

# Functional Specifications Document

## Team Defiant

### *Project Description and Background*

In Fall 2000 8 teams of three were created for a competition of autonomous soccer playing robots. One of these teams, team Defiant, consists of Jeff Johnson, Paul Thatcher and Brandon Langford. Over the course of Fall 2000 and Winter 2001 a small, completely autonomous robot will be constructed that will play one-on-one MLS style shoot-out soccer.

This project not only will test the technical skills of each team member, but will also teach team-work and real-world problem solving.

### *Project Requirements*

The following is a list of customer needs (including interpreted needs) and their relative importance:

NEED NUMBER	CUSTOMER STATEMENT	RANK	INTERPRETED NEED
1	I want it to play soccer.	1	<ul style="list-style-type: none"> <li>The robot needs to be able to play soccer</li> </ul>
2	On a pre-built playing field.	2	<ul style="list-style-type: none"> <li>The robot will need to be built for the specified playing field.</li> </ul>
3	It will move around on the playing field	1	<ul style="list-style-type: none"> <li>The robot needs to be able to navigate the playing field and obstacles.</li> </ul>
4	Needs to get the ball into the goal	1	<ul style="list-style-type: none"> <li>The robot needs to be able to complete a goal.</li> </ul>
5	They were able to control the ball.	3	<ul style="list-style-type: none"> <li>The robot needs to be able to manipulate ball movement.</li> </ul>
6	They moved autonomously	1	<ul style="list-style-type: none"> <li>The robot needs to play soccer without intervention from the user.</li> </ul>
7	They could launch a ball	7	<ul style="list-style-type: none"> <li>The robot is able to propel the ball in a specified direction.</li> </ul>
8	I want it to be agile.	4	<ul style="list-style-type: none"> <li>The robot needs agility.</li> </ul>
9	It should be simple to use.	3	<ul style="list-style-type: none"> <li>The robot controls need to be simple to use.</li> </ul>
10	It should be easy to debug.	8	<ul style="list-style-type: none"> <li>The programming should be built for easy debugging.</li> <li>The construction of the robot should be built for easy debugging.</li> </ul>
11	I want a cool looking robot.	1	<ul style="list-style-type: none"> <li>The robot should be aesthetically pleasing.</li> </ul>
12	It should be able to get out of deadlocked situations.	5	<ul style="list-style-type: none"> <li>The programming needs to have features to detect and/or prevent deadlock</li> </ul>
13	It needs to consider my opponent's strategy.	6	<ul style="list-style-type: none"> <li>The robot is able to predict and defend an opponent's strategy.</li> </ul>
14	I want it to predict where the ball and opponent placement will be.	1	<ul style="list-style-type: none"> <li>The robot should monitor and watch the opponent and ball movement.</li> </ul>
15	It should be light enough to move around easily.	2	<ul style="list-style-type: none"> <li>The robot's physical construction should be lightweight and easy to move.</li> </ul>
16	I don't want it ramming into other robots.	1	<ul style="list-style-type: none"> <li>The robot should be able to detect the distance to the opposing robot.</li> </ul>
17	It's needs to be fast and maneuverable at the same time.	4	<ul style="list-style-type: none"> <li>The robot needs to be fast.</li> <li>The robot needs to be maneuverable.</li> </ul>
18	It has to see the field boundaries and stay inside them.	1	<ul style="list-style-type: none"> <li>The robot should be able to see the markings and goal nets on the playing field.</li> </ul>
19	It should be able to turn accurately while moving	3	<ul style="list-style-type: none"> <li>That the robot will not need to stop before turning</li> </ul>
20	It should be able to defend the goal.	7	<ul style="list-style-type: none"> <li>Be able to intercept the ball coming at different angles 0 to 180 degrees</li> </ul>
21	Needs to defend opponent's shots	7	<ul style="list-style-type: none"> <li>It should be able to defend the goal.</li> </ul>
22	Not get locked up into corners or against sides of walls	5	<ul style="list-style-type: none"> <li>The robot needs to have the ability to detect and avoid physical deadlock situations.</li> </ul>
23	It should be of reasonable cost	9	<ul style="list-style-type: none"> <li>The robot should be inexpensive.</li> </ul>
24	Should be accurate in knowing it's own position and other key positions (opponent, ball, and field walls)	1	<ul style="list-style-type: none"> <li>The robot must be able to accurately compute its own position and that of other markings and objects on the playing field.</li> </ul>
25	It must meet the required size	2	<ul style="list-style-type: none"> <li>The final robot must fit in a 7" cube</li> </ul>
26	It shouldn't wear out the batteries too fast	2	<ul style="list-style-type: none"> <li>The robot should have a long battery life</li> </ul>
27	Have good balance, or center of gravity	2	<ul style="list-style-type: none"> <li>The robot should have a high degree of balance</li> </ul>

## Product Specifications

Listed here are the interpreted needs that have associated metrics to evaluate performance. Each of these has an associated unit or units, depending if the need has more than one performance factor. We have also included ideal and minimal values we want to achieve over the next year for these metrics.

INTERPRETED NEED	METRIC	UNITS	VALUE (IDEAL/MINIMAL)
• The robot needs to be able to navigate the playing field and obstacles.	distance between desired stopping point and real stopping point	cm	(2cm/6cm)
• The robot needs to be able to complete a goal.	# of goals	goals	(100%/>50%)
• The robot needs to be able to manipulate ball movement.	length of contact with ball	seconds	(30sec/10sec)
• The robot is able to propel the ball in a specified direction.	distance velocity	cm cm/sec	(length of field/300cm)
• The robot controls need to be simple to use.	time to program time to setup	hours minutes	
• The programming should be built for easy debugging. • The construction of the robot should be built for easy debugging.	time spent revising time spent looking for bugs	hours hours	
• The robot should be aesthetically pleasing.	# of oohs and aahs	oohs and aahs	(a lot)
• The robot is able to predict and defend an opponent's strategy.	predicted vs. real values # of opponents shots blocked velocity (opponent)	# predictions shots cm/sec	
• The robot should monitor and watch the opponent and ball movement.	predicted vs. actual prediction	predictions	
• The robot's physical construction should be lightweight and easy to move.	weight	lbs	< 10 lbs.
• The robot should be able to detect the distance to the opposing robot.	distance from other robot (moving or stopping)	cm	(2cm/6cm)
• The robot needs to be fast.	velocity	cm/sec	for field length (2 sec/3.5 sec)
• The robot should be able to see the markings and goal nets on the playing field.	distance from boundaries	cm	
• That the robot will not need to stop before turning	angle velocity	degrees cm/sec	(±70° before needing to stop)
• Be able to intercept the ball coming at different angles 0 to 180 degrees	# goals prevented	goals	
• It should be able to defend the goal.	# shots prevented	number of shots	
• The robot should be inexpensive.	price	dollars	(\$0/<\$300)
• The robot must be able to accurately compute its own position and that of other markings and objects on the playing field.	actual vs. real position	cm	(0cm/3 cm)
• The final robot must fit in a 7" cube	size	inches	7" on all sides
• The robot should have a long battery life	battery strength battery life	volts minutes	
• The robot's construction should be balanced and centered	angle lifted before turning over	degrees	

## Linking of Project Requirements and Product Specifications

Our team is has several goals in mind to make this the most successful robot. The first and foremost of course is that our robot will win. In order to make this happen we have broken down the functional components of the robot into several sections: control, defensive programming, offensive programming, physical construction, debugging issues, cost and vision.

The robot functionality will be primarily software driven. The hardware involved will be light and minimal, but leaving open the possibility of adding on hardware enhancements. Since the robot will be software driven, we have derived needs that encompass learning an opponent's strategy, taking strategic opportunities, software feedback of the robot's condition (battery, velocity, position, etc.). We are also open to the possibility that ideas may not work, hence, we will be modular in our design (physically and software) so we don't have to redo all of our code or structure in order to fix it.