Goggle,GPS Tracker and Water Purity Detector

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Abstract **- Having seen this Wonderful creation of god, it amazes everyone for the beauty around us is mesmerizing, the nature and the habitats on this planet. Every day we happen to encounter beautiful sunrise and starting the day with full potential and ending day peacefully and calmness like a sunset at evening. But What about those people who aren't blessed sight, wonder how they spend their entire life with only one color and no sight. So, the aim is to help the blind people sense the surrounding so that they can at least feel their surroundings and don't miss the God's creation. We for the first-time combining Internet of Things (IoT) and Machine Leaning (ML) together and creating a real-time product which can help the blind to hear and know things in their surroundings. We will be using a Raspberry Pi 3 microcontroller and a Raspberry pi cam to feed the video recording and then apply the Object Detection Algorithm on the video and detects objects for real.**

Keywords - ***habitats, Internet of things, Machine Learning, raspberry pi, Object Detection, Algorithm.***

I. INTRODUCTION

Presently, a visually impaired person has limited choices when it comes to moving about in known or unknown territory or travel. The person has to either employ the services of another person who can see, or use the help of a seeing-eye or guide dog if the person is unfamiliar with the surroundings. Even when the person does not use the aid of another person who can see or a seeing eye dog because the environment is known to the sight impaired person (like in the person's home or work), the person may face difficulties when environmental conditions change, such as when items are misplaced, dropped, replaced in the incorrect location, etc.

In particular, a visually impaired person often wants to be able to identify certain objects without the aid of another. Even when a guide dog is available, the guide dog may not be able to identify certain objects, such as denominations of money, pens, labels on food cans, etc.

One prior art solution to aid in the identification of objects is to maintain specific locations for various items. For example, a visually impaired person may always keep the different denominations of currency in certain pockets or pouches so that an assumption can be made as to what the currency is when spending it. Also, food and drinks may be stored in specific locations based on contents, or marked with some sort of identifying marker, such as a braille tag or some other indicator that can be felt by the visually impaired person. Although these systems can work at times, they are prone to error and mistake. It is preferred to have a manner of identifying objects for a visually impaired person that does not require the aid of another person.

Currently the estimated number of people visually impaired in the world is 285 million [1]. This is a very large number to believe, and the steps adopted to help these visually impaired people is replacement of eye and there are very few people who donates their eye. So, when we consider the ratio of visually impaired people with the number of people giving eye donation it turns out to be 1:10696 and this not helping every impaired people. So, this Project aims to build a device which can help the blind people feel their surrounding and give them the taste of this beautiful nature. This product is made by combining IOT and Machine Learning and the microcontroller used for this is raspberry pi and pi cam. Pi cam will capture the live scenario and feed it to the microcontroller and then the backend process where this video captured will be analyzed and process and give out the shapes of objects around them.

II. CASE STUDY

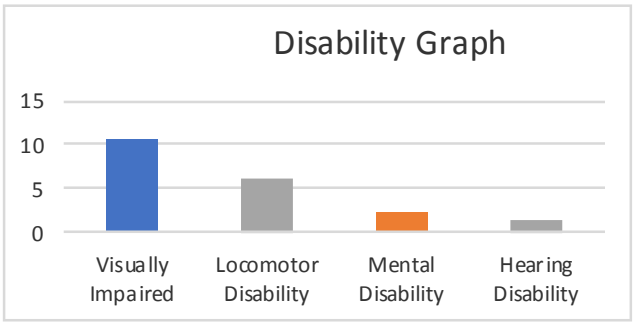


Fig 1. Graph comparing the disabilities [2]

There are many disabilities present but when we have a closer look, we notice that the highest disability is Visually Impaired and that measures adopted to help them is very minimal. when we consider the ratio of visually impaired people with the number of people giving eye donation it turns out to be

1:10696 and this not helping every impaired people. This means not every visually impaired will get an eye transplant.

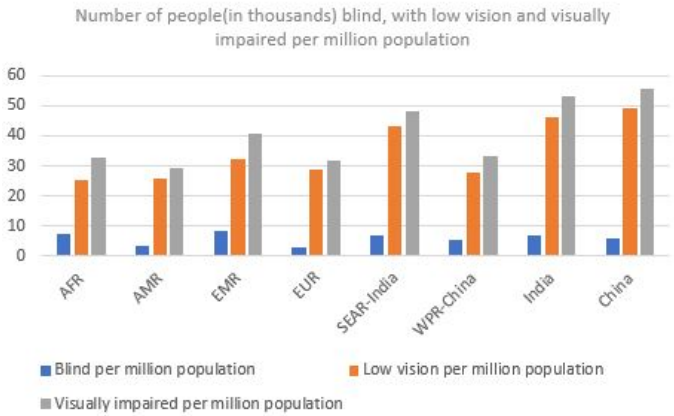


Fig 2. Number of people (in thousands) blind. [2]

		Blindness	Low vision	Visual Impairment
WHO Region	Total population (millions)	No. in millions (percentage)	No. in millions (percentage)	No. in millions (percentage)
Afr	804.9 (11.9)	5.888 (15)	20.407 (8.3)	26.295 (9.2)
Amr	915.4 (13.6)	3.211(8)	23.401 (9.5)	26.612 (9.3)
Emr	580.2 (8.6)	4.918 (12.5)	18.581 (7.6)	23.499 (8.2)
Eur	889.2 (13.2)	2.713 (7)	25.502 (10.4)	28.215 (9.9)
Sear (India excluded)	579.1 (8.6)	3.974 (10.1)	23.938 (9.7)	27.913 (9.8)
Wpr (China excluded)	442.3 (6.6)	2.338 (6)	12.386 (5)	14.724 (5.2)
India	1181.4 (17.5)	8.075 (20.5)	54.544 (22.2)	62.619 (21.9)
China	1344.9 (20)	8.248 (20.9)	67.264 (27.3)	75.512 (26.5)
World	6737.5 (100)	39.365 (100)	246.024 (100)	285.389 (100)

Fig 3. Number of visually impaired in world

Fig 2 and Fig 3, basically shows the graph and table on the number of visually impaired and types line low vision, complete blind. When we consider these values, it is not a small issue but a bigger one on how to decrease this on global scale. India along with 7.8 million blind people and while 45 million are visually challenged [3], this numbers show that 20 percent of the visually impaired is in India.

Also digging a bit deeper we study that there are different degree of blindness also, there are only around 15% of total visually impaired who cannot actually see or in short they are totally blind.

Around 80% of the vision problems can be avoided or cured by means of medical treatment and regular eye care.

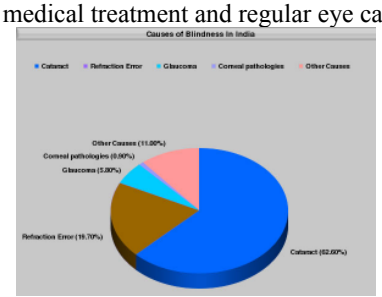


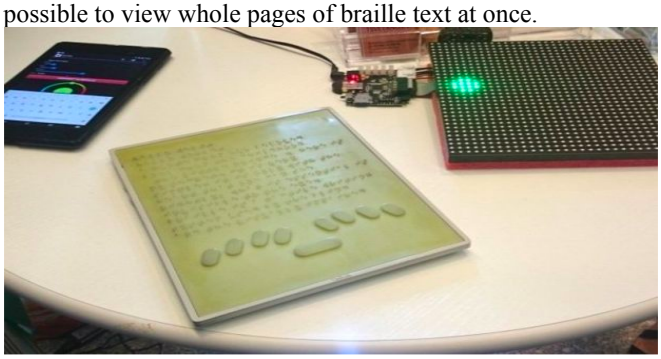
Fig 4: Cause of blindness in India

III. RELATED WORK

There are many invention and ideas utilized in order to help visually impaired.

- Blitab (A new Level of Feeling)

The device looks similar to an eBook but it uses small physical bubbles on it to display the characters, making it possible to view whole pages of braille text at once.

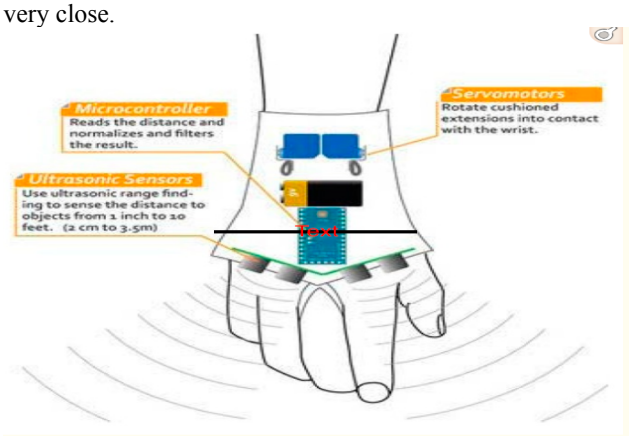


- Tingle the tongue – Brain Port v100

The BrainPort is a wearable recording device which records the surrounding and then converts these images into an electrical signals which is transmitted by a flat electrode which is a studded mouthpiece.

- Assistive device for visually impaired

A wearable device and also a portable device which can assist the visually impaired to show the progress in assistive technology. The design is build such a way that whenever there is some obstacle in front the ultrasonic notes the distance of the obstacle and then it buzzer is used when the obstacle is very close.



- Image recognition for visually impaired

This paper aims to help the blind or visually impaired to help them see through the ears that is the are placing camera on the glass and then through image processing algorithm they will

detect shapes and then give out those shapes in terms of natural voice.

IV. ROLE OF MACHINE LEARNING

Machine Learning is not a new technology and has been in existence since long but the computing power required to process the huge amount of input data has been achieved in recent times. Goal of this project is to combine ML with pi camera and use the live feed to do real time image and video processing to produce a virtual prediction of the object in focus of video. And based on the data set models we choose it is very efficient n detection of day to day objects

V. SYSTEM MODEL

A. COCO Datasets

The COCO datasets has 91 things classes(1-91) these includes all day to day used or seen datasets like desk, door, eye, glasses, brush, person etc.

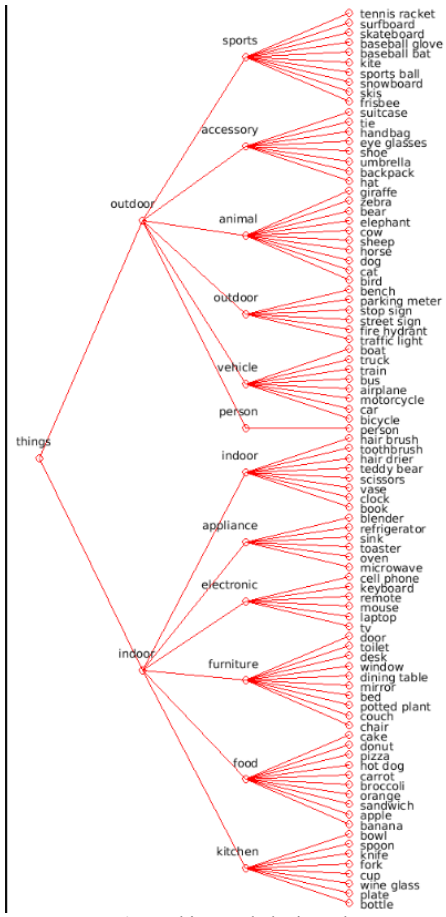


Fig 5. Things Label Hierarchy

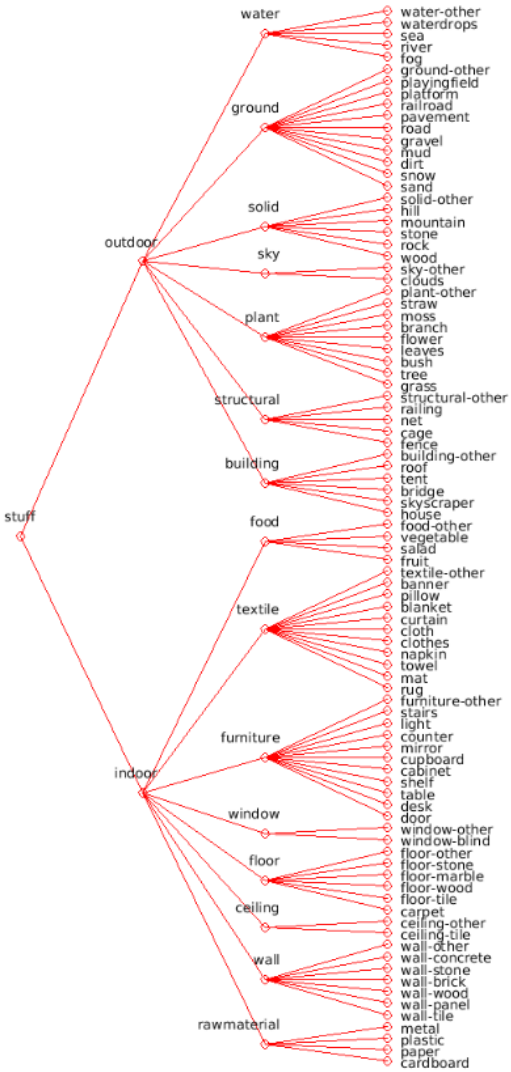


Fig 6 Stuffs Label Hierarchy

Model Name	**Speed (ms)**	**COCO mAP**
Ssd_mobilenet_v1_coco	30	21
Ssd_mobilenet_v1_0.75_dept_coco	26	18
Ssd_mobilenet_v1_quantized_coco	29	18
Ssd_mobilenet_v1_ppn_coco	26	20
Ssd_mobilenet_v2_fpn_coco	56	32
Ssd_resnet_50_fpn_coco	76	35
Ssd_mobinet_v2_coco*	**31**	**22**
Ssd_mobilenet_v2_quantized_coco	29	22
Ssdlite_mobilenet_v2_coco	27	22

Ssd_inception_v2_coco	42	24
Faster_rcnn_inception_v2_coco	58	28
Faster_rcnn_resnet50_coco	89	30

Table 1: Various COCO-trained models

Looking at the above table we can compare various COCO pre-trained models and use an appropriate one.
We will be using ssd_mobilenet_v2_coco(*) for the identification of the object and the priority of the object is also available out of the box with the COCO dataset models.

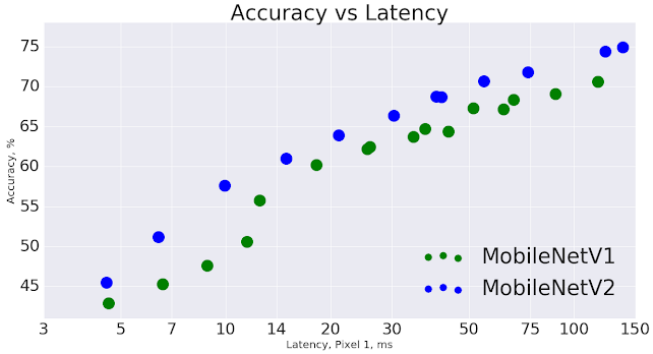


Fig 7. Comparison between MobileNetV1 and V2

Looking at the above graph we can see that the accuracy of MobileNetV2 is increased compared to the older version. Plotting the graph accuracy vs Latency the MobileNetv2 performs better. This is also one of the reason for selecting the MobileNetv2 Data model in this prototype.

B. Working of Camera Module

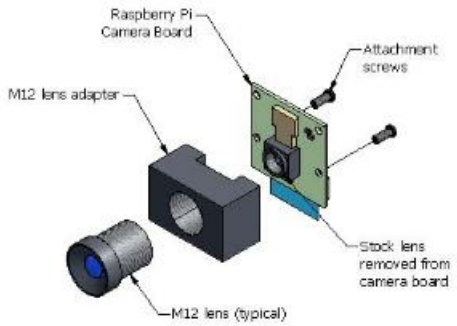


Fig 8. Inside a Pi camera

The pi camera module is a mobile camera module, it is used for capturing images and videos. When ever the camera needs to capture image, it reads out the pixel from the sensor at time rather than capturing all the pixel value at once.
The maximum horizontal resolution we can get is 1920 and it captures by default in H264 config, the maximum framerate of the camera with overclocking is 120fps and the maximum time exposure is 10 seconds.

The pi camera module uses MMAL components together to pass the image data around by encoding, the mmalobj layer introduced in pi camera is aware of these encoding between components and performs more efficient.

C. Working of GPS Tracker

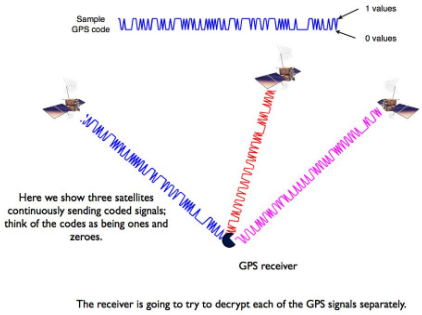


Fig 9. Wireless mic

At every 20,180 Kilometers above sea level is a constellation of satellites, each orbiting Earth every 11 hrs 58 min. These satellites are continuously beaming data down to us on earth, which in turn is received by devices such as our phone or navigation units in our cars, allowing us to see where we are on the planet. GPS stands for global positioning system, which works through trilateration, and not triangulation or multilateration, which is commonly misconceived. The most commonly used system is Navstar, which is USA system.

GPS satellites are setup in a way that from any point on the of Earth we can have a direct line of sight of at least three GPD satellites. Each GPD satellites broadcasts a navigational message towards Earth contains an extremely accurate timestamp (obtained through atomic clocks on-board the satellites), and the satellites also broadcasts their position at the time of broadcast, with all GPS signals broadcasting at 1.57542 Ghz and 1.2276 Ghz signal. This two information allows us to begin to work out our position on earth. With the satellites all sending exceptionally accurate time down to earth, our Phone or GPS receiver can compare the difference of time between the signal being sent and received to work out the distance between us and the satellite. By multiplying this time difference with the speed of light (as the signal is sent as the speed of light0, we can get the distance we are from the satellite. As the satellite are also sending whereabouts they are, you can begin to draw spheres around. As we introduce more GPS satellite into the mix we begin to get closer to where we are, by calculating the time difference between these satellites we move from having no idea where we are, to being able to pinpoint where we are, typically down to five to ten meters on average, with the potential error of 15 meters.

VI. PROPOSED SYSTEM

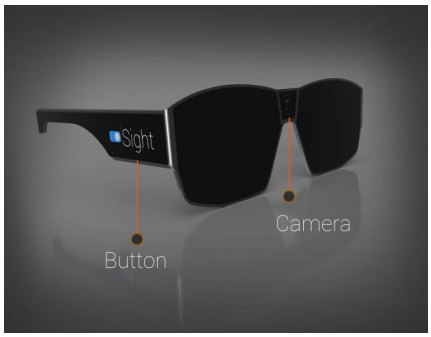


Fig 10. The prototype model of the product.

One is the goggle, the goggle will be used for image and video processing. The image taken will be processed and the object is detected and then the output in form of natural voice, and the output will be a phase trying to give info about the objects and material in the surrounding.

Another will be the GPS Tracker, this will be used by the family/relative/friend of the visually impaired to get the exact location of the visually impaired and can track them in any emergency.

The Water purity detector helps the visually impaired to know the purity of the water they consuming. This will alert them and they can avoid drinking of impure water.

The product aims to help the visually imparted people to feel Working of the model

- Real-time Object Detection

A camera is mounted on the eye-glasses of the visually impaired person. This camera is connected to a microcontroller(In this case Raspberry pi) used to capture video and each frame from the video is fed to the TensorFlow Object detection API and the objects from the frames are detected. A computer-based synthesizer is used to verbally announce the name of the objects in context.

Fig 11. The output of the goggle

The above fig shows the output of the goggle when the goggle capture a image and how the speech is generated. Considering the above image the image is a baseball game and the output is given as “The man in grey swings the bat while the man in black looks down”

- OCR Reader

Optical Character Recognition, or OCR is a method of converting any scanned image to text. This technique is been implemented using the same camera mounted on the eye-glasses which was mentioned in the first part. A button is provide on the eye-glasses for the individual to capture image of sheet of paper of the printed document that is to be read. By using Tesseract-OCR, the captured image is scanned for text and is then converted to String object. This string is fed to espeak which is used to read the string out loud. The visually impaired individual can then hear this audio feedback with the help of ear phones.

Fig 12. OCR

- GPS Tracker

It is essential for the caretaker/family/relative of the visually impaired individual to know his location at most times. We embed a GPS Tracker to get the location of the individual in real time so that the caretaker/family/relative can track his movements and assist or bring him back in emergencies.

Fig 13. The output of GPS

The above is the Screenshot of mobile showing the GPS location and the latitude and longitude of visually impaired.

- Water Purity Detector

To measure the purity of the water that is been feed to the visually impaired we will be using a pH meter. A pH meter provides values as on how acidic or basic(alkaline) a liquid is. The pH meter with a buzzer will help the impaired to know whether the liquid should be consumed or not.

Fig 14. Ph sensor for detection water purity

VII. ARCHITECTURE OF PROTOTYPE

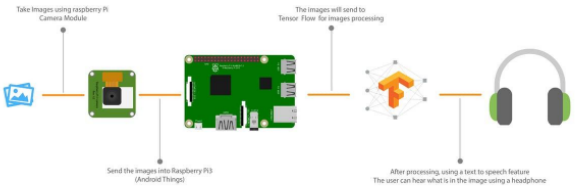


Fig 15. Architecture of the Prototype

The architecture shows the different layers involved in the process. At first the camera record or send the live video to the microcontroller then from the microcontroller it is sent to two different layers simultaneously. In the above layer all the essentials details are acquired and from there the sensors are activated like speakers, temperature. Another layer processes the video further for adding augmented reality. All this backend process is carried out very fast and then result is been sent to the microcontroller which then sorts and search the best reply to be passed on. The prototype will also include offline text and speech replies which will be controlled by the Microcontroller. Raspberry Pi Camera Module v2 is used to take images and sent to Raspberry Pi where the image is processed by TensorFlow Object Detection API. Then the objects are detected and stored in variable in form of String. Next COCO caption model is used to generate sentences in English Language and stored is a String. After this the string is sent to "Text-to-Speech" Engine. String is converted to Speech and then it is ran as a subprocess. Image caption generation models combine recent advances in computer vision and machine translation to produce realistic image captions using neural networks. Neural image caption models are trained to maximize the likelihood of producing a caption given an input image, and can be used to generate novel image descriptions. For example, the following are possible captions generated using a neural image caption generator trained on the MS COCO data set. Tesseract is an optical character recognition engine for various operating systems. It is free software, released under the Apache License, Version 2.0, and development has been sponsored by Goggle since 2006. We will be using this Framework by goggle to convert the optical character to text and then to natural voice. The objective for doing this is to help the visually impaired to listen to the text or book what they want to read (which cannot be brailed).

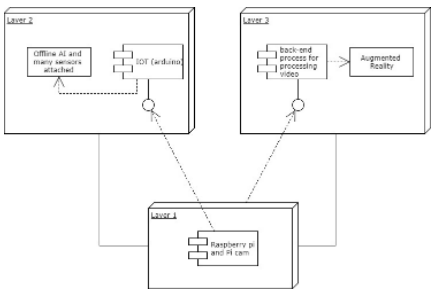


Fig 16. Architecture of the Prototype

VIII. FLOWCHART AND CASE DIAGRAM

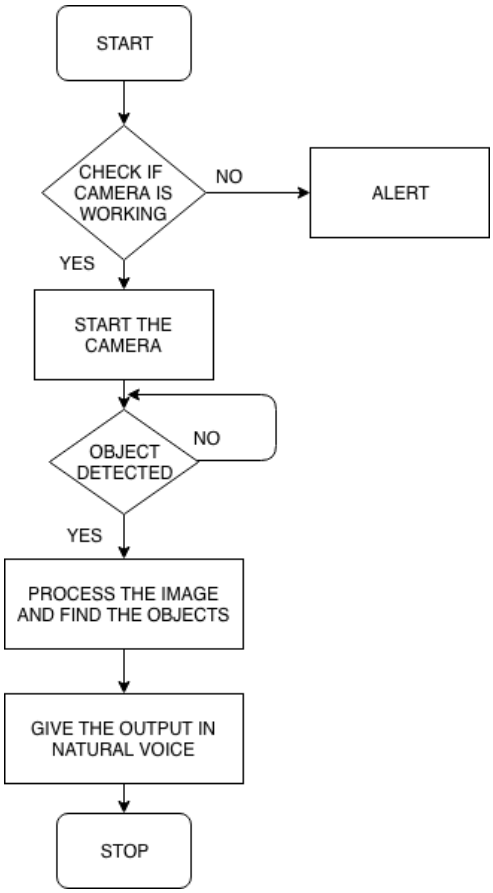


Fig 17. Flowchart of flow of process.

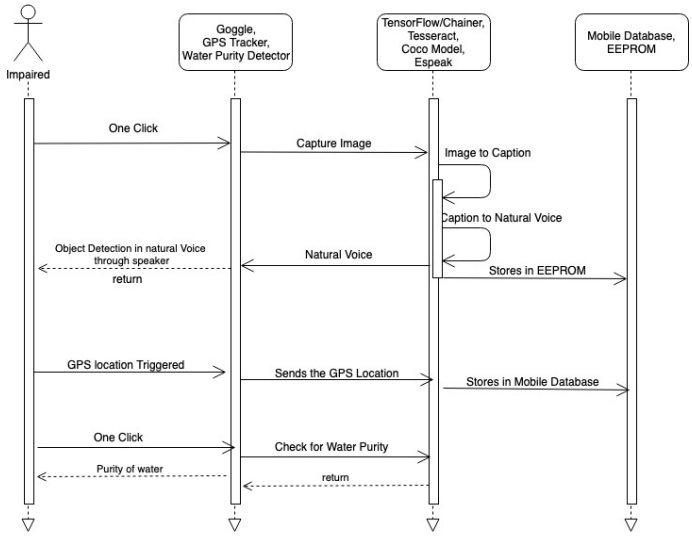


Fig 18. Case Diagram.

The flowchart shows the graphical way for the flow of process and the placement of each system models at first the raspberry pi checks If the camera is working and Arduino

microcontroller checks if the other sensor and module is working. Once the validation is done the camera starts the live video recording and sends the data to the raspberry for further video processing.
When ever there is an voice command the Microcontroller records it and then sends it for speech recognition and based on AI the output is given.

IX. CONCLUSION

This product can help many visually impaired to experience their surrounding and also have a taste of this nature. Another benefit of our prototype is that any family member of visually impaired or any relative can keep the track or know the live location, this feature allows them to know where the impaired is in present and if any danger then they can track the visually impaired. Another benefit of having this prototype is that they can use the water purity detector to know purity of water and this way they can avoid drinking of impure water. Our complete prototype can be used without any internet services which is the key benefit as the visually impaired cannot have the internet connection everywhere or anytime.

X. REFERENCES

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