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Cost-Effective Design, Content Management System Implementation and Artificial Intelligence Support of Greek Government AADE, myDATA Web Service for Generic Government Infrastructure, a Complete Analysis

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Abstract: One significant digital initiative that is changing Greece's tax environment is the myDATA platform. The platform, which is a component of the wider digital governance agenda, provides significant added value to enterprises and the tax administration, despite the challenges of adaption. Despite the positive response, we find that the development of the platform could have been carried out quickly and at a significantly lower cost and could have been able to cope much faster with the rapid and necessary changes that the platform will have to comply with. For these reasons, development in WordPress would be considered essential as this CMS platform guarantees a fast and developer-friendly environment. In this publication, as a contribution, we provide all the necessary information to develop a myDATA-like platform in a fast, economical and functional way using the WordPress CMS. Our contribution also contains the analysis of the minimum necessary amount of services of the myDATA platform in order to perform its basic functionalities, the description of the according database relational model, which must be implemented in order to provide the same functionality with the myDATA platform, and the analysis of available methods to quickly create the necessary forms and services. In addition, we study how to develop Artificial Intelligence mechanisms with a success rate reaching up to 90% for automatic tax violation detection algorithms.

Keywords: cost effective; CMS implementation; AADE; myDATA; web service; generic government; infrastructure; AI; tax violations detection; e-Government

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1. Introduction

It is a fact that one of the main challenges that governments have faced in recent years is the modernization of their services due to the recent technological evolution. This transition makes states responsible for their integration into a new reality in which the internet prevails in such a way that it is one of the strongest, if not the strongest, means of power. This means that the main concern of governments is to get closer to the citizen through e-Government services [1–3]. This creates various issues of approach regarding the

implementation of quality service models. Citizens who evaluate the respective services are becoming increasingly informed on the one hand and demanding on the other, resulting in the work of companies and governments becoming extremely demanding in their attempt to rectify any confusion that is created [4,5].

The digital age has radically changed the way governments interact with citizens and businesses [6,7]. The concept of Electronic Government (e-Government) has emerged as a key concept of the digital transformation of the public sector, offering automated and user-friendly services to citizens, improving transparency and increasing the efficiency of public organizations [8]. In this context, government agencies are able to use a range of technological tools, including Content Management Systems (CMS), to provide easy access to information and enhance two-way communication with the public [9–11].

As a result, the Greek government is trying to respond to the modern era and the demands of Greek citizens by providing an online portal to serve them and to carry out the necessary procedures for the operation and execution of the necessary tax procedures by citizens [12,13]. The existing myDATA infrastructure that has been developed by the Greek state and which is currently the prevailing platform of the Greek government for serving Greek citizens has been characterized as a very bulky, dysfunctional and at the same time expensive tool that took a lot of time and effort to be implemented and also cost the Greek government a lot of money to fully develop [14,15].

The aim of this work is to provide to the user the necessary instructions and information for the development and implementation of the basic and necessary procedures in a quick and economical way, using the WordPress CMS platform [16–19], for the construction of an online portal that will be able to perform the basic functions of the myDATA platform in a similar way to the real platform. Moreover, we present a prototype example of an automatic tax violation detection algorithm that could easily be used by the Greek government, perhaps even as it is, without making any major and significant changes.

The rest of this paper is structured as follows: In Section 2, we briefly describe the e-Government topic and its principles. In Section 3, we introduce the use of CMSs by governments. In Section 4, we examine the use of AI in e-Government. In Section 5, we analyze the use and impact of social media in e-Government. In Section 6, we show the case of the Greek myDATA service. In Section 7, we describe the WordPress implementation of the myDATA service. In Section 8, we introduce the use of Python AI algorithms in order to auto detect tax violations. Finally, Section 9 concludes this paper and presents directions for future work.

2. Related Work

2.1. The Definition, Evolution and Basic Principles of e-Government

E-Government is defined as a capacity to transform public administration through the use of ICTs (Information and communication technology) or indeed is used to describe a new form of government built around ICTs [1,2]. This aspect is usually linked to internet use. Although there are various definitions, there isn't a clear theory of e-Government. Researchers and practitioners use the term "e-Government" or a synonym to describe a wide range of activities. As long as they fit into one or more of the several precise definitions that are currently in use, none of these items may be disregarded. Examples of the latter that are not controversial include trust, accountability, privacy and many others. Controversial ones would discuss public ideals and government structure [20].

Two methods can be combined to define the e-Government domain. One is to take into account all of the precise definitions that academics and organizations adopt in order to describe the field. On the other hand, analyzing the consequences of what is carried out in practice and research under the umbrella of e-Government is the other, complementary

strategy. Definitions of the e-Government domains can include both depth and breadth approaches. Depth refers to how well models address the issues at hand, including the relationship with the government, while breadth refers to how well they cover all the issues and people involved [20].

2.2. The Advantages of e-Government

The research findings showed that performance expectancy, social influence, facilitation conditions and trust in the internet positively affect the behavioral intention to use services, while in addition, trust factors enhance performance expectancy, a relationship that had not been examined previously in the context of e-Government [3,21]. On the other hand, the factor of effort expectancy and trust in the government did not have a significant effect on citizens' behavioral intention. The results of the study, as Figure 1 shows, can serve as a guide for policy makers and practitioners to improve and promote e-Government services in Greece, responding to what citizens consider to be priorities, as shown in the following figure.

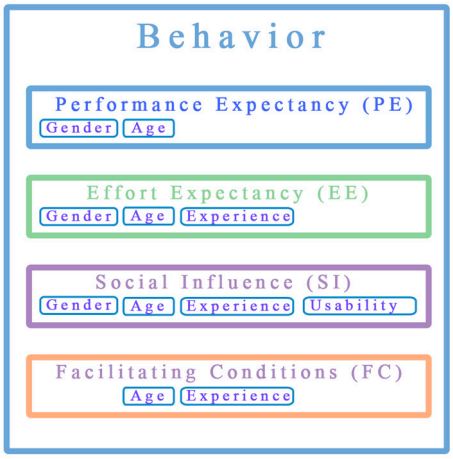


Figure 1. Unified theory of acceptance and use of technology [22].

Developments in Information and Communication Technologies (ICT) have led to radical changes in public services via the internet, laying the foundations for the concept of e-Government. E-Government aims to reform governance processes through the use of modern ICTs, which has led to the creation of national websites and portals in many countries, as stated in the 2014 UN report. Furthermore, the advantages of e-Government are highlighted, such as 24 h access, transparency, enhanced engagement between citizens and government, reduced costs and improved quality and speed of services. However, the number of citizens adopting these services is a critical indicator in order to evaluate their success. Despite the fact that there are many models and theories explaining the adoption of technology and e-Government, the gap in the literature is evident in the case of Greece, where there has been no adequate analysis of adoption from the user perspective, despite the fact that its implementation began almost two decades ago [22].

2.3. Separation of e-Government Services

E-Government can be classified into different forms based on who the recipients of the services are.

One of the main categories is G2C (Government to Citizen), where the government provides digital services to citizens. This allows access to public information and electronic transactions such as paying taxes or submitting requests for documents, as well as citizen participation in decision-making processes through interactive platforms.

Another important category is G2B (Government to Business), which concerns services to businesses. In this context, government platforms facilitate processes such as licensing, tax management and regulatory compliance.

In addition, there is G2G (Government to Government), which refers to the exchange of information and cooperation between different government organizations. This form of governance aims to improve efficiency, reduce bureaucracy and create a unified data infrastructure for decision-making.

Finally, G2E (Government to Employee) concerns the provision of services to public employees, such as payroll management, training and access to internal government systems.

2.4. Transition from e-Government to e-Society

The transition from e-Government to e-Society is a process that involves the integration of technology not only in public administration, but also in social, economic and political processes [23–26]. The e-society seeks transparency and citizen participation in government processes through open data and interactive platforms. Some of the key factors influencing this transition are citizens' trust in digital services and the security and protection of users' privacy, as well as the utilization of modern technological tools. One of these tools is a CMS (Content Management System), which is used to manage a government digital platform. WordPress and other similar CMSs have been chosen by many governments to create websites and provide electronic services, due to their flexibility, adaptability and security. The transition towards a fully digital society requires a combination of technological infrastructure, government policies and social acceptance, while CMSs and secure digital platforms are the foundation for the success of this evolution. E-Governance allows for the creation of a more flexible and efficient administrative system, which reduces bureaucracy and enhances transparency and citizen participation [23].

2.5. Content Management Systems (CMSs), Artificial Intelligence and Their Relationship with e-Government

Content Management Systems (CMSs) and Artificial Intelligence (AI) play an important role in the evolution of government digital services (e-Government). CMSs are key tools for organizing and managing digital content, while Artificial Intelligence enhances the functionality of government systems, enabling the automation of processes and the provision of personalized services to citizens.

3. Content Management Systems (CMSs) in e-Government

Content Management Systems (CMSs) have evolved and are important tools for e-Government, allowing governments to create, manage and maintain web portals that provide services to citizens and businesses [27]. With the ever-increasing importance of the internet, government organizations cannot simply have a website, but must ensure that it is functional, secure, accessible and adaptable to the needs of users. A CMS offers a platform for easy content management without the need for advanced technical knowledge, allowing public authorities to quickly update information, ensure transparency and meet citizens' expectations for modern and easy-to-use digital services. Choosing the right CMS is recommended for the sustainability and success of government online platforms [27]. Moreover, there is a set of desirable characteristics in the choice of a CMS. Within the ones mentioned, the most relevant are:

- Ease of use;
- Low acquisition cost;
- Low maintenance cost;
- Speed in content development;

- Speed and accuracy in publishing content;
- Functions for collaborative work;
- Single access point;
- Customizable access via user type;
- Security.

An effective CMS should support multiple languages, have high-level security techniques, be flexible in presenting information and allow for the integration of new features through extensions or plugins. In addition, its architecture should allow the development of a single framework for different government portals, allowing adaptation to each entity without requiring the creation of separate solutions for each case. In addition, it should ensure interoperability between different government services and integrate APIs that allow automatic data exchange, reducing bureaucratic burden and improving the efficiency of digital services.

The choice of WordPress as the main platform for government websites is based on its scalability, large support community, ease of use and high security. Although initially created as a tool for managing blogs, it has evolved into one of the most flexible and powerful CMSs, used by governments and organizations worldwide. WordPress offers a dynamic architecture based on events and filters, allowing it to be customizable through plugins and themes, without requiring any modification of the system's core code. This feature is particularly important for e-Government, as it allows for the gradual expansion of services without the risk of incompatibility or data loss.

The integration of APIs into the CMSs of government websites allows for seamless connections with other digital services, offering increased interoperability and automation of processes. Through APIs, different government platforms can communicate with each other, ensuring the flow of data without the need for any human intervention. A typical example of API application in government services is the Greek myDATA service of the Public Revenue Authority, which allows businesses to digitally transmit their accounting data to the tax office. This process not only reduces bureaucracy but also enhances transparency and compliance with tax laws.

Implementing a CMS for government services requires the use of advanced web development technologies, such as HTML5, CSS3, JavaScript, PHP and MySQL, combined with cloud-based infrastructures for increased security and scalability. The implementation allows the unification of different services under a single system, improving user experience and reducing the development and maintenance costs. In addition, the use of modular architecture and security management mechanisms ensures the stability and long-term viability of the solution. CMSs play a crucial role in the success of e-Government, enabling governments to deliver modern, user-friendly and secured digital services to citizens. Choosing an open source platform, such as WordPress, offers customization and extensibility, ensuring that the system can continuously evolve with technological trends. API integration and interoperability with other platforms are critical factors in creating an integrated e-Government ecosystem, enhancing the efficiency of services and facilitating the relationship between the state, citizens and businesses [28].

4. Artificial Intelligence (AI) and Its Application in e-Government

e-Government is a vital factor in the effective delivery of government services to citizens and decision-makers. Its goal is to increase efficiency and reduce the cost of services through digitization and automation of processes. With the advancement of technology, governments are seeking to integrate advanced technologies, such as Artificial Intelligence (AI) and the Internet of Things (IoT), in order to enhance the functionality and effectiveness of their digital services [29,30]. However, to achieve a comprehensive

transformation, governments must overcome critical challenges related to interoperability, data security, sustainability and ethical use of technology (Figure 2).

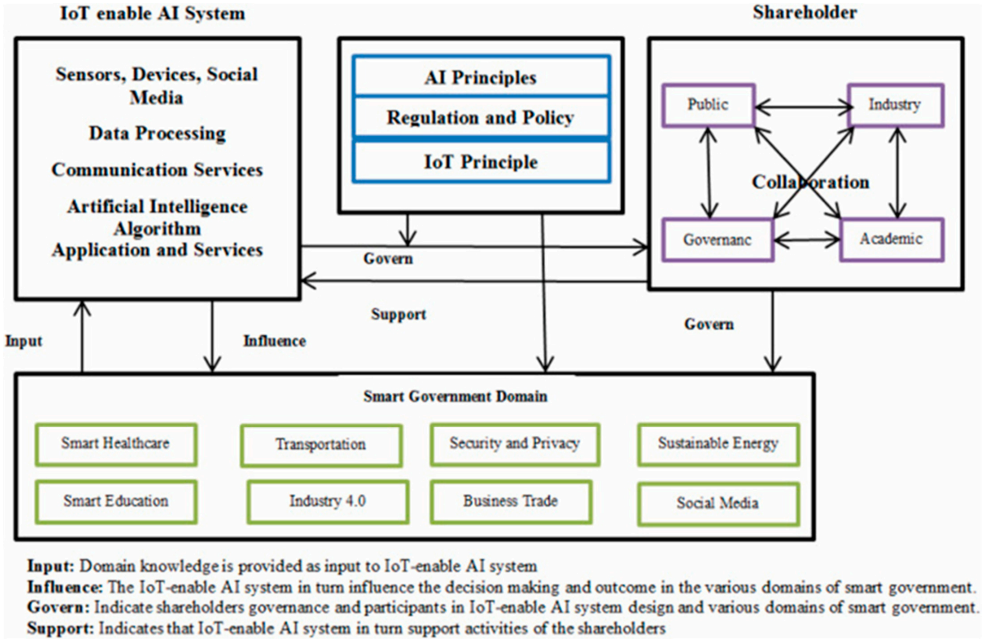


Figure 2. Generic description of data entry into IoT-enabled AI system.

Artificial Intelligence (AI) allows for the improvement of e-Government services through automated systems capable of processing huge amounts of data and supporting governments in decision-making [31–34]. Integrating AI techniques into e-Government systems can lead to process optimization, better citizen service, increased transparency and faster response to citizen needs. Governments can use machine learning and deep learning technologies to analyze data and predict needs, such as traffic management, public safety and environmental pollution monitoring. AI can also enhance information security and help detect and prevent cyber-attacks, protecting citizens' data.

On the other hand, the Internet of Things (IoT) also plays an important role in e-Government, as it allows for the collection and analysis of data from sensors, cameras and other smart devices in real time [35–38]. IoT applications in e-Government include traffic management, environmental monitoring, urban security, smart agriculture and e-health. Through IoT, governments can receive more accurate and timely information about the condition of infrastructure and take immediate interventions to prevent problems.

However, the widespread adoption of AI and IoT in e-Government faces challenges. One of the biggest issues is interoperability, as government systems and data need to be integrated and communicate with each other through common standards. In addition, data security and privacy are key concerns, as the collection and storage of personal information can expose citizens to risks of data breaches and cyber-attacks.

Contributing to deterrence, AI and IoT can be used to enhance security through anomaly detection algorithms that identify suspicious activities in real time. Additionally, environmental sustainability is another important factor, as the use of IoT and AI requires huge computing resources, which can increase energy consumption. To address this issue, governments need to invest in energy-efficient data centers and green technologies. Another critical issue is the ethical challenges associated with the use of AI, as the algorithms used for decision-making may exhibit bias and create issues of trustworthiness and transparency.

To effectively implement these technologies, it is proposed to develop an integrated framework that will allow governments to combine AI and IoT into a common system,

which will optimize public services and ensure data protection. Governments must invest in partnerships with academic and research institutions, promote legislative regulations that ensure transparency and privacy protection, and strengthen citizens' digital education so that they can fully utilize the potential of digital services. All of the above topics are schematically described in the image below which summarizes the concepts and relationships.

Summarizing, the integration of Artificial Intelligence and the Internet of Things in e-Government can lead to a smarter, clearer and more efficient public administration, provided that the challenges related to security, interoperability and ethical use of technology are addressed. With proper design and implementation, digital services can improve the quality of life of citizens and offer a more flexible, secure and user-friendly public system [31].

5. Social Media Applications and e-Government

5.1. The Role of Social Media in Public Administration

Social media have become integral parts of modern public administration, contributing to the creation of a more transparent and participatory communication framework between governments and citizens [39–43]. In contrast to traditional e-Government services characterized by a one-way flow of information (government-to-citizen), social media offer new possibilities for two-way communication, allowing citizens not only to receive information, but also to comment, make suggestions and co-shape public policies. Transparency is enhanced as information is disseminated more directly and widely, while government agencies are called upon to respond and publicly account for questions and concerns. Especially in times of crisis or in cases of important public announcements, social media can function as key information channels, bypassing bureaucracy and reducing the time delay in disseminating critical information.

However, this new form of communication also comes with challenges, such as privacy issues, information security problems and the risk of spreading inaccurate or misleading information.

According to a survey conducted among small local governments in Nebraska, Facebook and Twitter are the two most popular social media platforms used by local governments to communicate with the public.

Facebook is primarily used to provide information and strengthen existing social ties within a local community. Governments use it as a complementary information channel, posting announcements, information about events and reminders about deadlines, such as paying bills or submitting applications. Twitter, on the other hand, is used more for rapid dissemination of information, such as real-time updates (e.g., weather conditions, emergencies, various events) and for broadcasting political decisions and announcements. The platform allows for the rapid dissemination of messages to a broad audience, even to users who are not directly connected to the local community. However, despite the potential for interactivity, the use of these two platforms by local governments remains largely one-way, focusing more on information and less on participatory decision-making.

Nebraska is a prime example of the use of social media by small local governments. A 2015 survey found that 44.8% of small local governments use Facebook, while 31% use Twitter. These governments have adopted social media as a tool that is complementary to traditional e-Government services, but with distinct approaches [44]. Nebraska's small local government sections use Facebook more for providing transactional services (e.g., paying bills, registering for services), leveraging its popularity and the ability for users to share such information within their network. Twitter, in contrast, is preferred for public policy updates, announcements and general information, due to its ability to disseminate content in real time and to a wider audience. The research also revealed that factors such

as population density, budget and institutional policies significantly influence Facebook adoption, while Twitter usage appears to be more independent of such factors. Smaller and less organized local government departments are hesitant to invest in managing social media accounts, mainly due to a lack of expertise and staff.

5.2. Benefits and Challenges of Social Media in Public Administration

The use of social media by local governments offers significant benefits as well as challenges [43]. On the one hand, social media enhances transparency, promotes immediacy in communication and creates opportunities for participatory governance, allowing citizens to express opinions and make demands directly to authorities. Furthermore, the reduced need for intermediaries (e.g., media) reduces the cost of communication and strengthens citizens' sense of proximity and trust towards local authorities. Social media can function as powerful tools to enhance e-Government, provided that they are part of a clear digital governance strategy and accompanied by the necessary institutional, organizational and technological adjustments [45].

However, there are also serious challenges, such as the lack of clear usage policies, insufficient staff to manage accounts, risks of privacy breaches and misinformation management. In addition, small local government departments often lack the technical skills and resources to fully exploit the interactive features of social media, resulting in them remaining trapped in a passive information model [45].

5.3. The Role of Social Media in Public Health and e-Government

Public health is one of the most critical areas of government responsibility, absorbing a significant proportion of national spending worldwide [46]. In recent years, as governments attempt to adopt e-Government models to improve transparency, participation and service delivery, social media have emerged as important tools for communication and interaction.

In reality, public health organizations use platforms such as Facebook, Twitter, and YouTube to communicate with citizens, disseminate information, promote participation in public consultations, gather opinions and enhance accountability. This use of social media is part of the broader context of e-Government, which seeks to bring citizens closer to decision-making and enhance the transparency of public organizations.

The main objectives of using social media fall into four basic categories of e-Government:

- Transparency and accountability: Social media act as platforms where public organizations share information about services, actions, programs and policies. This enhances transparency and citizen awareness;
- Democratic participation: Through social media, citizens can comment, express opinions and participate in public consultations on health issues;
- Co-operation: Although a less developed practice, some organizations use social media to solicit proposals or invite citizens to joint actions;
- Evaluation: Here social media posts feedback on the quality of services provided.

Particularly important is the category of evaluation, which emerged as a new theme from the review, showing the importance that citizens attach to providing comments and evaluations regarding their experience of public health services [46].

On the other hand, using social media for e-Government purposes cannot always be implemented successfully due to the following reasons:

- Absence of a clear strategy: Use is fragmented, without a unified strategic plan;
- Untapped data: Data resulting from social media interactions is not systematically analyzed to provide useful information for improving services;
- Ethical issues: Using personal data or citizen comments for research purposes raises privacy and consent issues;

- Risks of manipulation: Organized campaigns by interest groups can distort deliberations and disproportionately influence political decisions.

5.4. Social Media and the Greek e-Government Case

At this point, while analyzing the role of social media in the general public sector as implemented by other countries, we would like to point out the lack of official usage of social media platforms by the Greek government [47–49]. As previous research based on interviews with the social media managers of Greek government agencies from the central, regional and municipal government shows, it is concluded that in the examined government agencies, social media are used only to a small extent for enhancing their absorptive capacity (ACAP), making limited exploitation of the potential that social media have for this purpose. In particular, social media services are utilized to a certain degree by the Greek government to improve one of ACAP's essential components, which is the capacity for external exploratory learning, but not at all to improve the other two: the capacity for exploitative and transformative learning.

Finally, recognizing the benefits of social media usage by public administration and the fact that WordPress already provides all the necessary tools and means to host external agents or communicate through APIs with social media apps, this strengthens our choice to use WordPress as the development platform because of its capability to link with these external social media services like Facebook, Twitter, etc., through the available information transfer channels and plugins.

6. The myDATA Service of the e-Government Infrastructure of Greece

Describing the Current State of the myDATA Service

The digital transformation of public administration is one of the most important challenges and at the same time the most important opportunity for Greece, as it is directly linked to improving the functionality of the state, serving citizens and enhancing transparency and accountability [50,51]. The concept of digital governance (e-Government) describes the use of Information and Communication Technologies (ICT) to provide public services, enhance citizen participation and improve the efficiency of administration. In this context, the Greek state has promoted a series of digital initiatives over the last decade, with a leading example being the implementation of the AADE's (Independent Authority for Public Revenue) myDATA system, which introduces electronic bookkeeping for businesses and seeks to transform the tax administration landscape in Greece [12–15,52].

In the case of Greece, Digital Governance (e-Government) is not limited to the electronic provision of services, but achieves a comprehensive framework for the reformation of public administration. In Greece, the need for digital modernization became more intense after the economic crisis and the demands for increased transparency and the fight against tax evasion. The National Digital Transformation Plan (2020–2025) describes the strategy of the Greek state with the following key points:

- Improving citizens' access to public services;
- Reducing bureaucracy;
- Transparency in the management of public resources;
- Improving accountability and tax compliance.

In this context, tax management and interaction with businesses occupy a central position, with myDATA being the emblematic reform of the Public Administration and Revenue Authority, which brings the mandatory maintenance of electronic books and the automatic transmission of data to the tax office.

One of the most important technological innovations introduced by myDATA is the use of the REST API for data transmission. The API allows businesses to directly connect

their accounting systems (ERP) with the AADE platform, automating the process of sending and updating electronic books. In this way, uninterrupted data flow is ensured and errors caused by manual entry are avoided [53]. The use of the API makes myDATA flexible and extensible, as it allows accounting programs from different vendors to be interconnected in a unified manner, while at the same time creating the conditions for further automation and interoperability in the future, based on the current capabilities such as the following:

- Management of income/expenses documents;
- Linking and characterizing/tagging transactions;
- Matching transactions between suppliers and customers;
- Receiving reports and updates on the status of electronic books.

Implementing the above services, the myDATA timologio service, for example, can ensure that the myDATA application offers the tax administration of the Greek government a direct access to analytical data. This enhances tax transparency and drastically reduces the opportunities for income concealment. Moreover, the automated transmission and electronic exchange of data between the parties creates a closed system of cross-checks, limiting the possibility of discrepancies and creating a comprehensive control system. Last but not least, myDATA acts as a catalyst for digital modernization, especially for small and medium-sized businesses that until recently maintained classic handwriting logistics books. This transition requires investments in accounting software and training, but contributes to the overall digital maturity of the Greek economy.

7. Implementing the Basic Scenario

7.1. General Description and Required Knowledge

At this stage, we should become familiar with the web programming environment based on Content Management Systems (CMS) using WordPress tool. Our goal is to build a fully functional mechanism that is able to perform services equivalent to AADE's "timologio" service that currently serves the needs of Greek businesses (https://www.aade.gr/timologio, accessed on 20 May 2025). Timologio is the application provided free of charge by the Public Administration for the digital publication of business documents and their simultaneous transmission to myDATA. Its target group can be considered to be all Greek corporations that either do not have a digital system able to carry out the necessary functionalities or do have the required digital systems but they can no longer cover their daily needs because of the newly created services and requirements by the Greek government.

Through a fully customizable environment, a business can create its online profile, compose its customers list, organize its products and services, and issue its invoices, while simultaneously sending all the necessary information to the myDATA platform accordingly.

7.2. Main Services to Implement in Order to Achieve Basic Functionality

Our role in this phase is to analyze and improve the tool's processes and build a corresponding service that is able to provide a fully functional and autonomous website (frontend & backend). Serving the business partners (who are the main customers of the AADE main services) and protecting the society as a whole is a strategic objective of the Public Administration. The continuous improvement of the service and the provision of quality services constitute a prerequisite for an effective and efficient tax administration that focuses on the taxpayer. The simplification and digitalization of procedures contributes to improving the service time for citizens and businesses, reducing the physical presence and communication of taxpayers with the services, as well as reducing the administrative burden that all involved parties are called upon to bear. As part of the above framework, the «timologio» service (which means invoice), is a useful tool for the taxpayers to quickly and

securely carry out their transactions with the Public Revenue Authority, taking advantage of the digital innovative services provided by the Greek government. In order to support the above requirements, the website must be able to support a secured Registration—Login service. The user of the page, moreover, should be able to perform at least the following tasks (Figure 3):

- New customer registration;
- New product registration;
- New invoice issuance;
- Customer list observation;
- Product list observation;
- Invoice list observation.



Figure 3. Basic interface of the myDATA platform.

As the following figure shows, we were able to fully manage to reproduce the interface of the initial platform easily, implementing a CSS close enough to the real system.

7.3. Database Relational Model

The design of the database was based on the data we were able to extract from the actual myDATA platform. In the figure below, we can observe the basic tables and the relationships between the entities. It should be emphasized that the mechanism was not fully implemented because as far as we know, there is no available source that presents the database schema in its current state (Figure 4). The database used is MySQL and the API for connecting to the database is in PHP 8.

7.4. PHP Code Injection in Order to Implement Necessary Forms and Services

One of the most popular and useful features of WordPress is the ability to insert PHP code or change the existing one. Also, one of the flexibilities of the system is the fact that the new code can easily make use of the existing one and call services while possessing all the rights and capabilities of WordPress. For example, using the plugin "Woody code snippets" you can easily insert PHP code and the plugin generates shortcodes that can be inserted in the appropriate places. The reason why it was chosen to import code through this particular plugin is that in this way we do not need to affect the code that concerns the core operation of WordPress and thanks to this, the entire system can successfully perform the necessary upgrades without affecting the operation of the algorithms that have been added by us. This means that we are able to simultaneously achieve the continuous operation of

our own algorithms and the continuous ability to upgrade all parts of the platform that hosts us. So, we are able to operate according to the operating rules of WordPress but also maintain a form of autonomy and encapsulation or separation from the rest of the system. For example, as Figure 4 shows, we can easily connect to the same database as the WordPress core is connected and perform queries on our tables which are also hosted in the same MySQL database. The example shows the execution of a simple and generic SELECT Query making use of the system provided "*get_results()*" function which in this case can retrieve data from specific columns in the given table [54]. Although there are other ways to retrieve data from database in WordPress, we choose the following approach due to its simplicity and clarity.

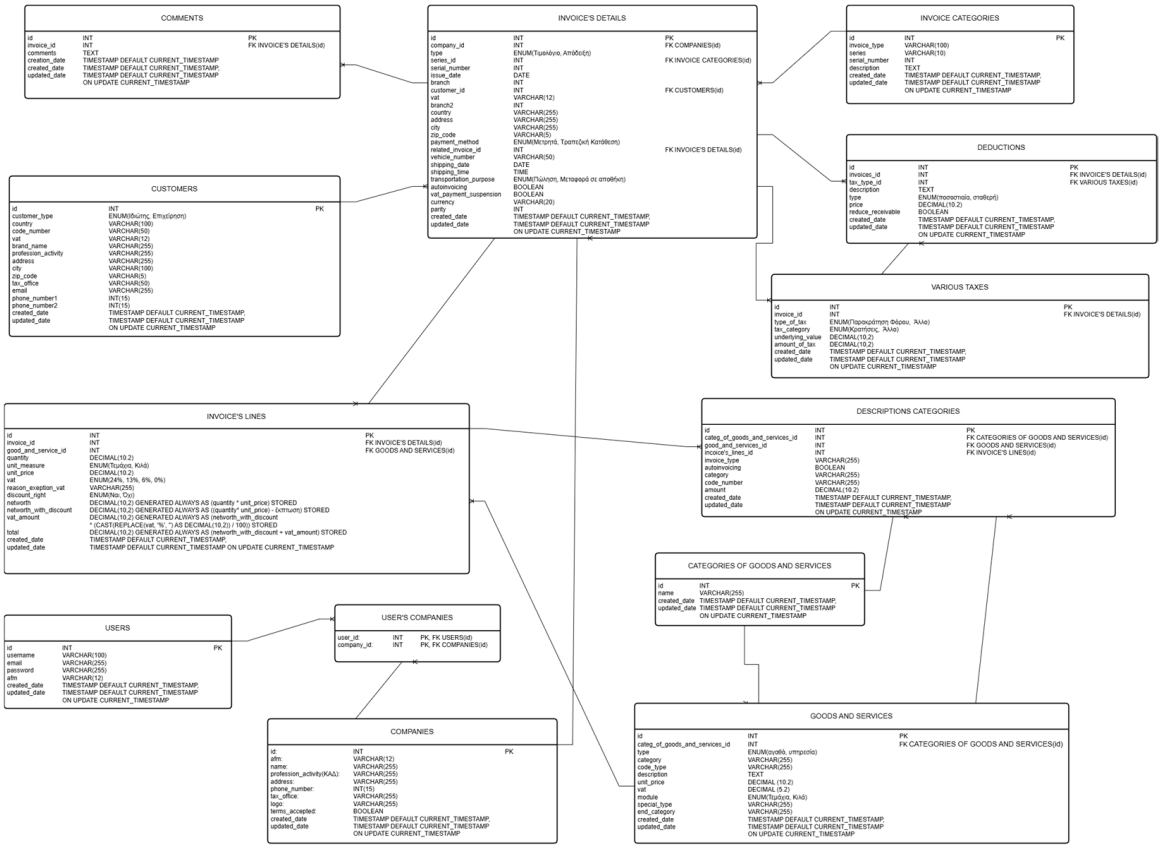


Figure 4. Presenting the Relational Diagram of the Database.

WordPress provides a global object, $wpdb, which is an instantiation of the wpdb class. By default, $wpdb is instantiated to talk to the WordPress database. An instantiated wpdb class can talk to any number of tables, but only to one database at a time. In the rare case you need to connect to another database, instantiate your own object from the wpdb class with your own database connection information. The $wpdb object can be used to read data from any table in the WordPress database, not just those created by WordPress itself. The "*get_results()*" method returns the entire query result as an array. Each element of this array corresponds to one row of the query result and, like get_row, can be an object, an associative array, or a numbered array. If no matching rows are found, or if there is a database error, the return value will be an empty array. If your $query string is empty, or you pass an invalid $output_type, NULL will be returned (Figure 5).

```
////////// Server Side - BackEnd for Database Select //////////
// Execute a select query to retrieve a column from database //
function make_database_get_columns_query( $table, $columns )
{
    $results = $GLOBALS['wpdb']->get_results( "SELECT $columns FROM $table" );
    foreach ($results as $result)
    {
        echo "<tr>";
        foreach ($result as $name => $value)
            echo "<td class=\"w3-border-0 w3-border-bottom\" id=\"$name\">$value</td>";
        echo "</tr>";
    }
}

?>

<div class="w3-container w3-section w3-padding" >
    <table class="w3-table w3-hoverable" id="OSD">
        <tr class="w3-light-grey">
          <th class="w3-border-0 w3-border-bottom">ID</th>
          <th class="w3-border-0 w3-border-bottom">Cost</th>
          <th class="w3-border-0 w3-border-bottom">UploadDate</th>
          <th class="w3-border-0 w3-border-bottom">UserID</th>
        </tr>
        <?php make_database_get_columns_query( "invoices", "ID, Cost, UploadDate, UserID"); ?>
    </table>
</div>
```

Figure 5. Executing a SELECT Query through PHP source code and WordPress.

7.5. WordPress and AI Engines Integration

To further assist the e-Government to citizens' services and communication, WordPress can easily be extended to encapsulate, integrate or cooperate with open source LLM AI Engines. Integrating an open source LLM model into a WordPress website can result into a powerful AI conversational builder that lets you create chat bots or AI agents [55]. Also, integration with your favorite LLM model, whether it's by using ChatGPT Version 3.5 [56,57], Mistral [58], Gemini [57,59] or other models can be easily implemented thanks to well-known free plugins. AI Engines can seamlessly connect WordPress with the world of AI, bringing modern AI capabilities straight into our site [60–62]. For example, we can create a chat bot to assist Greek or foreign citizens, answer support questions, or guide users through the myDATA services [63–67]. This service could be really beneficial for citizens due to the huge bureaucracy problem that Greece is facing [50,51,68,69].

AI Engines can also translate Greek e-Government infrastructure services naturally into other languages (which remains an issue since Greek government websites are not always translated into English "or into other languages" since the English language usually remains the only alternative choice and even that is not always provided) [64,66,67]. For developers, AI Engine provides internal APIs, flexible short codes, and sophisticated real-time voice to code capabilities. On top of WordPress, with LLM and AI Engines we can develop our own AI-powered tools, automate processes, or even build SaaS apps [70–75].

8. Introducing AI Algorithms for the Automatic Detection of Financial Violations by Citizens

8.1. Designing the Neural Network

A major problem for the Greek government is that the myDATA platform did not emphasize or focus from the beginning on the development of smart algorithms for the automatic execution of smart systems that would be able to carry out controls and cross-checking mechanisms on their own. For this reason, one of the areas we investigated is the possibility of applying Machine Learning and Neural Network algorithms for the automatic processing of tax violations checks on Greek citizens [76–78]. In short and in simple words, the mechanism that was implemented approaches the problem of finding possible violations by using the K Nearest Neighbors (KNN) search algorithm to be able to find similarities between the data that existing users have and the data concerning people

who have already committed tax fraud [79–81]. In order to be able to understand the mechanism that was implemented, we must first be able to understand the basic concepts of Neural Networks, analyze the code that was developed, as well as the necessary training that should be carried out in a Neural Network and finally interpret the results that can be extracted [82–84].

An Artificial Neural Network (ANN) is a model designed to mimic the learning process of the human brain [85–89]. ANNs can recognize and can detect underlying patterns in data and learn from them. They are used for the following:

- Classification;
- Regression;
- Segmentation;
- Clustering;
- etc.

In order to achieve successful operation of the Neural Network, we must convert any data into a numerical form before feeding it to the neural network. By performing this conversion appropriately, many different types of data (for example, visual, text, time series and so on) can be given as an input to the appropriate algorithms in order to be able to extract the correct results.

To achieve our goal we need to understand how to represent problems in a way that can be understood by artificial neural networks. The human learning process is hierarchical. There are several stages in the neural network of our brain, where each stage corresponds to a different level of detail and granularity.

For example, the visual recognition of a box by our human brain involves the following:

- The first stage identifies simple things, like corners and edges;
- The next stage identifies the general shape;
- The next stage identifies the type of object.

To simulate the learning process of the human brain, an artificial neural network is created using layers of neurons. Neurons, or as they are called in computer science "Perceptrons", are inspired by biological neurons. A Perceptron is the building block of an artificial neural network. It is a single neuron that receives inputs, performs calculations on those inputs and then produces an output. To calculate the output based on the inputs, it usually uses a simple linear function. For example, with an N-dimensional input data point, it calculates the weighted sum of the input and then adds a constant (bias) to produce the output. These simple Perceptrons are used to design very complex deep neural networks as shown in the following Figure 6.

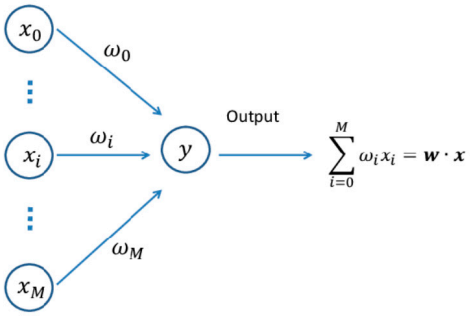


Figure 6. Creating a Perceptron classifier.

Furthermore, each layer is a set of independent neurons and finally, each neuron in a layer is connected to the neurons in the next layer. The layers between the input and output layers are called hidden layers.

A simple neural network consists of a few layers. A deep neural network consists of many layers. If we are dealing with N-dimensional input data, then the input layer will consist of N neurons. If we have M distinct categories/classes in the training data (as possible outputs), then the output layer will consist of M neurons (as shown in the Figure 7 below).

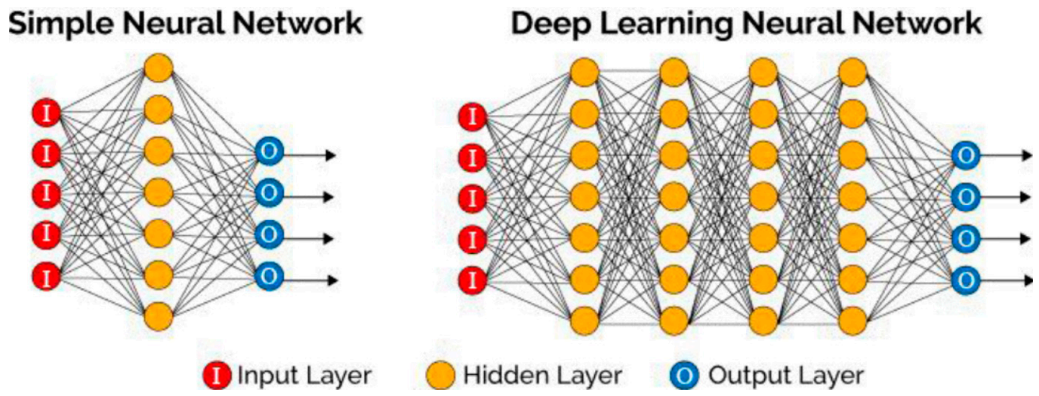


Figure 7. Designing simple versus deep Neural Networks.

8.2. Implementing the Neural Network as a Back End Server Side Service Using Python Programming Language

Machine learning systems are usually built using different modules that are combined in a specific way to achieve an end goal (the creation of pipelines) [90]. The functions of the scikit-learn library allow us to create such pipelines that combine modules together. We need to define these modules along with their corresponding parameters. The pipeline can include modules that perform various functions:

- Feature selection;
- Pre-processing;
- Random forests;
- Clustering;
- etc.

Recommender systems use the concept of nearest neighbors to find good recommendations. This is the process of finding the closest points to the input point from the data set. That is why we use sorting based on the proximity of the input data into different categories. To find the nearest neighbors of a given point in Python we will write the following code (Figure 8).

A K Nearest Neighbors (KNN) classifier is a classification model that uses the nearest neighbor algorithm to classify a given point. The algorithm finds the K closest data points in the training data set (known points) to determine the point's category. It then categorizes the point based on the majority of neighboring points. From these K data points, we examine the corresponding categories and select the one with the largest number of points. The value of K depends on the problem.

To achieve our goal we load the input data from data.csv (CSV format), which in this example that we use, it contains four categories/classes as we see from the figure in case (1). Then, in case (2) we map the training points using four different shapes and the mapper variable to map each shape to the different classes. At point (3), we define the number of nearest neighbors and the grid step size that will be used to visualize the model boundaries. At point (4), we create the KNN model and train it with the training data. At point (5), we create the value grid that will be used to visualize the model. At point (6), we evaluate the classifier at all points in the grid to create a visualization of the boundaries. Finally, at point (7), we create a color grid to visualize the model output (Figure 9).

```
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.cm as cm
from sklearn import neighbors, datasets

# Load input data
input_file = 'data.txt'
data = np.loadtxt(input_file, delimiter=',')                    (1)
X, y = data[:, :-1], data[:, -1].astype(int)

# Plot input data
plt.figure()
plt.title('Input data')
marker_shapes = 'v^os'                                          (2)
mapper = [marker_shapes[i] for i in y]
for i in range(X.shape[0]):
    plt.scatter(X[i, 0], X[i, 1], marker=mapper[i],
            s=75, edgecolors='black', facecolors='none')

# Number of nearest neighbors
num_neighbors = 12
                                                                (3)
# Step size of the visualization grid
step_size = 0.01

# Create a K Nearest Neighbours classifier model
classifier = neighbors.KNeighborsClassifier(num_neighbors, weights='distance')

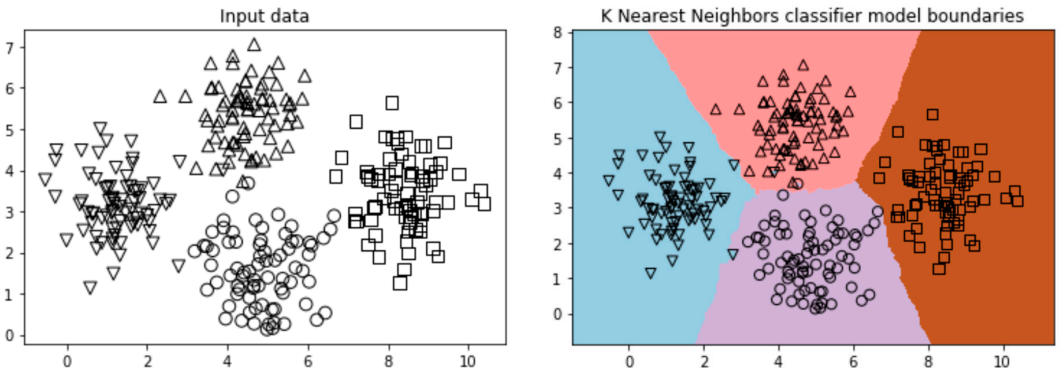
# Train the K Nearest Neighbours model                          (4)
classifier.fit(X, y)

# Create the mesh to plot the boundaries
x_min, x_max = X[:, 0].min() - 1, X[:, 0].max() + 1
y_min, y_max = X[:, 1].min() - 1, X[:, 1].max() + 1             (5)
x_values, y_values = np.meshgrid(np.arange(x_min, x_max, step_size),
    np.arange(y_min, y_max, step_size))

# Evaluate the classifier on all the points on the grid (6)
output = classifier.predict(np.c_[x_values.ravel(), y_values.ravel()])

# Visualize the predicted output
output = output.reshape(x_values.shape)
plt.figure()                                                    (7)
plt.pcolormesh(x_values, y_values, output, cmap=cm.Paired)
```

Figure 8. Python implementation of the K Nearest Neighbors algorithm to detect tax violations.



(**a**) (**b**)

Figure 9. (**a**) We map the training points using 4 different shapes and the mapper variable; (**b**) A color grid to visualize the model result.

8.3. Training the Neural Network

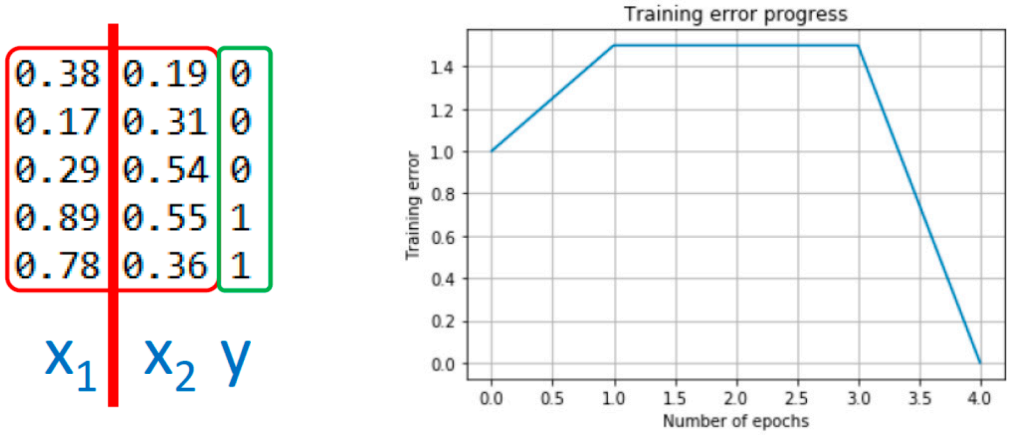
Training a Neural Network is one of the most important phases in the development of an Artificial Intelligence algorithm. A single Perceptron is limited to linearly separable data. With a set of Perceptrons working together, we can overcome this limitation. To allow for greater accuracy, we need to give the neural network more freedom. This means that more than one layer of Perceptrons is required to extract the underlying patterns in the training data.

The first step for a successful training operation is to collect the appropriate training data and label it. Each neuron acts as a simple function and the neural network is trained until the error falls below a certain value. We define the error as the difference between the predicted and actual output. Based on the error, the neural network is adjusted and retrained until it gets closer to the solution.

As input and training data for the Neural Network, we used the information present in the tables of users and invoices in the MySQL database after exporting the tables to CSV local files. In addition, the algorithm is general purposed and not directed. This means that it is able to also process the remaining tables and find correlations. In this CSV file, the auditors appointed by the Greek government could very easily add an extra column of data as the last one, for example with additional information in binary format 0–1, in order to state with the number zero the opinion that the specific individual does not appear to have committed any accounting violation or with the number 1 to state the opinion that the specific individual appears from the financial data concerning him to have committed a violation.

In a more advanced version of the application, the extra column may not contain a simple binary version of the information but values from 0 to 10 (0, 1, 2, . . ., 10), so that tax auditors could more accurately state the probability that someone has committed a tax violation. In this way, the Neural Network can be trained so that in the future it can automatically perform checks and, based on the similarity of the entries in the database by the according users or invoices, it can automatically extract lists of suspicious individuals who should be checked by a person who is an employee of the Greek government.

To describe our statements more accurately we are providing the following example. As shown in Figure 10, let us assume that in our example we have only two columns extracted to the local CSV file from our users concerning table in our database. Moreover, let us assume that a government employee checked these entries and decided to mark the first three persons with the value zero because they do not seem to have committed a violation and the following two persons with the mark one because they look suspicious and must be checked in person. Because of this, the first two columns will be considered as input data for our neural network (X1, X2) and the last column will be considered as the preferred output value (Y) according to the input data provided. This example is providing just a binary approach and the real implementation could be much more complicated. Figure 10b shows the progress of the training error while the Neural Network keeps repeating its learning processes.



(**a**) (**b**)

Figure 10. (**a**) The description of the content of the csv file which will be given as input to the ANN; (**b**) Description of the training progress of the Artificial Neural Network.

8.4. Detecting Financial Violations by Citizens Using Developed AI Algorithms

In order to be able to make a successful prediction of accounting violations, we need to define a test data point to see how the classifier works. To visualize the information (as shown in the figure below), we need to create an image with training data points and a test data point. Then, we extract the K Nearest Neighbors to the test data point and plot them in a new plot. Finally, we print the prediction (classification) of the test point.

By testing our data, we found that KNN can achieve a tax violation detection rate of up to 90%, with typical results ranging around 80%, which can significantly improve the Greek citizen monitoring system (Figure 11).

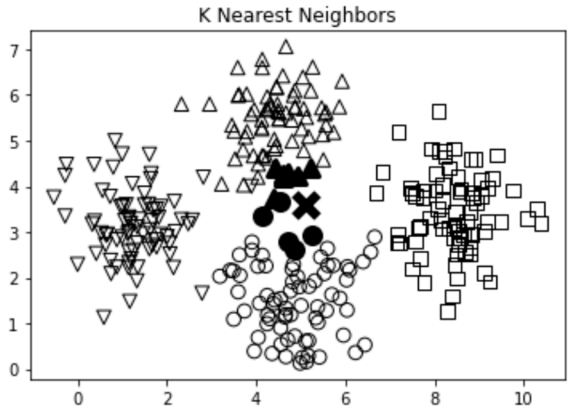


Figure 11. Prediction (classification) of violations as shown as a test point in our data.

We must point out the fact that the algorithm provided to detect tax violation can be considered to be cost effective since it only uses known Neural Networks methods and free to use Libraries. In the design and implementation of the Artificial Intelligence mechanisms, we tried to adopt solutions that would not be costly so that in case that a governmental infrastructure would like to use them, the purchase or cost of software development would not be a problem.

9. Conclusions

The myDATA platform is a major digital intervention that is transforming the tax landscape in Greece. Despite the difficulties of adaptation, the platform offers substantial added value to both the tax administration and businesses, while it is part of the overall digital governance strategy. Its success depends on ongoing support and continuous adaptation to market needs [91–93]. The implementation of myDATA was accompanied by a series of technical, operational and organizational challenges:

- Lack of adequate information and training of businesses;
- Complex transaction scenarios that are not adequately covered;
- Technical problems with ERP and the transmission API;
- Resistance from small businesses with low digital knowledge.

Although several problems were found during the development and operation of the myDATA system, the final result shows that it has contributed to the Greek government and the taxation system of Greek citizens.

In this study we focused on using WordPress CMS to quickly, easily and inexpensively develop a similar platform to the Greek government's myDATA service. We identified and implemented the basic functionalities that a similar platform should contain. We developed a relational model for the database so that the patterns of our own platform are similar to the real myDATA service. We also indicate how developers could introduce their code into WordPress without getting involved and modifying its basic functionalities. Finally, we

demonstrate that the Greek government could easily and quickly equip its mechanisms with Artificial Intelligence algorithms for the automatic detection of tax violations by Greek citizens. As shown by the results of the approach we studied in this publication, the platform could have been developed more rapidly and at a substantially cheaper cost, and it could have been able to handle the essential and rapid adjustments that the platform will have to comply with much more swiftly, even with a good reaction.

These factors make WordPress development crucial because this CMS platform ensures a quick and developer-friendly environment. In addition, thanks to the existence of plugins, the basic and necessary functions concerning critical services of the myDATA platform such as user account management, user action monitoring, implementation of security systems and tools and so on, are already available as plugins from the official WordPress platform. It is important to emphasize that all plugins used gave us the right of free use or use within normal parameters and even if they had been purchased, again, the cost would have been significantly less than the actual cost it took to develop the actual myDATA platform. Also, thanks to the ability to import custom made PHP code into the WordPress basic functionality source code, we can easily, quickly and securely develop all the necessary forms and functions.

Finally, as future work, we intend to investigate further the use of AI methods and the use of LLM for dynamic code snippets generation [94,95] in order to make use of text to code generation because we believe that this optimization can greatly improve government to citizens service and to the best of our knowledge it is not supported by the current infrastructure of the Greek government's myDATA platform. Additionally, voice to code generation service could have a significant impact, using techniques mainly used by chat bots, providing the necessary means to the citizens to interact verbally with the system. Thanks to the general architecture used, the implementation topology of the services and the Artificial Intelligence algorithms provided using the Python programming language (giving the possibility of applying smart AI algorithms for the automatic detection of financial violations by citizens), we proved that the Greek government could very easily implement a similar approach to ours, which would be completely safe, functional and at a very low cost.

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Abbreviations

The following abbreviations are used in this manuscript:

DOAJ	Directory of open access journals
ANN	Artificial Neural Network
KNN	K Nearest Neighbors
LLM	Large Language Model
ACAP	Absorptive Capacity
AADE	Greek Independent Authority for Public Revenue

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