Progress Report: Week 1

LASER Mapping Team

25 October 2013

1 Project Block Diagram

The project naturally splits along the hardware-software divide. There are further natural subdivisions on both the hardware and software components (Figure 1). The hardware is split into three components — the analog laser modulation / phase measurement circuit, the Inertial Measurement Unit (IMU) and its support circuitry, and the microcontroller that aggregates the information and transmits it to the PC. The software can be structured as a pipeline:

1. decode the ranging and position integration information coming from the hardware,
2. transform the measurements from the hardware's egocentric frame to a common world frame,
3. visualize the measurements in the common world frame, and
4. (possibly) lift a representation of the scanned object from the common world frame.

2 Member Assignments

- Hardware
  - Laser Modulation / Phase Measurement: Jeff Terrel, John Boyd, Doug Maunder
  - IMU: Ashton Jackson, Sam Carey
  - Microprocessor: Clayton Crawford, Sam Carey, Taahir Ahmed
- Software
  - Pose Transform: Clayton Crawford
  - Visualization: Tengyan Wang

3 Four-Week Timeline

1. *1 November 2013:* All hardware schematics finished. PCB layouts finished. First PCB revision produced. Software pose transformation and simple visualization working on test fixture data.
2. *8 November 2013:* Hardware subunits debugged, second board revision laid out and in production. Tentative microcontroller control of the board. Pose transformation and visualization working on test data produced on the microcontroller. Progress on model lifting.
3. *15 November 2013:* Full microcontroller control of the board, data passing through the full pipeline. Planar scanning assembly produced and integrated. Model lifting working.
4. *22 November 2013:* Schedule slack.

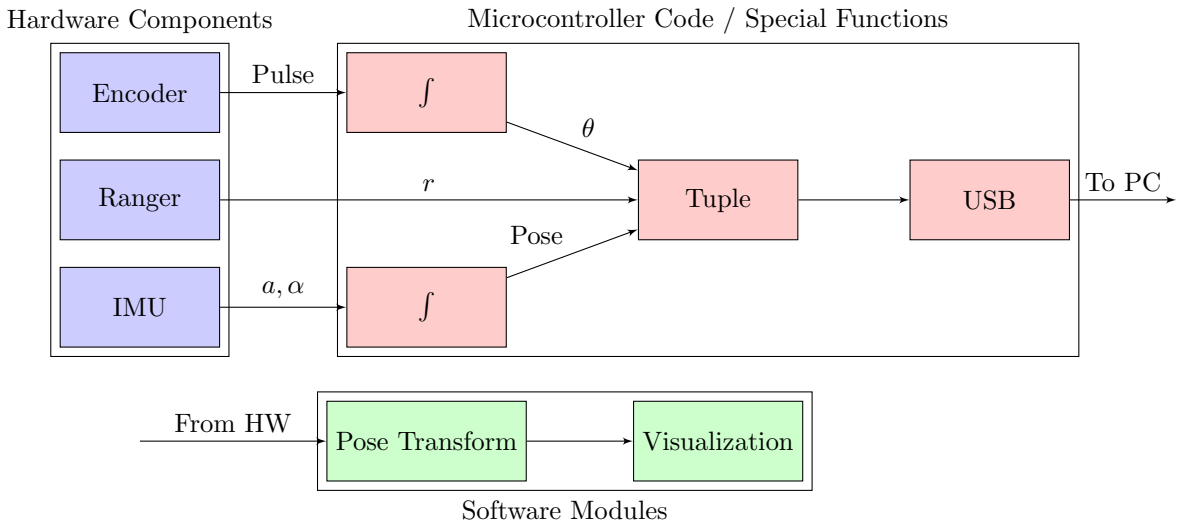

Figure 1: Block representation of project dataflow. Sensed data originates on the indicated hardware components. The data is processed and assembled into tuples on the microcontroller, and transmitted over the USB connection. On the attached computer, the software pipeline performs pose normalization, model lifting, and visualization.

4 Component Statuses

4.1 Ranger

All components have been selected and ordered. The laser diode will be driven directly by a programmable oscillator (frequency controlled by I^2C from the microcontroller). The original signal and the phototransistor return will be fed into the phase comparator, which outputs analog representations of the detected phase difference and attenuation. These analog signals will be sampled by the dedicated analog to digital converter pins on the microcontroller.

Schematic capture of the ranger unit has begun and is on-track.

4.2 IMU

Both a self-contained chip and a stand-in module (Razor IMU, from SparkFun) have been identified. Pads will be placed on the board revision a for both units. The dedicated chip is accessed via I^2C, while the Razor IMU is accessed via UART.

4.3 Microcontroller

The AT90USB1286 from Atmel has been selected as the on-board microcontroller. Its relevant features are:

- dedicated I^2C and USART (Universal Synchronous and Asynchronous Receiver and Transmitter) controllers,
- dedicated USB stack (allowing direct implementation of a USB-to-Serial converter, as well as more apropos USB communication standards),
- 8 dedicated analog to digital converters, as well as a selection of analog comparators,
- on-chip USB bootloader, enabling simple programming over a direct USB connection,
- 16 external interrupts, to allow interfacing with pulse devices such as encoders.

The Atmel requires some on-board support circuitry, but an open reference design has been located and schematic capture has begun.

4.4 Pose Transformation

The math has been worked out, and implementation is under way.

4.5 Visualization

A simple visualization program for visualizing the returned point cloud has been created.