

A close-up, high-resolution image of a human eye, showing the iris, pupil, and eyelashes. The eye is looking slightly to the right. The image is dark and moody, with the eye's features highlighted by soft lighting.

“See the World through my Eyes!”

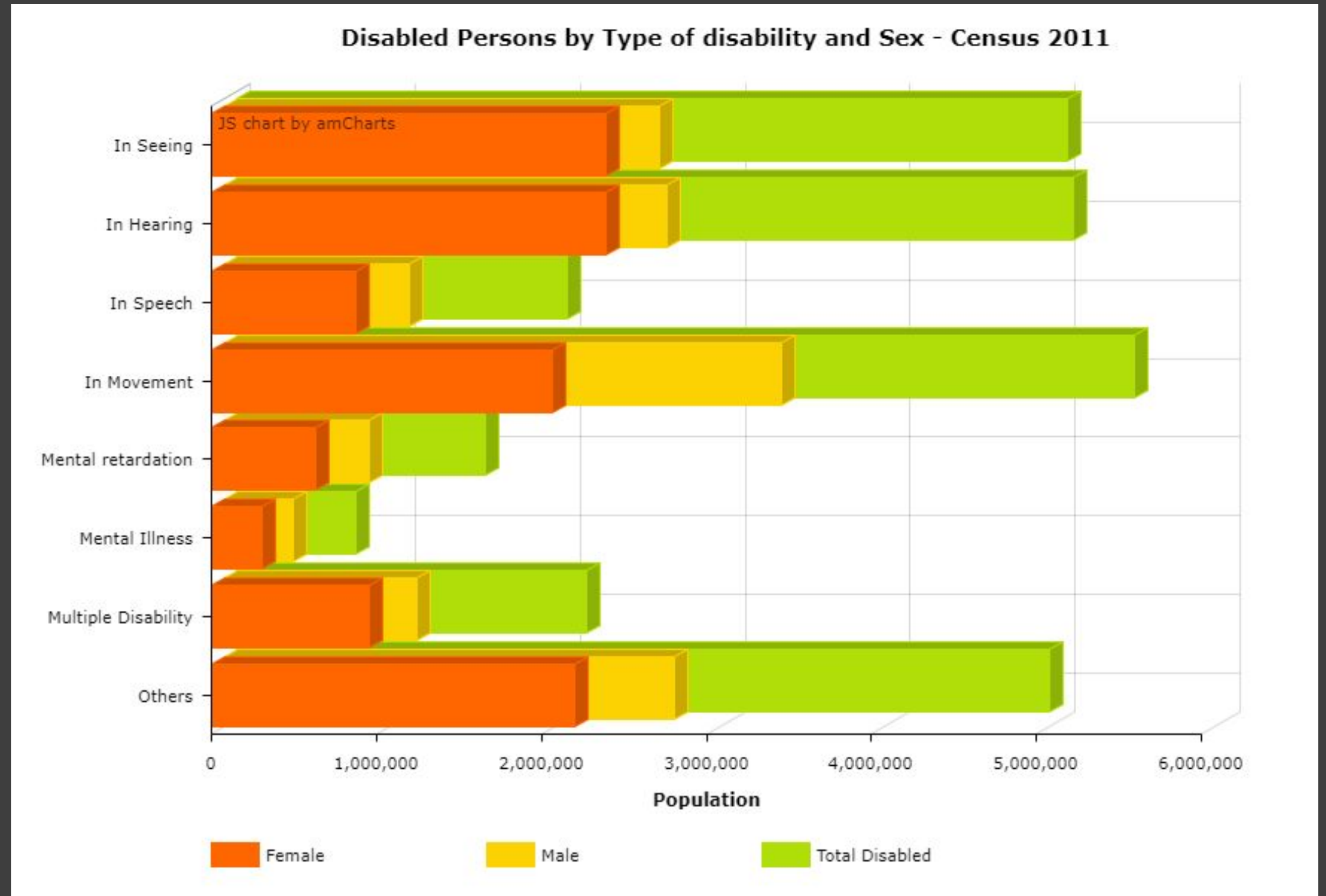
HURRY-CANE

AN ELECTRONIC AID TO PROVIDE ARTIFICIAL VISION TO THE
VISUALLY IMPAIRED

LITERATURE REVIEW

□ According to census 2011, in India out of the 121 Cr population, 2.21% (2.68Cr) are disabled. Among the disabled population 56% (1.5Cr) are males and 44% (1.18Cr) are females.

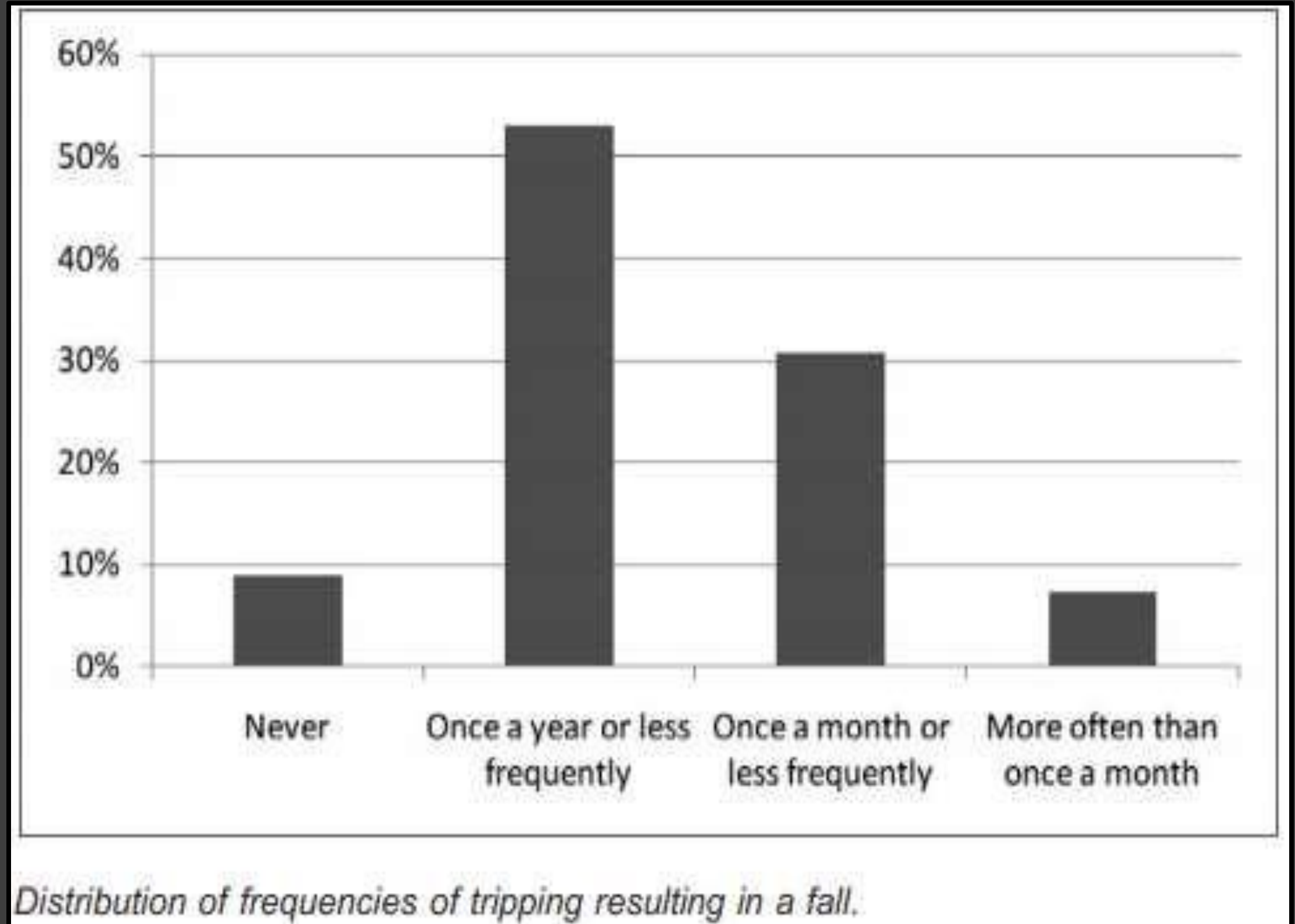
□ Majority of the blind use the walking cane as a device to help them for indoor and outdoor navigation. Even though it is cheap and requires minimal training for the blind to use it to find their way towards the place they want to go, only tactile information that is within the reach of the cane is available.



LITERATURE REVIEW

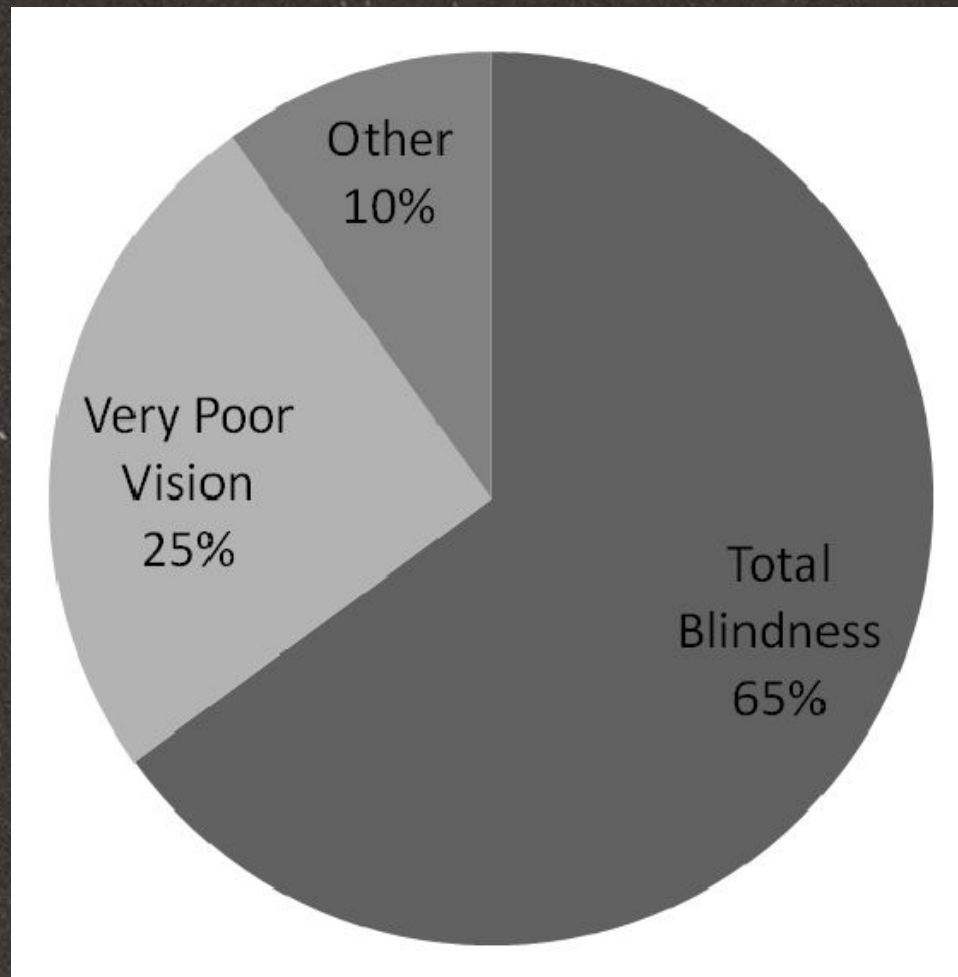
□ Previous researches have focused mainly on the use of ultrasonic sensors and a piezo buzzer which goes off whenever the person comes near an obstacle.

□ A survey interview also highlighted the head and fall level accidents that occur to the visually impaired people while navigating which sometimes even prove out to be fatal. They also pointed out that use of dog guides or present market aids also failed to provide any significant decrease in this frequency.

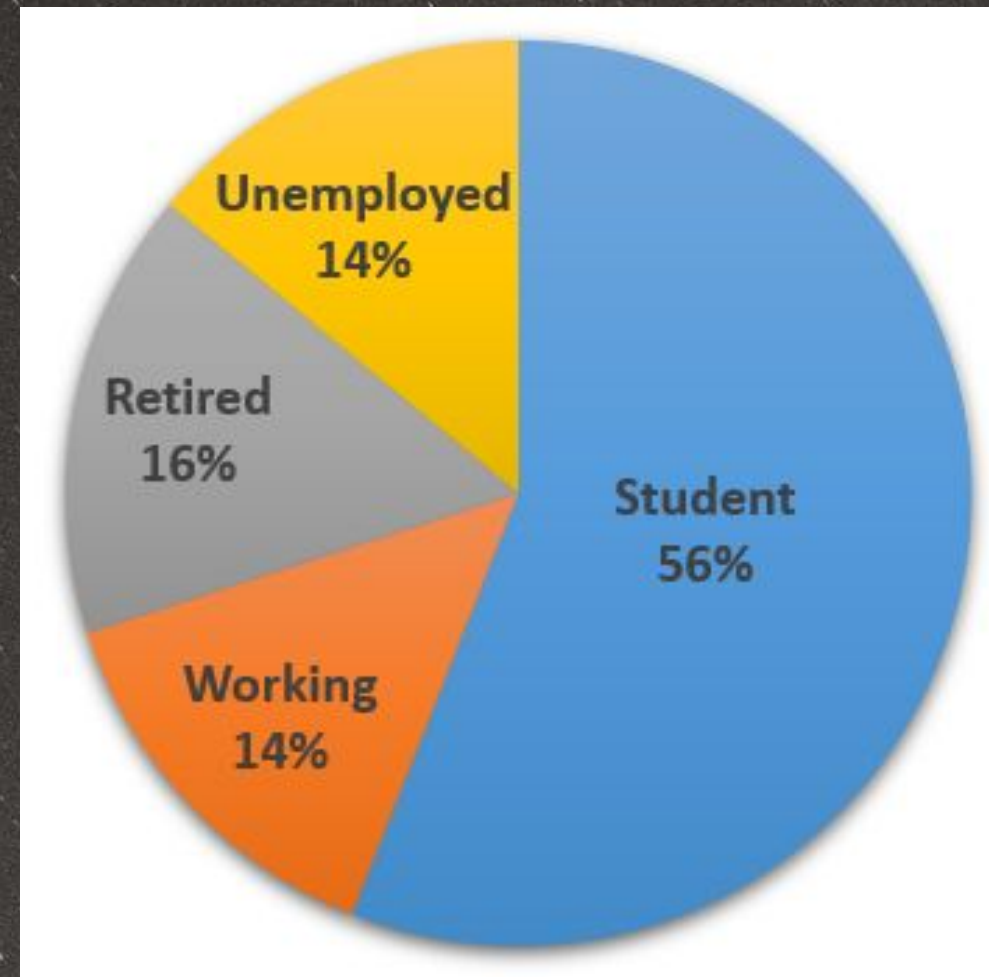


SURVEY

The survey has been conducted on 100 blind respondents. Majority of them (84%) were blind by birth, followed by 9% participants who started facing visual problems from 1 month to 1 year of age. The remaining participants belonged to the category of 1 year and above.



Types of Vision Problems



Working Status

1. What was your age when your vision problems started?

- ☐ From birth
- ☐ 1 month - 1 year
- ☐ 1 year - 12 years
- ☐ 13 years - 30 years
- ☐ > 30 years

2. What type of vision problem do you have?

- ☐ Total blindness
- ☐ Very poor vision
- ☐ Night blindness
- ☐ Others

3. What is your working status?

- ☐ Student
- ☐ Working professional
- ☐ Retired
- ☐ Unemployed

SURVEY

If "Student" :

i. Are you a school student or a college student?

- ☐ School
- ☐ College

ii. Is your educational institution privatised or government funded?

- ☐ Privatised
- ☐ Government funded

If "Retired/Unemployed" :

i. What is your family income?

- ☐ < INR 5000
- ☐ INR 5000- 10000
- ☐ INR 10000-20000
- ☐ > INR 20000

If "Working Professional" :

i. What is your profession?

- ☐ Service
- ☐ Business

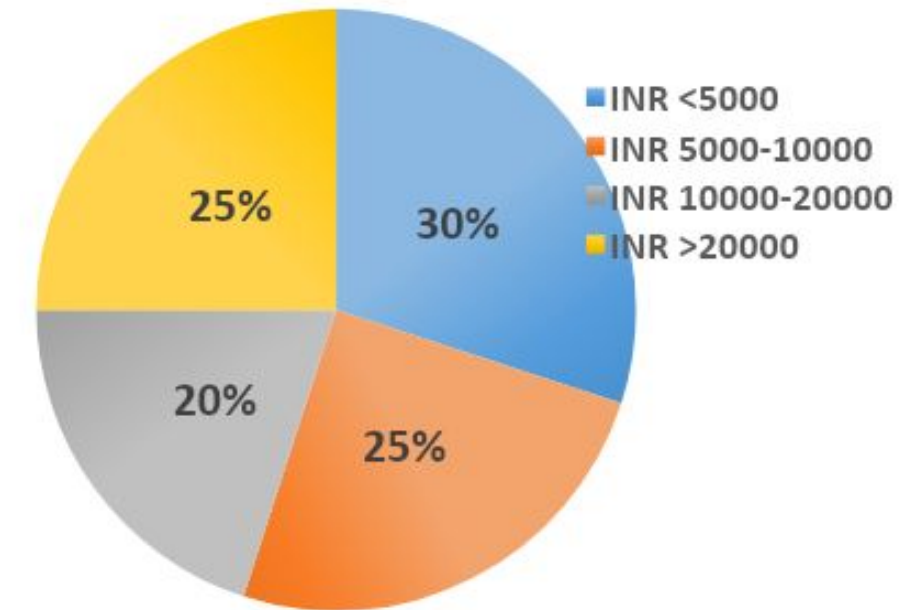
ii. What is your mode of working?

- ☐ Work from home
- ☐ Sedentary work at office
- ☐ Work on field

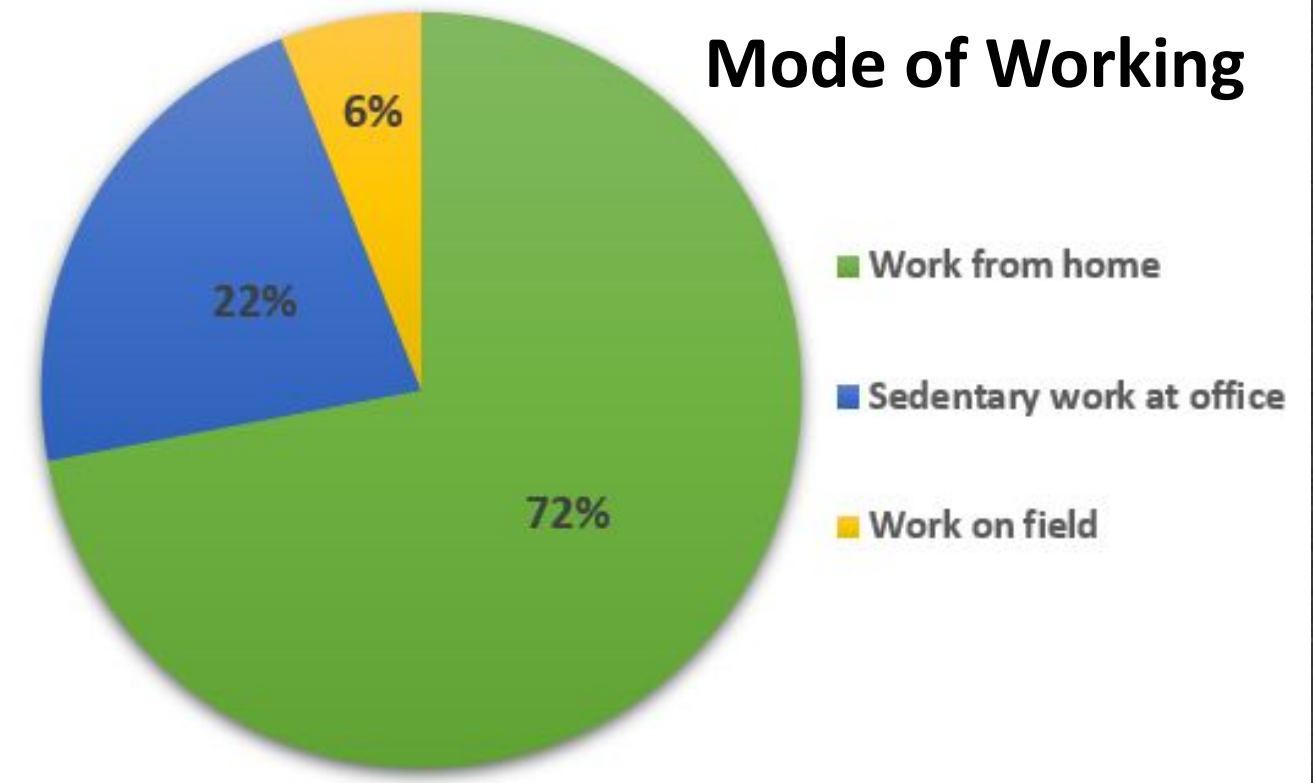
iii. What is your monthly income?

- ☐ < INR 5000
- ☐ INR 5000-10000
- ☐ INR 10000-20000
- ☐ > INR 20000

Monthly Family Income



Mode of Working



SURVEY

4. What is the frequency of your moving outdoors per month?

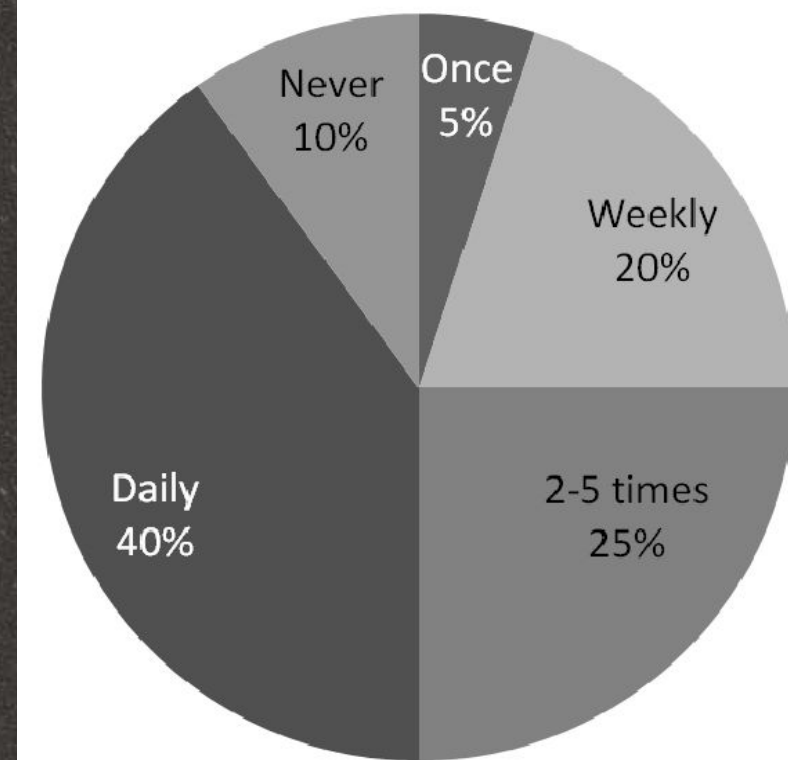
- ☐ Daily
- ☐ Weekly
- ☐ One or two times
- ☐ Never

5. What is the average number of hours you spend outside your residence per day?

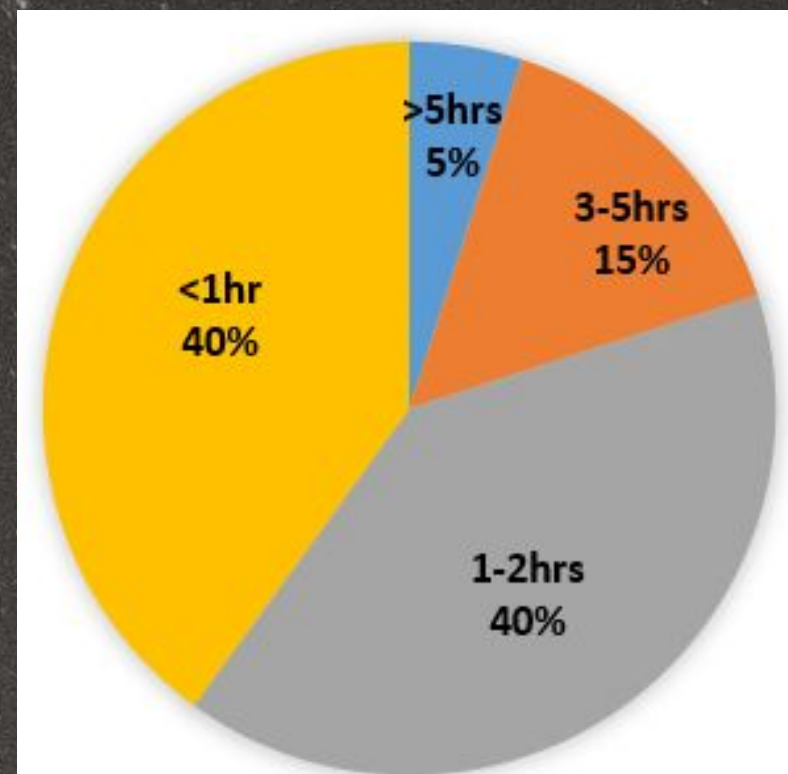
- ☐ > 12 hours
- ☐ 8 - 12 hours
- ☐ 5 - 7 hours
- ☐ < 5 hours

6. What is the average number of hours you spend commuting per day?

- ☐ > 5 hours
- ☐ 3 - 5 hours
- ☐ 1 - 2 hours
- ☐ < 1 hour



**Frequency
of moving
outdoors
per month**

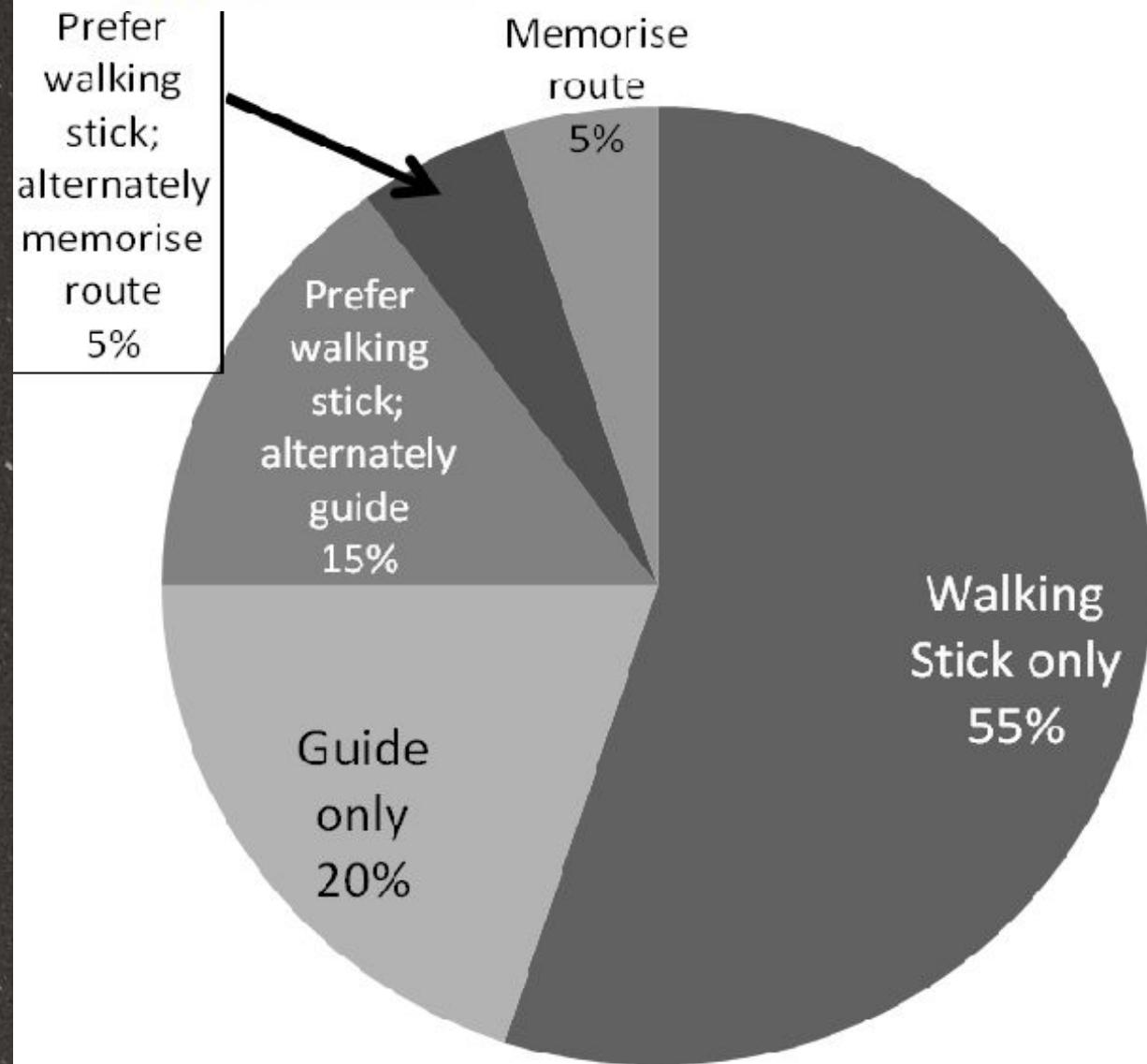


**Number of
Hours Spent
Commuting
per day**

SURVEY

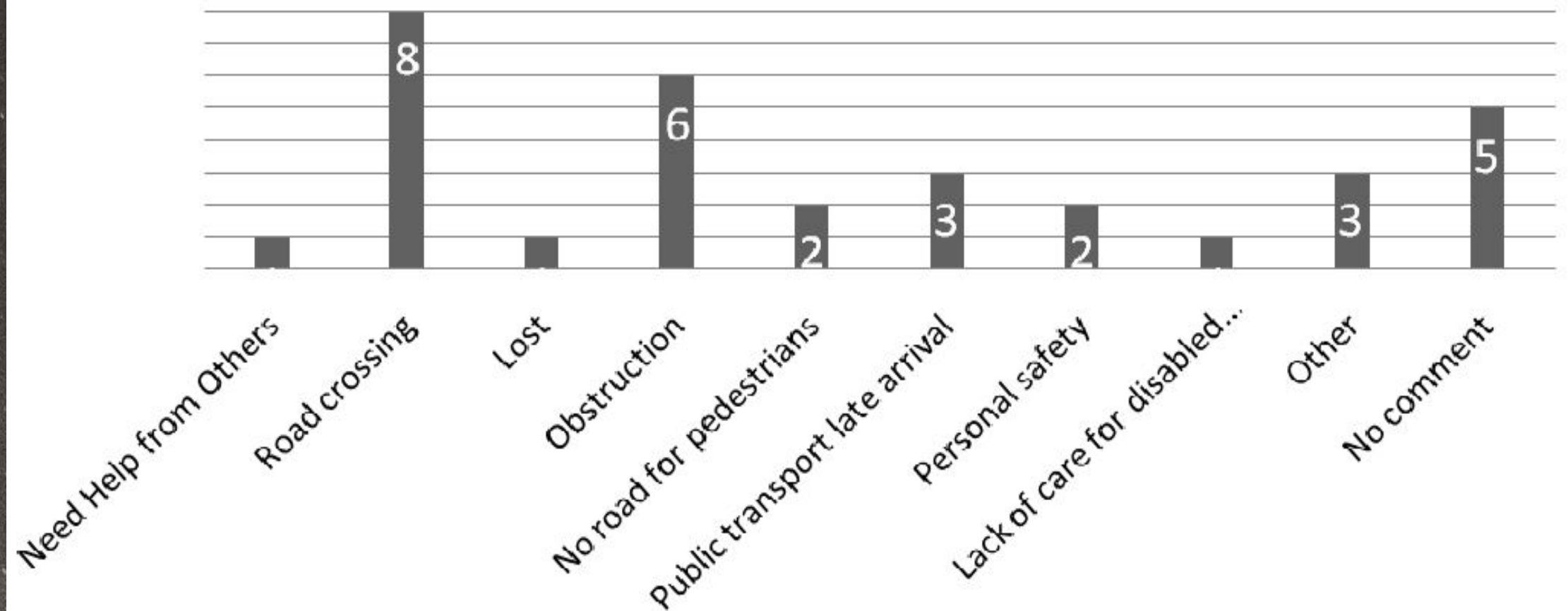
7. What is your preferred mode of aid for navigation?

- ☐ Walking Stick
- ☐ Guide only
- ☐ Memorise route
- ☐ Other

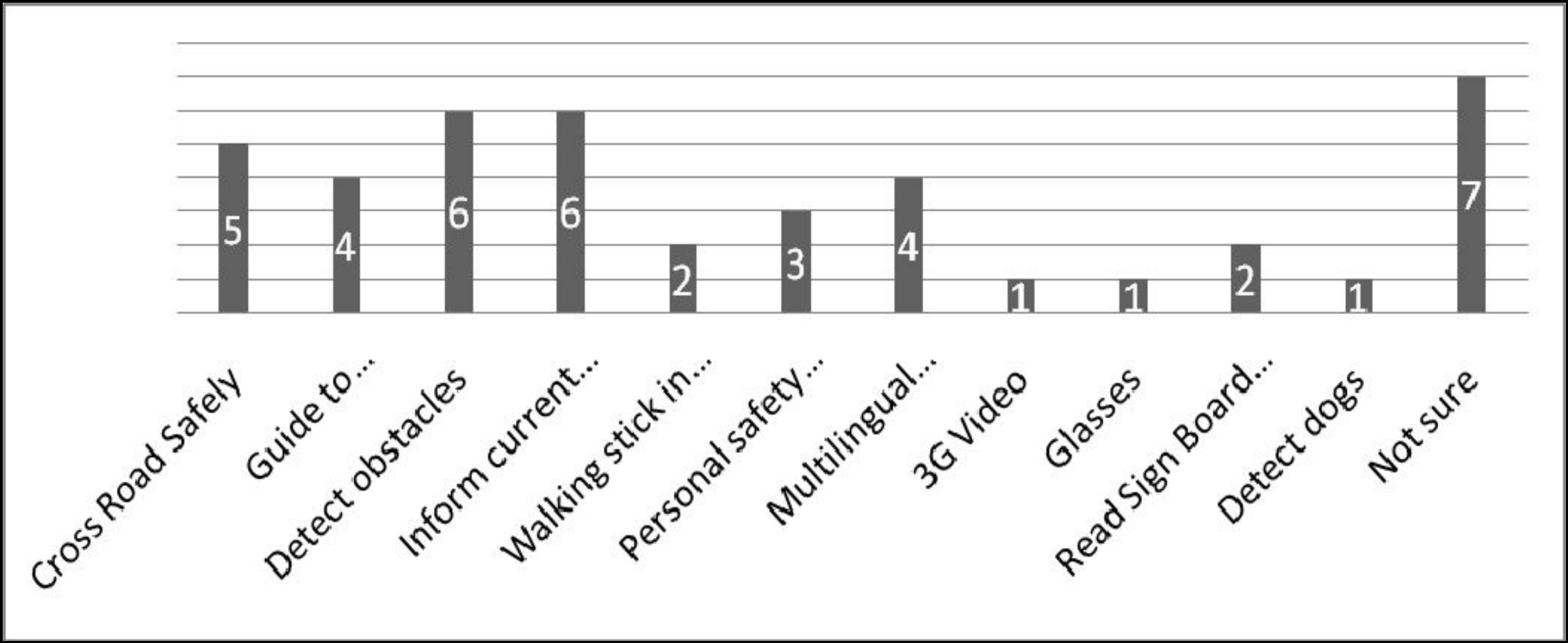


8. What are the outdoor navigation problems that you face often?

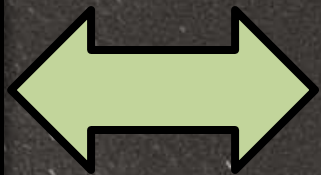
- ☐ Need help from others
- ☐ Road crossing
- ☐ Lost
- ☐ Obstruction
- ☐ No road for pedestrians
- ☐ Personal Safety
- ☐ Other




PRESENT MARKET AIDS AND OUR MOTIVATION



Outdoor Navigation System Features as wanted by the participants from our survey



Best seller



Easily adjustable height

Light weight

LED light and emergency flashlight

Alarm buzzer

Gets fully charged in 3 hours - 5 V USB or AC powered

Plays 6 hours of Radio when fully charged

Built-in rechargeable lithium battery

Present Market Scenario

HURRY-CANE FEATURES



OBSTACLE
DETECTION



FIND YOUR
CANE



WATER
DETECTION



ROAD
CONDITION
RECOGNITION



TRAFFIC LIGHT
NOTIFICATION
SYSTEM

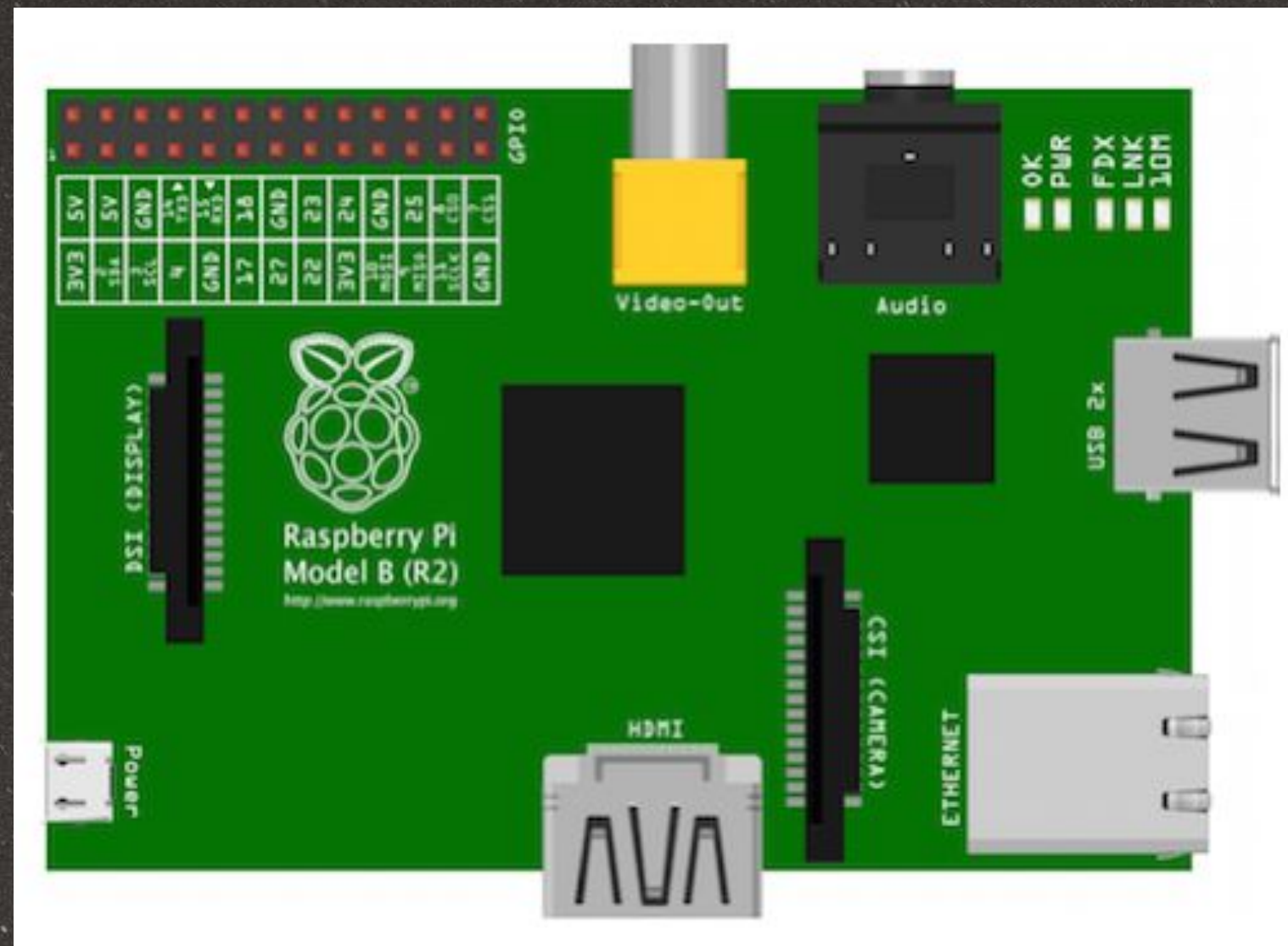


GLOW IN
THE DARK
INDICATOR

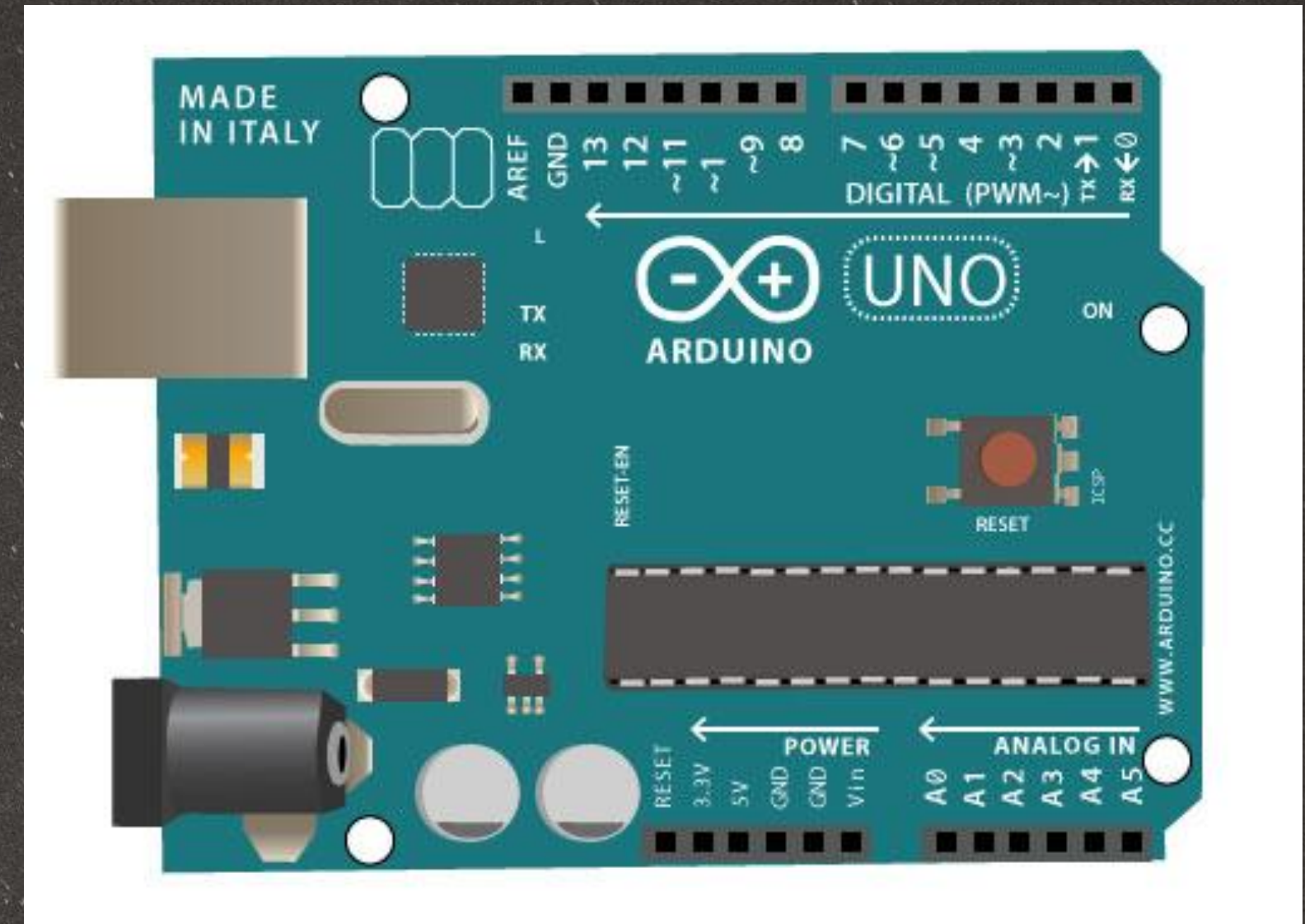


NAVIGATION
USING GPS

EMBEDDED SYSTEMS PLATFORMS USED IN MODEL DEMONSTRATION



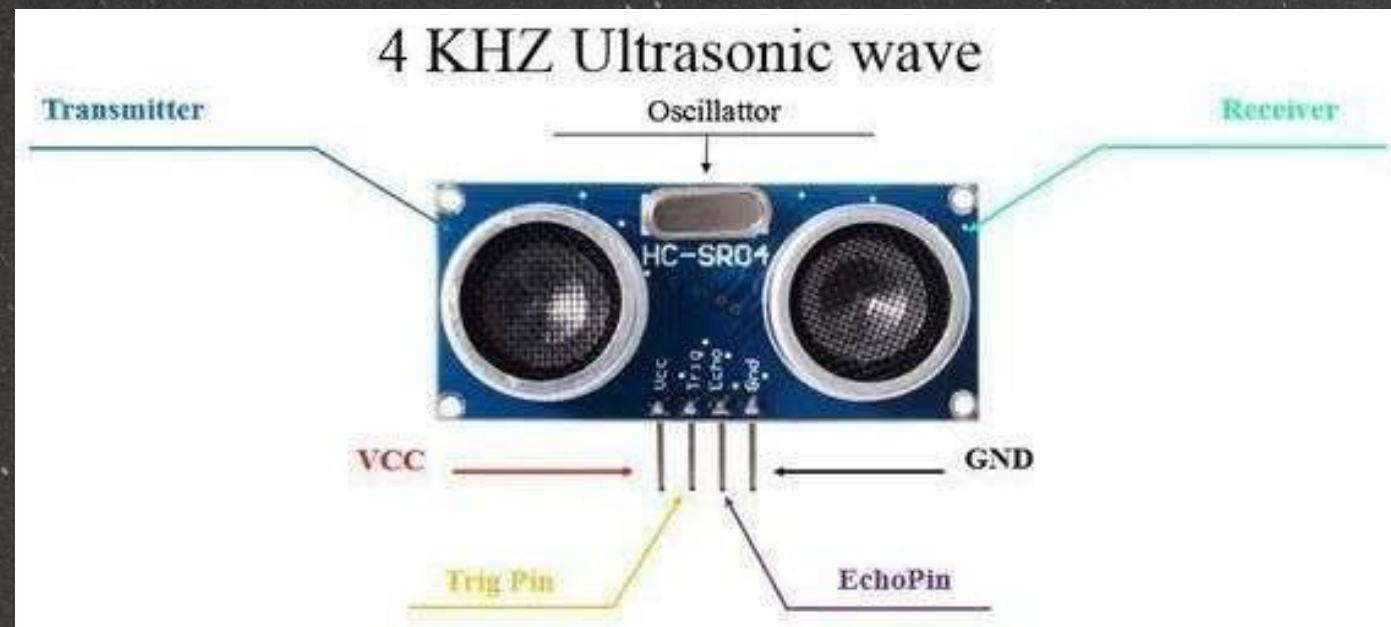
RaspberryPi3(ARM processor)



Arduino UNO(ATmega microcontroller)

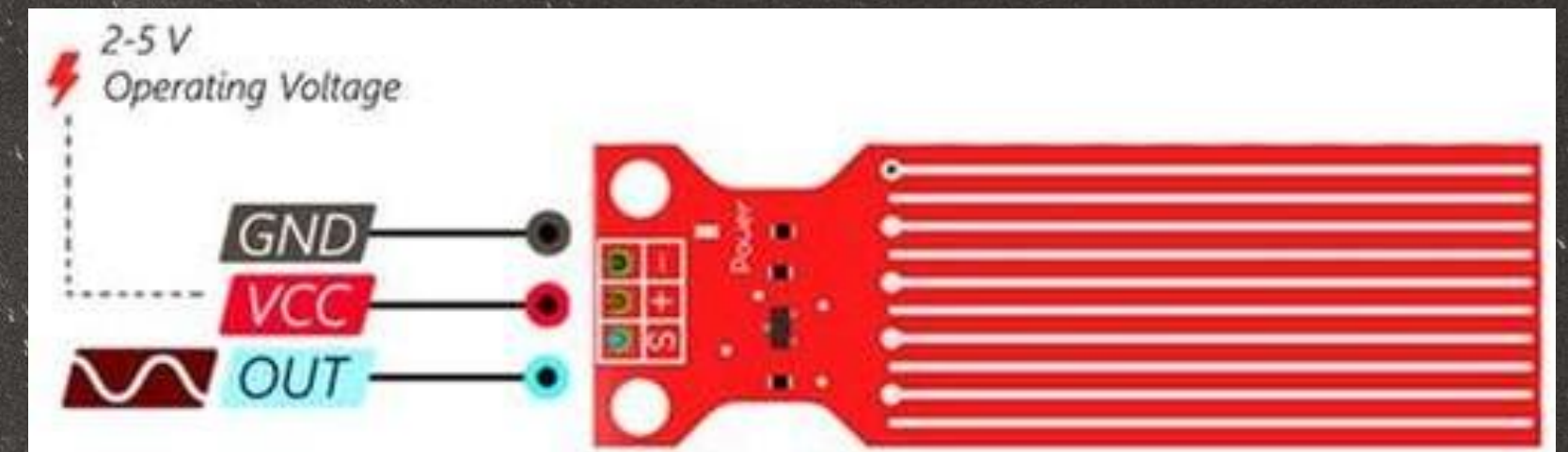
OBSTACLE DETECTION

One of the most basic features of the stick is to detect presence of obstacles within a certain range. In case of the **HC-SR04 sensor**, as we have used in our demo version of the stick, the distances ranging from 2cm - 400cm can be measured with an approximate accuracy of 3mm. If any obstacle is sensed within that range, the visually impaired person will be made aware through appropriate actuation.

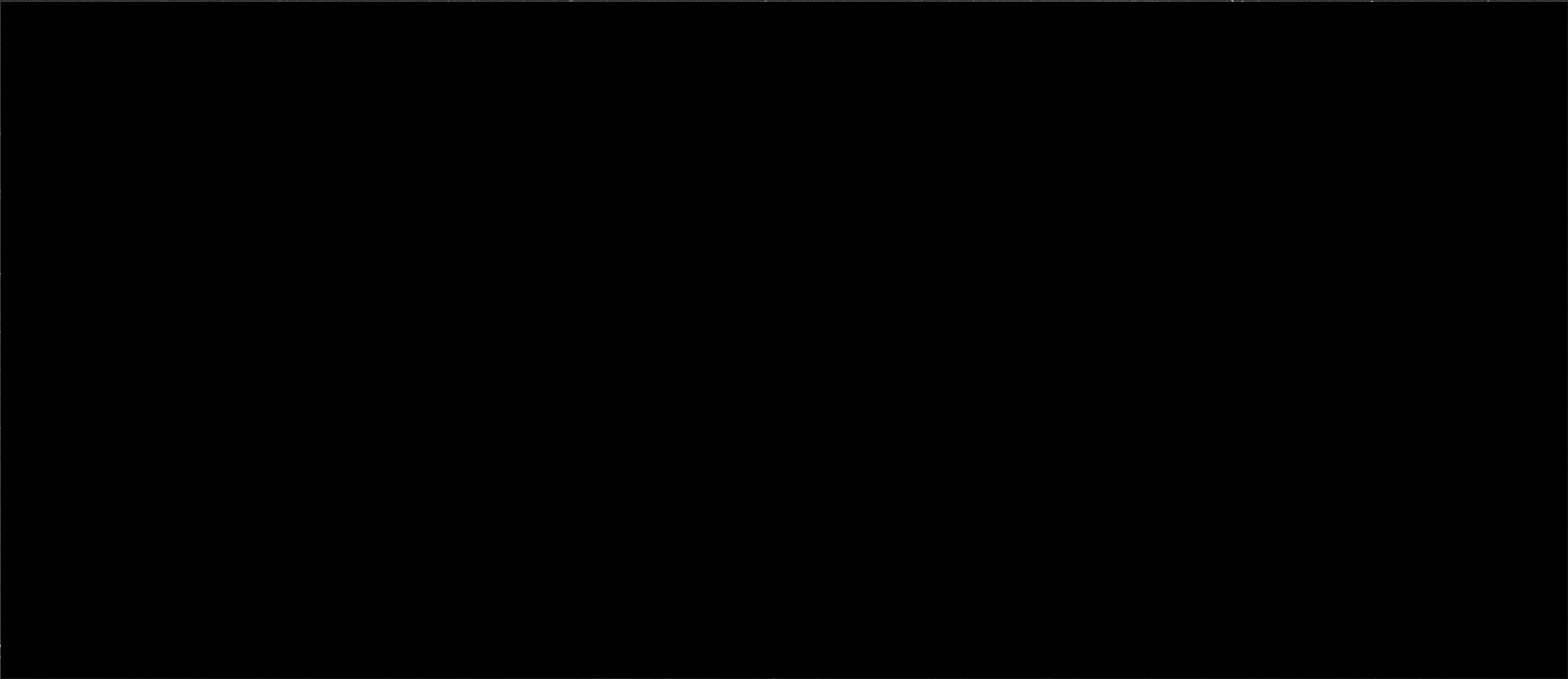


WATER DETECTION

The water sensor, known as "**Funduino**" has two wires open circuited at the end surface which gets shorted when comes in contact with impure water on streets. As soon as the path gets shorted, a current flows through the circuit which is sensed by the sensor and is then accordingly actuated, alerting the blind person of the impending water puddles ensuring his safety.



DEMONSTRATION



TRAFFIC LIGHT NOTIFICATION SYSTEM

The main objective of this system is to notify the visually impaired about the current status of the traffic signal he wants to cross. There will be Bluetooth modules installed on each traffic signal acting as the transmitter. The receiver is the Bluetooth of the mobile device of the user himself. The status of the traffic signal will be transmitted by the Bluetooth transmitter. The PMD of the user will be paired to the appropriate traffic signal by reading the password of the target signal from its corresponding zebra crossing. After this pairing, the exchange of the data packets containing the status of the signal, will be performed.



TRAFFIC LIGHT STATUS NOTIFICATION SYSTEM



Password Extracting

As soon as the zebra crossing appears within the immediate 4 steps of the user, the embedded camera module on the cane captures the image containing the bluetooth password and an pre-employed ML algorithm extracts the code from the image, storing it in a text file.

Pairing Target Traffic Signal

The extracted password unlocks the target traffic signal thus giving access to its current status.

Notifying The Status

Once successful pairing has been done, correct status of the traffic signal will be notified through an Android App, deployed in Android Studio Platform.

WHY THIS OVER THAT ??

1

DISADVANTAGES OF IMAGE PROCESSING

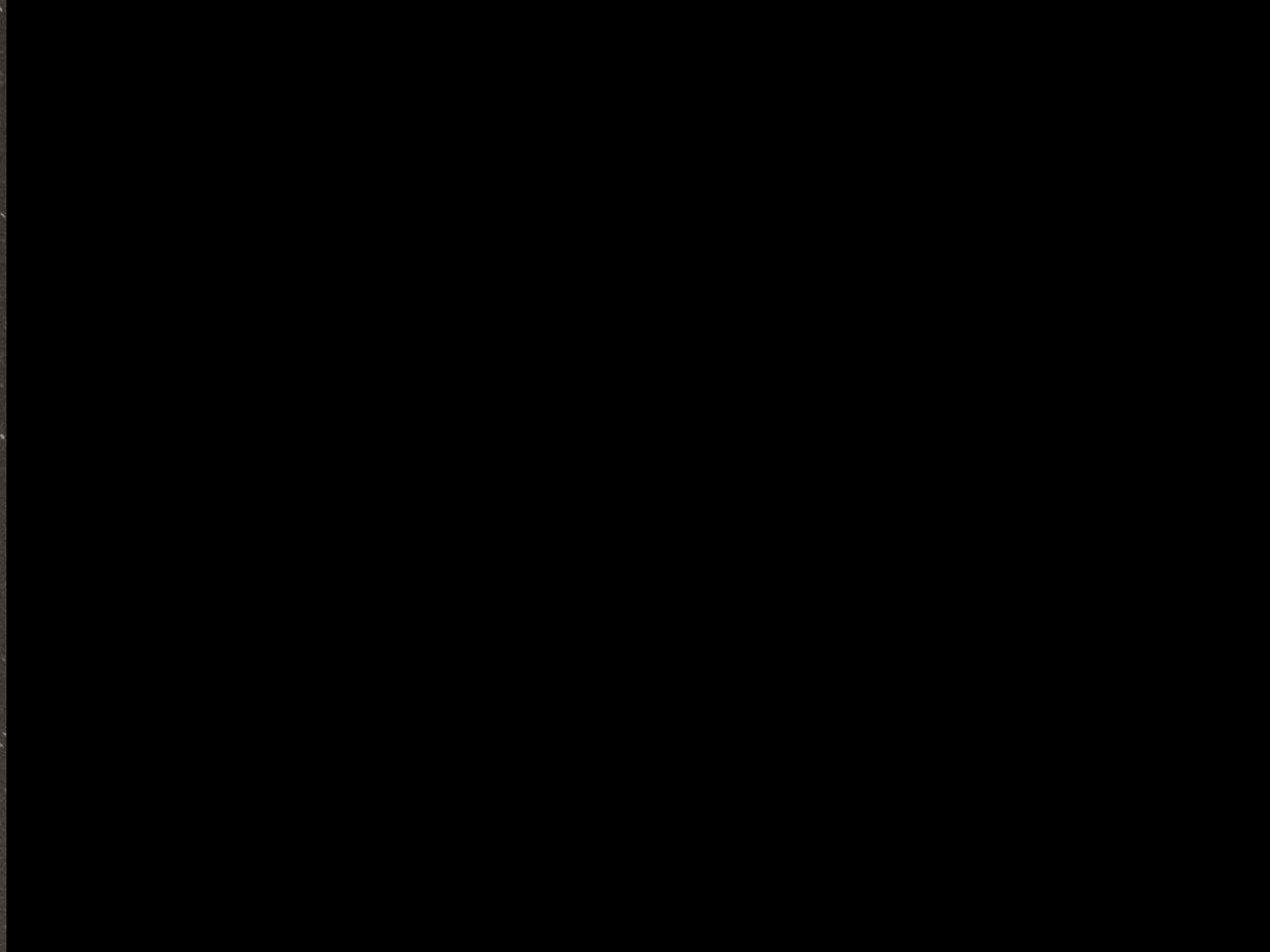
If we choose to implement it by image processing, we need to ensure that the camera sensor on the stick is able to catch the traffic signal properly, that is, there must exist a direct line of sight between the wide angle camera sensor and the traffic lights ahead for the function to be carried out. Now, this is way too much expectation for a crowded city. There might be plenty of possible obstructions between the cane held close to the lower half of the user's body and the traffic signal placed at a great height. Thus, this method of sensing is highly unreliable.

2

DISADVANTAGES OF TRANSCEIVER MODULE

If we choose to implement it by integrating a transmitter chip on the traffic signal and a receiver chip on the cane, we need to ensure that proper pairing between the transmitter and receiver takes place at the required time. However, only predetermined pairing can be done, but pairing needs to be done as and when required on spot, which is difficult. However, for IoT, the upload of data to the cloud is unconditional, which makes data available always. The receiver can download the data whenever required.

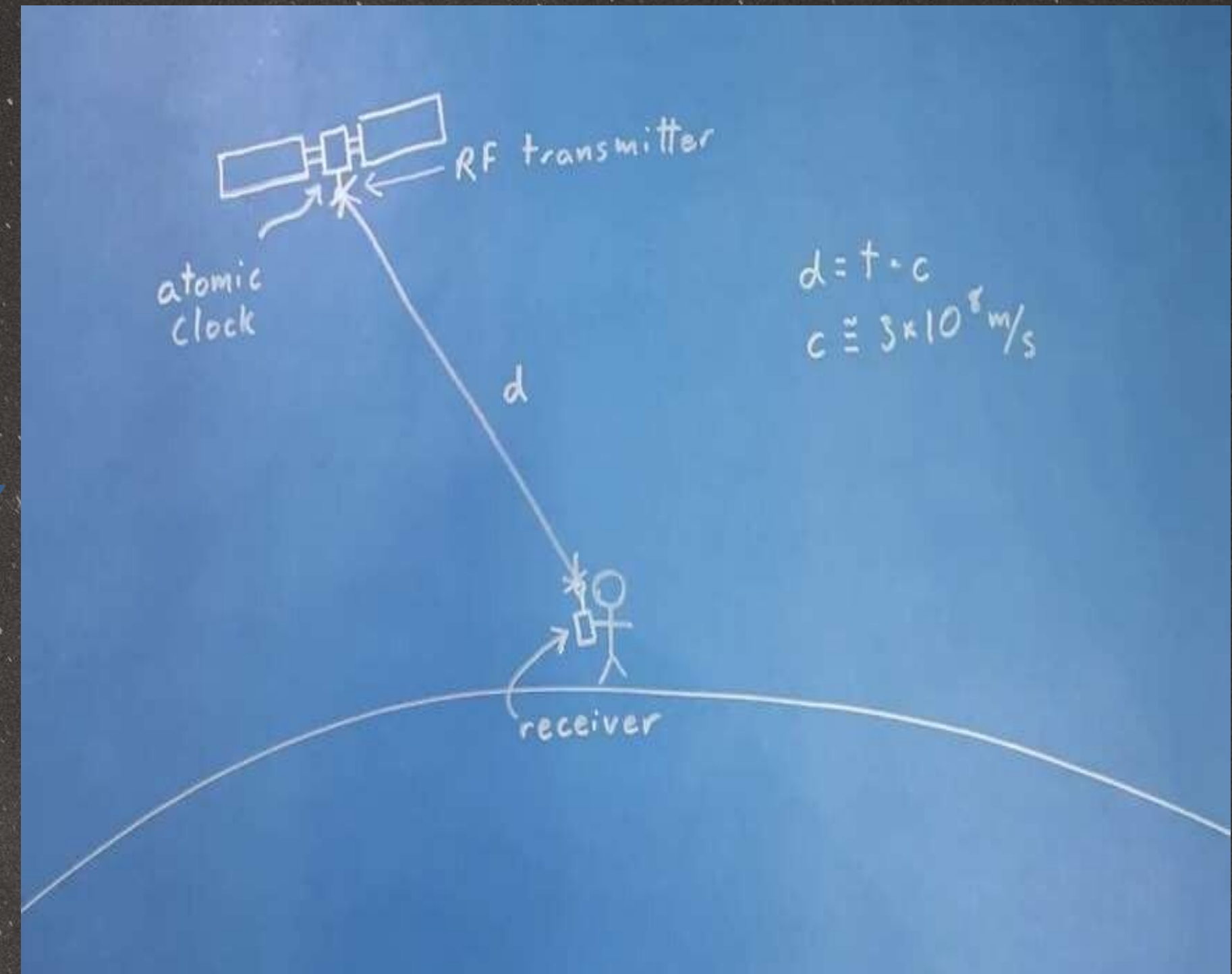
DEMONSTRATION



NAVIGATION USING GPS

The main objective of this feature is to notify the family and close ones of the user about his current location so that they can log in to a website and track his movements in real time.

GPS uses 4 satellites to locate a particular position on the surface of the earth. Every satellite has an accurate atomic clock that broadcasts after every 30 seconds. When a message from the satellite is received, the distance to the satellite from a particular location can be calculated by multiplying the time of flight of the RF signal with the velocity of light. Three satellites determine position in terms of latitude and longitude coordinates. The fourth satellite for time.



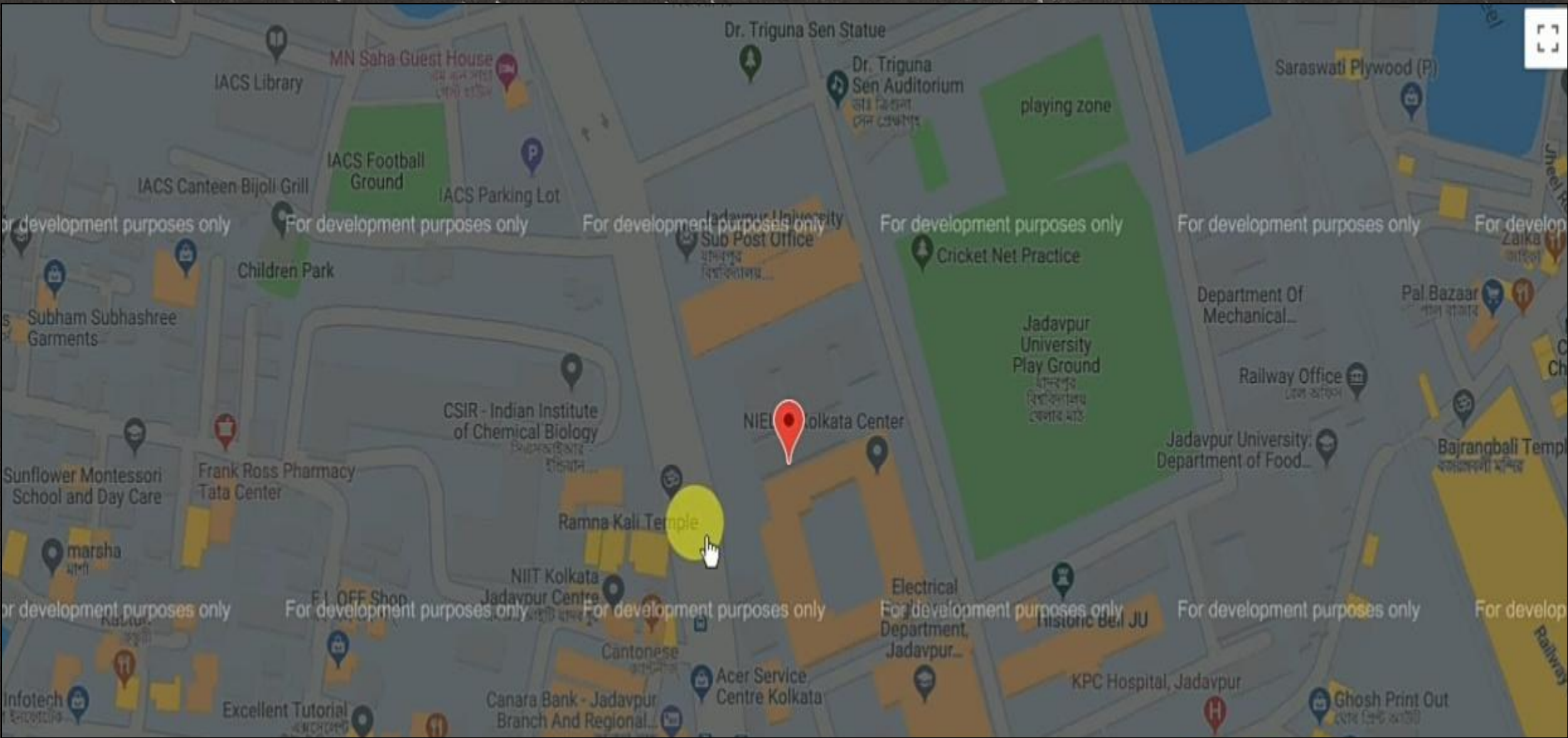

```
Gpsdemo
Serial.print(gps.date.year());
}
else
{
  Serial.print(F("INVALID"));
}
}
Serial.print(F(" "));
if (gps.time.isValid())
{
  if (gps.time.hour() < 10) Serial.print("0");
  Serial.print(gps.time.hour());
  Serial.print(F(":"));
  if (gps.time.minute() < 10) Serial.print("0");
  Serial.print(gps.time.minute());
  Serial.print(F(":"));
  if (gps.time.second() < 10) Serial.print("0");
  Serial.print(gps.time.second());
  Serial.print(F("."));
  if (gps.time.centisecond() < 10) Serial.print("0");
  Serial.print(gps.time.centisecond());
}
else
{
  Serial.print(F("INVALID"));
}
}
Serial.println();
}
```

COM4

Date/Time: 2/4/2020 05:40:27.00
22.497208
88.370972
Date/Time: 2/4/2020 05:41:07.00
22.497208
88.370972
Date/Time: 2/4/2020 05:41:07.00
22.497173
88.370987
Date/Time: 2/4/2020 05:42:11.00
22.497173
88.370987

☒ Autoscrol ☐ Show timestamp

Newline 115200 baud Clear output



ROAD CONDITION RECOGNITION

The system discussed here uses a single video camera as a sensor. To get the input data from the image, video image sequences are captured. The input data of this system is provided by coloured image sequences taken from a previously calibrated video camera, mounted on the stick. The images captured at a specific shutter speed are transferred to computer where it is processed to predict the presence of any bump or hole on the road within the next 4 steps of the visually impaired person.

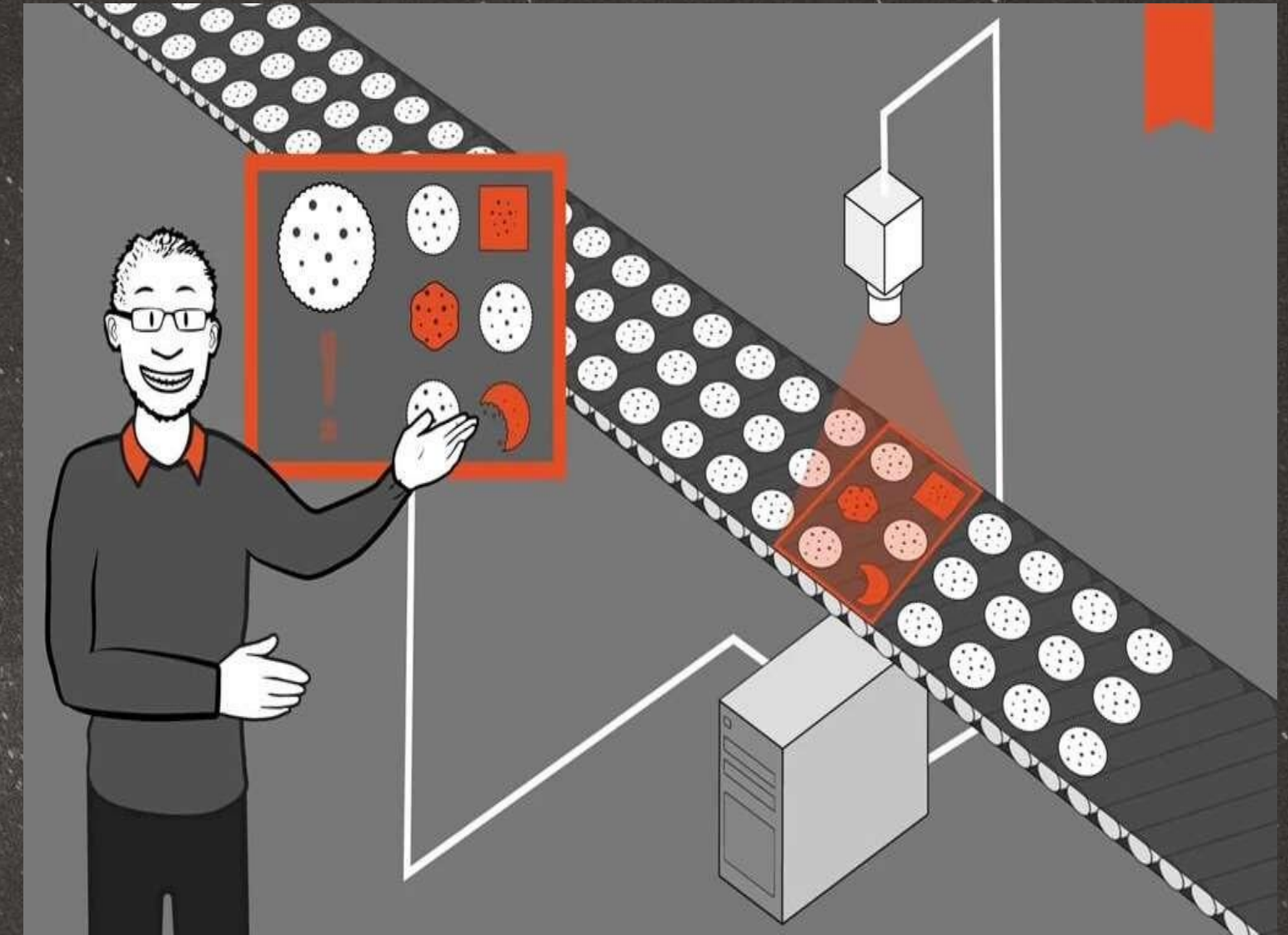
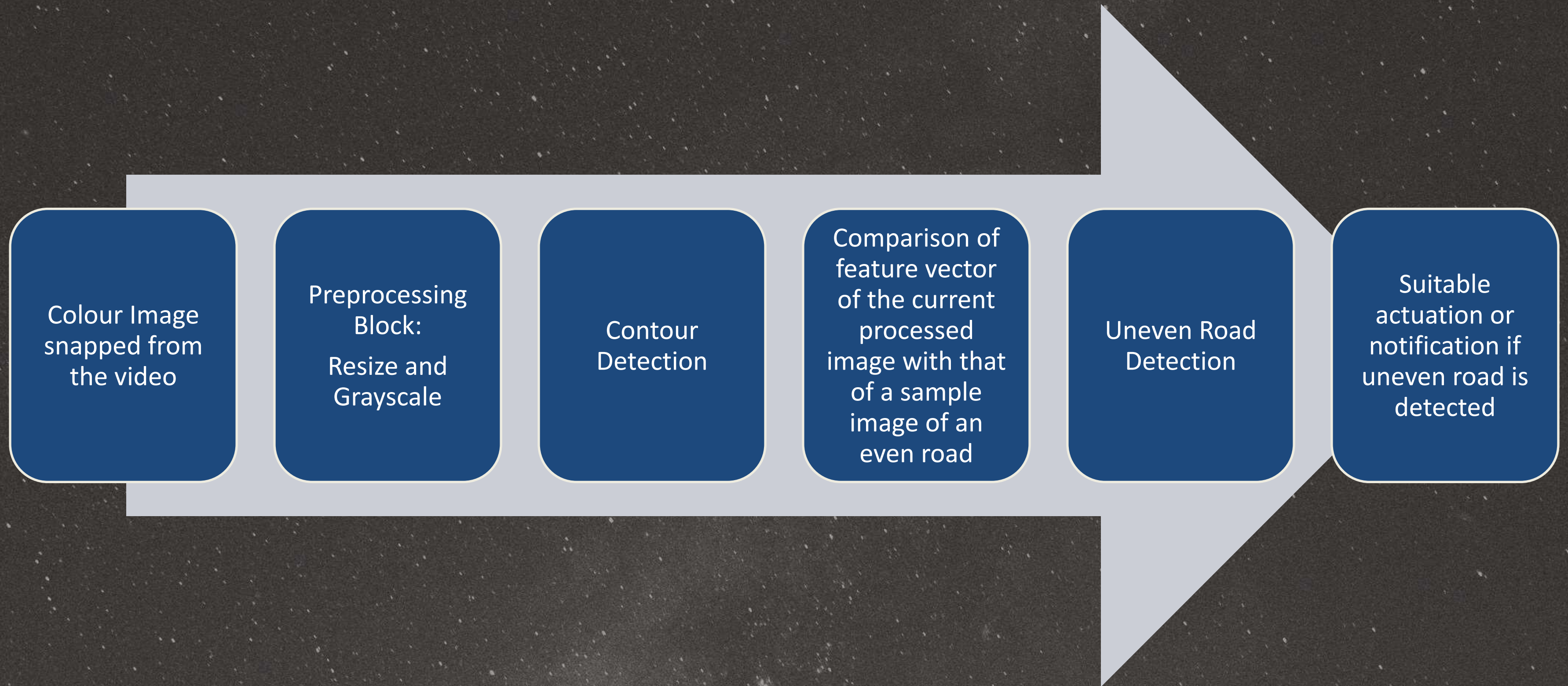


IMAGE PROCESSING MODULE



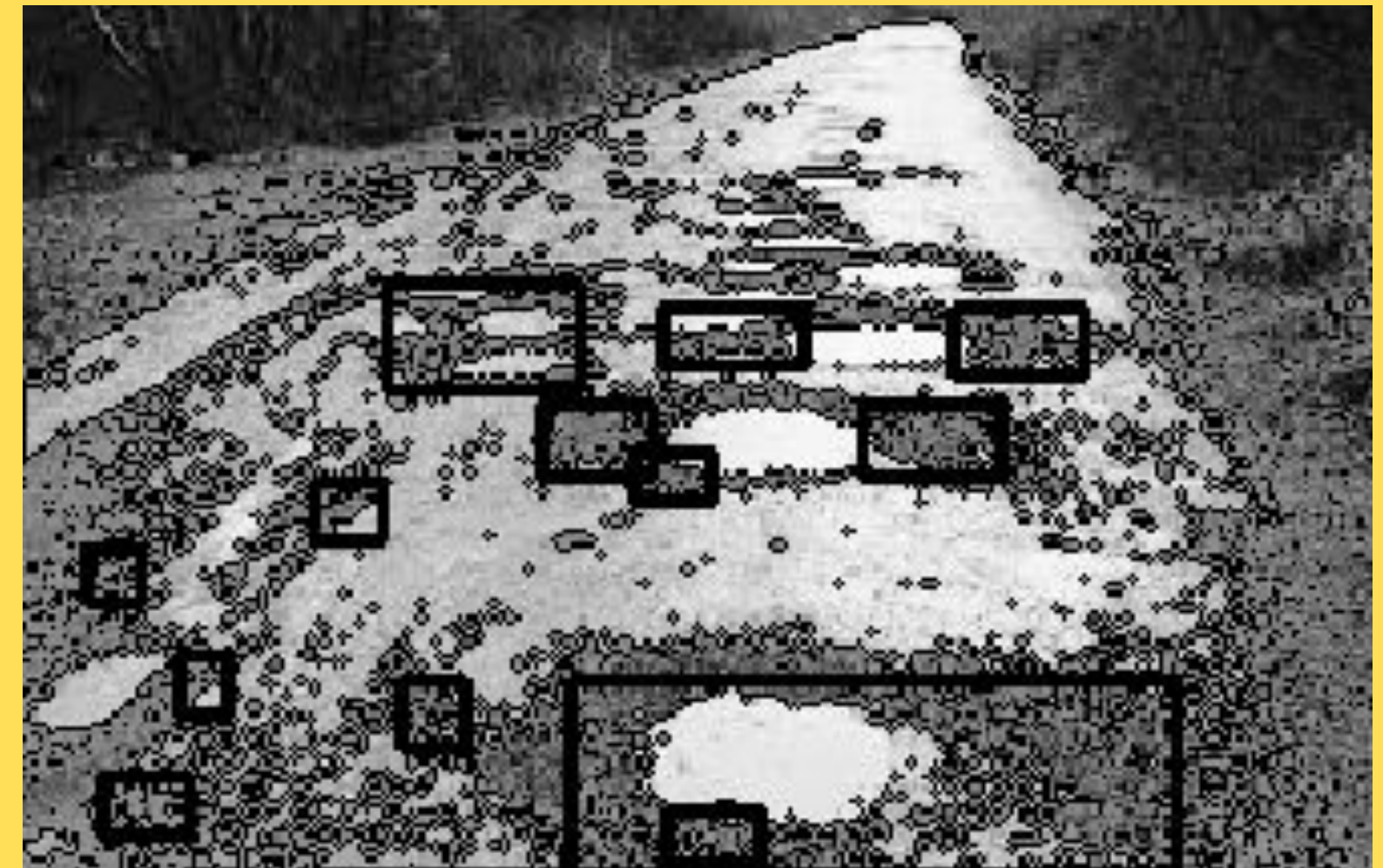
RESULT

Input



Image captured by the camera module embedded in the stick

Output



Processed image depending on which the road condition is determined

"FIND YOUR CANE" FEATURE

This feature is just like the "Find Your Phone" feature available in many smart watches. There will be a push button switch, provided along with the stick, that will be connected to the Transmitter Bluetooth module. The receiver Bluetooth will be connected to an alarm, both integrated on to the stick. The sound will lead the man towards his lost cane and help him locate it anywhere within the range of 3 meters to 100 meters.



GLOW IN THE DARK INDICATOR

A blind man needs to make his presence felt when he is commuting in the dark, so that he does not get bumped into or run over by those who are unaware. Thus the cane is designed to have an indicator controlled by an LDR, which switches on when the light falls below a certain level.



ACTUATION VIA EARPHONES AND SPEAKERS

The actuation of the smart cane involving obstacle detection, water detection and navigation features is employed by earphones or speakers as per user convenience. In our model demonstration, we have used standard speaker and earphones.



SHORTCOMINGS

Involvement of PMDs

Using a PMD as an intermediary for bluetooth communication introduces a delay and additional power loss in the PMD,

Bulky, Increased Hardware Cost and Damage Prone

Due to the integration of microcomputer and many sensors, the stick becomes bulky and cost ineffective.

Need for Smart City

For the traffic signal notification system to be implemented using IoT, sensors need to be installed in every traffic signal.

REMEDIES



Direct Connectivity Technology

We need to bypass the mobile device in bluetooth communication and pair the bluetooth earphone directly with the bluetooth transmitter on the cane. In this way, we can both save power and get rid of the delay.

Fabrication using VLSI Technology

Integrating all the components (sensors and microcontrollers) on a single chip using an embedded system platform (say, ASIC), can minimise the hardware cost, bulkiness and fragility of the cane.

Smart City

Digital India!

SOME MANUFACTURING SPECIFICATIONS

Material

Polyvinyl Chloride is a light weight, cheap, mechanically strong, abrasion resistant insulator and thus is a good choice for the material of the stick.

Estimated cost

The arduino is a microcontroller and has to be separately provided with an integrated block.

PVC stick- Rs 80

Add-ons-Rs1000-Rs1200

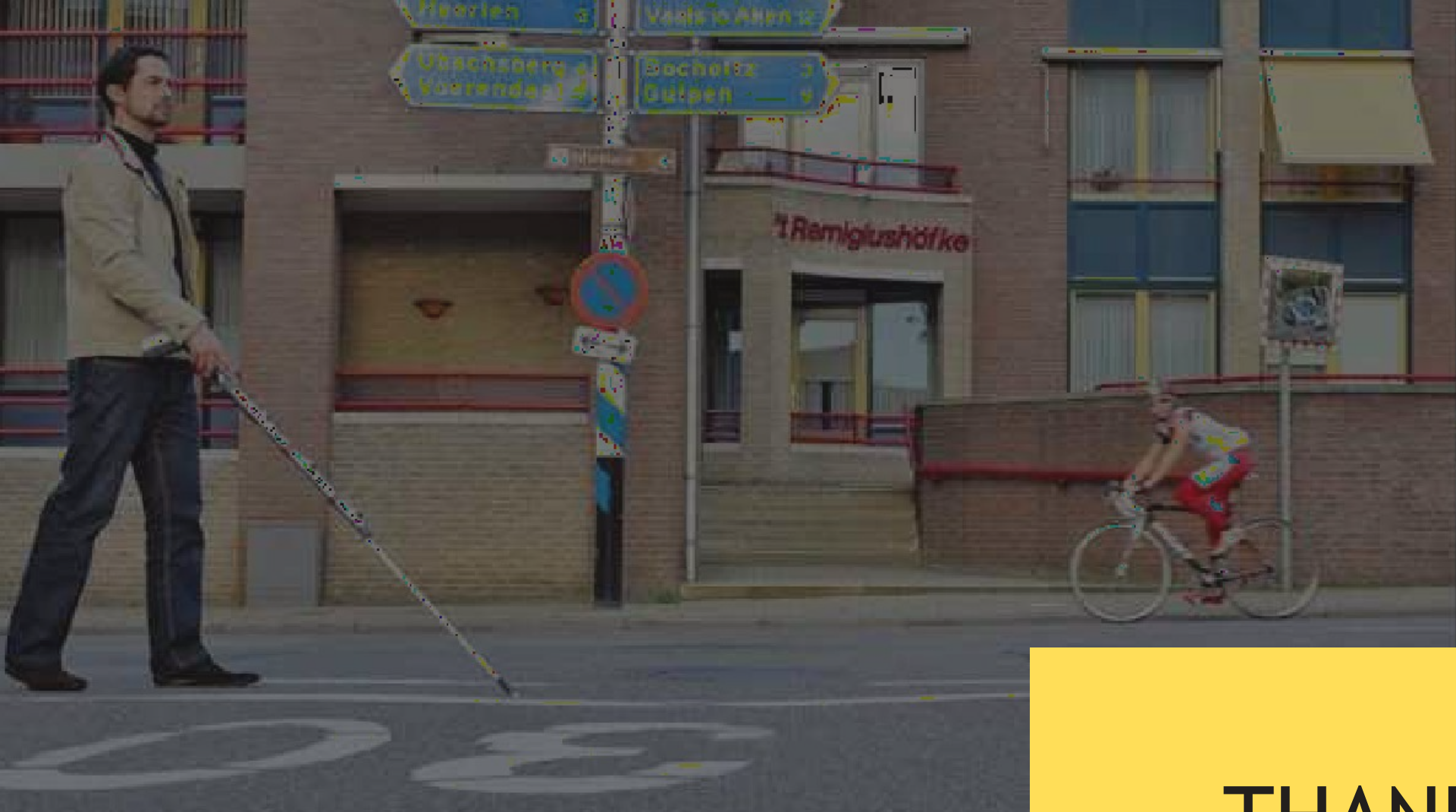
This price is expected to decrease considerably when integrated into a block.

Estimated Power budget

Voltage rating = 1.8V

Current rating = 125mA

Power rating = 225mW
(for the ASIC block)



THANK YOU

