



wisdom 

20
23

PROJECT PROGRESS REPORT



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Introduction

WisdomX is committed to providing a platform to enable seamless integration of artificial intelligence techniques to mammography screening workflow while privacy of patients is preserved.

Breast cancer is the leading cause of cancer incidence around the globe. Almost all breast screening methods rely on medical imaging techniques among which X-ray imaging (mammography) is the most effective one.

It has been forecasted that the gap between the number of imaging exams and the number of expert radiologist readers required to address this discrepancy will continue to expand. Furthermore, we have been witnessing the proliferation of Artificial Intelligence (AI) solutions to solve routine everyday tasks. Consequently, the demand for AI-based tools that enable radiologists to interpret these exams more efficiently is on the rise.

It has been accepted that although AI development might be supportable by larger and prosperous institutions with enough radiologists and technical personnel for training and deployment of AI models, such infrastructure is neither present nor affordable in many underprivileged healthcare settings. Hence, WisdomX defined its mission *to build a platform for transforming mammography images into wisdom and incorporating this wisdom in action.*

This report summarizes 32 months of endeavor for designing, developing, and introducing the WisdomX platform.

Founders



MARYAM BARZIN
COO
Radiology Specialist



HOSSEIN KHORRAMI
CEO
MSc. Entrepreneurship Mgmt.



SIMINDOKHT ABBASLOU
CQO
Radiology Specialist



MOJTABA AAJAMI
CTO
PhD Computer Sci.



HAMED MOHAMMADI
CIO
BSc. Computer Eng.

Message from founders

Thanks to its distinctive and innovative approach, WisdomX has aptitude to grow on a global scale and consequently create various job opportunities in Canada.

We are thrilled to introduce WisdomX. Our primary field of work is mammography images analysis and our mission is to build a platform that engages healthcare experts and data scientists in developing AI models that turn mammogram images into actionable insights, saving lives through early detection of breast cancer.

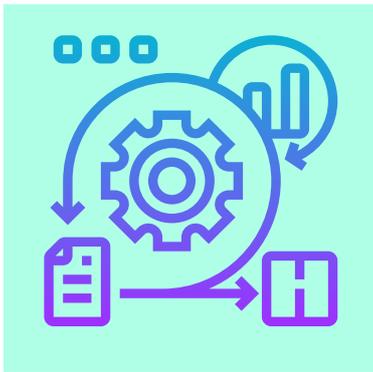
Our team has put in countless hours of research, development, and testing to create a solution that will revolutionize breast cancer screening and diagnosis AI models. We believe that our platform has the potential to significantly improve the accuracy and speed of mammography interpretation.



We envision that our solution will be highly influential in furthering the progress of the healthcare industry.

Report Structure

This report presents the activities of the WisdomX team and consists of two major parts:



PRODUCT DEVELOPMENT ACTIVITIES

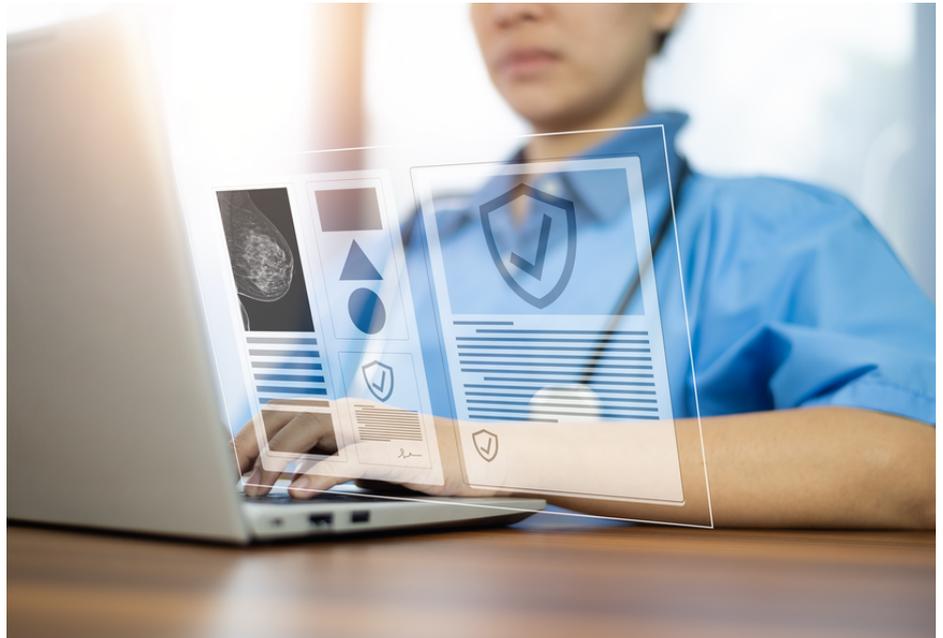
The first part of this report (i.e. page 4 to page 12) provides an overview of the activities undertaken to develop each module of the WisdomX platform.



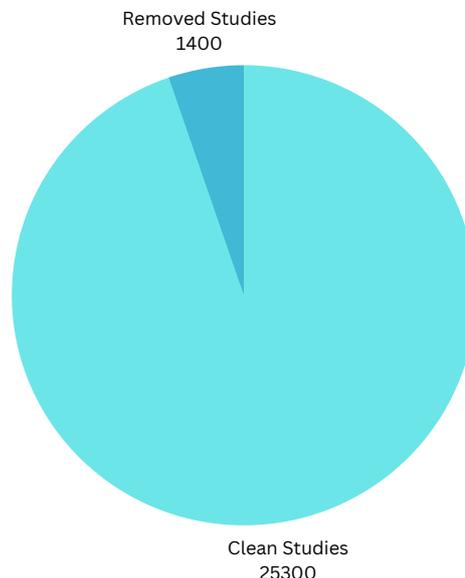
OTHER ACTIVITIES

The second section of this report outlines the initiatives that have been taken to establish and streamline the operations of WisdomX.

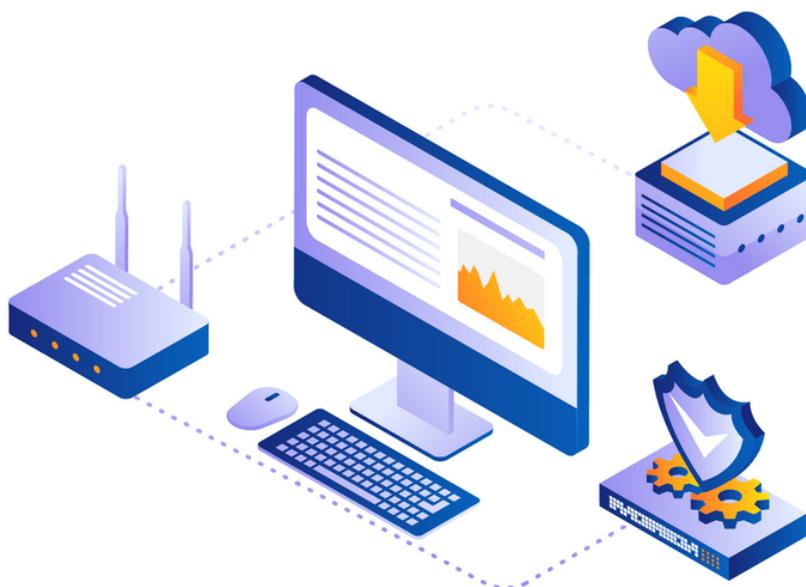
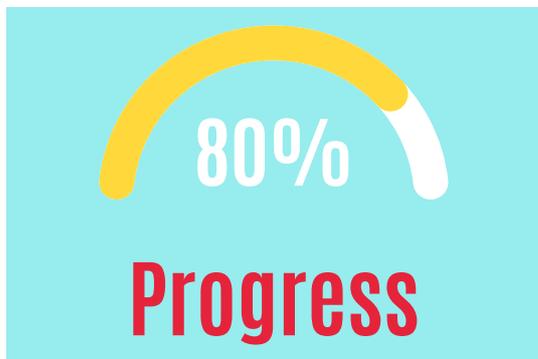
Dataset Curation



Data is the most valuable asset of an AI company. The more data an AI company has, the better it can train its models and improve the accuracy of its predictions. Therefore, WisdomX defined a dataset curation project launched in July 2021. At the first stage of this project, mammography studies and their respective radiologist reports of three medical imaging centers were *collected*. *Data anonymization* is performed at the second stage by a computer program that removed all the private information from study images and reports. The third stage involved *data cleaning* in which studies that were incomplete (a complete study consists of 4 images) or inconsistent were removed. At fourth stage, the images of each study are *labeled* as benign or malignant according to its respective mammography report. Also, breast density of each image is labeled according to the BIRADS standard.



Edge Device



Data privacy is one of the fundamental design criteria of WisdomX platform. Hence, all the processing of client data will be performed on its premise. For this purpose we implement radiologist assistant modules of WisdomX platform on the low-cost single board computers(SBC) that support AI-processing hardware features. We selected two different SBCs from two different manufacturers. For Maximum performance WisdomX software modules need to be ported (i.e. customized and optimized) to each of SBC models separately.

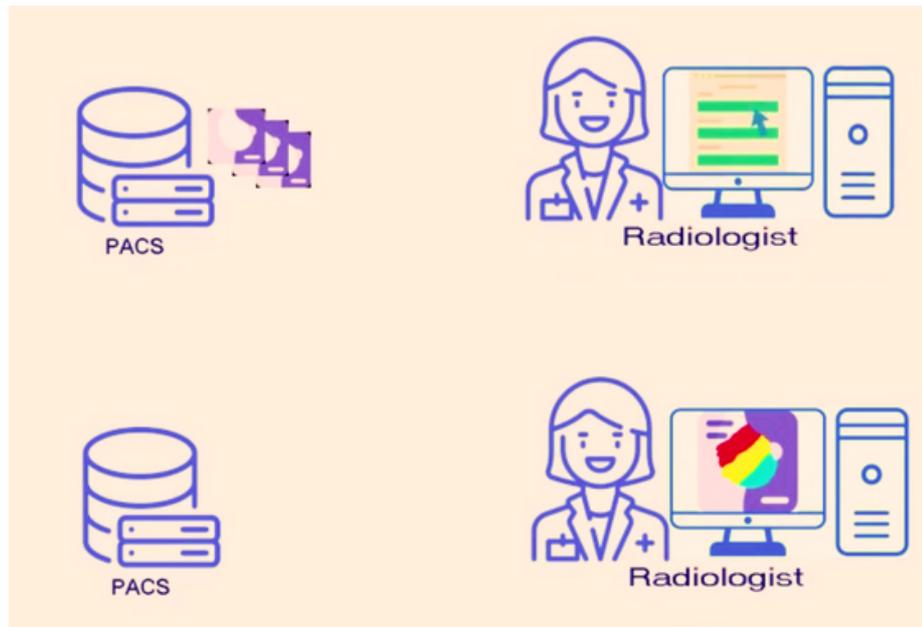
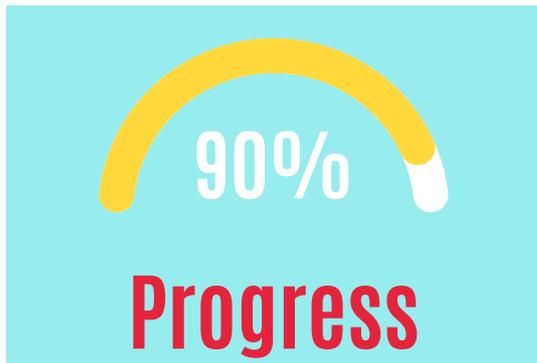
We started by implementing our solutions on *NVIDIA Jetson Nano* board. All the software modules have been configured and customized to run efficiently on this board.



As an alternative edge device, WisdomX solutions will also be offered on *Khadas VIM4* board. Most of the software modules have been ported to this board successfully. Currently we are working to port AI module.



Viewer

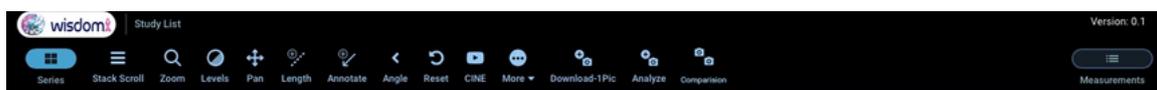


Radiologists incorporate a *medical image viewer* as an essential component of their regular operational processes. This tool enables them to retrieve images relating to a patient study from the Picture Archiving and Communication System (PACS) and then view both the imagery and its associated data.

WisdomX has developed its own customized viewer, capable of seamlessly integrating with any typical PACS system. This viewer provides a host of features that are commonly utilized by radiologists such as zooming, flipping, and much more. Furthermore, the AI tools provided by WisdomX may also be leveraged through this viewer.

For the creation of this viewer, we made use of the [Cornerstone-core](#) software library which is offered under an MIT License allowing us to utilize it for commercial purposes.

Evaluation and trials to apply for FDA 510(k) Clearances of this viewer are ongoing currently.



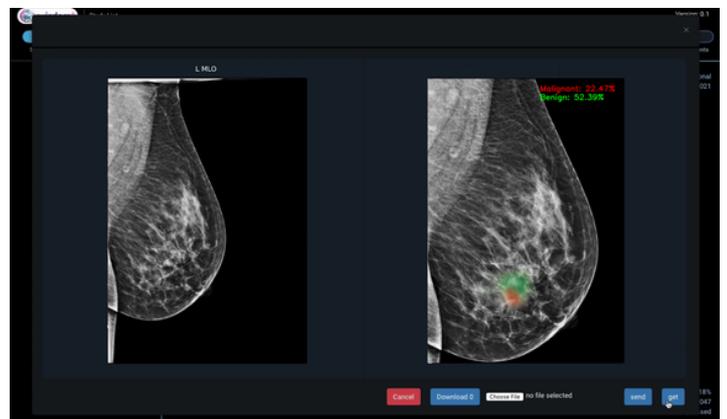
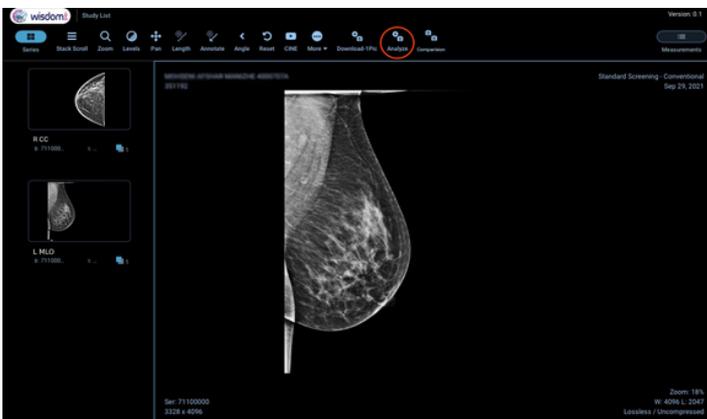
Interpretation Tool



During the examination of mammograms, radiologists are responsible for locating any suspicious lesions in the breast and assessing their malignancy or benignity. This task is referred to as interpretation, and the Interpretation module applies artificial intelligence to support it.

For the development of AI model of this tool at first stage, more than 50 scientific papers were studied. At the second stage, the architecture of model was designed and implemented in the computer. The third stage was training in which we used our curated dataset consisting of 100K images to train and test the interpretation model. In the last stage model was ported to the edge device and integrated with the viewer .

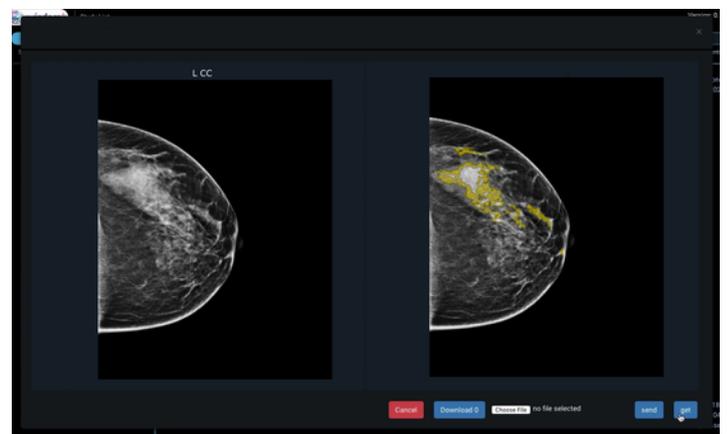
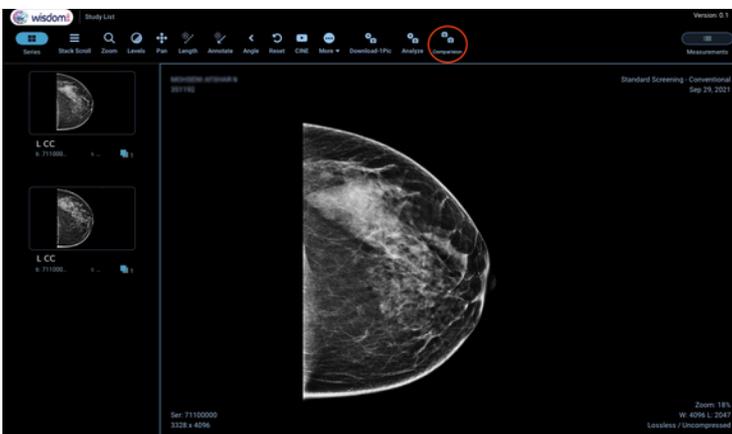
The evaluation and subsequent trials needed to attain a FDA 510(k) Clearance are currently in progress for this model.



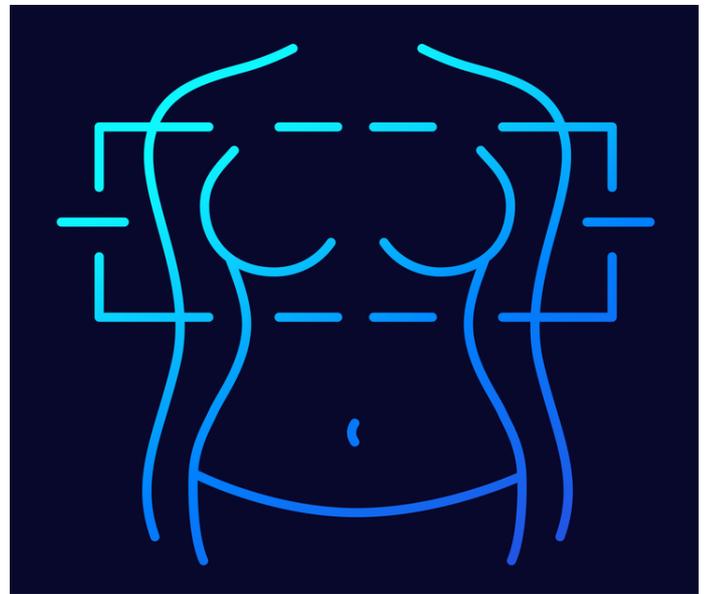
Comparison Tool



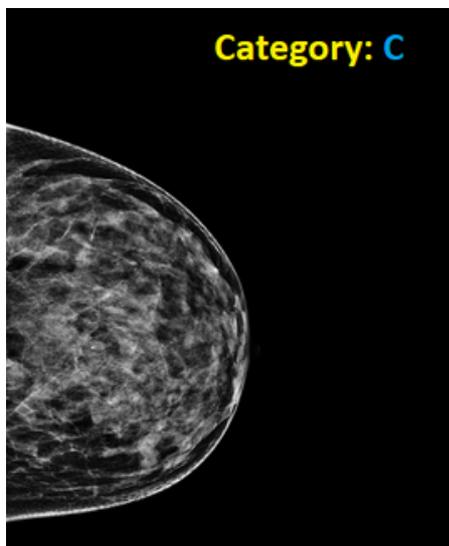
Good practice for examining mammography images involves comparing each image with another, such as those from previous studies, different views, or different breasts. The comparison tool compares two given images and determines the difference of one image with respect to the other one. For this purpose, this tool leverages a machine learning model that determines the deformation an image with respect to a reference image. This kind of model is called image registration model. At first stage of development of this tool we designed and trained a registration model to compare two images of Cranial Caudal (CC) view. This model is ported to the edge device and integrated with the viewer. In the coming stages we are going to design and train image registration model for comparison of images of mediolateral oblique (MLO) view and a model for CC and MLO comparison.



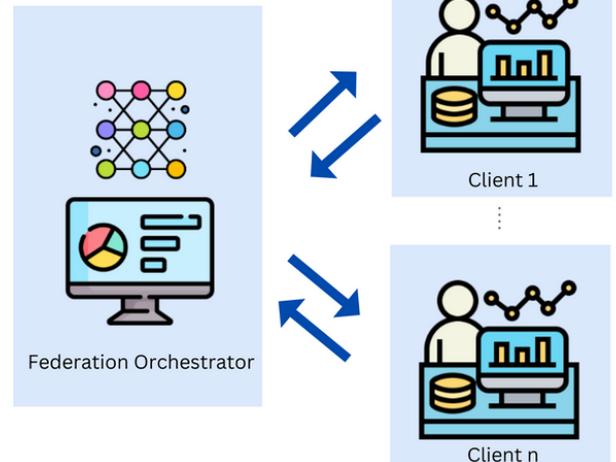
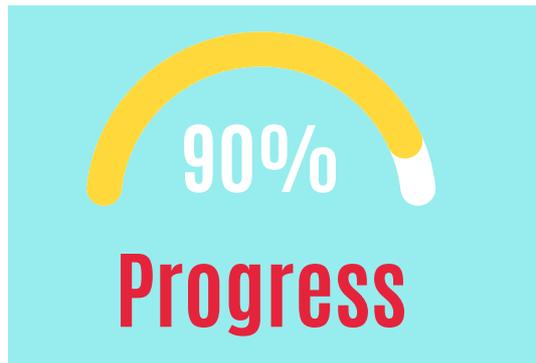
Assessment Tool



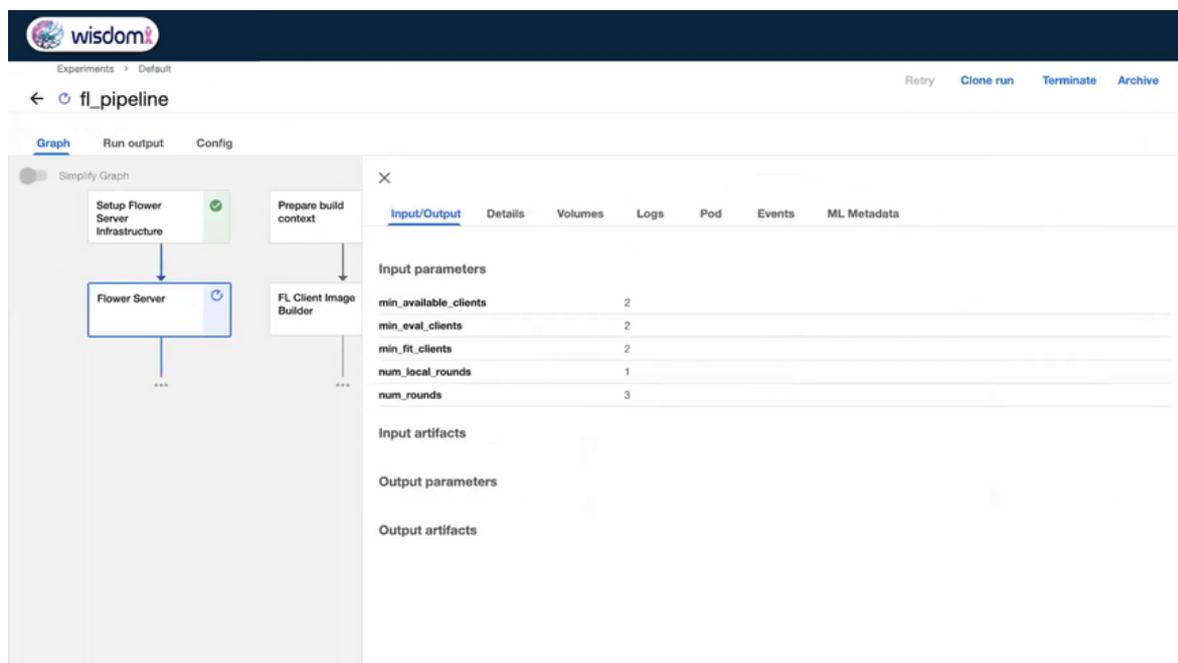
Radiologists provide an evaluation of a patient's breast density in mammography reports. According to recent research, the qualitative evaluation of mammographic breast density is subjective and exhibits significant variation among radiologists. Hence, the Assessment module of WisdomX platform enables radiologists to assess breast density with consistent accuracy. We designed a deep-learning model that receives four mammography images of an study and determines the breast density of a patient in terms of the Breast Imaging-Reporting and Data System (BI-RADS) categories. We trained and validated the designed model using our dataset. This models has been ported to the edge device. The final step that is integration of this model and the viewer is expected to be finished until Apr 15th, 2023. The assessment and following trials required to obtain an FDA 510(k) Clearance for this specific model are presently underway.



Federative Learning Software



Federative Learning (FL) is the disruptive module of the WisdomX platform. It enables to engage the clients in training the WisdomX AI models in completely privacy-preserved and incentivized manner. For the implementation of this technology initially we decided to use PySyft open source software after several months of work and evaluation unfortunately we did not get the expected performance from the developed software. Hence, we started again with another open source software called Flower framework. We customized this framework to make it *production ready*. The first version of WisdomX FL software has been developed and passed our tests. We believe this module is an *adaptive machine learning-enabled medical devices (MLMDs)*. Accordingly it is regulated by Schedule G of the Food and Drugs Act of Canada. We contacted authorities to get guidance about regulatory license acquisition.

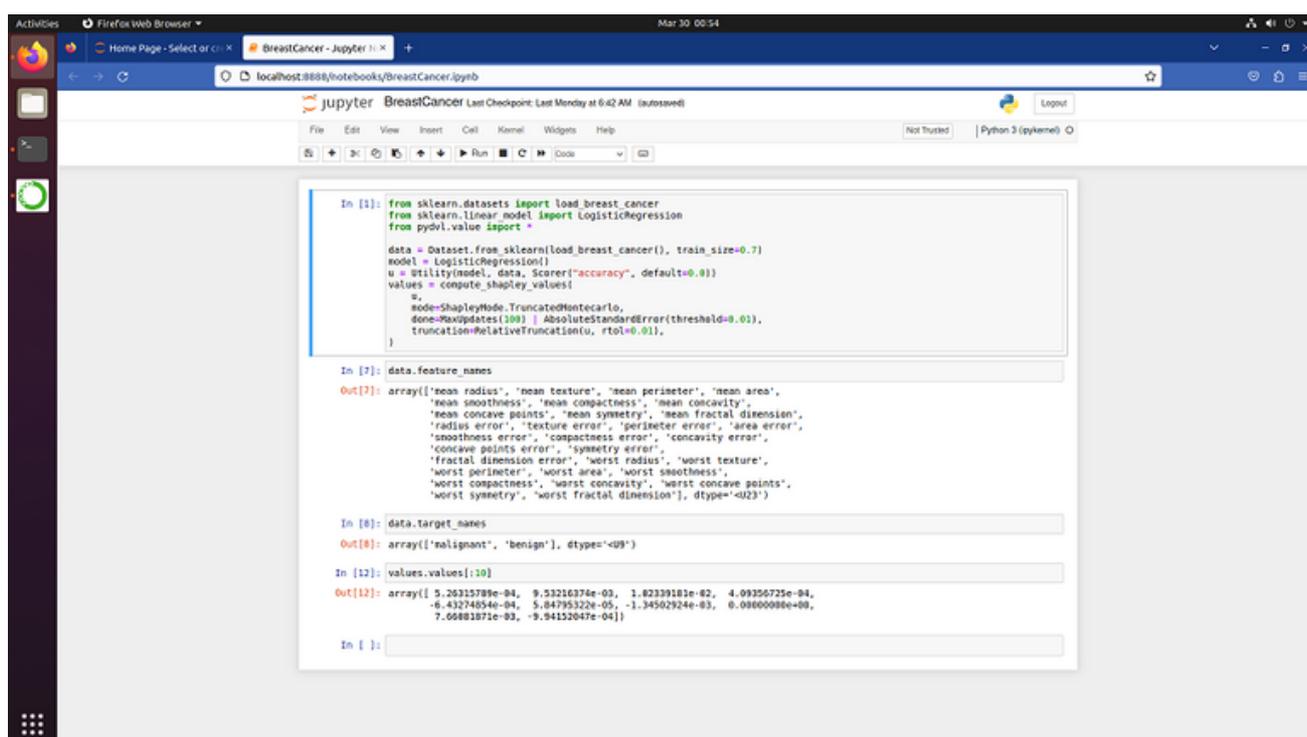


Input parameters	
min_available_clients	2
min_eval_clients	2
min_fit_clients	2
num_local_rounds	1
num_rounds	3

Data Valuation Algorithm



The most innovative aspect of WisdomX business model is to ascribe value to the clients participating in the federated learning process and incentivize them according to the value of their contributed data. Therefore, we need an efficient and fair data valuation algorithm to be implemented in our FL system. We studied and implemented more than ten algorithms that have been recently published in scientific papers. This enabled us to design and implement our own algorithm. However, in our evaluations, the performance of the designed algorithm did not meet our requirements. Hence, a joint project with Information Technology and Communication Research Centre (ITCRC) of Lambton College was defined to develop a solution for this problem (Please see appendix II). WisdomX technical team is still working on the development of this algorithm. We expect to release the first version our data valuation algorithm on Sep. 2023.



```
In [1]: from sklearn.datasets import load_breast_cancer
from sklearn.linear_model import LogisticRegression
from pydv.value import *

data = Dataset.from_sklearn(load_breast_cancer(), train_size=0.7)
model = LogisticRegression()
u = Utility(model, data, Scorer("accuracy", default=0.0))
values = compute_shapley_values(
    u,
    mode=ShapleyMode.TruncatedMontecarlo,
    done=MaxUpdates(100) | AbsoluteStandardError(threshold=0.01),
    truncation=RelativeTruncation(u, rtol=0.01),
)

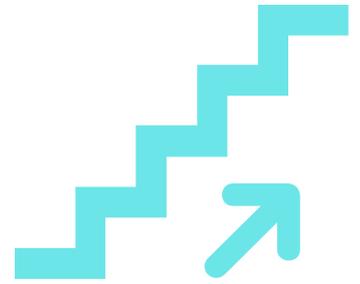
In [2]: data.feature_names
Out[2]: array(['mean radius', 'mean texture', 'mean perimeter', 'mean area',
              'mean smoothness', 'mean compactness', 'mean concavity',
              'mean concave points', 'mean symmetry', 'mean fractal dimension',
              'radius error', 'texture error', 'perimeter error', 'area error',
              'smoothness error', 'compactness error', 'concavity error',
              'concave points error', 'symmetry error',
              'fractal dimension error', 'worst radius', 'worst texture',
              'worst perimeter', 'worst area', 'worst smoothness',
              'worst compactness', 'worst concavity', 'worst concave points',
              'worst symmetry', 'worst fractal dimension'], dtype='<U23')

In [8]: data.target_names
Out[8]: array(['malignant', 'benign'], dtype='<U9')

In [12]: values.values[:10]
Out[12]: array([ 5.20315789e-04,  9.53216374e-03,  1.82339181e-02,  4.09356725e-04,
                -6.43274854e-04,  5.84795322e-05, -1.34502924e-03,  0.08600080e+00,
                7.05881871e-03, -9.94132047e-04])

In [ ]:
```

Next Steps



The Minimum Viable Product(MVP) of WisdomX platform is ready and validated. This MVP consists of Interpretation Tool, Comparison Tool and FL system. The next steps to move forward are:

01

Application for regulatory license

We are going to apply to obtain FDA 510(k) Clearance for WisdomX Viewer and Tools.

02

Releasing Data valuation mechanism

The first version of data valuation algorithm will implemented and integrated into the FL system.

03

Building AI models

The Comparison Tool involves two more models that will be designed and trained.

04

Optimizing and completing platform

The Tools and models of the platform demands a continuous optimization and integration.

Partnerships



WisdomX has been accepted into Microsoft for Startups Founders Hub, which provides a mix of technical benefits and business resources for WisdomX at every stage of its development.(Please see appendix I)



The ITCRC is interested to pursue a potential opportunity with WisdomX to collaborate on a research project involving WisdomX's proposed project. (Please see appendix II)

Saint Mary's University Entrepreneurship Centre (Please see appendix III). will corporate and provide WisdomX with a business model assessment to determine the ideal market entry strategy.(Please see appendix III)



Intellectual Properties



Patent


Innovation, Sciences et Développement économique Canada
 Office de la propriété intellectuelle du Canada

Innovation, Science and Economic Development Canada
 Canadian Intellectual Property Office

Courtoisie - Certificat de dépôt Courtesy - Filing Certificate	
AAJAMI, MOJTABA aajami732@gmail.com	
Renseignements sur le certificat Certificate Details	
Date du certificat: Certificate Date:	2023/03/30
N° de la demande: Application N°:	3,193,004
Votre n° de référence: Your Reference N°:	
Date de dépôt: Filing Date:	2023/03/14
Demandeur(s)/Applicant(s):	AAJAMI, MOJTABA; KHORRAMI, HOSSEIN
Inventeur(s)/Inventor(s):	AAJAMI, MOJTABA; KHORRAMI, HOSSEIN
Titre de l'invention: Title of invention:	DATA VALUE AWARE FEDERATED LEARNING SYSTEM AND METHODS
Date prévue de mise à la disponibilité du public: Expected Open-to-Public Date:	2024/09/14
Données de priorité/Priority Data:	

Copyright

[Home](#) → [Business](#) → [Intellectual property and copyright](#) → [Copyright](#)

Signed in as mojtaba732 [Access my profile](#) [Sign out](#)

Transaction history search results

Your search criteria was **End date: 2023-03-29**

Perform a [new](#) search or [refine](#) your search

Search results:

Registration number	Title	Payment date	Payment status	Confirmation number	Fee	Documents
1201224	Intelligent Mammogram Analysis System	2023-03-20		15354671	\$50.00	Global (HTML , PDF) Individual (HTML , PDF) Submission (HTML , PDF)

Perform a [new](#) search or [refine](#) your search

Market Research



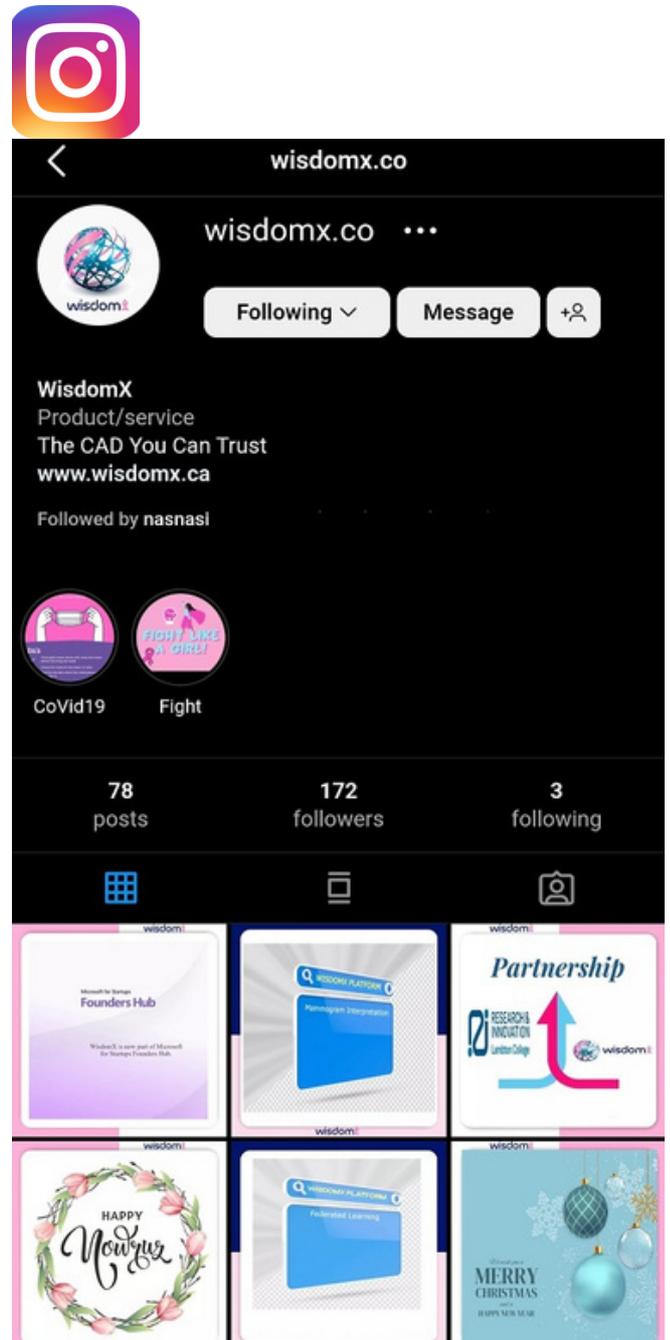
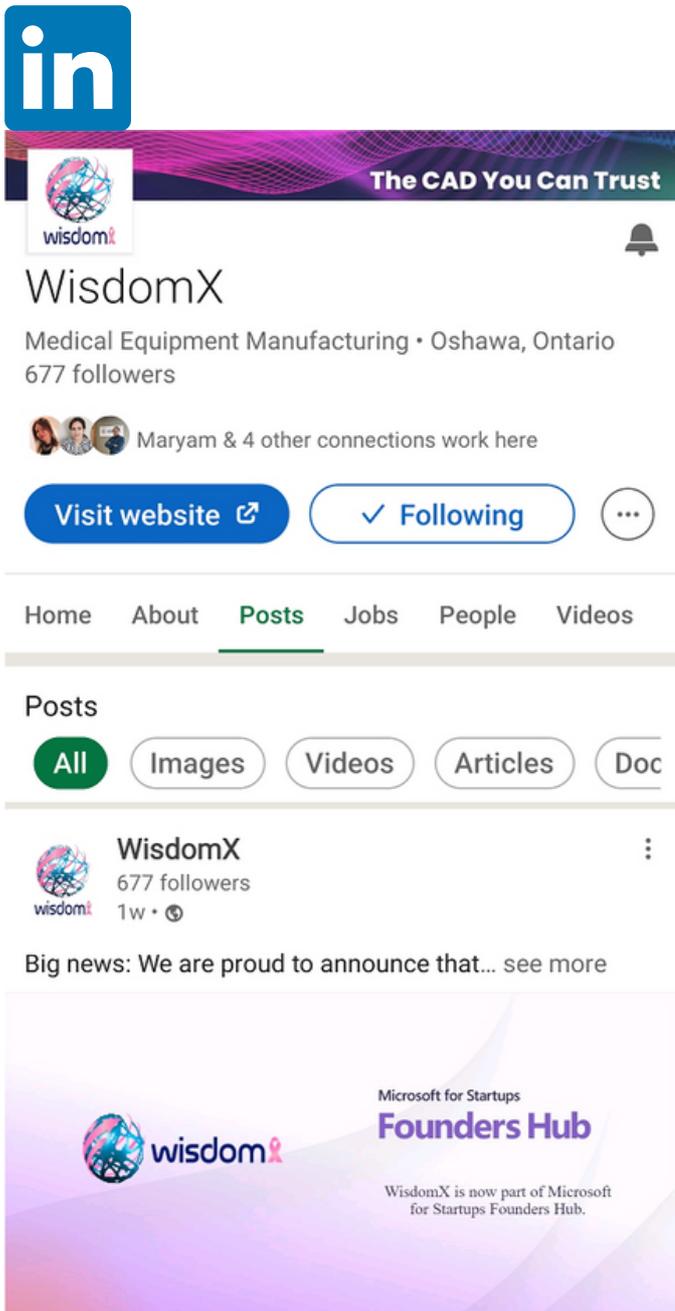
Canada

Canadian market research has been done through studying technical and financial reports as well as scientific papers. Moreover, as part of WisdomX strategic facilitation project market and competitor research will be conducted to acquire more comprehensive insight about Canadian market. (Please see appendix III)

Iran

A field survey was conducted through questionnaire at the 37th Iranian Congress of Radiology. From this survey we learned that most of the participants had a positive attitude towards AI-based mammogram analysis tools. They mostly prefer to use such tools for interactive diagnostics during image reading. Their major concerns are performance (accuracy) of tools, cost and business process changes.

Social Media Activity



We have produced a variety of videos, images and posters to present WisdomX's offerings and business in the social medias.

Appendix I



Proud to partner with Microsoft for Startups

Welcome to Microsoft for Startups Founders Hub

Hi Mojtaba,

Congratulations on your acceptance to Microsoft for Startups Founders Hub! We're thrilled to welcome you on board with a mix of technical benefits and business resources including:



\$5,000 USD of Azure credits valid for one year; supported by 24/7 Azure Standard Support.



Visual Studio Enterprise Cloud valid for the duration of your time with us.



Personalized Azure Technical Advisory sessions and 24/7 technical support.



Microsoft 365 valid for one year.



Dynamics 365 valid for one year.



\$2,500 in OpenAI credits valid for 6 months.



GitHub Enterprise Cloud valid for one year.



PowerApps valid for one year.

To receive the above benefits and more, first [review and complete your registration](#) by logging in to the Microsoft for Startups Founders Hub with the LinkedIn account you used when applying: mojtaba.aajami@gmail.com.

We also encourage all of our startups to share their partnership with us on social media. [Click here](#) for guidance on announcing your acceptance into Microsoft for Startups Founders Hub. If you have questions, please don't hesitate to [contact us](#).

Appendix II



Information Technology &
Communications Research Centre (ITCRC),
Research & Innovation,
Lambton College
1457 London Road
Sarnia, Ontario, N7S6K4

March 16, 2023
Hossein Khorrami
CEO,
WisdomX.
Suite 300, 2 Simcoe Street S,
Oshawa, L1H 8C1, Canada

Mr. Khorrami,

This letter indicates a potential partnership between Lambton College's Information Technology and Communication Research Centre (ITCRC) and WisdomX. After several months of negotiation, multiple meetings, and assessment of WisdomX competencies/capabilities, this letter of support indicates a potential partnership between Lambton College's ITCRC and WisdomX. The ITCRC is interested to pursue a potential opportunity with WisdomX to collaborate on a research project involving WisdomX's proposed project "An Inventive Mechanism for a Federated Learning Platform". The Intellectual Property generated from this collaboration would be owned and be used for commercial viability for WisdomX.

WisdomX is willing to contribute capital in conjunction to the project development, to support potential grant opportunities to help fund the project. The project will consist of multiple full time employees from WisdomX, with the assistance from a Lead Researcher and a series of graduate and student researchers from Lambton College's ITCRC. I hope the presence of the founders in Canada would remove the barriers to apply for grant funding.

Thank you,

Digitally signed by Chad Nedin
DN: cn=Chad Nedin, o=Lambton College,
ou=Research and Innovation,
email=chad.nedin@lambtoncollege.ca, c=CA
Date: 2023.03.16 11:56:38 -0400

Chad Nedin
ITCRC Coordinator
Research & Innovation

E Chad.Nedin@lambtoncollege.ca
W www.lambtoncollege.ca/research/
1457 London Road, Sarnia, ON N7S 6K4



Appendix III



March 20, 2023

Hossein Khorrani
Chief Executive Officer, WisdomX

Dear Hossein Khorrani,

This letter of support signifies a potential partnership between the Saint Mary's University Entrepreneurship Centre (SMUEC) and WisdomX. Having conducted multiple discovery meetings with the WisdomX team and reviewing the business plan, a strategic plan will be developed for WisdomX to launch in Canada.

SMUEC is interested in conducting the strategic facilitation project with WisdomX. The project will involve thorough research of the current market, conducting a market assessment, and developing a strategic plan to achieve product-market fit. Moreover, our proposed partnership will encompass identifying critical stakeholders for entry into Canada and establishing relevant connections.

The project will involve the full-time team from WisdomX, who will work with the Business Design department, including 2 full-time employees from SMUEC. This partnership will aim to identify the ideal path for WisdomX to launch in Nova Scotia, Canada.

Regards,

Meredith Drost

Meredith Drost
Project Manager, Business Design
Saint Mary's University Entrepreneurship Centre

Saint Mary's University
M 506.333.0695 www.smu.ca



923 Robie Street Halifax NS B3H 3C3 Canada
smu.ca



World without limits.

Confidentiality Acknowledgement

Information, data, and drawings in this business plan are strictly confidential and are supplied on the understanding that they will be held confidentially and not disclosed to third parties without the prior written consent of WisdomX.

Contact

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Spark Centre Head Office
Suite 300, 2 Simcoe Street South,
Oshawa, L1H 8C1
Canada

www.wisdomx.ca
info@wisdomx.ca