

## SmartSense Glove

Imagine taking a stroll in a garden or navigating a bustling Mumbai street without being able to see what is in front of you. For blind individuals a seemingly simple daily walk or commute can be quite arduous. Simple assistance while navigating unfamiliar environments can significantly empower blind individuals to participate more fully in education, employment, social activities, and daily life, ultimately leading to a more inclusive society.

In my endeavour to make the society more inclusive for the blind, I designed a hand glove which has inbuilt sensors that detects an obstacle in front of a person and vibrates enabling a blind person to avoid such obstacles and help them walk on the roads, parks, and other public spaces without external assistance.

Blind people are normally dependent upon someone else while walking in unknown places or they use the white cane to help them to detect objects in front of them. The white cane has been in usage since the 1930's with minimal improvement in technology. The cane has various limitations such as limited forward detection, it can detect only low-lying obstacles and focuses on paths directly ahead. Hence, I decided to make a wearable glove with sensors that would detect any object in any direction and vibrate, thus alerting the blind person.

My target customer is a blind person who is independent, typically above the age of 12 years, someone who cannot afford expensive devices, walk dogs and is not savvy to using complicated devices. I carried out primary research by directly interviewing blind people to understand their requirements and below are some of the findings which I kept in mind while designing the product. Clients wanted a product with a good grip so that the product does not slip. They wanted the product to have only 1 or 2 buttons which can be easily located. They wanted a simple product which can be used easily and a product attached to them so there is no chance of the product falling off. If the product falls, it is extremely difficult for the user to find it without assistance. One client said that once his walking stick slipped out of his hands and it took him almost 30 minutes until someone came and helped him out. They also wanted a light weight product.

After completing primary and secondary research and having made my choice of making a hand glove, I started designing the product to meet the client specifications and various factors as outlined below:

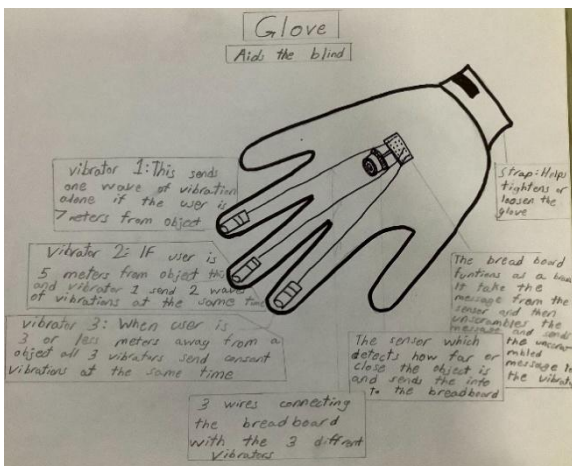
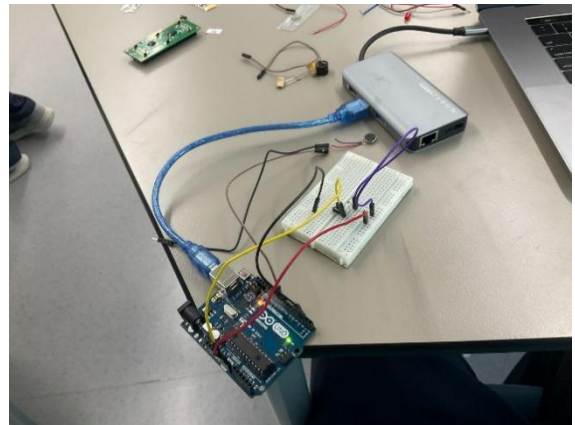
- *Material:* Following materials were used (i) leather glove with soft interior, (ii) an ultrasound sensor to be attached to the glove with hot glue and a vibrator sensor (iii) the breadboard which will be put in the glove after making a small cut, jumper wires and Arduino uno. Breadboard can be reused multiple times and it also can be recycled making it completely sustainable. The vibration motor will be small to make a light weight product. Care was taken to use materials which are not good conductors of electricity so if there is a leak in one place it stays there and does not circulate around the whole product
- *Aesthetics* (Comfortable, light weight and good grip): Waves of vibration which are to be sent should feel right without giving an eerie feeling or hurting the user. The aesthetics and design are appealing and can be worn like any other glove. It has two layers, with a battery pack hidden between them, while a small sensor along with an on/off button is visible on the top. Unlike a walking stick which some people may not prefer to carry in social events, the glove does not carry a social stigma.
- *Design* (small ultrasound sensor on top): The circuits under the ultrasound sensor are protected with a small cushion and a small vibration motor near the thumb. This product is also extremely easy to carry and cannot be dropped as this is attached to the user's body. I tried to cushion the sensitive parts such as circuits while making the product as they are the most important and delicate parts.



- *Size and weight* (size like standard average glove): In terms of weight, it is 425 grams. Reducing the weight was a challenging task because I had cut a lot of features to make the product light weight.
- *Function* (object detection): Depending on the distance in front of the sensor, it will send vibration accordingly. If an object is at a distance around 7 to 10 meters it will send one wave of vibration. For 4 to 6 meters away there will be two waves of vibration and if the object is only 1 to 3 meters away the vibration will be non-stop.

In terms of functionality, gloves are a superior product because the user can wave his hand to detect objects and obstacles in any direction, it can be removed and worn easily. Unlike canes, gloves allow hands free navigation and are portable. The user who is a blind person, simply needs to wear the glove and switch on the power source. After that the ultrasound sound sensor will automatically detect when there is an object in the way and send vibrations.

I made basic circuit using an Arduino Uno, jumper wires, an ultrasound sensor, a vibrator motor, and a breadboard. The ultrasound sensor was connected to the breadboard which was then connected to the Arduino and vibrator motor. For the coding of the circuit C++ was used on Arduino IDE where the code was written to detect the distance from the ultrasound sensor and according to the distance supply power to the vibrator motor. The vibrator motor was connected directly from the Arduino uno and tapped onto the top of the glove. All the circuitry parts were stitched inside the middle layer of the glove so they could not be seen from the outside nor cause discomfort from the inside. The whole circuit is powered by four batteries placed in a battery pack below the circuit. Four batteries ensure a long span without running out of charge ensuring the product does not go out of charge in the middle of the day.



I choose this as my design project to provide a low cost and easily accessible solution to the visually impaired, moving beyond existing expensive and complex technologies. Primary research to understand the client needs was of paramount importance while choosing the parameters to design this product. I understand that the ultrasound sensor has its own limitations in depicting the kind of objects and adding cameras with AI could provide more information. Beyond basic obstacle detection, there's potential to integrate other features like GPS for navigation or object recognition.

I believe that creating a sensor-equipped glove for the blind represents a promising avenue and ongoing research and development are needed to overcome existing limitations and unlock the full potential of such devices in empowering blind individuals to navigate the world with greater safety and independence.

