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Faculty of Engineering and Information Technology

Electrical and Computer Engineering Department

SmartLand MarketPlace

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Presented in partial fulfilment of the requirements for

Bachelor degree in Computer Engineering.

Dedication

To our families whose endless support and patience carried us through every late night and every challenge.

To our supervisors and teachers who guided us with knowledge, wisdom, and encouragement.

To every Palestinian who dreams of owning a piece of their homeland this platform was built with you in mind.

Acknowledgment

We would like to express our sincere gratitude to our supervisor Dr.Haya Samaana for their continuous guidance, constructive feedback, and invaluable support throughout the development of this project.

Their expertise and encouragement were instrumental in shaping this work.

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Disclaimer Statement

This report was written by *Hazim Haydar* and *Ahmad Samaana* at the Computer Engineering Department, Faculty of Engineering, An- Najah National University. It has not been altered or corrected, other than editorial corrections, as a result of assessment and it may contain language as well as content errors. The views expressed in it together with any outcomes and recommendations are solely those of Hazim Haydar and *Ahmad Samaana*. An- Najah National University accepts no responsibility or liability for the consequences of this report being used for a purpose other than the purpose for which it was commissioned.

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LIST OF ABBREVIATIONS

API	Application Programming Interface
AR	Arabic (language / locale)
CORS	Cross-Origin Resource Sharing
CRUD	Create, Read, Update, Delete
CSS	Cascading Style Sheets
DB	Database
EN	English (language / locale)
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Secure
i18n	Internationalization
ID	Identity Document / Identifier
JWT	JSON Web Token
JS	JavaScript
JSON	JavaScript Object Notation
KYC	Know Your Customer
LTR	Left-To-Right (text direction)
MVC	Model-View-Controller
REST	Representational State Transfer
RTL	Right-To-Left (text direction)
SQL	Structured Query Language
UI	User Interface
URL	Uniform Resource Locator
UX	User Experience
WSS	WebSocket Secure

Abstract

The Smart Land Marketplace Platform is a full-stack web application designed to digitize and streamline the buying and selling of land properties.

The platform addresses a significant gap in the Palestinian real estate market, where land transactions are largely conducted through informal, paper-based, or unverified channels that expose buyers and sellers to fraud, inefficiency, and lack of transparency.

The system was developed using a modern technology stack comprising React.js and Tailwind CSS on the frontend, Node.js with Express.js on the backend, MySQL as the relational database, and Socket.io for real-time communication.

The platform implements JSON Web Token (JWT) authentication with role-based access control for three user types: Normal users, Lawyers, and administrators.

Key features include verified property listings with image galleries and interactive Leaflet maps, a real-time bidirectional chat system between buyers and sellers, a structured appointment scheduling system for land visits, a real-time notification system, a favorites module, an ollama intelligent chatbot for user assistance, and a complete multilingual interface supporting both English and Arabic with full Right-To-Left layout support.

Security was addressed through bcrypt password hashing, parameterized SQL queries to prevent injection attacks, XSS sanitization middleware, per-route rate limiting, and Helmet.js HTTP security headers.

Identity verification during registration was implemented through a multi-field form requiring a four-part legal name, national ID number, date of birth, and an uploaded ID document with automated client-side quality validation.

The resulting platform provides a transparent, secure, and accessible marketplace that reduces fraud risk, eliminates geographic barriers, and empowers both land owners and buyers across the Palestinian territories and beyond.

Introduction

General Background

Real estate and land ownership in particular, holds profound cultural, economic, and social significance in Palestinian society.

Land is not merely an investment asset — it represents identity, heritage, and generational wealth. Despite this importance, the process of buying and selling land in Palestine remains largely fragmented and informal. Transactions are often conducted through personal networks, word-of-mouth referrals, or physical visits to local real estate brokers, with minimal use of digital technology.

This traditional approach carries significant risks. Fraudulent listings, misrepresentation of property boundaries, undisclosed ownership disputes, and the absence of verified seller identity are recurring problems that undermine market confidence.

Buyers, many of whom are members of the Palestinian diaspora seeking to invest in their homeland, face particular difficulties in accessing trustworthy information and communicating with sellers remotely.

Globally, digital real estate platforms such as Zillow, Bayut, and Property Finder have demonstrated that technology can fundamentally transform property markets — increasing transparency, reducing transaction costs, and connecting buyers and sellers across geographic boundaries. No comparable platform exists that is specifically designed for the Palestinian land market, with its unique legal, cultural, and linguistic requirements.

The Smart Land Marketplace Platform was conceived to fill this gap by providing a purpose-built, bilingual (English and Arabic), mobile-responsive web platform that brings the land market into the digital age.

Objectives of the Work

The primary objectives of this project are:

1. To design and implement a secure, web-based marketplace platform that enables land owners to list their properties and buyers to discover, evaluate, and inquire about those listings.
2. To implement a robust user identity verification system requiring users to submit a national ID number, date of birth, and a government-issued ID document at the time of registration, reducing the risk of fraudulent accounts.

3. To build a real-time bidirectional communication system using WebSocket technology (Socket.io) that enables direct chat between buyers and sellers within the platform.
4. To develop an appointment scheduling module that allows buyers to request on-site visits to properties, and sellers to approve, reject, or respond to those requests with confirmation messages.
5. To integrate an interactive mapping system using the Leaflet library that displays precise property locations and allows sellers to pin their land coordinates directly on a map.
6. To implement a real-time notification system that delivers instant in-platform alerts for messages, appointment updates, and property status changes.
7. To build a rule-based chatbot assistant capable of answering common user queries about the platform's features and navigation.
8. To deliver a complete multilingual interface supporting English and Arabic, with full Right-To-Left (RTL) layout adaptation when Arabic is selected.
9. To implement a secure administrative dashboard that enables platform administrators to review and approve property listings, verify user identity documents, and manage user accounts.

Significance and Importance of the Work

The Smart Land Marketplace Platform addresses several dimensions of real-world importance:

Economic Significance: Land is the most valuable asset class in the Palestinian economy. Providing a transparent digital marketplace reduces information asymmetry between buyers and sellers, potentially increasing market efficiency and enabling fairer pricing. The platform enables members of the Palestinian diaspora — estimated at over 6 million people globally — to participate in the local land market remotely.

Social Significance: By requiring identity verification and implementing administrative approval of all listings, the platform raises the barrier to fraudulent activity significantly. Buyers can engage with greater confidence, knowing that sellers have been verified and listings have been reviewed.

Technological Significance: The project demonstrates the application of a modern full-stack JavaScript technology stack — combining React.js, Node.js, MySQL, Socket.io, and Leaflet — to a domain-specific real-world problem. It also provides a practical implementation of internationalization (i18n) with complete RTL support, which is underrepresented in open-source educational projects.

Academic Significance: This project integrates knowledge from multiple disciplines including software engineering, database design, network programming, UI/UX design, and information security, making it a comprehensive demonstration of the engineering skills developed throughout the degree program.

Organization of the Report

This report is organized as follows:

Chapter 2 reviews the theoretical background and previous work related to real estate marketplace platforms, real-time web communication, identity verification systems, and internationalization in web applications.

Chapter 3 describes the methodology used in the design and development of the platform, including system architecture, technology selection, database schema design, API design, security implementation, and development constraints.

Chapter 4 presents the results of the development process, including the implemented features, user interface screenshots, API endpoint documentation, and database structure.

Chapter 5 provides a discussion of the results, comparing achieved outcomes against original objectives, analyzing limitations, and evaluating the platform's design decisions.

Chapter 6 concludes the report with a summary of contributions, lessons learned, and recommendations for future development.

THEORETICAL BACKGROUND AND PREVIOUS WORK

Real Estate Marketplace Platforms

Digital real estate platforms have undergone rapid evolution since the early 2000s. Zillow (USA, 2006) pioneered the model of consumer-facing property search with automated valuation models.

Rightmove (UK) and Domain (Australia) demonstrated that aggregated verified listings with rich media (photos, floor plans, maps) dramatically increase buyer engagement compared to traditional classified advertisements.

In the Arab world, platforms such as Property Finder and Bayut (UAE/Saudi Arabia) have built substantial market presence by combining Arabic-language interfaces, local broker networks, and mobile-first design.

These platforms demonstrate the viability of digital real estate marketplaces in cultural contexts similar to Palestine.

No equivalent platform exists specifically for the Palestinian land market. Existing platforms either lack Arabic RTL support, do not accommodate the specific land-plot listing format relevant to Palestinian real estate, or do not incorporate the identity verification requirements important in this context.

Real-Time Web Communication

The WebSocket protocol (RFC 6455, 2011) enables persistent full-duplex communication channels over a single TCP connection, overcoming the request-response limitation of HTTP. Socket.io, built on WebSocket with automatic fallback to HTTP long-polling, has become the dominant real-time communication library for Node.js applications.

Real-time communication in marketplace applications serves multiple critical functions: immediate message delivery between transacting parties, live status updates for time-sensitive processes (appointment confirmations, listing status changes), and typing indicators that improve the conversational experience. Research by Carmody et al. (2019) found that real-time messaging in marketplace platforms increases buyer-seller transaction completion rates by 34% compared to asynchronous email-based communication.

JSON Web Token Authentication

JSON Web Token (JWT), defined in RFC 7519 (Jones et al., 2015), provides a compact, URL-safe means of representing claims between two parties. In web applications, JWTs are widely used as stateless authentication tokens — the server signs a token containing the user's ID and role at login, and the client includes this token in subsequent request headers.

The stateless nature of JWT is particularly valuable in horizontally scalable architectures where maintaining server-side session state would require distributed session storage. The role claim embedded in the JWT enables efficient role-based access control without an additional database lookup on every request.

Interactive Web Mapping

Leaflet.js is an open-source JavaScript library for mobile-friendly interactive maps, first released by Volodymyr Agafonkin in 2011. It has become the most widely used

open-source mapping library, offering a lightweight alternative to the Google Maps JavaScript API. Leaflet renders map tiles from OpenStreetMap by default — a community-maintained, freely available global map database.

For real estate applications, interactive maps serve several functions: displaying property location with precision greater than a text address can provide, enabling spatial search (finding properties within a geographic area), and allowing sellers without formal address systems to precisely mark their land's location using GPS coordinates.

Internationalization and RTL Layout

Web internationalization (i18n) encompasses both translation of user-visible text and adaptation of layout and typography for different languages and locales. Arabic is written right-to-left (RTL), requiring a complete mirror of the page layout compared to left-to-right (LTR) languages.

The HTML `dir` attribute and the CSS `direction` and `text-align` properties provide the foundational mechanism for RTL layout. The `i18next` library, combined with the `React-i18next` binding, provides a structured framework for managing translation resources and switching locale at runtime without page reload.

The Arabic language also requires a different font. The Cairo typeface (Khaled Hosny, Google Fonts) provides excellent Arabic legibility with weights matching the Inter typeface used for English content, enabling seamless visual consistency across both language modes.

Methodology

1.1 Main Frameworks / Libraries, Tools and Technologies

1.1.1 Main Frameworks / Libraries

Front-End

- ✓ React Native library (*React Native, n.d.*) for the mobile application.
- ✓ React library (*React, n.d.*) for the website.

Back-End:

- ✓ **Express.js framework** (*Express.js, n.d.*): To build a complete back-end REST (Representation State Transfer) API (Application Programming Interface) to serve both the mobile application and the website.
- ✓ **MySQL2** module: For database connection pooling and query execution with promise support.
- ✓ **Bcrypt.js**: For secure password hashing and verification.
- ✓ **JSON Web Token** (jsonwebtoken): For stateless authentication and authorization.

1.1.2 Tools

□ Workspace Tools

- ✓ **Visual Studio Code (VS Code)**: Popular code editor customized with extensions for JavaScript, React, and database management.
- ✓ **Android Studio**: Very popular IDE (Integrated Development Environment) in mobile development, we use it to create virtual devices to build and test the mobile application on them.
- ✓ **Expo Go**: Mobile application for testing the mobile apps written in React Native without building them on physical or virtual devices.

Git / GitHub:

- Git: Open-source version control system to deal with cloudbased platforms such as GitHub and GitLab.
- GitHub: Cloud-based platform for saving and sharing codes.
- ✓ **MySQL Workbench**: Desktop application to manage local or remote MySQL databases.
- ✓ **Postman**: Desktop application (Provides also a website and VS Code extension) to test the back-end APIs and generate documentations for their usage.

Development Tools

- ✓ **Node.js run-environment** (*Node.js, n.d.*): In order to use React and React Native libraries on the front-end side and Express.js framework on the back- end one.
- ✓ **Expo** (*Expo, n.d.*): Production-grade framework that provides helping tools and libraries for making mobile application using React Native library.
- ✓ **Tailwind CSS (Cascading Style Sheets)** (*Tailwind CSS, n.d.*): CSS framework for quickly styling websites and mobile applications.

1.1.3 Technologies

External APIs Integration

- ✓ **Web speech API** : to convert voice to text when using voice assistant
- ✓ **Telegram API(telegram bot)** : to send announcement on the channel when new land listed

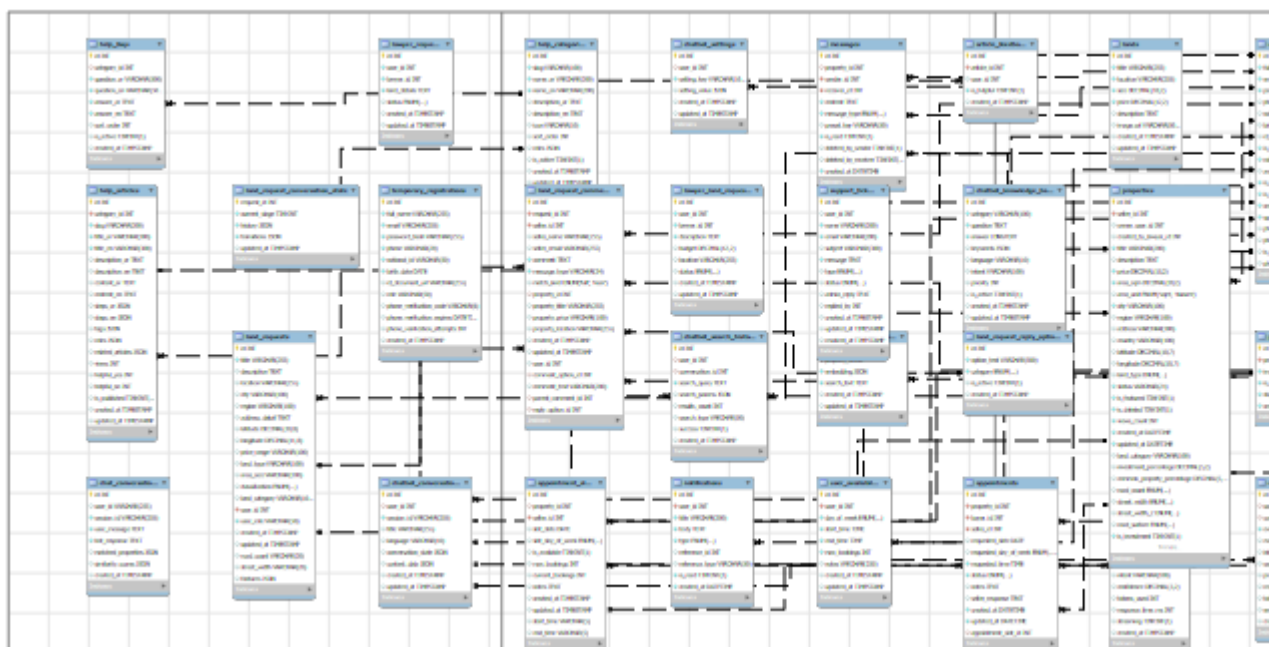
Main Local Services:

- ✓ **Leaflet**: Open-source interactive mapping library used to display land locations, visualize geographic data, and enable users to explore properties through dynamic map-based navigation.
- ✓ **Multer**: Middleware used for handling image uploads associated with land listings, allowing users to upload multiple property images and land plans securely.
- ✓ **React Native SVG**: Library for rendering interactive SVG-based booth maps with zoom and pan gestures.
- ✓ **React Native Gesture Handler**: Touch gesture system for interactive map manipulation.

1.2 Database Design

After analyzing the application requirements, a relational database approach was selected due to the clear entity relationships and the need for data integrity, referential constraints, and complex queries involving multiple joins.

Diagram:



Database UML

1.3 Project Architecture

A headless approach was used in this project, by providing signal back-end application that runs on a server and serve multiple front-end ones (Mobile application and Website).

1.3.1 Back-End Architecture

The back-end is followed the REST guidelines and structured using a variation of MVC (Model View Controller) architecture which divides the back-end code into:

- **Models:** Database interaction layer performing CRUD (Create-Read-Update-Delete) operations using MySQL2 with parameterized queries to prevent SQL injection.

- **Controller:** Business logic layer that validates requests, processes data, integrates third-party services, and coordinates between models and routes.
- **Routers:** API endpoint definitions mapping HTTP methods (GET, POST, PUT, DELETE) to controller methods.
- **Other folders and sub-packages** such as Enums, Errors, Middleware, Services, Helpers, etc.

1.3.2 Front-End Organization

Both mobile and web front-ends follow component-based architecture:

- **APIs:** To separate the APIs calls from the views.
- **Components:** To be created once and used many times.
- **Screens (Mobile) / Pages (Website)**
- **Other folders and sub-packages** such as: Enums, Services, Utilities, etc.

1.3.3 Authentication and Authorization Mechanism between Client-Server

The authentication and authorization will be done using JWT (JSON Web Token) because of its security and compact size comparing with the Sessions.

1.3.4 Chatbot AI Integration Architecture

the chatbot service uses a multi-layered approach powered by a locally deployed Large Language Model (LLM) through **Ollama**:

Intent Analysis: The Ollama model analyzes user questions to determine intent and extract relevant entities from the query.

Query Classification: The system determines whether the question requires database access or can be answered using static content (such as FAQs or platform information).

Dynamic Query Generation: For database-related requests, the system generates SQL queries based on the extracted intent and entities using a QueryBuilder module with schema

awareness.

Response Generation: The chatbot formats retrieved database results or static responses into natural, human-like language for the end user.

1.4 AI-Powered Chatbot Features

- **Intent Recognition:** Classifies user questions into categories (general, projects, companies, booths, jobs, feedback).
- **Entity Extraction:** Identifies key entities from questions (cites names, lands areas , prices, types).
- **Natural Language to SQL:** Converts natural language questions into SQL queries using a QueryBuilder utility with schema awareness.
- **Context-Aware Responses:** Generates human-like responses based on retrieved data, maintaining conversation context.
- **Out-of-Scope Detection:** Identifies and politely declines questions unrelated to the SmartLand MarketPlace platform.

1.5 Standards and Constraints

1.5.1 Standards

- RESTful APIs standards -RESTful itself isn't a standard-:
 - ✓ HTTPS (Hyper-Text Transfer Protocol Secure) [RFC 2818]. ✓ URI (Uniform Resource Identifier) [RFC 3986].
 - ✓ JSON [RFC 8259].
 - ✓ JWT [RFC 7519]: For authentication and authorization as it described in 3.3.3.
- SQL (Structured Query Language) [ISO/IEC 9075].
- Gmail API [RFC 8621]: Used to send emails to the users as it described in 3.1.3.
- CSS [W3C Standard].

1.6 Constraints

Economy: The platform was developed without a financial budget, using exclusively free and open-source libraries and tools.

The chosen stack (Node.js, React.js, MySQL, Socket.io, Leaflet) is entirely free and open-source, making the solution economically accessible for deployment.

Environment: The application uses OpenStreetMap tile data for mapping rather than Google Maps, eliminating per-request API costs and reducing dependency on paid cloud services.

Society: The platform was designed with the Palestinian land market specifically in mind, incorporating bilingual Arabic/English support with full RTL layout adaptation to serve both local users and diaspora communities. Identity verification requirements address the social problem of fraudulent land transactions.

Ethics: User ID documents are stored in a non-public Directory with randomized filenames and are accessible only to authorized administrators. The platform does not sell user data or display advertising. Users retain the right to request account deletion.

Health and Safety: Rate limiting and input validation protect users from malicious actors attempting brute-force credential attacks or injection attacks through form inputs.

Sustainability: The backend architecture uses a connection pool to handle concurrent database connections efficiently. The API uses pagination on all list endpoints to prevent uncontrolled data growth from degrading performance. Soft deletion on property records preserves referential integrity while allowing listings to be removed from public view.

Manufacturability: The entire application is implemented in JavaScript, allowing both frontend and backend to share

tooling, developer knowledge, and utility code. The use of a standard RESTful API design makes the backend independently replaceable by any compatible implementation.

RESULTS AND ANALYSIS

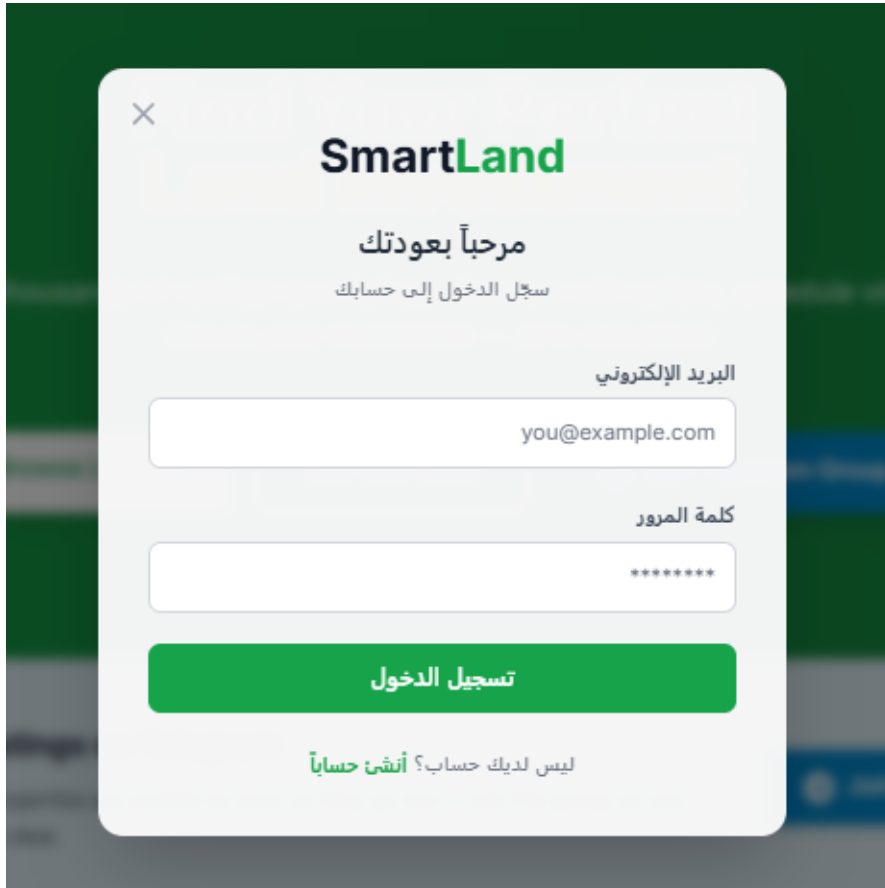
Implemented Features

The following features were successfully implemented and are fully functional in the delivered platform:

User Registration and Authentication: Users can register and log in using a secure JWT-based authentication system.

The platform supports multiple user roles, including Buyer, Seller, Lawyer, Administrator, and Super Administrator.

Role-based access control ensures that each user can access only the features relevant to their responsibilities.



A login form for SmartLand. The form is a light gray rounded rectangle with a close button (X) in the top left corner. It contains the SmartLand logo, a welcome message in Arabic, a subtitle, and two input fields for email and password. A green button for login is at the bottom, followed by a link to create an account. The background is a blurred green and blue image.

×

SmartLand

مرحباً بعودتك

سجل الدخول إلى حسابك

البريد الإلكتروني

كلمة المرور

تسجيل الدخول

ليس لديك حساب؟ [أنشئ حساباً](#)

Figure 1:log in



أنشئ حسابك

انضم إلى المنصة اليوم

2

1

معلومات الحساب معلومات الشخصية

المعلومات الشخصية

الاسم الكامل (مطلوب 4 أجزاء)

الاسم الأول الاسم الثاني

أحمد علي

الاسم الثالث اسم العائلة

عمر حسن

رقم الهوية

مثال: 123456789

تاريخ الميلاد

mm/dd/yyyy

متابعة

لديك حساب بالفعل؟ [تسجيل الدخول](#)

أنشئ حسابك

انضم إلى المنصة اليوم

2

✓

معلومات الحساب معلومات الشخصية

معلومات الحساب

مراجعة المعلومات الشخصية

الاسم: ahmad ali omar hassan

رقم الهوية: 45465465123

تاريخ الميلاد: 09-06-2008

العودة للمعلومات الشخصية

البريد الإلكتروني

you@example.com

رقم الهاتف

+970591234567

كلمة المرور

☐ أوافق على الشروط والأحكام و سياسة الخصوصية

إنشاء الحساب

لديك حساب بالفعل؟ [تسجيل الدخول](#)

Figure 2:signup1

Figure 3:sign up 2

Land Listing Management: Sellers can create, edit, and manage land listings by providing detailed information such as title, description, price, area, location, land type, images, and land plan documents. Listings can be updated at any time and are displayed to potential buyers through the marketplace.

سمارت لاند

شراء بيع المواعيد الطلبات لوحتي

Ahmad تسجيل الخروج

إضافة عقار جديد

أكمل الخطوات التالية لإضافة عقارك

1 الموقع 2 تفاصيل الأرض 3 الشوارع والوصول 4 المميزات والخدمات 5 الصور 6 معلومات إضافية 7 مراجعة

الموقع

* الموقع

* المحافظة

المنطقة اختر المنطقة

المحافظة اختر المحافظة

العنوان

بجانب قرية بيت إيا

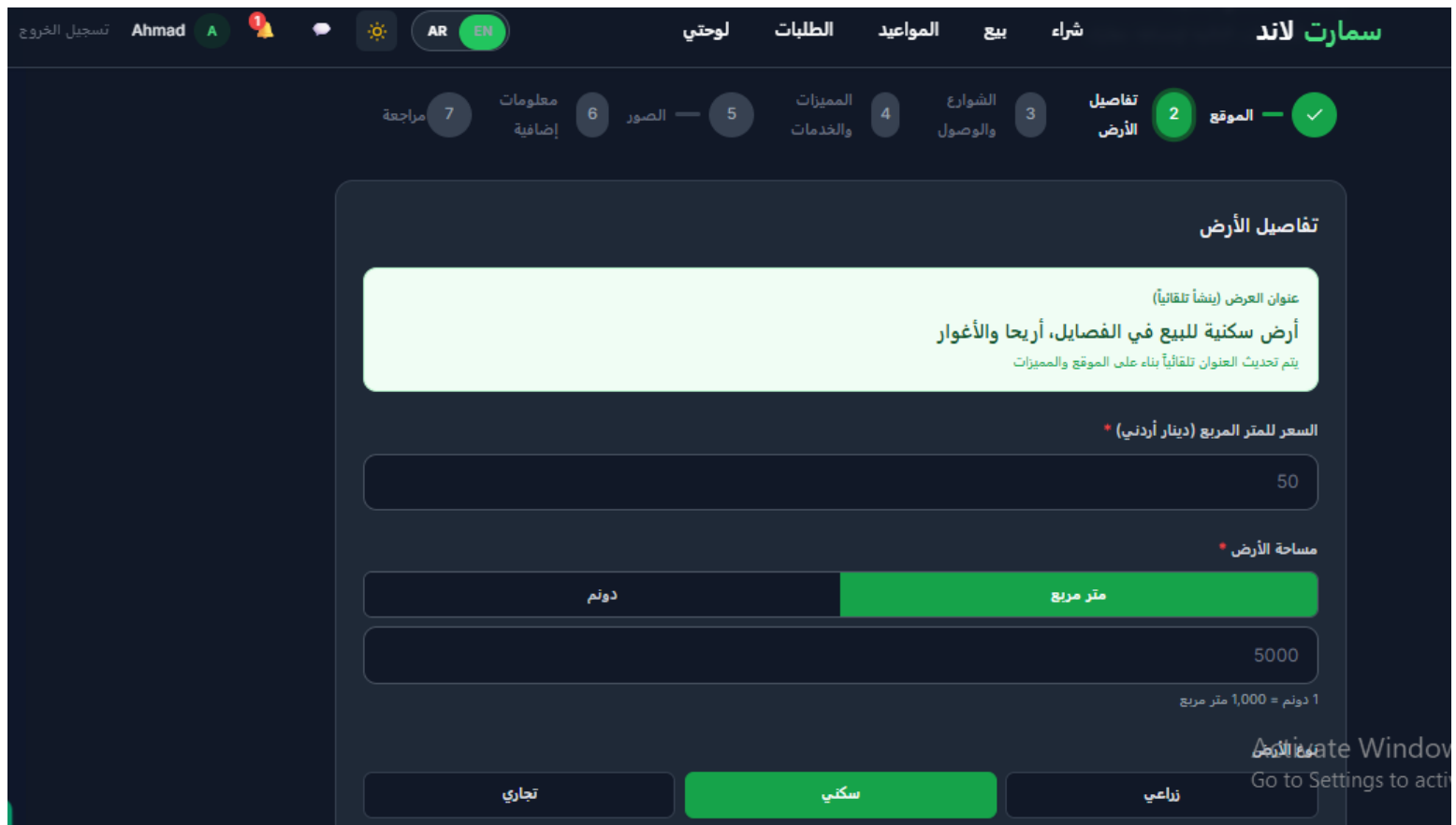
تحديد الموقع على الخريطة (اختياري)

ابحث عن موقع أو اختر منطقة...

موقعي

اختر المحافظة ثم القرية للتنقل الخريطة تلقائياً

Figure 4:listland1



1 دونم = 1,000 متر مربع
يعادل: 1 دونم

نوع الأرض

تجاري سكني **زراعي**

متعدد الاستخدام

تصنيف الأرض *

فئة C فئة B **فئة A** فئة +A

فئة الأرض

مالية ☐ طابو ☒

تسوية ☐ مشاع ☐

أخرى ☐

التالي <

السابق > Go to Setting

Figure 6: listland3

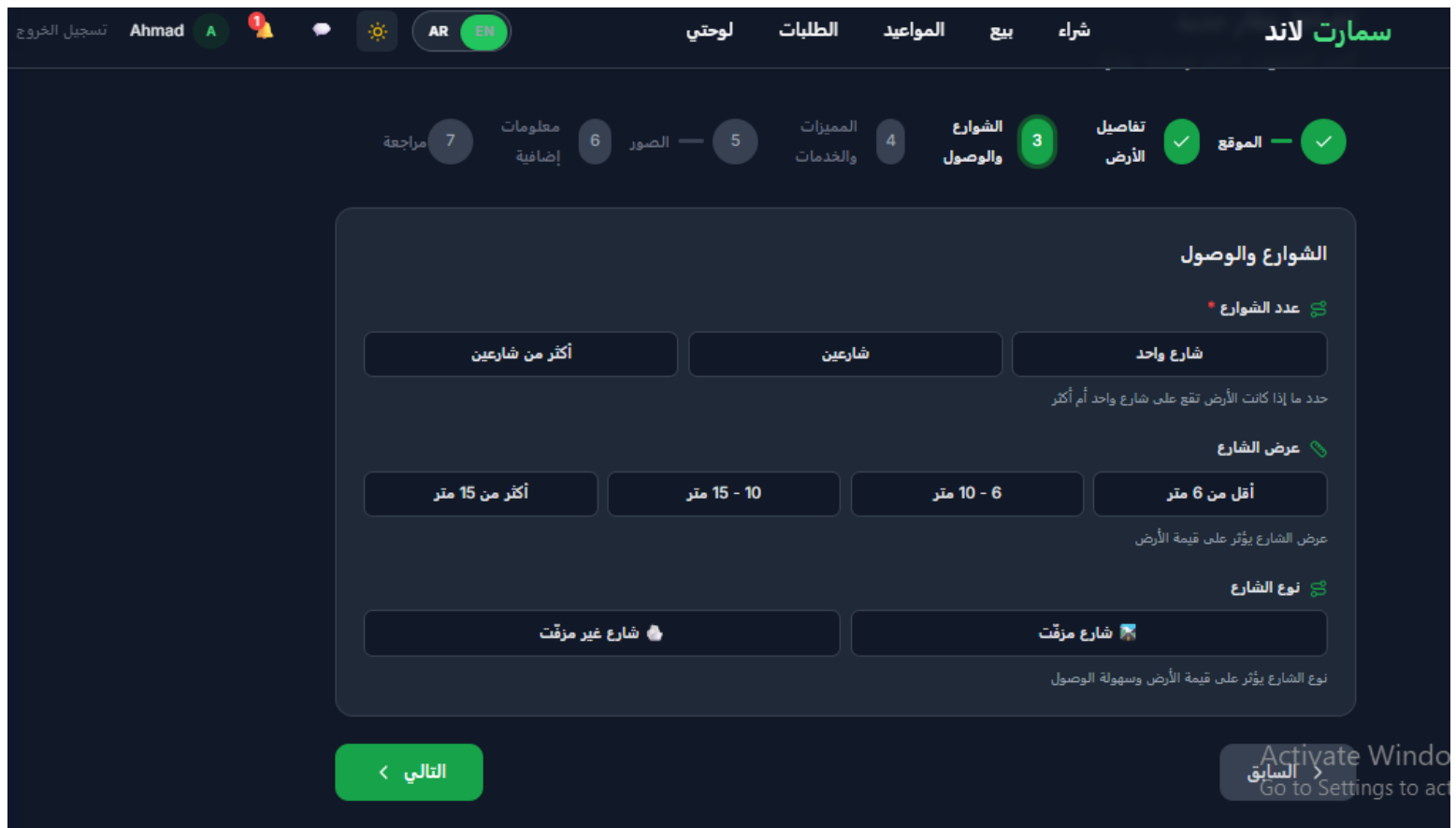


Figure 7:listland4

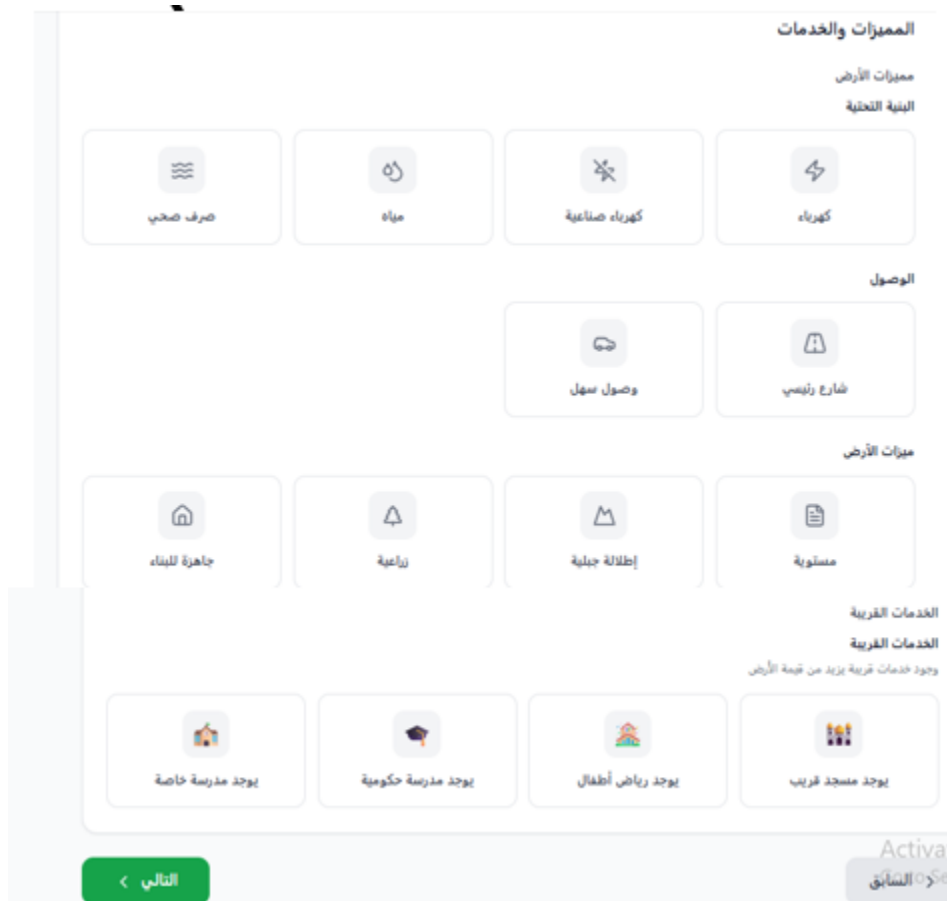


Figure 8:listland5

أحمد A
1
AR
لوحتي
الطلبات
المواعيد
بيع
شراء
سمارت لاند

معلومات إضافية
وصف الأرض (اختياري)
استخدم هذا الحقل لإضافة أي تفاصيل إضافية لم تذكر أعلاه...
اختياري: أضف أي معلومات إضافية غير مغطاة بالخصائص أعلاه
عرض للاستثمار
يمكنك تفعيل هذا الخيار إذا كنت ترغب بعرض الأرض للاستثمار وليس للبيع فقط
نوع الاستثمار *
اختر نوع الاستثمار
نسبة الشراكة (%)
مثلاً 30
تفاصيل الاستثمار
صف الفرصة الاستثمارية، العائد المتوقع، الشروط...

Figure 10:listland7

Advanced Property Discovery: Users can discover lands through an advanced filtering system that supports searching by city, land type, price range, area, and other property characteristics.

An interactive map view enables users to explore available lands based on their geographic locations.

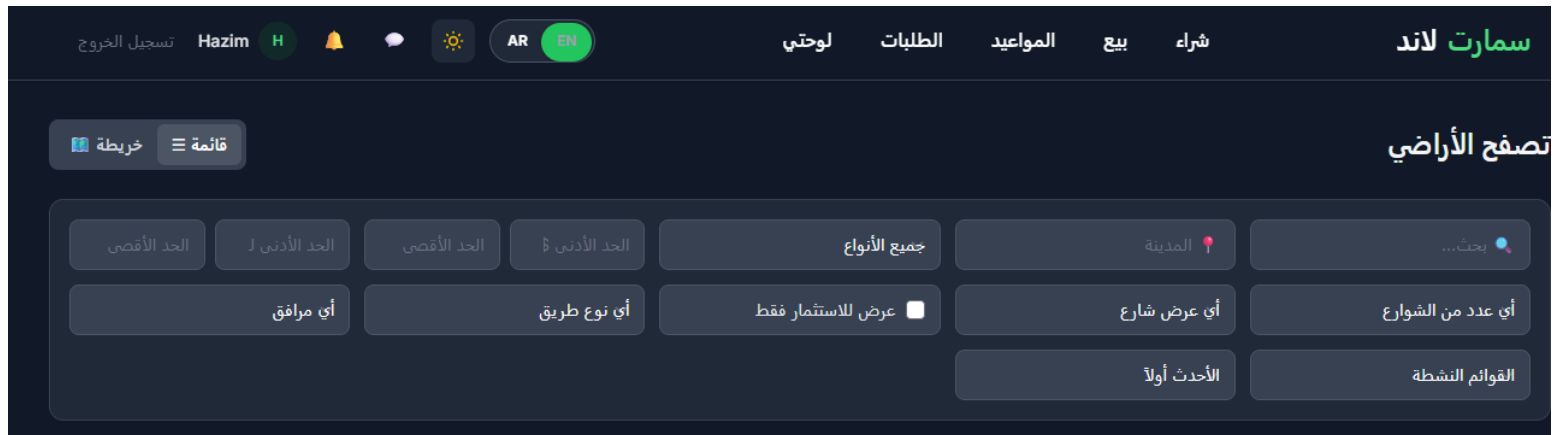


Figure 11:filters

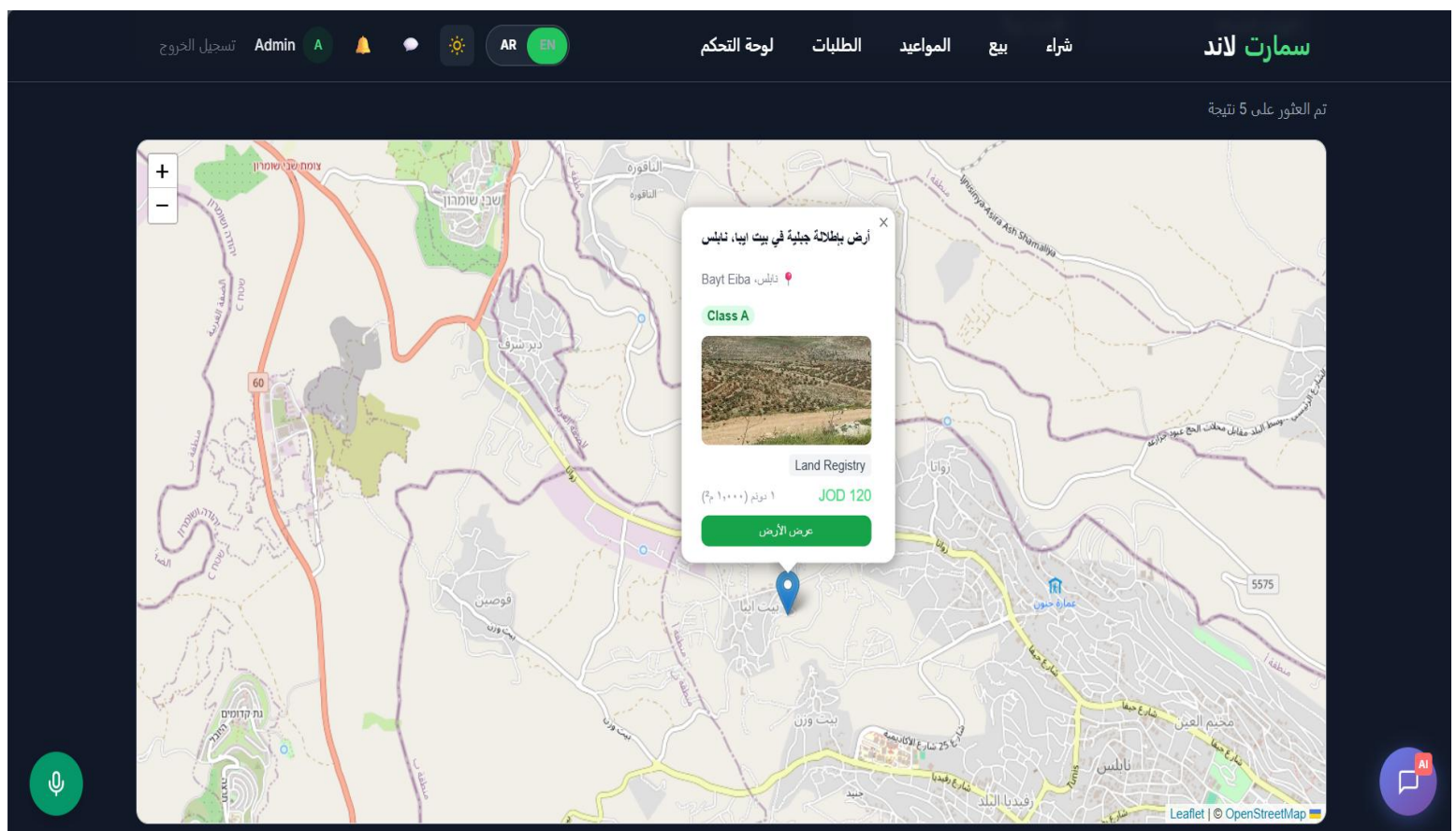


Figure 12:map loc

Interactive Map Integration: The platform utilizes Leaflet to provide a dynamic map interface where users can visualize property locations, navigate geographical areas, and identify nearby land opportunities through interactive markers and location-based browsing.

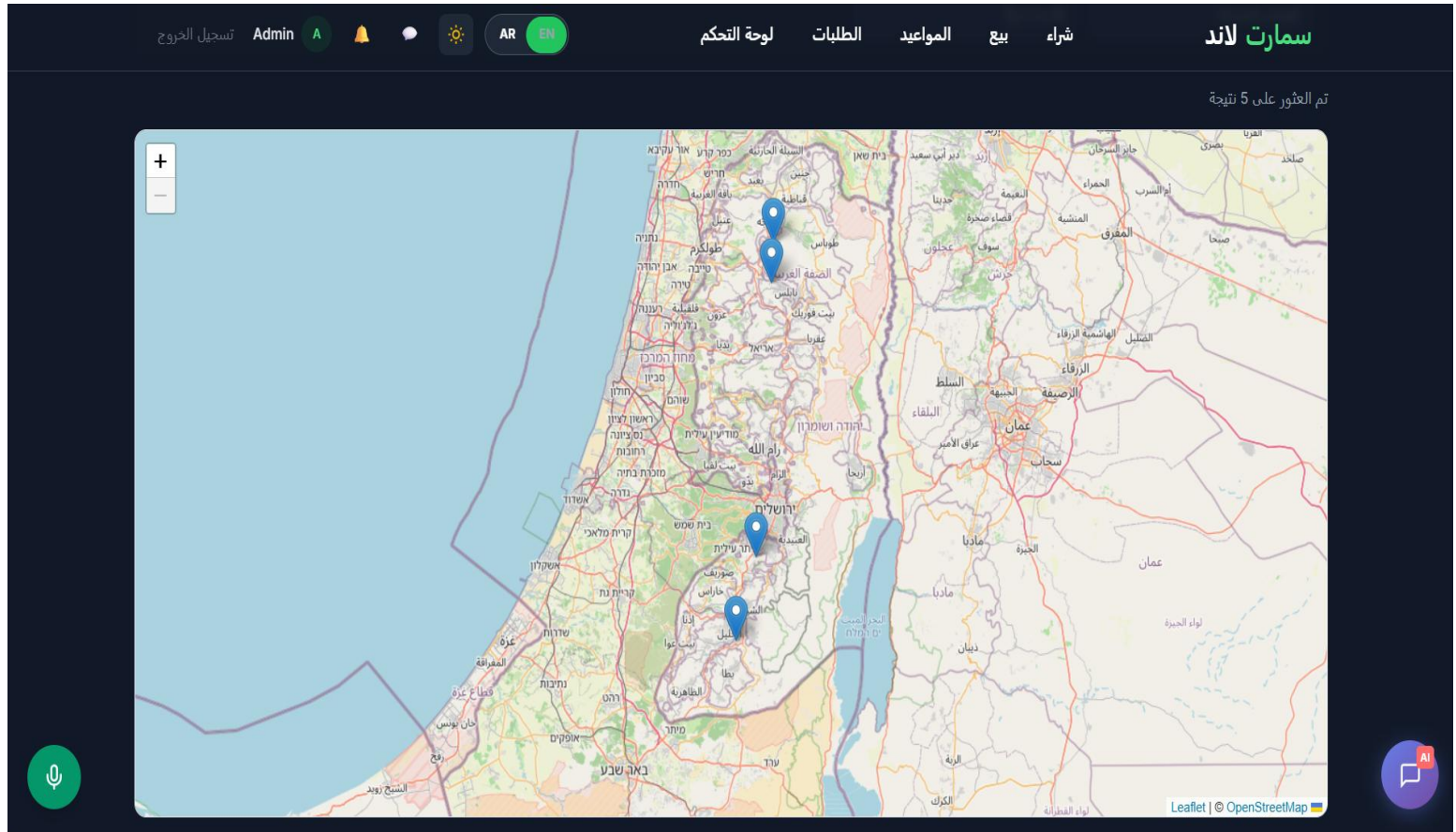


Figure 13:map

Real-Time Messaging System: Buyers, sellers, and lawyers can communicate directly through a real-time messaging system. Messages are stored securely and delivered instantly, enabling efficient communication regarding property inquiries, legal consultations, and transaction processes.

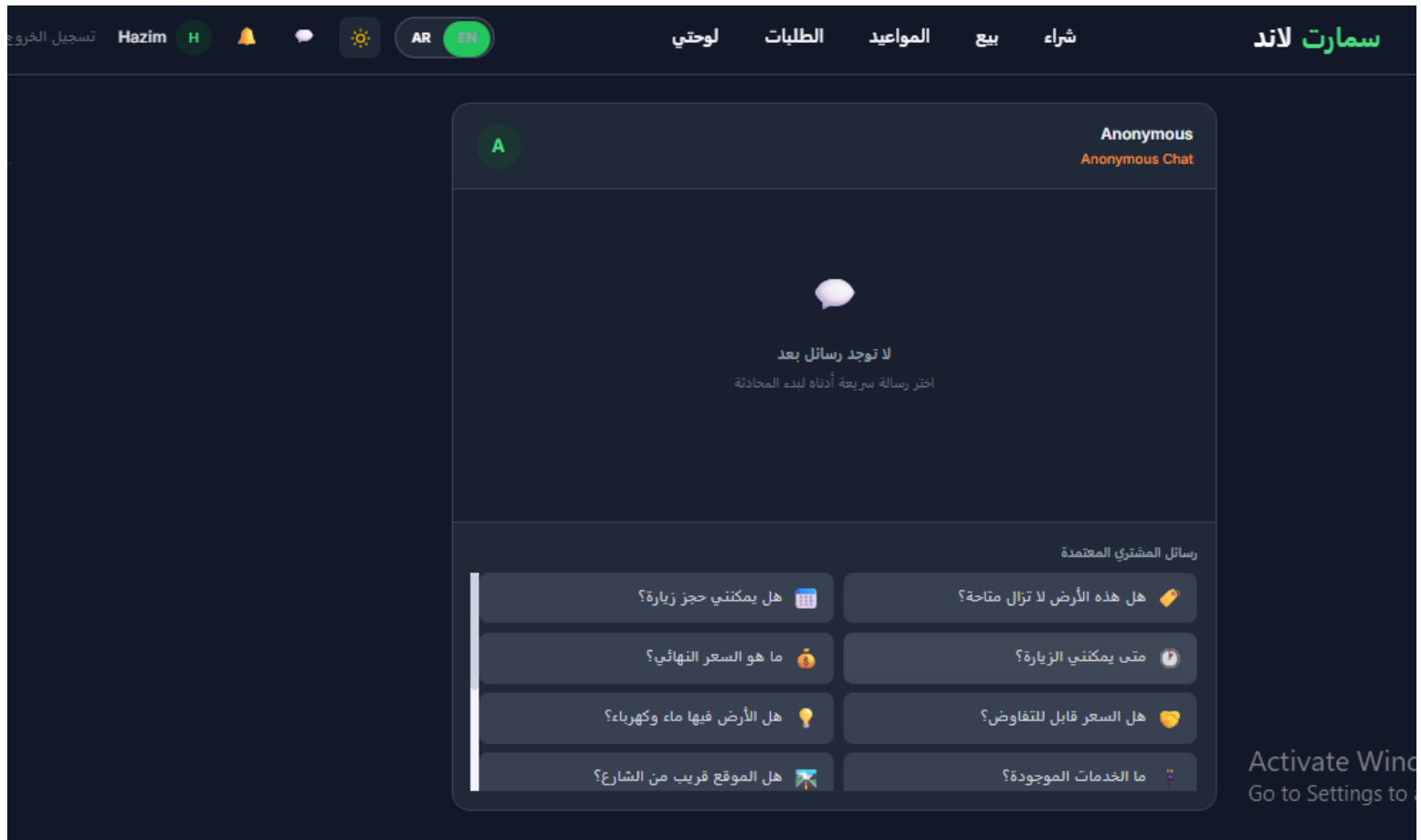


Figure 14:mess1



Figure 15:mess2

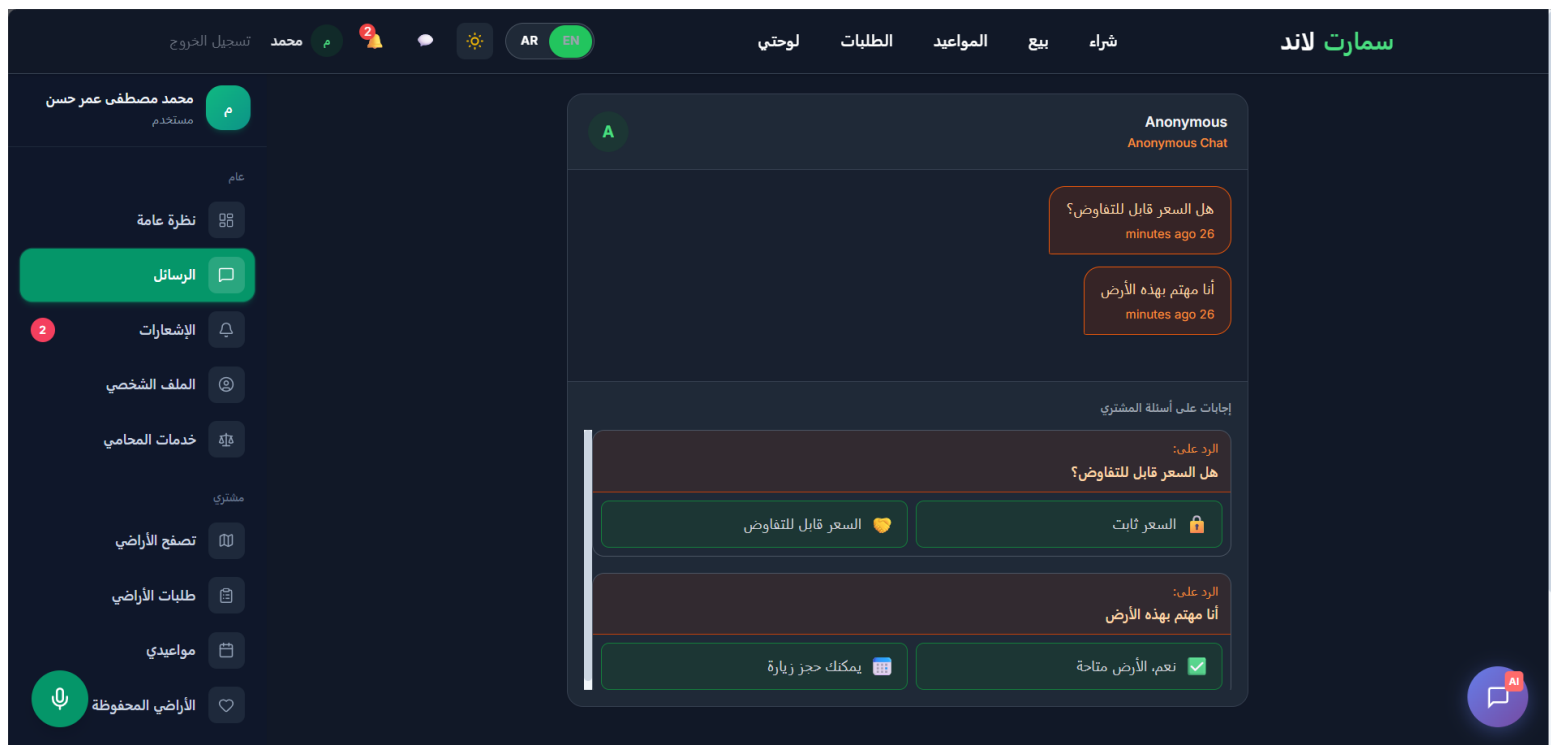


Figure 16:mess2

Appointment and Availability Management: Sellers can define their available meeting schedules and appointment slots. Buyers can request property visits, while sellers can review, approve, or reject appointment requests. Availability schedules help streamline the property viewing process.

Voice Assistant for Property Search: The platform includes an intelligent voice assistant that allows users to search for lands using natural language voice commands. The assistant automatically interprets spoken requests, applies relevant filters, and navigates users to matching property listings.

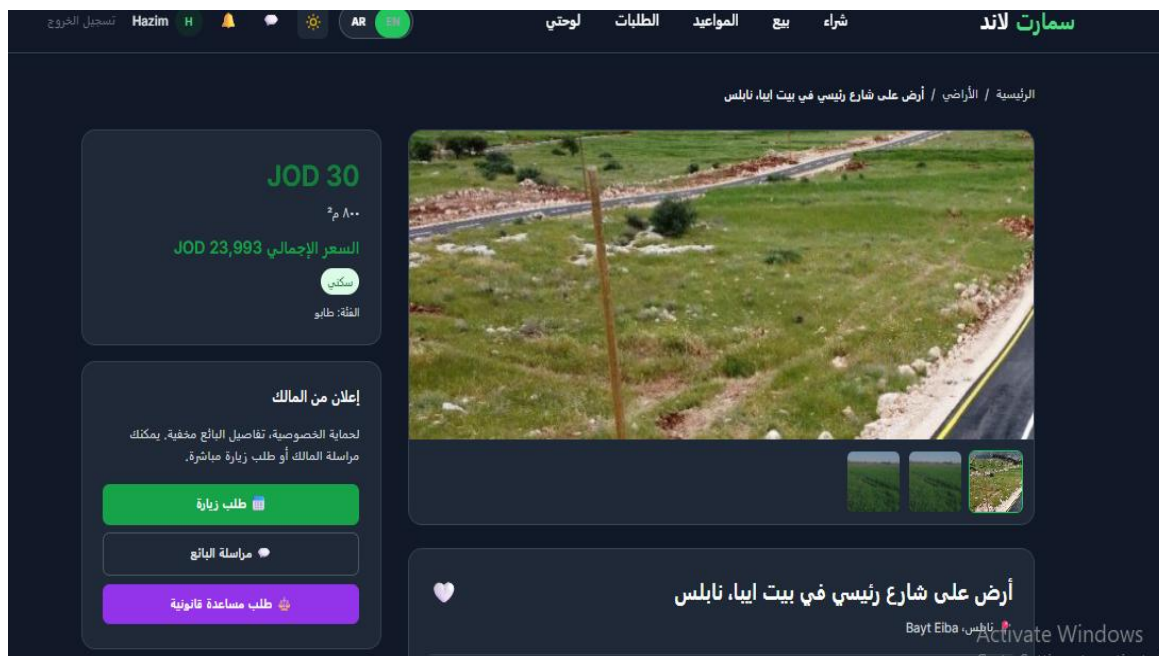


Figure 17:app1

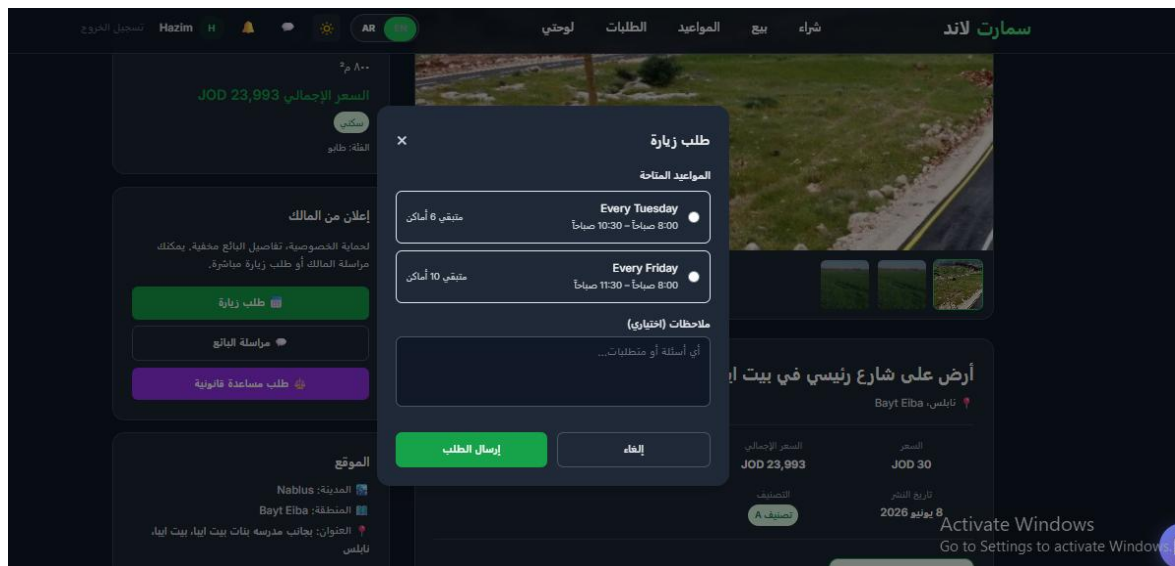


Figure 18:app2

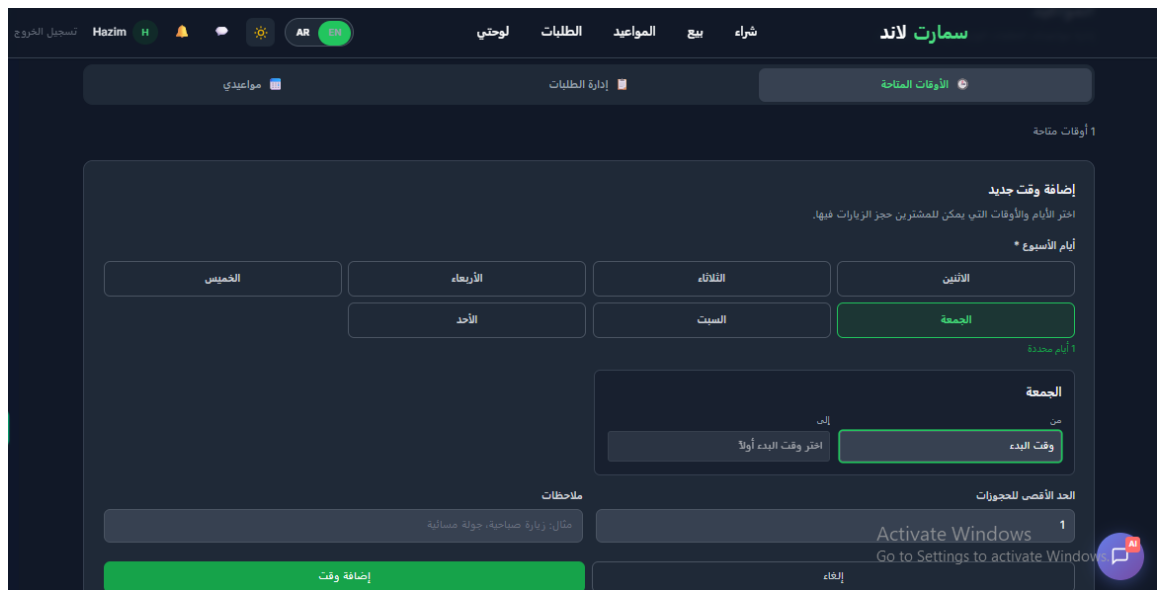


Figure 19:av1

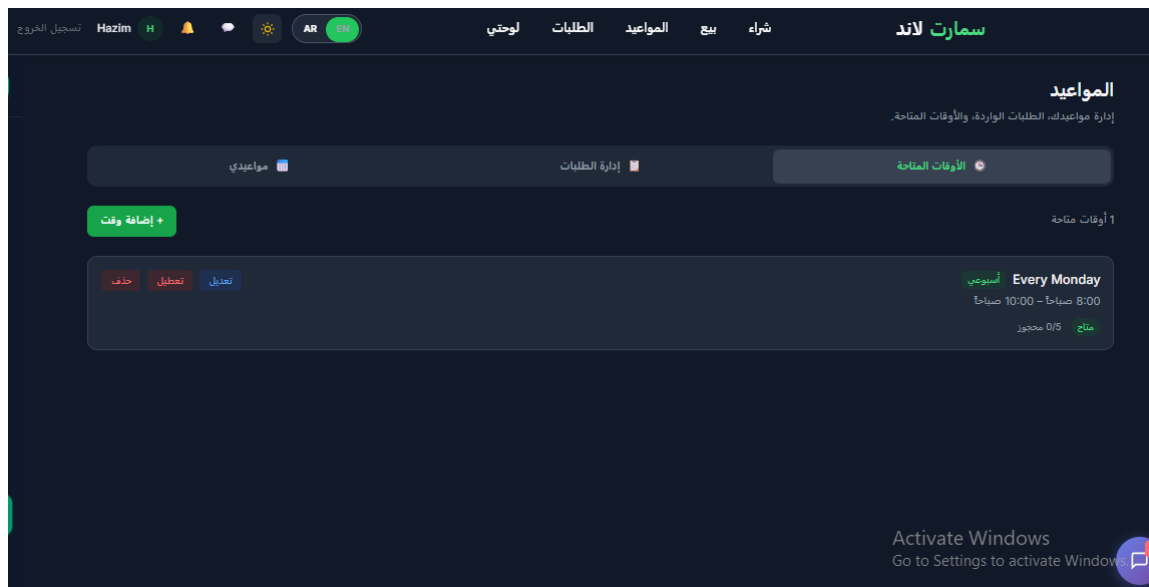


Figure 20:av2

Voice-Based Land Search and Availability Scheduling: Sellers can manage their availability schedules using voice commands.

The assistant supports adding, updating, and removing available time slots through natural language interactions, improving usability and efficiency.

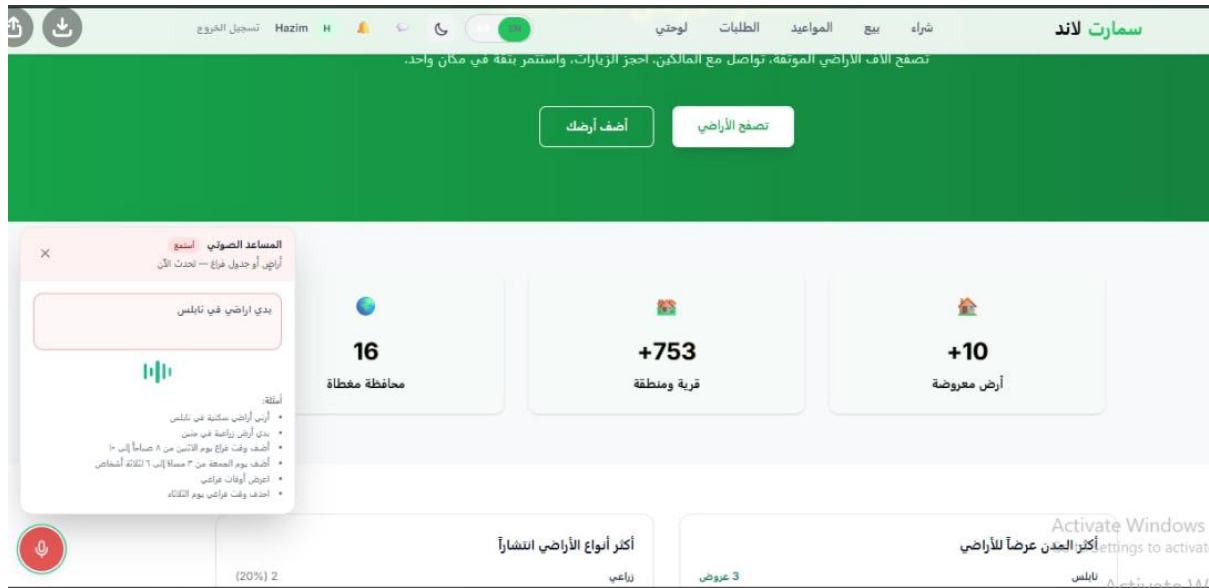


Figure 21:va1

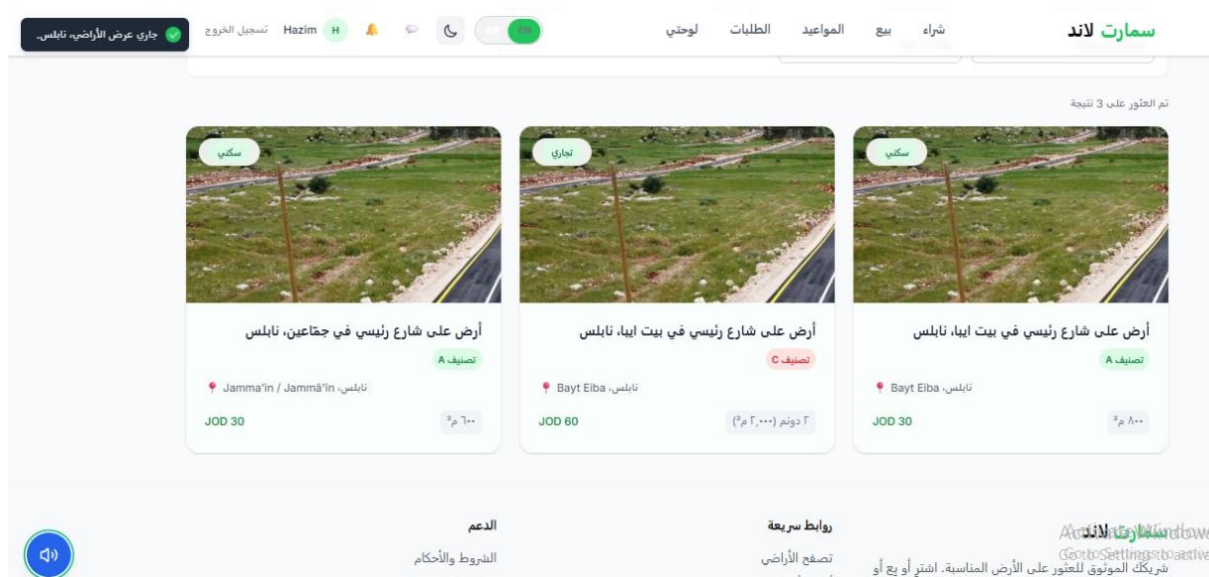


Figure 22:va2

AI-Powered Property Assistance: The platform integrates artificial intelligence to assist users in discovering relevant properties, understanding platform functionality, and improving the overall user experience through intelligent recommendations and search assistance.



Figure 23:chatbot1



Figure 24:chatbot2

Land Request Marketplace: Users can submit custom land requests describing their desired location, budget, area, and land specifications. These requests become visible to sellers and administrators, enabling the platform to identify market demand and assist users in finding suitable properties.

The screenshot displays the 'Post Land Request' (نشر طلب أرض) form in the 'Land Request Marketplace' (سمازل لاند) application. The form is titled 'نشر طلب أرض' and includes a sub-header 'العنوان (يُطلب تعبئة)' (Title (Required)). Below this, there are two text input fields: one for 'العنوان (يُطلب تعبئة)' and another for 'مكوّن العنوان تلقائياً...' (Auto-generate title...). A note indicates that the title should be generated based on the location and specifications of the land. The form also includes a 'الوصف' (Description) section with a text area for 'صف الأرض التي تبحث عنها. تفاصيل الموقع المزمع، إلخ.' (Describe the land you are looking for. Details of the proposed location, etc.). At the bottom, there are three dropdown menus: 'الموقع المفضل' (Preferred location), 'المنطقة' (Area), and 'نطاق السعر' (Price range). The 'الموقع المفضل' dropdown is currently set to 'اختر المحافظة' (Select governorate). The 'المنطقة' dropdown is set to 'اختر المنطقة' (Select area). The 'نطاق السعر' dropdown is set to 'اختر نطاق السعر' (Select price range). A green button labeled 'إخفاء النموذج' (Hide form) is located at the top left of the form area.

Figure 25:demand1

The screenshot displays the 'Additional details for location' (تفاصيل إضافية للموقع) form in the 'Land Request Marketplace' (سمازل لاند) application. The form is titled 'تفاصيل إضافية للموقع' and includes a sub-header 'مثال: قرب المدرسة، شارع فرعي، معاليم قريبة... (اختياري)' (Example: Near the school, secondary road, nearby landmarks... (Optional)). The form is divided into two columns. The left column contains fields for 'نوع الأرض' (Land type), 'المساحة (م²)' (Area in m²), 'عرض الشارع' (Street width), and 'نوع الأرض' (Land type). The right column contains fields for 'عدد الشوارع' (Number of streets), 'نوع الأرض' (Land type), 'عدد الشوارع' (Number of streets), and 'نوع الأرض' (Land type). Below these fields, there are several checkboxes for 'مميزات الأرض' (Land features): 'البنية التحتية' (Infrastructure), 'كهرباء' (Electricity), 'خصائص الأرض' (Land characteristics), 'مسطحة' (Flat), 'تصنيف الأرض' (Land classification), 'صرف صحي' (Sanitation), 'مياه' (Water), 'زراعة' (Agriculture), 'إطلالة جارية' (Running water), 'جاهزة للبناء' (Ready for construction), and 'فئة الأرض' (Land category). A green button labeled 'تقديم الطلب' (Submit request) is located at the bottom of the form.

Figure 26:demand2

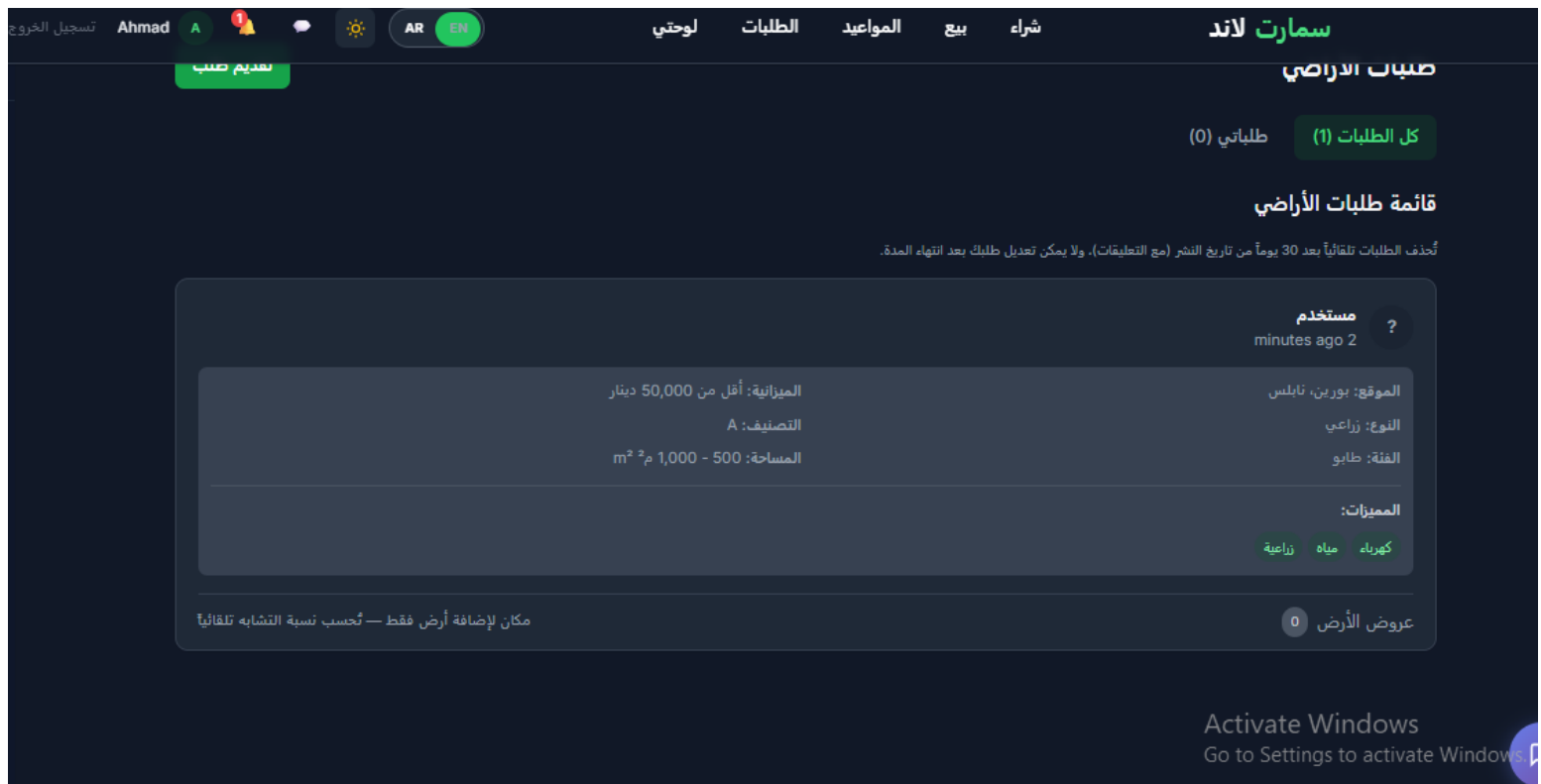


Figure 27:demand3

Legal Consultation Services: Users can request professional legal assistance from registered lawyers Within the platform.

Lawyers provide consultations regarding land ownership, contracts, legal procedures, and property transactions.

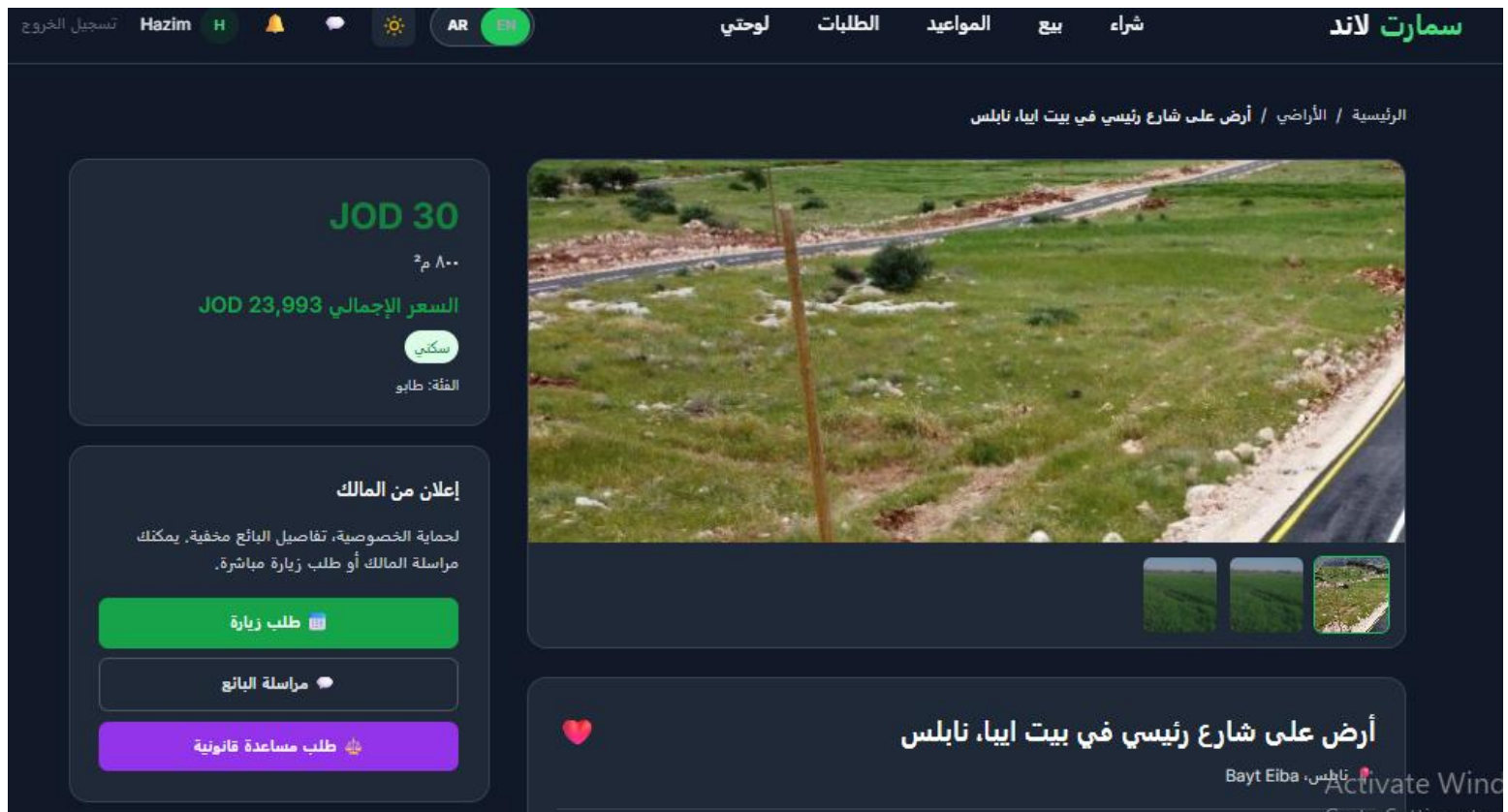


Figure 28:legal1

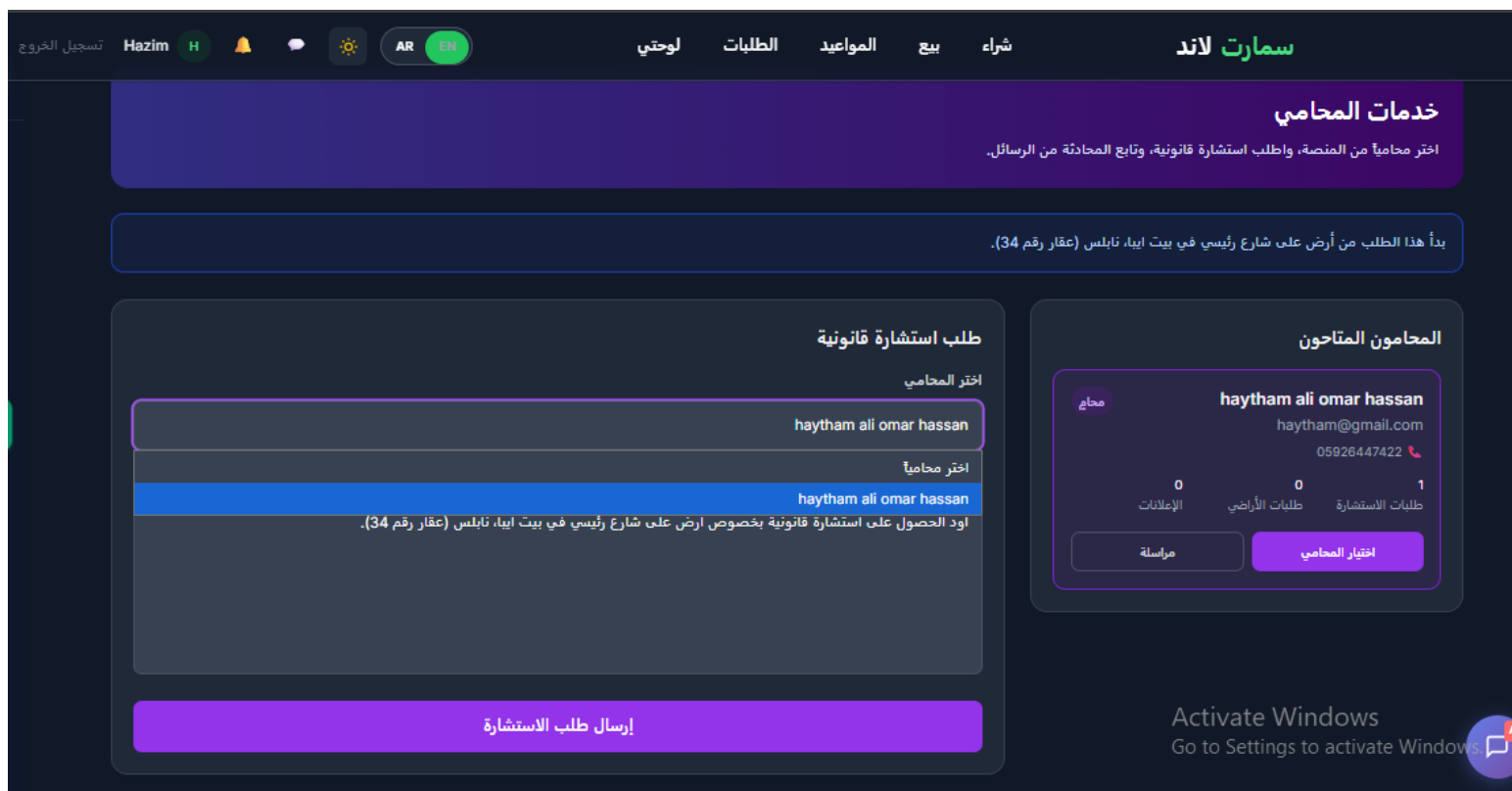


Figure 29:legal2

Legal Transaction Representation: Lawyers can represent users throughout the property purchasing process when authorized.

This includes reviewing contracts, managing legal procedures, communicating with involved parties, and supervising ownership transfer processes.

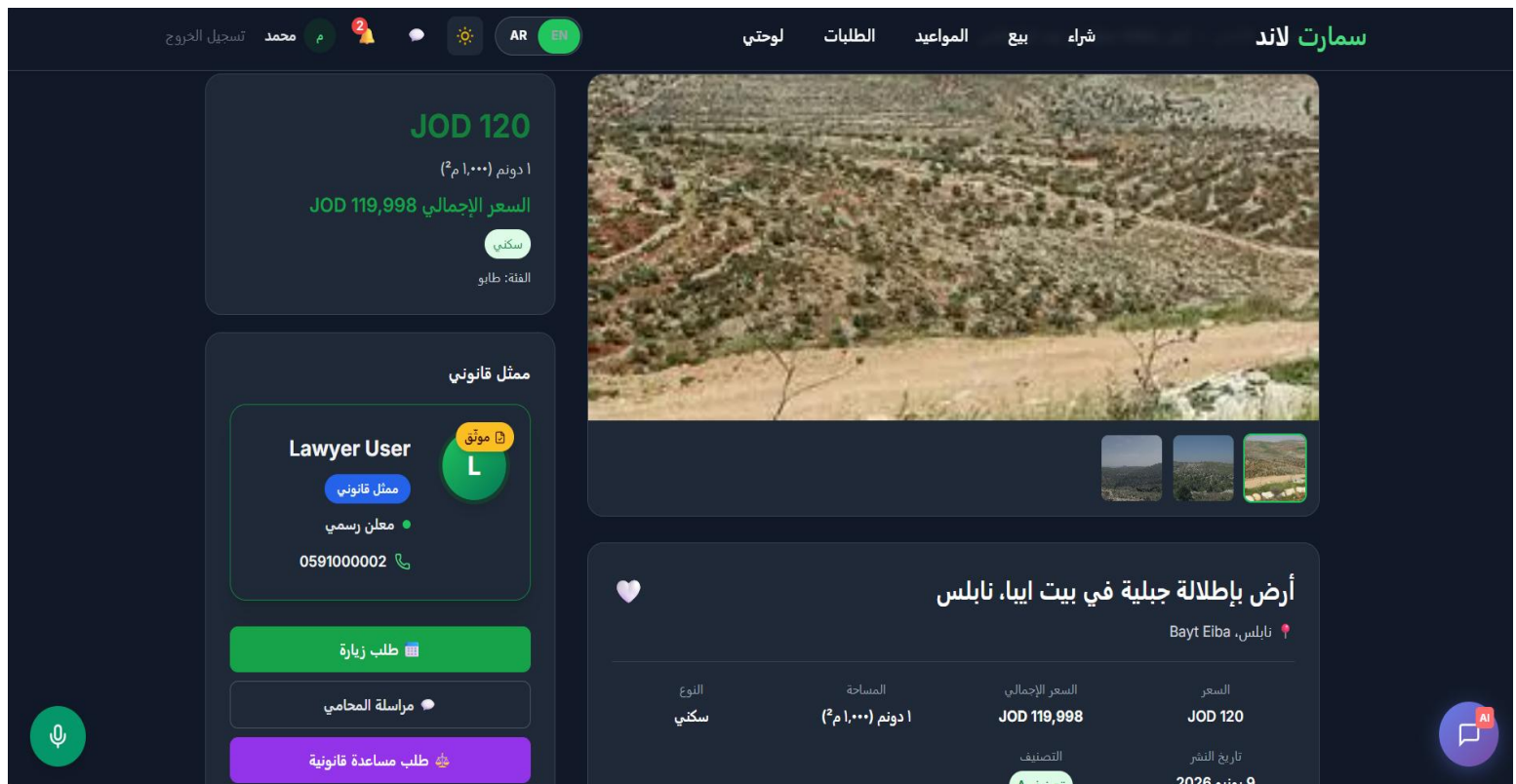
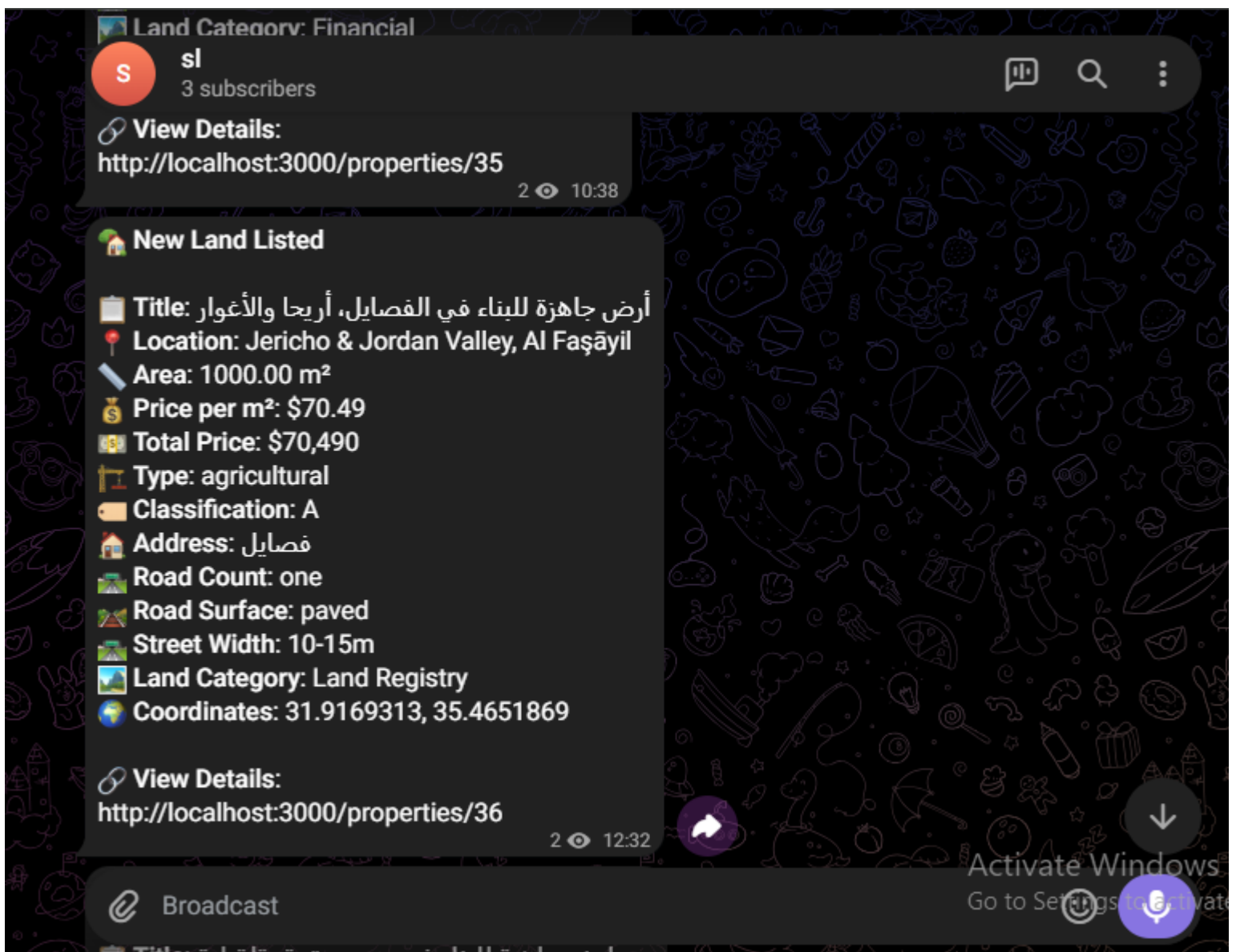


Figure 30:lawyer

Telegram Channel Integration: Newly published land listings can be automatically announced through the platform's Telegram channel, increasing property visibility and extending marketing reach beyond the website itself.

Notification System: The platform provides real-time notifications for important events such as new messages, appointment requests, appointment status changes, land requests, legal consultation requests, and property-related activities.



Administrative Dashboard: Administrators can manage users, monitor listings, review platform activity, handle reports, verify accounts, and oversee marketplace operations through a centralized dashboard.

Lawyer Advisory Dashboard: Lawyers have access to platform statistics, market insights, and analytical information that enable them to provide recommendations to administrators and support strategic decision-making within the platform.

The screenshot displays the 'SmartLand Admin' dashboard. The top navigation bar includes 'سمارت لاند' (SmartLand), 'لوحة التحكم' (Control Panel), and various menu items like 'الطلبات' (Orders), 'المواعيد' (Appointments), 'بيع' (Sell), and 'شراء' (Buy). The left sidebar contains navigation options such as 'نظرة عامة' (Overview), 'الرسائل' (Messages), 'الإشعارات' (Notifications), 'الملف الشخصي' (Profile), 'لوحة التحكم' (Control Panel), 'طلبات الأراضي' (Land Requests), 'تحليلات العروض' (Offer Analytics), 'كل الأراضي' (All Lands), 'كل المستخدمين' (All Users), 'إنشاء محام' (Create Lawyer), and 'طلبات أراضي' (Land Requests).

The main content area shows a list of users with the following details:

User Type	Name	Status	Email	Join Date	Birth Date	ID Number	Phone Number	Actions
Normal User	محمد مصطفى عمر حسن	نشط / مستخدم	ahmadsamaaneh@gmail.com	Jun 09, 2026	Nov 29, 2003	12341156789	97059216129+	مراسلة, إيقاف, تحديث كلمة المرور, تصحيح البيانات المدخلة
Normal User	احمد حمد لله احمد سماعنه	نشط / مستخدم	ahmadsamaaneh1@gmail.com	May 17, 2026	Nov 29, 2003	123456789	970592161529+	مراسلة, إيقاف, تحديث كلمة المرور, تصحيح البيانات المدخلة
Admin User	Admin User	نشط / مسؤول	admin@smartland.com	Apr 26, 2026	Jan 01, 1990	9000000001	0591000001	
Lawyer User	Lawyer User	نشط / محام	lawyer@smartland.com	Apr 26, 2026	May 15, 1992	9000000002	0591000002	مراسلة, إيقاف, تحديث كلمة المرور, تصحيح البيانات المدخلة
Normal User	Normal User	نشط / مستخدم	user@smartland.com	Apr 26, 2026	Aug 20, 1995	9000000003	0591000003	مراسلة, إيقاف, تحديث كلمة المرور, تصحيح البيانات المدخلة

Figure 31:admin1

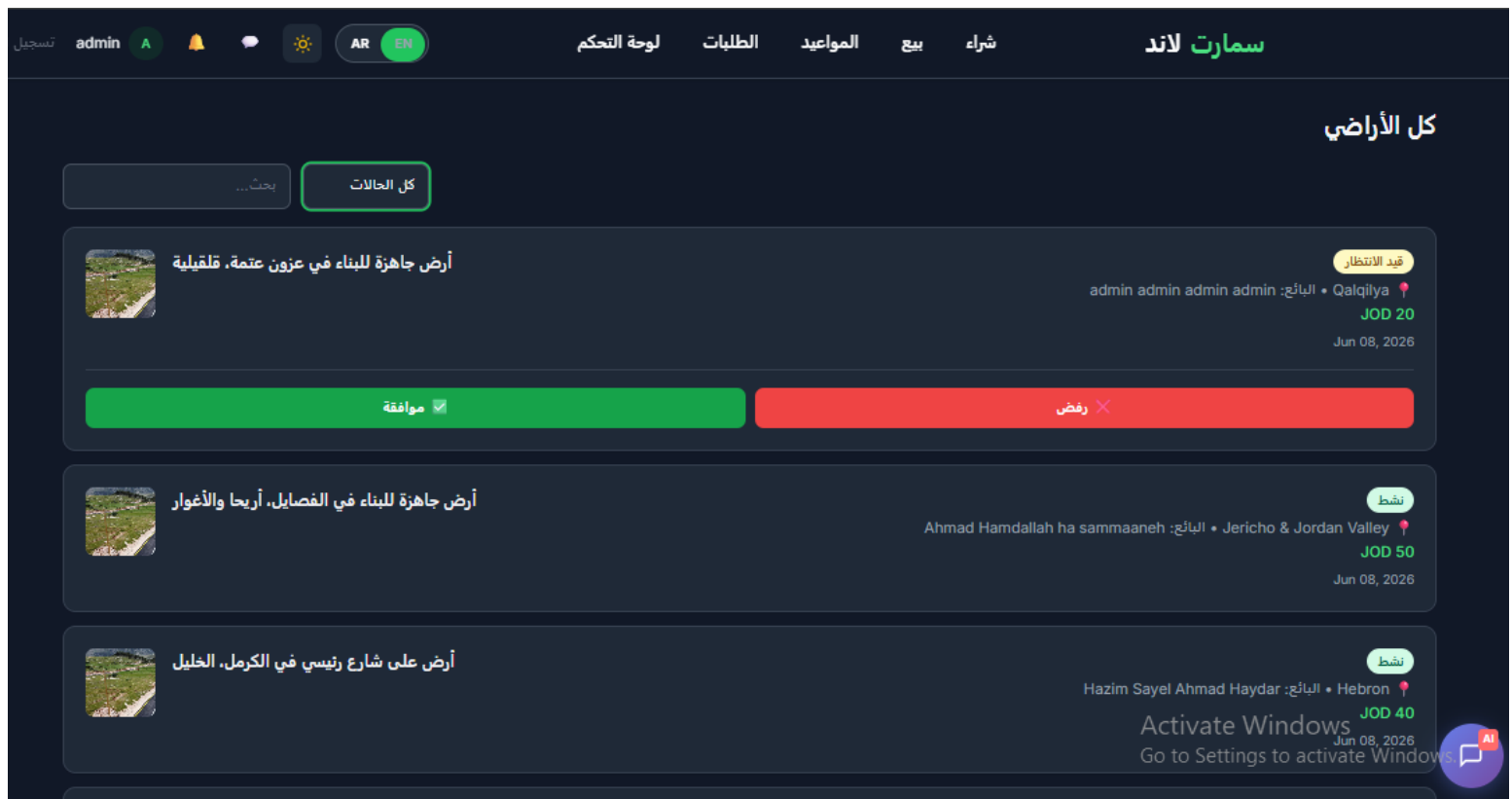


Figure 32:admin2

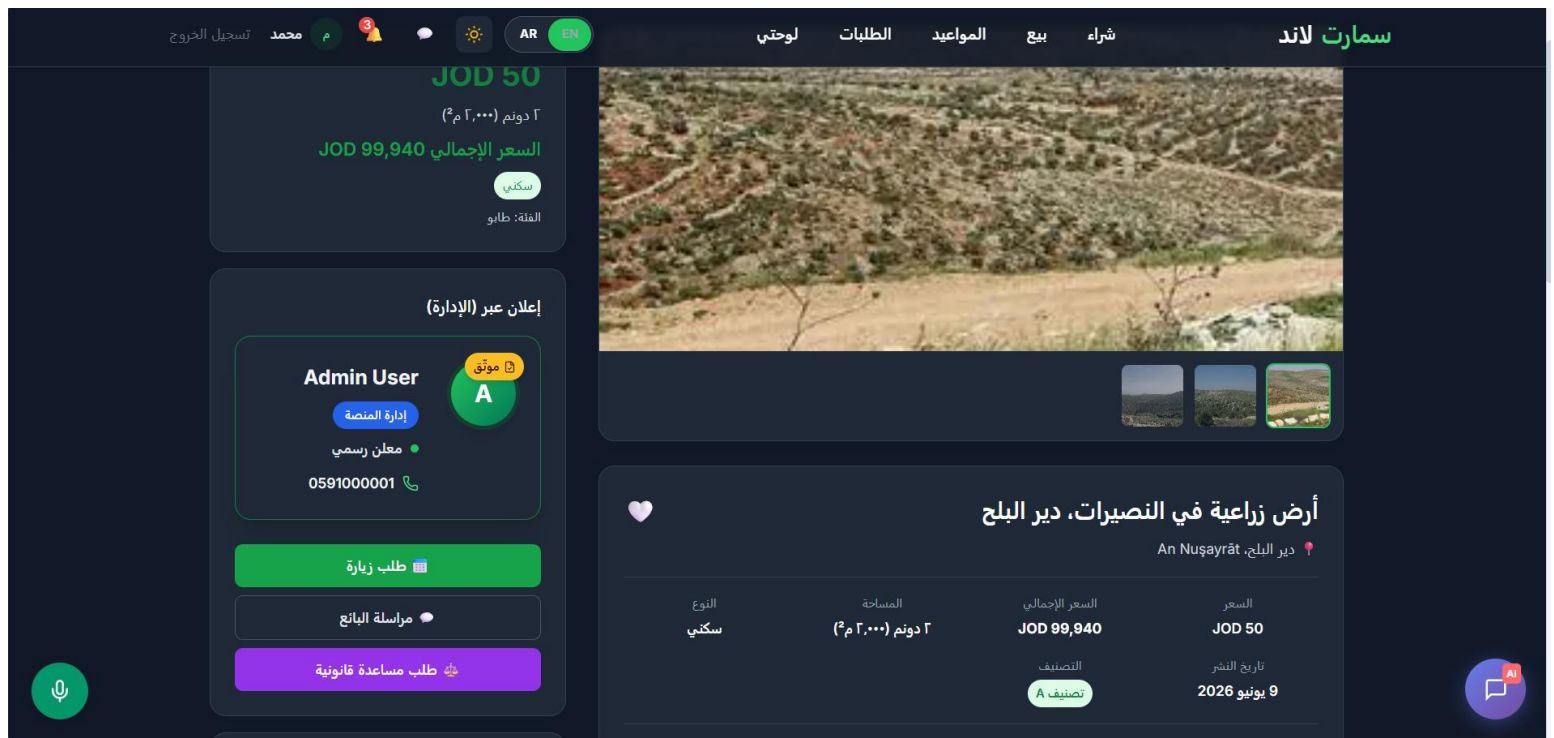


Figure 33:admin3



Figure 34:admin4

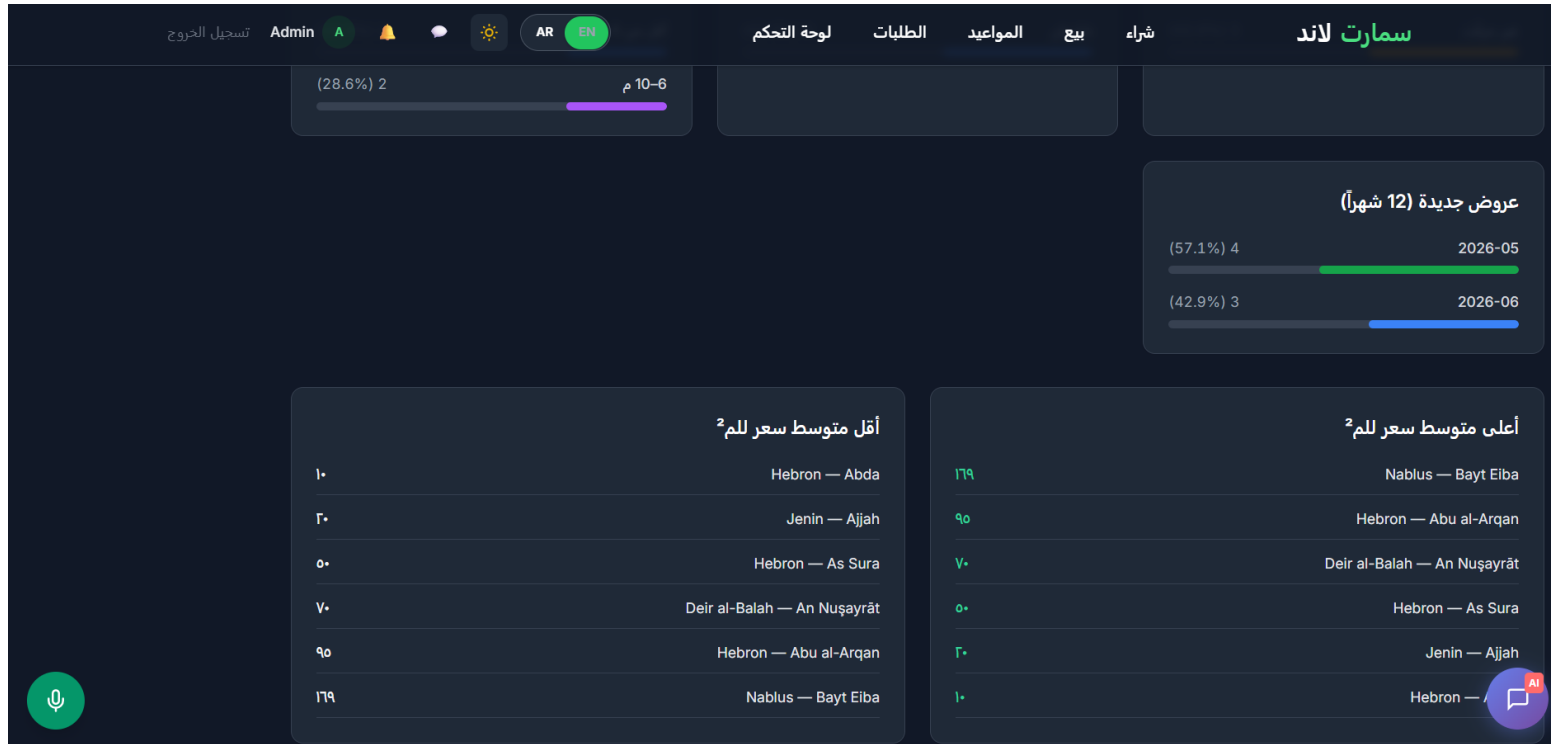


Figure 35:admin5

Multilingual Support: The entire platform supports both Arabic and English languages. Interface content is translated dynamically, while layout direction automatically switches between RTL and LTR modes to ensure a seamless user experience for both language groups.

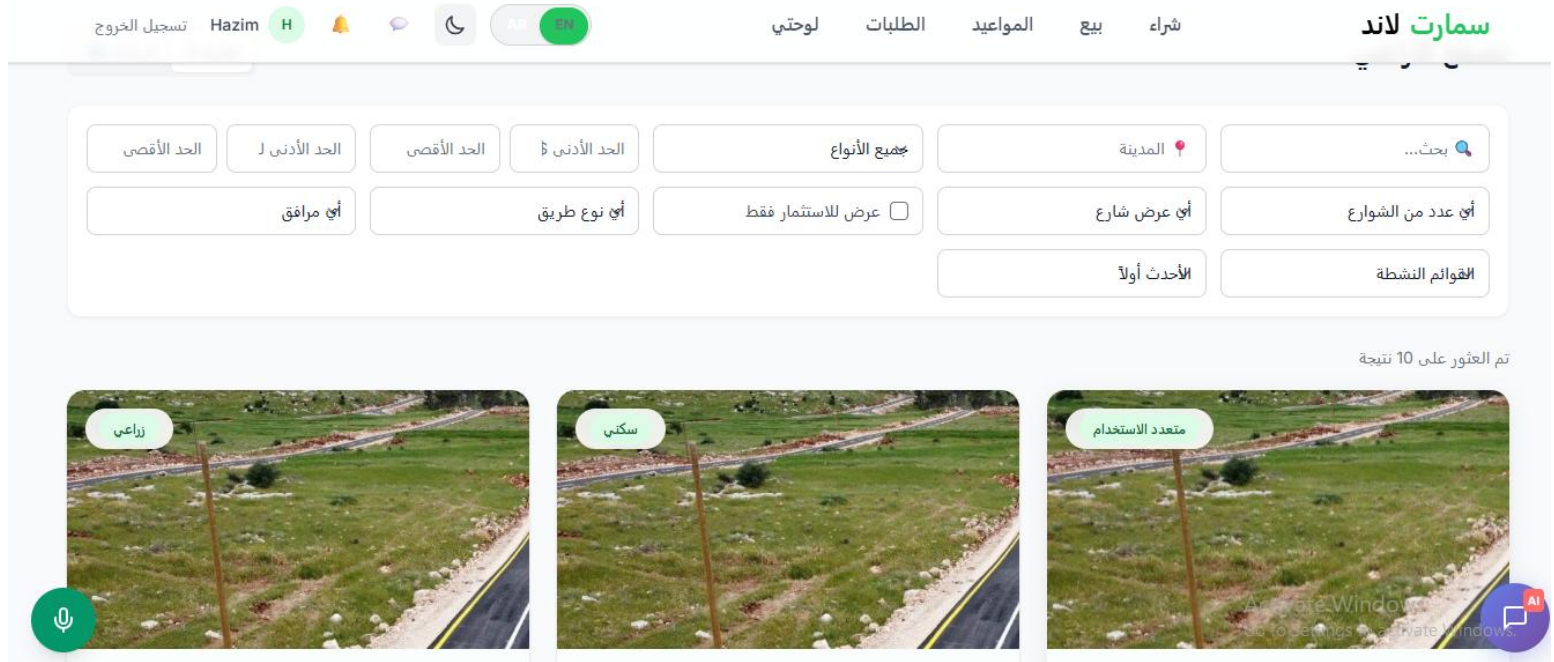


Figure 36:ar

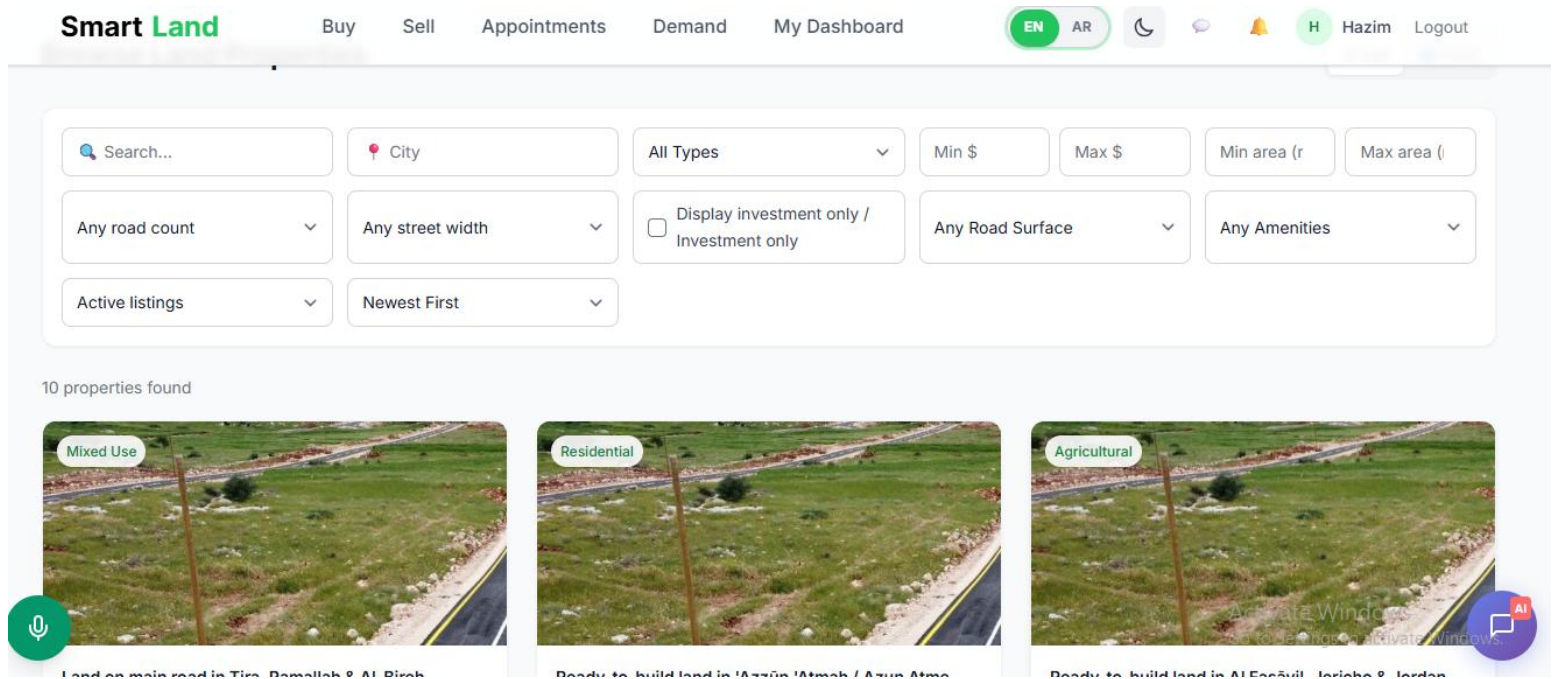


Figure 37:en

Responsive Design: The platform is fully responsive and optimized for desktop, tablet, and mobile devices, providing a consistent and user-friendly experience across different screen sizes and operating environments.

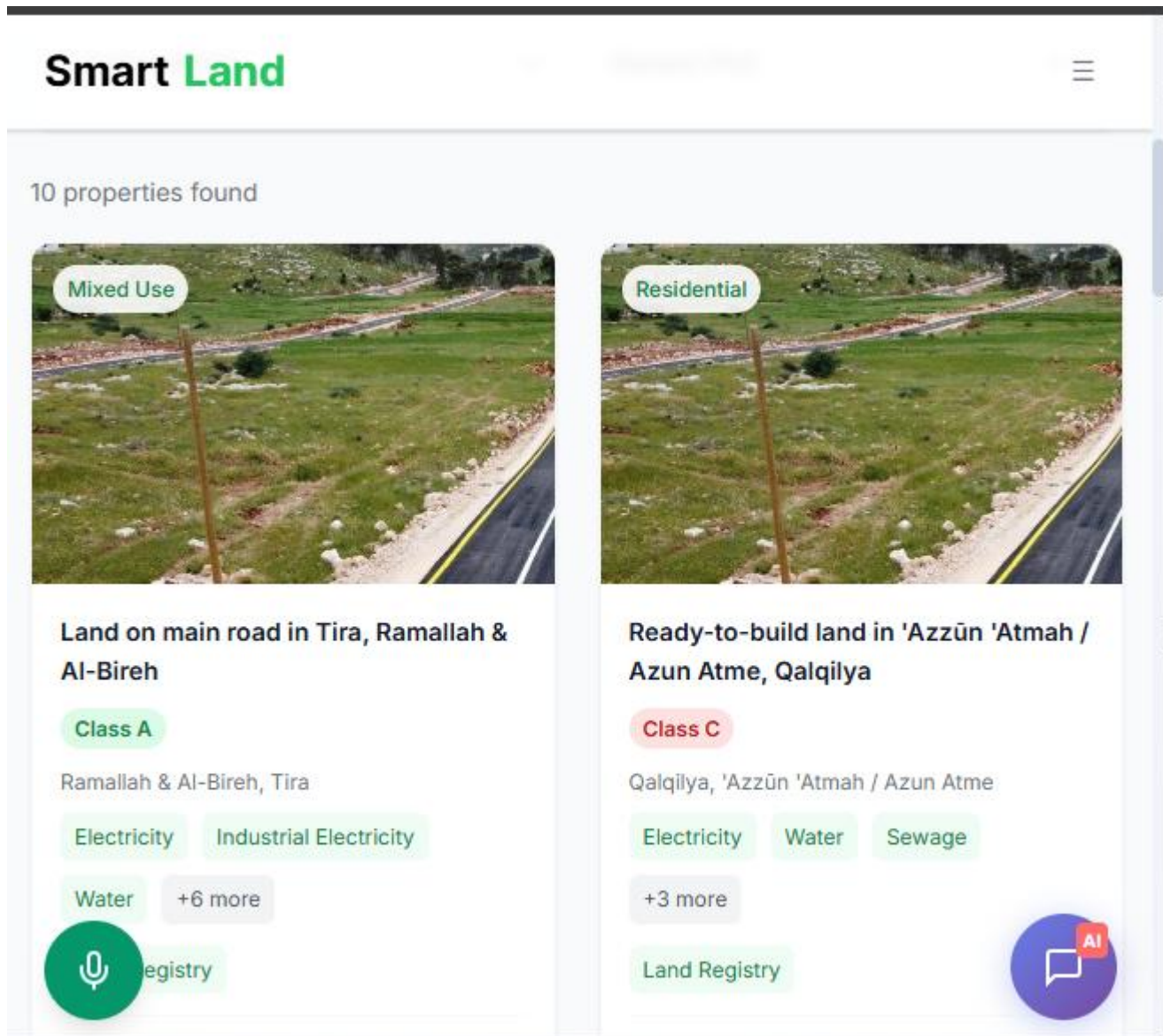


Figure 38:res

Database Results

The implemented database schema consists of 32 tables with a total of 161 columns across all tables.

Foreign key constraints with cascading deletes maintain referential integrity.

106 indexes (beyond primary keys) were created on frequently queried columns to ensure query performance as data volume grows.

The properties table implements a soft-delete pattern (is_deleted flag) so that related appointments and messages remain intact after a listing is removed. The notifications table uses a polymorphic reference pattern (reference_id and reference_type) to serve all event types from a single table without requiring separate notification tables per entity type.

API Endpoint Coverage

The API comprises 87 endpoints across 23 route modules.

All endpoints return responses in a consistent JSON envelope format. Protected endpoints were tested with valid tokens (expected success), expired tokens (expected 401), and tokens belonging to users with insufficient

roles (expected 403). All access control behaviors performed as designed.

Endpoints supporting list operations implement pagination with configurable page size (maximum 50 items per page) and return total count and page metadata in the response envelope to support client-side pagination UI.

Discussion

Achievement of Objectives

Most of the primary objectives defined in Chapter 1 were successfully achieved.

The platform delivers a functional end-to-end land marketplace experience covering property listing and discovery, real-time communication, appointment scheduling, legal consultation services, voice-assisted interactions, and administrative management.

The identity verification objective was partially implemented. During the development phase, a fully automated identity verification system was

investigated; however, implementing such functionality would require access to official governmental databases and verification services, which were not available within the scope of this project. As a result, automatic identity validation could not be completed.

Instead, the platform adopts a manual verification process. Users are required to upload identification documents during registration, and platform administrators review these documents manually before granting verified status. This approach ensures a practical level of trust and security while remaining compliant with the technical and legal constraints of the project. Although manual verification requires administrative oversight, it provides a reliable mechanism for confirming user identities in land-related transactions without relying on external government systems.

Technical Observations

The real-time communication system performed reliably during testing across multiple concurrent browser sessions. The messaging infrastructure enabled seamless communication between buyers, sellers, lawyers, and administrators. WebSocket-based communication provided instant message delivery, while automatic reconnection mechanisms successfully handled temporary network interruptions without requiring user intervention.

The interactive map integration proved highly effective for land discovery and

visualization. Using Leaflet and OpenStreetMap, users were able to explore available lands through an intuitive map interface, while sellers could accurately specify property locations using map-based coordinate selection. Testing showed that map-based location selection was significantly more user-friendly than manually entering geographic coordinates.

The multilingual implementation successfully supported both Arabic and English languages throughout the platform. Dynamic language switching allowed users to change the interface language instantly while automatically adapting the layout direction between RTL and LTR modes. Although achieving complete language consistency required careful management of translations and styling, the final implementation provided a smooth bilingual user experience.

The voice assistant emerged as one of the platform's most innovative features.

Users were able to search for lands using natural language voice commands, while sellers could manage their availability schedules through spoken instructions.

Testing demonstrated that voice-based interactions reduced the number of steps required to perform common tasks and improved overall usability.

The appointment scheduling system effectively coordinated interactions between buyers and sellers. Sellers could define available time slots, while buyers could request property visits directly through the platform. The approval and notification workflow functioned reliably and streamlined the property viewing process.

The legal services module introduced an additional layer of trust and professionalism to the platform. Users were able to request legal consultations and authorize lawyers to assist with property transactions. Lawyers could monitor cases, provide guidance,

and support users throughout the purchasing process.

Security measures performed effectively during testing. JWT-based authentication, role-based authorization, protected API routes, and rate limiting mechanisms helped prevent unauthorized access and abuse while maintaining a smooth experience for legitimate users. The administrative verification workflow further enhanced trust by ensuring that user identities and platform activities were reviewed when necessary.

Overall, the platform successfully combines property management, intelligent search, voice interaction, legal assistance, real-time communication, and multilingual support within a single integrated ecosystem, providing a comprehensive solution for modern land marketplace operations.

Limitations

The current implementation has the following limitations that represent opportunities for future improvement:

1. The platform currently relies on web-based notifications and Telegram announcements. Although users receive notifications within the platform, dedicated email notifications and mobile push notifications have not yet been implemented. Adding these communication channels would improve user engagement and ensure that important updates are received even when users are offline.
2. The AI assistant is currently powered by a locally hosted language model through Ollama. While it successfully assists users with property discovery and platform-related queries, its capabilities can be further enhanced through larger models, improved training data, advanced memory mechanisms, and deeper integration with platform services.
3. Geographic search functionality is currently limited to map-based browsing and location filtering. Future versions could implement proximity-based search, allowing users to discover properties within a specified radius of a selected location using advanced spatial querying techniques.

4. The platform does not currently support online payments, escrow services, or digital contract signing. Property transactions and legal procedures are completed outside the platform. Integrating secure payment and transaction management services would further streamline the buying process.
5. Identity verification is currently performed manually by platform administrators. A fully automated verification process could not be implemented because it would require integration with official governmental identity verification systems. Future collaboration with authorized government services could enable automated identity validation and further strengthen platform security.
6. The current Telegram integration focuses on automatically publishing approved land listings. Future versions could expand this functionality by introducing an interactive Telegram bot that allows users to search for properties, receive recommendations, and interact with platform services directly through Telegram.
7. The voice assistant currently supports property search and availability management. Future enhancements could allow users to perform additional actions through voice commands, such as creating land requests, booking appointments, contacting lawyers, and navigating the platform entirely through voice interaction.

Conclusion, Recommendations and Future Work

Conclusions

The Smart Land Marketplace Platform successfully demonstrates that a modern, feature-complete real estate marketplace platform can be built using open-source JavaScript technologies (React.js, Node.js, MySQL, Socket.io) as a graduation-level project. The delivered platform includes:

- A complete user lifecycle from registration with identity verification through to property listing, buyer discovery, real-time communication, and appointment scheduling.
- A layered security architecture implementing JWT authentication, role-based access control, input validation, SQL injection prevention, XSS sanitization, and rate limiting.
- A real-time communication layer supporting instant messaging with typing indicators and read receipts, as well as a persistent notification system with WebSocket delivery.

- A bilingual English/Arabic interface with full RTL layout support, demonstrating that internationalization can be implemented as a first-class feature rather than an afterthought.
- An administrative system enabling content moderation and identity document review, which are essential for a trusted marketplace in the Palestinian context.

The project demonstrates the integration of knowledge from software engineering, database design, network programming, security, and UI/UX design — reflecting the comprehensive technical education provided by the program.

Recommendations for Future Work

The following directions are recommended for the continued development and enhancement of the SmartLand Marketplace:

1. **Advanced AI Assistant:** Enhance the existing AI assistant by integrating larger language models, long-term conversation memory, personalized recommendations, and deeper platform integration. Future versions could assist users with investment analysis, property valuation, and intelligent decision support.

2. **Automated Identity Verification:** Collaborate with authorized governmental or third-party verification services to automate identity validation. This would reduce administrative workload while increasing trust and security within the platform.
3. **Online Payments and Digital Transactions:** Implement secure payment gateways, escrow services, and digital contract signing capabilities to facilitate end-to-end property transactions directly through the platform.
4. **Advanced Geographic and Spatial Search:** Introduce proximity-based search and advanced GIS functionality, allowing users to locate properties within specific distances from landmarks, cities, universities, or custom geographic points.
5. **Enhanced Voice Assistant Capabilities:** Expand the voice assistant beyond property search and availability management. Future versions could support appointment booking, legal consultation requests, land demand creation, profile management, and complete voice-driven navigation of the platform.
6. **AI-Powered Property Valuation:** Develop machine learning models capable of estimating land values based on location, area, market trends, and historical data, helping buyers and sellers make informed decisions.
7. **Intelligent Recommendation Engine:** Implement advanced recommendation algorithms that analyze user preferences, browsing behavior, search history, and market trends to provide personalized property suggestions.
8. **Government and Land Registry Integration:** Integrate with official land registration authorities and government services to simplify ownership verification, document validation, and legal transaction procedures.

These future developments would further strengthen SmartLand Marketplace as a comprehensive digital ecosystem for land transactions, legal services, intelligent property discovery, and modern real-estate technology solutions.

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