**Strategic Project Grants Progress Report**

**Due Date: June 30, 2013**

**Covers the Period: September 30, 2011 to June 30, 2013**

**Is your personal information below correct? (please enter an “x” in the appropriate box)**

|  |  |
| --- | --- |
| **X** | **Yes** |
|  | **No** (please make the necessary corrections) |

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**Is the project information below correct?**

|  |  |
| --- | --- |
| **X** | **Yes** |
|  | **No** (please make the necessary corrections) |

**Project title:** Interactive and Visual Analysis Tools for Activity Monitoring Data

**File Number:** STPGP 413145 - 11

**Co-investigator(s):**

B.D. Fisher, Interactive Arts and Technology, School of (SIAT), Simon Fraser

M.J. McGuffin, Génie logiciel et des TI, École de technologie supérieure

**Collaborator(s):**

**Supporting Organization(s):**

E. Nerat, PureLink Technology Inc.

T. Kapler, Oculus Information Inc.

G.K. Mustapha, SMT Research Ltd

**1. Progress Towards Objectives/Milestones**

Using approximately 5 pages, please provide in the box below:

* a brief description of the overall objectives of the research project as awarded;
* the list of milestones as presented in the application and a description of the progress made towards each milestone/objective during the period covered by this report; and
* a description and justification for any deviations from the original objectives and a discussion of the path forward.

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| Section 4 of our original grant proposal explained our "proposed workplan", which was divided into objectives A1, A2, B1, B2, C1 - C5. Below, we present the progress made toward each of these objectives.  **Objective A1 - Observational studies and interviews with stakeholders (100% complete)**  People involved: F. Amini, Z. Hossain, P. Irani (U of M); S. Rufiange, Q. Ventura, S. Gupta, M. J. McGuffin (ETS); G. Mustapha (SMT); T. Kapler (Oculus); E. Nerat (Purelink).  As planned, we interviewed our 3 industrial partners (SMT, Oculus, and Purelink) to better understand the tasks that they need support for. In the case of Oculus and Purelink, we learned that talking directly to end customers about their tasks might not be as useful as we initially thought, because many customers only use basic features of the companies' software products, or use them in an occasional, casual fashion. We did, however, learn more about tasks to support for advanced users by talking to Oculus and Purelink, and also by looking at tasks that have been tested in previous literature (Kristensson et al., 2009). We also identified additional tasks for our own experimental comparison of 2D and 3D visualizations of movement data (Amini et al., submitted 2013); these tasks were chosen after 2 pilot experiments to more clearly demonstrate the respective strengths of 2D and 3D visualizations. We also identified a list of tasks for higher-level analysis of movement data in the course of developing the prototype described in (Gupta et al., in press 2013).  **Objective A2 - Taxonomy of spatio-temporal tasks and queries (100% complete)**  People involved: F. Amini, Z. Hossain, P. Irani (U of M); S. Rufiange, Q. Ventura, M. J. McGuffin (ETS).  We considered previously identified tasks, and previous taxonomies of spatio-temporal tasks and queries (Andrienko and Andrienko, 2005; Kristensson et al., 2009). We judged previous taxonomies to be insufficiently precise, and therefore sought our own. We held multiple group discussions, in person and over skype, and using a collaborative document editing tool (titanpad.com), to discuss ways to classify tasks and to modify previous taxonomies, however our initial attempts resulted in overly complicated classifications with ill-defined categories. Finally, in the course of preparing a journal submission, we hit upon a taxonomy with cleanly-defined categories, that was more precise than previous taxonomies, without being overly complex, and that was rich enough to classify all the tasks we had identified. This taxonomy is described in (Amini et al., submitted 2013) and is shown in a graphical form in the Figure 4 of that article (see attached PDF of the article). This work helped us understand that there are many more types of tasks than we initially expected, but nevertheless the taxonomy will serve to check if our future designs have covered all the important tasks that we need to support, somewhat in the style of a "heuristic evaluation" used in HCI. Furthermore, this elaborate task taxonomy is the first ever developed for spatio-temporal datasets and will assist our partners in structuring their future software development directions. Researchers will also be able to build upon this task taxonomy to advance techqniues for spatio-temporal data visualizations.  **Objective B1 - Methods for representing interrelated spatio-temporal data (visual representations, animations, hybrid visualizations) (60% complete)**  Amir Meghdadi, PDF at the University of Manitoba, developed a method to extract movement paths of persons from video data sources. Given that video data is inherently spatio-temporal in nature, we were able to collect large sources of movement data using this approach. He further designed novel methods for summarizing and browsing the data. This led us to turn ou attention to video (or spatio-temporal data) summarization methods, which has attracted attention from 2 new partners (Wire Services and The Northwest Company).  Quentin Ventura, at ETS, has developed a novel hybrid visualization of movement data within buildings, that was of interest to Purelink. He is currently evaluating this prototype with users, and we intend to submit a paper about it in the coming 2 weeks. Ventura will soon finish his master's thesis about this project.  Shrey Gupta, at ETS, has developed a visualization of movement data over city-sized areas. His prototype uses two 2D views (one geographic, one based on a Gantt chart), and emphasizes meeting places between people. This prototype is being developed in collaboration with Oculus, with whom ETS has had approximately 10 meetings over the course of several months to discuss progress. A poster abstract about this project, co-authored with Tom Kapler of Oculus, has been accepted for publication at the IEEE VIS 2013 conference (listed in References below, under Gupta et al.). Gupta is now beginning a master's degree to continue this project.  Sébastien Rufiange, at ETS, developed and evaluated a hybrid visualization of time-varying network data, which has been accepted for publication in TVCG (Rufiange and McGuffin, 2013). Although the data involved is not movement data, Rufiange's visualization is related to the goals of our project in that it is a hybrid combination of animation and small multiples. This work taught us that hybrid visualizations must be used carefully, because they can be confusing for users, and the effect they have on user performance can be complicated.  Fereshteh Amini, PhD student at the University of Manitoba has been working closely with industry partner SMT Research (SMT) which is a Canadian firm in Vancouver that deploys sensor devices for structural monitoring and is interested in advance data analysis that enable easy harnessing of required information from their massive database of sensor readings by people with any background ranging from engineers and analysts to building owners, and building workers. The input from SMT has been important in understanding the data and its associated tasks throughout the design process. The work so far has resulted in the design and development of visualization tool capable of representing instantaneous sensor readings and trends over time while allowing direct and quick correlation of these multi-dimensional values with the physical location of the sensors. Inspired by how SMT generated reports in their day to day workflow and by the concept of annotating over printed floor plans to report sensor readings to clients and others, the designed visualization brings temporal information on to the 3D model of the building using small data graphs (i.e. Sparklines) and color coding of different regions associated to each sensor based on the instantaneous values for the selected time. The resulting visualization is expected to facilitate the analysis and sense making process and is currently under evaluation by the domain experts testing it under different projects and use case scenarios (e.g. roof monitoring). The visualization method and the evaluation results will be submitted to a high tier journal or conference in a near future.  **Objective B2 - Semi-automatic filtering and designing for small screens (40%)**  In the section about objective B1, above, the projects by Shrey Gupta and Quentin Ventura both involve filtering information. Gupta's project does this by reducing movement data to transitions between key geographic locations, and Ventura's does this by summarizing detailed movements to transitions between rooms in a building. This kind of summarization allows us to list key locations, for example, as rows in a Gantt chart.  MSc student Zahid Hossain at the University of Manitoba, has developed a technique FlockViz for showing the collective properties of clusters of data sets. While not intially designed for small screens, the next stage will be to shrink the visualizations further to place them on small screens. This will allow at-a-glance inspection of properties of clusters on small devices.  Regarding small screens, Céline Pelletier, an intern at ETS in the summer of 2013, worked with McGuffin to develop a code infrastructure for collaborative, pen-based editing of documents over multiple networked Android tablets. This infrastructure could serve as the basis for further work where movement data is visualized on tablets and/or with pen-based annotation and/or in a collaborative manner with many devices on a network.  **Objective C1 - Going beyond traditional dynamic queries (30% complete)**  To explore advanced techniques for coordinated views, Shrey Gupta has implemented a "snakes" technique in his prototype, which highlights selected contiguous segments in a geographic map and a Gantt chart at the same time.  Furthermore, Maxime Dumas at ETS has performed a literature review of interactive lenses and selection techniques for selecting points, lines, or curves within large data sets. This will be useful for designing new interactive techniques for selecting trajectories within large movement data sets.  Summer student Paymahn Moghadasian at the University of Manitoba (summer 2012), devised a novel technique for filtering large datasets. This technique summarizes the values in a dataset into bins, and allows rapid access by allowing users to select the relevant bin, and then perform detail queries once the user has navigated to the bin.  **Objective C2 - Advanced fluid multi-touch gestural input (30% complete)**  Michael McGuffin at ETS developed a novel multitouch radial menu. This will soon be evaluated in a controlled experiment with help from Maxime Dumas at ETS, and submitted for publication. This menu could be used in visualizations, as well as many other applications involving multitouch input.  Objective C3 - Immersive analytics (with mobile devices); (40% complete)  Objective C4 - Collaborative spatio-temporal analysis; (20% complete)  Objective C5 - Annotation (20% complete)  The code infrastructure developed by Céline Pelletier, mentioned above related to objective B2, also addresses aspects of C3, C4, and C5, since it works on mobile devices, supports real-time collaboration, and pen-based input.  Ashik Rabbani, MSc at University of Manitoba, was assigned the task of designing an immersive visual analytic system (objective C3) for movement data. For this, he extracted movement paths of users from videos and has conducted prelimary evaluations of how accurately observes of such data can perform analytic tasks, when specifically they hold the content on a mobile device and move within the enviroment. This work is now continuing with PDF Amir Meghdadi and Ashik Rabbani.  Another form of annotation is visible on Amini`s project. She explored the possibilty of annotating graphically sensor data values. These annotations are small representations of the data, super-imposed on the spatial maps of a building`s floor plan.  **Additional achievements not originally planned**  - Several of us (Amini, Hossain, Irani at U of M; and Rufiange, Ventura, McGuffin at ETS) conducted a controlled experiment to compare 2D and 3D visualizations for performing tasks involving movement data. This spanned about 12 months, and involved developing a software prototype for both visualizations, performing 2 pilot experiments and 1 full experiment, and more than 10 skype meetings between all of us. The outputs of this activity were a better understanding of the strengths of 2D and 3D visualizations, which is relevant for Oculus, as well as a submitted journal article (listed in the References below, as Amini et al.).  - Amir Meghdadi impemented a system to extract movement data from video and subseuqently designed methods to summarize long video footage. The extraction algorithms have been useful throughout the project, give the lack or shortagae of that type of actual dataset. This was motivated as we needed to get movement data for the various stages of our project. This helped us get the data an also resulted in a IEEE TVCG journal paper.  - Shrey Gupta at ETS developed algorithms to analyze movement data to find locations (of some maximum radius) where people remain for some minimum amount of time, and also extracts meeting events between multiple people. These algorithms are useful within Gupta's prototype visualization, and the source code for the algorithms have also been given to Oculus (as they requested) for their use.  - Rory Finnegan at UofM, developed 3D visualization tools for showing spatio-temporal datasets in a large immersive and stereop-scopic display. This was accompanied by methods for querying the data using tangibles that can be manipulated directly.  - Hina Aman at the UofM, designed a system to correlate text information from spatio-temporal regions, and visualize the common themes in the data. This for instance is crucial for disaster relief by identfying what are the needs of the local people during the disaster and to be able to address these specific needs by exmaining the visualizations.  - Six members of the lab at ETS generated a real high-resolution movement dataset by having their cell phones tracked by GPS over a 1 month period. Over this one month, multiple group meetings were held at ETS as well as at a few restaurants for group meals; these created real meeting events in the collected data. This data has been used internally at ETS to test prototype visualizations, such as the one developed by Shrey Gupta.  - Quentin Ventura at ETS developed a powerful graphical tool for generating synthetic movement datasets, that was used for our 2D vs 3D experiment. The tool has a graphical user interface for defining locations on a 2D map and defining temporal constraints, and can simulate movements of multiple people through the desired locations, automatically solving for shortest paths and input constraints. Oculus has expressed interest in this tool, and the source code for the tool will be given to Oculus after the code has been polished in the fall of 2013.  - Quentin Ventura, a student at ETS, spent a 6 month internship at Purelink, during which he developed a library of graphical routines to improve the graphical rendering of Purelink's software products. This library was developed under Purelink's direct supervision, following their source code conventions and practices. This internship was a requirement of Ventura's program of study.  **Comparison with originally proposed time-line:**  - Our progress for objectives A1, A2, B1, and B2 are on schedule with the original proposal.  - Our progress for objectives C1, C2, C3, C5 have been slower than expected. This is justified because multitouch input and mobile devices are a lower priority for our industrial partners than we had originally anticipated, and also because we decided to focus on the activities listed in the section above "Additional achievements not originally planned" which we decided were a higher priority, and in many cases of direct interest to our industrial partners.  - Our progress for objective C4 is ahead of schedule, as work on C4 was planned to only begin in the 3rd year of the project.  **Principal directions for future work:**  - Shrey Gupta will continue his prototype visualization of meeting events for his master’s degree, and McGuffin and Gupta will continue to hold regular skype meetings with Oculus about this work.  - Maxime Dumas will work with Oculus on visualizations of movement data that are more scalable to large data sets (large in terms of number of points, and/or time span, and/or number of moving objects). This has been identified as a priority topic by Oculus.  - Ashik Rabbani will continue to work in tools for immersive analytics, a focus that has significant amount of novelty and of interest to partner SMT, where analysis can take place in the field of investigation, such as on a roof for detecting and isolating water leaks (as task commonly performed by SMT-Research).  - Dale Hilderbrandt will continue working on novel ways of displaying spatio-temporal datasets, including methods using stereo-scopic displays.  - Fereshteh Amini will continue investigating ways that one can related spatio-temporal datasets to end-users of the data.  References:  F. Amini, S. Rufiange, Z. Hossain, Q. Ventura, P. Irani, M. J. McGuffin (submitted 2013). 2D versus 3D: The Impact of Interactivity on Visualization of Movement Data. Submitted to IEEE Transactions on Visualization and Computer Graphics (TVCG) in June 2013.  Andrienko, N., Andrienko, G. (2005). Exploratory Analysis of Spatial and Temporal Data: A  Systematic Approach, Springer-Verlag, 2005.  S. Gupta, M. J. McGuffin, T. Kapler (in press, 2013). Visualizing Locations of Interest in 2D GPS Movement Data. 2-page poster abstract, accepted for publication at the IEEE VIS conference, to be held October 2013. <http://ieeevis.org/>  P. O. Kristensson, N. Dahlbäck, D. Anundi, M. Björnstad, H. Gillberg, J. Haraldsson, I. Martensson, M. Nordvall, J. Stahl (2009). An Evaluation of Space Time Cube Representation of Spatiotemporal Patterns, IEEE Transactions on Visualization and Computer Graphics (TVCG), 2009, 15(4).  S. Rufiange, M. J. McGuffin (in press, 2013). DiffAni: Visualizing Dynamic Graphs with a Hybrid of Difference Maps and Animation. A 10-page paper accepted for publication in IEEE Transactions on Visualization and Computer Graphics (TVCG), 2013, Proceedings of the IEEE Information Visualization Conference (InfoVis) <http://ieeevis.org> |

**2. Research Team**

Please provide an overview of the participation in, and scientific contributions to, the project for each member of the research team (principal investigator, co-investigators, collaborators, company and government scientists, research associates, postdocs, students, etc.).

|  |
| --- |
| University of Manitoba   * Dr. Pourang Irani – PI * Dr. Amir Meghdadi – Postdoctoral fellow * Fereshteh Amini – PhD * Zahid Hossain – MSc * Hina Aman – MSc * Dale Hilderbrandt – Winter 2013 undergraduate student * Ashiak Rabbani – MSc * Paymahn Moghadasian – Summer 2012 undergraduate student * Rory Finnegan – Fall 2012 undergraduate student   Ecole Techonolgie Superieure   * Dr. Michael McGuffin – Co-PI * Sebastien Rufiange – PhD * Maxime Dumas - PhD * Quentin Ventura – master’s student * Shrey Gupta – undergrad summer intern 2013; master’s student starting fall 2013 * Céline Pelletier – undergrad summer intern 2013   Simon Fraser University   * Dr. Brian Fisher – Co-I   Oculus   * Tom Kapler – Research Director * BilL Wright – President   SMT Research   * Gamal Mustapha – President * Farhan Masud – Lead programmer * Derek Gregory – Lead researcher |

**3. Training**

Please list **each** trainee (Undergraduate Students, Master’s Students, Doctoral Students, Postdoctoral Fellows, Research Associates, Technicians …) on a separate line in the table below providing: a) the number of years they have been on the project, b) the percentage (%) of time each type of trainee spent on this project, and c) the percentage (%) of funding from this strategic grant. If a trainee is fully paid from other sources, enter “0” in the “% of funding from this grant” column. Insert additional rows if necessary. (DO NOT INCLUDE PERSONAL NAMES.)

|  |  |  |  |
| --- | --- | --- | --- |
| **Specify type of trainee (e.g. M.Sc., Ph.D. etc)**  **(one trainee per line)** | **(a)**  **Number of calendar years on the project** | **(b)**  **% of research time spent on this project** | **(c)**  **% of salary from this grant** |
| PDF | 1.5 | 80 | 80 |
| PhD | 1.5 | 100 | 100 |
| PhD | 1 | 20 | 25 |
| PhD | 0.5 | 10 | 5 |
| Master’s | 2 | 100 | 100 |
| Master’s | 0.75 | 60 | 100 |
| Master’s | 2 | 70 | 20 |
| Master’s | 2 | 100 | 100 |
| Master’s | 0.5 | 100 | 100 |
| Undergrad intern (Summer 2012) | 0.5 | 100 | 100 |
| Undergrad intern (Fall 2012) | 0.5 | 100 | 100 |
| Undergrad intern (Winter 2013) | 0.5 | 100 | 100 |

**4. Dissemination of Research Results and Knowledge and/or Technology Transfer**

4.1 Please provide the number of publications, conference presentations, and workshops to date arising from the research project supported by the grant in the table below.

**Publications, Conference Presentations, etc.**

|  |  |
| --- | --- |
|  | None to date |

**- OR -**

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| --- | --- | --- | --- |
|  | **Number of publications, presentations…** | | |
| **Status** | **Refereed**  **Journal Articles** | **Conference**  **Presentations/**  **Poster** | **Other (including Technical Reports, Non-Refereed**  **Articles, etc.)** |
| **Accepted/Published** | 1 | 1 |  |
| **Submitted** | 1 | 3 in preparation |  |

4.2 Please provide the bibliographical reference data for the above publications, conference presentations and workshops under the corresponding headings. For publications, specify whether submitted, accepted or published.

**Refereed Journal Articles:**

|  |
| --- |
| F. Amini, S. Rufiange, Z. Hossain, Q. Ventura, P. Irani, M. J. McGuffin (submitted 2013). 2D versus 3D: The Impact of Interactivity on Visualization of Movement Data. Submitted to IEEE Transactions on Visualization and Computer Graphics (TVCG) in June 2013, 14 pages.  A.H. Meghdadi, and P. Irani (2013) Interactive exploration of surveillance video through action shot summarization and trajectory visualization, IEEE Conference on Visual Analytics Science and Technology, to appear in IEEE Transactions on Visualization and Computer Graphics (TVCG) in October 2013, 10 pages. |

**Conference Presentations/Poster:**

|  |
| --- |
| S. Gupta, M. J. McGuffin, T. Kapler (in press, 2013). Visualizing Locations of Interest in 2D GPS Movement Data. 2-page poster abstract, accepted for publication at the IEEE VIS conference, to be held October 2013. http://ieeevis.org/ |

**Other (Including Technical Reports, Non-Refereed Articles, etc.):**

|  |
| --- |
| H. Aman, F. Amini, P. Irani (2013) Geo-Temporal Tag Cloud: Visualizing Crisis Maps, in preparation for submission to PacificVis 2014.  Z. Hossain and P. Irani (2013) FlockViz: A Visualizing Technique for The Properties of Spatio-temporal Cluster, in preparation for submission to PacificVis 2014.  Q. Ventura, M. J. McGuffin (in preparation 2013). TopoGeo: a hybrid visualization of movement data within building floorplans. In preparation for submission to PacificVis 2014. |

* 1. **Patents and Licences**

Please provide in the table below the **number** of patents (filed and issued) and licences to date arising from the research project supported by the grant in the table below. (Provide details in 4.4.)

|  |  |
| --- | --- |
|  | Not applicable |

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| X | None Yet Filed/Issued |

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| --- | --- | --- | --- | --- | --- |
|  | **Number of Patents** | | | | |
| **Description** | **Canada** | **U.S.** | **EP** | **Other** | **Totals** |
| **# of Patent Applications Filed** |  |  |  |  |  |
| **# of Patents Issued** |  |  |  |  |  |

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| --- | --- | --- |
| **# of Licences** |  | **(Provide details in 4.4.)** |

4.4 Please provide details (titles, patent application number, patent number…) about the above listed patent applications, patents, and licences under the corresponding headings.

**Patent Applications Filed:**

|  |
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**Patents Issued:**

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**Licences: (licencees, exclusive/non-exclusive…)**

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4.5 Describe how the results achieved to date are being transferred to the user sector and the prospects for their commercial/industrial exploitation or their use by other sectors (e.g., revising or formulating policy or regulations).

**Prospects for the Transfer of the Results to the User Sector**

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| There is potential for three forms of transfer of results to the end-user sector  With SMT Research: Current development is taking place with SMT Research to integrate research output, in particular software prototypes into their mainstream buidling analytic system. Discussion is in place to identify the suitable architecture to transform the system designed by Amini and to integrate this into their tools. Amini is working with two members of SMT, Farhan Masud and Derek Gregory.  With Oculus:  Our current results have clarified some of the benefits of using 3D visualization for space-time data, which is relevant for Oculus’ flagship software product, GeoTime. We have also identified 3 directions for work that are directly relevant to Oculus: (1) Designing visualizations of data that is derived from raw movement data, such as locations travelled to and meeting events. This line of research is well under way with work done by Shrey Gupta, who will present a poster about his work up to now, and continue working on it for his master’s degre, in close collaboration with Oculus. (2) Visualizations that scale up to large data sets, e.g. with many points, and/or long time spans and/or many moving objects. Oculus has identified this as another priority for them, and Maxime Dumas will be working with them to define and prototype ideas around it. (3) We are also experimenting with a new 3D stereoscopic platform to identify if they can significantly aid the analysis of movement data in a product similar to GeoTime. This work began with students Hilderbrandt and Finegan at the UofM and will continue with Hilderbrandt for another internship.  With new partners:  Our recent results in movement data analysis has evoked interest in two other firms. The first is The Northwest Company (based in Winnipeg), the largest retailer of consumer goods in the Northern Territories. They are interested in movement data analysis to investigate patterns of their customers in their retail environments. The tool designed by post-doctoral fellow Amir Meghdadi will serve the purpose of motioring movement of buyers in their retail stores. Additional visualization modules are necessary to suit their particular needs.  Furthermore, Wire Services, a division of Manitoba Hydro International (based in Winnipeg), has pioneered and gained over 12 years of experience in performing LiDAR surveys and transmission line analysis to customers all over the world. Currently Wire Services is working with ING Robotics Aviation (in Ottawa) to expand its business to facilitate more detailed power line inspection using UAV imagery. ING Robotics is an Ottawa based company that provides airborne sensing solutions using UAVs. The specific challenge that Wire Services needs to have addressed, for which the HCI lab at the UofM was invited to work on, consists of providing a practical and efficient solution for browsing and examining very lengthy video imagery. This is a direct result of work done by PDF Dr. Amir Meghdadi on this Strategic project. In particular, the novel methods we have derived for summarizing movement is being sought after by Wire Services. This collaboration is significant for Wire Services who is currently pursuing a contract with an international firm to provide power line analytics based on our tools. This has recently (in the last two weeks) led to an NSERC Engage proposal, and Wire Services is highly interested in a Strategic grant or a CRD. This would not have been possible without the current focus of the given Strategic project grant. |

**5. Problems Encountered**

Identify the main problems encountered during this instalment of the grant from the list below (select all that apply):

|  |  |  |
| --- | --- | --- |
|  | Technical or scientific problems | |
|  | Problems with direction of research or findings | |
|  | Equipment and facilities | |
|  | Staffing issues (including students) | |
|  | Funding problems | |
| X | Partner withdrew from project | |
|  | Partner interaction issues | |
|  | Other (specify) |  | |

**- OR -**

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|  | No problems occurred during this instalment of the grant |

Briefly describe the main problems identified above and the steps taken to resolve each one.

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| One problem encountered was that one of our original partners, Purelink, withdrew from the project. The primary reason for this withdrawal was over issues related to IP ownership. Quentin Ventura spent a 6 month internship at Purelink developing a code library to improve the graphics rendering in Purelink’s software, and as agreed at the start of the internship, Purelink would own the IP of this code library. This initial internship was intended to be for training and did not involve research. However, Purelink and ETS subsequently disagreed over how to proceed with the research phase of Ventura’s work. Purelink preferred that Ventura continue working in their offices, without pay, with Purelink retaining control over all subsequent IP, including having final say over what would be published, whereas ETS and Prof. McGuffin required that the student be able to work in a way that would not preclude publication of research results and not automatically surrender all IP to Purelink. In addition to this issue, Purelink was very hesitant to share data with us. McGuffin’s team adjusted to this impasse by subsequently working more closely with Oculus, and also by generating data sets in the lab as well as leveraging publically-available open datasets such as data from the GeoLife project. We also overcame this challenge by building our tool (by PDF Amir Meghdadi) to etract movement data from video sources. This eventually became its own project and has been accepted to the prestiguous IEEE Transactions on Visualization and Computer Graphics. |

1. **Collaboration with Supporting Organizations**

6.1 Who initiated this strategic project?

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| --- | --- | --- |
| X | The university researcher | |
| X | The industry partner (if applicable) | |
|  | The government partner (if applicable) | |
|  | Other (specify) |  | |

6.2 In what way were the partners directly involved in the project (select all that apply)?

|  |  |
| --- | --- |
|  | Partners were not involved in the project apart from their financial and/or in-kind contributions |
| X | Partners were available for consultation |
|  | Partners provided facilities |
|  | Partners participated in the training |
|  | Partners received training from university personnel |
| X | Partners discussed the project regularly with the university team |
|  | Number of meetings during the period covered by this report:\_\_ > 45 meetings \_ |
| X | Partners were involved in the research |

6.3 Describe the partner’s involvement and comment on the collaboration.

|  |
| --- |
| Our partners, Oculus and SMT-Research have been exceptional collaborators. We have had very open exchanges and consultations as a result of their engagement. SMT-Reesarch has also generously provided us access to their data along with in-kind time of their staff and resources for advancing the goals of this project. |

6.4 Was any cash committed to this project?

|  |  |
| --- | --- |
|  | Yes |
| X | No |

6.5 Was any in-kind committed to this project?

|  |  |
| --- | --- |
| X | Yes |
|  | No |

6.6 If any cash or in-kind was committed, please enter the amounts below, along with the amount of cash and in-kind that has been received (if any) to date. If no cash or in-kind was received, please enter “0”. Where cash or in-kind was not committed enter “n/a”.

|  |  |  |
| --- | --- | --- |
|  | **Amount Committed** | **Total Amount Received to Date** |
| **Cash** | n/a | n/a |
| **In-Kind** | Oculus Info - $20,000  SMT-Research - $20,500 | Oculus Info - $19,450  SMT-Research - $33,920 |

6.7 Describe the in-kind received and explain variations between commitment and actual cash and in-kind contribution if applicable.

|  |
| --- |
| In-kind from Oculus Info  Oculus has given us two licenses for their GeoTime software, and annual maintenance for each, over two years, amounting to $8,850. Having access to Geo-Time has been crucial in the development of our own prototypes and visualizations. In addition to these, we have counted over 53 hours of consultation with Oculus team (32 hours of in-person meetings in Toronto and Winnipeg, 15 hours of skype/phone meetings, 6 hours of reviewing paper drafts), which at a rate of 200$/hour (burdened rate), amounts to $10,600. This yields a total of 8,850+10,600=$19,450 contributed by Oculus.  In-kind from SMT-Research  SMT-Research generously offered all the data it has collected on over three different projects. In addition, our student regularly engaged with members from SMT. The costs of storing, collecting and managing such data was approximated at $24,000 over two years (12K/year). In addition, SMT engaged in weekly dialogue with senior PhD student Fereshteh Amini and added two other personnel other than Mr. Mustapha (which was the intial plan as per the proposal), Derek Gregory and Farhan Masud. These conversations over 2 years total an amount of 45 hours over two years. We also had a day-long meeting with President Mr. Mustapha in Winnipeg (8 hours). It is estimated that since the start of the project till now the time spent by SMT is approximately 62 hours. Total in-kind: 24,000 (for data) + 62 \* $160/hr (burdened rate) = $33,920 (for 2 years). |

**7. Financial Information**

The purpose of this section is to provide additional project-specific detail; it cannot be substituted with a Statement of Account (Form 300).

Please provide the following financial information:

|  |
| --- |
| **$ 799.85** |

Amount remaining in grant account as of June 30th:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Budget Item | Budget for Year 1 | Actual Expenditures | Budget for Year 2 | Actual Expenditures to date in current grant year | Projections from now to September 30 (current year) | Planned Expenditures for the Next year of Support |
| **Salaries and Benefits** | | | | | | |
| Students | 104,500 | 79,831.52 | 104,500 | 121,549.92 | 8,500 | 104,500 |
| Postdoctoral fellows | 19,250 | 22,500 | 19,250 | 8,229.78 |  | 19,250 |
| Technical/professional assistants | 0 |  |  |  |  |  |
| Other (specify) | 0 |  |  |  |  |  |
| **Equipment or Facility** | | | | | | |
| Purchase or rental | 3,300 | 6,078 |  |  | 4,500 |  |
| Operation and maintenance costs | 3,400 |  | 3,400 |  | 3,400 | 3,400 |
| User fees |  |  |  |  |  |  |
| **Materials and Supplies** | | | | | | |
| Materials and supplies |  | 57.61 |  |  |  |  |
| **Travel** | | | | | | |
| Conferences | 6,000 | 3,980.06 | 6,000 | 4506 | 1200 | 6,000 |
| Field work |  |  |  |  |  |  |
| Collaboration/consultation | 2,000 | 3,115.76 | 2,000 | 3851.5 | 1,500 | 2,000 |
| **Dissemination Costs** | | | | | | |
| Publication costs |  |  |  |  |  |  |
| Other (specify) |  |  |  |  |  |  |
| **Other (specify)** | | | | | | |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Totals** | 138,450 | 115,562.95 | 135,150 | 138,137.20 | 19,100 | 135,150 |

Please provide detailed explanations for any deviation in the current period and in the budget for the coming year. (Note that deviations from the budget of greater than 20 per cent require pre-approval from NSERC.)

|  |
| --- |
| There are no foreseable deviations from the intial proposal. |