



SECURITY HANDS FREE ENTRY SYSTEM

“SHES”

GROUP 17



Who is SHES?



Presented by:

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 - Mentor: Sean P. Wicks – HDR Inc.
 - Sponsor: Workforce Central Florida
 - Sponsor: Michael E. McCoy - Stanley Security Solutions, Inc.

What is SHES?



- Two-pronged security system for hands-free entry into secured environment
- Easily integrates with existing residential and business security systems
- Brought about by need to improve homeland security

Goals and Objectives



- Implement a system that utilizes both identification card and voice recognition securities
- Easily adaptable to various building systems
- Offers hands-free, keyless entry into a facility with added convenience and security
- The Security Hands-Free Entry System should be easy to use and robust
- Thorough integration of software and hardware disciplines

Motivation



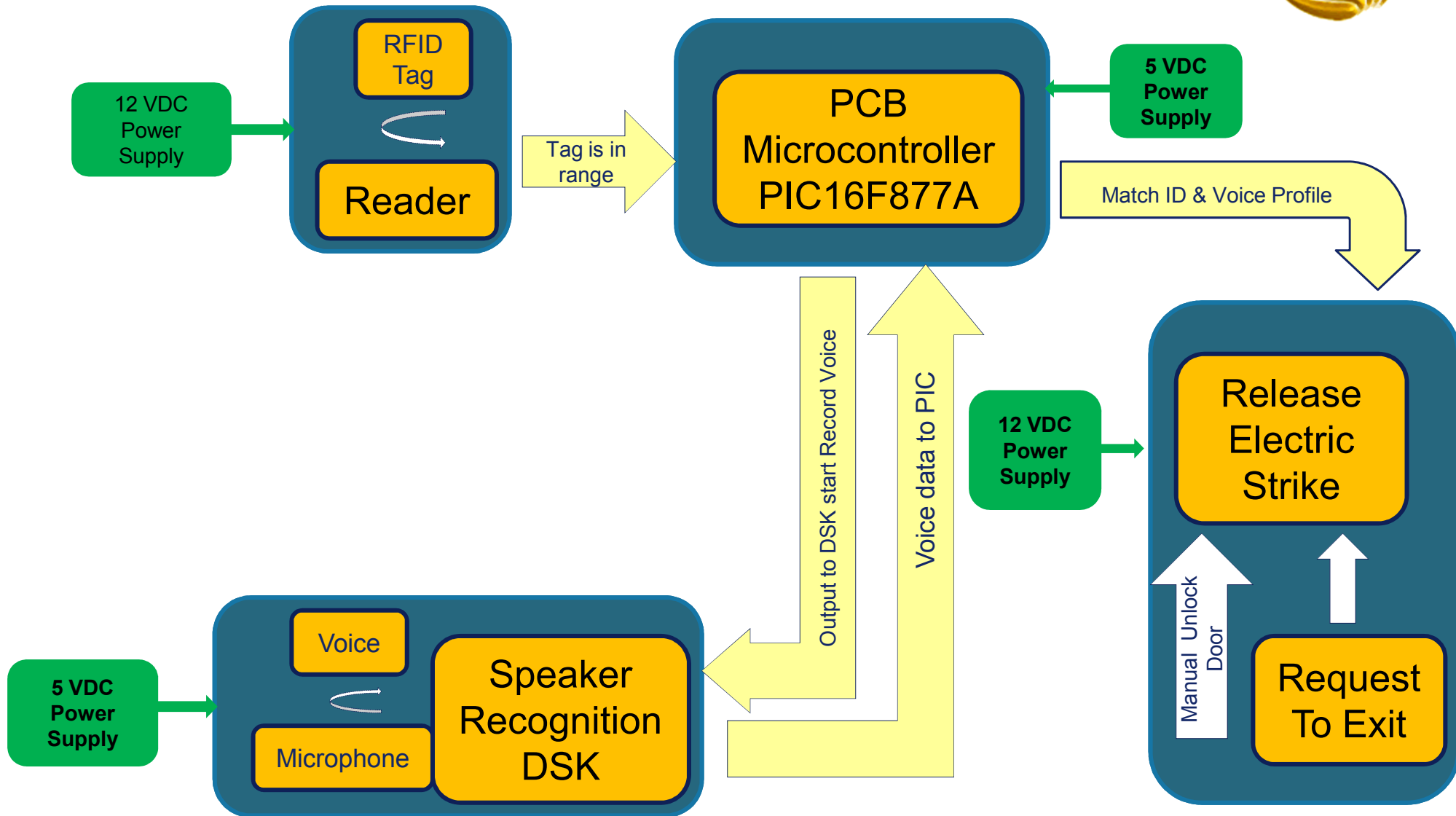
- This project is motivated by the many times when people are hurriedly entering or leaving their residence as they are carrying groceries or boxes which may occupy the use of both hands.
- The product created offers a hands-free entry system that offers protection and can be used in any home or office
- Maintaining personal security should be of the utmost importance. With this proposed solution it will require more effort to obtain the card key and the voice at the same time.

Specifications



- Standard 12V and 5V power supply units
- Full functionality for 4 user profiles, expandable
- 18 inch range RFID card
- Utilizes C-Programming within Peripheral Interface Controller (PIC) to integrate 3 independently-functioning subsystems

SHES Block Diagram



Operations

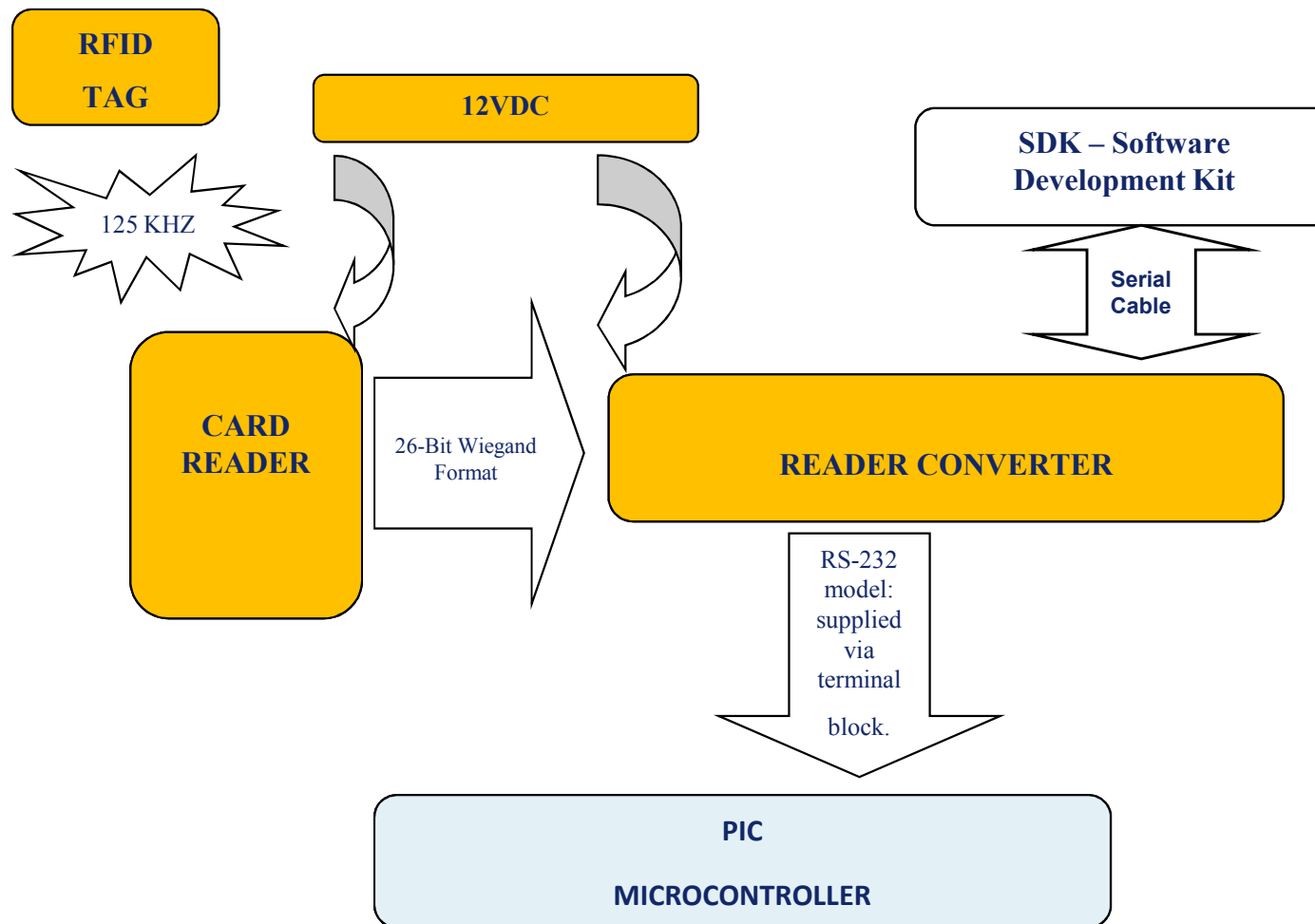


| PIC | Status | Electric Relay | Door |
|----------------------|--------|----------------|--------------|
| RFID is in Range | 01 | 00 | Remain Close |
| No Voice Data | 00 | | |
| | | | |
| RFID is not in Range | 00 | 00 | Remain Close |
| Voice Data | 01 | | |
| | | | |
| RFID is in Range | 01 | 11 | Unlock |
| Voice Data | 01 | | |
| | | | |
| Manual Lock/Unlock | x | x | Unlock |



Card Access System

Block Diagram – Card Access System



Comparison



| Card Type | Memory | Type | Function | Range |
|-------------|---|------------------|------------------------------|-----------------------|
| Contactless | Read and Write Capacity of 512 bytes and up | Strong Security | Hundreds of Security Feature | Typical 2 inches |
| RFID Tag | Small memory (92 bytes)- Often Read Only | Minimal Security | Single Function | Typical Several yards |

| Reader | Thinline II | MaxiProx | Long Range Reader |
|---------------------|----------------------------|--|---------------------------|
| Base Part Number | 5395 | 5375 | 620 Core Module ASR-620XX |
| Dimension | 4.7"x3.0"x.68" | 12.0"x12.0"x1.0" | 11.2"x11.2"x1.8 |
| Power Supply | 5-16VDC | 12VDC or 24VDC | 12/24VDC |
| Current Requirement | 35mA | 200/700 mA @12VDC 260 mA/1.2A @24VDC | 1.0A/750 mA |
| Termination | Pigtall | Terminal Strip | Terminal Strip |
| Output Formats | Wiegand and Clock and Data | Wiegand, Clock and Data, RS-232, RS-422 and RS-485 | Wiegand, ABA Track II |
| Read Range | Up to 5.5" | Up to 8' | Up to 26" |
| Tamper | No | Switch | No |

Comparison



| Card | ProxCard II | iCLASS Prox | FlexCard |
|--------------------------------------|---------------------|---|-----------|
| Base Part Number | 1326 | 202X/212X; 203X/213X | FPCRD |
| Read Range | | | |
| Thinline II | Up to 5.5" | Up to 5.0" | N/A |
| MaxiProx | Up to 29.0" | Up to 20.0" | N/A |
| Long Range Reader | | | Up to 25" |
| Memory Size/ Application Area | N/A | 2k bits with two applications areas, 16k/2 + 16k/1, 16k/16 + 16k/1 | N/A |
| HID Proximity 125kHz | Yes | Yes | Yes |
| Contact Smart Chip Module Embeddable | No | Optional | Optional |
| Wiegand Strip | No | No | No |
| Magnetic Stripe | No | Optional | No |
| Printable | Yes | Yes | Yes |
| Slot Punch | Vertical (standard) | Vertical Optional | Vertical |
| Visual Security Options | N/A | Yes | Yes |
| Cost Each | \$2 | \$9.19 | \$4.25 |

Reader System Specifications



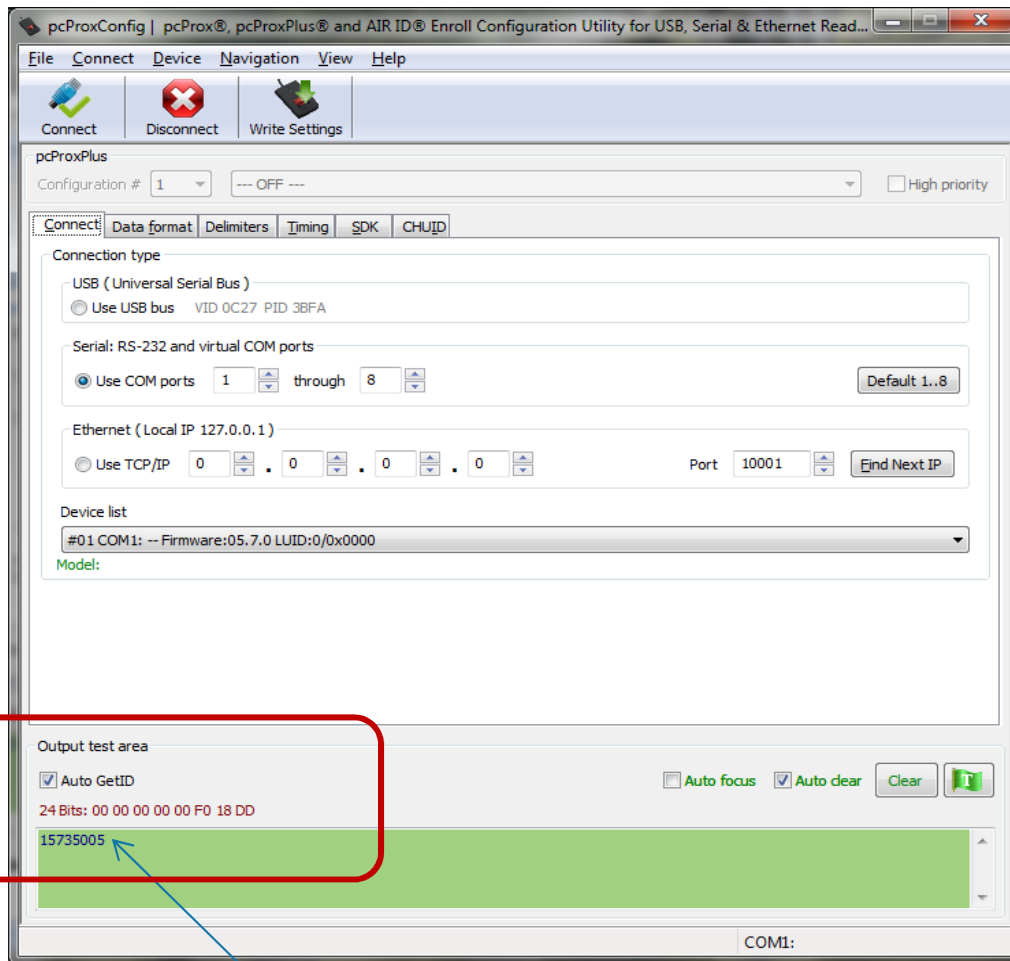
- Prox Card II:
 - a passive RFID
 - carries a set of 26 bit Wiegand number

- MaxiProx 5375 Reader:
 - 125 kHz Long Range reader with maximum 8' range
 - Tamper switch
 - Active the passive card with RF energy
 - Extract information from card, transfer card ID to converter

- A Reader Converter OEM-W2RS232-V3 :
 - Recognize the data and accept or reject card
 - Decode Wiegand format to ASCII string
 - RS-232 communications parameters: 9600 baud, N no parity, 8 data bits, 1 stop bit, no hardware flow control

- 12VDC Power Supply

Converter Interface

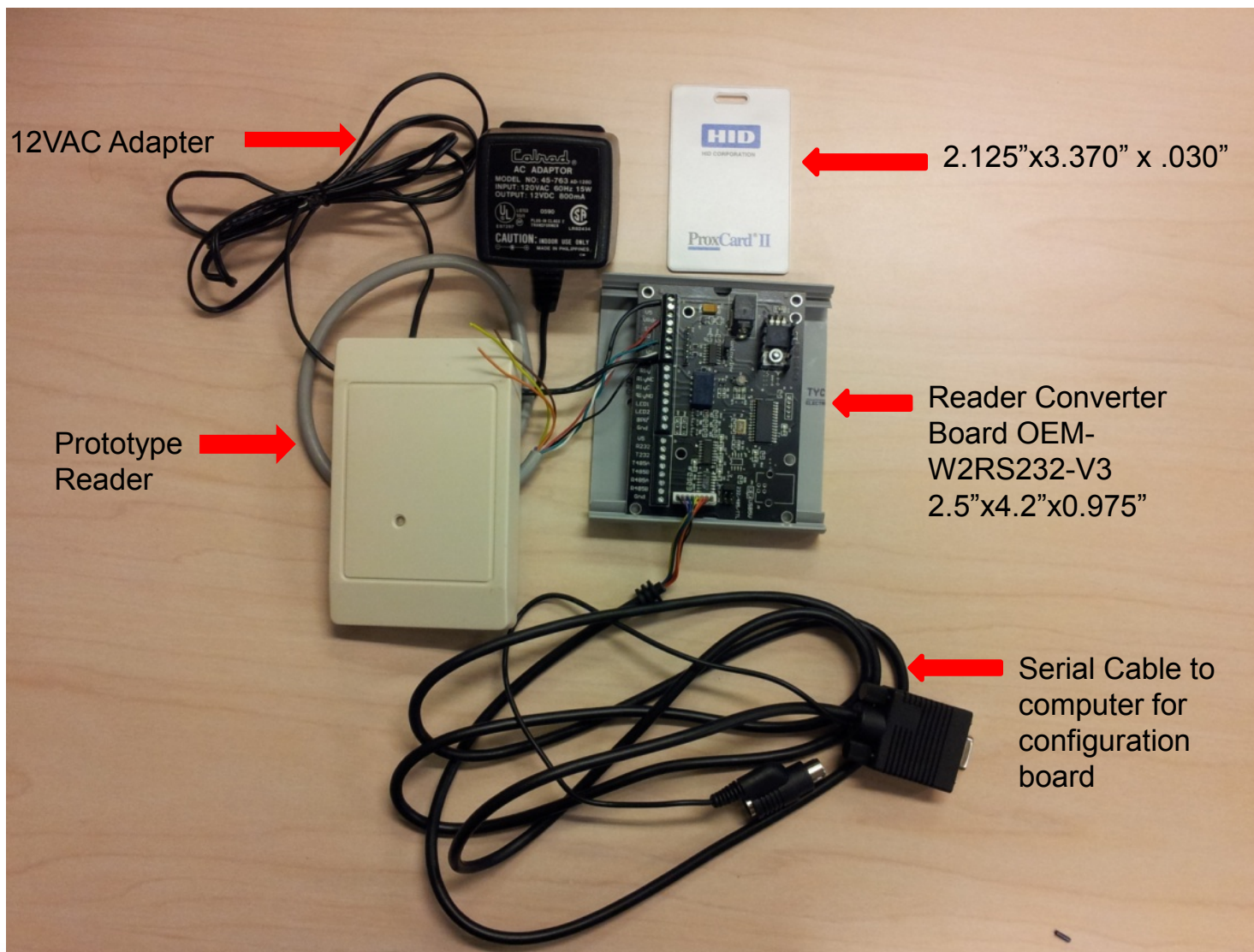


- Configure the reader
- Read card data
- Convert data to ASCII code
- Transfer code to PIC

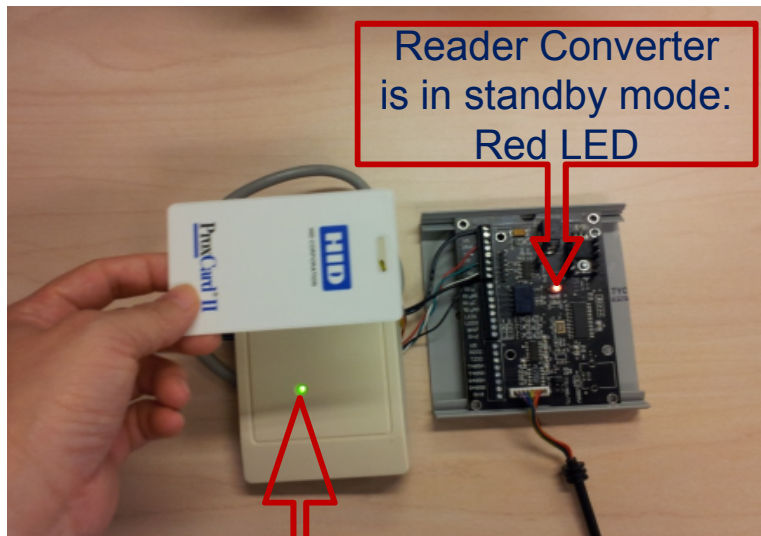
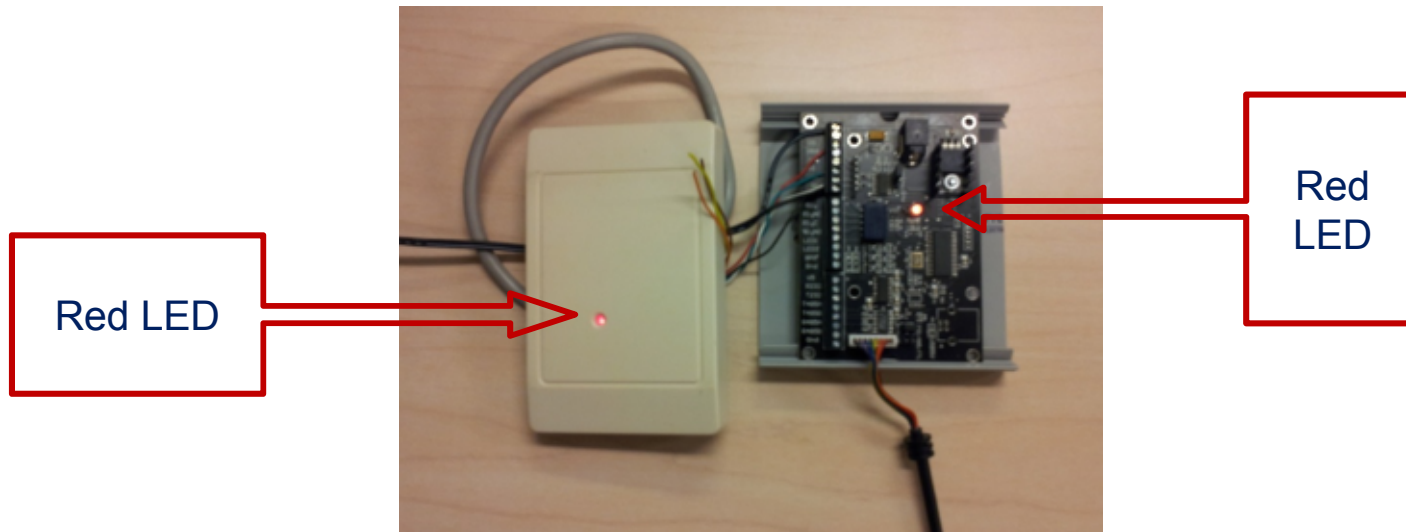
Card Data



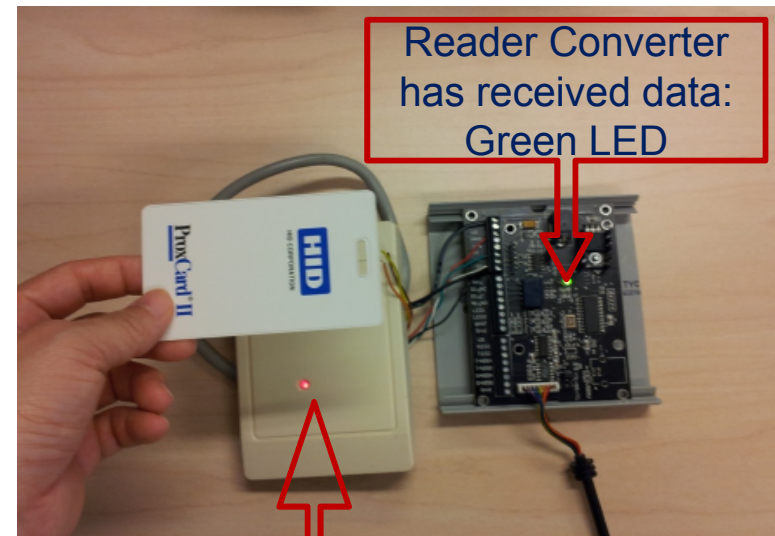
Card Access System Prototype



Card Access System Prototype



Reader accepted
Card: Green LED



Reader has read
data: Red LED



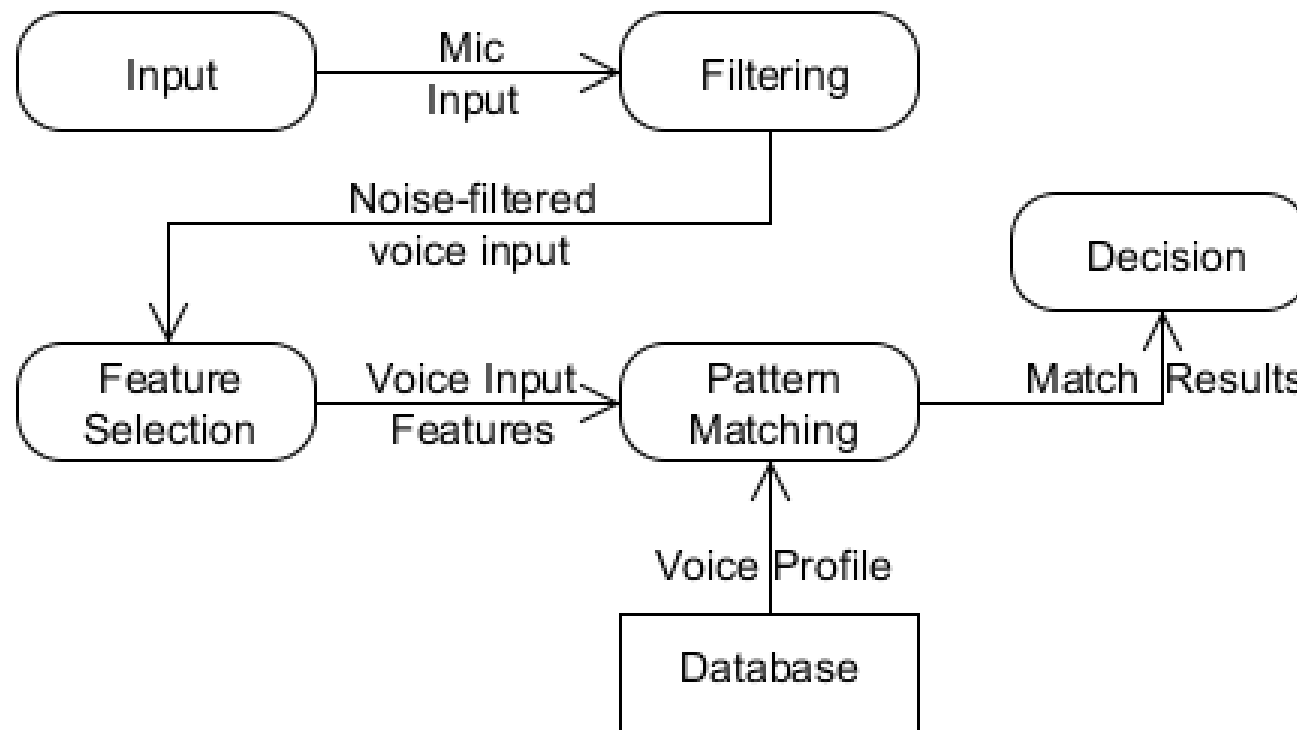
Speaker Recognition System

Introduction to Speech Processing



- **Speaker Recognition** vs Speech Recognition
- **Verification** vs Identification
- **Text-Dependent** vs Text-Independent

Block Diagram – Speaker Recognition



Speaker Recognition Requirement



- Process input voice data in the real time
- Store voice profile data for multiple users
- Accuracy in verification

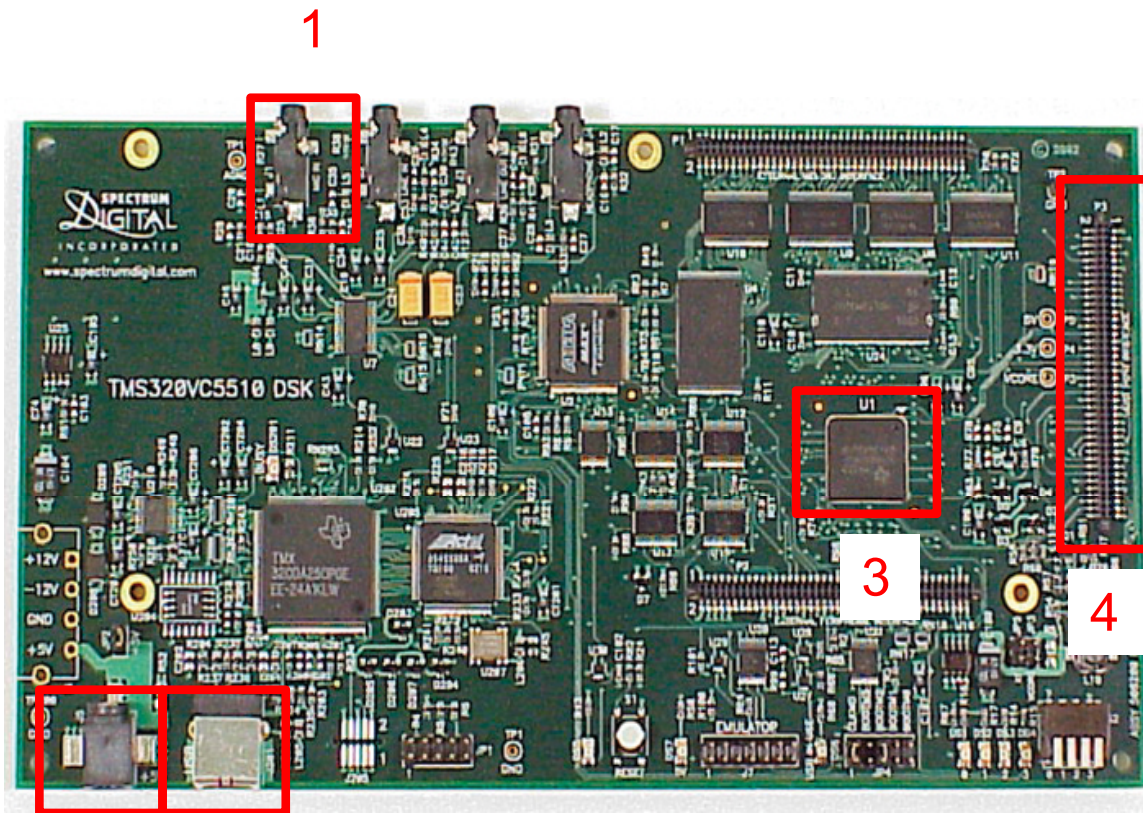
Comparison and Considerations



| <u>Device Name</u> | MSP430F449 MCU EVM | TMS320VC5510A DSP | SI SR-07 |
|-------------------------|------------------------|----------------------------|------------------|
| Max Operating Frequency | 1 MHz | 200 MHz | 3.58 MHz |
| RAM | 2 KB | 320 KB (expandable +NVRAM) | 64 KB (external) |
| ROM | 60 KB | 32 KB | N/A |
| IO Pins Available | 48 (readily available) | 13 (software set) | 8 (output only) |
| Price (USD) | 199.00 | 395.01 | 114.95 |

- Motivation for selecting MSP430 derived from previous [DIY project](#)
- MSP430 cannot perform feature selection or pattern matching
- Unknown if SR-07 Speech Recognition Unit can perform Speaker Recognition as opposed to Speech Recognition
- C5510 DSP selected for real-time processing and Speaker Recognition ability

TMS320VC5510 DSK Specifications



2

Texas Instruments TMS320VC5510
Digital Signal Processor Starter Kit

1. High-quality 24-bit stereo codec and 3.5 mm Microphone
2. Embedded JTAG support via USB/5V universal power supply
3. C5510A DSP
4. Expansion port connector for plug-in modules or GPIO

- On-board standard IEEE JTAG interface
- Size: 8.25" W * 4.5" L
- Expandable NVRAM Connector
- Additional Line-in/out, Speaker jacks

SPEAKER RECOGNITION

Basic Operation

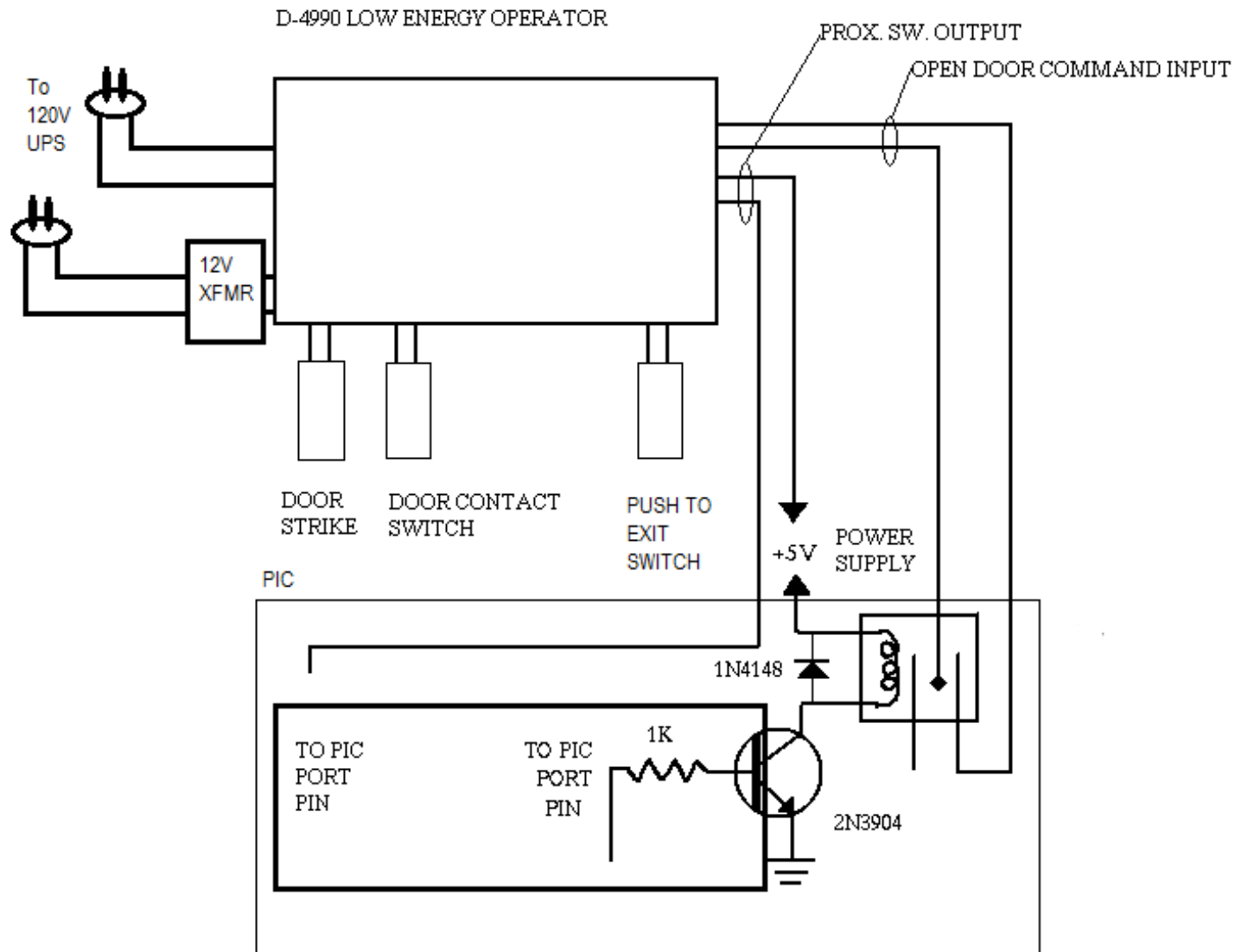


- Using ID from PIC, retrieve voice profile data
- Record voice using microphone
- Select features and perform pattern matching
 - Mel Frequency Cepstral Coefficients (MFCC)
 - Hidden Markov Models (HMM)
- Output match result to PIC



Electronic Door Lock

Block Diagram – Electronic Door Lock



Electronic Door System Functions



- Dependent or independent operation
- From the system, ability to open the door without having to insert a key or turn a knob
- Without integrated system, can manual open or closed the door by pushing a button.

Comparison



| Type of Security | Manufacturer / Part Number | Cost | Concern | Voltage | Image |
|--------------------------|---|----------|--|---------------------------|---|
| Electric Strike | Hes / 5000 Series Heavy Duty Electric Strike Body | \$80.00 | Breakaway Static strength 1,500 lbs. Dynamic strength 70 ft-lbs. | 12/24V 450mA/ 225mA |  |
| Magnetic Lock | Seco-larm / E-941SA- Electromagnetic Lock | \$85.00 | Security - Loss of Power 1200 lbs Holding Force | 12/24V 500mA/ 250mA |  |
| Electric Lock (Pin Type) | Von Duprin / 050535 EL Solenoid Plunger | \$164.00 | Safety - Loss of Power | 24V 500mA |  |

Electronic Door System Specification



- Electric Strike:
 - 12 VDC @ 0.5A
 - Fail Secure
- Door Position Switch:
 - Normally Open Magnetic Contact
 - Recessed Mounted – Concealed
- Request to Exit Switch:
 - N.O. Contacts
 - Clearly marked EXIT device
- Door Assembly
 - 3' wide half door construction
 - Relay Circuit to PIC
- The D-4990 Low Energy Operator
 - 115 VAC \pm 15% 60Hz
 - Built-in Controller

Door System Prototype



SECURE SIDE (EXTERIOR)



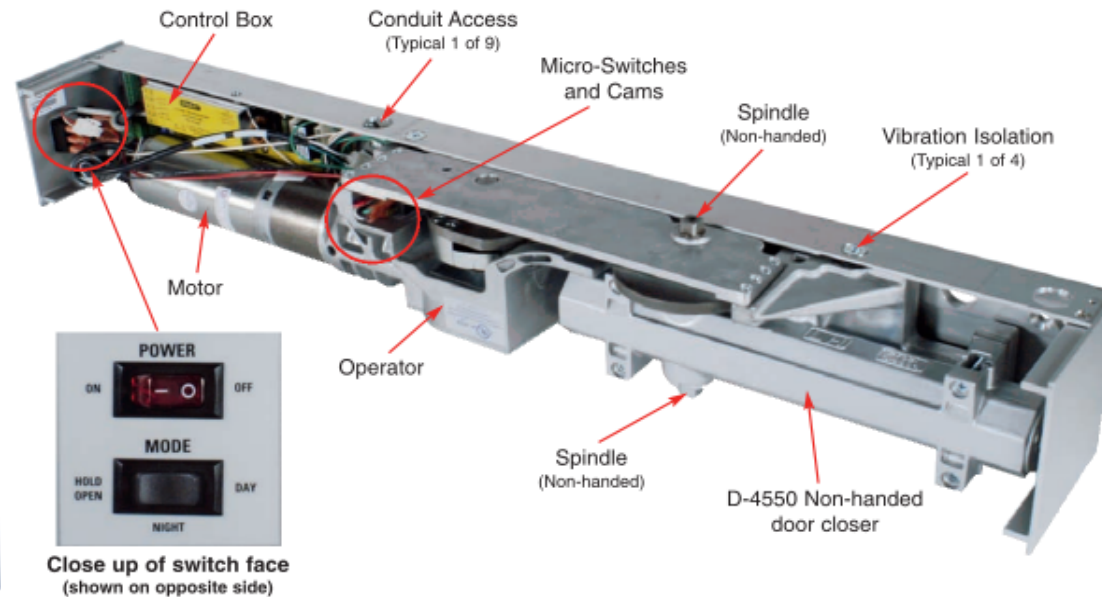
UNSECURE SIDE (INTERIOR)



OPENING VIEW

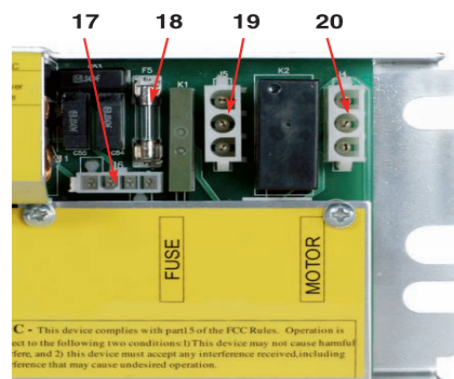
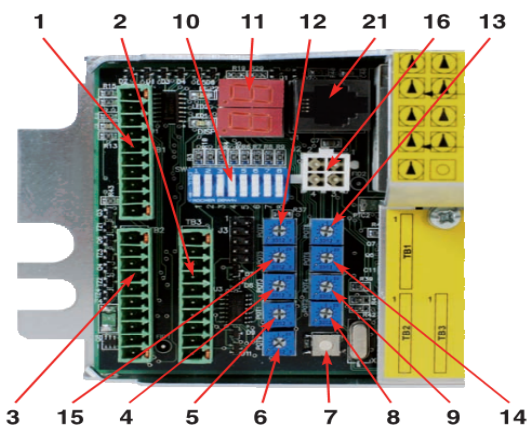


D-4990 LOWER ENERGY OPERATOR





Controller



Switch Setting

| SETTING | ON | OFF |
|--------------------------|-------------|-----------|
| 1. Electric strike logic | fail secure | fail safe |
| 2. Electric strike | enabled | disabled |
| 3. PUSH side/PULL side | PULL side | PUSH side |
| 4. PUSH and GO | enabled | disabled |
| 5. Power close | enabled | disabled |
| 6. N/A | | |
| 7. N/A | | |
| 8. N/A | | |

1. TB-1
2. TB-3
3. TB-2
4. Pot #3 not used
5. Pot #1 Hold open time 0-28 seconds. Must be a minimum of 5 seconds after door fully open
6. Pot #9 Vestibule time delay
7. Self test button
8. Pot #2 Full open position adjustment
9. Pot #4 Stall force
10. DIP switches (See chart above)
11. Digital readout
12. Pot #7 opening torque, only needs changed for use on heavier doors
13. Pot #8 not used
14. Pot #6 open sweep speed
15. Pot #5 open check speed
16. Encoder plug input
17. AC power in
18. Fuse
19. N/A
20. Motor socket
21. N/A



PIC Microcontroller

Comparison

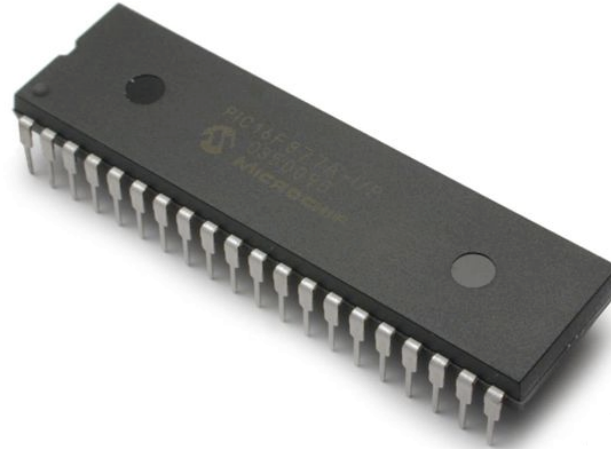


| Microcontroller | Pin Count | Advantages | Disadvantages |
|----------------------|-------------|--|---|
| TI MSP430G2231 | 14 (10 I/O) | <ul style="list-style-type: none">- Free support- Free software- Ample documentation | <ul style="list-style-type: none">- Limited I/O pins- No support for RS232 communication |
| Atmel AVR ATmega8 | 28 (23 I/O) | <ul style="list-style-type: none">- Active community of users- Supports RS232 communication | <ul style="list-style-type: none">- Concern regarding number of I/O pins |
| Microchip PIC16F877A | 40 (33 I/O) | <ul style="list-style-type: none">- Ample I/O- Supports RS232 communication- Free software | <ul style="list-style-type: none">- More features than needed |

PIC16F877A Specifications



- Operating Speed: DC – 20 MHz clock input
- Up to 8K x 14 words of Flash Program Memory
- Up to 368 x 8 bytes of Data Memory (RAM)
- Up to 256 x 8 bytes of EEPROM Data Memory
- Wide operating voltage range (2.0V to 5.5V)
- I/O Ports:
 - A (6 pins)
 - B (8 pins)
 - C (8 pins)
 - D (8 pins)
 - E (3 pins)

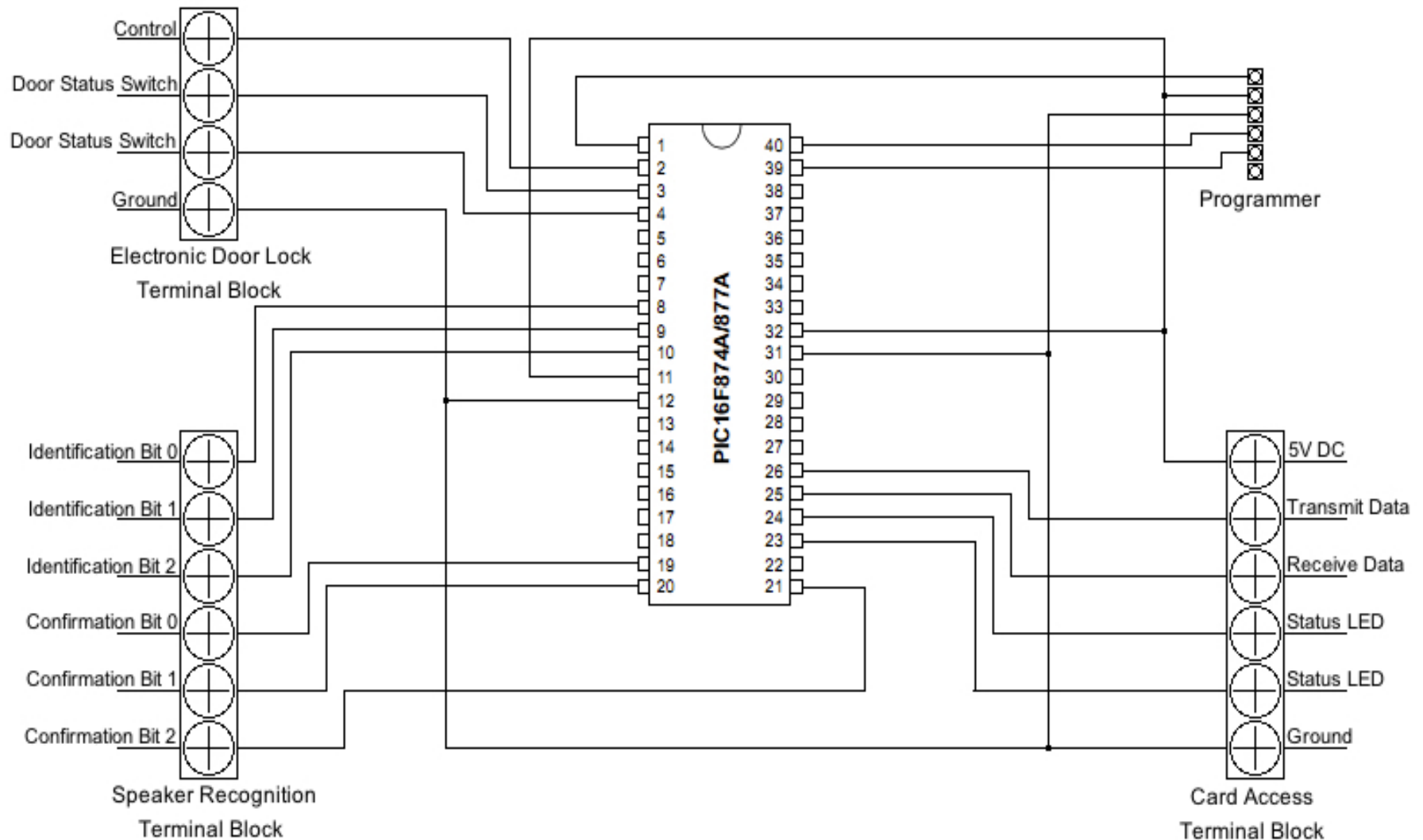


PIC16F877A Project Functions



- The PIC is the “brain” of the project
- PIC will serve as the driving force for the Reader, Speaker Recognition and Electronic door
- Programming
 - `configure();`
 - `waitForCard();`
 - `waitForVoice();`
 - `operateDoor();`
- Read the incoming data and decide what to do
 - Incoming data from Reader System
 - Incoming data from Speaker Recognition
- Output
 - To initialize the Speaker Recognition
 - Release the door relay

PIC16F877A Connections





Administrative

Project Schedule



SCHEDULE-SD2

| Date | Anh Nguyen | Jordan Acedera | Christopher Spalding | John E. Van Sickle |
|------------|--|---|--|--|
| 01/15/2012 | Review Introduction/ Cost Analysis and Block Diagram Description | Review Verifications, Testing Procedures, Block Diagram | Review: Introduction/Block Diagram Description | Review: Introduction/Block Diagram Description |
| 01/16/2012 | Order RFID Reader System, | Order Speaker Recognition | Order PIC Microcontroller | Order Electric Door Lock |
| 02/16/2012 | WCF/Mentor Meeting | WCF/Mentor Meeting | WCF/Mentor Meeting | WCF/Mentor Meeting |
| 02/28/2012 | CDR Presentation | CDR Presentation | CDR Presentation | CDR Presentation |
| 03/22/2012 | WCF/Mentor Meeting | WCF/Mentor Meeting | WCF/Mentor Meeting | WCF/Mentor Meeting |
| 04/12/2012 | Final Presentation | Final Presentation | Final Presentation | Final Presentation |
| 04/18/2012 | Finished SD2 Paper | Finished SD2 Paper | Finished SD2 Paper | Finished SD2 Paper |

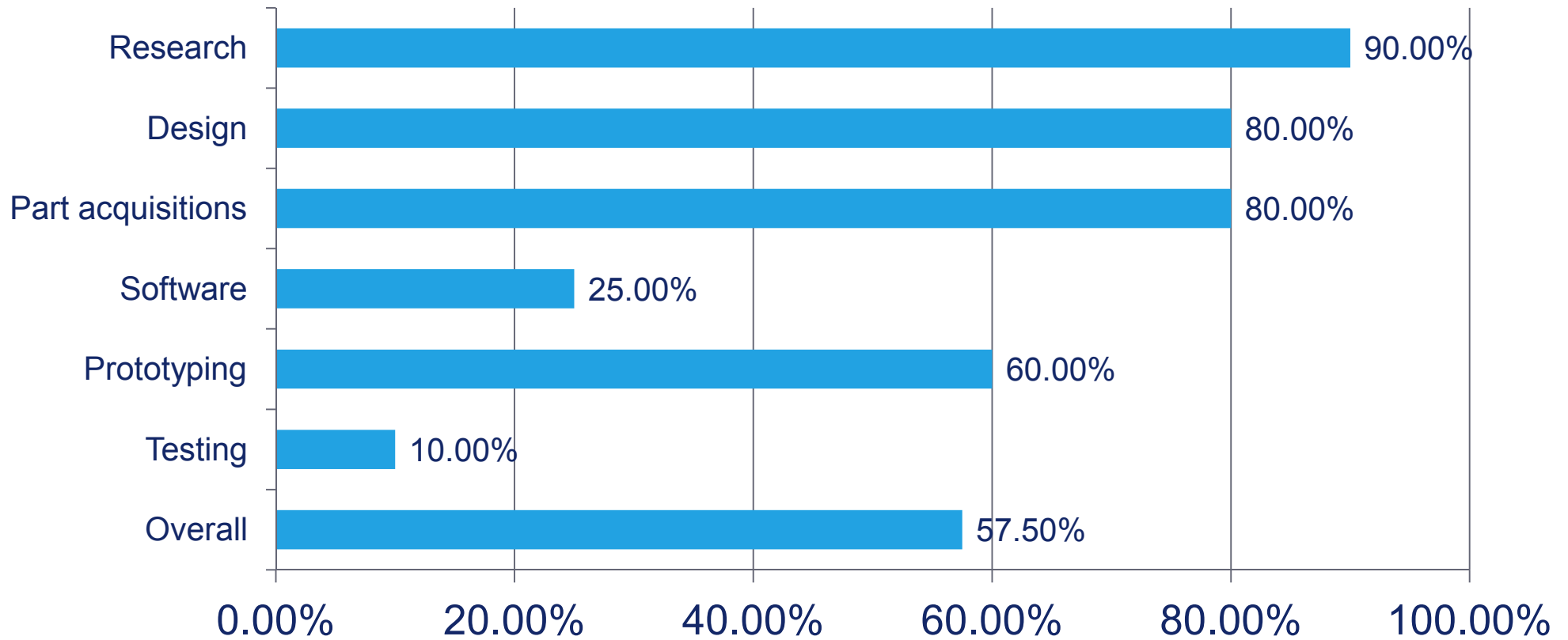
Project Budget



| Parts | Quantity | Unit Price | Price |
|------------------------------|----------|------------|-----------------|
| Card reader | | | |
| Long Range Reader | 1 | 450.00 | 450.00 |
| Tag | 4 | 15.00 | 60.00 |
| Power Supply | 1 | 25.00 | 25.00 |
| Reader Converter | 1 | 181.70 | 181.70 |
| Miscellaneous | 1 | 100 | 100 |
| Sub Total | | | 816.70 |
| | | | |
| Door Hardware | | | |
| Magnetic contact/prox switch | 1 | Free | Free |
| Electrified Hinge | 1 | 201.08 | Free Rent |
| Push to exit switch - | 1 | 15 | 15 |
| Low Energy Operator D4990 | 1 | 3899 | Free Rent |
| Electric Strike | 1 | 55 | 55 |
| Door Assembly | Assy | 340 | 340 |
| Power/Cable | 1 | 20 | 20 |
| Miscellaneous | 1 | 298.35 | 298.35 |
| Sub Total | | | \$728.35 |
| | | | |

| Parts | Quantity | Unit Price | Price |
|------------------------------|----------|------------|------------------|
| Microcontroller | | | |
| Programable Circuit Board | 1 | 39.60 | 39.60 |
| PIC16F877A | 2 | 24.00 | 48.00 |
| PCB Assembly | 1 | 200.00 | 200.00 |
| Sub Total | | | 287.60 |
| | | | |
| Voice Recognition | | | |
| TMS320VC5510 DSP Starter Kit | 1 | 395.00 | 395.01 |
| SoftBaugh ES449 Demo Board | 1 | 199.00 | 199.00 |
| MSP430 LaunchPad | 1 | 4.30 | 4.30 |
| Miscellaneous | 1 | 1 | 600.00 |
| Sub Total | | | 1198.30 |
| | | | |
| Total | | | \$3030.95 |
| | | | |

Milestone



To-Do



- Complete programming PIC and DSK
- Set up voice profiles
- Fabricate printed circuit board
- Integrate system together
- Test the system

Issues



Resolved

- Issue with programming PIC
- Initially programming DSK
- Acquiring WCF Funding

Expected

- Ambient environment noise
- PCB fabrication
- Integrate system together



Question ?