SMART WALKING STICK FOR BLIND

A Project Report

Submitted to the APJ Abdul Kalam Technological University

in partial fulfillment of requirements for the award of degree

Bachelor of Technology

in

Electronics and Communication Engineering

by

MINTA MERIN JACOB(KTE20EC037)

AMAN AKTHAR P A(KTE20EC041)

SUSAN MARY(KTE20EC052)

TONY S THOMAS(KTE20EC054)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

RAJIV GANDHI INSTITUTE OF TECHNOLOGY

KERALA

May 2024

DEPT. OF ELECTRONICS & COMMUNICATION ENGINEERING

RAJIV GANDHI INSTITUTE OF TECHNOLOGY KOTTAYAM

2023 - 24

CERTIFICATE

This is to certify that the report entitled **SMART WALKING STICK FOR BLIND** submitted by **MINTA MERIN JACOB** (KTE20EC037), **AMAN AKTHAR P A** (KTE20EC041), **SUSAN MARY** (KTE20EC052) & **TONY S THOMAS** (KTE20EC054) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Electronics and Communication Engineering is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Prof. Nelsa Sebastian
(Project Guide)
Assistant Professor
Dept.of ECE
Rajiv Gandhi Institue of Technology
Kottayam

Dr. Anil kumar C D
(Head of the department)
Professor
Dept.of ECE
Rajiv Gandhi Institue of Technology
Kottayam

Prof. David Solomon George
(Project Coordinator)
Professor
Dept.of ECE
Rajiv Gandhi Institue of Technology
Kottayam

Prof. Sujithamol S
(Project Coordinator)
Associate Professor
Dept.of ECE
Rajiv Gandhi Institue of Technology
Kottayam

DECLARATION

We hereby declare that the project report **SMART WALKING STICK FOR BLIND** , submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by us under supervision of Prof. Nelsa Sebastian

This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

MINTA MERIN JACOB
AMAN AKTHAR P A
SUSAN MARY
TONY S THOMAS

KOTTAYAM
03-05-2024

Abstract

The Smart Walking Stick marks a pioneering leap in assistive technology for the visually impaired. Its integration of moisture sensors, ultrasonic sensors, and Raspberry Pi-powered image processing forms a comprehensive safety net. Moisture sensors adeptly detect potentially hazardous surface conditions, boosting confidence in navigating unpredictable environments. Meanwhile, ultrasonic sensors provide real-time alerts about obstacles, enabling swift responses to avoid collisions. The true innovation lies in the Raspberry Pi-powered image processing. Through sophisticated machine learning algorithms, it identifies and categorizes objects in the user's path, delivering auditory or tactile feedback. This amalgamation of cutting-edge technology not only heightens safety but also fosters independence by granting users the ability to interactively comprehend their surroundings. More than a conglomeration of tech features, this Smart Walking Stick embodies a profound commitment to enriching the lives of the visually impaired. By merging innovation with empathy, it transcends mere functionality, potentially reshaping the daily experiences of its users. It stands not just as a technical marvel but as a testament to inclusivity, promising to revolutionize accessibility and redefine autonomy for the visually impaired.

Acknowledgement

We take this opportunity to express my deepest sense of gratitude and sincere thanks to everyone who helped us to complete this work successfully. We express our sincere thanks to Dr. Anil kumar C D, Head of Department, Electronics and Communication Engineering, RAJIV GANDHI INSTITUTE OF TECHNOLOGY for providing us with all the necessary facilities and support.

We would like to express my sincere gratitude to the Prof. Sujithamol S, Associate Professor, department of Electronics and Communication Engineering,and Dr. David Solomon George, Professor, Department of Electronics and communication engineering for the support and co-operation.

We would like to place on record my sincere gratitude to our project guide Prof. Nelsa Sebastian, Assistant Professor, Electronics and Communication Engineering for the guidance and mentorship throughout this work.

Finally I thank my family, and friends who contributed to the succesful fulfilment of this project.

MINTA MERIN JACOB
AMAN AKTHAR P A
SUSAN MARY
TONY S THOMAS

Contents

List of Figures

Chapter 1

Introduction

The Smart Walking Stick project stands as a beacon of innovation and compassion in the realm of assistive technology, aiming to significantly enhance the mobility and safety of visually impaired individuals. Through an amalgamation of cutting-edge sensors and advanced image recognition capabilities, this revolutionary device addresses a myriad of challenges encountered by the visually impaired community, empowering users to navigate their surroundings with newfound confidence and security.

At its core, the Smart Walking Stick integrates moisture sensors within its lower section, meticulously designed to detect the presence of wet or slippery surfaces in real-time. This innovative feature offers users invaluable feedback on surface conditions, particularly invaluable during inclement weather conditions such as rain. By providing instantaneous alerts, individuals can traverse potentially hazardous environments with heightened assurance and safety.

Moreover, the inclusion of ultrasonic sensors further fortifies the walking stick's functionality, facilitating seamless obstacle detection and navigation. Through auditory or haptic feedback mechanisms, users receive immediate alerts regarding objects obstructing their path, enabling swift course corrections and collision avoidance even in the most complex of environments.

Elevating its capabilities to unprecedented heights, the Smart Walking Stick harnesses the power of a Raspberry Pi-powered system equipped with a sophisticated camera module for image processing. Leveraging state-of-the-art machine learning algorithms and pretrained models, the device adeptly identifies and classifies objects within the user's field of view. This groundbreaking feature delivers spoken or tactile feedback, augmenting the user's situational awareness and fostering informed decision-making.

Beyond its technological prowess, the project underscores a profound commitment to enhancing the quality of life for visually impaired individuals. By offering a holistic solution that champions independence, safety, and accessibility, the Smart Walking Stick heralds a new era in assistive technology. With its potential to revolutionize daily life for those with visual impairments, this remarkable innovation represents a monumental leap forward in the quest for inclusivity and empowerment.

Chapter 2

Literature Review

1. M. A. Ikbal, F. Rahman and M. H. Kabir, ”Microcontroller Based Smart Walking Stick for Visually Impaired People,” 2018 4th International Conference on Electrical Engineering and Information & Communication Technology (iCEEiCT), Dhaka, Bangladesh, 2018, pp. 255-259, doi: 10.1109/CEEICT.2018.8628048.

   To assist the blind people a smart walking stick is designed in such a way that the stick operates just like a radar system. The main objective of this work is to produce a complete prototype that can help the visually impaired person by detecting an object or obstacle(s) in front of them. In this system, the ultrasonic sensor and infrared sensor are used to sense the obstacle(s). If any obstacle in front of the sensor, the sensor detects the obstacle and receive the signal which then send to the microcontroller to operate buzzer and vibrator. An electronic circuit is used for controlling water sensor. This circuit alarms the user by giving a sound through the buzzer when it contacts with water. Another sensor, the temperature sensor is additionally included in this work.

2. K. Jivrajani et al., ”A IoT-Based Smart Stick for Visually Impaired Person,” in IEEE Transactions on Instrumentation and Measurement, vol. 72, pp. 1-11, 2023, Art no. 2501311, doi: 10.1109/TIM.2022.3227988.

   The proposed project is an A IoT-based smart stick designed to assist visually impaired individuals with daily activities. It includes advanced features such as real-time health and location tracking, object and currency recognition, and integration with Android applications for remote monitoring. The device is cost-effective and easy to use, with an obstacle detection accuracy of 91.7individuals by providing greater independence and safety in daily activities.

3. C.S. Kher, Y.A. Dabhade, S.K Kadam., S.D. Dhamdhere and A.V. Deshpande "An Intelligent Walking Stick for the Blind." International Journal of Engineering Research and General Science, vol. 3, number 1, pp. 1057-1062, 2015

The paper introduces a navigation device tailored for the visually impaired, prioritizing voice output for obstacle detection and navigation via infrared sensors, RFID technology, and Android devices. It addresses the limitations of existing navigation systems by offering dynamic guidance in both indoor and outdoor settings. Equipped with proximity infrared sensors and RFID tags, the device seamlessly integrates into the user's walking stick, enhancing their ability to navigate safely. Through Bluetooth connectivity with an Android phone, the device interacts with a dedicated application for voice-based navigation and location updates on a server. Furthermore, an additional application permits family members to access the user's location information when necessary.

Chapter 3

System Description

The Smart Walking Stick is an assistive device for the visually impaired, equipped with moisture and ultrasonic sensors, alongside Raspberry Pi-powered image processing. Moisture sensors detect slippery surfaces, ultrasonic sensors identify obstacles, and the image processing system recognizes objects in the user's path. This combination provides real-time feedback, enhancing safety and navigation in various environments, ultimately aiming to improve the independence and security of visually impaired individuals.

3.1 Block Diagram

The Smart Walking Stick for the visually impaired integrates an Arduino Uno-based system for surface and obstacle detection, comprising moisture and ultrasonic sensors that relay data to the Arduino. This section processes the sensor data and generates audio output, signaling the type of surface and alerting the user about obstacles. Simultaneously, a separate section involving a Raspberry Pi with a camera module utilizes image recognition algorithms to identify objects in the user's path. The Raspberry Pi processes visual data, recognizes objects, and triggers an audio output interface, informing the user about the detected objects. These independent sections work in tandem to provide real-time auditory information, enhancing navigation and object awareness for visually impaired individuals.

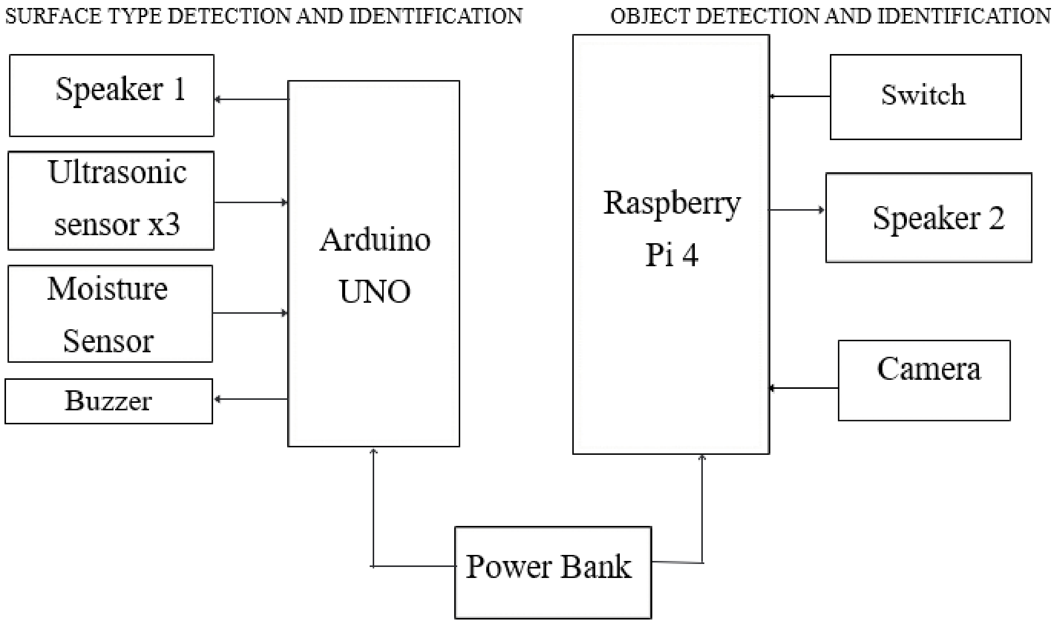

Figure 3.1: Block Diagram

3.2 Flow Chart

The flowchart for the Smart Walking Stick consists of two primary segments: the initial part involves surface detection and identification utilizing moisture and ultrasonic sensors interfaced with the Arduino Uno. Here, the sensors are initialized to gather data on surface moisture and obstacles, processed by the Arduino Uno to determine surface conditions and detect obstacles. The generated data is translated into specific signals for the speaker, providing audio feedback about surface conditions and obstacles to the user. The second segment encompasses object identification employing the Raspberry Pi camera. The camera captures visual data, processed by the Raspberry Pi using image recognition algorithms to identify objects. The recognized objects' information is converted into audio signals, relayed through the speaker, informing the user about the identified objects. This comprehensive process enhances user awareness, aiding visually impaired individuals in navigating their surroundings safely through real-time auditory feedback.

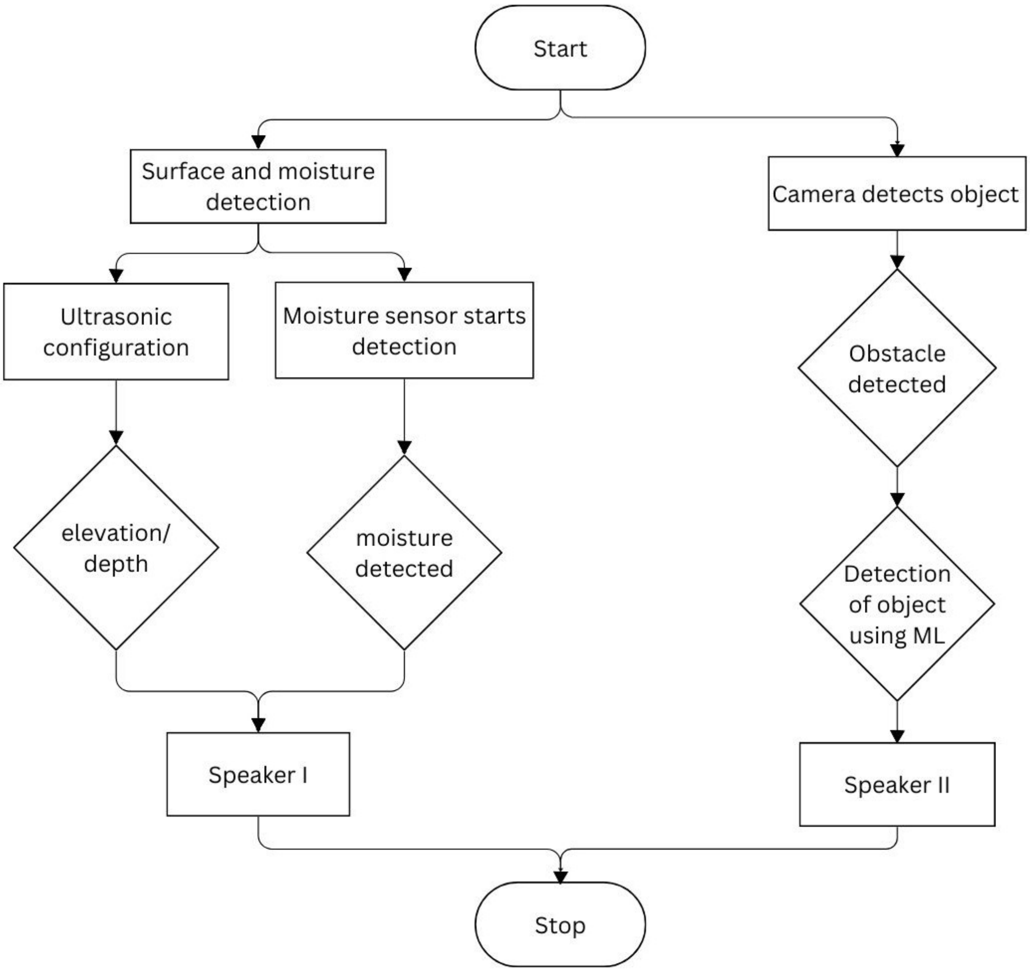

Figure 3.2: Flow Chart

3.3 Circuit Diagram

The circuit diagram of the Smart Walking Stick project includes an Arduino Uno microcontroller connected to a HC-SR04 Ultrasonic sensor for measuring distance. The Arduino is also connected to a rain sensor for detecting wet surface. The system also have a speaker connected to it to give an audio output. A raspberry Pi is connected to a camera which used to detect the real time objects. A stable power supply is provided to power all the components. This circuit setup enables accurate measurement of distances and produce correct ouptuts through speakers to assist the visually impaired.

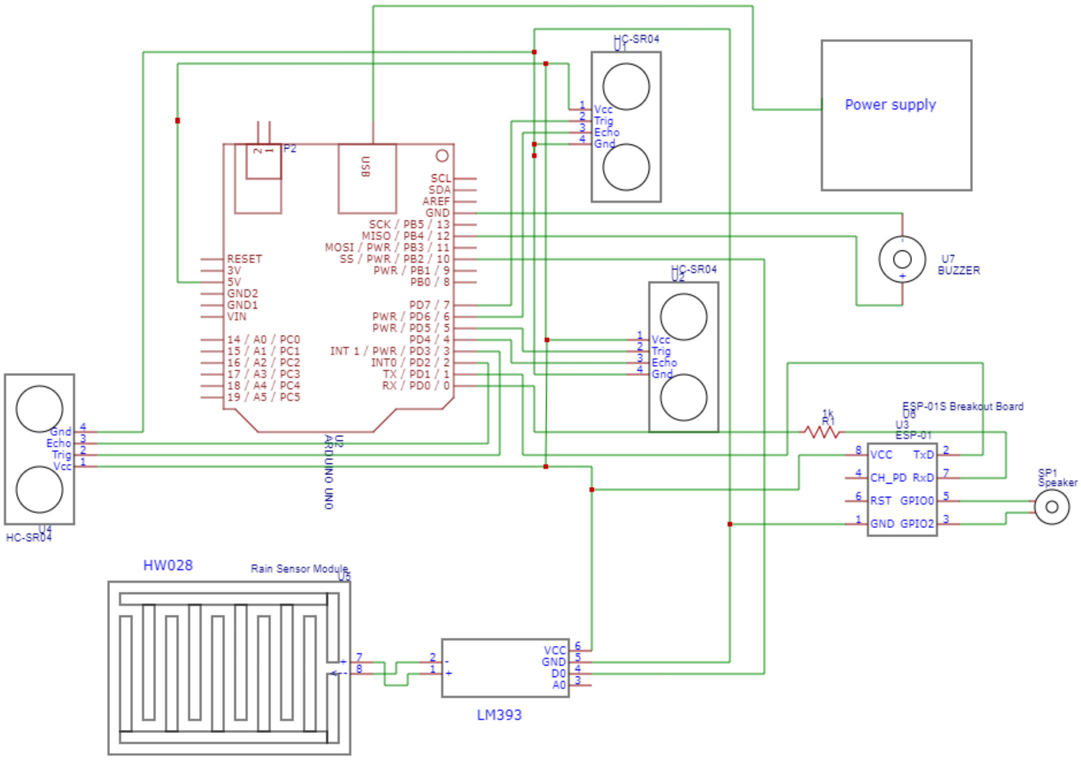

Figure 3.3: Circuit Diagram for surface type detection and identification

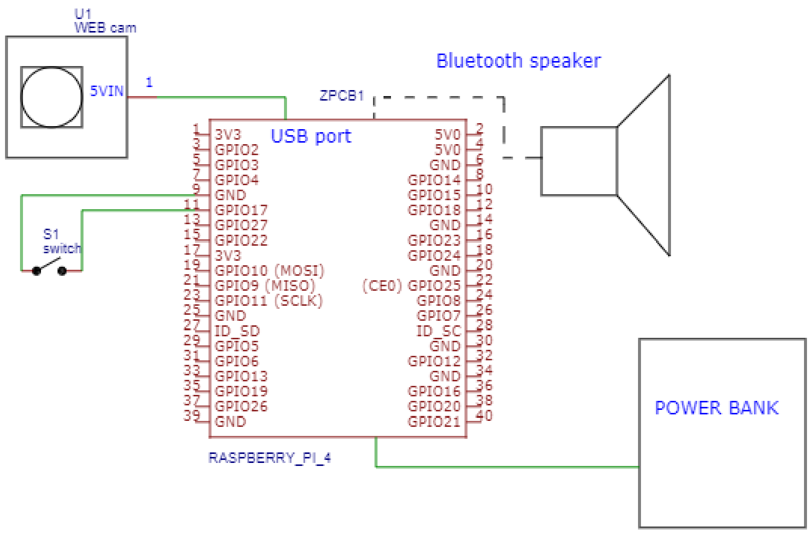

Figure 3.4: Circuit Diagram for object identification

3.4 Working

The Smart Walking Stick for the visually impaired integrates cutting-edge sensor technologies and advanced computing components to ensure enhanced navigation and safety. It combines a network of sensors, including moisture and ultrasonic sensors linked to an Arduino Uno, to discern surface conditions and detect obstacles in the user's path. The moisture sensor accurately identifies surface conditions, distinguishing between wet and dry areas, while the ultrasonic sensor adeptly recognizes obstacles by emitting and analysing sound waves' reflections. This data is swiftly processed by the Arduino Uno, which generates specific audio alerts based on the surface type and obstacle presence. Simultaneously, a Raspberry Pi, equipped with a camera module and sophisticated image recognition algorithms, employs machine learning models to identify and classify objects in real-time. Upon object recognition, the Raspberry Pi triggers an audio output interface, providing users with auditory cues about the identified objects in their vicinity. This comprehensive integration of sensors, microcontrollers, and image processing technologies empowers visually impaired users with critical real-time information for safe and independent navigation.

Through continuous auditory feedback, the Smart Walking Stick ensures users receive essential environmental information crucial for safe movement. Users are provided with immediate audio cues about surface conditions, alerting them to wet or dry surfaces, and obstacles detected ahead. Additionally, the object recognition system notifies users about identified objects, such as individuals, vehicles, or other items in their path. This real-time feedback enables users to adapt their movements, make informed decisions, and navigate diverse environments confidently. By offering an amalgamation of surface detection, obstacle identification, and object recognition translated into accessible auditory cues, the Smart Walking Stick significantly enhances the navigation experience for visually impaired individuals, promoting greater independence and safety in their daily lives.

Chapter 4

Hardware and Software Description

The Smart Walking Stick project for visually impaired individuals encompasses both hardware and software components aimed at improving navigation and safety. On the hardware side, the device integrates moisture and ultrasonic sensors connected to an Arduino Uno microcontroller for detecting surface conditions and obstacles. Meanwhile, a Raspberry Pi, equipped with a camera module, runs specialized software employing image processing algorithms for object recognition. The software utilizes machine learning models to identify and classify objects in the user's path. Together, this hardware-software amalgamation delivers real-time auditory feedback, enhancing user awareness of surface conditions, obstacles, and identified objects, ultimately promoting safer and more independent navigation for individuals with visual impairments.

4.1 Hardware Description

The Smart Walking Stick integrates moisture and ultrasonic sensors with an Arduino Uno for surface detection and uses a Raspberry Pi with a camera for object recognition. This hardware setup offers real-time auditory feedback, enabling visually impaired users to navigate safely by identifying surfaces, avoiding obstacles, and recognizing objects.

4.1.1 Raspberry Pi 4 Model B

The Raspberry Pi 4 Model B offers ground-breaking increases in processor speed, multimedia performance, memory and connectivity compared to the prior-generation Raspberry Pi 3 Model B+, while retaining backwards compatibility and similar power consumption. For the end user, Raspberry Pi 4 Model B provides desktop performance comparable to entry-level x86 PC systems. This product's key features include a high-performance 64-bit quad-core processor, dual-display support at resolutions up to 4K via a pair of micro-HDMI ports, hardware video decode at up to 4Kp60, 8GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0 and PoE capability (via a separate PoE HAT add-on). The dualband wireless LAN and Bluetooth have modular compliance certification, allowing the board to be designed into end products with significantly reduced compliance testing, improving both

- Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- 8GB LPDDR4 SDRAM
- 2.4GHz and 5.0GHz IEEE 802.11b/g/n/ac wireless LAN, Bluetooth 5.0, BLE
- True Gigabit Ethernet
- 2x USB 3.0 ports, 2x USB 2.0 Ports
- Fully backwards compatible 40-pin GPIO header
- 2x Micro HDMI ports supporting up to 4K 60Hz video resolution
- 2-lane MIPI DSI/CSI ports for camera and display
- 4-pole stereo audio and composite video port
- MicroSD card slot for loading operating system and data storage
- Requires 5.1V, 3A power via USB-C or GPIO

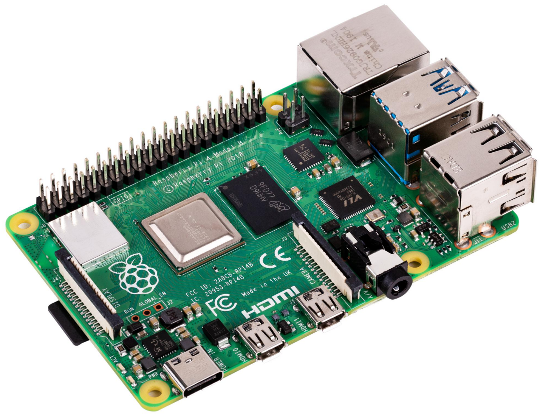

Figure 4.1: Raspberry Pi 4 Model B

4.1.2 Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong. The worst-case scenario is that you would have to replace the chip and start again.

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- In out Voltage (limit): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins: 6
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC current for 3.3V Pin: 50 mA

- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz
- LED BUILTIN: 13
- Length: 68.6 mm
- Width: 58.4 mm
- Weight: 25 g

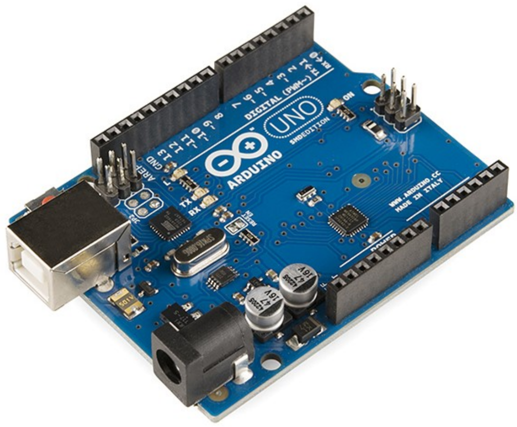

Figure 4.2: Arduino Uno

4.1.3 HC-SR04 Ultrasonic Sensor

HC-SR04 is an ultrasonic ranging sensor that provides 2 cm to 400 cm non-contact measurement function. The ranging accuracy can reach to 3mm and effectual angle is less than 15°. It can be powered from a 5V power supply.

- Working Voltage: DC 5V
- Working Current: 15mA
- Working Frequency: 40Hz
- Max Range: 4m
- Min Range: 2cm
- Measuring Angle: 15 degrees
- Trigger Input Signal: 10µS TTL pulse
- Echo Output Signal Input TTL lever signal and the range in proportion
- Dimensions: 45 * 20 * 15mm

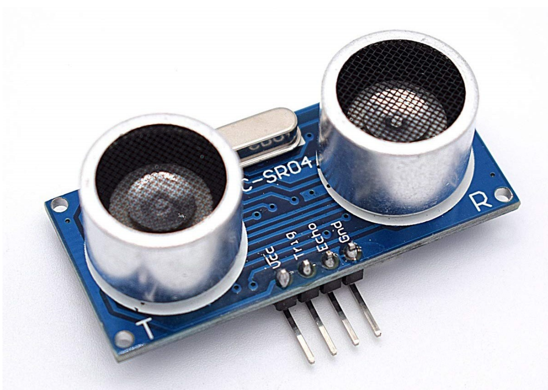

Figure 4.3: ultrasonic sensor

4.1.4 Raindrop Sensor

Raindrop Sensor is a tool used for sensing rain. It consists of two modules, a rain board that detects the rain and a control module, which compares the analog value, and converts it to a digital value. The raindrop sensors can be used in the automobile sector to control the windshield wipers automatically, in the agriculture sector to sense rain and it is also used in home automation systems.

- Working voltage 5V
- Output format: Digital switching output (0 and 1), and analog voltage output AO

- Potentiometer adjust the sensitivity
- Uses a wide voltage LM393 comparator
- Comparator output signal clean waveform is good, driving ability, over 15mA
- Anti-oxidation, anti-conductivity, with long use time
- With bolt holes for easy installation

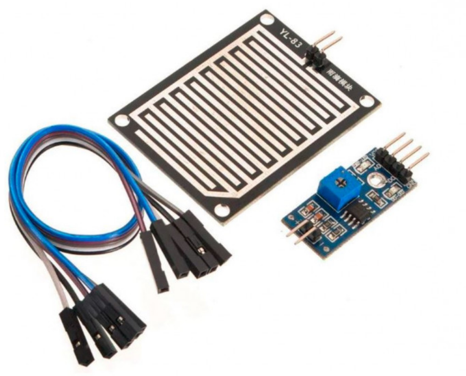

Figure 4.4: Raindrop sensor

4.1.5 3W Power Speaker 8 Ohm

The purpose of speaker is to produce audio output that can be heard by the listeners. Speakers are the transducers that used to convert the electromagnetic waves into sound waves. It receives audio input from computer or audio receivers. The input fed to speaker is in analog or digital form. Analog speakers simply amplify electromagnetic waves into sound waves while digital first convert the signal into analog and then amplify it. Sound produced by the speaker is defined by frequency and amplitude, where frequency determines how high or low the pitch of the sound is. Amplitude or loudness of the speaker is defined by the change in the air pressure created by the speaker's sound waves.

- Nominal Size: 20 mm
- Impedance: 8 Ohm ± 15 % at 1 KHz 1V
- Resonant frequency: 750 Hz± 150 Hz at 1V
- Sound pressure level: 86 dB/w ± 3 dB
- Response: 10 dB (max)
- Input power: 0.5W
- Handling capacity: 1W
- Operation must be normal at program source of 0.5W
- Buzz, rattle, etc. must be normal at sine wave of 2 V
- Magnet Size: 8 x 1 mm
- Heat test: 60 ± 2° C
- Humidity test: 40 ± 2° C

Figure 4.5: 3W Power Speaker 8 Ohm

4.1.6 Camera-Logitech C310 HD Webcam

C310 HD Webcam gives you sharp, smooth video calling (720p/30fps) in a widescreen format. Automatic light correction for clearer, better conference calls.

- Max Resolution: 720p/30fps.
- Camera mega pixel: 1.2.
- Focus type: fixed focus.
- Lens type: plastic.
- Built-in mic: Mono.
- Mic range: Up to 1 m.
- Diagonal field of view (dFoV): 60°

Figure 4.6: Camera-Logitech C310 HD Webcam

4.1.7 DFPlayer Mini

DFPlayer Mini is a compact and inexpensive MP3 module can be connected directly to the speaker. Module with battery power supply, speaker, the keypad can be used alone, or through the serial port control, as the FOR Arduino UNO or any microcontroller with a serial port module. The module itself perfectly integrated hardware decode MP3, WAV, WMA's. While the software supports TF card driver to support FAT16, FAT32 file system. Can be done by simple serial command plays the specified music, as well as how to play music and other functions, without tedious low-level, easy to use, stable and reliable.802.11 b/g/n

- Max Resolution: 720p/30fps.
- Camera mega pixel: 1.2.

- Focus type: fixed focus.
- Lens type: plastic.
- Built-in mic: Mono.
- Mic range: Up to 1 m.
- Diagonal field of view (dFoV): 60°

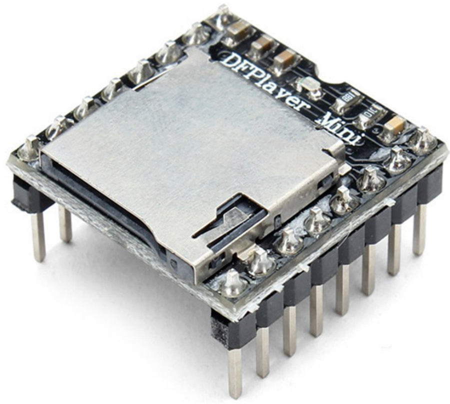

Figure 4.7: DFminiplayer

4.1.8 URBN Power Bank

- 10,000 mAh Premium Lithium Polymer Battery for longer uninterrupted use
- LED Indicator indicates the status
- 4-Level Protection for safe and super-fast charging
- 12 W Super-Fast Charge
- Charge your phone in a jiffy
- Travel Friendly and convenient use

Figure 4.8: URBN Power Bank

4.1.9 Bluetooth Speaker

The FoMe J-B-L Mini Boost 4 is a compact and powerful portable Bluetooth speaker designed to deliver impressive sound quality in a small package. Perfect for music lovers on the go, this speaker offers a blend of sleek design, advanced features, and exceptional audio performance.

Key Features:

- Compact Design: The J-B-L Mini Boost 4 features a compact and lightweight design, making it highly portable. Its small size allows you to carry it in your pocket, backpack, or purse, ensuring you can enjoy your music wherever you are. Wireless Bluetooth
- Connectivity: Seamlessly connect your devices to the speaker via Bluetooth technology. Enjoy wireless streaming from smartphones, tablets, laptops, and other compatible devices within a range of up to 30 feet, eliminating the hassle of tangled wires. Impressive Sound Quality: Despite its small size, the Mini Boost 4 delivers clear and powerful sound with deep bass. Its precision-tuned dual drivers and built-in bass port ensure a rich audio experience for your favorite music, podcasts, and more.
- Long Battery Life: The speaker is equipped with a rechargeable battery that

provides several hours of playback time on a single charge. This long battery life allows you to enjoy uninterrupted music during parties, outdoor activities, or on-the-go adventures.

- Durable Construction: Designed for durability, the speaker is built with rugged materials that can withstand minor impacts, making it suitable for outdoor use and travel.

- Pros: Portability: The small and lightweight design makes it easy to carry the Mini Boost 4 anywhere, ensuring you always have high-quality sound at your fingertips.

- Impressive Sound: Despite its size, the speaker delivers surprisingly powerful and clear sound, making it a great choice

Figure 4.9: Bluetooth speaker

4.1.10 Buzzer

A buzzer is a simple electronic device that produces a buzzing or beeping sound when an electric current passes through it. It typically consists of a small electromechanical component, such as a coil of wire or a piezoelectric element, housed in a plastic or metal enclosure. Buzzer units are commonly used in various applications such as alarms, timers, electronic games, and notification systems to provide audible alerts or signals. They are easy to use, cost-effective, and widely available, making them a popular choice for adding sound output to electronic circuits and devices.

Figure 4.10: Buzzer

4.1.11 Switch

A push button switch is a type of electrical switch activated by pressing a button. It controls electrical circuits by making or breaking the connection when pushed. These switches come in various types, including momentary and latching, and are commonly used in appliances, control panels, and electronic devices for easy operation.

Figure 4.11: Switch

4.2 Software Description

The software involves programming the Arduino microcontroller to acquire data, perform calculations, and a Raspberry Pi for real time object detection. Here is a description of software components involved:

4.2.1 Arduino IDE

Arduino IDE is a powerful software platform specifically designed for programming Arduino microcontroller boards. With its user-friendly interface, it simplifies the process of writing, compiling, and uploading code to Arduino devices. The IDE provides a range of features, including a text editor with syntax highlighting and code completion, making coding easier and more efficient. It also offers a vast library of pre-written code that allows users to control various components and sensors without the need for extensive coding knowledge. Additionally, Arduino IDE supports code uploading to Arduino boards through USB connections, enabling users to bring their electronic projects to life. Its versatility and simplicity make it a popular choice among beginners, hobbyists, and professionals alike for prototyping, tinkering, and exploring the world of electronics.

Figure 4.12: ARDUINO IDE

4.2.2 Easyeda

EasyEDA, a web-based Electronic Design Automation (EDA) suite, empowers hardware engineers by enabling schematic design, simulations, and PCB creation. It facilitates both public and private sharing, supporting comprehensive project management through detailed bill of materials creation and file generation for manufacturing (e.g., Gerber, pick and place). Output formats like PDF, PNG, and SVG streamline communication and documentation among collaborators and manufacturers.

Its intuitive interface enables schematic design and editing, while SPICE simulation accommodates analog and digital circuits, enhancing predictive accuracy. EasyEDA's capacity to create and modify PCB layouts expedites the transition from concept to tangible boards. Optional PCB manufacturing within the platform ensures a seamless workflow.

EasyEDA stands not just as a design suite, but an ecosystem fostering collaboration and precision. Its user-friendly nature and robust feature set make it an industry-leading solution for engineers and enthusiasts, revolutionizing electronic design with its versatility and accessibility.

Figure 4.13: EASYEDA

4.2.3 VNC Viewer

VNC Viewer is a versatile software tool designed for remote desktop access and control. With VNC Viewer, users can connect to and interact with distant computers or devices over a network, regardless of their physical location. This powerful application facilitates real-time viewing and manipulation of the remote desktop environment, allowing users to perform tasks, access files, troubleshoot issues, and manage systems remotely.

By simply entering the network address of the target computer running the VNC Server software, users can establish a secure connection and gain instant access to the remote desktop within the VNC Viewer interface. Once connected, users have full control over the remote system, enabling them to navigate menus, launch applications, manipulate files, and execute commands as if they were sitting directly in front of the remote computer.

VNC Viewer's intuitive interface and seamless performance make it an indispensable tool for a wide range of applications, including remote technical support, system administration, software development, and remote collaboration. Its ability to bridge the geographical gap between users and remote systems enables efficient problem-solving, enhances productivity, and facilitates teamwork in today's increasingly interconnected world. Whether users are working from home, managing servers in a data center, or providing support to clients across the globe, VNC Viewer empowers them to stay connected, productive, and in control, regardless of their physical location.

Figure 4.14: VNC viewer

Chapter 5

Results and Discussion

This chapter evaluates the technology's effectiveness in obstacle detection and its impact on aiding visually impaired navigation, providing insights into its performance and potential improvements.
The Smart Walking Stick for the Blind successfully integrates both surface type detection and object detection functionalities. During testing, the device demonstrated the following results:

- Accurate Surface Type Detection: The Arduino system accurately identified various surface types, including elevation, depression and wet surface.
- Effective Object Detection: The Raspberry Pi-based object detection system reliably identified obstacles in the user's path, alerting the user in real-time.
- Seamless Integration: The integration of the Arduino and Raspberry Pi systems allowed for smooth operation and synchronized feedback to the user.

5.1 Surface identification using Arduino Uno

The Smart Walking Stick for the blind is equipped with sensors that can detect elevated surfaces, depressed surfaces, and wet surfaces. When these sensors detect such conditions, the information is conveyed to the user through a speaker. This auditory feedback system alerts visually impaired individuals to potential hazards in their path, enabling them to navigate safely and confidently.

5.1.1 Elevated surface identification

The Smart Walking Stick for the blind is equipped with ultrasonic sensors tailored to detect elevated surfaces. Through a speaker, it promptly announces ”elevated surface detected,” empowering visually impaired individuals to navigate safely by alerting them to changes in ground level. This feature enhances their mobility and independence.

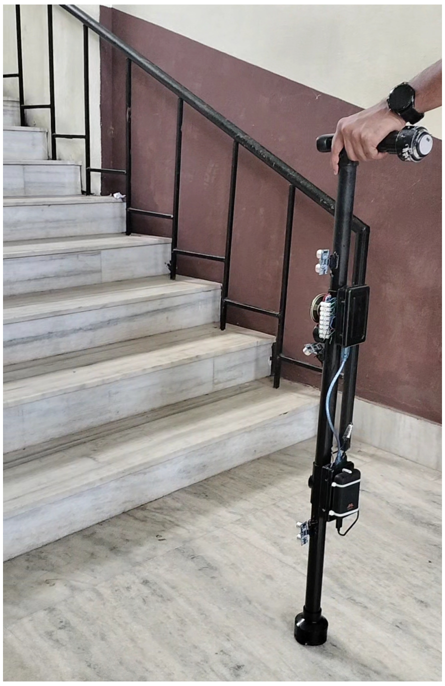

Figure 5.1: Elevated surface identification

5.1.2 Depressed surface identification

The Smart Walking Stick for the blind uses ultrasonic sensors to detect depressed surfaces, signaling ”depressed surface detected” through a speaker. This notifies visually impaired individuals of changes in ground level, boosting their safety and confidence during navigation.

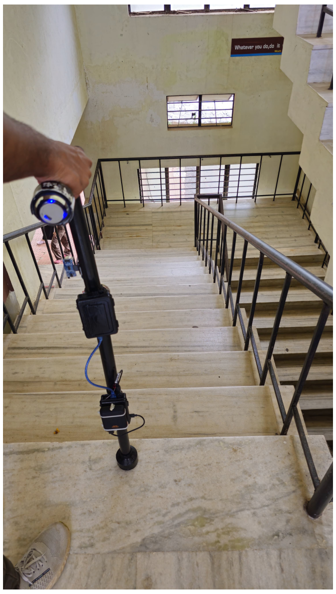

Figure 5.2: Depressed surface identification

5.1.3 Wet surface identification

Moisture sensors integrated into the Smart Walking Stick for the blind identify wet surfaces and promptly announce ”wet surface” through a speaker. This alert system enables visually impaired individuals to recognize potential hazards, enhancing their safety and enabling confident navigation in diverse weather conditions.

Figure 5.3: Wet surface identification

5.2 Object identification using Raspberry PI

Using a webcam, the Raspberry Pi employs machine learning algorithms to identify a diverse array of objects, from people and dogs to cars, cats, plants, and more within images. This versatile capability unlocks a multitude of applications, ranging from automated surveillance to tailor-made assistive technologies for the visually impaired. Moreover, successful testing has verified the Smart Walking Stick's ability to detect objects like persons, dogs, cars, chairs, and plants, affirming its reliability in practical scenarios. Notably, for person detection, the speaker output is programmed to announce "person detected," enhancing user awareness and safety during navigation. This comprehensive object identification functionality not only broadens the device's utility across diverse contexts but also highlights its potential to significantly enhance the daily lives of users.

Figure 5.4: Person identification using Raspberry PI

Chapter 6

Conclusion

In conclusion, the Smart Walking Stick project represents a groundbreaking endeavor in enhancing the mobility and safety of visually impaired individuals. By integrating state-of-the-art sensor technologies and sophisticated image recognition capabilities, this innovative solution addresses the immediate challenges faced by users while embodying a profound commitment to improving their overall quality of life. Through the strategic deployment of moisture sensors and ultrasonic sensors, the Smart Walking Stick empowers users to confidently navigate diverse environments, providing real-time feedback on surface conditions and obstacles, thereby fostering a sense of security and independence in daily travels.

Moreover, the integration of image recognition technology using a Raspberry Pi platform enhances situational awareness for visually impaired individuals, allowing for accurate identification and classification of objects within their field of view. This holistic approach not only addresses mobility concerns but also promotes inclusivity and accessibility. By prioritizing the needs of the visually impaired community and fostering collaboration, the Smart Walking Stick project sets a new standard for innovation, offering a transformative solution that has the potential to profoundly impact the lives of millions, ushering in a future of independence, safety, and empowerment.

Chapter 7

Future Scope

The future scope of the Smart Walking Stick project holds immense potential for transformative advancements in enhancing the mobility, safety, and independence of visually impaired individuals. Continued developments in sensor technologies offer a myriad of opportunities to expand the capabilities of the device, paving the way for more comprehensive environmental monitoring and hazard detection. By integrating additional sensors to detect variables such as temperature, humidity, air quality, and even terrain texture, the Smart Walking Stick could provide users with a richer and more nuanced understanding of their surroundings. This holistic approach to environmental sensing would empower users to navigate diverse and dynamic environments with greater confidence and autonomy, as they receive real-time feedback on potential obstacles and hazards.

Moreover, the ongoing refinement of the device's image recognition capabilities through advancements in AI and machine learning presents a pathway towards more robust and versatile object detection. By leveraging cutting-edge algorithms and training models, the Smart Walking Stick can improve its ability to accurately identify and classify a wider range of objects in various environmental conditions. This would not only expand the utility of the device across different contexts but also enhance its adaptability to the evolving needs and preferences of users. Additionally, optimizing the Smart Walking Stick's processing capabilities with efficient processors designed for low-latency computing holds promise for further enhancing its responsiveness and real-time feedback mechanisms. By minimizing latency and expediting object detection, the device can deliver instantaneous alerts and notifications to users, facilitating quicker responses and mitigating potential risks during navigation.

Furthermore, the integration of connectivity features and smartphone applications could unlock new dimensions of functionality and accessibility for the Smart Walking Stick. By enabling seamless communication and data exchange between the device and mobile devices, users could access a wide range of supplementary services and functionalities, such as real-time navigation assistance, location-based alerts, and personalized settings customization. This convergence of technologies would not only enhance the user experience but also foster a more interconnected and supportive ecosystem for visually impaired individuals. Overall, the future of the Smart Walking Stick project is characterized by a relentless pursuit of innovation and inclusivity, with a steadfast commitment to improving the quality of life for visually impaired individuals around the world.

References

- M. A. Ikbal, F. Rahman and M. H. Kabir, ”Microcontroller Based Smart Walking Stick for Visually Impaired People,” 2018 4th International Conference on Electrical Engineering and Information and Communication Technology (iCEEiCT), Dhaka,Bangladesh, 2018, pp. 255-259, doi: 10.1109/CEEICT.2018.8628048.
- K. Jivrajani et al., ”A IoT-Based Smart Stick for Visually Impaired Person,” in IEEE Transactions on Instrumentation and Measurement, vol. 72, pp. 1-11, 2023, Art no. 2501311, doi: 10.1109/TIM.2022.3227988.
- C.S. Kher, Y.A. Dabhade, S.K Kadam., S.D. Dhamdhere and A.V. Deshpande “An Intelligent Walking Stick for the Blind.” International Journal of Engineering Research and General Science, vol. 3, number 1, pp. 1057-1062, 2015
- B.G. Roopashree, B.S. Patil and B.R. Shruthi “Smart Electronic Stick for Visually Impaired.” International Journal of Innovative Research in Science, Engineering and Technology, vol. 4, number 7, pp. 6389-6395, 2015.
- R. Radhika, P.G. Pai, S. Rakshitha and R. Srinath “Implementation of Smart Stick for Obstacle Detection and Navigation.” International Journal of Latest Research in Engineering and Technology, vol. 2, number 5, pp. 45-50, 2016
- G. Gayathri, M. Vishnupriya, R. Nandhini and M. Banupriya “Smart Walking Stick for Visually Impaired.” International Journal of Engineering and Computer Science, vol. 3, number 3, pp. 4057-4061, 2014