is also expected to improve the consumer shopping experience by making it more likely that the products they want to purchase are available. Recent announcements from some key retailers have brought the interest in RFID to the forefront. This guide is an attempt to familiarize the reader with RFID technology so that they can be asking the right questions when considering the technology. RFID tag consists of microchip that stores data and antenna. Two types of Tags are there, Passive and Active Tag. The RFID reader directs the RF transceiver to transmit RF signals, receives the encoded signal from the tag through the RF transceiver, decodes the tag's identification, and transmits the identification with any other data from the tag to the host computer. The reader may also provide other functions.

2. Literature Review

Radio Frequency Identification (RFID) tags, which are increasingly being used in pervasive healthcare applications. Specifically, we study the dynamics of locating and identifying the presence of a tag in such systems. Although a tag may be present, it may not necessarily be visible to the tag reader due to various constraints or reasons. We propose and illustrate several algorithms for locating the presence of RFID tagged objects in the field of the reader and study their dynamics as well as their strengths and benefits. Our results indicate that the location accuracy of RFID tag readers can be improved through appropriate data collection as well as algorithms used for data inference (Yu-Ju Tu, et al, 2009). A flaw which has gone unnoticed in RFID protocol literature and present the resulting attacks on authentication, untraceability, and desynchronization resistance. (Ton van Deursen et al, 2009). Passive Radio Frequency Identification (RFID) tags, due to their ability to uniquely identify every individual item and low cost, are well suited for supply chain management and are expected to replace barcodes in the near future. However, unlike barcodes, these tags have a longer range in which they are allowed to be scanned, subjecting them to unauthorized scanning by malicious readers and to various other attacks, including cloning attacks. Therefore, a security protocol for RFID tags is necessary to ensure the privacy and authentication between each tag and their reader. (Alex X. Liu , LeRoy A. Bailey, 2009). They have proposed a Linear Congruential Generator (LCG) based lightweight block cipher that can meet security coexistence requirements of WSNs and RFID systems. (Bo Sun et al, 2008).

Research and development in RFID has been focused on hardware and firmware components such as active and passive RFID tags, readers, and embedded software, for the purpose of its deployment in specific application domains. RFID is being incorporated in supply chain management, giving enterprises a real-time view on the location and integrity of their inventories [sarma, 2002]. Novel architectures for deployments of RFID in libraries are described in [Molnar, 2004]. We propose and illustrate several algorithms for locating the presence of RFID tagged objects in the field of the reader and study their dynamics as well as their strengths and benefits. Our results indicate that the location accuracy of RFID tag readers can be improved through appropriate data collection as well as algorithms used for data inference (Yu-Ju Tu, et al, 2009). A flaw which has gone unnoticed in RFID protocol literature and present the resulting attacks on authentication, untraceability, and desynchronization resistance. (Ton van Deursen et al, 2009). Passive Radio Frequency Identification (RFID) tags, due to their ability to uniquely identify every individual item and low cost, are well suited for supply chain management and are expected to replace barcodes in the near future. However, unlike barcodes, these tags have a longer range in which they are allowed to be scanned, subjecting them to unauthorized scanning by malicious readers and to various other attacks, including cloning attacks. Therefore, a security protocol for RFID tags is necessary to ensure the privacy and authentication between each tag and their reader. (Alex X. Liu , LeRoy A. Bailey, 2009). They have proposed a Linear Congruential Generator (LCG) based lightweight block cipher that can meet security coexistence requirements of WSNs and RFID systems. (Bo Sun et al, 2008). Based on the literature, all are used the RFID technique to secure the system. There is a literature gap to design the dynamic system using embedded microcontroller system.

3. RFID Security System

Most companies invested in RFID technology only use the tags to track items within their control; many of the benefits of RFID come when items are tracked from company to company or from country to country. The proposed implementation of the work is shown in the block diagram (Figure 1). This work focuses to implement RFID based supply chain system. This system is implemented using an embedded microcontroller. The embedded microcontroller used here is 89C51 microcontroller. The 89C51 microcontroller is a derivative of 89C51 microcontroller whose architecture and instructions are same as 89C51 microcontroller with some additional functionality. Since this microcontroller has inbuilt peripherals it is called as embedded microcontroller. The person holds the RFID tag and the RFID reader is placed at the in front of the factory gate. The registered number and the corresponding code to the tag are already stored in the microcontroller. While the person is passing through gate, the reader automatically identifies the person. The Figure 1 shows the block diagram of RFID system design. RFID transceiver value is transferred from the RFID reader to the 8-bit embedded microcontroller through serial port. After identifying the person, the active tag will enable and to open the factory gate and to allow the person to access the real work. If need gate will be open or close by using the stepper motor. The controller identifies the unauthorized person it will not allow the person, at that time web camera will be enabled then capture the photo for a particular person and stored on a administrator PC. In an advanced manner to design this system, the administrator PC storage images will be transferred to control room via wire or wireless technology. The control room will be sent the appropriate command to administrator for further decision.

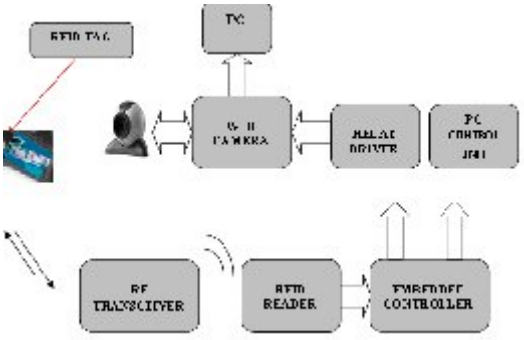

Figure 1 RFID System block diagram

4. RFID Architecture - Embedded Microcontroller – P89C51RD2

Fingerprint based access control system is implemented by using P89C51RD2 microcontroller, which is the 8-bit microcontroller developed by Philips. The microcontroller used here is P89C51RD2BN.The expansion of the part number of this microcontroller is given below Figure 2.

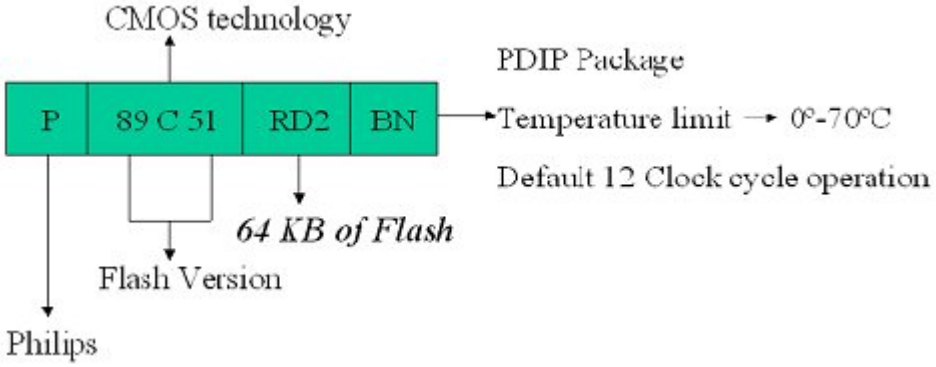

Figure 2 89C51 Microcontroller Part

The P89C51RD2BN contains a non-volatile 64KB Flash program memory that is both parallel programmable and serial In-System and In-Application Programmable. In-System Programming (ISP) allows the user to download new code while the microcontroller sits in the application. In-Application Programming (IAP) means that the microcontroller fetches new program code and reprograms itself while in the system. This allows for remote programming over a modem link. A default serial loader (boot loader) program in ROM allows serial In-System programming of the Flash memory via the UART without the need for a loader in the Flash code. For In-Application Programming, the user program erases and reprograms the Flash memory by use of standard routines contained in ROM. The device supports 6-clock/12-clock mode selection by programming a Flash bit using parallel programming or In-System Programming. In addition, an SFR bit (X2) in the clock control register (CKCON) also selects between 6-clock/12-clock mode. Additionally, when in 6-clock mode, peripherals may use either 6 clocks per machine cycle or 12 clocks per machine cycle. This choice is available individually for each peripheral and is selected by bits in the CKCON register. This device is a Single-Chip 8-Bit Microcontroller manufactured in an advanced CMOS process and is a derivative of the 80C51 microcontroller family. The instruction set is 100% compatible with the 80C51 instruction set. The device also has four 8-bit I/O ports, three 16-bit timer/event counters, a multi-source, four-priority-level, nested interrupt structure, an enhanced UART and on-chip oscillator and timing circuits. The added features of the P89C51RD2BN make it a powerful microcontroller for applications that require pulse width modulation, high-speed I/O and up/down counting capabilities such as motor control. When the 89C51 microcontroller is connected to a crystal oscillator and is powered up, we can observe the frequency on the XTAL2 pins using the oscilloscope. The time to execute the instruction is calculated by using the following expression,

$$T(inst) = (MC \times Cn) / (crystal\ frequency)$$

MC→ Number of Machine Cycles for an instruction to execute and Cn is the number of clock cycles for one machine cycle. For 89C51RD2BN the number of clock cycles for one machine cycle is 12. For example, If the number of machine cycles to execute a instruction is 1 and the oscillator frequency used is 11.0592MHz, the time to execute an instruction is 1.085μs.

4.1 Pin Description

Examining the following figure, note that of the 40 pins a total of 32 pins are set aside for the four ports P0, P1, P2 and P3, where each port takes 8 pins. The rest of the pins are designated as Vcc, GND, XTAL1, XTAL2, RST, EA, ALE, and PSEN. Of these 8 pins, all 8051 derivatives use six of them. In other words, they must be connected in order for the system to work**.** The Figure 3 shows the Pin diagram of 89C51 Microcontroller.

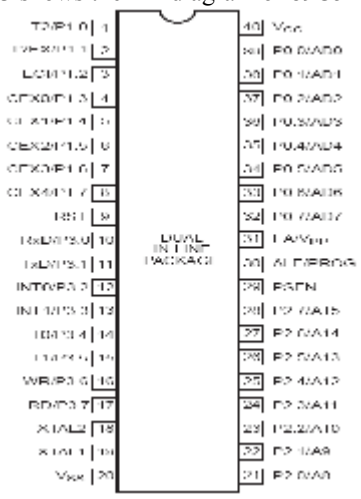

Figure 3 Pin Diagram of 89C51 Microcontroller

4.2 Architecture of 89C51 Microcontroller

The architecture of the 8051 family of microcontrollers (8051 derivatives) is referred to as the MCS-51 architecture (Micro Controller Series – 51), or sometimes simply as MCS-51. The block diagram of 89C51 microcontroller is shown below Figure 4.

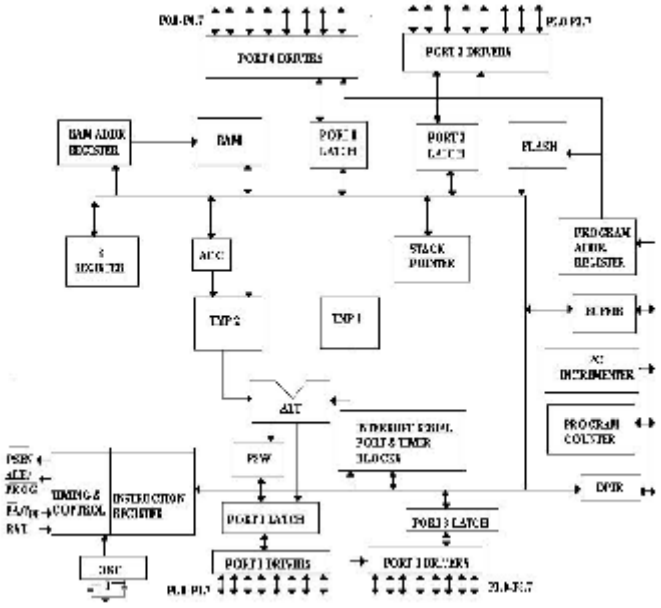

Figure 4 Architecture of 89C51 microcontroller

5. Results and Discussion

Final dynamic design of RFID system security is shown in Figure 5. In this design we have introduced the web camera in an advanced manner. And the 89C51 microcontroller based embedded controller to secure the system of supply chain management.

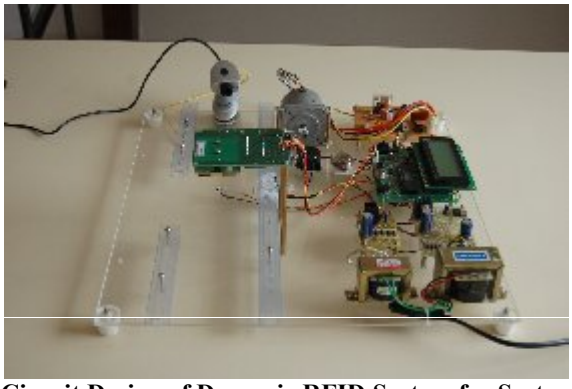

Figure 5 Circuit Design of Dynamic RFID System for System security

From this dynamic design, the distance and cost matrix of the salesman node cities can be generated using computing techniques. Table 1 shows the input data's of 12 node distance matrix, which is generated by the designed RFID system.

Table 1 12 Node distance matrix

Nodes	1	2	3	4	5	6	7	8	9	10	11	12
1	0	148	248	90	190	423	328	180	275	93	373	135
2	148	0	286	58	111	275	185	53	140	63	229	50
3	248	286	0	254	201	499	369	338	417	283	476	280
4	90	58	254	0	121	335	238	100	193	31	286	45
5	190	111	201	121	0	303	177	158	220	148	275	113
6	423	275	499	335	303	0	134	249	169	333	63	290
7	328	185	369	238	177	134	0	183	155	248	129	198
8	180	53	338	100	158	249	183	0	95	87	195	61
9	275	140	417	193	220	169	155	95	0	182	108	151
10	93	63	283	31	148	333	248	87	182	0	282	113
11	373	229	476	286	275	63	129	195	108	282	0	241
12	135	50	280	45	113	290	198	61	151	113	241	0

Table 2 Required optimal sequence (Linear equal clustering)

S. No.	Algorithm	Number of cities	Cluster Number	Optimal Route sequence	Distance traveled
1.	Unoptimized method	12	1	1-2-3-4	688
			2	8-7-6-5	620
			3	11-12-9-10	574
2.	GA	12	1	3-2-4-1	574
			2	7-6-5-8	532
			3	12-9-11-10	520
3.	SA	12	1	2-3-1-4	554
			2	6-7-8-5	524
			3	10-12-11-9	512
4.	GA-SA	12	1	2-1-4-3	512
			2	6-7-5-8	502
			3	10-11-9-12	504

The proposed algorithm of GA integrated with SA is coded in C++ language. All tests have been executed on Pentium IV processor under Microsoft windows 2003 operating system. The computer time for smaller size problems say less than 20 cities is only below two minutes. Required optimal sequence is shown in Table 2. Table shows the proposed algorithm gives the better results when compared with other algorithms. It gives the better and optimal supply chain management system.

6. Conclusion

Radio Frequency Identification (RFID) is used to describe various technologies that use radio waves to automatically identify people or objects**.** RFID is a method of remotely storing and retrieving data using RFID tag. The scope of this work is to design and implement a effective and optimal supply chain management system using the designed dynamic RFID system and also the proposed algorithm of Genetic Algorithm integrated with Simulated Annealing. RFID technology has been attracting considerable attention with the expectation of improved supply chain visibility for consumer goods, apparel, and pharmaceutical manufacturers, as well as retailers and government procurement agencies. It is also expected to improve the consumer shopping experience by making it more likely that the products they want to purchase are available. Recent announcements from some key retailers have brought the interest in RFID to the forefront. This guide is an attempt to familiarize the reader with RFID technology so that they can be asking the right questions when considering the technology. In this work, we have introduced the dynamic RFID system technique using 89C51 microcontroller based embedded system for effective and optimal supply chain management system by applied the Genetic algorithm integrated with simulated annealing.

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