Visvesvaraya Technological University

Belagavi, Karnataka-590 018

A Project Report on

"DESIGN AND IMPLEMENTATION OF SMART ID CARD"

A project report submitted in partial fulfillment of the requirement for the VIII semester degree of

Bachelor of Engineering

In

Electrical & Electronics Engineering

Submitted by

Name: Raaga Sundar A, Prajwal P, Vikram J, Salman S

USN: 1CR17EE-051,047,084,062

Under the Guidance of

Mrs. Sanitha Michail.C

Associate Professor, Department of Electrical & Electronics Engineering

CMR Institute of Technology

CMR Institute of Technology, Bengaluru-560 037

Department of Electrical & Electronics Engineering

2020-2021

CMR INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

AECS Layout, Bengaluru-560 037

Certified that the Project work entitled **"DESIGN AND IMPLEMENTATION OF SMART ID CARD"**has been successfully presented by **Raaga Sundar A, Prajwal P, Vikram J and Salman S** at CMR Institute of Technology, Bengaluru, in partial fulfillment of the requirements for the VIII Semester degree of Bachelor of Engineering in Electrical & Electronics Engineering of Visvesvaraya Technological University, Belagavi during the academic year 2020-2021. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library.

The Project report has been approved as it satisfies the academic requirements in respect of Project work as prescribed for the said Degree.

Signature of the Guide	*Signature of the HOD*	*Signature of the Principal*
----------	----------	----------
Mrs. Sanitha Michail.C, Associate Professor EEE Department CMRIT, Bengaluru	Dr. K. Chitra Professor & HOD EEE Department CMRIT, Bengaluru	Dr. Sanjay Jain Principal, CMRIT, Bengaluru

CMR INSTITUTE OF TECHNOLOY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

AECS Layout, Bengaluru-560 037

DECLARATION

We hereby declare that the Project report entitled **"DESIGN AND IMPLEMENTATION OF SMART ID CARD"** has been carried out by us under the guidance of **Mrs. Sanitha Michail.C,** Associate Professor, Department of Electrical & Electronics Engineering, CMR Institute of Technology, Bengaluru,in partial fulfillment of the requirements for the VIIISemester degree of **Bachelor of Engineering in Electrical & Electronics Engineering** of Visvesvaraya Technological University, Belagavi during the academic year 2020-2021.

Place: Bengaluru

Date: 09/08/2021

Student's Name with signature

Name: Raaga Sundar A, Prajwal P, Vikram J and Salman S.

USN: 1CR17EE-51,047,084,062

Abstract

In the presentation we will see about digital smart ID card, which is built with a microcontroller, few sensors, LCD display and few buttons. This type of ID card can make things easier in schools, colleges and offices. For example, it can do a lot more tasks and applications than that of a traditional ID card. Our ID card would also act as a smart card with e-wallet loaded on it. As we all know our ID card has a RFID encoded on it and this card can act as a mode of carrying out secure transaction. UniqueRFID tags will be provided to student to ensure secure usage.

Acknowledgement

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people, who are responsible for the completion of the Seminar work and who made it possible, because success is the outcome of hard work and perseverance, but steadfast of all is encouraging guidance. So, with gratitude,I acknowledge all those whose guidance and encouragement served me to motivate towards the success of the Seminar work.

I take great pleasure in expressing my sincere thanks to ***Dr. Sanjay Jain****,* ***Principal, CMR Institute of Technology, Bengaluru*** *for providing an excellent academic environment in the college and for his continuous motivation towards a dynamic career.I would like to profoundly thank* ***Dr. B Narasimha Murthy****, Vice-principal of CMR Institute of Technology and the whole* ***Management*** *for providing such a healthy environment for the successful completion of the Seminar work.*

I would like to convey my sincere gratitude to ***Dr. K Chitra****,* ***Head of Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru*** *for herinvaluable guidance and encouragement and for providing good facilities to carry out this Seminar work.*

I would like to express my deep sense of gratitude to ***Mrs. Sanitha Michail.C, Associate Professor, Electrical and Electronics Engineering, CMR Institute of Technology, Bengaluru*** *for hisexemplary guidance, valuable suggestions, expert advice and encouragement to pursue this Seminar work.*

Iam thankful to all the faculties and laboratory staffs of ***Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru*** *for helping me in all possible manners during the entire period.*

Finally, I acknowledge the people who mean a lot to me, my parents,for their inspiration, unconditional love, support, and faith for carrying out this work to the finishing line.I want to give special thanks to all my friendswho went through hard times together, cheered me on, helped me a lot, and celebrated each accomplishment.

Lastly, to the ***Almighty****, for showering His Blessings and to many more, whom I didn't mention here.*

CONTENTS

CHAPTER 01:

INTRODUCTION

- Smart technology is abundant today in every aspect of life and makes a lot of work including retrieval of information much more convenient. Our project tries to incorporate this aspect into ID cards for an institution.
- This particular incorporation will focus on connecting student database to a common data cloud or server which can be accessed through the said ID card. Hence giving powerful insights to the user
- We'll be employing the usage of microcontrollers or SoC's depending on the future usages of the ID.
- Currently student cardsare implementedwith eithermagnetic strip or ordinary plastic cards which have very limitedspace to store dateand most have oneuse,i.e.,as an

identification card. Smart cards have a great advantage over magnetic strip cards in space, security,reliability and functionality.

- As mentioned above magnetic strip cards have very low storage mainly a few bytes and in general smart cards can store hundred times more information than magnetic.
- In the corporate world, colleges, universities etc. identity cards have become a part of the dress code. The identity has multiple features for the user comfort thus lead to the coining of the term smart identity card.
- This card disclosed in the present invention provides prepaid wallet system that keeps track of all the payments through mobile application. The system further provides parental control. Additionally, the smart identity card provides access control, authorization, and location identification.
- Smart cards can provide personal identification, authentication, data storage, and application processing. Applications include identification, financial, public transit, computer security, schools, and healthcare.
- Smart cards may provide strong security authentication for single sign-on (SSO) within organizations. Numerous nations have deployed smart cards throughout their populations.

CHAPTER 02:

OBJECTIVE

- This project is developed to ease the work of students. The project involves a RFID built card with a receiver which contains a display that can be mounted on every classroom and any Bluetooth devices such as smart phones or laptops to view the data.
- The details that this card holds can be refilled/edited with data as and when required by the student with the help of admin. This card is useful for the student in places like library, canteen and stationary shops.
- This card can be used to hold important data that will be needed by the student for any of its work
- This card is useful for the student in places like library, canteen and stationary shops.
- This card can be used to submit important documents that will be needed by the student for any of its work.
- This is done by scanning the RFID tag, which is the sent to the server where the student's document is stored and is directly sent from the server wherever needed.
- Thus, the user doesn't have to carry its documents always.
- Complex Cards can be equipped with biometric sensors allowing for stronger user authentication. In the typical use case, fingerprint sensors are integrated into a payment card to bring a higher level of user authentication than a PIN. Depending on Complex Card types, buttons have been added to allow an easy interaction between the user and the card.
- Displaying data is an essential part of Complex Card functionalities. Depending on the information that needs to be shown, displays can be digital or alphanumeric and of varying lengths

CHAPTER 03:

LITERATURE REVIEW

This section deals with the books, organizations and companies that were of use in determining the benefits of Smart Cards over existing card based technologies.

- "Smart Cards" by Jose Luis Zoreda and Jose (Zoreda & Ot6n, 1994) provides a good comparison of emerging Smart Card technologies, including existing card technologies such as magnetic stripe cards and optical cards. In addition to this, it also provides in depth information on how to access and program Smart Cards.
- However, due to the rapid advancements in Smart Card technology there existed no authoritative book on new emerging Smart Card technologies for some years after 1994. The "Smart Card Handbook" by Rankl Wolfgang (Wolfgang & Wolfgang, 1997) is one of the most authorative books on Smart Cards presently and attempts to fill this gap. This book focuses primarily on defining the Smart Card itself; from the physical form factor sizes to the protocols used for communicating to them and the various instruction sets used to program processor based Smart Cards.
- For this, it is recommended to read "Smart Card Security and Applications" by Mike Hendry (Hendry, 1997) that provides a comprehensive in-depth study into Smart Card security. This includes techniques such as public/private key encryption and biometrics that are not fully documented elsewhere. In addition, this book also contains useful example applications and documentation on how Smart Cards can be utilized within the industry.
- The ADS7843 is a 12-bit sampling Analog-to-Digital Converter (ADC) with a synchronous serial interface and low on resistance switches for driving touch screens. Typical power dissipation is 750µW at a 125kHz throughput rate and a+2.7V supply. The reference voltage (VREF) can be varied between 1V and +VCC, providing a corresponding input voltage range of 0V to VREF. The device includes a shutdown mode which reduces typical power dissipation to under0.5µW. The ADS7843 is specified down to 2.7V operation. Low power, high speed, and onboard switches make theADS7843 ideal for battery-operated systems such as personal digital assistants with resistive touch screens and other portable equipment. The ADS7843 is available in anSSOP-16 package and is specified over the –40°C to +85°Ctemperature range

- A touchscreen GUI needs to reserve RAM for each element in the interface. The base Arduino (ATmega328) has very limited RAM resources available (2KB), so care must be taken to optimize RAM utilization as much as possible, particularly if your design contains many menu buttons, controls or other dynamic elements. With that in mind, GU slice has been designed with a few key features that support such resource-constrained devices: No dynamic memory allocation by avoiding new () / malloc (), reduced memory due to fragmentation can be avoided Pure C code

CHAPTER 04:

METHODOLOGY

For this ID card we would require some electronic components such as:

- **Graphical LCD (used 16x2 for simulation):**

  The Graphical LCDs are used to display customized characters and images.

- **PIC16F877A Microcontroller:**

  PIC16F877a is a 40-pin PIC Microcontroller, designed using RISC architecture, manufactured by Microchip and is **used in Embedded Projects**.

- **RFID Module (EM-18):**

  EM18 RFID Reader is a module which reads the ID information stored in **RFID TAGS**. This ID information is unique for every TAG which cannot be copied.

- **RFID Tags**

- **Bluetooth Module (HC-05):**

  HC-05 is a module that is designed for wireless control, used in this project for communicating

Fig 1. Graphical LCD

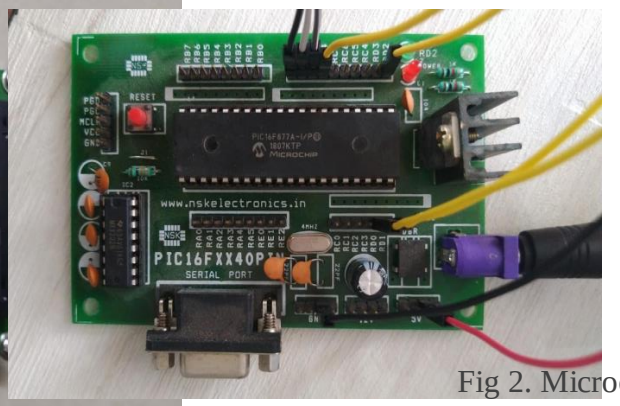

Fig 2. Microcontroller

Fig 3. Bluetooth Module

Fig 4. RFID Tags

Fig 5. RFID Module

THE ASSEMBLY

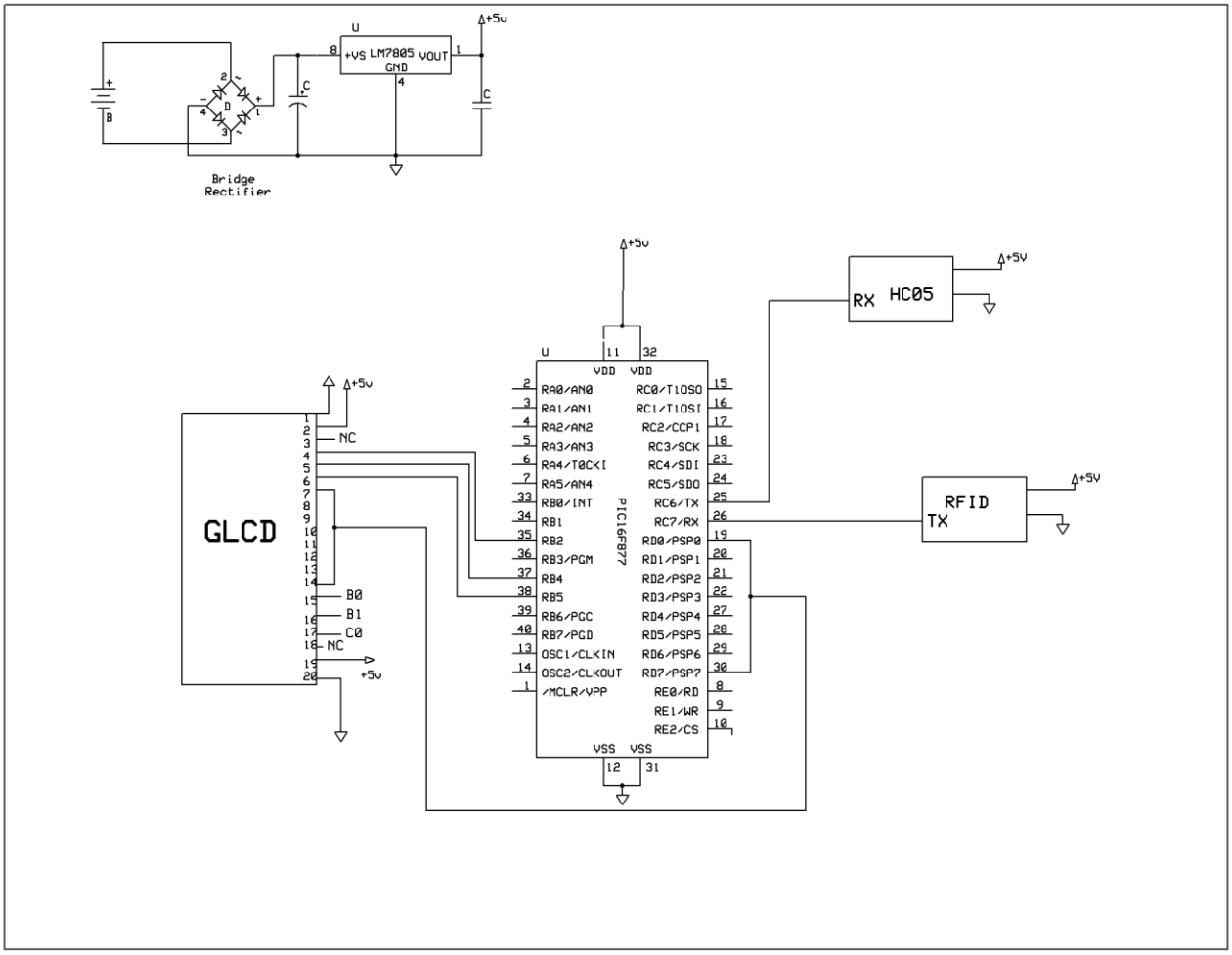

Fig 6. Pin Diagram

The respective pin diagram with the appropriate connections to the components are shown above. The components in the pin diagram are: Bridge rectifier (Adapter for power supply), GLCD display, PIC16F877A Microcontroller , Bluetooth module and RFID module.

CODE-

The code for the **PIC16F877A Microcontroller** and the **GLCD display** was written in C language and debugged, built using the MP lab IDE that specializes in coding and hex files.

And further the code was dumped into the Microcontroller with the help of the PIC boot Plus software. The code written for this microcontroller is given below.


```
//Code for working and interfacing of GLCD with the microcontroller
#if defined(__PCM__)
#include <16F877A.h>
#fuses HS,NOWDT,NOPROTECT,NOLVP
#use delay(clock=20000000)

#elif defined(__PCH__)
#include <18F458.h>
#fuses HS,NOWDT,NOPROTECT,NOLVP
#use delay(clock=20000000)
#define FAST_GLCD    // Try commenting this out to see the differences
#endif
#use rs232(baud=9600,xmit=pin_c6,rcv=pin_c7)
#include <HDM64GS12.c>
#include <graphics.c>
#include <math.h>

unsigned char Ten_Msec_Cnt;
unsigned char rfid[13];
char RX_DAT;
boolean SW_EN_FLAG=0,TOTAL_ATTEND_FLAG=0;
int SW_LOW_Cnt=0,SW_HI_Cnt=0;
void SW_SENSE(void);

#define  SW_SNS_PIN        PIN_A0
int8 i=0;
int8 CLR_CNT;

boolean CLR_GLCD_FLAG;
int16 FivHun_Msec_Cnt,msec_Cnt;
int8 GLCD_DISP_STAGE;

void TO_FIFTY_mSEC(void);
void FIVE_hMSEC_ISR(void);
void ONE_SEC_ISR(void);
void TEN_MSEC_ISR(void);
void ONE_MIN_FUNCTION(void);

boolean RX_DATA_FLAG;
int8 RX_COUNT,MIN;
boolean S1_FLG=0,S2_FLG=0,S3_FLG=0;
int8  S1_DAYS_CNT=0, S2_DAYS_CNT=0, S3_DAYS_CNT=0;

int8 SEC,D;
```

```
char   SCHOOL[11]="CMR SCHOOL",CLASS[16] = "CLASS:VI-A  DOB",S_ADD[68]="Kundalahalli
Gate,Marathahalli,Bang-37 PH:080-43675673";
char  S1NAME[13]="NAME:AAKASH",S1REG[24]="R NO:101  06/06/2010";//S1_ADD[62]="Address:AECS
```



```
layout,D-Block Marathalli-37,PH-9234321466";
unsigned char S2NAME[12]="NAME:SUNDAR",  S2REG[]="R NO:123  03/01/2010";//,S2_ADD[]="Address:ITI
layout ,5th cross,Marathalli-37,PH-8764321466";
  unsigned char S3NAME[]="NAME:VEDHA",S3REG[]="REG NO:86
08/10/2010";//S3_ADD[]="Address:SURABHI layout ,2nd cross,Marathalli-37,PH-9234378784";
unsigned char WELCOME[]="WELCOME TO";

#INT_TIMER2
void timer2_isr()
{
Ten_Msec_Cnt++;if(Ten_Msec_Cnt>10){ TEN_MSEC_ISR();  Ten_Msec_Cnt=0; }
msec_Cnt++;if(msec_Cnt>=1000){      ONE_SEC_ISR();  msec_Cnt=0; }

FivHun_Msec_Cnt++;if(FivHun_Msec_Cnt>=500){  FIVE_hMSEC_ISR(); FivHun_Msec_Cnt=0; }
}
#int_rda  // Reciecve Data
void serial_isr(){

  RX_DAT=getc();
rfid[D]=RX_DAT;
  D++;if(D>11){ D=0;  }
}
void main()
{
setup_timer_2(T2_DIV_BY_4,250,5); //setup up timer2 to interrupt every 1ms
enable_interrupts(INT_TIMER2);

enable_interrupts(INT_RTCC);
enable_interrupts(INT_RDA);
enable_interrupts(GLOBAL);
glcd_init(ON);

while(true)
{
if((rfid[4]=='1')&&(rfid[5]=='5')&&(rfid[6]=='7')&&(rfid[7]=='8')){ glcd_init(ON);

    glcd_text57(30,0,SCHOOL, 1, ON);   if(S1_FLG==0){ S1_DAYS_CNT++;  S1_FLG=1;}
    glcd_text57(0,11,S1NAME, 1, ON);
    glcd_text57(0,21,CLASS, 1, ON);
    glcd_text57(0,31, S1REG, 1, ON);
    glcd_text57(0,41,S_ADD, 1, ON);
delay_ms(2500);

printf("SCHOLL :CMR SCHOOL\n\r");
```

```
printf("NAME   :AAKASH NP \n\r");
printf("CLASS  :CLASS:VI-A\n\r  ");
printf("REG No :101\n\r  ");
printf("DOB    :06/06/2010\n\r  ");
printf("BLOOD G:O+ve \n\r  ");
printf("ADDRESS:#29,AECS layout,D-Block Marathalli-57 \n\r");
printf("GENDER :MALE \n\r ");
```



```
printf("PHONE NUM:9234321466\n\r ");
printf("SCHOOL ADDRESS:Kundalahalli Gate");
printf("SMarathahalli,Bangalore-37 PH:080-43675673 \n\r");
printf("Attendance          %d\n\r",S1_DAYS_CNT);
printf("  \n\r  ");  printf("  \n\r  ");
delay_ms(1000);    glcd_rect(0, 0,128, 64, YES, OFF);
rfid[7]='A';
}else if((rfid[4]=='9')&&(rfid[5]=='1')&&(rfid[6]=='4')&&(rfid[7]=='1')){
    if(S2_FLG==0){ S2_DAYS_CNT++;  S2_FLG=1;}

    glcd_text57(30,0,SCHOOL, 1, ON);
    glcd_text57(0,11,S2NAME, 1, ON);
    glcd_text57(0,21,CLASS, 1, ON);
    glcd_text57(0,31, S2REG, 1, ON);
    glcd_text57(0,41,S_ADD, 1, ON);
delay_ms(2000);

printf("NAME   :SUNDAR \n\r");
printf("CLASS  :CLASS:VI-A\n\r  ");
printf("REG No :123\n\r  ");
printf("DOB    :03/01/2010\n\r  ");
printf("BLOOD GROUP:A+ve \n\r  ");
printf("ADDRESS:#Address:ITI layout ,5th cross,Marathalli-37 \n\r");
printf("GENDER :MALE \n\r ");
printf("PHONE NUM:8764321466\n\r ");
printf("SCHOOL ADDRESS:Kundalahalli Gate");
printf("Marathahalli,Bangalore-37 PH:080-43675673 \n\r");
printf("Attendance          %d\n\r",S2_DAYS_CNT);
delay_ms(1000); rfid[7]='A';glcd_rect(0, 0,128, 64, YES, OFF);
}else if((rfid[4]=='0')&&(rfid[5]=='0')&&(rfid[6]=='9')&&(rfid[7]=='8')){
   if(S3_FLG==0){ S3_DAYS_CNT++;    S3_FLG=1;  }

    glcd_text57(30,0,SCHOOL, 1, ON);
    glcd_text57(0,11,S3NAME, 1, ON);
    glcd_text57(0,21,CLASS, 1, ON);
    glcd_text57(0,31, S3REG, 1, ON);
    glcd_text57(0,41,S_ADD, 1, ON);

delay_ms(2000);
printf("NAME   :VEDHA \n\r");
printf("CLASS  :CLASS:VI-A\n\r  ");
printf("REG No :86\n\r  ");
printf("DOB    :08/10/2010\n\r  ");
printf("BLOOD GROUP:B+ve \n\r  ");
```

```
printf("ADDRESS:#45,SURABHI layout ,2nd cross,Marathalli-37 \n\r");
printf("GENDER :FEMALE \n\r ");
printf("PHONE NUM:9234321466\n\r ");
printf("SCHOOL ADDRESS:Kundalahalli Gate");
printf("Marathahalli,Bangalore-37 PH:080-43675673 \n\r");
printf("Attendance          %d\n\r",S3_DAYS_CNT);
delay_ms(1000);  rfid[7]='A';  glcd_rect(0, 0,128, 64, YES, OFF);
```



```
}else{

    glcd_text57(10,10, WELCOME ,2, ON);
    glcd_text57(10,31, SCHOOL ,2, ON);
}

if(TOTAL_ATTEND_FLAG){
printf("STUDENT NAME     ATTANDANCE IN DAYS \n\r");
printf("AAKASH NP          %d\n\r",S1_DAYS_CNT);
printf("SUNDAR            %d\n\r",S2_DAYS_CNT);
printf("VEDHA             %d\n\r",S3_DAYS_CNT);
  TOTAL_ATTEND_FLAG=0;
}

  #ifdef FAST_GLCD
glcd_update();
   #else
delay_ms(100);    // Reduces flicker by allowing pixels to be on                    // much longer than off
    #endif
}
}
void ONE_SEC_ISR(void){

  SEC++;if(SEC>=60){  ONE_MIN_FUNCTION();  S1_FLG=0;  S2_FLG=0;  S3_FLG=0;   SEC=0;  }
}
void FIVE_hMSEC_ISR(void){

}
void ONE_MIN_FUNCTION(void){
 MIN++;if(MIN>=1){          MIN=0; }
}

void TEN_MSEC_ISR(void){
if(CLR_GLCD_FLAG){
     CLR_CNT++; if(CLR_CNT>=10){ GLCD_DISP_STAGE=1; CLR_GLCD_FLAG=0; CLR_CNT=0; }
 }
if(RX_DATA_FLAG){ RX_COUNT++; if(RX_COUNT>100){ RX_DATA_FLAG=0; D=0; RX_COUNT=0; }   }

  SW_SENSE();
}
void SW_SENSE(void)//CALLING IN TIMER INT
{
  if(!input(SW_SNS_PIN))
  {
```

```
if(SW_EN_FLAG==0)
            {
                  TOTAL_ATTEND_FLAG=1;
                        SW_EN_FLAG=1;
           }else{
SW_LOW_Cnt++;if(SW_LOW_Cnt>=250){
SW_LOW_Cnt=0;S1_DAYS_CNT=0;S2_DAYS_CNT=0;S3_DAYS_CNT=0;
```



```
           }
         }
}else{   SW_HI_Cnt++;  SW_LOW_Cnt=0;
           if(SW_HI_Cnt>=100)
{  SW_HI_Cnt=0;  SW_EN_FLAG=0;
              }
     }
}
```

HARDWARE MODEL:

Fig 7. GLCD display with details displayed

Fig 7. Project assembly

CHAPTER 05:

ADVANTAGES AND DISADVANTAGES

Advantages:

- It can hold a lot more data in the storage/server and can be viewed anytime with the help of any Bluetooth device.
- The student doesn't have to carry its document always, all it needs to carry is the portable card.
- It is more reliable.
- Data can be added or deleted by the admin.

Disadvantages:

- There can be case where the student ID may not be scanned properly due to some system error and thus the system may fail to record the attendance.
- There must be a power backup to avoid any interruption in the working.
- Since it contains display and electronic components it can easily damage.
- The cost is bit higher when compared to a physical ID card.

CHAPTER 06:

APPLICATIONS

- Can be used in schools, colleges and offices.
- A persons data can be viewed with security.
- Can be used to register attendance instead of biometric method.
- Instead of using many ID's we can use single ID card.
- Smart card applications include its use as GSM mobile phone for the identity requirements.
- Electronic coupons and credit programs are other attractive applications of smart cards.
- Secure Computer Networks: A secure access for networks can be assured through digital signatures of a user. They are utilized in granting only specified people to have the access to a particular computer network
- Data Authentication: Information with respect to the user is authenticated by the data already stored in the smart card or a token system also known as knowledge arrangement based may be exercised for the purpose

CHAPTER 07:

CONCLUSION AND FUTURE WORK

The emphasis on correct identification of every citizen is the basic proposition of all the sovereign governments across the globe. Perceived security threats to existing identification technologies are compelling factors to pursuit for evolving smart card technology. Security mechanism incorporating the complex encryption technology in place by this technology makes it more attractive compared to similar other available applications. This is a tool which offers to store and use the minimum desired data against a set of people or entity [42]. A suitable authentication scheme and security algorithm for faster and protected processing of data is always a challenge for any such technology. The above proposed study illustrates that user acceptance for constant evolving smart card technology will be the most prominent factor for the expected outcome. Further studies on the smart card system are likely to bring better dividends on issues as discussed in the subjects to be dealt with in above mentioned future scope.

Adaptability of this multifunctional technology in Internet of Things (IoT) with varieties of purposes makes it a lucrative proposition for commercial aspirants. Concerns on accessibility for both physical and logical control of the smart card applications are needed to be addressed adequately. The underlying intent of this research paper is to make the most of the smart card technology to exploit it to the fullest for the benefit of civilization. Endeavor is to combine all the existing traditional identity technologies and propose a workable single multipurpose identity supported by smart card technology [43]. Simplicity in use and robustness of the system must be assured in all the applications of this technology. A fundamental prerequisite for any modern technology including smart card technology increasingly relies on its adjustment with all accessible applications by of online services. The degree of convenience, cost effectiveness, multi-application solution and reasonable execution time for transactions are

some of the few factors contributing in successful implementation of the smart card technology [44]. Above all, potential of this technology to replace all existing identity solution shall lead to a much desired instrument for all the government across the world to exercise their authority on their citizens and to ensure that all the warranted privileges to be driven to the deserving entities only. Implementation of a nationwide single multipurpose smart card ID will enable to carry forward the vision of having a worldwide single global ID for every user across the globe.

We are working to bring smart ID into colleges and insituations that can provide ease of access and maintain attendance records linked to a cloud maintained by the institution server. One of the main objectives is cost efficiency as it must be pocket friendly and environment friendly too. We also saw the ease of access and convenience that can be mustered through this project.

Future work can include incorporating other features like:

- WIFI connectivity
- Record Maintenance
- One ID as in All Purpose ID.

REFERENCES

[1] Munizaga, Marcela A and Carolina Palma, ―Estimation of a disaggregate multimodal public transport origin-destination matrix from passive smartcard data from Santiago to Chile" in Transportation Research Part C: Emerging Technologies 2012, vol. 24 pp. 11-17.

[2] Sven Vowe, Ulrich Waldmann, Andreas Poller and Sven Türpe, "Electronic Identity Cards for User Authentication Promise and Practice", IEEE Security & Privacy January/February 2012, vol.10, No. 1, pp. 48-53.

[3] Y. Wang and X. Ma, "Development of a data-driven platform for transit performance measures using smart card and GPS data" J. Transp. Eng 2014, vol. 140 no. 12 pp. 4026-4053.

[4] M. Batty, C. Zhong, J. Wang, E. Manley, F. Chen, Z. Wang and G. Schmitt, "Variability in regularity: Mining temporal mobility patterns in London Singapore and Beijing using smart-card data" PLoS ONE 2016, vol. 11 no. 2 pp. 1-15.

[5] M. Mesbah, A.A. Alsger and L. Ferreira, "Use of smart card fare data to estimate public transport origin–destination matrix" Transp. Res. Rec. J. Transp. Res. Board 2015, vol. 2535, pp.89-94.

[6] Y. Asakura, T. Kusakabe and T. Iryo, "Estimation method for railway passengers train choice behavior with smart card transaction data" Transportation 2010, vol. 37 no. 5, pp.732-747.

[7] C. Morency, M. P. Pelletier and M. Trépanier, "Smart card data use in public transit: A literature review" Transp. Res. C Emerging Technol 2011, vol. 19, no. 4, pp.558-567.

[8] Al Khouri A. M, _Targeting Results: Lessons Learned from UAE National ID Program―, Global Journal of Computer Application & Technology 2012, vol. 2, no. 1, pp.832-835.

[9] Albert Levi and Omer MertCandan, ―Robust Two-factor smart card authentication‖, IEEE International Black Sea Conference on Communications and Networking (Black Sea Com) Year: 2017, pp.1-4.

[10] Jisung Kim, Hyongmin Lee, Taehoon Kim, Dongwoo Ha and Suhwan Kim, ―Differentiating ASK Demodulator for Contactless Smart Cards Supporting VHBR‖, IEEE Transactions on Circuits and Systems II: Express Briefs 2015, Vol 62, Issue: 7, pp.642-644