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A recent *New York Times* investigative report revealed 34 large-scale operations of Bitcoin mines use at least 30,000 times as much power as the average U.S. home.

LABZ

MOPS Research Group Empowers Communities

Baldwin Wallace University

Located in Berea, OH, the Mobile and IoT for Planet and Society (MOPS) Research Group, founded in 2015 and affiliated with the School of Science & Engineering at Baldwin Wallace University, is an undergraduate research team dedicated to privacy, security, and sustainability with mobile devices, mobile applications, and embedded computing. Under the leadership of Dr. Brian Krupp, our group has six active researchers who engage in interdisciplinary work, collaborating closely with engineering and sustainability faculty and students.

One of our projects, Campus Plate, exemplifies our dedication to using computing to improve society and make an impact within our local community. At our home university, a study conducted in 2017 found that 53% of students had high food security, 24% had marginal food security, and 20% had low or very low food security. Supported by the EPA, Campus Plate is a mobile app and food distribution system designed to reduce student hunger, food insecurity, and food waste on our campus. The approach involves packaging extra food from dining halls and distributing it to designated food stops. Users, including students, staff, and faculty, can reserve these meals free of cost via our mobile app, which is available on both iOS and Android platforms. Importantly, our system prioritizes privacy, ensuring students' identities remain confidential. Upon reservation, users receive a unique code to present to Food Stop Managers for meal collection. Campus Plate has successfully recovered 2,997 meals across our seven food stops since its launch in 2021. It is still active on campus today.

In the summer of 2022, we launched the Fine-Grained Air Quality Sensing project, which the NSF recently funded. This initiative seeks to establish a cost-effective, low-power Internet-of-Things (IoT) sensing network throughout Cleveland, OH. Traditional regulatory air quality sensors are expensive, making them inaccessible to many communities, especially those most affected. Additionally, in Cleveland, there is a large steel mill next to a historically redlined neighborhood on the east side of the river. Still, the EPA sensor is on the west side, making it unable to capture accurate air quality data for that community and Cleveland as a whole since there is a single sensor for an area of more than 400 square miles. In response, we've leveraged low-cost sensors capable of detecting particulate matter (PM) to provide localized, real-time air quality data. Our IoT setup combines Raspberry Pi and Arduino boards with PM sensors to focus on PM 2.5, known for its harmful impact on human health. Partnering with PCs for People, a company specializing in refurbished electronics to eligible customers for affordable prices, we deployed three sensors in Cleveland using their Wi-Fi hotspot towers. Our pilot deployment showed a significant difference between two locations less than four miles apart, supporting the need for fine-grained air quality monitoring. We also noticed substantial trends in higher PM 2.5 levels during rush hour in the mornings and evenings and a very high level corresponding with the 4th of July fireworks show in Cleveland. Currently, we are exploring opportunistic sensing to eliminate connectivity dependencies, integrating LoRa technology, and collaborating with engineering students to develop suitable housing units for our sensors. Our current goal is to have a campus-

Mercedes-Benz has partnered with Nvidia to use the Omniverse platform to create realistic models to test prototype vehicles, provide remote assistance to trainees, and launch VR showrooms to sell cars.

wide sensor deployment to observe trends and troubleshoot issues before deploying more sensors across Cleveland. Additionally, we are working on creating a middle/high school curriculum to empower students with computer science skills while teaching them about air quality.

As an undergraduate team, we have members interested in industry and academia and encourage their growth by having them present their research at various conferences. We presented our pilot deployment research results in Boston at ACM SenSys 2022, Ohio Chapter of Women in Computing (OCWiC 2023), and Cleveland Big Data Meet-Up 2023. Through these presentations, we received lots of great suggestions about how to use our data meaningfully from an audience of data scientists, professionals, students, and academics. We eagerly anticipate sharing further insights at ACM Midwest CCSC 2023 in October and look forward to the feedback and ideas we will gather about our project and research, which will help us as undergraduate students and researchers.

As a research group, we remain dedicated to growing each MOPS student while making meaningful contributions to computer science research. Since we are solely an undergraduate group, we let our researchers dive deep into various areas they are interested in or curious about. We have 22 alums who have excelled in industry and academia, using skills and knowledge gained through their participation in MOPS research. We want MOPS to be a fun, innovative, and meaningful part of the undergraduate experience while building projects that last beyond our undergraduate years.

If you want to learn more, please visit our website at https://mops.bw.edu/.

—Julia Gersey

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BACK

Humanoid Robots in Healthcare: Synergy of empathy and innovation

Humanoid robots have showcased remarkable utility in physical, occupational, and rehabilitation therapies. Those robots can emulate the appearance and demeanor of healthcare providers to assist patients in numerous ways, such as offering emotional support, guiding recovery exercises, providing medication reminders, monitoring patient progress, and much more.

In the cases of cognitive disease, such as Alzheimer's and dementia, traditional treatment plans predominantly relied on medication and cognitive exercises guided by healthcare experts, which necessitated considerable time and effort to deliver personalized care and companionship. Today, humanoid robots help with cognitive disease management by facilitating memory recall, providing medication reminders, engaging in tailored cognitive exercises, stimulating mental activity, and nurturing self-reliance among patients. They utilize machine learning algorithms to dynamically adjust their responses according to the individual preferences, needs, and progress of each patient. In addition, they employ various technologies, such as natural language processing, computer vision, edge computing and sentiment analysis, to learn insights from previous interactions. These insights enable them to deliver highly personalized support to patients.

Initially, humanoid robots in healthcare faced skepticism regarding its potential dehumanization of care. The adoption of humanoid robots has assisted plenty of healthcare providers and patients, especially during times of healthcare worker shortages. Recent studies also indicate the outcomes of robot-assisted cognitive treatment can be further enhanced by promoting patient's immersion and motivation. While encouraging the broader adoption of this approach has the potential to foster a more accessible, equitable, and inclusive healthcare system for all, it is crucial to perceive the development of humanoid robots as a synergy between human empathy and technological advancement rather than replacements for healthcare providers. Their invaluable experience and human empathy are irreplaceable when it comes to delivering healthcare.

—Zhongxuan He

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