Project Deliverable B: Needs, Problem Statement, Benchmarking, Metrics and Target Specifications

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A list of client statements/observations obtained from client interviews.

The client needs a fall detection/prevention device for seniors with limited disabilities.
Falls are one of the greatest cause of injury for people attending SVH.
Patients may have a variety of different physical restraints, such as cognitive function disability, balance control, disorientation or mobility restraints.
Device should detect/prevent the falls in any circumstances, such as transfer from bed to a wheelchair, getting off or on to a bed, moving around the hospital rooms, moving on their own or with assistance.
The device should not restrain the patients or discomfort them in any way. Should have a form acceptable in a hospital environment i.e. size, movability, storage.
The device should be able to alert the hospital staff about the incident/fall as soon as possible.
The device should meet the client's criteria: high tech but low cost.
The device should not interfere with the hospital alarm/light system but can be integrated.
Patients' rooms sometimes indicate whether the patient is a "Fall risk patient" or not via signage
Patients in some countries are taught how to fall properly. Implement this in Canadian hospitals to prevent further injury from falls?
The project can be based on previous prototypes or work done by other teams in the past.
The client needs a useful, simple, low cost and working prototype.
"The simplest solution might be the best" in this scenario.

A list of translated and prioritized customer needs (using the five techniques shown in class: what not how, specificity, positive, attribute of the product and avoid words must and should)

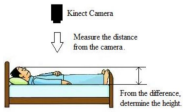
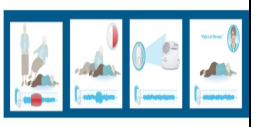
Need statements
1. The fall detection system is adaptable for use with patients who have varying degrees of mobility.
2. The fall detection system runs 24/7 providing a continuous analysis of the patient's state.
3. The fall detection system sends an immediate alert to caregivers right after a fall is detected.
4. The fall detection system is affordable and is easily deployable
5. The system integrates with the patient or caregiver without disrupting routine/typical activities.
6. The system works with surrounding medical and hospital systems without modifying their behaviour.
7. The system detects falls such as slips, tumbles, buckles and rolls with a high level of accuracy and efficacy.

A problem statement (what is the problem, who has the problem, and what form can the solution be)

Falling is a common occurrence in everyday life for anyone. Overtime, from a young age, we learn to fall less due to an increase in coordination and balance; this is especially important since an increase in age also results in an decrease in body flexibility and reformability. However, there are those who are not as fortunate to keep this full range of mobility, resulting in higher risks of falling and harming the body further. For hospital staff who are responsible these types of patients, a quick and accurate detection (and possible prevention) of a fall is imperative. For this reason, Saint Vincent's Hospital is looking for a product that helps accurately and quickly detect (and ideally prevent) falls when a caregiver is not present.

Benchmarking of similar products (this can be products which satisfy some or all of the needs defined above). Provide descriptions and pictures when possible!

The following products and descriptions were retrieved from reports provided by previous teams who have attempted to create a solution for the fall detection system for SVH.

	Alarm with a magnetic cord 	Pressure mat 	Blood pressure monitor 	Depth detector 	Sensor-based device 
The device prevents the fall	This device prevents the fall by having a rope attached to the patient's garment and that triggers when the patient falls and the magnet at the other end of the rope detaches from the speaker of the alarm	This device tries to prevent the fall of a patient when it detects a considerable change of weight when the patient has fallen	This device tries to prevent falls of patients by calculating the arterial pressure, indeed, when a person passes from a sitting position to a standing up position or during falls, the arterial pressure of the individual increases considerably, which triggers an alarm	This device attempts to prevent the fall by using a depth sensing system that is hooked to the ceiling above the patient's bed, that gets triggered when the patient approaches the camera (then gets up from his bed eventually)	This device works with sensors in a powerful microprocessor placed around the neck of the patient and a box serving as an alarm. The microprocessor records all day long data on the patient when he is lying down, sitting or standing and detects falls by processing this data
The device doesn’t send false alarm	This device seems very easy to remove, it is possible that some sudden movements during the night or during the	The disadvantage of this device is that it will send a huge number of false alarms even when the patient hasn’t fallen at all, caused by a variation	This device should not limit false alarms according to the way it is programmed, to make sure, tests and investigations have to be conducted	This device does not make a false alarm, depending on the product's efficiency or sensors	This device seems to be quite effective according to user comments but it depends on the company that produces the dispositif

	day can cause false alarms	of weight of the patient when trying to be more comfortable for example	continuously		
The device doesn't restrain the patient	the device does not restrain the patient as there is only one hooked rope that can easily come off	There are no restraints simply because the device is placed under the patient	This device does not restrain the patient as it looks like a small bracelet or watch attached around the patient's wrist	This device is attached to the ceiling,in order to not get in the way of the patient,therefore, it will not be a restraint for the patient	This device is a necklace, it won't restrain the patient because of its size and weight
The device warns the caregivers	The device can warn nurses with an alarm of 70 to 85 decibels	This device can send a powerful signal to the nurses after the patient fell	This device can send a powerful signal to the nurses when it detect an high heart rate	This device can send a powerful signal to the nurses when it detect a difference in the hight	This device can send a powerful signal to the nurses when the device calculate a fall detection
Cost	About 60 $ per alarm	This system doesn't last too long, usually it has to be replace simply after being used once. About 50$ per alarm	About 70 $ per alarm	About hundreds of dollars	About 50 $ per month
Durability	Depends on the materials used	Not very durable due to the fact that it can only be used once	durable device due to the fact that it is waterproof	Depending on the materials used	Depending on the company that manufacture this device

The device can't be deactivated by the patient	This device should not be disabled because it is in the back of the patient having difficulty with movement but it is possible to manually unhook the rope or cut it	This device can't be deactivated by the patient while it's being hanged on the bed or on a chair	This device can't be deactivated by the patient unless the patient try to hard to deactivate the system and the patient can remove the device from his hand very easily	This device can't be deactivated by the patient or accessible for the patient	This device can't be deactivated by the patient but the patient can remove the device very easily

A list of metrics with associated units. Identify which needs each metric address.

The ten items in the following table are measures that will be used to evaluate the performance of the product solution space.

Metrics #	Needs #s	Metrics	Imp	Units
1	3, 7	Time to detection of fall	1	s
2	1, 7	Accuracy [true positives/(all positive detections)]	1	%
3	1, 5, 6	Mass of product	1	kg
4	1, 5, 6	Volume of product	2	m^3
5	1, 5, 6	Length of product	2	m
6	1, 5, 6	Width of product	2	m
7	2	Run time over single 'cycle'	3	s
8	2, 5, 6	Electrical power Required	4	w
9	4	The cost of the product	1	$
10	4, 6	Product Implementability	2	subj.

A set of target specifications (both ideal and marginally acceptable values). Provide reasons for your choices.

For each of the ten measures provided above, a range of specific desired quantities are assigned based on client interview.

Metrics #	Metrics	Desired Value Range	Units
1	Time to detection of fall	< 5	s
2	Accuracy [true positives/(all positive detections)]	> 96	%
3	Mass of product	< 0.75	kg
4	Volume of product	< 800	cm^3
5	Length of product	< 10	cm
6	Width of product	< 5	cm
7	Run time over single ‘cycle’	> 21, 600	s
8	Electrical power Required	< 10 > 3	w
9	The cost of the product	< 70	$
10	Product Implementability	-	subj.

For each of the value limits specified in the table above, it is implicitly provided that there is an optimal value. However, since this optimal value cannot reasonably achieved or known for all metrics, the range is provided. Take eg. cost; the optimal cost is $0, but this is not reasonable, of course.

A reflection on how the client meeting impacted your results and the process.

- The range of mobility that patients who are being considered for a fall detection system is wide
- The hospital has a few implementations for the falling patients problem:
    - Seat belts for wheelchairs
    - Lowering beds and cushions
    - “Fall risk patient” signs
    - Buttons in the patients’ rooms for assistance call
    - Lights in front of the rooms for assistance call

- The nurses and doctors use displays at the nurse station to see which patients have called for help
    - These displays and call bell system are not available for use during development cycle
- The client prefers a simple yet working prototype to a more advanced(applies to all cases and scenarios) but incomplete
- The client wants a high tech and low cost solution for this problem