Overly Intelligent Room Scheduler

Brett Tully

btully@bellarmine.edu

1/17/23

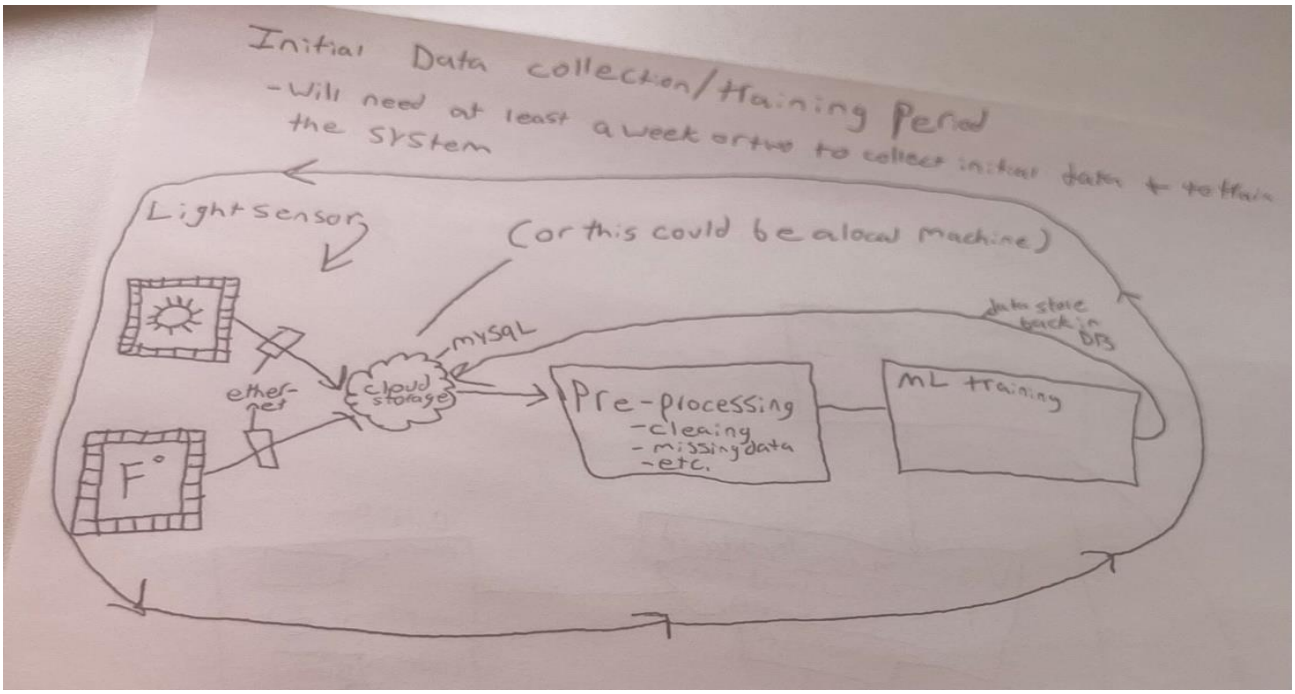
The last couple of years has brought many new changes in our lifestyle for better or worse. With businesses and schools shifting to primarily in-person attendance, we must have a reliable method for finding empty classrooms/conference rooms. While there are systems that exist that can help with this, they are quite clunky and unreliable as it is not a “intelligent” system that reacts to real-time data to find currently open rooms and rooms that will be open in the future. Generally, the normal method for finding an open room would be to simply check to see if somebody else has scheduled it or not, but that is not always reliable. By using an AI system that incorporates ambient lighting and temperatures in classrooms, we can collect the sensor data to create a reactive and accurate scheduling assistant that solves a simple problem by using the simplest solution of detecting the presence of people in realtime or learning when and at what times certain rooms get used.

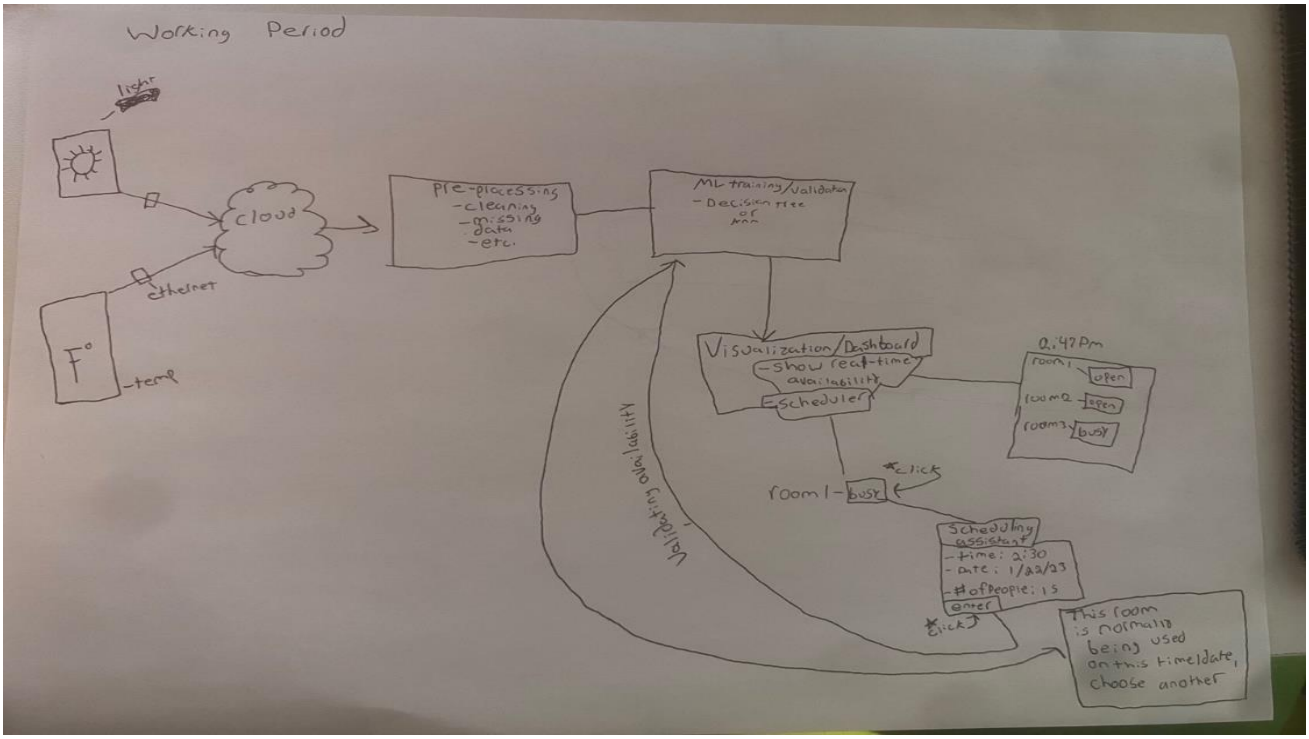
Using light and temperature sensors placed inside classrooms to detect ambient temperature and lighting, my program will be able to accurately predict if/when a particular classroom will be available and give a real-time overview of rooms (assuming the sensors are placed inside the rooms) that are currently open. The light sensor will play a heavy role because generally if the light of the classroom is on, there is a good chance somebody is in the classroom or just left. To verify the availability, the temperature sensors will be able to detect a change in the ambient room temperature as our bodies produce heat, which effectively will alter the temperature of the room. These sensors will be hooked up to Raspberry Pi’s (or Arduinos) that will be getting data every 5-10 minutes while simultaneously feeding the data through the ethernet ports in the classroom which then will be directed to either a cloud storage database or a local machine database that uses SQL. Raspberry Pi is one of the most popular single-board controllers (SBCs) due to the cost and availability of resources. Pi’s come with general input/output (GPIO) ports to make them a very versatile piece of technology. From there, the data will be fed through a preprocessing pipeline that will denoise the data, detect outliers, missing data imputation, data aggregation, and general data cleanup. Once the data has been processed, it will move to the machine learning model. As of right now, I am thinking about using an ensemble technique of different neural networks to be able to get the most accurate predictions, but that is subject to change as I get to that because I could find the system is too slow to be used practically. Truthfully, I think a decision tree may suffice because at the very root of this project, is it a classification problem. Once the data gets fed through the ML process, it will be ready for user input.

The dashboard of the system will provide input boxes, where one input box will be for scheduling classroom use in the future and allow you to select the date/time of the meeting and the number of students you have. From here, the user will be provided with a list of rooms that will be available within the time frame that was selected while simultaneously taking into account the number of students that will be attending to ensure plenty of space is available for everyone. The second method of usability is for real-time scheduling and the user wants to find a room right now. The user will simply put in how many people there will be and how long the session will last and then this action will ping the sensors to fetch data and feed it back to the user to tell which rooms are currently open/will be open for the allotted timeframe. I want to push the idea further to be more intuitive, such as when you are scheduling a meeting, it will ask you if this is a reoccurring meeting or a one-time thing. The purpose of that will be so the system does not get skewed data on classroom availability for future predictions.

I briefly touched on my motivation for this project in the executive summary, but that is not where it all comes from. I could have done something much simpler such as predicting sale prices or anything in that type of category, but I like to be different, and I want to make something that makes a difference/ is helpful. One thing about myself is that I want to be an innovator/entrepreneur, my goal would be to improve/refine this program as much as possible and potentially pitch the idea of adapting it to all classrooms within Bellarmine to provide the school with an effective method of scheduling rooms (consider how useful it would be for finding a room inside the library). Beyond that, this can be widely adopted inside businesses or even homes. And of course, Dr. Kelley helped plant this idea in my head, so going beyond just a class project, I would like him to be on board the team for the program if it was to be implemented officially.

Framework


Initial Data collection/training Period
-Will need at least a week or two to collect initial data & to train the system
Light sensor
(or this could be a local machine)
mySQL
ether-net
cloud storage
F°
Pre-processing
-cleaning
-missing data
-etc.
ML training
data store back in DB


Working Period
light
cloud
ethernet
F°
-temp
Pre-processing
-cleaning
-missing data
-etc.
ML training/validation
- Decision tree
or
ANN
Visualization/Dashboard
-show real-time availability
-scheduler
validating data
0:47 Pm
room1 open
room2 open
room3 busy
click
room1 - busy
Scheduling assistant
-time: 2:30
-date: 1/22/23
-#of people: 15
enter
click
This room is normally being used on this time/date, choose another

I will be using a predictive modeling method to achieve my goal of predicting room availability. Most likely, I will use a form of a decision tree to predict whether a room is open. A decision tree should work with this as the light sensor will emit a Boolean value (Yes or No, True or False, etc.). Along with that, the temperature of the room will generally remain consistent until there are people in the room, thus raising the temperature to a certain degree threshold that will be able to signify activity in the room. The only issue that comes to mind is the change of weather/seasons which will cause an increase or decrease in the ambient room temperature which I will have to adjust accordingly. It may be helpful to add a data stream of outside temperatures to give my model more accuracy as it will build a connection between the ambient room temperature and the outside temperature. I am going to experiment with multiple different types of models, such as possibly a voting ensemble/classifier paired with the decision tree to get the most accurate results.

This project will not only have real-world usability but solves a particular problem the schools & businesses have, which is being able to schedule meetings/gathering in rooms in a reliable/accurate manner. While I am sure many methods that I am using will change as I progress through this project, the main concept of predicting availability with light and temperature sensors will remain the same. For someone who has never worked with Raspberry Pi's or sensor data in general, it is surprisingly quite simple to accomplish because once you satisfy the connection from the sensor to the machine/database, you feed it into the rest of the pipeline. I am very excited to see how this project unfolds and how we might be able to take this concept to a higher level of implementation.