VALLURUPALLI NAGESWARA RAO VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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(Approved by AICTE, New Delhi, Govt of T.S and Affiliated to JNTU, Hyderabad)

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Bachupally, Hyderabad – 500090

Telangana, India.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SEVEN HABITS OF HIGHLY EFFECTIVE PEOPLE

1. Be Proactive.
2. Begin with the end in mind.
3. Put first things first.
4. Think Win-Win.
5. First Understand, then be understood.
6. Synergies.
7. Sharpen Your Saw.

We have followed the above 7 steps during the course of our project work

|	
Kuncham Prashanth	**20071A04N3**
Sunkari Sai Deekshith	**20071A04Q0**
Chirraboina Shiva	**20071A04K2**

Smart Drain Management Using Internet Of Things

MAJOR PROJECT WORK SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENT FOR THE AWARD OF THE DEGREE OF

BACHELOR OF TECHNOLOGY
IN
ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted by

Kuncham Prashanth	(20071A04N3)
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UNDER THE GUIDANCE OF
Mr. C KAUSHIK
Assistant Professor

TAMASŌMA JYOTIRGAMAYA
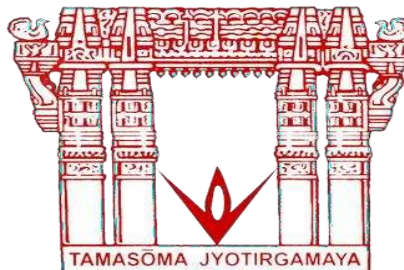
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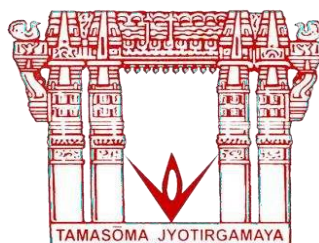
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

TAMASOMA JYOTIRGAMAYA

CERTIFICATE

This is to certify that the industry oriented major project report entitled **"Smart Drain Management Using Internet Of Things"** being submitted by **Kuncham Prashanth (20071A04N3), Sunkari Sai Deekshith (20071A04Q0), Chirraboina Shiva (20071A04K2)** in partial fulfillment of the degree of Bachelor of Technology in Electronics and Communication Engineering during the academic year 2023 – 2024.

Certified further, to the best of our knowledge, the work reported here is not a part of any other project on the basis of which a degree or an award has been given on an earlier occasion to any other candidate. The result has been verified and found to be satisfactory.

SUPERVISOR   HEAD OF THE DEPARTMENT
Mr. C. KAUSHIK   Dr. S. RAJENDRA PRASAD
Assistant Professor   Professor & Head
Dept. of ECE   Dept. of ECE
VNRVJIET   VNRVJIET
Hyderabad   Hyderabad

III

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Telangana, India.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DECLARATION

We do declare that the project report entitled **"Smart Drain Management Using Internet Of Things"** submitted to the department of Electronics and Communication Engineering (ECE), Vallurupalli Nageswara Rao Vignana Jyothi Institute of Engineering and Technology, Hyderabad, in partial fulfillment of the requirement for the award of the degree of **BACHELOR OF TECHNOLOGY** in Electronics and Communication Engineering is the bonafide record of the project report presented under the Supervision of **Mr. C KAUSHIK**, Assistant Professor, VNRVJIET.

Also, we declare that the matter embodied in this project report has not been submitted by me in full or in any part there for the award of any degree/diploma of any other institution or university previously.

PLACE: Hyderabad

                                         KUNCHAM PRASHANTH

                                         SUNKARI SAI DEEKSHITH

                                         CHIRRABOINA SHIVA

ACKNOWLEDGEMENTS

We wish to express our deep sense of gratitude to **Mr. C KAUSHIK**, Assistant Professor, VNRVJIET for his valuable guidance and constant encouragement in all respects during the course of our project work.

Our sincere thanks to **Dr. S. RAJENDRA PRASAD**, Professor and Head of Department of Electronics and Communication Engineering, VNRVJIET, Hyderabad for the encouragement and guidance provided during the course of our project work.

We are thankful to the Principal **Dr. C.D. NAIDU**, VNRVJIET, Hyderabad, for giving us permission to carry out this project.

We are thankful to all the project committee members of ECE department, VNRVJIET for helping us during this project.

We are thankful to all the staff members of ECE department, VNRVJIET for helping us during this project.

Finally, we are very thankful to our family members and our friends for their great moral support.

KUNCHAM PRASHANTH

SUNKARI SAI DEEKSHITH

CHIRRABOINA SHIVA

ABSTRACT

The proposed innovative solutions aim to tackle the challenges encountered by municipal workers during periods of heavy rainfall, thereby enhancing the municipality's control room's ability to monitor drainage situations effectively. One key innovation involves the introduction of an anti-clogging drain system, complemented by Block Detection sensors, which promises to revolutionize rainwater management practices.The anti-clogging system works by ensuring continuous flow even during intense rainfall events. It achieves this by capturing debris using recyclable cloth bags, thereby preventing blockages and maintaining smooth water flow. Meanwhile, the Block Detection sensors employ a cost-effective Plastic Flap mechanism connected to a potentiometer. This setup allows the sensors to swiftly identify and signal any blockages within drainage pipes, enabling timely intervention to prevent potential flooding issues. The data collected from these sensors serves as the backbone of the Drainage Grid monitoring system, providing comprehensive oversight of the entire drainage network .There is 6 junctions in the user interface we kept 6 sensors at the each junction, from the each junction we will get a data from the sensors and transmits the data to the ESP32 which is an server that takes the data and store in the JSON(JavaScript object Notation) file . This browser will take the JSON File data and which will be displayed.

CONTENTS

CHAPTER - 1
INTRODUCTION

The Drainage Monitoring System, a pivotal element in fostering smart cities through the Internet of Things (IoT), addresses environmental concerns arising from drainage water leakage. Aligned with the ethos of "Smart City" initiatives, this innovative system, utilizing IoT technology and ESP32 micro controllers, ensures cleanliness by monitoring manhole water levels. Employing ultrasonic sensors, it detects and compares these levels with drainage depth, utilizing a Wi-Fi modem to transmit data. Displayed on an LCD screen and a dedicated web page, the system provides real-time graphical insights, aiding in traffic reduction and mitigating environmental impact, while a buzzer alerts to critical levels, fostering cleaner, smarter urban lifestyle [8].

The drainage system is crucial for managing excess water in densely populated cities, but irregular monitoring due to the absence of dedicated teams often leads to blockages and flooding. Manual monitoring is inefficient and prone to errors, causing disruptions to daily life. Moreover, the lack of computerization hinders early detection of blockages and gas buildup, posing risks to both workers and residents. Wireless Sensor Network (WSN) technology offers a solution, providing precise and cost-effective monitoring capabilities that can enhance efficiency and prevent potential hazards, thereby ensuring the smooth functioning of urban drainage systems [6].

1.1 During heavy rains, the drainage system gets overwhelmed due to:

The drainage system faces several challenges during heavy rainfall, including a high inflow of rainwater that surpasses the system's capacity to handle it efficiently. This overflow can lead to localized flooding and disrupt normal drainage processes. Additionally, the accumulation of waste on the drains becomes a prevalent issue, impeding the smooth flow of water and exacerbating the risk of flooding. Moreover, the drainage pipelines often experience clogging due to the buildup of waste materials, further hindering the effective discharge of water. These combined factors underscore the critical need for innovative solutions to enhance the resilience and efficiency of the drainage infrastructure in order to mitigate the adverse impacts of such challenges.

Fig. 1.1 Overflowing Manhole

1.2 The inefficiency of the drainage system leads to:

Torrential rains frequently cause a cascade of problems, ranging from waterlogging and traffic congestion to infrastructure damage, making properties more vulnerable. The deluge inundates residential areas and colonies, increasing the risk of flash flooding and complicating an already difficult situation. These severe conditions not only disturb everyday routines, but also endanger infrastructure integrity and public safety. In the aftermath of such unpredictable weather occurrences, the critical necessity for effective drainage solutions becomes clear. These solutions are critical for minimizing the negative effects of excessive rains and strengthening communities' resilience to the assault of water-related difficulties. A graphic portrayal in Fig.1.2 and Fig.1.3 emphasizes the gravity of the situation, exhibiting a clogged drain choked with garbage, hindering the smooth flow of water.

Fig. 1.2 Clogged Drain with wastage restricting the inflow of water

Fig. 1.3 Water Logging on the road

1.3 The Municipality workers are facing many difficulties in the maintenance of drains:

The challenges faced by workers in drainage management are multifaceted. Identifying clogged drains is hindered by the inundation of waterlogged roads, making detection laborious and time-consuming. Clearing drain blockages proves to be a labor-intensive task, contributing to extended working hours and potential overtime. Moreover, a lack of awareness regarding on-field situations compounds these difficulties. The arduous nature of clearing drain wastage not only places a strain on human resources but also highlights the urgency for innovative solutions that streamline and enhance the efficiency of drainage maintenance processes, mitigating the impact of these challenges on both the workforce and overall urban infrastructure.

Fig. 1.4 Drain Chocked with plastic waste

CHAPTER - 2
LITERATURE SURVEY

Sriram Venkata Sai Bharath, Sidhartha T, Sravani kaviti, Bhuvaneswari B, "Drainage Monitoring System Using IoT (DMS)" Article in Indian Journal of Public Health Research and Development· October 2017 DOI: 10.5958/0976-5506.2017.00472.7

The proposed idea is that Poorly managed drainage systems in cities frequently cause waterlogging, road deterioration, and health risks. Traditional methods of maintaining these systems are frequently inefficient and labor-intensive, particularly when it comes to quickly detecting blockages and leaks. To address these concerns, researchers recommend incorporating Internet of Things (IoT) technology into drainage monitoring systems. This method involves using sensors to monitor sewer vents in real time. By collecting data from these sensors and transmitting it to a central processor via communication modules, these systems enable early detection of blockages, allowing municipal authorities to take appropriate action. The development and testing of sensory drains demonstrates a growing interest in implementing IoT-based solutions for effective drainage management.

Kamal Sahoo1, Janhvi Tambe, Shravani Patil, Abhishek Mathpati, Mrs. Prachi Kalpande "Smart Drainage System using IOT", International Journal of Research Publication and Reviews, Vol 4, no 10, pp 2151-2155 October 2023, ISSN 2582-7421.

The proposed idea is for the project on developing a smart drainage system using Internet of Things (IoT) technology emphasizes the critical need for new solutions to address issues such as effective well maintenance, inconsistent monitoring of drainage systems, and the dangers posed by open manhole covers in cities. Previous research emphasizes the importance of continuously monitoring sewer networks and optimizing them with data-driven methods, which can lead to lower maintenance costs and better flood prevention. Incorporating IoT sensors into infrastructure is also viewed as a game changer in making cities more resilient and environmentally friendly. According to research, sensor networks play an important role in collecting and analyzing real-time data, which can improve decision-making in fields such as healthcare, agriculture, and transportation.

Tushar Pathak, Sanyogita Deshmukh, Pooja Reddy, Prof H.P.Rewatkar "Smart Drainage Monitoring and Controlling System Using IOT" International Journal of Research in Engineering and Science (IJRES) ,Volume 9 Issue 7 ‖ 2021 ‖ PP. 23-29, ISSN 2320-9356.

The proposed idea is drainage systems in Indian cities highlights the critical need for improved infrastructure management as urban areas rapidly expand. As cities strive to become smarter, priority must be given to managing essential services such as water, electricity, and transportation, which includes the maintenance of underground networks such as water pipes and communication cables. The current manual methods for managing these systems are ineffective, resulting in contamination and health risks. To address these issues, a proposed project suggests implementing sensor-based monitoring systems based on technologies such as the Internet of Things (IoT). These systems would continuously collect real-time data, monitoring variables such as water levels, temperature, and toxic gases. By combining these sensors and employing automated detection mechanisms for blockages and overflows, the project aims to improve the efficiency and reliability of urban drainage systems.

Samiha Sultana, Ananya Rahaman, Anita Mahmud Jhara, Akash Chandra Paul, Jia Uddin "An IOT Based Smart Drain Monitoring System with Alert Messages". In book: Intelligent Human Computer Interaction (pp.84-95), February 2021.

The proposed drainage management system focuses on addressing the serious issue of inadequate drainage systems in countries such as Bangladesh. These systems frequently create unsanitary conditions and pose health risks. Previous research has identified a number of issues caused by clogged drains, including the release of harmful gases and the breeding of disease-carrying mosquitoes due to stagnant water. The suggested solution combines GSM and IoT technologies. The system would employ MQ135 sensors to detect sewage gases, ultrasonic sensors to measure sewage levels, and water level sensors to monitor water flow. Real-time data would be sent to authorities via GSM communication, allowing them to take action before the drains overflow. GPS technology would allow for precise location tracking, while a Wi-Fi-based NodeMCU system would send daily updates to appropriate authorities. Security measures would be put in place to limit control access to authorized personnel while granting local communities read-only access.

Gaurang Sonawane, Chetan Mahajan, Anuja Nikale, Yogita Dalvi "Smart Real-Time Drainage Monitoring System Using Internet of Things" May 2018 | IRE Journals | Volume 1 Issue 11 | ISSN: 2456-8880.

The proposed idea demonstrates the importance of drainage system monitoring in urban areas for preventing flooding and maintaining public health. Traditional manual monitoring methods are inefficient and prone to errors, resulting in infrequent surveillance and potential blockages that can cause flooding and hazardous gas buildup. The proposed solution, a smart Drainage and Manhole Monitoring System based on Internet of Things (IoT) technology, addresses these shortcomings by deploying a network of sensors such as gas detectors, water level indicators, and blockage sensors. This system provides real-time monitoring of drainage conditions, allowing for early detection of problems and timely intervention to mitigate risks. The use of Wireless Sensor Network (WSN) technology improves the system's precision, flexibility, and reliability, making it a promising solution for urban drainage management in Metropolitan areas. Cities can use IoT applications and sensor networks to proactively manage drainage systems, ensuring public safety and mitigating environmental hazards.

CHAPTER - 3
PROBLEM FORMULATION

3.1 MOTIVATION:

The Motivation of this project is to deal with thee issues of the current ineffective drainage system. The aim is to aid the current drainage system during heavy rains and floods.The inconvenience caused by overflowing manholes and Blockages should be addressed. The need for an effective drain system very crucial for the welfare of the society.Through this process we aim to improve the current situation of the drainage system in the cities.

3.2 PROBLEM STATEMENT:

In urban municipalities, heavy rainfall often poses significant challenges for municipal workers tasked with managing drainage systems effectively. Despite existing drainage infrastructure, blockages and flooding remain persistent issues, leading to disruptions, property damage, and safety hazards. The current lack of efficient monitoring tools and timely intervention mechanisms exacerbates these challenges, hindering the municipality's ability to respond promptly to drainage issues during intense rainfall events. Consequently, there is a pressing need for innovative solutions that enhance the monitoring and management of drainage systems, ensuring continuous flow and minimizing the risk of blockages and flooding.

3.3 OBJECTIVES

1. Designing an effective manhole system.
2. Designing and Prototyping the sensor for block detection.
3. Integration of Sensors for monitoring the Flow
4. Design Implementation of Hardware of monitoring the Flow
5. Implementation of monitoring and alert Systems for Identification
6. User Interface Development for monitoring all the Nodes

CHAPTER - 4
METHODOLOGY

The water flow rotates the flap connected to the potentiometer, whose data is processed by a microcontroller. This processed information then activates LEDs, creating an integrated system where the movement of the flap translates into illuminated LEDs, showcasing a dynamic interplay between water flow, potentiometer, microcontroller, and lighting elements.
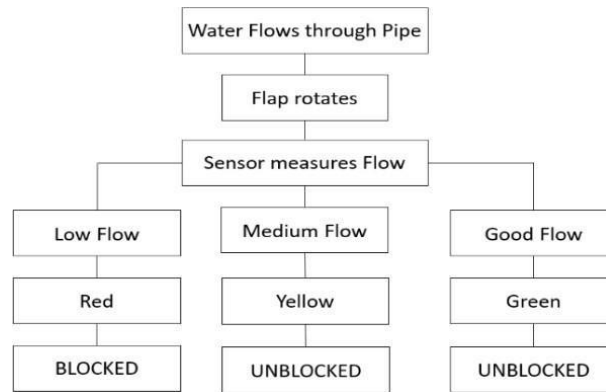

Fig. 4.1 Sensor Measures Flow of water

The pipe system incorporates flow indicators that respond to varying water rates, providing users with a straightforward means of assessing fluid dynamics within the pipe. When experiencing high flow, indicated by the flap positioned at 90°, a green indicator lights up. Medium flow conditions cause the flap to adjust to 45°, triggering a yellow indicator. In instances of low flow, where the flap reaches 0°, a red indicator activates [5]. This intuitive setup offers users a quick visual reference for assessing flow rates, utilizing color-coded indicators corresponding to the respective flap angles.
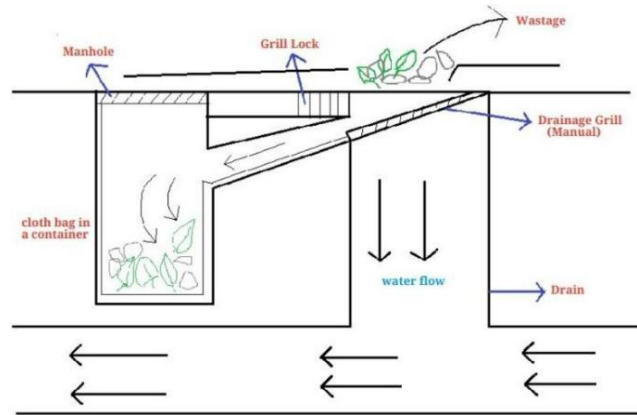
Fig. 4.2 Design of Anti-Clogging Drain System

During intense rainfall, a practical solution involves manually adjusting the drain inlet to a 30° angle, diverting rainwater and debris into an underground container equipped with a cloth bag for waste collection. This approach ensures uninterrupted water flow while preventing clogging in the drainage line. Regular replacement of the cloth bag promotes cleanliness and minimizes blockages. Notably, the system is cost-effective, user-friendly, and safe for installation on roads. Additionally, the collected waste is recycled, contributing to environmental sustainability. Despite its manual operation, this solution effectively addresses drainage issues during heavy rainfall events.
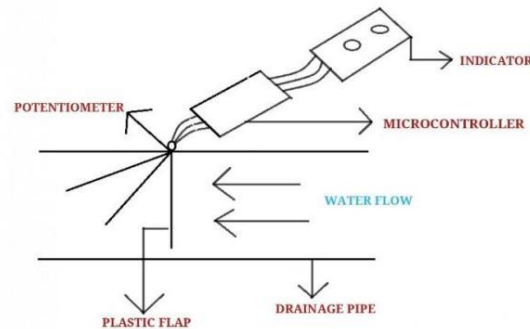

Fig. 4.3 Design of Block Detection Sensor

The novel drainage pipe innovation integrates a Plastic Flap mechanism connected to a Potentiometer, strategically positioned within the system. This setup allows the Flap to respond to water flow by rotating and adjusting the Potentiometer accordingly. A Spring mechanism ensures that the Flap resets to its original position when water flow ceases. The Potentiometer data is then processed by a Microcontroller, which controls ground-level LEDs serving as flow

indicators. What sets this system apart is its reliance on solar power, activating exclusively during heavy rains to optimize energy usage and conserve battery life during inactive periods. Its straightforward design facilitates easy construction and user operation, while its affordability renders it a practical solution for drainage management. By combining sensor technology with sustainable energy practices, this innovative solar-powered system offers an efficient and cost-effective solution tailored specifically for heavy rain scenarios.
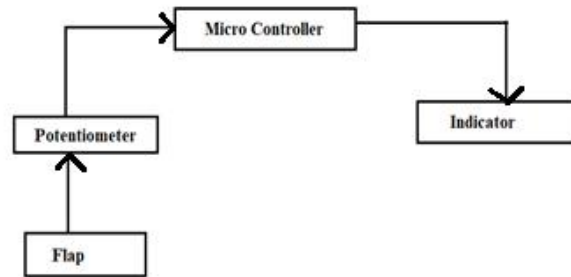
Fig. 4.4 Block Detection Sensor

The drain management process is depicted step by step in Fig 3.4. Initially, a flap connected to a potentiometer rotates. This rotational movement is crucial because it allows the potentiometer to calculate data values corresponding to the percentage of water flow. Essentially, the potentiometer converts the physical action of the flap into measurable data, which represents the volume or rate of water flowing through the drain. These calculated percentages are then used in the following steps of the procedure. Finally, based on these percentage values, an indicator initiates the final step in the drain management process. This indicator is most likely used to provide feedback or initiate actions based on the flow rate or volume indicated by the potentiometer readings.
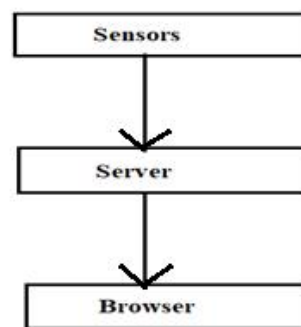
Fig. 4.5 Block Diagram of Internal Operations to see User Interface

In this Project Drainage Monitoring System utilizing IoT is to detect fluctuations in drainage flow effectively. The proposed idea is to collect real-time data on drainage flow rates and patterns by integrating IoT devices. This data collection process will allow us to continuously monitor the drainage system's performance and quickly detect any irregularities. There is 6 junctions in the user interface we will keep 6 sensors at the each junction,from the each junction we will get a data from the sensors.and transmits the data to the ESP32 which is an server that takes the data and store in the JSON(JavaScript object Notation) file . This browser will take the JSON File data and which will be displayed.

The user interface consists of 6 junctions of 6 blocks which consists of D,NB,FB,PG,ABC,MBA each equipped with 6 potentiometer sensors to gather data. For the potentiometer will be kept the flap.The water will flows from the pipe . If the water flows through that potentiometer and flap will be rotated.It will stores the resistance values which is from 1- 1023.Based on the values we kept that LED colour. If the Led glows Green flow of water is high, If it is red it is block state, if it is yellow normal flow of water.
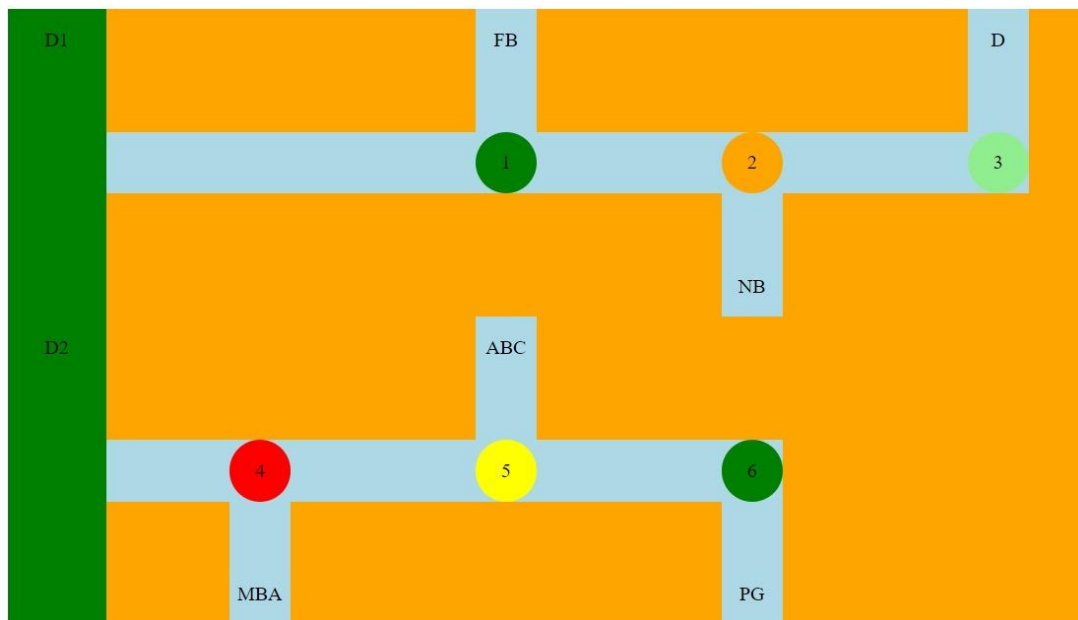

Fig. 4.6 User Interface To see the flow of water

CHAPTER - 5

COMPONENTS

5.1 SOFTWARE DESCRIPTION:

ARDUINO COMPILER :

The Arduino IDE is a versatile application built in Java, originating from the IDE developed for the processing programming language and the wiring project. Its purpose is to simplify Arduino programming using fundamental C/C++ libraries. The IDE is equipped with a code editor that offers functionalities like syntax highlighting, brace matching, and automatic indentation. Additionally, it provides the capability to verify code through compilation and allows seamless uploading to an Arduino device.
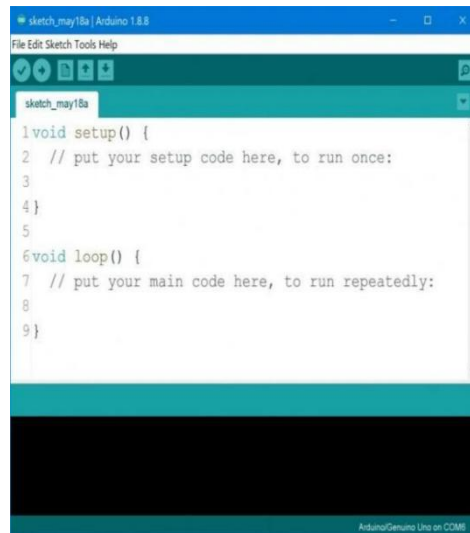

Fig. 5.1 Arduino Compiler

Programming Technologies Used :

1. HTML
2. CSS
3. JavaScript

1.HTML:

In the context of designing a drainage system interface, HTML could be used to create the basic layout of the page. Elements like <div>, <section>, and <canvas> can be utilized to represent different parts of the drainage system.

For example, you could use HTML to define the layout of pipes, drains, obstacles, or any other elements relevant to your drainage system visualization.

2. CSS:

In the context of designing a drainage system interface, CSS could be applied to style the elements created with HTML. This includes setting the size, color, and position of different components to represent the drainage system effectively.

3.JavaScript:

In the context of designing a drainage system interface, JavaScript could be used to add functionality such as simulating the flow of water, detecting blockages, and providing interactive features for users to interact with the drainage system.

For example, you could use JavaScript to animate the movement of water through the system, detect when a blockage occurs, and provide feedback to the user about the status of the drainage system.

5.2 HARDWARE REQUIREMENTS:

1. Esp32
2. Cable
3. Bread Board
4. Jumper wires
5. LED
6. Pipe
7. Potentiometer
8. 9v battery

1. Esp32

The ESP32, developed by Espressif Systems, builds upon the success of its predecessor, the ESP8266 SoC, offering an affordable and versatile solution for embedded systems. Featuring both single-core and dual-core variations of the Tensilica 32-bit Xtensa LX6 Microprocessor, it integrates Wi-Fi and Bluetooth capabilities. One of its standout features, akin to the ESP8266, is the inclusion of RF components such as Power Amplifiers, Low-Noise Receive Amplifiers, and Antenna Switches, streamlining hardware design by reducing the need for external components.
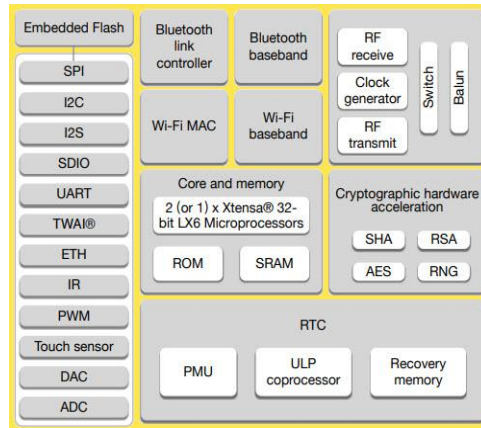
Fig. 5.1 ESP 32

2. Cable:

The ESP32 microcontroller typically communicates with external devices or computers via a USB cable.

Fig. 5.2 Cable

3. Bread Board:

A breadboard, solderless breadboard, or protoboard is a construction base used to build semi-permanent prototypes of electronic circuits. Unlike a perf board or stripboard, breadboards do not require soldering or destruction of tracks and are hence reusable.
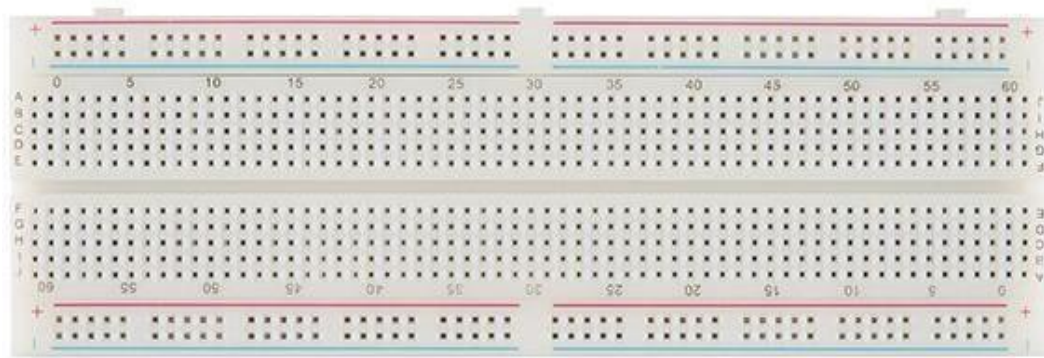
Fig. 5.3 Bread Board

4.Jumper Wires:

Jumper wires are essential components in electronics and prototyping. They are used to create connections between various electronic components such as breadboards, microcontrollers, sensors, and other hardware modules. Jumper wires come in different types based on their connectors:
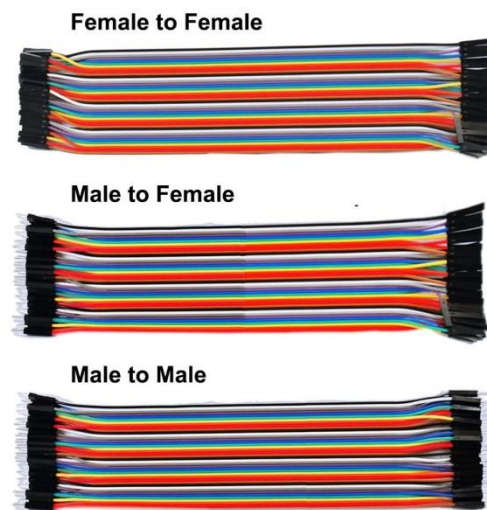

Fig.5.4 Jumper Wires

5. LED:

We used in our Smart Drain Management using IOT embedded project, it is commonly used as an indication signal. For example, it can show whether or not electricity is applied to the circuit. In our project, we used three LEDs to show the movement of water. The three LEDs have the hues red, green, and white
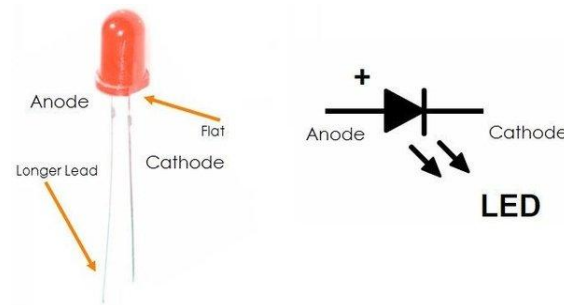

Fig. 5.5 LED

6. Pipe:

Plastic drainage pipes transport water and other liquid materials from one location to another. There are numerous types and grades (strengths) of pipes.

Fig.5.6 Drainage Pipe

7. Potentiometer:

A potentiometer, sometimes referred to as a pot or potmeter, is a manually adjustable three-terminal variable resistor used to regulate the flow of electric current. A voltage divider that may be adjusted is a potentiometer.

In this Smart Drain Management System Project We have used 6 potentiometer.

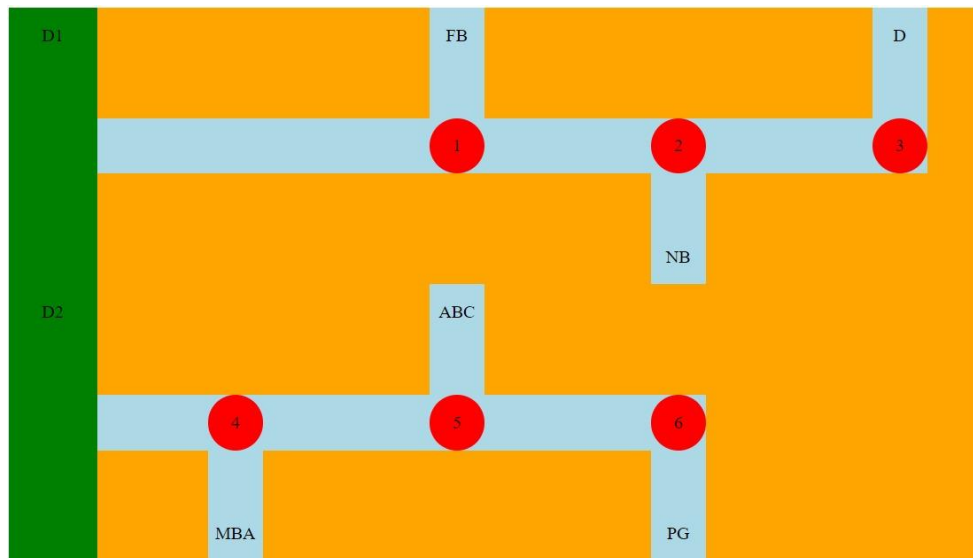Fig. 5.7 potentiometer

8.Battery:

A 9-volt battery is a small, widely used power source that provides a dependable and convenient energy supply for portable electronic equipment. The small rectangular shape of the 9-volt battery and its snap-on connectors make it easy to identify.
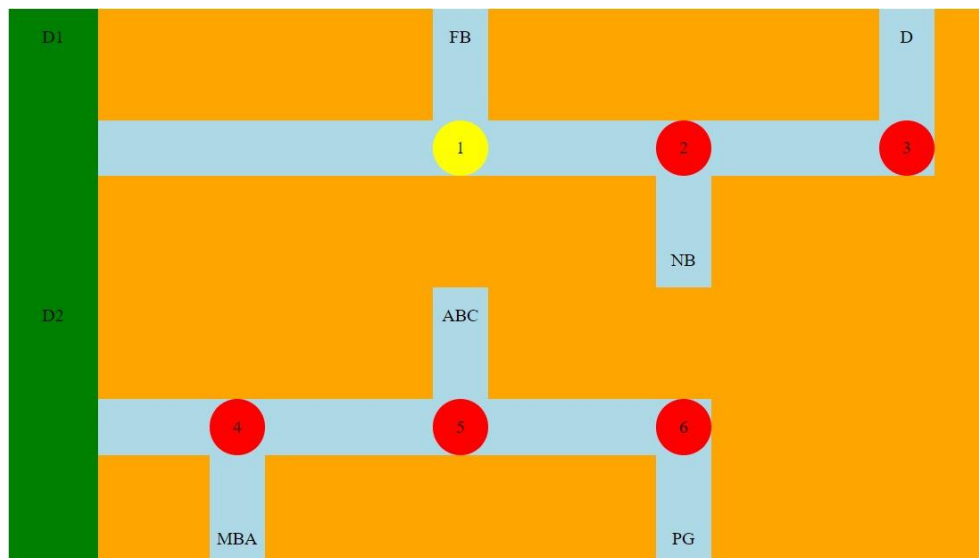


Fig. 5.8 9v Battery

CHAPTER 6
OBSERVATIONS

In the above image the observation is that there is no flow of water it means there is a blockages. which indicates us red in colour in the interface .

 In the above image the observation is block 1 is in red colour . It means there is a flow of water .Remaining blocks are in red it means no flow of water that is blockage as been happened.
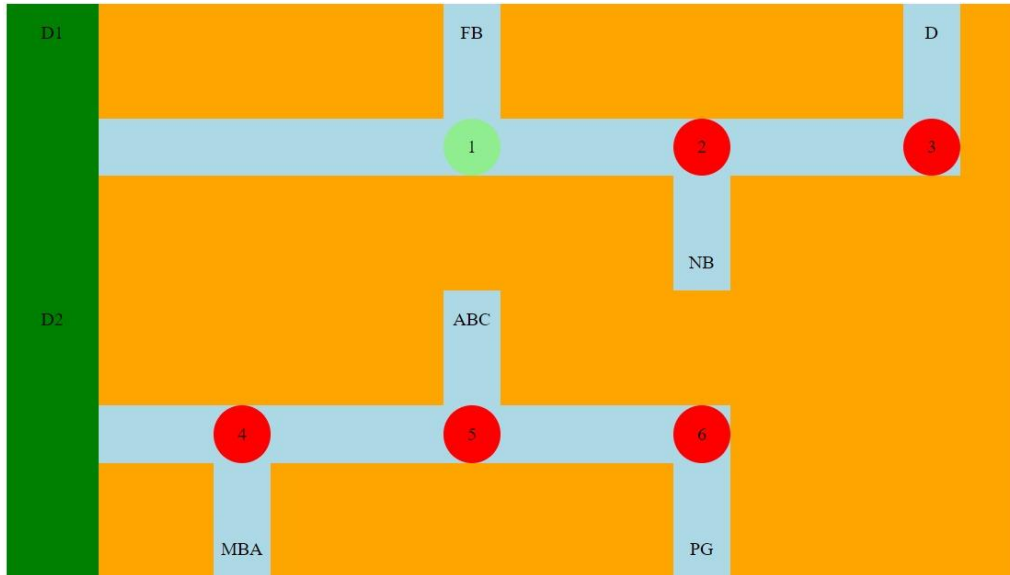
In the above image block 1 is light green colour . There is flow of water.Reaming blocks are red colour it means no flow of water .
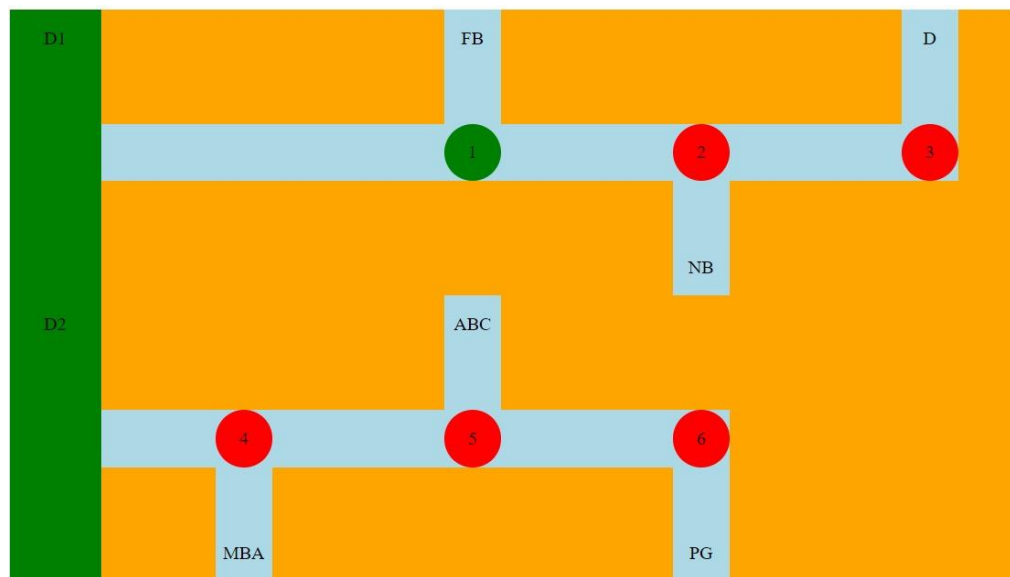
In the above image block 1 is dark green colour it means heavy flow of water through that block 1.Reaming blocks are red colour it means no flow of water .
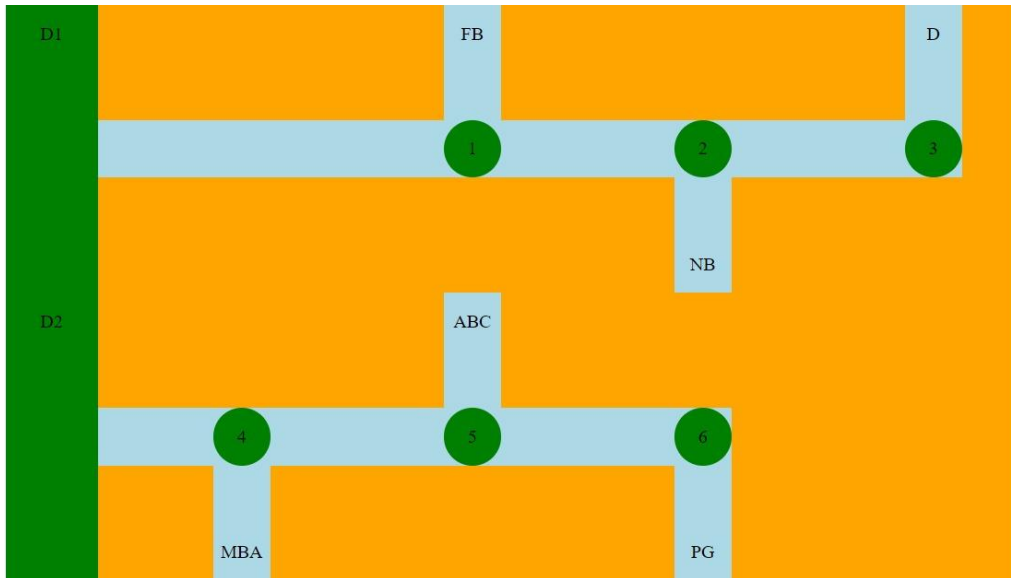
In the above image all the blocks are in green colour. There is inflow of water. It indicates no blockages are present.
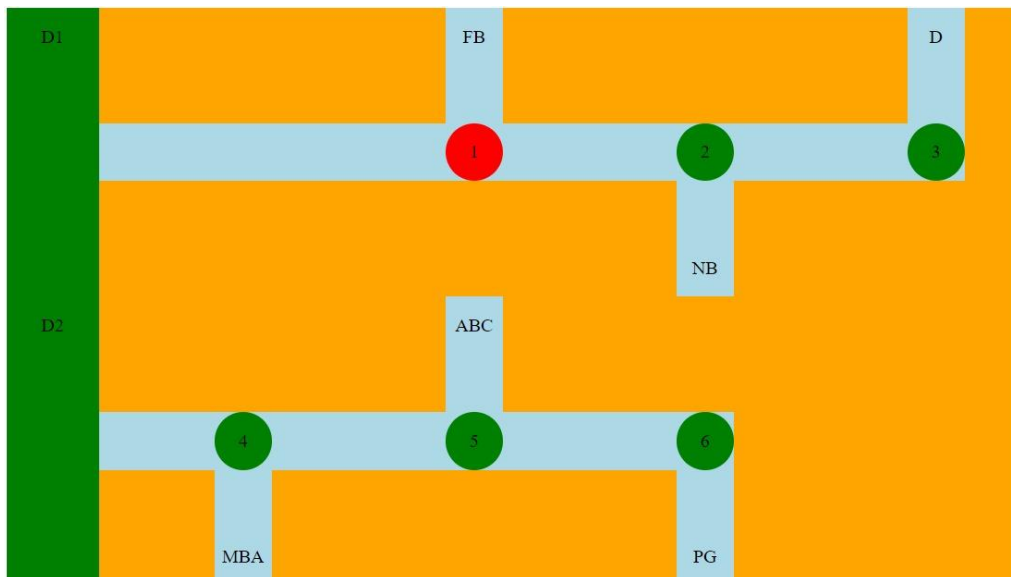
In the above image all the blocks are in green colour but the block 1 is in red colour which means after the block 2 flow of water block is in blockage. No flow of water will happen . There is inflow of water. It indicates no blockages are present.
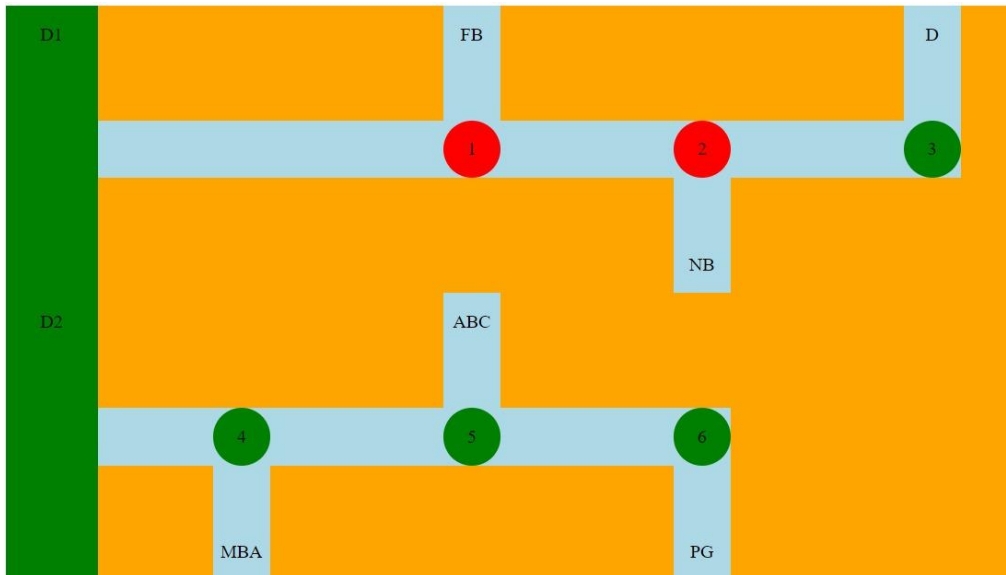
In the above image all the blocks are in green colour but the block 1 and block 2 is in red colour which means after the block 3 flow of water. No flow of water will happen through block 2 and block 1. Because the blocks are in blockage.
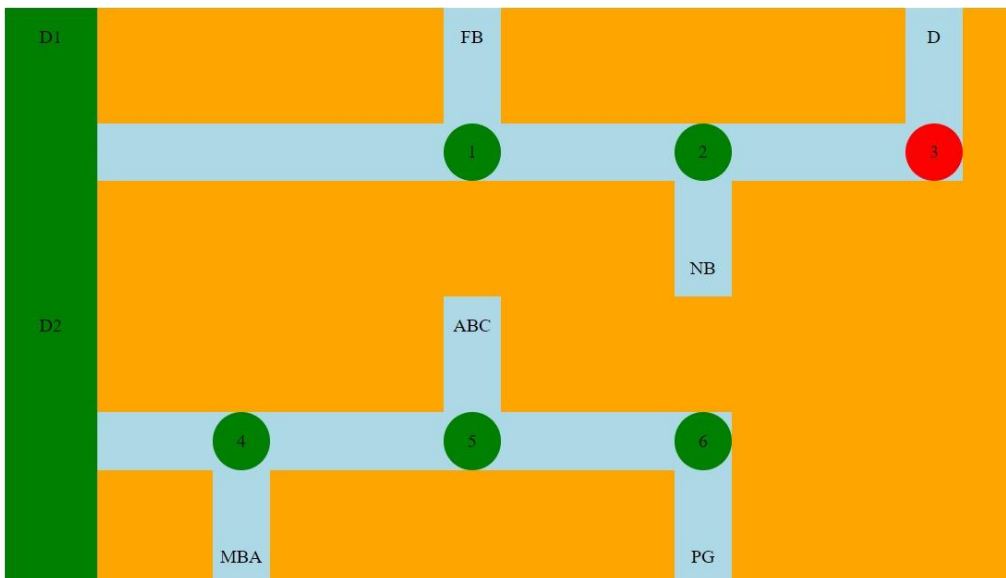
In the above image all the blocks are in green colour but the block 3 is in red colour which means it is in block. No flow of water will take place through block 3. But in this case reaming blocks are in green it means the flow of water is present in those blocks .The water may already present before the blockage of block 3. or else the water may came through rainfall.

In the above image all the blocks are in different in colour . The flow starts from the block 3 it is in green colour , there is a flow of water to block 2, it is orange it means flow of water is less than previous block. The water continuous flows to the block 1 . It is in dark green , it means no blocka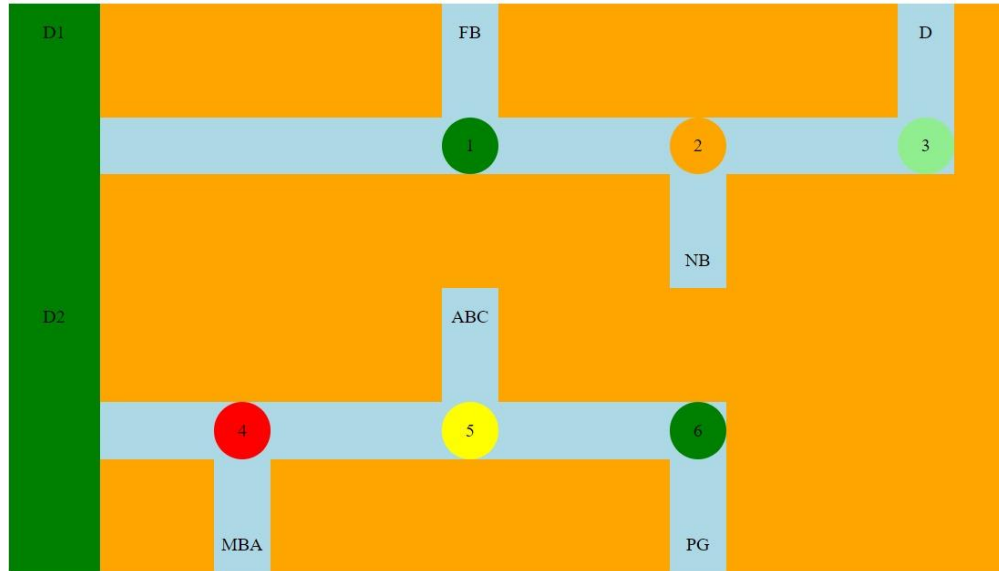ge flow of water is high . The block 6 is in flow of water to block 5 , and there is no complete blockage . The water flows to the block 4 , it is completely blocked.No flow of water will takes place.
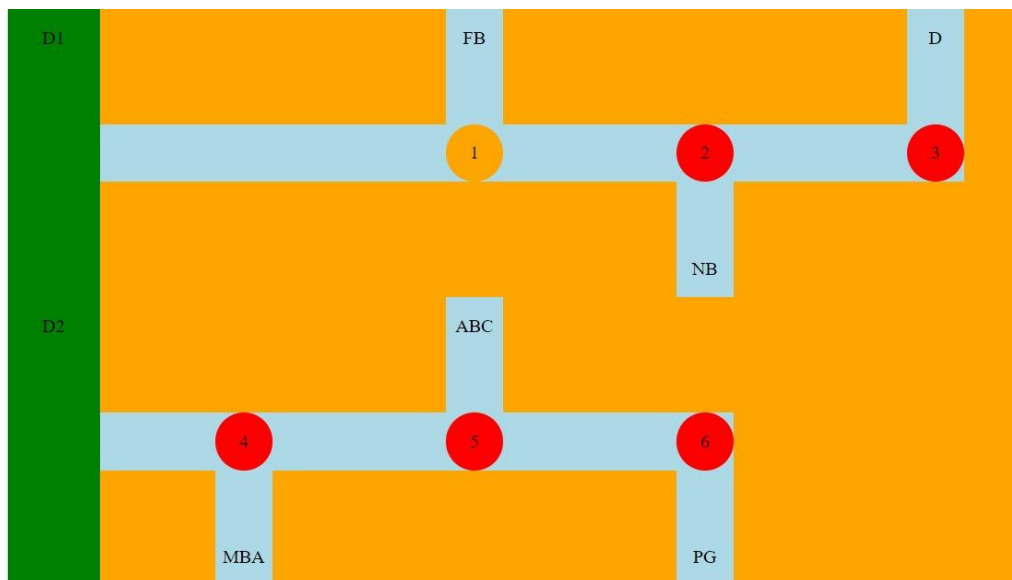
The image observation is that all the blocks are in blockage. There is no flow of water through the blocks. But the block 1 is in orange , it means flow of water is occurring.
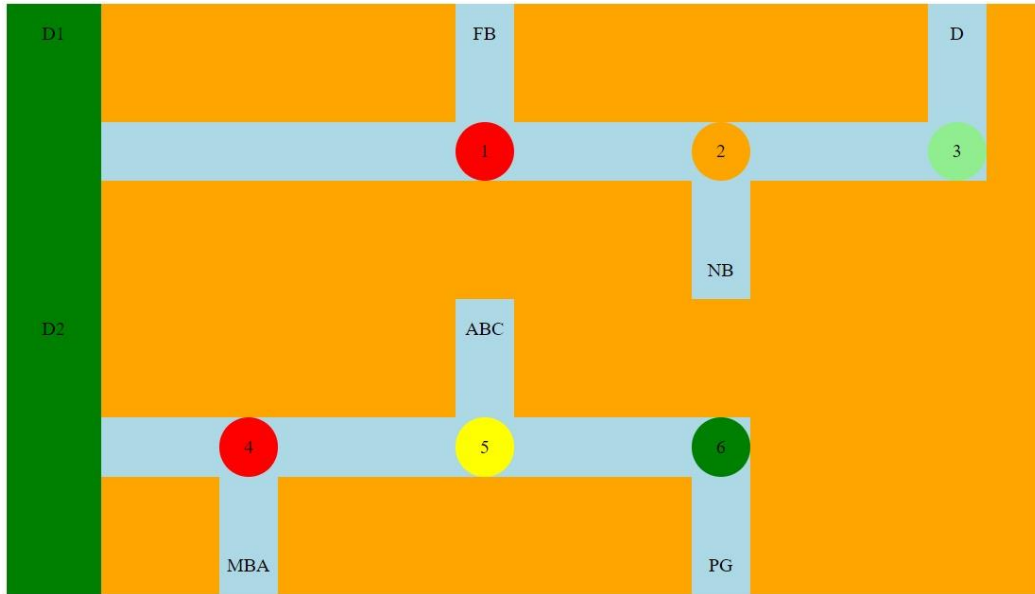
In the above image all the blocks are in different in colour . The flow starts from the block 3 it is in light green colour , there is a flow of water to block 2, it is orange it means flow of water is less than previous block. The water continuous flows to the block 1 . It is in red colour , it means blockage . The block 6 is in flow of water to block 5 , and there is no complete blockage in block 5 . The water flows to the block 4 , it is completely blocked.No flow of water will takes place.

CHAPTER 7
RESULTS AND ANALYSIS
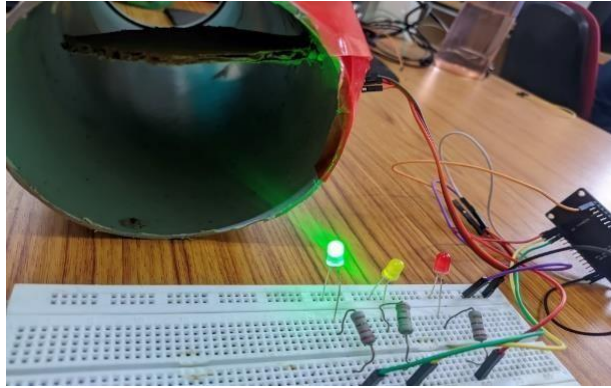
Fig. 7.1 LED Green Light glows Indicates that Flow of water is High

A high flow rate is required for effective pipe functioning, which is achieved by carefully arranging the flap at a 90° angle to optimize fluid movement. This arrangement guarantees that fluid dynamics promote optimal performance by maintaining a steady and efficient flow. A green indication is included to give users a clear visual cue of positive flow conditions, allowing for quick and straightforward monitoring of the system's operational state. This indication provides a quick reference point, allowing users to easily confirm the appropriate flow conditions. Overall, the 90° flap position combined with the green indicator ensures optimal fluid management, boosting the pipe system's efficiency and performance.
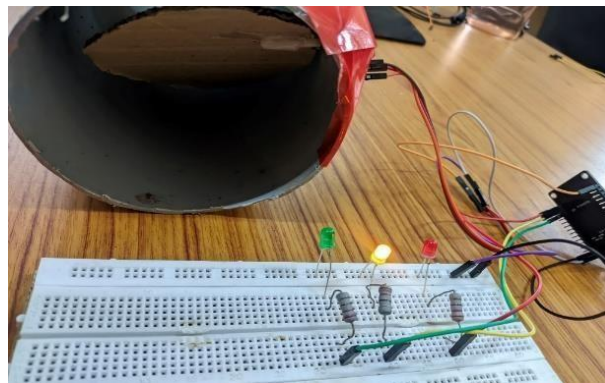
Fig. 7.2 LED Yellow Light glows Indicate that Flow of water is Moderate

The pipeline has a steady flow, which allows fluids to circulate smoothly within it. Its operation is controlled by a flap mechanism at a 45-degree angle, which effectively manages

flow dynamics. A visually appealing indication with a brilliant yellow hue acts as a clear signal for monitoring the system's status. This simplified layout, which includes modest flow, a 45-degree flap orientation, and a bright yellow signal, improves the pipeline's efficiency. These features work together to give straightforward and clearly recognizable input, enhancing the monitoring process while maintaining efficacy.
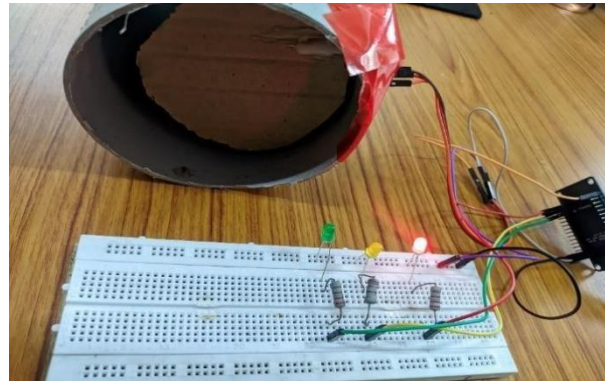
Fig. 7.3 LED Red Light glows Indicate that flow of water is low

The dynamics within the pipe emerge slowly, with water flow registered at a low level. When placed into the pipe, the flap remains static at an angle of 0°, indicating either closure or a restriction hindering the flow. This lack of mobility is clearly shown by a large red sign that is carefully placed to alert onlookers to probable blockages or diminished water flow. The combination of these factors—low flow rate, immovable flap, and noticeable red signal—provides a consistent visual indicator, allowing for more efficient monitoring and remediation of pipeline concerns. This integrated strategy allows for timely intervention, ensuring the system runs ideally while reducing the risk of future consequences.
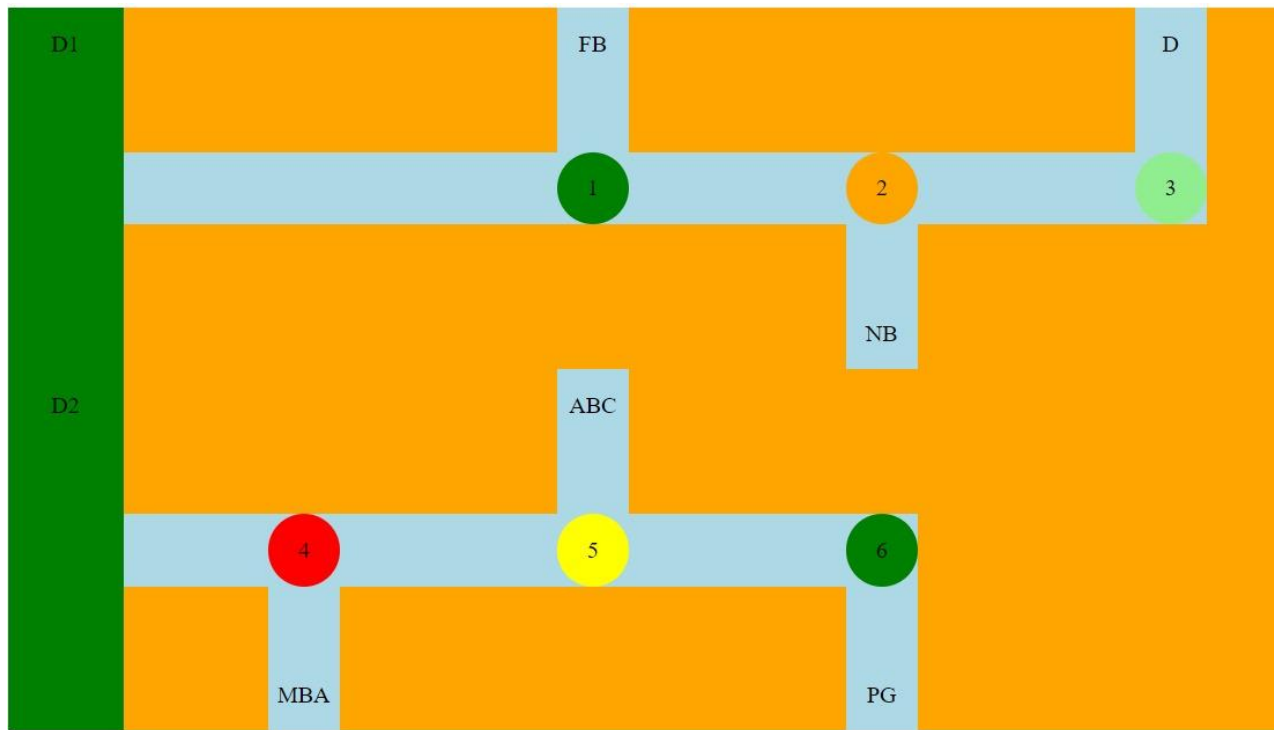
Fig. 7.4 User Interface Indicates the flow of water

There is 6 junctions in the user interface we will keep 6 sensors at the each junction,from the each junction we will get a data from the sensors.and transmits the data to the ESP32 which is an server that takes the data and store in the JSON(JavaScript object Notation) file . This browser will take the JSON File data and which will be displayed. One such application involves the utilization of potentiometer strategically positioned at different points to capture values within the range of 1 to 1023.It will show the flow of water.

CHAPTER 8

APPLICATIONS

Smart drain management systems leveraging the Internet of Things (IoT) offer a range of user applications across various sectors. Here are some examples:

Municipalities and Urban Planning:

Real-time Monitoring: IoT sensors installed in drains can monitor water levels, flow rates, and detect blockages or overflow events in real-time. This enables municipalities to promptly address issues and prevent flooding or sewage backups.

Predictive Maintenance: By analyzing data collected from IoT sensors, municipalities can predict when drains are likely to become clogged or require maintenance. This allows for proactive maintenance scheduling, reducing the likelihood of costly emergency repairs.

Resource Optimization: Smart drain management systems can optimize resource allocation by directing maintenance crews to areas with the highest priority based on real-time data analytics. This improves operational efficiency and reduces costs.

Industrial Facilities and Commercial Properties:

Pollution Monitoring: IoT sensors can monitor the quality of water flowing through drains in industrial facilities and commercial properties. This helps in detecting and mitigating pollution incidents, ensuring compliance with environmental regulations.

Water Conservation: Smart drain management systems can help identify areas of excessive water usage or leakage within industrial facilities or commercial buildings. By addressing these issues promptly, businesses can conserve water resources and reduce operational costs.

Hazard Prevention: IoT sensors can detect the presence of hazardous substances or chemicals in drainage systems, alerting facility managers to potential safety hazards. This enables timely intervention to prevent accidents or environmental contamination.

Residential Buildings and Smart Homes:

Leak Detection: IoT-enabled drain management systems can detect leaks in residential plumbing systems, helping homeowners identify and repair leaks before they cause significant damage or water wastage.

Flood Prevention: By monitoring drain conditions and weather forecasts, smart home systems can alert homeowners to potential flooding risks, allowing them to take preventive measures such as installing flood barriers or redirecting water flow.

Water Usage Monitoring: IoT sensors installed in drains can track water usage patterns within households, providing insights to homeowners on their water consumption habits and opportunities for conservation.

Agriculture and Irrigation Systems:

Drainage Optimization: IoT sensors can monitor soil moisture levels and drainage efficiency in agricultural fields, enabling farmers to optimize irrigation schedules and prevent waterlogging or soil erosion.

Nutrient Management: Smart drain management systems can analyze the nutrient content of water draining from fields, helping farmers adjust fertilizer application rates to optimize crop yields while minimizing environmental impact.

Irrigation Automation: IoT-enabled drain management systems can be integrated with automated irrigation systems, allowing farmers to remotely control water flow based on real-time data and weather conditions.

CHAPTER 9
CONCLUSION AND FUTURE SCOPE

9.1 CONCLUSION :

In conclusion, our project offers innovative methods for efficiently managing underground drainage systems. In addition to applications like real-time underground drainage and manhole identification, we have expanded our scope to include the development of a web-based user interface for monitoring water flow. This interface utilizes various sensors to detect flow rates categorized as high, low, and medium. These flow levels are visually indicated through LED colors, with red denoting low flow, green for high flow, and white for medium flow [4]. By implementing this system, manual scavengers can optimize their efforts by quickly identifying areas of potential blockage through the intuitive user interface. This not only saves valuable time but also enhances safety measures by minimizing unnecessary trips into hazardous environments. Additionally, real-time updates provided by the interface ensure regular drainage checks, thereby mitigating potential hazards and optimizing the organization of underground drainage systems.

9.2 FUTURE SCOPE:

The Future Scope of the current work may be extended as:

In our future smart drain management project, we're aiming to enhance various aspects of our system. This includes improving the quality of power sources, servers, and water sensors to ensure efficient and reliable operation. Additionally, we plan to implement a biometric switch system for emergency purposes, enabling the quick notification of authorities in case of device malfunctions. To prevent false alarms, the biometric switch will verify the identity of the person activating it. We aim to utilize GIS technology to accurately detect the location of drainage issues. Another crucial aspect involves detecting harmful gases like carbon monoxide and methane emitted from choked waste materials, aiding in early intervention and mitigation efforts [8]. Furthermore, our idea will be concentrating on the consumption of water [9]. In addition to that, the removal of clog can be eradicated using robots. Instead of eradicating manually, the clog can be removed using robots to avoid hazards to humans [10].

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APPENDIX

SOURCE CODE

ARDUINO CODE:

```
#include <Arduino.h>

#include <WiFi.h>

#include <AsyncTCP.h>

#include <ESPAsyncWebServer.h>

#include "SPIFFS.h"

#include <Arduino_JSON.h>

const char* ssid = "moto g54";

const char* password = "123456789";

AsyncWebServer server(80);

// Create a WebSocket object

AsyncWebSocket ws("/ws");

JSONVar readings;

#define P1  36

#define P2  39

#define P3  34

#define P4  35

#define P5  32

#define P6  33

// Timer variables

unsigned long lastTime = 0;

unsigned long timerDelay = 5000;

String getSensorReadings(){

  readings["sen1"] = String(analogRead(P1));

  readings["sen2"] = String(analogRead(P2));

  readings["sen3"] = String(analogRead(P3));
```

```
readings["sen4"] = String(analogRead(P4));

readings["sen5"] = String(analogRead(P5));

readings["sen6"] = String(analogRead(P6));

String jsonString = JSON.stringify(readings);

return jsonString;

}

void initSPIFFS() {

  if (!SPIFFS.begin(true)) {

    Serial.println("An error has occurred while mounting SPIFFS");

  }

  Serial.println("SPIFFS mounted successfully");

}

// Initialize WiFi

void initWiFi() {

  WiFi.mode(WIFI_STA);

  WiFi.begin(ssid, password);

  Serial.print("Connecting to WiFi ..");

  while (WiFi.status() != WL_CONNECTED) {

    Serial.print('.');

    delay(1000);

  }

  Serial.println(WiFi.localIP());

}

void notifyClients(String sensorReadings) {

  ws.textAll(sensorReadings);

}

void handleWebSocketMessage(void *arg, uint8_t *data, size_t len) {

  AwsFrameInfo info = (AwsFrameInfo)arg;
```

```
  if (info->final && info->index == 0 && info->len == len && info->opcode == WS_TEXT) {

    //data[len] = 0;

    //String message = (char*)data;

    // Check if the message is "getReadings"

    //if (strcmp((char*)data, "getReadings") == 0) {

      //if it is, send current sensor readings

      String sensorReadings = getSensorReadings();

      Serial.print(sensorReadings);

      notifyClients(sensorReadings);

    //}

  }

}

void onEvent(AsyncWebSocket *server, AsyncWebSocketClient *client, AwsEventType type,
void *arg, uint8_t *data, size_t len) {

  switch (type) {

    case WS_EVT_CONNECT:

      Serial.printf("WebSocket client #%u connected from %s\n", client->id(), client-
>remoteIP().toString().c_str());

      break;

    case WS_EVT_DISCONNECT:

      Serial.printf("WebSocket client #%u disconnected\n", client->id());

      break;

    case WS_EVT_DATA:

      handleWebSocketMessage(arg, data, len);

      break;

    case WS_EVT_PONG:

    case WS_EVT_ERROR:

      break;

  }
```

```cpp
}
void initWebSocket() {
  ws.onEvent(onEvent);
  server.addHandler(&ws);
}
void setup() {
  Serial.begin(115200);
  initWiFi();
  initSPIFFS();
  initWebSocket();
  server.on("/", HTTP_GET, [](AsyncWebServerRequest *request) {
    request->send(SPIFFS, "/index.html", "text/html");
  });
  server.serveStatic("/", SPIFFS, "/");
  // Start server
  server.begin();
}
void loop() {
  if ((millis() - lastTime) > timerDelay) {
    String sensorReadings = getSensorReadings();
    Serial.print(sensorReadings);
    notifyClients(sensorReadings);
  lastTime = millis();
  }
  ws.cleanupClients();
}
```

HTML Code:

```html
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <title>DMS</title>
    <link rel = "stylesheet" type = "text/css" href = "./style.css">
</head>
<body>
    <div class = "DMS">
    <div class = "side align">
        <div class = "drain side">
            <p class = "align">D1</p>
        </div>
        <div class = "side main">
            <div class = "line1">
                <div class = "box12">
                    <p class = "align">FB</p>
                </div>
                <div class = "box14">
                    <p class = "align">D</p>
                </div>
            </div>
            <div class = "line2">
                <div class = "box12"></div>
                <div class = "box14"></div>
            </div>
            <div class = "line3">
```

```
<div class = "side dash11"></div>

<div class = "box11"></div>

<div class = "side dash12"></div>

<div class = "box12"></div>

<div id = "sen1" class = "circle1 align"></div>

<div class = "side dash13"></div>

<div class = "box13"></div>

<div id = "sen2" class = "circle2 align"></div>

<div class = "side dash14"></div>

<div class = "box14"></div>

<div id = "sen3" class = "circle3 align"></div>


</div>

<div class = "line4">

<div class = "box13"></div>


</div>

<div class = "line5">

<div class = "box13">

<p class = "align">NB</p>

</div>

</div>

</div>

</div>

</div>

<div class = "side align">

<div class = "side drain">

<p class = "align">D2</p>

</div>
```

```html
<div class = "side main">
  <div class = "line1">
    <div class = "box22">
      <p class = "align">ABC</p>
    </div>
  </div>
  <div class = "line2">
    <div class = "box22"></div>
  </div>
  <div class = "line3">
    <div class = "side dash11"></div>
    <div class = "box11"></div>
    <div id = "sen4" class = "circle0 align"></div>
    <div class = "side dash12"></div>
    <div class = "box12"></div>
    <div id = "sen5" class = "circle1 align"></div>
    <div class = "side dash13"></div>
    <div class = "box13"></div>
    <div id = "sen6" class = "circle2 align"></div>
  </div>
  <div class = "line4">
    <div class = "box21"></div>
    <div class = "box13"></div>
  </div>
  <div class = "line5">
    <div class = "box13">
      <p class = "align">PG</p>
    </div>
```

```html
        <div class = "box21">

            <p class = "align">MBA</p>

        </div>

        </div>

    </div>

    </div>

    </div>

    </div>

    <script src = "./script.js"></script>

</body>

</html>
```

CSS Code:

```css
.DMS{

    position: fixed;

    top: 130px;

    left: 350px;

}

.side{

    display: inline-block;

}

.align{

    display: inline-block;

    display: flex;

    align-items: center;

    justify-content: center;

}

.main{

    position: relative;
```

```css
    height: 250px;

    width: 800px;

    background-color: orange;

}

.line1{

    position: relative;

}

.line2{

    position: absolute;

    top: 50px;

}

.line3{

    position: absolute;

    top: 100px;

}

.line4{

    position: absolute;

    top: 150px;

}

.line5{

    position: absolute;

    top: 200px;

}

.dash11{

    position: absolute;

    height: 50px;

    width: 100px;

    background-color: lightblue;
```

```
}
.dash12{
    position: absolute;
    left: 150px;
    height: 50px;
    width: 150px;
    background-color: lightblue;
}
.dash13{
    position: absolute;
    left: 350px;
    height: 50px;
    width: 150px;
    background-color: lightblue;
}
.dash14{
    position: absolute;
    left: 550px;
    height: 50px;
    width: 150px;
    background-color: lightblue;
}
.dash15{
    position: absolute;
    left: 750px;
    height: 50px;
    width: 150px;
    background-color: lightblue;
```

```
}
.box11{
    position: absolute;
    left: 100px;
    height: 50px;
    width: 50px;
    background-color: lightblue;
}
.box21{
    position: absolute;
    left: 100px;
    height: 50px;
    width: 50px;
    background-color: lightblue;
}
.circle0{
    position: absolute;
    left: 100px;
    height: 50px;
    width: 50px;
    background-color: white;
    border-radius: 50%;;
}
.circle1{
    position: absolute;
    left: 300px;
    height: 50px;
    width: 50px;
```

```css
    background-color: white;

    border-radius: 50%;;

}

.circle2{

    position: absolute;

    left: 500px;

    height: 50px;

    width: 50px;

    background-color: white;

    border-radius: 50%;;

}

.circle3{

    position: absolute;

    left: 700px;

    height: 50px;

    width: 50px;

    background-color: white;

    border-radius: 50%;;

}

.circle4{

    position: absolute;

    left: 900px;

    height: 50px;

    width: 50px;

    background-color: white;

    border-radius: 50%;;

}

.box12{
```

```css
    position: absolute;

    left: 300px;

    height: 50px;

    width: 50px;

    background-color: lightblue;

}

.box22{

    position: absolute;

    left: 300px;

    height: 50px;

    width: 50px;

    background-color: lightblue;

}

.box13{

    position: absolute;

    left: 500px;

    height: 50px;

    width: 50px;

    background-color: lightblue;

}

.box14{

    position: absolute;

    left: 700px;

    height: 50px;

    width: 50px;

    background-color: lightblue;

}
```

```css
.box15{

    position: absolute;

    left: 900px;

    height: 50px;

    width: 50px;

    background-color: lightblue;

}

.drain{

    position: relative;

    height: 250px;

    width: 80px;

    background-color: green;

}
```

JavaScript Code:

```javascript
var gateway = ws://${window.location.hostname}/ws;

var websocket;

window.addEventListener('load', onload);

function onload(event) {

    initWebSocket();

}

function getReadings(){

    websocket.send("getReadings");

}

function initWebSocket() {

    console.log('Trying to open a WebSocket connection…');

    websocket = new WebSocket(gateway);

    websocket.onopen = onOpen;

    websocket.onclose = onClose;
```

```javascript
        websocket.onmessage = onMessage;
    }
    function onOpen(event) {
        console.log('Connection opened');
        getReadings();
    }
    function onClose(event) {
        console.log('Connection closed');
        setTimeout(initWebSocket, 2000);
    }
    function onMessage(event) {
        console.log(event.data);
        var myObj = JSON.parse(event.data);
        var keys = Object.keys(myObj);
        for (var i = 0; i < keys.length; i++){
            var key = keys[i];
            document.getElementById(key).innerHTML = (i + 1);
            if(myObj[key] > 800 ){
                document.getElementById(key).style.backgroundColor = "green";
            }else if(myObj[key] > 600 && myObj[key] < 800){
                document.getElementById(key).style.backgroundColor = "lightgreen";
            }else if(myObj[key] > 400 && myObj[key] < 600){
                document.getElementById(key).style.backgroundColor = "yellow";
            }else if(myObj[key] > 200 && myObj[key] < 400){
                document.getElementById(key).style.backgroundColor = "orange";
            }else if(myObj[key] < 200){
                document.getElementById(key).style.backgroundColor = "red";
            }else{
```

```
            document.getElementById(key).style.backgroundColor = "grey";

        }
    }
}
```

mpk1

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