

Problem Statement and Goals for SmartLock

4TB6 - Mechatronics Capstone

Team #5, Locked & Loaded

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Table 1: Revision History

Date	Developer(s)	Change
25-09-22	Steffi	Completed
19-11-22	Steffi	Updates for Consistency

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1 Problem Statement

1.1 Problem

There are many problems associated with bike locks today. People often forget or lose their keys, lock or combination. Additionally, current locking systems are often not comprehensive – they may not lock all parts of the bike that can be stolen, (the seat, front and back wheels and frame).

Furthermore, the problem stretches beyond the locking mechanisms; bike locks can be bulky, heavy and dangerous to carry around and it can also be tedious to find and lock one's bike to an external frame. The combination of these issues can lead to individuals leaving their bikes without properly locking them. The city of Toronto reports an average 3625 stolen bikes annually, and the Canadian Cycling Magazine estimates that only 15-20% of stolen bikes are reported which indicates a rather expansive problem that needs to be solved [1,2].

Our team presents the Smart Lock, which is a bike lock that is locked/unlocked through a cellphone application. Users can secure their bikes automatically, eliminating the need for manual locking through keys and a combination. The application includes a GPS component to locate the bike in case the user forgets where they parked it or in the event that it is stolen. Additionally, the Smart Lock is intended to be mounted permanently on the bike frame, eliminating the need to carry a lock. The sleek design will ensure that the lock is unobtrusive while riding.

1.2 Inputs and Outputs

Inputs	Outputs
SignalLock (to lock latch)	LatchLocked
SignalUnlock (to unlock)	LatchUnlocked
SignalOpened	LockOpened
SignalClosed	LockClosed
BatteryPower	Battery % Status
GpsLocation	BikePosition

1.3 Stakeholders

Cyclists or aspiring cyclists interested in improving the efficiency, usability and security of locking their bike.

1.4 Environment

Below is a list of the hardware and software needed to implement the solution to the problem. Hardware: physical lock, power source, motor/actuator,

input device (Bluetooth/ antennae/ transmitter/ receiver), positioning sensors
Software: phone app

2 Goals

Goals	Measurability
Wireless communication and engagement/disengagement of bike lock	Quality and distance of signal strength
Effective bike lock	Lock functions, X amount of force before failure
Long lasting battery life	Time - in months
Fits on many different styles of bikes	Can easily be mounted to mountain bikes, city bikes, children's bikes and road bikes
Easily mount on bike frame	Does not require special tools for mount/dismount

3 Stretch Goals

- Integrating with fitness apps (ie. strava) for increased capabilities
- Integrating the battery with a solar panel for self charging to reduce user interaction with the lock further
- GPS location services
- Cross platform app implementation for accessibility using an Android in addition to an IOS device

4 References

- [1] "bicycle-thefts," data.torontopolice.on.ca. <https://data.torontopolice.on.ca/pages/bicycle-thefts> (accessed Sep. 25, 2022).
- [2] L. Hansen-Gillis, "Bike thefts are increasing in Canada: Here's what you can do to protect your bike," Canadian Cycling Magazine, Nov. 04, 2020. <https://cyclingmagazine.ca/sections/news/bike-theft-canada/> (accessed Sep. 25, 2022).