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Efficient Authorized Access Security System Control Using ATMEL 89C55 & Mobile Bluetooth

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Abstract—Security is gaining awareness and importance in recent years. Authorized Access Security System (AASS) is a network device for validating, monitoring and controlling the security within buildings. Today, they are many building that are using security access approach to protect the building from unauthorized access. In this paper a low cost electronic system has been designed which can control different locking mechanisms. Low operating power consumption, small circuit, flexible mechanical design and user friendly interface are the salient features of this security system. The system implemented to meet both of these needs uses a user-friendly high-security interface that allows users to access an alarmed area, and authorized users to have field control of the access lists to that alarmed area. The paper presents the technology of Authorized Access Security System. This technology uses ATMEL 89C55 microcontroller and visual basic program to build data logger which provides multiple accesses to a protected area that can be an office, home, bank or whatever needed. The data logger was added to the system to make records of users who accessed the system at any time. Bluetooth-enabled mobile phones design is also proposed providing wireless and automatic unlocking

Index Terms—Security System, ATMEL 89C55 microcontroller, visual basic, and data logger, bluetooth

I. INTRODUCTION

Research and industrial applications related to security include several areas such as personal security, organizational security, and computer security, among others. Access control involves maintaining information about which users can access system resources and ensuring that access is restricted to authorized users. Security access control (SAC) is an important aspect of any system. SAC is the act of ensuring that an authenticated user accesses only what they are authorized to and no more. Adequate security of information and information systems is a fundamental management responsibility. Nearly all applications that deal with financial, privacy, safety, or defense include some form of access control. Access control is concerned with determining the allowed activities of legitimate users, mediating every attempt by a user to access a resource in the system. In some systems, complete access is granted after successful authentication of the user, but most systems require more sophisticated and complex control. Nowadays, locks and keys are not enough to keep an environment secure against unwanted or uncontrolled visitors. To have access, mechanical security systems are widely used, however, such systems—purely mechanical—can be easily defrauded. To

construct high-security access systems, the embedded electronics have associated to the mechanical security, with the objective of increasing the level of reliability of such systems. Besides, with the increasing use of mobile devices, users are more and more interested in mobile solutions to support several activities, including security-related ones. This paper presents an access control system that uses Bluetooth technology. By using the proposed system, a person with mobile phone can use it to get access to environments, such as buildings, labs, rooms, and so forth. The objective of this paper is to build an authorized access security system using two access ways, one of these ways is a complete hardware design using ATMEL 89C55 is able to detect any unauthorized motion inside the protected. The functionalities of the design are being able to:

- 1) Give the facility multiple access system, an administrator and 5 users. (Users number can be extended depending on the size of the used EEPROM).
- 2) The user is able to access only the system.
- 3) The administrator is able to:
 - Add new user.
 - Delete an existing user account. (Not allowed deleting an empty location warning message will appear).
 - Modify an existing user account.
 - Only modifying the administrator password is allowed.
- 4) Detect any motion within the time of user inexistence, the system will hang up and the alarm will be on till the moment of administrator coming.
- 5) Combatale with the visual basic program.
- 6) Save the accounts passwords even if the power is down.
- 7) Visualize all the functionalities provided using LCD.

II. SYSTEM HARDWARE COMPONENTS

This section will present the architectural components of Authorized Access Security System and detail their functioning.

A. ATMEL 89C55 Microcontroller

A microcontroller (or MCU) is a computer-on-a-chip used to control electronic devices. Atmel Corporation (NASDAQ: ATML) is a manufacturer of semiconductors, founded in 1984. Its focus is on system-level solutions built around flash microcontrollers. Its products include microcontrollers (including 8051 derivatives and AT91SAM ARM-based micros), and its own Atmel AVR and AVR32 architectures, radio frequency (RF) devices, EEPROM and Flash memory devices (including Data Flash-based memory), and a number of application-specific products. Atmel supplies its devices

as standard products, ASICs, or ASSPs depending on the requirements of its customers. In some cases it is able to offer system on chip solutions. Atmel serves a range of application segments including consumer, communications, computer networking, industrial, medical, automotive, aerospace and military. It is an industry leader in secure systems, notably for the smart card market. The Microcontroller used in this project is ATMEL 89C55, the choice of this type of Microcontroller is determined by the following criteria [1][2]:

- 1) The size of the flash memory.
- 2) The types of the contained memory FLASH, EEPROM or ROM.
- 3) The interfaces it support RS232, Ethernet, USB or other interfaces.
- 4) The size of the MCU layout on the PCB.
- 5) The low cost of MCU.
- 6) The clock cycle has fast speed processing.

AT89C52 as shown in Fig. 1 consist of [3]:

- CPU which needs a crystal of 12MHz
- MEMORY(flash)
- REGISTERS
- Addressing

AT89C52 microcontrollers consists of three banks that each has 8 registers for data storage R0-R7, also have four ports each consisting of 8 pins which can be programmed to be input/output[4].

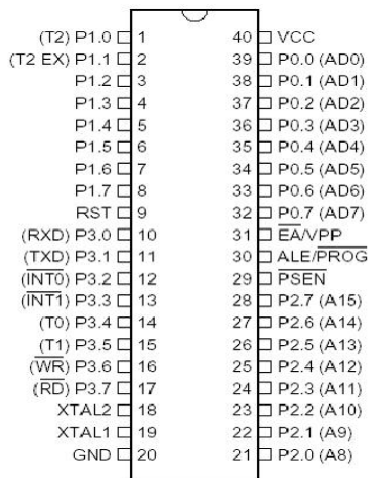


Fig. 1. ATMEL 8052 structure.

AT89C52 can be programmed by three different languages [5]:

- Assembly language.
- Basic language.
- C language

Basic language is used in this paper to program AT89C55, because it is easy to deal with LCD programming.

B. Intelligent LCDs

The Ability to display letters, words, and all manner of symbols, not just numbers, makes LCD better than familiar 7-segment led. There are many types of LCD according to its functionality, and varies in Characters length and lines. Most LCD modules conform to a standard interface specification.

A 14-pin access is used in this paper, having eight data lines, three control lines and three power lines as shown in Table I[6].

TABLE I: LCD PIN LOCATIONS

Pin No.	Name	Function
1	Vss	Ground
2	Vdd	+ve supply
3	Vee	Contrast
4	RS	Register Select
5	R/W	Read/Write
6	E	Enable
7	D0	Data bit 0
8	D1	Data bit 1
9	D2	Data bit 2
10	D3	Data bit 3
11	D4	Data bit 4
12	D5	Data bit 5
13	D6	Data bit 6
14	D7	Data bit 7

One of the reasons for using the basic language to program the MCU is that BASCOM deals with LCDs, using only three command lines is enough to write a text on LCD, as shown in Fig. 2.

```
Config Lcdpin = Pin , Db4 = P1.2 , Db5 = P1.3 ,
Db6 = P1.4 , Db7 = P1.5 , E = P1.1 , Rs = P1.0

Config Lcd = 16 * 2

Lcd " Welcome to "
Lowerline
Lcd "Security System"
```

Fig. 2. Three commands to write a text on LCD.

C. Keypad Interface with ATMEL 89C55

Using keypad provides an easiest and visualized way to pass a certain data to your microcontroller; keypad can be used to design a calculator, games, door lock system, etc, as shown in Fig. 3.



Fig. 3. Keypad Interface.

There are three techniques of keypad interface:

- Scanning technique
- An external electronic design.
- Using keypad encoder IC (74C923)

Using 16key encoder IC (74C923)

The chip scans the keypad waiting for a key press. When a button is pressed pin 11 of the 74922 goes high. Then a 4 bit binary number corresponding to the button press is sent to pins 14-17 of the IC. The programming is straight forward; use the button command to read the state of pin 11 of the

74922. When its high read the states of pin 14 to 17 and save it. Now it has to convert the 4 bit binary number to a decimal number. Then use a bunch of if statements to do what you want with each pin of the keypad. The two capacitors are for scanning and debouncing times. Pin 5 is for scan and pin 6 is the debounce. They don't have to be .1 uf and 1uf. If a faster auto repeat needed, go with a .1uf cap. Table II is the key pressed and the corresponding 4 bits output.

TABLE II: ENCODER OUTPUT

Key	0	1	2	3	4	5	6	7	8	9	clear	help	enter	2nd	down	up
Output A	1	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0
Output B	1	0	0	0	1	1	1	0	0	0	1	1	1	0	1	0
Output C	1	1	1	0	1	1	0	1	1	0	1	0	0	0	0	0
Output D	0	1	0	1	1	0	1	1	0	1	1	1	0	0	0	0

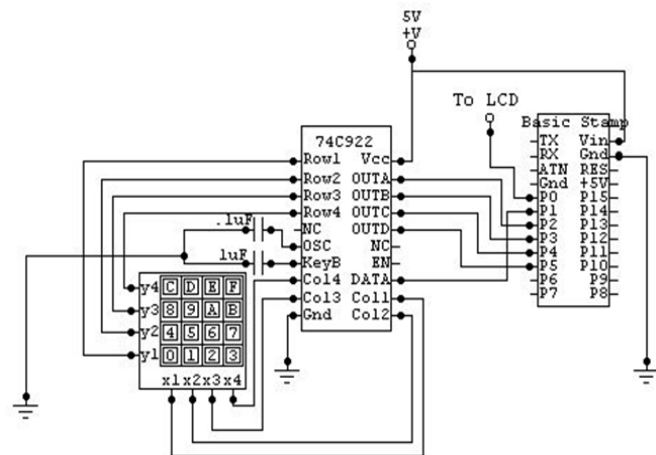


Fig. 4. Keypad to LCD connection schematic

D. Passive Infrared Detector (PIR)

Motion detection is the sensing of physical movement in a given area. The principal methods by which motion can be identified are infra-red detection and acoustical detection. RK210PR motion detection sensor used in AASS design shown in Table III [7].

TABLE III: RK210PR MOTION DETECTOR SPECIFICATION

Specification	CoMET PIR	CoMET PET
Pet immunity	Small rodents	42lbs(20kg) dog, 2 cats or multiple rodents
Pattern at 2.4m(7'10") mounting height	12m X 12m (40'x 40')	8m (26') 90°
Operating voltage	9 to 16V regulated	
Current consumption	12mA at 12V	
Alarm contact	50mA, 24V, N.C	
Tamper contact	100mA, 24V, N.C	
Alarm time	2.2 seconds minimum	
Pulse count selection	1, 2 or 3 pulse count	
Temperature compensation	Automatic, thermistor controlled	
Optical filtering	White light protection, pigmented lens	
IF immunity (10 MHz to 1GHz)	20V/m	
Operating temperature	-5 to 50°C (23 to 122°F)	
Storage temperature	-20 to 55°C (-4 to 131°F)	
Dimensions	89 x 52 x 39 mm (3.5 x 2.0 x 1.5 inch)	

III. AASS DESIGN USING ATMEL 89C55

The purpose of this paper is to design an authorized access security system as shown in Fig. 5, using three access ways.

One way is a complete hardware design. The design is able to detect any motion inside the protected room.

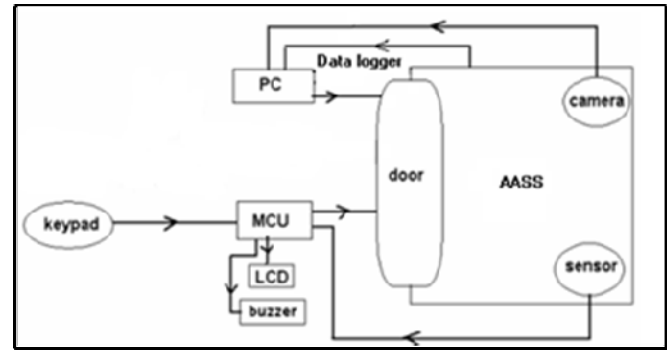


Fig. 5. AASS Diagram

The users of the AASS are divided into two groups; an administrator, and 5 users group. This system is design to deal with those two groups with some actions and also to deal with the process of illegal entrance. Fig. 6 shows the users and the administrator authorities.

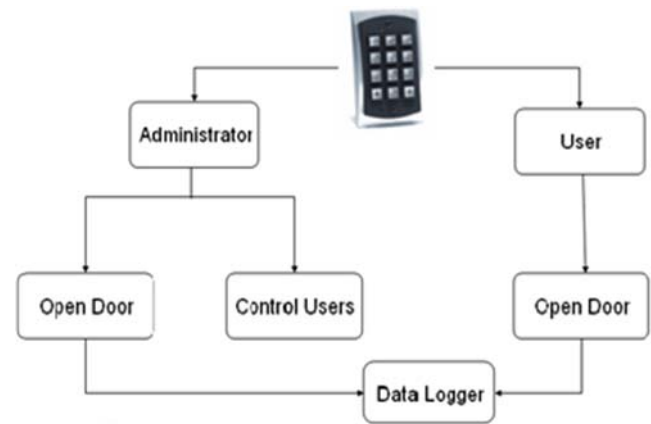


Fig. 6. System Functionalities

ATMEL 89C55 Connection with Components:

ATMEL 89C55 is divided into four ports, port 0 to 3. Every port is to interface with a component of AASS circuit. Port 0 is chosen to interface with keypad decoder, Port 1 interfaces with LCD, Port 2 interfaces with sensor, alarm, door, and buzzer and Port 3 interfaces with Parallel Port as shown in Fig. 7, and Fig. 8.

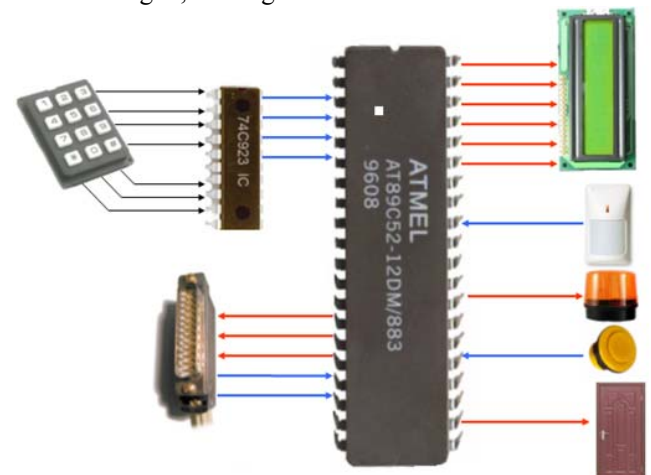


Fig. 7. ATMEL 89C55 Pin Connections

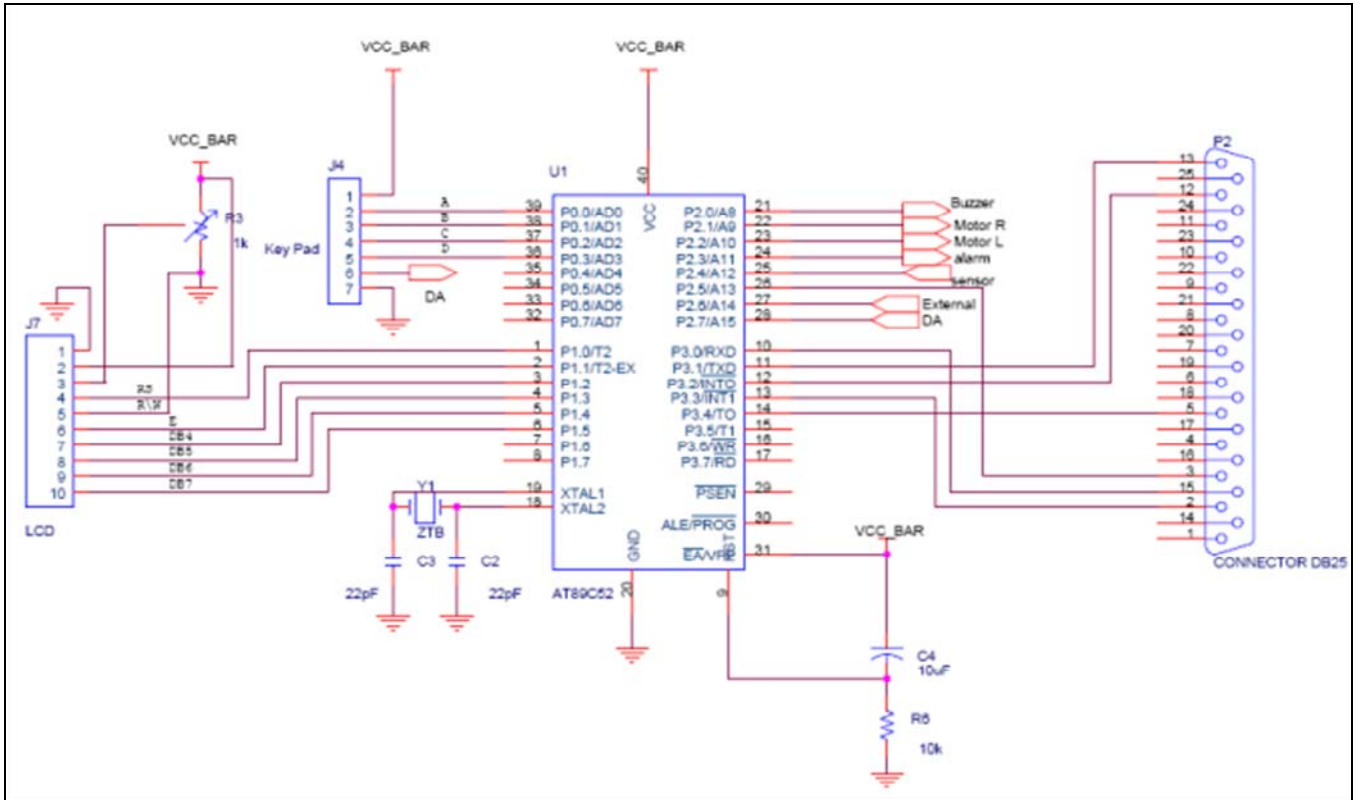


Fig. 8. ATMEL 89C55 Circuit Diagram.

IV. VISUAL BASIC PROGRAM

Visual basic programming and built library provides very strong tools which help the program to use RS232, USB and parallel port easily [8]. This program is used by the administrator of the system to control the system from a computer which also records the logs by using the data logger facility. This system is connected to the keypad-LCD system using the parallel port.

When the program run a login dialogue will appear as shown in Fig. 9, to write the administrator username and password



Fig. 9. Login Dialogue

As user enters the right information he will be logged into the system control program and ready to use the control panel.

A. The Data Logger

Data logger is designed as shown in Fig. 10, because need to know who had an access to the system. The system have many users who can log in using the keypad, so this control records the events of logging on and also specifies the exact time and date for that. It also records when the alarm goes on, and if an un-authorized action had happened as in Fig. 11.



Fig. 10. Data Logger Access

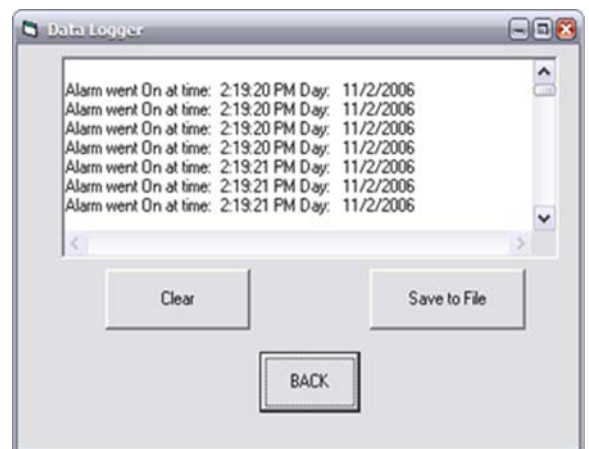


Fig. 11. Data Logger Panel

As a development to the system a save button is added that can save the exact data recorded in the text field to a file at a specified program folder that can be accessed any time. Also

an auto save technique designed that will save the data in the text field automatically every 10 seconds so that can avoid losing data if the electricity goes off, and it saves the data in a file called auto save.

B. The Camera Control

The camera control is added as an accessory to the system, because AASS is specialized in the authorized access to the room not monitoring. AASS is designed to be a part of a bigger system that includes monitoring, detection of motion as an accessory too. Fig. 12 shows how the camera control works, if want to monitor the room just click the camera control button on the control panel then click capture.

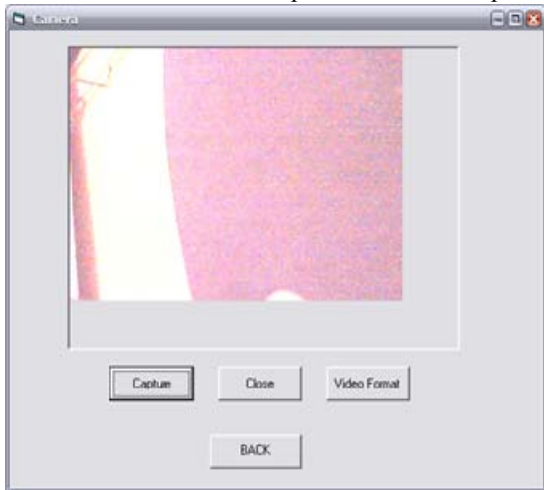


Fig. 12. Camera Control

C. The Door Control

The administrator can open the door from this panel by clicking the open door button shown in Figure 10.

V. AASS DESIGN USING BLUETOOTH

Access control using Bluetooth mobile device is a design solution for a secure access control that can replace physical keys for accessing private buildings. The design of the Bluetooth access control is using digital keys on Bluetooth enabled mobile phones providing wireless and automatic unlocking [9]. The number of mobile phones equipped with Bluetooth is steadily increasing, and it is becoming the widely accepted standard for short-range point-to-point communication A Bluetooth interface to AASS that is an independent interface from the LCD & Keypad, users can access the system using their mobiles phone that have Bluetooth support by entering their passwords to access the system. Bluetooth is an optional communication technology that can replace their normal proprietary system. In designing AASS using Bluetooth (shown in Fig. 13, and Fig. 14); there are two protocols have to be programmed by the designer, first the designer has to program the mobile phone or the PC, second has to program the toothpick device. When the user enters the system he must enter the correct password by using his mobile phone or PC. The password data will be transmitting directly to toothpick device, and it will reply back a message true or false. The system will unlock if the true message arrived.

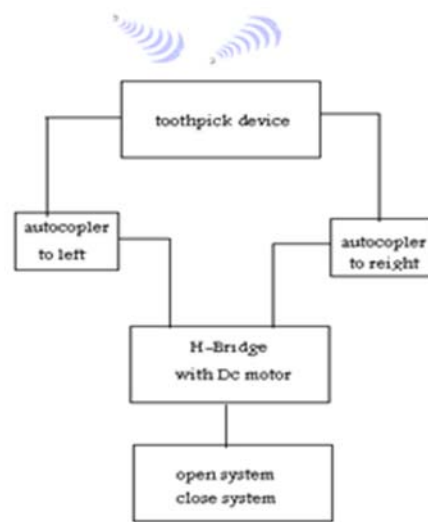


Fig. 13. AASS Design using Bluetooth

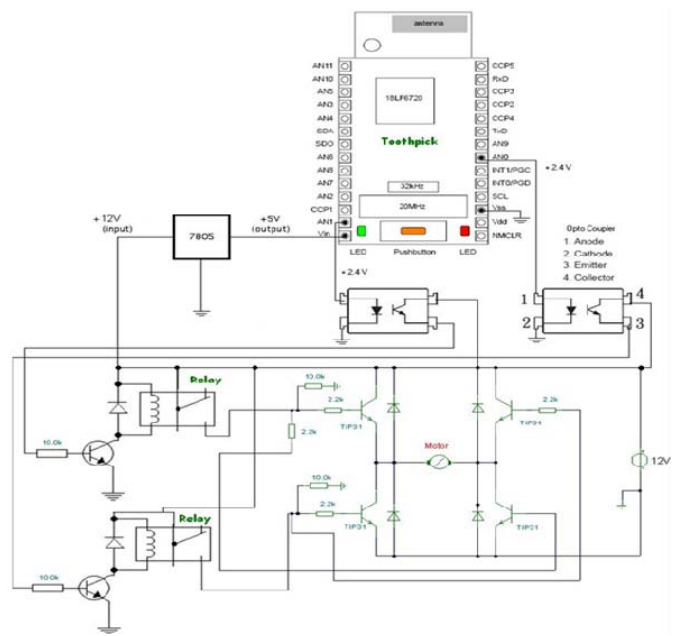


Fig. 14. AASS Circuit Diagram using Toothpick

H-bridge is designed to control the four dc motors used to open and close the door. The operation of the H-bridge is shown in Fig. 15 and Table IV.

TABLE IV: H-BRIDGE MODES

High Side Left	High Side Right	Lower Left	Lower Right	Quadrant Description
On	Off	Off	On	Motor goes Clockwise
Off	On	On	Off	Motor goes Counter-clockwise
On	On	Off	Off	Motor "brakes" and decelerates
Off	Off	On	On	Motor "brakes" and decelerates

Toothpick

Toothpick (Figure 16) is a PIC microcontroller and BlueMatik radio combination, preloaded with Toothpick. It can be programmed by C language or stamp edition. Toothpick may be powered with a 5V regulated input to the Vdd pin. Maximum regulated supply voltage is 5.5V. Minimum rated voltage is 4.5V [10].



Fig. 15. H-Bridge Operation

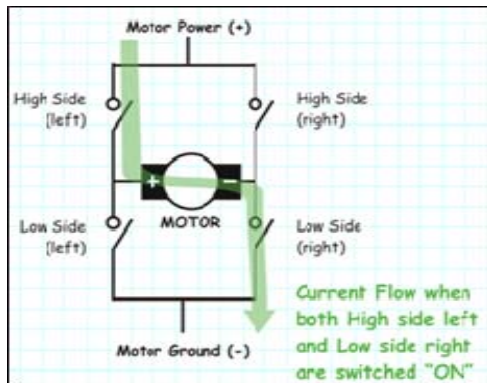


Fig. 16. Toothpick

Toothpick Services Features

- FlexiPanel server – creates user interfaces on computers, PDAs, cellphones with no development needed on remote devices
- Wireless field programming lets developers distribute firmware upgrades electronically
- System services including: Bluetooth communications, interrupt and memory management, sleep-safe real time clock with daylight savings time / day-of week calculator as shown in Fig. 16.

Toothpick Hardware Features

- FCC/CE/IC certified Class 1 Bluetooth V1.1 radio, 100m range, integral antenna
- 128Kbyte Flash, 3.5K RAM, 1K EPROM up to 512Kbyte I2C external memory with 2 interrupts
- 12 × 10-bit A to D converter
- 5 × 10-bit PWM outputs
- Serial UART, I2C and SPI communications
- 20MHz and 32KHz oscillators
- Low dropout 400mA power regulator
- 45 × 22 mm through-hole mount, suitable for breadboards

Using PC to access AASS

- Make sure Bluetooth is connect to toothpick
- Open FlexiPanelWin30.exe then click connect
- When connect is occur the red led will light and Bluetooth Security Interface will appear
- Enter password then click OK
- Bluetooth will send the password to toothpick, if your password correct , welcome message will arrive else invalid message will arrive

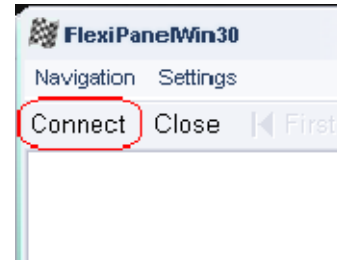


Fig. 17. FlexiPanelWin30.exe



Fig. 18. Bluetooth Security Interface

Using Mobile to Access AASS

- Make sure that FlexiPanel.jar is installed in your mobile
- Click FlexiPanel from Menu
- FlexiPanel will search for Bluetooth devices in the area, and list it
- Click Bluetooth security from the list and wait until connect with toothpick
- when connect is occur the red led will light and Bluetooth Security Interface will appear , click Enter Password
- Password text will appear, enter password then go to Option Menu and choose Exit
- At this stage return to pervious field, and then click Ok, Bluetooth will send the data to toothpick.



Fig. 19. Mobile Menu



Fig. 20. Bluetooth Security Interface



Fig. 21. Password Text

VI. CONCLUSION

Security is a growing need throughout the world, and lack of security can result in great damage. Many solutions are available for all levels of access control—from highly restricted areas such as banks, or laboratories to less restricted areas such as classrooms. The ultimate purpose of developing an AASS is to enforce security features of the entire building structure, equipped with appropriate management control. In this paper we have designed two systems that allow unlocking a secure door. Hardware designed using a low-cost low-power ATMEL 89C55 microcontroller, and a Bluetooth-enabled mobile device without user interaction. The design fulfills the requirements of supporting autonomous lock devices, easing key distribution compared to physical keys, having minimal requirements for the hardware, and supporting personalized keys. To demonstrate and evaluate the design, a prototype was developed. The evaluation shows that the design works well, consumes minimal power from the hardware and is able to unlock a door.

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