cartridge key. The test protocols may specify such details as how long to mix sample preparation reagents through sonication, the frequency of the sonication, when to heat the various heat-sensitive valves, etc. The information may also include correlation tables for each cartridge type, which correlate detected sensor signals to the absence, presence, and/or a specific quantity of a target analyte. Additionally, the information stored by the reader **3130** and/or the server **3150** may include one or more past results. In some embodiments, the reader **3130** stores test results at least until the reader **3130** comes into communication with a remote computing device; at such time, the results may be transmitted to the remote computing device (mobile computing device **3140** or server **3150**) for display and/or long-term storage.

In some embodiments, the server **3150** also stores user profiles, which may include biographical information entered into the system by a user through the device having a user interface **3140**. In some such embodiments, a log of test results for each user is also stored by the server **3150** and accessible for viewing by the user through transmission of such data to the device with a user interface **3140**.

In one embodiment, when a cartridge **3120** is loaded into the reader **3130**, the reader **3130** detects signals from a label, such as a resistor label or electronic barcode, on the cartridge **3120** to detect the cartridge type. The reader **3130** compares the detected signals to a database of known label signals or cartridge keys to determine which cartridge type is present. If the detected label signal is not found within the database of cartridge keys, the reader **3130** may transmit a message to a server **3150** requesting updates to the database of cartridge keys. The reader **3130** may transmit the message directly to the server **3150** or indirectly by way of the mobile computing device **3140**. The reader **3130** may additionally receive, directly or indirectly, data for cartridge key database updates. The data may include new cartridge types and the cartridge keys and test protocols corresponding to each new cartridge type. In some embodiments, the reader **3130** then identifies and implements the test protocol associated with the detected cartridge type. Upon receiving signals from a detection sensor, the reader **3130** of some embodiments compares the signals to a correlation table to process the signals and generate meaningful results. The results may be transmitted to the device with a user interface **3140** for display to a user. One skilled in the art will appreciate that the various information stored by the computing devices of the detector system **3100** may be stored by any one or more of the devices and may be accessible to the other devices through the receipt and transmission of data signals.

The Computerized Methods of Detection

As mentioned above, the computerized reader largely controls the operations of the detection system. The reader includes a processor and memory, the memory having instructions stored thereon for implementing various methods needed to successfully detect the presence, absence, and/or quantity of target analyte within a collected sample. For example, an embodiment of one method performed by the computerized reader in an automated manner is provided in FIG. **32**.

At block **3202**, the computerized reader detects the presence of a cartridge loaded into or onto the reader. For example, in some embodiments, a cartridge is coupled to the reader such that electrical leads on the cartridge come into physical contact with electrical pins on the reader, completing a circuit that turns on the reader and signals the reader to the presence of a cartridge.

At block **3204**, the reader detects identification information associated with the cartridge. For example, the cartridge of some embodiments includes a unique identification key on its circuit board component, which generates signals unique to the particular cartridge type of the cartridge, allowing the reader to distinguish between cartridge types. The identification key may be a resistive element, for example, a surface mount resistor or a resistive ink-based element having a unique size or shape, or it may be another unique electrical signal generator.

The reader's processor receives the unique identification key signals from the reader's circuitry which detected the signals, and as shown at block **3206**, identifies a proper test protocol for the cartridge based on the unique identification key. In some embodiments, the reader's processor compares the unique identification key signals to a database of identification keys stored in memory. Within the database of some embodiments, each identification key is associated with a particular cartridge type and test protocol. If the identification key signals received from the processor match a key in the database, the corresponding test protocol will be opened and executed by the processor. If the identification key signals do not match a key in the database, the processor may communicate with a remote computing device such as a mobile computing device and/or a server to signal that an unidentifiable cartridge has been detected. In some embodiments, the reader downloads updates directly from a server or indirectly with the mobile computing device acting as an intermediary. In some embodiments, when an unknown cartridge type is detected, a user is prompted via the user interface of the mobile computing device, to download updates; in other embodiments, the updates are downloaded automatically. In various embodiments, the updates include newly developed cartridge identification keys and test protocols. Once the new identification keys and test protocols are downloaded, they will be added to the reader's database of supported tests so that future tests with this cartridge type will automatically be recognized and implemented without the need for communicating with remote computing devices.

As shown at block **3208**, in various embodiments, the computerized reader detects insertion of a sample collection device into a first reservoir of the cartridge. Various processes can be implemented to accomplish this detection, as provided in more detail in the discussion of sonication above. In various embodiments, the reader's processor receives signals from a sonicator element comprised partially or wholly of a piezoelectric element, in the reader. By monitoring the sonicator element to identify changes in the signals generated from a mechanical event within the reservoir, the processor can identify when a change in pressure and/or a change in resonance and/or a change in a reflected signal (pressure or sound wave) has occurred in the first reservoir of the cartridge through the ability of the piezoelectric component to transduce mechanical signals into electric signals which can be amplified and understood through a combination of circuitry and processor in electronic communication with said piezoelectric element; such changes are indicative of entry of a sample collection device into the reservoir.

At block **3210**, the reader's processor sends signals to the sonicator to instruct it to initiate a sonication protocol to mix a plurality of reagents, affinity molecules, and sample particles within a liquid disposed within the first reservoir. In various embodiments, the resulting mixture includes magnetic particles bound to: target analytes, target analytes and detector agents, and/or competitive binding agents. As used herein, sandwich complexes refer to magnetic particles bound directly or indirectly to target analytes and detector agents; competitive binding complexes refer to magnetic particles bound to competitive binding agents. Each sandwich