

Design Lighting Talk



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Context

- Increased building security: a keyword can be replicated, but matching someone's voice is much more difficult.
- Consumers may be reluctant to use our lock, as it utilizes AI to store biometric data.
- As an electronic fixture, there will naturally be some small bit of power consumption required by our device.
- For the added security it provides, the lock will inevitably be more expensive than more conventional “dumb” locks.



User Needs

Our users need:

- Building owners/renters need an easier way to lock and unlock their doors using their voices.
- Locksmiths/Safe Companies need new products to sell and to increase ease of use and security.
- Insurance Companies need to lower the risk of a payout as much as possible, so they could add incentives for their clients to use these locks.
- Security Companies need ways to increase the security of the properties and products that they are securing.



Prior Work

- Coursera embedded machine learning course
 - Lots of documentation and tools available if we have questions/concerns.
 - Project done during the course was simple, so added complexity will be on us to implement.
- August Lock company makes smart door locks, including voice activated locks



Technical Complexity

- Microcontroller element controls a system of hardware.
- Acquiring data for training in the machine learning models.
- Necessary to design a physical interface between the locking motor and lock itself
- We will be training machine learning models to work with an individual's voice, which meets and perhaps exceeds the current market solution.



Design Decisions

- COTS lock or build custom ourself
- Which neural network libraries/tools to use
- How to distribute computing resources



Ideation

- Infrastructure
 - Standalone
 - Interconnected
 - Mobile App
 - Base station
- And if not standalone how would we connect them together
 - Wifi
 - Bluetooth
 - RF
 - USB/Serial

Decision Making

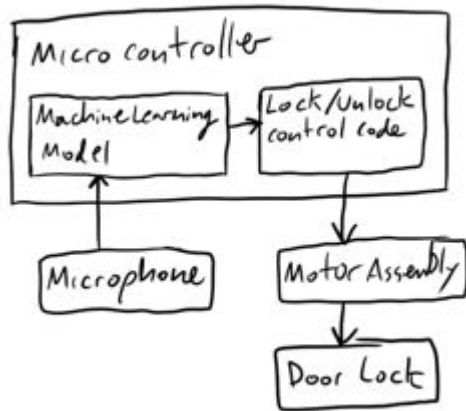
		Options							
Criteria	Weight	Standalone		Interconnected		Mobile app		Base Station	
		Score	Weight	Score	Weight	Score	Weight	Score	Weight
Able to implement in 1 semester	1	1	1	4	4	2	2	3	3
Able to explain upon ML model	2	3	6	4	8	2	4	1	2
Security	3	1	3	2	6	4	8	3	9
Lock/ unlock quickly	4	1	4	2	8	3	12	4	16
Easy for customer to set up	5	1	5	4	20	2	10	3	15
Totals: Lowest is best			19		46		36		45



Proposed Design

- Microcontroller is the heart of the design
 - Holds the Machine learning model and also controls the lock/unlock mechanism
- Will also need to use...
 - Microphone
 - Motors
 - Door lock

Design Visual and description



The microcontroller is at the center of the design with some peripherals to help with interaction outside of the system.

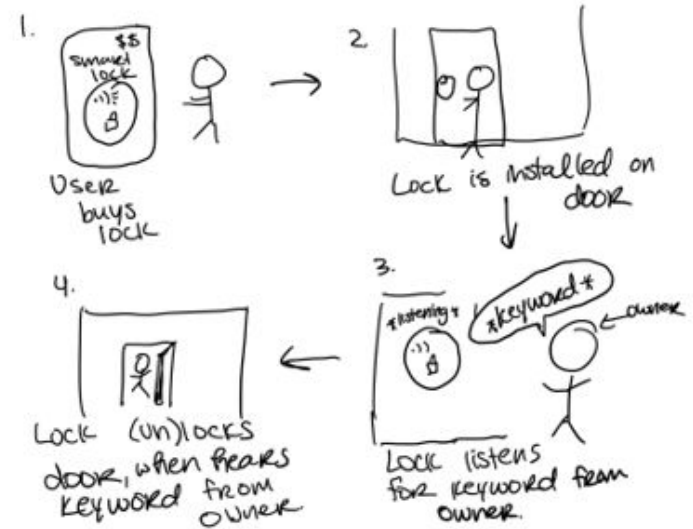
A microphone will be used to get audio from the user. The captured audio will be tested using the MLM to give a true or false value to send to the motors telling it to lock or unlock.

Motors will be used to control the door lock.



Functionality

The functionality of this device is very similar to a regular lock and the only difference is that a certain keyword will have to be give to the lock by the user that will unlock the door for them.





Concerns

- Model accuracy and unbiased data
 - Making sure the lock only works for the correct person
- Not being able to find a commercial lock that we can modify

Plans to solve these concerns

- Begin data collection and model training as soon as possible
- Begin researching locks that may be viable
- Consulting with other majors (mechanical engineers) to look over our lock designs
- Dr. Rover has also connected us with an ISU grad as our SME to reach out to.