Thief-Catcher Voice Lock

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Introduction

We utilize the unique property of our voices to make this voice lock, only the model himself are able to unlock the lock.

Our goal

Our product is able to identify the voices of strangers. If the sound is the same with the model, then the lock will be unlocked. If the sound is different with the model, then the cellphone we set will take a picture to warm the master.

Cross correlation

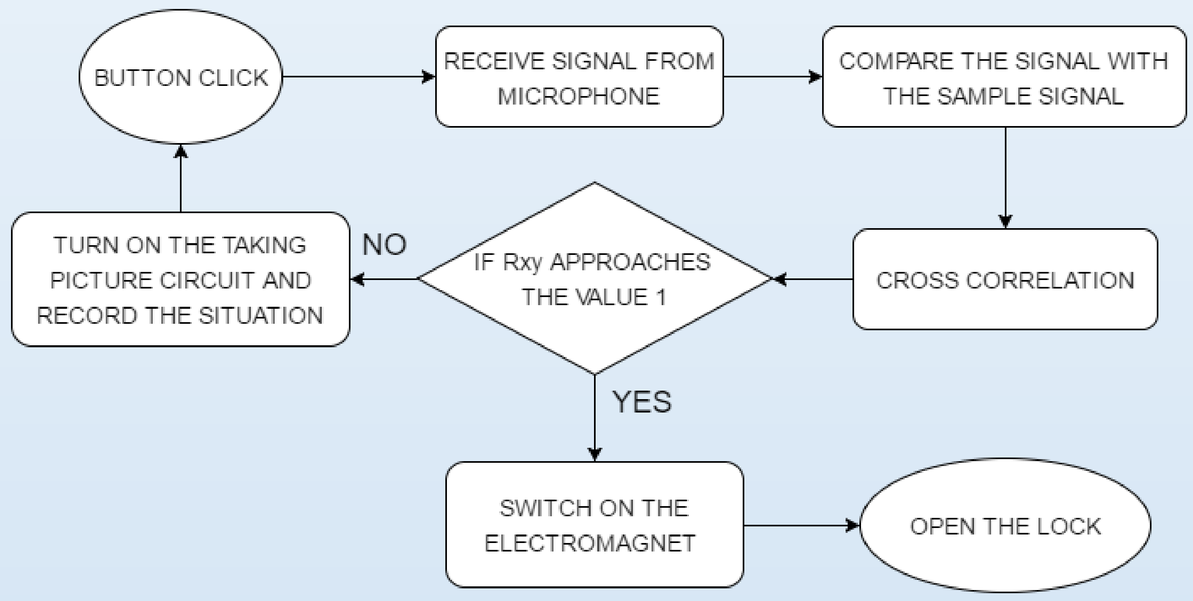
When comparing the model signal and the tested signal, we use cross correlation. Its skill is keeping shifting the signal until the correlation is the most similar with the model. We take the maximum to be the correlation value, the signals are more similar when the value approaches to 1 more closer.

$$R_{xy} = \frac{n \times \sum x(i)y(i) - \sum x(i) \times \sum y(i)}{\sqrt{\left[n \times \sum x^2(i) - \sum x(i)^2\right] \times \left[n \times \sum y^2(i) - \sum y(i)^2\right]}}$$

Ref: https://dsp.stackexchange.com/questions/27451/the-difference-between-convolution-and-cross-correlation-from-a-signal-analysis

How to make it work?

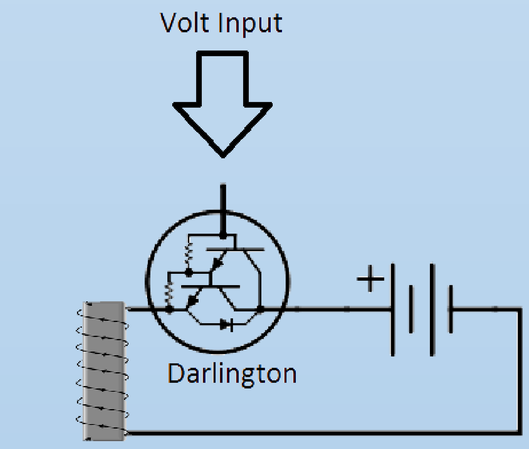
We used microphone to receive the signal, and conduct Fourier transform, then the spectrum will be compared with the model spectrum. If the two voices are similar, then the lock will be unlocked.



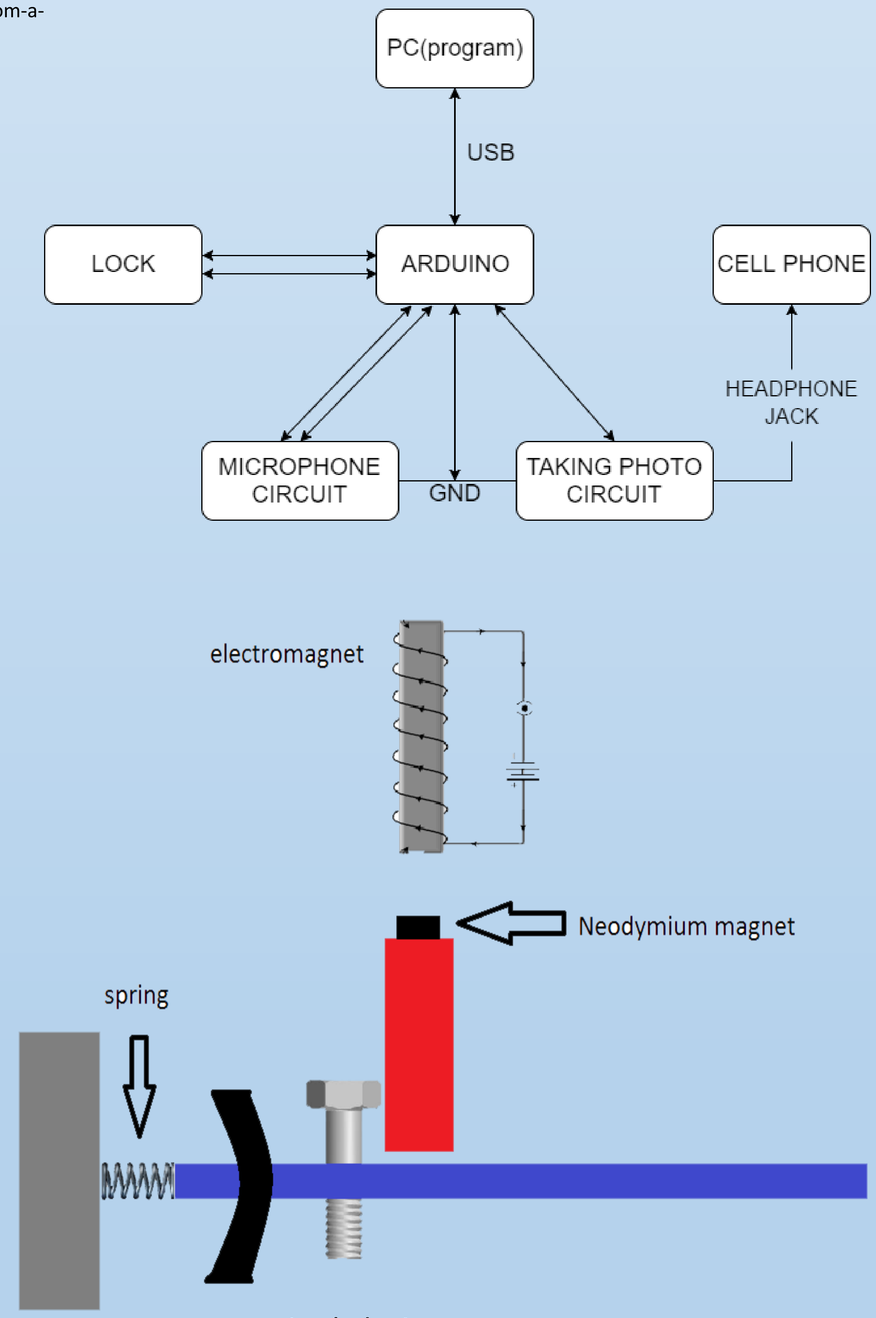
Voice lock system

Electromagnetic lock circuit

We use Darlington transistor to get the larger current, the goal is to make the magnetic force be greater. When the stick is attracted, the latch will be ejected.



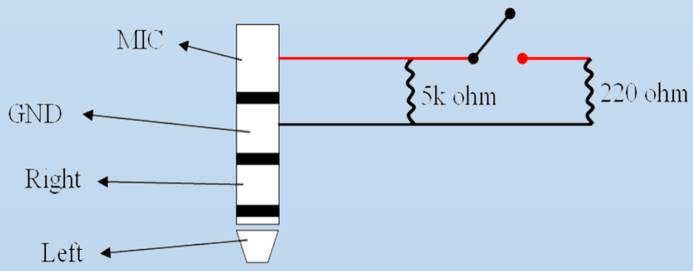
Unlock circuit



Lock device

Taking pictures

We utilize the principle of selfie stick, using the connector of the earphone which is equipped with microphone. We connect two resistors in parallel with BJT, when BJT is on then the resistance of the circuit will change. The cellphone will detect the resistance automatically; when it changes it will take the picture.

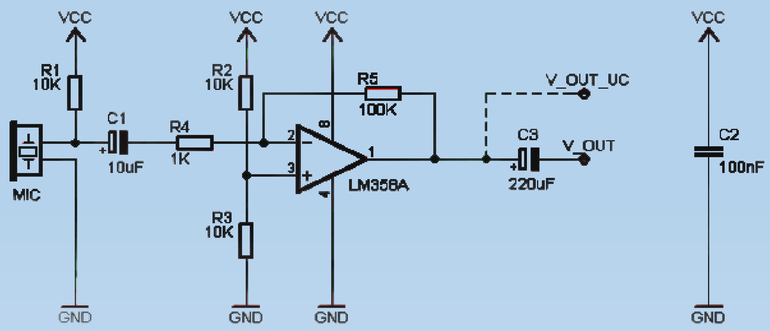


Simple earphone shutter circuit

Ref: http://gsyan888.blogspot.tw/2014/09/diy-headset-shutter.html

Microphone amplifier

Because the signals of our voices are too small, so we need the microphone to amplify the input signal. And because Arduino can not receive the negative signal, so we need to give an offset to increase the signal.



Microphone amplifier circuit

Ref: https://lowvoltage.wordpress.com/2011/05/21/lm358-mic-amp/

Conclusion

We successfully identify the acoustic waves. If they are identical, the latch will be ejected by our electromagnetic lock. On the contrary, if they are different, Arduino will output voltage to make cellphone take pictures.

Reference

郭鈴莉, 劉宗憲, 崔致豪, ”自動控制工程學系專題製作”, pp.5-20, June 2008