CASHES: Growing Digital Intergenerational Health Behavior Solutions through Social Networking

College is meant to be a time when students gain knowledge and skills that guide them towards achieving financial security while becoming positive contributors to society, and developing supportive lifestyle habits.[1] Yet college students across the board struggle with forming positive patterns. Student health habits are at all time lows; many students do not even eat one serving of fruits and vegetables a day. Students are also rewarded for what amounts to long hours of inactivity (sitting down in class and while studying). Recent research has shown that helping others has also been linked to increased well-being, lower depression, and a reduction in the risk of dying.[2] Older adults are another vulnerable population with health disparities in mental and physical health.[3] Taking advantage of increased interest in social networking and gaming, I am proposing a smartphone application and backend system that partners students with older adults in a social network game of personal health.

This system is called Connected Asynchronous Student Health and Education System (CASHES), where each student is matched with an older adult and they work as a team to earn points together by creating challenges and tools for health through their smartphone sensors. By creating a social network of student and older adult teams, other team members will vote on which tool they "like" and will be given the opportunity to apply (or practice) the tool to gain more points. The challenges and their corresponding tools will attempt to tackle three main problems in student health: physical (sedentary lifestyles), nutritional (poor diets) and emotional (stress, anxiety, and depression) well-being. Since many students already feel an increased sense of stress related to academic competitions, teams will not directly compete against each other, but rather the system will reward the teammates by featuring the winner of the week (the tool with the most likes or most applied/practiced). Also, to empower the student and older adult to lead by example, physical activity, food intake and stress-related data collected from the smartphone will be shared between parties.

Technical Challenge

The system will model the information and connections between students, older adults, and the data collected through a heterogeneous network with multi-type objects and relations (e.g. a student node can be {male, or female}, and fruit can be an {apple, banana, orange etc…}). To represent the relations between nodes in the network the system will use meta paths. A novel meta path selection algorithm will be deployed to calculate the different weights of each relation path depending on how many students or older adults "like" or practice/share the tools. Figure 1 provides a sample network with five types of nodes, each student and older adult will have a probability of liking a tool depending on a-priori information established from the connections. Since not all students and older adults will "like" or practice a tool, a novel transductive classification algorithm[4] will be developed that attempts to predict, given a subset of the information in the network which tools the students and older adults may "like." Through this growing network and the transductive classification algorithm, recommendations can be made from the predictions for other students and older adults in the college or community outside the social networking game.

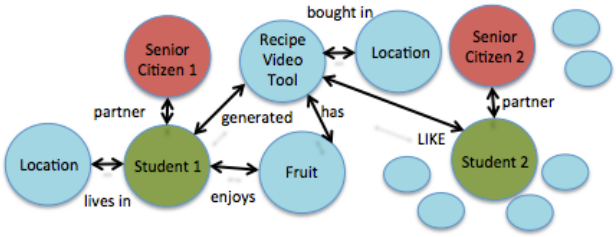

Figure 1: A heterogeneous network for CASHES.

Connecting Students and Older adults

Students and underserved older adults will be partnered to help each other in a game of health. A stable matching algorithm will be applied, using personal goals as a priority list. They will meet at the beginning of each quarter/semester to enter an agreement regarding which health habits (or goals) they would like to achieve. As an example, older adults might help students cope with stress or identify quick healthy recipes, while students may choose to help older adults improve their physical activity. This way each one helps the other to improve a health behavior and feels they have something to contribute that brings out the best in each party through a real-world perspective-creating experience.

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[1] Liu, K, Daviglus, ML, Loria, CM, Colangelo, LA, Spring, B, Moller, AC, Lloyd-Jones, DM (2012). Healthy lifestyle through young adulthood and the presence of low cardiovascular disease risk profile in middle age: the Coronary Artery Risk Development in (Young) Adults (CARDIA) study. *Circulation*, 125, 8:996-1004

[2] Konrath, S, Fuhrel-Forbis, A, Lou, A, Brown, S (2012). Motives for volunteering are associated with mortality risk in older adults. *Health Psychol*, 31, 1:87-96.

[3] Ziokowski, A, Blachnio, A, Pachalska, M (2015). An evaluation of life satisfaction and health - Quality of life of senior citizens. *Ann Agric Environ Med*, 22, 1:147-51.

[4] Sun, Yizhou, and Jiawei Han. "Mining heterogeneous information networks: principles and methodologies." *Synthesis Lectures on Data Mining and Knowledge Discovery* 3, no. 2 (2012): 1-159.

Smartphone Challenges: Physical, Nutritional, and Emotional Well-Being

The CASHES app will share health-related information between the student and the older adult. Each week the older adult and student alternate in creating a challenge that attempts to tackle one of their goals. A tool for this challenge will be presented in the form of a video, photo, recipe, physical trail/pathway, or story. The tool will then be presented to the other teams in the network providing an opportunity to "like," or apply/practice (points are earned by the creator and the one that applied/practiced the tool among the participants in the network).

Nutritional Well-Being Challenge: Participants will select a "superfood" in the supermarket using a barcode scanner provided by the smartphone application through the smartphone camera (or if no barcode is available they can manually enter the name). The challenge will then be to define a recipe using this "superfood" by scanning the barcodes of all the ingredients and/or creating a video to go with the recipe. Extra points are earned when using healthier ingredients (less sodium, more vegetables and fruits, less red meat, etc.). Other participants in the network can share their experience by scanning the food items in the store, or recording a video and sharing their own experience in cooking the recipe.

Physical Well-Being Challenge: Participants will be able to challenge each other to find novel and exciting tools to being more active. Using the smartphone GPS one could create a map of a beautiful route or pathway on campus by the botanical gardens, and the inertial sensors along with the temperature and humidity sensors (available in some smartphones) can determine how safe and difficult the pathway may be. One could also opt to create a video of the pathway or a video of a fun workout or routine. Other participants can "like" the pathway or share their experience of applying/practicing the tool by treading the path (validated by their own embedded GPS and inertial sensors).

Emotional Well-Being Challenge: Participants can record a nice story, soothing song, article, or beautiful painting that inspired them to relax and feel better. They could also record an activity or pathway or food recipe that helped them feel better.

The tool will become a separate node in the information network and connected to each descriptor (e.g. each recipe item, or GPS location, or song or story article). Each descriptor is generated automatically by the application and is also a node in the network. The app will also share the following information between each teammate: physical activity level, steps taken, distance traveled, caloric expenditure, heart rate, stress level, and snapshots of meals/foods consumed. This way students and older adults are leading by example and working to help each other improve their own goals and their teams tools in the social networking game. The app will reinforce the notion that education is important, but that caring for others along with physical, nutritional, and emotional well-being is equally so, and its successful deployment will see universities recognized for their commitment to both providing academic education, and also to producing holistically healthy students mindful of their own and their communities' well-being.

Broader Impact

CASHES will further improve student well-being while helping build a digital intergenerational community that continuously creates tools to help everyone. It will also tailor tools for different kinds of people while using social networking as a means for students and older adults to take joy in sharing and earning recognition. It will also enable us to come up with improved data analytics, meta path selection algorithms and transductive classifiers that will help predict what tools students and older adults may gain/benefit from. It will also create unique automated descriptors for each tool that will enable us to create a health and wellness profile for each participant.

Background of Proposer

Nabil Alshurafa is an Assistant Professor of Preventive Medicine and of Computer Science at Northwestern University. He received his PhD in 2015 from the University of California, Los Angeles (UCLA), and was part of the Wireless Health Institute (Computer Science Department). His research interests are in the area of embedded systems, computational modeling, data analytics and algorithm design. He has been awarded government grants for research and development of algorithms related to activity recognition and nutrition monitoring. Alshurafa has been heavily involved in a Wireless Health funded mentoring program, along with developing sensors and applications for community health. He holds four U.S. patents licensed to nationally renowned bio-medical device companies, and his research brought about "Wanda," a RHMS that has shown success in helping reduce risk factors in health disparate communities afflicted with cardiovascular disease, diabetes, sleep apnea, obesity, and AIDS. In collaboration with the UCLA School of Nursing, he also developed Wanda-CVD, a unique application added to smartphones that aided in behavior change resulting in cardiovascular risk reduction for young, at risk African American women in underserved areas in Los Angeles. He has also designed a "Fit-Bit for Diet" that is currently being licensed and commercialized by WearSens Inc. He also works with the BRITE Center, a National Institute of Minority Health and Health Disparities P60 Center, in the implementation and dissemination of a Korean youth smoking cessation project in collaboration with the Los Angeles County Tobacco Control and Prevention Program.