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Automated Invoice Processing using Low Code Technologies

A Case Study and App Development

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Declaração

Declaro que o presente documento é um trabalho original da minha autoria e que cumpre todos os requisitos do Código de Conduta e Boas Práticas da Universidade de Lisboa.

Declaration

I declare that this document is an original work of my own authorship and that it fulfills all the requirements of the Code of Conduct and Good Practices of the Universidade de Lisboa.

Abstract

This master thesis describes a collaborative project with a medical insurance organization aimed at improving its outdated invoice management process. Traditionally, customers had to submit their invoices in person or by mail, resulting in long delays of 3 to 4 months before reimbursements were processed. The early sections of the thesis provide a clear introduction and explore the organizational context, highlighting the inefficiencies of the existing processes.

The focus then shifts to explaining the Power Platform technology and the tools used to develop the new solution. This solution includes two Power Apps applications: a mobile app for customers to submit invoices digitally, and a desktop app to help employees process invoices more efficiently. A Power Automate flow, enhanced with AI Builder, automates the extraction of data from the invoices, changing the role of employees from entering data manually to simply checking that the data extracted by the system is correct.

The thesis demonstrates the improvements brought by the new system using a sample invoice and evaluates the new process in comparison to the old one. The mobile app makes it easier for customers to submit invoices, contributing to a better experience and a quicker start to the reimbursement process. The automated data extraction and validation processes save time, reduce errors, and allow employees to focus on more important tasks. In conclusion, the project significantly reduces processing times and improves the experience for customers, setting a new standard for efficiency in the insurance organization.

Keywords: Invoice Management, Process Automation, Power Platform, Digital Transformation

Resumo

Esta tese de mestrado descreve um projeto colaborativo com uma seguradora que opera no ramo da saúde, visando a melhoria do seu processo de gestão de faturas, que se encontrava desatualizado. Tradicionalmente, os clientes eram obrigados a submeter as suas faturas pessoalmente ou por correio, resultando em longos atrasos de 3 a 4 meses até que os reembolsos fossem processados. Os primeiros capítulos da tese proporcionam uma introdução clara e exploram o contexto organizacional.

De seguida, o foco é dirigido para a explicação da tecnologia Power Platform e as ferramentas utilizadas para desenvolver a solução. Esta solução inclui duas aplicações Power Apps: uma aplicação móvel para os clientes submeterem as faturas digitalmente e uma aplicação desktop para ajudar os funcionários a processar as faturas de forma mais eficiente. Um fluxo de Power Automate, combinado com o AI Builder, automatiza a extração de dados das faturas, mudando o papel dos funcionários de inserir dados manualmente para simplesmente verificar se os dados extraídos pelo sistema estão corretos.

A tese demonstra as melhorias trazidas pelo novo sistema usando uma fatura de amostra e avalia o novo processo em comparação com o antigo. A aplicação móvel facilita a submissão de faturas pelos clientes, contribuindo para uma melhor experiência no processo de reembolso. Os processos automatizados de extração de dados e validação poupam tempo, reduzem erros e permitem que os funcionários se concentrem em tarefas mais importantes. Em conclusão, o projeto reduz significativamente os tempos de processamento, estabelecendo um novo padrão de eficiência na seguradora.

Palavras-chave: Gestão de Faturas, Automatização de Processos, Power Platform, Transformação Digital

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List of Acronyms

API - Application Programming Interface

RPA – Robotic Process Automation

GUID - Globally Unique Identifier

AI – Artificial Intelligence

SaaS – Software-as-a-Service

1 Introduction

The present chapter intends to contextualize the Motivation (1.1), to state the Objectives and Deliverables of the dissertation (1.2), and to present the Thesis Outline (1.3).

1.1 Motivation

The field of Robotic Process Automation (RPA) is growing rapidly, changing the way businesses operate and handle complex tasks. My deep involvement in RPA within my current job has sparked a strong interest in exploring its potential further, particularly in the area of invoice processing and validation for medical insurance providers. Medical invoices follow certain patterns and require a high level of accuracy, making them an ideal candidate for automation. This aligns well with my skills and professional goals, presenting a valuable opportunity for learning and development.

Deciding to undertake this master thesis was a strategic choice, providing a bridge between my daily work responsibilities and a new application area filled with opportunities to learn and grow. The healthcare insurance sector is complex and demands precision, offering a unique environment in which I can apply and expand my automation expertise. This project not only aligns with my current professional path but also helps in advancing my understanding and skills in RPA and automation.

1.2 Objectives

In the rapidly evolving landscape of the medical insurance sector, efficient management of medical invoices is key for customer satisfaction. The primary objective of this master thesis was to conduct a comprehensive analysis of the medical invoice management process within the organization, a company in the medical insurance field. As the process was predominantly manual, involving the circulation of physical invoices for data validation, there was a clear opportunity for innovation and streamlining. This presented a unique challenge and a chance to significantly impact the operational efficiency of the organization.

One of the main goals was to document the existing processes regarding invoice management. This step was crucial, as it laid the groundwork for understanding the current workflow, identifying bottlenecks, and pinpointing areas with potential for automation. By doing so, it was possible to create a clear description of the current state of operations, providing a solid foundation upon which improvements could be built.

Concurrently, the development of a prototype solution to expedite the invoice management process was identified as a deliverable. Given the manual nature of the existing process, the introduction of a low-code app aimed at automating key aspects of invoice validation represented a significant leap toward modernization. This prototype not only served as a tangible proof of concept but also highlighted the potential benefits of automation within the organization.

In essence, the master thesis aimed to bridge the gap between the traditional, manual processes and the streamlined, automated workflows of the future. By documenting the existing processes and developing a prototype solution, the project sought to lay the foundation for a more efficient and responsive invoice management system, ultimately contributing to the organization's ongoing efforts to enhance operational efficiency.

1.3 Thesis Outline

This master thesis is structured to provide a comprehensive understanding of the automated invoice processing and validation system developed for a medical insurance provider, unfolding across seven chapters. Chapter 2, "Organizational Context," delves into the specifics of the organization, shedding light on its operational dynamics and the central role of medical invoice management within its activities. This sets the stage for a detailed exploration, providing essential background information to comprehend the complexities of the existing manual process.

Subsequent to this, Chapter 3, "Process Automation," introduces the concept of Robotic Process Automation, elaborating on its significance and applicability in transforming traditional business operations. This chapter serves as a foundational piece, establishing the theoretical underpinnings necessary for the reader to grasp the potential of RPA and other types of automation and integrations in revolutionizing invoice management. Following this, Chapter 4, "Power Platform," outlines the specific low-code development environment utilized in this project, delving into its features and capabilities, and setting the scene for the prototype solution presented later in the thesis.

Chapters 5 and 6, "Proposed Solution" and "Demonstration," lie at the core of this work, detailing the design, development, and practical application of the automated invoice processing system. These chapters meticulously describe the prototype solution, showcasing its functionality, and demonstrating its impact on the organization's invoice management process. Finally, Chapter 7, "Conclusion," encapsulates the main contributions of this research, discusses its limitations, and outlines potential avenues for future work.

2 Organizational Context

This chapter provides an overview of the organizational context surrounding the organization's structure and processes.

2.1 The Organization

The organization is a medical insurance provider, and as of writing, has around 100,000 customers. As per usual on the medical insurance business, there are various systems in place to ensure that certain benefits are given to costumers. Usually, these benefits are represented by cost reductions in medical procedures that the clients, for some reason, need to submit to. However, even though the benefits are usually cost reductions, the way the customer normally obtains those cost reduction can vary. The two most common types of cost reduction situations that happen in the medical insurance sector are explained in the next paragraphs and serve as the basis for understanding why the organization needed an intervention at the process level.

One of the most common ways for a medical insurance policy to be used is by customers choosing medical providers that already have an existing agreement with their insurance provider. This option is frequently used by costumers, and using this method, the benefits to the customer are normally processed instantaneously, because the agreements made previously by both parties (the service provider and the insurance company) facilitate communication and price setting. In this situation, the customer doesn't "see" the whole processing happening on the background for his medical act to be covered by his insurance policy. The price that the customer pays for the medical act already includes the discounts granted by the insurance policy, and on the eyes of the customer, there are no waiting times, which is generally regarded as positive.

On the other hand, sometimes customers need or want to use medical services from providers that don't have a previously made agreement with their insurance policy provider. When this happens, the policy in place at the insurance company states that customers need to pay upfront for the medical act (covering the cost in full), and then submit the invoice that was given to them by the medical provider to the insurance company. After this, the company will process it and eventually, if the company finds that based on the individual's insurance policy, that the invoice is reimbursable, then a bank transfer is made to the customer's account with the value that is to be covered by the insurance policy.

While the first way to obtain a benefit from the insurance policy may be straightforward, as the insurance company has already defined communication channels and standards to transmit the information regarding each medical act, the second way is significantly more challenging, because even though every company is by law forced to emit invoices that contain certain fixed elements, the structure of those invoices is highly flexible and changes drastically from medical provider to medical provider.

On the next sub-chapter the invoice processing workflow will be detailed, pointing out the challenges of this second type of invoice processing.

2.2 Current Invoice Process

The problem is understood in a clearer way when the whole invoice processing process is analysed. In this section a simplified explanation of the whole process will be presented.

The Figure 1 below tries to visually explain the current invoice management process:

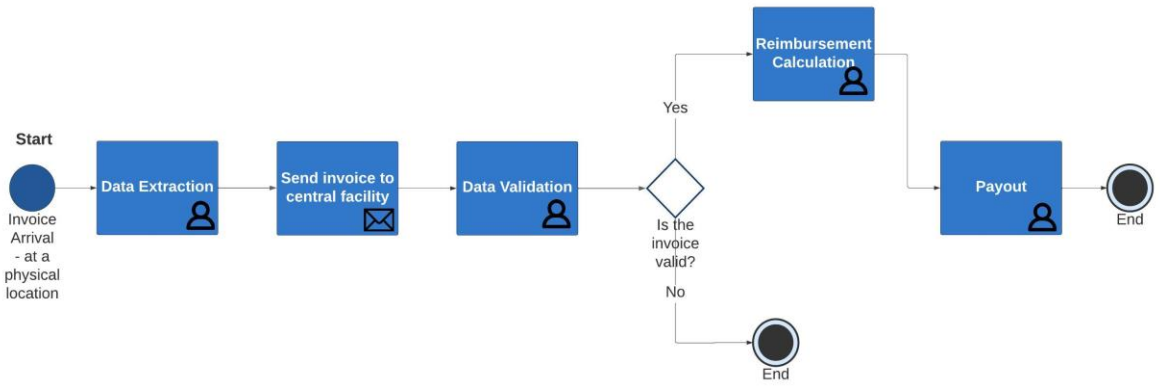

Figure 1 - Current Invoice Management Process

2.2.1 Invoice Arrival

After the customer goes through a medical act in a medical provider that does not have a pre-made agreement with the insurance provider, the customer must grab the invoice and deliver it to the insurance company for processing. At the time of writing, this could be made in two ways: either by physical delivery of the invoice to one of the insurance company's physical locations or by sending the invoice through physical mail to the same locations. There was still no way for the customers to digitally submit their invoices.

2.2.2 Invoice Data Extraction

This is one of the most time-intensive steps, depending on the size of the invoice. Whenever an invoice arrives, a worker must open the invoice, and using a legacy windows desktop application built in 2008 for this purpose, he must manually insert all the relevant data points from the invoice into the application. This involves parsing several different fields from the invoice, that are listed below:

- Service Provider Taxpayer Number (NIF)
- Customer Taxpayer Number (NIF)
- Service Provider Name
- Invoice Number
- Invoice Total Price
- Invoice Date
- Line Item(s) price
- Line Item(s) date

- Line Item(s) name
- Line Item(s) product code
- Line Item(s) quantity

The fields that mention “line item(s)” are each one of the products or services provided by the medical service provider, inside one invoice. As it is easily understood, these can turn into a substantial number of data points that needed to be extracted by hand from each of the invoices, with some invoices’ information extraction taking more than 10 minutes of dedicated attention from a worker.

This part of the process (the initial data extraction) was always made by the worker that received the invoices delivered on one of the physical centers of the insurance company.

2.2.3 Invoice Verification

After the initial Data Extraction, the invoices are sent by physically to a central location, where they are processed from that stage onwards. After arriving at the facility, and as the “Data Extraction” stage is very error prone (due to human error), there is a second verification step where the invoice is passed on to another individual, who confirms the validity of the information inserted on the application. This involves once again opening the physical invoice and confirming that the data that was inserted on the system correctly matches the information on the invoice.

2.2.4 Invoice Reimbursement Calculation

After the validity of the data has been confirmed, another process takes place – the calculation of the specific reimbursement to be made for each invoice. While, on simpler invoices, this can represent a rather trivial task (because most of the invoices contain fewer than two items and those items represent common medical acts that are frequently calculated), sometimes the invoices are very complex, with many items, each one having their specific reimbursement rate.

This task is made even more complex because of the nature of some reimbursements: some categories of medical acts have sublimits for each customer. So the worker needs not only to calculate what is the specific reimbursement for each item on the invoice, he also needs to verify if the yearly sublimit for that kind of medical act hasn’t been reached yet by the customer.

2.2.5 Invoice Payout

After the reimbursement is calculated, the due value is sent to the customer’s bank account, ending the invoice processing.

2.3 Challenges

Having detailed, in a broad way, the invoice processing system built at the insurance company, this section will focus on detailing the main problems that arose from the current state of the system:

- Outdated Physical Processes: One of the pressing challenges facing the organization is the need for digital transformation. In an era where digitalization has become the norm, the company still relies heavily on physical methods for customers to submit their invoices. The absence of a streamlined digital submission process presents inefficiencies in data handling and processing.
- Manual Data Entry: The manual data extraction process, involving the entry of numerous data points from invoices, is a labor-intensive and time-consuming task. Human error is an inherent risk in this process, and it significantly hampers efficiency. Furthermore, the reliance on legacy applications from 2008 adds complexity and reduces adaptability to changing intergration needs.
- Variability in Invoices: The flexibility in the structure of medical service provider invoices poses a significant challenge. The lack of standardized formats makes it challenging to automate data extraction and verification. Each invoice may require a unique approach, leading to increased processing times and potential errors.
- Verification Bottlenecks: The verification step, introduced to rectify potential errors from the initial data extraction, adds another layer of complexity and time consumption. This dual-check process can lead to bottlenecks, especially during peak periods, delaying reimbursements to customers.
- Complex Reimbursement Calculations: The calculation of reimbursements for each invoice is a multifaceted task. Complex invoices with numerous items and varying reimbursement rates demand meticulous attention. Additionally, tracking yearly sublimits for specific medical acts adds further complexity to the process, making it time consuming.
- Customer Experience: The prolonged processing times and reliance on physical submissions negatively impact the customer experience. Lengthy waiting periods for reimbursements erode customer trust and satisfaction.

These challenges have been the driving force behind the company's decision to embark on the implementation of a new solution, marking the creation of this project. As we go further into the project's details, it becomes evident that the primary focus has been on mitigating the first two challenges, namely, the Outdated Physical Processes and Manual Data Entry. These were identified as the main issues with the most substantial impact on the entire system and resolving them would pave the way for more efficient solutions to address the remaining challenges.

2.4 Organizational Impact

Solving the challenges outlined above has significant implications for the organization. The impact of addressing these problems extends across various dimensions. The goals of this project are:

- Operational Efficiency: The foremost impact of resolving these issues is a substantial improvement in operational efficiency. The transition from outdated physical processes to streamlined digital submissions reduces the reliance on physical locations, manual handling,

and legacy applications. This shift minimizes the time and effort required for invoice processing, allowing the organization to allocate its resources more effectively.

- Cost Reduction: With reduced manual data entry and improved automation, the organization can expect a decrease in labor costs associated with invoice processing. The need for a large workforce dedicated to data extraction and verification diminishes, resulting in significant cost savings.
- Data Accuracy and Compliance: Automation and digitalization of the process enhance data accuracy. Minimizing human intervention reduces the risk of errors, ensuring that the information processed adheres to compliance standards. This not only improves the quality of service but also mitigates the potential for legal or regulatory issues.
- Enhanced Customer Experience: Faster processing times and a shift towards digital submission methods enhance the overall customer experience. Customers can expect quicker reimbursements, reduced waiting times, and a more convenient process. This, in turn, leads to higher customer satisfaction and loyalty.
- Adaptability and Scalability: A digitalized and automated invoice processing system is inherently more adaptable and scalable. It can accommodate changes in the structure of invoices from various medical service providers more easily, reducing the impact of variability in invoice formats.

In summary, solving the problems associated with the organization's outdated invoice processing system represents a significant shift that would positively impact operational efficiency, cost-effectiveness and customer satisfaction to a high degree, making the decision to proceed with the transformation obvious.

On the next chapter an overview of the technology framework used will be made, explaining the basis that enabled building the solution.

3 Process Automation

This chapter delves into the transformative role of process automation in the contemporary business landscape, with a specific focus on its application in the medical insurance sector. It explores various facets of this innovation, including Robotic Process Automation (RPA), workflow automation platforms, API-based integrations, and Artificial Intelligence (AI), discussing their respective advantages, challenges, and the synergies created when these technologies are integrated.

3.1 Introduction

In the rapidly evolving landscape of today's business world, process automation stands out as a pivotal element of organizational transformation (Jämsä-Jounela, 2007). Process automation involves the strategic application of technology to optimize and streamline repetitive procedures and workflows, thereby enhancing operational efficiency (Jämsä-Jounela, 2007). This is can be applied in the context of medical insurance, where the processing of customer medical invoices is a routine yet crucial activity.

The shift towards process automation represents a paradigm change, moving away from labor-intensive, manual processes to a more agile and responsive operational model. In the medical insurance sector, this transition is vital for handling the voluminous nature of medical invoices. By automating the invoice processing workflow, insurance (and other) organizations that manage invoices can ensure accuracy, speed up processing times, and significantly reduce operational costs (Lima et al., 2021).

Key tools and technologies in this domain include Robotic Process Automation (RPA), workflow automation platforms, API-based integrations, artificial intelligence (AI), and machine learning (Desai et al., 2021). RPA, for instance, can automate the data entry and initial validation steps in invoice processing. Workflow automation platforms and API-based integrations are crucial for tasks that involve cloud-based services and intricate data flows, ensuring seamless information exchange between disparate systems.

In essence, embracing process automation is not just a technological upgrade; it is a strategic necessity. It is about positioning the organization for long-term success, ensuring that it remains at the forefront of innovation and efficiency in today's competitive business environment. For any organization dealing with a considerable amount of customer invoices (or any other kind of high-volume semi-structured data), this transition is not just beneficial; it is vital for maintaining accuracy, efficiency, and customer satisfaction (Sobczak, 2021).

3.2 Robotic Process Automation (RPA)

Robotic Process Automation (RPA) stands out as a transformative technology with the potential to redefine business processes across various industries. In the domain of insurance, RPA's impact is particularly pronounced (Tarquini, 2018), offering a pathway to enhanced efficiency and accuracy in handling customer invoices, among other options.

At its core, RPA involves the use of software robots, or “bots,” designed to replicate and execute high-volume, repetitive tasks that were traditionally performed by human operators (Syed et al., 2020). These bots interact with digital systems, applications, and databases in a way that mimics human behavior, performing tasks such as data entry, data extraction, and process execution. A defining feature of RPA is its ability to seamlessly operate across diverse applications and systems without necessitating extensive modifications or integrations (van der Aalst et al., 2018).

RPA operates based on a set of predefined rules and workflows, making it a highly adaptable and flexible solution for automating routine processes. Its applications can span across various sectors, including finance, healthcare, manufacturing, and customer service, addressing the need for operational efficiency in environments characterized by repetitive and high-volume tasks.

In the context of an insurance organization, RPA can revolutionize the way customer invoices are processed. For instance, bots can be programmed to extract relevant data from invoices, regardless of their format, and input this information into the organization’s system for further processing. This not only speeds up the processing time but also promotes a high level of accuracy, reducing the likelihood of errors that are common in manual data entry (Zhang & Wen, 2021).

However, it is crucial to acknowledge that RPA is not without its limitations. Being rule-based, it operates best in environments where processes are well-defined and do not require human judgment or decision-making capabilities. This is where the integration with other technologies, such as AI and machine learning, comes into play, enhancing RPA’s capabilities and enabling it to handle more complex tasks (Zhang & Wen, 2021).

In conclusion, RPA represents a significant stride towards operational excellence in the medical insurance sector. By automating routine tasks associated with invoice processing, organizations aim to achieve faster processing times, reduce errors, and free up human resources for more value-added activities, ultimately aiming to enhance overall efficiency and customer satisfaction.

3.3 Other Variants of Process Automation

While Robotic Process Automation (RPA) has made significant strides in automating repetitive, rule-based tasks, the landscape of process automation is continually evolving, with various forms of automation coming to the fore.

Traditional RPA is primarily focused on mimicking human interactions with desktop applications. However, other forms of automation, such as workflow automation platforms and API-based integrations, are gaining traction. These platforms extend automation capabilities beyond the desktop environment, integrating cloud services and API-based tasks into the workflow. Tools like Zapier or Microsoft Power Automate exemplify this trend, offering automation solutions that do not necessarily rely on UI-based interactions.

Unlike traditional RPA, workflow automation platforms and API-based integrations facilitate direct data flows between disparate systems through API calls. This is particularly beneficial for tasks

that involve cloud-based services and complex data flows, common in the insurance domain where customer data and invoice details might be spread across different systems.

However, it is important to note that these variants of process automation are not mutually exclusive and can be used in conjunction to achieve optimal results (Chakraborti et al., 2020). While traditional RPA can handle the initial data entry and routine checks, workflow automation and API-based integrations can take over for tasks that require connectivity with cloud services and complex data manipulations.

In conclusion, the insurance sector stands to benefit significantly from the diverse range of process automation solutions available today (Tarquini, 2018). By understanding the unique capabilities and applications of each, organizations can create a comprehensive automation strategy that addresses the full spectrum of their process automation needs, ensuring efficiency, accuracy, and responsiveness in their operations.

3.4 Artificial Intelligence (AI) in Process Automation

The integration of Artificial Intelligence (AI) into process automation marks a significant leap forward, expanding the capabilities of traditional automation solutions like Robotic Process Automation (RPA) (Chakraborti et al., 2020). While RPA excels at performing rule-based, repetitive tasks, AI introduces the ability to understand context, make decisions, and learn from experience, thereby handling more complex and nuanced activities.

In the realm of insurance, the application of AI in process automation is particularly transformative. For instance, when it comes to processing customer medical invoices, an AI-powered system can be trained to recognize and extract information from a variety of invoice formats, significantly reducing the reliance on manual data entry. This not only streamlines the process but also mitigates the challenges associated with variability in invoice structures and potential human errors.

However, it is important to approach the integration of AI in process automation with a clear understanding of its implications. The complexity of AI algorithms requires a robust framework for implementation and ongoing management, ensuring that the system continues to function optimally and adapts to changing requirements over time.

In summary, the incorporation of AI into process automation within the insurance sector brings about a paradigm shift, enabling organizations to handle complex tasks with a level of efficiency and accuracy that was previously unattainable (Lima et al., 2021). This not only enhances operational effectiveness but also contributes to a better customer experience, as processes become faster and more reliable. As we continue to navigate the complexities of the insurance landscape, the role of AI in process automation will undoubtedly become increasingly central, driving innovation and excellence in service delivery.

3.5 Benefits and Challenges

The convergence of Robotic Process Automation (RPA), workflow automation platforms, API-based integrations, and Artificial Intelligence (AI) presents significant opportunities for organisational operations across all domains. Although each technical framework possesses distinct advantages, its integration enables the realisation of synergistic benefits that surpass their separate capabilities. However, the combination of these technologies poses a series of issues that necessitate further examination. This section provides a detailed analysis of the distinct benefits and potential drawbacks that arise from the integration of Robotic Process Automation (RPA) with Artificial Intelligence (AI).

3.5.1 Advantages

Enhanced Data Analysis: The AI algorithms excel in scrutinizing complex data structures, identifying patterns, and generating actionable insights. When coupled with RPA, which can handle routine data collection tasks, the result is a significantly enriched data analysis capability that facilitates more informed decision-making processes (Gotthardt et al., 2020).

Predictive Capabilities: AI's predictive analytics can forecast trends and patterns based on historical data. This enables organizations to transition from reactive operational modes to proactive planning. For instance, predictive models could signal alerts when a customer’s pattern of invoice submissions follows a pattern that previously was associated with fraud. (Gotthardt et al., 2020).

Adaptability: Traditional RPA systems, being rule-based, are constrained by the limitations of fixed algorithms and cannot autonomously adapt to changes in data formats or operational protocols. AI algorithms, on the other hand, can learn from new data, thereby enhancing the system's flexibility and reducing the need for manual intervention (Agostinelli et al., 2019).

Improved Customer Experience: Integrated systems offer enhanced customer interaction by automating personalized communication. AI's capability to analyze customer behavior and preferences can significantly improve customer satisfaction rates (Gotthardt et al., 2020)

Interoperability: Workflow automation and API-based platforms often provide native integrations with a wide array of cloud services, databases, and applications. When combined with AI, these platforms can serve as powerful tools for automating complex, multi-step processes that involve both rule-based tasks and decision-making (Chakraborti et al., 2020).

3.5.2 Challenges

Implementation Complexities: Achieving a seamless integration of AI and RPA is technologically intricate and necessitates expertise across multiple domains, including AI, RPA, and general IT management. These complexities can act as potential barriers to successful implementation (Gotthardt et al., 2020).

Data Privacy and Security: As AI becomes increasingly involved in data processing and analysis, organizations must grapple with the potential risks associated with data privacy and compliance, particularly in sectors with stringent data protection regulations (Gotthardt et al., 2020).

Cost Implications: The long-term cost-efficiency promised by the integration of RPA and AI is counterbalanced by significant upfront investment requirements. Organizations must, therefore, perform a rigorous return-on-investment analysis that considers both immediate and future impacts (Gotthardt et al., 2020).

Algorithmic Bias and Fairness: AI systems may inadvertently perpetuate biases present in the training data or the perspectives of the developers. Such biases can have various ramifications, including legal repercussions and impact on brand reputation (Gotthardt et al., 2020).

Technical Debt: The pace at which AI and RPA technologies evolve necessitates continual updates and improvements. Organizations must be prepared for ongoing investments in system upgrades and staff training to maintain operational effectiveness (Chakraborti et al., 2020).

Dependence on Data Quality: The efficacy of AI algorithms hinges largely on the quality of the data they are trained on. Inaccurate or incomplete data can severely compromise the reliability and accuracy of the system's output (Gotthardt et al., 2020).

Standardization Issues: Unlike traditional RPA, which often operates in a more controlled desktop environment, workflow automation and API-based integrations may face challenges related to standardization and interoperability, especially when dealing with a diverse range of cloud services and APIs (Chakraborti et al., 2020).

In brief, the convergence of Robotic Process Automation (RPA) and Artificial Intelligence (AI) presents major possibilities for organisational transformation, albeit accompanied with inherent intricacies and obstacles. Organisations must possess a thorough comprehension of these aspects in order to effectively incorporate these technologies and use their combined potential.

4 Power Platform

In this chapter, we delve into the multifaceted functionalities of Microsoft Power Platform, focusing on Power Apps, Power Automate, and AI Builder to highlight how they collectively facilitate seamless automation, intelligent data analysis, and user-centric application development in a low-code environment. We will also assess the platform's ability to overcome some of the challenges associated with process automation, providing a comprehensive understanding of its application in various business contexts.

4.1 Introduction

Microsoft Power Platform serves as a comprehensive suite of business application platforms designed to enable seamless automation, data analysis, and application building in a user-friendly, low-code environment. Comprising Power BI, Power Apps, Power Automate, and Power Virtual Agents, this platform offers diverse capabilities for process automation and data management. This chapter aims to delve into the Power Platform's capabilities in RPA, AI integration via AI Builder, and low-code app development through Power Apps. Additionally, this chapter will assess how Power Platform addresses some of the disadvantages discussed in the preceding chapter related to process automation.

4.2 Power Automate[1]

Power Automate, a key component of Microsoft Power Platform, offers robust capabilities for automating workflows and business processes. It transcends the boundaries of traditional RPA by providing a more user-friendly, low-code approach to building automated flows. This is particularly valuable for automating tasks across Microsoft applications and third-party services, thanks to its extensive library of connectors.

Moreover, Power Automate extends its automation capabilities into the cloud through API-based workflow automation. Unlike desktop-based RPA, which is more confined to automating tasks on local systems, API-based workflow automation enables businesses to integrate disparate cloud services seamlessly. By facilitating direct API calls, it streamlines data flows between different cloud-based systems, thereby automating complex tasks that require interaction with multiple services. This is especially pertinent in today’s digital landscape, where businesses increasingly rely on a variety of Software-as-a-Service (SaaS) platforms. By enabling both RPA and API-based workflow automation, Power Automate offers a versatile, end-to-end solution for automation challenges in the modern business environment.

The foundational components of a Power Automate flow typically consist of triggers and actions. A "trigger" functions as the initial event that activates the automated sequence. Triggers exhibit a wide range of diversity, encompassing various events such as the reception of an email inside the Microsoft

[1] https://powerautomate.microsoft.com/en-us/

Outlook platform or the inclusion of a new data input into a SharePoint list. In essence, triggers function as conditional statements that, upon fulfilment, initiate the subsequent actions inside the process.

After being triggered, a sequence of "actions" is carried out. Actions refer to predetermined tasks that are executed by the flow in response to a certain trigger. These actions may involve a diverse range of procedures, including the delivery of alerts, the movement of files across directories, or the modification of records inside a relational database system. Actions function as the operative elements inside the workflow, carrying out tasks that are in line with the goals of the automated process.

To illustrate the functionality of Power Automate with a simple, yet comprehensive example, envision a scenario involving customer service management, particularly, handling complaints through email. Visualize a company that receives customer complaints via a dedicated email address. A practical application of Power Automate might involve creating an automated flow that triggers when an email lands in the "complaints" inbox.

In this instance, the reception of a new email becomes the "trigger". Upon the occurrence of this event, a sequence of "actions" is activated. The first action might be to extract information from the received email, such as the customer's name and complaint details. Subsequently, an action may generate a unique ticket number for tracking the complaint and ensure that it is stored in a database, like Microsoft's SharePoint, along with the relevant customer details. The subsequent action might involve sending an acknowledgment email back to the customer, ensuring them that their complaint is registered and under review. This email will include the unique ticket number for their reference and future communications regarding their complaint.

Thus, from the moment the complaint email is received to sending an acknowledgment with a unique ticket, the entire process is automated, eliminating manual intervention, reducing response time, and enhancing customer experience. This simplistic example showcases Power Automate's potential in streamlining operations, managing data, and maintaining efficient communication with minimal manual involvement.

Figure 2 below demonstrates graphically what this flow would look like after development:

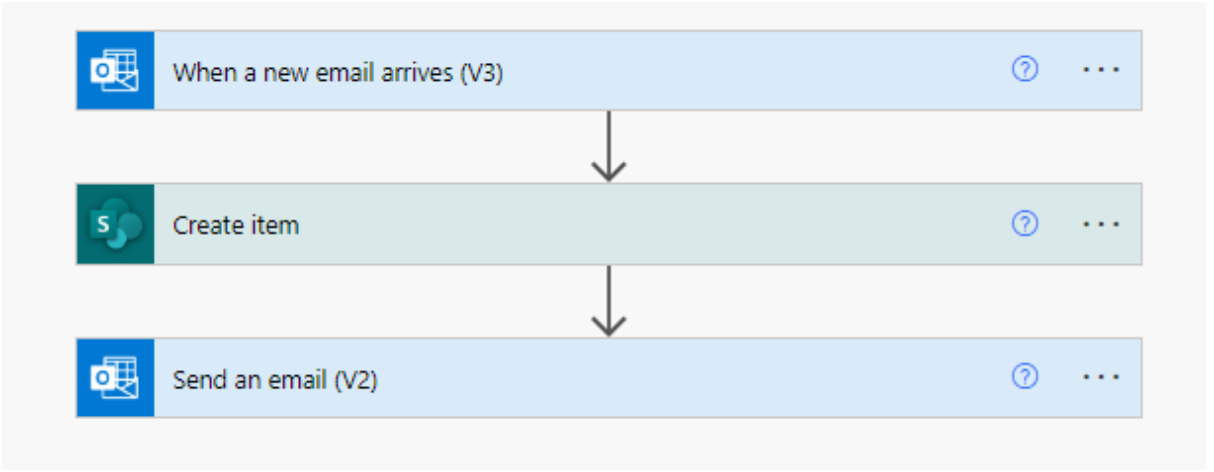

Figure 2 - Example Power Automate Flow

4.3 AI Builder[2]

Expanding the horizons of the Microsoft Power Platform, AI Builder serves as a pivotal tool, joining simplicity with advanced artificial intelligence capabilities, thus empowering apps and flows with smart, data-driven functionalities. While Power Automate facilitates robust, automated workflows, AI Builder steps in to embed intelligent mechanisms into these workflows and applications developed through Power Apps, with a simple, low-code, user-friendly approach.

AI Builder opens the door to a vast array of artificial intelligence models - both pre-built and customizable. The pre-built models offer ready-to-use AI solutions, eliminating the necessity of technical expertise in model development. Examples of such pre-built models include Key Phrase Extraction, which identifies the main points in text; Sentiment Analysis, determining whether the expressed sentiment in text is positive, negative, or neutral; and Object Detection, recognizing and counting objects within an image. This aids in effortlessly implementing intelligent functionalities, like automatic text categorization, image analysis, and sentiment assessment, across applications and workflows without delving into complex AI model development. Figure 3 contains all the ready-to-use models available in AI Builder as of October 2023:

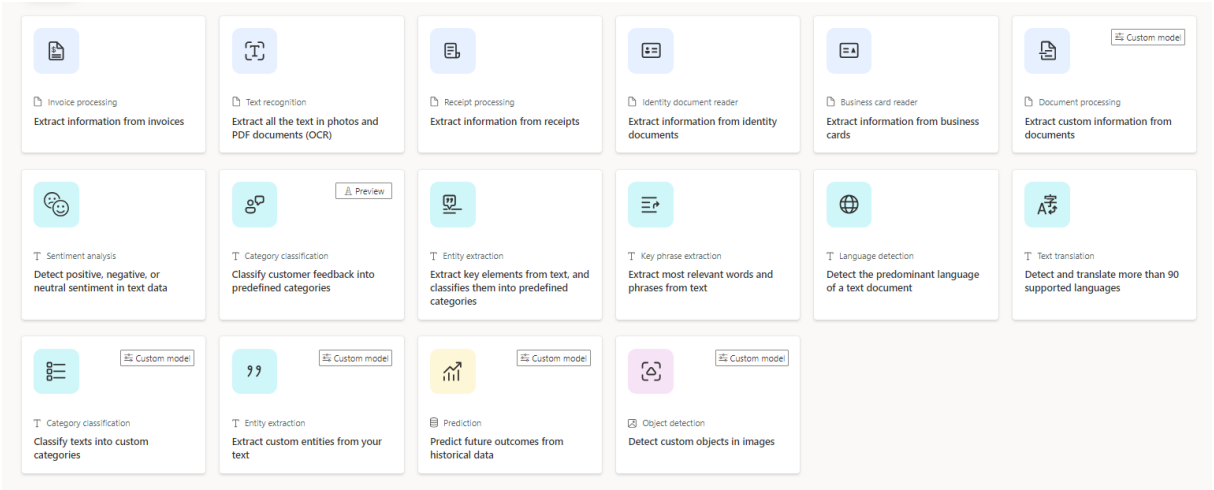

Figure 3 - Ready-to-use AI models available on the AI Builder platform

In addition to utilizing pre-built models, AI Builder provides the capability to train custom models tailored to specific use-cases and business requirements. The process is demystified, allowing users with varied expertise levels to develop, train, and implement AI models without necessitating deep technical knowledge in artificial intelligence or machine learning. For instance, users can train a model to recognize specific forms related to their business or identify particular products in images, enhancing the automation process by introducing specialized intelligent capabilities.

The integration of AI Builder not only amplifies the operational efficiency of workflows and applications by incorporating intelligent functionalities but also renders the deployment of AI more accessible and practical for businesses with varied technical proficiencies. By offering a palette of pre-

[2] https://powerapps.microsoft.com/pt-pt/ai-builder/

existing models and the flexibility to craft customized models, AI Builder exemplifies a pragmatic approach to assimilating intelligent capabilities into business processes, thereby enriching data analysis, improving decision-making, and enhancing user experiences across the Power Platform ecosystem. This functionality ensures that organizations can navigate through the complexities of AI implementation, ensuring intelligent solutions are both attainable and straightforward to deploy, aligning closely with specific organizational needs and objectives.

4.4 Power Apps[3]

Power Apps, an essential component of Microsoft Power Platform, provides businesses with a low-code application development platform, bridging the gap between complex application development and user-friendly design. It allows organizations to craft applications that can seamlessly interact with automated workflows and users alike, curating a harmonious integration of back-end processes and intuitive, user-centric interfaces. Furthermore, by utilizing Power Apps, businesses empower individuals across varied technical backgrounds to contribute to application development, thereby democratizing app creation and propelling digital transformation forward.

Power Apps is distinguished by its versatility in application design, offering different types of apps, namely, Canvas Apps and Model-Driven Apps, each with its unique approach and application. Canvas Apps provide users with a blank canvas, giving them the liberty to design apps starting with the user interface, and then connect to over 200 different data sources, ensuring a tailor-fit user experience crafted to specific needs. In contrast, Model-Driven Apps begin with the data model, focusing on the core business processes and data relationships, with the user interface adapting automatically. Both these approaches offer different paths to achieving solution-centric application development, ensuring both data-driven and user-experience-driven approaches are attainable. The main differences of both types of apps are displayed on table 1.

Table 1 - Key Differences Between Canvas Apps and Model-Driven Apps in Microsoft Power Apps

Feature	Canvas Apps	Model-Driven Apps
Design Approach	User interface-first	Data model-first
User Interface	Highly customizable	Automatically generated, limited customization
Data Connections	Connects to multiple data sources simultaneously	Primarily uses the Dataverse
App Creation	Begins with a blank canvas	Begins with defining data and business processes

[3] https://powerapps.microsoft.com/en-gb/

User Experience	Tailor-made	Uniform across apps
Development Flexibility	High flexibility in design and user interface	Structured and defined by data relationships
Best Used For	Task-specific apps, focused user experiences	Complex business solutions, data-intensive apps
Mobile Readiness	Fully mobile-ready, build once, deploy everywhere	Mobile version available with limited experiences
Offline Capabilities	Can be configured for offline use	Limited offline capabilities
Learning Curve	Easy to start with	Steeper due to data modeling requirements
Use Case Example	Customer feedback app	Sales management system

Moreover, Power Apps provides the flexibility to deploy applications across various formats, ensuring accessibility and usability across different devices and platforms. Applications can be developed and optimized for both mobile and desktop formats, ensuring that users have access to critical business apps using whatever device is available. Power Apps encourages an adaptive design strategy, where applications not only fulfill functional requirements but also cater to the diverse access points of a modern, mobile workforce. An example representation of a mobile app and a desktop app can be found in Figures 4 and 5, respectively. As it is possible to observe, the only relevant change between these two types of developments is the aspect ratio of the resulting app.

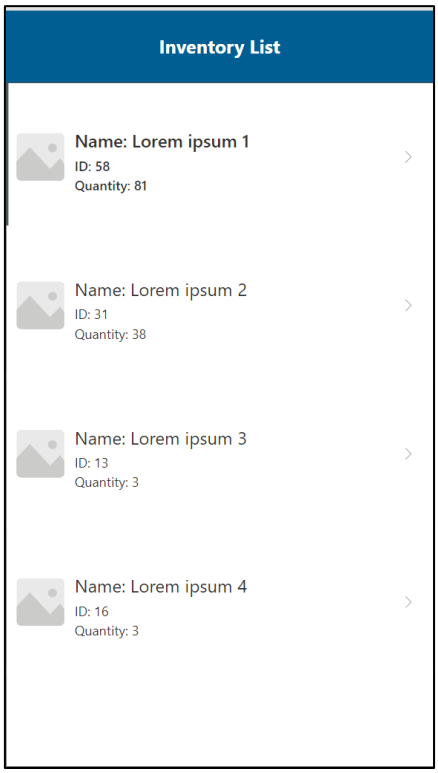

Figure 4 - Example Mobile App in Microsoft Power Apps

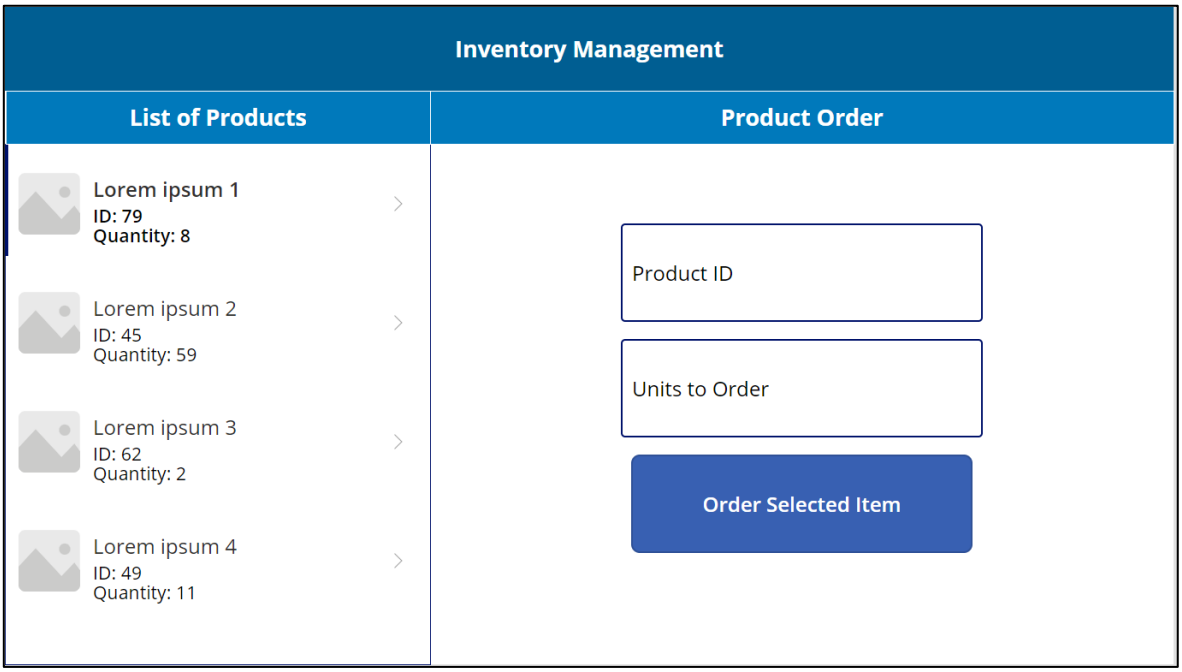

Figure 5 - Example Desktop App in Microsoft Power Apps

Power Apps enables businesses to develop applications that integrate smoothly with automated and AI-powered workflows, maximizing the use of the extensive features of the Power Platform. It presents these sophisticated backend processes through simple and easy-to-use interfaces, ensuring that both automation and intelligence are easily accessible to end-users.

4.5 Project Fit

Microsoft Power Platform effectively alleviates some of the disadvantages of RPA and AI integration discussed in the previous chapter. For example, the low-code nature of the platform reduces implementation complexities. Additionally, Microsoft's stringent compliance policies and native security features can help in mitigating data privacy concerns. The platform's integrated environment allows for streamlined updates, helping to manage the issue of technical debt.

4.6 Conclusion

Microsoft Power Platform stands as a versatile tool in the realm of process automation. Its capabilities in RPA, enabled by Power Automate, and its seamless integration of AI through AI Builder, make it a compelling solution for businesses looking to optimize their operations. Furthermore, its low-code app development environment provided by Power Apps allows for the rapid development and deployment of user interfaces that interact seamlessly with automated workflows. Collectively, these features not only facilitate the automation of repetitive tasks but also offer advanced functionalities like data analysis and user interaction, rendering Microsoft Power Platform as a valid framework for the development of the solution.

5 Proposal

In this chapter, a detailed explanation of the solution designed to change the way medical invoices are processed within the organization is provided. The solution aims at shifting from a manual, labor-intensive approach to a streamlined, automated system. Utilizing Microsoft Power Platform, Power Apps, Power Automate, and AI Builder are integrated to create a cohesive architecture that addresses the challenges previously faced in invoice management, enhancing efficiency, accuracy, and overall user experience.

5.1 Problem Statement

As talked about previously, the manual process of data extraction and manipulation from medical invoices has been a significant bottleneck for the organization, leading to inefficiencies and increased operational costs. There was an urgent need for a different system that allowed for automation of the previously manual invoice processing.

5.1.1 Objectives

- To digitize the process of invoice submission from customers.
- To streamline invoice management within the organization, especially the extraction and validation of invoice data, which presented itself as one of the most time consuming tasks on the current system.

- To employ AI technologies for intelligent data extraction from invoices, avoiding whenever possible human intervention on data extraction.

5.1.2 Expected Outcomes

- Reduced manual labor and operational costs.
- Increased accuracy in data extraction and manipulation.
- Enhanced customer experience through a simplified and faster invoice submission process.

5.2 Solution Architecture

The solution is built on Microsoft's Power Platform and consists of the following components:

- PowerApps Mobile App
- PowerApps Desktop App
- Power Automate Flow
- Dataverse Database

The Figure 6 holds a representation of how the system components interact together.

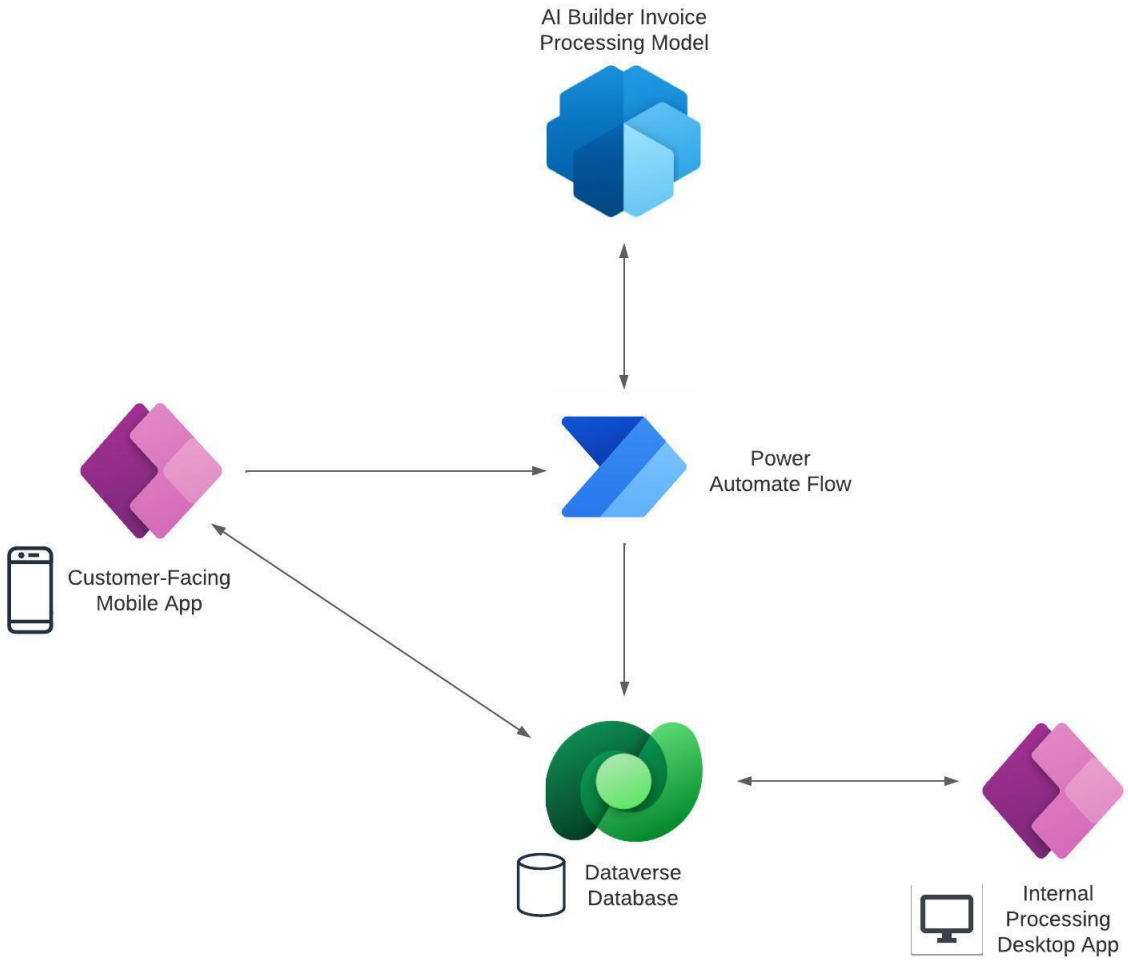

Figure 6 - Solution Architecture, based on Microsoft Infrastructure

5.3 Process Design

Invoice Submission

1. A customer submits an invoice using the PowerApps Mobile App.
2. The Power Automate flow triggers and extracts the necessary information using AI Builder.
3. A new record is created in the Dataverse database.

Invoice Validation

1. An employee from the organization accesses the new record through the PowerApps Desktop App.
2. The data extracted by the Power Automate flow (involving AI) is reviewed and approved by the worker. This consists on confirming that the information extracted by the flow was correct.
3. Once approved, the record is updated in the Dataverse database, being sent for further processing (outside the scope of this project).

The next sections will provide additional details on the structure of the solution, and how every one of the chosen components contributes to the end goal of the system.

5.4 PowerApps Mobile App

This is a customer-facing application that allows users to submit invoices. Its main purpose is to digitize the process of submitting invoices, that previously were only delivered either by physical mail or by hand. The app is built using PowerApps and is designed for mobile devices. A full review of the app is shown on the “Prototype Demonstration” section. A screenshot of the app can be found in Figure 7.

Figure 7 - Example Screen from Solution's Mobile App

5.5 PowerApps Desktop App

This application is used by the organization for invoice management. It is one of the most important pieces of the solution, as it enables the workers of the organization to stop having to manually extract data from the invoices, having just to validate the information gathered by the AI model. It provides functionalities like viewing and editing invoice information, and approving invoices. A full review of the app is shown on the “Prototype Demonstration” section. A screenshot of the app can be found in Figure 8.

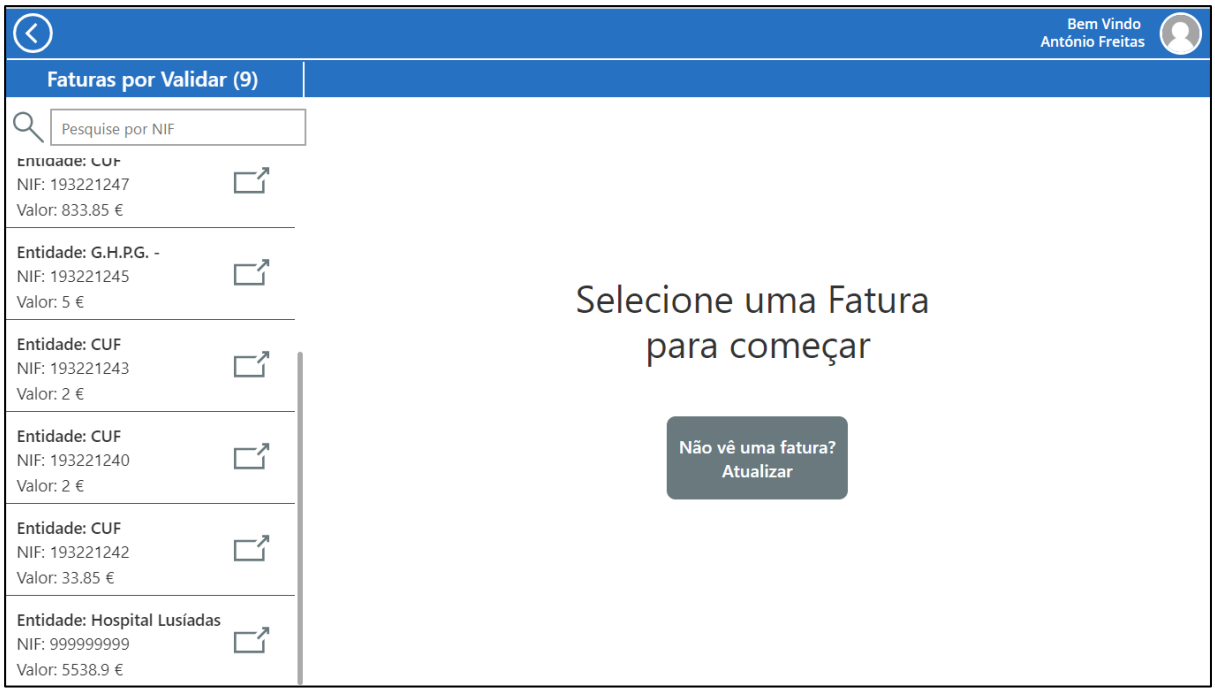

Figure 8 - Example Screen from Solution's Desktop App

5.6 Power Automate Flow (with AI Builder)

Having been one of the core developments of the solution, this Power Automate flow serves as the bridge between the mobile and desktop applications. It uses AI Builder for intelligent data extraction and creates new records in the Dataverse database. The subsequent sections will explain in detail how the workflow was set up.

5.6.1 Flow Overview

The following Figure 9 represents the whole Power Automate Flow:

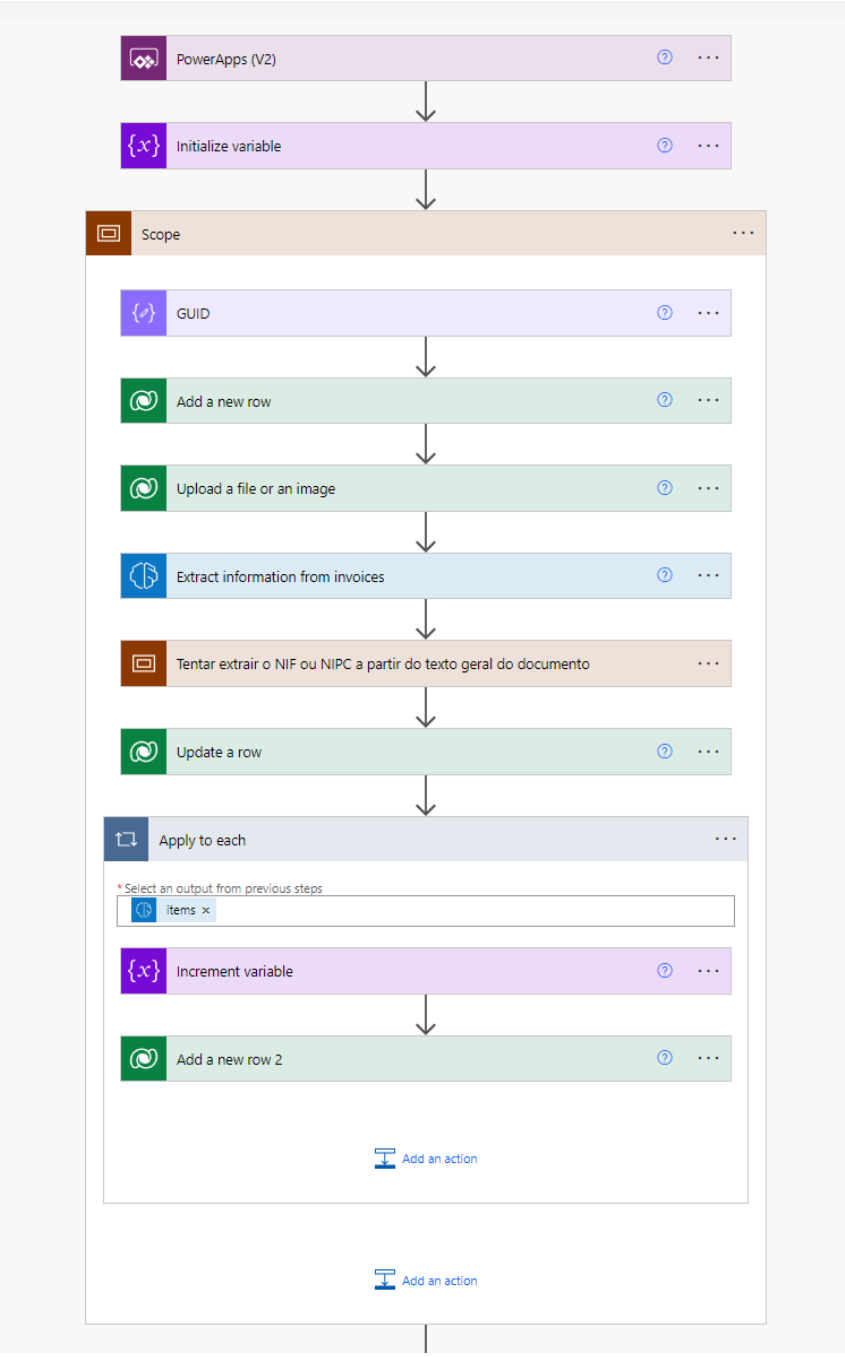

Figure 9 - Full representation of the Solution's Power Automate Flow

Each section of the flow will now be explained in detail.

5.6.2 Flow Trigger

As explained previously, each power automate workflow must start with a trigger (an event that is defined by the developer so that, whenever it happens, a subsequent set of actions is ran). This flow is triggered when a function is ran within PowerApps, specifically when a user submits a new invoice for processing. In this case, as it is possible to verify in the Figure 10 below, the function must be passed with three arguments (File Name, NIF Submissao, and File Content). File Name and File Content refer to the file that was uploaded by the user in the mobile app. The “NIF Submissao” refers to the user that

was logged in while the submission was performed. All these three data points will be needed in the flow for further processing.

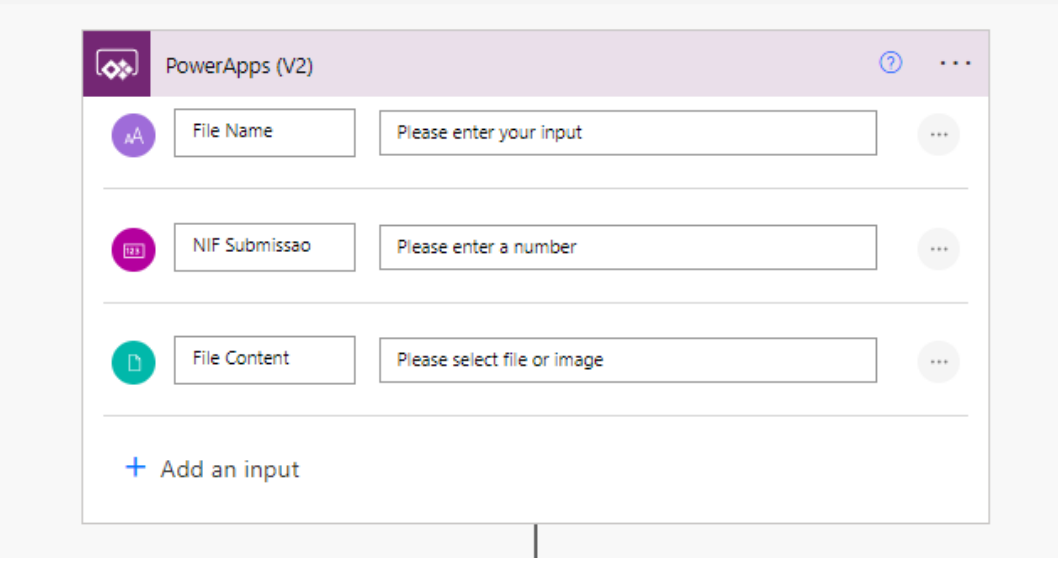

Figure 10 - Power Automate Flow Trigger

5.6.3 Flow Actions

Each action inside the flow has a different purpose. This section will detail all of the actions and their relevance to the flow's output. Auxiliary actions (like initializing variables) will be skipped.

5.6.3.1 GUID Creation

Every time a new invoice is submitted, a guid() function is ran. This function generates a globally unique identifier set of numbers and letters for that specific invoice. This is a crucial part of the workflow due to this being the primary key that enables the search of information within the two tables of the database.

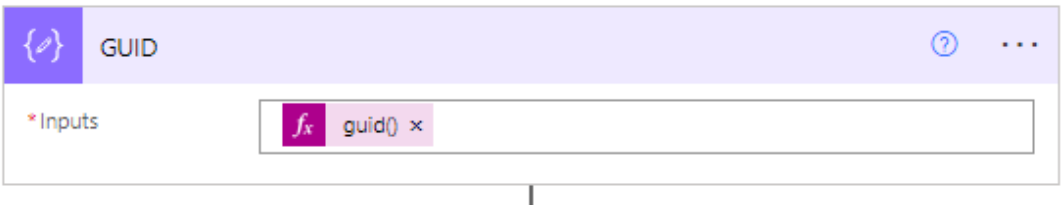

Figure 11 - GUID Creation Action inside Power Automate Flow

5.6.3.2 Creating a new row on the "Faturas" table

With the GUID having been generated in the previous step, the flow's next important step is to create a new row on the "Faturas" table. This row is created without any specific information yet, only the previously generated GUID as one of its columns. This initial row creation serves the purpose of showing the user that even though one of the submitted invoices hasn't been processed, it has already been successfully submitted.

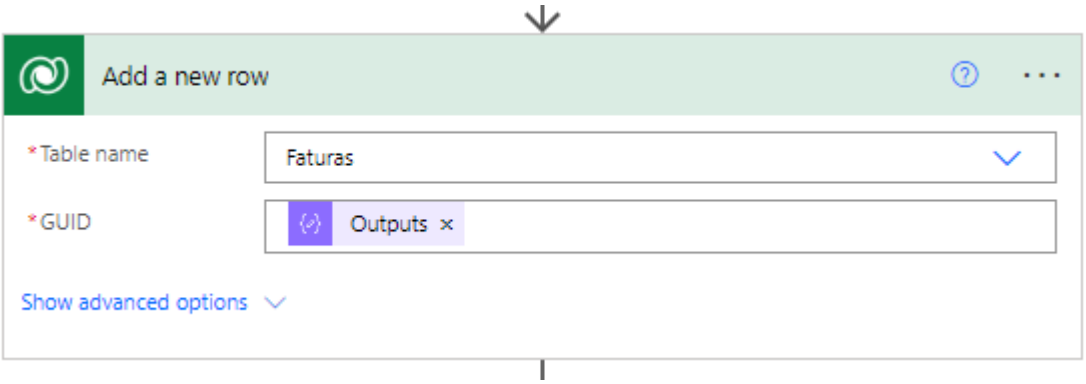

Figure 12 - Row Creation Action inside Power Automate Flow

5.6.3.3 Adding the invoice to the "LinkFatura" column

After having created the row for the new invoice that was submitted by the user, the flow then grabs one of the inputs from the flow's trigger (the submitted File Content) and inserts the file submitted by the user inside the appropriate column of the "Faturas" table. This column is named "LinkFatura".

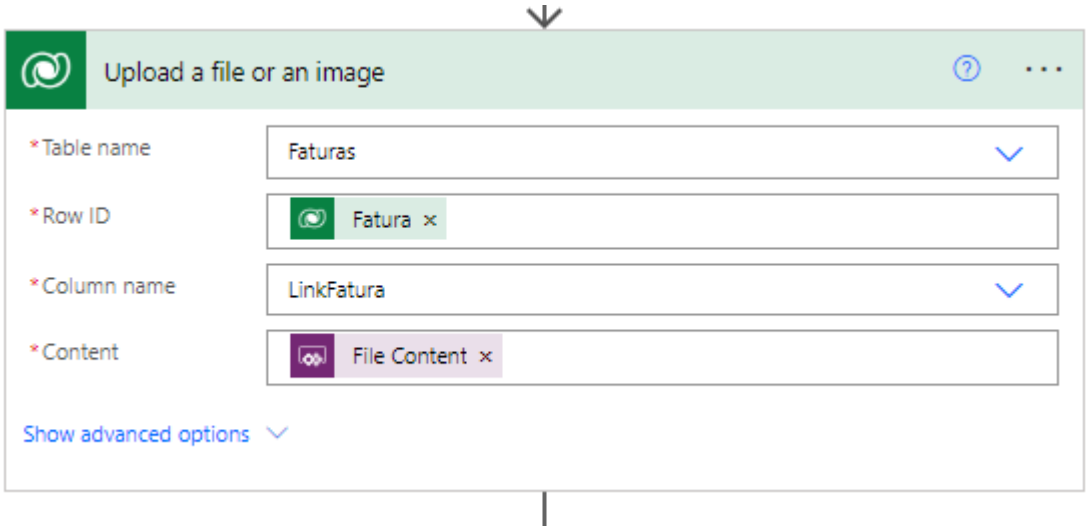

Figure 13 - File Upload Action inside Power Automate Flow

5.6.3.4 Running the AI model from AI Builder to extract the information from the submitted invoice

This is arguably the most important step of the entire workflow, because this is the section where all the manual work of extracting the information from each invoice is saved. This "Extract information from invoices" action relies on an AI model created by Microsoft specifically built for the use-case of invoice processing. The model successfully extracts via OCR every bit of text present on the file, and tries to categorize those strings extracted into fields. Some field examples are: "Invoice Number", "Customer Taxpayer Number", "Invoice Total", "Invoice Date", etc. Bearing in mind that all these bits of information needed to be manually extracted by a worker physically looking at the invoice in the previous process, this already represents a huge step forward in saving intensive manual labor.

Also worth noting that, for every field that the AI model is able to extract from the invoice it is given, it also outputs a "confidence level". This confidence level, measured from 0 to 1, represents the

confidence that the model has in having extracted the correct value for that specific field. As we will see later in the desktop app demonstration, these confidence values will be very helpful for the workers who will need to validate the information extracted by the AI model, as it will be easy to differentiate between a field with high extraction confidence and a field with low extraction confidence.

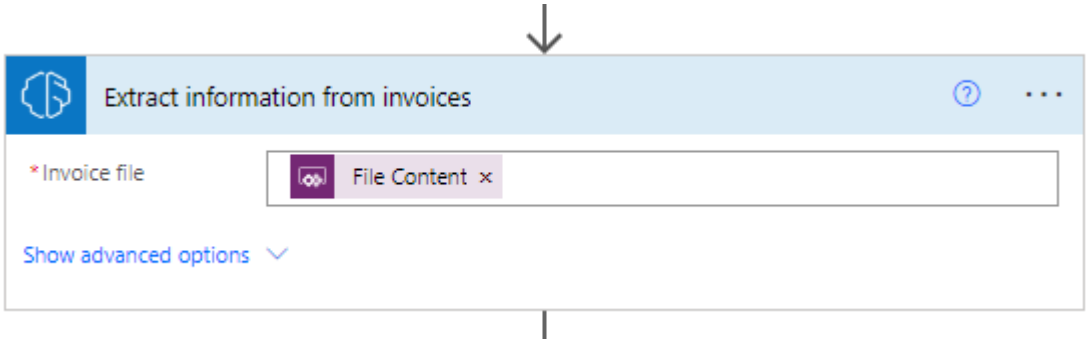

Figure 14 - AI Builder Extraction Action inside Power Automate Flow

5.6.3.5 Adding the information extracted by the model to the table row created previously

After having extracted the information using the AI model detailed previously, the flow proceeds to add all the relevant data points found into the table row that was created as the first step of the flow. As it is possible to verify on Figure 15, a total of 12 fields are extracted from the AI model:

1. ConfData – the confidence of the model in the extraction of the correct invoice date;
2. ConfEmpresa - the confidence of the model in the extraction of the correct invoice company;
3. ConfID - the confidence of the model in the extraction of the correct invoice ID;
4. ConfNIF - the confidence of the model in the extraction of the correct customer taxpayer number;
5. ConfNIFEmp - the confidence of the model in the extraction of the correct medical provider taxpayer number;
6. ConfTotal – the confidence of the model in the extraction of the correct invoice total;
7. Data – the invoice date;
8. Empresa – the medical provider name;
9. ID Fatura – the invoice ID;
10. NIF Cliente – the customer taxpayer number;
11. NIF Empresa – the medical provider taxpayer number;
12. Total – the invoice total value.

If, for any reason, the AI model is not able to extract one or many of the values for the respective fields, this action will leave the specific row columns with blank values, that can then be changed by a human validator.

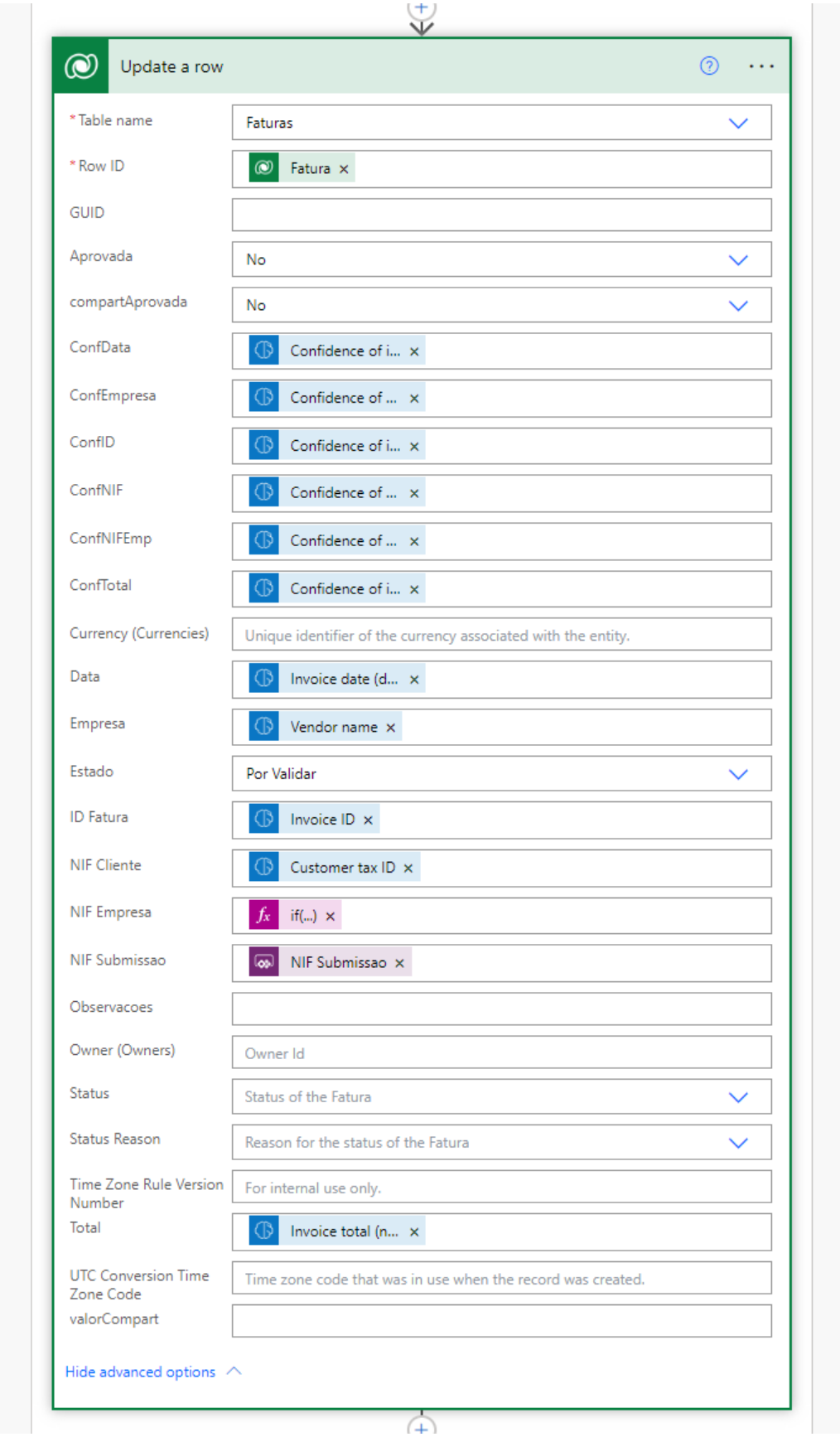

Figure 15 - Update Row Action inside Power Automate Flow

5.6.3.6 Creating one table row in the table “ItensFatura” for every line item of the invoice

This flow action represents a “for each”. It is configured in such a way that for every line item the AI model detects in the invoice, it will create a row on the line items table (called “Itens Fatura”). To maintain consistency over the database, the line items will have the same GUID value calculated in the first step, in order to create a one-to-many relationship between the two tables “Faturas” and “Itens Fatura”.

For every line item in the invoice, the AI model extracts:

1. confCodigo – the confidence of the model in the extraction of the correct line item code;
2. confData - the confidence of the model in the extraction of the correct line item date;
3. confQuantidade - the confidence of the model in the extraction of the correct line item quantity;
4. confTitulo - the confidence of the model in the extraction of the correct line item name;
5. confValor - the confidence of the model in the extraction of the correct line item value;
6. Codigo – the line item code;
7. Data – the line item date;
8. Quantidade – the line item quantity;
9. Title – the line item name;
10. Valor – the line item value.

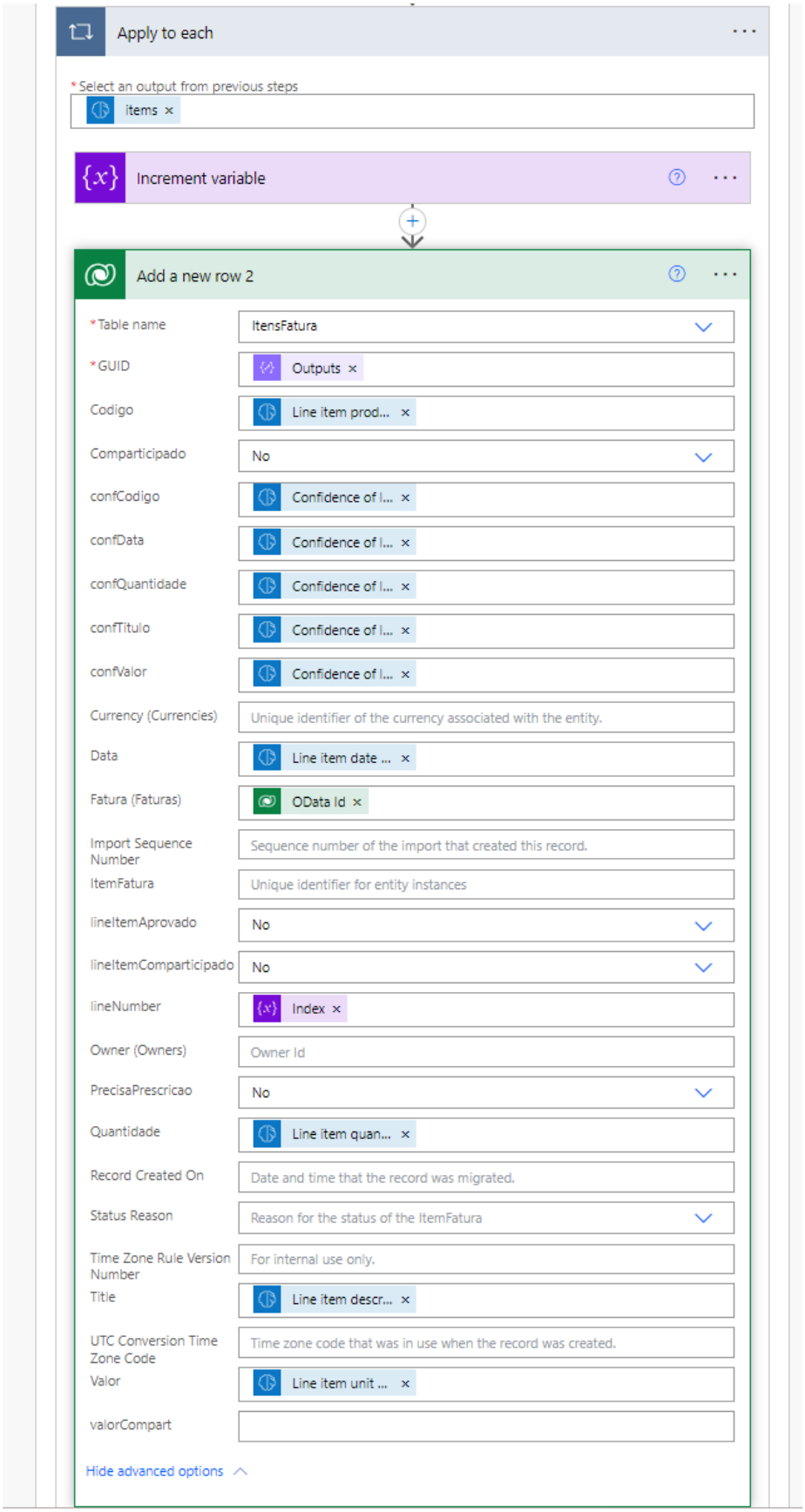

Figure 16 - Loop Action to add Rows to Line Items Table inside Power Automate Flow

The flow terminates after every line item is sucessfuly converted into a row on the “Itens Fatura” table. After the flow has ended, which normally takes around 30 seconds (depending on the number of line items), the invoice is ready to be validated by the human worker (the set of actions necessary will be shown in the “Prototype Demonstration” chapter.

5.7 Dataverse Database

Dataverse was chosen as database technology because it is fully integrated with the Power Plaftorm development suite, allowing for an easier setup. The database stores all the records associated with both applications. It contains two tables: one for invoices and another for invoice line items. These tables are connected by a primary key (GUID). The table details are presented below.

5.7.1 Invoices Table

The invoices table is responsible for storing the general information related with each invoice submitted by the customers. Table 2 displays all the columns available on this table, their corresponding data types and the purpose of each column:

Table 2 - Invoices Table Fields Description

Column Name	Data Type	Purpose
Aprovada	Boolean	True if the data gathered by the model has been approved by a human operator. Default False.
ConfData	Decimal	Confidence of AI Builder model in the correct extraction of the Invoice Date value
ConfEmpresa	Decimal	Confidence of AI Builder model in the correct extraction of the Company Name value
ConfID	Decimal	Confidence of AI Builder model in the correct extraction of the Invoice ID value
ConfNIF	Decimal	Confidence of AI Builder model in the correct extraction of the Invoice Customer Taxpayer Number value
ConfNIFEmp	Decimal	Confidence of AI Builder model in the correct extraction of the Invoice Company Taxpayer Number value
ConfTotal	Decimal	Confidence of AI Builder model in the correct extraction of the Invoice Total value
Data	Date only	Invoice Date.
Empresa	Single line of text	Company that issued the invoice.
Estado	Choice	Choice field that reflects the state of the invoice along the internal processing. Options: To Validate, To Certify, To Be Paid, Paid, Rejected.

GUID	Single line of text	Globally Unique Identifier of this invoice. Used as primary key to connect both tables.
ID Fatura	Single line of text	Invoice ID.
LinkFatura	File	Invoice file, uploaded by the customer.
NIF Cliente	Whole number	Customer Taxpayer Number.
NIF Empresa	Whole number	Company Taxpayer Number.
NIF Submissao	Whole number	Taxpayer number of the user that submitted the invoice in the mobile app.
Observacoes	Multiple lines of text	Internal observations from the processing team regarding the invoice.
Total	Currency	Invoice total value.
Created By	Lookup	Who created the table row.
Created On	Date and time	Date and time when the row was created.
Modified By	Lookup	Who last modified the table row.
Modified On	Date and time	Date and time when the row was last modified.

5.7.2 Line Items Table

The Line Items table is responsible for storing the data associated with each item of each invoice. As one invoice can and typically has more than one item being billed, this table will have a greater number of rows when compared with the Invoices Table. Table 3 displays all the columns available on this table, their corresponding data types and the purpose of each column:

Table 3 – Invoice Line Items Table Fields Description

Display Name	Data Type	Purpose
Codigo	Single line of text	Line item code.
confCodigo	Decimal	Confidence of AI Builder model in the correct extraction of the Line Item Code.
confData	Decimal	Confidence of AI Builder model in the correct extraction of the Line Item Date.

confQuantidade	Decimal	Confidence of AI Builder model in the correct extraction of the Line Item Quantity.
confTitulo	Decimal	Confidence of AI Builder model in the correct extraction of the Line Item Title.
confValor	Decimal	Confidence of AI Builder model in the correct extraction of the Line Item Value.
Data	Date only	Line item date.
GUID	Single line of text	Globally Unique Identifier of this invoice.
ItemFatura	Unique identifier	Unique identifier of this line item.
lineItemAprovado	Boolean	True if the line item content has been approved by a human operator. Default False.
lineNumber	Whole number	Integer that follows the order of the line items inside the invoice. Used to order the line items in the UI.
Quantidade	Whole number	Line item quantity.
Title	Single line of text	Line item title.
Valor	Currency	Line item value.
Created By	Lookup	Who created the table row.
Created On	Date and time	Date and time when the row was created.
Modified By	Lookup	Who last modified the table row.
Modified On	Date and time	Date and time when the row was lasst modified.

5.8 Conclusion

This chapter provided a comprehensive overview of an automated medical invoice processing solution that has been specifically built to address the many issues encountered by organisations when relying on manual data extraction methods. The system effectively incorporates Microsoft's Power Platform, which encompasses PowerApps for mobile and desktop, Power Automate, and AI Builder. The processes result in the implementation of a digitalized system for submitting invoices, enhancing internal management efficiency, and facilitating intelligent extraction of data. The proposed method not only reduces operational expenses but also enhances accuracy, hence improving the user experience through a more efficient invoice processing system.

6 Demonstration

This section of the report aims to describe, in detail, all the functions of the solution, together with their visual representation. The demonstration will use an invoice with dummy data (the invoice is shown in Annex 1) going through the whole system, demonstrating the kind of work is needed to process the invoice from start (Invoice Submission) to finish (Invoice Validation).

As was also described previously, the solution was built to focus on improving the current processes “low hanging fruit” (the processes that took the most time and effort on the current system). The reimbursement calculation and the invoice payout were not included in the prototype application.

Also note that the application was built as a proof-of-concept, so the UX/UI of the solution isn’t optimized, but should be user-friendly enough so that a user can intuitively understand the logic behind it.

6.1 Invoice Submission Mobile App

As described previously, the first action that the system focuses on digitizing is the process of invoice submission. This process was previously only done physically at one of the organizations’ locations. This was achieved through the creation of a mobile app (app to be used on mobile phones) using PowerApps, that users of the organization could use to login and submit their invoices, as well as check for the status of the invoices they had previously submitted.

6.1.1 Login Screen

Figure 17 below shows the initial (login) screen of the application.

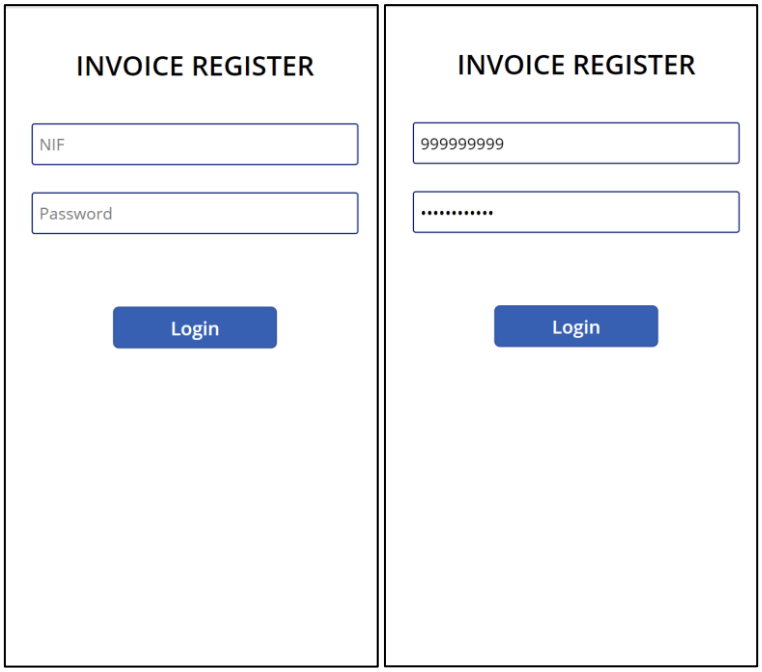

Figure 17 - Mobile App Login Screen without (left) and with (right) data inserted

As it's possible to see, the initial screen is very simple, presenting two very simple and intuitive information fields (NIF – the user's taxpayer number - and Password) that should be filled in by the user to access the platform, and a button to validate the information inserted and login. For the purposes of this demonstration, the NIF number used was "999999999".

6.1.2 Menu Screen

Once the user logs in by clicking the "Login" button, a new screen (the Menu screen) is displayed. The screen is shown in Figure 18.

Figure 18 - Mobile App Menu Screen

As it is possible to observe, the initial screen that shows up after the Login presents a total of 4 options:

1. Minhas Faturas – "My Invoices" – this button takes the user to a screen where all of his invoices will be listed;
2. Faturas Submetidas por mim – "Invoices Submitted by Me" – this button also takes the user to a different screen, where all the invoices submitted by the current user will be listed. Note that this list can be different from the first one, because the application was built to predict the scenario in which one user can submit invoices for, or in the name of, another user;
3. Submeter Nova Fatura – "Submit New Invoice" – this button takes the user to a new screen where the user is prompted to input the desired invoice for processing.
4. Sair – "Log Out" – this button is self-explanatory, taking the user back to the first Login screen.

Also, note that the current users' name (in this case, "António Freitas") is shown on the top left corner. This isn't due to a previous register of an account with this NIF being related with this name. The name is shown leveraging the name present in the Microsoft account that was used to log into PowerApps.

6.1.3 Submit New Invoice Screen

Lets continue by analysing the "Submit New Invoice" screen, which is shown after users click in the corresponding button. The screen is displayed in Figure 19.

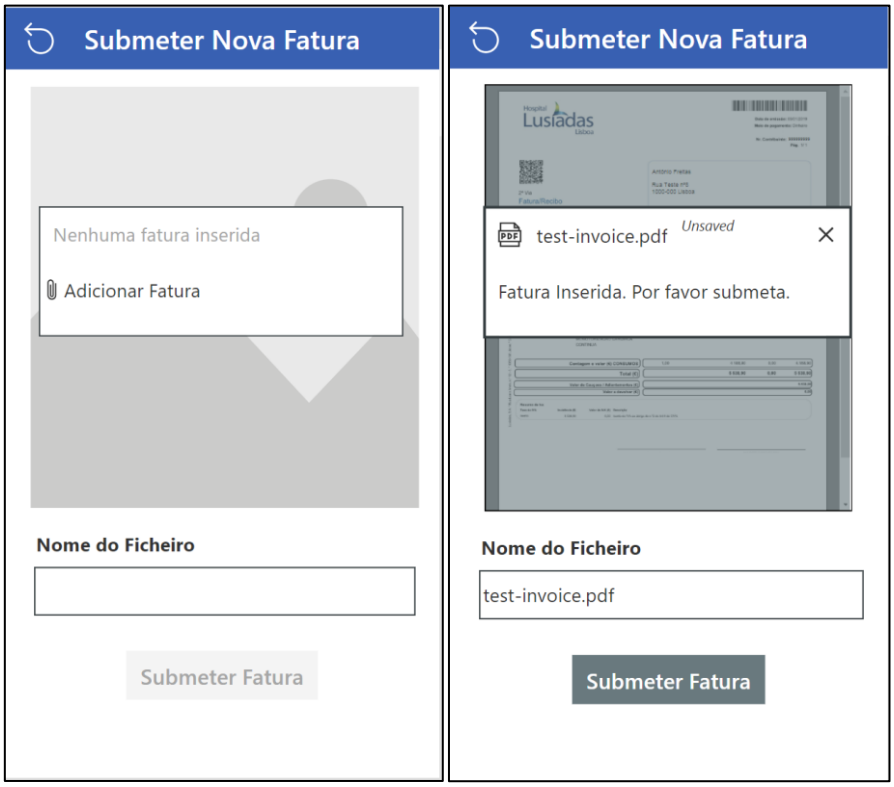

Figure 19 - Mobile App Submit New Invoice Screen with (left) and without (right) an invoice uploaded

This screen is composed of four main sections.

1. The top section, where users can click the top left "back" button to return to the previous screen;
2. The invoice upload section, which is represented by an attachment icon, followed by Adicionar Fatura – "Add Invoice". This section also allows the users to confirm that the invoice they submitted is the correct one, because once the invoice is attached, a preview of that invoice is shown in the background of the section, as can be observed in the image to the right of Figure 19;
3. The "Nome do Ficheiro" section, where the users will be able to confirm that the invoice they are submitting is correct. This section allows no written input, only being filled when the user attaches an invoice to the invoice upload section;

4. The submit invoice section “Submeter Fatura”, that contains a button for the users to click after the invoice is uploaded to effectively submit it into processing by the system. The button changes color when an invoice is uploaded, as it is possible to observe on the image to the right of Figure 19.

After the user uploads the invoice using the invoice upload section, the user is automatically redirected to the Menu screen, while on the background, the invoice is being processed by the Power Automate flow, that will try to extract all the data points from the invoice and send it for further processing with the organizations’ internal team.

6.1.4 My Invoices and Invoices Submitted by Me Screens

A couple seconds after the user submits the invoice, the user should be able to confirm that submission by opening the “Invoices Submitted by Me” screen, one of the options available in the Menu Screen. If the user is submitting the invoice for himself (if the taxpayer number on the invoice matches the number on the logged in account), then the user will be able to see the newly submitted invoice both in the “My Invoices” and “Invoices Submitted by Me” screens.

Both these screens are identical (both represent lists of invoices, in exactly the same format). The screens are displayed on Figure 20. As it is possible to observe, as the taxpayer number on the invoice matches the taxpayer used to login to the application, both screens present the same information (the invoice on the top that was submitted), together with some information about the invoice that was extracted by the Power Automate flow. The only relevant difference between the two screens is the title, changing from Faturas Submetidas “Submitted Invoices” to Minhas Faturas “My Invoices”.

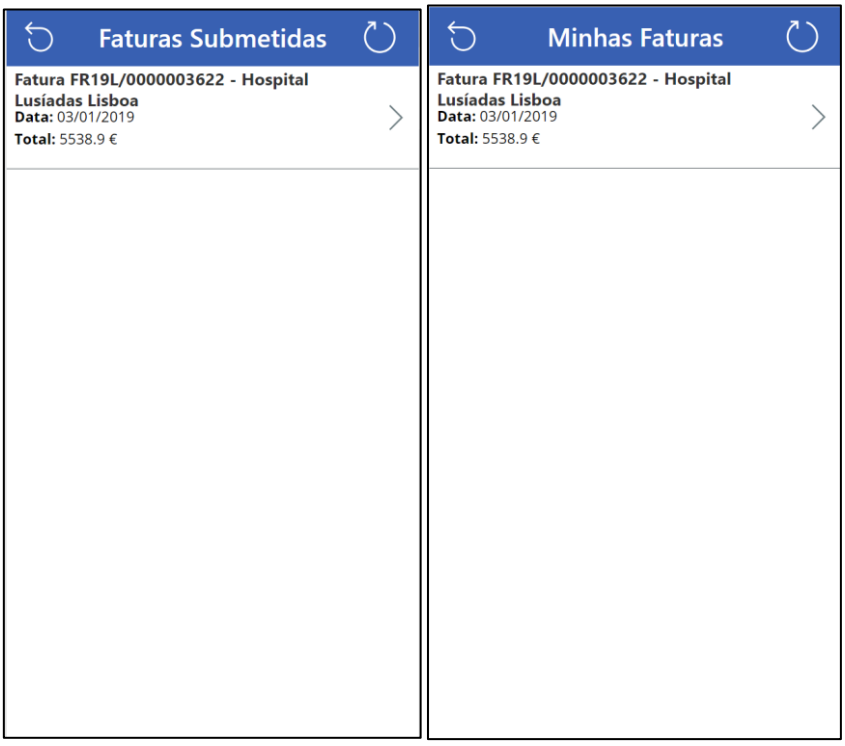

Figure 20 - Mobile App Submitted Invoices (left) and My Invoices (right) Screens

Note that, in these screens where a list of invoices is presented, each invoice row has an arrow on the right side. This arrow, when clicked, redirects the user to another screen, where the user is able to find additional details regarding the invoice that was submitted.

6.1.5 Invoice Details Screen

This screen is displayed in Figure 21:

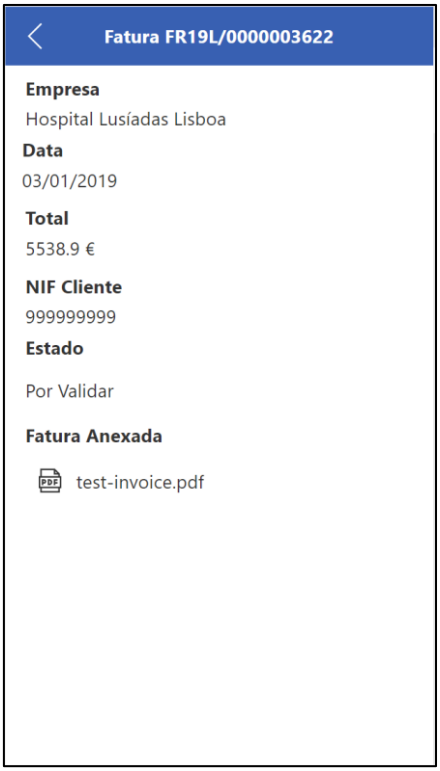

Figure 21 - Mobile App Invoice Details Screen

As it's possible to observe, this is a simple screen, presenting to the user some of the data points that were collected from the submitted invoice. The data points that are shown are:

1. Empresa "Company" – the medical provider;
2. Data "Date" – the date of the invoice;
3. Total – the invoice total value;
4. NIF Cliente "Customer Taxpayer number" – the customer taxpayer number present on the invoice;
5. Estado "State" – the state of the invoice processing;
6. Fatura Anexada "Attached Invoice" – a clickable link to download the invoice that was submitted previously.

This screen concludes the Mobile App demonstration, with all the features designed to help customers submit their invoices faster, and have a centralized repository of their previously submitted invoices where they can check their ongoing status.

Next comes the demonstration of the Desktop App, specifically built to help the internal workers of the organization on the Data Validation task, one of the most time-consuming parts of the whole invoice processing system.

6.2 Invoice Validation Desktop App

As written previously, this prototype application was built with the purpose of expediting the extraction and validation of information coming from invoices.

Previously, this process was done by a human worker, consisting on the handling and manual scanning of physical documents for information that would then be inserted on the information system. This task was tedious and very error prone – creating the need for additional validation steps throughout the invoice management process. The sole purpose of this application was to overcome the need for this manual input of data, effectively converting the task of the human worker from acting as a data extractor, to only acting as a data validator, validating the data extracted by the AI model.

In the following sections, all the aspects of the desktop app will be detailed, along with how they help on the invoice validation process. The same example invoice used in the previous Mobile App demonstration will be used for this section.

Bear in mind this is no longer the view of the customer, but the view of a worker that belongs to the organization, which would have to be trained in using all the capabilities of the system, that may not be as intuitive and user friendly as the mobile app at first.

Also, important to note, unlike the mobile application, the desktop application only consists of one screen, with the possibility of more screens being added in the future, to assist on the next stages of the invoice processing.

6.2.1 Invoice Validation Screen

Despite being just one screen, unlike the screens of the mobile application, this one screen contains a lot more functions. The next sections will detail, by function, what each part of the application screen is responsible for, and how the worker would interact with the application.

6.2.2 Invoice List

Upon opening the application, the internal worker of the application would be met with the screen in Figure 22:

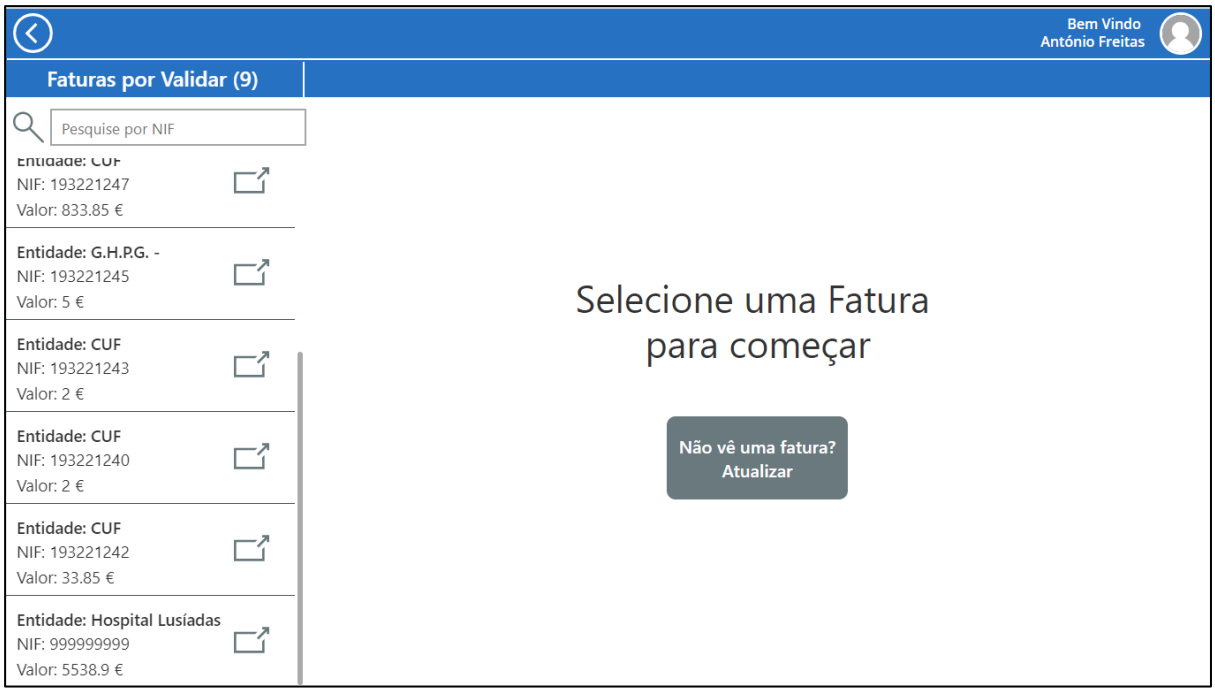

Figure 22 - Desktop App Initial Screen

As it is possible to observe, there are two main sections:

1. On the left side, the Faturas por Validar “Invoices to be Validated” section, where there is a list of all the current invoices waiting for processing. Notice there is also a filter option on the top of the left section, allowing the user to filter the list by taxpayer number, if the worker so desires.
2. On the right side, there is no information (yet) because no invoice was selected. The screen prompts the user to “Select an invoice to start”, and there is a button to refresh the database to check for new records.

The real processing comes after the worker selects the “Expand” icon that is located on the desired row. This action selects an invoice.

6.2.3 Invoice Selected

Once an invoice is selected, a function runs in the background that shows the user more information. The resulting screen can be found in Figure 23.

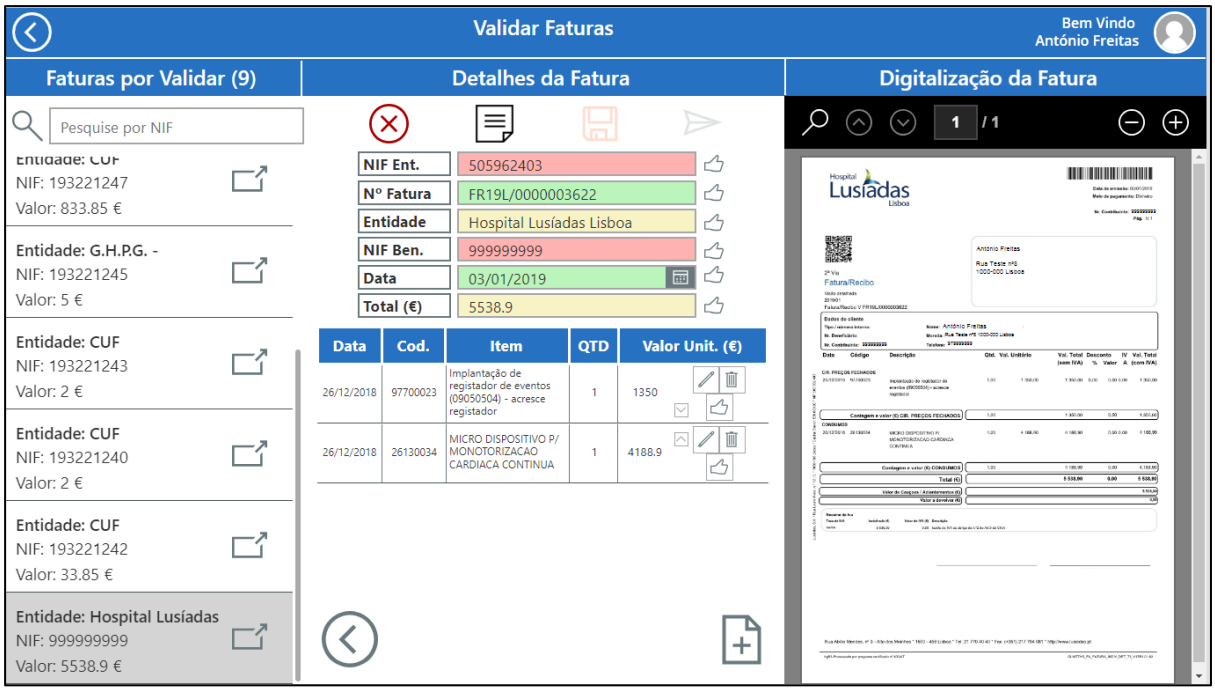

Figure 23 - Desktop App Initial Screen with an Invoice Selected

As it's possible to observe, a significant amount of information is displayed to the worker. All of this information, as described previously, has been extracted by the Power Automate and placed on the respective Dataverse database.

It is also intuitive to note that the user selected the last record on the list to the left – the invoice that had been submitted previously with taxpayer number "999999999".

The screen is now split into three different sections:

1. The left segment is still the same as before, a list of all the invoices pending validation;
2. The middle segment, Detalhes da Fatura "Invoice Details", is where the information extracted by the Power Automate flow is displayed, and some other functions are also presented. These will be explained in detail in the next section.
3. The right segment, Digitalização da Fatura "Invoice Display", is relatively straightforward, giving workers the possibility of looking at the digitized invoice to validate any specific datapoint they need, with an integrated zoom in/out function for a clearer view.

Let's now dive into the middle section, "Invoice Details".

6.2.4 Invoice Details

First of all, as it is possible to verify on Figure 23 above, the screen contains a lot of information, looking very packed and not easy to manipulate. To solve this, in the bottom left corner of the middle segment, there is an icon with an arrow to the left , allowing workers to collapse their view of the invoice list when they are working on a specific invoice. Figure 24 below showcases how the application looks when the left section is collapsed.

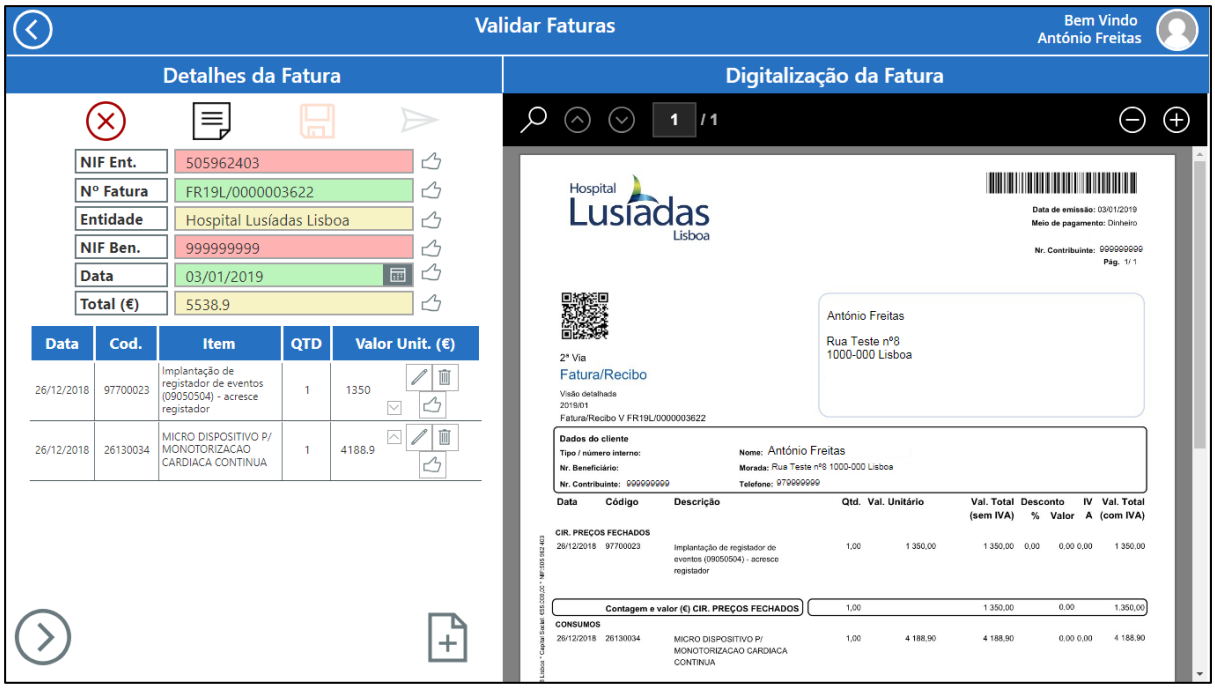

Figure 24 - Desktop App Invoice Details Screen after collapsion the list of invoices

It's clear that the worker now has a lot more space, especially when it comes to easily verifying the elements on the document. In order to reverse the collapse of the left pane, the worker just needs to press the right facing icon .

6.2.5 Invoice General Information

Now lets analyse the information contained on the Details section, and the way the information is formatted. On the top, six information fields are displayed. They can be seen in a bigger scale in Figure 25.

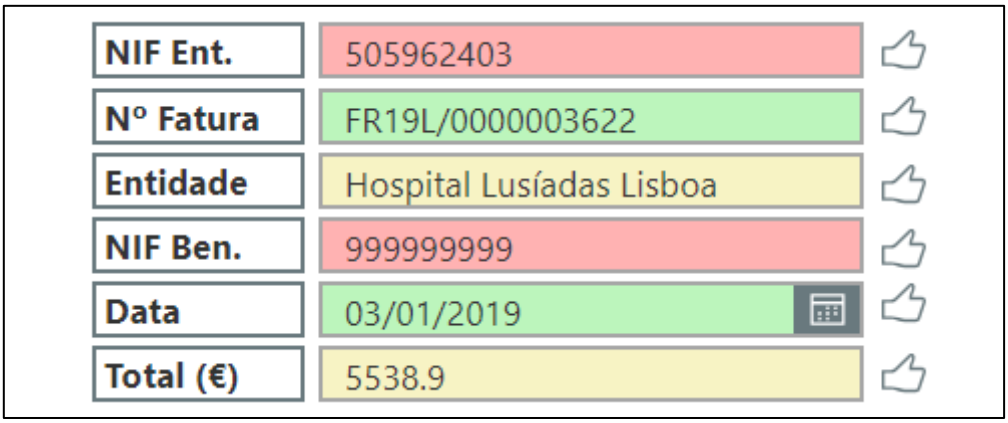

Figure 25 - Desktop App Invoice General Information Display

The information on these fields has been extracted from the invoice by the Power Automate Flow that ran after the customer submitted the invoice (the example displayed on the Mobile App).

Data points displayed:

1. NIF Ent. – Medical provider company taxpayer number;
2. Nº Fatura – Invoice Number;
3. Entidade – Name of Medical Provider;
4. NIF Ben. – Customer taxpayer number;
5. Data – Invoice date;
6. Total (€) – Invoice total value.

It is worth noting that all the fields have a different color. This was created to help the worker distinguish between a high-certainty field and a low-certainty field. The logic is simple:

1. Green – a field has green color If the model had a confidence level greater than 80% when extracting the value from that field from the invoice;
2. Yellow – a field has yellow color If the model had a confidence level between 30% and 80% when extracting the value from that field from the invoice;
3. Red – a field has red color If the model had a confidence level lower than 30% when extracting the value from that field from the invoice;

These color distinctions help the worker on the process of validating the information provided, allowing for the worker to allocate more effort into validating the red datapoints, and less effort into validating the green datapoints, that were considered robust extractions by the model.

You can also observe that, to the right of each field, there is a “thumbs-up” icon . This icon is a button that must be clicked by the user to validate the information extracted by the model for that specific field. After being clicked, the icon (and row) change – the resulting UI can be found on Figure 26.

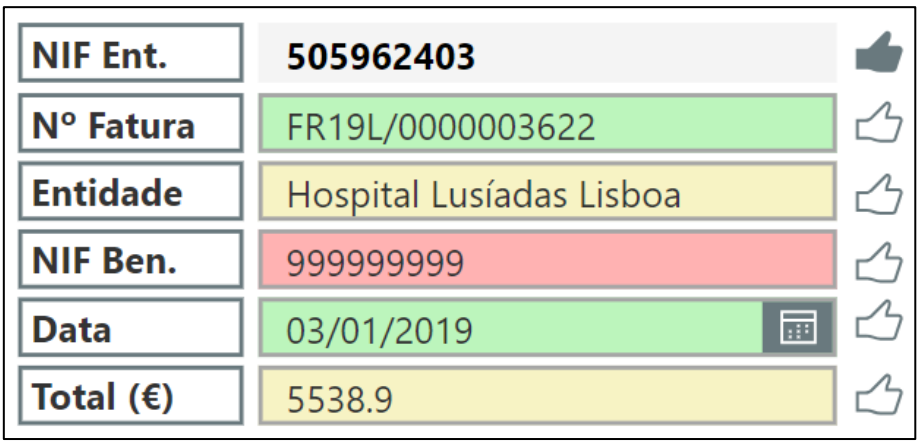

Figure 26 - Desktop App General Invoice Information Display after one field was validated

It is possible to observe that the row that was validated (NIF Ent.) now shows a different appearance, with the content of the field in bold and the “thumbs-up” icon now filled in . This lets the user know and keep a record of the fields that have been validated previously. The same procedure needs to be done to every available field.

6.2.6 Editing Information

Sometimes, the information extracted by the model may be wrong. That is why this process wasn't fully automated and still needs human supervision. When that happens, workers need to have a way to change the information that the model extracted and save a new version. They can do this by changing the text directly on the corresponding field. Whenever one of the fields is changed, the user is prompted to save the changes made to the record (the save icon, on the top of the page, turns brown). An example scenario can be found on Figure 27.

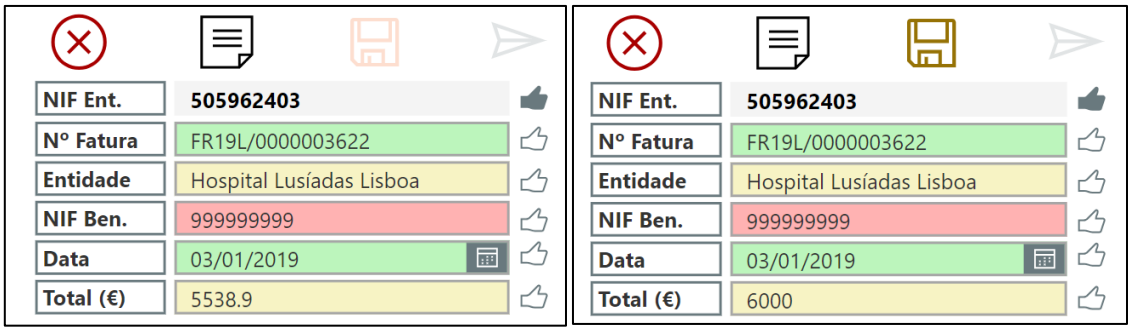

Figure 27 - Desktop App Save button before (left) and after (right) the "Total (€)" field value was changed

As seen on the images above, the Total value of the invoice was changed by the user from 5538.9 to 6000, prompting the save icon to turn brown, indicating to the user that the save button must be clicked for the changes to be committed to the database.

If the worker saves the new information by clicking on the save icon, the icon turns into grey again (like it is on the left example of Figure 27 above).

6.2.7 Line Item Validation – Table Version

As described previously, in order to process an invoice and accurately calculate the amount due as a reimbursement to the client, not only the main details from the invoice (such as the total invoice value) need to be extracted, but also the finer details of that invoice, that make up to that total value. This is because, in certain situations, the many medical procedures that on the same invoice have different reimbursement levels. For this reason, the Power Automate flow also extracts all the line items present on the invoice and shows them in a table format for the worker to validate. An example of this data extraction is shown in Figure 28.

Data	Cod.	Item	QTD	Valor Unit. (€)
26/12/2018	97700023	Implantação de registador de eventos (09050504) - acresce registador	1	1350
26/12/2018	26130034	MICRO DISPOSITIVO P/ MONOTORIZACAO CARDIACA CONTINUA	1	4188.9

Figure 28 - Desktop App Invoice Line Items Table Representation for a specific invoice

The data points shown are:

1. Data – the line item date;
2. Cod. – the line item code;
3. Item – the line item name;
4. QTD – the line item quantity;
5. Valor Unit. (€) – the line item per unit price.

The concept behind this table of information is similar to the one governing the general details of the invoice – the worker needs to validate that the content of each row is correct, and after that, they should click the "thumbs up" icon on that specific row, in order to store the information that that line item was correctly verified. When the icon is clicked, the whole row turns into bold and the icon is filled, letting the user visually know that that line item has been approved. A visual representation of this approval is shown in Figure 29.

Data	Cod.	Item	QTD	Valor Unit. (€)
26/12/2018	**97700023**	**Implantação de registador de eventos (09050504) - acresce registador**	**1**	**1350**
26/12/2018	26130034	MICRO DISPOSITIVO P/ MONOTORIZACAO CARDIACA CONTINUA	1	4188.9

Figure 29 - Desktop app Invoice Line Items Table after one row has been validated

6.2.8 Line Item Validation – Specific Display Version

The table validation method for line items can be used by workers, but it doesn't allow neither for editing of the data if any data point is wrong, or to assess the confidence values that the AI model had in extracting each of the line items' data fields. In order to accomplish this, a new section was created, that is shown only when the users click on any of the edit icons on one of the table rows. The resulting screen from clicking the pencil icon on the second line item is shown in Figure 30.

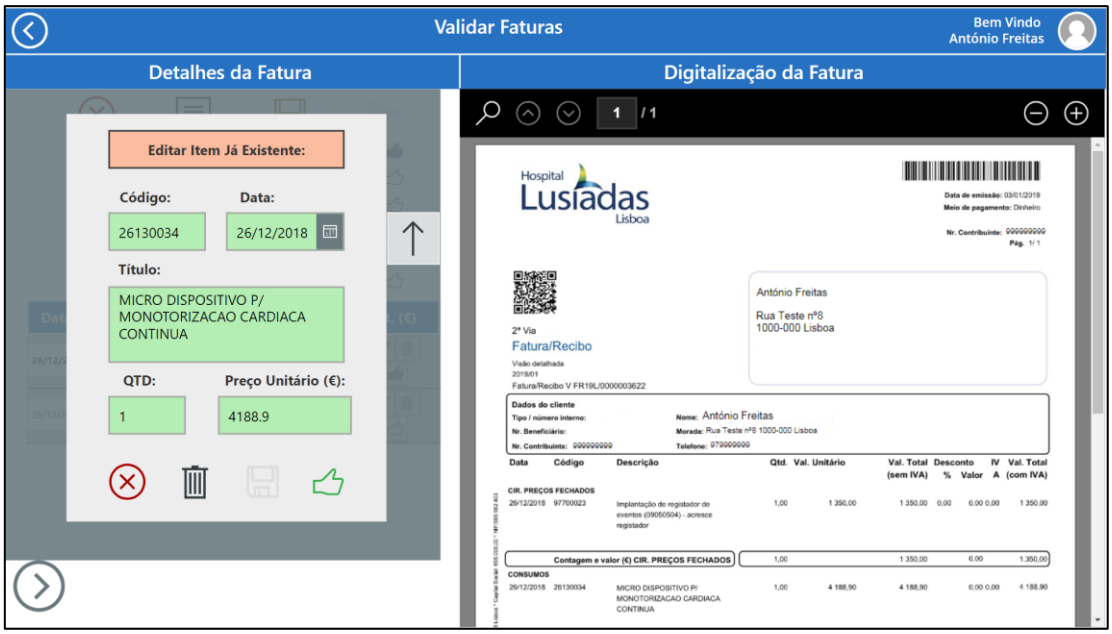

Figure 30 - Desktop App Overlapping Section that shows up after pressing the "pencil" icon

As it is observable in the above figure, whenever the pencil icon is clicked, an overlapping section shows up, with title Editar Item Já Existente, “Edit Already Existing Item”. This section allows the same kind of editing that is present on the invoice general details (as detailed in Figure 27). The save button also performs in the same manner. There is also the possibility of the user deleting the line item (if the model didn’t extract it correctly) with the trash icon  , and the possibility of directly moving into other line items without leaving this view, using the arrow icons to the right of the data  . Figure 31 shows what happens after the arrow item is clicked (remember that the line item above had already been validated by the user previously):

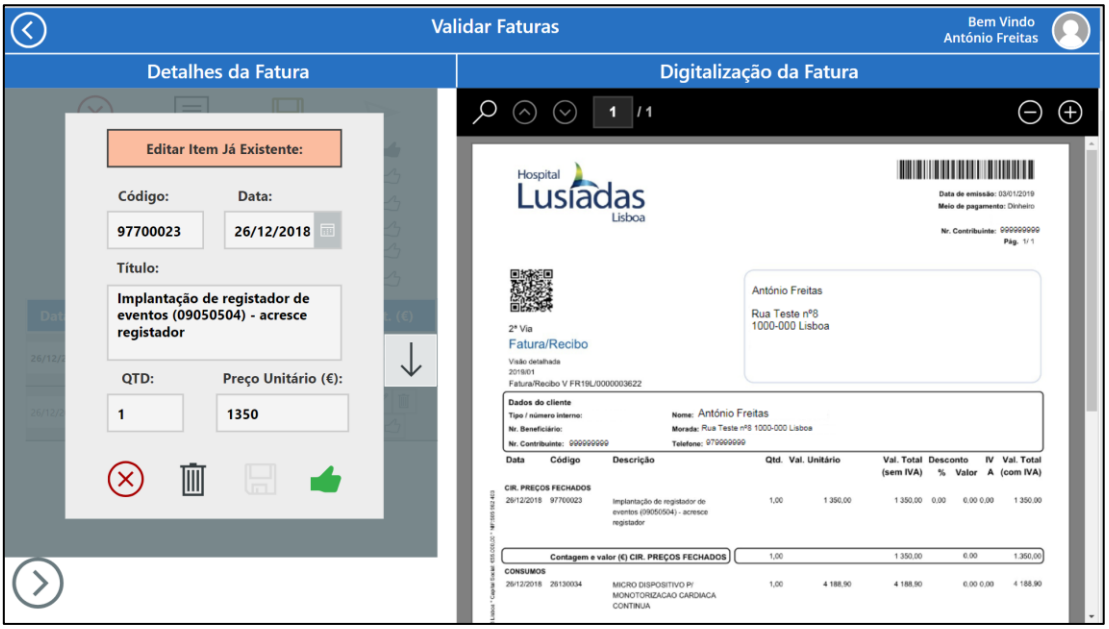

Figure 31 - Desktop App Demonstration of the Up and Down arrows for navigation between Line Items

As it is now possible to observe (in Figure 31), as the user had previously validated the first line item, all of the fields appear in a bold, read-only format.

In order to exit the line item view, the worker just needs to press the cross icon .

6.2.9 Adding Missing Line Items

Although rare, it can be the case that the model, for any reason, misses to extract one (or more) line items from the submitted invoice. In this scenario, the worker must have the possibility to add line items to the invoice. This can be done easily by clicking the “add item” icon . The placement of this icon can be checked on Figure 24. Once clicked, a very similar overlapping section to the one used to edit line items is shown to the user. The main difference is that all the fields are empty, waiting for the user’s input. This section is shown on Figure 32 below.

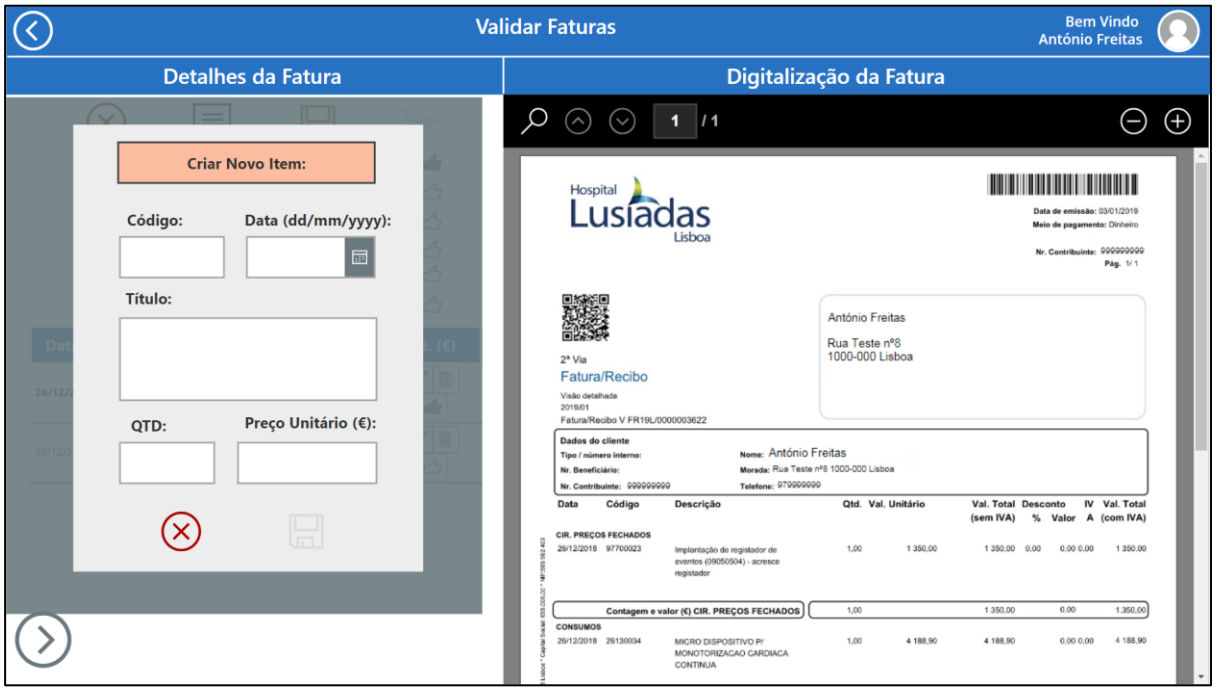

Figure 32 - Desktop App Overlapping Section for the creation of a new Line Item

As it is observable in the figure above, the title of the generated section is also different, now stating Criar Novo Item “Create New Item”. When the information is filled in, the save icon, as demonstrated previously, turns brown, allowing the user to save the new line item. Just for demonstration purposes, Figures 33 and 34 below showcase a line item being added.

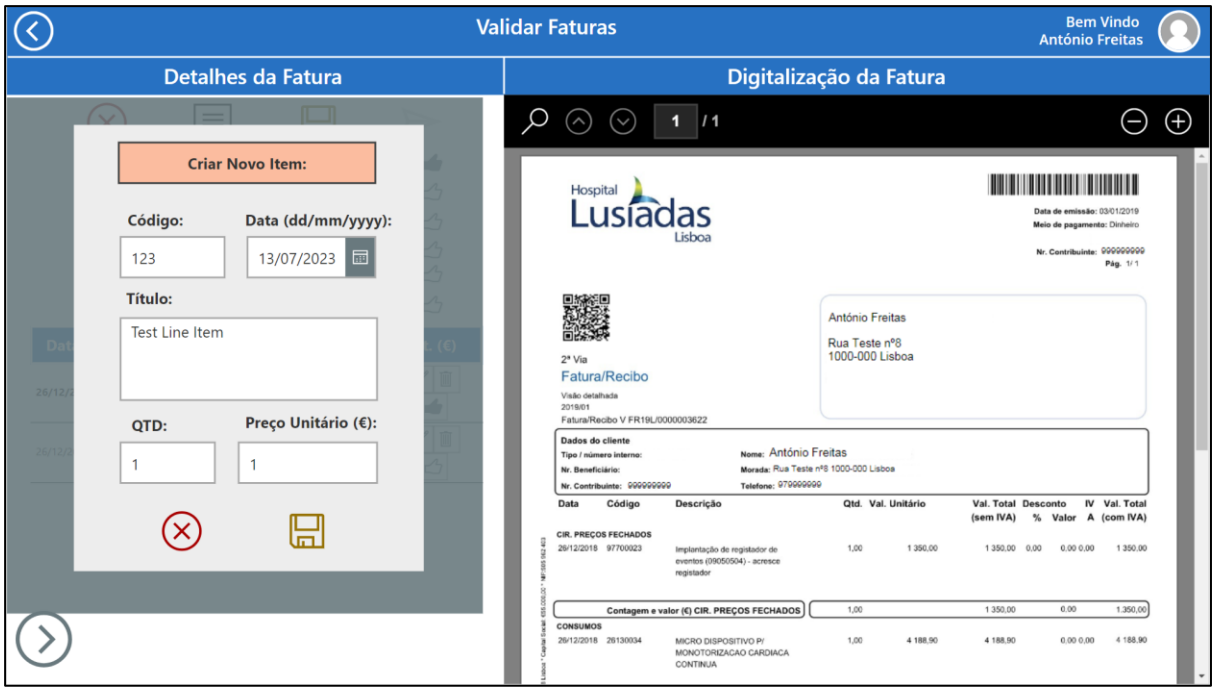

Figure 33 - Desktop App New Line Item Creation, before pressing "save"

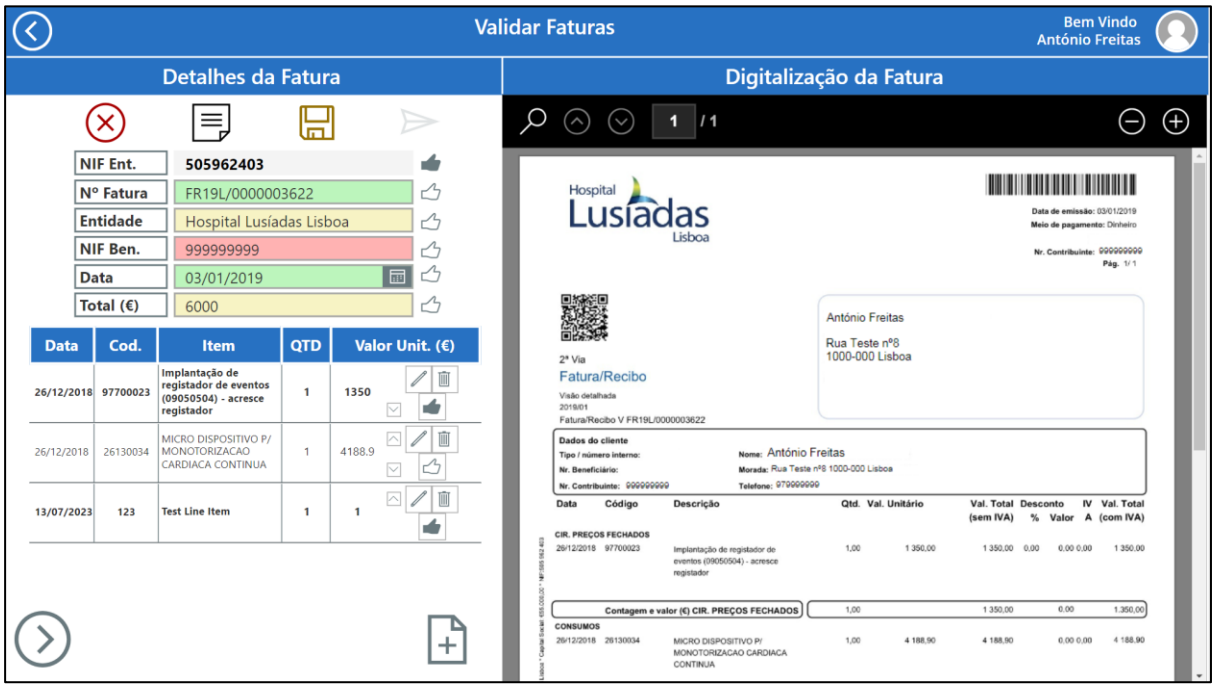

Figure 34 - Desktop App New Line Item Creation, after pressing "save"

As is demonstrated on Figure 34 above, the new line item that was created by the user is already validated (demonstrated by the bold font and the filled “thumbs-up” icon). This is default behavior, as the creation of a line item by a user signals to the system that that line item information must be correct.

6.2.10 Reordering Line Items

As visible on Figure 34 above, whenever the user creates a new line item (that was missed by the AI model), it is added to the other line items on the bottom of the table. Sometimes this may match the actual order of the line items on the document, but other times it may not. In order to predict scenarios in which the order of the line items must be changed, pointing upward and downward arrows were added to the line item table on each of the rows.

This makes it easy for the worker to reorder the line items. Figure 35 depicts what the table looks like after clicking on the upward arrow on the line item created previously “Test Line Item”.

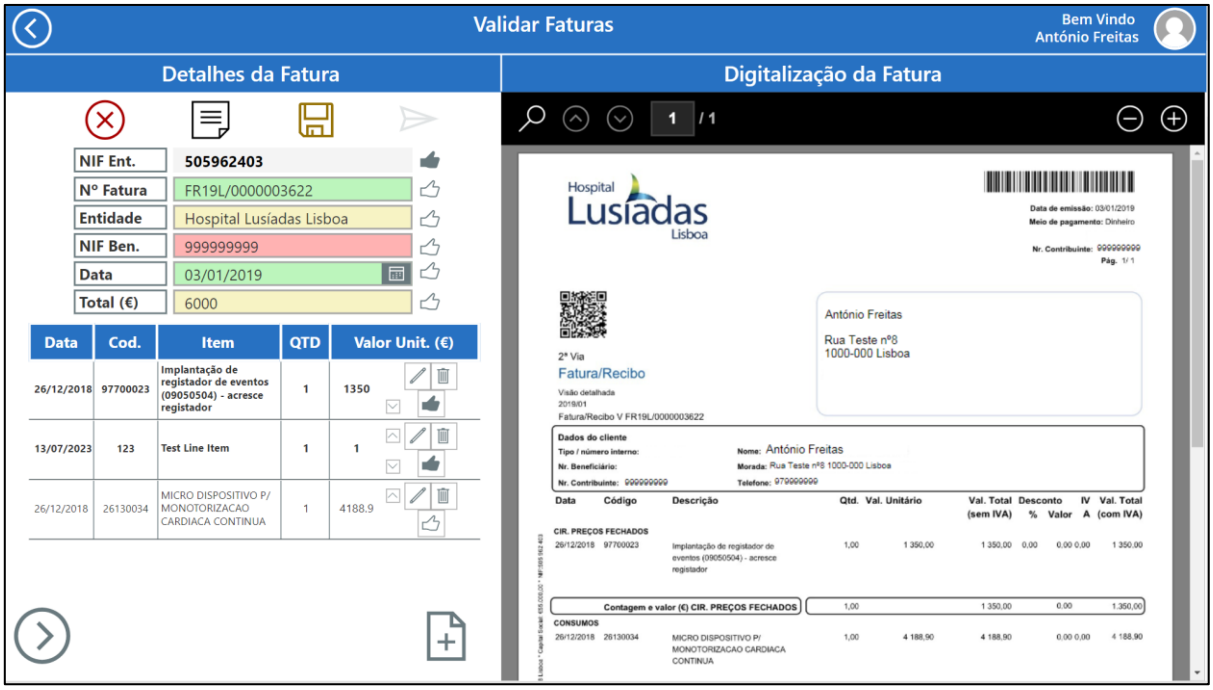

Figure 35 - Desktop App behavior demonstration of the up and down arrows present on the table rows for reordering Line Items

As can be noticed, the “Test Line Item” row moved into the middle row of the table.

6.2.11 Adding Comments

Due to specific circumstances, some invoices may have certain exceptions or specificities, that are hard to transmit internally using a standardized field of information. For this reason, an Observations field was created. It can be accessed by clicking on the post-it note icon. Figure 36 depicts what happens when the worker presses on this icon.

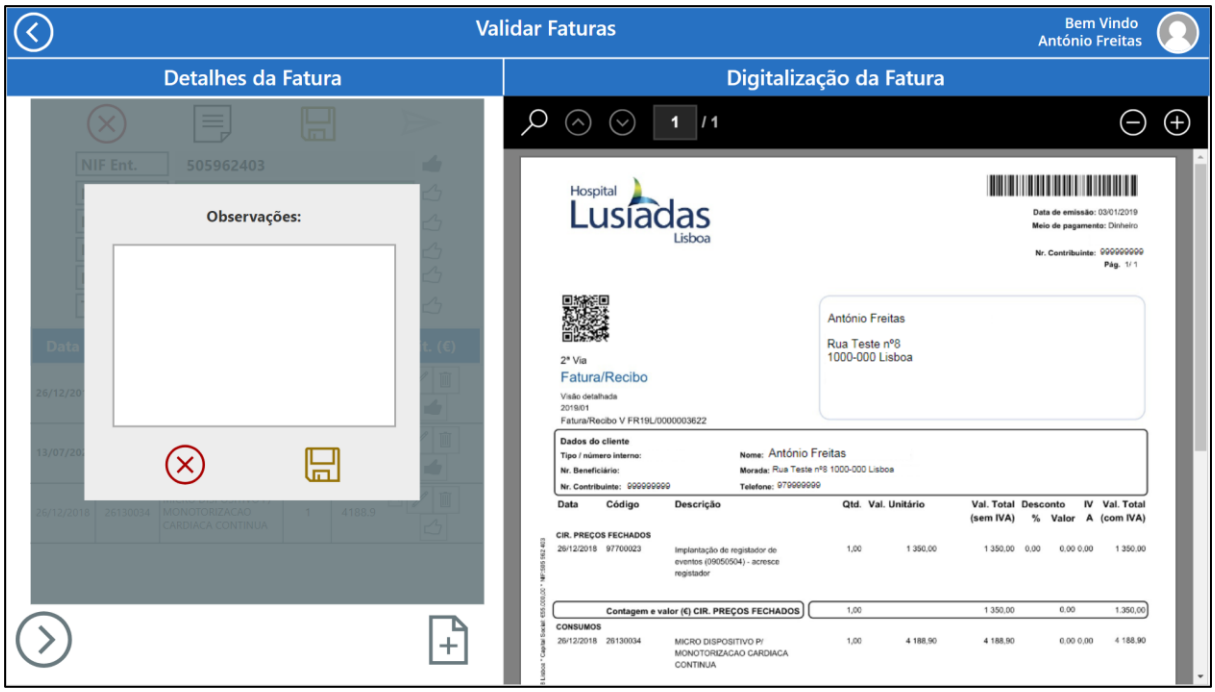

Figure 36 - Desktop App Observations section demonstration

As is evident, when a user clicks on the icon, another overlapping section shows up, with a field named Observações “Observations” where the user is prompted to insert any relevant comments on this invoice. Upon saving the comments by using the save icon, the information is stored in the Dataverse database, allowing the next worker to analyse it and act accordingly.

If an observation is present on an invoice, the worker is visually alerted of this by a visual change in the icon (the post-it icon becomes filled). Figure 37 accurately represents this scenario.

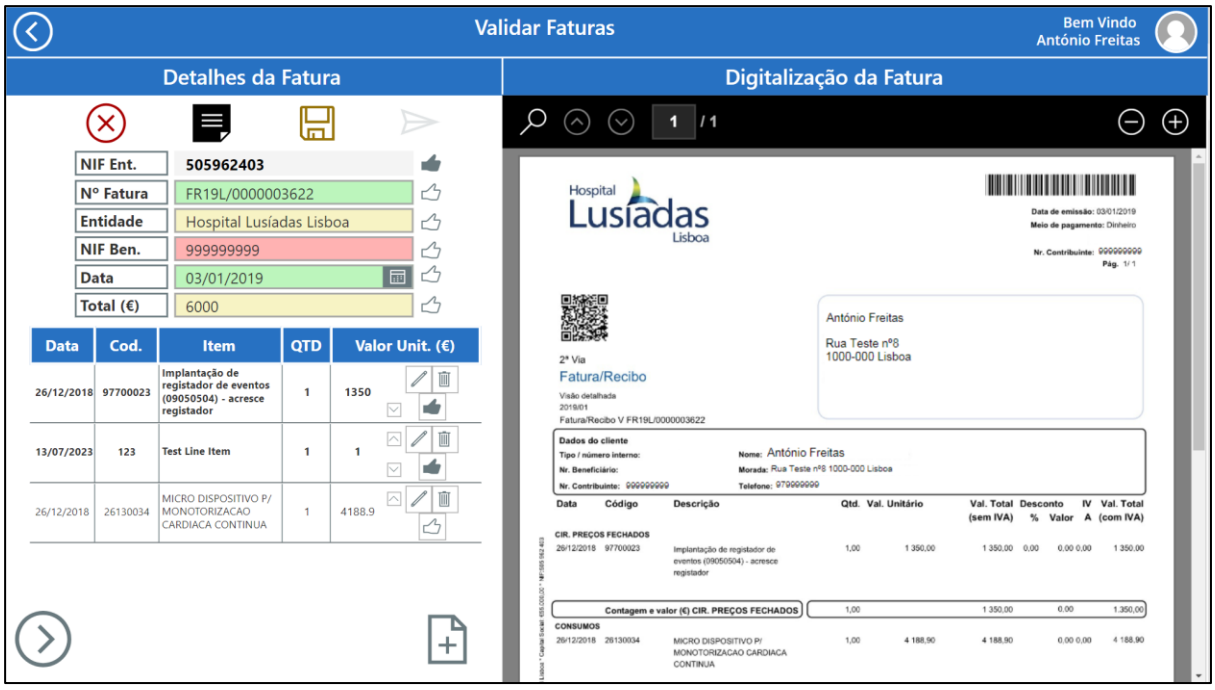

Figure 37 - Desktop App representation of an invoice with Observations inserted

6.2.12 Validating the invoice

After all the individual fields have been validated, the invoice is ready to be passed on to a different part of the process, the Reimbursement Calculation. The worker does this by confirming that all the data points (including the line items) are validated by checking the “thumbs-up” icons are all filled. When this happens, the send icon on the top of the page turns green, indicating to the user that the invoice can be sent for further processing. A representation of this can be found in Figure 38. Notice the “Test Line Item” was deleted because it was no longer needed for the demonstration.

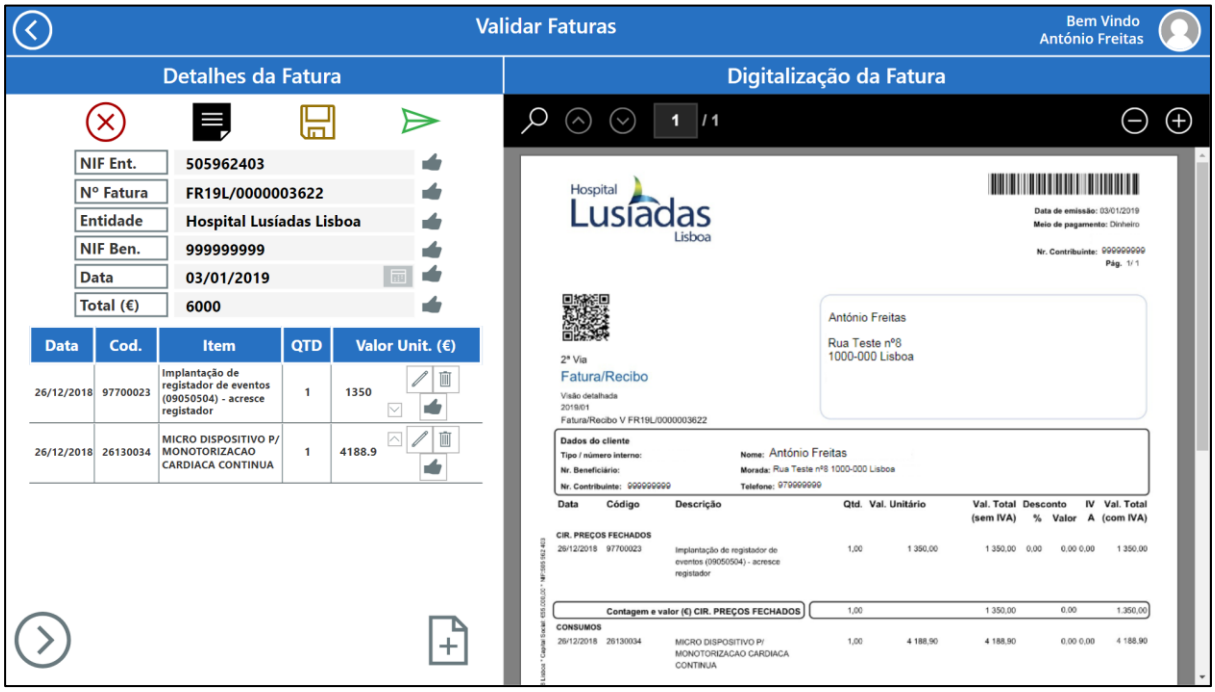

Figure 38 - Desktop App representation of a fully validated invoice, ready to be sent for further processing

6.3 Conclusion

This chapter has provided a comprehensive walkthrough of the invoicing solution, detailing each step from invoice submission via the Mobile App to data validation through the Desktop App. The solution aims to simplify and streamline the invoicing process, reducing manual effort, and enhancing data accuracy.

While the prototype application focuses on showcasing the “low hanging fruit” and is not fully optimized in terms of UX/UI, it serves as a robust proof-of-concept demonstrating the potential benefits and efficiencies that can be realized through digitizing and automating the invoice processing workflow. Future developments could include further optimizations, additional features, and integrations to enhance the solution’s capabilities and user experience.

7 Evaluation

In this chapter, a comparison will be made between the new system, which was built utilizing Power Platform tools, and the already existing processes at the medical insurance organization. The objective is to highlight the potential transformative impacts, improvements, and the overall efficiency gains anticipated from this change.

7.1 Expected Improvements

The implementation of the Power Platform-based system is expected to bring about significant advancements in the way invoices are managed and processed within the organization. Below are summarized the key areas of anticipated improvement:

7.1.1 Invoice Submission

Current State: Customers are required to physically submit their invoices, either by visiting one of the company's offices or mailing them, a method that is time-consuming and inconvenient.

Future State: The introduction of a customer-facing mobile Power App is anticipated to ease the submission process. Customers will be able to submit their invoices digitally at their convenience, saving time and initiating the reimbursement process as soon as possible. This shift is not just better for customer experience but is also expected to contribute to environmental sustainability by reducing physical paperwork.

7.1.2 Data Extraction and Entry

Current State: Manual insertion of data by a worker is a tedious and error-prone task, at times taking up to or more than 10 minutes per invoice, depending on its complexity. At 200,000 invoices per year, this amounts to a very substantial time investment that could be used on other higher value-adding tasks.

Future State: With the integration of Power Automate and AI Builder, the system is expected to autonomously extract the necessary data from the submitted invoices. The automation is anticipated to significantly cut down the time spent per invoice, mitigate human error, and free up human resources for more critical tasks.

7.1.3 Invoice Verification

Current State: A second worker is required to manually verify the data inserted, adding another layer of time consumption and potential for errors.

Future State: The automated data extraction process is expected to considerably lower the likelihood of errors. However, to ensure the biggest accuracy possible, an employee will review the extracted data through the Desktop Power App. This review process is quicker as it merely involves

verification rather than manual data entry, ensuring a more efficient and reliable verification process. The application will also inform the worker using visual cues of what fields the AI model was more or less confident on extracting, helping the worker to validate the invoice information.

7.2 Anticipated Time and Cost Efficiency

The digitization and automation of the invoice processing system are expected to result in substantial time savings and cost reductions. The promptness in processing is not only expected to enhance customer satisfaction but is also anticipated to expedite reimbursement payouts. Furthermore, the reduction in the need for physical space (owing to less paperwork) and the optimal utilization of human resources are projected to translate into significant cost savings.

7.3 Challenges

Despite the evident anticipated improvements, the transition to a digital system wouldn’t be without its challenges. The adoption of this new technology would necessitate adequate training for both clients in using the mobile app and employees in navigating the desktop app, and there may be some level of aversion to change inside the organization when making such a radical change in the process structure.

8 Conclusion

8.1 Main Contributions

This master thesis represents a significant stride toward modernizing the invoice processing system of the organization. The project involved a comprehensive analysis of the existing invoice management process, documenting each step to lay a solid foundation for process improvement.

One of the paramount achievements of this endeavor was the development of two distinct applications using Power Platform's low-code technologies. The first application, a mobile app, facilitates customers in submitting their invoices digitally, eliminating the need for physical submission and thereby substantially enhancing customer experience. This app effectively addresses the previously outdated mechanism that required either in-person submission at a store or via mail, a process that was not only time-consuming but also inconvenient for the customers.

The second application is a desktop app, designed to streamline the internal workflow of the invoices inside the organization. This app integrates with Power Automate and AI Builder to automate the extraction of invoice data, feeding it into a Dataverse database. Consequently, this innovation significantly reduces the manual labor previously required for data extraction, thereby accelerating the process and mitigating the risk of human error. Internal workers would now be able to validate the extracted data through an intuitive UI, a task that is considerably less burdensome than the manual extraction previously necessitated.

8.2 Limitations

Despite the evident progress made, the project is not without its limitations. The newly developed system is not yet fully integrated with the organization’s existing systems, which hampers its efficiency to a certain extent. Its reliance on Microsoft Infrastructure also presents a limitation, as it creates a dependency that may pose challenges in terms of flexibility and adaptability to other platforms or technologies in the future.

Additionally, the system still requires human validation, which, while considerably reduced, indicates that there is room for further automation. The effectiveness of the system is also contingent on the quality of invoices submitted. Poor quality invoices could lead to inaccurate data extraction, necessitating manual intervention and thus diminishing the efficiency gains achieved by the system.

8.3 Future Work

Looking ahead, there are several avenues for future work and improvement to bolster the effectiveness and efficiency of the invoice processing system. A primary objective should be the full integration of the developed system with the organization’s existing systems. This integration would ensure a seamless workflow and augment the system’s efficiency.

Further enhancement of the UX/UI of both applications would also contribute to a more user-friendly experience, encouraging adoption and facilitating easier navigation for users.

Additionally, future endeavors should aim for the full automation of invoice information extraction, striving to reach a point where human validation becomes obsolete. This would entail improving the AI model's accuracy and reliability, ensuring it can handle invoices of varying quality and complexity with high precision.

Finally, addressing the more complex stages of the Invoice Reimbursement Calculation and Invoice Payout, which were beyond the scope of this thesis, represents a significant opportunity for future work. These stages demand intricate integrations with a variety of systems and a thorough understanding of the complexities involved, posing a challenging yet rewarding avenue for improvement and innovation.

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Appendix

Annex 1 – The Invoice used for the tests

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Hospital Lusíadas Lisboa

Data de emissão: 03/01/2019
Meio de pagamento: Dinheiro

Nr. Contribuinte: 999999999
Pág. 1/ 1

António Freitas

Rua Teste nº8
1000-000 Lisboa

2ª Via

Fatura/Recibo

Visão detalhada
2019/01
Fatura/Recibo V FR19L/0000003622

Dados do cliente

Tipo / número interno:
Nr. Beneficiário:
Nr. Contribuinte: 999999999
Nome: António Freitas
Morada: Rua Teste nº8 1000-000 Lisboa
Telefone: 979999999

Data	Código	Descrição	Qtd.	Val. Unitário	Val. Total (sem IVA)	Desconto %	Desconto Valor	IVA	Val. Total (com IVA)
CIR. PREÇOS FECHADOS									
26/12/2018	97700023	Implantação de registador de eventos (09050504) - acresce registador	1,00	1 350,00	1 350,00	0,00	0,00	0,00	1 350,00
Contagem e valor (€) CIR. PREÇOS FECHADOS			1,00		1 350,00		0,00		1.350,00
CONSUMOS									
26/12/2018	26130034	MICRO DISPOSITIVO P/ MONOTORIZACAO CARDIACA CONTINUA	1,00	4 188,90	4 188,90		0,00	0,00	4 188,90
Contagem e valor (€) CONSUMOS			1,00		4 188,90		0,00		4.188,90
Total (€)					**5 538,90**		**0,00**		**5 538,90**
Valor de Caucoes / Adiantamentos (€)									**5.538,90**
Valor a devolver (€)									**0,00**

Resumo de Iva

Taxa de IVA	Incidência (€)	Valor de IVA (€)	Descrição
Isento	5 538,90	0,00	Isento de IVA ao abrigo do n.º2 do Art.9 do CIVA

Lusíadas, S.A. * Rua Laura Alves, n.º 12 - 6. * 1050-138 Lisboa * Capital Social €55.000,00 * NIF:505 962 403

Rua Abílio Mendes, nº 3 - Alto dos Moinhos * 1500 - 458 Lisboa * Tel: 21 770 40 40 * Fax: (+351) 217 704 081 * http://www.lusiadas.pt

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