

Concept Design Proposal

Date: November 5, 2009

To: Dr. Stephen Batill

AME 30362: Design Methodology

From: Brittney Dudley, Ian Mills, Spencer White, John Howard, Nicholas Abercrombie, Mark Costanzo, Allison Cudworth

Subject: Project 3: Mechatronic Football Combine Concept Design Proposal

A Mechatronic Football Combine will be used to assess the Second Generation players against several set project design requirements. The proposed combine will be held in Stepan Center, include two parts (a physical exam and performance testing), and will last three hours.

A. Plan for Conducting the Combine

i. Time and Location

The combine will be from 1600 to 1900 on the Tuesday preceding the Saturday game in order to get statistics from game ready players, but not tire the players and trainers directly before the game. The combine will be held in Stepan Center, because it provides enough space to run the test drills. Additionally, the players will be tested in the same environment (temperature, turf, and size of field) as they will use on game day.

ii. General Schedule and Data Tracking

All players will begin with their physical exam followed by performance testing. The performance testing will be split into two halves: basic ability and advanced testing skills. The basic tests will be run first and all robots will complete them, followed by position specific tests.

An anticipated time breakdown per robot is shown in Table 1.

Table 1: Schedule of Events

Time	Event
10 min.	Check-in

30 min.	Physical Exam
65 min.	Basic Performance
65 min.	Position Specific Performance
10 min.	Card turn in and departure

Upon arriving at the combine, each robot trainer will be given a “Combine Assessment Card,” that he will use to record all of the data generated on his player. Combine drill administrators and physicians will use a stamp or their own signature to verify the data written on the card. Before leaving, robot trainers will be required to return their card to the check-in table or their robot will not be permitted to participate in the game the following day.

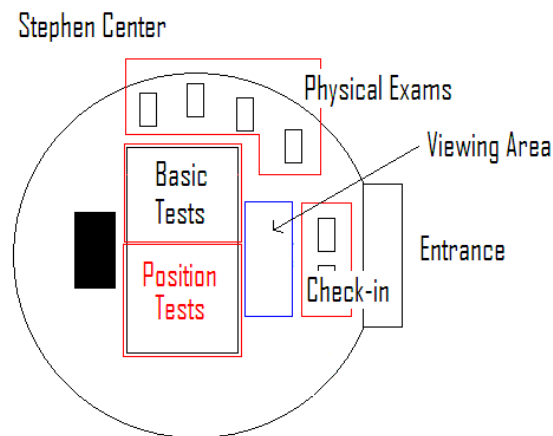


Figure 1: Stepan Center Combine Layout

B. Testing and Criteria

i. Physical Examination

The document “The Rules of Collegiate Mechatronic Football” includes 28 rules pertaining to the structure of each robot. In order to guarantee credit to teams that follow each rule, the first part of the combine is a physical exam to determine if these 28 rules have been upheld. Four physicians will be stationed as shown in Figure 1 and will examine robots individually. A 16’’ x 16’’ x 24’’ tall box will be placed over the robot to determine if it meets dimensional standards. Each physical exam will also include a collision test. A remote controlled car with a flat front

panel attachment will start from rest 3 feet from the player and will be driven into the robot to determine if the tackle sensors are working properly. Failing any aspect of the physical exam will result in forfeiture of the combine and game.

ii. Performance Assessment

Recently Nike cited speed, power, and quickness as three basic elements of athleticism and created a test, known as the SAT of athletes, to measure these elements. Tests based on the Nike model will be used in the mechatronic combine. Following these basic tests positions specific tests will be held. Scoring for each event is on a 10.0 scale, with robot design requirements set at 7.0.

a. Basic Performance Assessment

The elements of speed, power, and quickness will be tested for all players as outlined in Table 2.

Table 3: The Basic Performance Tests for Mechatronic Football

criteria	Justification for Criteria	Test
Speed	Whether a robot needs to scramble from a defender, sprint to the end zone, or race to make a tackle, speed is a critical element to the success of all football players.	The 40 foot dash will be used. This run is shortened from the traditional 40 yard dash to account for the fact that the mechatronic field is scaled to approximately 1 foot per 1 yard of a real football field.
Quickness	The need to move and change direction quickly, perhaps to move past a defender or to recover a fumble, is necessary for all players.	The field will be marked with tape in a pattern like that drawn in figure 2. The time that it takes the robot to drive to complete the shuttle run will be taken as a measure of its quickness.
Power	From pushing back another lineman to fighting for position to make a catch, power is key for all players	A sled push will be used. Each robot will push a 35 pound (the maximum weight of another player) sled of bricks for 10 seconds.

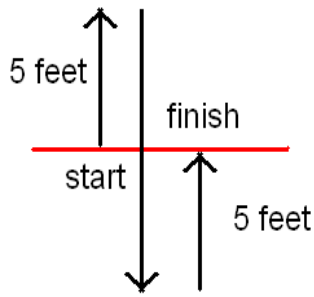


Figure 2: Quickness Test: A Timed Shuttle Run

b. Position Specialized Performance Assessment

Some player specific functions can only be assessed through specialized testing and thus position specific tests, see Table 4, will be used for further assessment.

Table 4: Position Specific Tests for Mechatronic Football

Position Assessed	Justification for Criteria	Test
Quarterback	Ability to throw the football	The quarterback will throw the ball three times to a laundry basket or similarly sized container placed at three different distances. The distances will be 10 feet, 15 feet, and 25 feet. The number of completed passes will be counted.
Kicker	The time that it takes the kicker to get the ball in the air should be minimized within the standards.	The kicker will attempt two field goals from 1/3 of the distance of the field from the center of the field, and an additional two from the left and right hash marks for a total of six. He will then attempt two field goals from midfield from the center of the field. Using a tee is optional for these final two kicks which are worth double points.
Wide Receivers	Ability to catch a quarterback's throw	Based on unanimous decision of both coaches, a quarterback will be selected to throw to both team's receivers. If a unanimous decision cannot be reached, a coin toss will be used to decide. 10 throws, 5 longer than 5 feet and 5 longer than 25 feet will be made. Each catch of the 25 foot series will count for double points.
All Others	Ability to get to a spot.	A ball will be lofted from the stage into a 2 ft. circle (if the ball lands outside of the circle, it will be re-thrown). The robot can start from any position, but cannot move until the ball hits the ground. Upon impact he tries to touch the ball as quickly as possible, see figure 3. The drill will be repeated three times and the fastest time will be recorded.

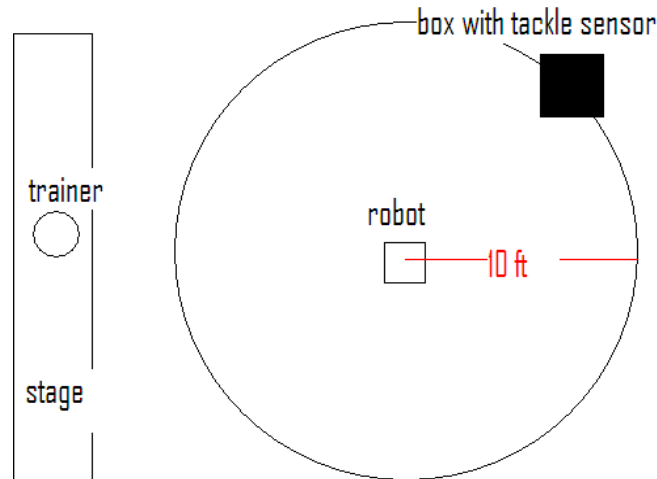


Figure 3: Position Specific Test For All Others

c. Scoring

As this is the first combine, setting standards poses some difficulty. Thus this combine will employ linear scoring schemes that allow players to be compared to each other and also provide a benchmark for future mechatronic football players, but at the same time, allowing for a wide range of deviation from speculated results, see Figures 4 and 5. The design requirement is the value receiving 7.0 points for each test. Each test will be scored based on 10.0 points and the average of the four tests will be taken to assess each player. However, in any formal report of the results of the combine, the top five scorers will be listed with their times or distances to give a more complete picture than the 10.0 scale allows.

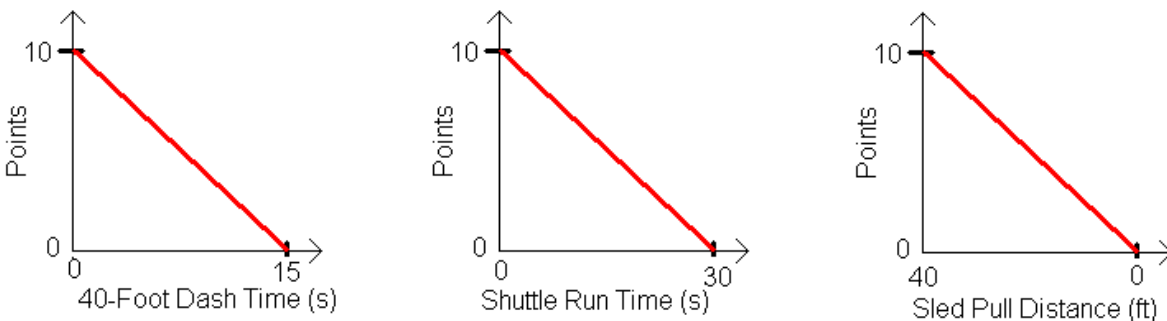


Figure 4: Basic Test Scoring

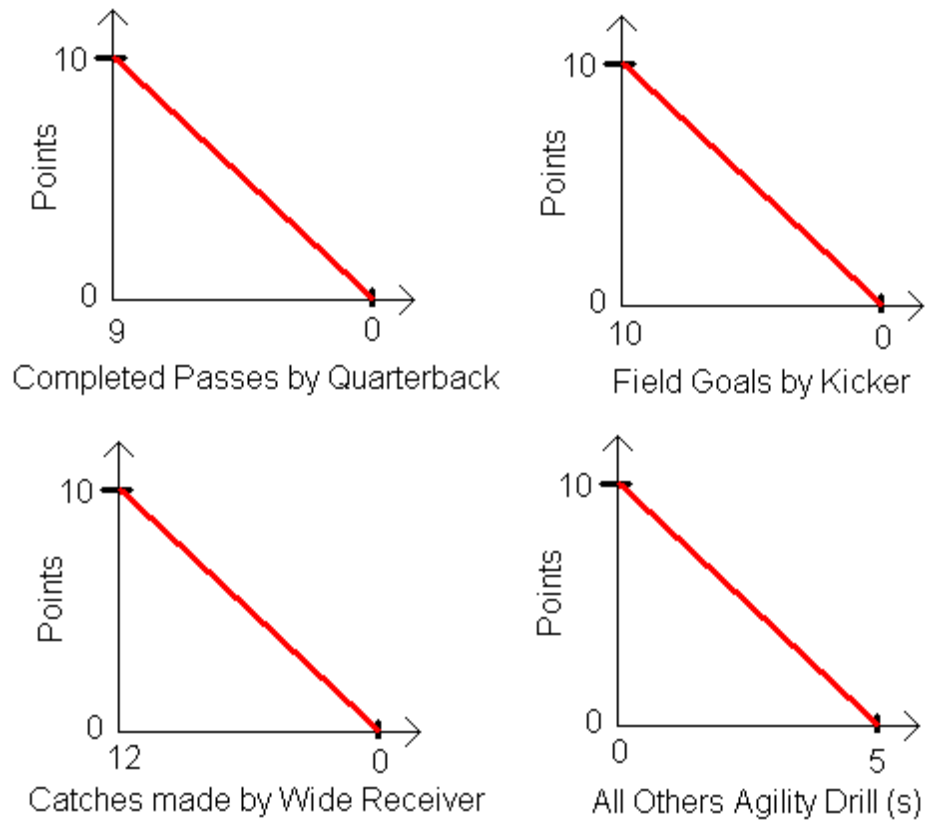


Figure 5: Position Specific Test Scoring