Overview:

Volunteer computing (VC) uses consumer devices such as PCs and smartphones for scientific computing. Currently 500,000 devices participate, with 2.3 million CPU cores and 290,000 GPUs. VC supplies 44 PetaFLOPS of computing power, and it could provide ExaFLOPS. VC has supplied computing power worth hundreds of millions of dollars, but at a much lower cost to funding agencies, because hardware and energy costs are borne by volunteers. Using the BOINC middleware system, VC can support high-throughput computing (HTC) applications in all areas of science. It has enabled breakthroughs in several areas, published in journals such as Science and Nature. However, VC’s potential is largely untapped. We propose work that will make VC a central part of the U.S. research cyberinfrastructure and bring its computing power to many thousands of scientists.

We will complete and extend current work adding BOINC-based VC back ends to existing computing providers: nanoHUB and the Texas Advanced Computing Center (TACC. Qualifying HTC jobs will be automatically migrated to VC and run on consumer devices. This will benefit thousands of scientists using nanoHUB and TACC by increasing HTC capacity and freeing HPC resources for other jobs. Scientists won’t have to learn or change anything – they’ll just get faster turnaround. These key integrations will provide software building blocks by which other computing providers (HPC centers and science gateways) can add VC back ends.

Secondly, we will develop “Science@home”, a new Web-based system in which volunteers register for scientific areas (such as biomedicine, environmental research, or astrophysics) rather than for specific projects. This approach simplifies marketing and PR by creating a single “brand”; it provides a flexible mechanism for allocating computing power; and it maintains a coherent public interface as the number of projects and applications increases.

Finally, we will do work aimed at increasing volunteer recruitment and retention, including a) conduct PR activities; b) integrate with social media such as Twitter and Facebook; c) develop new incentive and reward features; and d) work with corporate partners (Steam, Blizzard, EE, HTC) to target consumer product areas such as computer game systems and GPU-equipped mobile devices.

Intellectual merit: The proposed activity will significantly increase the computing resources available to scientists in areas such as nanotechnology, proteomics, genomics, climate modeling, epidemiology, cancer research, bio-fuels, and astrophysics. It will thereby both accelerate current research and enable new research in these fields. It will also address technical problems in the integration of heterogeneous and untrusted computing resources with existing HTC systems, and in scalable multi-objective resource allocation.

Broader impact: VC is the most widespread form of “citizen science”. It lets the public participate in cutting-edge scientific research projects. This increases public awareness of and interest in science, creates science-centered online communities, and creates a powerful channel for public outreach and education. The proposed activity will strengthen this impact by increasing the number of volunteers, broadening the range of research they can support and follow, and connecting thousands of scientists to this unprecedented pool of people and computing power.