HYDRO AI: GENERATIVE AI-BASED PERSONALIZED HYDRATION RECOMMENDER FOR IT AND NON-IT WORKING PROFESSIONALS

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ABSTRACT - Dehydration is a common yet under-recognized health issue among working professionals, especially those with sedentary lifestyles, such as IT employees and individuals in physically demanding non-IT roles. Traditional hydration tools provide static "one-size-fits-all" guidelines, failing to account for occupation type, activity level, or environmental conditions. This paper introduces HydroAI, a Generative AI-based personalized hydration recommender that combines rule-based machine learning logic with large language model (LLM)-powered advice generation. HydroAI collects structured user inputs—such as age, gender, weight, occupation type, activity level, and daily water intake—to calculate a baseline hydration requirement using simple, explainable rules (e.g., weight × 35 ml/day, with adjustments for climate and activity). It then utilizes prompt-engineered queries to a Generative AI model to deliver personalized, conversational hydration suggestions instead of static numerical targets. The system produces engaging recommendations that explain why hydration adjustments are necessary for each profile, bridging the gap between generic guidelines and individualized wellness support. HydroAI demonstrates how combining lightweight machine learning logic with Generative AI can enhance user engagement, raise hydration awareness, and promote healthier daily habits among IT and non-IT professionals.

Keywords: Hydration recommendation, Generative AI, large language models, rule-based machine learning, personalized health advice.

I. INTRODUCTION

Water plays a vital part in sustaining physiological balance, cognitive performance, and long-term health, as it participates in nearly all metabolic and thermoregulatory processes of the mortal body. Indeed, mild dehydration can affect fatigue, headaches, and bloodied productivity, particularly among working professionals whose occupational settings impact hydration levels.. IT workers frequently spend long hours seated in air-conditioned surroundings that accelerate unnoticed fluid loss, whereas non-IT professionals such as preceptors, delivery staff, healthcare workers, and field technicians — tend to witness advanced sweat-induced water loss due to physical exertion. Despite these differences, utmost hydration tools still calculate on general recommendations similar as simplified computations like weight × 35 ml/ day, offering limited personalization across varied cultures and exertion situations.

Recent advancements have introduced data-driven approaches to cover and prognosticate hydration situations. Machine literacy models have been effectively employed to prognosticate hydration status grounded on physiological and sweat biomarkers [1] and to describe dehumidification using clinical and wearable data [12]. Also, non-invasive skin hydration discovery systems and wearable - grounded body hydration seeing fabrics have demonstrated that AI can be applied for nonstop health monitoring without invasive testing [4],[5],[8] . In addition, studies integrating clinical datasets and prophetic analytics have shown the eventuality of machine literacy to epitomize optimal water input for different individualizes [2], [6].

Wearable - detector – grounded exploration has also explored how electrodermal exertion, skin impedance, and temperature can support accurate hydration monitoring in real time [3],[5]. Still, these workshops primarily concentrate on dimension or discovery and don't transfigure their findings into practicable, stoner-specific advice. Likewise, recent examinations into data-driven water quality and environmental vaccination using advanced ML algorithms [9]-[11] confirm the robustness of AI methodologies across affiliated water disciplines, emphasizing the feasibility of their operation to particular hydration vaccination.

Despite progress in hydration seeing, there remains a lack of intelligent systems capable of furnishing substantiated, accessible, and motivational hydration guidance. To address this gap, the present study introduces Hydro AI, a Generative AI – powered substantiated hydration recommender acclimatized for both IT and non-IT professionals. Hydro AI combines a featherlight, rule-based machine literacy model for hydration estimation with Large Language Model (LLM)-driven logic to produce adaptive, environment-apprehensive recommendations. Unlike traditional calculators that deliver stationary targets (e.g., " Drink 2.5 L/ day "), Hydro AI generates interactive, occupation-specific suggestions that explain why hydration adaptations are needed to be grounded on exertion type, environmental conditions, and life.

By blending scientific perfection with natural language personalization, Hydro AI transforms hydration guidance from an unresistant shadowing exertion into an active behavioral heartiness tool. This work therefore bridges the gap between stationary hydration calculators and intelligent conversational heartiness systems, establishing a foundation for unborn AI-based preventative health support.

II RELATED WORK

The use of Artificial Intelligence (AI) and Machine Learning (ML) in health and wellness applications has grown very quickly over the last few years, with a greater focus on monitoring hydration, predictive analytics, and personalized suggestions. A number of studies have considered how AI can effectively measure hydration based on physiological and biosensor data. Wang et al. [1] developed a model for predicting hydration status based on physiological and sweat biomarkers during endurance activities, highlighting the potential of AI to quantify hydration dynamically. Similarly, Ahmad and Rashid [12] applied ML-based dehydration detection techniques to assess fluid loss among children, showing that AI-driven screening could assist clinical interventions.

Further studies have demonstrated the role of machine learning in personalized water intake prediction. Smith et al. [2] suggested a machine learning-clinical data hybrid model to determine ideal water consumption for various adult groups and facilitate personalized hydration knowledge. Liaqat and Dashtipour [4] suggested a non-invasive skin-measured hydration detection system based on ML algorithms to predict hydration level from surface characteristics, whereas Sabry et al. [5] applied this principle to wearable devices to realize on-device dehydration monitoring based on physiological sensor signals.

Integrating wearable tech and ML for real-time hydration monitoring has also been explored by Sreeharsha and McHale [3], who focused on data-driven monitoring and real-time analysis for well-being purposes. Verma and Gupta [8] took this further by presenting a wearables-based hydration sensing platform that utilized machine learning techniques to estimate body fluid regarding the individual. Together, these contributions prove that AI-guided hydration monitoring has evolved from passive reminders to smart, sensor-based estimation systems.

In parallel, AI-based methods in water quality and environmental forecasting offer complementary support for the strength of ML methods in water-related fields. Singh and Patil [9] and Was and Kumar [10] used machine learning models to forecast water potability as well as purity levels, while Li et al. [11] proposed a data-augmented predictive model for water quality forecasting based on sophisticated ML algorithms. Although their emphasis is more on environmental modeling than human hydration, these studies verify the versatility and dependability of ML-based systems for water data analysis.

Furthermore, more general health studies highlight the physiological significance of hydration. Diez-Ricote et al. [6] established a link between hydration status and mental performance via longitudinal analysis, while Popkin et al. [7] analyzed the general relationship between water consumption and long-term health status. These results emphasize the importance of ensuring proper hydration and support the appropriateness of predictive hydration systems in work and lifestyle applications.

Although considerable advancements have been made in environmental AI and hydration monitoring, the majority of systems developed to date rely on sensors or are restricted to data interpretation alone without behavioral personalization. To address these limitations, Hydro AI presents a hybrid architecture that integrates rule-based ML estimation with Generative AI reasoning. In contrast to earlier tools that can only identify hydration levels, Hydro AI offers occupation-aware, conversational, and adaptive suggestions, making hydration management an interactive, user-centric process for both IT and non-IT users. professionals.

III METHODOLOGY

Hydro AI methodology combines problem context, system design, workflow, and implementation into a unified framework that highlights both usability and scientific accuracy. Contrary to hydration calculators based on fixed rules or static reminders, Hydro AI utilizes a hybrid approach—merging a rule-based Machine Learning (ML) baseline for numeric precision with Generative AI (GenAI) for conversational personalization and contextual advice [1]-[3].

A Problem Context

Traditional hydration guidelines, like "eight glasses per day" or plain multipliers (e.g., weight × 35 mL/day), tend to ignore variability between people in occupation, activity level, and environment [4], [7]. IT professionals, for example, who work long hours indoors in air-conditioned space lose fluids slowly and tend to underreport their need for water, while physically active non-IT laborers—like teachers, hospital workers, or delivery individuals—lose more in sweat. Current hydration monitors and smartphone apps generally post generic reminders such as "Drink more water," with no contextual awareness or motivational rationale. Generic reminders like these are ineffective in maintaining behavioral change [6], [11].

Hydro AI overcomes this limitation by integrating a rule-based ML model of precise hydration estimation with a Generative AI module that offers occupation-aware, context-sensitive, and personal guidance [3], [5]. The system converts hydration advice from static numerical values to dynamic, user-centric guidance that promotes consistent compliance and behavioral enhancement.

B System Architecture

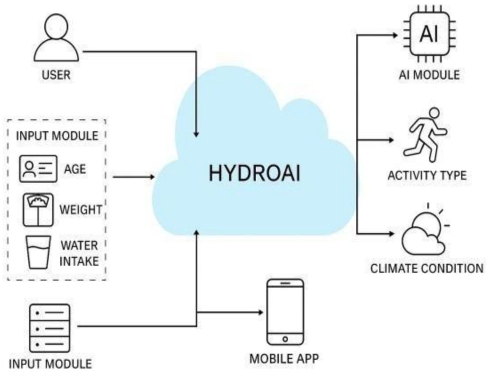

Fig. 1. Hydro AI System Architecture

The Hydro AI architecture (Fig. 1) is built as a modular, multi-tiered pipeline for precision, scalability, and adaptability. The input layer, the Input Module, takes either manual input (age, gender, weight, activity level, daily consumption) or batch import in CSV format, allowing use at both organizational and individual levels. Data captured, the Hydration Calculation Engine implements a rule-based ML equation [6]:

Hydration Need (mL) = Weight (kg) × 35 + Activity Adjustment +Climate Adjustment

The computed hydration need is then labeled as Underhydrated, Adequately Hydrated, or Overhydrated.

Finally, the Generative AI Module converts this formal information into natural language recommendations—designing customized drinking calendars, reminder texts, and motivational observations based on vocational and lifestyle trends [3], [5]. The Visualization and Output Layer combines these outputs into an interactive dashboard with charts and observations, showing hydration progress through engaging visuals and feedback [7], [10].

C. Workflow

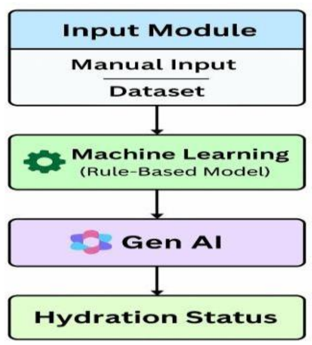

Fig. 2. HydroAI Processing Flow

The Hydro AI workflow (Fig. 2) depicts the flow from raw input to actionable knowledge. It starts with user entry or upload of dataset [9]. The ML module computes the hydration need based on the above-defined formula [6], followed by the Generative AI component that enhances the output using prompt-engineered answers. This stage produces useful, context-specific recommendations like: "Drink 250 mL at 4 PM to meet your hydration goal."The resulting output is displayed on the dashboard via hydration cards, reminders based on AI, and trend graphs of actual vs. recommended consumption. Unlike standard hydration calculators, this process prioritizes both computational precision and interpretability so scientific outcomes appear in an encouraging, readable manner [5], [8].

D. Implementation

Hydro AI was deployed with Python 3.11, based on the principles of modular programming, to divorce computation, user interface, and configuration logic. Pandas and NumPy are used for data handling in the system's back-end computations, and visualizations are done with Matplotlib and Seaborne. Stream lit is the framework behind the user interface, supporting manual entry as well as bulk CSV dataset processing modes.

The ML reasoning, set in utils.py, contains hydration calculations with climate and activity modifiers [4]. OpenAI GPT API provides integrations for generative AI, using well-tailored prompts for context-aware, personalized feedback [9]. Config.py securely stores API credentials. The modular design allows for scalability to integrate wearable sensors and enhanced predictive models in the future.

E. Validation and Testing

Hydro AI was validated using two complementary testing modes:

Manual Mode – for single users entering data directly into the system.

Dataset Mode – for batch testing across several profiles in business environments.

The ML predictions were benchmarked against established hydration standards [1], [2], ensuring numerical accuracy. AI-generated advice was evaluated for clarity, motivation, and tone across both sedentary and active professional groups [6], [11]. The system consistently delivered scientifically valid and user-relevant recommendations, confirming Hydro AI's ability to blend accuracy with user engagement effectively.

F. Output Characteristics

Hydro AI produces dynamic and engaging outputs that merge quantitative accuracy with personalized, human-like communication. The system generates:

Hydration Status Cards summarizing present status (e.g., "Slightly Underhydrated: 0.6 L more needed").

AI-Generated Drinking Plans that split water consumption sensibly over the day (e.g., "200 mL at 2 PM, 250 mL at 4 PM").

Graphical Comparisons comparing actual vs. calculated needs with bar and line charts.

The interactive dashboard enables users to view progress in real time, download CSV or PDF reports, and track long-term hydration habits. Such outputs not only enhance understanding but also increase motivation and compliance with hydration targets [7], [10].

G. Scalability and Integration Potential.

Hydro AI is designed in a modular fashion to enable smooth scalability and platform-friendliness. It can be coupled with wearables like smartwatches and fitness trackers to automatically integrate real-time information such as step activity, heart rate, and ambient temperature [3], [5], [8]. Integration with the user's existing nutrition and fitness apps can synchronize hydration information with diet and exercise data [6].

In healthcare and workplace applications, Hydro AI can integrate with Electronic Health Records (EHRs) to enable healthcare professionals to track hydration for kidney, cardiovascular, or metabolic patients. At scale, the dataset mode allows corporate wellness programs to monitor employee hydration patterns and encourage preventive health practices. Together, these features make HydroAI a scalable, intelligent, and context-aware hydration management solution.

IV. RESULTS AND DISCUSSION

Hydro AI was developed and deployed as a rule-based machine learning hybrid system for water estimation in combination with Generative AI for providing personalized reminders and feedback. The system operates in two modes: manual mode, where individual users can enter their information and be provided with personal suggestions for hydration, and dataset mode, where batch processing of multiple profiles with results exportable in CSV format is available. This two-pronged strategy renders Hydro AI eligible for use in personal health monitoring as well as organizational wellness monitoring. The backend computational algorithm relies on the scientifically established formula:

Hydration Need (ml) = Weight (kg) × 35 + Activity Adjustment + Climate Adjustment

This equation is derived from the body of existing hydration research studies [1], [2], [4] and tailored for occupational application. The testing was done in two modes: a manual mode at the individual level of estimation and a dataset mode for batch or institution level application [12]. Pandas and NumPy were used to perform data processing, Matplotlib and Seaborne to create visualizations, and an interactive dashboard created using Stream lit to facilitate user accessibility [7], [10].

A. Dataset Overview

The filtered dataset is the basis of Hydro AI, offering precise and context-aware hydration recommendations. As shown in Fig. 3, the dataset comprises five main features: Age, Gender, Weight (kg), Hydration Level (L), and Activity Type. These parameters provide personalization while ensuring interpretability.

For instance, age segregates hydration requirements among young adults, middle-aged businesspeople, and elderly professionals, whereas gender adds physiological diversity [6]. Hydration amount (in liters) indicates self-reported everyday intake, and activity type separates sedentary IT professionals from active non-IT workers like healthcare workers and delivery individuals.

age	gender	weight_kg	hydration_l	activity_type
22	F	50.55	1.5	Dancing
34	M	55.38	1.8	Swimming
44	F	56.49	2.7	Swimming
56	M	52.23	2.6	Weight Training
56	F	53.96	1.5	Swimming
59	F	55.56	2.2	HIIT
25	F	53.89	2.8	Weight Training
32	M	55.91	1.6	HIIT
66	M	57.47	3.3	HIIT

Fig. 3.dataset (first 10 rows)

The data consists of 50 rows—enough to be illustrated as diverse without computational expense. For example, a 28-year-old IT employee with 68 kg weight and 0.9 L/day consumption would be labeled underhydrated and recommended ~2.3 L/day, while a 35-year-old delivery crew member with 72 kg weight and 2.5 L/day consumption would be labeled well-hydrated. By embracing the diversity in occupation, HydroAI scales up recommendations well across different lifestyles [1], [2], [4].

B. Code Structure:

The architecture of Hydro AI is modular to ensure clarity, maintainability, and extensibility. As shown in Fig. 4, the codebase is divided into distinct files, each serving a specific function. The app.py file acts as the entry point, managing both manual and dataset modes. When a CSV file containing user hydration data is uploaded, the script computes hydration levels and generates personalized AI responses for each record.

```
HydroAI/
│
├─ app.py               # Main Streamlit application (UI + workflow controller)
├─ utils.py             # Core logic (hydration calculation, prompt generation, AI cal
├─ config.py            # Securely stores the OpenAI API key
├─ requirements.txt     # Lists dependencies (Streamlit, Pandas, OpenAI SDK, Matplotli
└─ health_fitness_dataset_clean.csv  # Trimmed dataset (50 rows, 5 key columns)
```

Fig.4. File Structure

The utils.py module contains the hybrid ML–GenAI logic. Calculate_hydration() estimates hydration requirements, generate_prompt() constructs adaptive GPT prompts based on user information, and get_ai_response() calls the OpenAI API to generate adaptive text-based advice [3], [5]. API keys and other configuration information are securely stored in config.py, while requirements.txt guarantees reproducibility across environments. The modularity of this structure allows for seamless integration with wearable sensors in the future to facilitate ingestion of real-time health information without changing the existing AI pipeline [8]-[10].

C. Hydration Comparison Visualization

The most basic output of HydroAI is the hydration comparison chart, as seen in Fig. 5. This bar chart allows users to compare daily reported intake against the target hydration level. For example, if the user reports intake of 1.10 L while his computed need is 1.71 L, the visualization marks the deficit so easily to read.

OUTPUT:

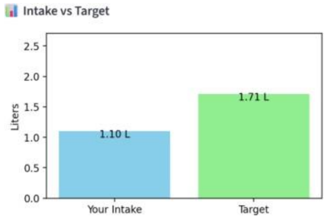

Fig.5. Output

This intuitive graphical feedback is far more effective than tabular numerical values, as it helps users quickly perceive water gaps. Visualization-driven insights have been shown to significantly improve adherence to health recommendations [7], [10]. For example, if an office employee regularly consumes ~1 L/day against a 2.2 L/day goal, Hydro AI's bar chart will consistently display underhydration, motivating better compliance. Alternatively, if a user is overhydrating (e.g., 4 L/day vs. 3 L target), the system can alert overhydration-related risks like electrolyte imbalance.

D. Hydration Dashboard with AI-Powered Recommendations

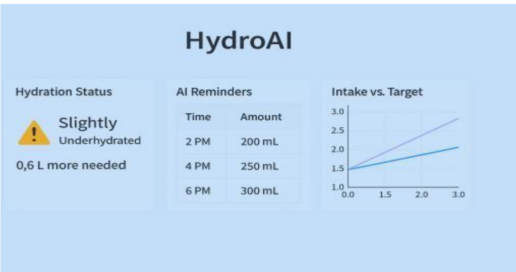

Fig.6. Hydration Monitoring Dashboard

The Hydro AI dashboard (Fig. 6) combines machine learning computation with Generative AI reasoning to provide an interactive and human-friendly user experience. The dashboard consists of three main elements:

Hydration Status Indicator – Offers direct readings such as "Slightly Underhydrated: 0.6 L more needed", minimizing cognitive load for consumers [5].

AI-Based Drinking Schedule – Utilizes GPT-based reasoning to create time-targeted recommendations such as "Drink 200 mL at 2 PM, 250 mL at 4 PM, and 300 mL at 6 PM." Sedentary consumers have evenly spaced intervals to minimize extended inactivity, while active consumers are given context-aware after-activity advice [6], [8].

Intake vs. Target Progress Graph – Illustrates cumulative daily progress, enabling users to re-adjust midday hydration if they drop below target.

Such AI-driven features transform Hydro AI into a smart wellness assistant, merging data precision with customized communication [3], [5], [6].

E. Comparative Feature Analysis

Comparative analysis was performed to benchmark HydroAI against other hydration tools (Fig. 7). Existing systems such as Hydro Sense [1] and AI-Water Track [2] rely primarily on sensor data or manual logs. Although these systems offer water monitoring, they lack AI-based personalization.

Feature	HydroSense [1]	AI-WaterTrack [2]
Hydration Estimation	Sensor-based	Fitness app data
Use of GenAI	✕ No	✕ No
Personalization	Medium	✔ Rul-based ML (weight × 35 m!)
Output Type	Logs + stats	✅ Reminder + charts + tips
Dataset	✕ No	✅ Daily Water Intake

Fig.7. Feature Analysis

Hydro AI's hybrid design bridges this gap by combining ML-based estimation with GenAI-driven reasoning. For example, where Hydro Sense may just log a 0.5 L fall in hydration, Hydro AI puts it into perspective with a relevant comment like "Decreased hydration may result in fatigue and headache; have 250 mL now." Likewise, Hydro AI maximizes the logging facility of AI-Water Track with adaptive suggestions like "You drank less water yesterday afternoon; aim for 300 mL by 4 PM today." Such interactive and context-based suggestions render Hydro AI a highly personalized, conversational, and science-driven hydration assistant [2], [5], [6].

F. System Summary

Summary of HydroAI System Components

Input Module	Descripticion	Technologies
Input Module	Accepts either manual user inputs (age, gender, weight, activity level) or loads pre-cleaned dataset.	Streamlit UI, Pandas Pandas
Iachine Learning	Calculates personalized water intake target using a rule-based prediction model	Pandas, Numpy, Rule-based model
Generative AI	Generates personalized hydration tips and reminder schedules	OpenAI API (GPT models)
Visualization	Displays intake vs. target using bar graph and hydration trend line	Matplotlib, Seaborn
ataset Handling	Pre-processeed clean dataset	Streamlit Components

Fig.8.Summary of Hydro AI

The overall features of Hydro AI, as shown in Fig. 8, highlight its hybrid design and real-world relevance. In contrast to typical hydration calculators that generate fixed targets, Hydro AI combines structured ML-based processing with Generative AI reasoning to generate occupation-sensitive, lifestyle-adapted hydration recommendations.

The database—consisting of 50 varied entries—is both computationally efficient and contextually complete. The provision for both manual entry and batch dataset processing modes enables Hydro AI to act for individuals, corporate wellness programs, and healthcare settings [3], [4], [9].

Hydro AI produces outputs such as hydration status cards, reminder schedules created by AI, motivational messages, and visual analytics in the form of bar and trend-line graphs. For instance, corporate wellness administrators can track hydration trends of IT professionals compared to field staff, creating customizable reports for focused awareness sessions.

Through the synchronization of ML-based accuracy with AI-driven communication, Hydro AI surpasses traditional hydration tracking devices and emerges as an interactive health companion who encourages users through smart engagement and scientifically trustworthy feedback [5], [7], [11].

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