Operations Manual

Team # 7

Revision of Lockheed Martin Human Type Target for Manufacturability

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Sponsor (Contact):

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ABSTRACT

Lockheed Martin desires to produce a human type target system, resembling a human in size, shape, and appearance, which will react appropriately to being hit with small arms fire. This will be done via hit sensors on the target, which will be able to detect vibrations caused by a bullet being fired into the target. The target itself will be a commercially available mannequin, sold for use specifically as a small arms target. Seeing as the mannequin is indeed commercially available, and the fall mechanism itself has already been invented by Lockheed Martin and is currently patent pending, Team #7 is tasked with revising the prototype and making improvements in order to bring it to a production ready state. This will include designing, at a minimum, a stand for the target, interface plates between the target and stand, 2x4 adapters, and a test stand to activate the fall mechanism. The final outcome of this project will be an operational human type target which will fall when hit with an appropriate sequence of small arms fire, including ready for manufacturing designs of the aforementioned components. Team #7's prototyping components have been designed, are currently being analyzed, and will soon be ready for production and testing.

ACKNOWLEDGMENTS

Team #7 would like to thank our contact and representative from Lockheed Martin, Mr. Chris Isler. Chris has been a pleasure to work with and from the start of the project and has done everything he can to ensure the success of this project. He has provided a tremendous amount of wisdom and input that has proved extremely beneficial to the team and has allowed the project to progress quickly over the semester.

Team #7 would also like to thank our faculty advisor Dr. Patrick Hollis. He has not only made himself available and present for our presentations, but he has also provided us with meaningful critique and advice throughout the semester. Team #7 is grateful for all of his help.

1. Functional Analysis

This device is designed for the training of law enforcement and military personnel. It has been designed to resemble a human in shape and size and, when hit with a lethal series of bullets, fall to the ground in a lifelike way. The objective of this target is to accurately simulate a real life training scenario to provide its users with the tools necessary to be prepared for real life encounters. To make the device life like in the way that it falls, the location at which a lethal blow occurs determines the fall direction of the target. Due to the nature of Team #7's task, the "lethal blows" will be simulated using several buttons attached to the rear of the target. Once the target has fallen to the ground it can easily be picked up and reset. Figure 1 below provides a visual of the assembled target.

Figure 1: Assembled Human Type Target

Figure 1 below depicts the target as it would be set up in a training facility in the ready-to-fall position.

2. Project/Product Specifications

The Human Type Target consists of three main parts; the stand, the mannequin, and the Arduino Uno communication. The stand is responsible for supporting the target, providing an easy means for mobility, and housing the electronics needed to trigger the fall. The mannequin is responsible for receiving impact from a variety of ammunition rounds and falling when a lethal blow occurs and the Arduino Uno is responsible for determining fall direction and timing.

1.1 The Stand

Figure 2 below provides a visual of the stand and all of the components attached:

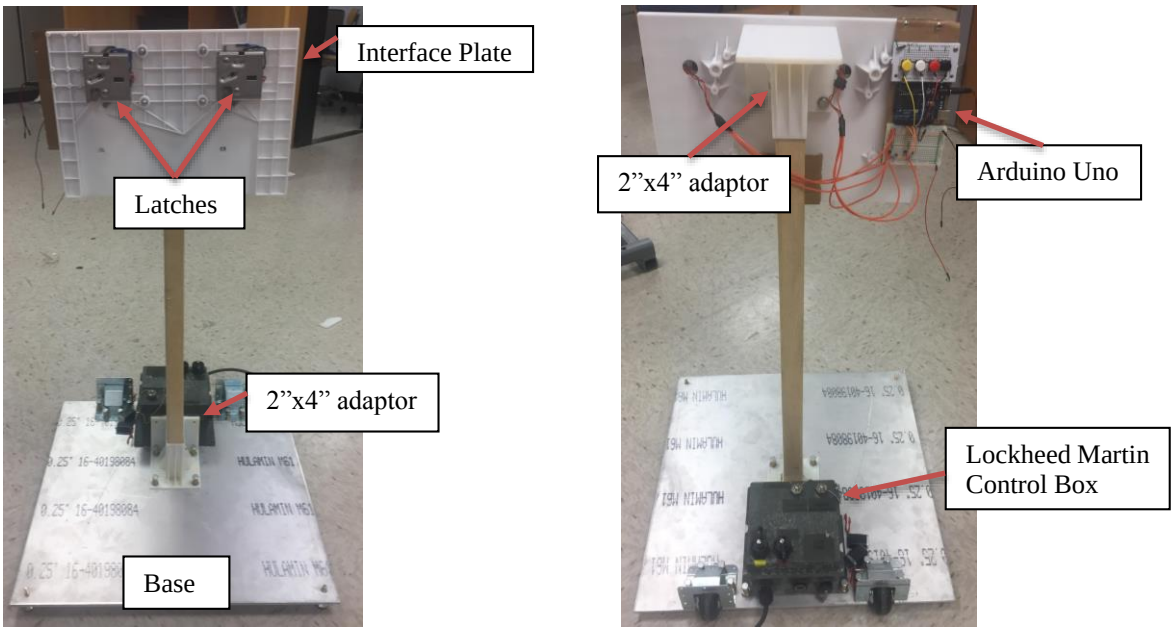

Figure 2: Front of stand (left) and rear of stand (right)

Looking at the image to the left of Figure 2, the front of the interface plate can be seen with the two latches purchased from Southco installed. The approximate dimensions of the interface plate is 15”x10”x1”. In order to trigger the latches (when a lethal series of blows is experienced), a signal of 12-24 volts must be sent to the latches. Moving down the image, the 2”x4” can be seen inserted into the 2”x4” adapter and attached to the base. The approximate dimensions of the 2”x4” adapter is 3.5”x4”x4.5”. The aluminum base itself occupies a 2’x2’ area with two feet attached to

the front and two wheels attached to the rear. Referring to the image on the right, the control box provided by Lockheed Martin can be seen attached in a location where it should be safe from the falling target. The Arduino Uno located in the top right corner will be used to simulate the “lethal blow”. Depending on which button is pressed, the target will fall in a different direction.

1.2 The Mannequin

Figure 3 below shows the mannequin and its attachment point to the stand.

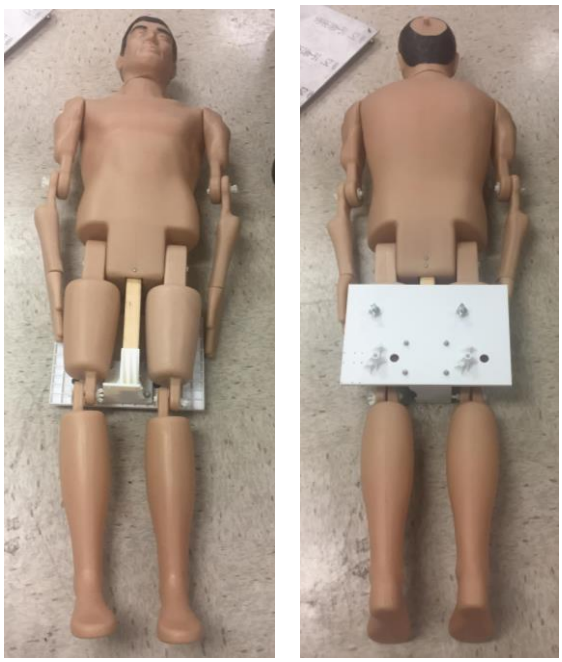

Figure 3: Front and rear view of mannequin

The mannequin is commercially available and comes with a 2”x4” slot set into is torso. The 2”x4” then sets into the 2”x4” adaptor and attaches to the interface plate. This interface plate has two bolt attached which allow it to connect to the stand. The mannequin stands approximately 6’ tall and has adjustable arm and leg positions. Once set into the latches, the mannequin stands about 6’2”. This is easily adjusted if desired by trimming the length of 2”x4”.

The 2”x4” adaptors as well as the interface plates have been designed for injection molding and should be strong enough to withstand hits from a variety of ammunition round. The overall device is designed to be quickly and easily repaired if something is damaged beyond working condition.

The latches used to hold the target up and drop when triggered are rotary latches purchased from Southco. The device used to trigger these latches is an Arduino Uno hooked up to several different buttons.

1.3 The Arduino Uno Communication

In order to simulate the "lethal blows" required to trigger a fall, an Arduino Uno will be used along with four trigger buttons; the configuration of the Arduino Uno and the buttons can be seen below in Figure 4.

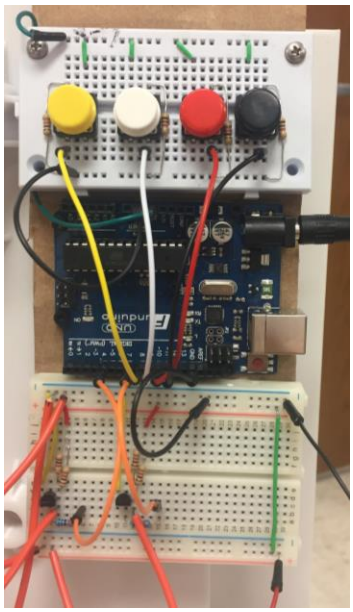

Figure 4: Arduino Uno communication set up.

Starting from the left in Figure 4, the yellow button triggers a fall to the left, the white button triggers a fall straight down, the red button triggers a fall to the right, and the black button resets the latching mechanism. The Arduino Uno requires 9V to power it and the latches require 12-14V to power them; two different sets of rechargeable batteries are used to power these. Each of the batteries supplies 4V and will be connected in series to achieve the desired voltage.

3. Project Assembly

Table 1 below provides all of the parts needed for assembly of the target.

Table 1: Parts List

2”x4” Adaptor (x2)	Base (x1)	Feet (x2)	Wheels (x2)	2”x4”x4’ (x1)
Lockheed Martin Control Box (x1)	Interface Plates (x2)	Southco Latches (x2)	Arduino Uno (x1)	Breadboard (x2)
Jumper Cables (x22-various colors)	Bolts (x27)	Press-in Inserts (x28)	Wood Screws (x8)	Mannequin (x1)
100 Ohm Resistor (x8)	500 Ohm Resistor (x2)	Transistor (x2)	4 Volt Batteries (x5)	Battery Charger (x1)

Figure 5 below shows a visual of the finished assembly (excluding mannequin).

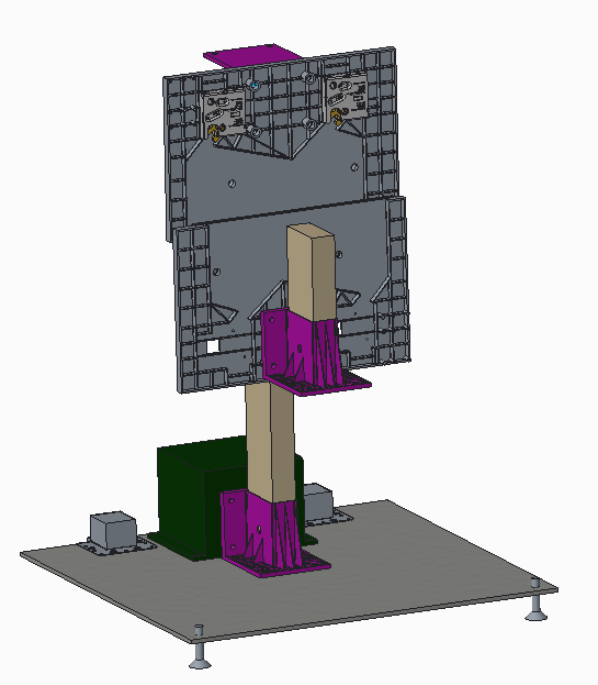

Figure 5: Complete assembly

The target is design to be assembled in 6 steps. The first step is the base assembly which is shown below in Figure 6.

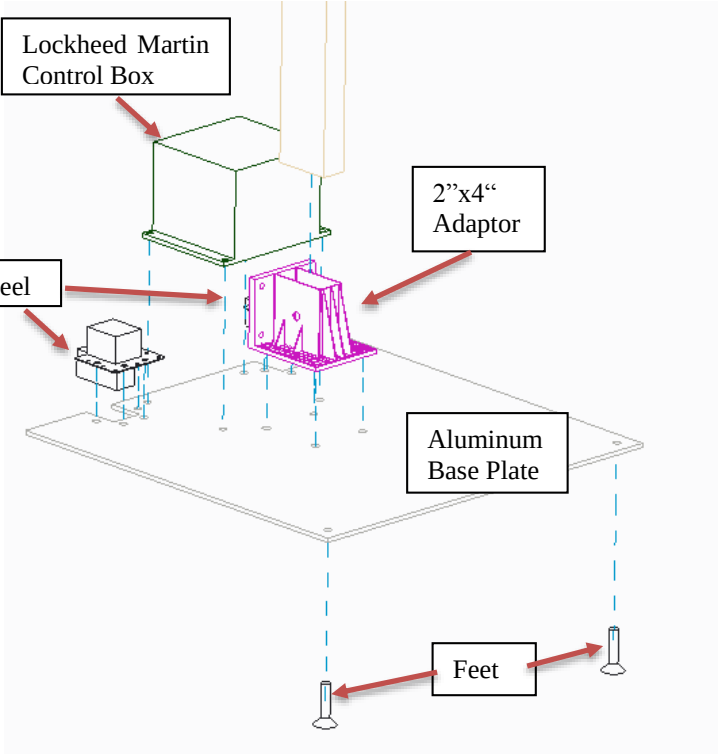

Figure 6: Explodes view of base assembly.

The aluminum base plate should have 18 holes drilled in it. The first step is to press each of the press-in inserts into place from the top of the aluminum plate. Once these inserts are set, the feet and wheels can be bolted down using a socket wrench. Next the Lockheed Martin Control Box and 2”x4” adaptor can be bolted into place. Then the piece of 2”x4” should be cut into a 1’ piece and a 3’ piece. The 3’ piece will be set into the 2”x4” adaptor at this point and fastened by setting a wood screw through the 2”x4” adapter into the wood. Next the stand-side interface plate can be assembled. The exploded view of this interface plate can be found below in Figure 7.

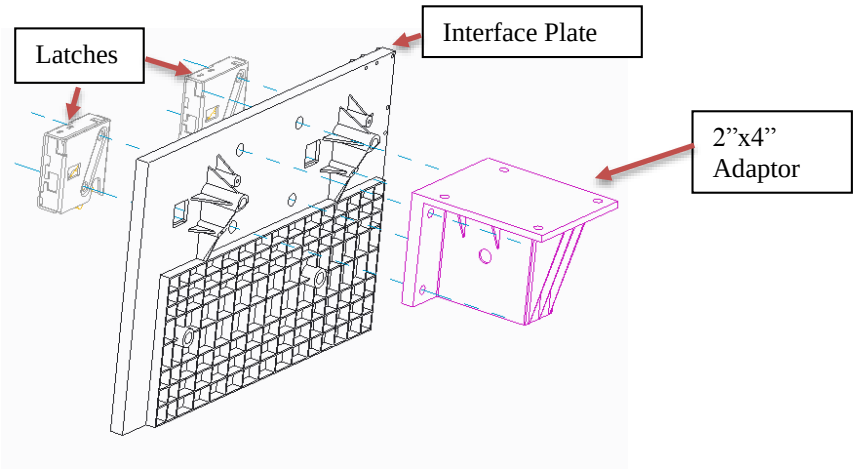

Figure 7: Interface plate to connect to stand

This interface plate should have 4 press in inserts at the 4 locations that line up with the 2”x4” adaptors holes. The 2”x4” adapter will be bolted onto these locations. To attach the two latches, there will be two wood screws set through the latches into the interface plate. Next the interface plate attached to the dummy will be assembled and is shown below in Figure 8:

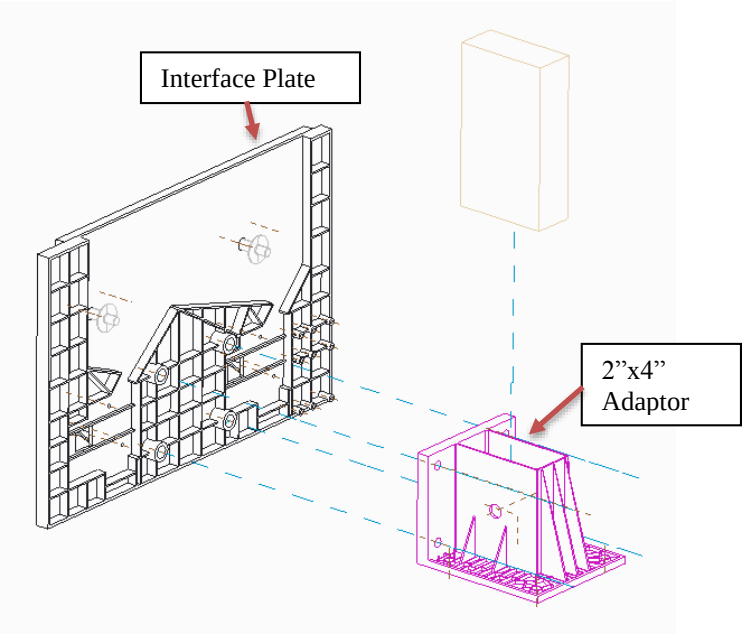

Figure 8: Interface plate to connect to mannequin

For this interface assembly there will be 4 press-in inserts set into the interface place at the locations shown above that line up with the 2”x4” adaptor. Then the remaining 1’ section of 2”x4” will be set into the 2”x4” adaptor and fastened using another wood screw. The other end of the

2”x4” will be placed into the back side of the mannequin and a wood screw will be set through the mannequin’s lower back to fasten them together. The next step will be to attach the stand side interface plate to the stand. This is done by simply sliding the 2”x4” adaptor onto the 2”x4” and fastening with a wood screw. The finished product should look like Figure 5.

The next part to take care of assembling is the electronic components. The Arduino and Bread Boards should be assembled as shown below in Figure 9.

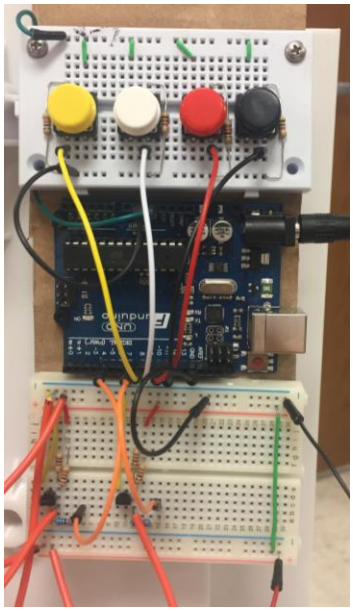

Figure 9: Arduino Uno and breadboard configuration

Once the circuit is set up properly, connect it to the latches and test the attached code found in Appendix A. The target should respond as specified on page 4.

4. Operation Instruction

The device is designed for ease of operation. Once assembled correctly, operation is as simple as the press of a button. When the mannequin is standing in the ready-to-fall position, pressing the yellow, white, or red button will trigger a fall (Refer to Figure 4 if needed). After the mannequin has fallen to the ground, the black button must be pressed to allow the latches to reset. Once they have been reset the mannequin is lifted back up by the user and slid into the latching mechanism. The latching mechanism will auto lock when fully slid into place. Once in place the procedure can be repeated as many times as desired.

5. Troubleshooting

The Human Type Target comes with a variety of pieces to assemble, all of which are easily replaceable. If the 2x4 adaptor or interface plate crack it is a simple fix of replacing the component. Another potential problem could be the latches malfunctioning. In this case simply manually release the latches by pressing the levers on the top of the latches. This will open the latches releasing the dummy. Then determine if the problem is with the latches or the control box by repeatedly opening and closing the latches manually. If the latches will not open or close, then the latches will either need to be lubricated or replaced. If the control box is malfunctioning contact the supplier to receive further assistance. If any other subsidiary part breaks ie, 2x4s, base plate or sensor, simply replace the parts.

6. Regular Maintenance

The target does not need much maintenance. Before use check the 2x4 adaptors and interface plate for any cracks. Manually release the dummy then reinsert it into the clamps. If there are any cracks in the 2x4 adaptors or interface plates replace those parts. If the latches do not work refer to the troubleshooting section of this manual. Repeat the process after use.

7. Spare Parts

This is a list of spare parts needed to ensure continuous operability of the Human Type Target.

Spare Parts	Quantity
2x4 adaptor	2
Interface Plate	1
2x4 wood	2
Inserts	4
Sensor	2
Clamp	1

Appendix A

```
int L = 4; //output pins to trigger latches
int R = 7;
int Sig= 2;
int count = 1;
int counter = 0;

int Selection = 2; //0 is fall straight down, 1 is left, 2 is right
int timebetween = 300; //time between the left and right latch releasing

void setup()
{
  pinMode(L,OUTPUT);
  pinMode(R, OUTPUT);
  pinMode(Sig, OUTPUT);
  pinMode(8,INPUT);
  pinMode(9,INPUT);
  pinMode(10,INPUT);
  pinMode(11,INPUT);
  Serial.begin(9600);
  digitalWrite(Sig,HIGH);
}
void loop()
{
  Serial.print(count);
  if(digitalRead(11) == HIGH){
    count = 0;
    digitalWrite(L, HIGH);
    digitalWrite(R, HIGH);

    while(digitalRead(11) == HIGH){
      } //Wait Until Button is Released

  }

  while(count == 0){
  Serial.print(2);
  //Fall Straight Down
  if(digitalRead(9) == HIGH){
  digitalWrite(L, LOW);
  digitalWrite(R, LOW);
  count = count+1;

  while(digitalRead(9) == HIGH){}
```

```
  }

  //Fall Left
  else if(digitalRead(8) == HIGH)
  {
  digitalWrite(L, LOW);
  delay(timebetween);
  digitalWrite(R, LOW);
  count = count +1;

  while(digitalRead(8) == HIGH){}

  }

  //Fall Right
  else if(digitalRead(10) == HIGH)
  {
  digitalWrite(R, LOW);
  delay(timebetween);
  digitalWrite(L, LOW);
  count = count +1;

  while(digitalRead(10) == HIGH){}

  }
  }

}
```

Biography

Raymond Lessig: Raymond has been studying Mechanical Engineering at FSU and is the projects Website Designer. Raymond has kept our deliverables and assignments up to date and posted online. Raymond has also been in charge of the ordering of parts and ensuring their arrival dates and shipment.

Kraig Williams: Kraig is also a Mechanical Engineering student at FSU and is the teams Financial Manager. Kraig has worked to ensure the team remains on budget and has the funds necessary to make all necessary purchases.

Joe Nowicki: Joe is a Mechanical Engineering student at FSU as well and is the Team Leader for the project. Joe has worked to coordinate meetings with the group and calls with the sponsor. Joe has also been responsible for keeping track of deadlines and delegating tasks.

Daniel Kozell: Daniel is the Lead Mechanical Engineer on the team and is also an FSU student. Daniel is responsible for the CAD design for the project as well as submitting work orders to be completed in the machine shop to ensure all necessary parts are received on time.