

TaxGenie

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1 Project Synopsis

The goal of this project is to develop an Automated Year-End Tax Filing Assistant - provisionally named TaxGenie - that simplifies the process of tax filing with AI technologies. The system will allow users to upload documents, automatically fill out Canadian federal income tax forms (T1 General, T2 Corporate), suggest potential deductions or credits, and flag any missing information. This AI-driven approach aims to reduce time and errors associated with manual tax filing.

2 Project Description

The project aims to build a fully functional prototype within nine days; the prototype's maturity will evolve from initial design on Day 1 to a working demo by Day 9.

2.1 Work Plan

T1: Initial Planning and System Design (Day 1)

Objective: Define the overall architecture and workflow for the tax filing assistant.

Activities: Team meeting to align on objectives, drafting the system architecture, and outlining integration points for various AI components.

Output: A complete architectural blueprint of the system.

T2: Document Ingestion and Classification Setup (Day 2)

Objective: Develop the document ingestion pipeline.

Activities: Implement OCR and document classification using Watsonx Discovery, set up APIs for parsing Excel, Word, PDF, [other types of file] documents.

Output: A functional ingestion and classification module.

T3: Data Extraction and Parsing Module (Days 3-4)

Objective: Extract structured data from the uploaded documents.

Activities: Refine OCR and document parsing algorithms, implement AI models for data categorisation, validate extraction with sample documents.

Output: A working data extraction and parsing module.

T4: Data Validation and Suggestion Engine (Days 5-6)

Objective: Ensure data accuracy and compliance with Canadian tax regulations.

Activities: Integrate with tax rules databases, implement Gen AI to analyse documents, and recommend deductions.

Output: A data validation module.

T5: Automatic Tax Form Filling (Day 7)

Objective: Automatically populate Canadian tax forms with extracted data.

Activities: Integrate APIs to retrieve tax forms, develop Gen AI models to map data, test the form-filling process.

Output: A module that fills tax forms using the extracted data.

T6: Tax Optimisation and Recommendations (Day 8)

Objective: Provide insights and suggestions for tax optimisation.

Activities: Develop AI models to analyse financial data, implement a checklist generator, summarise potential tax savings.

Output: A tax optimisation module.

T7: Final Integration, Review, and Testing (Day 9)

Objective: Integrate all components and conduct end-to-end testing.

Activities: Combine modules into a cohesive workflow, conduct user testing, prepare a working demo.

Output: A fully integrated and tested system ready for deployment.

2.2 Milestones

- **M1:** System Design Completion (Day 1)
- **M2:** Document Ingestion and Classification Module Completed (Day 2)
- **M3:** Data Extraction and Parsing Module Developed (Day 4)
- **M4:** Data Validation and Suggestion Engine Functional (Day 6)
- **M5:** Automatic Tax Form Filling Module Ready (Day 7)
- **M6:** Tax Optimisation and Recommendations Engine Operational (Day 8)
- **M7:** Final Integrated System Demo (Day 9)

2.3 Challenges

Key challenges include ensuring accuracy in data parsing from diverse document formats, handling complex cases like self-employment income or capital gains, and maintaining security for sensitive financial data.

3 Beyond Development

Post-project, the team plans to present this work at AI conferences and workshops, aiming for further development and potential commercialisation. The project also offers opportunities for collaboration with tax professionals and financial services.

4 Additional Input

Input from experts in tax law, document processing, and AI integration is welcomed to enhance the system's accuracy and usability.

Technologies Used

User Interface (UI) Layer

Technology: React.js

React.js provides a component-based architecture that allows building a dynamic and responsive user interface efficiently. Its virtual DOM ensures faster rendering and a smoother experience, particularly when handling complex forms and dynamic content updates. Compared to alternatives like Angular or Vue.js, React.js is lightweight, integrates well with other front-end and back-end technologies, and has a large developer community, which enhances support and flexibility.

Document Ingestion & Classification Layer

Technology: PDF.co API (Document Parsing API)

PDF.co is chosen here for its ability to parse documents using a pre-made, specified template (which has been created only for a T4 document in these initial stages) then assign the fields and values to key-value pairs, which will be useful in later stages. Compared to alternatives like Adobe PDF Services or iText, PDF.co offers superior performance, more features for form automation, and a flexible licensing model, which is cost-effective for scaling in a production environment.

Technology: Watsonx Discovery API

Watsonx Discovery is utilised for document understanding, classification, and information extraction. It offers pre-trained models for various domains, including financial documents, and can be fine-tuned for custom use cases. Compared to alternatives like Azure Form Recogniser or Google Document AI, Watsonx Discovery provides a more comprehensive feature set for understanding unstructured data, coupled with strong natural language processing (NLP) capabilities, essential for categorising and interpreting diverse tax-related documents.

Tax Rules Validation Layer

Technology: CRA API (Tax Rules Database Integration)

The CRA API is used for connecting to up-to-date tax rules, regulations, and forms for

various jurisdictions, including Canada. It is the standard for validating extracted data against Canadian tax laws and generating suggestions for missing forms or deductions.

Automatic Tax Form Filling Layer

Technology: PDF.co API (Form Filling API)

PDF.co is also chosen here for its comprehensive solution for PDF manipulation, including form filling, annotation, and validation. It supports the automated filling of complex forms such as T1 and T2 tax forms and handles different formats, signatures, and attachments.

Tax Optimisation & Validation Layer

Technology: Watsonx (IBM Granite and Watsonx Discovery)

Watsonx Discovery will be employed for generating personalised tax-saving strategies and summarising financial information, as well as validating PDFs. Its advanced NLP capabilities make it ideal for this task.

Document Review & Submission Layer

Technology: NETFILE API (Submission)

The NETFILE API is chosen for its direct electronic tax filing service provided by the CRA for Canadian tax forms submission. It ensures compliance with Canadian tax regulations and provides secure, encrypted communication channels. Compared to third-party submission services, NETFILE offers direct integration with the CRA, ensuring accuracy, reliability, and compliance with Canadian laws.

Technology: IBM RPA (Human-in-the-Loop Integration)

An IBM RPA can be used to facilitate human-in-the-loop processes for manual validation and correction of flagged errors.

Error Handling Layer

Technology: Custom Error Handling Framework

A custom error handling framework can be implemented, although the details of this will fluctuate according to the prototype's development and end-design.

Technology: Postage API (Address Validation)

Postage API is utilised for real-time address validation, ensuring that user-provided addresses are accurate and up-to-date. Compared to alternatives like SmartyStreets or Google Maps API, Postage API is optimised specifically for postal address validation, offering competitive pricing and high accuracy for Canadian addresses, making it the preferred choice.

Deliverable: Written Problem and Solution Statements

The TaxGenie is designed to improve the tedious and error-prone process of filing taxes for individuals and businesses. In particular, this solution targets tax professionals, accountants,

and individual taxpayers who manage complex tax situations such as those involving self-employment income, capital gains, or multiple deductions.

Currently, tax filing is often a manual, time-consuming task that requires carefully filling out various forms like the T1 (General Income Tax) for individuals and T2 (Corporate Income Tax) for businesses. These forms need to be cross-checked against deductions and credits that individuals or businesses may be eligible for. Mistakes can lead to fines, missed deductions, or costly audits.

Our solution leverages IBM Watsonx to introduce AI-driven automation into this process. Specifically, Watsonx Discovery is used to automate document ingestion, classification, and data extraction from tax-related documents, while watson.ai is employed to offer generative AI-based suggestions for missing deductions or additional credits. Unlike existing tax-filing software, which may only help populate forms based on static inputs, this assistant actively suggests potential optimisations based on real-time tax law updates retrieved via the CRA API.

Watsonx's NLP capabilities allow it to understand unstructured data (e.g., handwritten notes, invoices, receipts) and convert them into structured data that can be automatically filled into tax forms. This creative use of AI offers tax professionals a powerful tool to reduce time spent on repetitive tasks while ensuring greater accuracy and compliance.

In short, the innovation lies in the intelligent use of Watsonx's AI to simplify and streamline the tax filing process, offering a unique blend of automation and real-time insights that other solutions do not currently provide.

Deliverable: Description of Productivity Improvement

Our solution significantly improves the productivity of tax professionals and individuals by reducing the time and effort involved in manually collecting, organising, and filling out tax forms. Currently, the average time required for an individual or small business to prepare taxes manually can range from 8 to 10 hours for individuals and as much as 20 to 40 hours for small businesses depending on the complexity of their income and deductions¹.

With the TaxGenie in place, the time required to prepare taxes could be reduced by as much as 60-70%. For instance, by automating the process of document classification and data extraction using Watsonx, the system can handle large amounts of documents in minutes, reducing the need for manual input and cross-checking. The integration of the CRA API ensures real-time validation against tax laws, removing the need for manual research and updates. Moreover, the suggestion engine powered by watson.ai streamlines the deduction identification process, potentially saving users hours of effort in locating tax-saving opportunities.

In terms of cost savings, professional tax preparers charge an average of CAD 150-500 for individual tax preparation and more for businesses², but the automation provided by this system would drastically reduce the number of billable hours required for such tasks.

¹<https://www.cpacanada.ca/en/the-cpa-profession/financial-literacy/blog/2022/filling-your-tax-forms-tips>

²<https://www.canada.ca/en/revenue-agency/services/tax/businesses/>

Additionally, error rates and the likelihood of audits due to missed deductions or improper filing are reduced, which can save thousands in potential penalties or missed savings.

Overall, the system not only improves speed but also enhances accuracy, resource allocation, and cost-effectiveness, making it a compelling choice for tax professionals and individuals alike.

Limitations

The development pipeline encountered significant delays and could not progress further than the process of reading keywords from a filled-in T4 document. The PDF.co API, which was critical for parsing and automatically filling tax forms, did not work as intended, halting the system at an early stage. Several attempts were made to resolve the issue, as confirmed by email interactions between PDF.co API support and myself.

As a result, much of the downstream workflow, including automatic tax form filling, tax optimisation, and submission, could not be tested in a fully integrated environment. Despite these challenges, the PDF.co API remains a strong solution for document processing and automation due to its extensive features and flexibility in form automation.

Statistics from online sources support this claim, noting that over 90% of Canadian tax professionals who use automated solutions report improved efficiency and a reduction in errors during tax season³. This is in line with the potential benefits that our solution could achieve with further technical refinement and API troubleshooting.

Bibliography

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