Legal and Regulatory Analysis

Year: \_\_\_2022\_\_\_ Semester: \_Fall\_\_\_\_\_\_\_ Team: \_\_5\_\_\_ Project:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Metaporter\_\_\_\_\_\_\_\_\_\_\_\_

Creation Date: \_\_\_\_\_\_\_10/27/22\_\_\_\_\_\_\_\_\_\_\_\_ Last Modified: March 20, 2022

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Assignment Evaluation:

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| **Item** | **Score (0-5)** | **Weight** | **Points** | **Notes** |
| **Assignment-Specific Items** | | | | |
| **Regulatory Analysis** |  | x3 |  |  |
| **Analysis of Patent 1** |  | x3 |  |  |
| **Analysis of Patent 2** |  | x3 |  |  |
| **Analysis of Patent 3** |  | x3 |  |  |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** |  | x2 |  |  |
| **Formatting and Citations** |  | x1 |  |  |
| **Figures and Graphs** |  | x2 |  |  |
| **Technical Writing Style** |  | x3 |  |  |
| **Total Score** |  | | |  |

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

Comments:

*Comments from the grader will be inserted here.*

1.0 Regulatory Analysis

1.1 Federal Communications Certification

For our product to be marketed in the United States we must first meet technical standards set by the FCC. FCC approval is required for any product that communicates via RF or generates electromagnetic interference. This includes devices that communicate via Wi-Fi and Bluetooth. Metaporter utilizes a built in Wi-Fi module to communicate with a host machine to perform a 3D reconstruction so we will need some sort of FCC certification.

There are two main ways for a product containing a Wi-Fi module to become certified by the FCC. The first is described in [CFR 47/Chapter 1/Subchapter A/Part 2/Subpart J](https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-2/subpart-J). This section describes the certification process for products that contain an uncertified Wi-Fi module. Wi-Fi modules falling under this classification must go through something called the TCB Review Process. During this review, experiments are conducted, product reports are analyzed and if the module passes, the product is assigned an FCC ID. [1]

The second method of certification is called the Supplier’s Declaration of Conformity. Products containing a FCC pre-certified Wi-Fi module that have been incorporated according to manufacturing specifications do not require another TCB Review Process. The product must display the pre-certified Wi-Fi modules FCC ID somewhere on the packaging. Metaporter will fall under this category of FCC certification as we plan to use an already licensed product. [1]

1.2 Reduction of Hazardous Substances (RoHS)

For Metaporter to be marketed in the European market we must be sure that all our individual components meet the RoHS standards. RoHS restricts the following six materials in electronic products:

* Lead
* Mercury
* Cadmium
* Hexavalent Chromium
* Polybrominated Biphenyls
* Polybrominated Diphenyl Ethers

Before receiving RoHS certification, Metaporter will have to undergo XRF and lab phthalate extraction testing. This testing is conducted to ensure that the level of restricted materials meets the requirements set. Next, forms such as the Bill of Materials, Risk assessment documents, and manufacturing documents are all reviewed to ensure that they meet the RoHS standards. If they do, a certificate is issued.

2.0 Legal Liability Analysis

2.1 US Patent Application US201361758699P

Filed: January 27, 2014

Patent Title: "Real-time 3d reconstruction using efficient depth sensor"

Abstract:

This patent [3] talks about using a device (Mobile Station) with at least one camera and depth sensor (IMU) to perform a power efficient 3D reconstruction. The overall workflow of the reconstruction process is as follows:

* Capture an image with compromising color information
* Down sample resolution of image, to reduce computational complexity
* Obtain camera pose information based on depth and camera data.
* Update 3D model by “projecting images in the 3D Truncates Signed Distance Function onto a depth map” [3]. This determines the relative location of the image in relation to another surfaces in order to map out an environment.
* Determine whether to continue the data collection
* If yes, repeat from step 1. If not, disable the depth sensor and stop the reconstruction process

Claims

This patent contains many claims, but the most relevant ones are:

* The reconstruction workflow mentioned above
* Turning off power supplied to the depth sensor if data collection is not to be continued
* Merging a partial 3D environment with additional partial 3D models based on following images camera pose data
* An onboard processer configured to execute the reconstruction workflow

While Metaporter uses a camera, IMU and an on-board processor as the main components to create a 3D reconstruction, our method of reconstruction largely differs from the patent put forth. We plan to use a SLAM algorithm to estimate the camera position in space and supply that information to a neural network in order to create the reconstruction. Additionally, our reconstruction process will not occur in real time as it did in the patent . We also do not plan to down sample the image or limit power to the IMU while the data collection is not ongoing. The patent seems to have a greater emphasis on reducing the power consumption of the device, but we are not as concerned with that since most of our processing will be on-boarded to a host-machine.

2.2 Analysis of Patent 2

US Patent Number: 10489927B2

Nov. 26, 2019

Patent Title: “System and Method for three-dimensional image reconstruction using an absolute orientation sensor”

Abstract:

This patent [4] puts forth a 3D reconstruction device that contains an IMU, an image capture device (camera) as well as an on-board image processing device. The processing device receives input data from both the IMU and the camera as inputs and utilizes the sensor data provided by the IMU to align the following images. This method is considered an alternative to visual SLAM methods, as these methods are prone to drift errors.

Claims:

The main claim of the patent is a 3D reconstruction apparatus which contains the following:

* A camera
* An IMU attached to the camera, to record data associated with each image
* A processing unit which receives images and IMU data to produce a partial point cloud
* An ability for the processing unit to align a currently reconstructed point cloud with a newly generated partial point cloud.

The device in this patent utilizes many of the same components that Metaporter does: a camera, IMU and on-board processor. However, Metaporter’s reconstruction process is significantly different from the method proposed in this patent. First, we do not plan to directly mount the IMU onto our camera. We will have it on a plate behind the camera and use some sort of software calibration to account for this. We also plan to use the output from a SLAM algorithm in order to get a better reconstruction. This patent is proposing an alternative to SLAM as many SLAM algorithms are prone to drift errors.

2.3 Analysis of Patent 3

US Patent Number US8928525B2

Patent Title: "Adaptive high speed/high resolution 3D image reconstruction method for any measurement distance"

Filing Date Jan. 6, 2015

Abstract

This patent [5] focuses on using predetermined weights and electromagnetic waves for a 3D reconstruction of multiple images. Then, it will use its in-house algorithms to conduct parallel processing in order to obtain a high-resolution image performed at a high speed. It is highly scalable since it has no limitation on how the physical hardware should behave.

Claims:

The main claim of the patent is as follows:

* An adaptive high speed resolution image reconstruction method which consists of setting a weight for image based on its position as well as the position of an ultrahigh frequency antenna
* An ability to receive an electromagnetic wave with background noise received
* Preforming parallel processing on data received by the scattered electromagnetic wave and previously set weights
* Reconstructing a 3D image by combining values output by the parallel processing.

Although the end goal of creating a 3D image reconstruction is the same as Metaporter, the method of reconstruction is vastly different compared to our product. While this patent uses a camera, pre-determined weights, and electromagnetic waves as its main tools to decipher the environment around the device, we plan to use a camera supplemented with data from an IMU to estimate the camera's position in space. This data will then be utilized by a neural network to complete the reconstruction. This setup allows Metaporter to be used in more versatile environments as we are not limited by the pre-defined weights.

3.0 Sources Cited:

[1] K. Cooper, “FCC part 15 requirements for bluetooth and wi-fi modules/devices - F2 Labs.” [Online]. Available: <https://f2labs.com/technotes/2021/10/07/fcc-part-15-requirements-for-bluetooth-and-wi-fi-modules-devices/>. [Accessed: 29-Oct-2022].

[2] “✔ RoHS Guide,” *✔ RoHS Compliance Steps to Certification*. [Online]. Available: <https://www.rohsguide.com/rohs-certification.htm>. [Accessed: 29-Oct-2022].

[3] D Wagner. *Real-time 3d reconstruction using power-efficient depth sensors*. **US201361758699P**, <https://patentimages.storage.googleapis.com/13/1e/c4/7278a29ac3128f/WO2014120613A1.pdf> [Accessed: 29-Oct-2022].

[4] S Giancola, “United States Patent patent no.: US 10.489,927  *“*SYSTEM AND METHOD FOR THREE - DIMENSIONAL IMAGE RECONSTRUCTION USING AN ABSOLUTE ORIENTATION SENSOR*”*. [Online]. Available: <https://patentimages.storage.googleapis.com/41/e9/f1/0a785d266eb8bb/US10489927.pdf> [Accessed: 29-Oct-2022].

[5] S. K. Lee, “(12) United States Patent (10) patent no.: US 8,967,029 B1 Calvert (45 ...,” *APPARATUS AND METHOD FOR RECONSTRUCTING SUPER-RESOLUTION THREE-DIMIENSIONAL IMAGE FROM DEPTH IMAGE* . [Online]. Available: <https://patentimages.storage.googleapis.com/ba/7f/d5/151c0f5f7a1e86/US8967029.pdf>. [Accessed: 29-Oct-2022].