A Minor Project Report

On

SMART STRIDE

Submitted in partial fulfillment of requirements for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

Under the guidance of

Mrs. S. ANANTHI

Assistant Professor/CSE

Submitted By

JAISHRI V S (927622BCS040)

BOOMIKA M (927622BCS016)

KEERTHANA S (927622BCS051)

INDHUJA S R (927622BCS036)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.KUMARASAMY COLLEGE OF ENGINEERING

(Autonomous)

KARUR – 639 113

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M. KUMARASAMY COLLEGE OF ENGINEERING

(Autonomous Institution affiliated to Anna University, Chennai)

KARUR – 639113

BONAFIDE CERTIFICATE

Certified that this minor project report **"SMART STRIDE"** is the bonafide work of **"JAISHRI V S (927622BCS040), BOOMIKA M (927622BCS016), KEERTHANA S (927622BCS051), INDHUJA S R (927622BCS036)"** who carried out the project work during the academic year 2023-2024 under my supervision.

Signature	Signature
Mrs. S. ANANTHI M.E.,	**Dr. D. PRADEEP M.E., Ph.D.,**
SUPERVISOR,	**HEAD OF THE DEPARTMENT,**
Department of Computer Science and Engineering, M. Kumarasamy College of Engineering, Thalavapalayam, Karur -639113	Department of Computer Science and Engineering, M. Kumarasamy College of Engineering Thalavapalayam, Karur -639113.

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ABSTRACT

The uniqueness of the "Smart Stride" project lies in its seamless integration of multiple technologies to provide a comprehensive and user-friendly solution for visually impaired individuals. Unlike traditional mobility aids, this system combines sensor-based obstacle detection with real-time audio feedback delivered through a Bluetooth device, offering an intuitive and hands-free navigation experience. Additionally, the incorporation of solar-powered charging for the Bluetooth device ensures continuous functionality without the need for manual recharging, making the system more sustainable and convenient for users. This innovative approach not only enhances safety and independence but also offers a portable and energy-efficient solution, setting it apart from existing mobility aids for the blind.

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Note: 1- Low, 2-Medium, 3- High

SUPERVISOR **HEAD OF THE DEPARTMENT**

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LIST OF ABBREVATION

IR	Infrared
LED	Liquid Emitted Display
RF	Radio Frequency
IOT	Internet of Things
LCD	Liquid Crystal Display
IDE	Integrated Development Environment
BLE	Bluetooth Low Energy
RFID	Radio-Frequency Identification
AI	Artificial intelligence

CHAPTER -1

INTRODUCTION

In today's world, Blind people's challenges significant obstacles to their freedom and safety, where urban landscapes are changing quickly. In Traditional approaches to helping blind individuals sometimes fail to offer complete answers to their mobility and awareness demands, regardless of technological developments. The prevalence of vision impairment affects people's confidence and ability to navigate new environments in addition to their daily routines. Given that there are an estimated 253 million persons with vision impairment globally, creative solutions are needed to solve these grave issues. By utilizing Internet of Things (IoT) technology, the "Smart Stride" project aims to transform the assistive equipment market by creating intelligent footwear specifically designed to meet the needs of blind individuals.

The challenges faced by the blind are entrenched in physical assistance and traditional aids. The suggested remedy represents a paradigm change in terms of environmental and human impacts. We are using IOT capabilities to give blind people real-time warnings and help with navigation. The smart shoes enable individuals to move through their surroundings more confidently and independently by using sensors for environmental monitoring and obstacle detection. Additionally, the project integrates IoT-based security capabilities to address privacy and security issues.

In conclusion, by embracing innovation and utilizing IoT capabilities, smart stride project offers a substantial advancement in supported automation and has the potential to change the lives of blind people worldwide.

1.1. OVERVIEW

"Smart Stride" is an innovative project designed to empower visually impaired individuals through advanced technology. By seamlessly integrating multiple IoT technologies, Smart Stride offers an intuitive, hands-free navigation system that enhances safety, independence, and convenience.

1.2 DOMAIN INTRODUCTION

The field of assistive technology focuses on developing tools and systems that improve the quality of life for individuals with disabilities. For visually impaired individuals, navigating complex environments safely and independently remains a significant challenge. Traditional mobility aids, such as white canes and guide dogs, provide basic support but lack real-time awareness and discretion in crowded spaces. Advancements in technology, particularly with sensor-based systems and Bluetooth connectivity, are enabling smarter, more intuitive solutions. The integration of solar power further enhances sustainability and convenience, making these technologies more energy-efficient and accessible. The "Smart Stride" project exemplifies these innovations by providing a discreet, hands-free, and sustainable navigation system tailored to the needs of visually impaired individuals .

1.3 PROBLEM STATEMENT

Traditional mobility aids for the visually impaired often use loud external audio alerts, causing inconvenience to others, and require frequent recharging. This project aims to solve these issues by delivering private audio alerts through Bluetooth, ensuring a more discreet and sustainable navigation experience.

1.4 OBJECTIVE

Develop an integrated system that combines sensor-based obstacle detection and real-time audio feedback, allowing visually impaired users to navigate their environment safely and confidently.

Implement a solar-charging mechanism for the Bluetooth device, ensuring continuous functionality without the need for manual recharging, promoting an eco-friendly solution for users.

Create an intuitive and user-friendly interface that allows individuals with varying levels of technological familiarity to easily operate the system, enhancing their independence and mobility.

CHAPTER 2

LITERATURE SURVEY

IOT based Navigation Assistance for Visually impaired prople proposed by M. Arunkumar and E. Lokesh [1], the authors introduce an innovative IoT-based smart shoe designed to facilitate independent travel, integrating an ultrasonic sensor and an Arduino UNO board. The shoe operates by detecting obstacles in the wearer's path, triggering a buzzing alert mechanism upon detection. This alert system provides immediate feedback to the wearer, effectively notifying them of potential obstacles in real-time, thus enhancing their situational awareness and aiding in safe navigation. The simplicity of the buzzer as the sole outcome of object detection underscores the device's practicality and user-friendly design, making it accessible and effective for individuals seeking assistance in navigating their surroundings independently.

The paper of P. Ebby Darney [2], This project employs an ultrasonic sensor to detect obstacles along a blind person's pathway, with a DC vibrator motor providing alerts upon obstacle detection. Additionally, GPS technology is utilized to track the location of the blind individual. However, relying solely on one sensor may result in a limited scanning method, potentially reducing the system's adaptability to different obstacles and environmental situations. To enhance flexibility and accuracy, future iterations could consider integrating multiple sensors, such as infrared or camera-based systems, alongside modern sensor fusion algorithms, enabling more comprehensive obstacle identifications and improving the overall effectiveness of the assistance system for blind individuals.

IOT -Based Smart Shoe for Blind proposed by Teja Chava [3], This paper aims to enhance the autonomy and safety of blind people by developing a device capable of detecting obstacles in their path. The device utilizes infrared (IR) sensors coupled with servo motors to scan the surrounding atmosphere for obstacles, maximizing coverage. However, it's essential to note that the IR sensor's signal range is constrained, potentially limiting accuracy over long distances or when obstructed by walls and other objects.

In the study presented by Alessio Carullo [4], This paper presents an innovative ultrasonic sensor designed for calculating base length at specific points on a motor vehicle, utilizing a method that incorporates the frequency result of the ultrasonic transducer. The sensor achieves sub-wavelength detection capabilities. This advanced methodology enables precise and accurate distance measurements, enhancing the sensor's applicability and effectiveness in various automotive contexts.

2.1 EXISTING SYSTEM ARCHITECTURE

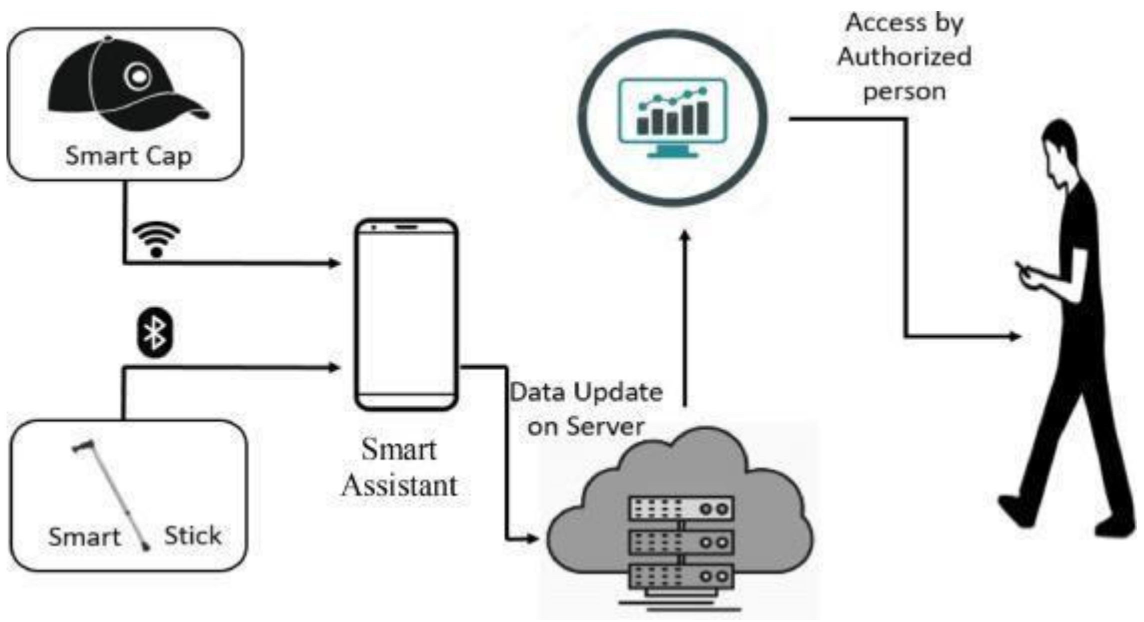


Fig 1: System Architecture for Smart Cap and Stick

2.2 DRAWBACKS OF EXISTING SYSTEM ARCHITECTURE

Many smart shoe systems, particularly those using ultrasonic or infrared sensors, have a limited range of detection, which may not provide enough time for users to react to obstacles at a distance.

The continuous use of sensors, motors, and communication systems often leads to short battery life, requiring frequent recharging, which can limit the device's for daily use.

2.3 PROPOSED SYSTEM ARCHITECTURE

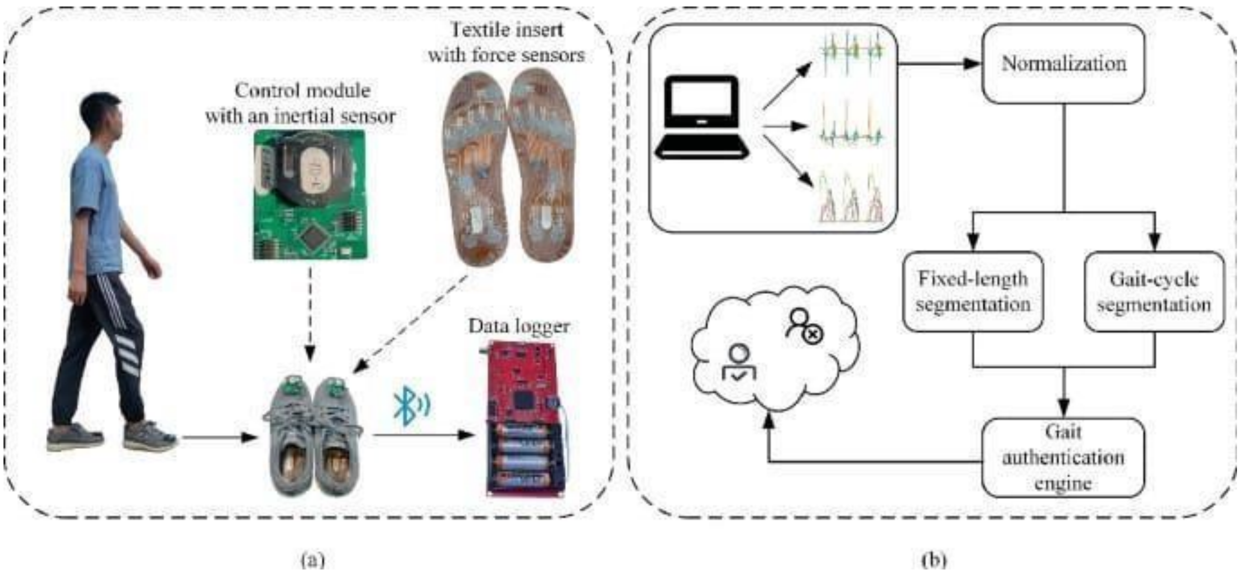


Fig 2: System Architecture for Smart Stride

CHAPTER 3

PROJECT METHODOLOGY

3.1 BLOCK DIAGRAM

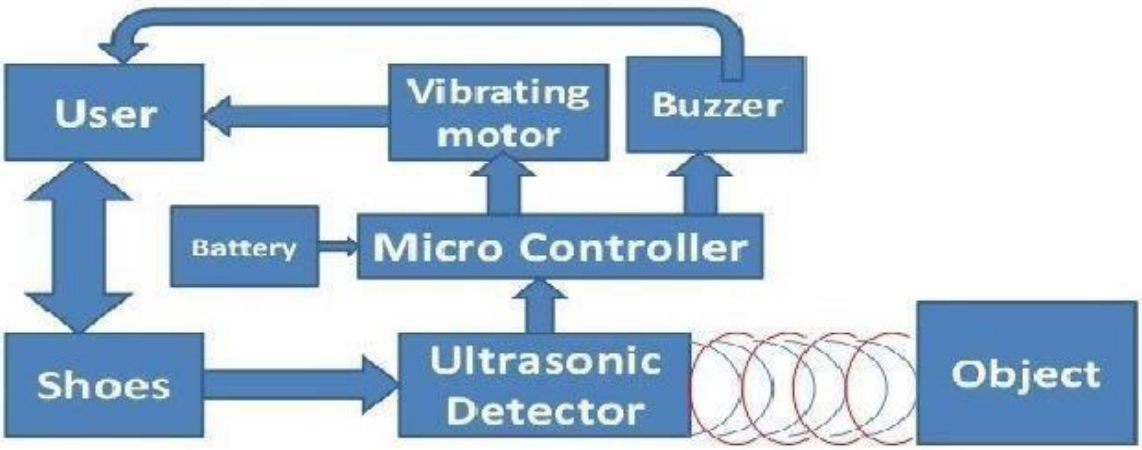


Fig 3.1 : Block Diagram for Smart Stride

The block diagram explains for a "Blind People's Shoes with Obstacle Detection" project can cover how each component contributes to enabling the shoes to detect obstacles and help blind individuals navigate safely.

3.2 MODULE DESCRIPTION

Modules available:

- Ultrasonic sensor
- Radio frequency
- Power supply
- Arduino uno
- LCD display
- Buzzer
- Bluetooth

ULTRASONIC SENSOR

An **ultrasonic sensor** measures the distance to an object by emitting ultrasonic sound waves and receiving the reflected waves. The sensor has two main components: a **transmitter** (which sends the sound) and a **receiver** (which detects the reflected sound).

The sensor works by emitting a pulse of ultrasonic waves, which travel to the object and reflect back to the sensor. The sensor calculates the distance by measuring the time taken for the sound wave to travel to the object and return.

This process is repeated continuously, and the distance is displayed on an **LED display**, which updates in real-time as the object moves closer or farther from the sensor.

RADIO FREQUENCY

Radio Frequency (RF) refers to the oscillation rate of electromagnetic waves ranging from 9 kHz to 300 GHz, used in wireless communication. RF fields enable broadcasting and communication through antennas and transmitters, without the need for physical wires.

Radio frequency is measured in hertz (Hz), representing cycles per second, and can range from kilohertz (kHz) to gigahertz (GHz). Microwaves, a type of radio wave, have higher frequencies and are invisible to the human eye.

In a radio wave, the wavelength is inversely proportional to the frequency. If f is the frequency in megahertz and s is the wavelength in meters, then

$$s = 300/f$$

As the frequency is increased beyond that of the RF spectrum, electromagnetic energy takes the form of infrared (IR), visible, ultraviolet, X-rays and gamma rays.

POWER SUPPLY

An electronic power supply converts mains AC voltage into regulated DC voltage for use in various devices. DC power is essential for circuits using tubes or transistors, such as tube amplifiers or transistor biasing. Batteries are typically not used for this purpose due to their cost and frequent replacement needs. Instead, an AC power supply with a rectifier-filter system is commonly used.

The rectifier-filter combination in an ordinary AC power supply converts AC to pulsating DC. However, this output still contains AC components, which cause fluctuations in the DC voltage. The filter circuit removes these AC components, providing a smoother and more consistent DC voltage across the load.

In some applications, it is important to have a constant DC voltage despite variations in AC mains voltage or load. This requires the use of voltage-regulating devices. A regulated DC power supply uses these devices to maintain a constant output voltage, even when the input or load changes. Such supplies are essential in applications where stable and reliable power is critical, such as in communication systems or sensitive electronic equipment.

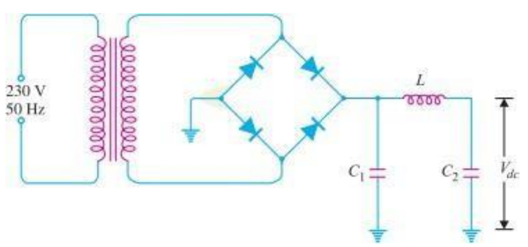


Fig 3.2: Single-Phase Full-Wave Rectifier with LC Filter

ARDUINO ID

Arduino IDE: Initial Setup

This is the Arduino IDE once it's been opened. It opens into a blank sketch where you can start programming immediately. First, we should configure the board and port settings to allow us to upload code. Connect your Arduino board to the PC via the USB cable.

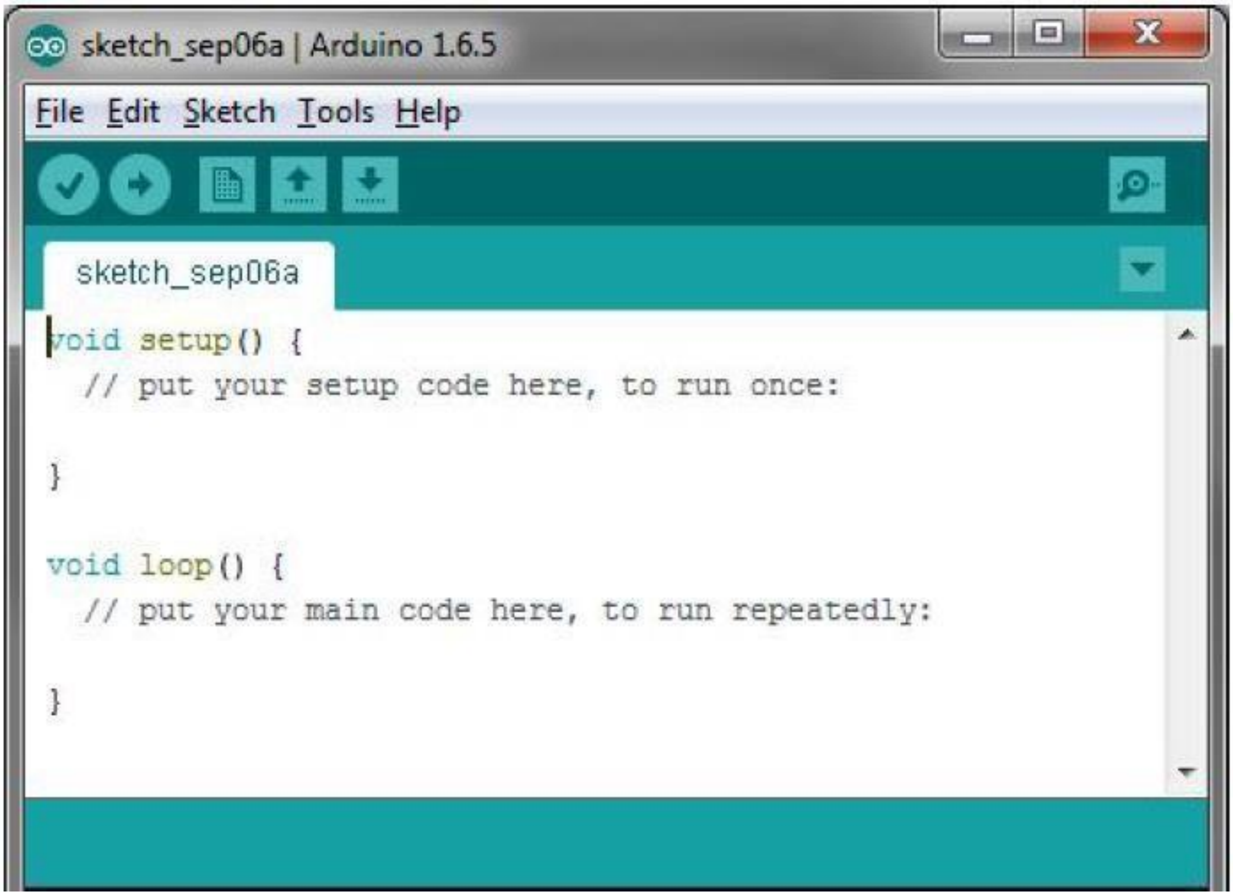
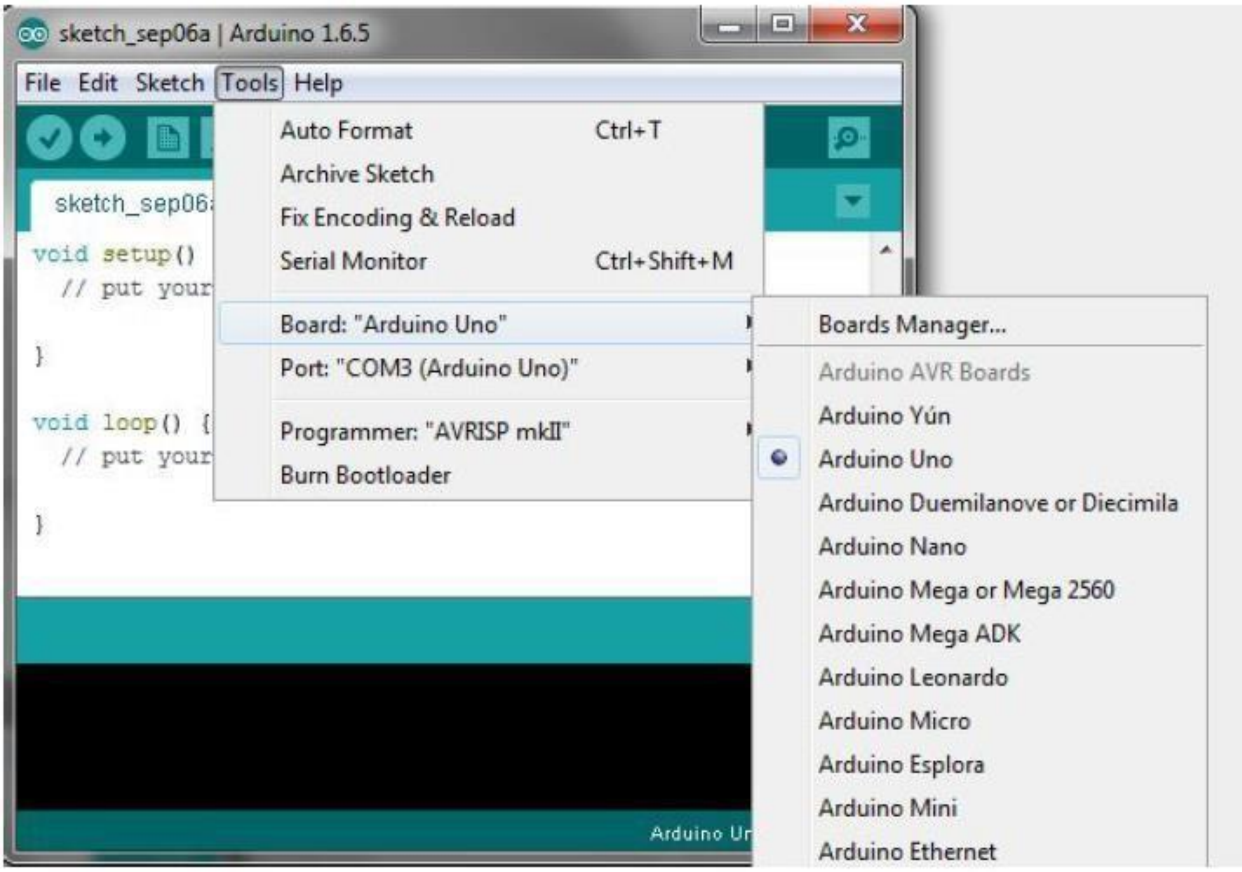


Fig 3.3 : Arduino IDE: Basic Sketch Structure

IDE: Board Setup

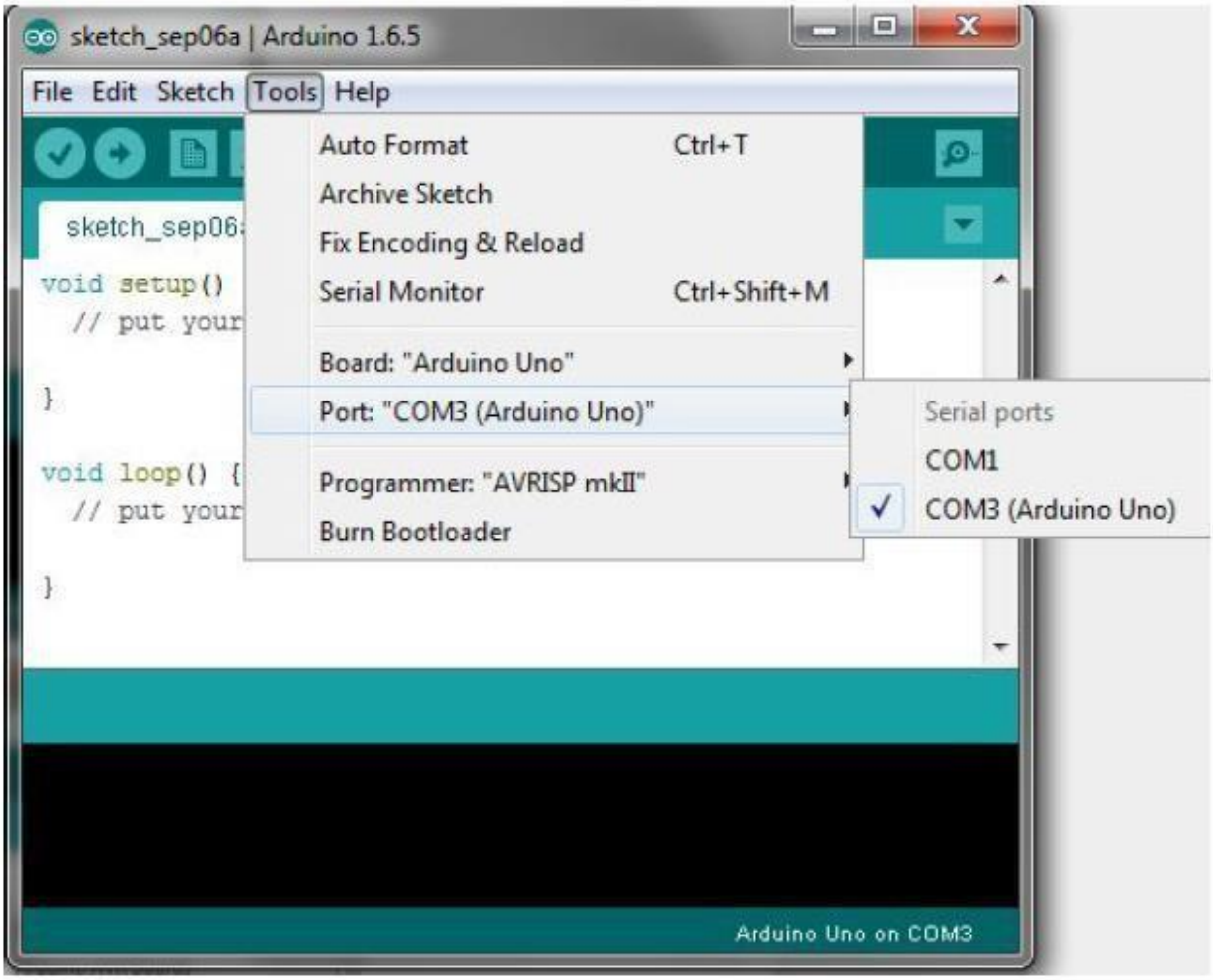
In Arduino IDE, go to Tools > Board to select your board. Choose Arduino Uno for Uno or Uno-compatible clones (e.g., Funduino, SainSmart). For other boards or clones, select the corresponding board type.



Arduino IDE: Board Setup Procedure

IDE: COM Port Setup

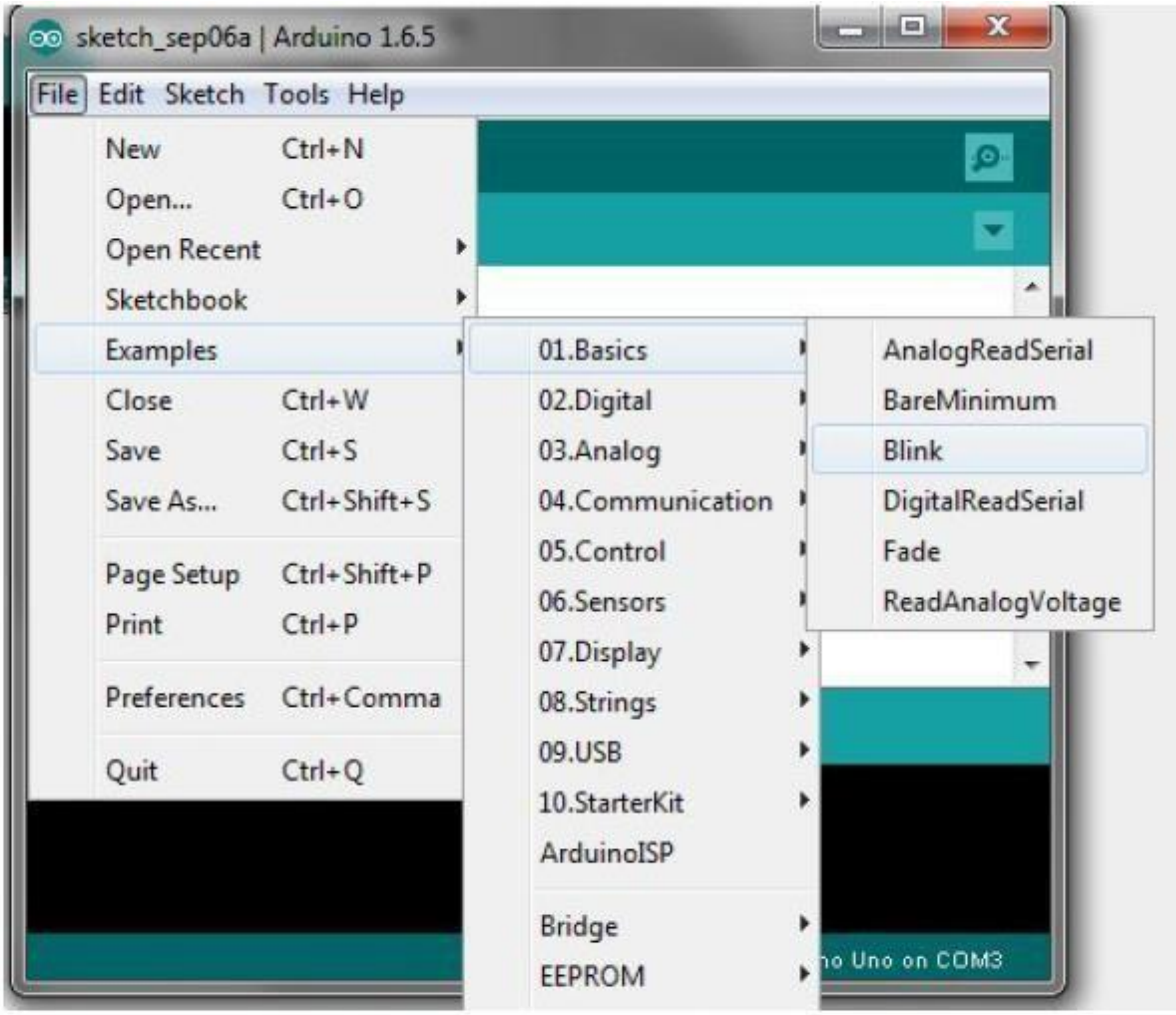
In Arduino IDE, go to Tools > Port to select your connected Arduino board. The IDE should show available COM ports, labeling recognized Arduino boards with their names. Choose the correct board, and you'll see its type and COM number at the bottom right of the IDE.



Arduino IDE: COM Port Setup

Testing Your Settings: Uploading Blink

To test your Arduino setup, upload the "Blink" sketch from File > Examples > 01.Basics > Blink. This will blink the onboard LED on pin 13, confirming successful code upload. Click Upload to send "Blink" to your board.



Arduino IDE: Loading Blink Sketch

LCD DISPLAY

An LCD (Liquid Crystal Display) is a cost-effective output device with a limited viewing angle, often chosen for displaying text. Compared to a 7-segment display, LCDs are better suited for alphabets. Various types exist, but a common model for projects is a 16x2 LCD with 2 lines and 16 characters per line, ideal for displaying data from a microcontroller. It includes 8 data lines, 3 control lines, and operates with a 5V supply (Vcc) and GND. This type of LCD is user-friendly, displaying information like remaining balance or the active card in a system.

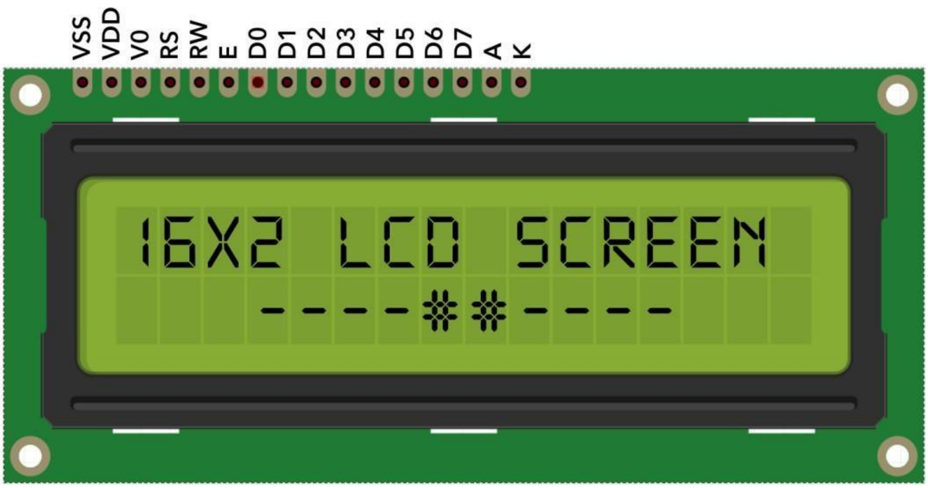


Fig 3.7 : 16x2 LCD Display

LCD Pin Descriptions:

Fig 3.8 : LCD Pin

VCC, VSS and VEE

While VCC and VSS provide +5v and ground respectively, VEE is used for controlling LCD contrast.

RS, Register Select

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

R/W 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.

E, ENABLE

The enable pin is used by the LCD to latch information present to 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. This pulse must be a minimum of 450ns wide.

D0-D7

The 8-bit data pins, D0-D7, are used to sent information to LCD or read the contents of the LCD’s internal registers.

The LCD commands codes are as shown in table.4. To display letters and numbers, we send ASCII codes for the letters A-Z, a-z, and numbers 0-9 to these pins while making RS=1.

BUZZER

A buzzer is an electronic signaling device commonly used in appliances, automobiles, and game shows. Traditional buzzers were electromechanical, similar to electric bells without a gong, creating sound by vibrating a wall or ceiling panel. Later, some buzzers used circuits with AC current connected to speakers, but today piezoelectric sounders like Sona alerts are popular

In game shows, buzzers, also called “lockout systems,” prevent multiple contestants from signaling simultaneously. When one contestant buzzes in, others are locked out. Some shows also use alternative methods, such as lights instead of sound, or effects like smoke cannons.

Piezoelectric materials, which generate electric charges under mechanical stress, enable modern buzzers. This effect is reversible, meaning these materials can also change shape under an electric field. Piezoelectric applications include sound production, high-voltage generation, frequency generation, and precision control in scientific instruments like scanning probe microscopes. The term "buzzer" has also evolved to describe someone who can create excitement or "buzz" around a brand or event.

BLUETOOTH

Bluetooth is a wireless communication technology that allows devices to connect and share data over short distances (typically up to 10 meters or 33 feet). It operates on radio frequencies and is commonly used for connecting devices like smartphones, headphones, computers, and smart home devices without needing physical cables.

For a project aimed at helping visually impaired or blind people, Bluetooth can play a significant role by enabling devices to communicate and provide audio feedback, guiding users with real-time information. Here are some ways Bluetooth can be integrated:

1. **Navigation Assistance**: Bluetooth-enabled devices can connect to beacons placed in various locations, guiding users indoors or outdoors by providing voice instructions. For example, Bluetooth Low Energy (BLE) beacons could signal a mobile app to give information about surroundings, directions, or nearby obstacles.
2. **Device Interaction**: Bluetooth can connect to devices like smart speakers or headphones, allowing visually impaired users to interact with devices through voice commands. This hands-free access can make everyday tasks easier, such as adjusting

settings on a smartphone or receiving information without needing visual cues.

3. **Alert System**: Bluetooth can trigger vibrations or sounds on a wearable device (like a smartwatch) to notify users of nearby hazards or alerts, providing additional sensory feedback that can be very helpful for navigation and safety.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Required time to pass and number of collisions

Figures 4.1 and Figure 4.2 respectively present the results of the average required time to pass and number of collisions in the S-shaped and obstacle sections. The required time to pass increased for both the S-shaped and obstacle sections when walking with the obstacle detection shoes compared with walking with the white cane. The number of collisions decreased in both sections when the obstacle detection shoes were used but the differences were not significant.

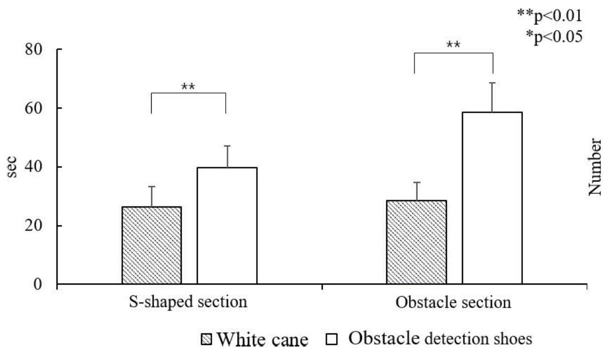


Fig 4.1 Required time to pass.

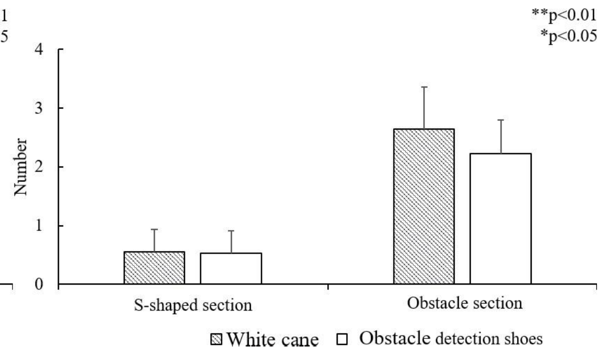


Fig 4.2 Number of collisions.

4.2 Plantar pressure distribution

Figure 4 shows the results of the plantar pressure distribution during walking. In the S-shaped section, the high peak pressure in all foot regions on both sides decreased significantly when walking with the obstacle detection shoes. On the left side, the peak pressure was reduced significantly by 11.52% (p = 0.000), 27.99% (p = 0.000), and 16.55% (p = 0.000) in the WF, FF, and MF, respectively. On the right side, it was reduced significantly by 11.21% (p = 0.000), 31.02% (p = 0.000), and 14.9% (p = 0.000) in the WF, FF, and MF, respectively. Similar to the results in the S-shaped section, in the obstacle section, the high peak pressure in all foot regions on both sides also decreased significantly when walking with the obstacle detection shoes. On the left side, the peak pressure was reduced significantly by 5.85% ($p = 0.000$), 17.16% ($p = 0.003$), 11.17% ($p = 0.000$), and 7.45% ($p = 0.007$) in the WF, FF, MF, and RF, respectively. On the right side, it was reduced significantly by 6.8% ($p = 0.007$), 28.05% ($p = 0.000$), and 9.35% ($p = 0.003$) in the WF, FF, and RF, respectively. However, there were no significant differences in the peak pressure between the left and right sides under all experimental conditions

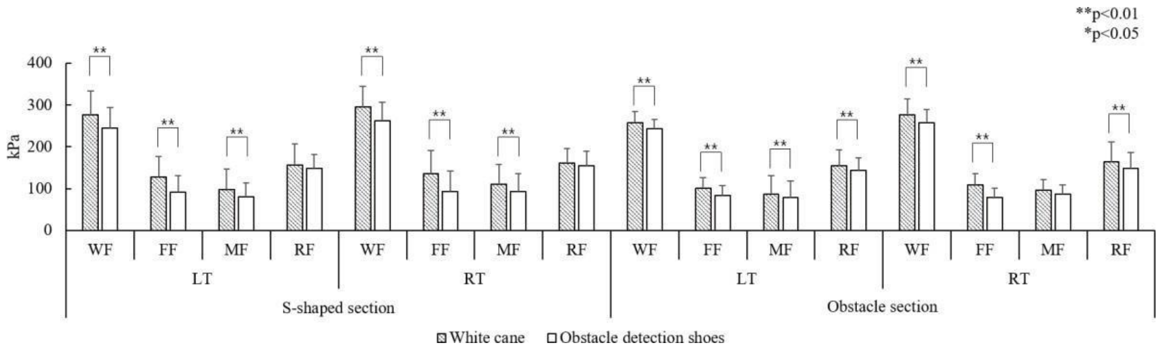


Fig. 4.3 Results of the plantar pressure distribution.

4.3 Muscle activity

The results of the muscle activity are presented in Fig. 5. In the S-shaped section, all muscle activity was lower when walking with the obstacle detection shoes than when walking with the white cane. However, there was only a significant decrease in the activity of the TA muscle on the left side ($p = 0.029$). In addition, a significant difference in the muscle activity between the left and right sides was shown in the TA muscle when walking with the white cane ($p = 0.032$). In the obstacle section, the activity of all muscles decreased significantly when walking with the obstacle detection shoes. On the left side, it was reduced significantly by 15.08% ($p = 0.005$), 13.43% ($p = 0.004$), and 19.11% ($p = 0.000$) in the BF, LG, and TA muscles, respectively. On the right side, it was reduced significantly by 9.92% ($p = 0.029$), 18.79% ($p = 0.001$), 15.72% ($p = 0.000$), and 14.50% ($p = 0.001$) in the VL, BF, LG, and TA muscles, respectively

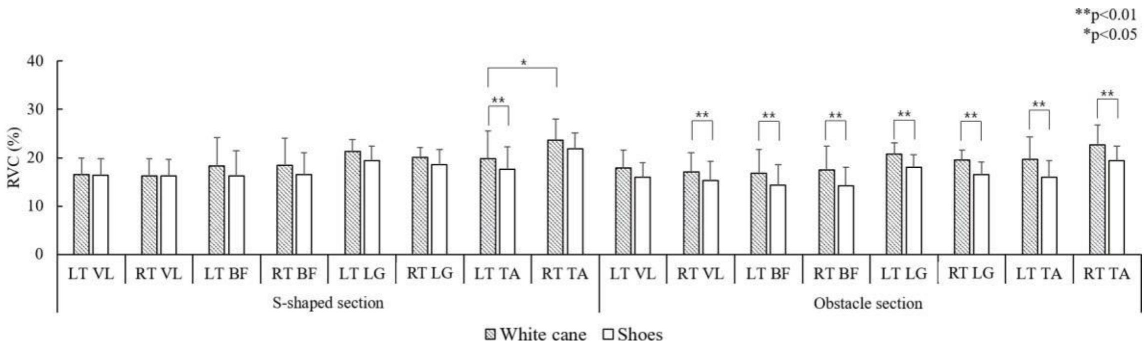


Fig. 4.4 Results of the muscle activity.

4.4 Discussion

The walking assistive device proposed in this study was designed to improve detection accuracy for obstacles located at a low position on the ground by considering the sensing range of the sensor and the user's walking direction. To evaluate the obstacle detection performance of the developed shoes, the required time to pass and the number of collisions were measured. In addition, plantar pressure distribution and lower limb muscle activity were measured to evaluate the effect on gait characteristics. The measured data were compared with those obtained when using a white cane, which is the most commonly used walking assistive device for visually impaired people. When comparing the results of all measured variables between the two experimental conditions, the required time to pass increased, while the number of collisions, plantar pressure distribution, and muscle activity all decreased when walking with the obstacle detection shoes

The white cane is a simple walking assistive device that extends the tactile sensation of the user. Visually impaired people can acquire information about the location of the obstacle as well as the obstacle distance by direct contact during walking. In this study, a non direct contact method was applied to the obstacle detection shoes to improve detection accuracy for obstacles located at a low position on the ground. It usually takes time for users to adapt to new types of walking assistive devices with sensors. Accordingly, the increased required time to pass when walking with the obstacle detection shoes may be due to the decreased gait speed because the subjects have not adapted enough to the device in our experiments. In the case of visually impaired people, the number of collisions may be associated with falls, causing various types of injury. In particular, decreasing the frequency of collisions is very important for elderly visually impaired people. Therefore, the result of this study, which shows a decrease in the number of collisions, is meaningful for developing walking assistive devices to prevent injuries of visually impaired people.

With respect to the plantar pressure distribution, the high peak pressure in all foot regions, including the WF, FF, MF, and RF, was reduced when walking with the obstacle detection shoes. The high peak pressure may be caused by the gait characteristic of visually impaired people, which has more forward propulsion than normal during walking while detecting obstacles. Previous research found that the reduction of plantar pressure is a critical component and key factor in the pathogenesis of plantar wounds in the elderly. This means that the use of the obstacle detection shoes should promote injury prevention by decreasing the peak pressure of elderly visually impaired people.

There was decreased muscle activity when walking with the obstacle detection shoes. In particular, the decreased activity of all muscles in the lower limb when walking with the obstacle detection shoes may be correlated with the decreased gait speed indicated by the increased required time to pass. Low muscle activity may be related to the decreased muscle fatigue and improved walking condition of visually impaired people, which could reduce postural imbalance as well as prevent falls Several walking assistive devices for visually impaired people were developed by utilizing useful technologies such as various types of sensors, information fusion, RFID, and AI. However, visually impaired people may not be able to buy devices because of their relatively low average income and the high price of the devices; the minimum price of walking assistive devices is currently roughly $500. To solve this problem, our new walking assistive device for visually impaired people has a simple structure and a light weight, and it should be possible to manufacture it at a low cost. However, it has some technical limits of accuracy in distance detection. Therefore, in future research, it is necessary to improve system performance by combining navigation and RFID technology

CHAPTER 5

CONCLUSION AND SCOPE FOR FUTURE WORKS

The "Smart Stride" project offers an innovative solution that redefines mobility aids for visually impaired individuals. By integrating sensor-based obstacle detection with private audio alerts via Bluetooth, Smart Stride enhances safety, discretion, and user independence. The addition of solar-powered charging ensures a sustainable, energy-efficient system that reduces the need for constant recharging, making it convenient and reliable for everyday use. This project not only addresses the limitations of traditional aids but also empowers users with a more intuitive and user-friendly navigation experience, contributing to greater autonomy and confidence in navigating diverse environments.

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