SENSOR BASED SMART ASSISTANT SYSTEM FOR DESTITIUTE OF VISION PERSON BY USING IOT

A MAJOR PROJECT REPORT

Submitted by

VIMALPANDIYAN K-721420104058

JEYA SANTHOSH P-721420104013

KARTHIK K -721420104018

SANJAIKUMAR V -721420104040

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

NEHRU INSTITUTE OF ENGINEERING AND TECHNOLOGY

COIMBATORE -641105

ANNA UNIVERSITY: CHENNAI 600 025

MAY-2024

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project reported **SENSOR BASED SMART ASSISTANT SYSTEM FOR DESTITUTE OF VISION PERSON** is the bonafide work of **VIMALPANDIYAN K** (721420104058), **JEYASANTHOSH P** (721420104013), **KARTHIK K (**721420104018**)** and **SANJAIKUMAR V** (721420104040) who carried out the project work under my supervision.

SIGNATURE	**SIGNATURE**
Mrs. S. PRIYA (INTERNALGUIDE)	**Dr. S. SUBASREE**
ASST.PROFESSOR- SG	**PROFESSOR & HEAD**
Department of Computer Science & Engineering	Department of Computer Science & Engineering
Nehru Institute of Engineering and Technology	Nehru Institute of Engineering and Technology
Coimbatore -641105	Coimbatore -641105

Submitted for the Anna University Project Viva - Voice Examination held on ___________at Nehru Institute of Engineering and Technology.

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

At this pleasing moment of successful completion of our major project, we thank God Almighty for his blessings. We convey our sincere thanks to our respected Founder Chairman Late **Shri. P.K. DAS**, Chairman and Managing Trustee **Adv. Dr. P. KRISHNADAS** and CEO & Secretary **Dr. P. KRISHNAKUMAR** who provided the facilities for us to complete the major project successfully.

We express our sincere gratitude to the beloved and honorable Executive Director, Academics & Administration **Dr. H.N. NAGARAJA** for his valuable support. We express our deep gratitude to our beloved and honorable Principal, **Dr. P. MANIIARASAN** for his valuable support. We sincerely thank our respected Dean, Academics **Dr. N. K. SAKTHIVEL** for his valuable support.

We owe grateful and significant thanks to **Dr. S. SUBASREE.,** our Head of Department, Computer Science and Engineering., and our sincere thanks to our internal guide **Mrs. S. PRIYA** Assistant Professor-SG/ CSE , who has given constant support and encouragement throughout the completion of our course and our major project work.

We thank our Major Project Coordinator **Mr. M. MADAN MOHAN,** Assistant Professor-SG/ CSE & **Ms. M.S. VINU** Assistant Professor / CSE, who rendered us all possible help along with their valuable suggestions and constructive guidance for successful completion of our major project.

We are very thankful for the support and guidance from all the **Faculty Members of Computer Science and Engineering Department** and sincere thanks to our supporting staff for their timely assistance. Finally, we would like to express our gratitude towards our parents for their motivation and support which helped us in the completion of this major project.

ABSTRACT

The Smart Assistive Walking Stick for the Visually Impaired represents a significant advancement in aiding individuals with visual impairments to navigate their surroundings safely and independently. Leveraging state-of-the-art technologies including computer vision, object detection, and audio feedback, this innovative system offers real-time identification and vocalization of obstacles and objects encountered during mobility. With integrated obstacle detection and orientation features, along with voice alerts and supplementary visual feedback, this comprehensive solution ensures enhanced navigation and obstacle avoidance capabilities.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVATIONS

S.NO		ACRONYMS
1	GPS	GLOBAL POSITIONING SYSTEM
2	LCD	LIQUICD CRYSTAL DISPLAY
3	IOT	INTERNET OF THINGS
4	UNO	UNITED NATION ORGANIZATION
5	SES	SMART ELECTRONIC STICK
6	USB	UNIVERSAL SERIAL BUS
7	US	ULTRASONIC SENSOR
8	POE-HAT	POWER OVER ETHERNET-HAT
9	CM4+	COMPUTE MODULE 4+
10	LAN	LOCAL AREA NETWORK
11	EMMC	EMBEDDED MULTI MEDIA CARD
12	GPIO	GENERAL PURPOSE INPUT OUTPUT
13	SPI	SERIAL PERIPHERAL INTERFACE
14	UART	UNIVERSAL ASYNCHRONOUS RECIEVER TRANSMITTER
15	HDMI	HIGH DEFINITION MULTI MEDIA INTERFACE
16	VRLA	VALUE REGULATED LEAD ACID
17	PPE	PERSONAL PRODUCTIVE EQUIPMENT
18	CFM	CUBIC FEET PER MINUTE
19	IDE	INTEGRATED DEVELOPMENT KIT
20	LIDAR	LIGHT DETECTION AND RANGING

CHAPTER 1

1.1 INTRODUCTION

The Smart Assistive Walking Stick for the Visually Impaired introduces a pioneering approach to empower individuals with visual impairments to navigate their environments with confidence and autonomy. This groundbreaking system harnesses cutting-edge technologies, amalgamating computer vision, object detection, and auditory feedback mechanisms to provide real-time assistance in identifying and circumventing obstacles during mobility. By seamlessly integrating advanced features such as obstacle detection, orientation assistance, and vocal alerts, coupled with supplementary visual cues, this innovative solution sets a new standard in enhancing navigation and The Smart Assistive Walking Stick for the Visually Impaired introduces a pioneering obstacle avoidance for the visually impaired community. In an era where technology continues to revolutionize accessibility and inclusivity, this project stands as a beacon of progress, poised to profoundly impact the lives of those with visual impairments by fostering greater independence and safety in their daily travels.

The Smart Assistive Walking Stick for the Visually Impaired embodies a transformative leap in the realm of assistive technology, offering a multifaceted solution to address the challenges faced by individuals with visual impairments in navigating their surroundings. By leveraging state-of-the-art technologies and innovative design principles, this project aims to provide an inclusive and empowering tool for enhancing mobility and independence.

Navigating through environments fraught with obstacles can pose significant challenges for individuals with visual impairments, often limiting their ability to explore and engage with the world around them. Traditional walking aids provide basic support but lack the sophistication needed to identify and alert users to potential hazards in real-time. Recognizing this gap, our project endeavors to bridge it by integrating advanced features that not only detect obstacles but also provide intuitive feedback to users, enabling them to make informed decisions and navigate safely.

At the heart of our system lies computer vision technology, which enables the detection and recognition of objects and obstacles in the user's path. By employing machine learning algorithms, the walking stick can discern between various objects and classify them accordingly, from stationary obstacles like poles and furniture to dynamic hazards such as moving vehicles or pedestrians.

This real-time object recognition capability forms the foundation of our assistive system, empowering users with timely information about their surroundings. In addition to object detection, our project incorporates auditory feedback mechanisms to convey critical information to users. Through the use of voice alerts and cues, the walking stick communicates the presence and location of obstacles, enabling users to adjust their path or take necessary precautions. This auditory interface is designed to be intuitive and non-intrusive, providing assistance without overwhelming the user's senses.

Furthermore, our system includes orientation assistance features to help users maintain their sense of direction and spatial awareness. By utilizing GPS technology or indoor positioning systems, the walking stick can provide users with guidance and route information, allowing them to navigate unfamiliar environments with ease. This aspect of the project aims to reduce the anxiety and uncertainty often associated with traveling independently for individuals with visual impairments.

In summary, the Smart Assistive Walking Stick for the Visually Impaired represents a holistic approach to enhancing mobility and independence for individuals with visual impairments. By combining advanced technologies with user-centered design principles, our project endeavors to empower users to navigate their surroundings with confidence and dignity, ultimately fostering greater inclusivity and accessibility in society.

In today's rapidly evolving technological landscape, the intersection of innovation and accessibility has opened up new avenues for improving the quality of life for individuals with visual impairments. Among the myriad advancements, the Smart Assistive Walking Stick for the Visually Impaired emerges as a beacon of progress, poised to revolutionize the way individuals with visual impairments navigate and interact with their environments.

For many individuals with visual impairments, the simple act of moving through physical spaces can be fraught with uncertainty and danger. Traditional walking aids offer limited assistance, often leaving users vulnerable to unforeseen obstacles and hazards. Recognizing the pressing need for a more robust solution, our project sets out to redefine the paradigm of assistive technology by leveraging the latest advancements in computer vision, artificial intelligence, and sensory feedback systems.

At its core, the Smart Assistive Walking Stick harnesses the power of computer vision to perceive and interpret the surrounding environment in real-time. Equipped with sophisticated cameras and image processing algorithms, the walking stick continuously scans the user's surroundings, identifying obstacles and potential hazards with unprecedented accuracy and speed. This dynamic object recognition capability not only enhances safety but also promotes greater independence and autonomy for users as they navigate diverse environments.

In addition to object detection, our system integrates a sophisticated feedback mechanism designed to convey vital information to users in a clear and intuitive manner. Through a combination of audio alerts, tactile feedback, and visual indicators, the walking stick provides real-time guidance and assistance, enabling users to make informed decisions and navigate with confidence. Whether it's a warning about an upcoming obstacle or guidance on the best route to take, our system ensures that users remain informed and empowered throughout their journey.

Furthermore, the Smart Assistive Walking Stick incorporates advanced orientation and navigation features to further augment the user experience. By leveraging GPS technology, indoor positioning systems, and mapping data, the walking stick provides users with comprehensive spatial awareness, helping them to navigate complex environments with ease. Whether indoors or outdoors, in urban or rural settings, our system ensures that users can travel with confidence and independence, unlocking new opportunities for exploration and engagement.

In summary, the Smart Assistive Walking Stick for the Visually Impaired represents a groundbreaking fusion of technology and empathy, designed to empower individuals with visual impairments to lead fuller, more independent lives. By reimagining the traditional walking aid through the lens of innovation and accessibility, our project seeks to break down barriers, foster inclusivity, and create a world where all individuals can navigate their surroundings with dignity and confidence. In the quest for inclusivity and accessibility, the Smart Assistive Walking Stick for the Visually Impaired emerges as a pioneering solution, poised to revolutionize the way individuals with visual impairments navigate and interact with the world around them. In a landscape where technological advancements continually redefine the boundaries of what is possible, our project stands at the forefront, driven by a commitment to harness innovation for the betterment of society.

For individuals with visual impairments, the challenges of mobility extend far beyond the physical act of walking. Navigating through unfamiliar environments, avoiding obstacles, and maintaining spatial awareness are daily struggles that can profoundly impact independence and quality of life. Traditional walking aids offer limited support, often falling short in providing the real-time feedback and assistance needed to navigate dynamic and unpredictable surroundings.

Enter the Smart Assistive Walking Stick—a convergence of cutting-edge technologies meticulously crafted to address the complex needs of individuals with visual impairments. At its core lies a sophisticated array of sensors, cameras, and intelligent algorithms, working in tandem to perceive and interpret the surrounding environment with unparalleled precision. Through the power of computer vision and machine learning, the walking stick can identify and classify obstacles, hazards, and landmarks in real-time, empowering users with vital information to make informed decisions about their path forward.

But our project goes beyond mere detection—it embraces a holistic approach to assistive technology, prioritizing user experience and empowerment at every turn. Through a carefully designed feedback system, the Smart Assistive Walking Stick provides intuitive auditory, tactile, and visual cues, ensuring that users are not only aware of their surroundings but also equipped to navigate them confidently and independently. Whether it's a gentle vibration to alert the presence of a low-hanging obstacle or a spoken prompt guiding the user towards a safer route, our system strives to foster a sense of agency and autonomy in every interaction.

Moreover, the Smart Assistive Walking Stick integrates seamlessly into the broader landscape of assistive technologies, offering compatibility with smartphones, wearable devices, and other connected platforms. By leveraging the power of connectivity, our system opens up new possibilities for personalized assistance, remote monitoring, and data-driven insights—all aimed at enhancing the overall user experience and fostering a sense of community and support.

In essence, the Smart Assistive Walking Stick for the Visually Impaired represents more than just a technological innovation—it embodies a vision of inclusivity, empowerment, and dignity for individuals with visual impairments. By reimagining the traditional walking aid through the lens of empathy and innovation, our project seeks to not only break down physical barriers but also to inspire a world where all individuals are empowered to navigate their own paths with confidence and grace.

In an era defined by technological advancement and social progress, the Smart Assistive Walking Stick for the Visually Impaired emerges as a beacon of innovation, poised to redefine the landscape of accessibility and empowerment for individuals with visual impairments. Grounded in the principles of inclusivity and human-centered design, this project represents a collaborative effort to bridge the gap between ability and disability, enabling greater independence and autonomy in everyday life.

For individuals living with visual impairments, navigating the physical world can often feel like traversing a labyrinth of challenges and obstacles. From uneven terrain to crowded spaces, the simple act of moving from one place to another can become a daunting task fraught with uncertainty. Traditional walking aids offer a degree of support, but they often lack the sophistication needed to provide real-time feedback and assistance in dynamic environments.

Enter the Smart Assistive Walking Stick—a revolutionary fusion of cutting-edge technology and compassionate design aimed at empowering individuals with visual impairments to navigate their surroundings with confidence and ease. At its core, the walking stick harnesses the power of computer vision, employing advanced algorithms to detect and classify objects, obstacles, and hazards in real-time. By leveraging machine learning techniques, the system continuously adapts and improves its ability to identify and respond to the ever-changing environment, providing users with timely and accurate information about their surroundings.

But the true innovation lies not just in detection, but in communication. Through a carefully crafted feedback system, the Smart Assistive Walking Stick provides users with intuitive auditory, tactile, and visual cues, enabling them to interpret and respond to their surroundings with greater clarity and confidence. Whether through spoken alerts, vibrational feedback, or LED indicators, the walking stick ensures that users remain informed and empowered as they navigate through diverse environments.

Furthermore, the Smart Assistive Walking Stick embraces a holistic approach to accessibility, incorporating features that extend beyond basic navigation to enhance overall well-being and quality of life. From integrated GPS functionality to personalized route planning and assistance, the system offers a comprehensive suite of tools designed to support users in every aspect of their journey. By fostering greater independence and autonomy, our project aims to not only improve mobility but also to promote a sense of empowerment and inclusion within the visually impaired community.

In summary, the Smart Assistive Walking Stick for the Visually Impaired represents a paradigm shift in the way we approach assistive technology, placing the needs and experiences of users at the forefront of design. By harnessing the power of innovation and empathy, our project seeks to create a world where individuals with visual impairments can navigate their surroundings with confidence, dignity, and independence, ultimately breaking down barriers and fostering a more inclusive society for all.

1.2 BACKGROUND

A sensor-based smart assistance system for the blind integrates cutting-edge sensor technologies to provide real-time support and enhance independence for individuals with visual impairments. By leveraging sensors such as ultrasonic, LiDAR, and infrared, the system detects obstacles and objects in the user's environment, offering auditory or haptic feedback to alert them of potential hazards. Additionally, GPS and inertial sensors enable precise navigation assistance, guiding users along safe routes and providing turn-by-turn directions. Machine learning algorithms further enhance the system's capabilities by recognizing objects and interpreting environmental cues, allowing for more personalized and context-aware assistance. Through user-centric design and considerations for accessibility and affordability, these systems aim to empower blind individuals to navigate their surroundings with confidence and autonomy.

1.3 MOTIVATION

Sensor-based smart assistance for blind individuals is a beacon of hope, offering a transformative pathway to independence and empowerment. By harnessing the capabilities of sensors, this innovative technology serves as the guiding light through the labyrinth of darkness, providing real-time feedback and crucial information about the surrounding environment. From detecting obstacles and navigating unfamiliar terrain to identifying objects and facilitating safe mobility, these sensor-driven solutions become the steadfast companions in the journey of the visually impaired. Beyond mere aids, they symbolize the dawn of a new era where barriers dissolve, and opportunities flourish, fostering a world where blindness is not a limitation but a challenge met with ingenuity and compassion. With each step guided by these intelligent sensors, a brighter future emerges, where every individual, regardless of their visual impairment, can navigate the world with confidence and dignity.

1.4 OBJECTIVES

A sensor-based smart assistance system for blind individuals aims to enhance their autonomy, safety, and accessibility in navigating their surroundings. By utilizing various sensors such as ultrasonic, infrared, or LiDAR, combined with intelligent algorithms, this system can detect obstacles, landmarks, and environmental cues in real-time. The primary objectives include providing auditory or tactile feedback to the user about their surroundings, offering navigation assistance to help them reach their destination safely, and enabling them to interact with everyday objects and devices more independently. Additionally, such systems often incorporate features like object recognition to identify common items or facial recognition to assist in social interactions. Ultimately, the goal is to empower blind individuals with greater confidence and freedom in their daily lives, bridging the gap between their abilities and the challenges posed by their environment.

1.5 SCOPE OF THE PROJECT

The scope of a sensor-based smart assistance system for blind individuals encompasses a wide range of technological, usability, and societal considerations. From a technological standpoint, the project involves designing and implementing a robust sensor network capable of accurately detecting obstacles, landmarks, and environmental cues in various settings and conditions.

This may include researching and selecting appropriate sensor technologies, developing algorithms for data processing and interpretation, and integrating the system with wearable or handheld devices for user interaction.

Usability is another crucial aspect of the project's scope, focusing on creating an intuitive and user-friendly interface that provides relevant feedback and guidance to the blind user in real-time. This involves conducting user research and testing to understand the needs and preferences of the target demographic, as well as iterating on the design to optimize usability and accessibility.

Furthermore, the scope extends to considering the societal impact of the system, including issues related to privacy, ethics, and inclusivity. This may involve addressing concerns about data security and consent, ensuring that the system respects the autonomy and dignity of its users, and promoting awareness and acceptance of assistive technologies within broader society.

The sensor-based smart assistant system for disabled persons aims to provide a comprehensive solution that enhances accessibility, independence, and safety for users with disabilities. One of the primary functionalities of the system is object detection and recognition, which enables users to identify common objects in their environment. This feature is particularly useful for individuals with visual impairments, as it allows them to navigate their surroundings with greater confidence and independence. By leveraging computer vision algorithms and pre-trained models, the system can detect objects such as doors, furniture, electronic devices, and other essential items, providing users with valuable information about their surroundings.

Another key aspect of the project is gesture recognition, which enables users to control the system through hand gestures. Gesture recognition technology allows for intuitive interaction with the smart assistant, eliminating the need for physical buttons or controls. By recognizing basic gestures such as swiping, pointing, and waving, the system provides users with a natural and efficient way to interact with their environment. Whether it's adjusting environmental settings, controlling assistive devices, or navigating through menus, gesture recognition simplifies the user experience and enhances accessibility for individuals with limited mobility or dexterity.

Voice control is another essential feature of the smart assistant system, allowing users to control the system through voice commands. By implementing speech recognition algorithms and natural language processing techniques, the system can understand and interpret user commands, providing a hands-free interaction experience. Voice control enables users to perform a wide range of tasks, from controlling environmental settings and assistive devices to sending messages and making phone calls.

Overall this feature is particularly beneficial for individuals with mobility impairments or conditions that affect hand dexterity, allowing them to access the system and its functionalities with ease.

CHAPTER 2

2.1 LITERATURE SURVEY

1.Title: Smart Stick for Blind People

Authors : N.Loganathan, K.Lakshmi, N.Chandrasekaran, S.R.Cibisakaravarthi, R.Hari Priyanga, K.Harsha Varthini,

Publication: 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS)

Blind person finds it difficult to detect the presence of any obstacles in their way while moving from one place to another and it is very difficult to find the exact location of the stick if it have been misplaced. Thus, the smart stick comes as a proposed solution to help the visually impaired people in their day to day living without the help of others. In this paper we proposed a solution for the blind people by using an ultrasonic sensor in the blind stick. The instrument stands used to perceive the obstacles at the range of four meters and infrared instrument is castoff to perceive the nearer complications in front of the blind people. Thus the radio frequency transmitter and receiver help the user to find the exact location of the smart stick with the help of buzzer. The vibration motor which is placed in the smart stick gets activated and produces a vibration when any obstacle is detected. This proposed method uses the Arduino UNO as controller. The branch is accomplished of sensing all difficulties in front of the user. The smart stick is of user friendly, quick response, very low power consumption, lighter weight and it is easy to hold and fold by the user.",

2.Title: Smart Blind Stick

Authors: Prashik Chavan,Kartikesh Ambavade,Siddhesh Bajad,Rohan Chaudhari,Roshani Raut,

Publication: 2022 6th International Conference On Computing Communication Control And Automation (ICCUBEA).

Blind people need some aid or somebody's help to walk safely. Smart blind stick can prove as a helping hand to help them while walking and help them to understand their environment. In this paper we propose a Smart stick which consists of a stick with all the components and sensors mounted over it. Basically, this smart stick works in two cases. In case 1 the stick detects the obstacle in front with an ultrasonic sensor while in case 2 the servo motor rotates the ultrasonic sensor through angle to detect the obstacle in a crowded place. In both the cases obstacle detection results in buzzer sound to alert the blind person. The switch button is used to shift from case 1 to case 2 and vice-versa. This stick can detect all the obstacles in its range. Proper environments to use are also identified. By using this smart stick, the blind person can walk with confidence and overcome his fear while walking.",

3.Title: Smart Blind Stick for Visually Impaired People using IoT

Authors: Rajanish Kumar Kaushal,K. Tamilarasi,P. Babu,T. A. Mohanaprakash,S. E. Murthy,M Jogendra Kumar,

Publication: 2022 International Conference on Automation Computing and Renewable Systems (ICACRS)

Computing and Renewable Systems (ICACRS)","abstract

4.Title: Multi-Functional Blind Stick for Visually Impaired People

Authors: Vanitha Kunta,Charitha Tuniki,U. Sairam,

Publication: 2020 5th International Conference on Communication and Electronics Systems (ICCES)

One of the biggest problems faced by the visually impaired is navigating from place to place, be it indoors or outdoors. Further, the adverse conditions of the roads make it even more difficult for them to walk outdoors. They have to be alert at all times to avoid consequences like colliding with stable or moving obstacles, ascending or descending staircases, slipping down wet terrain. Also, at times they may be in distress and might want to send an alert message to their relatives or friends about their whereabouts. These problems of blind people can be addressed with the intervention of technology. The proposed solution employs the Internet of Things (IoT) paradigm to provide a medium between the blind and the environment. Several sensors can be used to detect anomalies like obstacles, staircases and wet terrains respectively. The prototype discussed here is a simple, sophisticated and affordable smart blind stick equipped with various IoT sensors and modules. Also, this solution provides a way to send a message about the whereabouts of the user to the concerned people. Adding to the above, a software application is designed to help the acquaintances of the blind to manage the stick's configuration ex: add or delete phone numbers to which alert messages have to be sent. Misplacing the stick indoors can also be a substantial issue. This solution also addresses this problem.",

5.Title: Smart Stick for the Blind and Visually Impaired People

Authors: Mukesh Prasad Agrawal,Atma Ram Gupta,

Publication: 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT).

There are many issues over which humans have no control blindness is one of such issues. It snatches the vivid visual beauty of the world from an individual's life. But missing the beauty of nature becomes one of the last worries of such people as they have to face numerous difficulties in order to perform even the most basics of tasks in their day to day life. One of their most dominant problems is of transport, such as crossing roads, traveling in trains, or other public places. They always require human assistance to do so. But sometimes they are rendered helpless when no such assistance is offered. Their dependencies deteriorate their confidence. Traditionally they have been using the conventional cane stick to guide themselves by touching/poking obstacles in their way. This causes a lot of accidents and hence is dangerous for them and others. As this is a technologically driven era we decided to aid these differently abled people by coming up with a technology utilizing solution. We call it the u201cSmart Sticku201d. It is a device which guides the user by sensing obstacles in the range of stick. It will identify all obstacles in the path with the help of various sensors installed in it. The microcontroller will retrieve data and pass it on as vibrations which will notify the user about hurdles on the way. It is an efficient device and will prove to be a big boon for blind people.",

6.Title: Smart Walking Stick for Blind Integrated with SOS Navigation System

Authors: Saurav Mohapatra,Subham Rout,Varun Tripathi,Tanish Saxena,Yepuganti Karuna,

Publication: 2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI)

Blind people face many difficulties to interact with their nearby environment. The aim of this paper is to provide a tool which will help blind people to navigate as well as sense the obstacles. We plan to propose a working model which is Walking Stick with in-built ultrasonic sensor with a micro controller system. The ultrasonic sensor is used to detect obstacles using ultrasonic waves. On sensing obstacles the sensor passes the data to the microcontroller. The microcontroller then processes the data and calculates if obstacle is close enough. If obstacle is not close enough the circuit does nothing. If obstacle is close then microcontroller sends Alert signal to the blind person. In addition we also plan to embed e-SOS (electronic Save Our Souls) system. Whenever blind person feels any discomfort while navigating then he presses an e-SOS distress call button on the stick to give a video call to his family member. The video is streamed in an Android mobile via Android application. The Android application also shows the location of the blind person to his family member. In this way, Blind person is guided to move along the path by his family member via the Android Mobile Application.",

7.Title: Smart Electronic Walking Stick for the Blind People

Authors: R. Kavitha,K. Akshatha,

Publication: 2023 2nd International Conference on Advancements in Electrical Electronics Communication Computing and Automation (ICAECA)

The Smart Electronic Stick (Smart E-Stick) is a clever device that blends sophisticated technology to help persons with vision impairments navigate more easily. The stick has an ultrasonic sensor that identifies obstacles as well as light and water sensors that alert the user to potential hazards. The data collected by the sensors is sent to a microprocessor, which analyses the proximity of the obstacle and, if necessary, activates a buzzer. The stick also has haptic vibrations to warn the user of water and pit holes, as well as the ability to detect if the surroundings is bright or dark. The device includes a wireless RF remote control that can activate a buzzer on the stick to assist the blind person in finding the stick if it becomes misplaced. As a result, visually challenged people can use the stick to easily identify obstacles and find their misplaced gadget. On an Android phone, the u201cSpeak for meu201d app is also used to generate voice messages for the user.",

8.Title: Ultrasonic Sensor Based Smart Blind Stick

Authors: Naiwrita Dey,Ankita Paul,Pritha Ghosh,Chandrama Mukherjee,Rahul De,Sohini Dey,

Publication: 2018 International Conference on Current Trends towards Converging Technologies (ICCTCT).

This paper presents design and implementation of an ultrasonic sensor based walking stick for visually impaired person. An ultrasonic sensor module, HC-SR04 is used for obstacle detection in the path of the blind person and a buzzer is used to make the person alert. The proposed system is implemented using PIC microcontroller 16F877A. Blind persons can use this walking stick for safe navigation. It can detect obstacle within 5 to 35 cm range of distance."

2.2 INFERENCE OF THE LITERATURE REVIEW

[1] The literature review likely delves into the challenges faced by blind individuals in navigating their environment safely and independently. It may discuss the limitations of traditional white canes and the need for innovative solutions that integrate advanced technologies to enhance mobility and improve quality of life for blind individuals.Furthermore, the review probably explores previous research on smart sticks or canes designed specifically for blind people. This exploration may encompass discussions on various sensor technologies, such as ultrasonic sensors, infrared

sensors, and gyroscopes, which are essential components for detecting obstacles and providing feedback to the user.Additionally, the literature review might examine studies on user preferences and feedback regarding smart stick designs and features. Understanding user needs and experiences likely influenced the design and functionality of the smart stick proposed by the authors.Moreover, the review may discuss emerging trends in assistive technology, such as the integration of GPS navigation, connectivity with mobile devices, and voice-based interfaces, which could further enhance the functionality and usability of smart sticks for blind people.By synthesizing insights from existing literature, the authors likely aimed to propose a novel smart stick design that addresses the limitations of traditional mobility aids and leverages advanced technologies to improve mobility, safety, and independence for blind individuals.

[2] The literature review likely explores existing technologies and solutions designed to assist visually impaired individuals in navigating their surroundings safely. It may discuss traditional white canes and their limitations, such as difficulty in detecting obstacles at head or chest level, and the challenges faced by blind individuals in crowded or dynamic environments. Additionally, the review likely examines previous research on smart assistive devices incorporating technologies like ultrasonic sensors, infrared sensors, and GPS navigation systems to enhance mobility for the visually impaired. It may highlight the need for more sophisticated and integrated solutions that offer real-time feedback and adaptability to various environments. The authors likely identified gaps in current approaches and aimed to address these through the development of their "Smart Blind Stick," combining advanced sensors and intelligent algorithms to provide more effective assistance to blind individuals in navigating their surroundings.

[3] The literature review likely delves into the challenges faced by visually impaired individuals in navigating their surroundings independently and safely. It may explore the limitations of traditional white canes and other existing mobility aids, emphasizing the need for more advanced solutions. The authors likely reviewed previous research on IoT (Internet of Things) applications in assistive technology for the visually impaired, examining how sensors, connectivity, and data processing can be leveraged to enhance mobility and safety.The review probably discusses various IoT-based solutions proposed in previous studies, including those incorporating ultrasonic sensors, infrared sensors, GPS technology, and communication modules. It may highlight the strengths and weaknesses of these approaches, identifying opportunities for improvement and innovation. Additionally, the literature review likely considers user feedback and usability studies conducted with visually impaired individuals to ensure that proposed solutions meet their needs effectively.

[4] The literature review likely explores the evolving landscape of assistive technologies for visually impaired individuals, focusing on the functionalities and features offered by existing blind sticks or canes. It may discuss the traditional white cane's role in aiding mobility and identifying obstacles but also its limitations in providing additional functionalities beyond basic navigation.The authors probably reviewed previous studies and advancements in multi-functional assistive devices tailored for the visually impaired, aiming to identify gaps or areas for improvement.

This review might include discussions on innovative technologies such as IoT, sensors, GPS, and haptic feedback systems, which have been integrated into smart blind stick designs to enhance user experience and safety.Additionally, the literature review likely examines user-centric design principles and feedback from visually impaired individuals to understand their specific needs and preferences regarding mobility aids. By synthesizing findings from previous research, the authors likely aimed to propose a novel multi-functional blind stick design that addresses existing limitations and incorporates advanced features to improve the independence and quality of life for visually impaired individuals.

[5] The literature review likely explores the historical development and current state of assistive technologies aimed at aiding navigation and enhancing independence for blind and visually impaired individuals. It may discuss the evolution of traditional white canes and their limitations in providing comprehensive assistance beyond basic obstacle detection.Furthermore, the review probably encompasses an examination of previous research on smart stick designs and related assistive devices.

This investigation likely includes a discussion of various sensor technologies such as ultrasonic sensors, infrared sensors, and GPS modules, which have been integrated into smart stick prototypes to provide enhanced functionality. Additionally, the literature review might delve into user-centered design principles and studies involving feedback from blind and visually impaired individuals. Understanding user needs, preferences, and challenges likely played a crucial role in shaping the design and functionality of the smart stick proposed by the authors. By synthesizing findings from existing literature, the authors likely aimed to propose a novel smart stick design that addresses the limitations of traditional white canes and incorporates advanced features to improve mobility, safety, and overall quality of life for blind and visually impaired individuals.

[6] The literature review likely investigates the challenges faced by blind individuals in navigating their surroundings independently and safely, particularly focusing on the limitations of traditional white canes and other mobility aids. It may discuss the need for innovative solutions that integrate advanced technologies to enhance mobility and address emergency situations effectively. Furthermore, the review probably explores previous research on smart walking sticks or canes designed for blind individuals, with a specific emphasis on systems integrated with SOS (emergency) navigation functionality. This exploration likely encompasses discussions on sensor technologies such as ultrasonic sensors, infrared sensors, and GPS modules, which are crucial for detecting obstacles and providing location-based assistance. Additionally, the literature review might discuss the importance of user feedback and usability studies in the development of smart walking sticks, ensuring that the proposed solutions meet the specific needs and preferences of blind individuals.

Understanding user requirements likely informed the design and features of the smart walking stick presented by the authors .By synthesizing insights from existing literature, the authors likely aimed to propose a novel smart walking stick design that not only assists blind individuals in navigation but also incorporates an SOS navigation system to address emergency situations, thereby enhancing their safety and independence.

[7] The literature review likely explores the evolution of assistive technologies designed to aid blind individuals in mobility and navigation. It may discuss the limitations of traditional white canes and the need for more advanced solutions that leverage electronic components and automation. Furthermore, the review probably delves into previous research on smart walking sticks or canes specifically tailored for blind individuals. This investigation likely includes discussions on sensor technologies such as ultrasonic sensors, infrared sensors, and gyroscopes, which are essential for detecting obstacles and providing feedback to the user.

Additionally, the literature review might explore advancements in electronic communication and computing that can be integrated into smart walking sticks to enhance functionality and usability. This could include features such as voice feedback, GPS navigation, and connectivity with mobile devices. Moreover, the review may discuss user-centered design principles and feedback from blind individuals to ensure that the proposed smart walking stick meets their specific needs and preferences. Understanding user requirements likely influenced the design and features of the electronic walking stick presented by the authors. By synthesizing insights from existing literature, the authors likely aimed to propose a novel electronic walking stick design that incorporates state-of-the-art electronic components.

[8] The literature review likely investigates the landscape of assistive technologies developed to aid blind individuals in navigating their surroundings safely and independently. It may discuss the limitations of traditional white canes and the necessity for more sophisticated solutions that integrate advanced sensor technologies. Furthermore, the review probably explores previous research on smart blind sticks or canes that utilize ultrasonic sensors as a key component. This exploration likely includes discussions on the principles of ultrasonic sensing, its advantages in detecting obstacles, and its potential for providing real-time feedback to users. Additionally, the literature review might examine studies on the effectiveness and usability of ultrasonic sensor-based assistive devices conducted with blind individuals.

Understanding user requirements likely informed the design and features of the smart walking stick presented by the authors. By synthesizing insights from existing literature, the authors likely aimed to propose a novel smart walking stick design that not only assists blind individuals in navigation but also incorporates an SOS navigation system to address emergency situations, thereby enhancing their safety and independence.

Understanding user experiences and preferences likely influenced the design and features of the smart blind stick proposed by the authors. Moreover, the review may discuss emerging trends and advancements in sensor technology, signal processing, and human-computer interaction that could further enhance the functionality and usability of ultrasonic sensor-based assistive devices. By synthesizing insights from existing literature, the authors likely aimed to propose a novel smart blind stick design that leverages ultrasonic sensor technology to improve obstacle detection and enhance the mobility and independence of blind individuals.

CHAPTER 3

SYSTEM ANALYSIS

3.1 PROBLEM DEFINITION

The sensor-based smart assistant system for disabled persons addresses the significant challenges faced by individuals with disabilities in their daily lives. One of the main issues is the lack of accessibility in both physical environments and technological devices. Many everyday tasks that able-bodied individuals take for granted, such as navigating through spaces, interacting with devices, and controlling their environment, can be extremely challenging for people with disabilities. The smart assistant system aims to improve accessibility by providing a user-friendly interface and a range of assistive functionalities that cater to the specific needs of individuals with disabilities.

Independence and autonomy are essential for maintaining a high quality of life, yet individuals with disabilities often rely heavily on caregivers or specialized assistive devices to perform even simple tasks. This reliance can lead to feelings of frustration, helplessness, and a loss of self-esteem. By providing users with tools and features that enable them to perform tasks independently, the smart assistant system promotes greater independence and self-reliance. Whether it's controlling home appliances, navigating through a crowded space, or communicating with others, the system empowers users to take control of their lives and live more independently.

Safety and security are also major concerns for individuals with disabilities, particularly those with mobility or sensory impairments. Without adequate support, they may be at increased risk of accidents, injuries, or emergencies. The smart assistant system includes features such as object detection, environmental monitoring, and health tracking to help users stay safe and secure in their homes and communities. By providing real-time alerts and assistance in emergency situations, the system enhances the safety and well-being of users, giving them and their loved ones peace of mind.

The smart assistant system aims to improve accessibility by providing a user-friendly interface and a range of assistive functionalities that cater to the specific needs of individuals with disabilities.

3.2 EXISTING SYSTEM

OpenCV (Open Source Computer Vision Library) can be utilized in sensor-based smart assistant systems for disabled persons for tasks such as object detection, gesture recognition, and facial recognition. However, it has some disadvantages in this context.

One of the fundamental algorithms in OpenCV is the Canny Edge Detection algorithm. Canny Edge Detection is a multi-step algorithm used to detect a wide range of edges in images. It begins with Gaussian blurring to smooth the image and reduce noise. Then, it calculates the gradient intensity and direction to highlight regions with significant intensity changes. Next, non-maximum suppression is applied to thin out the edges. Finally, hysteresis thresholding is used to isolate the strongest edges, discarding weak ones. This process results in a binary image with edges marked.

Another essential algorithm is Haar Cascade Object Detection . It is a machine learning-based approach used to detect objects in images or video streams. The algorithm involves training a cascade function from a large set of positive and negative images. This cascade function then employs a series of simple and complex Haar-like features to detect objects within an image.

Both of these algorithms are vital tools in computer vision, forming the basis for many higher-level vision tasks, such as object recognition, facial recognition, and motion tracking. They are frequently used in various applications, including robotics, security systems, medical image analysis, and augmented reality. OpenCV's extensive collection of algorithms and its ease of integration with popular programming languages like Python make it a go-to library for computer vision tasks.

3.2.1 DISADVANTAGES

Hardware Requirements : OpenCV algorithms can be resource-intensive, requiring powerful hardware for real-time processing. This can be a limitation for sensor-based systems, which may have limited computing resources.

Environmental Variability : OpenCV algorithms may struggle with variability in lighting conditions, background clutter, and occlusions. This can affect the reliability of the system, especially in real-world environments where conditions can change unpredictably.

Complexity : Implementing and fine-tuning OpenCV algorithms for specific tasks can be complex and time-consuming. This complexity may pose challenges for developers in customizing the system to meet the unique needs and preferences of individual users.

Privacy Concerns : Facial recognition algorithms in OpenCV raise privacy concerns, as they may inadvertently capture and analyze sensitive personal information. Ensuring user consent and data privacy protection is essential but challenging to achieve.

Limited Accessibility Features : While OpenCV offers powerful computer vision capabilities, it may not inherently support all accessibility features required for disabled users. Additional customization and integration with assistive technologies may be necessary to address specific accessibility needs.

Maintenance and Updates : OpenCV is an open-source library constantly evolving with new updates and improvements. However, ensuring compatibility with other components of the smart assistant system and maintaining the system's functionality over time can be challenging.

Overall, while OpenCV provides valuable tools for developing sensor-based smart assistant systems, it's essential to consider these disadvantages and address them through careful design, customization, and integration with other technologies to create effective and user-friendly solutions for disabled individuals.

3.3 PROPOSED SYSTEM

The proposed system combines the YOLO (You Only Look Once) object detection algorithm with Raspberry Pi to develop a sensor-based smart assistant system for disabled persons. This system aims to enhance accessibility and independence by leveraging real-time object detection and recognition capabilities. The Raspberry Pi serves as the central processing unit, running the YOLO algorithm and coordinating the interaction with sensors and actuators. With this setup, the system can detect and recognize objects in the user's environment, enabling them to interact with their surroundings more effectively.

The YOLO algorithm is the core component of the system, providing real-time object detection and recognition capabilities. It runs on the Raspberry Pi and processes video streams from the camera module to identify objects in the environment. Thanks to its speed and efficiency, YOLO is well-suited for real-time applications, making it an ideal choice for the smart assistant system. The camera module captures video streams of the user's environment, providing input to the YOLO algorithm for object detection and recognition. Mounted on the Raspberry Pi, the camera module can be positioned to provide the best view of the surroundings.

In addition to object detection and recognition, the smart assistant system interfaces with various sensors and actuators to provide assistance and support to users. Sensors such as ultrasonic sensors, motion sensors, and environmental sensors gather information about the user's surroundings, while actuators such as motors, lights, and speakers provide feedback and assistance based on the detected objects and environmental conditions. This comprehensive approach enables the system to control environmental parameters such as lighting, temperature, and electronic devices, as well as interface with assistive devices such as wheelchairs and robotic arms to assist users effectively.

Raspberry Pi boards are cost-effective, making them an accessible option for developing assistive technology solutions. The low cost of Raspberry Pi boards allows for the creation of affordable assistive devices that can benefit a wide range of users. Raspberry Pi boards are small and lightweight, making them suitable for embedded systems and portable devices. The compact size of Raspberry Pi boards allows for the development of compact and portable assistive devices that can be easily integrated into the user's environment.

Raspberry Pi boards are versatile and can be used for a wide range of applications, including home automation, robotics, and Internet of Things (IoT) projects. The versatility of Raspberry Pi boards makes them suitable for developing a wide variety of assistive technology solutions to meet the diverse needs of users.

Raspberry Pi boards feature General-Purpose Input/Output (GPIO) pins, which allow them to interface with a wide range of sensors, actuators, and other electronic components. The GPIO pins enable the Raspberry Pi board to interact with the physical world, making it well-suited for sensor-based applications such as the proposed smart assistant system.

Despite their small size and low cost, Raspberry Pi boards offer impressive processing power, capable of running complex algorithms and applications.
The processing power of Raspberry Pi boards makes them suitable for real-time applications such as object detection and recognition using algorithms like YOLO.

3.3.1 EXPECTED ADVANTAGES

Enhanced Accessibility:

The system improves accessibility for individuals with disabilities by providing real-time object detection and recognition capabilities.

Users can easily identify and interact with objects in their environment, enhancing their ability to navigate and perform daily tasks independently.

Improved Independence:

By leveraging the real-time capabilities of the YOLO algorithm and the processing power of the Raspberry Pi, the system empowers users to interact with their surroundings more effectively.

Users gain greater independence and autonomy, reducing their reliance on caregivers and assistive devices for everyday tasks.

Real-Time Assistance:

The system provides real-time assistance and support to users by detecting and recognizing objects in their environment.

Environmental parameters such as lighting, temperature, and electronic devices can be controlled automatically based on the detected objects, enhancing user comfort and convenience.

Customizable Interface:

The smart assistant system offers a customizable interface that can be tailored to the specific needs and preferences of individual users.

Users can interact with the system using voice commands, gestures, or a graphical user interface (GUI), providing a flexible and intuitive user experience.

Safety and Security:

The system enhances user safety and security by detecting and alerting users to potential hazards or emergencies in their environment. Environmental monitoring features provide real-time feedback on the user's surroundings, helping to prevent accidents and ensure user well-being .

Scalability and Flexibility:

The modular design of the system allows for easy scalability and flexibility, enabling additional sensors, actuators, and functionalities to be added as needed. The system can be customized to meet the evolving needs of users, ensuring that it remains relevant and useful over time.

CHAPTER 4

METHODOLOGY

The development of the Smart Assistive Walking Stick for the Visually Impaired will follow a structured methodology aimed at ensuring the effectiveness, reliability, and usability of the proposed system. The methodology will begin with a comprehensive review of existing literature and assistive technologies to identify relevant research findings, technological advancements, and user needs. Following this, the project will enter the design phase, where the specifications and requirements of the walking stick will be defined based on input from stakeholders, including individuals with visual impairments, caregivers, and healthcare professionals.

Once the design parameters are established, the development process will commence, involving the implementation of the necessary hardware and software components. This will include the integration of sensors, cameras, microcontrollers, and communication modules to enable object detection, data processing, and feedback mechanisms. The software development will focus on creating algorithms for object recognition, classification, and auditory feedback, leveraging machine learning techniques to enhance accuracy and responsiveness.

Throughout the development process, iterative testing and evaluation will be conducted to assess the performance and usability of the Smart Assistive Walking Stick. This will involve both simulated testing in controlled environments and real-world trials with individuals with visual impairments to gather feedback and identify areas for improvement. The iterative nature of the testing process will allow for continuous refinement of the system, ensuring that it meets the needs and expectations of its intended users.

Finally, the methodology will culminate in the deployment and dissemination of the Smart Assistive Walking Stick, with a focus on promoting accessibility, inclusivity, and user empowerment. This will involve collaborating with relevant stakeholders, including advocacy groups, assistive technology organizations, and healthcare providers, to ensure widespread adoption and impact. By following this structured methodology, the project aims to deliver a robust, user-centered solution that enhances the mobility and independence of individuals with visual impairments.

CHAPTER 5

COMPONENTS AND HARDWARE

5.1 OVERALL ARCHITECTURE

The block diagram appears to be a Raspberry Pi connected to various components including a USB camera, servo motor, converter, LCD display, and speaker. Here's a breakdown of how it might work, The Raspberry Pi is a minicomputer that can be used for a variety of purposes. It gets its power from a battery, likely via a DC-DC converter which converts the battery's voltage to a level that the Raspberry Pi can use. The Raspberry Pi can be connected to various input/output devices. The block diagram shows a USB camera, which can be used to capture video or images. It also shows a servo motor, which is a type of motor that can be precisely controlled. This could be used to control the movement of a robot or other device. The LCD display can be used to show information or images. The speaker can be used to generate sound. Ultra sonic sensor is used to analyze the obstacles in front of users and it emit certain frequencies if any obstacles are present in some distance it will sense and notify to the user by the help of servo motor . Ultrasonic sensors use sound waves to detect objects and measure distance. It could be used to help to navigate its environment.

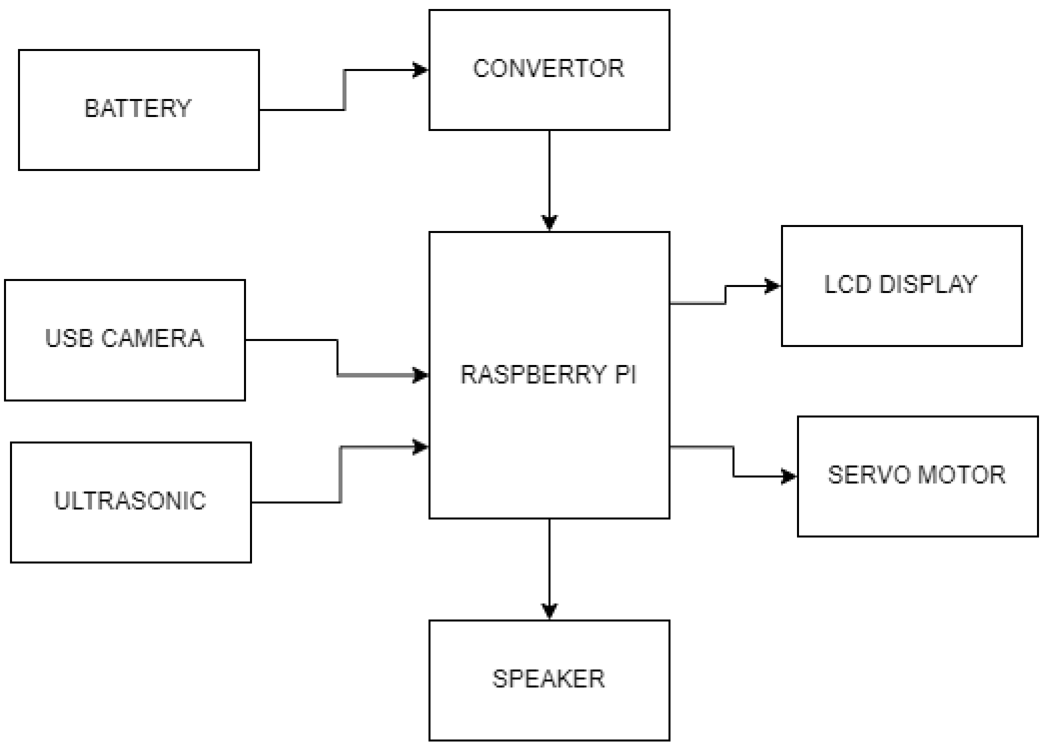

Figure 5.1 Overall Architecture

MODULE DESCRIPTION

5.2 HARDWARE DESCRIPTION

5.2.1 RASPBERRY PI :

The Raspberry Pi 4Model B+ is the latest product in the Raspberry Pi 4range, boasting a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market. The Raspberry Pi 4Model B+ maintains the same mechanical footprint as both the Raspberry Pi 2 Model B and the Raspberry Pi 4Model B.

Figure 5.2.1 Raspberry pi

The Raspberry Pi Compute Module 4+ (CM4+) is a range of DDR2-SODIMM-mechanically-compatible System on Modules (SoMs) containing processor, memory, eMMC Flash (on non-Lite variants) and supporting power circuitry. These modules allow a designer to leverage the Raspberry Pi hardware and software stack in their own custom systems and form factors. In addition these modules have extra IO interfaces over and above what is available on the Raspberry Pi model A/B boards, opening up more options for the designer. The CM3+ contains a BCM2837B0 processor (as used on the Raspberry Pi 4+), 1Gbyte LPDDR2 RAM and eMMC Flash. The CM3+ is currently available in 4 variants, CM3+/8GB, CM3+/16GB, CM3+/32GB and CM3+ Lite, which have 8, 16 and 32 Gigabytes of eMMC Flash, or no eMMC Flash, respectively. The CM3+ Lite product is the same as CM3+ except the eMMC Flash is not fitted, and the SD/eMMC interface pins are available for the user to connect their own SD/eMMC device. Note that the CM3+ is electrically identical and, with the exception of higher CPU z-height, physically identical to the legacy CM3 products. CM3+ modules require a software/firmware image dated November 2018 or newer to function correctly,

Hardware

- Low cost
- Low power
- High availability
- High reliability – Tested over millions of Raspberry Pis Produced to date – Module IO pins have 15 micro-inch hard gold plating over 2.5 micron Nickel .

Peripherals

- 48x GPIO
- 2x I2C
- 2x SPI
- 2x UART
- 2x SD/SDIO
- 1x HDMI 1.3a
- 1x USB2 HOST/OTG
- 1x DPI (Parallel RGB Display)
- 1x NAND interface (SMI)
- 1x 4-lane CSI Camera Interface (up to 1Gbps per lane)
- 1x 2-lane CSI Camera Interface (up to 1Gbps per lane)
- 1x 4-lane DSI Display Interface (up to 1Gbps per lane)
- 1x 2-lane DSI Display Interface (up to 1Gbps per lane) 2.3 Software
- ARMv8 Instruction Set
- Mature and stable Linux software stack – Latest Linux Kernel support – Many drivers upstreamed – Stable and well supported userland – Full availability of GPU functions using standard APIs.

Mechanical Specification The CM3+ modules conform to JEDEC MO-224 mechanical specification for 200 pin DDR2 (1.8V) SODIMM modules and therefore should work with the many DDR2 SODIMM sockets available on the market. (Please note that the pinout of the Compute Module is not the same as a DDR2 SODIMM module; they are not electrically compatible.) The SODIMM form factor was chosen as a way to provide the 200 pin connections using a standard, readily available and low cost connector compatible with low cost PCB manufacture. The maximum component height on the underside of the Compute Module is 1.2mm. The maximum component height on the top side of the compute module is 5.5mm .

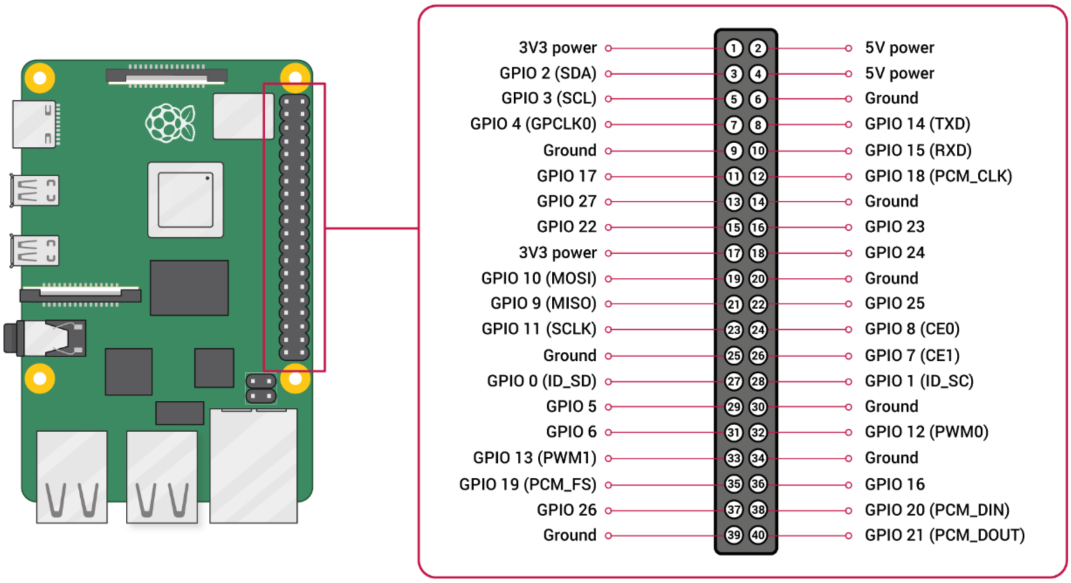

Figure 5.2.1.1 : the CM3+ mechanical dimensions

The Compute Module PCB thickness is 1.0mm +/- 0.1mm. Note that the location and arrangement of components on the Compute Module may change slightly over time due to revisions for cost and manufacturing considerations; however, maximum component heights and PCB thickness will be kept as specified. Figure 2 gives the CM3+ mechanical dimensions

The Compute Module 3+ has six separate supplies that must be present and powered at all times; you cannot leave any of them unpowered, even if a specific interface or GPIO bank is unused. The six supplies are as follows: 1. VBAT is used to power the BCM2837 processor core. It feeds the SMPS that generates the chip core voltage. 2. 3V3 powers various BCM2837 PHYs, IO and the eMMC Flash. 3. 1V8 powers various BCM2837 PHYs, IO and SDRAM. 4. VDAC powers the composite (TV-out) DAC. 5. GPIO0-27 VREF powers the GPIO 0-27 IO bank. 6. GPIO28-45 VREF powers the GPIO 28-45 IO bank.

5.2.2 LIQUID CRYSTAL DISPLAY (LCD)

A Liquid Crystal Display (LCD) is an electronically-modulated optical device shaped into a thin, flat panel made up of any number of colour or monochrome pixels filled with liquid crystals and arrayed in front of a light source (backlight) or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power. LCD has material, which continues the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered from similar to a crystal. They are used in similar applications where LEDs are used. These applications are display of display of numeric and alphanumeric characters in dot matrix and segmental displays.

LCD consists of two glass panels, with the liquid crystal materials sandwiched in between them. The inner surface of the glass plates is coated with transparent electrodes which define in between the electrodes and the crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. When a potential is applied across the cell, charge carriers flowing through the liquid will disrupt the molecular alignment and produce turbulence.

When the liquid is not activated, it is transparent. When the liquid is activated the molecular turbulence causes light to be scattered in all directions and the cell appears to be bright. Thus the required message is displayed. When the LCD is in the off state, the two polarizer’s and the liquid crystal rotate the light rays, such that they come out of the LCD without any orientation, and hence the LCD appears transparent. The fig. 6.1 shows the LCD display.

Figure 5.2.2 Liquid Crystal Display (LCD)

5.2.3 WORKING OF LCD DISPLAY

When sufficient voltage is applied to the electrodes the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating/highlighting the desired characters. The power supply should be of +5V, with maximum allowable transients of 10mV. To achieve a better/suitable contrast for the display the voltage (V) at pin 3 should be adjusted properly. A module should not be removed from a live circuit.

The ground terminal of the power supply must be isolated properly so that voltage is induced in it. The module should be isolated properly so that stray voltages are not induced, which could cause a flicking display. LCD is lightweight with only a few, millimetres thickness since the LCD consumes less power, they are compatible with low power electronic circuits, and can be powered for long durations. LCD does not generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. LCDs have long life and a wide operating temperature range. Before LCD is used for displaying proper initialization should be done. LCD is used to display the blood group and blood glucose level.

5.2.3.1 LCD PIN DESCRIPTION

The function of each pins of LCD is described below V_{CC}, V_{SS} and V_{EE} while V_{DD} and V_{SS} provide +5V and ground, respectively, V_{EE} is used for controlling LCD contrast.

Register select

There are two important registers inside the LCD. The RS pin is used for selection as follows. If RS=0, the instruction code register is selected, allowing the user to send a command such as clear display, cursor at home, etc. If RS=1 the data register is selected, allowing the user to send data to be displayed on the LCD.

Read/Write

R/W input allows the user to write information to the LCD or read information from it. R/W=1 when reading; R/W=0 when writing.

Enable

The enable pin is used by the LCD to latch information presented on its data pins. When data is supplied to data pins, a high to low pulse must be applied to this pin in order for the LCD to latch in the data present at the data pins.

D0 - D7

The 8-bit data pins, D0 – D7, are used to send information to the LCD or read contents of the LCD’S internal registers. There are also instruction codes that can be sent to the LCD to clear the display or force the cursor to the home position or blink the cursor. RS=0 is used to check the busy flag bit to see if the LCD is ready to receive information. The busy flag is D7 and can be read when R/W=1 and RS=0, as follows: if R/W=1, RS=0.when D7=1, the LCD is busy taking care of internal operation and will not accept any new information, when D7=0, the LCD is ready to receive new information.

TABLE : 5.2.3.1 PIN DESCRIPTION OF LCD

Pin No.	Symbol	Function
1	Vss	Ground terminal of Module
2	Vdd	Supply terminal of Module, +5v
3	Vo	Power supply for liquid crystal drive
4	RS	Register select RS=0…Instruction register RS=1…Data register
5	R/W	Read/Write R/W=1…Read R/W=0…Write
6	EN	Enable
7-14	DB0-DB7	Bi-directional Data Bus. Data Transfer is performed once, through DB0-DB7,incase of interface data length is 8-bits;and twice, thru DB4-DB7 in the case of interface data length is 4-bits.Upper four bits first then lower four bits.
15	LAMP-(L-)	LED or EL lamp power supply terminals
16	LAMP+(L+) (E2)	Enable

5.2.3 ULTRASONIC SENSOR

The HC-SR04 Ultrasonic Sensor is marketed as a Ranging Module as it can be accurately used for measuring distances in the range of 2cm to 400cm with an accuracy of 3mm. In order to send the 40 KHz Ultrasound, the TRIG Pin of the Ultrasonic Sensor must be held HIGH for a minimum duration of 10µS.

Figure 5.2.3 Ultrasonic Sensor

After this, the Ultrasonic Transmitter, will transmits a burst of 8-pulses of ultrasound at 40 KHz. Immediately, the control circuit in the sensor will change the state of the ECHO pin to HIGH. This pins stays HIGH until the ultrasound hits an object and returns to the Ultrasonic Receiver.

Based on the Time for which the Echo Pin stays HIGH, you can calculate the distance between the sensor and the object.

For example, if we calculated the time for which ECHO is HIGH as 588µS, then you can calculate the distance with the help of the speed of sound, which is equal to 340m/s.

Distance = Velocity of Sound / (Time/2) = 340m/s / (588µS /2) = 10cm.

5.2.4 LEAD ACID BATTERY

Lead acid batteries are the most common large-capacity rechargeable batteries. They are very popular because they are dependable and inexpensive on a cost-per-watt base. There are few other batteries that deliver bulk power as cheaply as lead acid, and this makes the battery cost-effective for automobiles, electrical vehicles, forklifts, marine and uninterruptible power supplies (UPS).

Lead acid batteries are built with a number of individual cells containing layers of lead alloy plates immersed in an electrolyte solution, typically made of 35% sulphuric acid (H_2SO_4) and 65%

water (Figure 1). Pure lead (Pb) is too soft and would not support itself, so small quantities of other metals are added to get the mechanical strength and improve electrical properties. The most common additives are antimony (Sb), calcium (Ca), tin (Sn) and selenium (Se). When the sulphuric acid comes into contact with the lead plate, a chemical reaction is occurring and energy is produced.

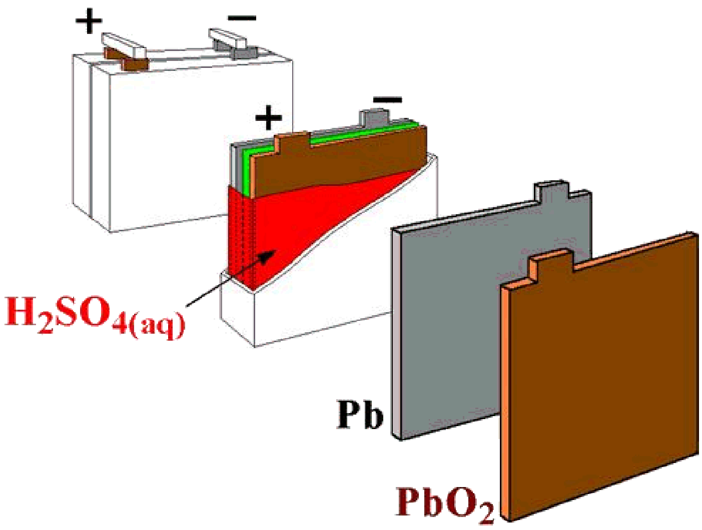

Figure 5.2.4 Systematic Typical Lead Acid Battery

Lead acid batteries are heavy and less durable than nickel (Ni) and lithium (Li) based systems when deep cycled or discharged (using most of their capacity). Lead acid batteries have a moderate life span and the charge retention is best among rechargeable batteries. The lead acid battery works well at cold temperatures and is superior to lithium-ion when operating in sub-zero conditions. Lead acid batteries can be divided into two main classes: vented lead acid batteries (spillable) and valve regulated lead acid (VRLA) batteries (sealed or non-spillable).

Vented Lead Acid Batteries :

Vented lead acid batteries are commonly called “flooded”, “spillable” or “wet cell” batteries because of their conspicuous use of liquid electrolyte (Figure 2). These batteries have a negative and a positive terminal on their top or sides along with vent caps on their top. The purpose of the vent caps is to allow for the escape of gases formed, hydrogen and oxygen, when the battery is charging. During normal operation, water is lost due to evaporation. In addition, the vent caps allow water and acid levels of the battery to be checked during maintenance.

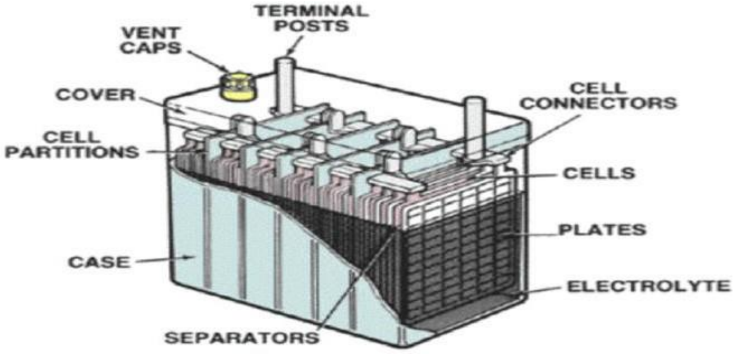

Figure 5.2.4.1 Systematic Typical Vented Lead Acid Battery

The main hazards associated with lead acid batteries are:

- Chemical (corrosive) hazards
- Risk of fire or explosion
- Electrical shocks
- Ergonomic hazards related to their heavy weight
- Transportation hazards
- Acid burns to the face and eyes comprise about 50% of injuries related to the use of lead acid batteries. The remaining injuries were mostly due to lifting or dropping batteries as they are quite heavy.
- Wear the proper personal protective equipment (PPE), specifically splash-proof goggles, acid- resistant lab coat or apron, safety shoes and rubber gloves. A face shield must also be worn when refilling batteries with electrolytes.
- Know where the emergency showers and emergency eyewash stations are located; they must be located near lead acid battery storage and charging areas.

- Slowly pour concentrated acid into water; do not add water to acid. (warning: electrolyte will become hot; do not close battery vents until electrolyte has cooled down)
- Use non-metallic containers and funnels.
- Ensure neutralizers (e.g. baking soda) are available for immediate use.
- Use extreme care to avoid spilling or splashing the sulphuric acid solution

The NFPA 1 and IFC state that, for vented lead acid and VRLA batteries, the ventilation system shall be designed to limit the maximum concentration of hydrogen to 1% of the total volume of the room or that a continuous ventilation shall be provided at a rate of not less than 1 cubic foot per minute per square foot [1ft3/min/ft2 or 0.0051 m3/(s . m2)] of floor area of the room. Other standards that are often used to determine proper ventilation include, but are not limited to:

National Fire Protection Association (NFPA) 76: suggests that any battery room exhaust fan capacity in Cubic Feet Minute (CFM) should be in the room area (in sq. ft.).

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 62: recommends 1 CFM per charging ampere to be provided, but not less than 6 air changes per hour.

While all batteries will operate within a fairly wide temperature range, the life expectancy of a battery can be severely shortened at high temperatures. The optimum temperature for air around a stationary battery is 22° +/- 5°C. The reduction of a vented lead acid battery life from heat above the recommended temperature is about 2.5% per each 1°C.

As these batteries contain an electrolyte in the liquid form, special spill containment systems (e.g. spill tray) (Figure 6) and the presence of an acid-neutralizing spill kit are required (NFPA 1 and IFC). An ABC- type fire extinguisher must also be present in these rooms.

5.2.5 SERVO MOTOR

A servo motor is a type of rotary actuator that allows for precise control of angular position. It consists of a small DC motor, a set of gears, and a feedback mechanism. Here's how it works:

Motor: The heart of a servo motor is a DC motor, usually a small, high-speed motor. This motor is responsible for providing the mechanical power required to drive the system.
Gears: The output shaft of the motor is connected to a series of gears. These gears help reduce the rotational speed of the motor while increasing torque, allowing the servo motor to exert more force on the output shaft.

Feedback Mechanism: One of the key features of a servo motor is its feedback mechanism, typically in the form of a potentiometer or an encoder. This mechanism provides feedback to the controller about the current position of the motor shaft.

Control Circuitry: The servo motor is controlled by a control circuit, which receives commands from an external source, such as a microcontroller or a computer. The control circuit compares the desired position (setpoint) with the actual position provided by the feedback mechanism and adjusts the motor's speed and direction accordingly to minimize the error.

Closed-Loop Control: Servo motors operate on a closed-loop control system, meaning that they continuously monitor their position and make adjustments to maintain the desired position accurately. This closed-loop control mechanism ensures precise positioning and repeatability, making servo motors suitable for applications requiring accurate control, such as robotics, automation, and motion control systems.

Servo motors are widely used in various applications due to their precise control, compact size, and ability to provide controlled motion over a wide range of speeds and positions. Here are some common uses of servo motors. Servo motors are commonly used in robotics for controlling the movement of robot joints and limbs. They provide precise and accurate motion control, making them ideal for applications such as robotic arms, grippers, and manipulators.

Servo motors are extensively used in remote-controlled (RC) vehicles, aircraft, and drones for controlling steering, throttle, and other functions. They provide responsive and accurate control, allowing users to maneuver RC vehicles with precision. Servo motors are used in camera stabilization systems such as gimbals and pan-tilt units.

Servo motors are popular in modeling and hobby projects for controlling moving parts such as doors, hatches, and landing gear. They provide a simple and cost-effective solution for adding motion control to model airplanes, cars, boats, and other projects.

Figure 5.2.5 Servo Motor

CHAPTER 6

6. SOFTWARE DESCRIPTION

6.1 PYTHON

6.1.1 PYTHON 3.7

Python is an interpreter, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace.

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object- oriented programming. Python’s elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in manya reason most platforms and may be freely distributed. The same site also contains distributions of and pointers to many free third party Python modules, programs and tools, and additional documentation.

The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications. This tutorial introduces the reader informally to the basic concepts and features of the Python language and system. It helps to have a Python interpreter handy for hands-on experience, but all examples are self-contained, so the tutorial can be read off- line as well. For a description of standard objects and modules, see library-index. Reference-index gives a more formal definition of the language. To write extensions in C or C++, read extending-index and c-api-index. There are also several books covering Python in depth.

This tutorial does not attempt to be comprehensive and cover every single feature, or even every commonly used feature. Instead, it introduces many of Python’s most notes worthy features, and will give you a good idea of the language’s flavor and style. After reading it, you will be able to read and write Python modules and programs, and you will be ready to learn more about the various Python library modules described in library-index. If you do much work on computers, eventually you find that there’s some task you’d like to automate.

For example, you may wish to perform a search-and-replace over a large number of text files, or rename and rearrange a bunch of photo files in a complicated way. Perhaps you’d like to write a small custom database, or a specialized GUI application or a simple game. If you're a professional software developer, you may have to work with several C/C++/Java libraries but find the usual write/compile/test/re-compile cycle is too slow. Perhaps you're writing a test suite for such a library and find writing the testing code a tedious task. Or maybe you've written a program that could use an extension language, and you don't want to design and implement a whole new language for your application.

Typing an end-of-file character (Control-D on Unix, Control-Z on Windows) at the primary prompt causes the interpreter to exit with a zero exit status. If that doesn't work, you can exit the interpreter by typing the following command: quit(). The interpreter's line-editing features include interactive editing, history substitution and code completion on systems that support read line. Perhaps the quickest check to see whether command line editing is supported is typing Control-P to the first Python prompt you get. If it beeps, you have command line editing; see Appendix Interactive Input Editing and History Substitution for an introduction to the keys. If nothing appears to happen, or if ^P is echoed, command line editing isn't available; you'll only be able to use backspace to remove characters from the current line.

The interpreter operates somewhat like the Unix shell: when called with standard input connected to a tty device, it reads and executes commands interactively; when called with a file name argument or with a file as standard input, it reads and executes a script from that file. A second way of starting the interpreter is python -c command [arg] ..., which executes the statement(s) in command, analogous to the shell's -c option. Since Python statements often contain spaces or other characters that are special to the shell, it is usually advised to quote commands in its entirety with single quotes. Some Python modules are also useful as scripts. These can be invoked using python-m module [arg]...,which executes the source file for the module as if you had spelled out its full name on the command line. When a script file is used, it is sometimes useful to be able to run the script and enter interactive mode afterwards. This can be done by passing -i before the script.

There are tools which use doc strings to automatically produce online or printed documentation or to let the user interactively browse through code; it's good practice to include doc strings in code that you write, so make a habit of it. The execution of a function introduces a new symbol table used for the local variables of the function. More precisely, all variable assignments in a functions to read the value in the local symbol table; whereas variable references first look in the local symbol table, then in the local symbol tables of enclosing functions, then in the global symbol table, and finally in the table of built-in names. Thus, global variables cannot be directly assigned a value within a function (unless named in a global statement), although they may be referenced.

The actual parameters (arguments) to a function call are introduced in the local symbol table of the called function when it is called; thus, arguments are passed using call by value (where the value is always an object reference, not the value of the object).1 When a function calls another function, a new local symbol table is created for that call. A function definition introduces the function name in the current symbol table. The value of the function name has a type that is recognized by the interpreter as a user-defined function. This value can be assigned to another name which can then also be used as a function.

Annotations are stored in the annotations attribute of the function as a dictionary and haven o effect on any other part of the function. Parameter annotations are defined by a colon after the parameter name, followed by an expression evaluating to the value of the annotation. Return annotations are defined by a literal ->, followed by an expression, between the parameter list and the colon denoting the end of the def statement.

The comparison operators in and not in check whether a value occurs (does not occur) in a sequence. The operator is and does not compare whether two objects are really the same object; this only matters for mutable objects like lists. All comparison operators have the same priority, which is lower than that of all numerical operators. Comparisons can be chained.

For example, a<b==c tests whether a is less than b and moreover b equals c. Comparisons may be combined using the Boolean operators and the outcome of a comparison (or of any other Boolean expression) may be negated with not. These have lower priorities than comparison operators; between them, not has the highest priority and or the lowest, so that A and not B or C is equivalent to (A and (not B)) or C. As always, parentheses can be used to express the desired composition. The Boolean operators and are so-called short-circuit operators: their arguments are evaluated from left to right, and evaluation stops as soon as the outcome is determined. For example, if A and C are true but Bis false, A and B and C does not evaluate the expression C. When used as a general value and not as a Boolean, the return value of a short-circuit operator is the last evaluated argument.

Classes provide a means of bundling data and functionality together. Creating a new class creates a new type of object, allowing new instances of that type to be made. Each class instance can have attributes attached to it for maintaining its state. Class instances can also have methods (defined by its class) for modifying its state. Compared with other programming languages, Python's class mechanism adds classes with a minimum of new syntax and semantics. It is a mixture of the class mechanisms found in C++ and Modula-3.

Python classes provide all the standard features of Object Oriented Programming: the class inheritance mechanism allows multiple base classes, a derived class can override any methods of its base class or classes, and a method can call the method of a base class with the same name. Objects can contain arbitrary amounts and kinds of data. As is true for modules, classes partake of the dynamic nature of Python: they are created at runtime, and can be modified further after creation. In C++ terminology, normally class members (including the data members) are public (except see below Private Variables), and all member functions are virtual. A sin Modula-3, there are no short hands for referencing the object's members from its methods: the method function is declared with an explicit first argument representing the object, which is provided implicitly by the call. A sin Small talk, classes themselves are objects.

This provides Semantics for importing and renaming. Unlike C++ and Modula-3, built-in types can be used as base classes for extension by the user. Also, like in C++, most built-in operators with special syntax (arithmetic operators, sub scripting etc.) can be redefined for class instances.(Lacking universally accepted terminology to talk about classes, I will make occasional use of Smalltalk and C++ terms. I would use Modula-3 terms, since its object- oriented semantics are closer to those of Python than C++, but I expect that few readers have heard of it.)

Objects have individuality, and multiple names (in multiple scopes) can be bound to the same object. This is known as aliasing in other languages. This is usually not appreciated on a first glance at Python, and can be safely ignored when dealing with immutable basic types (numbers, strings, tuples).However, aliasing has a possibly surprising effect on these mantic of Python code involving mutable objects such as lists, dictionaries, and most other types. This is usually used to the benefit of the program, since aliases behave like pointers in some respects. For example, passing an object is cheap since only a pointer is passed by the implementation; and if a function modifies an object passed as an argument, the caller will see the change — this eliminates the need for two different argument passing mechanisms as in Pascal.

A namespace is a mapping from names to objects. Most name spaces are currently implemented as Python dictionaries, but that's normally not noticeable in any way (except for performance), and it may change in the future. Examples of name spaces are: these to f built-in names (containing functions such as abs(), and built-in exception names); the global names in a module; and the local names in a function invocation. In a sense the set of attributes of an object also form a namespace.

The important thing to know about namespaces is that there is absolutely no relation between names in different namespaces; for instance, two different modules may both define a function maximize without confusion — users of the modules must prefix it with the module name. By the way, I use the word attribute for any name following a dot — for example, in the expression z. real, real is an attribute of the object z. Strictly speaking, references to names in modules are attribute references: in the expression modname.funcname, modname is a module object and funcname is an attribute of it. In this case there happens to be a straight forward mapping between the module's attributes and the global names defined in the module: they share the same namespace!1 Attributes may be read-only or writable. In the latter case, assignment to attributes is possible.

Module attributes are writable: you can write modname.the_answer = 42. Writable attributes may also be deleted with the del statement. For example, del mod name .the_ answer will remove the attribute the_answer from the object named by mod name. Namespaces are created at different moments and have different lifetimes. The namespace containing the built-in names is created when the Python interpreter starts up, and is never deleted. The global namespace for a module is created when the module definition is read in; normally, module namespaces also last until the interpreter quits.The statements executed by the top-level invocation of the interpreter, either read from a script file or interactively, are considered part of a module called main, so they have their own global namespace.(The built-in names actually also live in a module; this is called built ins.) The local namespace for a function is created when the function is called, and deleted when the function returns or raises an exception that is not handled within the function. (Actually, forgetting would be a better way to describe what actually happens.) Of course, recursive invocations each have their own local namespace.

To speed uploading modules, Python caches the compiled version of each module in the pycache directory under the name module. version.pyc, where the version encodes the format of the compiled file; it generally contains the Python version number. For example, in C Python release 3.3 the compiled version of spam.py would be cached as pycache/spam.cpython-33.pyc.

This naming convention allows compiled modules from different releases and different versions of Python to coexist. Python checks the modification date of the source against the compiled version to see if it's out of date and needs to be recompiled. This is a completely automatic process. Also, the compiled modules are platform-independent, so the same library can be shared among systems with different architectures. Python does not check the cache in two circumstances. First, it always recompiles and does not store the result for the module that's loaded directly from the command line. Second, it does not check the cache if there is no source module. To support anon-source (compiled only) distribution, the compiled module must be in the source directory, and there must not be a source module.

Some tips for experts:

You can use the -O or -OO switches on the Python command to reduce the size of a compiled module. The -O switch removes assert statements, the -OO switch removes both assert statements and doc strings. Since some programs may rely on having these available, you should only use this option if you know what you're doing. "Optimized" modules have an opt- tag and are usually smaller.

Future releases may change the effects of optimization:

A program doesn't run any faster when it is read from a .pyc file than when it is read from a .py file; the only thing that's faster about .pyc files is the speed with which they are loaded.

The module compile all can create .pyc files for all modules in a directory.

A switched-mode power supply (SMPS), sometimes referred to as a switch-mode power supply, or switcher, is a type of electronic power supply that includes a switching regulator. An SMPS, like all other power supply, transforms voltage and current properties as it delivers power to DC loads such personal computers from an either an AC or DC source (typically mains electricity; see AC adapter).

In contrast to a linear source of power, a switching-mode power source's pass transistor cycles among full-on and full-off stages with moderate dissipation and spends proportionally less time in phases with higher dissipation, minimizing lost energy. No power is lost in a hypothetical switched-mode power supply. Voltage is controlled by adjusting its proportion of on-to-off time, often known as duty cycles.

In contrast, a linear power source constantly releases electricity from the power transistor to regulate the output voltage. The switched-mode power supply's higher electrical efficiency is a significant advantage. Because the transformer may be far smaller, switched-mode power supplies can also be significantly lighter and smaller than a linear supply.

This is due to the fact that, in contrast to the 50 or 60 Hz mains frequency, it works at a high switching frequency that ranges from several hundred kHz to several MHz. Despite the smaller transformer, commercial designs often have a substantially higher component count and accompanying circuit complexity due to the power supply architecture and the need to control electromagnetic interference (EMI).

When switching regulators are required for higher efficiency, smaller size, or lighter weight, linear regulators are substituted for them. These are more challenging, though; switching currents can cause electrical noise problems if they aren't carefully controlled, and simple designs could have a poor power factor.SMPSs modify output current and voltage by switching optimally effective storage elements, such as inductors and capacitors, between multiple electrical topologies.

The effectiveness of converters made of perfect materials would be 100% because perfect switching elements, which may be approximately modelled by transistors functioning beyond the their active state, have no resistance when they are turned on and no current when they are turned off. As these ideal components don't exist in the actual world, a switching power supply can't be 100% efficient, but it is still much more efficient than a straight regulator.

6.2 THONNY IDE

Thonny is as mall and light weight Integrated Development Environment. It was developed to provide a small and fast IDE, which has only a few dependencies from other packages. Another goal was to be as independent as possible from a special Desktop Environment like KDE or GNOME, so Thonny only requires the GTK2 toolkit and therefore you only need the GTK2 runtime libraries installed to run it.

For compiling Thonny yourself, you will need the GTK (>= 2.6.0) libraries and header files. You will also need the Pango, Gliband ATK libraries and header files. All these files are available at http://www.gtk.org. Furthermore you need, of course, a C compiler and the Make tool; a C++ compiler is also required for the included Scintilla library. The GNU versions of these tools are recommended.

Compiling Thonny is quite easy. The following should do it:

% ./configure

% make

% make install

The configure script supports several common options, for a detailed list, type
% ./configure –help

There are also some compile time options which can be found in src/Thonny .h. Please see Appendix C for more information. In the case that your system lacks dynamic linking loader support, you probably want to pass the option --disable-vte to the configure script. This prevents compiling Thonny with dynamic linking loader support to automatically load libvte.so.4 if available. Thonny has been successfully compiled and tested under Debian 3.1 Sarge, Debian 4.0 Etch, Fedora Core 3/4/5, Linux From Scratch and FreeBSD 6.0.

It also compiles under Microsoft Windows At startup, Thonny loads all files from the last time Thonny was launched. You can disable this feature in the preferences dialog (see Figure 3-4). If you specify some files on the command line, only these files will be opened, but you can find the files from the last session in the file menu under the "Recent files" item. By default this contains the last 10 recently opened files. You can change the amount of recently opened files in the preferences dialog. You can start several instances of Thonny , but only the first will load files from the last session. To run a second instance of Thonny , do not specify any file names on the command-line, or disable opening files in a running instance using the appropriate command line option.

Thonny detects an already running instance of itself and opens files from the command-line in the already running instance. So, Thonny can be used to view and edit files by opening them from other programs such as a file manager. If you do not like this for some reason, you can disable using the first instance by using the appropriate command line option If you have installed libvte.so in your system, it is loaded automatically by Thonny , and you will have a terminal widget in the notebook at the bottom.

If Thonny cannot find libvte.so at startup, the terminal widget will not be loaded. So there is no need to install the package containing this file in order to run Thonny . Additionally, you can disable the use of the terminal widget by command line option, for more information see Section3.2.You can use this terminal (from now on called VTE) nearly as an usual terminal program like xterm. There is basic clipboard support. You can paste the contents of the clipboard by pressing the right mouse button to open the popup menu and choosing Paste. To copy text from the VTE, just select the desired text and then press the right mouse button and choose Copy from the pop up menu. On systems running the X Window System you can paste the last selected text by pressing the middle mouse button in the VTE (on 2-button mice, the middle button can often be simulated by pressing both mouse buttons together).

As long as a project is open, the Make and Run commands will use the project's settings, instead of the defaults. These will be used whichever document is currently displayed. The current project's settings are saved when it is closed, or when Thonny is shut down. When restarting Thonny , the previously opened project file that was in use at the end of the last session will be reopened.

Execute will run the corresponding executable file, shell script or interpreted script in a terminal window. Note that the Terminal tool path must be correctly set in the Tools tab of the Preferences dialog - you can use any terminal program that runs a Bourne compatible shell and accept the "-e" command line argument to start a command. After your program or script has finished executing, you will be prompted to press the return key. This allows you to review any text output from the program before the terminal window is closed.

By default the Compile and Build commands invoke the compiler and linker with only the basic arguments needed by all programs. Using Set Includes and Arguments you can add any include paths and compile flags for the compiler, any library names and paths for the linker, and any arguments you want to use when running Execute. Thonny has basic printing support. This means you can print a file by passing the filename of the current file to a command which actually prints the file.

CHAPTER 7

7. CODING

```
import cv2
import numpy as np
import RPi.GPIO as GPIO
import time
from LCDI2C_backpack import LCDI2C_backpack
import time
import RPi.GPIO as GPIO
import time

TRIG_PIN = 20
ECHO_PIN = 21
GPIO.setmode(GPIO.BCM)
GPIO.setup(TRIG_PIN, GPIO.OUT)
GPIO.setup(ECHO_PIN, GPIO.IN)

# Define GPIO pins
servoPIN = 17
GPIO.setmode(GPIO.BCM)
GPIO.setup(servoPIN, GPIO.OUT)
lcd = LCDI2C_backpack(0x27)
p = GPIO.PWM(servoPIN, 50)
p.start(2.5)
lcd.lcd_string("Blind Walking",lcd.LCD_LINE_1)
lcd.lcd_string("stick",lcd.LCD_LINE_2)
time.sleep(2)
lcd.clear()

# Load YOLO
net = cv2.dnn.readNet("yolov3.weights", "yolov3.cfg")
classes = []
with open("yolov3.txt", "r") as f:
```

```
    classes = [line.strip() for line in f.readlines()]

layer_names = net.getLayerNames()
output_layers = [layer_names[i - 1] for i in net.getUnconnectedOutLayers()]

# Initialize USB camera
cap = cv2.VideoCapture(0)

# Adjust the index if your camera is not the default
def get_distance():
    # Trigger the ultrasonic sensor
    GPIO.output(TRIG_PIN, GPIO.HIGH)
    time.sleep(0.00001)
    GPIO.output(TRIG_PIN, GPIO.LOW)

  # Measure the time for the ECHO pin to go high
    while GPIO.input(ECHO_PIN) == 0:
        pulse_start = time.time()

    while GPIO.input(ECHO_PIN) == 1:
        pulse_end = time.time()

   # Calculate distance from the time difference
    pulse_duration = pulse_end - pulse_start
    distance = pulse_duration * 17150

   # Speed of sound is 343 meters per second at sea level
    distance = round(distance, 2)

  # Round to two decimal places
    return distance
while True:
```

```
# Capture frame-by-frame
ret, frame = cap.read()
if not ret:
    break
height, width, channels = frame.shape

# Detecting objects
blob = cv2.dnn.blobFromImage(frame, 0.00392, (220, 220), (0, 0, 0), True, crop=False)
net.setInput(blob)
outs = net.forward(output_layers)

# Showing information on the screen
for out in outs:
    for detection in out:
        scores = detection[5:]
        class_id = np.argmax(scores)
        confidence = scores[class_id]
        if confidence > 0.5:

            # Object detected
            center_x = int(detection[0] * width)
            center_y = int(detection[1] * height)
            w = int(detection[2] * width)
            h = int(detection[3] * height)

            # Rectangle coordinates
            x = int(center_x - w / 2)
            y = int(center_y - h / 2)
            cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 255, 0), 2)
            cv2.putText(frame, classes[class_id], (x, y - 5),
cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 255, 0), 2)
            print(classes[class_id])
            lcd.clear() # we need to clear so it sets cursor back
            lcd.lcd_string(classes[class_id],lcd.LCD_LINE_1)
```

```
            m="espeak the_object_is"+str(classes[class_id])
            import os
            os.system(m)

    # Display the resulting frame
    cv2.imshow('Object Detection', frame)
    distance = get_distance()
    print(f"Distance: {distance} cm")
    if distance < 10:
        print("hi")
        p.ChangeDutyCycle(10)
        time.sleep(0.5)
        p.ChangeDutyCycle(2.5)
        time.sleep(0.5)

    # Press 'q' to quit the application
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

# Release the capture
cap.release()
cv2.destroyAllWindows()
```

CHAPTER 8

8.1 WORKING

The Smart Assistive Walking Stick for the Visually Impaired operates through a sophisticated interplay of hardware components and software algorithms meticulously designed to offer real-time assistance and feedback to users during their navigation endeavors. At its core, the walking stick is equipped with an array of sensors and cameras strategically positioned to capture and interpret the user's environment. These sensors, which may include ultrasonic sensors, LiDAR, or depth cameras, continuously collect data about the surrounding space, including the proximity and characteristics of nearby objects and obstacles.

Once the data is captured, it undergoes thorough processing using advanced computer vision algorithms aimed at detecting and recognizing objects within the user's path. Utilizing techniques such as convolutional neural networks (CNNs), the system analyzes the sensor data to identify objects based on their shape, size, and texture. This enables the walking stick to distinguish between various types of obstacles, ranging from stationary structures like walls and furniture to dynamic hazards such as moving vehicles or pedestrians.

Following object detection, the system meticulously processes and analyzes the data to assess the level of risk posed by each identified obstacle. Parameters such as distance, speed, and trajectory are carefully considered to prioritize the alerts and feedback provided to the user. This meticulous analysis ensures that users are informed about the most relevant threats to their safety, allowing them to make informed decisions about their navigation path.

To communicate this critical information effectively, the Smart Assistive Walking Stick incorporates multiple feedback mechanisms designed to cater to the diverse sensory needs of users. Auditory feedback, in the form of voice alerts or tones, serves as a primary means of informing users about the presence and location of obstacles. Additionally, tactile feedback, such as vibrations or haptic cues, may be integrated to provide supplementary sensory information. In certain scenarios, visual feedback through LED indicators or display screens may further enhance the user experience by offering additional cues and information.

Interaction with the walking stick is facilitated through intuitive controls or gestures, allowing users to customize settings, adjust sensitivity levels, or activate specific features to suit their preferences and needs. This user-centric approach ensures that individuals with visual impairments can seamlessly integrate the walking stick into their daily routines, empowering them to navigate their surroundings with confidence and independence.

Furthermore, the Smart Assistive Walking Stick is designed to continuously learn and adapt based on user feedback and environmental conditions. By leveraging machine learning algorithms, the system refines its performance over time, enhancing the accuracy of object detection and response mechanisms to better cater to the evolving needs of users. This adaptive learning process underscores the commitment to ongoing improvement and innovation, ensuring that the walking stick remains a reliable and effective tool for individuals with visual impairments.

The Smart Assistive Walking Stick for the Visually Impaired operates through a combination of hardware components and software algorithms, all designed to provide real-time assistance and feedback to users as they navigate their surroundings. Below is a detailed explanation of how the system works:

Sensors and Cameras : The walking stick is equipped with an array of sensors and cameras strategically positioned to capture the user's environment. These sensors may include ultrasonic sensors, LiDAR (Light Detection and Ranging) sensors, or depth cameras, depending on the specific design of the walking stick. These sensors continuously gather data about the user's surroundings, including the distance to nearby objects and obstacles.

Object Detection and Recognition : The captured data is processed using computer vision algorithms to detect and recognize objects in the user's path. Advanced image processing techniques, such as convolutional neural networks (CNNs), may be employed to analyze the sensor data and identify objects based on their shape, size, and texture. The system can distinguish between various types of obstacles, including stationary objects like walls or furniture, as well as dynamic hazards like moving vehicles or pedestrians.

Data Processing and Analysis : Once objects are detected and classified, the system analyzes the data to determine the level of risk posed by each obstacle. Factors such as distance, speed, and trajectory are taken into account to assess the potential danger to the user. This analysis helps prioritize the alerts and feedback provided to the user, ensuring that they are informed about the most relevant threats to their safety.

Feedback Mechanisms : The Smart Assistive Walking Stick employs multiple feedback mechanisms to convey information to the user in a clear and intuitive manner. Auditory feedback is provided through voice alerts or tones, informing the user about the presence and location of obstacles. Tactile feedback, such as vibrations or haptic cues, may also be incorporated to provide additional sensory information. In some cases, visual feedback through LED indicators or display screens may be used to supplement the auditory and tactile cues.

User Interaction and Control : The user interacts with the walking stick through simple controls or gestures, allowing them to customize settings, adjust sensitivity levels, or activate specific features. For example, the user may have the option to adjust the volume of voice alerts, customize the sensitivity of obstacle detection, or toggle between different modes of operation (e.g., indoor vs. outdoor navigation).

Continuous Learning and Adaptation : The system is designed to continuously learn and adapt based on user feedback and environmental conditions. Machine learning algorithms may be employed to improve the accuracy of object detection over time, incorporating feedback from users to refine the system's performance. This adaptive learning process ensures that the walking stick becomes more effective and responsive with prolonged use.

Overall, the Smart Assistive Walking Stick for the Visually Impaired combines cutting-edge technology with user-centered design principles to provide a comprehensive solution for enhancing mobility and independence. By leveraging advanced sensors, computer vision algorithms, and feedback mechanisms, the system empowers individuals with visual impairments to navigate their surroundings safely and confidently.

CHAPTER 9

9. DESIGN, OUTPUT IMAGES AND LIVE DEMO IMAGES

9.1 SCREENSHOT OF THE PRODUCT

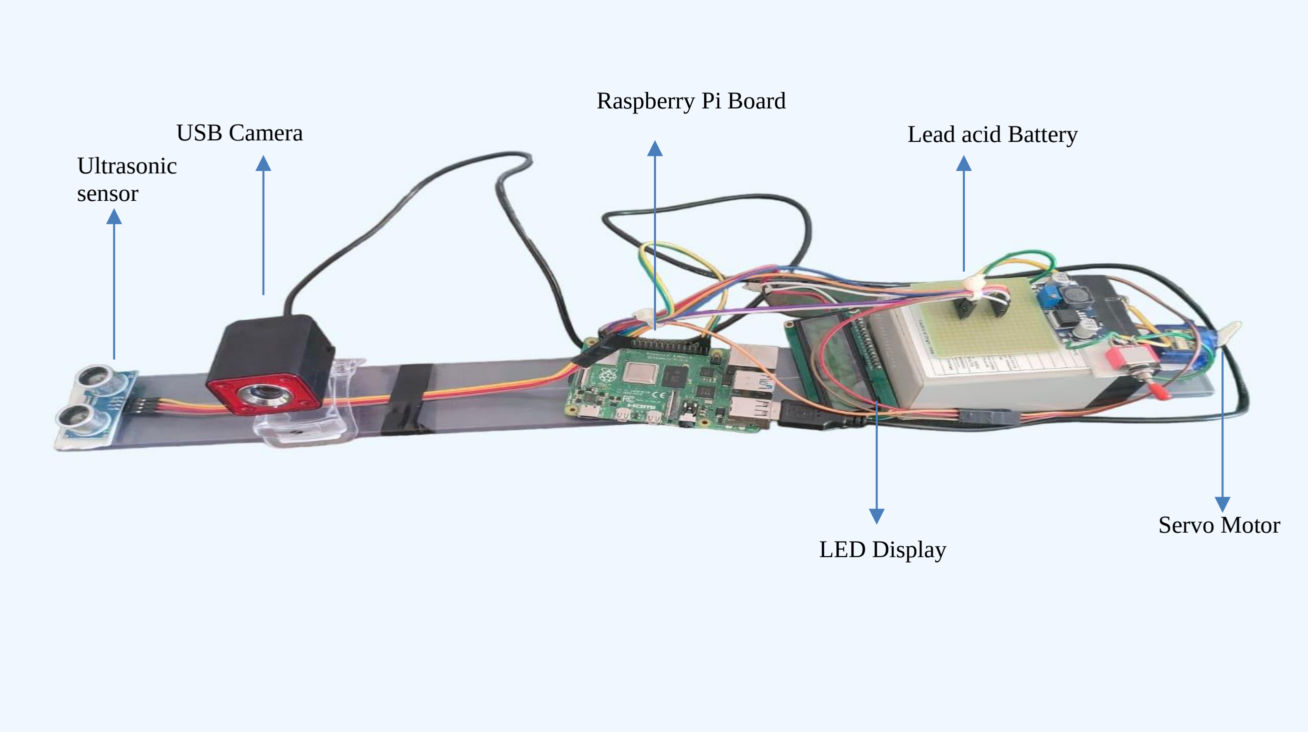

Figure 9.1 Prototype

9.2 SCREEENSHOT - OUTPUT IMAGES

9.2.1 SCREENSHOT 1 – FACE RECOGNITION

Figure 9.2.1 Face Recognition

9.2.2 SCREENSHOT 2 – KEYBOARD

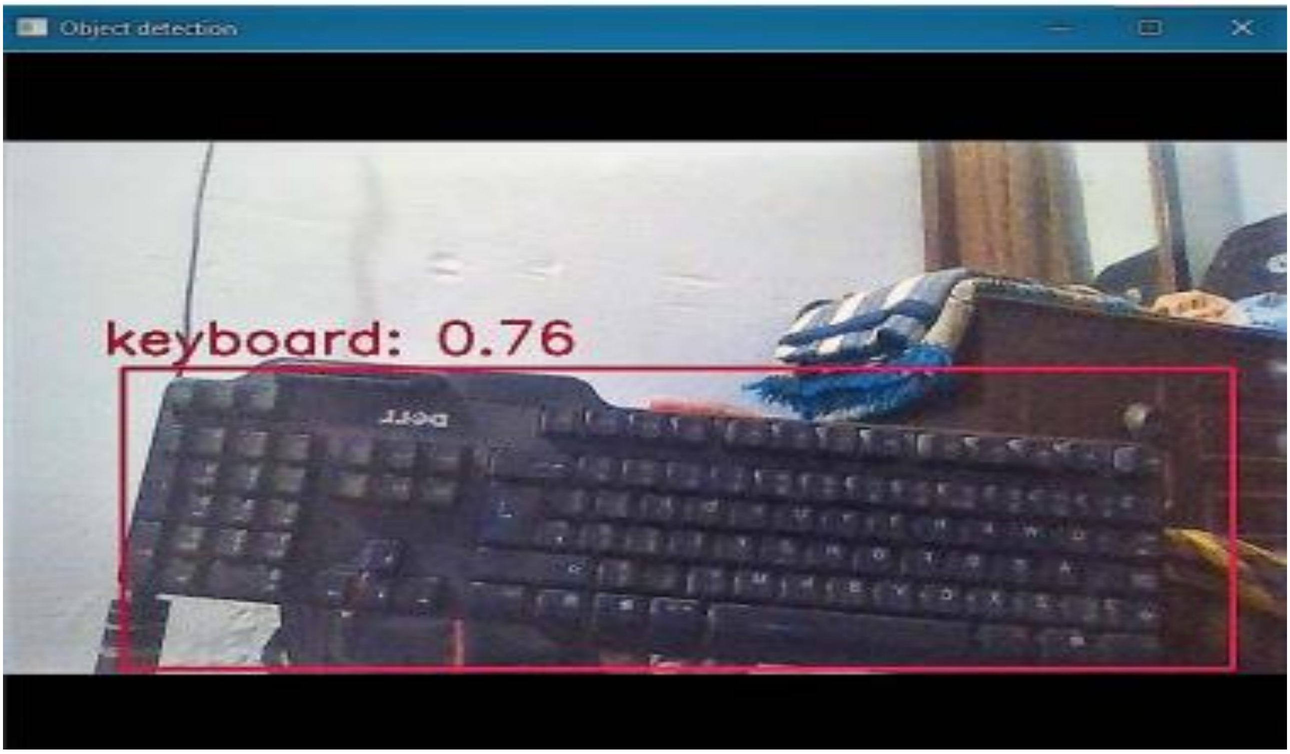

Figure 9.2.2 Keyboard

9.2.3 SCREENSHOT 3 – BOTTLE

Figure 9.2.3 Bottle

9.2.4 SCREENSHOT 4 – BACKPACK

Figure 9.2.4 Backpack

9.2.5 SCREENSHOT 5 – CELL PHONE

Figure 9.2.5 Cell Phone

9.3 SCREENSHOT - LIVE DEMO IMAGES

9.3.1 SCREENSHOT 1 – LCD DISPLAY BLIND STICK

Figure 9.3.1 LCD Display Blind Stick

9.3.2 SCREENSHOT 2 – LCD DISPLAY BOTTLE

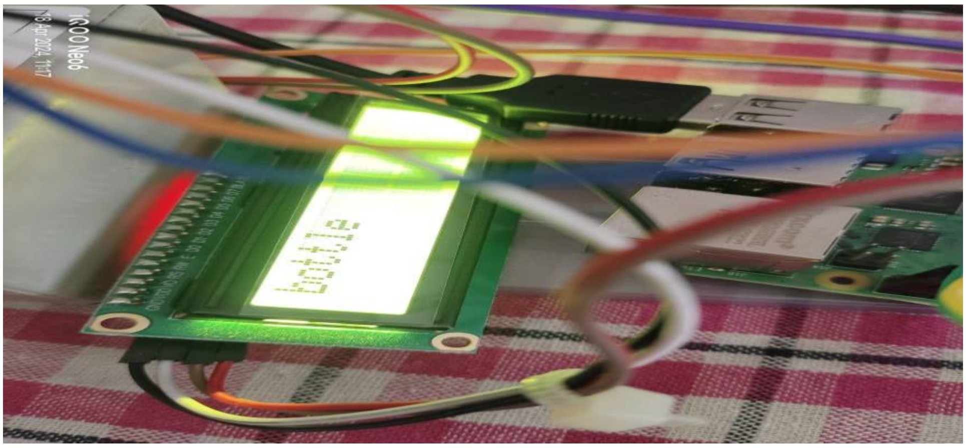

Figure 9.3.2 LCD Display Bottle

9.3.3 SCREENSHOT 3 – IMAGE ORIENTATION

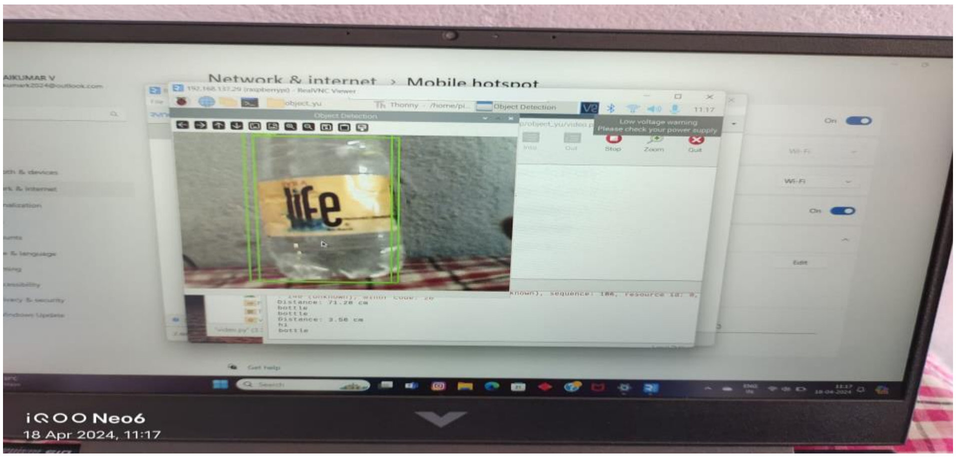

Figure 9.3.3 Image Orientation

CHAPTER 10

10. FUTURE WORKS AND CONCLUSION

10.1 CONCLUSION

In conclusion, the Smart Assistive Walking Stick for the Visually Impaired represents a significant advancement in assistive technology, offering a comprehensive solution to address the mobility challenges faced by individuals with visual impairments. Through the integration of cutting-edge technologies such as computer vision, object detection, and auditory feedback mechanisms, the walking stick provides users with real-time assistance and feedback to navigate their surroundings safely and independently.

The development and implementation of this project have been guided by a commitment to inclusivity, accessibility, and user empowerment. By prioritizing user-centered design principles and incorporating feedback from stakeholders, including individuals with visual impairments, caregivers, and healthcare professionals, the walking stick has been tailored to meet the unique needs and preferences of its intended users.

Furthermore, the iterative testing and evaluation process has ensured the reliability, effectiveness, and usability of the Smart Assistive Walking Stick in diverse real-world scenarios. Through continuous refinement and adaptation, the system has demonstrated its ability to provide accurate and timely assistance, enhancing the mobility and independence of individuals with visual impairments.

Looking ahead, the impact of the Smart Assistive Walking Stick extends beyond mere navigation—it fosters a sense of dignity, autonomy, and inclusion for individuals with visual impairments. By breaking down barriers and empowering users to navigate their surroundings with confidence and ease, the walking stick opens up new opportunities for exploration, engagement, and participation in society.

In essence, the Smart Assistive Walking Stick for the Visually Impaired stands as a testament to the transformative power of technology when guided by empathy, innovation, and a commitment to social good. As we continue to push the boundaries of what is possible, let us remain steadfast in our pursuit of creating a more accessible, inclusive, and equitable world for all.

10.2 FUTURE SCOPE

Future work in the realm of sensor-based smart assistant systems for disabled persons could focus on several areas to enhance functionality, accessibility, and usability. Here are some potential directions for future research and development.

- **Improve Sensor Technologies .**
- **Integration of AI and Machine Learning.**
- **Enhanced Human-Computer Interaction.**

The system's object detection and recognition capabilities can be further enhanced by training the YOLO algorithm on larger and more diverse datasets. By improving the accuracy and reliability of object recognition, the system can better assist users in identifying and interacting with objects in their environment. Future developments could include the recognition of more complex objects, such as specific brands or models of electronic devices, as well as the ability to recognize objects in cluttered or dynamic environments. The smart assistant system can be integrated with a wider range of sensors and actuators to provide more comprehensive assistance and support to users. Advanced sensors such as depth cameras, LiDAR, and thermal imaging cameras can be used to gather more detailed information about the user's environment, allowing for more accurate object detection and environmental monitoring. Actuators such as robotic arms, haptic feedback devices, and wearable devices can be used to provide more sophisticated feedback and assistance to users based on the detected objects and environmental conditions.

The smart assistant system can be integrated with cloud-based services to enable remote monitoring, management, and data analysis. Cloud integration allows for centralized control and monitoring of multiple smart assistant systems, making it easier to manage and support users in different locations. Cloud-based data analysis can provide valuable insights into user behavior, preferences, and needs, allowing for more personalized and effective assistance and support.

CHAPTER 11

ACKNOWLEDGEMENT

We would like to express our deepest gratitude to all those who have contributed to this project. Firstly, We are indebted to our guide [Mrs.S.Priya] for their invaluable guidance, support, and encouragement throughout this journey. Their expertise and mentorship have been instrumental in shaping the direction of this work.

We are also thankful to [Nehru Institute of Engineering and technology] for providing the necessary resources and facilities for conducting this research.

Furthermore, We extend our appreciation to our batch mates Vimalpandiyan.K, Jeyasanthosh.P, Karthik.K and Sanjaikumar.V for financial support, which enabled us to carry out this research. Their funding has been instrumental in covering expenses related to equipment, materials, and other essential resources.

We are grateful to our colleagues and fellow researchers who have provided valuable insights, feedback, and collaboration throughout this project. Their contributions have enriched the quality of this work and facilitated meaningful discussions and exchanges of ideas.

Last but not least, We would like to thank our family and friends for their unwavering support, understanding, and encouragement during this endeavor. Their love, patience, and encouragement have been a constant source of motivation and inspiration.

In conclusion, We acknowledge the collective efforts of all individuals and organizations mentioned above, without whom this project would not have been possible. Thank you for invaluable contributions and support.

CHAPTER 12

REFERENCE

[1] N. Loganathan, K. Lakshmi, N. Chandrasekaran, S. R. Cibisakaravarthi, R. Hari Priyanga, K. Harsha Varthini, "Smart Stick for Blind People",2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS).

[2] PrashikChavan, Kartikesh Ambavade, Siddhesh Bajad, Rohan Chaudhari, Roshani Raut,"Smart Blind Stick",2022 6th International Conference On Computing Communication Control And Automation (ICCUBEA).

[3] Rajanish Kumar Kaushal,K. Tamilarasi,P. Babu,T. A. Mohanaprakash,S. E. Murthy,M Jogendra Kumar,"Smart Blind Stick for Visually Impaired People using IoT",2022 International Conference on Automation Computing and Renewable Systems (ICACRS).

[4] Vanitha Kunta,Charitha Tuniki,U. Sairam,"Multi-Functional Blind Stick for Visually Impaired People",2020 5th International Conference on Communication and Electronics Systems (ICCES).

[5] Mukesh Prasad Agrawal,Atma Ram Gupta,"Smart Stick for the Blind and Visually Impaired People",2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT).

[6] Saurav Mohapatra,Subham Rout,Varun Tripathi,Tanish Saxena,Yepuganti Karuna,"Smart Walking Stick for Blind Integrated with SOS Navigation System",2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI).

[7] R. Kavitha,K. Akshatha,"Smart Electronic Walking Stick for the Blind People",2023 2nd International Conference on Advancements in Electrical Electronics Communication Computing and Automation (ICAECA).

[8] Naiwrita Dey,Ankita Paul,Pritha Ghosh,Chandrama Mukherjee,Rahul De,Sohini Dey,"Ultrasonic Sensor Based Smart Blind Stick",2018 International Conference on Current Trends towards Converging Technologies (ICCTCT).

[9] UN. (2021). Disability-Inclusive Communications Guidelines. [Online]. Available: https://www.un.org/sites/un2.un.org/files/un_disability-inclusive_communication_guidelines.pdf.

[10] C. Khasnabis, Z. Mirza, and M. MacLachlan, ‘‘Opening the GATE to inclusion for people with disabilities,’’ The Lancet, vol. 386, no. 10010, pp. 2229–2230, 2015, doi: 10.1016/S0140-6736(15)01093-4.

[11] UN. (2022). Ageing and Disability. [Online]. Available: https://www.un.org/development/desa/disabilities/disability-and-ageing.html.

[12] United Nations. (2019). United Nations Disability Inclusion Strategy. [Online]. Available:https://www.un.org/development/desa/disabilities/wpcontent/uploads/sites/15/2019/03/UNDIS_20-March-2019_for-HLCM.P.pdf.

[13] A. Lawson, ‘‘United Nations convention on the rights of persons with disabilities (CRPD),’’ in Proc. Int. Eur. Labour Law, Dec. 2018, pp. 455–461.

[14] G. L. Albrecht, S. L. Snyder, J. Bickenbach, D. T. Mitchell, and W. O. Schalick, Encyclopedia of Disability, vol. 1. New York, NY, USA: SAGE, 2006.

[15] N. Jehn and K. Griffin, ‘‘Assistive technology resource guide,’’ UKGovernment’s Dept. Int. Develop. (DFID), U.K., Tech. Rep., 920, 2008. [Online]. Available: https://assistedtechnology.weebly.com/uploads/3/4/1/9/3419723/at_guide.pdf.

[16] B. Rohwerder. (2018). Assistive Technologies in Developing Countries: Knowledge, Evidence and Learning for Development. [Online]. Available: https://assets.publishing.service.gov.uk/media/5af976ab40f0b622d4e9810f/Assistive_technologies_in_developing-countries.pdf.

[17] L. B. Theng, Assistive Technologies for Physical and Cognitive Disabilities. Hershey, PA, USA: IGI Global, 2014.

[18] Assistive Technology for Children With Disabilities: Creating Opportunities for Education, Inclusion and Participation A Discussion Paper, WorldHealth Organization, Geneva, Switzerland, 2015, p. 34.

[19] N. Gallup, J. Bow, and J. Pearce, ‘‘Economic potential for distributed manufacturing of adaptive aids for arthritis patients in the U.S.,’’ Geriatrics, vol. 3, no. 4, p. 89, Dec. 2018.

[20] J. M. Pearce, Open-Source Lab: How to Build Your Own Hardware and Reduce Research Costs. Amsterdam, The Netherlands: Elsevier, 2013.