

CLAIMS

1. An apparatus, comprising:
 - an acoustic receiver system configured for receiving dynamic friction acoustic waves produced via relative motion between an outer surface of the apparatus and a target object in contact with the outer surface; and
 - a control system including one or more processors, the control system being configured for communication with the acoustic receiver system, the control system being configured for:
 - receiving first acoustic signals from the acoustic receiver system, the first acoustic signals corresponding to a first instance of the dynamic friction acoustic waves;
 - extracting first target object features from the first acoustic signals, wherein the first target object features comprise fingerprint features; and
 - performing a first authentication process based, at least in part, on the first target object features.
2. The apparatus of claim 1, wherein the acoustic receiver system comprises an ultrasonic receiver system.
3. The apparatus of claim 1, wherein the acoustic receiver system comprises a piezoelectric receiver system.
4. The apparatus of claim 1, wherein the fingerprint features include one or more of fingerprint minutiae, keypoints, sweat port information, ridge ending information, ridge bifurcation information, short ridge information, ridge flow information, island information, spur information, delta information or core information.
5. The apparatus of claim 1, further comprising a user input device, wherein the acoustic receiver system resides in or on the user input device.
6. The apparatus of claim 1, further comprising a display, wherein the acoustic receiver system resides proximate a first side of the display and wherein the outer surface is proximate a second side of the display.
7. An Internet of things device that includes the apparatus of claim 1.

8. The apparatus of claim 1, further comprising a layer between the outer surface of the apparatus and the acoustic receiver system, the layer comprising one or more of metal, plastic, ceramic or polymer.
9. The apparatus of claim 1, wherein the control system is further configured for controlling access to the apparatus, or to another device, based at least in part on the first authentication process.
10. The apparatus of claim 9, wherein the control system is further configured for:
 - receiving second through *Nth* acoustic signals from the acoustic receiver system, the second through *Nth* acoustic signals corresponding to second through *Nth* instances of the dynamic friction acoustic waves;
 - extracting second through *Nth* target object features from each of the second through *Nth* acoustic signals;
 - performing second through *Nth* authentication processes based, at least in part, on the first target object features; and
 - controlling access to the apparatus, or to the other device, based at least in part on the second through *Nth* authentication processes.
11. The apparatus of claim 1, wherein the apparatus does not include a transmitter corresponding to the acoustic receiver.
12. The apparatus of claim 1, wherein the apparatus includes a transmitter corresponding to the acoustic receiver, but wherein the transmitter is not transmitting during the time the acoustic receiver system is receiving the dynamic friction acoustic waves.
13. A mobile device that includes the apparatus of claim 1.
14. An authentication method, comprising:
 - receiving, via an acoustic receiver system of an apparatus, dynamic friction acoustic waves produced via relative motion between an outer surface of the apparatus and a target object in contact with the outer surface;
 - receiving, via a control system that includes one or more processors, first acoustic signals from the acoustic receiver system, the first acoustic signals corresponding to a first instance of the dynamic friction acoustic waves;

extracting, via the control system, first target object features from the first acoustic signals, wherein the first target object features comprise fingerprint features; and

performing, via the control system, a first authentication process based, at least in part, on the first target object features.

15. The method of claim 14, wherein the fingerprint features include one or more of fingerprint minutiae, keypoints, sweat port information, ridge ending information, ridge bifurcation information, short ridge information, ridge flow information, island information, spur information, delta information or core information.

16. The method of claim 14, wherein the dynamic friction acoustic waves pass through a layer between the target object and the acoustic receiver system, the layer comprising one or more of metal, plastic, ceramic or polymer.

17. The method of claim 14, further comprising controlling access to the apparatus, or to another device, based at least in part on the first authentication process.

18. The method of claim 17, further comprising:

receiving second through *Nth* acoustic signals from the acoustic receiver system, the second through *Nth* acoustic signals corresponding to second through *Nth* instances of the dynamic friction acoustic waves;

extracting second through *Nth* target object features from each of the second through *Nth* acoustic signals;

performing second through *Nth* authentication processes based, at least in part, on the first target object features; and

controlling access to the apparatus, or to the other device, based at least in part on the second through *Nth* authentication processes.

19. The method of claim 14, wherein the apparatus includes a transmitter corresponding to the acoustic receiver, but wherein the method involves not causing the transmitter to transmit during the time the acoustic receiver system is receiving the dynamic friction acoustic waves.

20. One or more non-transitory media having instructions stored thereon for controlling one or more devices to perform a method, the method comprising:

receiving, via an acoustic receiver system of an apparatus, dynamic friction acoustic waves produced via relative motion between an outer surface of the apparatus and a target object in contact with the outer surface;

receiving, via a control system that includes one or more processors, first acoustic signals from the acoustic receiver system, the first acoustic signals corresponding to a first instance of the dynamic friction acoustic waves;

extracting, via the control system, first target object features from the first acoustic signals, wherein the first target object features comprises finger print features; and

performing, via the control system, a first authentication process based, at least in part, on the first target object features.

21. The one or more non-transitory media of claim 20, wherein the fingerprint features include one or more of fingerprint minutiae, keypoints, sweat port information, ridge ending information, ridge bifurcation information, short ridge information, ridge flow information, island information, spur information, delta information or core information.

22. The one or more non-transitory media of claim 20, wherein the dynamic friction acoustic waves pass through a metal layer between the target object and the acoustic receiver system.

23. The one or more non-transitory media of claim 20, wherein the method further comprises controlling access to the apparatus, or to another device, based at least in part on the first authentication process.

24. The one or more non-transitory media of 23, wherein the method further comprises:

receiving second through Nth acoustic signals from the acoustic receiver system, the second through Nth acoustic signals corresponding to second through Nth instances of the dynamic friction acoustic waves;

extracting second through Nth target object features from each of the second through Nth acoustic signals;

performing second through Nth authentication processes based, at least in part, on the first target object features; and

controlling access to the apparatus, or to the other device, based at least in part on the second through *Nth* authentication processes.

25. The one or more non-transitory media of claim 20, wherein the apparatus includes a transmitter corresponding to the acoustic receiver, but wherein the method involves not causing the transmitter to transmit during the time the acoustic receiver system is receiving the dynamic friction acoustic waves.

26. An apparatus, comprising:
an acoustic receiver system configured for receiving dynamic friction acoustic waves produced via relative motion between an outer surface of the apparatus and a target object in contact with the outer surface; and
control means for:
receiving first acoustic signals from the acoustic receiver system, the first acoustic signals corresponding to a first instance of the dynamic friction acoustic waves;
extracting first target object features from the first acoustic signals, wherein the first target object features comprise fingerprint features; and
performing a first authentication process based, at least in part, on the first target object features.

27. The apparatus of claim 26, wherein the acoustic receiver system comprises at least one of an ultrasonic receiver system or a piezoelectric receiver system.

28. An Internet of things device that includes the apparatus of claim 26.

29. The apparatus of claim 26, further comprising a layer between the outer surface and the acoustic receiver system, the layer comprising one or more of metal, plastic, ceramic or polymer.

30. The apparatus of claim 26, wherein the control system is further configured for controlling access to the apparatus, or to another device, based at least in part on the first authentication process.