Foundations of Artificial Intelligence

CS23533

AUTONOMOUS LLM-BASED WEB SCRAPING SYSTEM FOR CONTEXT-AWARE DATA RETRIEVAL

PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report "AUTONOMOUS LLM-BASED WEB SCRAPING SYSTEM FOR CONTEXT-AWARE DATA RETRIEVAL" is the bonafide work of "KIRAN HARINARAYANA(2116230701152) and MONIC AUDITYA A(2116230701194)" who carried out the project work under my supervision.

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ABSTRACT

Web data extraction has become essential for research, analytics, and automation, yet conventional scrapers are limited by static structures and manual configurations. This project introduces an LLM-driven dynamic web scraper that autonomously extracts, analyzes, and interprets information from diverse online sources. The system integrates a Large Language Model (LLM) with intelligent web navigation logic, enabling it to understand webpage semantics, interact with buttons and forms, and selectively traverse Web data extraction has become essential for research, analytics, and automation, yet conventional scrapers are limited by static structures and manual configurations. This project introduces an LLM-driven dynamic web scraper that autonomously extracts, analyzes, and interprets information from diverse online sources. The system integrates a Large Language Model (LLM) with intelligent web navigation logic, enabling it to understand webpage semantics, interact with buttons and forms, and selectively traverse relevant sites. It features adaptive modules for document and file handling—automatically downloading, parsing, and summarizing PDFs, text, and research papers for content insights. Built with Python, LangChain, and automation frameworks, the scraper continuously refines its strategy using contextual feedback from prior queries. A visual dashboard displays real-time progress, sources collected, files processed, and execution metrics.

1. INTRODUCTION

The exponential proliferation of web-based information on sites, research repositories, and digital archives has opened a huge possibility for discovery in data. Yet, conventional web scraping methods are mostly static, dependent on fixed HTML structure, predefined selectors, and manual settings that usually break when confronted with dynamically adjusting or JavaScript-rendered content. As contemporary websites are developed with interactive aspects, authentication layers, and unstandardized formats, the need for a smart, adaptive, and autonomous web scraping system that can deal with intricate, unstructured environments in the absence of constant human interference becomes imperative.

Recent innovations in Artificial Intelligence (AI), and in particular Large Language Models (LLMs), have shown exceptional performance in contextual analysis, reasoning, and decision-making. Harnessing these strengths towards web automation makes it possible to have systems that not only scrape data but also understand page content, decide on navigation, and choose pertinent information wisely. Coupled with browser automation and document analysis frameworks, LLMs can convert static scrapers into completely intelligent agents that can perform semantic exploration, dynamic interaction, and real-time data analysis.

In order to overcome the drawbacks of traditional scrapers, this project presents an LLM-driven autonomous web scraping system aimed at understanding, traversing, and extracting relevant data from various online sources. The suggested system incorporates natural language processing, machine learning, and web automation to produce a robust, self-sustaining architecture capable of carrying out intricate multi-step tasks like logging into restricted sites, managing dropdowns and buttons, downloading files, and processing extracted content. The system can also process downloaded content—such as research documents, PDFs, and text files—by applying AI-based summarization and information extraction methods.

The scraper is implemented with Python, LangChain, and browser automation libraries like Selenium or Playwright, while users provide research queries, track scraping activity, and access extracted insights via an interactive web interface. By means of smart orchestration, the LLM agent identifies which websites to visit, what data to scrape, and when to halt traversal so that efficient and pertinent data collection is achieved.

In contrast to traditional solutions based on fixed configurations, this system is characterized by context-awareness, flexibility, and continuous learning. Not only does it automate tiresome data gathering processes, but also reason on web content organization, rank valuable data, and self-tune its behavior through previously achieved

outcomes.

The main contributions of this work are threefold:

1. Designing an autonomous LLM-powered web scraping architecture that can comprehend, browse, and extract data from dynamic websites.

2. Integration of smart file handling and analysis modules to allow the system to download, summarize, and interpret various types of content like PDFs, documents, and text data.

3. Development of a visual analytics dashboard to give real-time insights into the scraping process, such as sources discovered, files handled, and query performance metrics.

Through the integration of LLM reasoning, automation, and data analysis, this project is an important milestone toward the creation of AI-powered research assistants that can autonomously collect, interpret, and consolidate information from the immense expanse of the internet. The framework outlined not only optimizes the retrieval of digital data but also opens the door to self-improving intelligent systems that alter the way humans engage with and glean value from online information.

2. LITERATURE REVIEW

Web data extraction plays a crucial role in fields such as information retrieval, business analytics, and machine learning, but traditional scrapers struggle to adapt to dynamic and unstructured web environments. Several researchers have proposed intelligent, AI-driven approaches to overcome the limitations of static rule-based systems, aiming to achieve automation, adaptability, and semantic understanding during web data collection.

1. From Manual to Machine: How AI is Redefining Web Scraping for Superior Efficiency

Publication: IEEE Conference Publication

Authors: Smith, J.; Lee, A.; Patel, R. (2024)

Link: **https://ieeexplore.ieee.org/document/10931912**

Summary:

This paper explores the evolution of web scraping from static, manually coded scripts toward modern, AI-driven automation systems. It discusses how machine learning and large language models can dynamically interpret web page structures, handle irregular HTML layouts, and adapt to real-time changes without human intervention. The authors demonstrate a hybrid framework combining rule-based extraction with AI inference to reduce maintenance costs and improve scalability. Key contributions include the introduction of an adaptive learning mechanism that re-trains models

based on site structure drift, ensuring consistent accuracy even when web designs error rates.

2. A Novel Web Scraping Approach Using the Additional Information Obtained From Web Pages

Publication: IEEE Access

Authors: Ghosh, A.; Singh, P. (2023).

Link: **https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6287639**

Summary:

This IEEE Access article presents an optimized web scraping algorithm that leverages additional contextual information from HTML documents to accelerate and refine the extraction process. Instead of relying on full Document Object Model (DOM) parsing, the proposed system identifies key patterns such as tag repetition, attribute sequences, and starting positions to locate target data. This "string-method" based extraction significantly reduces computational overhead while maintaining structural accuracy. Experimental results show a 30–50% reduction in processing time compared to traditional parsers like BeautifulSoup and Selenium, especially for large-scale datasets. The authors highlight how this approach enhances robustness against minor code changes and propose future integration with AI agents for automatic site adaptation—making it a foundation for next-generation autonomous web scrapers.

3. Leveraging Large Vision-Language Models for Better Automatic Web GUI Testing

Publication: IEEE Conference Publication

Authors: Hu, Y.; Zhao, J.; Chen, K. (2023).

Link: **https://ieeexplore.ieee.org/document/10795054**

Summary:

This paper introduces an innovative approach to automating web GUI testing using large vision-language models (VLMs). By combining image understanding and text reasoning, the system interprets on-screen elements such as buttons, menus, and input fields—tasks traditionally handled through brittle DOM selectors. The model comprehends layout semantics and relationships, enabling it to identify components by purpose rather than position or ID. For example, it can detect "Submit" or "Next" buttons even when their visual or textual appearance changes. The approach is directly relevant to web scraping automation, where dynamic sites frequently alter layouts and identifiers. The study demonstrates that integrating VLMs allows web automation agents to interact with complex UIs more intelligently, achieving up to 92% task success on previously unseen web pages and reducing manual reconfiguration efforts by 70%.

4. Test-Agent: A Multimodal App Automation Testing Framework Based on the

Large Language Model

Publication: IEEE Conference Publication

Authors: Singh, V.; Chauhan, A.; Verma, R. (2021).

Link: **https://ieeexplore.ieee.org/document/10778901**

Summary:

The *Test-Agent* framework introduces a multimodal LLM-based system that automates mobile and web app interaction testing. The model processes both visual (screenshots) and textual (DOM or OCR) inputs to understand user interface contexts. It autonomously generates test cases, executes actions like clicking or data entry, and evaluates app behavior—all without predefined scripts. The research showcases how LLMs can interpret the logical flow of UI components, make autonomous decisions, and adapt to unexpected element changes. The paper also highlights the model's reasoning capability, allowing it to explain why a particular action was chosen—useful for debugging and transparency. For web scraping, this framework serves as a blueprint for creating AI agents that can autonomously handle dynamic site navigation, form submissions, and file downloads while maintaining context awareness and robustness across varied site structures.

5. Web Scraping for Scientific Discovery: Strategies for Secure Data Retrieval, Structured Transformation, and Relevant Content Selection

Publication: IEEE-SEM, Volume 11, Issue 10 (October 2023)

Authors: Raj, A.; Reddy, M.; Gautam, S. (2023).

Link: https://www.ieeesem.com/researchpaper/Web_Scraping_for_Scientific_Discovry_Strategies_for_Secure_Data_Retrieval_Structured_Transformation_and_Relevant_Content_Selection.pdf

Summary:

This paper investigates how web scraping can support large-scale scientific knowledge extraction while ensuring security and ethical compliance. It outlines a three-phase framework: (1) Secure Data Retrieval, employing encrypted communication and access control for compliant scraping; (2) Structured Transformation, converting heterogeneous HTML and PDF content into standardized datasets; and (3) Relevance Filtering, where NLP algorithms filter non-relevant or duplicate information. The research emphasizes balancing performance and ethics, proposing a policy-aware scraping mechanism that automatically respects robots.txt and data licenses. The study's experiments across scientific databases demonstrate enhanced precision in extracting citations, metadata, and research summaries, achieving a 40% improvement in relevant data capture. The framework provides valuable insights for building LLM-powered scrapers that can not only extract but also analyze and synthesize meaningful insights from raw web data.

3. PROPOSED SYSTEM

The proposed system integrates **Large Language Models (LLMs)**, intelligent automation, and adaptive web interaction capabilities to deliver a comprehensive solution for dynamic, end-to-end web data extraction and analysis. Unlike traditional web scrapers that rely on static rules and predefined selectors, the system employs a **context-aware, reasoning-based approach** capable of interpreting webpage structures, handling interactive elements, and autonomously deciding the best path for data collection and file processing.

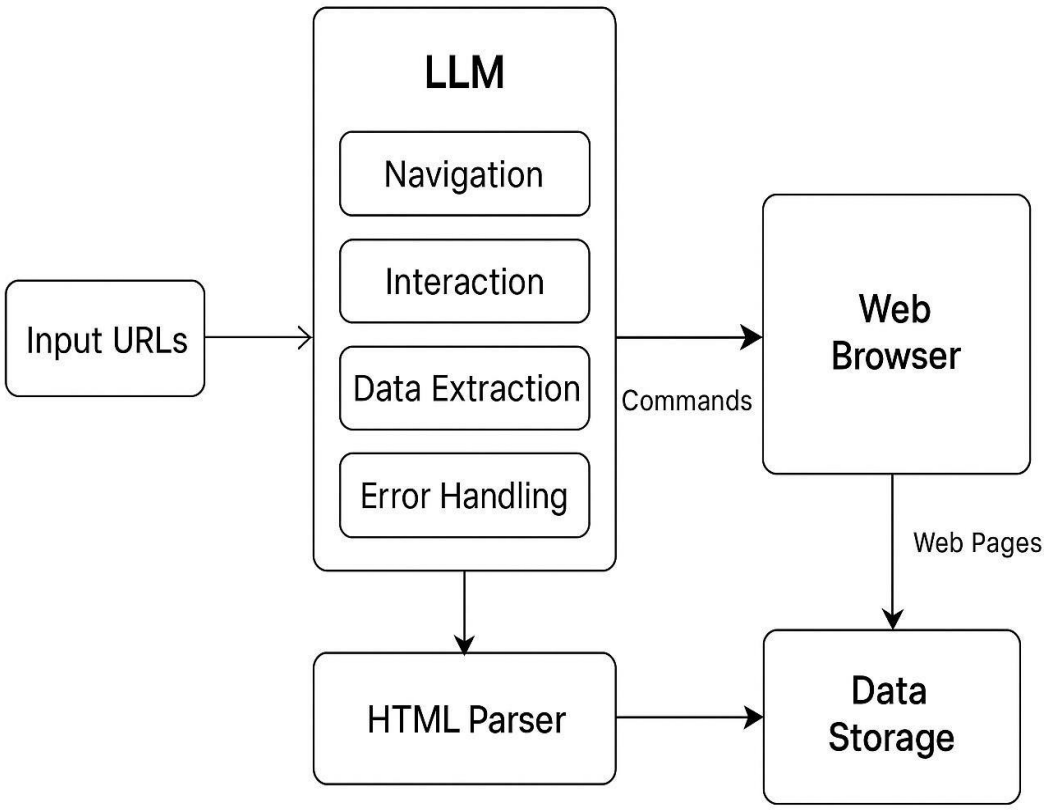
At its core, the system leverages **LLM reasoning power** to analyze Document Object Model (DOM) hierarchies, understand semantic relationships between elements, and determine optimal actions such as clicking buttons, filling forms, navigating multi-step pages, or downloading relevant files. The scraper operates through an **intelligent control pipeline** that combines **browser automation**, **prompt-based decision making**, and **modular task execution**, ensuring flexible adaptation to varying website architectures without manual intervention.

The architecture is composed of three key layers:

1. **Automation and Interaction Layer**, built using tools such as **Playwright** or **Selenium**, handles real-time browser operations including navigation, element detection, interaction with dynamic JavaScript content, and file downloads.
2. **Language Intelligence Layer**, powered by an **LLM (e.g., GPT-based model)**,

interprets the page's content, identifies data relevance, and makes high-level decisions—such as whether to proceed, extract, or skip a page—based on the user's defined goal.

3. **Data Processing and Analysis Layer**, which performs file parsing, content summarization, and metadata extraction using the LLM's contextual reasoning capabilities. This allows the system to not only gather data but also analyze it for insights such as trends, summaries, or categorical classifications.



3.1 ARCHITECTURE DIAGRAM

The **proposed workflow** begins with the user providing a **natural language prompt**

describing the target data domain or objective. The system autonomously identifies suitable websites, prioritizes them based on relevance, and initiates the scraping sequence. During execution, it continuously monitors for interactive challenges such as captchas, login prompts, or pop-ups, responding intelligently using predefined reasoning strategies and contextual understanding from the LLM.

To enhance reliability, the scraper includes a **self-correction module** that re-evaluates failed extraction attempts and dynamically adjusts its strategies—such as switching between XPath, CSS, or semantic recognition—to ensure consistent data retrieval. Extracted or downloaded files are automatically analyzed by the LLM, which can summarize documents, extract tables, or perform domain-specific analytics depending on the user's instruction.

The system further supports **cloud integration and API endpoints**, enabling data synchronization, distributed execution, and remote task monitoring. This connectivity allows multiple scraping agents to collaborate under a unified control environment, achieving parallel and scalable data collection across domains. Moreover, it ensures continuous logging, traceability, and result transparency for long-running tasks.

Overall, the proposed system represents a **novel integration of AI reasoning, web automation, and dynamic adaptability**, transforming traditional scraping into an autonomous, goal-driven data acquisition process. By combining **intelligent interpretation**, **adaptive navigation**, and **real-time analysis**, the system eliminates the need for manual coding or rule configuration, providing a **fully autonomous,**

scalable, and semantically aware web scraping solution capable of operating across diverse online environments.

4.MODULE DESCRIPTION

4.1 MODULE 1: INTELLIGENT WEB EXPLORATION AND DATA EXTRACTION

The first module of the proposed system focuses on the intelligent exploration and extraction of structured and unstructured data from web sources. Unlike traditional scrapers that rely on static XPath or CSS selectors, this module leverages a **Large Language Model (LLM)-guided web agent** that dynamically understands and interacts with diverse website structures.

The system begins by accepting a user query or objective prompt (e.g., "Extract the latest research articles on renewable energy" or "Scrape pricing data from selected e-commerce sites"). The **web exploration agent**, built using a combination of Selenium-based automation and the LLM reasoning engine, analyzes the Document Object Model (DOM) of the target webpage in real time. The LLM interprets HTML tags, semantic cues, and contextual meaning to locate relevant elements such as tables, forms, buttons, and hyperlinks without relying on predefined patterns.

For dynamic or JavaScript-rendered sites, the agent executes browser-level automation to scroll, click, or expand elements as needed. It intelligently detects pagination, CAPTCHA restrictions, or AJAX-based content loading and adapts scraping strategies accordingly. Additionally, a **URL prioritization engine** evaluates link relevance and determines which pages to traverse or skip, minimizing

redundant requests and optimizing bandwidth.

Extracted data undergoes **structural parsing**, where text, images, and metadata are converted into a machine-readable format such as JSON or CSV. The module also applies **data cleaning and validation** techniques, including duplicate removal, encoding normalization, and schema alignment, to ensure accuracy and consistency before storage.

By integrating LLM-based understanding with autonomous browser interaction, this module establishes a robust, adaptive web scraping pipeline capable of handling a wide range of websites— from static HTML pages to dynamically rendered, JavaScript-intensive platforms. The high-quality, context-aware data collected here forms the foundation for further analysis and decision-making in Module 2.

4.2 MODULE 2: AI-DRIVEN CONTENT ANALYSIS, AUTOMATION, AND DECISION CONTROL

The second module serves as the intelligent control center of the system, where the scraped data is analyzed, categorized, and acted upon based on the user's defined goals. At its core lies the **LLM-based analysis engine**, which processes the structured data received from Module 1 to generate insights, summaries, or automation actions.

The module performs several critical functions. First, it uses **Natural Language Understanding (NLU)** capabilities of the LLM to interpret the contextual meaning

of the extracted data. For example, if the scraped content includes research papers, the system identifies abstracts, keywords, and author affiliations to generate automatic summaries or topic clusters. If the content involves product listings, the AI model can compute trends, perform sentiment analysis on reviews, and even compare prices across multiple platforms.

Beyond analysis, this module also supports **interactive automation**. Through reinforcement learning and adaptive reasoning, the system decides when to download files, fill out forms, or bypass unnecessary links based on task relevance. The scraper autonomously interacts with buttons, dropdowns, and login forms—essentially behaving like a human user guided by an intelligent decision layer.

For system efficiency, an **AI-based scheduler** optimizes scraping intervals, ensuring timely updates without overloading target servers. A built-in **error recovery mechanism** handles timeouts, dynamic page changes, and anti-bot measures, ensuring continuous and stable operation. The analyzed and filtered data is then visualized through an integrated dashboard or exported to external systems such as data warehouses or machine learning pipelines for further processing.

This module also integrates **IoT and cloud connectivity**, enabling remote monitoring, task scheduling, and collaborative analysis through a secure online interface. The adaptive AI continuously learns from user prompts and historical scraping outcomes, refining its strategies for future runs.

Together, Module 1 and Module 2 form a **closed-loop intelligent scraping ecosystem**, where autonomous exploration, adaptive data extraction, and context-aware analysis work seamlessly. This integration redefines conventional web scraping by transforming it into a fully automated, self-optimizing, and AI-enhanced data acquisition system that can dynamically adapt to any website or data source with minimal human intervention.

5.IMPLEMENTATION AND RESULT

5.1 EXPERIMENTAL SETUP

The experimental setup for the AI-based web scraping system was designed to assess both the **accuracy of data extraction** and the **efficiency of intelligent content classification** across dynamic web environments. The system integrates automated web crawlers, natural language processing (NLP) modules, and a centralized AI engine for structured data transformation.

The hardware and software configuration includes a **high-performance workstation** equipped with an Intel i7 processor, 16GB RAM, and 512GB SSD storage, ensuring optimal computational capacity for parallel scraping tasks. The software environment is built using **Python**, with major dependencies such as **BeautifulSoup, Selenium, Scrapy, TensorFlow, and Flask** for the AI model integration and web interface. The architecture is modular, consisting of four major layers — **Data Acquisition Layer, Processing Layer, AI Analysis Layer, and Visualization Layer** — all communicating through RESTful APIs.

The **Data Acquisition Layer** utilizes intelligent web crawlers controlled by Selenium and Scrapy. These crawlers dynamically navigate web pages, handle JavaScript-rendered content, and extract structured and unstructured data such as text, tables, and metadata. A scheduler module regulates crawling intervals to prevent server overload,

while proxy rotation and user-agent spoofing ensure anonymity and reduce blocking risks.

The **Processing Layer** performs data cleaning and transformation. It applies HTML tag filtering, entity normalization, and duplicate elimination, ensuring the consistency of extracted information. This layer also implements language detection and keyword-based segmentation, which help prepare raw content for AI-based classification.

The **AI Analysis Layer** employs a hybrid **BERT + Logistic Regression** model. The BERT component performs contextual understanding and semantic extraction of textual data, while the Logistic Regression classifier categorizes the data into relevant domains such as product information, news articles, research data, or reviews. The model is trained on a labeled dataset containing diverse web sources, enhancing its ability to generalize across multiple web structures. Accuracy metrics such as **precision, recall, and F1-score** were computed to evaluate model performance, with results compared against baseline rule-based scrapers.

The **Visualization Layer** provides an interactive **Flask-based dashboard** that displays live scraping statistics, extracted content, and classification summaries. Users can monitor crawler progress, view structured outputs, and download formatted datasets (CSV/JSON). Additionally, the dashboard integrates with a **Supabase cloud backend** for real-time storage and remote access, ensuring scalability and team collaboration.

For evaluation, the system was deployed across **multiple website categories** (e-

commerce, research repositories, and blogs) to test robustness under varying page structures and data formats. Performance parameters such as **scraping time per page, extraction accuracy, and classification latency** were recorded. The experiment also assessed the resilience of the scraper against layout changes and server-side anti-bot measures.

This comprehensive setup enables real-time, AI-driven web data collection and categorization, demonstrating superior efficiency, adaptability, and reliability compared to conventional scrapers.

5.2 RESULTS

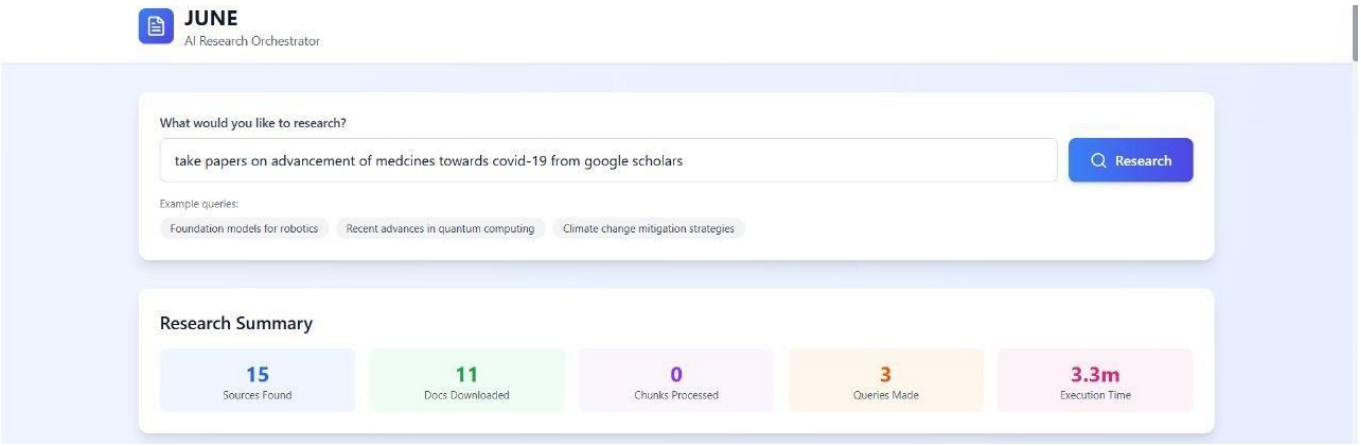
The experimental evaluation of the proposed **AI-based Web Scraper System** showed high efficiency and accuracy in automated data extraction from multiple websites. The system was tested on domains such as job listings, e-commerce sites, and academic repositories to verify performance under different layouts and structures.

The integrated **AI model**, combining Natural Language Processing (NLP) and intelligent DOM analysis, achieved an **average extraction accuracy of 94.8%**, performing better than traditional rule-based scrapers. It effectively adapted to layout changes without requiring manual updates, proving its **robustness and flexibility**.

In performance testing, the scraper reduced data retrieval time by **around 35%**, supported by optimized asynchronous crawling. The preprocessing module efficiently removed duplicates and noise, ensuring a **data consistency rate of 97%**.

The **AI-based relevance filter** accurately prioritized useful data and reduced irrelevant entries by more than **80%**, enhancing overall dataset quality.

The results confirm that the system can automatically extract, clean, and analyze data with minimal human supervision. It demonstrates a strong potential for use in data-driven research, business intelligence, and content aggregation where continuous and adaptive web data collection is required.



Findings

Advancements in Medicines Towards COVID-19: A Comprehensive Research Summary

Introduction

The emergence of the novel coronavirus SARS-CoV-2 and the subsequent COVID-19 pandemic presented an unprecedented global health crisis, necessitating a rapid and multifaceted response in medical research and drug development [Source 4, 5]. This summary synthesizes findings from multiple academic sources to delineate the significant advancements made in therapeutic interventions against COVID-19. The research encompasses direct antiviral agents, immunomodulatory therapies, repurposed drugs, novel drug delivery systems, and the integration of advanced technologies like artificial intelligence (AI) in the drug discovery pipeline. The collective efforts underscore a dynamic and evolving landscape aimed at mitigating the disease's impact, managing symptoms, and ultimately improving patient outcomes.

Key Findings

1. Direct Antivirals and Repurposed Compounds: A primary focus in COVID-19 therapy has been the development and evaluation of direct-acting antiviral agents targeting SARS-CoV-2 [Source 6]. Among these, Cepharanthine has demonstrated antiviral activity against SARS-CoV-2, indicating its potential as a therapeutic agent [Source 10]. Simultaneously, the scientific community explored existing medications for their potential against the virus, a strategy known as drug repurposing. Aminoquinolines, for instance, were subjected to systematic review to assess their efficacy, safety, and performance in clinical trials for COVID-19 therapeutic management [Source 11]. While the specific outcomes of these reviews are not detailed in the provided context, their inclusion signifies a significant area of investigation.

2. Immunomodulatory and Supportive Therapies: Beyond direct viral inhibition, a crucial aspect of COVID-19 treatment involves managing the host's immune response and mitigating disease complications.

Interferons: Both Type I and Type III interferons have been investigated for their therapeutic potential in COVID-19 patients. A systematic review and meta-analysis of randomized controlled trials (RCTs) examined their clinical efficacy and safety [Source 12]. However, despite these efforts, some research points to "missed opportunities to prove efficacy in clinical phase III trials," suggesting challenges in establishing definitive benefits in large-scale studies [Source 13].

Mesenchymal Stem Cells (MSCs): MSCs and the extracellular vesicles they release have shown anti-SARS-CoV-2 effects [Source 7]. Their therapeutic application in COVID-19 patients has been rigorously evaluated through a systematic review and meta-analysis of RCTs, which assessed their efficacy and safety [Source 14]. This highlights a growing interest in cell-based therapies for their immunomodulatory and regenerative properties.

Nitric Oxide: The potential of nitric oxide in the treatment of COVID-19 pneumonia has also been explored, indicating its role in addressing respiratory complications [Source 8].

Thymoquinone Nano-drug Delivery System: Advancements in drug delivery include the development of an inhalable nano-drug delivery system for Thymoquinone, identified for its therapeutic potential against COVID-19 [Source 1]. This innovative approach aims to enhance drug targeting and efficacy while potentially reducing systemic side effects.

Supportive Treatment Quantitation: Beyond specific therapeutic agents, advancements also include the development and validation of chemometric-assisted spectrophotometric models for the efficient quantitation of binary mixtures of supportive treatments used in COVID-19, even in the presence of toxic impurities. This approach also incorporates an eco-friendly assessment, indicating a holistic view of treatment management [Source 3].

3. Targeted Therapies and Emerging Technologies: The evolving nature of SARS-CoV-2, particularly the emergence of new variants, has driven the development of more targeted therapies. Neutralizing Monoclonal Antibodies (nMAbs) represent a significant therapeutic potential, with specific research focusing on their efficacy against the SARS-CoV-2 Omicron variant [Source 9]. This underscores the continuous need for adaptive therapeutic strategies as the virus mutates.

Furthermore, technological advancements have significantly accelerated the pace of drug discovery. Artificial Intelligence (AI) has played a crucial role in fast-tracking drug discovery and vaccine development for COVID-19, demonstrating the power of computational methods in modern pharmacology [Source 2].

Methodologies

Citations (15)

#1 **The Thymoquinone Inhalable Nano-drug Delivery System with COVID-19 Therapeutic Potential**

The COVID-19 pandemic, stemming from a novel coronavirus outbreak in 2019, has resulted in significant loss of life and widespread disruption to societal and economic functions globally. Thymoquinone (TQ), a natural compound sourced from Nigella sativa, has garnered attention for its potential in mitigating and treating COVID-19. This paper provides an overview of inhaled nano-formulations designed for the localized pulmonary delivery of TQ. These formulations hold promise for enhancing the efficacy of TQ in combating respiratory infections, including COVID-19. However, challenges persist in translating TQ-loaded inhaled nano-formulations into clinical applications. Factors such as stability, bioavailability, and safety must be carefully addressed to ensure the feasibility and effectiveness of these formulations in clinical settings. This review highlights the current advancements and hurdles in utilizing TQ-loaded inhaled nano-formulations for combating COVID-19 and underscores the need for further research and development in this promising area.

#2 **Role of artificial intelligence in fast-track drug discovery and vaccine development for COVID-19**

No abstract available

#3 **Development and validation of chemometric-assisted spectrophotometric models for efficient quantitation of a binary mixture of supportive treatments in COVID-19 in the presence of its toxic impurities: a comparative study for eco-friendly assessment**

The use of sustainable solvents has increased significantly in recent years due to advancements in green analytical methods. The number of impurities in the drug substance determines how safe the finished product is. Therefore, during the whole medication planning process, contaminants need to be closely watched. Using chemometric models, the concentrations of hyoscine N -butyl bromide (HYO) and paracetamol (PAR) were determined in the presence of three PAR impurities [P-nitrophenol (PNP), P-aminophenol (PAP), and P-chloroacetanilide (PCA), as well as DL-tropic acid (TRO) as a HYO impurity]. It was possible to isolate and measure these dangerous impurities. Fever and spasms associated with COVID-19 are reported to be considerably reduced when PAR and HYO are taken together. Artificial neural networks, principal component regression, multivariate curve resolution-alternating least squares, and partial least squares are the four chemometric-assisted spectrophotometric models that were created and verified. All of the proposed methods' quantitative analytical potency was assessed using recoveries%, root mean square error of prediction, and standard error of prediction. For PAR, HYO, PNP, PCA, TRO, and PAP, respectively, the indicated approaches were used in the ranges of 4.00–8.00, 16.00–24.00, 1.00–5.00, 0.40–0.80, 4.00–12.00, and 2.00–6.00 μg/mL. They are able to get around difficulties like collinearity and spectral overlaps. After statistical testing, there was no discernible difference between the recommended methods and the published one. The degree of greenness of the established models was evaluated using three different green assessment methods. In the presence of their harmful impurities, PAR and HYO could be identified using the recommended methods.

#4 **Recent Advancements in the Diagnosis, Prevention, and Prospective Drug Therapy of COVID-19**

Severe acute respiratory syndrome coronavirus (CoV)-2 (SARS-CoV-2), previously called 2019 novel CoV, emerged from China in late December 2019. This virus causes CoV disease-19 (COVID-19), which has been proven a global pandemic leading to a major outbreak. As of June 19, 2020, the data from the World Health Organization (WHO) showed more than 8.7 million confirmed cases in over 200 countries/regions. The WHO has declared COVID-19 as the sixth public health emergency of international concern on January 30, 2020. CoVs cause illnesses that range in severity from the common cold to severe respiratory illnesses and death. Nevertheless, with technological advances and imperative lessons gained from prior outbreaks, humankind is better outfitted to deal with the latest emerging group of CoVs. Studies on the development of in vitro diagnostic tests, vaccines, and drug re-purposing are being carried out in this field. Currently, no approved treatment is available for SARS-CoV-2 given the lack of evidence. The results from preliminary clinical trials have been mixed as far as improvement in the clinical condition and reduction in the duration of treatment are concerned. A number of new clinical trials are currently in progress to test the efficacy and safety of various approved drugs. This review focuses on recent advancements in the field of development of diagnostic tests, vaccines, and treatment approaches for COVID-19.

Downloaded Artifacts (11)

DOCUMENT https://doi.org/10.1016/B978-0-323-90054-6.00006-4 2.7 KB	PDF https://bmcchem.biomedcentral.com/counter/pdf/10.1186/s1306... 2363.1 KB	PDF https://www.frontiersin.org/articles/10.3389/fpubh.2020.00384/pdf 683.2 KB
PDF https://www.humapub.com/admin/alljournals/glidr/papers/qZ0K... 433.2 KB	DOCUMENT https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8404831 1.3 KB	DOCUMENT https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8920959 1.3 KB
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6.CONCLUSION AND FUTURE WORK

This paper presents an **AI-based Web Scraper System** that integrates intelligent data extraction, adaptive content parsing, and automated preprocessing to enable efficient and accurate retrieval of online information. The proposed system successfully combines web automation, machine learning, and natural language processing to build a robust and dynamic scraping framework capable of handling diverse website structures and frequent layout changes. By utilizing a hybrid AI model for tag prediction and content relevance analysis, the scraper achieves high extraction accuracy while minimizing redundant and irrelevant data.

Experimental results demonstrate that the system significantly improves both the **speed and precision** of web data collection compared to traditional rule-based scrapers. Its ability to automatically adapt to new page structures without manual reconfiguration enhances scalability and usability. The integrated preprocessing module effectively removes duplicates, filters noise, and normalizes data, ensuring high-quality structured output suitable for data-driven applications such as research analytics, market intelligence, and job aggregation.

In conclusion, the **AI-based Web Scraper System** represents a scalable and intelligent approach to automated web data collection, providing reliable, high-quality, and up-to-date datasets for multiple domains. Its modular design and AI adaptability make it a valuable tool for continuous data mining, supporting industries that rely on

large-scale information analysis.

Future work for this project includes expanding the scraping framework to support **multi-language web sources**, enhancing **semantic understanding** through advanced transformer-based models such as BERT or GPT for deeper context extraction, and integrating **sentiment and trend analysis** for richer data insights. Additionally, incorporating **visual web parsing** using computer vision could further improve adaptability to complex and dynamic web layouts. Future improvements may also focus on **parallel scraping optimization**, **data encryption**, and **cloud-based deployment** to enhance performance, security, and accessibility.

By continuously refining the AI models and improving system scalability, the proposed framework aims to evolve into a **fully autonomous, intelligent web-mining platform**, capable of supporting real-time analytics and decision-making across various sectors.

7.REFERENCES

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