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WEARABLE ASSISTIVE JACKET FOR BLIND PEOPLE

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Abstract
The goal of this innovative technology is to give blind people more freedom and independence by allowing them to drive vehicles. The jacket's sensors and haptic feedback provide the user continuous support, boosting their self-assurance and facilitating their movement across a variety of surroundings. The haptic feedback system receives information from the jacket's sensors about potential threats and relays it to the user. Tactile signals, like as vibrations or pressure, are then sent by the haptic feedback system to the user to make them aware of and navigate around obstructions. The jacket can help you get around thanks to its obstacle recognition technology, GPS, and voice commands. The user may program their desired location into the system, and the jacket will then provide instructions through haptic feedback and voice.

Keywords: *Automotive assistive jacket, haptic feedback, vibrations, sensor and hazards.*

I. INTRODUCTION

When it comes to movement and orientation, the visually handicapped confront major difficulties on a daily basis. Because traditional mobility aids like canes and guide dogs only help so much, many people who are blind or visually impaired feel alone and reliant on others to go about. Interest in creating innovative tools to aid the visually impaired in their everyday lives has increased in recent years[1]. The automobile assistive jacket for the blind is an example of such a piece of technology; it employs sensors and haptic feedback to offer the user with real-time support and direction. This technology has the potential to greatly enhance the mobility and freedom of the visually impaired by making it easier for them to move about in unfamiliar settings. 2015 statistics estimate that 253 million individuals worldwide have some kind of vision impairment, including 39 million who are totally blind. Eighty percent of them are fifty or older, and 78 percent reside in low- or middle-income nations. In the future, someone with a severe vision impairment that limits their independence will be referred to as "blind." Nonetheless, the word employed in the literature will be utilized to denote the population(s) for whom the technology was developed and evaluated. The public's resources are geared more toward the able-bodied eye than those of the blind[2]. As a result, they face several challenges. For instance, unavailable information and settings are one way in which these obstacles hinder the trip experience. This limits blind people's access to contemporary life's educational, occupational, recreational, and spiritual opportunities. Thus, they need help from (assistive) technology or other people to overcome difficulties[3].Technology has come a long way, and there are now electronic travel aids, but the long cane and guide dog are still the most prevalent alternatives for the visually impaired. The long cane is easy to use, durable, inexpensive, dependable, and needs little upkeep. Nevertheless, it can not help with navigation or wayfinding and cannot offer information on distant or high-level obstructions. Almost 40% of blind adults surveyed had encountered head-on crashes at least once a year, and 15% had had them at least once a month [4]. The long cane serves as a visible and distinguishable sign that the user is blind, allowing them to more easily get help and ensuring that other people avoid accidentally bumping into them. Despite its widespread availability, many would-be users shy away from it out of shame [5]. While traveling on predetermined paths, guide dogs perform tasks analogous to those of a human guide. They help individuals socially by providing company and opening up opportunities for conversation. Yet, only those with a genuine interest in and aptitude for canine care should consider adopting one.

The purpose of this article is to investigate the origins, evolution, and possible effect of the automobile assistive jacket for the visually impaired.

II. WEARABLE DEVICES

All of the technologies we've spoken about thus far are easily transportable, but they aren't wearable. The convenience of hands-free operation is a major selling point for wearable electronics [6]. Those who are blind and need to utilize a cane, guide dog, or other (travel) gadget can benefit greatly from this. Research on wearable gadgets for the visually impaired is expanding, but so far only a small number of these tools have made it beyond the prototype stage.

Prototypes of wearable gadgets for the visually impaired have been created for use in a variety of contexts, not only transportation. Tools like this may help individuals feel more comfortable interacting with others, whether that's via the emulation of eye contact [7] or the recognition of social signals and gestures [8,9]. Devices for reading, music notation, dancing, running, education, color perception, drug identification, and gait enhancement are a few more examples. Tactile communication, such as Braille or a deafblind manual alphabet [10,11], has been the primary focus of device development for the deafblind, however alternative uses, such as aiding deafblind cat owners, have also been explored.Now we'll take a quick look back at the results of the three earlier polls of assistive wearables and portable aids for the visually impaired. As an example, Velázquez [12] categorizes assistive wearables as wrist and forearm devices, tongue and head devices, vests and belts, and foot supportive devices. The emphasis is on tactile displays that may be worn on various portions of the body, although there is some discussion of wearable travel aids as well.

Instead of navigational or directional assistance, Dakopoulos and Bourbakkis [13] focus on wearable gadgets that help travelers avoid potential hazards. They exhibit a variety of prototypes and projects and provide a "maturity" analysis based on 14 criteria split between "user" demands and "engineer's viewpoint." These comprises features like instantaneous reaction, dependability, cheap cost, learnability, usability, simplicity, efficiency, availability, portability, and scalability (lightweight and small size). Unfortunately, the engineering requirements, in particular, do not make sense[14]. For instance, wireless connection isn't necessary for all gadgets and might introduce security and privacy issues if it isn't properly handled. Maybe not surprisingly, no one system meets every criterion. Consumers had little faith in the systems' steadiness, durability, or efficacy. More study is necessary in this area. One possible explanation is that consumers didn't see the big picture advantages of obstacle avoidance devices compared to the long cane and hence didn't adopt them. The writers stress the significance of long-lasting gadgets above those that boast every conceivable feature.Several of the assistive devices considered by Tapu et al. [15] are portable rather than worn, and many of them (but not all) facilitate mobility. Electronic travel aids are categorized as either active (using a network of sensors) or passive (using a network of cameras), and then further subdivided into sensor types and camera types. Nevertheless, this categorization overlooks the fact that not all devices perform the same functions; in particular, there is a significant difference between systems designed for avoiding obstacles and those designed for navigating new territory. In terms of real-time application, learnability, resilience (to scene dynamics and lighting conditions), and portability, their seven assessment criteria are similar to those of [16]. Their other requirements, however, are exclusive to object detection and will not apply to any other forms of navigational assistance. They give more consideration to camera vision systems than ultrasonic (or infrared) ones. As a result, the emphasis is on equipment worn on the head (and torso) and not the feet.

So, although current surveys of blind people's travel aids are helpful, they have a number of drawbacks[17]. This involves paying primarily attention to camera vision technologies used in obstacle avoidance systems and paying less attention to other applications and technologies. One restriction is that wearability and whether or not it affects the design were not addressed.

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III. PROBLEM STATEMENT

Mobility and navigation are extremely tough for the visually impaired, among the many other difficulties they confront every day. Many people who are blind or have low vision are frustrated by the limits of conventional mobility aids like canes and guide dogs. Their autonomy, sense of self-worth, and quality of life may all suffer as a result of this dependency[18]. There is an urgent need for innovative tools that might help the visually impaired become more mobile and self-reliant. To fill this gap, designers of an automobile assistive jacket for the visually impaired included sensors and haptic feedback in their garment. The cost and availability of the technology, its efficacy in varied situations, and the need for user-friendly interfaces are just a few of the issues that have yet to be resolved. This article will investigate these difficulties and provide suggestions for overcoming them.

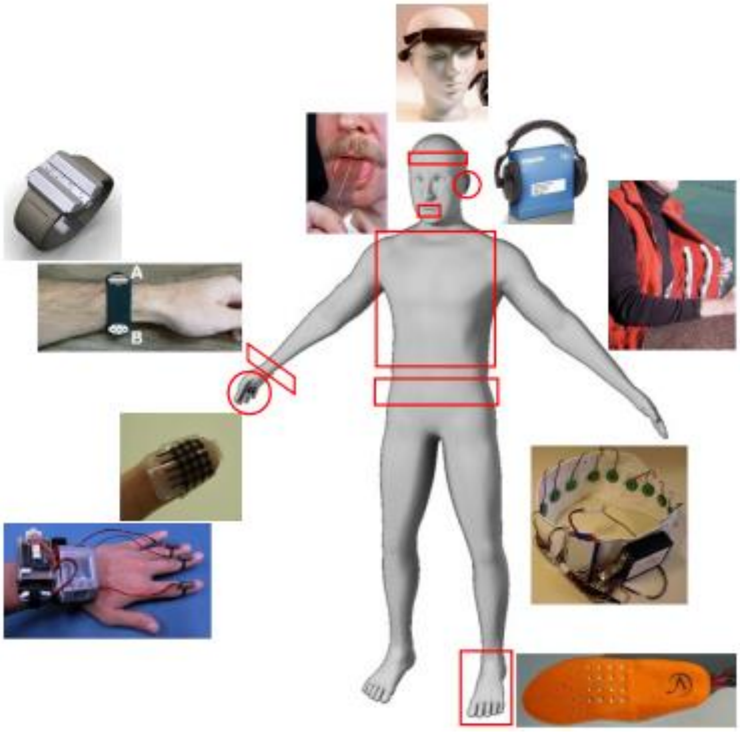

Figure.1:A survey of available wearable aids for the visually impaired.

For specialized tasks like reading or traveling, a variety of wearable assistance gadgets have been created. They can't see, so they have to find other ways to communicate, and they do it via sound and touch. In terms of both technology and placement on the body, there is a wide variety of devices available[19]. Figure 1 provides a high-level overview of the many parts of the body that have been investigated for their potential use in transmitting visual information to the visually impaired using wearable assistive devices. The purpose of this study is to evaluate a few prototypes so that their full potential may be grasped. Hearing and touch, after vision, are the next most important senses in humans. They naturally take on the roles of first and second ones for the visually impaired. Hearing environmental signals is crucial for blind persons in many ways, including but not limited to awareness, direction, movement, and safety. While crossing a street alone, for instance, they may stop and listen to their surroundings before proceeding until they have a firm grasp on the sequence of lights. The human ear is the organ responsible for sensing sound waves. It's the organ in charge of converting those vibrations into the brain-perceivable form of nerve impulses. Humans are able to analyze sounds and identify their loudness, pitch or frequency, timbre, direction, and distance from them. The human ear has a remarkable sensitivity of 0.5 to 1 Hz and can hear frequencies from 20 Hz to 20 kHz. There are two key factors that determine how well we can hear a sound: volume and frequency[20].The threshold hearing curve, which defines the minimum audible sound level as a function of frequency, is seen in Fig. 2. The average person has a hearing threshold of about 4 dB at 1 kHz, despite the fact that this frequency is often thought to be the norm. Specifically, although around 60 dB is needed to be audible at 30 Hz, only approximately 18 dB is needed to be audible at 10 kHz. The range of frequencies between 2 and 5 kHz where hearing is most acute is crucial for speech comprehension. The human hearing threshold is at 4 dB, whereas the pain threshold is around 120 dB, which is about the level a jet engine can generate. Exposure studies have shown that noises as low as 90 dB may harm ears for 8 hours, 110 dB for 1 minute, and 140 dB for any length of time. Deterioration and overload of the ear are also connected issues. Listening to music, speaking, or any other auditory activity for 20-30 minutes has been found in recent research to negatively impact posture, balance, and the accuracy with which sensors register information. Assistive gadgets that rely on the sense of hearing as a substitute must be developed with all of these considerations in mind.

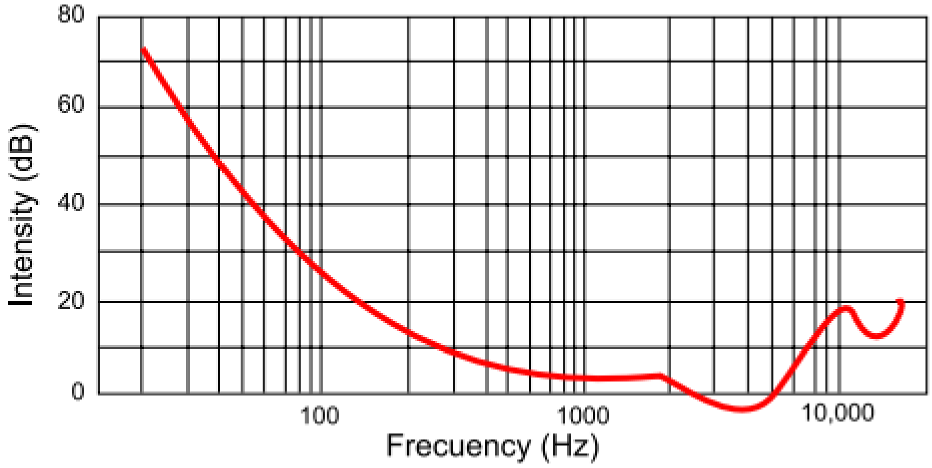

Figure.2: Hearing threshold: Minimum sound intensity thresholds as a function of frequency

Touch is utilized as either a complementary modality to supplement visual and auditory information or as an independent modality to communicate information in the case of healthy-sighted individuals. When it comes to non-auditory physical information, the blind rely heavily on touch as their main input. Those who are visually impaired have a remarkable capacity for tactile discrimination of three-dimensional things. They have the ability to use touch to navigate familiar spaces and determine their location. Readers of Braille do so by physically touching the text. The skin houses the biological receptors necessary for touch. Thermoreceptors, which detect heat, Nociceptors, which detect pain, and Mechanoreceptors, which detect mechanical stimuli and skin deformation, make up the three primary types of sensors that make up the skin's innate sensory apparatus. Because of their role in relaying information about mechanical changes caused by external forces to the nervous system, mechanoreceptors are of particular interest to us. Pacini corpuscles, Ruffini endings, Merkel cells, and Meissner corpuscles are the four types of mechanoreceptors present in human glabrous skin. According to [6], Merkel cells detect pressure, whereas Meissner corpuscles detect touch, Pacini corpuscles detect vibration, Ruffini endings detect lateral skin extension and articular movement. As Meissner and Pacini skin mechanoreceptors play a role in hand sensation during object exploration, they are of particular interest to us.

IV. METHODOLOGY

The Arduino platform is an open-source hardware and software environment for creating and implementing practical projects. This microcontroller device is useful for monitoring and manipulating items in real-world settings. A transmitter, a receiver, and a transceiver make up the ultrasonic sensor. The transmitter transforms electrical impulses into audible vibrations. The receiver then translates the electrical impulses back into sound waves. The transceiver is responsible for both transmission and receiving. Crystal oscillators are included as well. An audible signaling device, a beeper or buzzer, may be either electromechanical, piezoelectric, or mechanical. The primary goal here is to make a noise signal out of an audio stream. Little coreless DC motors may be used to generate vibrations that alert users to a signal without creating any audible noise. The Global System for Mobile Communications (GSM) module is a hardware component that establishes a wireless data connection to a network.

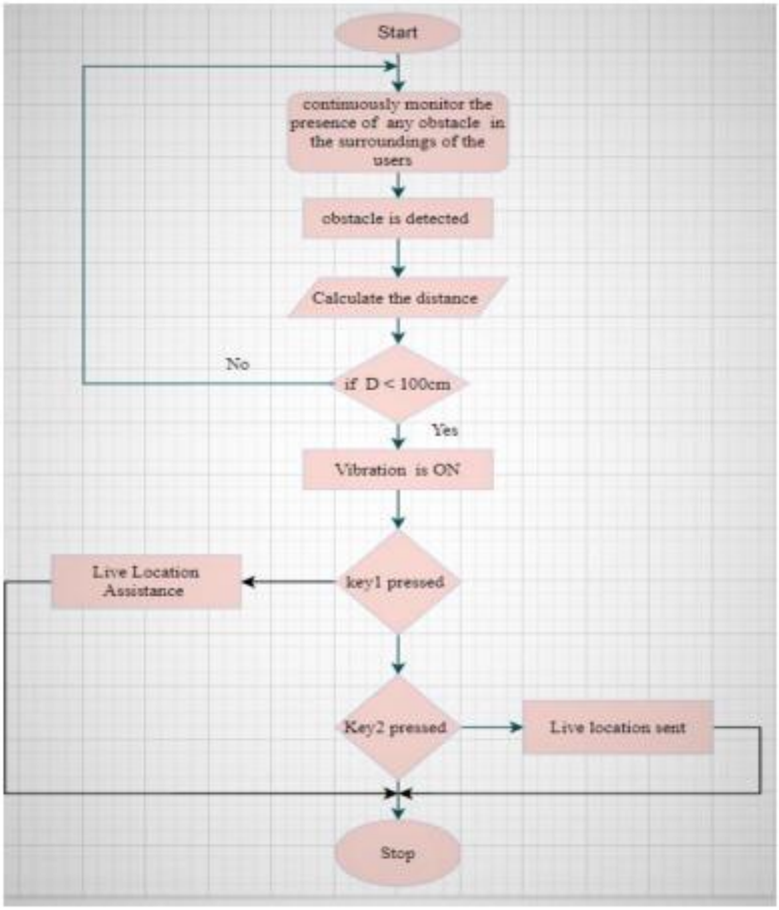

Figure.3: Flow chart

V. BLOCK DIAGRAM

Visual stimuli have a disproportionate impact on our worldview compared to other sensory inputs. With the help of our other senses, especially our hearing, we are able to build a holistic understanding of the environment and respond accordingly. Access to information, movement, navigating unfamiliar environments, and communicating with others are all made more difficult for those who are blind due to their inability to see. In reality, there is a significant analphabet and joblessness problem among blind people of school and working age. In the United States, for instance, there is a staggering 75% unemployment rate for blind people, while just 10% of blind children obtain Braille education. Although some do make accommodations for the visually impaired, the vast majority still do not. So, the blind individual and his or her family confront significant social and economic restraints. When considering health care and welfare, the question of the blind becomes critical. The state must cover the high costs of in-home care, nursing home care, unemployment insurance, and medical services. One method the government has helped people who are blind or have low vision lead more self-sufficient lives is by providing them with training in adaptive skills. Special education teachers, Braille instructors, psychiatrists, orienteers, mobility experts, low-vision experts, and vision rehabilitation therapists are just a few of the many professionals that contribute to this field. Clearly, the state will be responsible for the astronomical costs associated with this. In addition, there is not enough money or trained people to meet the needs of the current population. There must be other ways to help this group of people.

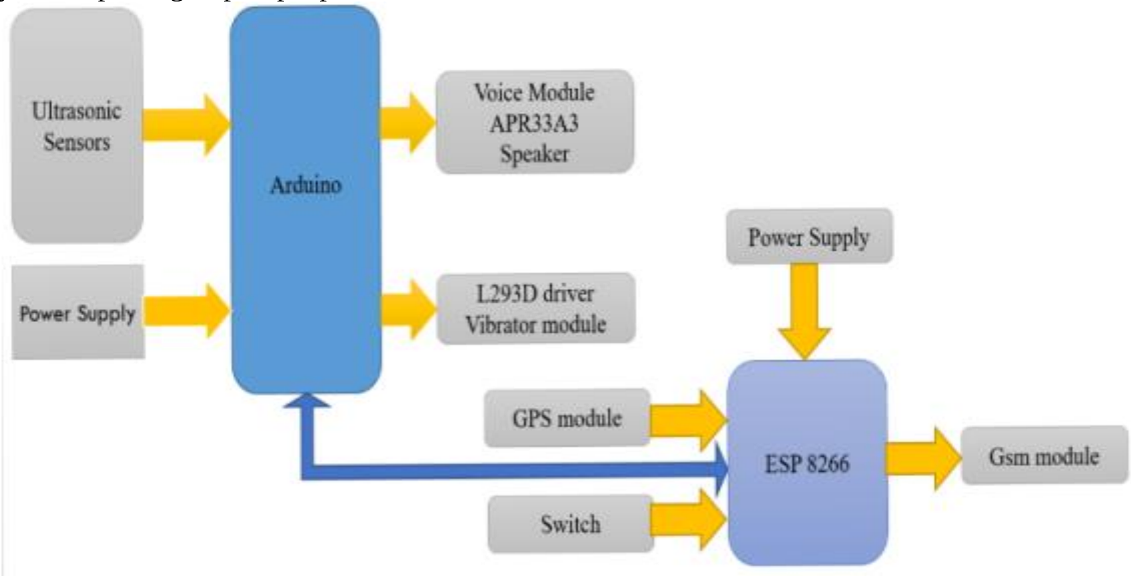

Figure.4 : Block diagram of Assistive jacket for blind people

When compared to portable devices, wearable ones are distinguished by their ability to facilitate hands-free interaction, or at least interaction in which the use of the hands is minimized. This is accomplished through the use of body-worn devices such as a head-mounted device, wristband, vest, belt, shoe, etc. Compact, light, and easy to carry (but not wear), portable gadgets demand continual hand involvement. Examples include electronic canes, cell phones, laptop computers, and tactile displays. Research into wearable technologies for the benefit of persons with impairments, such as the blind, is now a "hot" issue. As this is such a new and developing field, there aren't yet many well-established commercial items with a sizable audience.

VI. MATERIALS

A. Arduino uno

The Arduino Uno is an open-source microcontroller board created by Arduino.cc that utilizes the Microchip ATmega328P microprocessor. Both digital and analog I/O pins are included on the board.

B. ultrasonic sensor

It's a piece of electronic equipment that emits ultrasonic sound waves, and uses the reflected sound to calculate the distance to an object. Ultrasonic waves can go far further than regular sound waves can (i.e. the sound that humans can hear). There are two primary parts to an ultrasonic sensor: the transmitter (which uses piezoelectric crystals to generate the sound) and the receiver (which encounters the sound after it has travelled to and from the target).

C. Vibration motor

An electric motor specifically built to generate a mechanical vibration or shaking action is called a vibration motor. The rotor spins while being propelled by a magnetic field created by coils housed in the stator, which is often attached to an eccentric weight. Several portable gadgets rely on vibration motors to provide haptic feedback, such as mobile phones, gaming controllers, pagers, and more. Conveyor belts, feeders, and screens all employ them to assist transport or classify goods in industrial settings.

D. Electronic voice module

An electronic voice module, also called a voice synthesizer or electronic voice recorder, is a device capable of storing and playing back recorded audio messages. Toys, greeting cards, and security systems are just some of the many products that make use of these modules.

VII. RESULTS AND DISCUSSION

New devices and systems that can be sewn into clothing have been developed thanks to the miniaturization of actuators and electronics. These wearable systems allow the user to go about their day-to-day activities unencumbered by cumbersome technology. In this chapter we have focused on assistive technology for the visually impaired that can be worn. To showcase the breadth and depth of the research in this field, we present a brief, non-exhaustive survey of wearable assistive devices for this population. There have been numerous proposals over the past few decades for wearable solutions to the issues of reading and mobility, including devices that could be worn on the finger, hand, wrist, forearm, tongue, head, chest, abdomen, and feet. Those who are visually impaired rely mostly on their other senses, especially hearing and touch. Even though they can't see, they can still learn a lot about their surroundings to help them with their daily lives. Because of this, assistive technology includes auditory and tactile feedback to serve as a substitute for visual data. On the other hand, our senses of smell and taste are rarely recognized for the central role they play in our ability to engage with our surroundings. Many ideas for accessible, universally designed hearing and touch aids have been introduced. They outline methods for enhancing a person's sense of hearing and touch for optimal functioning.

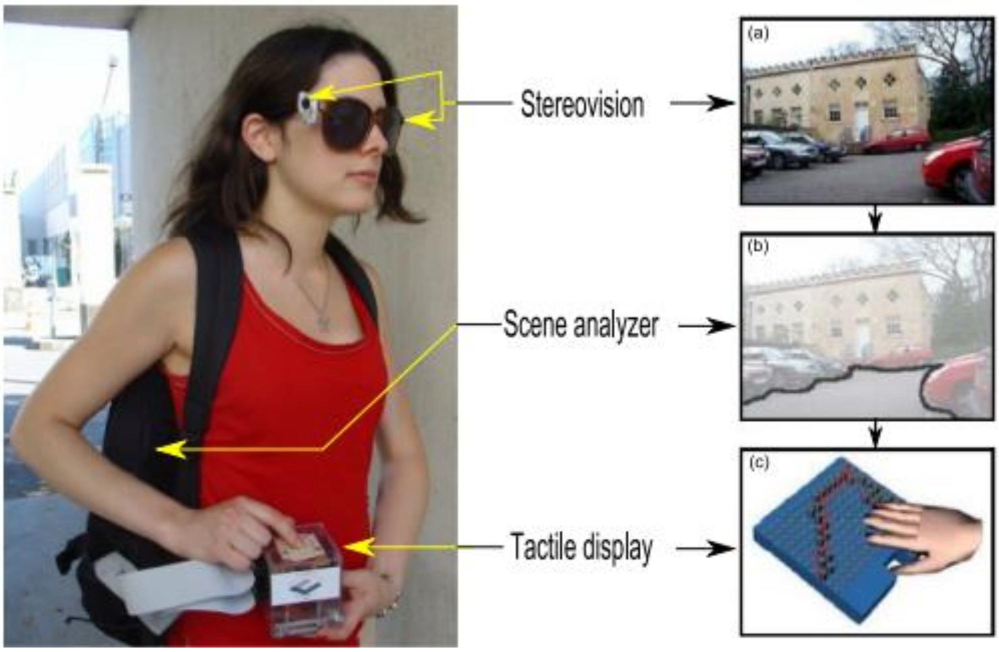

Figure.5: Examples of the IG wearable system's image-to-tactile rendering and the IG system itself

There are three key components that make up the IG system, and they are the vision module, the scene analyzer, and the tactile display. In Fig. 5, we can see the IG's first wearable prototype in action. (a) Two stereo cameras attached to the glasses' frames take pictures of their surroundings. The user's location in relation to the scene's barriers is then determined using vision algorithms. (c) Then, the user may quickly explore this data through a tactile display. The resultant tactile map consists of basic edges that indicate where the barriers are. Tactile domain data displays all potential obstructions as presence/absence binary data.

VIII. CONCLUSION

The automobile assistive jacket for the blind is a promising technological advancement that has the potential to greatly enhance the mobility and freedom of those who are blind or have low vision. The jacket's sensors and haptic feedback provide the user instantaneous support and direction, boosting their self-assurance as they move through unfamiliar situations. The cost and availability of the technology, its efficacy in varied situations, and the need for user-friendly interfaces are just a few of the issues that have yet to be resolved. Further study and development are required to fully realize the potential of the automobile assistive jacket for the visually impaired. This technology, if perfected, might have a profound impact on the lives of the visually handicapped, enhancing their levels of autonomy, confidence, and happiness.

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