Ensuring the reliability of qPCR reagents through automatic detection of genetic mutations

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Background

qPCR (quantitative Polymerase Chain Reaction) tests are widely used to detect infectious diseases by identifying specific genetic material. However, mutations in pathogen genomes can alter target regions, increasing the risk of false negatives and reducing the reliability of these assays. Maintaining the accuracy of qPCR reagents is essential for effective disease surveillance and diagnostics.

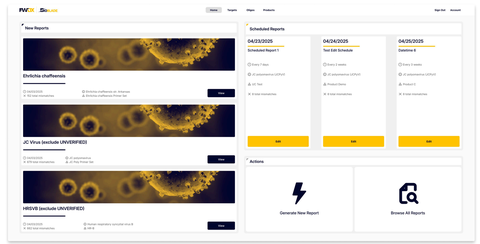
Currently, assay validation workflows are largely manual and depend heavily on third-party bioinformaticians to assess the impact of genetic mutations on assay performance. This process is time-consuming, inefficient, and does not scale well in the face of growing genomic data and emerging pathogen variants.

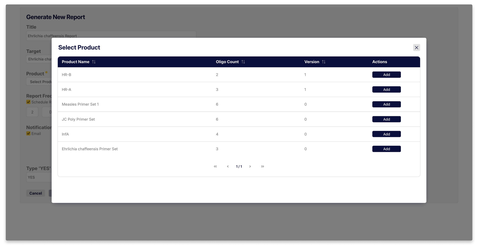
1. **Contact Bioinformatician**
2. **B.I. writes a script to gather data**
3. **Data is manually compiled into a static HTML page**
4. **File is sent to FWDX**
5. **Repeat when a new report is needed**

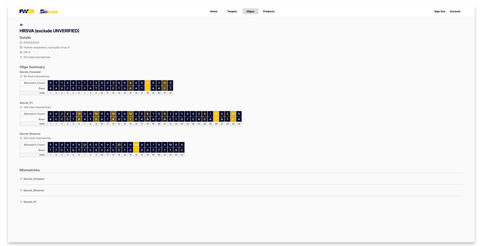
Outcome

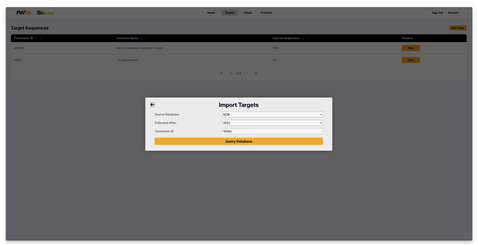
BioBlade eliminates the manual, resource-intensive steps traditionally required to validate qPCR assays and enhances the reliability of diagnostic testing. Through the development of a secure, web-based platform, we enable users across scientific disciplines to rapidly evaluate qPCR kit performance by comparing assay data to verified DNA reference sequences. This solution provides immediate, accurate insights into assay effectiveness, removes the dependency on external bioinformatics support, streamlines validation workflows, and strengthens confidence in disease detection and diagnostic outcomes.

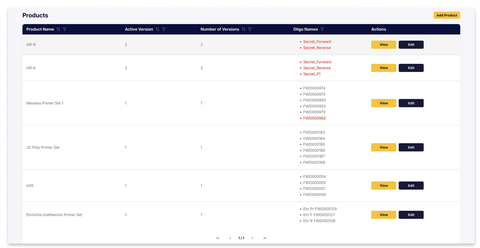
Design











Challenges

- Ensuring the application integrates well with national and international genomic databases
- Optimizing architecture for high-volume data storage, enabling seamless access and exceptional performance while minimizing infrastructure costs
- Implementing a computationally fast but cost effective deployment strategy
- Navigating domain-specific biological terminology
- Leveraging cutting-edge CPU vector instruction optimization to deliver ultra-fast global-local sequence alignments with unparalleled performance and accuracy
- Implementing advanced security protocols to safeguard Fort Worth Diagnostics proprietary information with industry-leading protection measures

Improved Workflow

1. **Visit the webpage**
2. **Select Product & Target**
3. **Click "Generate"**
4. **4a** Repeat when a new report is needed
4. **4b** Automatically receive scheduled reports

Summary

BioBlade leverages publicly available genomic sequence datasets to provide enhanced curation, normalization, and enrichment of target metadata, specifically benefiting qPCR manufacturers.

Our platform enables clients to manage their proprietary oligonucleotide sequences and product validation reports through an intuitive web interface. This allows clients to validate their products against real-world genomic sample data, ensuring statistically significant product outcomes.

Tech Stack

Frontend: HTML, CSS, JS, Vue.js

Backend: Python, biopython, Flask

Database: mongoDB

Wiki

qPCR: A lab technique used to amplify and quantify DNA.

Primers & Probes: Short DNA sequences or *oligos* used in qPCR to target specific genomic regions.

Mutation: A change in the DNA sequence that may affect diagnostic assays.

Sequence Alignment: A method to compare DNA sequences to identify variations.

False Negative: A test result that incorrectly indicates the absence of a pathogen.

Acknowledgments

Fort Worth Diagnostics

- Dr. Jerry Boonyaratanakornkit & Manuel Duval

TCU Department of Computer Science

- Dr. Bingyang Wei and the faculty for equipping us with the knowledge and skills that enabled the creative and innovative solutions presented in this project