

Treatment planning system for contact radiotherapy devices

Sibedge engineers have developed the "Treatment Planning System" (TPS) software package for contact radiotherapy of oncological diseases.

Challenge

Sibedge was contacted by RT7, which cooperates with Russian manufacturers of devices for contact radiotherapy. The client asked us to create a treatment planning system for home equipment, taking into account current technologies, as well as the requirements of medical physicists and radiotherapists.

Problems with existing systems

Today, several foreign systems for contact radiotherapy devices are available in Russia, but their use is associated with a number of problems:

- almost all systems are desktop, which reduces convenience for the user;
- the use of this software is contrary to the policy of import substitution;
- it is not possible to add new features required by the personnel;
- no free patches with bug fixes are released for this software;
- the interface is too overloaded and is currently considered outdated.

Industry

E-healthcare

Location

Russia

Key points

- we used the web architecture in the development of the system;
- we created a toolkit for automating contouring;
- we developed a voxel system for 3D image visualization.

Team

3 — Front-end
2 — Back-end
1 — QA-engineer
1 — analyst
1 — designer
1 — DevOps
1 — Project manager

Duration

November 2019 - ongoing

Technologies

React, TypeScript, .NET Core, PostgreSQL.

Approach

Communication with client was based on the following principles:



Quick Start



Transparency
of process



One-Hour
Response



Scalability



High level of trust

Equipment operation principle

A patient with an oncological disease is given a CT or MRI scan to identify the affected area. Medical experts study the images, outline the identified formations. An applicator is then inserted into the patient's body and the most appropriate location is selected.

The applicator is connected to the device, and a mobile source of ionizing radiation is introduced into its channel. Its stopping points and exposure time should be accurately calculated in advance to increase the effectiveness of radiotherapy and minimize damage to healthy organs.

When the treatment plan and radiation doses are approved by the medical staff, the system creates a program with instructions regarding radiation source movements and its stops inside the applicator. These instructions are loaded into the device using a flash drive, after which the treatment process begins.

Architecture

We suggested that the customer should discard the concept of a desktop system and develop a platform with a web interface. Such approach provides access to the tools from any device (computers, tablets, smartphones) and significantly simplify the work of medical personnel. There is no such flexibility in any of the foreign treatment planning systems.

Visualization

For convenience of operating with CT and MRI images, we have developed a system for 3D visualization of flat images of the DICOM industry standard. It is a three-dimensional matrix of 134 million voxels (Voxel — volume pixel). Mathematical algorithms allow one to add, multiply, interpolate, smooth voxels, as well as select individual sections of the 3D image.

Image segmentation

An important part of the system is the advanced tools for three-dimensional images operation. Radiotherapists spend a lot of time manually identifying individual organs or their areas that are going to be exposed to radiation. Thanks to the tool created by Sibedge, contouring and segmentation can now be performed in semi-automatic modes:

- The histogram mode allows one to automatically select a specific color range from the grayscale palette in the image.
- The sprawl mode allows one to select a specific area, and then the system itself will select the voxels associated with it in three-dimensional space.

Interface

Our designers created the system interface based on the experience and suggestions of practicing medical physicists and radiotherapists. Unlike foreign systems, the interface is simple, intuitive and includes only the necessary elements, discarding all unnecessary ones to avoid complexity and congestion.

Algorithms

Sibedge developers have done a great job on the project. They took visualization of three-dimensional images in the form of a matrix, selection and development of algorithms for semi-automatic segmentation, as well as various operations on structures on their shoulders. One of the most important functions of the system was geometric optimization. Thanks to it, a medical physicist can adjust the dose and direction of radiation to optimize the treatment plan.

Team and technologies

A team of 10 experts worked on the project: 3 frontend developers, 2 backend developers, a QA engineer, an analyst, a designer, a DevOps and a project manager. We used the following technologies: React, TypeScript, .NET Core, PostgreSQL.

\ Result

We initially built a process in which five developers were constantly loaded with tasks, and a DevOps engineer was responsible for continuous delivery of the software product to the client. The analyst and the project manager were in constant contact with the customer to receive feedback from them and take it into account in further work. Transparency was ensured through regular demos of the system and daily conference calls with the client. We also created a detailed guide on how to use the digital platform.

"Treatment Planning System" further development continues, but even today it is able to significantly speed up the processes that were previously performed by medical specialists manually. In terms of convenience and functionality, this digital platform has no analogues either in Russia or abroad. The system so impressed the Russian manufacturer of radiotherapy devices that they invested in its further development.

The client was satisfied with the current results and has already agreed with us the next stage of development. In the future, the system is planned to be supplemented with the following functions:

- admin panel to manage staff accounts and add new applicators;
- instructions transfer to the devices via LAN without using flash drives;
- fully automatic image segmentation mode;
- integration of the platform with the infrastructure of medical institutions.

Feedback



Alexey Moiseev

Ph.D. in Physics and Mathematics and head of the medical physics department

“ A key factor in our decision to partner with Sibedge was the professionalism they offered us. From the beginning, they gave us the impression that they were adequate performers. From my understanding, the quality of their services is foremost in well-established development processes.

We were glad to see Sibedge engineers interested in our project and offer some suggestions that eventually improved the final product. Initially, we set the bar high. Our labor costs definitely correspond to the result we obtained.

We really like the format in which we work, so I hope that we will continue to cooperate. I am happy with the product that we are getting—it is a high-quality system. I highly recommend Sibedge as a partner to my friends.

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contacts@sibedge.com

United States

10362 Leola Ct # 1
Cupertino, CA 95014

Australia

1/237 Stirling Hwy,
Claremont, 6010

Russia

Tomsk
75 Pushkina Street

Moscow
10 Bolshaja Tulsckaja
Street