

# SchoolTrace: App-Less Contact Tracing in Schools

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# Motivation

- Schools reopening in Fall 2020 amid global pandemic
- Why do we care?
  - Increased risk for teachers and students <sup>1</sup>
  - Unknown how COVID-19 will spread in schools among children <sup>2</sup>

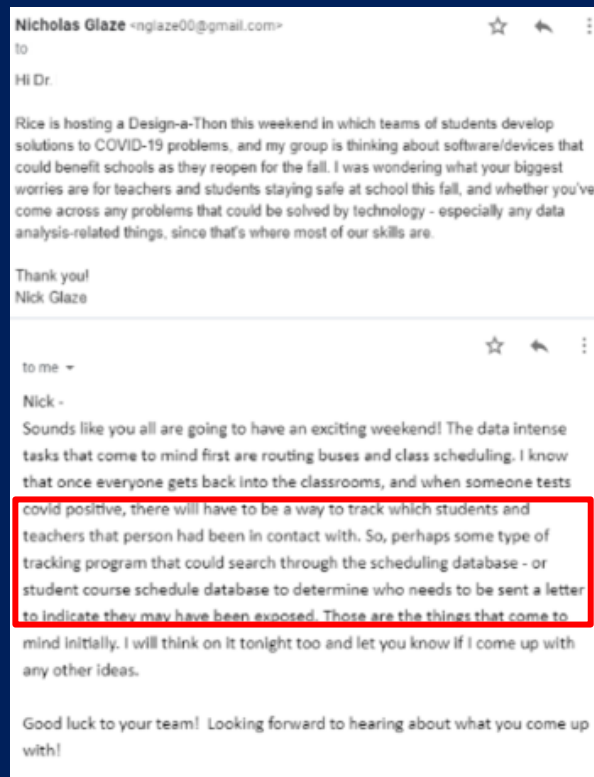


<sup>1</sup><https://www.usnews.com/news/education-news/articles/2020-05-01/one-third-of-teachers-are-at-higher-risk-for-coronavirus>

<sup>2</sup><https://www.nap.edu/read/25858/chapter/2>

# Primary Source

- School board member's input <sup>3</sup>
- Worried about contact tracing
- Leverage database of student schedules



Anonymized email exchange

# Existing Technology

- Current solution: Contact tracing apps <sup>4</sup>
- Problems
  - Requires widespread download of smartphone apps
  - Introduces privacy concerns



# Solution: Schedule-Based Contact Tracing

- Student and faculty schedules are readily available
- Compare class schedules to identify a student's past interactions with COVID-positive students
  - Focus on proximity in classrooms & hallways

# Working Proof of Concept

- Password-protected
- Interactions breakdown
  - Classroom
  - Walkway
- Video demo at the end

The image displays two screenshots of a web application titled "How Many Interactions Did I Have?".

**Top Screenshot (User: Thanos Simar):**

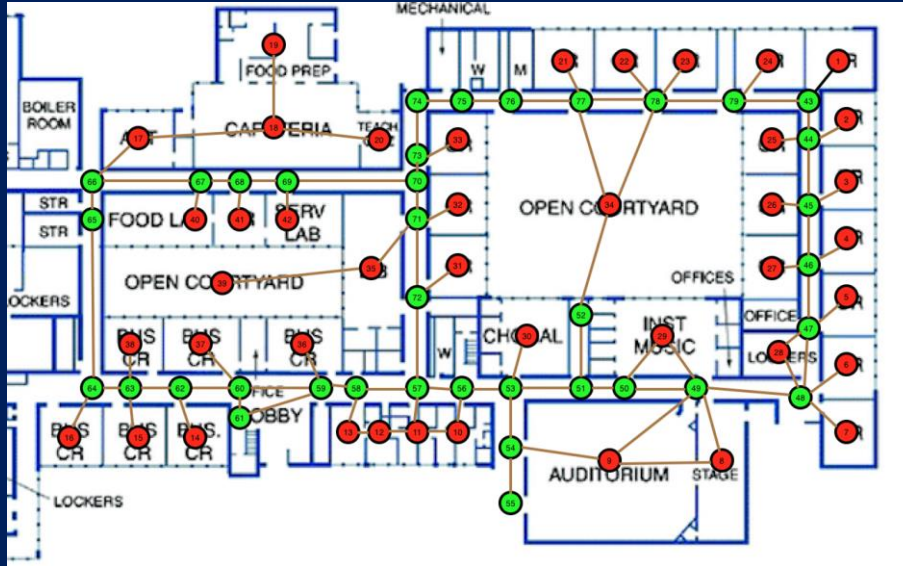
- Header:** How Many Interactions Did I Have?
- Greeting:** Hi, Thanos Simar
- Summary:** In the past week, you've had up to 6 daily interactions with COVID-positive students.
- Classroom Interactions:** Each day, you shared classrooms with up to 1 COVID-positive students: Period 5 (Teacher: Huang)
- Hallway Interactions:** Each day, you passed up to 5 COVID-positive students in the halls:
  - Between periods 2 and 3 (Teachers: Lewis and Finley)
  - Between periods 3 and 4 (Teachers: Finley and Senftle)
  - Between periods 3 and 4 (Teachers: Finley and Senftle)
  - Between periods 4 and 5 (Teachers: Senftle and Huang)
  - Between periods 4 and 5 (Teachers: Senftle and Huang)
- Form:** Includes a "Submit" button, a "Your Student ID" field (containing "TSimar"), a "Your PIN #" field (containing "\*\*\*\*"), and a "Max asymptomatic days" field (containing "7").

**Bottom Screenshot (User: Bill Jobs):**

- Header:** How Many Interactions Did I Have?
- Greeting:** Hi, Bill Jobs
- Summary:** In the past week, you've had up to 6 daily interactions with COVID-positive students.
- Classroom Interactions:** Each day, you shared classrooms with up to 2 COVID-positive students: Period 1 (Teacher: Finley), Period 4 (Teacher: Guerra)
- Hallway Interactions:** Each day, you passed up to 4 COVID-positive students in the halls:
  - Between periods 1 and 2 (Teachers: Finley and Gilbertson)
  - Between periods 1 and 2 (Teachers: Finley and Gilbertson)
  - Between periods 3 and 4 (Teachers: Rixner and Guerra)
  - Between periods 4 and 5 (Teachers: Guerra and Flynn)
- Form:** Includes a "Submit" button, a "Your Student ID" field (containing "BJobs"), a "Your PIN #" field (containing "\*\*\*\*"), and a "Max asymptomatic days" field (containing "7").

# Methodology: Graph Analysis

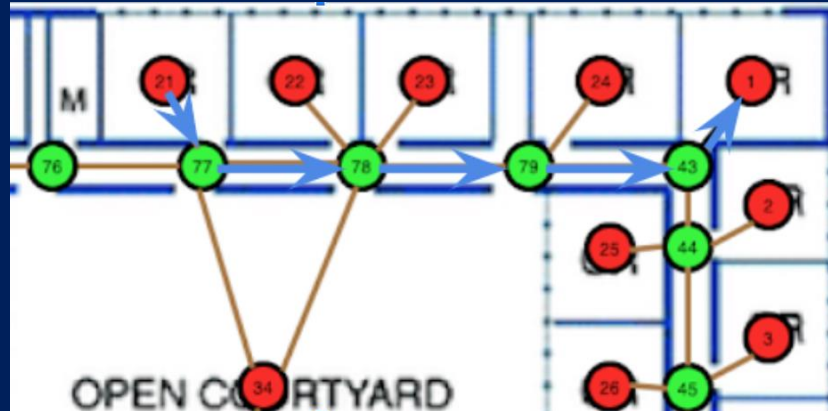
1. Label classrooms and walkway intersections as a graph



Red nodes = Classrooms  
Green nodes = Walkway intersections  
Orange edges = Walkable paths

# Methodology: Graph Analysis

2. Generate daily paths of students (and teachers)
  - Dijkstra's algorithm
  - Assumption: students will take the shortest path to class



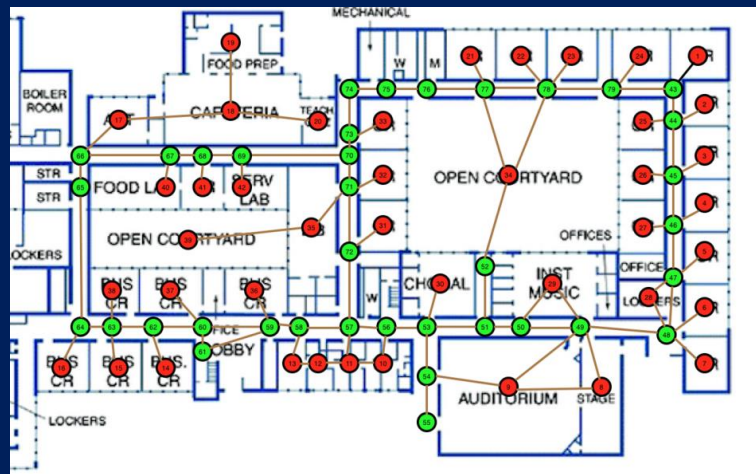


# Methodology: Graph Analysis

3. Identify your overlaps with paths of COVID-positive students
4. Report locations of your likely interactions
5. Students / parents make informed decisions
  - Increase individual precautions / quarantine

# Technical Details

- Python: pandas, networkx, tkinter
- Test dataset:
  - School graph
  - 10 student schedules (3 infected)
- In production:
  - Database software (MySQL, MongoDB)
  - Robust front-end (website interface)



# Integration with School COVID Policies

- Social distancing and staggered class transition policies
- Common areas
  - Some schools will limit access to common areas
    - Cafeterias are closed and meals are served in classrooms <sup>5</sup>
  - Divide into several nodes for pathfinding, add to the schedule like classes
- Lockers
  - Schools banning locker use or doing scheduled visits only
    - “To that end, lockers will not be used this year.” - Ortiz, Morris District Superintendent <sup>6</sup>
  - Treat student “cohort” lockers as hallway nodes to reduce graph complexity <sup>5</sup>

<sup>5</sup> <https://www.countryherald.com/news/local/towns/grundy-county/morris/morris-high-school-to-have-35-min-classes-ban-on-lockers-in-fall-2020/>

<sup>6</sup> <https://www.education.pa.gov/Schools/safeschools/emergencyplanning/COVID-19/SchoolReopeningGuidance/ReopeningPreKto12/PublicHealthGuidance/Pages/default.aspx>

# Target Users and Impact

- High Schools & Primary Schools
  - Promote safe practices
  - Inform decision-making
- Universities
  - Actionable analysis opportunities
  - Campus-wide policy updates

NOT 6ft. !



Compared to app-based contact tracing,  
our solution offers...

Advantages:

- No App Download
- Privacy and Anonymity
- Easy Usability

Disadvantage:

- Slightly Less Accurate

# Business Plan

- With current functionality, make a free standalone website
  - Give back to the community
  - Cheap to maintain
- With full features, use a business-to-business (B2B) model
  - Sell to school management platforms (Canvas, itsLearning)
  - Software as a Service (SaaS)
  - Minimize costs for schools and students

# Future Work

- Address regulations around anonymity and HIPAA/FERPA
  - Discuss with regulators
  - Hide interaction locations
- Automate / simplify labeling school graph
  - OCR model
  - Labeling tool
- School-level analysis tools
  - Interactions dashboard

Hi, Thanos Simar


In the past week, you've had up to 10 daily interactions with COVID-positive students.


Each day, you shared classrooms with up to 2 COVID-positive students.


Each day, you passed up to 8 COVID-positive students in the halls.


Hidden interaction locations


# Mockup: Canvas Integration


  
Account


  
Dashboard

  
Courses

  
Groups

  
Calendar

  
Tracing

  
Help

Confirmed COVID-19 Cases

Faculty: 4

Students: 3

Type here your message

Please avoid the Cafeteria and Classroom 26.

Send to Student and Faculty


Menu


Handoff


No comments


Student Mode


Admin Mode


  
Account


  
Dashboard

  
Courses

  
Groups

  
Calendar

  
Tracing

  
Help

Hi, Thanos Simar

In the past week, you've had up to 6 daily interactions with COVID-positive students.

Each day, you shared classrooms with up to 1 COVID-positive students:

Period 5 (Teacher: Huang)

Each day, you passed up to 5 COVID-positive students in the halls:

Between periods 2 and 3 (Teachers: Lewis and Finley)

Between periods 3 and 4 (Teachers: Finley and Sertile)

Between periods 3 and 4 (Teachers: Finley and Sertile)

Between periods 4 and 5 (Teachers: Sertile and Huang)

Between periods 4 and 5 (Teachers: Sertile and Huang)

Menu

Handoff

No comments

Please AVOID the Cafeteria and Classroom 26.



<https://marvelapp.com/prototype/67ch6hc>

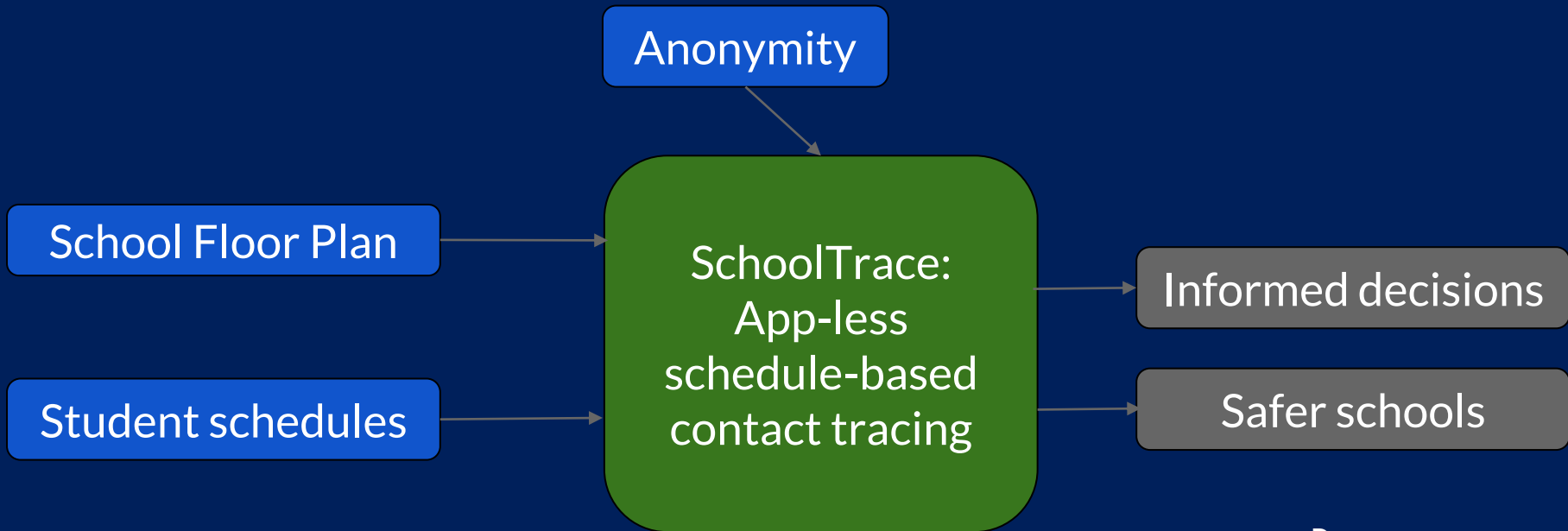


# Works Cited

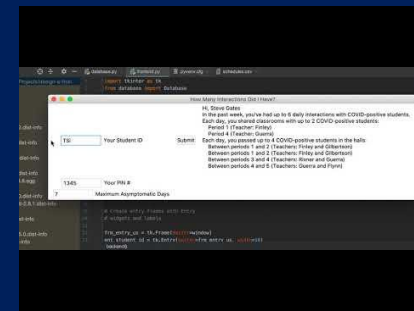
1. <https://www.usnews.com/news/education-news/articles/2020-05-01/one-third-of-teachers-are-at-higher-risk-for-coronavirus>
2. <https://www.nap.edu/read/25858/chapter/2>
3. Dr. Laura DuPont, CCISD board member
4. <http://www.tetoncountwy.gov/2156/PathCheck-SafePlaces-Mobile-App>
5. <https://www.education.pa.gov/Schools/safeschools/emergencyplanning/COVID-19/SchoolReopeningGuidance/ReopeningPreKto12/PublicHealthGuidance/Pages/default.aspx>
6. <https://www.countryherald.com/news/local/towns/grundy-county/morris/morris-high-school-to-have-35-min-classes-ban-on-lockers-in-fall-2020/>
7. Erik Wu, Jason Dennis (mentors)

More sources on school COVID policies:

1. <https://www.health.state.mn.us/diseases/coronavirus/schools/k12planguide.pdf>
2. <https://tea.texas.gov/sites/default/files/covid/Covid-19-SY-20-21-Public-Health-Guidance.pdf>
3. <https://services.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/clinical-guidance/covid-19-planning-considerations-return-to-in-person-education-in-schools/>
4. <https://www.tampabay.com/news/health/2020/05/30/when-will-pinellas-reopen-schools-the-virus-will-decide/>
5. <https://www.chalkbeat.org/2020/6/23/21300529/school-lunch-as-we-know-it-is-over-coronavirus-school-nutrition-directors>



Demo



# Bonus slide!

- Bathrooms
  - Hard to predict when students use the bathroom
  - Few school policies advise more than social distancing with regular sanitation
  - Simple modification to path generator
    - Add bathrooms as destinations during passing periods to student schedules
    - Give probability of meeting in bathroom being with a COVID-positive student

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“There is insufficient evidence with which to determine how easily children and youth contract the virus, and how contagious they are once they do.”

- National Academies of Sciences,  
Engineering, and Medicine