JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p. 3822-3829
https://publishoa.com
ISSN: 1309-3452

Ibutton Based Physical Access Authorization And Security System

Rahul S. Pol[1], Amar B. Deshmukh[2], Makarand M. Jadhav[3], Kazi Kutubuddin Sayyad Liyakat[4] and Altaf O. Mulani[5]

[1]Assistant Professor, E&TC Dept., VIIT Pune

[2]Associate Professor, E&TC Dept., MMCOE, Karve nagar, Pune

[3]Professor, E&TC Dept., NBN Sinhgad School of Engineering, Pune

[4]Associate Professor, Electrical Dept., SKN Sinhgad College of Engg., Pandharpur

[5]Associate Professor, E&TC Dept., SKN Sinhgad College of Engg., Pandharpur

rahul.pol@viit.ac.in, amarbdeshmukh@gmail.com, makj123@yahoo.com, drkkazi@gmail.com, aksaltaaf@gmail.com

Received 2022 March 15; **Revised** 2022 April 20; **Accepted** 2022 May 10.

Abstract:

The paper on access control using I-button delves the introduction of iButton for the purpose of security. This design moves away from traditional concept of using smart cards, RF tags, bar codes or magnetic stripes for access control. We have moved a step further to enhance portability, ruggedness, cost and ease of operation . This is possible as the size of iButton is comparatively smaller and works on the principle of single wire communication protocol. This design also allows future extensions in various regions of technological advancements.

1 Introduction

In recent days, the security requirement at all walks of our life in almost all security of society, commercial, domestic, or even in public sector security plays a very important part [ref. 1, 2]. Right from the early nineteenth century people have been inclined towards the necessity of security. With sufficient amount of security the user can avoid any kind of mishaps that could have taken place without using security. Taking into account the crimes and thefts occurring all around the globe, the author realized that the access control is the best way to control a system ultimate system that can be taken up as the paper work for our own . An access control system using iButton would be the most ideal to design and implement. Thus the final idea was arrived at.

The iButton [ref. 3, 4] is a embedded circuit chip integrated in a sixteen mille meter diameter metallic enclosure. This enclosure keep the ineer circuit protected and durable and can be use in transit anywhere. The metal button shape can be mounted easily at any configuration as it is more reliable which is withstanding safely for indoor as well as outdoor at type of severe environments. Also the durability of the hardware is good enough so as one can use easily as a key attachments for key fob, wrist watch, even in as items daily accessories[ref. 5,6,7]..

In this paper, the author have designed an access control system using iButton ID tag for identification in order to grant access to users under certain specific conditions, like time period, weekday, and key-in password are require for enhanced security measures. Access log of the users required were also prepared. A Personal computer or microcontroller have been used as the computing platform for the system in addition to the interface circuit that reads data from the iButton ID tag have been designed and constructed.

In the work presented here, one iButton will act as a master and others will act as slaves. Only the master iButton will be authenticated to update the database containing all the information. When the iButton is touched to the iButton reader, the microcontroller gives commands to the RTC, LCD and Stepper motor etc for further action to be taken. If iButton ID matches with the ID in the database, then the user is allowed to go to the next level.

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p. 3822-3829
https://publishoa.com
ISSN: 1309-3452

Fig. 1 shows the block schematics of the access control using iButton .

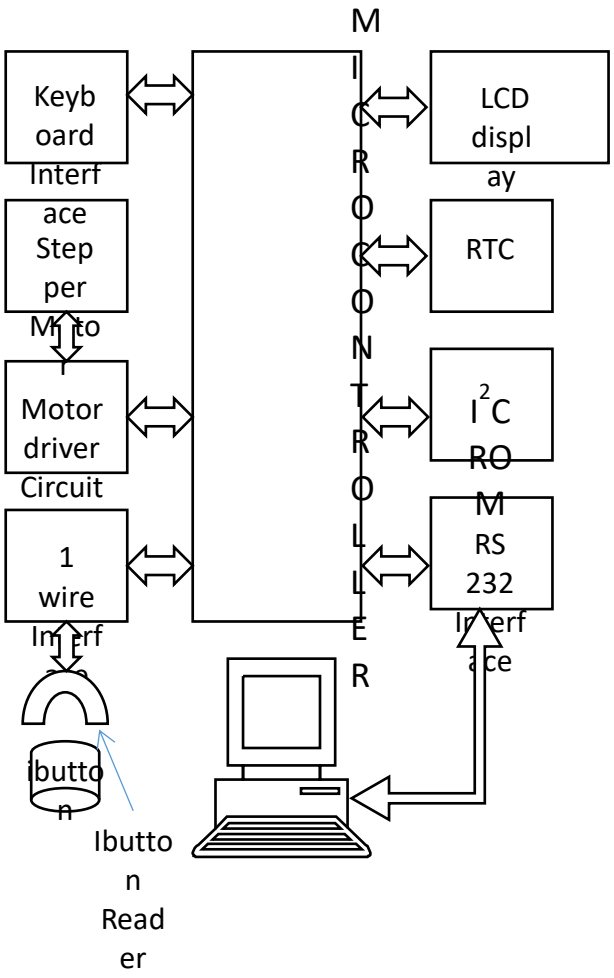

Fig. 1 Block Diagram of Complete i-Button System

This system includes following major elements are i-Button reader the heart of the system i.e. microcontroller help to compute and control the overall system process, LCD display to visualize the system decision outcomes such as access allowed or not, Keypad used to grant access to user to feed new code or granting access or not. It also has external memory for data storage along with Real Time Clock (RTC) for storing the time stampings of the access event. To convey the information to world it incorporate RS 232 Communication. The another major part is the stepper motor to move the physical access provider module

1.1 I-BUTTON Security code reader :

The iButton reader [ref. 4] is one of the most essential part of our block diagram. When the iButton is placed in the reader, it detects its unique ID and other relevant details and passes the information forward to the microcontroller via a single wire communication protocol for further processing as shown in figure 2

The iButton is shown in fig. 2 can be utilized for any real world physical access control and security application, This can be achieved through physical access control device through which access information needs can be carry by the corresponding user. This system intentionally uses iButton as it is compact and easily carry and can be attached to key fob or person wearing wrist watch, to any usually carrying object. This access or authentication device needs to touch to the iButton receiver module to allow the permission to access to restricted area, device or any private object or a piece of equipment. The iButton is a embedded circuit consist of inbuilt controller which communicate the hard coded access

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p. 3822-3829
https://publishoa.com
ISSN: 1309-3452

code through the contact point with the receiver which further transfer data to microcontroller through one wire communication. The length of the access code is 16 digit generally hard coded inside the iButton circuitry. It embedded circuit is safely enclosed inside the metal can as shown in figure 2. Each Ibutton has unique address field such as 4504005095D35109 acts as key or access identifier for specific iButton.

The construction of an iButton is shown in figure 2. It made of metallic enclosure acting as contact interface for the communications. The shape of can has divided into two part data contact which is also called as lid, along with ground connection though edge contact referred as base. Bothe contacts is joints to the fabricated chip placed inside the can. These contacts forming top and bottom of the iButton is separated through polypropylene grommet.

Figure 2. iButton and Secure Lock using iButton.

1.2 Computation and Controlling Device :

This proposed system utilized ATMEGA32L microcontroller as main controlling device of the system where most of the instructions regarding display, accepting input from iButton reader, keyboard, in-out instructions via RS232 or EPROM will be processed.

The. proposed microcontroller is ATMEGA32L [ref. 6,7] is a high performance, low power 8-bit microcontroller. Major features, encourage the author for the selection are,

i) Advanced RISC architecture with a powerful

instruction set of 131 instructions.

ii) Capable of performing complete operation with

16-20 MIPS throughput at 16 to 20 MHz

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p. 3822-3829
https://publishoa.com
ISSN: 1309-3452
iii) 32kb of on board flash and 1024 bytes of E2PROM.

iv) Equipped with 2kb internal SRAM and

programming lock for software security.

1.3 Visualizing Device:

In this system display is used in order to show whether access should be granted or not. Although variety types of visual indicators are readily available now a day to display live and recorded data over the indicators. These indicators includes visual form such as light emitting diode as well as liquid crystal display, the later one is very popular due to their common use in hand-held and other equipments. In contrast to LEDs which are active devices that generate light, LCDs are passive device that modify the light by scattering. The light from a separate light source is controlled by placing the liquid crystal cell in the light path and altering the optical transmission characteristics of the cell by the application of electric fields. The power consumption of these devices is extremely low, which is the foremost advantage of LCD types of displays, consider at the end.

1.4 User Interface :

The predominant interface between humans and computers is the keyboard. Being a commercial product, the available database needs to be updated at regular intervals of time. This is normally done by connecting it to the PC, which is a tedious and time consuming task. For this purpose the keypad will serve as a very handy component in this system. Any modifications and details of the database can be done via keypad.

The keypad need here is 4 x 4 matrix which is one of the most common used keypad. Their features are

- Integrated 4X2-Keypad for user input
- Good Power performance as it uses sleep mode.
- Utilization of microcontroller Sleep Mode feature.
- Compact Circuitry
- Various protection provided static discharge
- High Code density

1.5 Access and Authentication Data storage :

The internal memory of ATMEGA32 may be sufficient for many application however some applications may require more memory which the microcontroller may not be able to provide. For such applications we need to have external memory. Therefore the external memory is EPROM 24C02. This has 1 million data overwriting cycles with four decades of data retention. It is equipped with two wire serial interface and is fully compatible with I^2C bus.

1.6 RTC:

A real time clock is necessary to have control over different time periods such as when access should be allowed and when it should don't. This facility has been found prove to be very useful in hospitals, college labs, banks, etc. this block will add another dimension to our paper in improving the security aspect of it. The RTC will be interfaced to the microcontroller and will send and receive commands from it.

The proposed RTC is DS12887 and the features are,

i) Completely retained the data over ten years even power not applied.

ii) Counts seconds minutes, hours, days, weeks, and months with leap year compensation up to 2100.

iii) Daylight saving time option.

iv) Supports binary or BCD representation of time, calendar or alarm.

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p. 3822-3829
https://publishoa.com
ISSN: 1309-3452

1.7 External World Connectivity:

The RS232 interfacing is required for communication between the microcontroller and the PC. In serial data communication through wired with USART such as RS-232 data signaling between the two devices . generally used to transfer data from one communicating device to other for storing, retrieving or publishing information. This communication standard uses DB9 9 pin connector.

Although RS RS-232, data communication becomes absolute still some small embedded system retained this feature due to its simplicity and ease of programming. It supports synchronous communication where maximum speed can be achieved and handshaking overheads can be reduces to make more data efficient channel. Also it supports asynchronous where the channel noise can hamper the true speed of transmission and reception circuitry. The data transmission may be carried out simple, duplex or half duplex as per the system requirement. In proposed system it utilizes half duple communication for authentication. The data encryption is incorporated inside the ibutton system, the tags information is thus transmitted from the tag to the reciving system which further transmitt data through RS232 to other system such as desktop computer.

1.8 The Physical Access Device Interface :

To enable the physical security restriction for the area generally we used door or boom barriers, gates. These access restriction parts needs a driver which move them so as the restriction is enable or disable. This specific movement traditionally done with manually which now a day atomized using motors. Depending upon the type of restriction is needed or application need, the size of motor is decided, due to the topic restriction this proposed prototype system discussed mainly the security instead of designing the motor drive. In this proposed system stepper is as a moving element or driver for moving the restriction module so as to open or close the access area whenever it access is required.

The working of stepper motor in always closed loop and is simple. The number of pulses required to move the motor in required angle is already calculated and feed inside the memory. Thus the fixed sequence of pulses are provided so that motor rotate with pre-defined angle which in turn moved the corresponding attached assembly. The access is provided for fixed interval after which the stepper moves back to its original position i.e. rest position. Stepper has a good torque and smooth control compared to other motors, also it wont require feedback for finding the current position. Thus it is more convenient to incorporate the stepper for moving the restriction module. The working of stepper motor is simple and it requires simultaneous pulses at regular interval according to speed and motor specification. Thus depending upon the application requirement the movement can be customized and tuned so that safe passing can be achieved. Microcontroller are low power devices, generally directly used to interface with low power sensors and actuators, whereas to drive high power actuators such as motors and valve or pump it needs driver module which might be a transistorized circuit, relay circuit or driver IC;s. Now a day many ICs are available to drive different types of actuators according to there power requirement.

The proposed design incorporate stepper motor generate mechanical movement corresponding to applied microcontroller program generated excitation pulses. The power transfer assembly is required and design according to the application torque requirement, thus to rotation of stepper shaft may drive the physical access module completely or partially depending on the coupling gear ratio. The speed of the motor adjusted so as the overall movement of the module is smooth and not surprise or harm the end user.

The stepper motor each windings requires 700mA of current per coil. At any given stage, two coils of the motor are in active stage. So the total current requirement of the stepper motor is 1.4A. the microcontroller is however unable to provide more than 40mA of current. Thus the driver circuit is needed to meet the current requirements.

1.10 Supply Requirement:

The primary requirement of any embedded system is the power, designers always tries to maintain the power requirement of the complete system as minimum as possible. The proposed system uses power line source and can be transfer to mobile power supply such as 6V dc power supply. The proposed circuits powered with + 5V for working voltage and the max current sinked by the circuit is 1A. the rectified output is given to 7805 regulator which gives constant 5V DC as shown in figure 2.

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p. 3822-3829
https://publishoa.com
ISSN: 1309-3452

2 CIRCUIT DIAGRAM

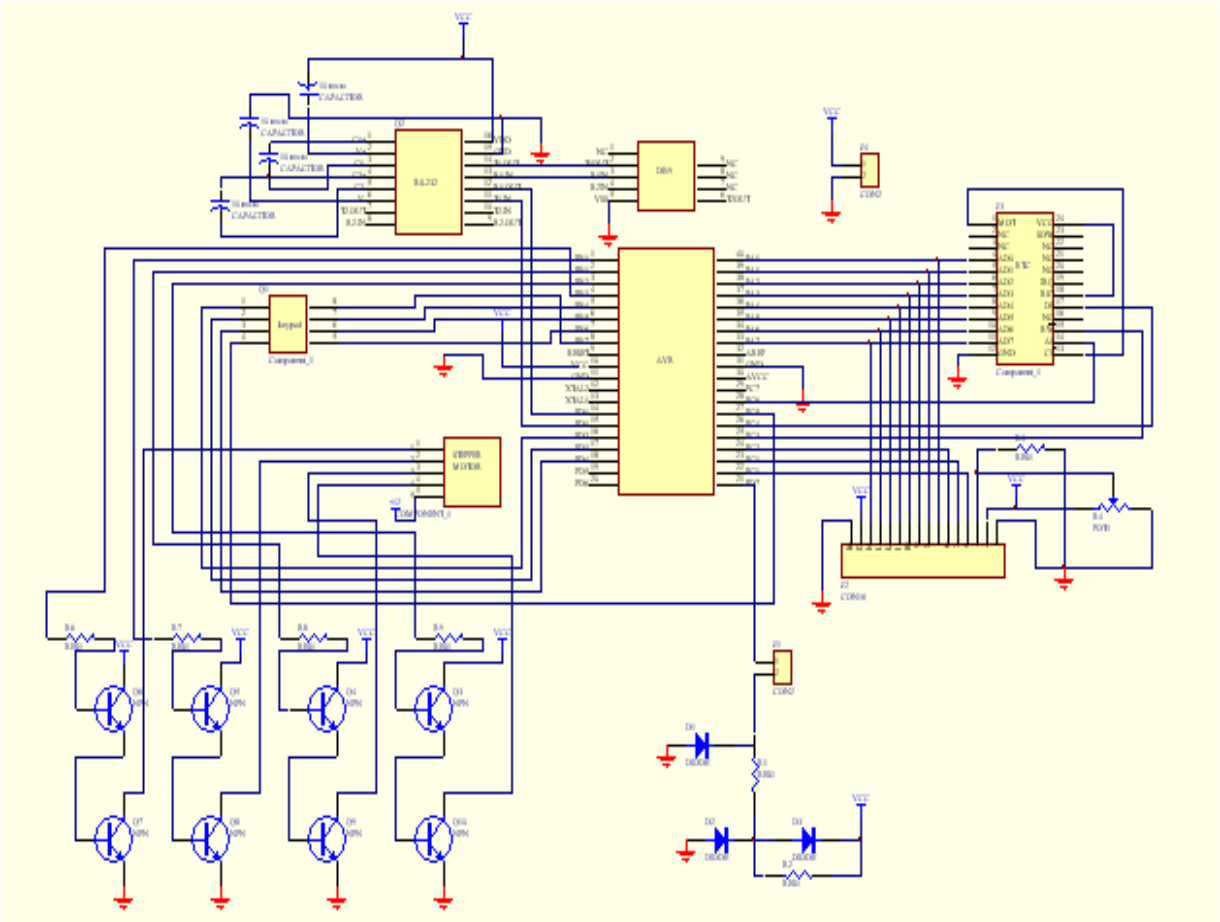

Figure 2: iButton based system schematics.

3. Methodology Used for Physical Access Authorization

The system is initiated by simply placing the iButton to the two physical contacts described in the previous section. This type of contact initiate 1-Wire communication which transfer the authentication id at the speed of 16kbps at standard rate, and 142kbps in override mode . thus simple touch for small period can transfer the access code to the microcontroller, the proposed system provide beep and indication to provide audiovisual indication for successful code transfer. The reader works in synchronized mode with the ibutton module. Whatever code received from the reader is fetched by the microcontroller for further action. The iButton reader is interfaced to to microcontroller through a 1-Wire interface called as adapter as shown in figure 3. The iButton reader and adapter are inexpensive.

The microcontroller receives the serial number required for further processing. Then, the serial number is checked by the microcontroller with respect to the database in the memory and the person is granted access if all the data and time constrains are met. The entries of the database can be very efficiently made with the help of the alpha-numeric keyboard. The entries have a wide range of options to add, delete, or to even create a new entry. To make things easier further, we have used a 16x2 bit LCD. The user can perform his operations by watching these entries and options on this LCD.

To well-suit the access system we have used a RTC within system. It allows access to different users according to the time slots allotted to it. For example information about the specific persons and their timings is fed and updated regular interval. The system will not grant access at all if the timing constrains are violated. Thus RTC can help us know about any intruder trying to access the system and thus strengthen the security aspects.

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p. 3822-3829
https://publishoa.com
ISSN: 1309-3452

The main locking system uses a latch whose working is purely is based on stepper motor. The stepper motor comes operates as soon as the access to the user is confirmed by the system. The movement of the latch is controlled by rotation of the stepper motor. This has proved to be a very efficient and sensitive system over the traditional methods. The stepper motor is driven using a stepper motor driver circuit comprising of 4 Darlington pairs.

An EEPROM is used as portable memory which keeps records of all user. Serial communication is done through RS-232. This helps in the handshaking between the PC and the microcontroller.

4. Software aspects and Simulation:

1) Cross compiler : AVR studio4

2) Programmer : unipro10

3) Circuit diagram and PCB design: Protel DXP

4) Simulation: Proteus software

5) Application software and User interface:

Microsoft visual basic 6.0 Event driven programming language. Easy to learn and program as compared to other languages (for GUI) viz. C++, MATLAB, JAVA, etc.

5. Conclusion

The proposed iButton system successfully designed and deployed for an access control system, This type of access control method can be deployed for simplest access control to authorized person at varieties of real world application. The proposed prototype model, can be easily deployed to provide access to the bank locker system. This may be applicable to any similar system, where the security is key aspect. It may be further enhanced to any numbers with minimum hardware and software modification. The limitation such as power back up at all iButton readers, stepper motors for closing and opening of the doors as well as the server which maintain the database are to be taken care for effective implementation of the system. The cost of the system may be further reduced if there are larger numbers of user and also by doing mass production.

6. References

1. Moi-Tin Chew , Tatt-Huong Tham , Ye-Chow Kuang, "Electrical Power Monitoring System Using Thermochron Sensor and 1-Wire Communication Protocol", 4th IEEE International Symposium on Electronic Design, Test and Applications (delta 2008) Issue January 2008, pp. 549-554
2. Neil J. Henderson, Neil M. white, H. Hartel "I button enrolment and verification requirement for pressure sequence Smart card Biomentric",E-smart 2001, LNCS-2140, pp – 134- 140, 2001,springer verlag- berlin, Heidelberg 2001.
3. http://www.evva.cz/czech/ibutton_security_rom.pdf
4. Kingpin (Grand J) : A Practical Introduction to the Dallas Semiconductor iButton, Published on @stake website, February, 2000.
5. S. Berger, H. Schulzrinne, S. Sidiroglou, and X. Wu. Ubiquitous computing using SIP. In ACM NOSSDAV 2003,June 2003.
6. Scott Campbell "Supporting Digital Signatures in Mobile Environments " Twelfth International Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises, Issue June 2003, pp. 238
7. Joe Grand ,"Exploring Security Problems in Hardware: Past and Present" Computer Security Conference, San Diego, Sept. 2005

O. Mulani and G. N. Shinde, "An approach for robust digital image watermarking using DWT- PCA", Journal of Science and Technology, Vol.6, Special Issue 1, 2021

8. U. P. Nagane and A. O. Mulani, "Moving Object Detection and Tracking Using Matlab", Journal of Science and Technology, Vol.6, Special Issue 1, 2021
9. Ganesh Shinde and Altaf Mulani, "A Robust Digital Image Watermarking using DWT- PCA", International Journal of Innovations in Engineering Research and Technology ﴾IJIERT﴿, Vol. 6 Issue 4 April 2019.

   O. Mulani and Dr. P. B. Mane, "Secure and area Efficient Implementation of Digital Image Watermarking on Reconfigurable Platform", International Journal of Innovative Technology and Exploring Engineering, Vol. 8, Issue 2,Dec. 2018
10. Wale Anjali D., Rokade Dipali, K. Kazi, "Smart Agriculture System using IoT", International Journal of Innovative Research In Technology, 2019, Vol 5, Issue 10, pp.480-483.
11. Pankaj R Hotkar, Vishal Kulkarni, Pranay Kamble, K S Kazi**, "**Implementation of Low Power and area efficient carry select Adder," International Journal of Research in Engineering, Science and Management, 2018, Vol 2, Issue 4, pp. 183-184
12. Karale Nikita, Jadhav Supriya, Heena Rafiq Shaikh, Kazi Kutubuddin, " Design of Vehicle system using CAN Protocol", International Journal of Research in Applied science and Engineering Technology, 2020, Vol 8, issue V, pp. 1978-1983, http://doi.org/10.22214/ijraset.2020.5321