G-LOCK

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Problem Statement

- Locks are boring, facial recognition isn't!
- Aim to make unlocking a door easier with facial profiles
- Smart lock technology
 - Motion Detector
 - Microphone
 - o UI



- Camera triggered by motion sensor
- Raspberry Pi verifies faces
- Unlocks magnet lock when face verified or user requests from UI
- Keypad for manual override
- Microphone for interacting with guests



Requirements

- Camera Vision & Machine learning Algorithm
 - will correctly classify faces with less than 10% error rate
- Automatic locking mechanism
 - Magnetic Lock that unlocks and locks door within less than a 500ms of receiving signal
 - Lock that can remotely be unlocked without any manual assistance.
- Web application
 - Notifications whenever a failed attempt to open door within 3 seconds.
 - Ability to manually lock/unlock door from web app within 5 seconds.

Architecture



Component #1 - Computer Vision

- 3 Steps for facial recognition
 - Detection
 - Determining the presence of a face
 - Tracking
 - Continually follow face until complete
 - Identification
 - Real time computation using ML



Machine Learning

- Test multiple ML algorithms to find most accurate
 - Neural Networks
 - Using pattern recognition and classification to perform feature extraction using neural networks.
 - Principal Component Analysis
 - Performs a dimensionality reduction by extracting the principal component of multi-dimensional data.



Component #2 - Locking Mechanism

- Voltage-triggered lock connected to Raspberry Pi
- Pi receives HTTP Request
 - If verified, unlocks lock



Component #3 - Web App



• Unlock/lock remotely

- See who's at the door (notifications)
- Speak to guests through microphone

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Testing, Verification and Metrics

• Testing

- Test System using real people as test subjects
- Ensure Algorithm recognizes all residents
- Track speed/resources of each component
- Verification
 - All Web App features fully tested
 - Given controls, ensure system behavior is deterministic
 - Robust to various scenarios (multiple persons, poor lighting)

• Metrics

- Unlock Time from Face Recognized to Unlock Mechanism
- Accuracy of Facial Recognition

Schedule

TASK (Components in Gray)	week 1	week 2	week 3	week 4	week 5	week 6	week 7	week 8	week 9	week 10
Compoent #1 - ML/CV										
Research Image Processing Techniques										
Choose ML Algorithm for Face Recognition										
Choose ML Algorithm for Voice Recognition										
Implement RasPi camera functionality										
Data Collection										
Train Algorithm										
Face Tracking										
Festing Verification										
Compoent #2 - Hardware										
Reaserch Locking Mechanisms										
Quantify and Compare Sensor Performance										
mplement Physical Locking Functionality										
ntegrate Lock with KeyPad and Remote Acecess										
est Locking Performance										
tergrate Sensors to send data to RasPi										
tergrate Locking with RasPi								التا التا التا الأراد		
ace Electrical Components in Casing										
esting Verification										
compoent #3 - WebApp										
ayout Web App Features										
Create UI using React for Mobile										
Remote Locking on Command							_ الحاص بي الاربي حيا حيا			
Notifications for Activity										
ive Feed Implementation							أصراها بعراه زمراه زهرته			
Jser Managaement (Add/Del Users)										
esting Verification									المنجوا بيزارين ورزي	
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ensor to RasPi Communication										
asPi to Locking Hardware										
aspi to WebApp Alerts/System Status										
WebApp to RasPi Lockign control										
Testing										
Verification										
venication										

Minimum Viable Product / Stretch Goals

- 90% facial accuracy (single face)
- Functional lock without microphone
- Minimal UI



- High accuracy w/ various situations (multiple faces)
- Microphone PA system
 - Robust UI w/ analytics