CITS5506: Internet of Things

Project Proposal: Smart Vision Hat

1. Name of Project:

System Diagram is missing.

Smart Vision Hat

2. Group information:

Group Number: Group 17

N	Names	Student Numbers
1		
2	=	
3		
4		

3. Why do we want to do this project?

We're living in this incredibly beautiful world, where our eyes are treated to the vibrant green of trees and lawns, the deep blue of the ocean and the sky, and these fluffy white clouds just drifting by up above. We can observe the people strolling around, cars in motion, and the food right in front of us. However, under the same expanse of sky, there's another bunch of people who are missing out on all of this. It is a beautiful day, but they cannot see it. ✓

According to a survey by Vision 2020, it's been revealed that in Australia alone, there are over 575,000 individuals who are either blind or suffering from visual impairments [1]. What's more, visual challenges are poised to become a significant health concern for several generations of elderly Australians in the future. Reports from the Australian government indicate that approximately 444,400 individuals aged 55 or older are dealing with visual impairments [2]. ✓

Blindness presents significant challenges that impact various facets of daily life. Mobility becomes a hurdle, as navigating spaces independently becomes both complex and risky. Opportunities to access information through methods like Braille or technology are limited, hindering education and employment prospects. With the absence of visual cues, social interactions are affected, potentially resulting in feelings of isolation and emotional stress. These challenges are something they confront on a daily basis [2]. ✓

Even with guide dogs or other assistive tools, individuals with visual impairments still lack the ability to fully perceive and interact with their surroundings [3]. This is where our inspiration stems from. ✓

Our "Smart Vision Hat" project has a clear mission: we aim to combine IoT technology with machine learning to create a smart hat that caters to the needs of the visually impaired community [4]. By equipping the hat with sensors and machine learning, we aim to provide near real-time accurate information on objects, people, and obstacles in front of the user. Through the "Smart Vision Hat," we're picturing a future where technology seamlessly integrates into daily life, making devices an integral part of the visually impaired individuals' experiences and transforming the way they navigate the world. Ultimately, this project represents our commitment to using innovation to improve individuals and society as a whole. ✓

4. What is the problem we will solve? What benefit our solution will bring? What is its impact?

(1) Problems to solve:

Individual Problems:

a. Limited Environmental Awareness: Visually impaired people often have difficulty navigating their surroundings, recognizing objects and avoiding obstacles, resulting in a lack of independence and potential safety hazards.
b. Dependence on others: Many visually impaired people rely on the help of others to perform everyday tasks and adjust to unfamiliar environments, which can affect their autonomy and self-confidence.
c. Safety concerns: Without real-time information about the environment, visually impaired individuals may be at risk of accidents and injuries due to obstacles, moving vehicles, and other hazards.
d. Social Interaction: Difficulty recognizing faces and interpreting body language can hinder social interaction, making it difficult for the visually impaired to participate in conversations and build relationships.

Social problems:

a. Inclusive Participation: Limited environmental awareness excludes visually impaired individuals from various activities, limiting their societal involvement.
b. Information Divide: Inaccessible visual information creates disparities in accessing education and crucial details.
c. Employment Barriers: Their challenges in navigating environments restrict their employment opportunities and career growth.
d. Elevating Well-being: Addressing these challenges enhances their overall quality of life and integration into the community.

(2) Benefits:

Benefits for individual:

a. Enhanced Independence: Visually impaired individuals gain greater autonomy in navigating their surroundings and performing daily tasks, reducing their dependence on others.
b. Improved Safety: Real-time information about obstacles and hazards helps prevent accidents and ensures safer mobility.
c. Enriched Social Interaction: The ability to recognize faces and interpret non-verbal cues fosters more meaningful and inclusive social interactions.
d. Expanded Opportunities: With increased awareness of their environment, visually impaired individuals can explore new educational, vocational, and recreational avenues.

Benefits for society:

a. Inclusivity: The project promotes a more inclusive society by providing visually impaired individuals the means to actively participate in various activities.
b. Equal Access to Information: Bridging the information gap ensures that visually impaired individuals have the same access to critical information as others, promoting equality.
c. Employment Diversity: By addressing navigational challenges, the project contributes to a more diverse workforce by enabling visually impaired individuals to pursue a wider range of careers.
d. Technological Innovation: The project showcases the positive impact of technology in addressing real-world challenges, inspiring further innovations in assistive devices and accessibility solutions.
e. Empathy and Awareness: The project raises awareness about the challenges faced by visually impaired individuals, fostering empathy and understanding within society.
f. Overall Well-being: As individuals experience increased independence and participation, society benefits from a more empowered and engaged population.

(3) Impact:

a. Wide-reaching Impact due to Large Population: The hat is designed to be available for any individuals with vision difficulties, potentially making a meaningful difference in the daily lives and safety of a substantial portion of the population – exceeding 575,000 people in Australia, and potentially even more on a global scale.
b. Impact on the Elderly Population, Elevating Overall Quality of Life: With over 70% of individuals being 65 or older, our project has a direct impact on the elderly community, enhancing their overall quality of life by providing them with the means to navigate their surroundings and engage with the world.
c. Economic Impact: From the report of 2022 Pre-budget submission [5] for vision 2020 Australia. There are significant social and economic costs associated with vision loss. The total annual economic cost of vision loss in Australia is estimated to be $16.6 billion or $28,905 per person with vision loss aged over 40 [6]. Our project signifies an opportunity to allocate investments more effectively, potentially leading to optimized outcomes for both the economy and the visually impaired population.
d. Creating Market Value: In the market, numerous products aid the visually impaired with varying market values. For guide dogs, the total value is $59,600: $50,000 upfront plus $1,200 annually over an estimated 8-year working span [7]. When compared to our visual assistance hat, it will generate a certain market value.
e. Generating Employment Opportunities: Our initiative generates new employment opportunities, ranging from research and development to manufacturing, distribution, and ongoing maintenance of the "Smart Vision Hat."
f. Enhancing Societal Well-being, Inclusivity, and Social Harmony: By addressing the challenges faced by visually impaired individuals, our project contributes to the overall well-being of society. It promotes inclusivity by reducing barriers and fostering social harmony, stability, and cohesion.

Good points

5. Methodology

(1) Research and Assessment:
Our research aims to identify the specific requirements of visually impaired individuals. Furthermore, we will evaluate previous projects and research papers that are relevant to the algorithm we intend to employ for object detection to assess the feasibility of our project goals [8].

(2) Define Project Scope:
Determining and documenting a list of specific project goals, deliverables, tasks, cost and deadlines. Especially, determining what functionalities are included and not included.

(3) Conceptual Design:
Define and explore different ideas and concepts based on the requirements and goals set by the scope.

(4) Hardware Selection:
The hardware selection for the Smart Vision Cap involves carefully evaluating various components to ensure compatibility, efficiency, and effectiveness in running the object detection algorithm [9]. Factors such as cost, power consumption, size, and user comfort are also taken into consideration.

(5) Software Development:
a. **Unit Testing** will be conducted in this stage to verify the functionality of each sub-system individually.
b. **Object Detection**: The process involves taking images captured by the camera as input, processing them using OpenCV [10], and then utilizing a pre-trained object detection model such as YOLO [11].

c. to detect the object. Finally, these results will be returned to the users via the speaker [12].
d. **Near Real-time Communication**: Send the real-time footage captured by the camera to the server and transmit it to contacts of the user, while simultaneously transmitting their voices back in near real time.
e. **User Interface**: A user-friendly interface is provided for people with partial vision or for caregivers who are assisting visually impaired people to:
    - View the images captured by the camera and listen to the audio feedback provided by the speaker.
    - Adjust the refresh rate of the camera in Eyes-on mode for their closed contacts.
    - Configure the device and update its software.

(6) Testing and Iteration: Continuous Integration (CI) and Continuous Delivery (CD) will be practiced ensuring seamless integration between software system and the physical device. This approach ensures continuous validation of the system's functionality, performance, and reliability. It allows for rapid iterations and improvements based on user feedback and evolving requirements.

(7) Documentation:
- User Manual
- Project Report

A basic system diagram will give better and easy insight.Always include system diagram in your design

6. Functionality

(1) Insight Snap Mode:

The process for the mode will be:
a. Click the button.
b. The camera takes pictures.
c. The microcontroller and the software analyze the picture.
d. Objects detect and speaker speak out the result.

The primary function of the software is to utilize an object detection model to identify objects captured by the camera and provide their names. It uses a speaker to audibly announce the names of the identified objects. As the product is designed for individuals with visual impairments, the software provides a user interface for system developers to collect system logs for debugging and troubleshooting purposes [13].

(2) Eyes-On Mode:

The process for the mode will be:
a. Click the button.
b. Camera keeps capturing pictures.
c. The microcontroller and the software analyze the picture.
d. Objects detect and speaker speak out the result.

This mode activates the hat's continuous visual capability. By toggling the switch, the camera will remain on and take photos at regular intervals for analysis, enabling users to gather information about surrounding objects while on the move [14].

(3) Vision Assist Mode

The process for the mode will be:
a. Click the button.
b. A video call will be established between the blind and the caretaker.
c. The vision impaired will be able to talk with their chosen caretaker with a microphone to receive assistance.

In this mode, users are seeking human assistance, and their contacts become their visual assistants, helping them navigate their surroundings by providing a description of what the camera captures.

7. Hardware

No.	Items Description	Available at UWA (Yes/No)	Amount	Cost	Web address [15]	Delivery Time
1	ESP32-CAM Development Board	No	1	$21.46	Link to order	2-5 working days
2	5000mAh Slim Power bank	No	1	$22.95	Link to order	2-5 working days
3	TTGO T-Beam v1.0 ESP32 - 915MHZ Version	Yes	1	NA	Link to order	In stock with Uni
4	USB Cable Type A to Micro B (1m)	Yes	1	NA	Link to order	In stock with Uni
5	Raspberry Pi	Yes	1	NA	NA	In stock with Uni
6	5V Speaker	Yes	1	NA	NA	In stock with Uni
7	Jumper wires	Yes	Multiple	NA	NA	In stock with Uni
8	Camera from the Lab Week 4	Yes	1	NA	NA	In stock with Uni
9	Buttons	Yes	3	NA	NA	In stock with Uni
10	Microphone	No	1	$7.95	Link to order	2-5 working days

ESP 32 alternate are available at UWA

What alternate is available to power bank?

8. Initial Distribution of Work

Name of Student	Work Assigned
Student 1	Object Detection, Video and Audio
Student 2	Hardware researching and development, Design and Architecture
Student 3	Documentation & User Interface Development
Student 4	User Interface Development & Testing

The distribution of work can be more specific.

9. Reference

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[14] Tim, "Object and Animal Recognition with Raspberry Pi and OpenCV - Tutorial Australia," Core Electronics, 12 August 2021. [Online]. Available: https://core-electronics.com.au/guides/object-identify-raspberry-pi/0. [Accessed 20 August 2023].

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