Group G- deliverable 2

by Ahbab El Tahir

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UNIVERSITY
OF WOLLONGONG
IN DUBAI

ECTE250:

ENGINEERING DESIGN AND MANAGEMENT 2

D E L I V E R A B L E - 2

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1. EXECUTIVE SUMMARY

This project entails designing and manufacturing a stick that can assist vision impaired folks in detecting hazards and securely navigating their environment. Unlike the outdated walking stick, this device guides the visually impaired people to respective direction by notifying them if any obstacles are present around them.

Sensors and processors will be used in the stick to offer real-time information about the surroundings, as well as feedback systems to guarantee the user understands the signals. The stick will be lightweight and simple to use, making it available to everyone.

Figure 1: Representation of Smart Walking Stick

The study describes the design process, obstacles faced, and technologies used to create the obstacle detecting stick. Potential enhancements and their impact are discussed.

The invention of a blind obstacle detecting stick can improve the safety and freedom of visually impaired people.

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2. INTRODUCTION

Visual impairment is a serious issue that impacts the quality of life for millions of individuals throughout the world. When navigating their environment, blind people encounter various challenges, including the risk of tripping or colliding with items. Several technologies targeted at enhancing the mobility of blind persons have been developed to address this issue. One such innovation is the creation of obstacle sensing and avoidance devices, such as the stick now under development.

The goal of this project is to develop and create a stick for blind people that can detect impediments in their route and inform them to avoid them, boosting their safety and independence. The stick will employ a combination of sensors, processors, and feedback mechanisms to offer real-time information about their surroundings to the user. The stick will also be lightweight, simple to use.

We will detail the design approach and technologies employed during the development of the obstacle detection and avoidance stick in this report. The report concludes by emphasizing the device's significance as well as the possibility for future upgrades and uses.

3. DESIGN

3.1 Working of product

The device is by default on "idle" mode wherein if no obstacle or water is detected, no outputs are received. The product is meant to notify the user if there are any obstructions in their path, indicating them to move appropriately. This aids them in terms of independence by allowing the visually impaired to commute without the need of a caretaker or guide dog. Another key feature of the design and working of the product is the implementation of image recognition using a camera. This component will inform the user of any upcoming road construction and other facilities within their vicinity, for eg. an upcoming pedestrian crossing or intersection. Additionally, the aim is to integrate geotagging within the device as well to suggest nearby landmarks that the user might wish to visit; the information will be delivered through audio. This is to mimic how someone who is not visually impaired would spot a store or restaurant to visit during their commute.

To elaborate on detection of closer physical components, the product utilizes 3 sensors: a ground obstacle ultrasonic sensor, a direct obstacle ultrasonic sensor and a water sensor. If any of these detects an obstacle within a specified range of distance or if the moisture level is above the threshold, a buzzer is triggered on the handheld part of the smart walking stick, thereby alerting the user of the nearest obstacle in their path. The flowchart below is an illustration of how these features work.

3.2 Flowchart

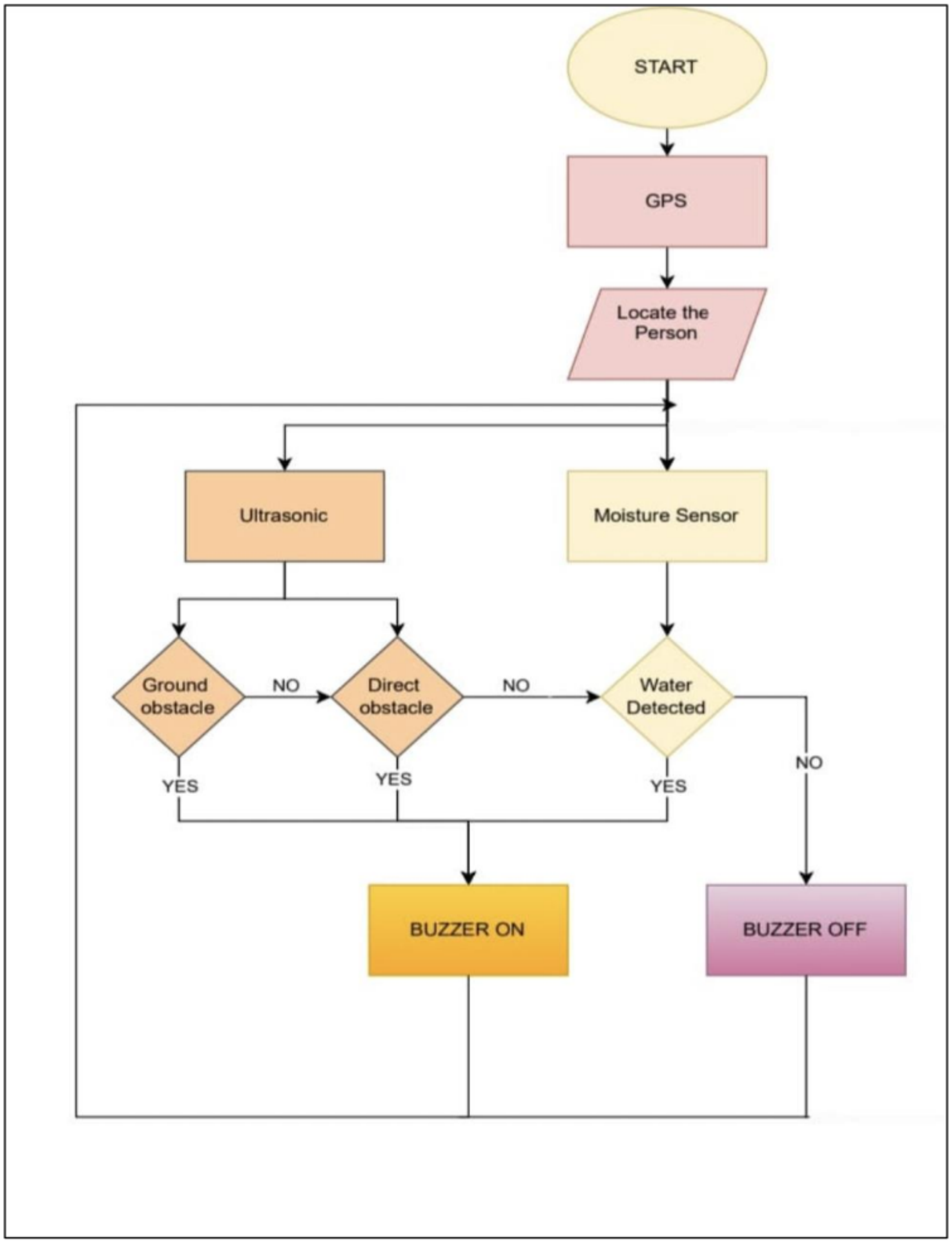

Figure 2: Flow Chart

3.3 State Diagram

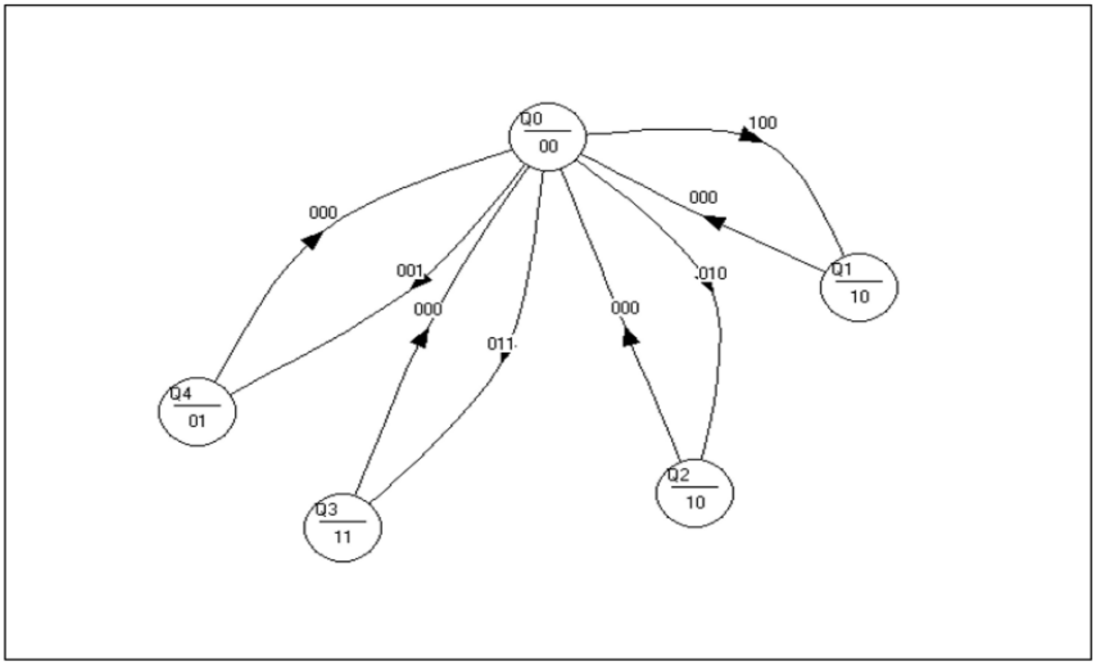

Figure 3: State Diagram

3.3.1 Overview of Inputs

This state machine has 3 inputs:

Ultrasonic sensor (Underground obstacle) : LSB (Least significant bit)

Ultrasonic sensor (Direct obstacle)

Water sensor: MSB (Most significant bit)

3.3.2 Overview of Outputs

This state machine has 2 outputs:

Buzzer A (Ultrasonic sensor)

Buzzer B (Water sensor)

3.3.3 Overview of the states

Q0: Idle state

In this state, the smart walking stick has not received any inputs from the sensors that have crossed the specified threshold, hence the buzzer is OFF and the sensors continue to collect data. Therefore, the input to this state is 000, where none of the sensors provide an output of 1.

Q1: Underground obstacle detected

In this state, the ultrasonic sensor for underground obstacles has detected an obstacle and buzzer A is ON. The input to this state is 100, and buzzer A remains ON unless the input changes to 000.

Q2: Direct obstacle detected

In this state, the ultrasonic sensor for direct obstacles has detected an obstacle and buzzer A is ON. The input to this state is 010, and buzzer A remains ON unless the input changes to 000.

Q3: Wet surface and obstacle detected

In this state, the water sensor detects a level of water that has crossed the threshold, and the direct obstacle ultrasonic sensor detects an object that is within the specified range of distance, hence both buzzers are turned ON. The input to this state is 011, indicating that two sensors have an output of 1.

Q4: Wet surface detected

In this state, the water sensor detects a level of water that has crossed the threshold, and buzzer B is turned on. The input to this state is 001, and the buzzer remains on unless the output changes back to 000.

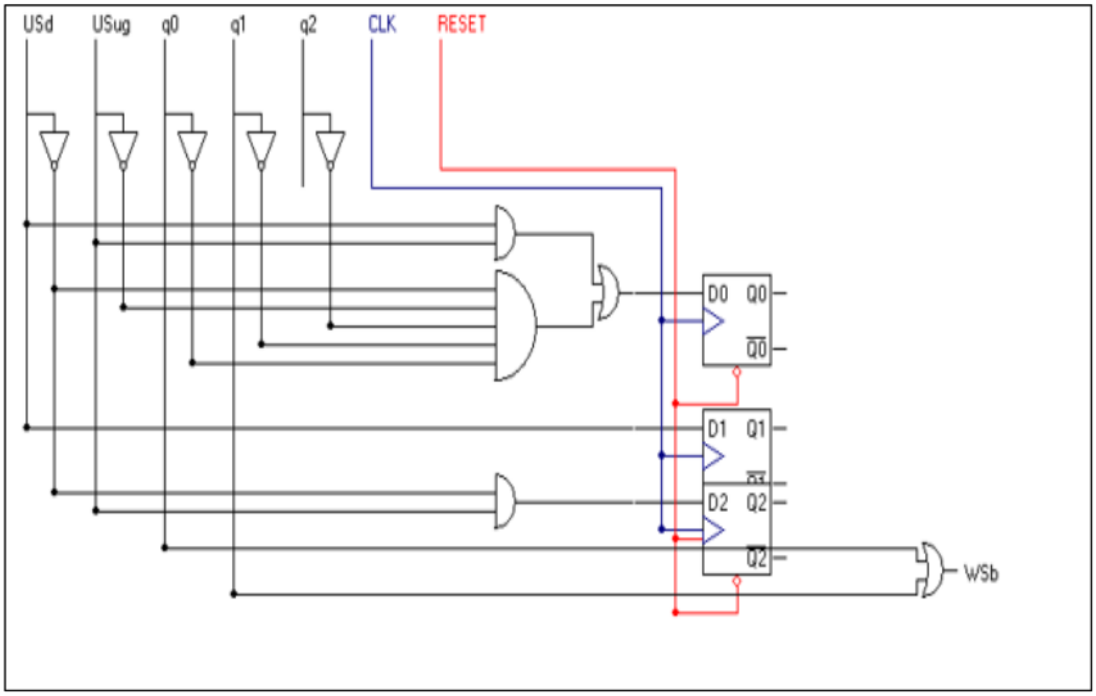

Figure 4: Circuit to show the working of Water Buzzer

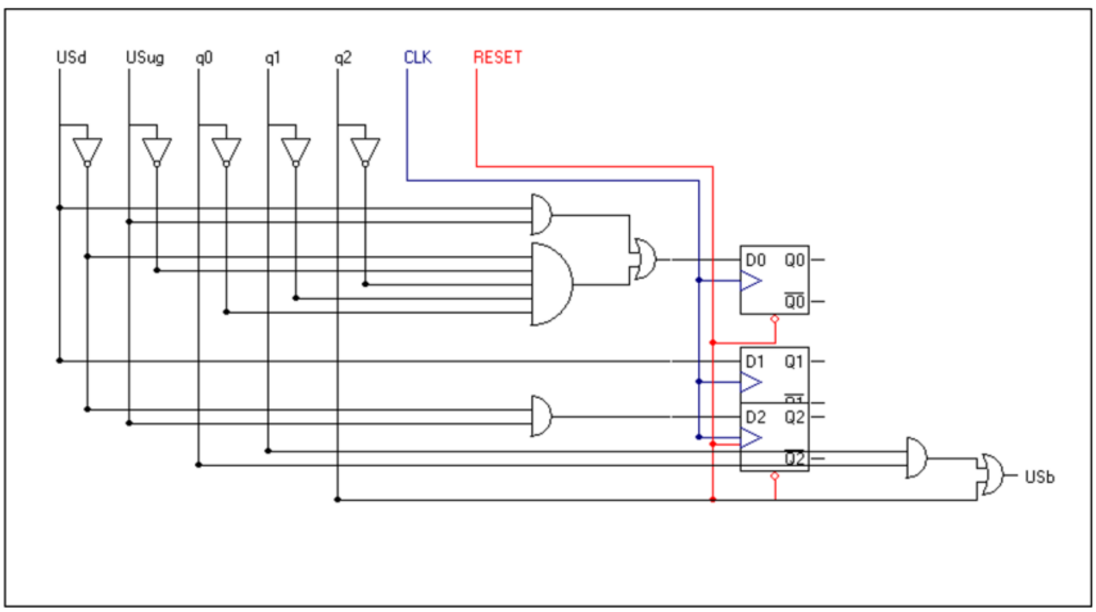

Figure 5: Circuit to show the working of Ultrasonic Buzzer

3.4 Timing Diagram

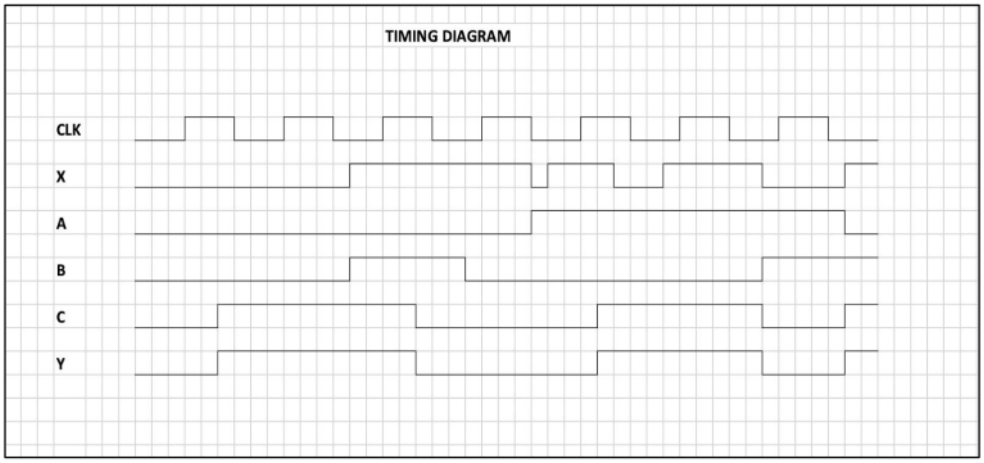

Figure 6: Timing Diagram

3.5 Block Diagram

The block diagram (figure) visually describes the layout of how the Arduino circuit set up should contain, the outputs and inputs are denoted using arrows.

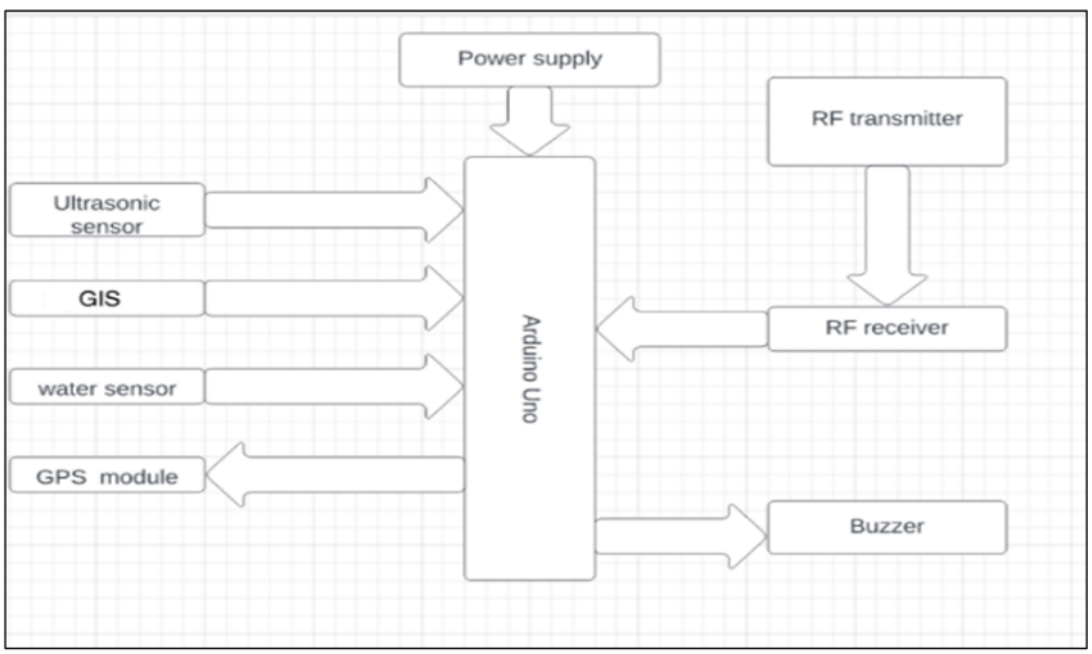

Figure 7: Block Diagram

4. ALIGNMENT

The scope of this project design has met all of the design aligns with requirements and constraints, to begin with the design incorporates a moore synchronous state machine with 5 states as shown in the design section as well as a switch is used to toggle between on and off. Moreover it meets IOT requirement that is considered as the subtitle topic of this project design. On the other side our design add few of the modifications that were suggested by one of honor guest for instance an ear buds were suggested keeping in mind that we had an initial plan to implemented as well as a wrist bracelet was suggested but due to not over complicating the process we were advised not to add it in the design project. In additional the design met the complexity factor such as the functional requirements that was mentioned in the plan section.

5. TESTING

The testing phase is conducted by confirming that each of the product's individual components function correctly and then verifying if they work appropriately when they are implemented together into one system.

Proximity Input 1 - Ultrasonic sensor for underground obstacle:
During the testing phase, verify that Buzzer A turns on when an object is within a specified range of distance under the smart walking stick. If the position of the object is beyond the range, the buzzer should remain off. The state machine moves to state 10 as the appropriate output is received. Testing samples can be used to verify this. Objects at different distances from the base of the stick should be used to improve the accuracy of the sensor's detection.

Proximity Input 2 - Ultrasonic sensor for direct obstacle:
During the testing phase, verify that Buzzer A turns on when an object is within a specified range of distance directly in front of the smart walking stick. If the position of the object is beyond the range, the buzzer should remain off. The state machine moves to state 10 as the appropriate output is received.

Moisture Input - Water level sensor
During the testing phase, verify that Buzzer B turns on when a slippery surface or water beyond a certain depth is detected by the water level sensor. If the amount of moisture detected is below the threshold, the buzzer should remain off. The state machine moves to state 01 if this appropriate output is received. There is an additional case where both the ultrasonic sensor and the water level sensor provide an output of 1; in this case, it is required to verify that both buzzers are turned on.

Simulation Testing

During the simulation testing phase, the functionality of our product is tested through Multism and tinkercad and the scope of the project is altered based on how feasible the project is. It is crucial at this stage to check whether the state machine is cohesive and is accurate to the functions of the final product. The electrical connections of all the hardware components need to be understood thoroughly during the simulation phase to ensure a smooth prototype testing phase.

Prototype testing

During the perfoboard testing, proper working of all hardware components is verified, i.e, sensor detection, microprocessor connections, buzzer functioning. During this phase the GPS module is installed, and testing is done for this component as well, to ensure it is correctly locating the person's geographical position.

6. PLAN

6.1 DELIVERABLES

This project has 8 deliverables in total. The team succeeds in presenting a clearer picture of the prototype with each deliverable.

The first deliverable required the team to propose two ideas. Vertical farming and the Smart Blind walking stick were the concepts selected. The team was asked to conduct a presentation for 15 minutes, describing the key functionalities, working and budget for both ideas. The judging panel evaluated the proposals and then selected an idea for the team to work on.

For the second deliverable, the team was asked to submit a 4000-word detailed report describing the design, alignment, testing, plan, budget and market for the selected proposal. Works were divided amongst the

Deliverable 3 requires presenting an electrical simulation with a report explaining the design. This includes diagrams, flowcharts, and tables. This deliverable mainly focuses on building a strong base for the hardware part of the project. The submission for this deliverable is anticipated to fall in S1-W10.

The objective of the fourth deliverable is a Breadboard-based Prototype and a Technical Report. This involves using breadboard and electronic components to build, test and troubleshoot all hardware and software components that will be used in this project. This deliverable mainly aims to create a base for the hardware section of the prototype. The submission for this deliverable is anticipated to fall in S2-W4.

The fifth deliverable is to submit a Perfboard-based Prototype and a Short Technical Report. This involves demonstrating a working prototype assembled, integrated, and soldered on a Perfboard. The submission for this deliverable is anticipated to fall in S2-W7.

The sixth deliverable of ECTE250 is the Final Design Report. The report must cover design, the final built Arduino subsystem prototype, all testing procedures, any consequential changes to the original and photos of the finished working prototype. The submission for this deliverable is anticipated to fall in S2-W10.

The seventh deliverable is a 20-minute presentation that involves details of the design and prototyping activity, the performance of the team and Budget, details of marketing strategy, and a working prototype. This deliverable is anticipated to fall in S2-W10.

For the eighth deliverable, the team is asked to attend an Innovation fair where they can present their project prototype to the public attendees. This deliverable is anticipated to fall in S2-W10.

6.2 WORK BREAKDOWN STRUCTURE

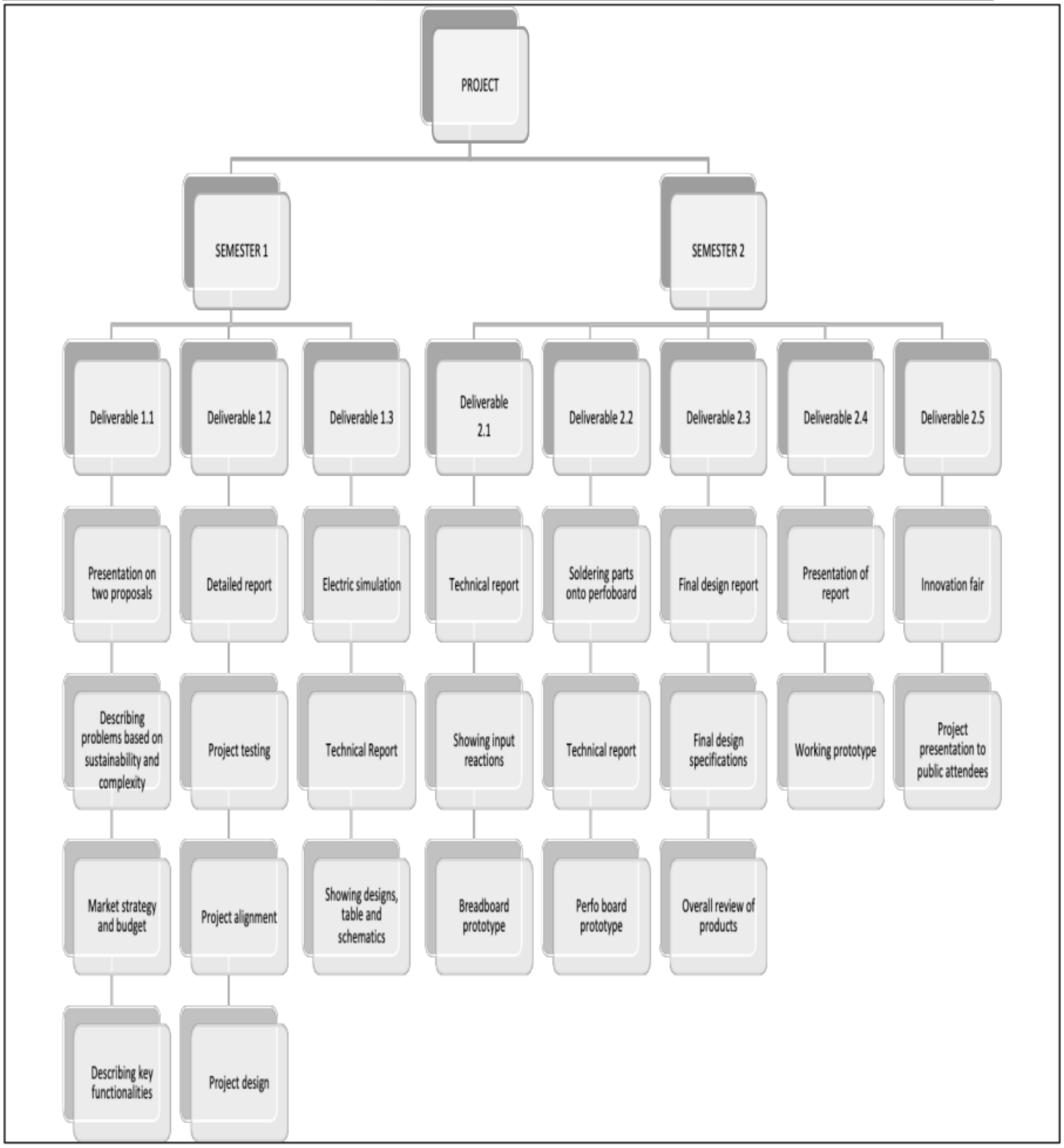

Figure 8: Work Breakdown Structure

6.3 GANTT CHART

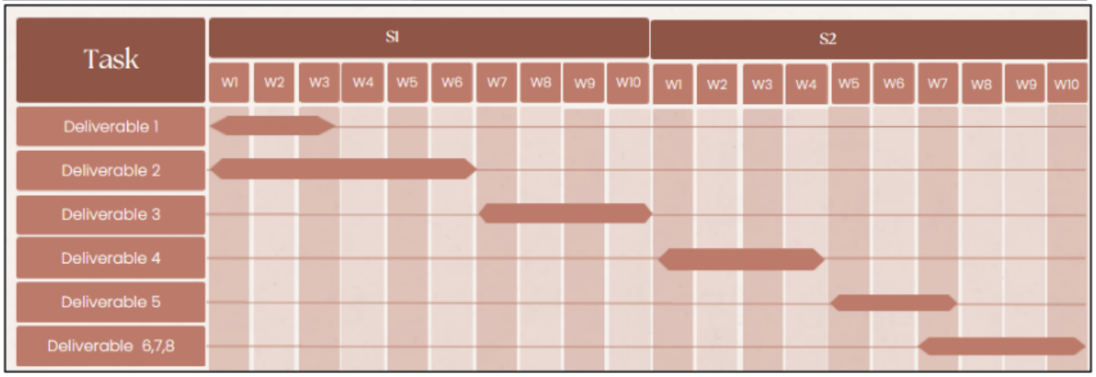

Figure 9: Gantt Chart

6.4 RISK ASESSMENT

The planning of our project has a lot of possible dangers attached to it. One of them is the risk of receiving shocks or other serious injuries when dealing with electric devices.

While working with solder, the same caution might be used. By taking the proper precautions, like as donning safety clothing when getting ready to build the circuit, this can be readily managed. The technical problems that the Application intended to monitor the registered products in the refrigerator may cause are another concern that could be important. This could be anticipated and avoided by making sure the app's coding and connection to the prototype device are both completely functional.

Smart walking sticks are expected to cost more than conventional walking sticks, which may prevent those with low financial resources from purchasing them. If the smart walking stick depends on a battery to function, it could be uncomfortable if the battery dies while the user is using it and leaves them helpless.

6.5 PERFORMANCE ASESSMENT

Till date, the team succeeds in completing all the objectives of each deliverable before the deadline. During the first deliverable, the team collectively selected ideas for presentation and the slides were made. A Gold Medal was awarded for Deliverable-1. For the second deliverable, the work was divided equally amongst the team members. The team completed constructing the state diagram, transition states, circuit, and budget for the parts before the deadline.

7. BUDGET

7.1 COMPONENT COST

The team was asked to design a prototype with an AED 900 budget. The smart walking stick works with the help of 2 Ultrasonic Sensors, 1 Water Sensor, 1 Image Sensor and 1 GPS Module. The outputs are two buzzers. Additional parts to construct the circuit include logic gates (AND, OR and D flip flops). The cost of building the prototype is significantly reduced since some parts are already provided by the university. The following table represents the component costs (in AED) of the Smart Walking Stick.

COMPONENTS	QTY	PER UNIT COST(AED)	COST(AED)
Arduino/Genuino Starter Kit	1	600	600
Cane Stick	1	10	10
Buzzer	2	5	10
Water Sensor	1	15	15
Ultrasonic Sensor	2	6	12
GPS Module	1	40	40
Image Sensor	1	30	30
Air Tag	1	110	110
Headset	1	20	20
74LS08 (Quad 2-input AND gate)	6	4	24
74HCO2 (Quad 2-input 0R gate)	3	4	12
74HC74 (Dual D type flip flops)	3	4	12
			TOTAL: AED 895

Figure 10: Component Cost distribution table

7.2 LABOR COST

The labor cost includes the cost for each deliverable and consultation with the Lecturer and the Tutor.

The following charges were decided to estimate the labor cost:

- consultation with Lecturer - AED 500 per hour
- consultation with tutor - AED 400 per hour
- for each Deliverable - AED 300 per hour.

The below table represents the estimated labor cost (in AED) to construct the walking stick.

DELIVERABLE	NO. OF HOURS (PER PERSON)	COST PER PERSON (AED)	COST FOR TEAM (AED)
Deliverable 1	6	1800	9000
Deliverable 2	11	3300	16500
Deliverable 3	5	1500	7500
Deliverable 4	7	2100	10500
Deliverable 5	20	6000	30000
Deliverable 6	30	9000	45000
Deliverable 7	5	1500	7500
Deliverable 8	6	1800	9000
Consultation with Lecturer	5	2500	2500
Consultation with Tutor	5	2000	2000
			TOTAL: AED 139,500

Figure 11: Labor Cost distribution Table

8. MARKETING

This project has a huge business scale capability as it aims to get the focus of people from all over the globe who are facing issues related to blindness. It can attract a lot of organizations in its field that can use this developed product such as being sold to a professional medical organization which increases their profits dramatically to the specific part of the medical community (the visually impaired blind individuals).

The main target users for "the Smart walking Stick" as mentioned in the name itself aid the impaired community who have trouble navigating their way through their surroundings. The project is designed to be friendlyand can be used anywhere at any moment. For example, customers who are impaired in UAE can use it to navigate their path on the walking tracks next to Parks or inside malls without facing much trouble.

9. REFERENCES

1. **https://wewalk.io/en/**
2. **https://www.safewalk.it/en/index.html**
3. **https://www.engineeringforchange.org/solutions/product/smartcane/**
4. **https://nevonprojects.com/ultrasonic-blind-walking-stick-project/**

10. APPENDIX

10.1 Contribution Sheet

NAME	STUDENT ID	WORK DONE	MARKS (Out of 10)
AHBAB ELTAHIR	6564264	• Block Diagram • Marketing	10
HIBA AHMED	7299205	• Flow Chart • State Diagram • Testing	10
MUJIDAT JIBRIN	6710608	• Timing Diagram • Work breakdown Structure • Risk Assessment	10
NANDINI RAJAGOPALAN	7352888	• Cover page • Deliverables • Gantt Chart • Performance Assessment • Budget	10
KARIM SAFARINI	7391560	• Executive Summary • Introduction	5

10.2 Minutes of Meeting

1. Discussed the progress of Lab tasks.
2. Changed Scope of design
3. Switched roles
4. Allocated work for deliverable 2.
5. Set deadlines for Deliverable 2