ECE 4012 Project Summary

Project Title	Swimming Tango: Underwater Implementation of Visual Odometry
Team Members (names and majors)	Anupam Goli, CmpE: Team Leader Rishabh Ananthan, EE: Web Master
Advisor / Section	Mick West / L7A
Semester	Spring 2016 Circle: Either Intermediate (ECE4011) or **Final (ECE4012)**
Project Abstract (250-300 words)	The project is aimed at creating an underwater means of visual odometry that also has ability to communicate via text for the U.S. Department of Defense. The goal is to limit the size of the hardware to within the profile of a handheld tablet. This is to help them link divers and topside personnel for increased diver safety and navigational accuracy. Our team will focus on the visual odometry aspect, with another team handling the communications aspect of this device. The navigation component will include implementing sensors such as a 2D sonar scanner, an inertial measurement unit (IMU) and a pressure transducer. The sensors will measure and record acceleration and deceleration on the vertical, horizontal, and transverse planes, data about the landscape and topography of the environment, and information on obstacles and how to avoid them. The mapping component of the project will utilize sensory data as well as imaging data (such as images or pointclouds) and create a visual odometry implemention similar to that of the 'Explorer' app in Google's Project Tango. The sensory data will be analyzed and processed using algorithms such as the FAST corner detection algorithm. The end goal of the mapping would be to produce a visualization of the underwater environment, which can then be viewed and used for robotic purposes. This product would help deep-sea divers find their way back to their starting point should they get lost while under the water. The device would also be designed in such a way as to complement the divers' Underwater Breathing Apparatus and not interfere with their gear or buoyancy.

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List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	• Universal Serial Bus (USB): It is a set of interface specifications for high speed wired communication between electronics systems peripherals and devices with or without PC/computer. The USB was originally developed in 1995 by many of the industry leading companies like Intel, Compaq, Microsoft, Digital, IBM, and Northern Telecom. The major goal of USB was to define an external expansion bus to add peripherals to a PC in easy and simple manner [8]. This standard was used when connecting the MBED microcontroller to the computer and had no effect on any design decisions, • RS-232: It is a standard for serial communication transmission of data. It formally defines the signals connecting between a DTE (data terminal equipment) such as a computer terminal, and a DCE (data circuit-terminating equipment, originally defined as data communication equipment), such as a modem [9]. This standard was used to connect the compass to the computer. However, since the computer used did not have a serial port, a serial-to-USB converter had to be used. • GNU General Public License (GPL): Over the course of implementing this project, a lot of open-source software was used, such as Ubuntu 14.04 LTS, Ubuntu ARM, Python, Eclipse and OpenCV. Using these required compliance with the GNU GPL.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	• Cost is one of the most important constraints for the design of any project, as it is the budget available that decides what parts can be purchased. This in turn would affect the implementation of the design. For example, one of the main aims of our project was portability, for which we wanted to use Tritech's DST Micron SONAR. However, this SONAR was well beyond our budget, and as such we could not afford it. • Time is just about as important a design constraint as cost. Since the team just had one semester to work on this project, a prototype of the device could not be built from scratch. • The final constraint would be team size. The team was slated to have four members initially, however this reduced to two members. Thus, it became hard to manage time, thereby limiting what the team could achieve over the course of the semester. .

Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	• The team had to make a choice between portability and functionality. Initially, it was decided that a Tritech Micron DST SONAR would be used, with a Raspberry Pi as the development platform. However, the Tritech Micron DST exceeded the budget by a significant amount and the team had issues installing some essential software on the Raspberry Pi. As such, it was decided that the Blueview P900-5 SONAR would be used, along with a laptop as the development platform. While this SONAR is significantly bulkier than the Micron DST, it is more accurate. Also, the team was able to run all software on the laptop. • The team also had to decide between focusing on the underwater aspect of the project or the visual odometry implementation first. It was decided that visual odometry would be implemented first, since this is the essence of the project. However, shortage of time combined with the shortage of manpower meant that the team was unable to implement the algorithm for underwater purposes. As such, the project was demonstrated by showing the implementation of the algorithm using an on-the-surface image feed.
Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions. *Complete if applicable; required if team includes CmpE majors.*	The project involves utilizing powerful algorithms for mapping and navigation. Given a small profile for the entire product, it was attempted to prototype the system using a Raspberry Pi. However, this was scrapped when it was found out that the SDK for the SONAR would not compile on the Raspberry Pi. In addition, algorithms were developed to read data from a serial port and convert it to a human readable format.

ECE4011/ECE 4012: International Program

(Only groups with one or more International Program participants need to complete this page)

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Global Issues (Less than one page)	(10 point font, single spaced)