1.5 Concept Generation

Over 100 concepts were generated to suit the functions required by the project scope. Of these concepts, 3 were chosen to be more suitable for the project than the rest. These are listed as the high-fidelity concepts. 5 more concepts were chosen as medium fidelity concepts – concepts that were also deemed suitable for the scope, but less so than the high-fidelity concepts. The remaining concepts – low fidelity concepts – were compiled into appendix C.

High Fidelity Concepts

Concept 1: Vending Machine with Symbolic Keypad

As seen in Figure 2, this device is disguised as a vending machine. Disguising this device as a vending machine will attract all types of children. Like a regular vending machine, this vending machine will contain common items, be toys, snacks, or drinks. However, a lenticular sign will be implemented inside the vending machine, which will allow the children to read a secret message that adults will not be able to read, based on height. The child in need will read the message that the lenticular sign displays and will be instructed to enter a combination of symbols on a child modified keypad. This will be a customized keypad containing symbols that children under the age of 14 can interpret. By having a keypad with symbols rather than numbers, children who may not know their numbers yet will be able to interact with the device easier. After the child enters the instructed combination, the vending machine will send out a GPS object disguised as some item which can be changed seasonally. The GPS tracker may be hidden within a multitude of items, including snacks, beverages, toys, and first aid supplies. Law Enforcement will be notified with updates containing the exact location of the child as soon as they interact with the device. Having the tracker disguised as some item which can be changed seasonally will fulfill the functions and customer needs by lowering the chances of children being spotted with this device, as well as allowing the child to be tracked, and helping to prevent false alarms with the use of the keypad. For all of these reasons, this concept was determined as a high fidelity concept.

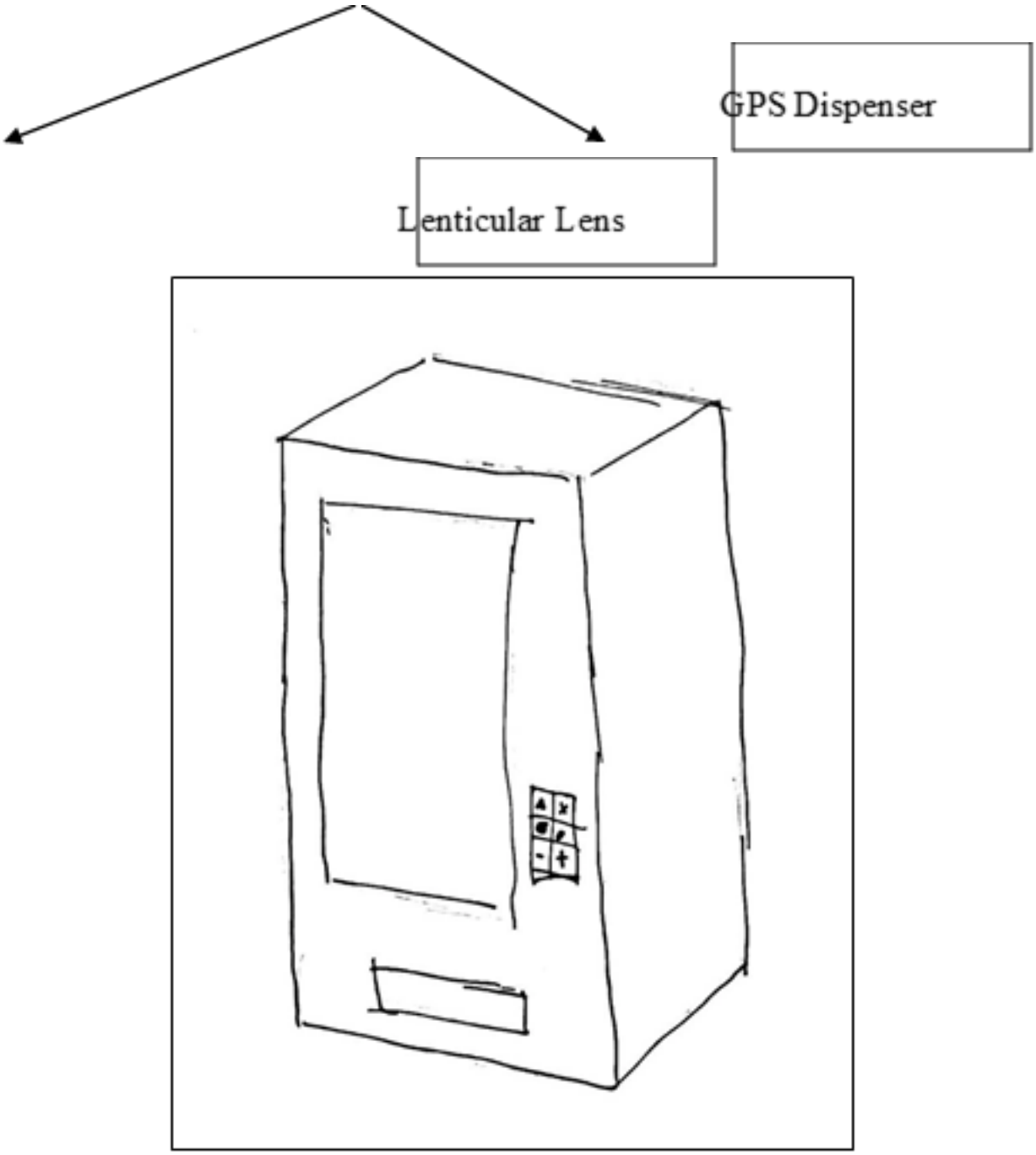


Figure 2. Vending machine that utilizes a lenticular lens, buttons with shapes, and dispenses a GPS tracker.

Concept 2: GPS Bur

As seen in Figure 3, this device will be a GPS tracker disguised as a sand spur that will make it extremely difficult for traffickers to identify. This device will not only have the resemblance of a sand spur, it will also have the ability to attach onto the victim's clothing through the implementation of hooks and loops. Furthermore, this tracking device will have a GPS navigation system to track the child in need. The device will first identify the child in need upon

interaction, then the GPS burr will stick to the clothing of the child and provide law enforcement with a live location of the child. This concept was chosen as a high-fidelity concept because it was found to be one of the most plausible due to its transparent design in society, thus making it more difficult for traffickers to identify the tracker. The overall design will sway traffickers away from detecting what it is, as well as fulfill the needs of law enforcement of rescuing the child and ceasing the trafficker.

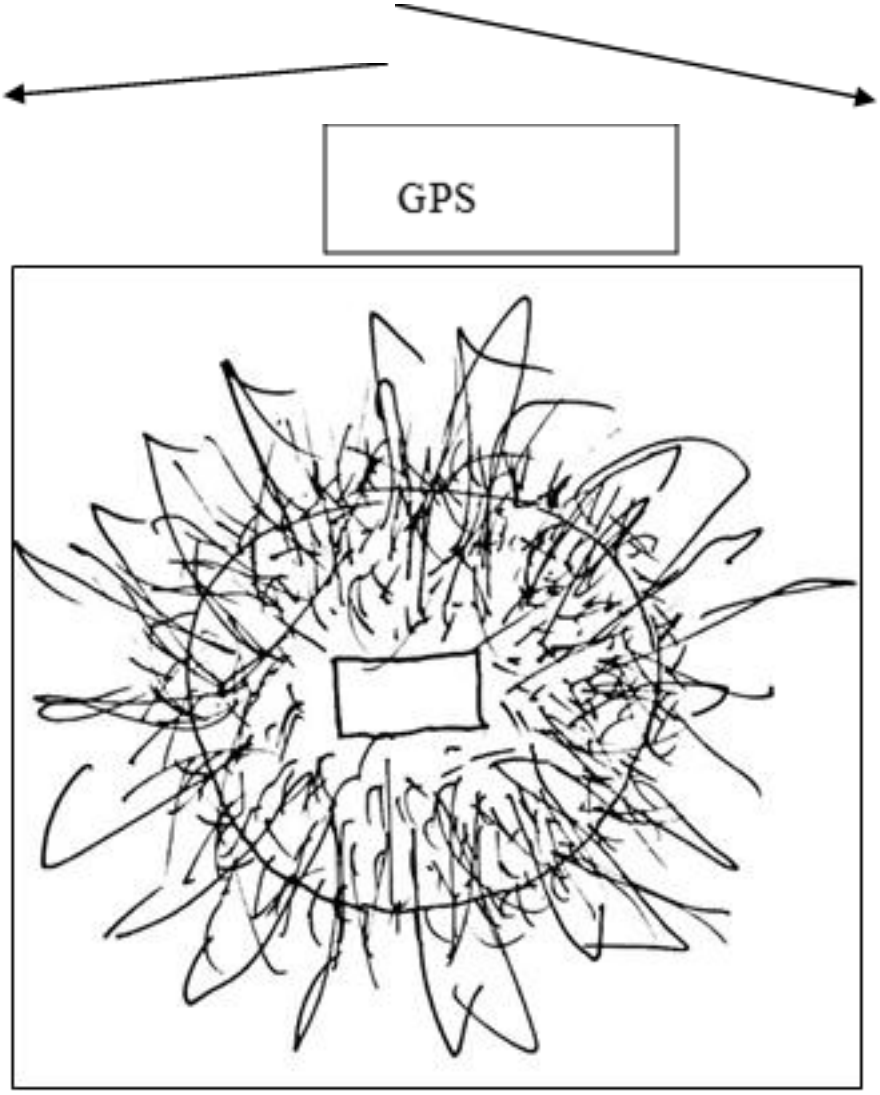
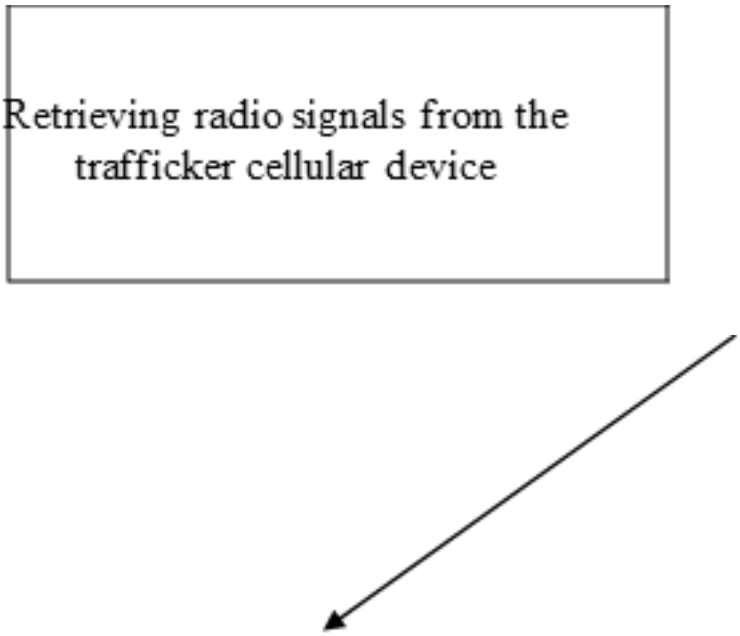


Figure 3. GPS device that attaches to victim with bur-like material.

Concept 3: Swift Pack

As seen in Figure 4, *Swift Pack* is concept by which the device will be able to track the trafficker by identifying their location near each *Swift Pack* device. It will be activated through the use of facial recognition: a database of victims faces, or their traffickers, will be referenced against any faces that come near the device. It will then utilize a mobile phone tracking process by identifying the location of the traffickers based on their cell phone service. *Swift Pack* obtains the GPS location of their device by using multilateration systems through radio signals sent out by the mobile phone. If the device has roaming signal from the nearest antenna tower *Swift*

Pack will maintain the location. *Swift Pack* will then provide law enforcement with the location of the trafficker each time a text message or call is received or sent out. *Swift Pack* will utilize the mobile phone tracking process by identifying the location of the traffickers. This concept was selected as a high fidelity because the device acts as a ghost, there's no child interaction with this device in which will make it extremely difficult for the traffickers to know that they're being tracked.



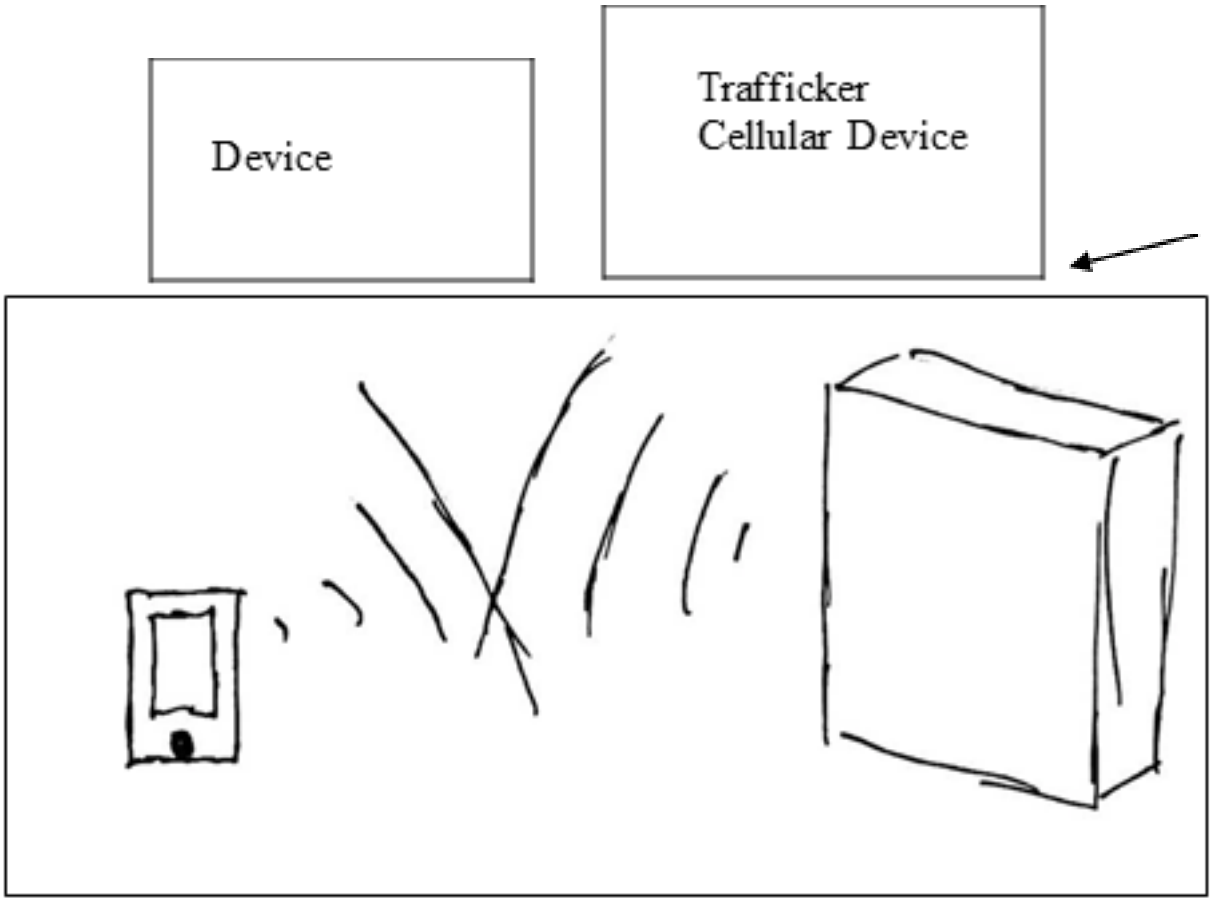


Figure 4. Device receives signals from nearby phones and can interpret phone calls and text messages.

Medium Fidelity Concepts

Concept 4: GPS Pills

As seen in Figure 3, the device will be activated by the child in need and dispense the *GPS Pill,* a pill for the child to consume. Immediately once the device has been activated and the pill has been consumed, law enforcement will be notified. In the case that the trafficker and child leave the scene and the local enforcement did not get there in time, the pill will have a GPS tracker inside in order to track and locate the child. This is ideal because the trafficker will have no indications that the child is being tracked since the pill is inside the child and impossible to see. This concept is considered a medium-fidelity due to the fact that it does seem plausible given the resources it requires and its ability to be extremely discrete. However, it does not seem as reasonable as the high-fidelity concepts as it is not known if swallowing a GPS tracker would be safe for the child.

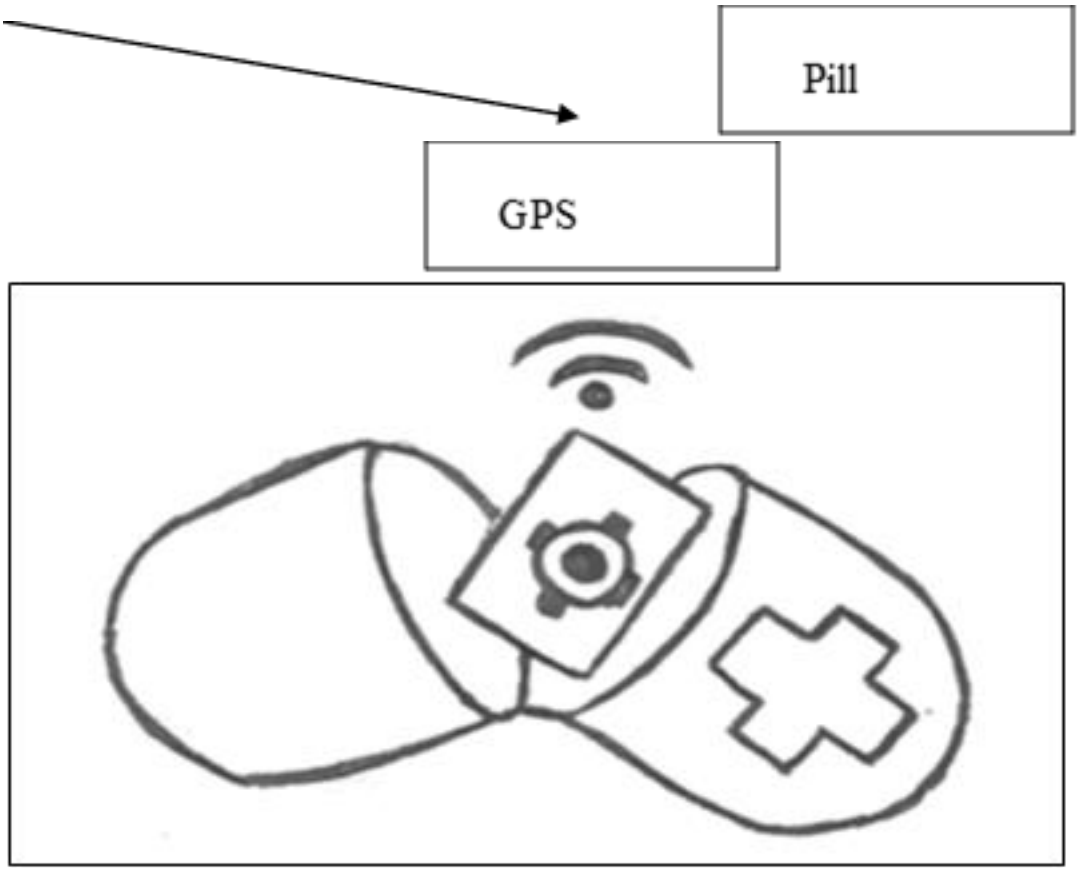


Figure 3. Pill with GPS tracker.

Concept 5: Two-Way mirror

This device shown in Figure 4, the *Two-Way Mirror*, will consist of a two-way mirror. The mirror would be located in gas station and hotel bathrooms, among other trafficking hot spots. In the hopes that the child would have complete privacy in the bathroom, the child does not have to worry about being caught interacting with a device by his or her trafficker. Technology would be located directly behind the mirror that only the child will be able to know and interact with. Once the child seeks for help and triggers the device, the local authorities will be alerted and arrive at the scene. This concept was a considered a medium fidelity because it substantially reduces the risk of the child being caught interacting with the device. However, the concept does not seem as plausible as the other high-fidelity concepts because it requires the child to be alone in a public bathroom, which is not a guarantee. Additionally, it would require gas stations, hotels, and other trafficking hot spots to be willing to install said mirrors, which may come at an expense to them given their current bathroom mirror setups.

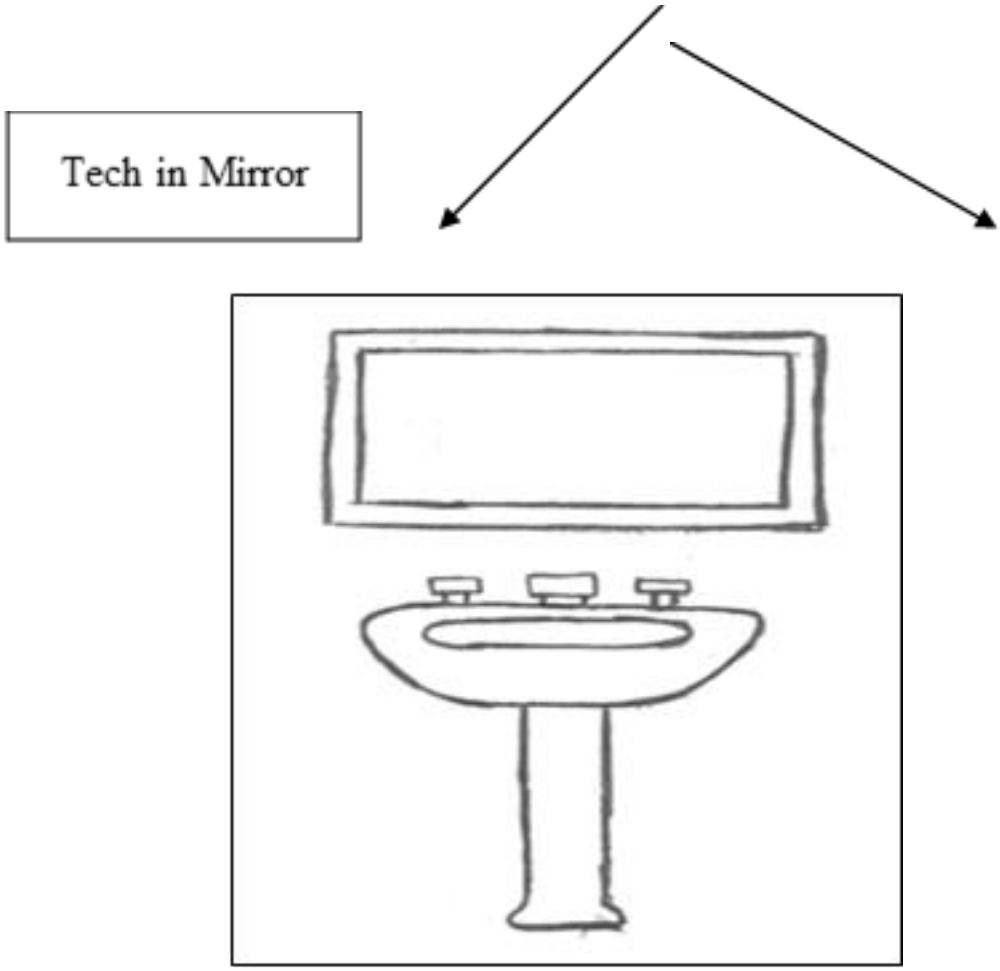


Figure 4 Device in the bathroom gives the opportunity for the child to interact with it in private.

Concept 6: Park Binoculars

This device, *Park Binoculars,* shown in Figure 5, consists of a tower viewer (binoculars permanently mounted on a stalk). These tower viewers are usually located at parks, zoos, or any type of scenic overlook. The device will be able to scan the eye of the user. Once the device scans and detects that it is a child, the child will be able to interact with the device. Once the child looks into the device, and pushes an appropriate button depending on the message they will read, the device will trigger and alert the local authorities. The device will be able to detect if it is an adult, which means that if the trafficker decided to use it, they will believe it is another normal tower viewer. This concept is considered a medium-fidelity because the trafficker would never know that the child was interacting with a device, but it does not seem as plausible as the other high-fidelity concepts. It also requires each child using the device to distinguish whether they are in trouble, which is subjective and may lead to false alarms.

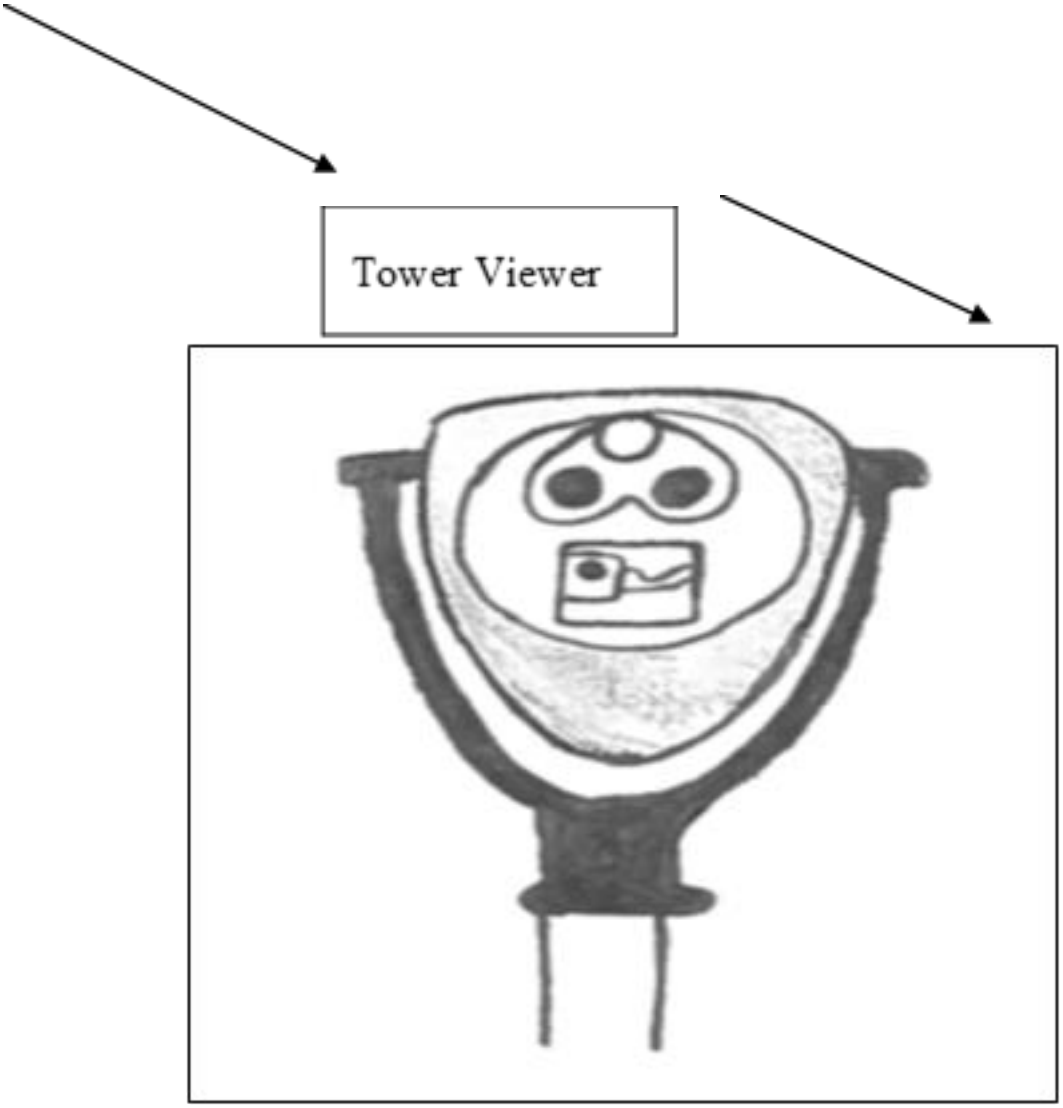


Figure 5 Device scans the eye of the user in order to determine if it is a child.

Concept 7: Weight Scale

As seen in Figure 6, this device is a weight scale. This device would be located in local grocery and department stores. The device will be able to determine if the person being weighed is a child or not depending on the user's weight. If the weight satisfies the requirement, they will be able to interact with the device, and identify whether or not they are in a dangerous situation. Once the child interacts with the device, the device will trigger, alerting the local authorities immediately. This concept is considered a medium fidelity since it would be very difficult for the trafficker to know the child was interacting with a device. However, the concept does not seem as feasible as the other high-fidelity concepts. It also requires each child using the device to distinguish whether they are in trouble, which is subjective and may lead to false alarms.

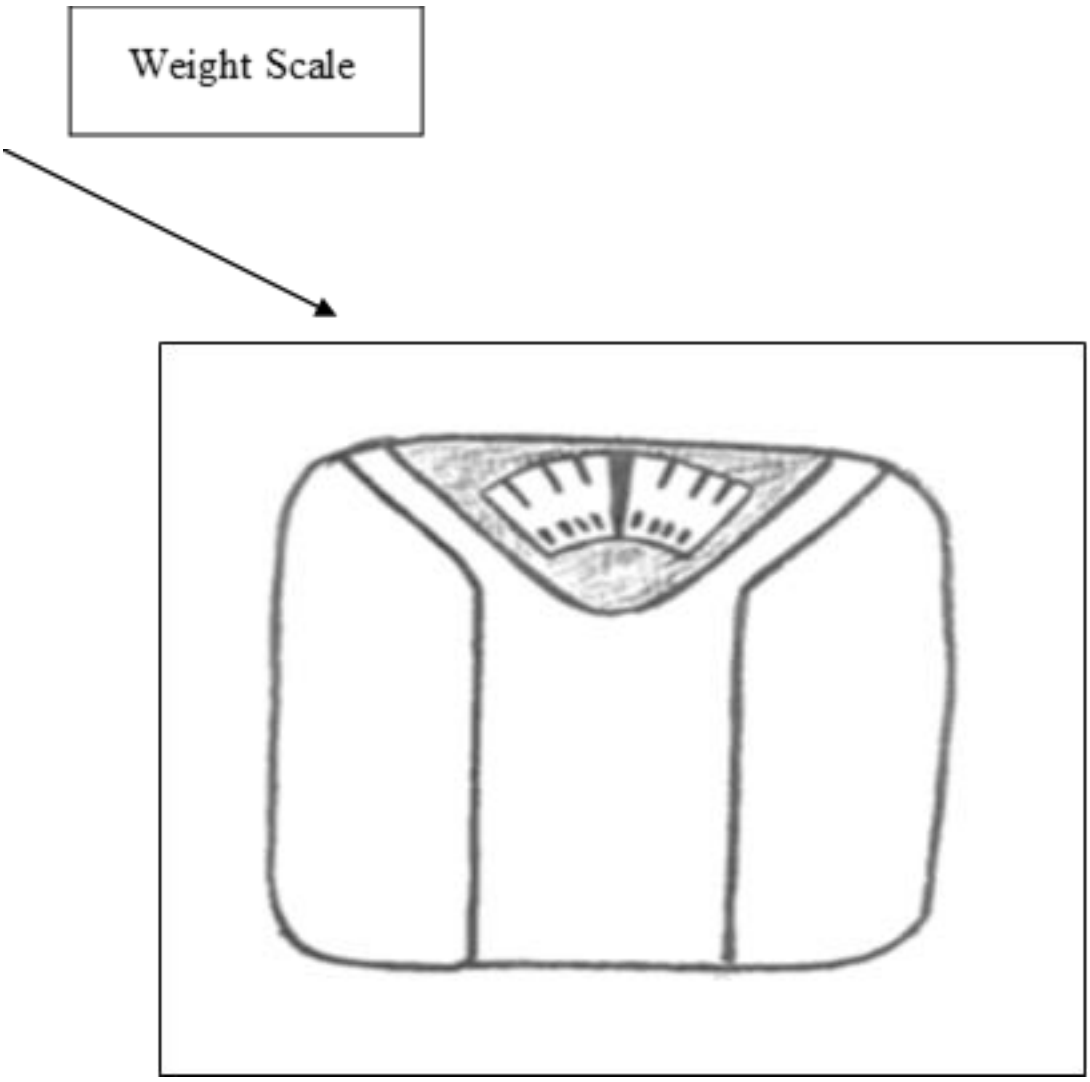


Figure 6 Device determines if it is a child or not depending on the user's weight

Concept 8: Scanner

As seen in Figure 7, this device, *The Scanner,* scans for bodily fluids in hotels. More specifically, the device will be scanning mainly for semen. If a child walks past the device while having some type of bodily fluid on any article of clothing or them themselves the device will trigger (with a black light). Once the scans are positive, it will reference the camera on the device or in the hallways to make sure the situation is not a false alarm. If it is proven that it is not a false alarm, the device will notify the front desk immediately and they will connect the call with the police. This concept is considered a medium fidelity since it does seem feasible given the resources that it requires and its ability to scan for any bodily fluid, however, the concept does not seem as feasible as the other high-fidelity concepts.

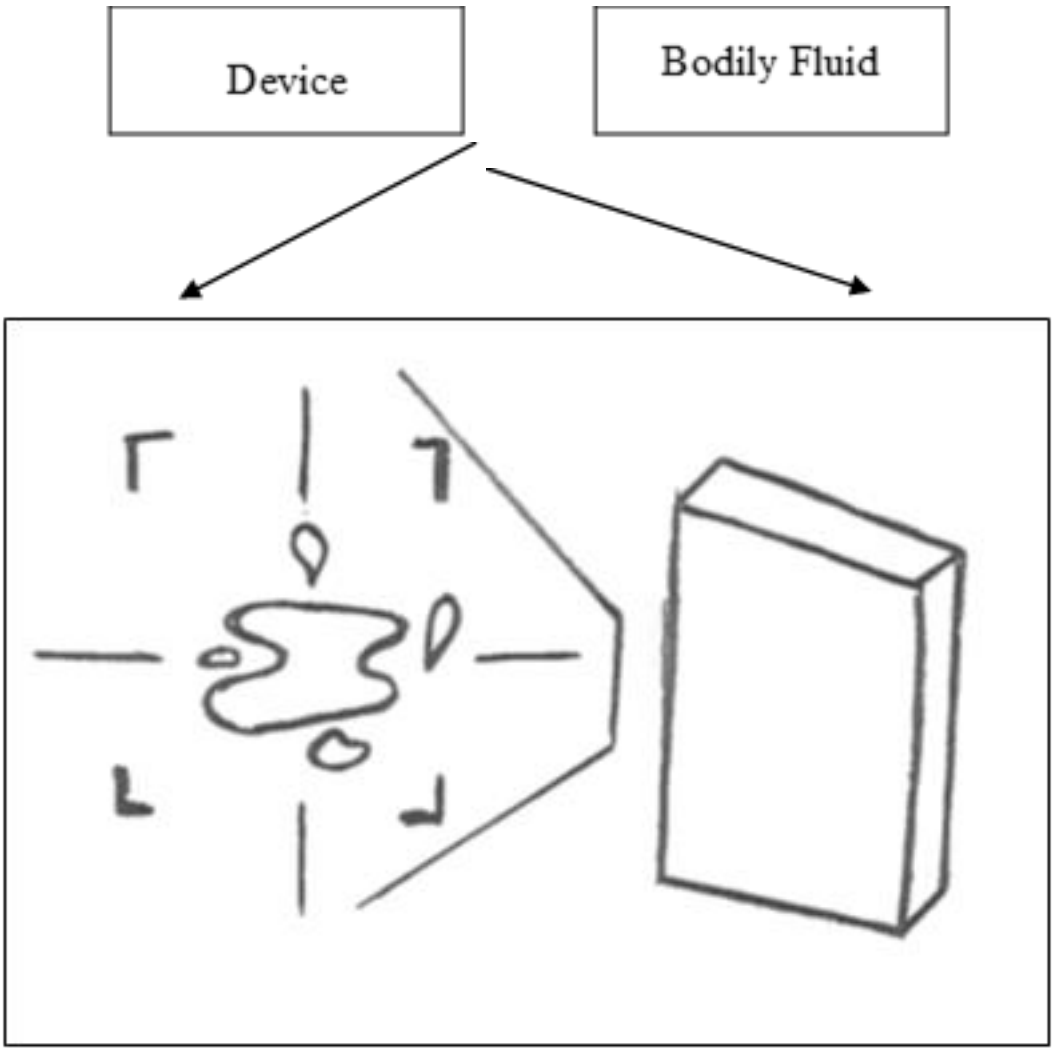


Figure 7 Device scans for any type of bodily fluid

Concept Generation Tools

Biomimicry is the idea of observing biological systems and seeing how they handle engineering problems. An example of this concept is the high-fidelity concept 2, *GPS Bur*. The *GPS Bur* concept was created by observing nature's use of burs. Certain plants use burs to transport seeds to other locations through animals and this is due to the Velcro-like property of burs. In the same way that burs are easily attached to animals, the *GPS Bur* operates in a way that easily attaches to the victim of human trafficking. This is just one example of how Biomimicry was used to generate concepts.

The Morphological Chart shown below in Table 2 is another tool used to develop concepts. This table is composed of different forms of technology under each function. Concepts are then generated by selecting one form of technology from each function and combining into one device at the end. Two examples of concepts generated are shown in Table 2 below as arrow

paths. The blue arrow, specifically, creates the concept of a vending machine that communicates to the victim with a picture, surveils the scene with audio recording, confirms the alarm with pressed buttons, alerts the authorities with a phone call, and tracks the victim with a GPS device. This is just one of many concepts that can be created with the Morphological Chart. In fact, a total of 648 concepts can be made from this specific Morphological Chart.

Table 2 *Morphological Chart*

The Battle of Perspectives is another concept generation tool that was used. This is where the engineering team met to discuss and debate potential solutions with the intention of improving the team's current solutions and create new ones. From these discussion, one concept that was generated is shown in Appendix C, concept 11. This concept is one idea of how to filter the age of the people interacting with the device based on hand size. The device will use the handprint of interactors to filter the age and if the age is within a certain range, further functions will follow.

The crap shoot tool of concept generation allows for fate to decide on a random situation that will ideally allow for inspiration. Several possible scenarios were generated using different combinations of people, material, and events. For an example, concept 23 in Appendix C used the person (a child), the material (hand stamp) and the event (Chuck E. Cheese's) in order to devise the idea that the child will be stamped with a hand stamp that can only be seen using black light in order to be tracked later on.

The forced analogy tool of concept generation offers the ability of a new perspective. A random, unrelated word is given, and ideally a concept would be inspired by said random word. Many concepts were created using this tool. For an example, concept 35 in Appendix C used the random word, "Alcoholic", to inspire the concept that the device will be able to measure the content of a user's breath (like a qalyzer). If the breathalyzer senses that the user has been drugged, the device will alert authorities.

The anti-problem tool of concept generation required us to analyze the downside of the goal that this project is attempting to accomplish. We brainstormed reasons that we should not interfere with the child trafficking industry. Many ideas were generated, such as preventing the suspicion with the child carrying a tracker or interacting with a device. From these ideas, we were able to devise several concepts. For an example, concept 9 in Appendix C confronts this problem, and provides the solution that the child will not carry a tracker if the device sprays the child with a scent that can be tracked with police dogs.