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DEVELOPMENT OF AN WHEAT FARMING MANAGEMENT INFORMATION SYSTEM

Introduction. Ukraine is one of the world's leading exporter of wheat [1]. The country's export is more than 10% of the world wheat market [2]. Agriculture holdings and farm holds are dominates in Ukraine agriculture. Agriholdings managers are forced to make a lot of decisions during the season: what kind of seeds to choose; seed time; how to tend crops; what to do in dangerous situations; etc. Subjectivity in decision-making results in loss of third part of future profit while cropping cultivation. Another third part of the profit is loss while harvesting and transportation. These losses can be reduced by using an automated control system (Hi-Tech Management).

The wide range of implementation of information technologies in the agriculture business is contributing to the organization of competitive production. It also provides an opportunity to find modern technologies and methods of their implementation. IT is contributing to the development of business plans that show production problems and methods to solve them [3].

It means, that implementation of business processes automation that takes into account business specifics and takes care of providing information to users on all production levels is an objective prerequisite for a wheat farming focused business growth.

Objective of the work – to develop an information system, for management and effective functioning of agriculture business focused on wheat farming, is based on geo maps.

Research object – automation of management of agro holdings and farm holds are focused on a wheat farming

Research subject – wheat farming management information system.

Dev Environment. Most modern online resources and servers are hosted on Linux Operational system (OS). Ubuntu 18.04 was used as OS for the friendly development Wheat Farming Management Information System (WFMIS). It also runs WFMIS server and Database server.

Ubuntu is a fast and lightweight operating system with a clean and easy-to-use user interface. It is an Ubuntu Linux distribution, that uses the minimal desktop Lightweight X11 Desktop Environment / Lightweight Qt Desktop Environment (LXDE/LXQT), and a selection of

light applications. Because of Linux open source license, Ubuntu is a good choice for educational and scientific projects [4].

Also, the latest version of Python is available by default for Ubuntu distribution.

System Technological Architecture. All software and services, are used in the project, are licensed under the terms of the GNU General Public License or Open Source License. The current implementation of WFMIS uses traditional server-client architecture. Data input/output between a database and a server is provided by PostgreSQL Database Server [5]. The back-end part of WFMIS is based on NGINX HTTP Server and connects with the Django framework by WSGI protocol [6].

WFMIS web application uses a powerful python web frameworks – Django [7] and Django Rest Framework [8]. Django implements modern Model-View-Controller development architecture. This means the system is divided into three layers.

The first is a model or data layer. This layer consists of data encapsulated in class objects - models. Models contain data fields and relationships fields. Django supports «one to one», «one to many» and «many to many» relationships. Django also supports most of the PostgreSQL data types. Models can be easily updated by adding new fields or relationships. Django converts all models and fields into PostgreSQL tables just by two simple terminal commands.

The second is the API View layer. This layer contains class objects that are registered to own URL. These objects are part of the Logic tier. They serialize data and create JSON objects that are listened to by the specific URL.

The third layer is a front-end view layer. Django is a good solution for full-stack development. WFMIS uses a combined UI template render system. First part is Jinja/Django template render. It was used to render static parts of the web page like the navigation bar, table bar, and input forms. The main part of the web app - an interactive map is rendered by JavaScript with using XML requests to system API provided by Django Rest Framework. This means that the current implementation of WFMIS uses AJAX technology for map rendering.

The interactive map is rendered into HTML5 canvas by the Google Map API that gets data in JSON from the web app's Rest API.

SVG icons from fontawesome.com [9] and bootstrap grid were also used in UI development of the project.

There is how is the current implementation of WMFIS working now. User follows the link or confirms the form -> NGINX Server [10] sends an information about the action to Django by uWSGI -> Django listens the URL and connects by SQL requests to DB for data to render HTML/CSS code into a template and send by NGINX Server to browser -> At the same time, Rest API listens to the URL and render JSON file with farm hold fields data into specific URL -> JavaScript file listens to the URL by XML requests and redraw a map canvas according to actual data (figure 1).

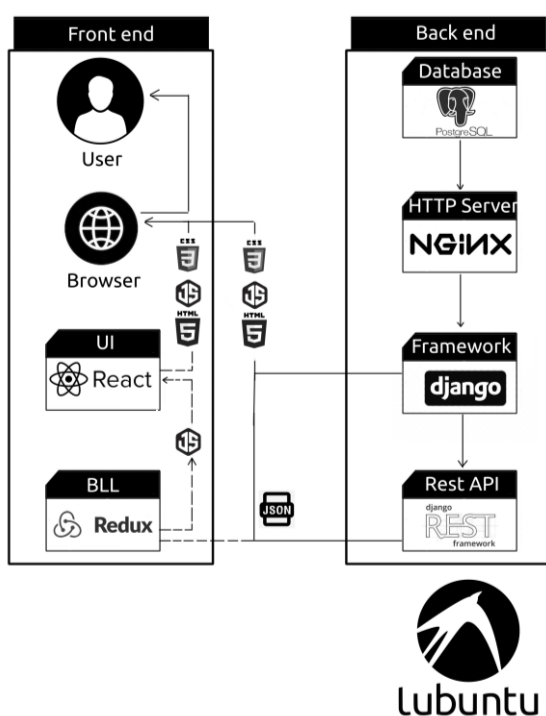


Fig. 1. System technological architecture

Farm hold Management Web app. The WMFIS is a web application for managing and sharing farm hold's seeds and fields state on a web-based interactive map.

Google Maps API is a source code interface that provides program libraries and services for generating a map over the internet. Google Maps API provides the key API to request spatial data about geographic information and process the map as an object in any external website. Google Maps API also allows us to customize the map controls including navigation slide bar, polyline, marker, button to switch between map or aerial and hybrid views. Google has released and develop a mapping based on the web. Google as a leader in the product development map with Google Maps provides a

slick, highly responsively visual, detail street and aerial imagery data [11].

Google Maps can be considered as an example of a GIS tool. GIS is an integrated system of computer hardware, software, and trained personnel linking topographic, demographic, utility, facility, image and other resource data that is geographically referenced [12].

Haversine is a very popular and frequently used formula when developing a GIS (Geographic Information System) application or analyzing path and fields. The haversine formula is a very accurate way of computing distances between two points on the surface of a sphere using the latitude and longitude of the two points [13].

Then the calculation using haversine formula can be modeled as follows [11]:

$$d = 2r \sin^{-2} \left(\sqrt{\sin^2 \left(\frac{\theta_2 - \theta_1}{2} \right) + \cos(\theta_1) \cos(\theta_2) \sin^2 \left(\frac{\varphi_2 - \varphi_1}{2} \right)} \right)$$

where d - distance between two point, r - radius of the earth, θ - latitude, φ - longitude.

The App consists of three pages for seeds, fields and agriculture management. Switch between each of them provided by a left navigation bar (figure 2).

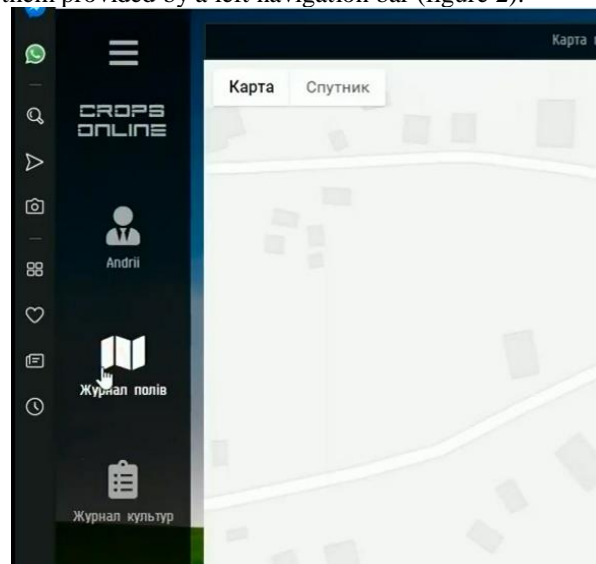


Fig. 2.

Fields page. Users can add, update, and delete farm hold's fields on this page (figure 3a). Users also can get field name by clicking on the field area on the map. Users can add a new field by clicking on the «Add Field» button is placed on the sidebar. User will be redirected on an adding field page with a form (figure 3b). A user creates a new point of the field by clicking on the map area. Users also can switch visualization mode (the map and the satellite). User is finished to create the field by clicking on the first point. The border is setup. Users also can change points position by dragging each point on the map. The field setup is finished after adding field name. User will be redirected on fields page after that.

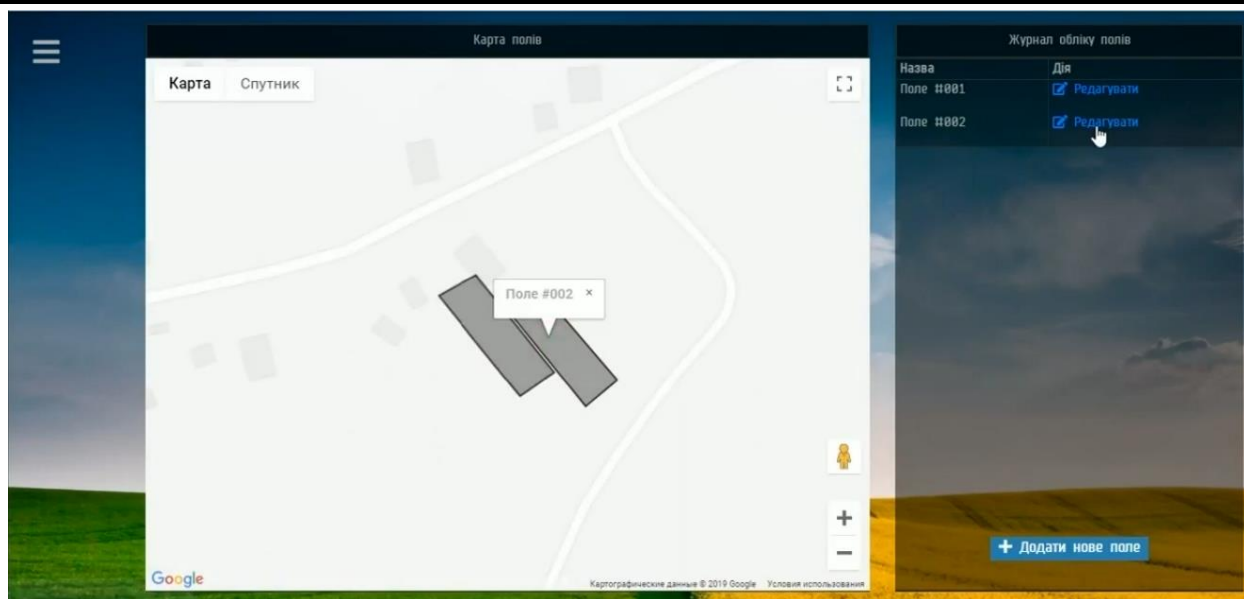


Fig. 3a. Fields page

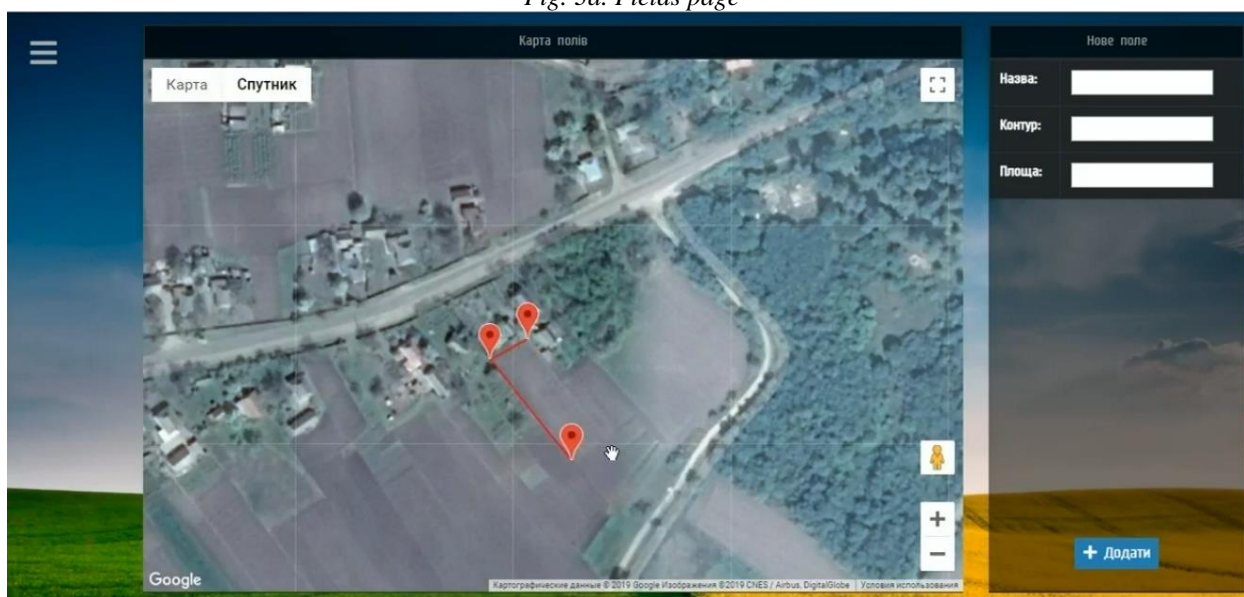


Fig. 3b. Fields page

Culture page. User can add, update and delete agricultures is used by the farm hold on the page. User can interact with an agriculture list by a table that consists of culture name and color. The UI uses a built-in browser color picker.

Seeds page. Users also can add, update, and delete farm hold’s seeds on the page (figure 4). Users can get information about each seed (id, seed and harvest date,

used culture) by an information table is placed on the sidebar or by clicking on a field area on the map. Users can add a new seed by clicking on the «Add seed» button is placed on the sidebar. An add seed form contains seed date and expected harvest date input fields, that use built-in browser calendar widget, farm hold’s field and culture drop-down lists. Users also can update the seed by a similar form.

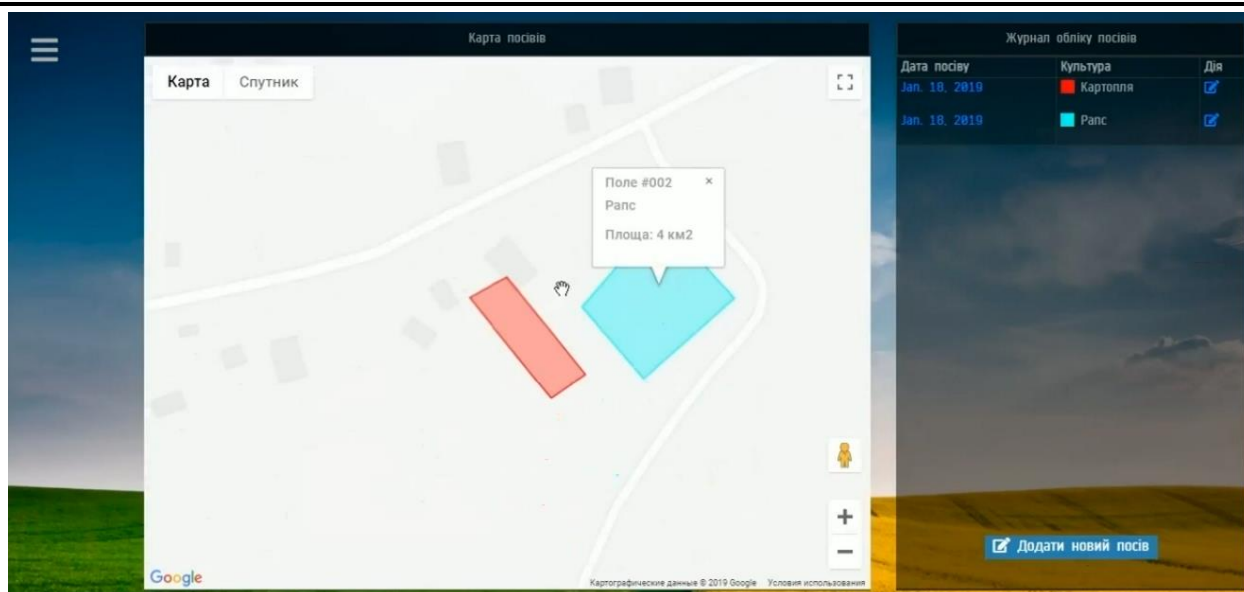


Fig. 4. Seeds page

The future of the project. Django Framework is a good decision for full-stack development, but there is a better conception for the front-end part of the project. This is the Single Page Application (SPA) development practice.

The current implementation of the system uses server render conception. This means that all HTML code is got by the web browser is rendered by the Django server-side. The map uses JavaScript and data that comes from API. But this JavaScript also sent to a browser by the server. The main disadvantage of this conception is high load on the server, especially with a high number of connections.

SPA conception separates Back end data, Business Logic Layer (BLL) and User Interface (UI). This means that the server sends an empty HTML frame and a current state of the client page in JSON format. All UI elements like input fields, table frames, buttons are rendered by JSX and JS that comes from React. It is happened only ones while page loading. They divided into the JSX components that listen to any changes in the app state and updates without browser page reload The state of web app and all button onClick callbacks are provided by BLL (Redux). So we have three separate layers: Server API, BLL (Redux), and UI (React). The advantages of this conception are server load reduction, no page reload, separation Back end logic and Front end UI. The last one can be useful in mobile app and native app development.

Conclusions.

1. The developed information system [14, 15] is adapted to meet the needs of domestic agribusiness. A common problem associated with ready-made software is that businesses are forced to alter some of their processes to fully utilize the product.

2. The information system is based on open-source technologies and uses modern software solutions.

3. Farming management system, that was developed, provides smart-farming technologies, that

helps to manage all levels of wheat production and rational resources distribution.

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ВІДОМОСТІ ПРО АВТОРІВ

ГЛАДКА Людмила Іванівна – кандидат фізико-математичних наук, доцент кафедри автоматизації та комп'ютерно-інтегрованих технологій Черкаського національного університету імені Богдана Хмельницького.

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ІНФОРМАЦІЙНІ СКЛАДОВІ ПІДГОТОВКИ ТА ПРОФЕСІЙНОЇ ДІЯЛЬНОСТІ ПРАЦІВНИКІВ СОЦІАЛЬНОЇ СЛУЖБИ

Постановка та обґрунтування актуальності проблеми. Вирішення проблеми підготовки майбутніх соціальних працівників згідно до нових стандартів освіти стимулює розвиток соціальної політики в Україні та дозволить підвищити якість обслуговування населення. Розглянути використання інформаційних технологій які будуть сприяти розвитку національної освіти та покращуватимуть надання соціальних послуг для населення.

Аналіз останніх досліджень і публікацій. Вирішенням проблеми наповнення освітнього середовища інформаційними технологіями досліджували науковці: Л. А. Карташова, В. В. Лапінський («Інформаційні технології в професійній діяльності вчителя іноземних мов» для спеціальності

6.020303 «Філологія»); Т. П. Костева - формування інформаційної компетентності магістрантів соціальної роботи; важливу роль інформаційних технологій в соціальних процесах було розглянуто С. В. Зінченко [7, с.130].

Під час вивчення проблеми використання інформаційних технологій в соціальній роботі, не знайшлося цілісного відображення проблеми. Найчастіше обговорюються питання надання соціальних послуг населенню через е-офіси, е-сервіси та трактується як е-урядування. Державна соціальна політика формується на засад діджиталізації державних органів влади так і виконавчих органів влади. Тому в нових умовах управління використовується термін державного е-урядування.