

A Smart Information Gateway to Support Businesses in an Giang Province

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Abstract

In recent years, digital transformation—comprehensive changes in lifestyle, work methods, and production processes based on digital technologies—has become a key focus in policies and regulations. An Giang province has gradually implemented digital transformation in its political system, developing e-government and reforming administrative procedures. The project "Building an intelligent information gateway to support digital transformation for small and medium-sized enterprises in An Giang province" aims to enhance the digital capabilities of local businesses. Through this website, businesses can update their digital transformation status, receive expert evaluations, and obtain recommendations for improvement. This initiative provides a clear overview of the digital transformation landscape, aiding both businesses and provincial leaders in monitoring progress and planning future development.

Keywords: Level Of Digital Transformation, Enterprise Data, Smart Information Gateway

INTRODUCTION

Building an intelligent digital transformation gateway for small and medium-sized enterprises in An Giang province has been a priority for the province in recent years. Digital transformation is unprecedented, so the correct perception is crucially challenging. The accurate perception of digital transformation must be placed within the specific context of an organization. Digital transformation is a matter of perception, not just a technological issue, it's about whether leaders dare to do it or not [1]. Therefore, focusing on building this system meticulously is an inevitable and urgent trend.

This intelligent information gateway is not only a means to monitor the digital transformation of businesses in the province but also a tool to manage the digital transformation information of enterprises. It helps businesses understand and evaluate the digital transformation status at each stage. Moreover, the gateway also has an analysis system for digital transformation needs according to the types of businesses, sending them to experts, business associations, and similar businesses. This helps businesses enhance their learning ability, regulate, and adapt to changes to foster development. At the same time, it helps the provincial business association have a comprehensive view of the business situation in the province, thereby proposing solutions to enhance economic and social development. The contributions of this article include:

- The information system and database are based on data collected through digital transformation training sessions in the province. Currently, there are over 320 samples of small and medium-sized enterprises in the province.
- The analysis system of business needs is based on Wit AI. This is a powerful NLP platform for building chatbots and virtual assistants through natural language.

RELATED WORKS

In recent years, digital transformation has been receiving significant attention and development from many countries around the world and within the region. The occurrence of the Covid-19 pandemic has underscored the essential nature of this trend. In fact, digital innovations that might have unfolded over the next 10-20 years have been "compressed" in the past two years. In this context, many businesses that are quick and astute in digital transformation have created a very clear gap with those businesses that have been slow or have not yet

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embarked on the digital transformation journey [2].

Specifically, according to a survey by Accenture in 2021, if the gap in growth rate between leading companies (Leaders) and lagging companies (Laggards) was only 2 times in 2019, by 2021, that gap had increased to 5 times. It can be observed that businesses that are adept at implementing advanced technology earlier have the opportunity to make greater strides, keeping pace with development trends, and generating additional new value [2].

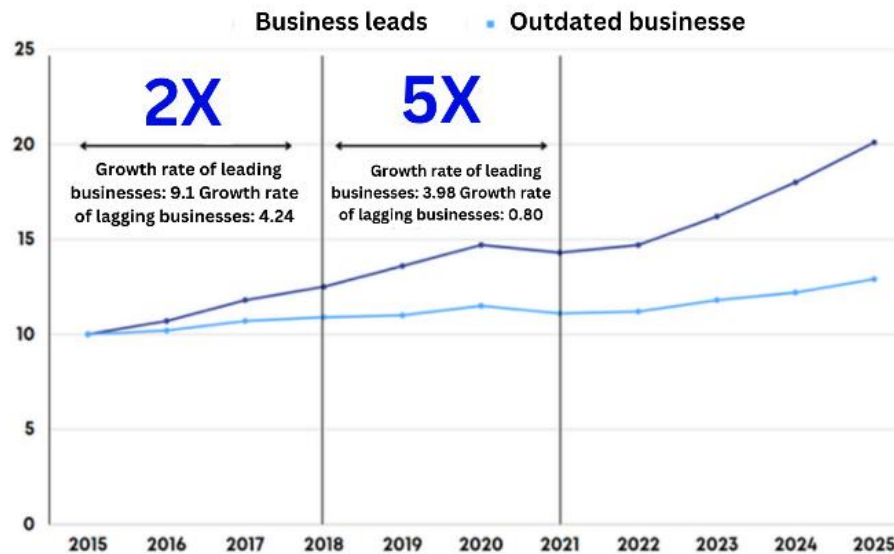


Figure 1 : The gap in growth rate is increasingly widening between leading companies and lagging companies.

As for the situation domestically, Vietnam has implemented the National Digital Transformation Plan until 2025 to promote the application of digital technology and improve the efficiency of both public and private sectors. Provinces have established Digital Transformation Steering Committees and issued resolutions, programs, and plans for a five-year period, demonstrating political determination to achieve the goals set by the Prime Minister.

In An Giang province, the digital transformation situation in 2023 has seen significant progress in the fields of agriculture, construction industry, and trade and services. The information gateway is predicted to be the most effective means of monitoring issues related to digital transformation of businesses in an online environment. It provides many practical and essential benefits for businesses, including:

- Digital transformation news viewing function: This is where businesses can regularly and continuously update information on digital transformation within and outside the province. It helps businesses gain an overview and detailed understanding of the digital transformation situation, thereby making appropriate adjustments according to the overall situation.
- Digital transformation forum function: A platform where businesses can post their needs. The system is capable of identifying the types of needs analyzed according to the type of business. Subsequently, notifications are sent to businesses and experts in the relevant field.
- Business information management function includes: Detailed information of the enterprise (Enterprise information, enterprise representative, enterprise account), the digital transformation readiness of the enterprise (Strengths, weaknesses of the enterprise through self-assessment of the degree of digital transformation), posting products of the enterprise (Promoting product information of the enterprise on multiple platforms: Information portal, Facebook, etc.).

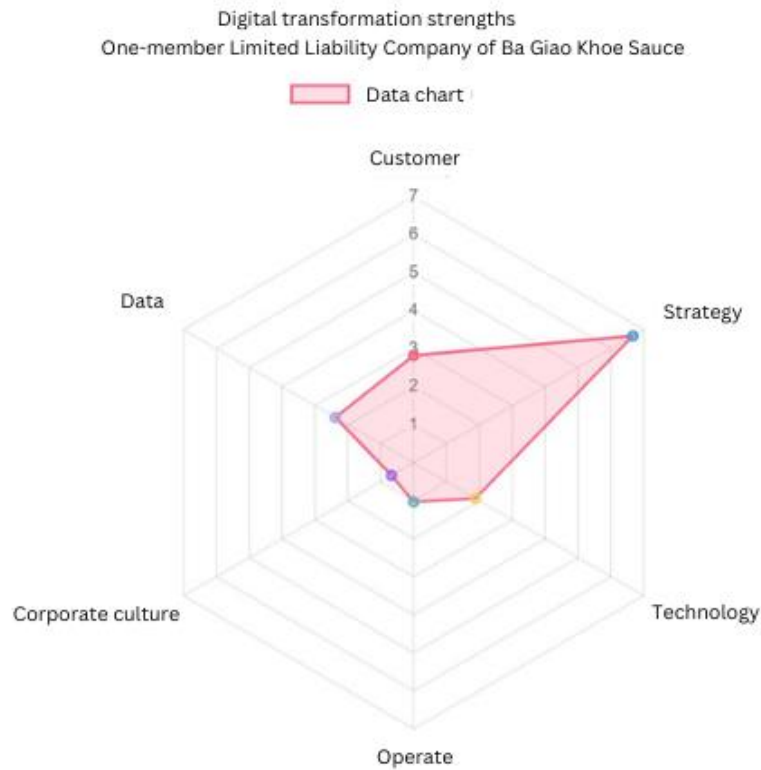


Figure 2 : The chart illustrates the strengths and weaknesses of the business.

- Message with experts: Exchange information, experiences on digital transformation with experts in the same field as the business.

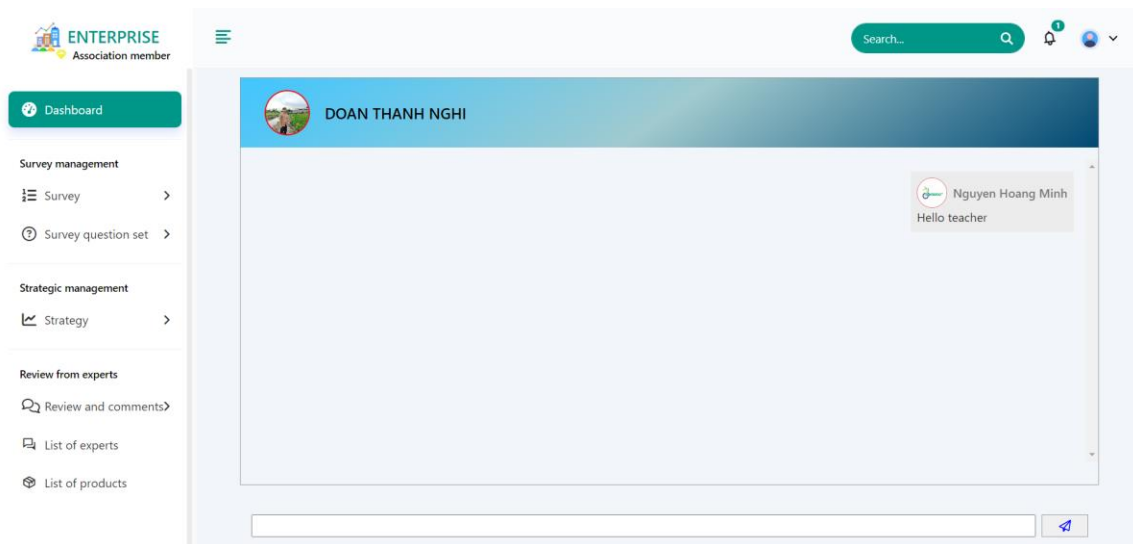


Figure 3 : The function of messaging with the business's experts.

- Function to assess the digital transformation level of the business: This can be considered the main function of this information gateway. Through these surveys, businesses will have a visual understanding of the readiness level for digital transformation. From there, there can be new steps in digital transformation in the future

In addition to businesses, experts will also have some specific functions such as: Viewing the list of

businesses, viewing the digital transformation level of each business, providing evaluations of the surveys conducted by businesses, proposing solutions for business development through surveys conducted by businesses, messaging with businesses.

Business associations will be the highest-capacity user group, as they will have rights to:

- Manage general information of the information gateway such as News, business and expert accounts, videos, digital transformation libraries, digital transformation forums, Commenting on news, etc.
- Grant accounts to businesses
- Statistics of surveys conducted by businesses
- Statistics of the number of businesses, accounts in the system, ...

MATERIALS AND METHOD

Business Digital Transformation Information Gateway

The data model for the readiness level of digital transformation of businesses is built based on the national model of digital transformation stages with 6 main pillars and 6 levels of digital transformation from 0 to 5 (Not digitalized to leading).



Figure 4 : 6 main pillars of business digital transformation.



Figure 5 : 6 levels of business digital transformation.

This information gateway is built based on the synthesis method, collecting document information: Some information about the current status of information technology application of small and medium-sized enterprises in An Giang province has been collected during digital transformation training sessions in the province. Therefore, initially, the research team will collect, synthesize, and analyze statistical data based on these documents.

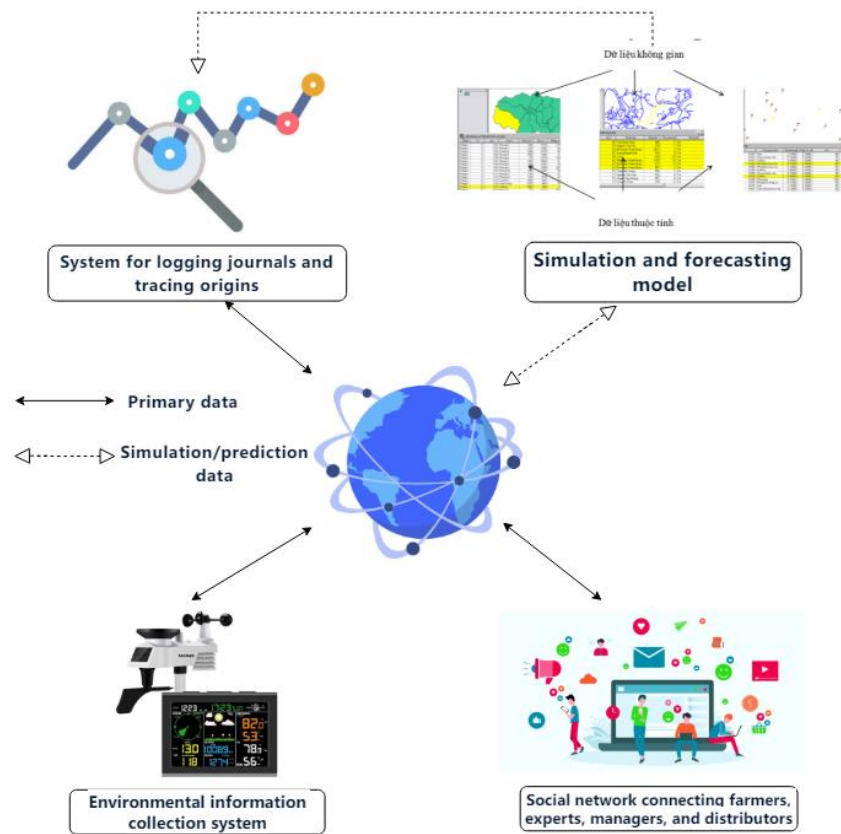


Figure 6 : The process of collecting business information.

Object-Oriented Analysis & Design (OOAD) involves focusing on user needs, represented through the construction of use case diagrams, to designing the database and processing, creating software, using, testing, and maintaining the software.

The information system is developed based on a three-layer architecture (MVC) for easy management of system components, changing functional modules, and enhancing data security.

Identification and authentication: Using user input methods for identification information such as user accounts, passwords. Specifies the complexity of passwords such as password length, the number of special characters required in the password.

Access control: Identifying a list of system access permission groups and granting permissions to user groups. Permission groups are determined at the system account level, permissions at the object level in the database have mechanisms to allow multiple users to access simultaneously.

Business Needs Analysis System by Business Type

1) Wit.ai Platform

This needs an analysis system is developed based on the Wit.ai Platform. Wit.ai operates based on a natural language processing (NLP) workflow to understand and respond to user requests. Below is a basic description of how Wit.ai works:

- Intent Recognition
- Entity Extraction

- Model Training
- Response

This process enables Wit.ai to interact naturally and intelligently with users, providing a flexible and powerful conversational interface. It's an ongoing process that improves over time as more data is gathered from users.

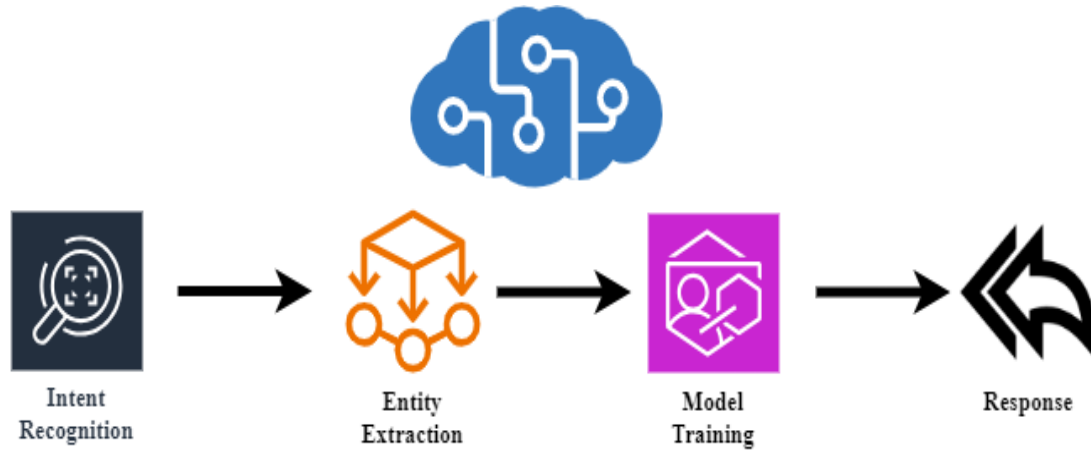


Figure 7 : The operation method of Wit.ai.

This is a detailed description of how each stage of Wit.ai operates:

*** Intent Recognition of Wit.ai** operates based on the following steps:

- Command Analysis: When a user inputs a command, Wit.ai analyzes the structure and wording to determine keywords and context.
- Intent Recognition: Based on the analysis, Wit.ai identifies the main intent the user wants to convey. Intents can be identified by comparing them with a list of keywords or using text classification methods such as bag of words or word embedding like word2vec.
- Using Stories: Wit.ai utilizes pre-defined stories to determine how to handle intents and entities. Each story represents a specific interaction scenario between the user and the bot.
- Confidence Rating: Wit.ai evaluates the confidence level of intent classification based on the match between the user's command and the training data. If the confidence level is high, the intent will be accepted.
- Handling Missing Information: If there is missing information in the command, Wit.ai can use branching to request additional information from the user or use existing context to fill in the gaps.

This process helps Wit.ai understand and accurately respond to user requests based on natural language.

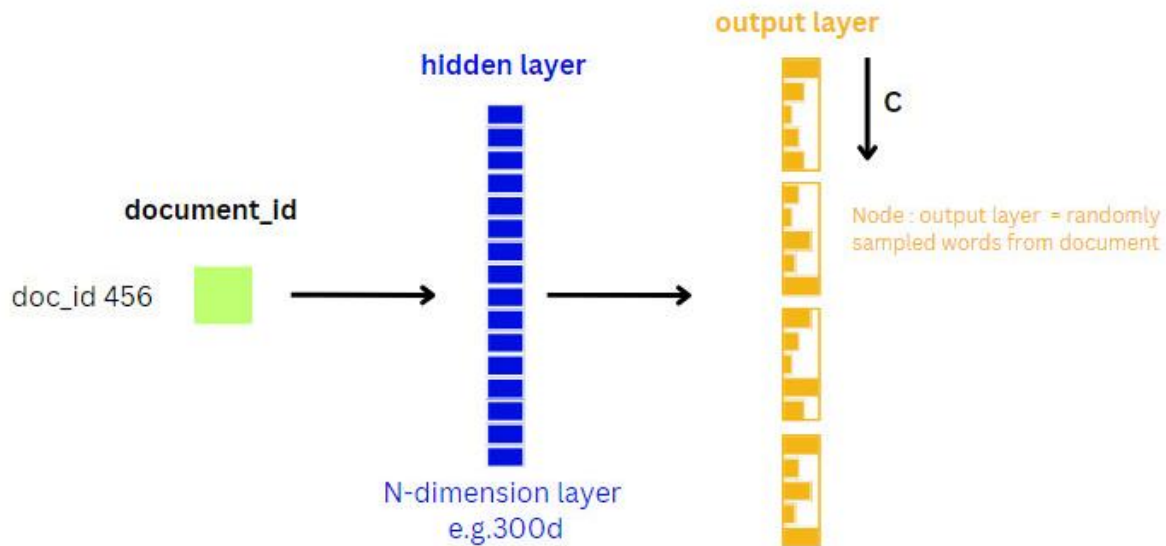


Figure 8 : The operational mechanism diagram of the Bag of Words model (BOW)

BOW Representation

Representing the sentence, "it is the best of the best"

it is the best of a an

[1 .1 .1 .1 .1 .0 .0]

(only the words present in the document are activated)

(or)

[1 .1 .2 .2 .1 .0 .0]

(the word count is taken into consideration instead of activation)

Figure 9 : Example illustrating representations of the BOW model.

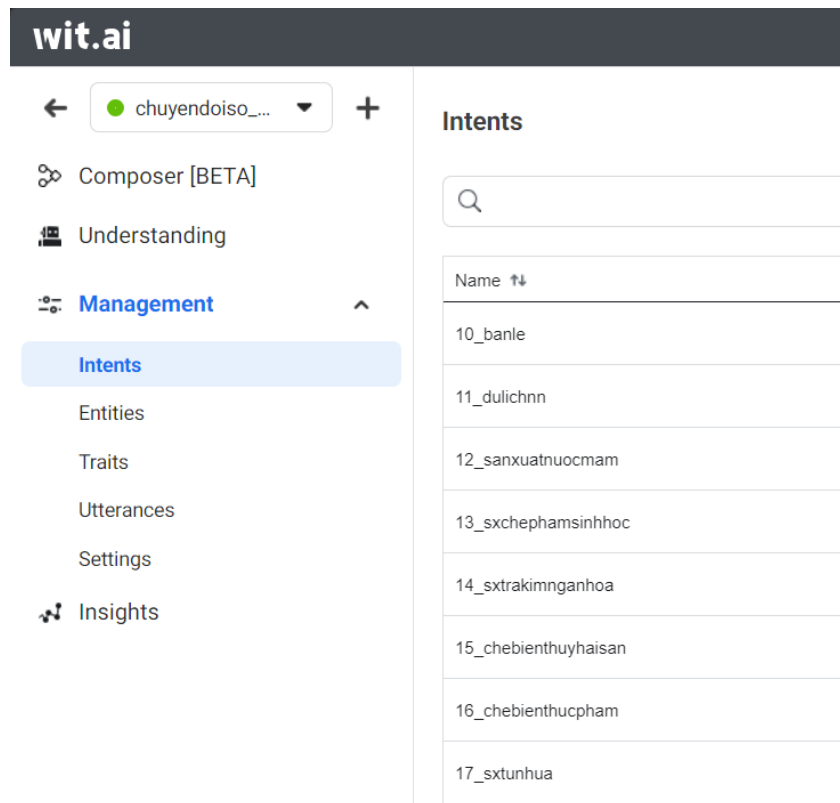
*** The Entity Extraction process of Wit.ai** operates as follows:

- Sentence Analysis: When the user inputs a sentence, Wit.ai analyzes the structure and language to identify keywords and context.
- Entity Identification: Based on the analysis, Wit.ai identifies the entities within the sentence. Entities can be names, dates, quantities, locations, etc.
- Using Duckling Library: Wit.ai utilizes the Duckling library to extract information from the text. Duckling is an open-source library, and you can learn more about the algorithm in this library.

To implement this AI into the business's needs analysis system, the following steps are taken:

2) Data Preparation

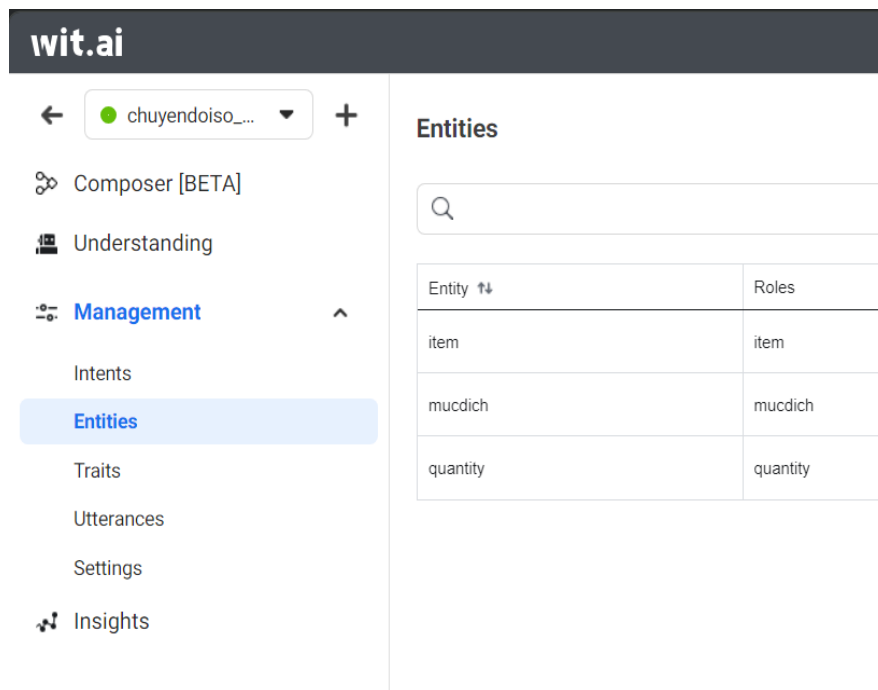
The training data includes Intents with 12 datasets representing different types of business activities. We input all these types into the Intent section of Wit.ai. Each type has a separate intent.



The screenshot shows the Wit.ai web interface. On the left is a sidebar with navigation options: Composer [BETA], Understanding, Management (selected), Intents (highlighted), Entities, Traits, Utterances, Settings, and Insights. The main area is titled 'Intents' and contains a search bar and a table of intent names.

Name ↑↓
10_banle
11_dulichnn
12_sanxuatnuocmam
13_sxchephamsinhhoc
14_sxtrakimnganhhoa
15_chebienthuyhaisan
16_chebienthucpham
17_sxtunhua

Figure 10 : Intent dataset for classifying needs.



The screenshot shows the Wit.ai web interface with the 'Entities' section selected in the sidebar. The main area is titled 'Entities' and contains a search bar and a table of entity names and their roles.

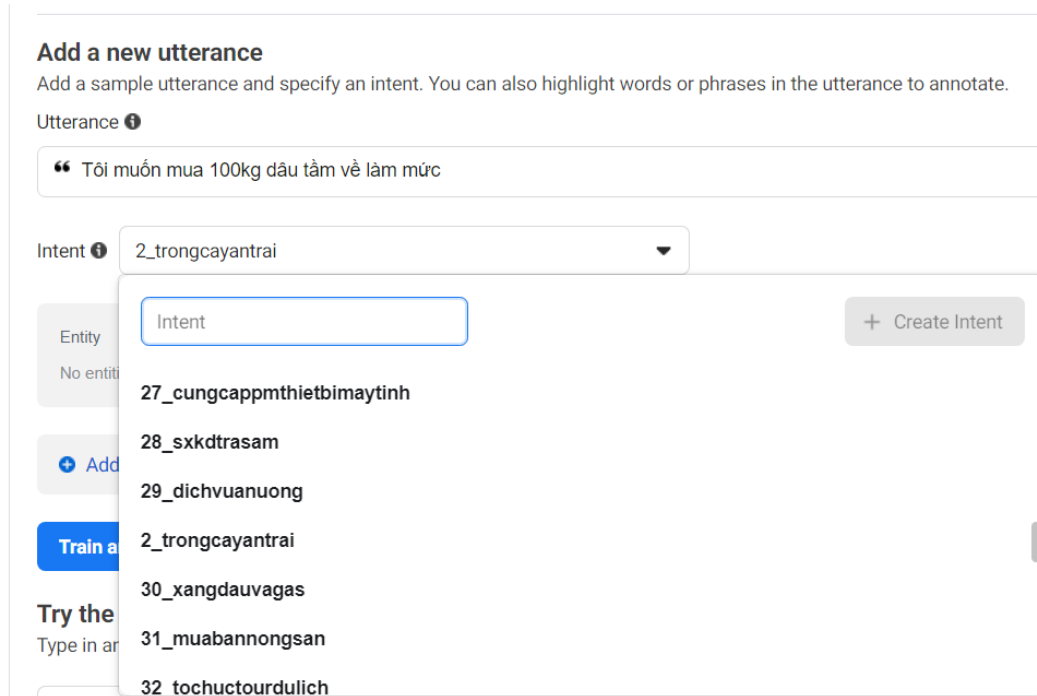
Entity ↑↓	Roles
item	item
mucdich	mucdich
quantity	quantity

Figure 11 : The dataset of entities analyzed.

3) The training method of Wit.ai

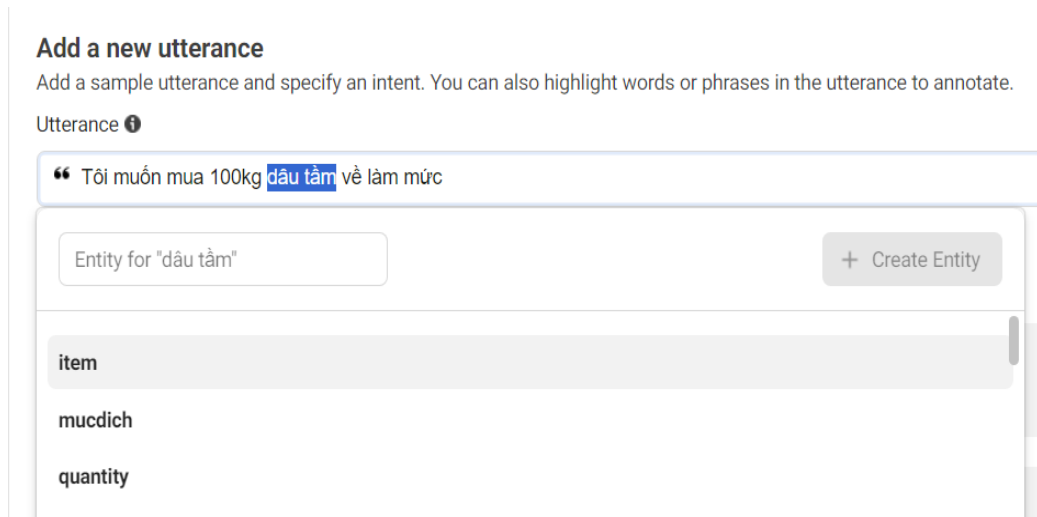
Wit.ai employs a training method based on interaction and feedback from users. There are two main ways to train a Wit.ai application:

Training through the web interface: Users can add utterances and define intents and entities through the Wit.ai web interface. This helps the system understand how users express themselves and thereby improves its natural language understanding capabilities.



The screenshot shows the 'Add a new utterance' form in the Wit.ai interface. The 'Utterance' field contains the text 'Tôi muốn mua 100kg dầu tằm về làm mứt'. The 'Intent' dropdown menu is open, displaying a list of intents: '2_trongcayntrai', '27_cungcappmthietbimaytinh', '28_sxkdtrasam', '29_dichvuanuong', '2_trongcayntrai', '30_xangdauvagas', '31_muabannongsan', and '32_tochuctourdulich'. A 'Create Intent' button is visible in the top right of the dropdown menu.

Figure 12 : Training Wit.ai according to business needs (Intent).



The screenshot shows the 'Add a new utterance' form in the Wit.ai interface. The 'Utterance' field contains the text 'Tôi muốn mua 100kg dầu tằm về làm mứt'. The 'Entity' dropdown menu is open, displaying a list of entities: 'item', 'mucdich', and 'quantity'. A 'Create Entity' button is visible in the top right of the dropdown menu.

Figure 13 : Training entities data based on business needs.

Figure 14 presents when newly trained with a new dataset, the confidence level will be N/A as it is new data not yet included in the trained database.

Add a new utterance
Add a sample utterance and specify an intent. You can also highlight words or phrases in the utterance to annotate.

Utterance ⓘ

“ Tôi muốn mua 100kg **đầu tâm** về làm mức ” 243

Intent ⓘ 2_trongcayntrai ☐ Out of Scope ⓘ

Entity	Role	Resolved value	Confidence	
quantity	quantity	100kg	N/A	×
item	item	đầu tâm	N/A	×

+ Add Trait

Train and Validate

Figure 14 : Training results of a dataset with Intent and Entities.

Training through API: Wit.ai provides an API that allows users to automatically add training data and update their models. This is useful for handling large amounts of data or integrating the training process into other automated systems.

Additionally, Wit.ai also supports the use of built-in entities and allows users to create their own custom entities. The training process involves analyzing utterances, determining intents and entities, and then testing to ensure that the model can understand and respond accurately.

The ability to recognize business needs will be more intelligent if the training dataset is larger and more realistic.

wit.ai Docs Help pha

← chuyendoiso... +

Composer [BETA]

Understanding

Management ^

Intents

Entities

Traits

Utterances

Settings

Insights

Utterances

Tìm kiếm...

“ bán 3 tấn chanh dây ” ▼ ×

“ Đang tìm kiếm bác sĩ chuyên khoa mới để gia tăng đội ngũ y tế. ” ▼ ×

“ Muốn tăng cường dịch vụ giao hàng để đáp ứng nhu cầu của khách hàng. ” ▼ ×

“ Cần mua 5000 con tôm giống để nâng cao sản lượng. ” ▼ ×

“ Muốn mua 200 cây giống cam sành để mở rộng diện tích vườn cây. ” ▼ ×

“ cần mua 3 tấn thóc cho vịt ăn ” ▼ ×

“ Cần mua 1000 kg phân bón hữu cơ cho mùa vụ mới. ” ▼ ×

“ Cần thuê thêm nhân viên lễ tân để cải thiện dịch vụ tiếp khách ” ▼ ×

“ nhà em còn tồn 5 tấn dưa leo tươi cần bán ” ▼ ×

“ Đang tìm kiếm nguồn cung ứng thịt bò chất lượng cao để phục vụ món steak. ” ▼ ×

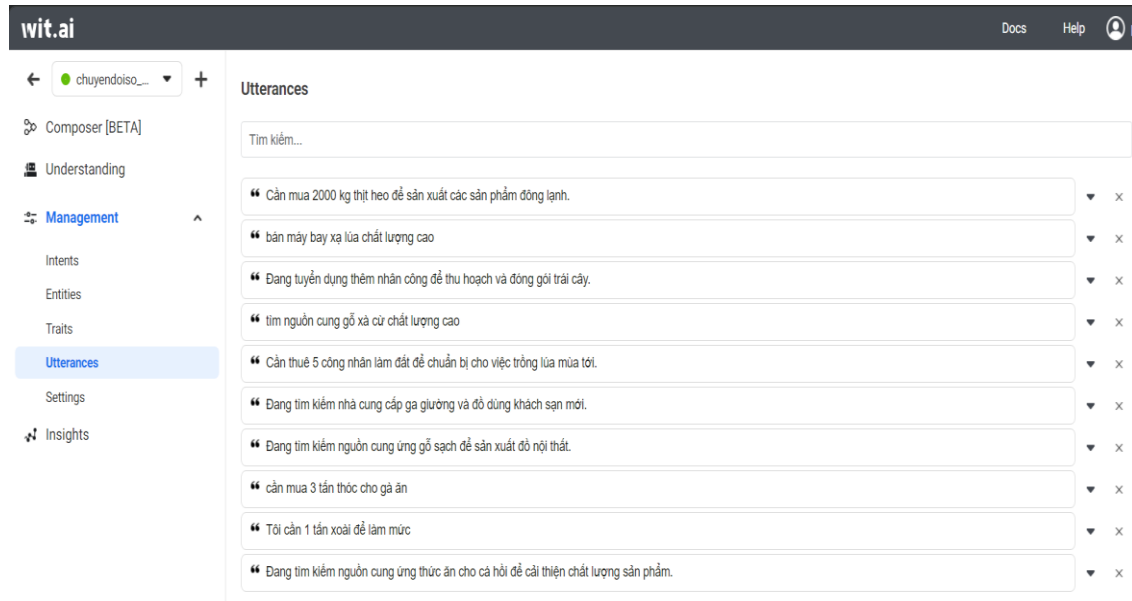


Figure 15 : Example of training dataset for Wit.ai.

4) Results of training Wit.ai

Figure 16: After analyzing the trained dataset (Utterances), the result identifies 2 entities (Quantity and SanPham). The higher the confidence level, the more accurate the analysis of needs.

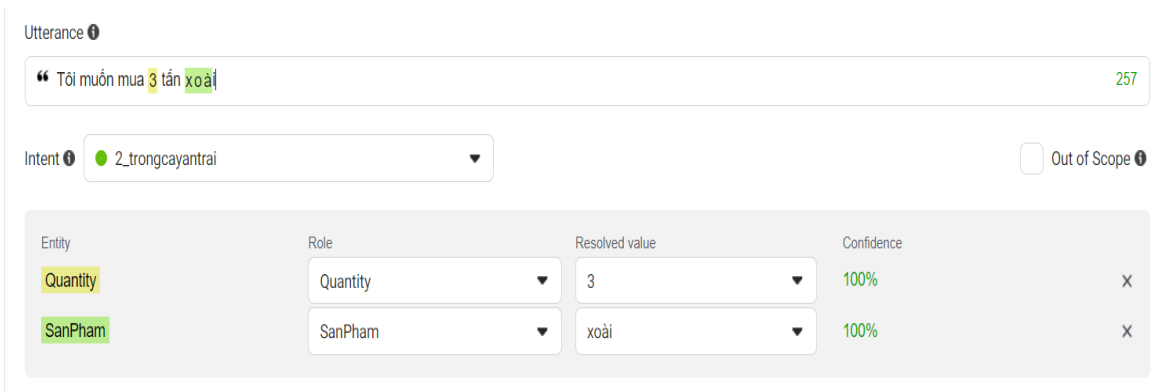


Figure 16 : The result when accessing an object with 100% confidence.

Figure 17: After training Wit.ai to understand "Mango" with 100% confidence, when searching for "Keo Mango," the confidence decreases to 88%. However, it still maintains enough confidence when it's above 75%.

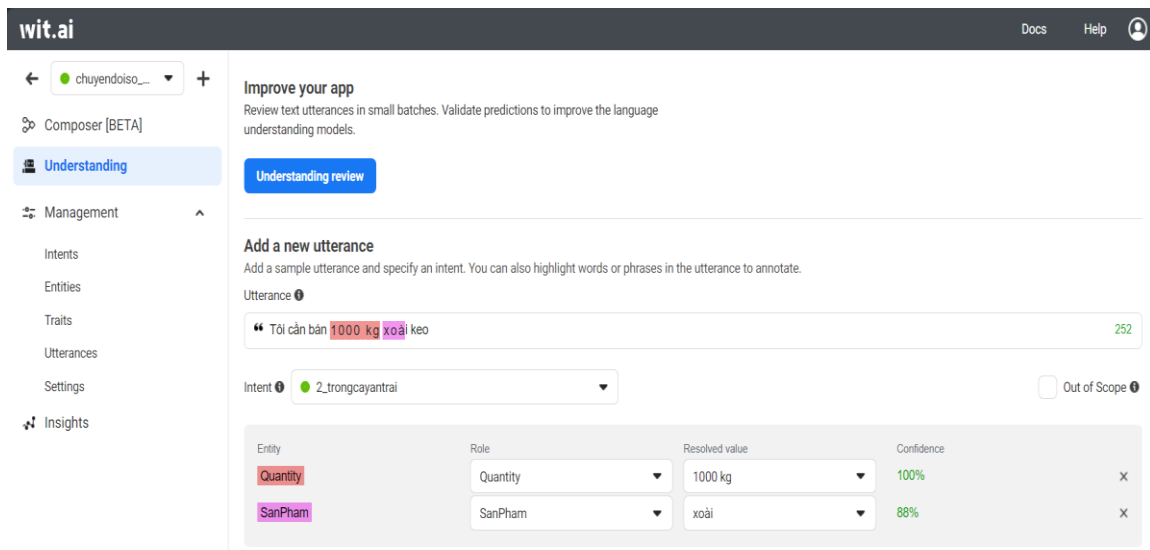


Figure 17 : Results when training multiple similar pieces of information.

5) Integrating Wit.ai into the digital transformation portal

```

class WitService
{
    1 reference | 0 overrides
    public function getIntentByMessage($message)
    {
        $witVersion = 20240508;

        $url = 'https://api.wit.ai/message?v=' . $witVersion . '&q=' . urlencode($message);

        $headers = [
            'Content-Type: application/json',
            'Authorization: Bearer ' . env('WIT_AI_API_KEY'),
        ];

        $ch = curl_init();

        curl_setopt($ch, CURLOPT_URL, $url);
        curl_setopt($ch, CURLOPT_POST, false);
        curl_setopt($ch, CURLOPT_HTTPHEADER, $headers);
        curl_setopt($ch, CURLOPT_RETURNTRANSFER, true);
        $reqsonse = curl_exec($ch);
        curl_close($ch);
        $response = json_decode($reqsonse);
        return $response->intents[0]->name;
    }
}

```

Figure 18 : Create a function to retrieve results from Wit.ai.

Figure 19: The results return with all necessary fields such as Entities, Intent, with a confidence level up to 0.9988 ~ 1 (100%).

```
{
  "entities": {
    "quantity:quantity": [
      {
        "body": "3 ký",
        "confidence": 0.999,
        "end": 12,
        "entities": {},
        "id": "335553779200673",
        "name": "quantity",
        "role": "quantity",
        "start": 8,
        "suggested": true,
        "type": "value",
        "value": "3 ký"
      }
    ]
  },
  "intents": [
    {
      "confidence": 0.9988754535456329,
      "id": "471124085589982",
      "name": "need_nongnghiep"
    }
  ],
  "text": "cân mua 3 ký lúa",
  "traits": {}
}
```

Figure 19 : Example illustrating a response from Wit.ai to the system.

6) *The results between the user and the wit.ai system*

The business logs into the system using their business account. Select the Demand Management section. Figure 20 shows the list of the business's demands.

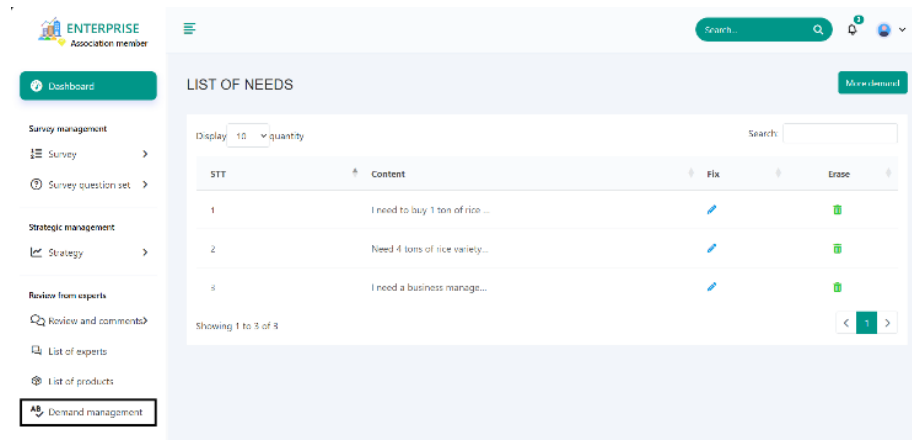


Figure 20 : List of Demand

Then, select Add Demand. On this page, the business can add its demand along with illustrative images.

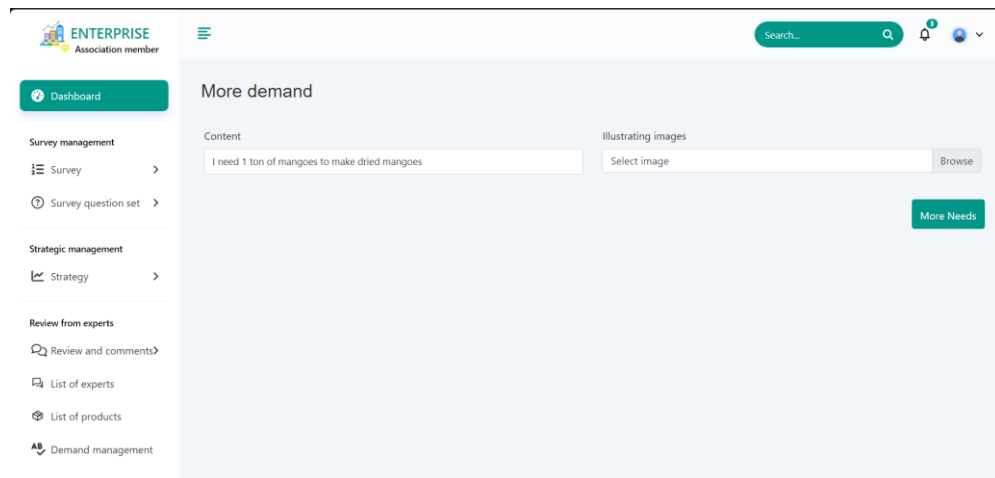


Figure 21 : Add Demand.

After the business posts its demand, the request will be sent to the wit.ai system. Wit.ai will analyze the request and then send the analysis results back to the Laravel server. The system will then send messages to businesses with the same type of demand that the business has added.



Figure 22 : Notify for the businesses.

EXPERIMENTAL RESULTS

The interface of the digital transformation information portal for businesses.

Figure 23 is the interface displaying detailed information of the latest news that users can view. This page includes functions such as viewing news, sharing news, and commenting on news.



Figure 23 : Interface of the detailed news information page.

Figure 24 is the system login page. There are two login methods here: logging in with a system account and logging in with a Google account.

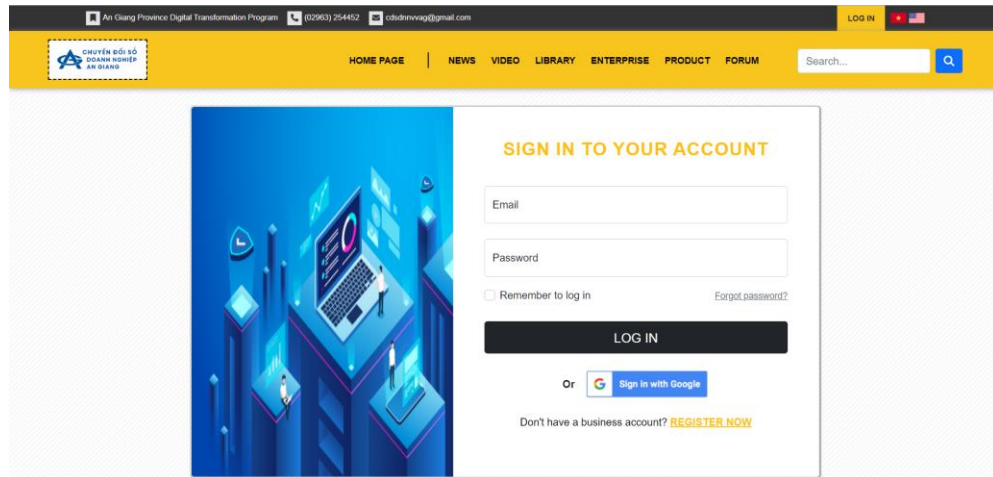


Figure 24 : Login page.

Figure 25 is the main interface when the business logs into its account, displaying data such as survey scores, strengths and weaknesses of the business in digital transformation, and the readiness level for digital transformation of the business.

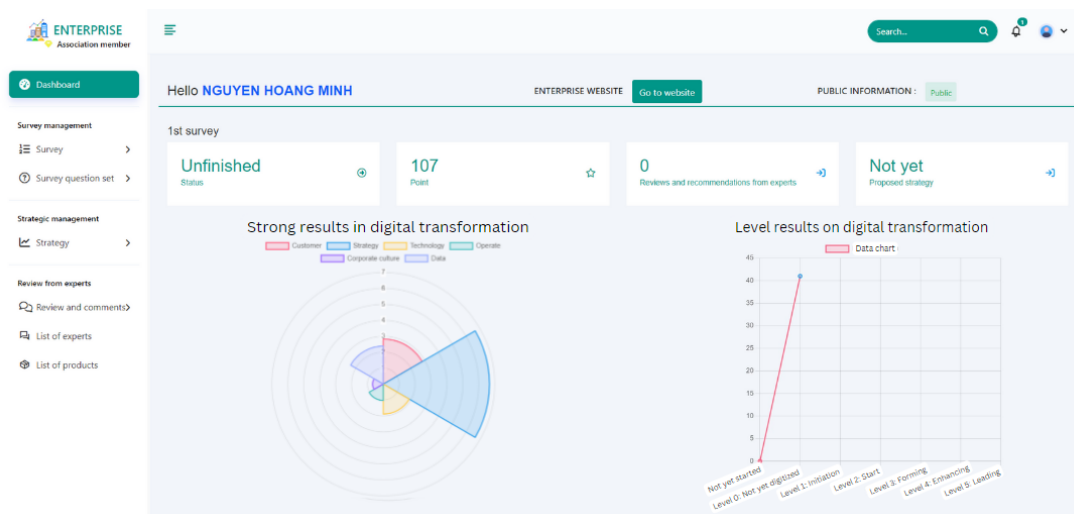


Figure 25 : Business dashboard.

Figure 26 is the business's product management page. The business can list its featured products here.

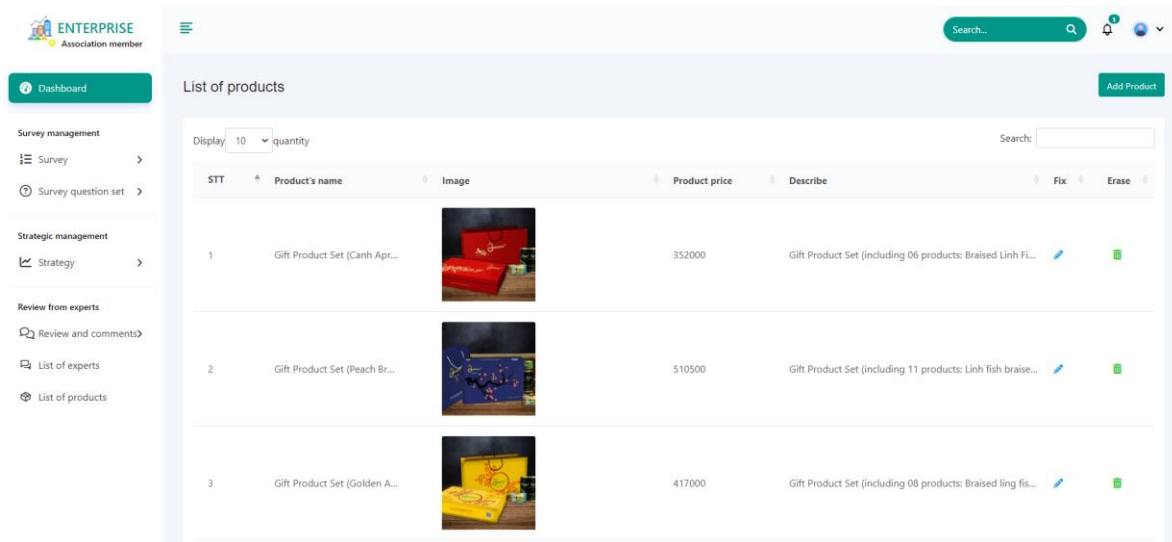


Figure 26 : The business's product management page.

Interface for business needs functionality.

Figure 27 is the business demand forum page. This is where businesses post their demands. The system will analyze these demands based on the type of business and then send notifications to businesses in the same field.

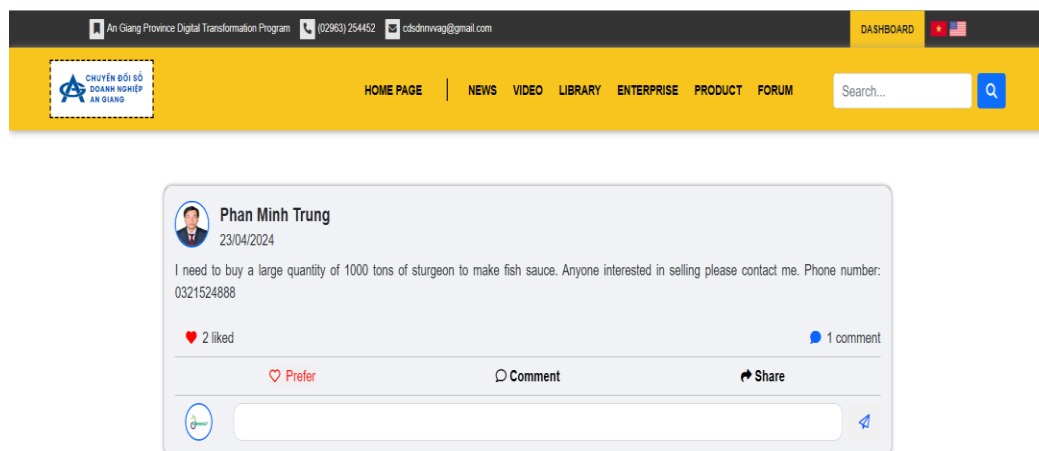


Figure 27 : The product demand of the business.

CONCLUSION AND FUTURE WORKS

The article has preliminarily presented the main functions of the Intelligent Gateway to Support Enterprises in An Giang province, particularly the business needs analysis function supported by the Wit.ai Platform. Currently, the business data is relatively moderate with nearly 300 businesses being members of the An Giang Business Association. However, there is an issue that the information for each business is still incomplete. Therefore, the accuracy of the business is not yet high. In the future, efforts will be made to collect more business information to complete the dataset. Additionally, regarding the function of needs analysis, since it has only been trained for a short time, it is not truly intelligent yet, and there are still many recognition errors. In the upcoming time, we will continue to train this function to improve its accuracy and effectiveness.

ACKNOWLEDGMENT

This research is funded by the People's Committee of An Giang province, Department of Science and Technology of An Giang under grant number “373.2023.06.”

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