Autonomous Pool Playing Robot

Hazard Analysis

Ernest Selman
selmae@mcmaster.ca
1201291

Guy Meyer
meyerg@mcmaster.ca
1320231

Eric Le Fort
leforte@mcmaster.ca
1308609

Andrew Danha
danhaas@mcmaster.ca
1223881

Derek Savery
saverydj@mcmaster.ca
1219142

Max Moore
moorem8@mcmaster.ca
1320009

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Date	Revision #	Comments	Authors
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Table 1: Revision History

1 Overview

This document's purpose is to help illustrate potential hazards associated with the automated pool-playing robot and how those hazards are to be addressed. The Hazards section will describe the section in more detail as well as provide an overall Fault-Tree Analysis (FTA) for this system. Each hazard will have its own subsection which will describe the hazard, discuss mitigation and/or plans of avoidance as well as provide a more detailed view of the portion of the FTA it concerns.

Certain sections may refer to the supporting documents: *High-Level Hardware Design* and *High-Level Software Design* for this project.

1.1 Naming Conventions & Definitions

This section outlines the various definitions, acronyms and abbreviations that will be used throughout this document in order to familiarize the reader prior to reading.

1.1.1 Definitions

Table 2 lists the definitions used in this document. The definitions given below are specific to this document and may not be identical to definitions of these terms in common use. The purpose of this section is to assist the user in understanding the requirements for the system.

Table 2: Definitions

Term	Meaning
X-axis	Distance along the length of the pool table
Y-axis	Distance across the width of the pool table
Z-axis	Height above the pool table
End-effector	The end of the arm that will strike the cue ball
θ	Rotational angle of end-effector
Cue	End-effector

1.1.2 Acronyms & Abbreviations

Table 3 lists the acronyms and abbreviations used in this document.

Table 3: Acronyms and Abbreviations

Acronym/Abbreviation	Meaning
VR	Visual Recognition
μC	Micro-Controller
FTA	Fault-Tree Analysis

2 Hazards

2.1 Pinch Points

Description
When parts in a machine move in close proximity to one another, there is always a risk of harmful pinching. In this project, there are two locations where this may pose a notable risk: where the x-rails meet the arm base and where the y-rail meets the end-effector base.

Plans for Avoidance/Mitigation

2.2 Harmful Pneumatic Activation

Description
The pneumatic actuator will involve a very fast-moving component in order to strike the cue ball with sufficient force. If there is something in the way of the end-effector other than the cue ball such as the table, other parts of the machine, or a person, there is likely to be resulting damage.

Plans for Avoidance/Mitigation

2.3 Jumping Pool Balls

Description
Pool balls have a tendency to jump off the table if struck in a certain way. If the ball bounces off of the table, there is potential for damage to the machine, the surrounding environment, or a person.

Plans for Avoidance/Mitigation

2.4 Dangerous Machine Traversal

Description
While the machine is traversing, anything in the way may be at risk. For example, depending on the speed, there could be damage due to impact. Another less severe example could involve knocking off items on the edges of the table.

Plans for Avoidance/Mitigation

2.5 Snagging of Loose Objects

Description
At various locations – namely the pinch points listed earlier as well as the rotational motor on the end-effector base and the belts on the x- and y-rails – loose clothing, jewellery or long hair may be caught and pulled in. If these objects are attached to a person, this can lead to strangulation or being pulled into dangerous areas of the machine.

Plans for Avoidance/Mitigation