Dr. Charles Kim -- Instructor
WWW.MWFTR.COM/SD1415.html

GELS

(GSM Electronic Lock System)

EECE Senior Design I
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Presentation Outline

- Background
- Problem Formulation
- Current Status of Art
- Solution Approach
- Conceptual Design and Design Selection
- Design Implementation
- Hardware Specifications
- Cost and Resources
- Assignments & Conclusion
- Implementation and Verification
- Conclusion
- Q&A

Background

•As we start to integrate our homes into this new digital age we must make sure that we can stay safe.

- SKYNET
- But in today's society it is almost impossible to not embrace technology
- Lets incorporate technology into the safety and security of our home.

Problem Formulation

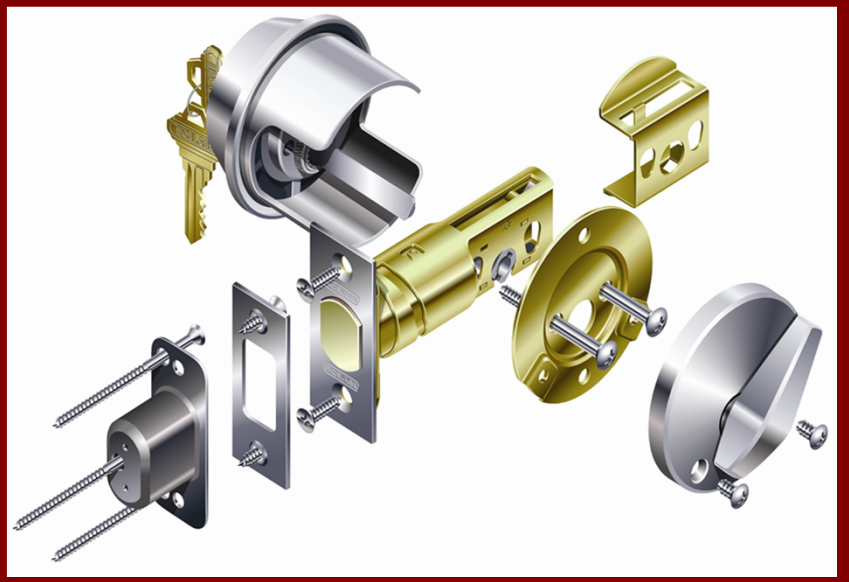
- Security needs in the world are growing rapidly with the development of new technologies.
- Must be secure and unique to the individual using it.
- A person must be able to gain access to their lock and also grant access to someone else securely.
- The core principle of the technology is to have a lock activate via voice over the GSM network.

Current State of ART

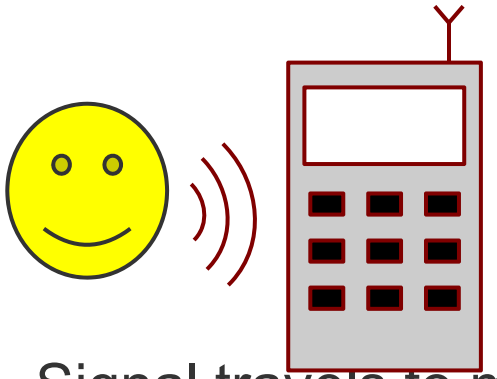
- Other companies have developed electronic locks that work over wireless and Bluetooth networks.
- Previous innovations are quite impressive, but are still vulnerable to security breaches if the Bluetooth network is hacked or the keypad manually hacked or removed.
- The technology to break these kinds of security, however, exist. The problem boils down to issues of security and access control.

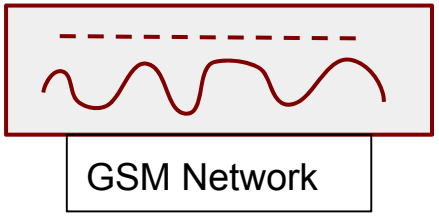
Solution Approach

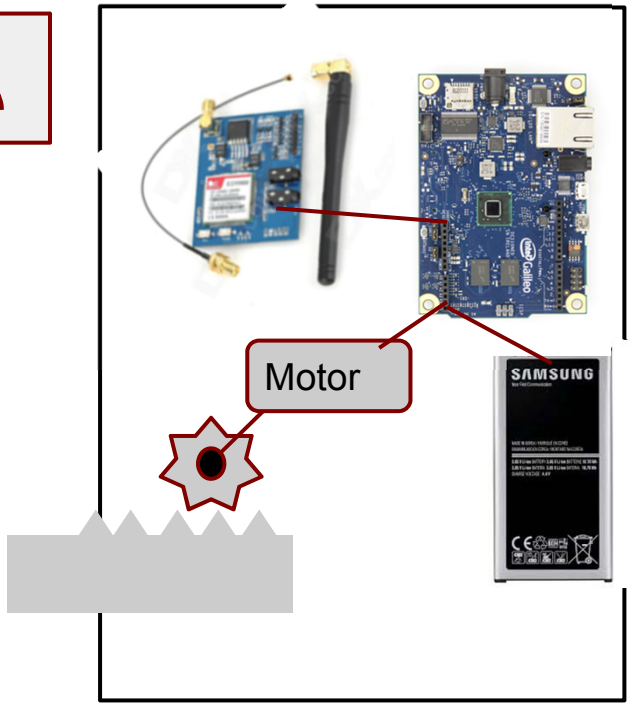
- Home security device with an integrated mobile phone app.
- User can call the lock.
- Lock will receive the signal from the app.
  - the GSM network



Conceptual Designs and Design Selection

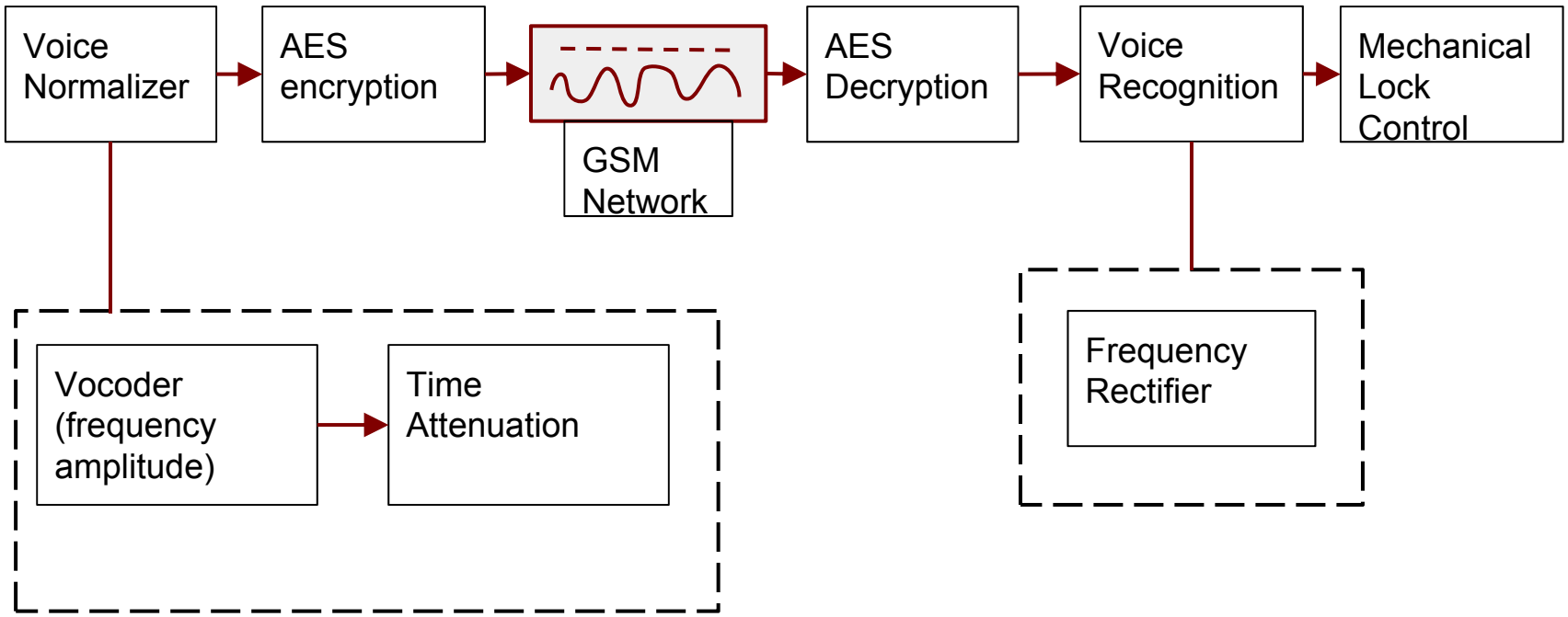


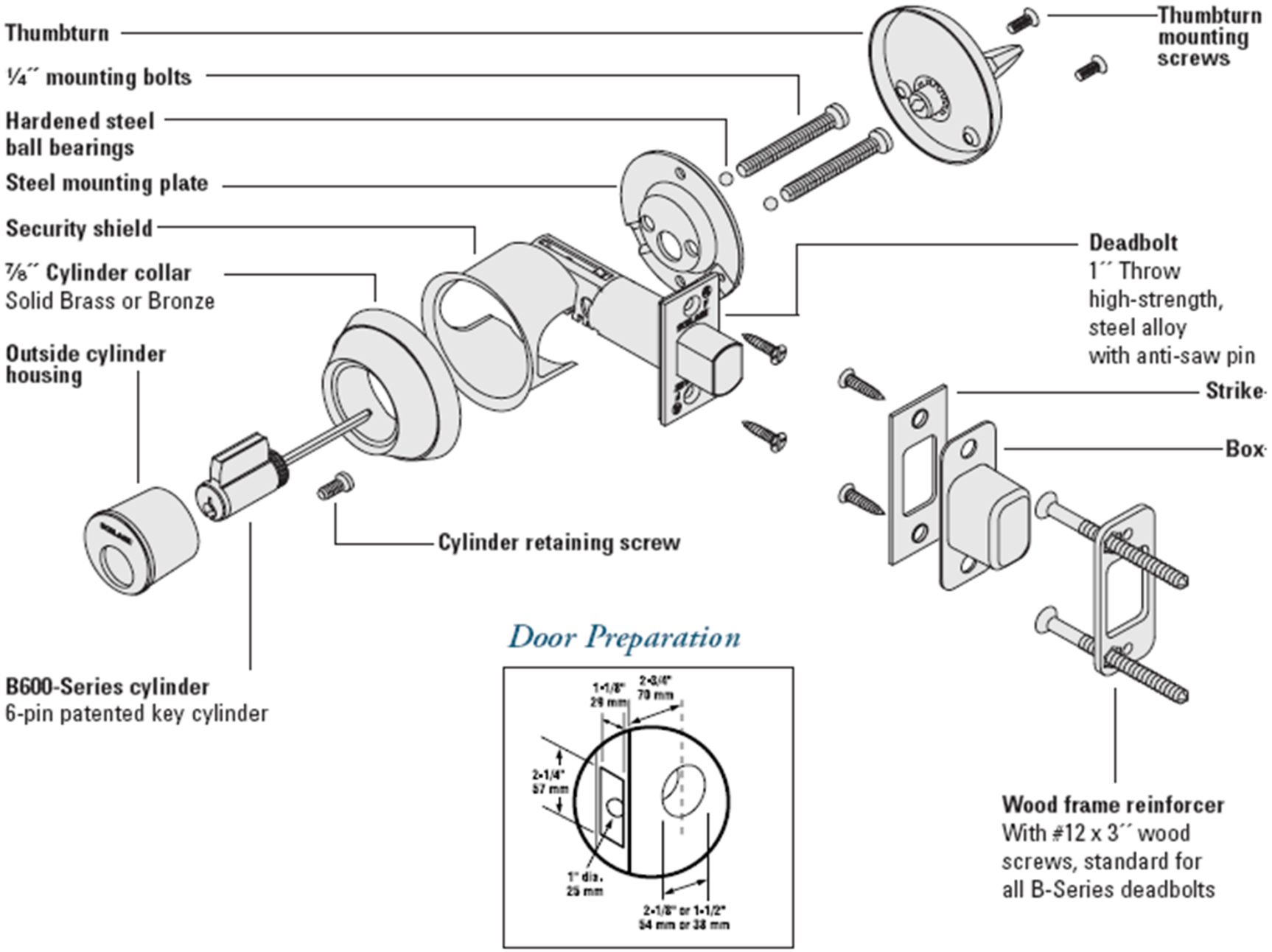




- Signal travels to module (sim card)
- Encryption recognition
- Motor control
- App

Signal Block Diagram




Thumbturn
¼″ mounting bolts
Hardened steel ball bearings
Steel mounting plate
Security shield
⅞″ Cylinder collar
Solid Brass or Bronze
Outside cylinder housing
B600-Series cylinder
6-pin patented key cylinder
Cylinder retaining screw
Thumbturn mounting screws
Deadbolt
1″ Throw
high-strength,
steel alloy
with anti-saw pin
Strike
Box
Wood frame reinforcer
With #12 x 3″ wood
screws, standard for
all B-Series deadbolts
Door Preparation
1-1/8" 29 mm
2-3/8" 70 mm
2-1/4" 57 mm
1" dia. 25 mm
2-1/8" or 1-1/2" 54 mm or 38 mm

Design Implementation Decisions

	Ease of installation	Accessibility	Security	Total
Single Cylinder	8	10	8	26
Jimmy Proof	7	10	9	26
Tumbler	6	10	6	22

- Single Cylinder
  - Secure
  - Easier to manipulate

Design Implementation Decisions

	Number of Inputs	Access to Preexisting Code	Ease of Conversion to GSM	Amount of Memory	Satisfaction of Competition Rules
Raspberry Pi	8	10	7	10	0
Arduino	5	10	7	5	10

- Raspberry Pi was an initial design winner, but due to competition constraints the Arduino became the board of choice

Design Implementation Decisions

Type of Battery	Ease of Implementation	Length of Charge	Environment Impact	Cost Effectiveness
Cell Phone	7	10	10	9
9 Volt	9	5	6	5

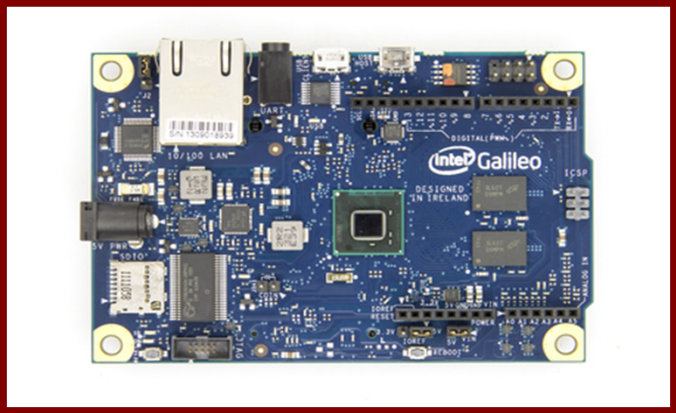
- Major concerns were:
  - Longevity
  - Charge Length
  - Cost

Design Implementation

- Microcontroller must be programmed to communicate with the phone via the app.
- The Unit shall be encased in stainless steel.
- Help of mechanical engineers for gearing.
- Powered by a cell phone battery.

Hardware Specifications

- Arduino Intel Galileo
  - Input Voltage (recommended) :5V
  - Input Voltage (limits):5V
  - Digital I/O Pins :14 (of which 6 provide PWM output)
  - Analog Input Pins: 6
  - Total DC Output Current on all I/O lines:80 mA
  - DC Current for 3.3V Pin:800 mA
  - DC Current for 5V Pin:800 mA



- **3V to 5V DC-DC Converter Step Up Boost Module**
  - Converts Inputs of 3.7V to 5V (Need Voltage for Microcontroller)

Hardware Specifications

•Sim 900 Gsm/GPRS Minimum System

Materials:

• PCB + Aluminum Alloy

Specifications:

•Quad-Band 850/900/1800/1900 MHz

•Low Power Consumption 1.5mA (Sleep Mode)

•Operation Temperture : -40 C to 85 C

Cost:

$53.07 + Shipping & Handling

•Samsung Galaxy S5 Standard Battery

Battery Type: Lithium Ion

Battery Rating: 2800mAh, 3.85V, and 10.78Wh

Hardware Specifications

- High Torque Gear Servo ($19.95 + Shipping & Handling)

  Power: 4.8V - 6V DC max (5V works well)

  Average Speed: 60 degrees in 0.20 sec (@ 4.8V), 60 degrees in 0.16 sec (@ 6.0V)

  Weight: 62.41g

  Torque: At 4.8V: 8.5 kg-cm / 120 oz-in, and at 6V: 10 kg-cm / 140 oz-in.

  Size mm: (L x W x H) 40.7 x 19.7 x 42.9

- Spur Gears
  - Planned to be 3d Printed to Size Specifications

Costs and Resources

Item	Cost
Arduino Intel Galileo	$60
GSM Module	$54
Deadbolt Lock	$15
Hardware equipment	$25
battery module	$10
battery	$29
	Total $193

Assignments

Tasks

- Project Management
  - Michael Robinson
- Hardware Technicians
  - Darrell Smith & Corbin Jackson
- Android App Development
  - Cherith-Eden Clements

Implementation and Verification

MONTH	WEEKLY TASKS		MEMBER In CHARGE	DELIVERABLES
	Week (FROM day TO day)	TASKS		
NOV 14	9 - 15	Top Design Selection (Report)	Team	Top Design w/ Detailed Components
	16 - 22	Finalize Design/Component Research	Team	
	23 - 29	Choose Components	Team	
DEC 14	1 - 6	Power & Additional Module Research	Darrell	List of Comps. w/ Purchasing Info.
	7 - 13	Consult Mechanical Department	Mike & Corbin	
	14 - 20	Software Design Research	Eden	

MONTH	WEEKLY ACTIVITIES		MEMBER In CHARGE	DELIVERABLES
	Week (FROM day TO day)	TASKS		
JAN 15	4-10	Order GSM Module	Corbin	Order Components Start Implementation
	11-17	reverse engineer lock	Team	
	18-24	App design (gui)	Eden	
	25-31	GSM Module Arrival (Tentative)(25-31)		
FEB 15	1-7	Start bulding gsm module	Corbin	Testing of Modules/ Encryption code finished
	8-14	program microcontroller	Eden	
	15-21	3d print components	Michael	
	22-28	App finished (encryption implimented)		
MAR 15	1-7	build casing	Team	System Evaluation and field tests
	8-14	encryption test	Eden	
	15-21	Extra feature implimentation	Team	
	22-28	Final Systems test	Team	
	29-31			

Conclusion

•In conclusion we will create an easier yet more secure and efficient way of lock access.

•The communication through a cellular network is the unique implementation to create a level of security not easily hacked.

•To personalize the unlocking of each door and make it safer the voice encryption will be very useful.

•Between losing your keys or needing to grant someone access to a door your aren't near, those issues will no longer be a problem.

Q&A