Legal Analysis

Year: 2018 **Semester:** Fall **Team:** 07 **Project:** Handi_glove
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Assignment Evaluation:

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

The CE certification [1] certifies that products have met EU health, safety, and environmental requirements that ensure user safety. This certification is required for electronic devices. The CE marking is affixed not through approval, but by us after we ensure that all required standards have been met. There are a number of tests that can be run in order to determine whether each standard is met or not. Typically, it takes about a month to complete CE certification. Our product is an electronic device, and will require the CE certification for all the parts (i. e. hand and glove). We will have to send our product in for approval at least a month before our desired publication date.

The FCC [2] is required within the US. It pertains to intentional or unintentional radiation caused by the product in question. In our project, since we use a chip, we would be required to have FCC certification to ensure our radiation is within safety limits. We have a microcontroller on both the hand and the glove, we will need to have both of them certified. FCC certification happens through a third-party FCC lab that has the necessary equipment to perform certification. It typically takes about a month for this to be completed. We will need to send our product in at least a month before desired publication.

The RoHS [3], Restriction of Hazardous Substances Directive, is a certification that ensures none of the materials used exceeds the safety threshold. There are many RoHS testing labs that our product can be sent to for RoHS certification. The process will take around 1-2 weeks. In our device, all the PCB's and soldering material as well as all other materials must go through RoHS testing to check if there are any thresholds exceeded. We will need to send our products in at least 1-2 weeks before desired completion date.

The WEEE [4], Waste Electrical and Electronic Equipment, certification ensures that electronic waste will be collected in a safe and responsible manner. This certification requires the equipment to be environmentally-safe even after its lifetime, while RoHS ensures that nothing used to construct the device is too hazardous, to begin with. WEEE, together with RoHS, will similarly take about 1-2 weeks at a third-party lab. Since our device is an electronic device, it will also need to be WEEE certified. We will need to find a third-party lab and send our device in at least 1-2 weeks before desired publication date.

2.0 Legal Liability Analysis
2.1 Analysis of Patent 1

Patent #1: CN204868848U
Patent Title: "Intelligence gloves and biomimetic mechanical hand based on synchro control"
Patent Holder: Liang Xie
Patent Filing Date: 2015-08-10

Abstract: This patent covers a grasping system that includes a glove and sleeve. There are force sensors attached to the palm of the glove. The sensor measures a force that is applied by the glove and transmits the data to a controller which is installed on the sleeve. The controller contains a configuration module that has selectable operating modes and it can calculate a tensile force to apply to the tendon for each of the selectable operating modes. The sleeve contains actuator assembly on one end of the tendon so that it will apply grasping force according to the pressure value received from sensors.

Potential Infringements: Among the claims, the grasping system potentially infringes upon the following [5]:

- A glove that is wearable on a hand of an operator that consists of pressure sensors, a microcontroller, and actuator assembly.
- The sensor in communication with the controller that is configured to measure biometric information of the operator, where the controller includes a monitoring unit in communication with the sensor that controls an operation of the glove.
- A tension sensor positioned with respect to the glove and configured to measure an actual tensile force acting on the tendon.

Analysis of Patent Liabilities: The patent claims that this grasp system is a wearable on hand which composed of the glove, sensors, motor and controller. The grasp system utilizes information from the pressure sensor to apply an assistive tensile force by the actuator which resides on the sleeve. One of the features from our project (Handi_glove) has a similar goal with this system but they work in a very different way. Firstly, handi_glove provides a feature called 'Motion Restraint' that limit the movement on user's hand which is the glove to emulate the robotic hand's restriction of motion due to an object on hand which prohibit the robotic hand to go beyond squeezing the object. There are sensor pressures attached on the robotic hand. However, the sensor resides on the fingertips instead of palm which is in the grasp system's design. Second, the grasping system has a 'one-way' communication that transmits data from sensor to actuator through the controller. However, handi_glove utilized a more complex design which involves two microcontrollers communicate with each other in a 'two-way' communication fashion. In addition, the main difference between the two is the purpose of the functionality provides. The grasp system is designed to provide an assistive force but the feature of handi_glove mentioned above is designed to restraint the glove's movement. Although both projects have a very similar structure in terms of components, design, positioning of parts and controller's firmware design, their main purposes conflicted with each other and thus the technical details of how actuator helps with exoskeleton on hand are completely different.

2.2 Analysis of Patent 2
Patent #2: US20080167662A1
Patent Title: "Tactile feel apparatus for use with robotic operations"
Patent Holder: Kulite Semiconductor Products Inc
Patent Filing Date: 2007-01-08

Abstract: This patent [6], consists of a robotic system that utilizes a robotic arm in surgical processes. The pressure sensors on the robotic hand are capable of sending processed output signals. The inflatable insides that are attached to the index finger and the thumb are proportional to that applied on the surgical instrument, which acts as an indicative signal for the operating surgeon.

Potential Infringements: Among the claims, the grasping system potentially infringes upon the following:

- The communication flow structure between the glove and the robotic hand
- A robotic control system using tactile feedback
- A robotic control system using heat feedback

Analysis of Patent Liabilities: The patent claims that the microprocessor receives the signals from the pressure transducer and the signals from the robotic control system to produce output signals for controlling a glove. Although this medical equipment used similar mechanical elements and communication system with our project (Handi_glove), different communication way to connect the glove and robotic hand make two project exchange information differently. This patent employs a master/slave system in the communication flow system but we finally decide to use UART communication module to transmit in our project. Another difference between our system and this patent is that the tactile feedback system in the filed patent does not provide with a proper force limit. Although both designs synchronize the indicative force between the glove and the robotic hand, our system has an add-on self-protective feature that when the pressure sensor mounted on the robotic hand detects that the object cannot be grasped even more, the microcontroller on the robotic hand will prevent itself from grasping even harder. This design logic can significantly diminish the damage on the chassis. The patent claims that other tactile indications such as heat can be employed but does not specify the heat system and implementation. They only mentioned that a warmer temperature would indicate a higher pressure in the pressure feedback system. However, in our case, we use two separate systems to implement pressure and temperature feedback system.

2.3 Analysis of Patent 3
Patent #3: CN204868848U
Patent Title: "Intelligence gloves and biomimetic mechanical hand based on synchro control"
Patent Holder: Liang Xie
Patent Filing Date: 2015-08-10

Abstract: This patent [7], held by Liang Xie relates to intelligent bionic gloves and five degrees of freedom robot, bending operation by a finger on the smart gloves, bionic robots mimic human hand can simultaneously make the appropriate action.

Potential Infringements: Among the claims, the grasping system potentially infringes upon the following [7]:

- Mechanical movements of the finger through the connection between servos and an STM32 Microcontroller
- Pressure and motion sensor components on each of the fingers of the glove exoskeleton
- Motion detection using an STM32 Microcontroller

Analysis of Patent Liabilities: This patent claims to use an STM32 Microcontroller to control the movements of the robotic arm through servos. This is exactly what we are doing in our project, in that we are also using an STM32 microcontroller that connects to servos in order to control the movements of the robotic fingers. In addition, the pressure and motion sensing components of our user glove exoskeleton are also controlled through the STM32 Microcontroller. The force and motion detection in this patent, however, does not utilize potentiometers. In our project, we utilize potentiometers which do not infringe on this patent. One huge difference between this patent and our design is that this patent uses wi-fi as communication between the user's glove and the robotic arm, whereas in our design we are using UART for communication between the microcontroller on the user's glove and the robotic arm. Another big difference is the degrees of freedom. In our design, we allow 3 degrees of freedom in joint movement whereas this patent allows 5 degrees of freedom, causing it to be way more versatile. This patent does not mention any claims pertaining to temperature sensors and temperature feedback controls, which are part of our project.

3.0 Sources Cited:

[1] "CE marking - Growth - European Commission", Growth, 2018. [Online]. Available: https://ec.europa.eu/growth/single-market/ce-marking_en. [Accessed: 27- Oct- 2018].

[2]"Equipment Authorization Procedures", *Federal Communications Commission*, 2018. [Online]. Available: https://www.fcc.gov/general/equipment-authorization-procedures. [Accessed: 27- Oct- 2018].

[3]"2018 RoHS Compliance Guide: Regulations, 10 Substances, Exemptions, WEEE", *Rohsguide.com*, 2018. [Online]. Available: http://www.rohsguide.com/. [Accessed: 27- Oct- 2018].

[4]W. www.wellkang.net, "WEEE registration & WEEE compliance", *Epeat.org*, 2018. [Online]. Available: http://www.epeat.org/. [Accessed: 27- Oct- 2018].

[5] *Control of a Glove-Based Grasp Assist Device*.

[6] Liang, Xie. *Intelligence Gloves and Biomimetic Mechanical Hand Based on Synchro Control*. 10 Aug. 2015.

[7]*Tactile Feel Apparatus for Use with Robotic Operations*.