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J Component Project Review 3

Smart Walking System for the Elderly and Blind

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By

Alekya Kowta 18BIT0123
Manya Smriti 18BIT0127

Faculty-In-Charge Prof. Ramya G

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Title: Smart Walking System for the Elderly and Blind

Introduction:

We propose a smart walking stick system especially made keeping the elderly in mind. With age comes diminishing memory and many more problems that seek support for both balance and navigation- cognitive and motor functions are diminished. Science and technology always make human life easier. Our application is on the go solution. A smart walking system which helps them navigate through life! Additional perks are that it can monitor heart rate and send out alerts to the nearest hospital whilst also alarming the people around for additional help. It also helps them cross the roads in a better and much safer way. Reminders for taking medicines in time/ general reminders can also be provided. We understand that the elderly might even have a very weak sense of vision. Keeping that in mind, we will be constructing a microcontroller based automated software that can corroborate a blind person to detect obstacles in front of him immediately. We implement this using ad hoc networks.

Objective:

- To help the elderly/visually impaired in navigating to the right path by directing routes to them.
- To help user by alerting if it comes across any obstacles in path.
- To help users with reminders to carry out their plan.
- Alerts if the user's heart rate changes or user feels uncomfortable.

Scope:

The scope of this project is the elderly and the visually impaired. With integration of features like ad hoc networks, sensors and claw vibrators and providing services like reminders and heart monitoring system integrated with a GPS ensuring safety of the elders.

Motivation:

- The existing smart walking system design concentrates on only the elderly and fails to consider the blinded / weak-vision of the elderly.
- It concentrates on only sending/ navigating the elderly in the right path by providing routes to them.

- It doesn't provide perks like giving them reminders or alerting them etc.
- It doesn't alert the people around if something goes wrong with the person (e.g. if elderly fells down) using the stick.

Provided suggestions:

- Elderly could have very weak vision, and this is not considered in the current design. We could incorporate OCR (Optical character recognition) techniques that helps the elderly. This could signal them and still help the same way even if they cannot see.
- It will be able to suggest how to cross the roads in a safe manner.
- It can also analyze the heart rate of the person and if it seems to be very high, then there may be chances of discomfort so the system will suggest a different route. E.g., there might be a route where there are a lot of stairs or a high slope, in this case the person's heart rate would be high. When this is the case, the stick could suggest an alternative, comfortable route.
- The elderly can only remember so little, they probably forget to take their medicines. The system can send daily reminders to them so that everything happens on time.
- If the person using the stick, unfortunately collapses or say, something happens to them, the stick should be able to sense it and alert the surroundings by an alarm.
- Our main aim is to make this stick as cost effective and reliable as possible, keeping in mind that it should be light weighted and portable.

Problem Statement:

Vision impairment affects approximately 18% of the world population and impacts directly on people's quality and style of life. The cane is a self-help device used by visually impaired people to improve their functional abilities.

The very same cane integrated with multiple functionalities like reminders, obstacle detection, optimal GPS navigation would prove to be very fruitful.

Literature Survey:

Paper 1:

Paper Title	Author	Advantage	Technique	Disadvantage
Smart Walking Stick	Srinivasan, Srinidhi Rajesh, M	1) to avoid leg weakness, balance loss and improper navigation of indoors and outdoors. 2) Robot cane used to monitor improvised navigation of outdoors and indoor by detecting obstacle at different heights on flat road. 3) consider real-time movements of person walking or their different style of walking by counting each step they are heading to and how much they travelled.	1) Combination of ultrasonic sensor and force sensor placed in the tip of shoe which will help to measure the distance between stick and leg. 2) Alert during falling : Hand's pressure will be more than usual one and pressure sensor will sense that pressure and force will be exerted to the shoe.	1) Ultrasonic sensor and force sensor is needed to be placed in the tip of shoe. Smart stick is not sufficient on its own to detect if the person fell. 2) Alert sound during falling does not increase if the person has fell for longer time.

Paper 2:

Paper Title	Author	Advantage	Technique	Disadvantage
Elderly monitoring system in a smart city environment using LoRa and MQTT.	Lachtar, Abdelfatteh Val, Thierry Kachouri, Abdennaceur	1) The proposed design involves a cane cased transmitter node, enabling to send data related to the position and the state of the elderly to a base station. 2) Successful M-Health system to help elderly to devise a special elderly tracking and monitoring system.	1) Implementation of sending data related to the position and the state of the elderly the LoRa technology 2) The message queuing telemetry transport (MQTT) protocol used to interact with the environment once a fall proves to take place	1) Isn't helpful on its own in case of emergency. 2) No alert system

Paper 3:

Paper Title	Author	Advantage	Technique	Disadvantage
Designs of an Effective Smart Walking Stick for Visually Disabled	Jadhav, Atharva Sarkar, Joydeep Patil, Roopali Pardeshi, Jay	1) Insists on camera-based image processing as an effective solution to visual disability 2) Allowing texture recognition, face recognition (elderly may find it hard to recognize face) & text recognition to support visual disability.	1) Deals with technique similar as Optical character recognition or OCR in which images can be converted into text.	1) Image converted into text should be further read by the device in case if the user is blind. 2) In this paper, elderly disabilities and visually impaired are mainly dealt in regard to vision only.

Paper 4:

Paper Title	Author	Advantage	Technique	Disadvantage
Smart Stick for Elderly	Boppana, Lakshmi Jain, Vishal Kishore, Ravi	1) Walking stick can monitor various health parameters and informs the nearby primary health center and caretaker of any	1) Using a low-cost Wi-Fi chip with TCP/IP stack 2) Battery for remainder is concealed	1) The proposed stick does not ensure security of elderly/visually impaired if in case

		abnormalities 2) It can help elder persons to reach home safely if they lost themselves when go out alone 3) The proposed stick can also be used to control home appliances and to remind the user for taking the medicine on time	inside the stick to reduce the risk of damage to the circuit	he fell in the way- no automatic invoked alert. 2) No heart rate monitoring and redirection to elderly in case of emergency.

Paper 5:

Paper Title	**Author**	**Advantage**	**Technique**	**Disadvantage**
Smart Assistance Navigational System for Visually Impaired Individuals	Divya, S. Raj, Shubham Praveen Shai, M. Jawahar Akash, A. Nisha, V.	1) Helps blind people to detect obstacles. 2) Sound generated by the Buzzer if they hit obstacles. 3) Recognize the fallen stick if elderly collapses in between.	1) Ultrasonic blind walking stick with the use of Arduino. The device measures the distance between objects and Smart Walking Stick by Ultrasonic sensor. 2) GSM and GPS module is used	1) No variation in buzzer sound in case the user collapses for a longer time(It should get louder after 3-4 min). 2) Cannot assist in knowing the surrounding to the user.

			provide alert message and location during the time of emergency. 3) RF transmitter and receiver which is utilized to recognize the fallen stick from the client if the stick is far from the visually impaired individual.	

Paper 6:

Paper Title	**Author**	**Advantage**	**Technique**	**Disadvantage**
Smart walking stick	Srinivasan, S. Rajesh, M.	1) Helps in detecting and alarming in case the elderly collapses 2) Detecting obstacles in path	1) Uses Force sensor and Pressure Sensor to sense user grip on the stick. 2) Uses Ultrasonic sensor for detecting obstacles in	1) No assistance provided to nearest hospital in case of emergency 2) No GPS monitoring.

			path.	

Paper 7:

Paper Title	**Author**	**Advantage**	**Technique**	**Disadvantage**
Design and Implementation of an Intelligent Assistive System for Visually Impaired People for Aerial Obstacle Avoidance and Fall Detection.	Chang, Wan-Jung Chen, Liang-Bi Chen, Ming-Che Su, Jian-Ping Sie, Cheng-You Yang, Ching-Hsiang	1) An intelligent assistive system based on intelligent walking stick and wearable smart glasses for aerial obstacle avoidance. 2) It is also effective in fall detection.	1) walking stick can vibrate to guide visually impaired people to avoid aerial obstacle collision accidents. 2) It can detect aerial obstacles within 3 meters, and the average accuracy of fall detection up to 98.3%	1) No alert system 2) No assistance provided to nearest hospital in case of emergency.

Paper 8:

Paper Title	Author	Advantage	Technique	Disadvantage
Navigation System for the Visually Challenged Using Internet of Things	Varalakshmi, I. Kumarakrishnan, S.	1) Navigational tool that will detect manhole and staircase in an environment. 2) It detect the obstacles and provide the alternate way to the visually impaired or elderly.	1) Ultrasonic sensor is used as navigational tool 2) Detect the obstacles through GSM and also calculates the shortest distant to the destination for their convenience.	1) No reminder if in case user needs one. 2) No alert to surrounding if user collapses.

Paper 9:

Paper Title	Author	Advantage	Technique	Disadvantage
Design and Testing of a Practical Smart Walking Cane for the Visually	Obaid, Nada M. Hamad, Ibrahim A. Madkhane, Ali M.	1) A light-weight stick 2) Helps the users locate places and move from one place to another with the aid of a communication	1) Ultrasound sensor that detects barriers of various shapes and types. 2) The	1) No image- text-sound conversion for assistance. 2) No reminder if

Impaired	Hamad, Yousif A. El-Hassan, Fadi T.	system.	GPS/GSM technology that helps the users locate places. 3) Speech recognition technology that facilitates interactive communication between the user and the cane.	in case user needs one.

Paper 10:

Paper Title	**Author**	**Advantage**	**Technique**	**Disadvantage**
Smart Portable Assisted Device for Visually Impaired People	Ray, Aritra Ray, Hena	1) Designed and developed version of a portable, low powered instrument while user walk on road easier. 2) Device is a miniaturized, non-invasive and is able to detect the obstruction in front of a road in all the three	1) Device is built on low power embedded hardware and software technologies, sensors and sensing technologies 2) Combination of pressure sensors and	1) No alert system 2) No assistance provided to nearest hospital in case of emergency.

		dimensions in space and also to detect the potholes or speed brakers on the road. 3) the speaker attached would respond with voice messages denoting the distance of obstruction in metres.	distance sensor embedding into the device to get 3D view.	

Paper 11:

Paper Title	Author	Advantage	Technique	Disadvantage
Blind Mate: A Friend to The Blind	Kairamkonda, Dheeraj Dhanvee Chandana Kodimela, Sree Kuchulakanti, Harish	1) GPS controlled walking stick with a portable wheel module to facilitate usage in both internal and external environments. 2) User-friendly speed and direction control system	1) Wireless communication between the stick's microcontroller Raspberry pi 3b and wheel module's microcontroller Arduino Mega through nrf24L01	1) No variation in buzzer sound in case the user collapses for a longer time (It should get louder after 3-4 min). 2) Cannot assist in

		3) Obstacle detection	transceiver module for portable wheel module. 2) Navigation is achieved by means of GPS and compass meter modules. 3) Obstacle detection is achieved by ultrasound and camera sensors.	knowing the surrounding to the user.

Paper 12:

Paper Title	**Author**	**Advantage**	**Technique**	**Disadvantage**
An Implementation of an Intelligent Assistance System for Visually Impaired/ Blind People	Chen, Liang-Bi Su, Jian-Ping Chen, Ming-Che Chang, Wan-Jung Yang, Ching-	1) Obstacle detection 2)Visually impaired/blind person is fall down, its information will be recorded and uploaded to the on-line information platform.	1) GPS to detect if visually impaired/blind person fall down. 2) On-line information platform to record and upload information about the user.	1) No reminder if in case user needs one. 2) No image- text-sound conversion for assistance.

	Hsiang Sie, Cheng-You			

Paper 13:

Paper Title	Author	Advantage	Technique	Disadvantage
Smart Technologies for Visually Impaired: Assisting and conquering infirmity of blind people using AI Technologies	Al-Muqbali, Fatma Al-Tourshi, Noura Al-Kiyumi, Khuloud Hajmohideen, Faizal	1) By using artificial intelligent and image processing, this smart device is able to detect faces, colors and different objects. 2) Visually impaired person is notified through either a sound alert or vibration.	1) Open CV and Python is used for programming and implementation. 2) The project prototype investigates the algorithms which are used for detecting the objects.	1) No assistance provided to nearest hospital in case of emergency. 2) No variation in buzzer sound in case the user collapses for a longer time.

Paper 14:

Paper Title	Author	Advantage	Technique	Disadvantage

Microcontroller based smart walking stick for visually impaired people	Ikbal, M.A. Rahman, F. Hasnat Kabir, M.	1) Acts as a good navigator for elderly/visually impaired 2) Detection of obstacles	1) Microcontroller: Wireless communication between the stick's microcontroller for portable wheel module. 2) Ultrasonic sensor is used for navigation. 3) IR sensor for detection of obstacles.	1) No alert system 2) No assistance provided to nearest hospital in case of emergency.

Paper 15:

Paper Title	**Author**	**Advantage**	**Technique**	**Disadvantage**
Smart Cane: Assistive Cane for Visually-impaired People	Mohd Helmy Abd Wahab Amirul A. Talib Herdawatie Abdul Kadir Ayob Johari	1) It communicates with the users through vibration and voice alert. 2) It detects objects or obstacles in front of users and feeds warning back.	1) Ultrasonic sensor is used for navigation. 2) Microcontroller used has the ability to store and run programs.	1) Does not calculates the shortest distant to the destination for their convenience. 2) No variation in buzzer sound in case the user collapses for a longer time.

Paper 16:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Smart Walking Stick for the Blind	Sathya, Santhoshini, Betty, Sabharinath, Ahanaa	Detects objects in front of the person with the help of a camera Measures the distance between the objects and signals the blind person with the help of headphones.	Ultrasonic sensor is used to measure the obstacles distance from the user. Sensors are placed in 5 locations to cover maximum bandwidth. Image manipulation of images from camera is done through Raspberry Pi. It is processed using Haar Classifier.	Haar Features have to be determined manually. So, there's a certain limit as to the type of things it can detect. Degree of freedom is less. However, the more you train, the better the results are.

Paper 17:

Paper Title	Authors	Advantages	Techniques	Disadvantages
Path Guidance System for Blind People	Badri Narayan Mohapatra, R.K. Mohapatra, P. Panda	Earphones that are used by the blind people so that they are made aware of the direction they're going in through GPS. Alerts the blind people when there are obstacles around and keeps them safe.	The system uses IoT based smart electronic aid. Uses ultrasonic sensors along with a voltage divider circuit. IoT based GPS Trackers are inserted and buzzer sounds are provided.	More safety measures of execution should be taken. Uses ultrasonic sensors- which are useful for short range distances only.

Paper 18:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
An Intelligent Walking Stick For Elderly and Blind Safety Protection.	Romteera Khlaikhayai, Chavana Pavaganun, Benja Mangalabruks and Preecha Yupapin	Movement of the blind is controlled and monitored. Very fast and efficient. Safety protection of the elderly and blind people can be provided, moreover, the special events, for instance, blind rally and disabled people networks can be performed and realized.	The system uses wireless sensors incorporating ad hoc networks. Vehicular ad hoc network adapted from mobile ad hoc network is used.	Ad hoc networks cannot disable SSID. Some WIFI enabled technology, like android, Google's Chromecast isn't supported by ad hoc.

Paper 19:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
An IOT Security Based Electronic Aid for Visually Impaired detection with Navigation Assistance System	R.Aiyshwariya Devi, U.Indumathi, S.Radha Rammohan, N. Keerthana, S.Shobana	Notify the impaired through voice commands. Active location can be shared to the care taker. Panic Switch is also integrated.	Uses Arduino IDE for the same. Text message about the whereabouts will be sent to the care taker. IoT microcontroller is used.	Infrared sensors have limited range. They can be affected by environmental conditions like rain, fog.

Paper 20:

Paper Title	Authors	Advantages	Techniques	Disadvantages
Cane with Electronic Wet Dirt Identifier for the Visually Impaired.	Andreia Insabralde, Marcos Antonio Ferreira Junior, Iandara Schetter t Silva, Maria Lucio Ivo.	Better storage for canes. Self-helping cane. Protects user from harmful bacteria deriving from the dirt on the streets.	The YL-69 moisture detector is integrated with Arduino. The equipment was tested and calibrated in a controlled environment and proved to be adequate.	A long and proper data analysis must be done. The training and calibration must be perfect for it to detect a certain kind of harmful bacteria.

Paper 21:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Evolution of Electronic Aid for Navigation	Afroz Sultana Pathan, Athar Mustafa, Imran Khazi, Chaitanya Krishna Jambotkar	Basic objective is to make a smart walking system so that the elderly does not have to depend on others. Artificial vision by providing them information about the surroundings.	IR sensors with ultrasonic range finder circuit, for hurdle detection. GPS + Android for navigation and panic situation texts.	Information regarding barriers is provided with vibration. Cost effectiveness compromises performance.

Paper 22:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Design of a Cheap Mountable Device for Walking Cane to Help Blind People	Almalki, Ahmed & Alzahrani, Abdullatif & Alkhozaee, Ahmed & Alshamrani, Abdullah.	Mountable and cheap means for a smart walking stick. Direction of obstacle is informed with a vibration.	GPS Module for navigation. IoT Microcontrollers for vibration. \	Information regarding barriers is provided with vibration. Durability and accuracy must be kept in mind. Cost effectiveness compromises performance.

Paper 23:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Low-Cost Portable Heart Rate Monitoring Based on Photoplethysmography and Decision Tree	Tatiya Padang Tunggal, Abdul Latif, and Iswanto	Can be used to detect the heart rate and then make changes to the route that is being used. Portable and simple device design is provided.	Makes a decision using a decision tree depending on the pulse rate and the blood volume. Algorithm and method for doing the same has been provided.	Feasibility and cost must be kept in mind. Results yielded must be very accurate.

Paper 24:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Portable Heart Rate Measurement for Remote Health Monitoring System	Hasmah Mansor, Siti Sarah Meskam, Nasiha Sakinah Zamery and Nur Quraisyia Aqilah Mohd Rusli, Rini Akmeliawati	Designed as a remote health monitoring system. Real-time data is observed by doctors via the internet.	Uses pulse sensor for the pulse detection. A microcontroller- Arduino with ethernet shield and a wireless communication device.	Remotely monitored at the doctor's computer. Isn't very feasible.

Paper 25:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Heart beat rate monitoring using optical sensors	Hamidreza Shirzadfar, Mahsa Sadat Ghaziasgar, Zeinab Piri, Mahtab Khanahmadi	Designed for measuring heart rate in a non-invasive way. Measures it in 15-20 seconds.	Heart rate detector with IR. The IR is transmitted to the fingertip and then reflects a light on a photodiode. This is converted to a signal which is then used for measuring heart rate.	Not portable. Is carried out with a machine. Could find ways to make it portable so as to integrate it with a walking system.

Paper 26:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Intelligent Walking Stick for Elderly and Blind People	Shalini Singh, Balwinder Singh.	Designed for providing support for the elderly. It lets the user sense the location of obstacle without the waggling problem.	Sensors are mounted on top of each other to help navigate outdoors and indoors. Uses GPS Module, TCRT100 Sensor is used.	Feasibility is limited. Should be cost effective.

Paper 27:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
An Intelligent Walking Stick for the Visually-Impaired People	Nadia Nowshin, Sakib Shadman, Saha Joy, Sarker Aninda, Islam Md Minhajul	Designed for providing support for the elderly and blind people. Informs the blind person about the obstacles in the path. A reliable, light weight, portable walking stick.	Uses Arduino Nano, HC SR-04 ultrasonic sensor. Bluetooth Module, push buttons and is developed with MIT App Inventor.	Arduino can be replaced with microcontroller chip. Can include VLSI technology to design the PCB Unit. High range ultrasonic sensor could be used.

Paper 28:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Smart Walking Stick for Visually Impaired People Using Ultrasonic Sensors and Arduino	Dada Emmanuel Gbenga, Arhyel Ibrahim Shani, Adebimpe Lateef Adekunle	A smart white cane for the elderly so that they can be independent. Easy to use. Puts their needs first. Detects obstacles within 2m distance from the user.	Uses a microcontroller. Programmed in C to detect obstacles. Low cost and low weight system.	Moisture detection sensors for detection of damp areas/ puddles can be added.

Paper 29:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Smart walking stick - an electronic approach to assist visually disabled persons	Mohammad Hazzaz Mahmud, Rana Saha, Sayemul Islam	Abates the difficulties of the blind by constructing a ping sonar sensor. Helps the elderly and the blind.	Ping sensor, Sonar sensor are used. A proximity sensor and wet detector, micro pager motor and additional equipment is used.	Heavy. Could make it lighter so that it is portable and easier.

Paper 30:

Paper Title	**Authors**	**Advantages**	**Techniques**	**Disadvantages**
Hardware Based Traffic System for Visually Impaired Persons with Voice Guidance	Saurabh Mittal, M. Meenalakshmi, Kirti Garg, Amlan Basu	Helps the visually impaired while crossing roads. Direct application with good security and strident usability.	Wireless modules are used coupled with ultrasonic sensors and voice synthesizers to alert the user.	Limitations are introduced for the system integration, but can be minimized easily.

Requirements:

1. 3 AI Alloy telescoping tubes (Firm and solid)
2. Alert system equipped with sensors – to sense and alert in case of emergency
3. OCR device – to perceive surrounding and convert it according to user's convenience.
4. Led indicator- to help in navigation
5. Power supply – to recharge the stick
6. Claw controller- for better grip
7. Proximity Sensor – to sense the surrounding
8. GPS chip

Input and Output Devices Comparison:

- Secure 45CSET-1 Chair Exit Alarm: Default vs static settings
- ECG (electrocardiography) sensors Vs **PPG sensors**
- PPG sensor **or force sensor**
- Audio based device Vs **Claw Vibrator** and an audio input

Traditional:

Heart rate monitoring

Input:	Input device	Output Device	Output
electrical signals produced by heart activity	**ECG (electrocardiography) sensors** measure the bio-potential generated by electrical signals that control the expansion and contraction of heart chambers	ECG recorder: first to take rest if high fluctuation in heart rate is observed. **Alarm** **140db safe sound personal alarm:** The emergency alarm can make a loud sound to draw attention if in case user has fainted for more time.	Pictures displaying heart Rate fluctuation Vibration, Audio Sound, Light Alert Indication

		Secure 45CSET-1 Chair Exit Alarm: Low sound alarm just after sudden fluctuation in heart beat.	

Our handy approach:

Input:	Input device	Output Device	Output
electrical signals derived from light reflected due to changes in blood flow during heart activity, Pulse rate	**PPG sensors** - a light-based technology to sense the rate of blood flow as controlled by the heart's pumping action. **An analog front end (AFE)** for detecting the reflective PPG signal. PPG signal which reflects the changes of blood volume in the microvascular bed	**LED** It alerts the user first to take a rest if high fluctuation in heart rate is observed. **Alarm** **140db safe sound personal alarm:** The emergency alarm can make a loud sound to draw attention if in case user has fainted for more time. **Secure 45CSET-1 Chair Exit Alarm:** Low sound alarm just	Vibration, Audio Sound, Light Alert Indication

		after sudden fluctuation in heart beat.	

Compare:

ECG	PPG
1) HR can be measured accurately	1) suitable for average or moving average measurements
2) ECG sensor features extremely low power consumption	2) ECG sensor features comparatively high-power consumption
3) No external microcontroller unit for HR calculation	3) requires external microcontroller unit for HR calculation
4) Not very handy to use for walking stick	4) Very handy to use for walking stick
5) Comparatively difficult Interpretation	5) Easy Interpretation

Reminder:

Input/output devices for setting new reminders:

Input:	Input device	Output Device	Output
Time setting using buttons or touch screen (whenever required)	**LCD screen** To set time (generally 16*2 LCD) **Buttons:** To choose to set reminder	**LED** It alerts the user first to take a rest if high fluctuation in heart rate is observed. **Alarm** **Secure 45CSET-1**	Vibration, Audio Sound, Light Alert Indication

		Chair Exit Alarm: Low sound alarm just after sudden fluctuation in heart beat.	

The default(static) setting:

Input:	Input device	Output Device	Output
No personal time setting on daily basis needed. Alarm triggered either by default setting or alarm set for medicine, walks just once	**LCD screen** To set time (generally 16*2 LCD) **Buttons:** To choose to set reminder	**LED** It alerts the user first to take a rest if high fluctuation in heart rate is observed. **Alarm** **Secure 45CSET-1 Chair Exit Alarm:** Low sound alarm just after sudden fluctuation in heart beat.	Vibration, Audio Sound, Light Alert Indication

Compare:

Static reminder (Default set)	Reminder of the day
1) Helps to carry out activities that user needs to do on daily basis.	1) Temporal reminder is not good option for static reminders
2) Ensures user doesn't miss the routine, beeps till reminder is not switched off, with intervals.	2) Temporal reminder is not good option for static reminders
3) Static reminder is not good option for temporal reminders.	3) Very handy for temporal reminders like buying fruit on the way.
4) Static reminder is not good option for temporal reminders	4) Ensures user doesn't miss the target, beeps till reminder is not switched off, with intervals.

Person collapsing

When a person faints there is a drop in blood flow.

Traditional:

Input:	Input device	Output Device	Output
electrical signals derived from light reflected due to changes in blood flow during heart activity, **Pulse rate**	**PPG sensors** - a light-based technology to sense the rate of blood flow as controlled by the heart's pumping action. **An analog front end (AFE)** for detecting the reflective PPG signal. PPG signal which reflects the changes of blood volume in the microvascular bed	**LED** It alerts the user first to take a rest if high fluctuation in heart rate is observed. **Alarm** **140db safe sound personal alarm:** The emergency alarm can make a loud sound to draw attention if in case user has fainted for more time.	Vibration, Audio Sound, Light Alert Indication

		Secure 45CSET-1 Chair Exit Alarm: Low sound alarm just after sudden fluctuation in heart beat.	

Our static approach:

Input:	**Input device**	**Output Device**	**Output**
Hand/Finger Touching	**a force sensor** (for sensing grasping and touching)	A **servo motors** Using position tracking, a voice coil actuator at the index fingertip generates vibrations for various textures synchronized with finger movement **LED** It alerts the user first to take a rest if high fluctuation in heart rate is observed. **Alarm** **Secure 45CSET-1 Chair Exit Alarm:** Low sound alarm just after sudden fluctuation in heart beat.	Vibration, Audio Sound, Light Alert Indication

Compare:

Claw Controller (Our approach for helping the fainting user)	**Heart rate monitor**
1) Suitable even after user heart rate is increased due to fast movements.	1) suitable for average or moving average measurements
2) Comparatively high-power consumption	2) Sensor needs comparatively high-power consumption
3) Lesser chance of false fainting alarms (due to lesser influence due to other reasons of heart rate increase)	3) Higher chance of false fainting alarms
4) Comparatively more obvious Interpretation with buzzers of high volume.	4) Easy Interpretation

Crossing Roads

Alert system for obstacles and crossing the road

Traditional:

Input:	Input device	Output Device	Output
Input can be the images processed by a camera	Cameras can capture the images and it can be processed through Raspberry Pi and directions can be given	Audio based device – a headphone that directs the user to the right side.	Audio as to which route to choose

Our static approach:

Input:	**Input device**	**Output Device**	**Output**
OCR devices, incorporating portability.	A camera detector, With a python program for image processing. Or trained data set for detection of obstacles.	Claw Vibrator and an audio input which gives the user the right direction and routes.	Vibration, Audio Sound, Light Alert Indication.

Compare:

Claw Vibrator along with an Audio Input	**Just Audio Input**
Sends a vibration along with audio directions. This will help in crossing the barriers and limitations.	Limited to certain barriers.
Comparatively high-power consumption	Sensor needs comparatively high-power consumption
Lesser chance of missing an important change of direction	Just audio, could be interrupted due to signal problems.
Comparatively more obvious Interpretation with two way helping.	Easy Interpretation

Task Analysis:

The listing of actions a user carries out in performing a task by gaining knowledge and arranging ingredients to carry out necessary actions for accomplishment of goal.

Our aim is to determine:

a) What they do

b) What things they use

c) What they must know

T.A. 1: Helping in finding way

1) Acquiring knowledge about how the device could help user in finding way.

2) Availability of enough time needed to understand the GPS signals on small screen on the walking stick and use of headphone.

3) User forgets which way to go/ want to take the shortest path.

4) Small screen attached to the claw controller shows an arrow in the direction user has to head.

5) Audio also helps directing the elder or visually impaired to take the right path.

6) User listens the audio on the headphone or see the screen (the option is restricted to the disability user is facing, some elder may having hearing issues while some may be suffering with vision problems).

7) User getting directed to the right direction.

TA2: Device helps out user if it come across puddle or obstacle

Lens-Style Cameras

1) Acquiring knowledge about how the device could help user if he comes across any obstacle in the way.

2) Availability of enough time needed to understand the GPS signals on small screen on the walking stick and use of headphone.

3) User comes across an obstacle.

4) Small camera at the bottom of walking stick captures pic.

5) The AI enabled data training model attached to stick analyzes if it hits an obstacle.

6) Small screen attached to the claw controller shows an arrow in the direction user has to head.

7) Audio also helps directing the elder or visually impaired to take the right path.

8) User listens the audio on the headphone or see the screen (the option is restricted to the disability user is facing, some elder may having hearing issues while some may be suffering with vision problems).

9) User getting directed to the right direction.

TA3: Heart rate monitoring during uneasy situations

1) Acquiring knowledge about how the device could help user in heart rate monitoring.

Ex: Knowing normal heart rate, LED, alarm.

2) Analyzing components and technology that would monitor heart rate.

Ex: PPG sensors - a light-based technology to sense the rate of blood flow

as controlled by the heart's pumping action.

3) Availability of enough time needed to set feed some extra information for emergency conditions.

4) User feels uneasy while climbing on stair or due to other factors.

5) PPG sensors (a light-based technology to sense the rate of blood flow

as controlled by the heart's pumping action) attached to the walking stick

senses fluctuation in blood flow rate.

6) LED alerts the user first to take a rest if high fluctuation in heart rate is observed.

7) Secure 45CSET-1 Chair Exit Alarm attached to walking stick produces low sound alarm just after sudden fluctuation in heart beat.

8) 140db safe sound personal alarm emergency alarm makes a loud sound to draw attention if in case user's condition shows no improvement for 2-3 min.

9) People in surrounding helps out the elderly as per the situation demands.

TA 4: Reminders

1) Acquiring knowledge about how the device could help user in setting reminder.

Ex: Knowing about normal reminder an elderly or visually impaired would need, function of LCD screen, LED, alarm.

2) Analyzing components and technology that would be needed to add the reminder and how it would be invoked.

Ex: LCD screen

3) Availability of enough time needed to learn to set the reminder.

4) User wants to set a reminder for carrying out any task.

5) Button pressed by user for enabling reminder option.

6) User sets time 16*2 LCD screen (like a touch mobile).

7) LED alerts the user about the activation of reminder.

8) Secure 45CSET-1 Chair Exit Alarm attached to walking stick produces low sound alarm just after sudden fluctuation in heart beat.

9) User gets reminded about the task he wanted to carry out.

Task 1:

Scenario	Analysis
User lost way	1) Acquiring knowledge about how the device could help user in finding way. 2) Availability of enough time needed to understand the GPS signals on small screen on the walking stick and use of headphone. 3) User forgets which way to go/ want to take the shortest path. 4) Small screen attached to the claw controller shows an arrow in the direction user has to head. 5) Audio also helps directing the elder or visually impaired to take the right path. 6) User listens the audio on the headphone or see the screen (the option is restricted to the disability user is facing, some elder may having hearing issues while some may be suffering with vision problems). 7) User getting directed to the right direction.

TA2:

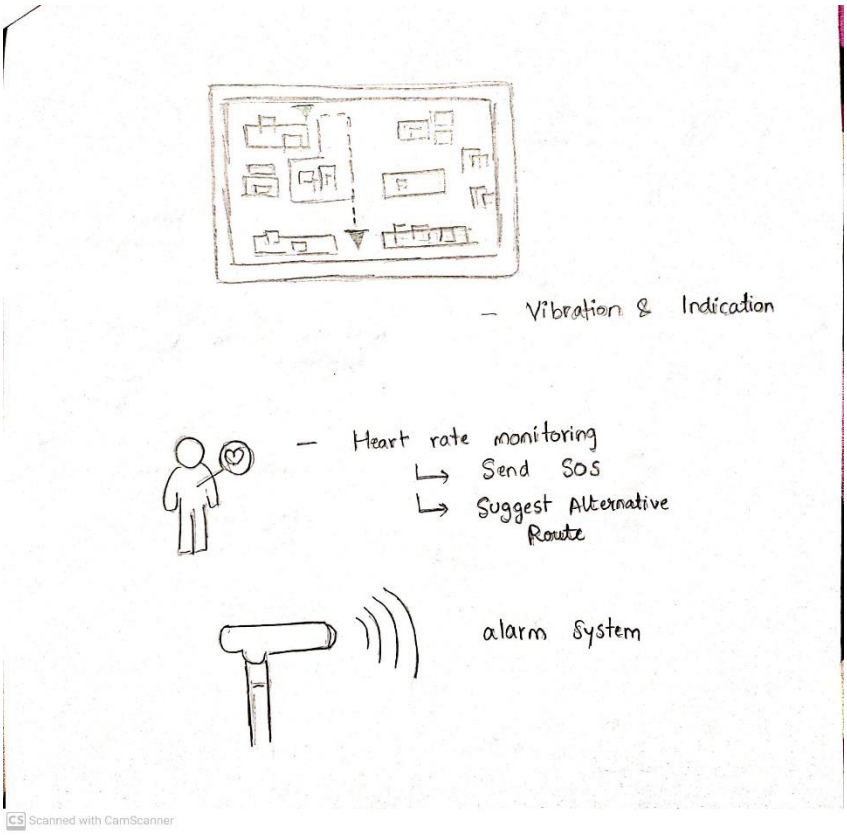
User comes across puddle or obstacle	1)Acquiring knowledge about how the device could help user if he comes across any obstacle in the way. 2) Availability of enough time needed to understand the GPS signals on small screen on the walking stick and use of headphone.

	3) User comes across an obstacle. 4) Small camera at the bottom of walking stick captures pic. 5) The AI enabled data training model attached to stick analyzes if it hits an obstacle. 6) Small screen attached to the claw controller shows an arrow in the direction user has to head. 7) Audio also helps directing the elder or visually impaired to take the right path. 8) User listens the audio on the headphone or see the screen (the option is restricted to the disability user is facing, some elder may having hearing issues while some may be suffering with vision problems). 9) User getting directed to the right direction.

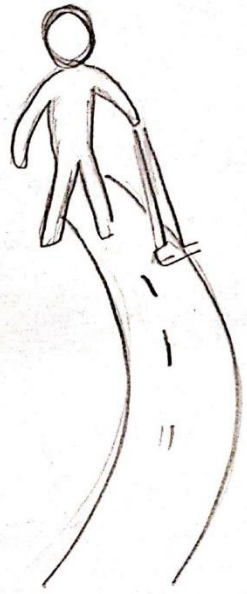
Features:

- GPS system that shows optimal routes to the user.
- Integrating OCR devices to make it accessible to the visually impaired too.
- Obstacle and Bacteria detecting features
- Heart Rate Monitoring System integrated with the smart walking system.
- Reminder and Alert System.
- Adding audio signals and integrate them with a claw controller (vibrations) to assist the elderly and the blind.

- Heart Rate Detection + GPS integration. (Suggest optimal routes based on pulse rate)
- Have a panic switch to alert surrounding people if necessary.



Bob wants to go on the road



Walking stick detects obstacles

Bob is feeling uneasy (heart rates)

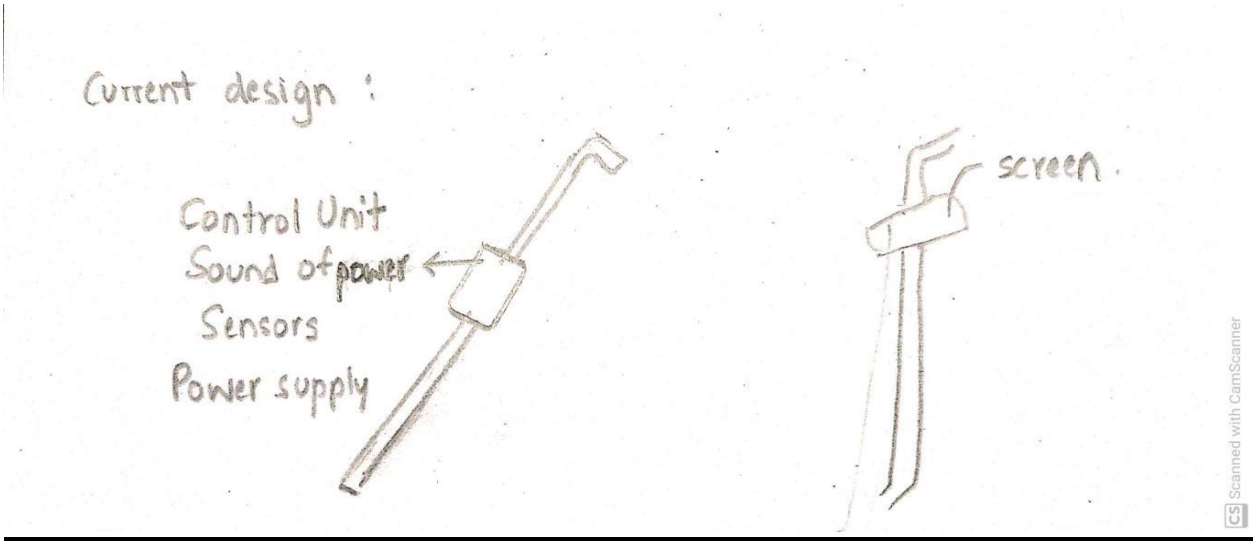
Detects pulse and alerts the care taker and audio for people around to help.

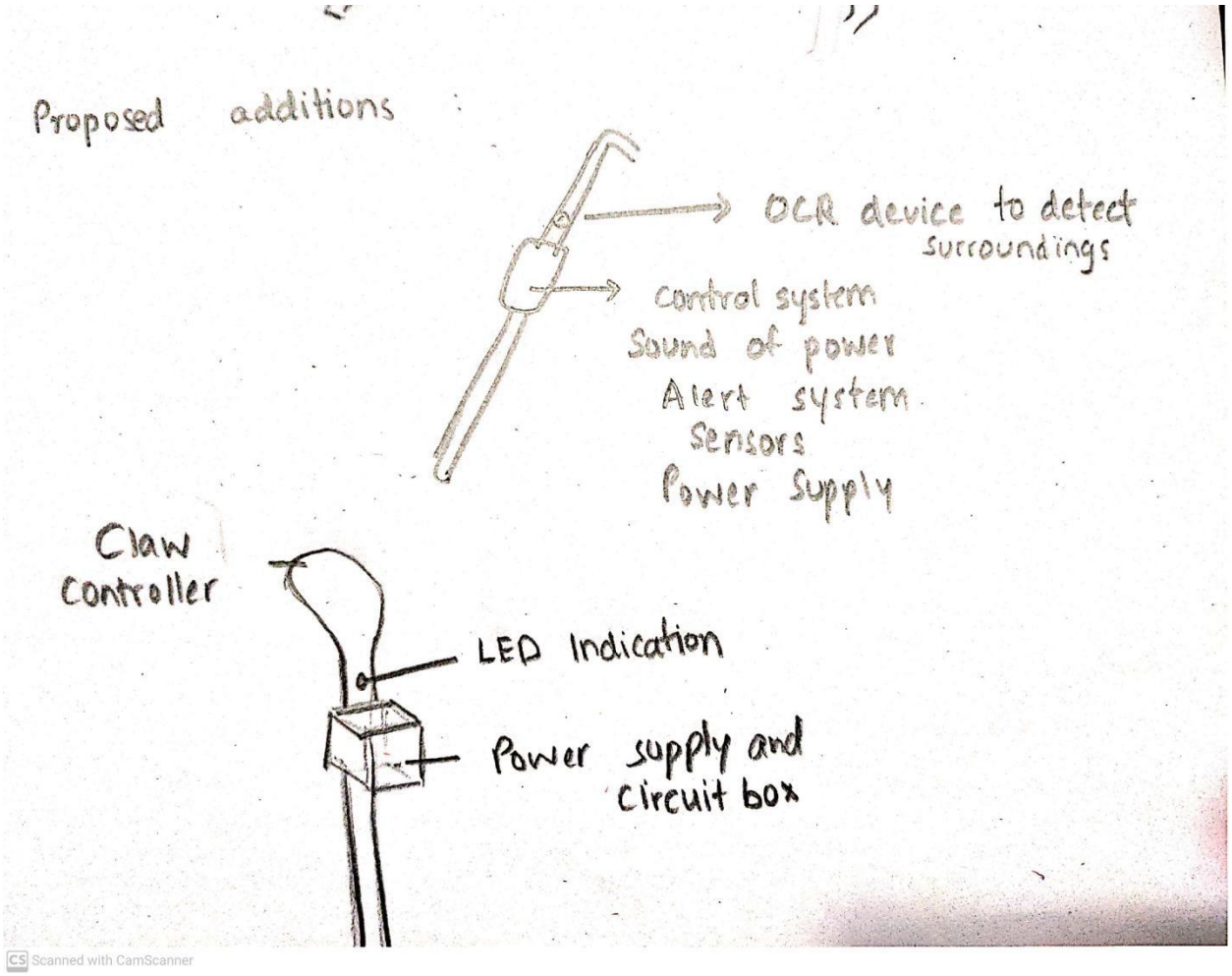
Bob forgot to take medicines

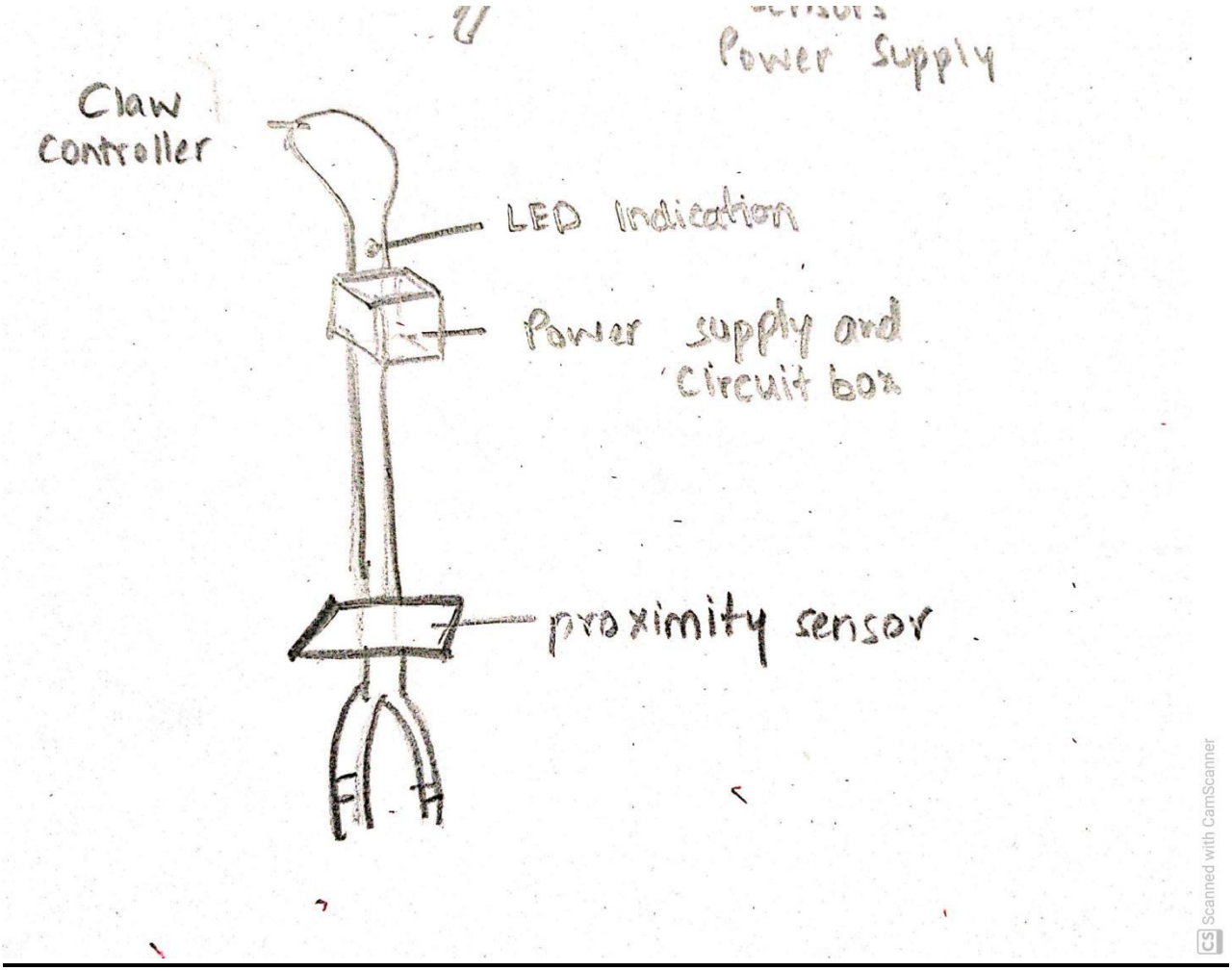
Daily reminders given

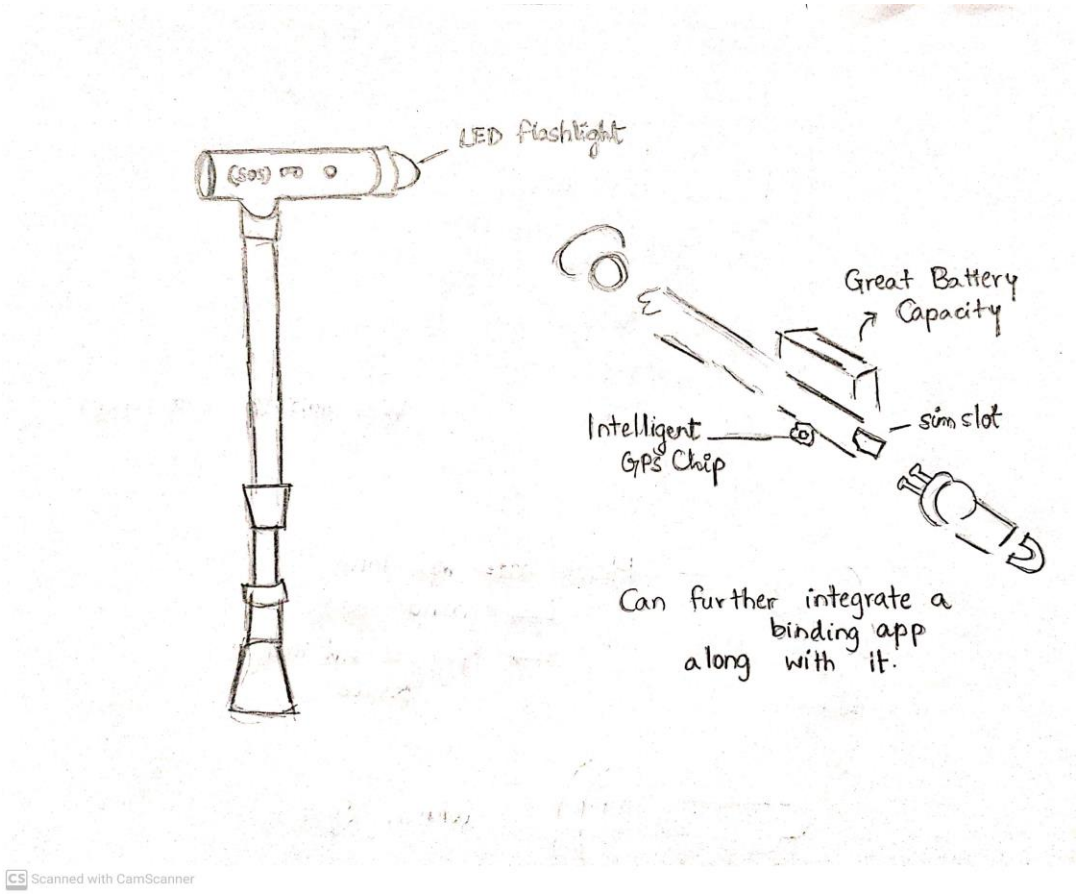
<Ring>

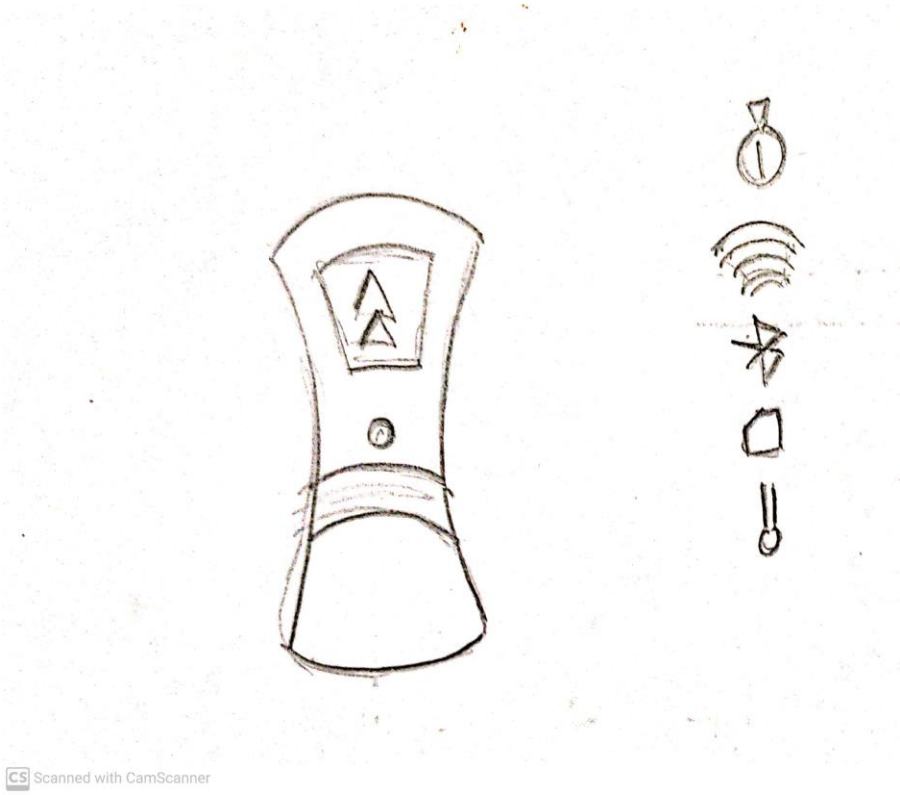
Prototype:


Current design :
Control Unit
Sound of power
Sensors
Power supply
screen.

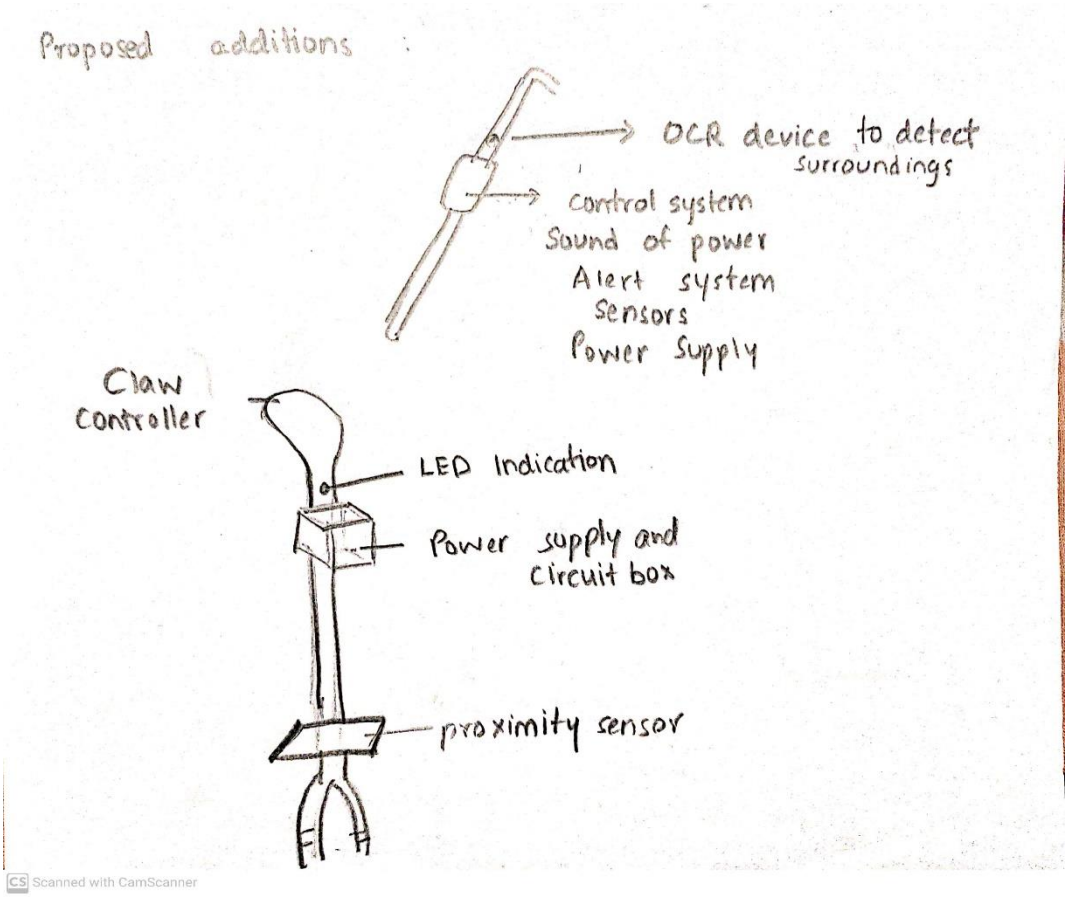

Proposed additions
OCR device to detect surroundings
control system
Sound of power
Alert system
Sensors
Power Supply
Claw Controller
LED Indication
Power supply and circuit box



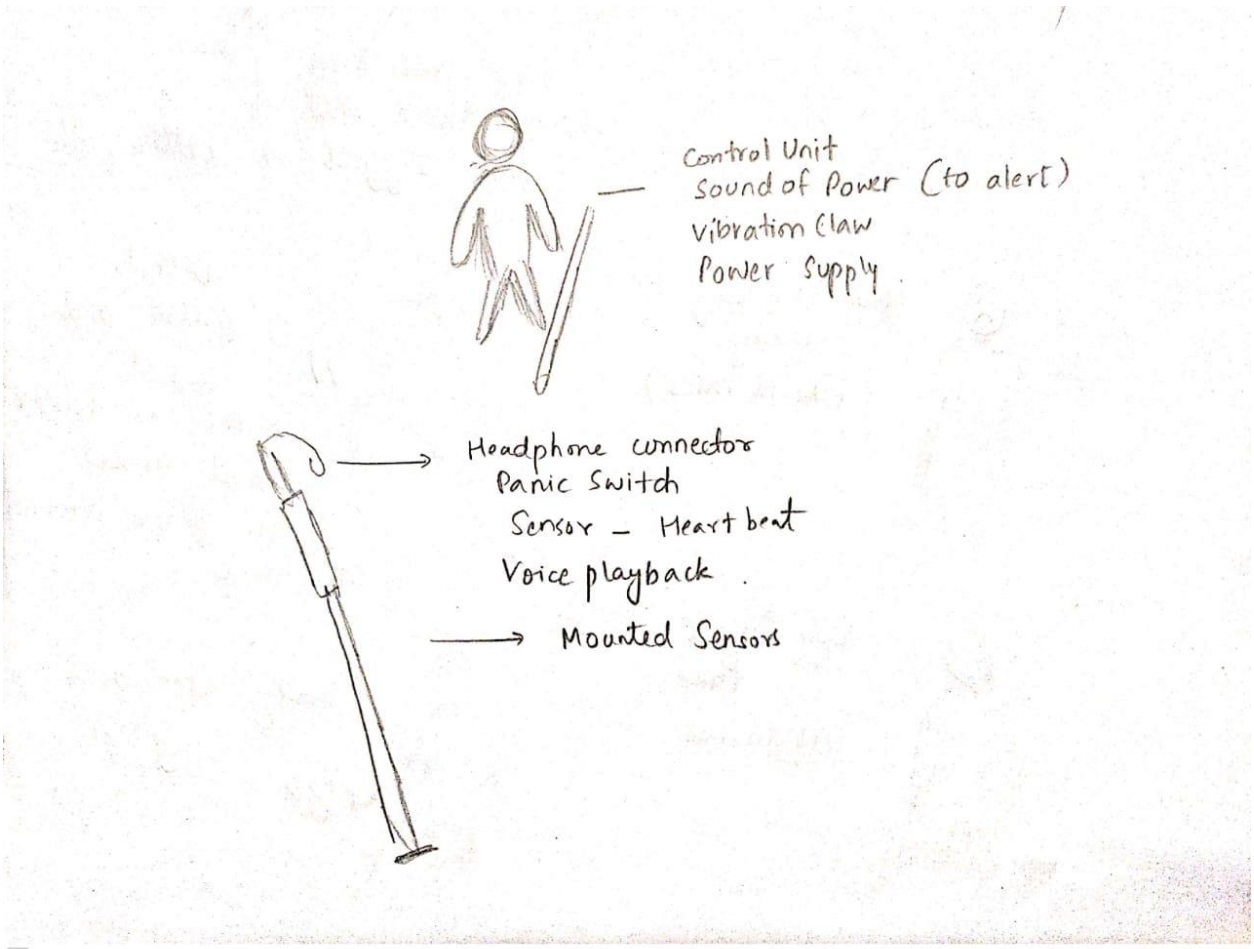


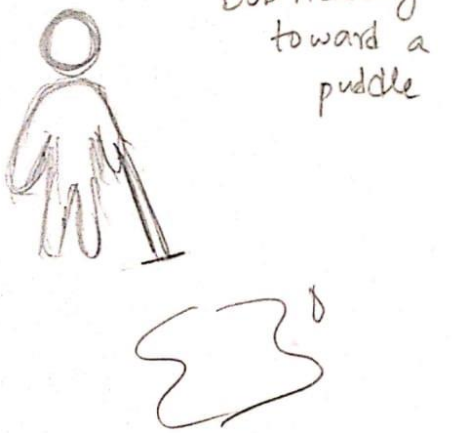


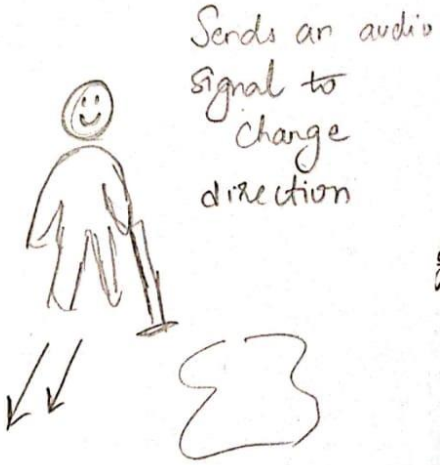
Proposed additions :

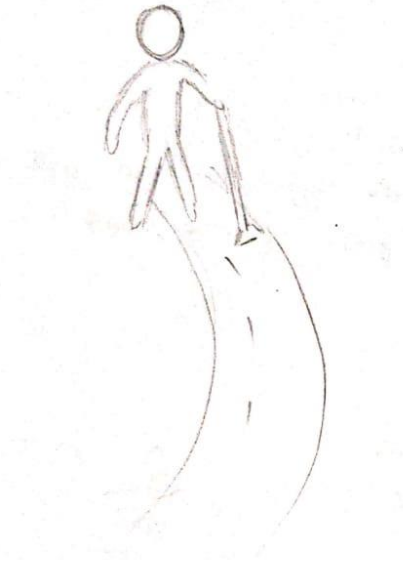


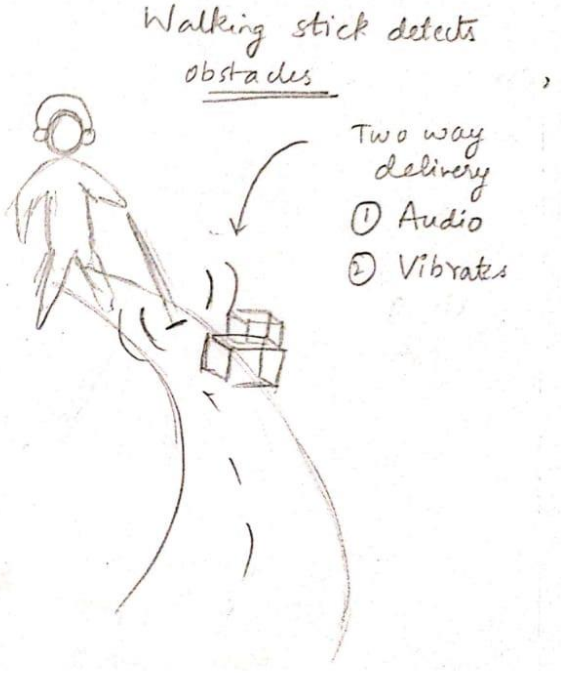
Story-Boarding:

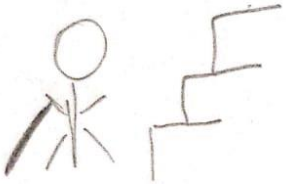












Bob is going on a staircase

The stick will detect heart beat and suggest a better path

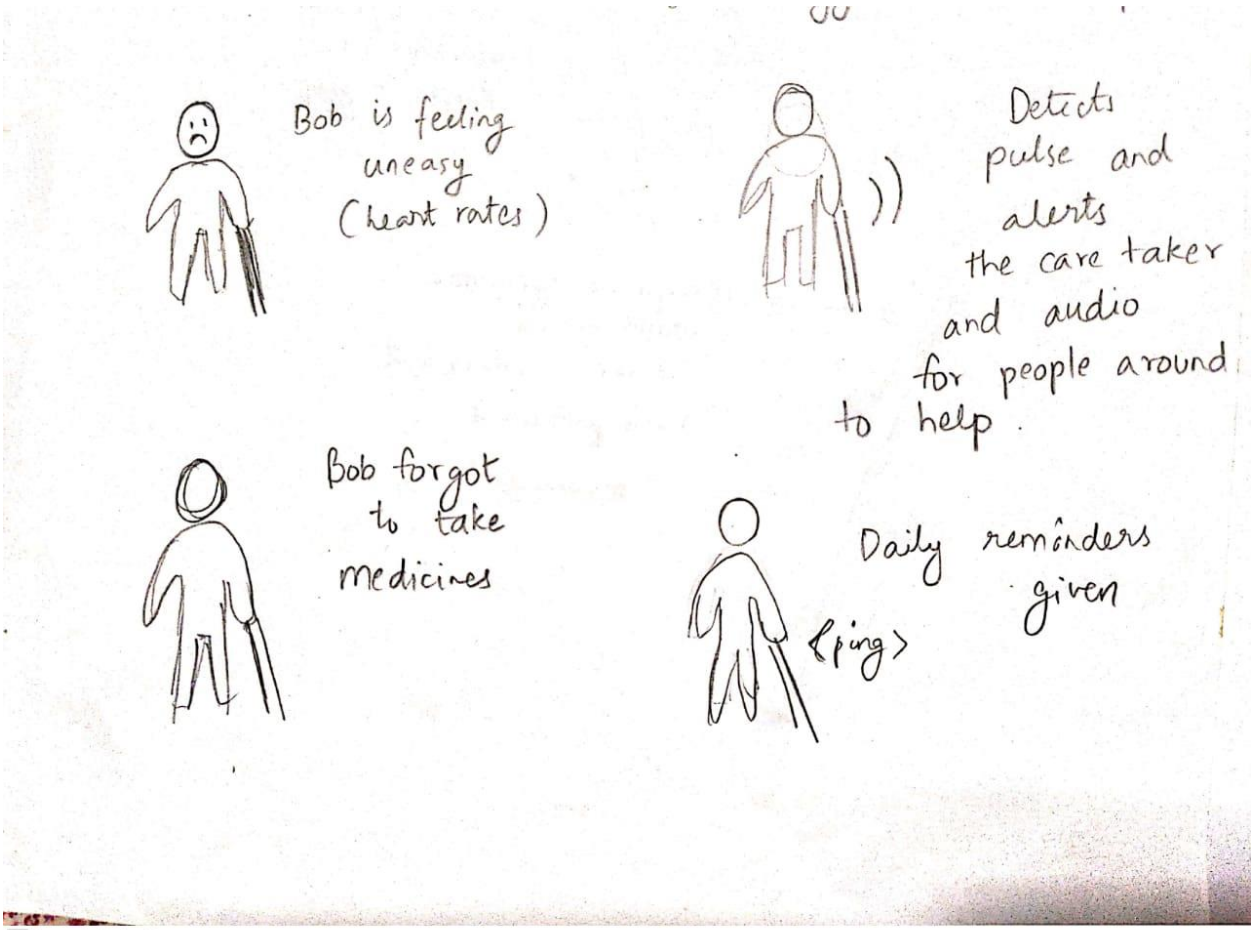
Bob is feeling uneasy (heart rates)

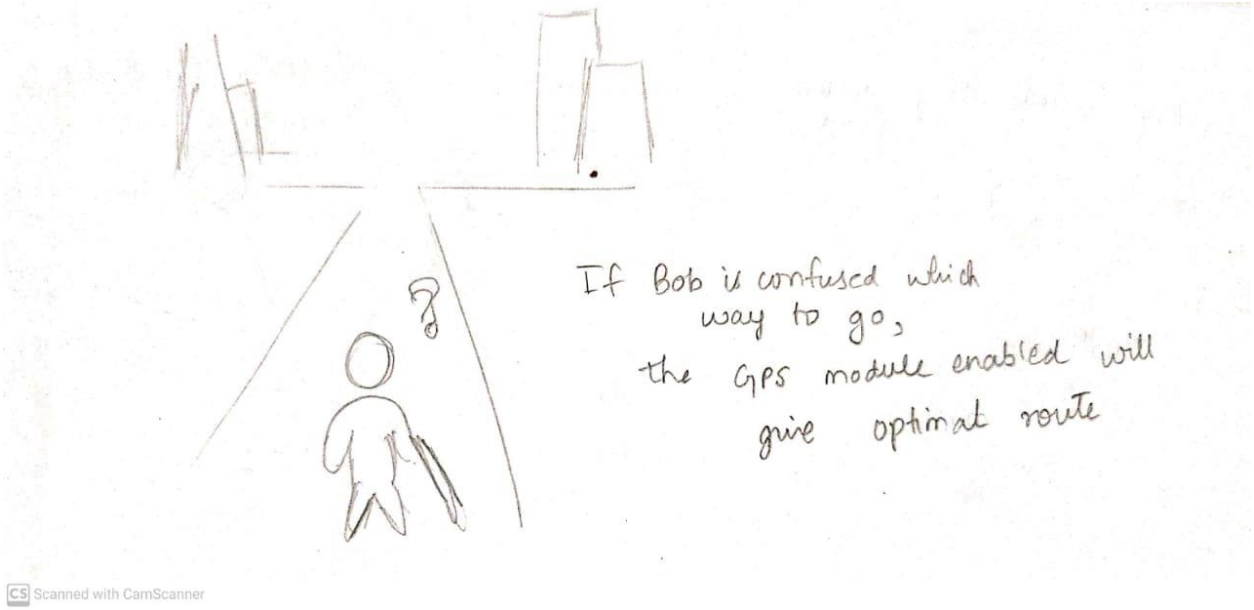
Detects pulse and alerts the care taker and audio for people around to help.

Bob forgot to take medicines

Daily reminders given

<ping>





Personas:

1. Persona is about customer experience and how to make them feel comfortable while using the product.
2. Our main aim with the following walking system is to make it hassle free for the elderly and the visually impaired.
3. Integrating vibrating claw controllers makes it easier for the blind and the elderly with vision problems.
4. Taking feedback and trying to make it comfortable for the customers and accommodating new changes will always be priority

PERSONA

Name: Mr. Benjamin

Age: 60
Work: Retired
Family: Married, 2 Children
Location: Hyderabad

Bio:
Mr. Benjamin is retired and loves taking walks on a fine evening. His vision is a little weak. He likes being independent and doesn't want to bother his children for his work. He prefers doing things on his own and is capable of taking care of himself, but with a push.

Frustrations:
Wants to go on walks alone, without anyone worrying.
Needs to be reminded to take his medicines.

Goals:
To not be dependent.
To have a navigator.
Reminder scheduled.

Cognitive Walkthrough:

Let's walk through a series of tasks and ask a set of questions from user's point of view.

Step 1: Choosing user or persona.

The persona of our user – Mr. Benjamin.

- Knowing persona's ability and assistive technology they use.

The elderly or visually impaired people are incapable to go to the market on their own. Generally, they use a simple cane. It might help them in providing support in their way, but wait that's not a smart solution for them. They need someone to take care of them and our smart walking stick is all set to help them out.

- Knowing the effect of their disability/ability on their digital experience.

  Many elders are not able to call out by dialing on emergency numbers like hospital's no when they meet with any accident due to weak memory problem or since it freaks them badly. Our smart walking stick is just a button away to any such help they desire.

- Knowing their motivation, emotion, risk tolerance and persistence.

  We generally find elderly or impaired people involved in spiritual activities. Our product's user is highly inclined towards visiting temples, gardens or shop nearby. These emotional inclinations of our user can be fulfilled by using the static settings of navigation helper using our smart walking stick. The user is highly intolerant to any physical hurt and thus we incorporate an alert system.

<u>Example of persona and the stigma of our stick user: Mr. Benjamin</u>

Mr. Benjamin is an old man incapable to go to the market on his own.

Staying home all day gets tiring and very routine.

His family members will be worried if he loses his way in between or unfortunately meets any accident.

He even forgets taking her daily medicines.

He is getting stressed and weak day by day.

<u>Step 2: Creating a list of tasks a user wants to do</u>

- User want to visit places safely
- User wants to cross any obstacle that comes in the way safely.
- User is worried about what if a health issue like abnormal heart rate problem occurs in way, he wants a monitoring system.

- The targeted users of our project are challenged at physical levels may be due to age or some inborn issues, they want an assistance or kind of reminder to carry out their work.

Step 3: Creating of list of steps needed to complete each task with Scenario-Based Designing

User wants to visit places safely.

Scenario: User forgets which way to go/ want to take the shortest path.

Steps: No extra effort, just see the static settings already incorporated in

stick.

Small screen attached to the claw controller shows an arrow in the direction user has to head.

Audio also helps directing the elder or visually impaired to take the right path.

User listens the audio on the headphone or see the screen.

User wants to cross any obstacle that comes in the way safely.

Scenario: User comes across an obstacle.

Small camera at the bottom of walking stick captures pic. The AI enabled data training model attached to stick analyzes if it hits an obstacle.

User is worried about what if a health issue like abnormal heart rate problem occurs in way, he wants a monitoring system.

Scenario: User feels uneasy while climbing on stair or due to other factors.

PPG sensors (a light-based technology to sense the rate of blood flow as controlled by the heart's pumping action) attached to the walking stick senses fluctuation in blood flow rate.

LED alerts the user first to take a rest if high fluctuation in heart rate is observed.

The targeted users of our project are challenged at physical levels may be due to age or some inborn issues, they want an assistance or kind of reminder to carry out their work.

Scenario: User wants to set a reminder for carrying out any task.

Steps:

Button pressed by user for enabling reminder option.

User sets time 16*2 LCD screen (like a touch mobile).

Step 4: Perform the complete walkthrough

If I am the user of smart walking stick and I see myself in user's foot i.e. I am assuming myself to be 65 years old lady.

In such condition, the only priority for me would be carrying out task comfortably and easily.

Ex: I want to set a reminder but I wouldn't want a complex task for that, a single button click would do.

I want short path, I am not so updated with technology at this age, a click or signal will do.

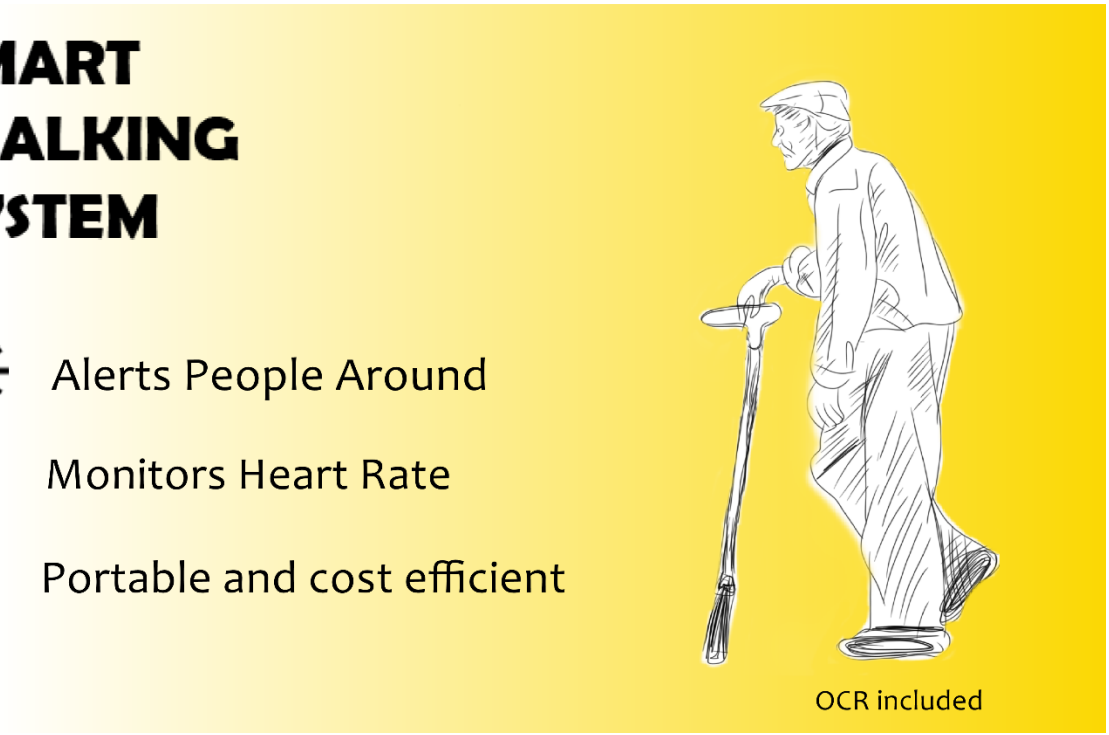
I want immediate help and since its urgency situation, I should be able to tackle the situation with single button click.

How to make it happen:

Participatory Design

Our approach throughout project:

Poster:



The introduction, scope, problem statement, features, requirements (like OCR), features, personas and prototype are tried to be covered without making the poster clumsy. Each topic is already discussed in detail in document above.

Navigation Map:

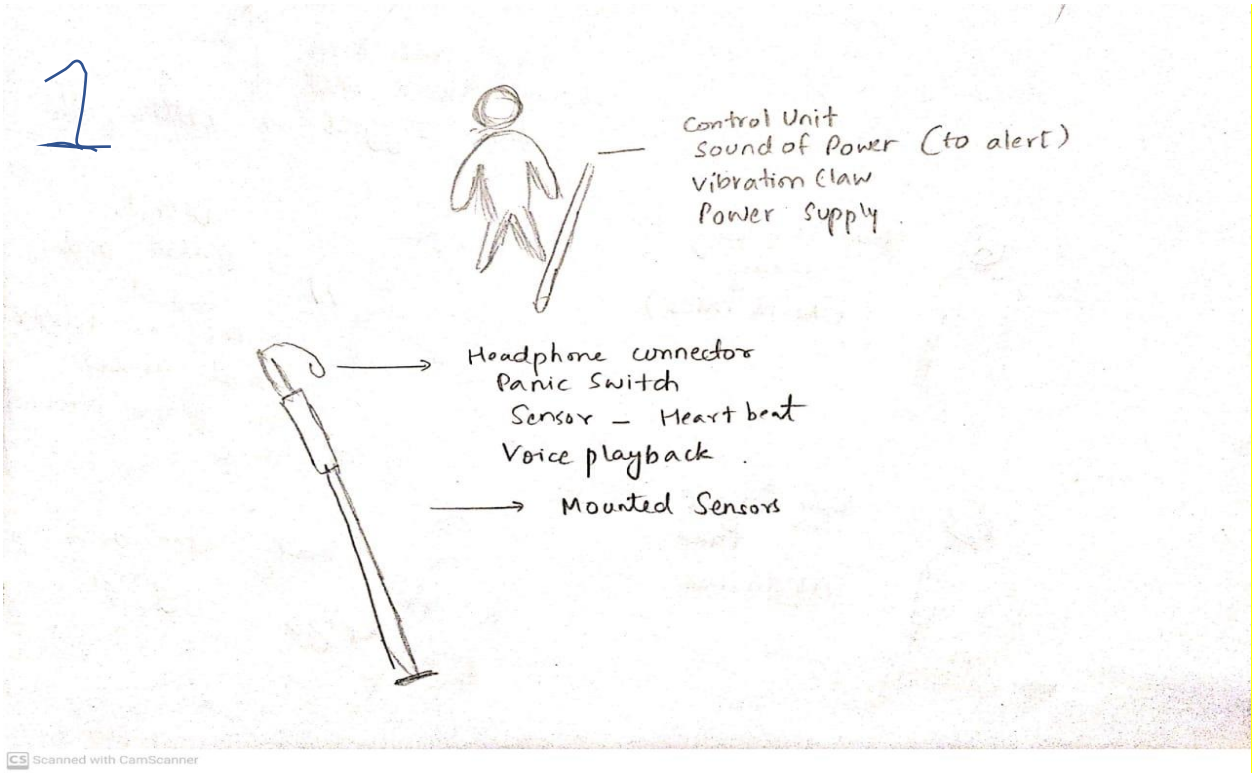
Navigation maps represent how the user navigates through the system.

1. Help identify how the user might navigate
2. Help identify how the information should flow
3. Plan for site creation and linking

Ours is a simple and intuitive interface. Story boarding will help see how the users can utilize various features in the system.

A picturized approach to navigation map

1

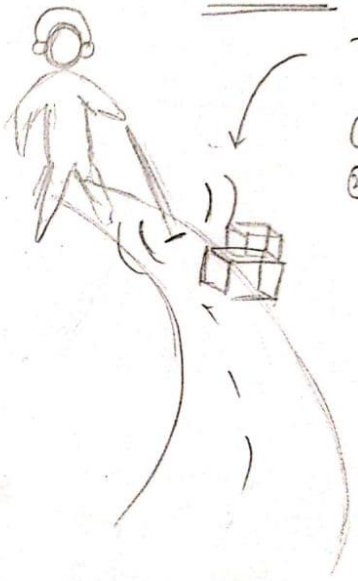


2

3

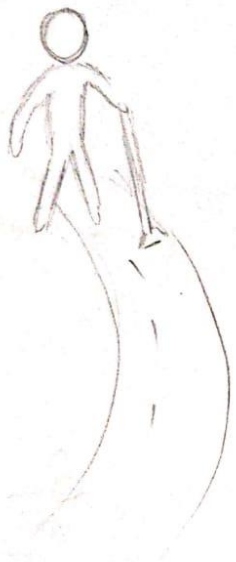
Bob wants to go on the road

Walking stick detects obstacles

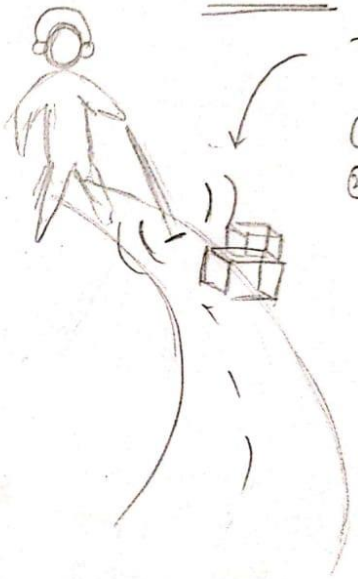


4

Bob wants to go on the road



Walking stick detects obstacles



5

Bob is feeling uneasy (heart rates)

Detects pulse and alerts the care taker and audio for people around to help.

6

Bob forgot to take medicines

Daily reminders given

<ping>

7

Bob is feeling uneasy (heart rates)

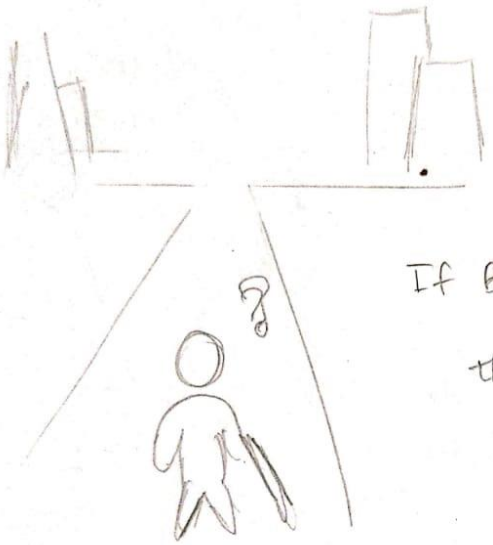
Detects pulse and alerts the care taker and audio for people around to help.

Bob forgot to take medicines

Daily reminders given

<ping>

8



If Bob is confused which way to go, the GPS module enabled will give optimal route

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