



**CALIFORNIA SCIENCE & ENGINEERING FAIR  
2018 PROJECT SUMMARY**

<b>Name(s)</b> <b>Vedansh Goenka</b>	<b>Project Number</b> <b>J1006</b>
<b>Project Title</b> <b>Lock That Can Operate Using Three Mechanisms: Magnetic Key Combination, NFC Card, and Remote IP Network</b>	
<b>Abstract</b> <b>Objectives/Goals</b> Build a prototype lock that replicates the multiple modes of operation common in today's smart locks, but one that is secure, and can be designed and printed with readily available tools and components such as 3D printers, magnets, Raspberry PI, a simple DC motor, a hotel key card, and so on. <b>Methods/Materials</b> Tinker CAD for 3D design of the lock. 3D Printer for printing the lock. Strong magnets purchased online and glued to operate. Raspberry PI kit and an NFC reader to operate a DC motor, assembled with a number of step-up gears salvaged from Lego set. Python code samples and sample audio files found online to program Raspberry PI and turn the motors with the tap of an NFC card key recycled from a hotel room key, and portable speaker to provide audio confirmation. <b>Results</b> Building a working engineering prototype requires several iterations and precise connection between parts. For instance, turning a motor to move a lever by an exact amount requires computing how consistent and accurate the motor turns, and reducing the noise through a system of gears. <b>Conclusions/Discussion</b> This project was really about overcoming a large number of engineering and design challenges in creating a repeatable locking mechanism that survived multiple iterations of testing to ensure it was reliable, quick to operate within 10 seconds, and allowed me to learn and explore several faculties, including programming a Raspberry PI. I learnt a great deal about practical 3D design, one that can be used to create a solid working prototype. I also learnt how to accomplish a goal through trial, error, and discovery with online resources.	
<b>Summary Statement</b> I designed, 3D printed, and assembled a mechanical lock that operates in 3 ways (1) mechanically using combination of magnetic taps (2) an NFC card tapped on an NFC reader connected to Raspberry PI (3) Remote login from a phone or computer	
<b>Help Received</b> I designed, built, and assembled the prototype myself. I searched online for sample computer programs. My dad reviewed and explained python programming and remote login concepts.	