Automated Water Quality Testing System

EC6020 – Embedded Systems Design

Group 20

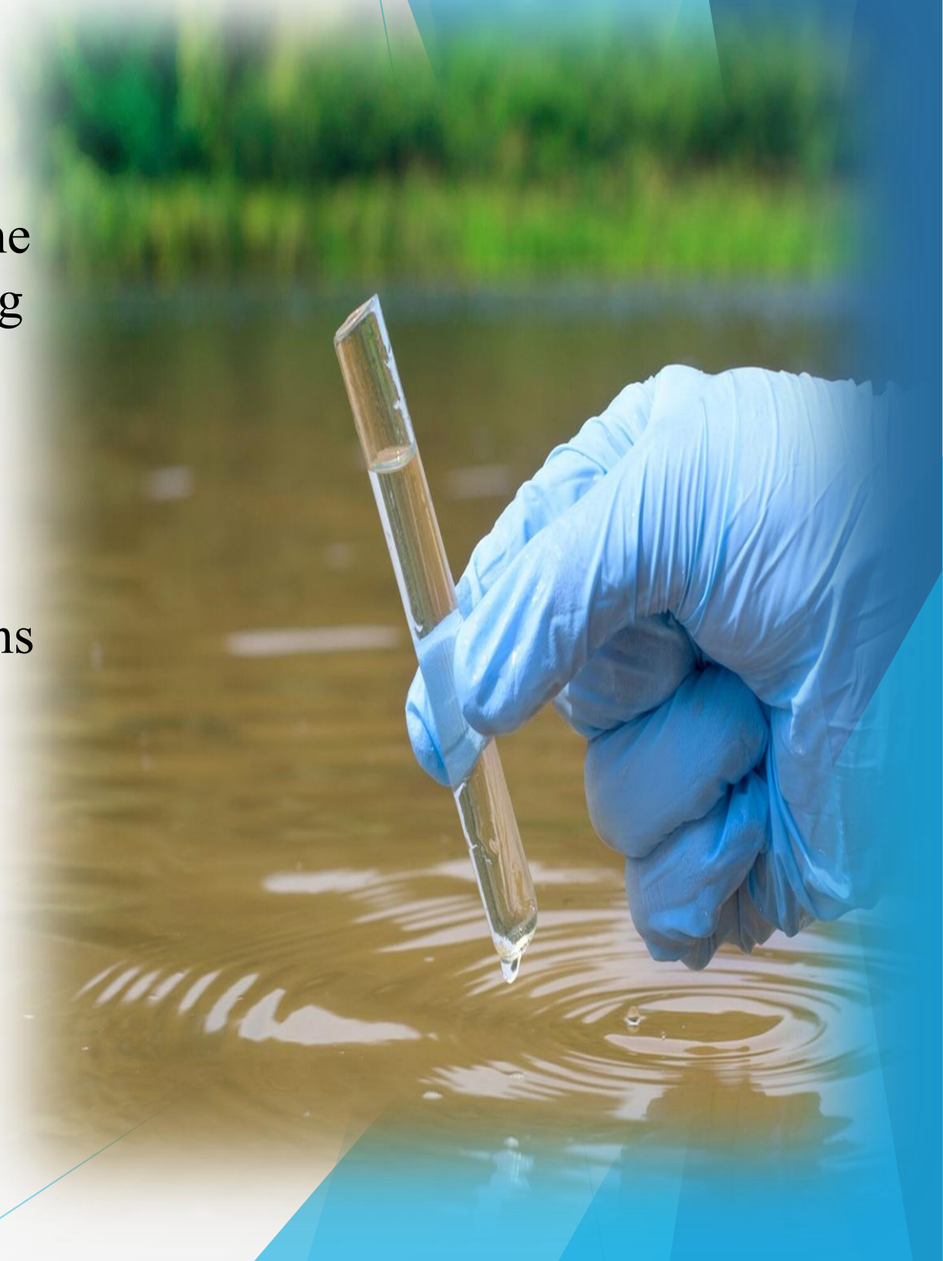
CONTENT

1. Problem Statement
2. Solution
3. Scope
4. System Overview
5. System Architecture
6. Circuit Diagram
7. Prototype Progress
8. Challenges
9. Budget
10. Next Steps
11. Timeline
12. Conclusion

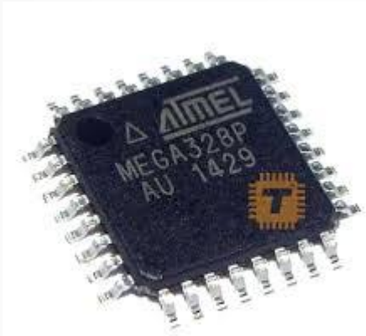
Problem Statement: The Urgent Need for Rapid Water Quality Assessment

- Due to increasing instances of flooding and contamination of wells, the traditional manual, laboratory-based water testing methods are proving to be too slow and resource-intensive, often requiring specialized personnel.

- There is a critical and immediate need for a faster, portable system to conduct emergency water quality assessments, particularly in situations where rapid data is vital for public health and safety decisions.



Our Solution: Real-time, Portable Water Quality Monitoring



Portable Embedded System

Developing a compact, self-contained unit for on-site analysis.

ATmega328P Core

Utilising the ATmega328P microcontroller for efficient processing.

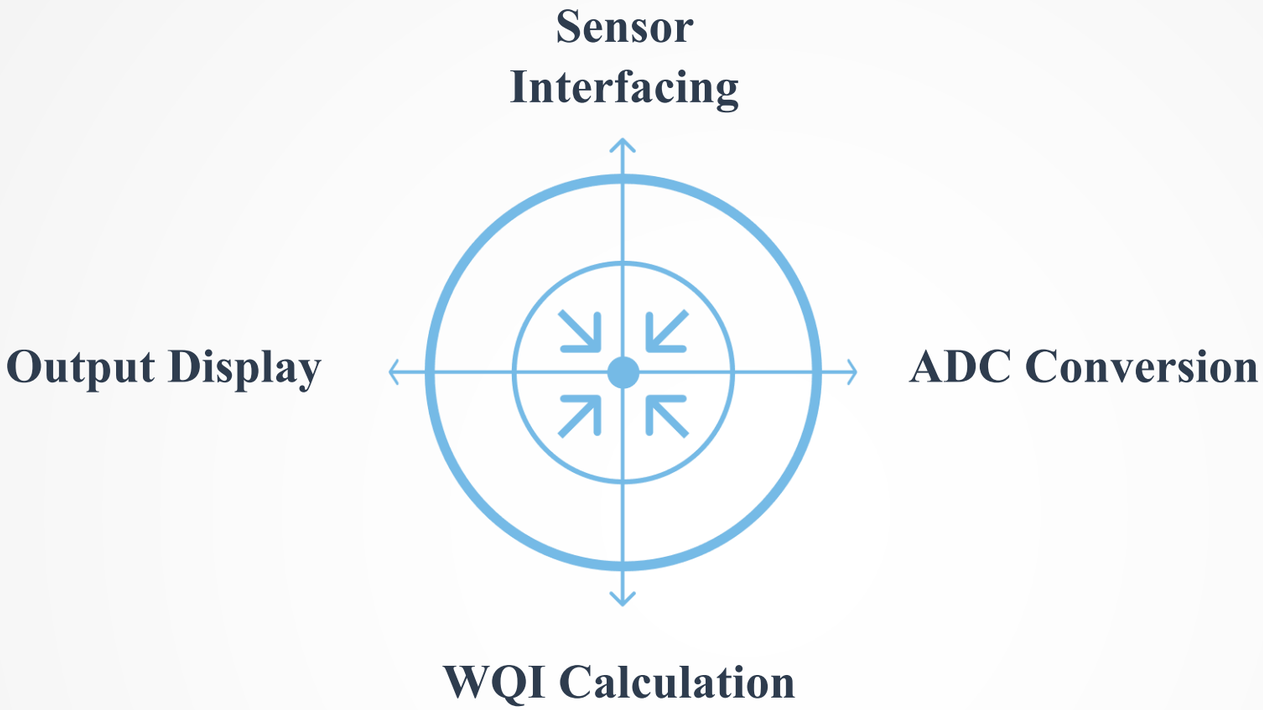
Multi-Parameter Sensing

Measuring Temperature, pH, Turbidity, and Conductivity simultaneously.

Real-time WQI Calculation

Calculating the Water Quality Index (WQI) instantly for immediate insights.

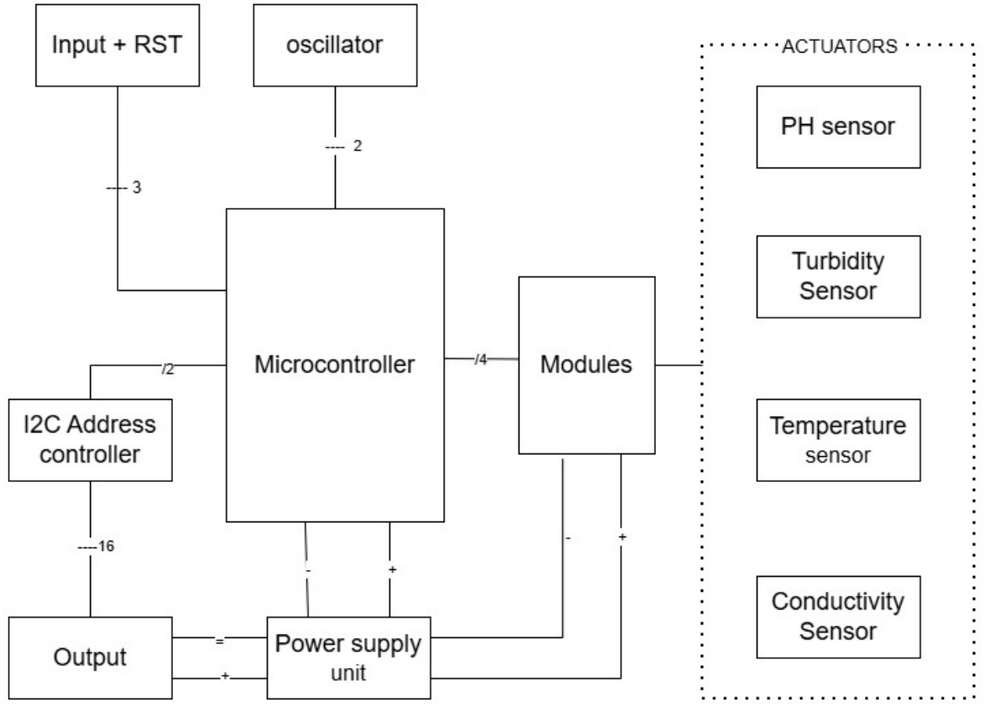
Project Scope: System Design and Core Functionalities



- Portable low-cost system for quick household water safety checks in post-flood and emergency situations.
- Simplified custom WQI using key sensor parameters for fast preliminary water quality screening.

System Overview

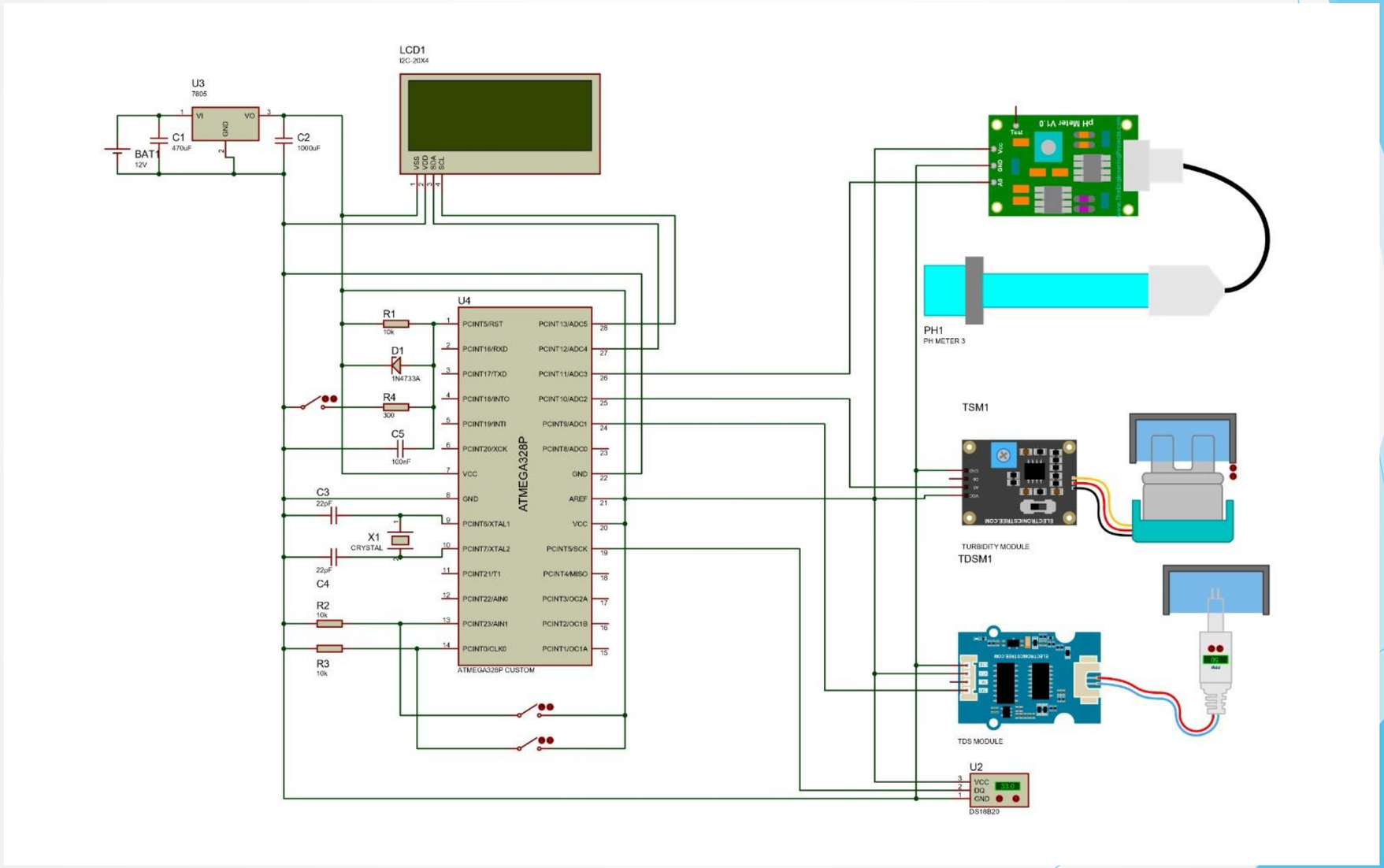
The system was designed with the ATmega328P microcontroller and an external crystal oscillator as the central unit. It acquired inputs from four water quality sensors, utilized two interrupt-driven user controls, and displayed processed results on a graphical display via I²C communication. All components were powered from a 12 V battery supply regulatedto5V using a simple step-down regulator.



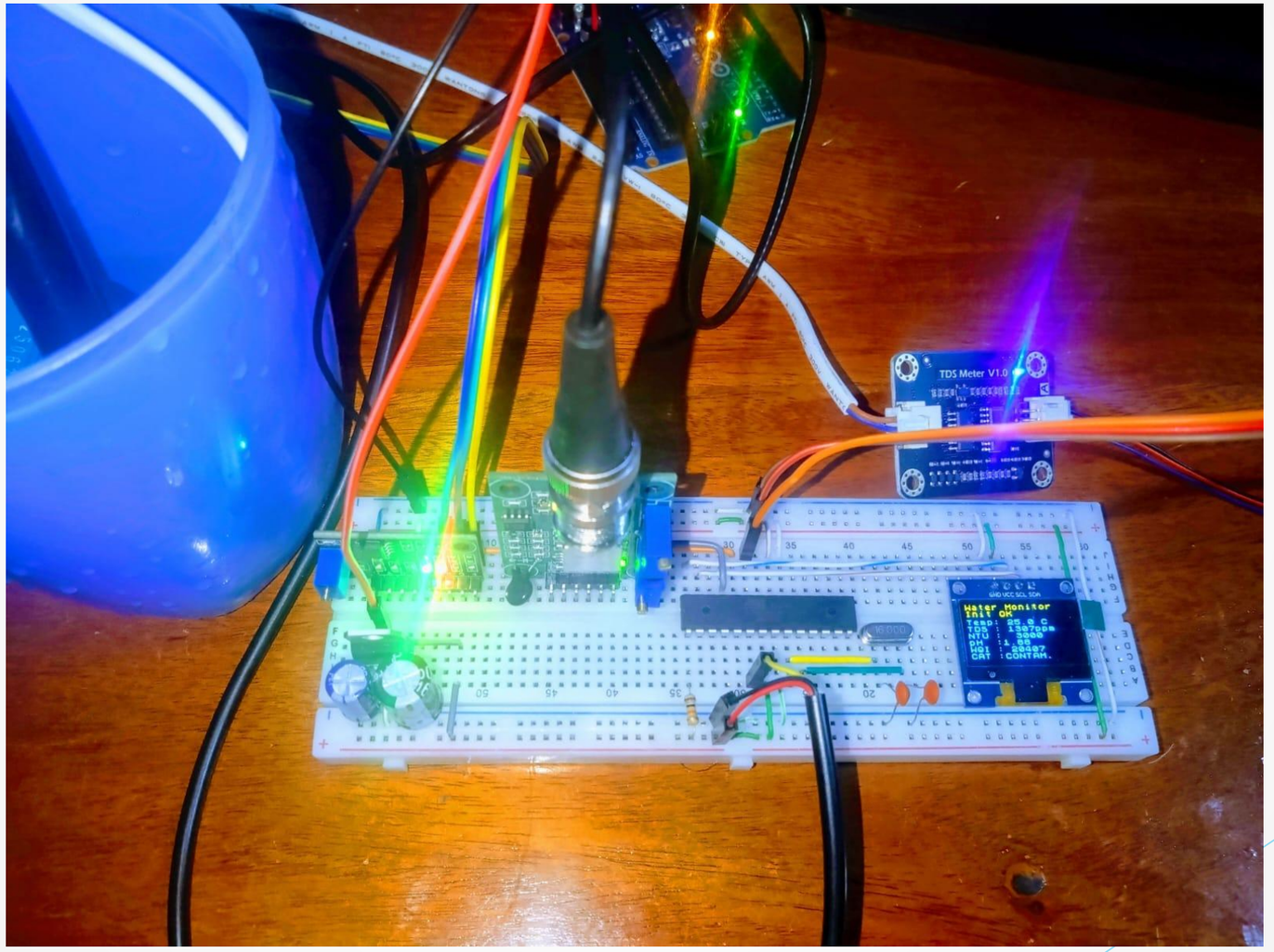
System Architecture

- The system first measures the water temperature.
- If the temperature is within the acceptable operating range of the other sensors, the system proceeds with further measurements.
- The following parameters are then measured:
  pH
  Turbidity
  Total Dissolved Solids (TDS)
- Based on the measured values, the system calculates the Water Quality Index (WQI).
- Finally, the water sample is categorized into a quality class (e.g., Poor, Normal, Good, Pure).

Circuit design



Prototype Progress



Challenges Encountered: Overcoming Design Hurdles

- Throughout the development process, we have addressed several critical challenges:

Turbidity and pH sensor needs buffer solutions and ntu calibration standard solution for proper callibration.

.

pH changes according to the temperature. therefor it needed to be calibrated at different temperature ranges.

Limited UNO SRAM (2 KB) is exceeded by the SSD1306 display buffer and additional sensor libraries, causing unstable or non-responsive OLED behavior despite successful code execution.

Compacting the all components to single potable cover which is water proof.

Budget

Component	Quantity	Price (Rs.)
Development Board	1	350.00
Temperature Sensor(DS18B20)	1	240.00
Turbidity Sensor	1	2410.00
Conductivity Sensor	1	2650.00
pH Sensor	1	4650.00
LED Display (I2C)	1	600.00
Push Buttons	2	300.00
12V Battery	1	1800.00
LM7805 Voltage Regulator	1	50.00
Crystal Oscillator (16 MHz)	1	30.00
Capacitors 22pF,100nF,470uF,1000uF	2	70.00
Decoupling Capacitors 100nF	3	10.00
Resistors (10k,330)	4	20.00
TOTAL		13180.00

Next Steps: Towards a Fully Integrated System

01

Sensor Integration

Connect all sensors into a single, unified system for comprehensive data collection.

02

WQI Finalisation

Refine and finalise the Water Quality Index calculation for accuracy and reliability.

03

Display Connection

Integrate the I2C display with the complete system for real-time result visualisation.

04

Integrated Testing & Debugging

Conduct thorough integrated testing, debug any issues, and continuously improve system stability.

Timeline

Work	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11
Component collecting											
Testing the components with programming tools.											
Simulation for Temp and conductivity											
Calibrating and programming Temp and conductivity to get input.											
Programming for ion concentration detection by values											
Simulation and for Turbidity and pH separately											
Calibration and Programming Turbidity and pH sensors separately											
Combine two simulations and testing											
Connecting all sensors to the system with the Input switches											
Simulation and Progress prototype for mid exam.											
WQI calculation added to the program											
I2C Display simulating and testing separately											
I2C Display connect to mcu and programming											
Connect the Display to the project system											
Testing the system and Debugging											
Enhance the functionality with expert opinions. Testing modifications											
Compacting the System With Development kit or PCB Design											
Finalized product demonstration											

Conclusion

- Ensures rapid assessment of water safety during emergency conditions such as floods and natural disasters.
- Provides a reliable and easily interpretable Water Quality Index (WQI) value for quick decision-making.
- Enables convenient, portable, and user-friendly operation for field deployment and household-level testing.

Group Members

Name	Registration Number
WICKRAMASINGHE G.A.G.M.	2022/E/037
HATHURUSINGHE H.D.H.M.	2022/E/045
RAJAPAKSHA K.G.M.S.	2022/E/080
LAWANYA M.A.S.	2022/E/090
H.W.S.P WISHIKA	2022/E/131

THANK YOU