RFID-Based Staff Members Attendance Management System

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Abstract: RFID is a nascent technology, deeply rooted by its early developments in using radar1 as a harbinger of adversary planes during World War II. A plethora of industries have leveraged the benefits of RFID technology for enhancements in sectors like military, sports, security, airline, animal farms, healthcare and other areas. RFID technology facilitates automatic wireless identification using electronic passive and active tags with suitable readers. In this paper, an attempt is made to solve recurrent lecture attendance monitoring problem in developing countries using RFID technology.

I. INTRODUCTION

RFID, which stands for Radio Frequency Identification, [1] is an automatic identification technology used for retrieving from or storing data on to RFID Tags without any physical contact. Personalized products and tailor-made solutions are taking over large shares of the marketplace from mass produced goods and standardized solutions respectively. The so-called smart parts based manufacturing system addresses these concerns well. The smart part carries operating instructions for the operating workers or automatic machines. Uniquely identified individual parts can be processed according to their specific requirements based on individual customer preferences.

Having a system that can automatically capture student's attendance by flashing their student card at the RFID reader can really save all the mentioned troubles. This is the main motive of our system and in addition having an online system accessible anywhere and anytime can greatly help the lecturers to keep track of their students' attendance. Looking at a bigger picture, deploying the system throughout the academic faculty will benefit the academic management as students' attendance to classes is one of the key factor in improving the quality of teaching and monitoring their students' performance. Besides, this system provides valuable online facilities for easy record maintenance offered not only to lecturers but also to related academic management staffs especially for the purpose of students' progress monitoring [2-3].

II. REVIEW OF RELATED WORKS

A number of related works exist in literature, application of RFID Technology to different areas and specifically to the area of academic attendance monitoring problem. In [6], authors designed and implemented a model of a secured and portable embedded reader system to read the biometric data from the electronic passport. The authors attempted to solve problems of reliability, security and privacy in E-passports by authenticating holder online using Global System of Mobile Communications (GSM) network. The GSM network is the main interface between identification center and the e- passport reader. The communication data is protected between server and e-passport reader by using AES to encrypt data for protection while transferring through GSM network. Author in [5] reviewed the current research application of RFID to different areas with emphasis on application for supply chain management and developed a taxonomic framework to classify literature which enables swift and easy content analysis to help identify areas for future research. Authors in [9] reviewed the use of RFID in an integrated- circuit(IC) packaging house to resolve inventory transaction issues. His study suggests that RFID contributes significant improvements to the water receiving process and the inventory transaction process that reduce lab our cost and man-made errors. In [10], an automated attendance management system was implemented both in electronic and mobile platform using stationary matrix AR 400 RFID reader with four circulatory polarized antennae and Symbol MC9000-G handheld RFID reader respectively. In the electronic platform, the attendance management system depicts a simple client (antennae placed at classroom entrance) /server (privileged student database) system. Students can visually see their names as they entered class on the screen and they are assured that their presence has been entered in the instructor's database. However, one important drawback about this system is the RFID tag read rates degrade tremendously as it comes closer to electronic devices.

III. RFID TECHNOLOGY

Operating Principle

The RFID system consists of three basic components:

Reader/Programmer, Antenna and Tag or Transponder. Today the vast majority of 13.56 MHz systems operate "passive", without the need for an integrated battery. They have positive implications on cost, lifetime and the environmental situation. The basic operating principle of passive 13.56 MHz and below 135 KHz RFID systems is energy and data transmission using inductive coupling. This is exactly the same principle as used in transformers. By changing one parameter of the transmitting field (amplitude, frequency or phase), the data transmission from the reader to the tag can realize. The return transmission of the tag concerns the load (amplitude and/or phase).UHF and MW (e.g. 400-1000 MHz, 2450 MHz &especially 5.8- GHz) RFID systems make use of conventional electromagnetic wave propagation to communicate their data and commands, and in the case of battery less tags also to power the RFID transponders. The basic operating principle of this RFID system is energy and data transmission using propagating radio signals ("E" field transmission).

Operating Distance

The operating zone of passive inductive RFID systems (13.56 MHz and below 135 KHz) is in the "near field" of the read transmission antenna, which results in achievable operating distances of approximately the diameter of the transmission antenna. Differences are mainly given by the output power of this RF-module and by the sensitivity and the selectivity of its receiver. The ranges are denoted as "proximity" (below 100mm), "medium range" (below 400mm),"vicinity" (long range - 1.5m), "far field" (0.5 to 12 meters -2450 MHz, passive power), and up to 30 meters (active power tags depending on microwave frequency).

Tag characteristics

Memory: On lines similar to computer memories there are three types at this time: Read-only (ROM); Write-once-read-many (WORM); Read/write (EPROM or EEPROM). Available sizes are 1 bit, 48 bits, 64 bits (8 byte) to several Mbytes.

Physical Forms: Tags are not limited by forms, shapes or nature of protective housings. A 0.3 mm2 tag (2450 MHz, 128bits, 300mm range) is currently available. Another version available for inserting beneath the skin to track animals is 0.16mm2 in size. Screw shaped tags to identify wooden items or credit card shaped tags for access applications are other examples.

Cost: Prices have dropped to a low range of 1 to 10 cents though active and long-range tags are still expensive. With increasing use, the production costs and hence prices will drop.

Miniaturization

In Japan, an ultra-small (0.4 x 0.4=0.16mm2) RFID chip has been developed named the "mu-chip". This 128-bitmemory, 0.06 mm thick chip can be applied to paper and to thin paper-like media. At 2450MHz the maximum communication distance between the mu-chip and a reader is 300 mm

Limitations & Cautionary Notes

Absorption, Reflection & Transmission through different media:

The RF field at 13.56 MHz is not absorbed by human tissue or water permitting operation in and through water and through human barriers. The influence of moisture upon performance is negligible. 2450 MHz UHF and microwave signals are attenuated and reflected by human tissue and moisture bearing objects and must be used with caution where human contact is involved. These signals easily penetrate wood, paper, board, clothing, paint, dirt etc. Short wavelengths of radio signals and reflective properties off metallic objects permit reader systems to be designed with high reliability for performance in regions having high metallic content. These offer higher data rates than inductive systems and allow many systems to operate independently without human intervention in confined operating areas.

Spectrum:
The choice of field or carrier wave frequency determines data transfer rates. In general higher frequencies enable higher data transfer rates. Channel bandwidth is required to be at least double the bit rate for the specific application.

Communication between parts and equipment for flexible manufacturing:
Tag readers can read the process information stored on each tag and instruct manufacturing stations to carry out the necessary processes required for a specific part. After the processing is carried out, the tag can be updated to indicate the operations that have been performed and this data can be read by the quality assurance station at which can run the necessary inspection. In turn, the inspection results can be uploaded on to the tag. Real time monitoring of the production Process is thus made possible.

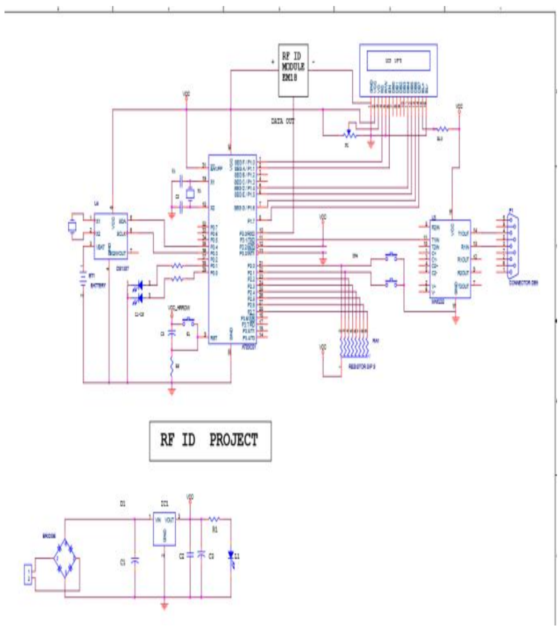
Automation in manufacturing, quality control, packaging, storage and delivery:
Tags can be made integral with the part by methods like embedding for the purpose of subsequent identification during packaging, storage, and delivery. They could also be used for subsequent field service records so that they may retain the part performance history which can be read off periodically and fed back into the manufacturer's management information system for the purpose of warranty enforcement and continued improvement of products and services.

Enabling concurrent manufacturing:
Response times to customer inputs can be dramatically reduced by integrating RFID technology with the concurrent manufacturing model. Let us imagine that a truck is to be assembled. The customer usually specifies the engine, possibly the transmission, make of tires, body paint and cabin accessories like the stereo and the upholstery. Designers and customers would have the flexibility to change specifications midway through manufacturing with each chassis being RFID
Tagged and labeled a smart part. At any moment of time, the specifications written onto the tag could be modified and production could proceed normally. This would shorten response times because design and manufacturing periods would have overlaps as shown in Moreover, designers & process engineers would be able to control the process changes using wireless signals to directly update the RFID tags, thus reducing paperwork and human interference and improving the efficiencies obtained through automation. Customers could obtain status updates and would be able to track the progress of their order in real time through the wireless internet based feedback made possible using the RFID system. In this way, the smart parts concept using RFID
Technology has the possibility of integrating the relationship between customers, vendors, design & and process planning, marketing and warehousing with real time information. The business is thus enabled to provide customer satisfaction through tailor made products supplied reliably and efficiently with competitive response times. After-sales-service and warranty obligations are better fulfilled because the RFID tags enable the manufacturer to track and record
Performance histories and continuously improve products based on real time performance feedback. The RFID tagging of engines in the Ford Motor Co. Case study cited above is an example of smart part manufacturing. A key part can be identified as a smart part and its progress followed closely through its manufacturing cycle. If, for instance, it has the longest machining cycle, then its progress determines the productivity of the line.

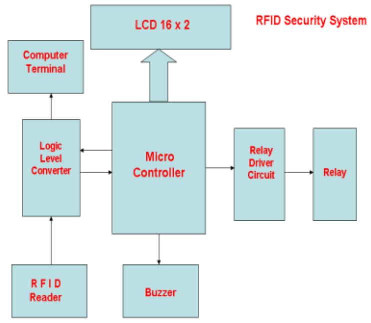
Selection of Smart Parts
Not all parts in a product need to become smart parts. There is an optimization selection that decides which parts need to be designated as smart parts and when. In the manufacturing process, the smart parts status is monitored in the entire control period. According to the control demands, some smart parts will retain smart-part status in the entire manufacturing process, Others in special machining process and others in whole life cycle of the product. Different smart parts would have differing start and end times according to the needs of concurrent manufacturing. Key parts are selected as smart parts and controlled with FID tags. In the production cycle, the smart parts usually have the longest machining cycle, or undergo the most difficult machining process, or have the most important function in the assembled final product or are patented parts. At the same time, smart parts form a good security ID of a product helping to prevent counterfeit and protect the rights of the producer.

Components of RFID:
An RFID system consists of various components that are connected to one another by a dedicated communication path. The individual components are integrated into the system to implement the benefits of RFID solution [11]. The list of components is as follows:

- Tags – an object that is attached to any product and uses a unique sequence of characters to define it. It comprises of a chip and the antenna.
- Antenna – it is responsible for the transmission of information between the reader and tag using radio waves.
- Reader – a scanning device that uses the antenna to realize the tags that are in its vicinity. It transmits signals at a certain frequencies.
- Middleware – it is a communication interface to interpret and process data being fed by the readers into information. It takes into account all relevant ports of communication and a software application to represent this information.
- Backend database – a repository of information, which is designed specific to the application. The database stores records of data specific to individual tags.



RFID Security System



PART LIST FOR RF ID SYSTEM		
RESISTORS :-		
R1,R2,R3		--10KΩ
R4,R8	--	-330Ω
R5,R6	-	-1KΩ
R7	-	--22Ω
P1	-	--10KΩ PRESET
CAPACITORS :-		
C1,C2	-	-33PF
C3,C5	-	-100KPF,0.1μF
C4	-	--1000μF/25V
C6	-	--100μF/16V
SEMICONDUCTORS :-		
B1		--1A Bridge
T1	-	--BC547
U4	-	--MAX232
U1	-	--89S52
U2	-	--DS1307
U3	-	--LM7805
RF1	-	--RF ID MODULE
X1	-	--11.0592MHz CRYSTAL
LCD1	-	--16*2 LCD
L1,L2	-	--RED/GREEN LED
MISCELLNOUS-		
IC SOCKETS-		-8 PIN-1, 40PIN DIP TYPE-1
SW1-SW4		--4 LEG MICRO SWITCH
RL1 RELAY	-	--12V, 1CO SUGSR CUBE
SOCKET -- CELL HOLDER		-FOR LCD & RF MODULE, 2
		-RF CARD,DB9FEMALE

MICROCONTROLLER: Microcontroller is the heart of the system. We have used P89V51RD2. It is similar to 8051 microcontroller. It is made by Phillips. The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM.
First of all reader fetches 12 character from tag. This 12 characters are then sent to microcontroller via serial communication. In microcontroller the controller matches the received characters with the saved characters. If it matches green LED glows else red LED glows. Microcontroller is interfaced with LCD in order to display the received data.

POWER SUPPLY: for power supply an adapter is used. Adapter converts 230v to 5v.

LCD: 16 x 2 LCD is used. LCD has 16 pins. It can read or write data. Here we use it for writing of data on it

RTC: RTC stands for Real Time Clock. RTC used for timing calculation. Whenever a person enters, data from RTC is fetched and stored on microcontroller. When the person leaves the room again data is fetched.

EEPROM: as the memory inbuilt in microcontroller won't be sufficient an extra EEPROM is attached. EEPROM (24C512) is attached. It has 512kb of memory. Around 2000 records can be saved

MATRIX KEYBOARD: 8 or 16 switch matrix keyboard is used in order to set RTC timing again and also to enter new data of user.

MAX232: MAX 232 IC is used. It is used as microcontroller and computer work on different logic level. Computer works on RS-232 level and microcontroller works on TTL level. So in order to have communication between two, a MAX232 IC is used. This IC brings RS-232 level to TTL level or TTL level to RS-232 level accordingly.

IV.WORKING OF RFID ATTENDANCE SYSTEM

When a person with RFID tag or transponder enters in the range of RFID reader, the RF field induces voltage in the coils of tag. The range can be set by using the appropriate reader of appropriate frequency. This induced field supplies the voltage in case of passive tags and act as a battery in that case. If active tags are used then the case will be different as they have battery of their own.

Due to interaction of Tag with Reader 12 characters from tag are sent to controller. This 12 characters are sent to controller via serial communication. Before this controller is loaded with a program. In controller data of employee are saved. In our case data's of two employees are saved i.e. tag number and name. When we provide power supply to the circuit, the circuit switches on and "RFID BASED ATTENDANCE SYSTEM" is displayed on LCD.

When 12 characters are transferred to controller, the controller matches the characters with the saved characters. If the characters are matched then controller sends '1' to green LED and time & date at time of entrance is fetched and stored.

If characters do not match with the saved characters, the controller sends '1' to red LED and displays tag number along with a string "ERROR".

This way it can be done number of times for different employees. Similarly there will be number of entries, valid or invalid. At the end of day, circuit can be connected to PC through RS232. And complete data is transferred to the computer on HYPERTERMINAL/TERATERM.

In order to enter entries of more number of employees an external EEPROM is attached. In our case 24C256 is used. It has 256 kb of ROM. So with the help of this 1000 records can be stored.

We have kept one tag for manager (ADMIN CARD). This card when moved over the RFID reader will erase all the contents. So at the end of the day manager can use this card to empty all contents for the day. And from next day it can be repeated similarly.

COMPONENT LIST

1. MICROCONTROLLE: P89V51RD2 – 1 no
2. 16 x 2 LCD – 1 no
3. RFID READER - RKI-1512 – 1 no
4. MAX 232 – 1 no
5. 9 PIN RESISTOR ARRAY (10K ohms) - 1 no
6. CRYSTAL 11.0592 MHz – 1 no
7. LEDs (RED & GREEN) – 2 no
8. RESISTORS: 8.2 K Ohms – 1 no
   2.2 K Ohms – 3 no
   360 Ohms – 2 no
9. CAPACITORS: 10 uF – 1 no
   0.1uF -4 no
   33 pF – 2 no
10. PUSH BUTTON SWITCH – 1 no
11. DB – 9 FEMALE CONNECTOR – 1 no
12. POWER SUPPLY CONNECTOR – 1 no
13. DC ADAPTER (230V AC TO 5V DC) – 1 no
14. RTC (DS1307)-1 no
15. LITHIUM CELL (CR2032)-1 no
16. EEPROM- 1 no

V.COMPONENT EXPLANATION

The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM. A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI.

The Flash program memory supports both parallel programming and in serial In-System Programming (ISP). Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible.

The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash Program memory to be reconfigured even while the application is running.

VI.FEATURES

- 80C51 Central Processing Unit5 V Operating voltage from 0 to 40 MHz
- 64 kB of on-chip Flash program memory with ISP (In-System Programming) and
- IAP (In-Application Programming)
- Supports 12-clock (default) or 6-clock mode selection via software or ISP
- SPI (Serial Peripheral Interface) and enhanced UART
- PCA (Programmable Counter Array) with PWM and Capture/Compare functions
- Four 8-bit I/O ports with three high-current Port 1 pins (16 mA each)
- Three 16-bit timers/counters
- Programmable Watchdog timer (WDT)
- Eight interrupt sources with four priority levels
- Second DPTR register
- Low EMI mode (ALE inhibit)
- TTL- and CMOS-compatible logic levels
- Brown-out detection
- Low power modes
- Power-down mode with external interrupt wake-up
- Idle mode
- PDIP40, PLCC44 and TQFP44 packages

V_{cc}, V_{ss} and V_{EE} :
V_{cc} :: grounded
V_{ss} :: +5V supply
V_{EE} :: used for controlling the contrast

RS, Register Select : There are two very important registers inside LCD. The RS pin is used for the selection as follows.

RS = 0:: instruction command code register is selected, allowing the user to send a command such as clear display, cursor at home etc.

RS = 1: data register is selected, allowing the user to send the data to be displayed on LCD.

R/W, Read Write: R/W input allows the user to write information to the LCD or read from it.
R/W = 1: Reading
R/W = 0: Writing

E Enable: the enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high- to-low pulse must be applied to this pin in order for the LCD to latch in the data presented data pins. This pulse must be minimum of 450 nano sec wide.

D0-D7: data pins

RFID READER (RKI - 1512):
The RFID reader is a standalone module with RFID reader and antenna. It's very small (32mmx32mm) in size and easy to integrate with any hardware design. It supports 125 KHz RFID tags and has DIP 0.1" pins to. Onboard antenna and hard plastic cover makes device small and sturdy. The module works on UART protocol which allows user to integrate it with any PC

Or Microcontroller based design. It also supports Weigand protocol.

TECHNICAL PARAMETERS:
Voltage: DC 5V
Current: <50ma
Operating Frequency: 125 KHz
Reading Distance: 5 CM, 10 CM (Maximum, only for special tags)
Dimensions 32mm X 32mm X 8mm

MAX232:
The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA-232-Fvoltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5-V TTL/CMOS levels.

These receivers have a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept ±30-V inputs.

CRYSTAL OSCILLATOR:
This is used in microcontrollers to generate internal Clock Frequency. P89V51RD2 can work in a range of 0-40 MHz, but here we use 11.0592 MHz to match universal baud rate, i.e. 9600 bauds for serial communication.

RESISTOR ARRAY (9- PIN):
Resistor array is used to meet the requirement of pull-up resistors. It has 9-pin. Its 1stpin is connected to V_{cc}. All other 8 pins are connected to Port-0.

Fig., RESISTOR ARRAY

RTC (DS 1307):
The DS1307 serial real-time clock (RTC) is a low-power, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. Address and data are transferred serially through an I2C, bidirectional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with AM/PM indicator.
The DS1307 has a built-in power-sense circuit that detects power failures and automatically switches to the backup supply. Timekeeping operation continues while the part operates from the backup supply.

4.1CIRCUIT DIAGRAM
Microcontroller P89V51RD2 is used. Microcontroller development board is created.

Oscillator circuit
Oscillator circuit is constructed between 18 and 19th pin of controller. It includes an oscillator of 11.0592 MHz and two capacitors of 33pF

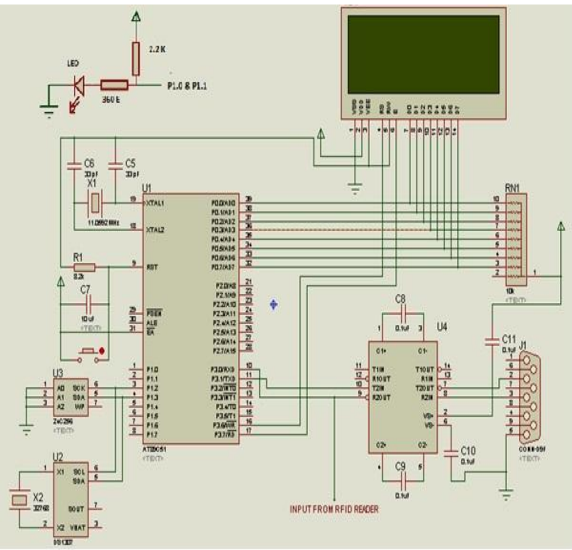
Reset circuit
9th pin of microcontroller is configured as RST pin, known as reset pin. It includes a switch, a capacitor (10uF) and a resistor 0f 8.2k ohm. When switch is pressed RST pin gets connected to $V_{cc}$and the controller gets reset.

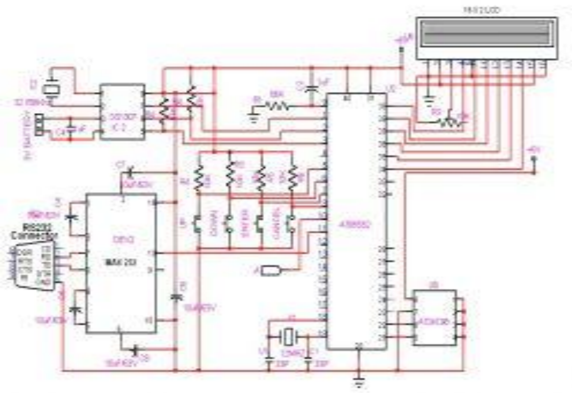
DB-9 connector and MAX232
DB-9 female connector consists of 9 pin. It is used for serial communication. MAX 232 IC of 20 pin is connected. 4 capacitors are connected with MAX 232 to store charge and discharge accordingly

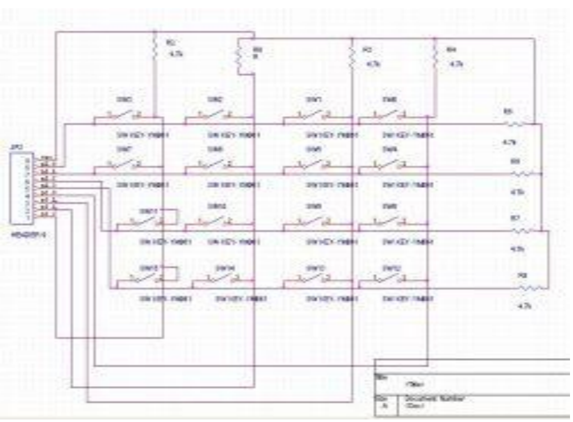
16 x 2 LCD
LCD is used for displaying data. It has 16 pin

Pull up resistor – RESISTOR ARRAY
Resistor array is used to meet the need of pull up resistors. 10k ohm resistors are used.
RFID reader and RS232 are connected to Microcontroller serially to P3.0 and P3.1 via jumper. So, while we need to connect the RS232 to microcontroller jumper is removed and whenever RFID reader is to be connected jumper is placed in.
SCL (6th pin) and SDA (5th pin) pins of RTC and EEPROM are connected to P1.2 and P1.3 respectively. EEPROM and RTC are connected via I2C bus. An Inter-IC bus is used to communicate across circuit-board distances. To 1st and 2nd pin a clock of 32.768 KHz is attached. Here we have connected a 3v lithium cell on 3rd and 4th pin. This cell is used so that RTC remains updated always. As when we switch off supply the power to RTC goes off and RTC will not be updated so cell will help to keep RTC updated every time.

Code for serial transmission of characters and comparison is created.







Software Used

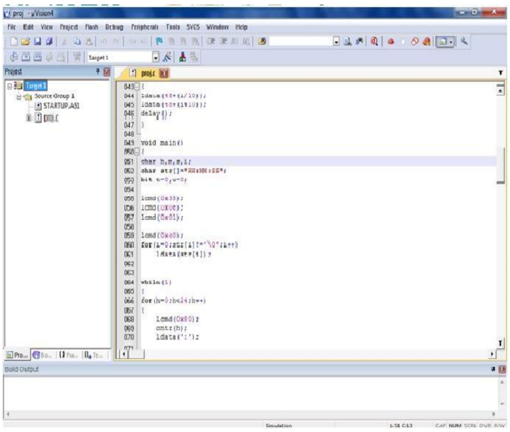
KEIL uVision 4:

1)This software is used for programming in C language & assembly.

2) It facilitates to debug & run programs.

3) Hex file of the program can be made & save.

4) It warns about the errors.



Fig, VIEW OF KEIL

Flash magic:

1) It is used to load & run the programs on hardware.

2) For the use of this software, the hex file of the programme is necessary.

3) It facilitates us to change the baud rate, chip etc.

4) The snap shot is shown.

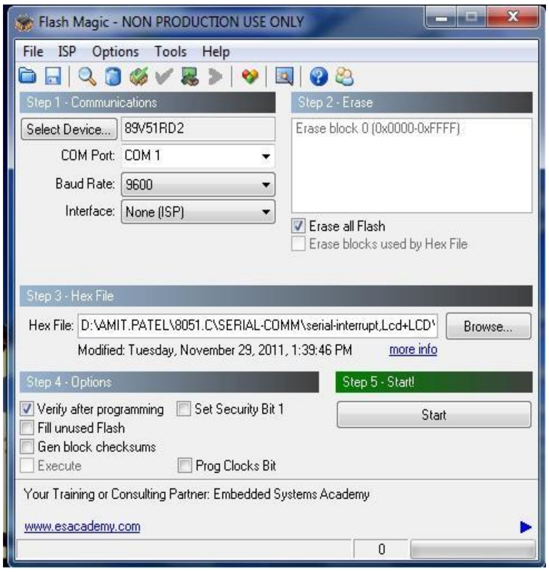


Fig. VIEW OF FLASH MAGIC

Proteus:

1) It is used to create circuits in Proteus Isis, simulate them and then create PCB with Proteus.

2) Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design.

3) It is developed by Lab center Electronics. The Proteus Design Suite includes: * ISIS - A schematic capture tool with the possibility to simulate programmable ICs like Microchip PIC, Atmel AVR (ATmega8, ATmega32, or ATtiny2313) etc.

4) To draw circuits using Proteus Isis.

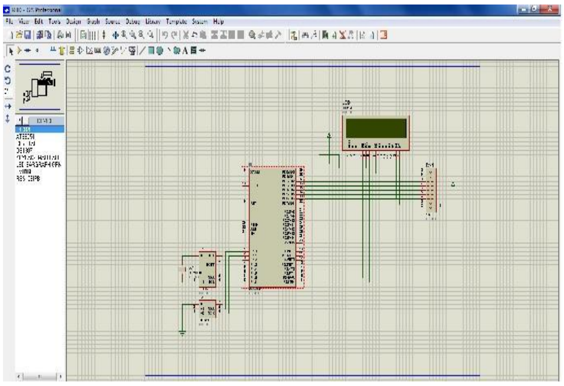


Fig. PROTEUS ISIS

HyperTerminal:

1. HyperTerminal is a program that you can use to connect to other computers.
2. HyperTerminal connections are made using a modem, a null modem cable (used to emulate modem communication), or an Ethernet connection.
3. HyperTerminal has capabilities beyond making connections to other computers. It can, for example, transfer large files from a computer onto your portable computer using a serial port rather than requiring you to set up your portable computer on a network. It can help debug source code from a remote terminal. It can also communicate with many older, character-based computers.
4. HyperTerminal records the messages passed to and from the computer or service on the other end of your connection. It can therefore serve as a valuable troubleshooting tool when setting up and using your modem. To make sure that your modem is connected properly or to view your modem's settings, you can send commands through HyperTerminal and check the results. HyperTerminal also has scroll functionality that enables you to view received text that has scrolled off the screen.

Applications of RFID

The primary aim of the research is to uniquely identify individual students based on their unique tag identifiers [11]. The research should shower light on how scalable and efficient the system is [12]. A systematic and serialized approach is required to solve this conundrum. The key characteristics of the application include:

- Perform automated attendance
- Generate report of attendees for a particular course
- Error free tag identifier detection
- Easy scalability to incorporate more records
- Integrity and security in data storage

This paper concentrates on the principal purpose to overcome the human errors while recording student attendance and the creation of a data centric student attendance database system with an improved overall efficiency. The application graphical user interface (GUI) is designed using Visual Basic 6.03 and Microsoft Access is used as the database provider. The Atmel4 AT89S52 is the heart of the system, which is a low-power high performance CMOS 8- bit microcomputer with 8K bytes of downloadable flash programmable and erasable read only memory [16]. It is operable in two modes namely (1) Idle mode and (2) Power down mode [14, 16]. The microcontroller can be programmed with the 80C51 instruction set along with additional standardized features like:

- 256 bytes of RAM5
- 32 Input/ Output data lines
- Three 16bit timers/ counters
- SPI6 serial interface
- Power off flag

The circuit contains a 16x2 LCD7 display panel, which is the output device of the system [17, 18]. It displays the user's information when the stored tag is read by the reader. The serial interface allows connectivity to a local database for data storage and retrieval. The input to the system is the unique tag identifier stored in the RF tag, which is sensed by the reader. The components are mounted on the printed circuit board for interconnectivity between them.

VII.CONCLUSION

The study has identified and explained the key benefits of RFID technology. RFID will open doors to a pool of applications from a plethora of industries. Although the focal challenge to thwart the adoption is its investment cost, RFID technology provides an ocean of lucrative business opportunities that could convince several firms adopt it. The first part of the paper explains the evolution of RFID technology and the role of its individual components within the system. The second part of the paper discusses the feasibility of employing RFID technology and how it is benefactor of improved efficiency at lowered costs. The last part of the paper highlights one of the numerous practical implementations of RFID technology. RFID technology definitely promises an increased effectiveness and improved efficiency for business processes. In the long run, with reducing unit tag and reader costs, several businesses will be able to leverage the benefits of RFID technology.

VIII.ACKNOWLEDGEMENTS

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