Voice Controlled Tank

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Our work

We design and construct a Tank which can move and fire a coil gun according to the different voice commands such as 'go', 'back', and 'stop'.

How it works?

Reading sound from microphone circuit → Converting analog signals into digital signals → Analyzing signals by FFT and correlation → Sending data to Arduino card by Bluetooth → Controlling tank and coil gun

Sound signal acquisition

The high pass filtered and amplified analog signal from a microphone is digitally sampled by an Arduino card at 2400Hz sampling rate.


Filter — Microphone — Amplifier
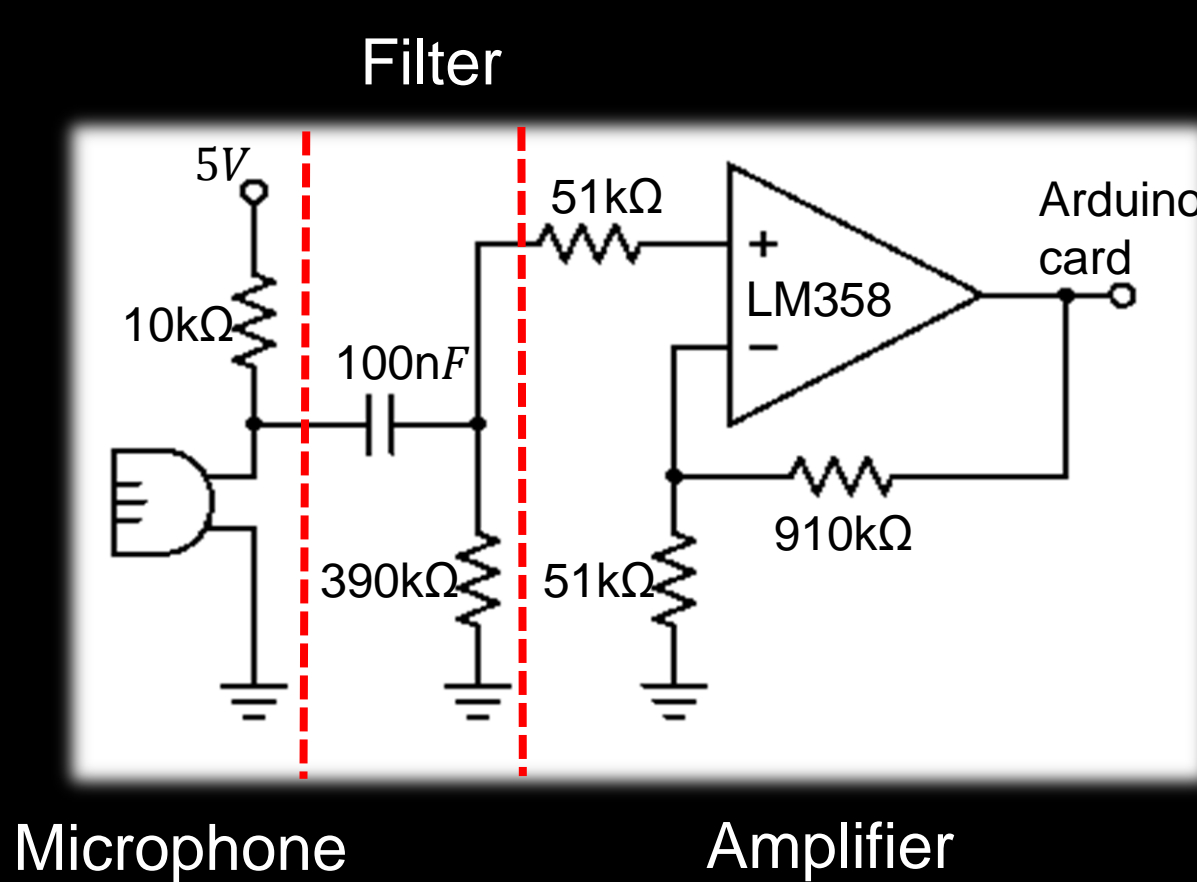
Power

The H-bridge is controlled by Arduino card which determines the rotate direction and speed of motors. The batteries are protected by the diodes. Moreover, this card can output PWM signals to LED and speaker.
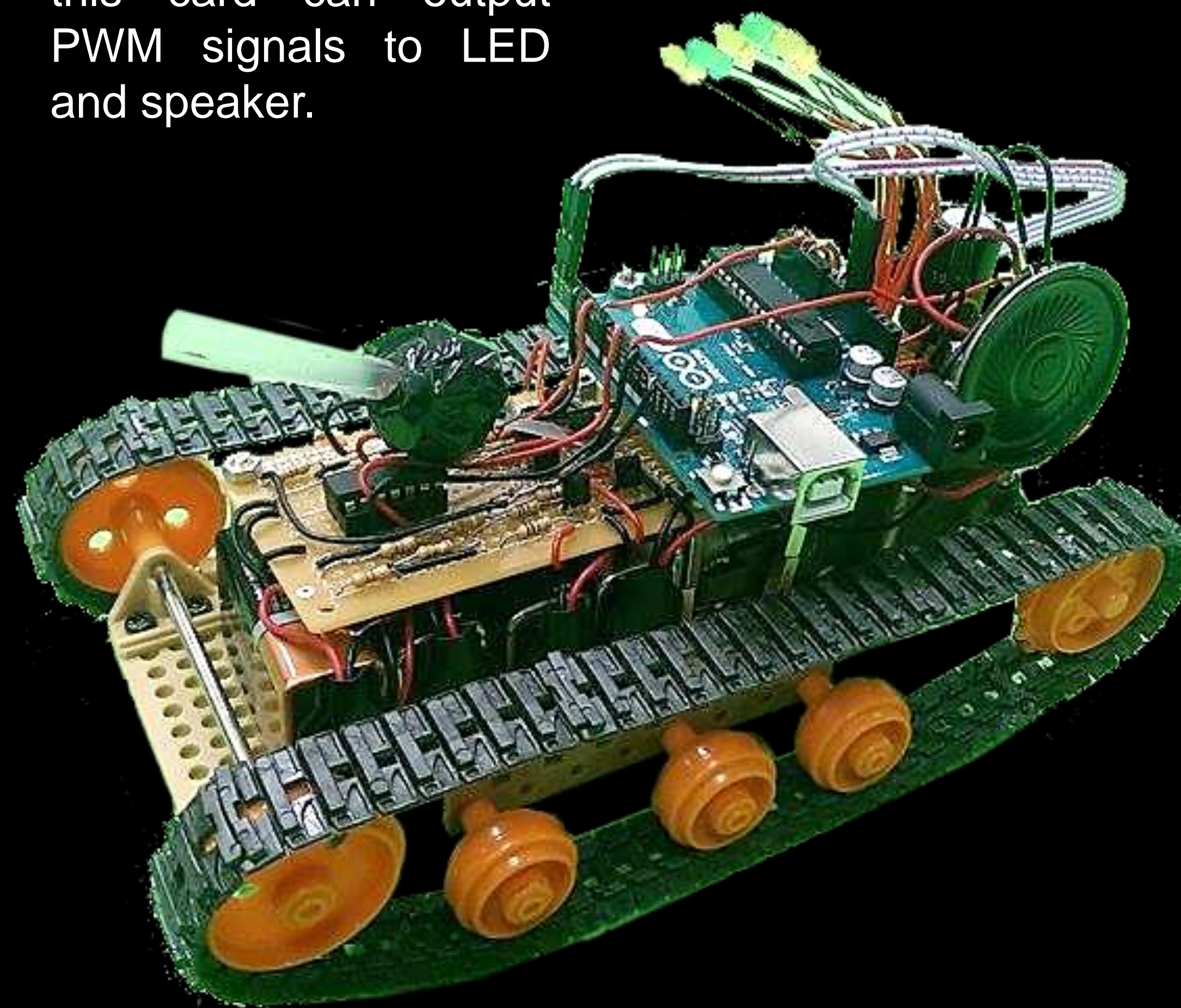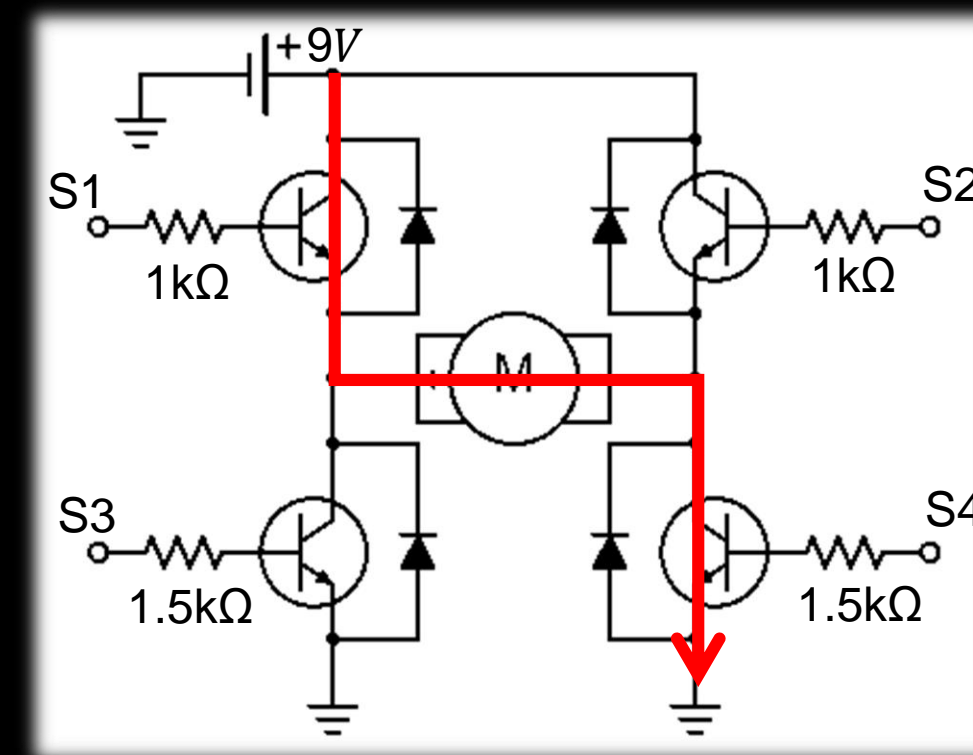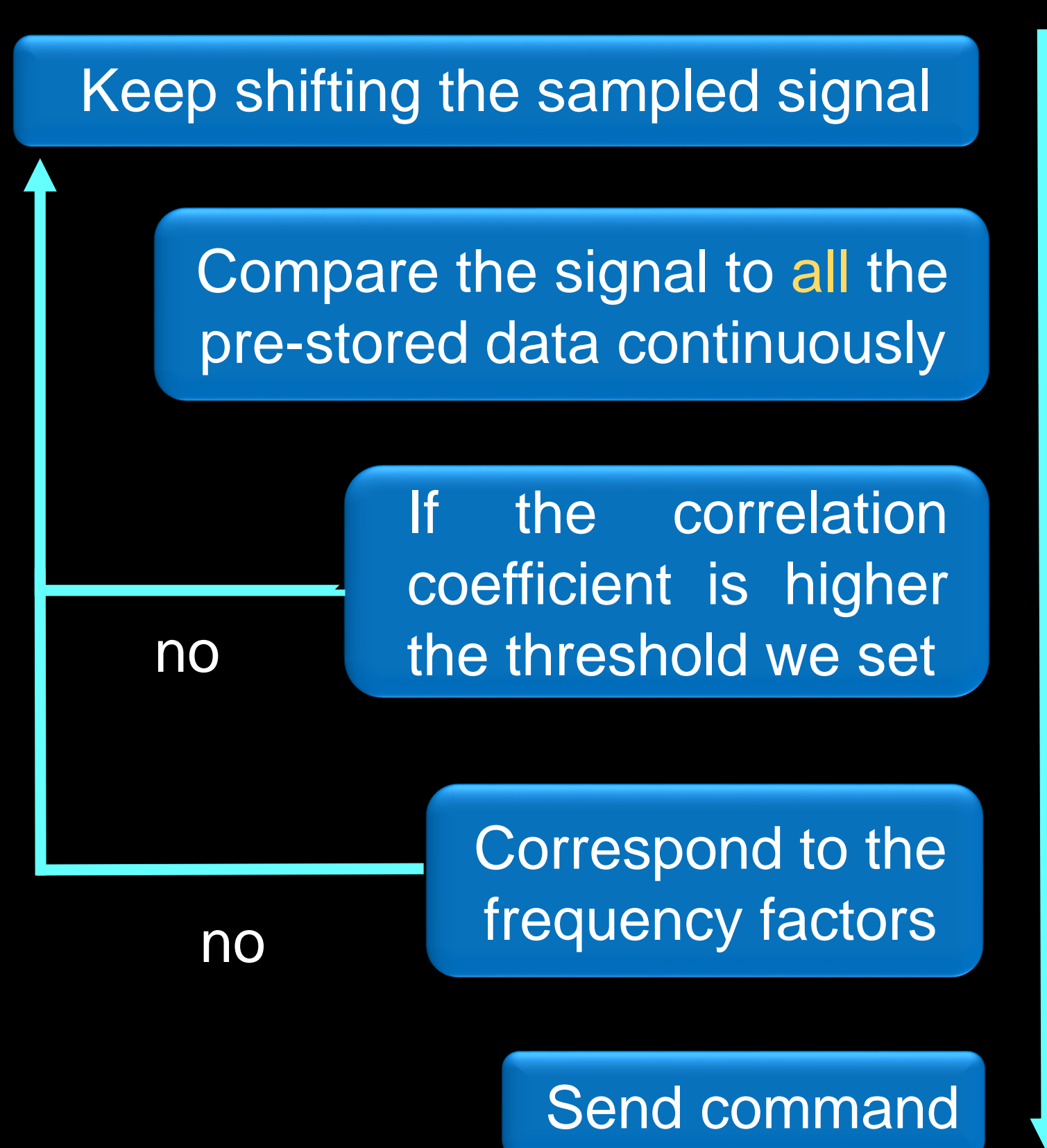

Coil gun

We use the coil, two SCRs, and two capacitors to build the gun. Because the coil and the projectile would become temporary magnets when the pulse current arrives, the coil can appeal the projectile.

If we want the projectile flies further, we should let the current shut down when the projectile passes through the center of solenoid. Hence, we need to use SCR to produce the pulse.
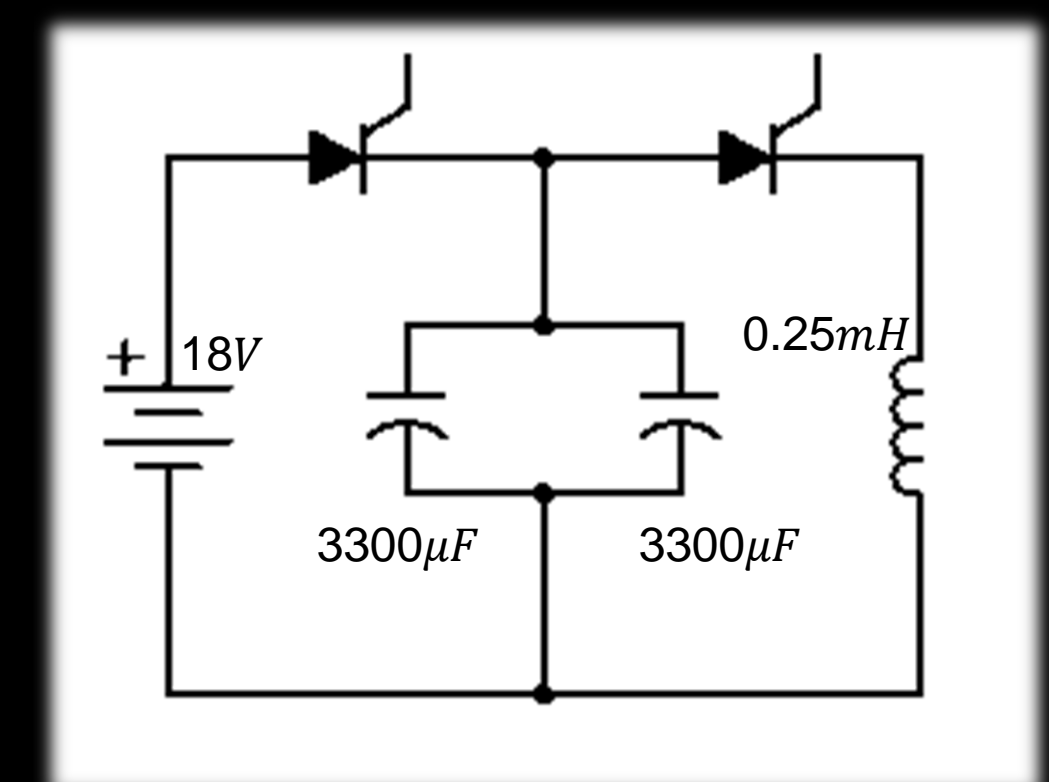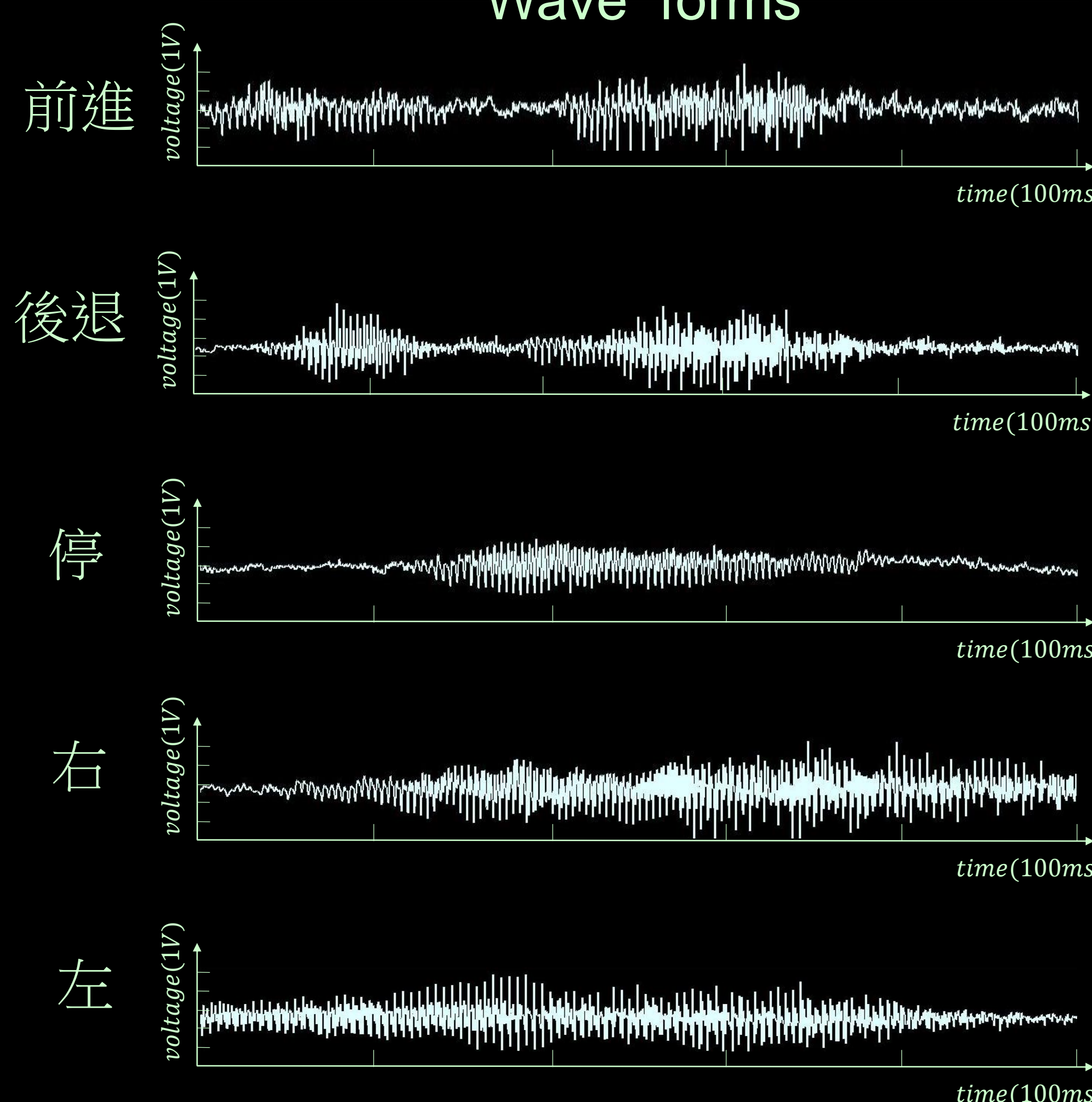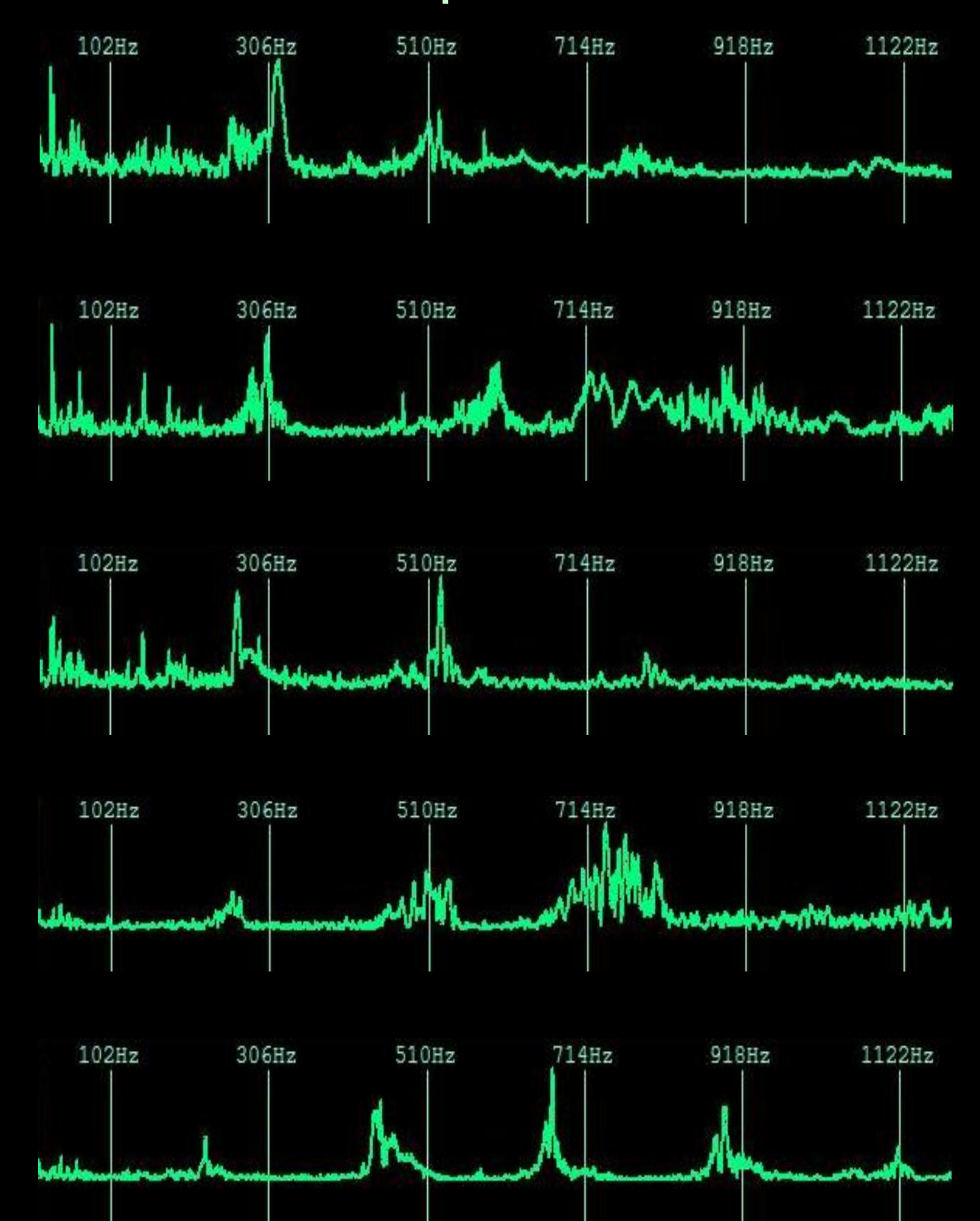

Data analysis for command recognition

Command recognition is achieved through cross-correlating the input voice waveforms with the waveforms of the existing commands in the data bank. Their spectra are also compared to improve recognition accuracy.

Keep shifting the sampled signal →
Compare the signal to all the pre-stored data continuously →
If the correlation coefficient is higher the threshold we set — no →
Correspond to the frequency factors — no →
Send command

Wave forms / Spectra

前進 / 後退 / 停 / 右 / 左

Cross-correlation

The coefficient of correlation is a value that we can judge the relevance between two signals. Compared to FFT analysis, the relevance is based on waveform.

$$r(\tau) = \frac{\int V_1(t)V_2(t+\tau)dt}{\sqrt{\int V_1(t)^2 dt}\sqrt{\int V_2(t)^2 dt}}$$

Data bank A / Input voice A' — $r_{AA'}(\tau)$

Data bank B / Input voice A' — $r_{BA'}(\tau)$