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PROJECT MANAGEMENT EXPERT SYSTEM WITH ADVANCED DOCUMENT MANAGEMENT FOR PUBLIC INSTITUTIONS

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This paper addresses public institutions' logistical challenges, focusing on project tracking and transparency. One challenging aspect of this endeavor is maintaining a clear and transparent record of ongoing projects while ensuring effective communication with all relevant stakeholders. Using machine learning and a comprehensive set of tools (to eliminate repetitive, time-consuming tasks), institutions can more efficiently manage and track projects with reduced manpower and fewer resources.

1. INTRODUCTION

Individual projects and contractors often use vastly different mechanisms to track and report their project implementation status. Despite nationwide systems in place to create a transparent public acquisition process, these systems are primarily used to validate the contractor's eligibility for each project rather than as a project management tool. Except for general timelines, project specifications, or important milestones, the end-user has no real oversight over the project timeline. Generating necessary documentation for reporting unforeseen circumstances and delays also takes significant time. In most cases, small issues are the major reason for delays.

Due to the costs associated with man-hours, equipment rental, ownership, and running costs, it is almost impossible to implement a single management solution on a city-wide scale while keeping the total cost of ownership low. This is due to the need to manage equipment, transportation, and real-time location data individually and efficiently allocate resources, do smart routing, and generate automatic reports.

With the addition of an advanced document management system (DMS), the system can become an all-in-one solution that may help organizations streamline project management and document-related processes, including document creation, approval, routing, and storage.

– This may lead to potential improvements in efficiency and productivity, resulting in possible time and cost savings.
– Organizations can enhance security and compliance by streamlining the types of documents used and how they are created, shared, and stored. This can help protect sensitive data from unauthorized access and ensure compliance with industry regulations. Additionally, organizations may consider utilizing antivirus software, firewalls, and other advanced security features to add document specifications to playbooks and more easily track flags and react to suspicious behavior.
– Improved collaboration and teamwork: Standardizing document types and procedures can facilitate employee collaboration and improve access to information while maintaining security. This enhances efficiency by reducing workloads and streamlining decision-making processes.
– Focus, visibility, and control: by implementing a document management system (DMS), organizations can have a centralized view of their workflows and project timelines, which can facilitate tracking and management of all activities. This, in turn, can lead to better decision-making and risk management.
– Reduced environmental impact: a document management system (DMS) can help organizations reduce waste by eliminating the need for paper documents. Paper backups can still be generated, but only upon specific request rather than by default, greatly reducing the environmental impact.

2. STATE OF THE ART

Efficient logistics can significantly impact the final price of products and services. Therefore, improving logistics can have a positive effect on the bottom line of most companies. It is worth noting that logistics costs heavily impact the final price of products and services. There has been a discernible trend among businesses to shift their focus from short-term to medium and long-term planning and conduct in-depth analysis of projects. As a result, there has been a migration from supplying small local markets to competing globally, utilizing economies of scale to reduce costs and maximize profits. It is worth noting that the logistics component plays an increasingly important role in both the private and public sectors, ranging from toys and laptops to infrastructure and construction projects [1]. Raw materials must be sourced and transported to the manufacturing site where intermediary and final products are produced. Additionally, the finished product must be delivered to the customer. The timing of these operations can have an impact on efficiency [2–4]. Similarly, the local government is undertaking several infrastructure, rehabilitation, and utilities projects at different completion stages.

Infrastructure projects require coordination between contractors to ensure timely completion. This includes paving roads, renovating parks, moving power and data lines underground, and replacing or modifying gas, water, and sewage lines. It is important to avoid negative impacts on each other's work, which can occur if contractors are not properly coordinated. To complete these projects, it is necessary to relocate resources and manpower, file paperwork, and plan and execute inspections. The beneficiaries of these projects may need more personnel to oversee the progress of all the projects, which can result in minor issues causing significant delays [5,6].

Most software solutions typically focus on location

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tracking, job dispatching and routing, vehicle maintenance, driver behavior, and electronic logging device (E.L.D.) compliance. However, our solution prioritizes smart dispatching and routing and has a user-friendly yet powerful last-mile feedback system. Furthermore, we offer a significant level of personalization for job and vehicle types that exceeds that of most commercially available solutions [7].

3. PROPOSED SOLUTION SYSTEM ARCHITECTURE

Implementing machine learning (M.L.) has developed a functional logistics platform that can easily integrate push-centric, pull-centric, and hybrid distribution channel models [8].

It also enables the definition of pick-up and drop-off points for specific goods and corresponding vehicle classes. The pick-up point is defined as having inventories that are transferable to vehicles/teams. Each vehicle can carry specific types of goods, so any available vehicle servicing a particular area can pick up a delivery task.

Contractors can manage the resources added to the platform or allow the system to manage everything automatically. Moreover, vehicles may be deemed appropriate for various goods or tasks, contractors may be assigned to specific duties or deployed regions, and independent workers may undertake tasks based on the vehicle or team load-out.

This adaptability allows for the swift expansion of transportation resources based on the urgency of the task and the accessibility of the vehicles or teams.

These functionalities are created using a combination of reinforcement learning (RL) and linear regression (LR). These algorithms optimize tasks and dynamically allocate resources [9,10].

LR is initially employed to analyze the provided data and identify statistically relevant relationships and patterns such as task duration, resource availability in real-time, etc. The resulting predictive model provides a baseline for prioritization. After this, RL takes over, using the generated predictions to model its decision-making process. Changes to the data fed into the algorithm (*e.g.*, the number of remaining vehicles after dispatching certain vehicles to certain jobs or job status updates when a job is partially completed or postponed) are continuously updated and considered in real time. The RL model dynamically adjusts to ensure optimal or near-optimal resource utilization and timely task completion. However, because of the real-world difficulties encountered by the work teams in the field, task completion timelines can greatly differ from one job to another. This is why we heavily depend on real-time updates to recalibrate [11].

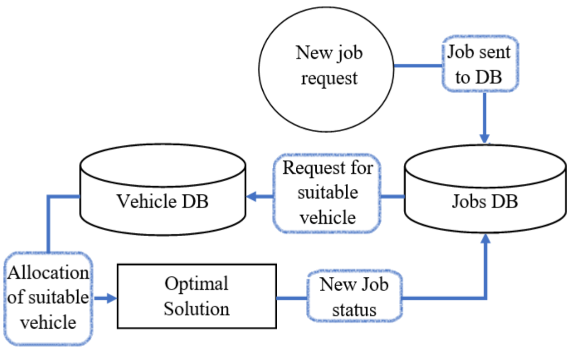

Fig. 1 – Web app mechanism architecture (task addition and automatic allocation).

The system could potentially assist in coordinating public transportation by suggesting the addition of more buses or trams to overcrowded lines, dispatching emergency vehicles to specific locations, monitoring traffic patterns to provide feedback to traffic controllers, and offering relevant data in real time.

Figure 1 depicts the overall functionality of the web application for introducing new jobs/tasks and allocating them to appropriate vehicles.

Additionally, Fig. 2 comprehensively describes the ML algorithm for intelligent resource allocation.

New jobs can be added to the web app either manually, by following the predefined steps in the appropriate user interface, or bulk by importing a database of tasks.

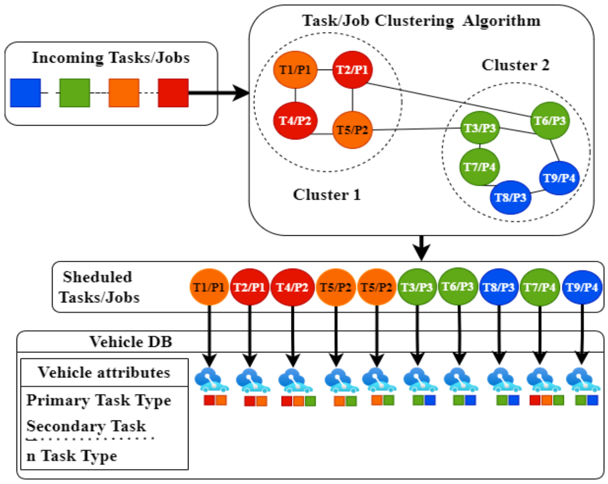

Fig. 2 – Resource allocation and task scheduling diagram.

The vehicles or teams in the diagram (Fig. 2) are color-coded to illustrate the different load-outs or types of jobs they can handle. Furthermore, the vehicles or teams are arranged in clusters based on the operator's job urgency. The machine learning algorithm evaluates the balance of clusters and job allocation based on patterns and conclusions drawn from the training dataset [12]. It responds and adapts to the pace at which field teams complete previous jobs.

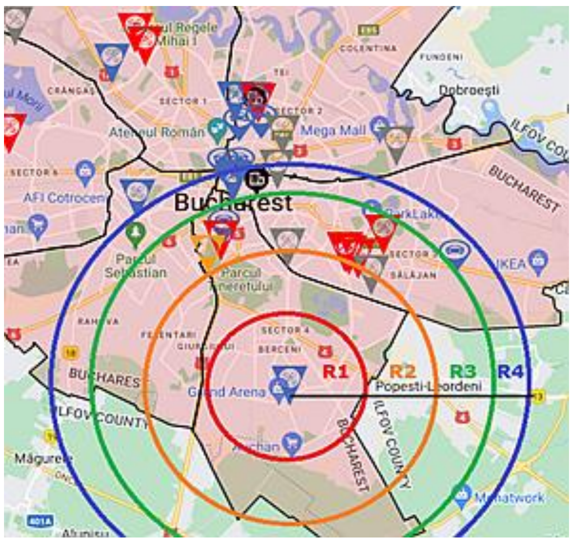

Fig. 3 – Graphical representation of job allocation based on road distance and vehicle/team loadout.

Machine learning allocates priorities to tasks, analyzes dependencies, and assigns tasks to clusters. For instance, in the scenario where Task 1 (T1) and Task 5 (T5) are assigned a priority level of 3/4 by the operator, the system will prioritize T1 because it is closer and requires completion before other operations can proceed. T2 is also assigned priority level one (P1), but it will be completed by a team with a similar loadout. Therefore, the system assigns it the second position and continues for the next tasks.

The conventional job allocation method relied on proximity to the job site, but it may have considered only some of the complex factors involved. Smart dispatching, on the other hand, aims to balance multiple factors, including road distance (not in-line distance), current and predicted traffic conditions based on statistical data, traveling direction (traffic conditions often differ depending on the direction of travel on the same stretch of road), reported obstructions, and vehicle loadout. To optimize processing power and resource usage, the navigation application handles all data through an Application Programming Interface (API) directly on the mobile terminal used in the field. The application can utilize established navigation technology like Google Maps, Waze, Maps. me, or an internally developed navigation web service containing only information for a specific area.

Figure 3 depicts the distribution of vehicles from a geographical standpoint. The work site is delineated by concentric circles, with the innermost circle in red (R1) and the outermost circle in blue (R4). Traditionally, identifying appropriate vehicles would commence at R1 and progress to R2 (orange) and R3 (green) if no suitable vehicles are found. The assignment would be granted to the vehicle identified in R3. However, our system can use the additional data provided by the navigation API and the internal ML algorithm to search outward to R4 (blue) and find another vehicle. After comparing the internal vehicle data and navigation data provided by the API, it can be concluded that the vehicle in R4 is more appropriate and dispatched instead. If a clear decision cannot be made, it will venture outside R4 to R5 and re-compare data.

Increasing the number of vehicles or teams available in the field can improve the efficiency of the resource allocation system.

The stored and interpreted data can be used to generate statistics on each team's working patterns, the remaining jobs for each team or job type, and the inventory data at the beginning and end of each workday. This information can be used to assign jobs and redirect teams to resupply stations. Additionally, it can generate efficiency reports for specific teams or contractors, considering factors such as time, complexity, and eventual defective interventions.

The system can suggest the most necessary types of vehicles or team load-outs and their optimal locations. For a diagram illustrating the relationships and interactions between the mobile app and the web app, please refer to Figure 4, which illustrates the mobile application operation used by drivers or team leaders.

Upon entering valid credentials, the user's status changes to 'available' to initiate the allocation process. The mobile app then requests a job allocation, and the web app responds with a suitable job based on the vehicle configuration, location, and job priority, among other specifications that depend on the job's complexity. The user is presented with job information and can accept or decline the job. In the case of the latter, the app will reset to the initial screen after the user provides feedback on the reason for refusal, such as unmet prerequisites at the job site or unforeseen circumstances. This approach enables event cataloging and flagging the location for a human operator to inspect, preventing the job from being allocated to another team while the issue remains unresolved. If the job is accepted, a navigation window will appear.

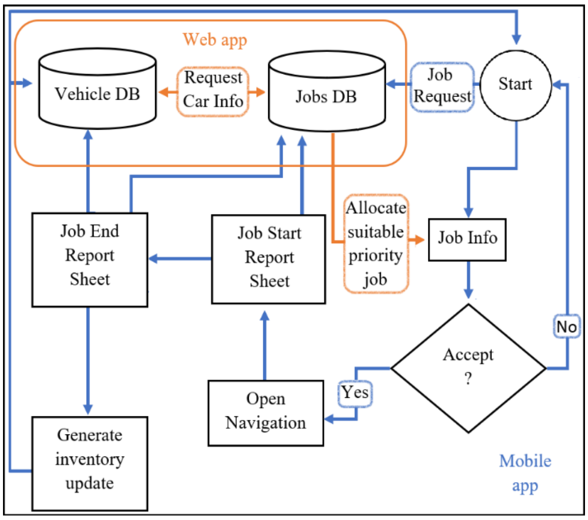

Fig. 4 – Real-time interaction of mobile app and web app.

Upon arrival at the destination, a report sheet will be displayed, requesting relevant information such as a picture of the location or the materials dropped off (encoded with GPS coordinates, date, and time). There is an option to report any problems with the delivery location. Each report sheet can be designed for specific destinations or job types. The job status will be updated in the web app, and a job end report sheet will appear. The process is intended to incorporate a report at the beginning and end. This ensures that the condition of the equipment is well-documented upon arrival and after any required repairs or installations.

The terminal application subsequently updates its inventory with the items that have been dropped off or picked up. It transmits the pertinent information to the web application, updating the vehicle status and screen. This system can aid operators in managing many incidents and staying up to date with events in the field. It offers valuable feedback to stakeholders on both successful and unsuccessful operations. It has been determined that the advantages of collecting, storing, and analyzing this volume of data may also apply to other procedures.

As a result, we have decided to expand the platform's features to include an advanced document management system. This system takes advantage of the benefits of a standardized data format regarding possible correlations between the data and security. A uniform data format for transfer and user access can facilitate the implementation of additional security measures, a cohesive security policy, and optimization of system resources while also providing advanced features [13].

Documents generated from data entered from the mobile app or uploaded via the online platform are automatically converted to PDF format. Any documents uploaded in other formats are also converted to PDF. The resulting PDF undergoes a series of tasks to prepare it for OCR, including text alignment, brightness and contrast adjustment, and de-noising. Text segmentation divides the document into individual characters by identifying the edges of the character image and processing it through the OCR filter. For feature extraction, the character's shape and pixel values are utilized, as well as the relationships of each character to the image. The next step involves the classification process, which utilizes the extracted features to classify each character. ML algorithms are then employed to determine the probability of each character's value based on the context. The resulting text is outputted in plain text format. The process does not end here; metadata such as the title, author, subject, keywords, and other information are identified, extracted, tagged, and encoded. The PDF document contains OCR text and metadata (Fig. 5). However, for the metadata to be fully utilized, it must be indexed in a search engine. This process enables advanced searches for all documents, allowing users to apply multiple filters and narrow their search.

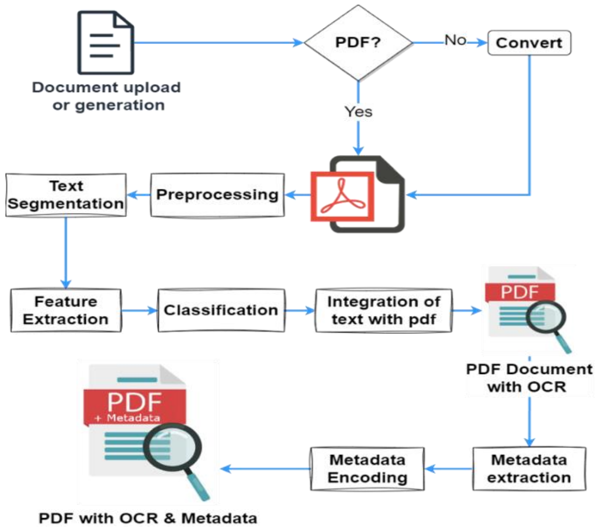

Fig. 5 – Document management system process for generating PDF files with optical character recognition (OCR) and metadata.

This tool can be highly effective for managing large projects and the day-to-day operations of public institutions or large businesses.

4. NAVIGATION APPLICATION USER INTERFACE AND API COMPARISON

The navigation component has been designed to be highly flexible, enabling integration with multiple APIs such as Google Maps, Waze, Maps.me, or the internal navigation app via its API, as previously utilized. After analyzing the results obtained from various map APIs on similar routes, it can be observed that utilizing an API that integrates direct real-time feedback from drivers into the plotting algorithm has clear advantages, as demonstrated by the resulting graph (Fig. 6). It is worth noting that although the graph only displays results for a 5 km distance, the results were also consistent for larger distances.

The estimated arrival time (ETA) and actual time of arrival (ATA) were measured using routes generated by four individual APIs on distances of 5 km, 7 km, 10 km, and 15 km. ETA, represented in blue, reflects the initial estimated time to reach the destination, while ATA, represented in orange, reflects the actual time recorded from departure to arrival. Although the results are generally consistent across the two measured indicators, the accuracy of the internal solutions can be influenced by various factors (number of devices providing feedback, size of the vehicle, and its ability to use the recommended 'shortcuts' by the navigation software). The crucial factor is the availability of real-time data and the number of sources it relies on.

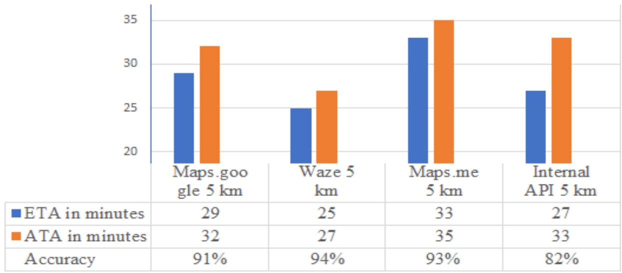

Fig. 6 – Accuracy of tested APIs on 5 km distance.

After analyzing the data based on 'route efficiency' and 'route accuracy', a rating system ranging from 1 to 4 was utilized for each of the four measured distances. This method of measuring accuracy was considered crucial because consistent planning and execution were deemed more important than small improvements that cannot be relied upon.

Table 1

Navigation API comparison

API	Distance (km)	ETA	ATA	Speed (position 1 to 4)	Average Speed position	Accuracy	Average accuracy
Maps.google	5	29	32	2		91%	
	7	35	37	2		95%	
	10	38	39	2		97%	
	15	40	45	3	2	89%	93%
Waze	5	25	27	1		93%	
	7	29	35	1		83%	
	10	39	37	1		95%	
	15	42	43	1	1	98%	92%
Maps.me	5	33	35	4		94%	
	7	40	39	3		97%	
	10	42	45	4		93%	
	15	42	50	4	4	84%	92%
Internal API	5	27	33	3		82%	
	7	35	40	4		88%	
	10	39	40	3		98%	
	15	42	44	2	3	95%	91%

Table 1 compares multiple APIs. One API appears to be more efficient and accurate in Bucharest, where it is widely utilized. This is likely due to the continuous feedback from other drivers on the route, which generates a more intricate dataset and consistently yields superior outcomes compared to other tested APIs.

The internal navigation component can incorporate data from various sources, such as vehicles owned by the municipality involved in public transportation or other users who opt-in, traffic cameras, or sensors [14,15]. This approach has been demonstrated to lead to more consistent results, as shown in the examples. By implementing a term frequency-inverse document frequency (TF-IDF) algorithm adapted for geographical data analysis, we prioritized and optimized routing decisions by treating checkpoints as terms and documents after dividing the road that needed to be traveled into sections [16]. The historical data on vehicle routers, frequency, and sequence of checkpoint visits is collected, the frequency of each checkpoint in individual routes is computed (TF). The inverse frequency of each checkpoint across all routes emphasizing less common but critical checkpoints is calculated (IDF). The TF-IDE score is calculated as TF multiplied by IDE for each checkpoint that obtains a significant score. The scores are then used to prioritize checkpoints in the routing algorithm.

However, this approach requires constant input from many devices in the field or access to data provided by an intelligent traffic management system [17,18]. In situations where traffic patterns deviate considerably from standard mapped patterns, it is possible that internal navigation may not be as efficient as the tested alternatives if many vehicles cannot be deployed. Additional data sources cannot be utilized. If enough devices provide real-time data, the accuracy may surpass the other tested solutions. Bluetooth low energy is a cost-effective method to obtain the required data points [19].

As a result, our system is designed to rely on its navigation solution and allow for integration with other established solutions. Furthermore, switching to any future compatible navigation system with an API is flexible. Moreover, municipal vehicles could utilize these APIs to improve the precision of navigation applications by offering numerous real-time data points. Information gathered from municipal vehicles utilizing the application is generally more pertinent than data from other users, given that these vehicles are driven for longer periods and distances than the average user who only commutes twice daily (to and from work).

5. GEOGRAPHIC INFORMATION SYSTEM AND USER INTERFACE

If users will only interact with the navigation screen, task information, and feedback forms, it is recommended that the interaction be streamlined as much as possible. However, the web app user interface is quite different. The focus of the web app is the city map, a complex geographic information system (GIS) that divides the City of Bucharest, Romania, into its six sector municipalities, as shown in Figure 8. The territorial limits of each city sector are used as a dividing line for jurisdictions [20,21].

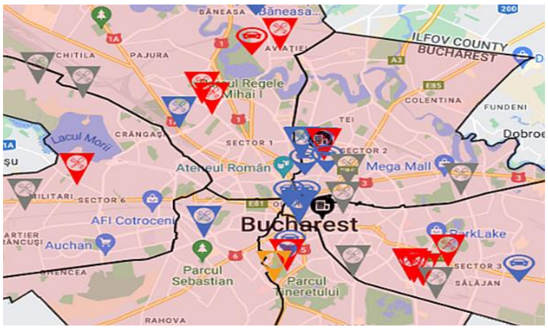

Fig. 7 – Geographic Information System with real-time data.

Considering the intricate relationships between various entities and their service providers and the interplay between sectors at an administrative level, including the General Municipality of the City, it is crucial to consider the job relationships and teams responsible for them in each area.

The interactive map provides a current display of all vehicles/teams deployed in the field, along with their job location and status, and all pertinent information is easily accessible. Contractors providing services to multiple districts may designate vehicles as primary serving sites in one district. However, vehicles may cross district lines for high-priority jobs if suitable. Figures 7 and 8 display specific job sites, statuses, and steps. The job has two steps in this scenario: the completed repair and the pending site paving.

Contractors who have been implicated can view the real-time status of pending assignments and detailed information based on their account type (by clicking on the title).

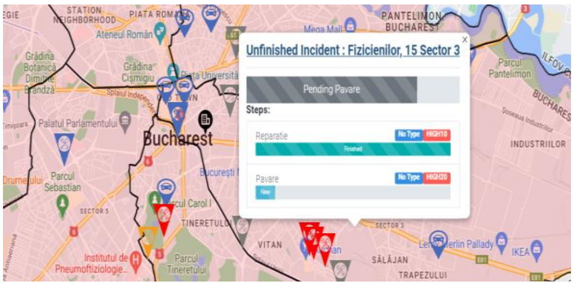

Fig. 8 – Job details as shown on the interactive map via GIS.

In addition, they can access reports of jobs or job steps they have worked on, technical details recorded, and all generated paperwork submitted through the platform.

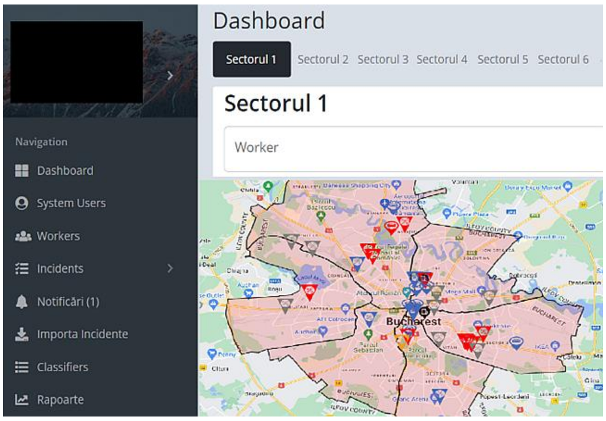

Fig. 9 – Web app user interface.

The public administration representative is granted access to all active sites and vehicles on the map and pertinent information regarding jobs and steps. They can add or skip steps, and each modification generates a log that includes the date, time, and user responsible for the change. Moreover, a file is generated for each task and step, which includes reports, contractor requests, and images, providing complete transparency for auditing purposes.

The web-based user interface is highly flexible, allowing easy customization of button locations and names to enhance accessibility. Figures 8 and 9 illustrate this by displaying buttons in both English and Romanian.

The platform's architecture facilitates the seamless integration of new job types. Locations can be added by inputting an address or GPS coordinates, supporting both Stereo70 and WGS84 formats [22,23]. For example, a job that requires a pickup and drop-off location with photo and GPS coordinates can be used by the city to ensure a basic postal service with proof of receipt. The administrator and user for this job will not directly interact with the rest of the database or other job types. In contrast, the administrator can review information from all job types.

The map can be augmented to permit future compatibility with electric vehicles, allowing for mapping and routing to intermediate locations such as charging stations to maximize productivity and availability while reducing pollution and significantly draining the electric infrastructure or disrupting the existing charging infrastructure [24].

6. CONCLUSIONS AND ADVANTAGES

This system results from a 5-year implementation process that began with the GIS and the smart task allocation manager in and around Bucharest, Romania. With the addition of the document management system, the system provides unprecedented control and integration, reducing repetitive and inefficient processes and automating them.

Therefore, our system can provide drivers with a faster and more efficient experience.

Tasks can be created in minutes, and templates can be utilized to generate workflows. After a brief introduction to the platform, drivers can begin using it immediately without requiring extensive training or procedures, as the procedures are integrated into the job type.

Utilizing this technology can potentially enhance efficiency for public municipalities and general contractors. By enabling a single dispatcher to oversee thousands of jobs and drivers simultaneously, and with the interactive map providing real-time data, the dispatcher can focus on the overall picture of individual vehicles or tasks.

The progress can be monitored, and job history and documentation can be automatically generated and updated. Detailed reports are generated for each task, allowing users to review job, driver, or vehicle details easily. Reports can also be automatically sent to stakeholders upon each job status change. An interactive map is available for all stakeholders involved. All uploaded or generated documents are converted to PDF format and stored in a versatile document management system. This system enables the municipality to manage all documentation electronically, reducing the need for paper backups unless specifically required.

The municipality benefits from several advantages, including real-time data and automatically generated reports and paperwork, which allow for high control, access, and transparency. Issues can be escalated from the field team to operators and beneficiaries in seconds, with simultaneous notifications and feedback from involved decision-makers. Effective communication and thorough documentation of all project steps ensure a timely and accurate completion.

The system offers contractors a range of advanced tools for personalized task and vehicle management. With the help of a single operator, thousands of tasks or jobs can be actively managed. Furthermore, the driver task allocation module can efficiently identify suitable vehicles or teams for specific tasks and queue them based on task urgency and the estimated arrival time (ETA) of all available vehicles. Reports are generated automatically using data obtained at each step of every task. Feedback from stakeholders can be obtained almost instantaneously when issues arise, which helps to minimize unproductive time and disputes. Additionally, the process is well-documented, ensuring traceability.

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REFERENCES

1. R. A. Novack, B. Gibson, Y. Suzuki, J. J. Coyle, *Transportation: A Global Supply Chain Perspective*, Cengage Learning, 2018.
2. M. Christopher, Forth Edition *Logistics and Supply Chain Management*, Library of Congress Cataloging-in-Publication Data, 2011.
3. D. H. Stolfi, E. Alb, *Sustainable Transportation and Smart Logistics*, Elsevier Inc., 2019.
4. A. Sampaio, M. Savelsbergh, L. Veelenturf, T. van Woensel, *Sustainable Transportation and Smart Logistics*, Sustainable Transportation and Smart Logistics Decision-Making Models and Solutions, 2019.
5. J. Barcelo, *Sustainable Transportation and Smart Logistics*, Sustainable Transportation and Smart Logistics Decision-Making Models and Solutions, 2019.
6. P. Carroll, P. Keenan, *Decision-Making Using Exact Optimization Methods in Sustainable Transportation*, Sustainable Transportation and Smart Logistics, Elsevier, 2019.
7. J. Faulin, S.E. Grasman, A.A. Juan, P. Hirsch, *Sustainable Transportation and Smart Logistics Decision-Making Models and Solutions*, Elsevier, 2019.
8. N. Boysen, S. Fedtke, S. Schwerdfeger, *Last-mile delivery concepts: a survey from an operational research perspective*, OR Spectrum, **43**, pp. 1–58 (2021).
9. A. Burkov, *The Hundred-Page Machine Learning Book*, https://themlbook.com/, 2019.
10. B.M. Rashed, N. Popescu, *Classification by a stacking model using CNN features for medical image diagnosis*, U.P.B. Sci. Bull., Series C, **86**, *1*, 2024.
11. H.B. Alwan, K.R. Ku-Mahamud, *Convolutional neural network algorithm for cancellable face template*, U.P.B. Sci. Bull., Series C, **86**, *1*, 2024.
12. H. Huang et al., *Research on the development and application of vehicle-goods matching system based on Saas and Cscw*, U.P.B. Sci. Bull., Series C, **84**, *2*, pp. 31–44 (2022).
13. A.V. Dragomir, C.V. Blanaru, *Theoretical aspects regarding cyber security in Romanian public institutions*, Law, Society & Organizations, **10**, *1*, (2021), https://ideas.repec.org/a/cmj/lawsor/y2021i10p51-56.html
14. F. Lacatusu, I. Damian, A.D. Ionita, M. Lacatusu, *Smart building manager software in cloud*, U.P.B. Sci. Bull., Series C, **83**, *4* (2021).
15. M.M. Taye, *Theoretical understanding of convolutional neural network: concepts, architectures, applications, future directions* Computation, **11**, *3*, p. 52 (2023),
16. H. Zhang, *Feature selection optimization method of traffic congestion case database based on TF-IDF algorithm*, U.P.B. Sci. Bull., Series C, **84**, *4*, pp. 235–248 (2022).
17. G. Long, A. Wang, T. Jiang, W. Zhu, *Traffic signal self-organizing control based on minimum expected traffic flow delay rule*, U.P.B. Sci. Bull., Series C, **84**, *2*, pp. 203–220 (2022).
18. C. A. Iordache, C. V. Marian, *Industrial expert system for intelligent traffic lane allocation using machine learning and pattern recognition*, 15th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), 2023.
19. A. Vasilateanu, N. Goga, L. Guta, M. Mihailescu, B. Pavaloiu, *Testing Wi-Fi and Bluetooth low energy technologies for a hybrid indoor positioning system*, IEEE International Symposium on Systems Engineering (ISSE), 2016.
20. R. Jardim, M. dos Santos, E. Neto, F.M. Muradas, B. Santiago, M. Moreira, *Design of a framework of military defense system for governance of geoinformation*, Procedia Computer Science, **199**, *1*, pp. 174–181 (2022).
21. J. Zhu, P. Wu, *Towards effective BIM/GIS data integration for smart city by integrating computer graphics technique*, Remote Sens., **13**, *10*, 1889 (2021).
22. C.V. Marian, M. Iacob, D.A. Mitrea, *GIS-based integrated system with interactive digital map for archaeological heritage protection*, 14th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), Ploiesti, Romania, 2022, pp. 1–4.
23. C. V. Marian, M. Iacob, *The ArchTerr project – a GIS-based integrated system for cultural and archaeological heritage protection (pilot phase tested in Romania)*, Applied Sciences, **12**, *16*, 8123 (2022).
24. A. Arpadzic, A. Bosovic, A. Merzic, M. Music, *Impacts of deregulated and regulated electric vehicle charging in a distribution network*, Rev. Roum. Sci. Techn. – Électrotechn. et Énerg., **67**, *4*, pp. 451–456, (2022).