IoT Augmented ScaledHome Testbed with Diverse Scenarios

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ABSTRACT

ScaledHome is an IoT augmented physical scale model of a suburban home. It has no interface for users to check the condition of their home remotely like most IoT augmented homes. Thus, we emulate the simulation virtually to integrate domotics more thoroughly.

METHODS

- We made a more realistic model of the Sun, which moves across the environment
- We emulated the ScaledHome scenarios with the Tkinter library
- We tested the ScaledHome under various environments to analyze the patterns of doors opening and closing in the home. Cities ranging from Orlando to New York were modeled, and were given case by case scenarios ranging on the size of the families living in the home and the activities to provide a more diverse dataset for the airflow
- We tested the model with different insulation types (thick roofing, thin roofing, and transparent ceiling)

RESULTS

- The emulation syncs up to the scenario when executed, so that users may view the changes inside the home in real life simultaneously
- The transparent ceiling absorbed the greatest amount of light in comparison to the thin and thick roofing
- The scenario is automated so that users may input their schedule and the model will simulate the window and door patterns throughout the day and collect temperature and humidity data throughout the simulation

Augmenting a Virtual Emulation of ScaledHome allows for real time access to sensors remotely.

Figure 1: Experimental setup of ScaledHome, confined within the greenhouse. The motor controlling the Sun position is located on the right side of the picture, while the motor controlling the Sun tilt is on the suspended system itself.

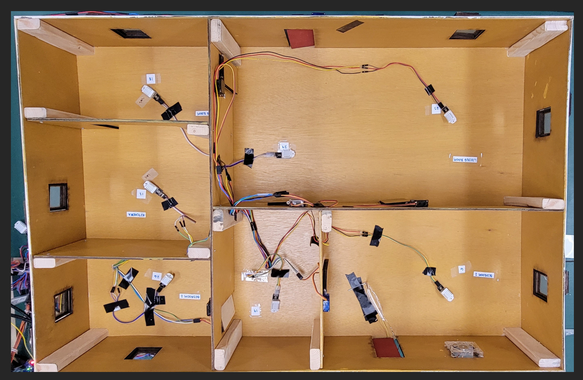

Figure 2: Interior design of ScaledHome Sensors for humidity and temperatures are located around areas of possible airflow such as windows and doors [1]

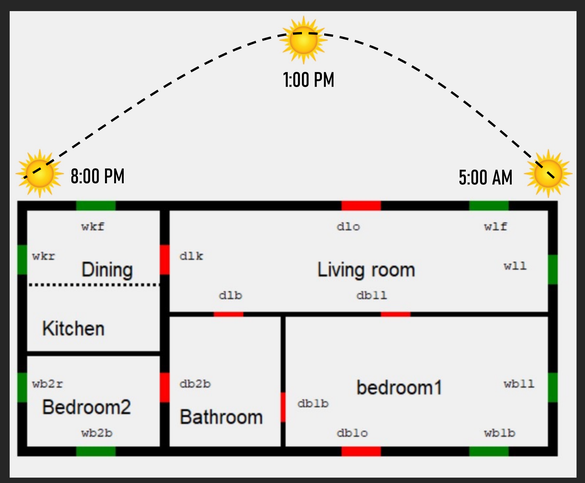

Figure 3: Virtual emulation of ScaledHome. The doors are labeled red while windows are labeled green. The sun moves from right to left.

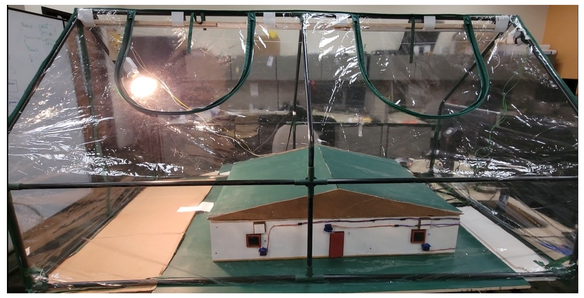

Figure 4: Simulation of summertime in Orlando, Florida.

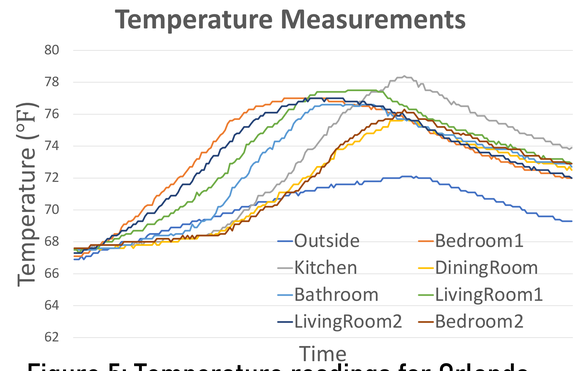

Figure 5: Temperature readings for Orlando simulation

CONCLUSION

- Dataset with different scenarios of home usage allows for diverse and realistic data
- Real time sensing improves practicality and scalability

FUTURE WORKS

- Open ScaledHome to public for remote simulation
- Training LSTM and Transformers model using the newly collected data
- Perform ablation study with different seasons

REFERENCES

[1] E. Sanchez, C. Petro, S. S. Bacanli, F. Cimen, L. Bölöni and D. Turgut, "Modeling Climate Management in a Smart Home using a Scaled Testbed with Accelerated Time," IEEE ICC 2022, May 2022.

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