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ORIGINAL

Leveraging Internet of Things (IoT) to Enhance Accessibility and Independence for People with Disabilities

Aprovechar el Internet de las cosas (IoT) para mejorar la accesibilidad y la independencia de las personas con discapacidad

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ABSTRACT

Any physical or mental ailment (impairment) that makes it harder for the affected individual to engage in particular activities (activity limitation) or engage with their environment (participation restrictions) is considered a disability. According to the 2011 Census, 2,68 Cr people (2,21 % of India's 121 crore total population) are classified as "Disabled." One way to combat disability is to develop intelligent prosthesis and assistive technology. The usability and functionality of these devices are improved by real-time monitoring, feedback, and control made possible by advanced sensors and networking. We have attempted to use some of the Internet of Technologies' (IOT) solutions to address the limits in this research. People with disabilities could live far better lives because to the Internet of Things (IoT), which offers creative solutions to a range of problems they could encounter. IoT integration offers a revolutionary chance to address disability and create a more inclusive society in many areas of life. IoT is transforming how we meet the requirements of people with disabilities, from smart assistive devices and home automation to health monitoring, communication aids, and accessible transportation. In this research paper, we have proposed some IoT based models to tackle few constraints of disabled people which can help the disabled people with their day-to- day problems.

Keywords: Internet of Things (IoT); Disability; Arduino; Sensor (IR Sensor, Ultrasonic Sensor); Buzzer; LED (Light Emitting Diode); Disabled Person; Assistive Technology.

RESUMEN

Cualquier dolencia física o mental (deficiencia) que dificulte al individuo afectado la realización de determinadas actividades (limitación de la actividad) o la participación en su entorno (restricciones de la participación) se considera una discapacidad. Según el Censo de 2011, 2,68 Cr personas (2,21 % de la población total de 121 crore de la India) se clasifican como «Discapacitados.» Una forma de combatir la discapacidad es desarrollar prótesis inteligentes y tecnología de asistencia. La usabilidad y funcionalidad de estos dispositivos mejoran gracias a la monitorización, retroalimentación y control en tiempo real que hacen posibles los sensores avanzados y las redes. En esta investigación hemos intentado utilizar algunas de las soluciones del Internet de las Tecnologías (IoT) para abordar los límites. Las personas con discapacidad podrían vivir mucho mejor gracias al Internet de las Cosas (IoT), que ofrece soluciones creativas a una serie de problemas con los que podrían encontrarse. La integración de IoT ofrece una oportunidad revolucionaria para abordar la discapacidad y crear una sociedad más integradora en muchos ámbitos de la vida. La IO está transformando la forma en que satisfacemos las necesidades de las personas con discapacidad, desde los dispositivos de asistencia inteligentes y la domótica hasta la vigilancia de la salud, las ayudas a la comunicación y el transporte accesible. En este trabajo de investigación, hemos propuesto algunos modelos

basados en IoT para hacer frente a algunas limitaciones de las personas con discapacidad que pueden ayudar a las personas con discapacidad con sus problemas del día a día.

Palabras clave: Internet de las Cosas (IoT); Discapacidad; Arduino; Sensor (Sensor IR, Sensor ultrasónico); Zumbador; LED (Diodo Emisor de Luz); Persona con Discapacidad; Tecnología de Asistencia.

INTRODUCTION

A physical disability is any impairment to an individual's ability to move, function, dexterity, or endurance. Different people have different types of diseases or limitations. The majority of disabled people are dependent on their parents or guardians as a result of these kinds of disability. Concerned about how to keep their impaired relatives safe, parents and guardians worry for their relatives. The networking of physical items with electronics integrated into their architecture to perceive and communicate with one another and the outside world is known as the Internet of Things (IoT).[1,2,3] With the help of various features that will aid disabled people in their daily functioning and prevent them from heavily depending on others for work, we hope to develop applications and prototypes that will be friendly to people with disabilities and enable them to contribute to society.

Objective

In this research we will capture the following objectives:

- Find/propose different assistive technologies to make the day-to-day working of a disabled person easier, making their lives comfortable.
- To provide easy accessibility so that it could provide equal opportunities regardless of their disabilities.

The ultimate goal is to bring about constructive, long-lasting reforms that improve the possibilities, inclusion, and quality of life for people with disabilities. The goal of the study project is to make society more accessible and equitable.

Hypothesis

The purpose of this study is to test the following hypothesis:
Disability: blind person.
Problem identified: it is challenging for blind people to navigate both familiar and foreign terrain.
Solution: making a glove with ultrasonic sensor which can detect the obstacles within specified distance.
Disability: person with hearing Impairment.
Problem identified: total or partial inability to hear sound.
Solution: creating a system so that when a bell is pressed the light bulb inside the house will blink.
Disability: bed Ridden Person.
Problem identified: bed ridden person who can't speak but only move their hands.
Solution: creating a machine so that when a bedridden person requests something, a buzzer will begin to beep and a LED will blink.

In essence, we are researching various challenges pertaining to people with disabilities and using IOT technologies to find better solutions.

What is Disability?

A physical, sensory, cognitive, or developmental problem that significantly limits a person's capacity to carry out everyday tasks, engage with their surroundings, or fully engage in society is referred to as a handicap.[4] People who are disabled face a variety of challenges in various areas of life, which might vary depending on the type and severity of the condition. It is noteworthy that the notion of disability is changing, underscoring the significance of fostering an inclusive society that celebrates diversity in skills.[5] There are a number of reasons why addressing the difficulties encountered by those with disabilities is crucial, all of which centre on the ideas of social justice, equality, and inclusivity. In order to ensure that every member of society has equal opportunities, accessibility, and participation, it is imperative to recognise that a handicapped person is an individual with a disability.[6] It's critical to develop a compassionate and understanding mentality that prioritises abilities over limitations in order to foster an atmosphere that is more welcoming and supportive of individuals with disabilities.

Internet of Things (IoT)

The term "Internet of Things" (IoT) describes a network of physically connected items, including buildings, cars, and other vehicles, that are implanted with network connectivity, software, and sensors to enable

data collection and exchange.[7,8] An intelligent and automated workplace is made possible by this enormous and complex network of gadgets, which facilitates smooth communication and teamwork. Effective data monitoring, analysis, and control are made possible by the IoT's integration into many facets of daily life and industry. Devices can collect data in real time, keep an eye on their surroundings, and react to changes on their own by using sensors. These connected devices generate data that can be used to improve productivity, streamline decision- making, optimize resource usage, and foster the creation of novel applications in a variety of industries, including smart cities, healthcare, agriculture, and transportation.[9] As IoT continues to evolve, it holds the potential to revolutionize how we interact with the world, fostering a more interconnected and intelligent future.

How Internet of things help in tackling the constraints of disability?

For people living with disabilities, daily activities that others may take for granted can be laden with obstacles. Mobility, communication, and access to information are just a few examples of areas where traditional solutions may fall short. Enter IoT, which holds the promise of introducing innovative, assistive technologies designed to enhance accessibility, independence, and overall quality of life for individuals with disabilities. In the rapidly evolving landscape of technology, the Internet of Things (IoT) stands out as a transformative force with the potential to revolutionize various aspects of our daily lives.[10,11] At its core, IoT refers to the interconnected network of devices, sensors, and systems that communicate and share data seamlessly over the internet. This interconnectedness opens up a realm of possibilities for creating smart and adaptive solutions, particularly in addressing the unique challenges faced by individuals with disabilities.[12] In essence, the integration of IoT into the realm of disability support represents a paradigm shift towards a more inclusive and accessible future. By harnessing the power of interconnected technologies, we have the opportunity not only to address the challenges faced by individuals with disabilities but also to empower them with tools that enhance their independence, autonomy, and overall well-being.[13] As we delve deeper into the possibilities of IoT, the journey towards a more inclusive and supportive society takes a bold and transformative step forward.

Proposed Model

Our concept aims to improve the quality of life, independence, and accessibility for those with various disabilities. Our model's primary goal is to slightly ease the lives of bedridden, blind, and deaf people. We included a variety of features, such as obstacle cues for the blind, communication aids for the deaf, and a method to communicate the demands of bedridden people, to help with these varied needs.

Smart Gloves

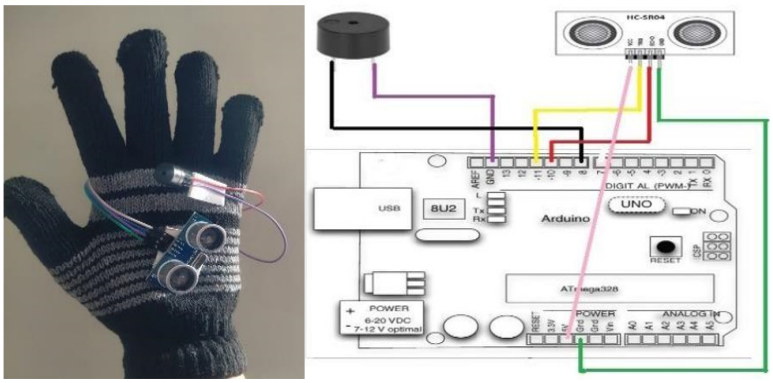

Figure 1. Smart Gloves

A technical innovation created specially to solve the particular difficulties experienced by those who are blind or visually impaired are smart gloves for the blind. The sophisticated sensors and feedback mechanisms incorporated into these gloves enable the wearer to get real-time environmental information. The buzzer or other tactile feedback is used by the sensors built into the gloves to communicate messages to the wearer when they identify obstacles or items in their surroundings. Because they can now perceive their environment through touch, blind people are able to move about more skillfully.[14] By giving wearers essential spatial awareness and environmental information, smart gloves for the blind can increase their independence and safety. The smart gloves' basic idea is fairly straightforward. It might be difficult for a blind person to get by on their own when they are out in public. They can be somewhat independent if they wear smart gloves. Smart gloves are able to detect objects within a specific range or distance. The buzzer on the smart gloves begins to beep at a frequency determined by the distance when it detects any obstructions. This notifies the blind individual of the impending obstacles.

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Accessibility Guidelines

- Adjust sensitivity levels and feedback preferences based on personal comfort and needs.
- Practice using the smart gloves in various environments and scenarios to build confidence.
- Use the device consistently to maintain familiarity with its functions.
- Learn to interpret the feedback signals accurately, including the meaning of different beep patterns or vibrations.
- Understand the relationship between feedback intensity and the proximity of obstacles.
- Regularly check the condition of the gloves, including sensors, buttons, and battery status.
- Follow the guidelines for cleaning and maintaining the device.
- Continue to use other safety precautions, such as listening for ambient sounds and being aware of your surroundings.

Future Scope

- There is a possibility of incorporating artificial intelligence (AI) and machine learning algorithms to enhance obstacle recognition and improve the system's ability to adapt to various environments.
- Develop more advanced object recognition capabilities to not only detect obstacles but also provide detailed descriptions of objects in the environment using natural language processing.
- Enhancing connectivity with the Internet of Things (IoT) to gather real-time data about the environment, traffic conditions, and other relevant information that can assist in navigation.
- Implement advancements in battery technology to extend the device's battery life and reduce the need for frequent recharging or changing.

Call bell driven LED System

A customized gadget made to offer a visual alert when a call bell is pressed is an Arduino- powered call bell driven LED system for the deaf. An Arduino microcontroller, a call bell switch, and LEDs are used in the system. With an internal pull-up resistor installed, the call bell switch is linked to one of the digital input pins on the Arduino. An LED indication is turned on by the Arduino when the bell switch, which indicates a request for help, is pressed and the corresponding pin goes LOW. This LED alerts the deaf person by producing a bright, visible signal. It functions as a visual cue. The LED is illuminated for a predetermined amount of time to improve usability and provide the user enough time to notice the alarm. For those who have trouble hearing, this solution provides an efficient way to communicate. It guarantees that they may get messages quickly and consistently in situations when there may not be enough auditory indications. Imagine that a deaf person is home alone when someone enters. When someone is outside their door pressing the call ball and requesting that they open it, how will the deaf person know? You'll find our Call Bell Driven LED System useful. An LED will blink to alert the deaf person when someone is pushing the bell outside the door, in place of the conventional bell.

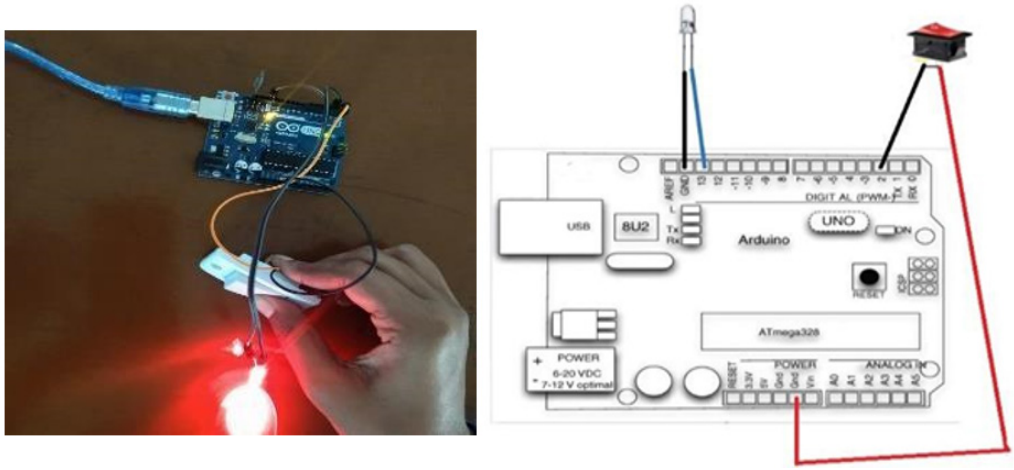

Figure 2. Call bell driven LED System

Accessibility Guidelines

- Adjust the brightness, colors, or patterns to suit personal preferences and visibility needs.
- Familiarize yourself with the different blinking patterns used by the LED indicator to understand the nature of the alert.
- If you encounter any issues with the system, such as a malfunctioning LED or connectivity problems, report them to the manufacturer or customer support promptly.
- Familiarize yourself with relevant accessibility standards to understand your rights as a consumer and to ensure that the system meets or exceeds these standards.

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Future Scope

- Attaching the device with a mobile phone for alert messages so that the user gets instant notification.
- Integrating advanced object recognition technologies to not only detect the presence of someone at the door but also identify specific individuals or objects. This could be particularly useful for security and personalization.

Arduino Controlled Basic Needs Indication Chart

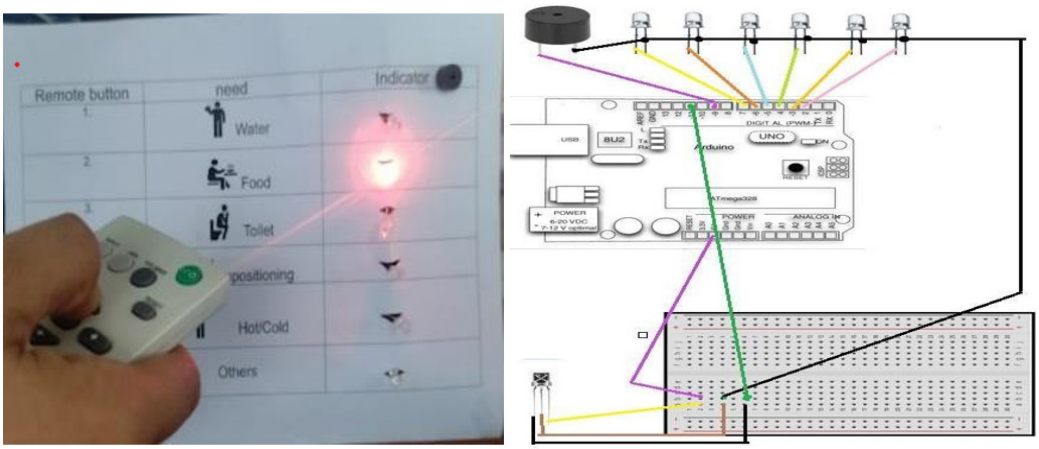

Figure 3. Arduino-controlled basic necessity indication chart

A specially created device called an Arduino-controlled basic necessity indication chart is intended to help those who are bedridden communicate and take care of their fundamental needs. An Arduino microcontroller, sensors, and a visual display chart are all included in this system. Different sensors, including motion or remote sensors, are positioned in strategic ways to keep an eye on particular elements of the person's health, like movement or help requests. The Arduino analyses the incoming data and turns on the appropriate signs on a visual display chart when a requirement is identified. This chart functions as an easy-to-use interface to provide information regarding basic needs including hydration, bathroom assistance, and repositioning. It is outfitted with LEDs and buzzers. Because each indicator light reflects a distinct need, family members or carers may quickly determine and meet the individual's needs. By graphically illustrating their everyday fundamental needs, this creative method improves communication for bedridden patients and promotes a more responsive and supportive care environment. This Arduino-controlled basic necessity indication chart will be useful when a bedridden person needs assistance and is unable to communicate verbally. To change the carer, all the bedridden person needs to do is press the designated button on the TV remote or any other remote. A buzzer will then begin to beep. A led will also blink on the chart in addition to the buzzer, better illustrating the bedridden person's true needs.

Accessibility Guidelines

- Take the time to familiarize yourself with the alert system, including the single-button remote and any additional features.
- Ensure the remote is within easy reach, either by using a holder or attachment on the bed frame or bedside table.
- User should practice pressing the button with finger to build muscle memory. Adjust the angle or position of user hand to find the most comfortable and effective way to press the button.
- The attendee should understand the visual feedback provided by the LED indicator on the remote. Ensure you recognize the blinking pattern or colour associated with the alert being sent.
- Keep an eye on the battery status indicator on the remote to ensure it is charged. Charge the remote regularly to prevent any disruptions in functionality.

Future scope

- Many other basic daily life necessities can be added which will be very helpful for the caretaker of the person.
- We can integrate the biometric sensors to detect vital signs or health indicators, providing an added layer of functionality for monitoring the well-being of the bedridden individual.
- We can integrate the system with the mobile phone of the caretaker and the family member so that they can an instant notification of what the person need.

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- We can implement artificial intelligence algorithms to analyse patterns and optimize the alert system's response based on the individual's behaviour, preferences, and potential emergency situations.

An IoT-based RFID Locking system for disabled washrooms

The IoT-based RFID locking mechanism for a disabled bathroom integrates Radio- Frequency Identification (RFID) technology to enhance security and accessibility. Users, particularly disabled individuals, are equipped with RFID tags or cards containing unique identification information. RFID readers installed on the bathroom door authenticate these tags, and the system's IoT connectivity enables remote monitoring and control. When a user approaches the door, the RFID reader verifies their tag, triggering the locking mechanism to unlock the bathroom door. Additional accessibility features, such as voice commands or mobile apps, can be incorporated to cater to diverse needs. The system ensures continuous operation with considerations for power sources like batteries or self-powered options. Facility managers can remotely monitor bathroom usage, promoting both security and efficient management. An emergency override mechanism is implemented for system failures or emergency situations, and a user management interface allows easy administration of RFID tag information, facilitating straightforward user access management. This innovative solution combines technology and accessibility to create a secure and user- friendly environment for disabled individuals accessing bathrooms.

CONCLUSIONS

In conclusion, this research project has undertaken a multifaceted exploration of the constraints faced by physically disabled individuals, aiming to contribute meaningful insights and practical solutions to enhance their overall quality of life. Through a comprehensive examination of physical, social, and technological dimensions, the project has highlighted the diverse challenges that individuals with physical disabilities encounter on a daily basis. By adopting an inclusive approach that recognizes the unique needs of various disabilities, the research has sought to transcend conventional perspectives, fostering a deeper understanding of the barriers that impede full participation in society.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AUTHORSHIP CONTRIBUTION

Conceptualization: Ansu A.
Investigation: Ansu A.
Methodology: Ansu A.
Writing - original draft: Ansu A.
Writing - review and editing: Ansu A.