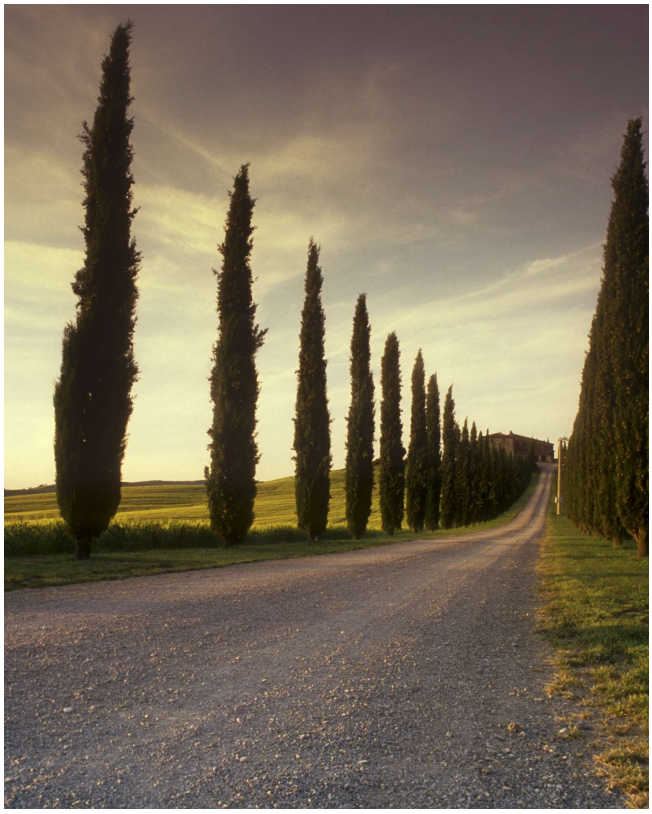


BIOMEDICAL ELECTRONICS

Dr. Engr. Muhammad Abul Hasan

GROUP MEMBERS:

AMMAD AFTAB [BM-21075]
MD. DANIYAL [BM-21071]
IZAAN KIDWAI [BM-21071]

ARDUINO BASED SMART CANE FOR VISUIALLY IMAPRED

INTRODUCTION:

Introducing an Arduino-based smart cane designed specifically for the visually impaired. This advanced assistive device combines the power of ultrasonic sensors, infrared sensors, a water sensor, and a flame sensor to provide real-time feedback, ensuring optimal safety and independence for users as they navigate their surroundings. With its comprehensive sensor system, this smart cane offers enhanced obstacle detection, hazard alerts, and environmental monitoring, empowering visually impaired individuals to confidently engage with the world around them.

COMPONENTS USED:

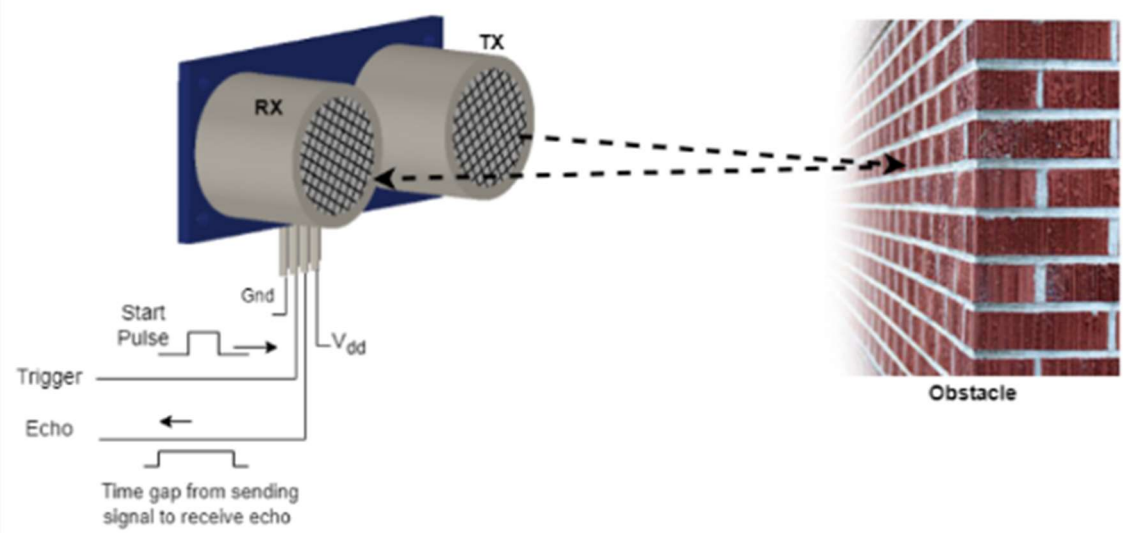
Sr. NO	Qty.	NAME
1.	1	Arduino UNO
3.	2	Ultrasonic sensor
4.	3	IR sensor
5.	1	Flame sensor
6.	1	Water Senor
7.	1	ISD1820 voice recording module
8.	3	Buzzer

WORKING PRINCIPLE:

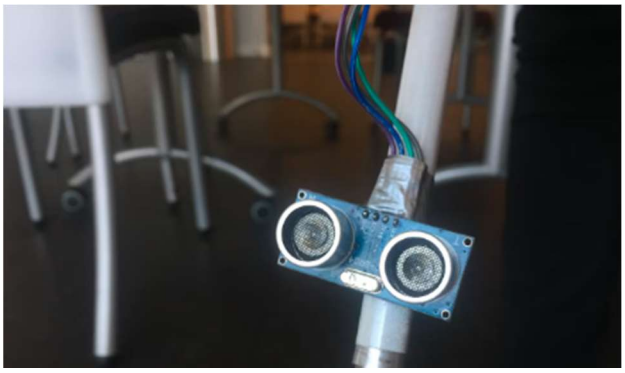
The working principle of the Arduino-based smart cane for the visually impaired revolves around its sensor integration and real-time feedback mechanism. The cane utilizes ultrasonic sensors, infrared sensors, a water sensor, and a flame sensor to gather data about the user's surroundings.

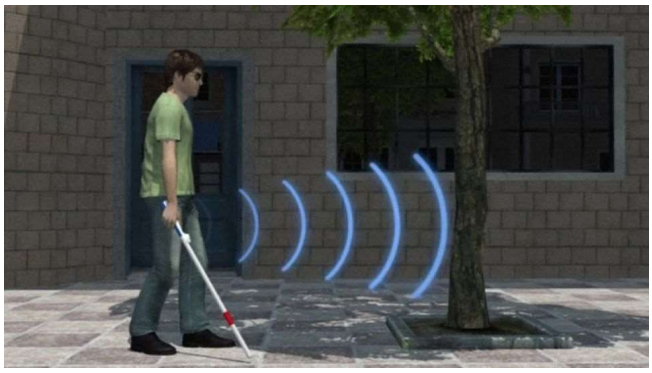
● ULTRASONIC SENSOR:

An ultrasonic sensor works by emitting high-frequency sound waves and measuring the time it takes for the waves to bounce back after hitting an object. The sensor calculates the distance to the object based on the time-of-flight of the sound waves. This distance information is used to detect presence of an object

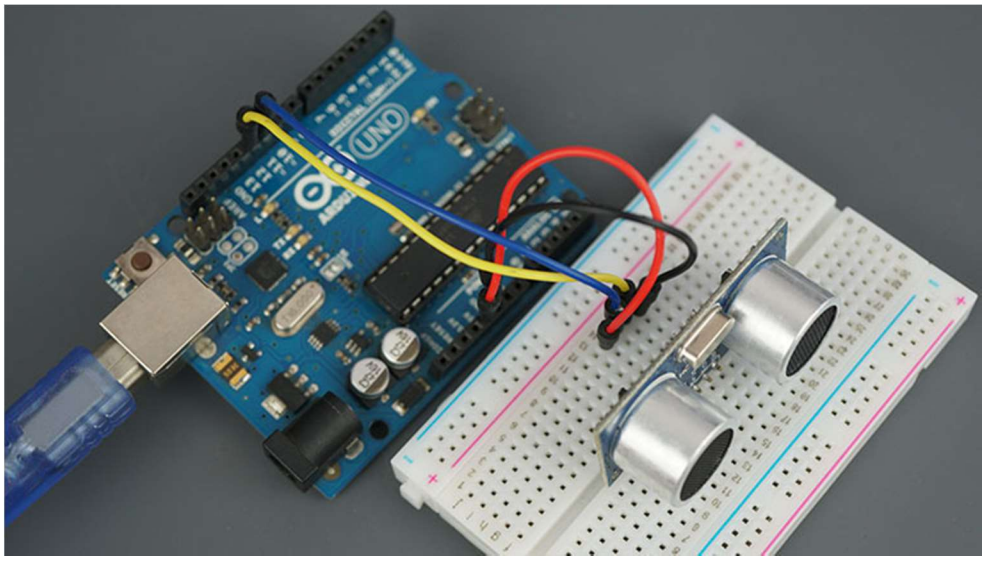


There are two ultrasonic sensors mounted at the cane, 1 is responsible for far object detection ***The first*** ultrasonic sensor is responsible for detecting obstacles or objects in the user's path. It emits high-frequency sound waves and measures the time it takes for the waves to bounce back after hitting an obstacle. Based on the time-of-flight calculation, it determines the distance between the sensor and the object. If the distance falls below a certain threshold 40cm, the smart cane will provide an alert to avoid the obstacle.





The second ultrasonic sensor is positioned at a specific angle, pointing slightly downward from the cane. This sensor's purpose is to detect downward surfaces, such as stairs or changes in terrain. By analyzing the distance between the cane and the ground, the sensor determines if there is a downward surface ahead. In this case, the Arduino microcontroller triggers a warning signal to notify the user about the potential hazard.

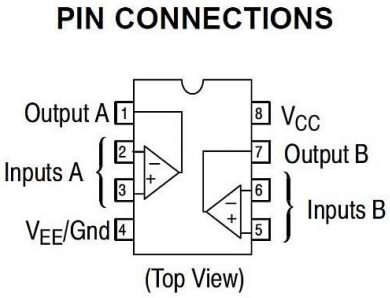


The second ultrasonic sensor is positioned at a specific angle, pointing slightly downward from the cane. This sensor's purpose is to detect downward surfaces, such as stairs or changes in terrain. By analyzing the distance between the cane and the ground, the sensor determines if there is a downward surface ahead. In this case, the Arduino microcontroller triggers a warning signal to notify the user about the potential hazard.

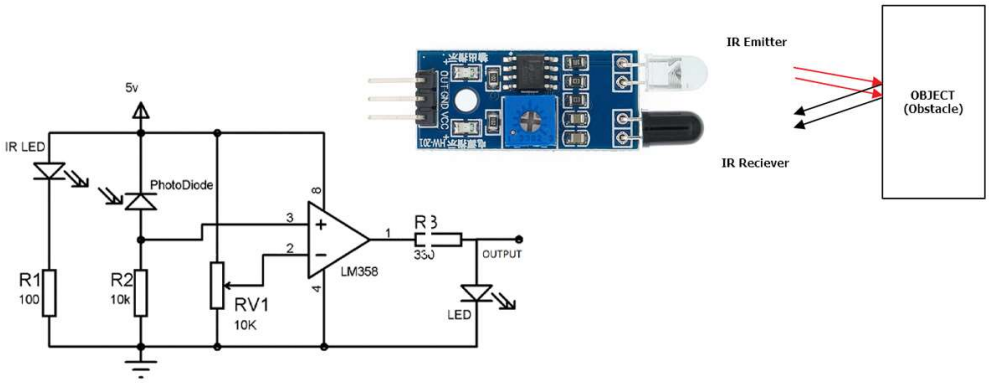
- **IR SENSOR:**

An IR (Infrared) sensor module typically consists of an LM358 IC, which plays a crucial role in its functionality. The LM358 IC is an operational amplifier (op-amp) that amplifies and processes the electrical signals received from the IR sensor. The IR sensor module emits infrared light and detects the reflection or presence of objects based on the amount of infrared light received. The LM358 IC helps convert the analog signal from the IR sensor into a digital output, allowing for object detection and proximity sensing applications.

LM358



IR Sensor Module Circuit



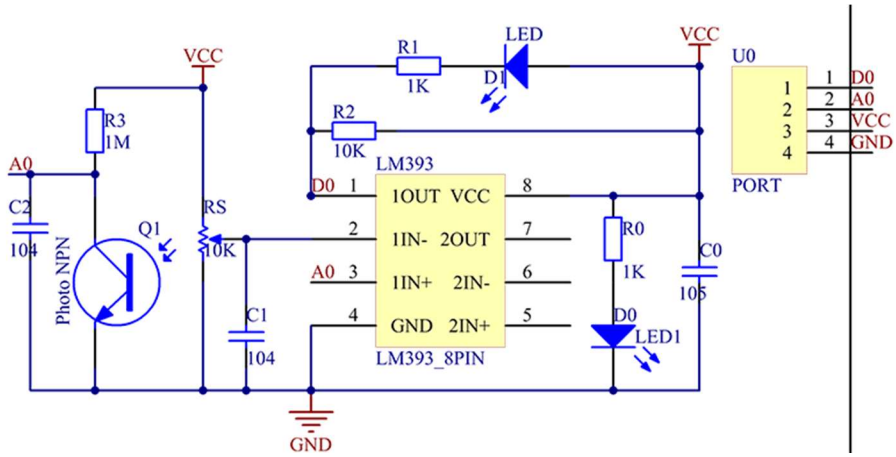
The Arduino-based smart cane incorporates ***three IR sensors*** positioned at the bottom of the stick, enabling detection of obstacles from different directions. One sensor is dedicated to detecting obstacles on the right side, another for the left side, and the third for detecting obstacles in the front. These IR sensors emit infrared light and analyze the reflected signals to identify the presence of objects, providing real-time feedback to the user about obstacles in their immediate surroundings. By strategically placing these sensors, the smart cane enhances the user's awareness and helps them navigate safely in various directions.

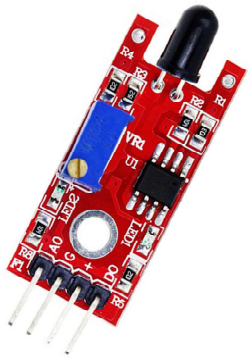
To enable the detection of stairs, ***two IR sensors*** with analog input are placed at the front of the stick. One sensor is positioned approximately 7.62 centimeters from the ground, while the other is positioned around 15.24 centimeters from the ground. By comparing the distance readings from both sensors, the smart cane can determine if there is a significant difference in the distances. If the lower sensor detects a shorter distance compared to the upper sensor, it indicates a step or an upward surface, triggering a notification to alert the user about the presence of stairs. This feature enhances the safety of visually impaired individuals by enabling them to navigate stairs with greater confidence and caution.

The smart cane incorporates five IR sensors, enabling precise obstacle detection from multiple directions. This enhances safety and awareness for visually impaired users, allowing them to navigate their surroundings more confidently.

● **FLAME SENSOR:**

The flame sensor module utilizes a flame sensor and the LM393 IC for its functionality. The flame sensor consists of an infrared receiver and a photodiode that detects the presence of flames or intense heat sources. When a flame is detected, the sensor sends a signal to the LM393 IC, which acts as a comparator to process the input signal. The LM393 IC then provides a digital output, indicating the presence or absence of flames. This integration of the LM393 IC enhances the accuracy and reliability of flame detection in the smart cane, ensuring prompt warnings and improved safety for visually impaired users

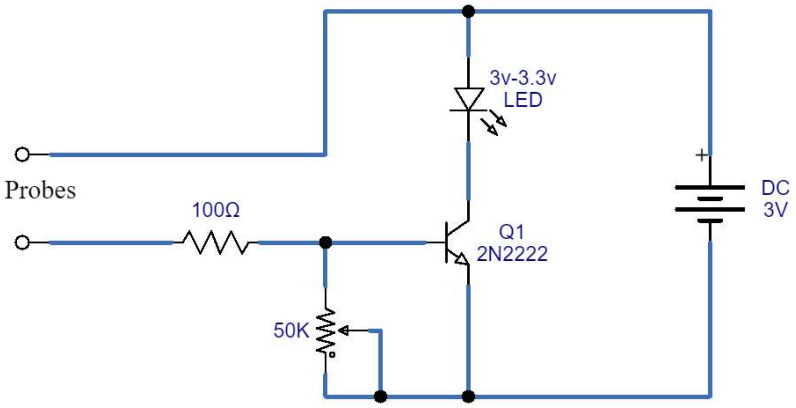


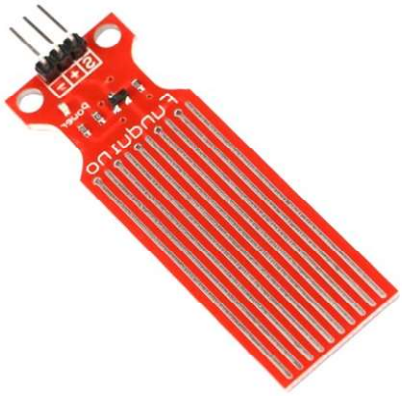


The flame sensor, strategically mounted on the smart cane's stick, functions by detecting the presence of flames or intense heat sources. It is comprised of an infrared receiver and a photodiode, which work in tandem to capture infrared radiation emitted by flames. When the sensor detects a flame, the infrared radiation is picked up by the infrared receiver, and the photodiode converts it into an electrical current, generating a voltage output. The fundamental principle governing the flame sensor's operation is that flames emit infrared radiation within a specific wavelength range. The voltage generated by the sensor varies depending on the intensity of the infrared radiation it receives from flames or intense heat sources. The higher the intensity of the flame, the higher the voltage output. To process this analog output and convert it into a digital signal, the flame sensor module still utilizes the LM393 IC as a comparator. The LM393 compares the varying analog voltage from the flame sensor with a preset threshold voltage. When the analog voltage exceeds the threshold voltage, the LM393 outputs a digital HIGH signal; otherwise, it outputs a digital LOW signal.

- **WATER SENSOR:**

The water sensor module consists of two conducting probes spaced apart on a non-conductive substrate, such as a PCB or plastic material. When water or moisture comes into contact with the probes, it completes the electrical circuit, allowing current to flow. The module includes signal conditioning circuitry to process the generated electrical signals, providing an output that can be used by connected microcontrollers or systems





The water sensor, integrated into the smart cane, operates based on its ability to detect the presence of water or moisture. The sensor consists of two conducting probes that are typically spaced apart. When these probes come into contact with water, the water completes the electrical circuit between them, allowing current to flow.

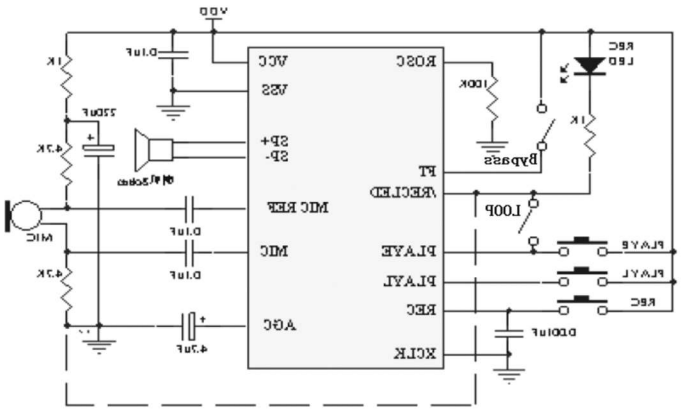
The working principle of the water sensor is simple yet effective. It is based on the electrical conductivity of water. Pure water is a poor conductor of electricity, but when impurities or ions are present in water, it becomes conductive. When the two conducting probes of the water sensor are exposed to water, the presence of these impurities enables the flow of current between the probes.

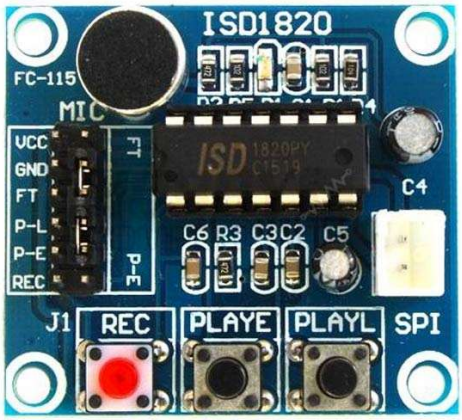
The smart cane's system monitors the electrical conductivity between the probes. If the water sensor detects current flowing between the probes, it indicates the presence of water or moisture in the environment.

Due to its incorporation of water sensors, the smart cane may not be suitable for use during the rainy season. The water sensors are designed to detect moisture or wet surfaces, which can trigger false alarms when exposed to rain or high humidity. In such conditions, the cane may consistently detect water, leading to inaccurate obstacle warnings and decreased reliability.

● ISD1820 VOICE RECORDING MODULE

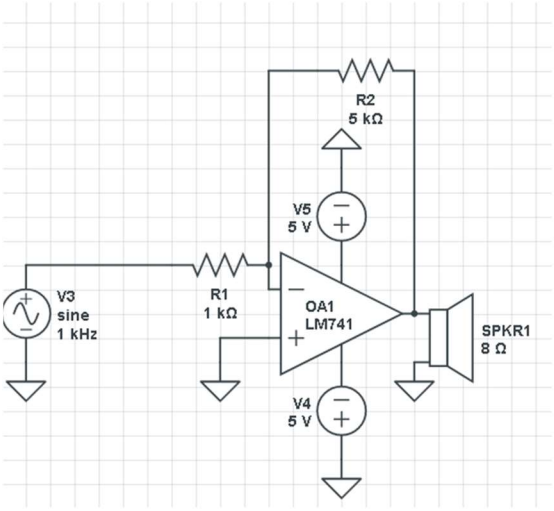
The ISD1820 is an audio recording and playback module widely used in various electronic projects. It is known for its simplicity and ease of use, making it an ideal choice for voice recording and playback applications. The module is equipped with an onboard microphone for recording audio and an audio output for playing back the recorded sounds. Additionally, it allows for direct control through external buttons, making it a convenient tool for integrating voice prompts or feedback in devices.



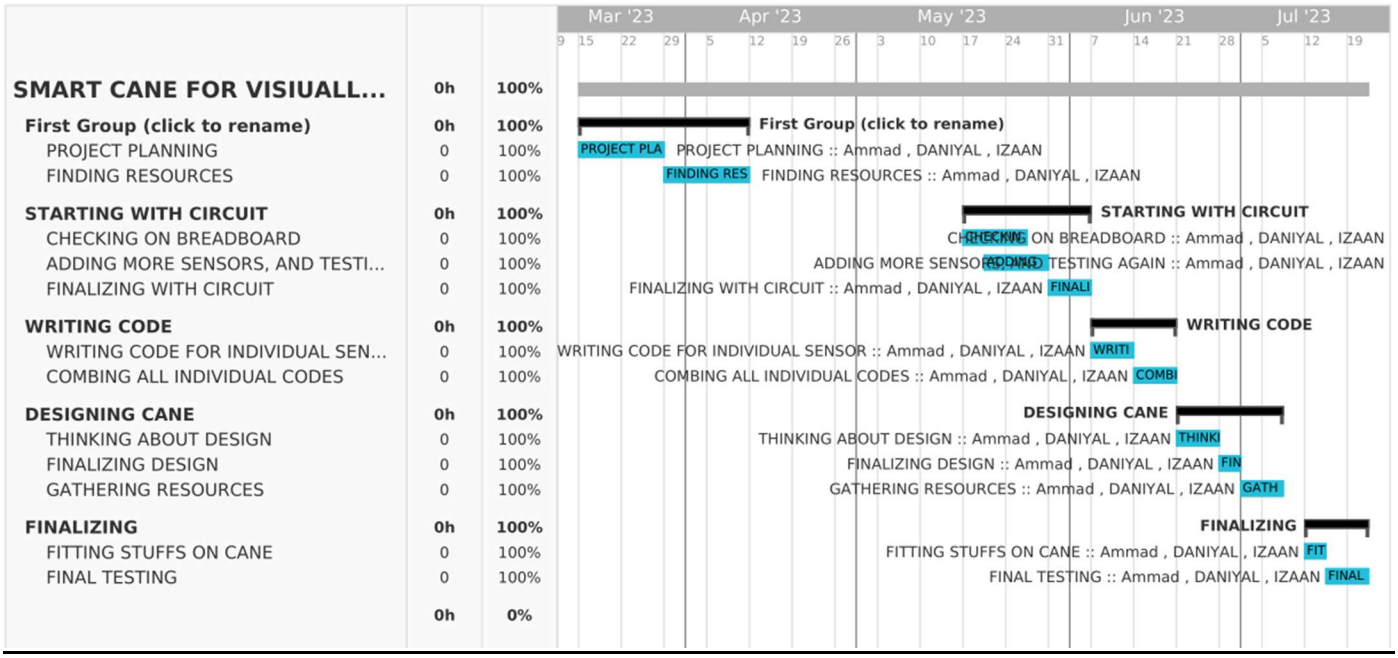


Whenever the water sensor detects a wet surface, the Arduino UNO triggers the ISD1820 audio module to play a pre-recorded audio prompt. This audio prompt serves as an alert, notifying the visually impaired user about the presence of a wet or slippery surface. By integrating the ISD1820 into the smart cane's system, the device becomes even more effective in providing real-time feedback and promoting the user's safety and independence during their daily navigation.

Between the ISD1820 audio module and the speakers, an LM741 amplifier is integrated to enhance the audio output. The LM741 amplifier boosts the audio signal, ensuring clear and audible playback of the recorded prompts, further improving the user's awareness of potential water hazards during their journey.



GANTT CAHRT:



CONCLUSION:

In conclusion, the Arduino-based smart cane for the visually impaired represents a remarkable and innovative assistive device, designed to enhance safety and independence. By combining two ultrasonic sensors for obstacle detection, five IR sensors for comprehensive surroundings awareness, a flame sensor for fire hazard alerts, and a water sensor to caution against wet surfaces, the smart cane provides a comprehensive solution for the visually impaired to navigate with confidence. The integration of the ISD1820 audio module and LM741 amplifier adds an essential audio feedback element, further improving user awareness and responsiveness. Empowered by the Arduino UNO microcontroller, this smart cane opens new possibilities for visually impaired individuals, fostering inclusivity and enabling them to embrace their surroundings with increased autonomy. As technology continues to advance, this project exemplifies how innovation can create transformative solutions that positively impact the lives of individuals with disabilities.