2nd International Conference on IoT and Related Technologies ICIRT 2025

Conference Proceedings Book

ICIRT 2025

ABIDJAN / COTE D'IVOIRE

ICIRT

International Conference on IoT and Related Technologies

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OPENING REMARKS

CONFERENCE GENERAL CHAIR

Professor Souleymane OUMTANAGA

Mr. Director of the Directorate General for Research and Innovation (DGRI), Representative of the Minister of Higher Education and Scientific Research;

Mr. Representative of the Minister of Digital Transition and Digitalization;

Mr. Deputy Director General in charge of Pedagogy at INP-HB;

Mr. Director of the National Computing Center of Côte d'Ivoire;

Ladies and Gentlemen, representatives of companies, universities, and research laboratories; Distinguished guests, honorable participants, Ladies and Gentlemen.

I am deeply honored to address you today on the occasion of the **2025 edition of the International Conference on IoT and Related Technologies (ICIRT)**.

It is worth recalling that today, the Internet of Things, Big Data, and Artificial Intelligence stand as fundamental pillars of our ever-evolving digital society. These technologies are transforming the way we interact with our environment, revolutionizing industries, services, and even lifestyles. This conference reflects that revolution: a privileged space where academics, researchers, experts, and partners meet to exchange ideas, share knowledge, and inspire new collaborations.

Over the next two days, we will have the opportunity to attend **31 scientific communications and 5 poster presentations**, all of high quality. These works will be preceded by an inaugural lecture delivered by **Professor Laurent Toutain**, on the theme: *"The Internet of Things: Challenges and Opportunities for the Sustainable Development Goals"*, followed by another keynote lecture on: *"National Strategy for AI and Data Governance: Implementation in Academic and Research Environments."*

We are gathered here not only as participants in a conference but also as members of a scientific community passionate about exploring the frontiers of knowledge. In this spirit, I encourage you to seize every moment of this meeting to broaden your horizons, build fruitful collaborations, and contribute to shaping a future where IoT, Big Data, and Artificial Intelligence serve as engines of sustainable progress.

Allow me to warmly thank all those who contributed to the success of this event: the dedicated organizers, the researchers who submitted their work, the partners, and the participants. Together, we are building an exceptional platform for knowledge exchange and the development of innovative ideas.

I wish you all a stimulating and enriching conference. May these days be filled with discoveries, inspiration, and fruitful collaborations. Thank you for your presence and for your commitment to advancing digital sciences.

Thank you.

REPRESENTATIVE OF MINISTER OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

Professor Nindjin Charlemagne, Director of Innovation and Knowledge Transfer

Mr. Representative of the Ministry of Digital Transition and Digitalization,
Ladies and Gentlemen, Representatives of Universities and Higher Education Institutions,
Distinguished guests, dear researchers, academics, experts, and partners,

It is a great honor to speak, on behalf of the Minister of Higher Education and Scientific Research, at the opening of the second edition of ICIRT 2025, dedicated to the Internet of Things and related technologies.

I warmly congratulate the Institut National Polytechnique Félix Houphouët-Boigny (INPHB) and its partners for organizing this international event. This conference takes place at a time when IoT, AI, Big Data, 5G, and emerging technologies are profoundly transforming our societies—whether in smart agriculture, healthcare, sustainable cities, cybersecurity, or digital education.

The Ministry reaffirms its commitment to supporting research and innovation by:

- training highly skilled professionals in strategic digital fields;
- fostering collaboration among researchers, engineers, and students;
- and strengthening international partnerships for an open and inclusive science.

We firmly believe that IoT and related technologies are not only drivers of scientific progress but also catalysts for economic, social, and cultural development in Africa. I therefore call on all participants to explore, innovate, and propose concrete solutions, making ICIRT a vibrant platform for cooperation, technology transfer, and innovative start-ups.

As we solemnly open ICIRT 2025, I express the hope that the outcomes of this conference will help shape a competitive, resilient, and inclusive digital Africa.

Long live international scientific cooperation!
Long live ICIRT 2025!
Long live Côte d'Ivoire!

INAUGURAL LECTURE

Lecture 1 : The Internet of Things: Opportunities and Challenges for the Sustainable Development Goals (SDGs)

Speaker : Professor Laurent Toutain, IMT Atlantique, France

Session Chair : Dr Beman Hamidja Kamagaté, Ecole Supérieure Africaine des TIC,(ESATIC), Côte d'Ivoire

Summary

The inaugural lecture by Professor Laurent Toutain highlighted the strategic role of the Internet of Things (IoT) in achieving the Sustainable Development Goals (SDGs) defined by the United Nations.

1. IoT as a lever for the SDGs

Professor Toutain emphasized that IoT is not just a technological revolution but a tool for societal transformation. Smart sensors, communication networks, and data analytics enable:

- more efficient agriculture (SDG 2: Zero Hunger),
- sustainable water management (SDG 6),
- affordable and clean energy through smart grid monitoring (SDG 7),
- sustainable and smart cities (SDG 11),
- and better environmental protection (SDG 13: Climate Action).

2. Challenges to be addressed

Despite its potential, IoT raises major challenges:

- Data governance: ensuring reliability, security, and accessibility;
- Standards and interoperability: avoiding technological silos that hinder innovation;
- Cybersecurity: mitigating risks linked to the proliferation of connected devices;
- Digital divides: ensuring equitable access to infrastructure and skills, particularly in developing countries.

3. Opportunities for Africa and the world

Africa, with its young population, expanding cities, and infrastructure needs, can become a laboratory for IoT innovation through:

- the deployment of low-cost solutions adapted to local realities;
- integration of IoT into academic and research programs;
- collaboration between the private sector, universities, and governments to build a sustainable ecosystem.

4. Conclusion

Professor Toutain concluded that IoT is both a scientific tool and a driver of human development. Its implementation, guided by the SDGs, must be inclusive and responsible. IoT thus represents a historic opportunity to build a more sustainable, resilient, and equitable society.

Lecture 2 : Côte d'Ivoire National AI Strategy and Data Governance: Implementation in Academic and Research Environments

Speaker :
Session chair : Dr Diako Doffou Jerôme, Ecole Supérieure Africaine des TIC,(ESATIC), Côte d'Ivoire

Summary
The conference focused on the vision and concrete actions undertaken by Côte d'Ivoire to integrate Artificial Intelligence (AI) and data governance into its academic and research ecosystems.

1. The National AI Strategy
The representative of the Minister recalled that the National AI Strategy is part of the country's digital transformation plan. It aims to:

- promote technological innovation in key sectors (health, education, agriculture, public administration);
- develop local AI skills through specialized training and applied research;
- foster the responsible and ethical adoption of AI, aligned with international standards and adapted to national realities.

2. Data Governance
It was emphasized that AI cannot develop without strong data governance, ensuring:

- the quality and interoperability of scientific data;
- the security and protection of sensitive data, particularly in academic settings;
- the establishment of reliable digital infrastructures for data collection, storage, and analysis.

3. Implementation in Academia and Research
In higher education and research, implementation translates into:

- the creation of laboratories and research centers in AI and Data Science;
- strengthening university–industry–government partnerships for collaborative projects;
- progressively integrating AI and Data Science into academic curricula to train a new generation of researchers and engineers;
- promoting open scientific data, to encourage knowledge sharing and international cooperation.

4. Conclusion
The representative concluded by reaffirming that the success of this strategy depends on the collective commitment of academic institutions, researchers, students, and private sector stakeholders. Côte d'Ivoire aims to become a regional leader in AI and data governance, serving sustainable development and digital inclusion.

LIST OF OBSTRACTS

paper presentation session

Kpatchaa Tombana BABA

Transfer Learning Approach for Photovoltaic Power Prediction Using External IoT Data in a Data-Scarce Context

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Abstract

Photovoltaic (PV) systems are a key source of renewable energy, but their operational efficiency heavily depends on the accuracy of solar energy production forecasts. The lack of historical data in new installations significantly complicates this task, leading to important practical consequences such as poor battery management, under- or overestimation of installed capacity, or even economic losses due to suboptimal energy planning. This raises a central research question: How can the accuracy of photovoltaic production forecasts be improved in data-scarce contexts by leveraging IoT technologies and transfer learning?

The Internet of Things (IoT) offers potential solutions by enabling real-time data collection via sensors installed at production sites. This study proposes an innovative approach using IoT combined with transfer learning, a technique that allows a model already trained on a data-rich site to be adapted to a new site with limited data [1].

The overall objective of this work is to demonstrate the effectiveness of transfer learning when applied to solar production forecasting in data-limited contexts [2]. To achieve this, several specific objectives have been defined:

- Develop a forecasting model based on recurrent neural networks (LSTM and GRU) using a rich dataset (Base 1).
- Transfer this model to a site with limited data (Base 2) and optimize its performance through a fine-tuning process [4].
- Evaluate the climatic compatibility between the two sites through a comparative analysis of weather conditions.
- Measure model performance using standard indicators such as RMSE and MAE.

The methodology followed consists of several clearly defined steps. First, the data collected via IoT sensors were preprocessed (cleaning, normalization, handling of missing values). Then, a GRU model and an LSTM model were trained on Base 1, which is rich in data (more than three years of multidimensional measurements), by performing a rigorous hyperparameter selection using cross-validation [3][5]. A comparative analysis of climatic characteristics (temperature, solar radiation, etc.) between Base 1 and Base 2 then made it possible to evaluate the relevance of the transfer. The pre-trained model was transferred to Base 2 (which has only six days of meteorological data), then fine-tuned [4]. This consisted of freezing certain encoding layers of the network and retraining the upper layers on the new data, with a limited number of epochs to avoid overfitting.

The performance of the models was evaluated on Base 2. With transfer learning, the GRU model achieved an RMSE of 15.61, an MSE of 243.93, and an MAE of 6.54, compared to 26.09, 680.88, and 9.91 without transfer; the LSTM model also improved its results (RMSE of 24.93 vs. 26.03, MAE of 10.38 vs. 10.35), but to a lesser extent than the GRU. It can be observed that non-transferred LSTM or GRU models showed a significant loss of accuracy, highlighting the benefit of knowledge transfer.

A more detailed error analysis shows that performance remains stable even under varying weather conditions, although some deviations are observed during unexpected radiation peaks, suggesting sensitivity to extreme events. The generalization of the model to other sites seems promising, provided that the climate profiles do not differ significantly. However, some limitations remain: transfer effectiveness may decrease in the case of climatically very different sites, or when the observation duration of the target site is even shorter than six days.

These results suggest that transfer learning, combined with IoT data, is an effective method for predicting solar energy production at sites with limited data. This approach opens promising perspectives for optimizing solar

production forecasts, especially for new installations or those with restricted access to historical data. By integrating IoT into this framework, this study highlights how modern technologies can enhance the efficiency of photovoltaic systems by making forecasting more accurate and more accessible.

Acknowledgements

The authors gratefully acknowledge the support of the Regional Center of Excellence for Power Management (CERME) at the University of Lomé, which made this research possible.

Key-Words
Transfer Learning; IoT ; Neural Networks; Photovoltaic Panels; Fine-Tuning

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Bobet Goualo Victorien

AirDL Data Architecture for Air Quality

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Abstract

Air quality data is collected through measurement stations. The organization of this data facilitates its effective processing. Indeed, poor organization exposes us to bias in health decision-making. Thus, we propose a solution through the development of a big data architecture for collecting air quality data with a view to future anomaly detection analysis. To achieve this result, we present a state-of-the-art review of big data architectures for data collection in general and more specifically for air quality data and subsequently propose a new architecture for efficient collection. At the end of our approach, we obtain optimal architecture for collecting air quality data.

Keywords: data, Internet of Things (IoT), air quality, big data architecture.

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Bodjré Aka Hugues Félix

Lightweight IDS System for Edge IoT: Zero-Day Anomaly Detection using LSTM and Autoencode

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Abstract

The rapid expansion of the Internet of Things (IoT) and Edge Computing in critical sectors such as Industry 4.0, healthcare, and energy presents significant cybersecurity challenges. These distributed and low-resource environments are highly exposed to Zero-Day attacks, which are difficult to detect using traditional signature-based Intrusion Detection Systems (IDS). For instance, a hacked health sensor may send false data without triggering alerts in legacy systems.
To tackle these issues, we propose a **hybrid IDS model** combining **Long Short-Term Memory (LSTM)** networks for temporal analysis and **unsupervised autoencoders** for reconstructing normal network traffic and detecting anomalies. Unlike classical systems, our model requires no labeled data and is optimized for **embedded devices** such as the **Raspberry Pi**, ensuring compatibility with Edge-IoT environments.
The solution aims to (1) autonomously detect unknown threats and (2) deliver high accuracy with low latency and resource consumption.
The system was tested on **TON_IoT** and **NSL-KDD** datasets, showing **over 95% accuracy**, **detection in under 1.1s**, and **low resource use (<40% CPU, <200MB RAM)**.
Our IDS outperforms Snort, CNN, and Random Forest across these metrics. It also offers **self-learning mechanisms** and **adaptive thresholding** to cope with changing network behavior. Despite these strengths, the system faces limitations like threshold sensitivity and the absence of real-time reactive features.
Future work includes integrating **blockchain-based logging**, **dynamic firewalls**, and **smart contracts** to improve security, traceability, and automatic mitigation in critical infrastructure.

Keywords : *IoT, Edge Computing, IDS, LSTM;*

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BOMISSO Gossrin Jean-Marc

Prediction of the vibrational energy decay rate in piezoelectric beams for smart infrastructures using a hybrid FEM–PINNs method

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Abstract

Smart infrastructures and IoT systems require mechanical components that can adapt to disturbances in real time while consuming minimal energy. This challenge arises in applications such as smart bridges, earthquake-resistant buildings, and wind turbines. In these systems, vibration monitoring, early anomaly detection, and adaptive control are essential for safety and long-term performance.

This study focuses on the relationship between control parameters and key dynamic indicators, such as the optimal energy decay rate and the spectral asymptote [2], for a piezoelectric Euler–Bernoulli beam. We generate a dataset using the Finite Element Method (FEM) [1], which links control inputs to the system's vibrational response. These results are then used to train a Physics-Informed Neural Network (PINN) [3], which learns to approximate this relationship efficiently. This original combination of FEM and PINNs [1, 4] eliminates the need for exhaustive parameter sweeps.

The PINN is trained using a loss function explicitly designed to incorporate the system's differential equations and boundary conditions, in accordance with the Physics-Informed approach. It employs the hyperbolic tangent (tanh) activation function and a symmetric four-layer architecture (e.g., 64-128-128-64) to ensure stable learning. A k-fold cross-validation across multiple configurations confirmed the model's reliability and robustness. Once trained, the PINN predicts the optimal energy decay rate in less than a second, with negligible dependence on hardware performance. In contrast, a full FEM simulation including spectral analysis may take several minutes depending on the model's complexity and machine specifications. Prediction accuracy was assessed using the Root Mean Square Error (RMSE), demonstrating strong generalization to unseen test cases.

This approach enables rapid evaluation of control strategies, making it highly suitable for the design phase of smart infrastructures. It allows engineers to explore parameter combinations efficiently, improve vibration damping, and ensure dynamic stability at early stages of system development. Future extensions will include nonlinear dynamic effects and broader structural configurations.

Keywords: *Piezoelectric beam; Smart structures; Finite Element Method; Physics-Informed Neural Networks; Energy dissipation.*

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CAMARA Amara

Integration of Artificial Intelligence in Child Nutrition Monitoring: Towards Smart Solutions to Combat Malnutrition.

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Abstract:
Child malnutrition represents a major structural challenge in many African countries, particularly in low-resource rural areas. Traditional nutritional monitoring tools show their limitations in terms of responsiveness, accuracy, and coverage. In this context, the present communication explores an innovative technological approach currently being designed at the *Centre de Recherche en Informatique et Cyber-Technologie (CRICT)*: an intelligent mobile application called NutriKids.
This solution will integrate connected devices for real-time data collection, combined with an artificial intelligence–based analysis engine. The objective is to provide a decision-support system for community health workers, parents, and health authorities, enabling early detection of malnutrition cases and rapid orientation of interventions. This communication will present the functional architecture under development, the technological choices, the envisioned use cases, as well as the expected outcomes of a pilot phase planned in rural Guinea. It is part of a proactive approach to leveraging Industry 4.0 to address child public health challenges in Africa.
Keywords: Artificial Intelligence; Child Health; Malnutrition; Social Innovation; Connected Health.

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Amadou DIABAGATE

Information system security: proposal of an intelligent agent for malicious pdf file detection

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Abstract

Information systems have become essential for the proper functioning of companies and institutions around the world. Their ubiquity is evident in all professional sectors: universities, banks, insurance companies, industry, and even the military domain [1]. However, this growing reliance on information systems is not without risk. The data managed by these systems represent valuable and coveted resources, often vulnerable to attacks [2]. In light of these challenges, detecting and preventing malicious activities has become a top priority in the management of information systems [3].

With cyberattacks becoming increasingly sophisticated and complex, cybersecurity experts are constantly seeking new strategies to proactively detect, prevent, and counter these threats. In this context, artificial intelligence (AI), through techniques such as machine learning, offers the ability to analyze large volumes of data in real time, detect abnormal patterns or behaviors, and even predict attacks before they occur [4]. This convergence between cybersecurity and artificial intelligence opens new perspectives in protecting digital infrastructures. It allows for the development of more robust solutions, capable not only of rapidly detecting potential threats but also of providing a swift and effective response to incidents [5].

This work focuses specifically on the application of machine learning methods (random forests, SVM, decision trees, XGboost, neural network and naïve bayes) to intrusion detection in PDF files—a commonly used format that can be exploited to spread malware. It contributes to the design of an intelligent agent for the detection of malicious PDF files in order to strengthen information system security. To achieve this, the best-performing machine learning method will be used to build an intelligent agent that collaborates with other agents within a multi-agent module for detecting malicious PDF files.

Keywords: Cybersecurity; malicious PDF files; machine learning; intelligent agent; information system

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Moustapha Diaby

Machine Learning Approach for Solving CVRP

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Abstract

The Capacitated Vehicle Routing Problem (CVRP) is a critical challenge in logistics optimization, with significant applications in IoT networks for smart fleet management and connected delivery systems. The CVRP aims to design efficient routes for a fleet of vehicles from a single depot, respecting capacity constraints while minimizing the total distance traveled [1]. Traditional approaches, such as the Clarke & Wright heuristic [2], provide fast solutions but lack geographic optimality, while modern metaheuristics, like tabu search [3], are computationally intensive. In the IoT context, where real-time data and dynamic constraints are prevalent, efficient and adaptive algorithms are essential for optimizing logistics operations.

We propose a hybrid approach combining adaptive K-means clustering with the Clarke & Wright savings algorithm. K-means partitions customers into geographic clusters by minimizing intra-cluster variance, defined as:

$$J=\sum_{k=1}^{K}\sum_{i\in Ck}||\ (Xi,Yi)-\mu_k||^2$$

where (x_i, y_i) are customer coordinates and μ_k is the centroid of cluster k. The initial number of clusters K_0 is estimated as $K_0 = \lceil(\sum_{i=1}^{N} di)/Q\rceil$, where d_i is the demand of customer i and **Q** is the vehicle capacity. If any cluster exceeds **Q**, **K** is incremented, and K-means is rerun until all clusters satisfy the capacity constraint. This dynamic adaptation distinguishes our method from fixed-cluster approaches [4]. Subsequently, Clarke & Wright optimizes intra-cluster routes by maximizing savings $S_{ij} = d_{0i} + d_{0j} - d_{ij}$, where d_{ij} is the Euclidean distance.

The approach was implemented in Python 3.9 and tested on Solomon's instances (C101, C102, R101, RC101), each with 100 customers and Q = 200. For C101, the method generates 10 clusters (10 vehicles) with a total distance of 836.50 units, achieving a 1.1% gap from the best-known solution (827.23 units) [5]. For C102, a similar distance (836.50 units) is obtained with 10 vehicles. In contrast, R101 yields 1261.62 units with 16 vehicles and RC101 1205.16 units with 13 vehicles, compared to 1645.79 units (19 vehicles) for R101 and 1691.11 units (14 vehicles) for RC101 in benchmarks [5,6]. These discrepancies suggest intra-cluster over-optimization, likely due to the uniform (R101) or mixed (RC101) geographic distribution of customers.

The method excels on clustered instances like C101 and C102, leveraging adaptive clustering efficiency with reduced complexity ($O(n_k^2)$ per cluster vs. $O(N^2)$ globally). The runtime, approximately 3 seconds on an Intel Core i7 with 16 GB RAM, is significantly lower than exact methods like Branch-and-Cut (180 minutes) [5], making it suitable for IoT applications requiring rapid computations. For dispersed instances, the lack of inter-cluster optimization limits performance. In an IoT context, where sensors provide dynamic demand and location data, our algorithm could be integrated into fleet management systems to optimize real-time deliveries.

Results on C101 and C102 validate the method's ability to produce near-optimal solutions with high computational efficiency. Deviations on R101 and RC101 highlight the need to validate assumptions (e.g., Euclidean distances, absence of time windows). Compared to metaheuristics like HGSADC or LNS [5,6], our approach is faster but less accurate on non-clustered instances. Future improvements could involve hybridization with metaheuristics, such as evolutionary algorithms [7], or reinforcement learning [8] to handle dispersed instances and incorporate time windows or multi-depot constraints [9].

Acknowledgements: The authors thank the Institut National Polytechnique Félix Houphouët-Boigny for providing computational resources.

Keywords: CVRP; K-means; Clarke & Wright; Adaptive clustering; Logistics optimization

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Jerome Diako

Intelligent anomaly detection in IOT using XLNet: a Transformer-explainable approach

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The rapid proliferation of Internet of Things (IoT) devices has brought undeniable benefits, but it also opens the door to increasingly sophisticated cyber threats. To address the security challenges of these dynamic environments, there is a growing need for intelligent, adaptive, and interpretable anomaly detection systems. This research introduces a novel approach leveraging XLNet, a Transformer-based model originally designed for natural language processing, to detect abnormal behaviours within IoT data streams. Our method exploits XLNet's capacity to model complex temporal dependencies in sequential data, making it well-suited for identifying subtle anomalies across multivariate IoT signals. To enhance the trust and transparency of the system, we incorporate explainability mechanisms, including attention analysis and SHAP-based explanations, allowing for deeper insights into the model's decision-making process. Empirical evaluations conducted on publicly available IoT intrusion datasets demonstrate that the proposed approach significantly outperforms traditional machine learning models such as SVM, LSTM, and Random Forest, while also providing interpretable outputs. The findings highlight the potential of combining advanced Transformers with explainable AI to build robust and accountable cybersecurity solutions for the IoT ecosystem.

Keywords : IoT, XLNet, Détection d'anomalies, Transformers, Explainable AI

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Diomande Siaho

Modeling with Recurrent Neural Networks (RNN) the Joint Evolution of Molds, Insects, Moisture Content and Sugar Content during Cocoa Bean Storage

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Abstract

The storage of cocoa beans in tropical climates presents significant challenges, particularly due to the proliferation of insects and the development of mold, which can compromise the quality and market value of the product. This study proposes an artificial intelligence-based predictive approach using Recurrent Neural Networks (RNNs) to model the evolution of four critical parameters during storage: insect infestation, mold growth, moisture content, and sugar content. Inspired by the work of Diomandé Siaho on insect prediction using AI, this research extends the modeling framework to a multitask context where all four parameters are predicted simultaneously. The hybrid nature of the approach combines temporal dynamics with multiple correlated outputs, offering an innovative tool to anticipate post-harvest risks. The results could inform better storage management strategies and contribute to reducing post-harvest losses in the cocoa value chain

Keywords: *cocoa; storage; mold; insects; recurrent neural networks.*

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Securing IoT networks with Blockchain technology

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Abstract

The Internet of Things (**IoT**) and blockchain are among the major technological advances of our time. IoT consists of connecting physical devices to each other and to the internet in order to facilitate the transmission of information. However, the rise of IoT networks is exposing billions of devices to increasing threats, amplifying attack surfaces and compromising data security. The lack of unified standards leads to critical vulnerabilities, increasing the vulnerability of critical infrastructure to cyberattacks. Without robust solutions, these vulnerabilities could disrupt vital systems ranging from healthcare to smart cities to logistics, jeopardizing the confidentiality and integrity of sensitive data.

This research aims to explore how the integration of blockchain into IoT networks can strengthen their security, reducing vulnerabilities related to the expansion of attack surfaces and lack of standardization. By highlighting the mechanisms of decentralization and traceability specific to the blockchain, we seek to provide solutions adapted to the security challenges of IoT infrastructures.

Our presentation will provide an analysis of vulnerabilities in the case of cyberattacks, compare existing blockchain solutions integrated with IoT networks and present the major challenges related to the implementation of new technological solutions.

Keywords: *IoT, Blockchain, security*.

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Eba Victoire. Kié

Securing IoMT systems using Artificial Intelligence

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The evolution of Health 4.0 has enabled the integration of the Internet of Medical Things (IoMT) into psychiatric care, allowing real-time monitoring of both clinical and behavioral parameters. However, the highly sensitive nature of mental health data such as PHQ-9 and GAD-7 scores exposes IoMT systems to critical threats, including unauthorized access, data tampering, insider attacks, and device spoofing [1].

This paper proposes an intelligent cybersecurity architecture specifically designed for psychiatric IoMT systems. The framework incorporates anomaly detection, multi-factor authentication, and automated threat response mechanisms powered by artificial intelligence. A Random Forest model is trained on a synthetic dataset simulating psychiatric patient data, combining biometric variables, clinical scores, and network traffic metrics [2].

The objective is to improve detection accuracy, minimize response time, and ensure secure access to sensitive data. Experimental results demonstrate a detection accuracy of 96.8%, recall of 95.5%, F1-score of 95.9%, with an average response time of 1.3 seconds and a false positive rate of 2.8%. These outcomes highlight the effectiveness of the proposed solution for deployment in connected hospital environments [3][4].

Keywords: Health 4.0; Cybersecurity; Artificial Intelligence; Psychiatry; Anomaly Detection

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Douatia Koné

Inteligent modelling of FSO links for smart cities using Physics-informed neural network (PINNs)

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Abstract

In the context of Smart Cities, Free Space Optics (FSO) presents a promising solution for delivering high-speed, interference-free wireless communication for Internet of Things (IoT) infrastructures. However, traditional statistical or empirical models often fall short in capturing the complex and dynamic urban conditions affecting FSO performance. This work investigates the use of Physics-Informed Neural Networks (PINNs) to model and optimize FSO links in smart urban environments. The main goal is to develop a simulation-based proof of concept that demonstrates the predictive capabilities of PINNs in urban FSO contexts. By embedding physical laws specifically the Helmholtz wave equation for optical propagation and the Beer-Lambert law for atmospheric attenuation into the neural network training process, PINNs enable enhanced predictive accuracy and generalization. The proposed model employs a feed-forward architecture with nonlinear activation functions (e.g., tanh), and is trained on simulated data reflecting urban disturbances such as fog density, vibrations, and pollution levels. Evaluation relies on metrics including Mean Squared Error, Bit Error Rate, and Signal-to-Noise Ratio. Comparative analysis with classical models demonstrates the advantages of PINNs in terms of robustness, interpretability, and reduced data dependency. Application scenarios in smart traffic systems and environmental monitoring illustrate the practical potential of this approach for self-adaptive, intelligent FSO links in future urban IoT networks.

Keywords: Free Space Optics (FSO), Internet of Things (IoT), Physics-Informed Neural Networks (PINNs), Channel Modeling.

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Charlemagne NDiffon. Kopoin

Development of a transform model for early detection of Swollen Shoot disease in cocoa plantations

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Cocoa Swollen Shoot Disease (CSSVD), caused by a virus transmitted by mealybugs, is one of the main threats to cocoa production in West Africa, particularly in Côte d'Ivoire, the world's leading producer with over 40% of global supply. This pathology causes a characteristic swelling of the twigs, a significant reduction in the yield of plantations and, eventually, the death of infected trees. Traditional control methods, such as felling infected plants, are proving costly and ineffective, especially due to the difficulty of early detection. Faced with these limitations, this article proposes an innovative approach based on Transformer-type deep learning models, in particular the Vision Transformer (ViT) for image processing, and BERT for the analysis of vector and text data from farmers' observation reports. We used a dataset consisting of 3000 images of cocoa leaves taken on a farm and other images from Kaggle. Experimental results reveal that the proposed model achieves an accuracy of 92.3%, demonstrating a significant improvement over conventional CNN-based approach. The model not only enables earlier detection of CSSVD outbreaks, but also more accurate modelling of its spatial and temporal spread.

Keywords: *Deep learning; smart agriculture; Transformer; Vision Transformer.*

Kouamé Appoh

Plant icons sketches via a web platform and specific iconems and icons recognition within generated plant-based remedy icon : ontoMEDTRAD's case

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Abstract

Since 1978 at Alma-Ata, WHO Directorate-General initiative [1] encourages traditional Medicines (TM) integration into developing countries national health care system. China had already anticipated this integration to steadily reinforcing it by university-level courses [2]. In west Africa, TM is still tacit despite of governments's efforts to integrate it with western medicine. TM schools are almost non-existent. TM practitioners (TMP), most part being illiterate, exercise in regional environment of proven multilingualism (over 1,100 local languages), and keep secretly TM knowledge. Their associations are for themselves assistance and dialogue with (non or governmental) structures. TM Knowledge is passed on usually orally through lineage, gratitude and innateness. Consequently, how can iconic language and ontological structuring that we propose, enable more accessible and sustainable preservation and sharing of TM knowledge within West African TMPs community? Our aim is to gradually and meticulously provide open framework based on ontoMEDTRAD [3] for TMPs, to exchange on TM knowledge. ontoMEDTRAD, a west african TM ontology, consists of ontoCONCEPT-Term and ontoICONE which are respectively terminological, and both terminological and iconic. Being iconization result, iconic language is one of essential tools TMPs need to overcome language barriers and their illiteracy. Starting on antimalarial medicinal plants, this ongoing iconization continues on plant-based remedies. WEKA (Machine Lear.) and ontologies Python library (PL) OwlReady 2, are capital in such process [3]. We generate icons for appropriate ontoMEDTRAD's concepts progressively and incrementally. On the basis of the above and in this paper, we've built this exchange framework part notably the web platform back-end for producing plant icons sketches with flexibility. Conjointly to PL, WSGI -Werkzeug is used. Secondary to this specific objective, we've attempted to recognize, in a generated plant-based remedy icon, the iconems and other icons used to its construction. 100% iconic language intelligible by computer means obtaining an icon by the sole compositional aggregation of iconems (signifying units denoting forms of concept's individuals). Such icons process is difficult, even impossible, due of fundamentally terminological nature of the computer languages, starting with binary. Icon is ultimately be obtained from iconems compositional assembly with procedural attachment. OWL (extending RDF/S), particular description logic, is well devoted to ontoCONCEPT-Term. ontoICONE's terminology being in sharing with ontoCONCEPT-Term, it results that, semantic intelligibility and inferential reasoning by computer, proper to ontoCONCEPT-Term, are induced on ontoICONE and then deported on this iconic language.

Keywords : *ontoMEDTRAD, ontology, iconic language, web exchange platform, west Africa TM*

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Grâce Yénin Edwige JOHNSON

From formulation to generation: the pedagogical impact of student prompts on the quality of code produced by ChatGPT in object-oriented Java

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The rise of generative artificial intelligence tools such as ChatGPT is transforming teaching practices in programming [1], [2]. These models enable the generation of software solutions from simple text instructions, but few studies have analyzed the impact of student-written prompts on the quality of the generated code [3], [4]. This research analyzes how second-year students in Systèmes Informatiques et Génie Logiciel (SIGL) formulate prompts to solve exercises in Java, and proposes concrete pedagogical recommendations, such as setting up prompt engineering workshops, integrating prompt evaluation grids, and using automated code analysis tools [2], [3]. Thirteen students participated in the experiment: a preliminary questionnaire was used to assess their familiarity with ChatGPT, followed by two exercises: one on library management (with minimal constraints) and one on a student management system (without instructions). The prompts and codes generated were evaluated according to clarity, OOP structuring, modularity, functional relevance (JUnit), and stylistic conformity (Checkstyle and SonarQube) [4]. The analysis reveals that the code produced, although organized into separate classes, remains rudimentary, with low modularity, little error handling, and no unit tests or fundamental SOLID principles. These shortcomings can be explained by prompts that are often directive and not very explicit ("Give me the complete code"), favoring turnkey solutions without pedagogical reasoning or an incremental approach [5]. These results confirm that the ability to write precise and structured prompts is an essential skill to develop in software engineering training. Although exploratory, this study opens up prospects for future research on other languages and educational contexts.

Keywords: Prompt Engineering; Java Programming; AI-Assisted Education; Automated Code Analysis; Code Generation.

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Lagasane Ouattara. Kra

Contribution of Artificial Intelligence in the Optimization of Energy Consumption in Modern Networks (CAIOECMN)

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The exponential growth of digital infrastructures and connected objects leads to an increasingly variable to anticipate energy demand. Indeed, in 2023, smart buildings represented nearly 20% of total energy consumption in urban areas [1], which underlines the urgency of optimized management. Optimizing energy consumption is therefore becoming a major concern. Thus, how can artificial intelligence (AI)-based methods improve real-time optimization of energy consumption in smart grids? The main objective of this study is to explore and demonstrate how artificial intelligence techniques can optimize energy consumption in modern grids. Specifically, it consists of (1) Analyzing and comparing current AI methods applied to energy management, (2) Evaluating their ability to predict energy demand and adjust distribution in real time and (3) Identifying challenges related to implementation in smart grids.

To achieve these goals, real-time consumption data from IoT sensors will be collected and pre-processed and several AI models will be tested, including multi-layer neural networks (MLP) and recurrent networks (LSTM) including data security, infrastructure compatibility and model robustness [2].

Initial experiments show a 25% improvement in the accuracy of energy demand forecasting compared to conventional methods, as well as a 15% reduction in energy losses during distribution. AI models are proving more adaptable to sudden fluctuations in consumption, reducing service interruptions. However, limitations remain, due to the need for large amounts of quality data, high implementation costs and the complexity of interoperability between different energy systems [3].

Keywords: *Artificial Intelligence; Smart Grid; Energy Optimization; Neural Networks; IoT.*

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KROU Iparbè

Convolutional Neural Networks and Model Predictive Control for Active Power Forecasting in The Blitta Solar Photovoltaic Power Plant in Togo Using Meteorological Variables

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Taking into account forecasting work carried out using computer tools, and more specifically IoT, allows new technologies to evolve faster than expected. The challenges related to forecasting the production of primary renewable energies injected into the national grid are multiple, among which we can cite voltage stability, energy quality, reduction of power losses, profitability, etc. Indeed, we have found that, until now, the active power obtained in the Blitta photovoltaic solar power plant is random, which complicates the injection of electricity into the national grid and, consequently, its management. This Communication presents the results of the forecast of the active power to be produced in the Blitta photovoltaic solar power plant in Togo. The target variables such as: direct irradiation, diffuse irradiation, wind speed, ambient temperature, relative humidity, are collected in the power plant at one-hour intervals, from 6 a.m. to 5 p.m. With 8,294 data per variable, we had to process a total of 41,470 samples from 2022 to 2023. This constitutes the material used. A statistical analysis is carried out on each variable. Convolutional Neural Networks and Model Predictive Control were used as methods to create the models. These models are subjected to some performance evaluation metrics. The results of the statistical analysis show that active power has a very weak correlation with wind speed: 10.3% but remarkable with direct irradiation (80.8%) and 74.2% with diffuse irradiation. For modeling, the two algorithms present identical metric results, quite efficient. The best results are obtained with either convolutional neural networks or Model Predictive Control. They give: MAE = 4.30, MSE = 38.36, RMSE = 6.19, RRMSE = 35.49%, R^2 = 76.43% with the ABCE configuration. The poor results are obtained with the CDE configuration by both algorithms. They are also identical and give: MAE = 7.71, MSE = 88.21, RMSE = 9.39, RRMSE = 53.82, % R^2 = 45.80%. We conclude that the modeling is very good from the parameters considered. However, taking into account other models is necessary for optimization without forgetting the integration of other meteorological variables for the resumption of work.

Keywords: *Convolutional Neural Networks; Model Predictive Control; Forecasting; Meteorological Variables; Solar Photovoltaic.*

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N'Takpe N'guessan. Christian Placide

Gateway Energy Aware Protocol for LoRaWAN

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Abstract

The Long Range Wide Area Network (LoRaWAN) is a promising low-power, low-bandwidth (LPWAN) technology in the context of the Internet of Things (IoT), attracting growing research interest. Due to the limited energy resources of network components, designing energy-efficient communication protocols is essential to prolong the lifetime of LoRaWAN networks. However, most protocols proposed in the literature focus on optimizing the energy efficiency of end devices, assuming that gateways are grid-powered. Yet, in critical scenarios such as precision agriculture, wildlife monitoring, or remote area management, gateways cannot easily be connected to a stable power source nor regularly recharged or replaced. In such cases, the network's lifetime also depends on that of the gateways themselves.To address this issue, we propose GEAP (Gateway Energy Aware Protocol), a dynamic energy-efficient communication protocol designed to extend the network's lifetime by accounting for gateway energy consumption in LoRaWAN networks. GEAP selects the gateway with the highest remaining energy to transmit downlink messages when one of the gateways reaches a critical energy threshold. An algorithm is provided along with an implementation using the NS3 simulator.The scenario we propose assumes that each gateway starts the simulation with a different energy level 80% for the first and 20% for the second. In this scenario, the results show that using GEAP enables a more balanced distribution of overall network energy consumption, leading to a 5% increase in network lifetime compared to the standard protocol, which relies solely on signal strength. Network lifetime is evaluated by comparing the minimum residual energy level of the gateways at the end of the simulation. The simulation parameters are described in the table below.

Paramètre	Valeur	Paramètre	Valeur
Niveau de Batterie	20%-100%	Capacité de la batterie	90Wh
Débit de transmission	1paquets/30 minutes	Durée de la simulation	24h

Keywords: *IoT, LoRaWan, Energy, gateway.*

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Adjo Christelle OGO

Electricity Production from Cocoa Pods through Gasification: Performance Analysis of the CCS-180 System

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Abstract
Côte d'Ivoire, the world's leading cocoa producer, generates each year large volumes of unutilized cocoa pods, with a significant environmental impact. This study assesses the techno-economic feasibility of their energy recovery through gasification, using the CCS-180 system, a downdraft gasifier with a capacity of 180 kWe, designed to operate efficiently in sparsely electrified rural contexts.
The experiments used dried pods (moisture < 12%, LHV > 24 MJ/kg). The system shows a specific consumption of 1.5 kg/kWh, with an overall electrical efficiency of 26.7% (excluding auxiliaries < 15%). It enables the production of approximately 666 kWh per ton of pods. The syngas is purified in three stages (cyclone separation, cooling, scrubbing), ensuring a tar content < 100 mg/Nm³, compatible with internal combustion engines.
The co-production of biochar (350–400 kg/ton) allows sequestration of up to 963 kg of CO_2. Rich in fixed carbon, potassium, and calcium, this biochar improves soil structure, with tests showing an 18–25% increase in vegetable crop yields.
From an economic perspective, the levelized cost of electricity (LCOE) ranges between 65 and 85 FCFA/kWh, with a payback period of 4 to 5 years, combining electricity sales and agronomic valorization of biochar. Finally, this solution aligns with Ivorian rural electrification programs (PEPT, PRONER) and is well suited for agricultural areas with high residue potential such as Tonkpi, Guémon, or Bas-Sassandra, offering a robust, replicable, and sustainable technological solution for rural territories in West Africa.
Keywords: Gasification; Cocoa Pods; Bioenergy; CCS-180; Sustainable Electricity.

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Ghislain Pandry

Noised image filtering based on physics-informed neural networks and jeffreys-type equation

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Preserving information contained in images remains an open and crucial problem in the field of image processing. Many works have proposed various approaches to provide effective solutions. Among these, methods based on Partial Differential Equations (PDEs) remain particularly effective in filtering and preserving the intrinsic structures of images [1]. Moreover, the recent advent of neural networks has opened new perspectives for solving problems associated with PDEs. Thus, Physics-Informed Neural Networks (PINNs)[2], a specific class of deep learning neural networks, explicitly integrate the physical constraints imposed by PDEs into the learning process. In this study, we propose an original approach named PINN-ETJ, which combines the principles of classical diffusion methods with the advantages of neural networks. This combination allows to significantly improve the preservation of structural information of degraded images. Furthermore, the PINN-ETJ method demonstrates increased robustness against different types of noise as well as remarkable generalization capacity on images not observed during the learning phase.

Keywords: *Machine Learning, filtering, Diffusion, EDP, PINN.*

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Tidiane Sylla

An Edge Online Federated Learning and IoT Based Solution for High Precision Smart Agriculture

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Agriculture is a crucial sector that plays a vital role in human beings feeding. Due to climate change and conflicts, many countries in the West Africa region suffer from food insecurity. Moreover, the population growth put supplementary pressure on the governments, farmers, and the existing agricultural ecosystem to increase production [1]. Despite the challenges posed by climate change-induced extreme weather, technologies like IoT and Artificial Intelligence (AI) can help counteract these phenomena and improve productivity [2]. AI, fed with real-time climate and soil data from IoT sensors, can precisely predict crop requirements for water and fertilizers (like NPK) [2]. Currently, training and deploying these AI models often necessitate costly cloud systems (AWS, GCP, Azure, etc.), demanding significant energy, bandwidth, and fees. Moving AI processing to the edge, however, lessens reliance on the cloud and aligns with Sustainable Development Goals (SDGs) [3]. As the climate and soil variables change over time and region, the models deployed on edge servers must be regularly updated. We propose a Federated Learning (FL) training network with farms Edge servers. Indeed, a key strength of FL in this context is its ability to process data locally by deploying the model directly to the data source [4]. This reduces the bottleneck in data transmission needed for model updates. In Sahelian countries, there are different climatic variations across areas. Thus, a general model for all areas could be inefficient. That is why we introduce in this paper area-based learning federation in order to have an area-specialized model and so a high efficiency by area. This approach not only enhances the accuracy of prediction but also allows to face the climatic challenge of each regions, and for higher crops yield.

This work was supported by the TWAS-UNESCO SG-NAPI under no. FR3240330996.

Keywords*: AI ; IoT ; Smart Agriculture ; Edge Computing ; Federated Learning.*

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Adlès Francis Kouassi

Advanced Diabetes Prediction: Synergy between ExtraTreesClassifier and KNN within an Optimized Ensemble Architecture

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Abstract
In this communication, we present an innovative approach for diabetes prediction, based on three main methodological pillars: contextual data preprocessing, advanced class balancing using the SMOTEENN method, and thorough Bayesian optimization of hyperparameters. Building on this solid foundation, we designed an ensemble architecture that strategically combines the ExtraTreesClassifier (ETC) and the k-Nearest Neighbors (KNN) algorithm within a weighted voting system.

Through optimization performed with Optuna, we identified the optimal configurations for each model, thereby maximizing their complementarity and performance. The results confirm the effectiveness of this hybrid approach, with performance clearly surpassing that of the individual models. Specifically, the system achieved an accuracy of 96.43%, a precision of 98.41%, a recall of 95.38%, an F1-score of 96.88%, and an area under the ROC curve (AUC) of 99.41%. Comparative analysis highlights the strategic complementarity of the two models: ETC stands out for its exceptional precision (98.39%) and remarkable discriminative ability (AUC-ROC: 99.80%), while KNN excels in recall, thus capturing more positive cases.

This hybridization of models provides an optimal balance between precision and sensitivity—two essential criteria for diabetes screening, where each diagnostic error can have significant consequences.

Keywords: Machine Learning; Diabetes Prediction; Bayesian Optimization; ExtraTreesClassifier; Ensemble Model; SMOTEENN.

Fatoumata Wongbé. TOKPA

Towards Generalizable Fake News Detection: A Meta-Learning Approach

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The proliferation of online misinformation poses a major societal threat, amplified by the diversity of sources, topics, and media formats. Traditional fake news detection models typically based on supervised learning. they struggle to generalize to new domains, particularly in the absence of large annotated datasets [1]. In this work, we explore a meta-learning-based approach to enhance of fake news detection models adaptability [2]. A detector based on Model-Agnostic Meta-Learning (MAML) [3]is trained to can shortly adapt to new domains using a few annotated examples (few-shot learning). We also explore multimodal architectures that integrate both text and images to capture manipulation cues in complex data. Preliminary experimental observations suggest a significant performance improvement in cross-domain scenarios compared to conventional methods.

This work was supported by National Grant no. ….

Keywords*: Fake news detection, Meta-learning, Few-shot learning, Multimodality, Artificial intelligence (Maximum 5).*

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Zacrada Françoise Odile TREY

Improving classifier performance on temporal data of stroke patients using the MixUp data augmentation method

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Abstract

We explore the impact of data augmentation using MixUp, a technique based on linear combination of examples, on the performance of classification models applied to clinical time-series data from patients who have suffered a stroke (Cerebrovascular Accident – CVA). The objective is to address data imbalance and scarcity in the medical field.

We use a longitudinal dataset of 5,000 stroke patients, including measurements of vital signs and neurological scores over several days. Several models (K-Nearest Neighbors, Random Forest) are trained to predict patient outcomes (improvement, stability, deterioration). The MixUp technique is applied to the time series, using various mixing coefficients.

Applying MixUp led to an increase in accuracy ranging from 8% to 16% depending on the model. The Random Forest model combined with MixUp achieved an average F1-score of 0.86, compared to 0.76 without augmentation.

This work confirms that MixUp enhances classifier generalization, particularly in low-data, high-variability medical contexts, provided the lambda parameter is carefully regulated.

Keywords: *Stroke, data augmentation, MixUp, time series, classification.*

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Cédric Yao

Agriculture in the Era of IoT and AI: Towards a Sustainable Transformation of Farming Practices for Smart and Precision Agriculture

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Abstract
Agriculture, a vital sector for global food supply, is facing increasingly complex challenges, including the effects of climate change, sustainable management of natural resources, and growing demographic pressure. The inefficiency of traditional farming practices, combined with the lack of precise tools and information for soil diagnostics and crop monitoring, leads to significant economic losses—estimated at over 20% in some rural areas—as well as considerable resource waste, particularly water (up to 40% unrecoverable water according to FAO [1]). In this context, the Internet of Things (IoT) and Artificial Intelligence (AI) emerge as promising technological solutions to enhance agricultural efficiency and address sustainable development challenges.

The primary objective of this study is to examine the integration of IoT and AI into farming practices to achieve more efficient and sustainable agriculture. More specifically, it seeks to answer the following questions:

- To what extent does the integration of IoT and AI enable more efficient management of agricultural resources?
- What is the actual impact of these technologies on yields, production costs, and sustainability?
- What are the barriers to their adoption, particularly in rural areas?
- How does the level of digital literacy influence farmers' appropriation of these tools?

The research protocol is based on a system composed of IoT sensors (8-in-1 module), an Arduino Uno, a SIM900 GSM module, a solar panel, and a battery. This setup allows real-time collection of agro-environmental data, transmitted to a centralized server for AI-based analysis. The results, contextualized with validated agronomic references, are then delivered to farmers through various interfaces adapted to literacy levels: web platforms, mobile applications, SMS, or voice messages in local languages. The entire process is carried out quickly, securely, remotely, and in real time, enabling effective and informed decision-making.

The experimental sites were chosen in Daloa (400 km from Abidjan), characterized by large-scale cash crop and food crop plantations, and Attinguié (25 km from Abidjan), marked by small-scale vegetable farming. These two complementary sites contribute respectively to export markets and urban food supply, thereby strengthening food security and agricultural sector performance. Experiments were conducted on rice fields in Daloa and vegetable crops (lettuce, tomato, chili) in Attinguié. Over a six-month period, the results revealed a 35% reduction in water consumption, an average 28% increase in yields, a 22% decrease in input-related costs, and active participation from 45 farmers. Despite these encouraging results, several challenges remain, including weak GSM coverage in some rural areas and reluctance to adopt technology due to initial costs and limited awareness.

In conclusion, IoT and AI represent powerful tools for transforming the agricultural sector. Their deployment requires modernization of rural infrastructure, farmer training, incentive policies, and strong, effective public–private partnerships to democratize access to digital technologies and innovations in agriculture.

Keywords: Agriculture; Internet of Things (IoT); Artificial Intelligence (AI); Sustainable Development; Digital Literacy.

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LIST OF OBSTRACTS

Poster session

Kouassi Adelphe Christian N'GORAN

Mask-Net: A U-Net Architecture with Spatial and Channel Attention Mechanisms for Improved Cloud Detection in Sea Surface Temperature Imagery

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Abstract

Oceans play a central role in climate regulation by absorbing nearly 95% of the excess heat generated since the industrial era. Sea Surface Temperature (SST) is a crucial indicator for monitoring oceanic and climatic processes, influencing global weather patterns and marine ecosystems. However, SST satellite observations are frequently hindered by cloud cover, obstructing infrared radiation and complicating accurate data retrieval. Addressing this challenge is essential for improving SST estimations and understanding climate dynamics.

In this study, we introduce MasKnet, a deep learning-based segmentation model designed to enhance cloud detection in SST imagery. MasKnet builds upon the U-Net architecture by integrating spatial and channel attention mechanisms, allowing it to better capture complex cloud structures and distinguish them from oceanic features. Our approach is specifically tailored for Advanced Very High Resolution Radiometer (AVHRR) satellite images, which provide continuous SST observations but suffer from cloud contamination.

The model was evaluated on a dataset of 365 daily AVHRR images of the tropical Atlantic, processed at two spatial resolutions: 9 km and 18 km. Experimental results demonstrate that MasKnet outperforms conventional cloud detection methods, achieving an Overall Accuracy (OA) of 89.08%, a mean Intersection over Union (mIoU) of 83.53%, and a Dice Score of 86.64% at 9 km resolution. The model shows significant improvements, particularly in upwelling regions, where traditional threshold-based methods tend to overestimate cloud coverage due to strong thermal contrasts.

An ablation study further highlights the importance of the attention mechanisms integrated into MasKnet. The combination of spatial attention, which focuses on relevant regions in the image, and channel attention, which enhances feature representation across spectral bands, allows for a more precise segmentation of cloud formations. Comparative analysis shows that these mechanisms significantly enhance cloud mask accuracy, leading to more reliable SST data by reducing misclassifications caused by atmospheric artifacts.

Future work will focus on leveraging MasKnet-generated cloud masks to refine SST reconstruction algorithms, mitigating data loss in cloud-covered regions. Additionally, integrating multi-sensor fusion techniques—combining AVHRR data with other satellite observations—could further improve SST estimations at large scales, supporting climate research and oceanographic modeling.

Keywords: *Sea Surface Temperature (SST), Cloud Detection, U-Net, Attention Mechanisms, Semantic Segmentation.*

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Koffi Bernadin-Pacome SAYNI[1]

Abstract MB-AGDSNet: A Dual-Stage Multi-Branch Attention-Guided Network with Climate-Aware Context for Robust Plant Disease Diagnosis in Real-World Conditions

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Automated plant disease diagnosis in real-world conditions is a significant challenge in precision agriculture due to the diversity of backgrounds, the visual similarity between symptoms, and the influence of climatic factors. Existing models, although effective on clean datasets such as PlantVillage [1], struggle to generalize to images from heterogeneous contexts or new locations [2], [3].

In this work, we propose MB-AGDSNet, a novel two-stage, multi-branch architecture that integrates both visual attention mechanisms and agro-climatic data. The first stage relies on YOLOv8 [4], enhanced by GhostNet [5], Coordinate Attention [6], and CBAM [7], for precise detection of symptomatic regions in images under natural conditions. The second stage uses a MobileNetV3-based classifier [8], structured in three branches: a local branch focused on symptoms, a global context branch, and a climatic branch leveraging meteorological data (temperature, season, humidity) extracted from metadata or IoT sensors, as suggested in [9], [10].

The model is trained and validated on two datasets: Kaggle [11], containing 4,269 images, and a field dataset comprising 4,736 annotated images collected from heterogeneous natural environments. The results show a 14.2% improvement in F1-score compared to classical visual architectures, with a significant reduction in false positives related to diseases inconsistent with the season [12], [13]. MB-AGDSNet maintains low complexity, enabling real-time execution on embedded devices.

This work represents an advance toward intelligent, adaptive, and reliable plant disease diagnostic systems that integrate both computer vision and environmental context for precision agriculture.

Keywords: *Plant disease diagnosis, precision agriculture, deep learning, attention mechanisms, Two-stage architecture.*

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Amani Marie Ange Melisa. Kouassi

Dedicated Path Protection Considering Jamming Attacks in Elastic Optical Networks

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Elastic Optical Networks, due to their spectral efficiency and flexibility, represent the solution to the increasing bandwidth demand caused by the growing number of connected people, connected objects, and numerous online services available today. A jamming attack or a link failure occurring on an optical path in such a network could lead to signal degradation on that path, disruption of all traffic passing through the path in the case of a link failure, or even interruption of all services on the network in the case of a jamming attack, as the attacked path may itself acquire the capability for secondary attacks. Therefore, this paper provides resilience for Elastic Optical Networks against inter-band, intra-band, and gain competition jamming attacks, as well as link failures, by proposing a routing and spectrum allocation scheme that takes into account protection and security in Elastic Optical Networks. For path protection, we use the dedicated path protection method to provide a working path and a backup path for each connection request. Jamming attacks occur due to crosstalk effects, which themselves arise from interactions between connections. Thus, reducing interactions between connections would reduce crosstalk effects on the network, and consequently decrease the likelihood of jamming attacks on the network. Therefore, we propose an Integer Linear Programming (ILP) model that reduces interactions between working paths and backup paths of connections by inserting guard bands between adjacent demands (i.e., demands sharing a link and having adjacent frequency slot indices) to mitigate inter-band crosstalk. We also prevent connection requests with power differences exceeding 20 dB from using the same link, to reduce gain competition effects. Finally, we assume optical switches with high port isolation levels to account for intra-band crosstalk. Simulation results indicate that the routing and spectrum allocation scheme considering protection and security significantly reduces interactions between connections, thereby providing better security for working paths and backup paths of the connections against jamming attacks.

Keywords: *Elastic Optical Networks; protection; security; jamming attack; RSA.*

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Olivier Edja

An Explainable Approach for Botnet Detection: Combining LSTM-Attention and SHAP

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Abstract

Artificial Intelligence (AI) has demonstrated its potential in many fields, including cybersecurity, particularly fordetecting malicious activities such as botnets. Understanding and anticipating these threats is crucial for securing IoT environments, which are increasingly vulnerable. Over the years, various AI techniques have been developed to analyze and detect botnets. These techniques rely on supervised or unsupervised learning algorithms to extract information from different data sources, such as network traffic flows, event logs, and IoT device characteristics.

The primary objective of this thesis is to develop explainable AI models for optimal botnet detection in IoT, with a focus on enhancing the understanding of the decisions made by these models. Since traditional detection methods are often limited by their lack of transparency and their inability to adapt to emerging threats, explainable AI-based approaches are increasingly being adopted. Network traffic data and IoT device characteristics, available in security databases, are used to train and evaluate AI models.

The development of explainable AI models for botnet detection generally involves two steps: extracting relevant features from IoT data and classifying network activities using a supervised learning algorithm. Feature extraction aims to identify the most discriminative attributes of botnets and to normalize IoT data from different sources into vectors of the same dimension. Thus, the success of the algorithms depends on the quality of data representation (the features). It is crucial to select features that reflect typical botnet behaviors and capture the essential information of network activities.

Keywords : botnets, Cybersecurity, Internet of Things , Explainability in AI

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An Approach for Indexing Spoken Audio Files in a Data Warehouse: State of the Art, Experimentation, and Validation

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With the exponential growth of multimedia data, particularly spoken audio files generated by e-learning platforms, videoconferencing systems, and digital archives, the automatic indexing of such content has become a crucial challenge to ensure its accessibility and value. This work aims to propose an innovative approach for indexing spoken audio files in a data warehouse, relying on advanced automatic audio descriptor extraction [1] and the application of dense neural networks for classification [2].

Our methodology combines traditional descriptors (MFCC, PLP) with enriched spectro-temporal indices, optimized through a genetic algorithm, in order to improve the representativeness of the extracted features. Experiments conducted on the GTZAN dataset and an internal speech corpus show a significant improvement in indexing accuracy, reaching 90% compared to 81.5% for classical methods such as SVM [2]. These results confirm the relevance of combining automatic feature extraction and deep learning in the processing of spoken audio files [3].

In conclusion, this approach opens new perspectives for the optimization of voice data warehouses, particularly through the integration of self-supervised representation techniques and the extension to multilingual and noisy corpora.

Keywords: Voice data mining; Spoken audio file indexing; Automatic audio feature extraction; Neural networks; Multimedia data warehouse.

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Koné Yeradounou Hermann

Study of the structural, optical, and electrical properties of intrinsic and Al-doped ZnO thin films-prepared by spin coating and dip coating

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Abstract:

The production and characterization of aluminum-doped zinc oxide (ZnO) thin films coated using spin coating and dip coating, two solution coating processes, are the main objectives of this study. With an eye on optoelectronics and photovoltaics, the goal is to investigate how Al doping and deposition techniques affect the structural, optical, and electrical characteristics of thin films. The ZnO precursor solution doped with varying Al concentrations (0–5%) was used to create the thin films. The films were deposited onto glass substrates using spin coating and dip coating methods, and then thermally annealed at 450 °C to enhance crystallinity. UV-Vis spectroscopy was used to examine the optical characteristics between 300 and 800 nm. The films have a high transmittance (more than 80%) in the visible spectrum and a noticeable absorption in the ultraviolet because of ZnO's bandgap (around 3.3 eV). An increase in the bandgap width is indicated by doping, which causes the absorption edge to move towards shorter wavelengths. Electrical studies confirmed the dopant's function as an electron donor by demonstrating that the resistivity of the films reduces as the concentration of Al increases.

Keywords: *ZnO; sol-gel; Aluminum-doped Zinc Oxide; spin coating; dip coating.*

Creating Smart Environment for Indoor Okra Cultivation Based on Open Source Home Automation Software

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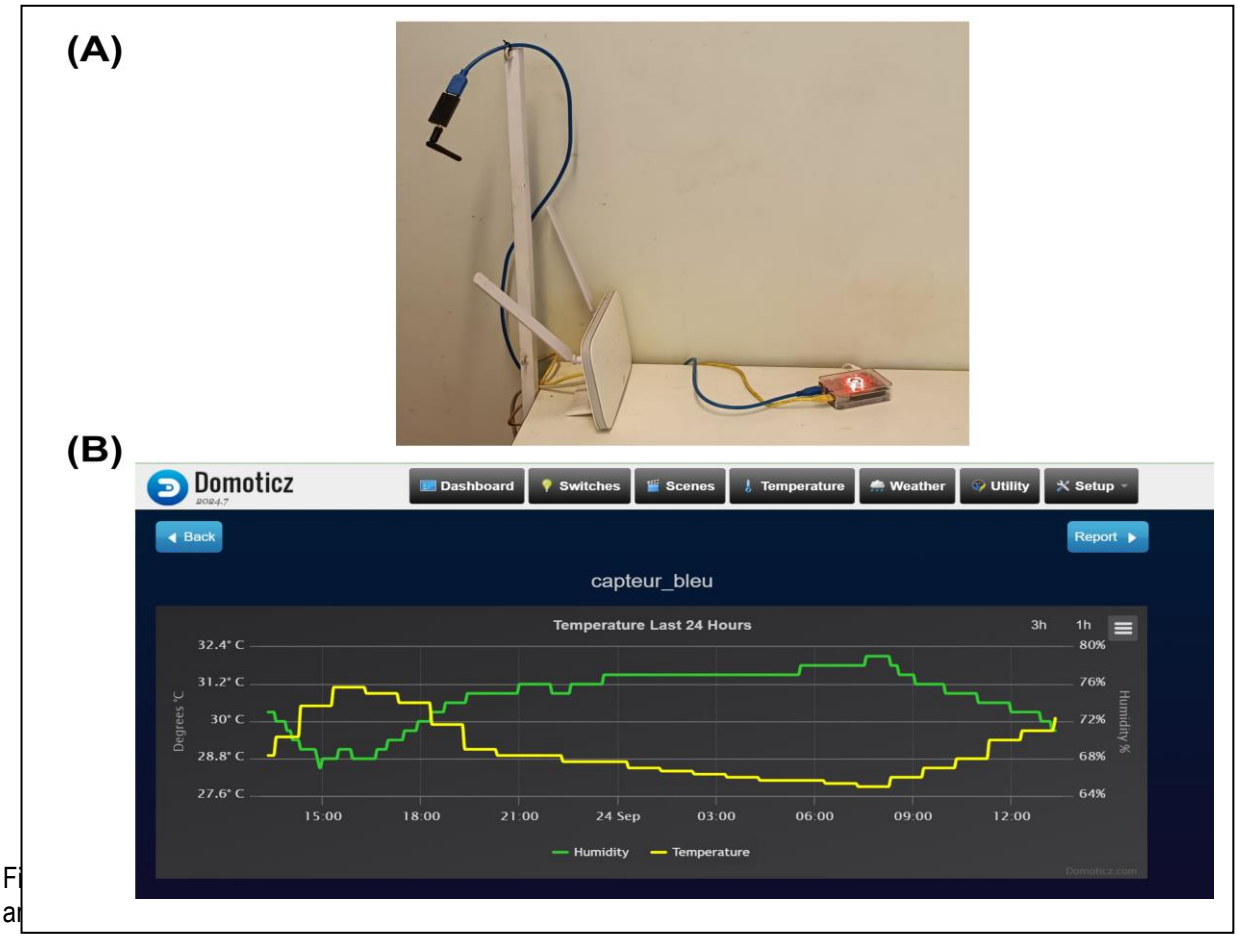
In this study, the main objective was to design a wireless sensor system to record temperature and humidity data, and to automatically programmed the photoperiod of our lighting system for the different growing boxes. The okra plants were grown in three different boxes with alternating blue, red and red-blue LED artificial lighting on a three-day cycle, as well as in a greenhouse and outdoors for two control experiments. The Internet of Agricultural Things refers to a type of network technology that applies wireless sensor network technology to connect environmental monitoring equipment and agricultural system control equipment to the Internet of Things. This connection is made via the user's chosen protocol for monitoring, controlling and managing agricultural environmental information [45]. Many environmental monitoring or smart home systems have been implemented on a Raspberry Pi [46]. In this project, the Raspberry Pi 3 Model B+ and the Zigbee wireless communication protocol were used. ZigBee devices always have a coordinator. The CC2531 USB sniffer was used as the coordinator, flashing the appropriate firmware according to the guidelines provided on the Texas Instruments website [49]. In order to optimally use the CC2531 USB sniffer as a ZigBee coordinator, the Zigbee2MQTT software, developed by Koen Kanters, was installed. This software converts messages from ZigBee devices into MQTT, making it easy to connect and control new devices, including those from different manufacturers, and to transmit measurement data from sensors and control LEDs via switches. As far as the sensors are concerned, five SONOFF SNZB-02p temperature and humidity sensors and a Smart Plug switch were chosen, all of which operate using the Zigbee protocol. The temperature and humidity sensors are placed in each type of experiment and the entire lighting system is connected to the Smart Plug. There is a whole range of platforms, both free and paid, dedicated to home automation systems. The aim of these platforms is to provide a common, centralized control interface for collecting data from different types of sensors and controlling various devices. The Domoticz open-source platform offers a richer graphical interface and allows interaction with the user via an integrated web server, making it particularly lightweight. It should be noted that the Raspberry Pi needs to be connected to the Internet to enable data relating to the temperature, humidity and energy consumption of the lighting system to be displayed in real time on the platform. Figure 1A shows the home automation system.

The data is recorded every five minutes in a CSV file. At the end of the experiment, these files were processed using RStudio software. The average day/night temperatures and the average day/night relative humidity over the 75 days of the experiment were as follows: Blue (28.81/28.25°C; 73.89/77.75%), Red (28.55/28.10°C; 74.07/77.96%), Red-Blue (28.31/28.01°C; 75.2/78.25%), Greenhouse (30.80/25°C; 75.29/86.98%), Outdoor (28.87/24.21°C; 82.2/89.88%). The electrical power of each type of lighting (Blue, Red and Red-Blue) was 144 W, 108 W and 92.4 W respectively. The higher the power dissipated by the LEDs, the higher the temperature in the cubicles and the lower the humidity. These results show that the power dissipated by the LEDs influences the temperature and humidity in the growth boxes. Figure 1B shows the evolution of the temperature and relative humidity of a sensor in the box Blue on the Domoticz platform.



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Keywords: *Indoor cultivation; Temperature; Humidity; Raspberry pi; Domoticz.*

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