Large communal areas such as libraries, computer labs, etc. constantly battle the problem of limited space that isn’t utilized efficiently; at certain times, seating demand can be high but extremely limited. Individuals will spend an excess amount of time to find either no seating available, or unknowingly failed to discover an empty seat to begin with.

**PROBLEM STATEMENT**

**OUR SOLUTION**

Our system offers an automated solution capable of analyzing a given space for its vacant seats and number of occupants. This system is comprised of two main components:

1. A camera module that is mounted to the ceiling of a room, which:
   - Periodically captures an image and algorithmically searches for human subjects
   - Transmits this information to the display module

2. A display module, which:
   - Receives the information from the camera module
   - Presents the information via monitor

**TECHNICAL SPECIFICATIONS**

- Maximum range of communication: 60 meters (without obstructions)
- Height-to-field of view ratio: 10.8 feet : ~8 (feet x 10.4 feet)
- Update interval: 30 seconds
- Display connection type: HDMI
- Live feed  No storage of information

**PERFORMANCE & RESULTS**

VacanSee, while not producing a perfect analysis of occupancy, does successfully detect a human subject in the seated position. Through extensive tests, we found that our program produces a strong confidence in human detection; however, can occasionally detect false positives. This is simply due to the fact that machine learning algorithms require thousands upon thousands of sample images, which is clearly inviable for our application. With more time, this problem could be resolved through the process of hard-negative mining as well as providing more sample images. In short, hard-negative mining involves extracting the false positives from the test results and feeding those images back into the negative samples to use during the training stage.

**CONCLUSION**

Overall, we were very satisfied with our end product as we tackled a very challenging area of concentration. When we were brainstorming back in the Fall semester, we were not aware of the various challenges and sheer density of the subject. In terms of future considerations, we would propose utilizing WiFi communication that would enable us to use web-based applications such as cloud databases and Android application development. Ultimately, we gained an immense amount of insight and hands-on experience regarding the entire life cycle of a project.

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**SPECIAL THANKS TO OUR ADVISOR: LIANG CHENG**

**ACKNOWLEDGEMENTS:** WILLIAM HALLER, TED BOWEN, SHALINEE KISHORE, XIAOLEI HUANG, ARNO KONINGS, JACK WOODS