



IEEE Southeastcon 2018

IEEE USF: Hardware Competition Rules

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Terminology

Pirate: Robot

Ship: Raised portion of the field

Island: The lower portion of the field not painted blue

Doubloons: Points

Gangplank: Ramp from the ship to the island

Treasure Map: The string of 3 binary bits transmitted by the infrared sensor

Destination A / Lowering the bridge: Push button that lowers the bridge

Destination B / Location of treasure key: Pressure plate

Destination C / Raising the bridge: Push button that raises the bridge

Treasure Chest: The conduit box filled with loose weights

Pirate Flag: The flag raised by the captain's wheel and provided with the field

Avast, Me Hearties!

A pirate begins the journey by reading a treasure map and lowering a gangplank onto the island. The pirate then crosses a narrow gangplank being careful not to fall into the shark infested waters. Once on the island, the map shows the path to the key; then the treasure chest can be claimed! While on the island, the pirate can raise their pirate flag to claim it for the crew. The pirate picks up the treasure chest, returns to the ship, and sets sail on the high seas.

Overview

The major tasks to complete are: reading the treasure map, lowering the gangplank, recovering the key, loading the treasure chest, raising the pirate flag, returning to the ship, and raising the gangplank. The route taken while completing these tasks depends on randomly selected treasure map coordinates. Pirates will have the option of completing all the tasks listed in the coordinates in order, or forgo some tasks in the interest of strategy. However, the key must be retrieved before the treasure chest can be collected. The end goal is to collect the maximum number of doubloons in the least amount of time.

The Treasure Map

At the start of a round, the robot will receive coordinates for the route that must be taken to retrieve the treasure chest. The coordinates will be sent as an IR signal in a 8 bit message. The last 3 bits contain the coordinates. Teams will have to receive, display, and use the code that will be randomly generated at the beginning of every round. Each binary bit represents one of the three destinations (Figure 1). Only destinations listed by the coordinates will earn doubloons. All combinations of destination routes are symmetrical, making all possible combinations equal in length.

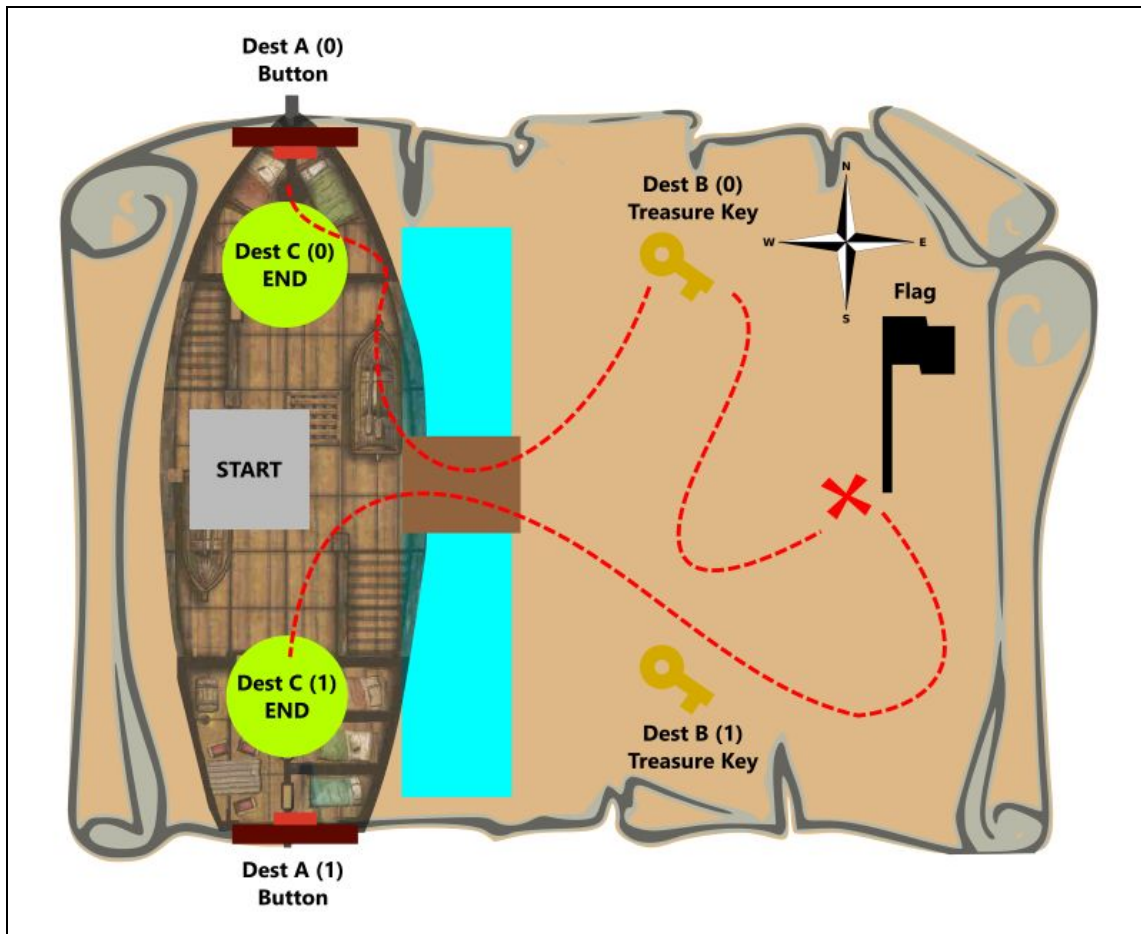


Figure 1: SoutheastCon18 Treasure Map

The Route

The robot starts over an infrared LED (Figure 2) where it receives an 8-bit signal. The received signal must then be displayed on the robot as a decimal number corresponding to the route number displayed in Table 1. This display may be either a 7-segment display or LCD screen and must be in a clearly visible position. See Table 11 for accepted display examples.

The round will begin when the signal begins to transmit from the IR LED. The robot must be placed in the correct starting position and turned on before the transmission occurs. It is encouraged that the robot stays in the position above the IR sensor until the signal is read and displayed. The signal will be set on a loop until the end of the match in the event the signal is not initially detected.

There are two possible locations: North (0) and South (1), for each destination (Figure 1). The route taken will depend on the coordinates the robot receives (see Table 1). The robot must go to each destination in alphabetical order: A-B-C. For example: if Destination B is activated before completing Destination A, the doubloons from Destination A can no longer be earned, and Destination C will be active and ready.

At Destination A, the robot will press a limit switch to “lower the gangplank” and cross the water by using the gangplank to get to the island. Successful completion of Destination A, determined by lighting an LED green, will indicate it is safe to cross the gangplank.

At Destination B, the robot will find the key to unlock the treasure chest by depressing a lever to activate a limit switch. A green LED next to the lever will confirm successful pad activation, and the robot may proceed to the treasure chest or Destination C, whichever desired.

For maximum doubloons the robot must retrieve the treasure chest and raise the pirate flag. The robot can earn doubloons by moving the treasure chest out of an orange outline that is the exact dimensions of the chest itself. More points will be awarded for picking up the chest and storing it on the robot (see Table 11 for scoring details). If a robot manages to pick up the chest and finish the round with both the robot and the chest on the ship, additional points will be awarded. The treasure chest will be located at the same position for every match inside of the orange outline.

Additionally, the robot may rotate a wheel in the clockwise direction to raise the pirate flag. Rotating the wheel 2.75 times will earn a small number of doubloons, while 4.75 times will result in the maximum number of doubloons. The RGB LED built into the rotary encoder will begin the match illuminated red. Once the wheel has been rotated 2.75 times the LED will illuminate yellow; 4.75 rotations will result in the LED changing to green. If the wheel is turned 5.25 turns it will reset back to zero turns, changing the LED back to red and awarding zero doubloons. Once the LED turns back to red, this effectively resets the turns and will need to turn it 2.75 times for the partial number of doubloons and 4.75 for full doubloons. Points will be awarded for the last position left on the flag.

The treasure chest and pirate flag are optional stages to earn extra doubloons. The chest requires the completion of Destination B prior to any manipulation. However, the pirate flag may be raised at any point during the match.

At Destination C, the robot will press a limit switch to signal the end of the round. Destination C will utilize the same buttons as Destination A. Pressing these buttons in the first 45 seconds will register Destination A; pressing these buttons after 30 seconds will register Destination C and ends the round.

A green LED is located above each major destination (A,B,C). For Destination A/C the indicator LEDs will be located at 1.5” and 4.5” on the top edge of the plywood in the provided 3D printed mount from the CAD files. The Destination A LED will be located on the left, and Destination C LED will be located on the right when viewing the button. This LED will illuminate if the correct station was activated; if the wrong station was pressed, the LED will not illuminate. The LEDs themselves may be used to indicate that the button is pressed; there will be a diffuser over the LEDs to better see which one is lit when the button is activated.

Table 1: Coordinate Locations on Treasure Map				
Route	Code (Right=LSB)	Destination A Location	Destination B Location	Destination C Location
1	0 0 0	A (0)	B (0)	C(0)
2	0 0 1	A (0)	B (0)	C(1)
3	0 1 0	A (0)	B (1)	C(0)
4	0 1 1	A (0)	B (1)	C(1)
5	1 0 0	A (1)	B (0)	C(0)
6	1 0 1	A (1)	B (0)	C(1)
7	1 1 0	A (1)	B (1)	C(0)
8	1 1 1	A (1)	B (1)	C(1)

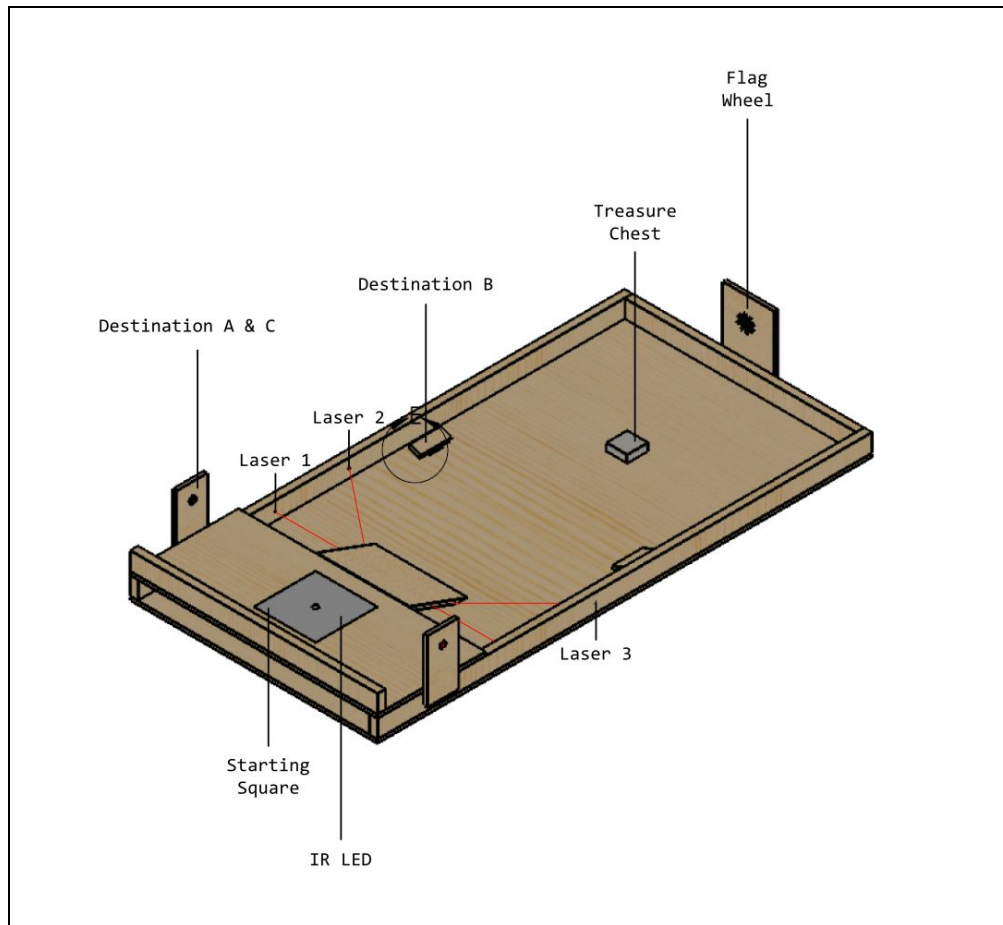


Figure 2: SoutheastCon18 Playing Field

Destination A & C: Button, Destination B: Treasure Key**, Destination C: Button

*The laser hits a LDR mounted on the bridge

**The treasure key is actually a lever, and pressing the correct one opens the chest

***The robot needs to turn the wheel to raise the flag

Playing Rules

The game is about earning doubloons (see Table 11 for doubloons breakdown) by completing objectives. Scores can also be influenced by how a team wants to play the game. Teams can earn a basic number of doubloons by doing the bare minimum of objectives; they can earn more doubloons by completing more tasks.

- Robot must be autonomous - No wired or wireless communications during competition other than IR receiver mounted on the bottom center location on robot to receive coordinate location.
- Robot must remain a single unit and can not be modular.
- Crossing the vertical line created by the 'water' zone will result in the round ending. Any doubloons earned up to that time will be kept.

- Team members are allowed to end the round at any time by having a team member make contact with their robot before interacting with Destination C. Points for time will be counted towards the team's overall score.
- A team making contact during play or tampering with another team's robot will result in the offending teams' disqualification and zero doubloons earned for that round.
- No two teams may occupy a playing field at the same time.
- A round ends when the robot presses the Destination C button (whether it is the correct button or not) or reaches the four minute time limit or when a team member makes physical contact with the robot.
- When the wrong destination is activated, the indicator light will not turn on.
- Each team competes in two rounds before a final round on the Saturday of the conference.
- The final round with the top four teams will be held on Saturday night during the awards banquet.
- Teams can only activate or complete a stage or destination one time.
- Before each round, Teams will have a 15 minute window, after their score is displayed, to file an appeal with the judges/timekeepers if they believe a scoring error exists. ***Judges reserve the right to deduct up to 200 points from a team score with frivolous claims for appeals on scores.*** After an appeal judges/timekeepers decisions are final.
- Robots must be present at the Starting sequester location beginning from 30 minutes to 15 minutes before the beginning of a round. The immediate 15 minutes prior to the competition is to ensure that all competition fields are working, AV setup, etc. At the end of a round teams must place robots in the End sequester location. Robots will be released from sequestering within 15 minutes of all teams completing Rounds 1 and 2 to resolve any appeals. If a team has not reported for sequestering prior to the 15 minute limit, that team will not be allowed to compete in that round, and may only earn doubloons collected outside of round (eg. team shirts, logo and flag).
- Teams must adhere to the the IEEE Code of Conduct or they will be disqualified from competition.
- Only 2 team members are allowed within the designated playing area at a time. Violations will result in a 250 doubloon deduction for the round. The team member in the playing area (robot handler) must wear the team shirt to get t-shirt points.
- Team shirts used for hardware competition must display the same team logo as the team flag in order to get doubloons credit for the shirts.
- Any teams found to be deliberately exploiting the field's automatic scoring system, firing projectiles, interfering with the microcontrollers, the IR sensor, etc. will be removed from the competition.
- Teams cannot drop the treasure chest more than 6 inches. This is to prevent damage to the field.

Doubloon earning locations

- Start Pad (when display shows correct sequence)
- Time - Each team starts with 240 doubloons and lose one per second until the end of the round
- Button (Destination A) - “lowers gangplank”
- Crossing Bridge
- Key (Destination B) - “unlocks treasure chest”
- Treasure chest
- Pirate flag being raised
- Button (Destination C) - Return to Ship and raise the gangplank

Doubloons earned outside of round

- Team Shirts - Hardware Team handlers must wear Team Shirts throughout hardware competition. 75 doubloons will be issued for every round.
- Team Flag - Team must provide a flag to be placed on the ship section of the field during a team's run (must include IEEE logo and school logo/colors)
- Team Logo - The same logo should be displayed on the team flag, team shirts, and robot.

Robot Specifications

The robot must not be greater than 12"x12"x12" at inspection. It cannot extend to more than 20"x20"x20" at inspection and during competition. The robot must not include any form of wireless communication, cannot fly, and cannot make use of projectiles.

Team Logo Specifications

In order to earn full credit for the team logo it must be displayed on the team flag, team shirts, and visible on the robot. If the team is from a school the team logo must incorporate a version of their school logo/mascot. Otherwise if not affiliated with a school no creative design specifications are required.

Team Flag Specifications

The team flag must display the team logo, and may be no larger than 8"x12" and may be any shape within those dimensions. The team flag may be constructed from laminated paper, fabric, or other robust material. Flags constructed of flimsy material (eg. Cardboard, unlaminated paper, tissue cloth, etc.) will not be accepted for points credit. Flags must be attached to a flagpole no longer than 2 feet and no wider than 1 inch in diameter, and the team flag must be attached to the robot. At the beginning of each match the team flag will be placed into a holder on the outside of the field. The team flag is separate from the flag raised by the captain's wheel stage, which will be provided.

Field Specifications

NOTE: All numerical specs for the field are listed or can be calculated from the provided CAD file at ieeesoutheastcon2018.slack.com. Email victorialepp@mail.usf.edu for an invitation to the Slack forum for the file and group Q&A.

The field will be 8'x4' area.

1 count: Plywood Sheet 4' x 8" $\frac{3}{4}$ thickness

1 count: Plywood Sheet 4' x 4" $\frac{3}{4}$ thickness

4 count: 8'x2"x4"

Decking screws

Paint Specifications (on D, treasure chest is covering the orange paint)

Table 2: Specific Paints and Locations				
Colour	Specific Name	ID Number	Brand	Location, Figure 3
Green	Hills of Ireland	M390-7^D	BEHR	A
Brown	Burnt Toffee	S230-6^D	BEHR	B
Blue	Azure Afternoon	89BG 37/353	Glidden	C
Orange	Jack O Lantern	89YR 36/694	Glidden	D
Yellow	English Daisy	P290-6^D	BEHR	E
Black	Black^D	TC-45	BEHR	F
White	Gloss White	39DP14	Rust-Oleum	G

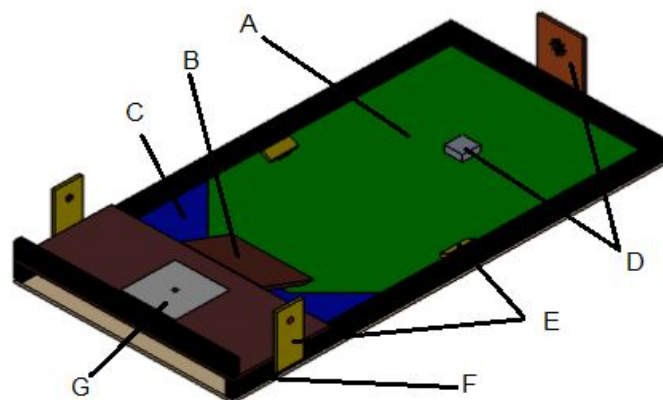


Figure 3: Playing Field Paint Colors

Initial Signal

Coordinates are sent as an IR signal in the following format: The message starts with an initial burst of 9ms, a space of 4.5ms, 8 bits that contain the message, and an ending burst. The first 5 bits of the message will be sent as logical 0s, and the last 3 bits will define the coordinates to follow based on logical 1s and 0s as detailed in the possible routes listed in table 1. The coordinates start from the left-most bit with A as the first one, followed by B and C. The message will be sent once every second.

NOTE: The format is similar to the NEC protocol, however this was just taken as a reference to determine the duration of the pulses for the logical 1s and 0s.

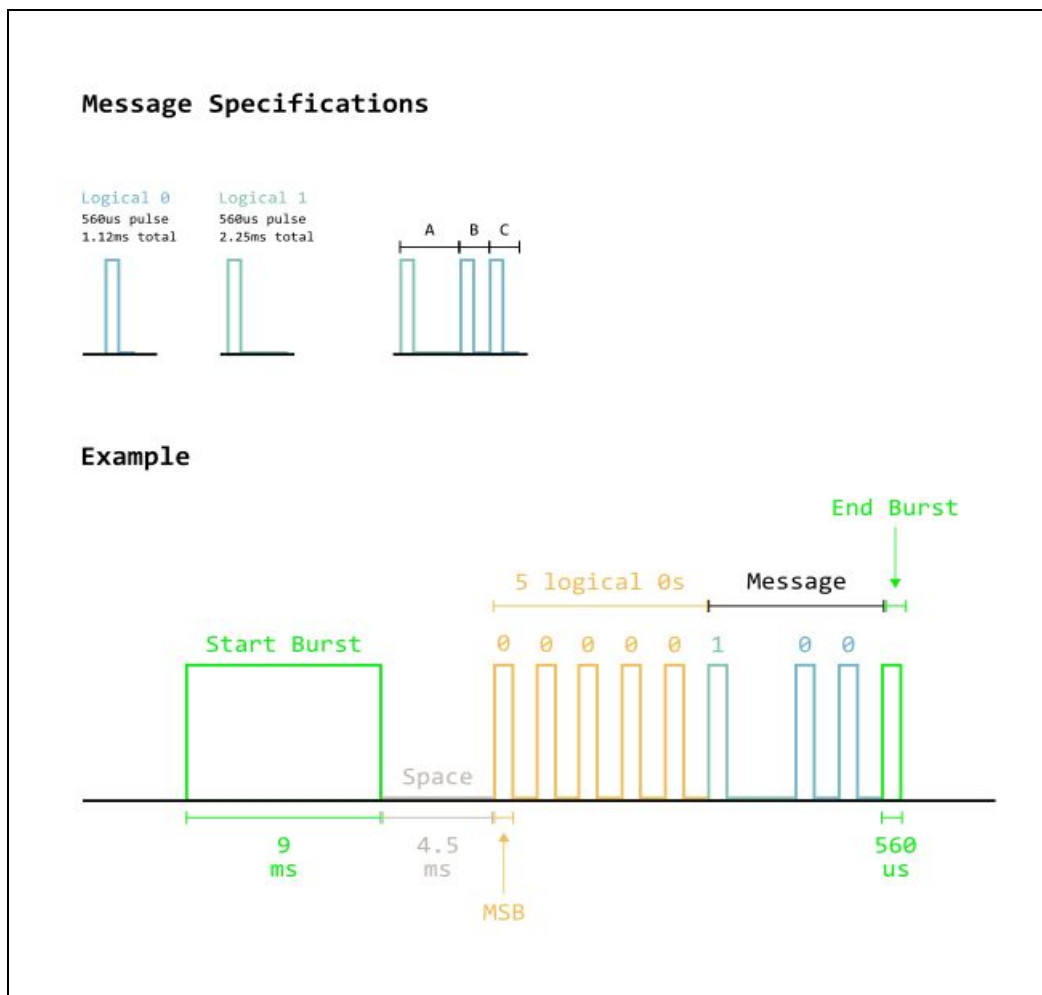


Figure 4: IR Signal Spec Description

Table 3: Initial Signal Parts	
Part Description	Part Number/Details
LED - Infrared 950nm (Initial Signal)	Model#: COM-09349 ROHS https://www.sparkfun.com/products/9349
We are currently using 5 Volts and a 240 Ohm resistor. However, this will most likely change to 3.3 Volts and at least 66 Ohms of resistance as we will start using GPIO soon	

Destination A and C

Destination A and C utilize the same button. This button is a round, arcade style button on a 6" x 12" piece of $\frac{3}{4}$ " plywood. This piece of plywood is centered 12" from the outside Western edge of the field with 9" above the top of the ship. The button is centered 6" above the top of the ship and on the centerline of the short side of the 6" x 12" plywood piece. The green indicator LEDs are located at 1.5" and 4.5" on the top edge of the plywood piece. The indicator LEDs for Destination A will always be on the left when viewing the button.

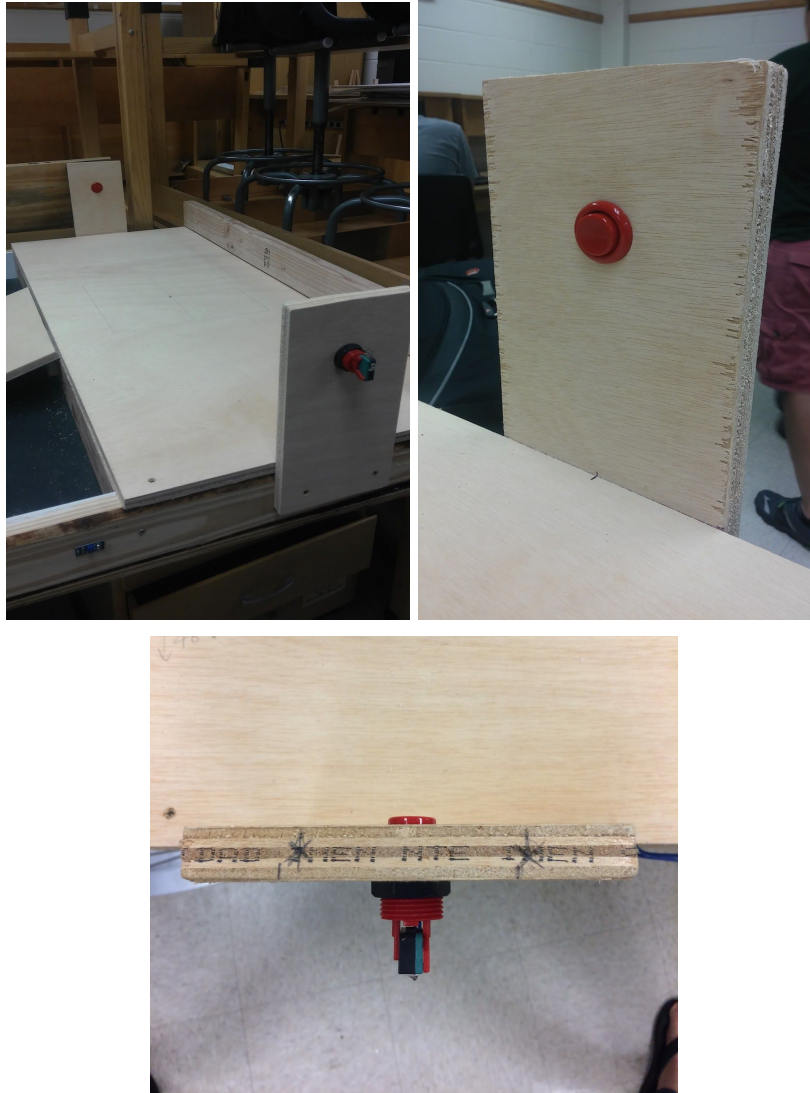


Figure 5: Destination A and C

Table 4: Destination A/C Parts	
Part Description	Part Number/Details
Destination A/B Button	Model#: 1568-1476-ND https://www.digikey.com/products/en?keywords=1568-1476-ND

The Water:

The area of water is located on the main playing board, east of the ship. This area extends from the edge of the ship to the lower edge of the gangplank at the point where the gangplank makes contact with the field (9.5" east from the edge of the ship). In addition, on the North and South sides of the ramp, there is an area of water extending from the edge of the gangplank to the 24.5" mark on the South and North walls, creating a right triangle. The water zone is displayed in Figure 6.

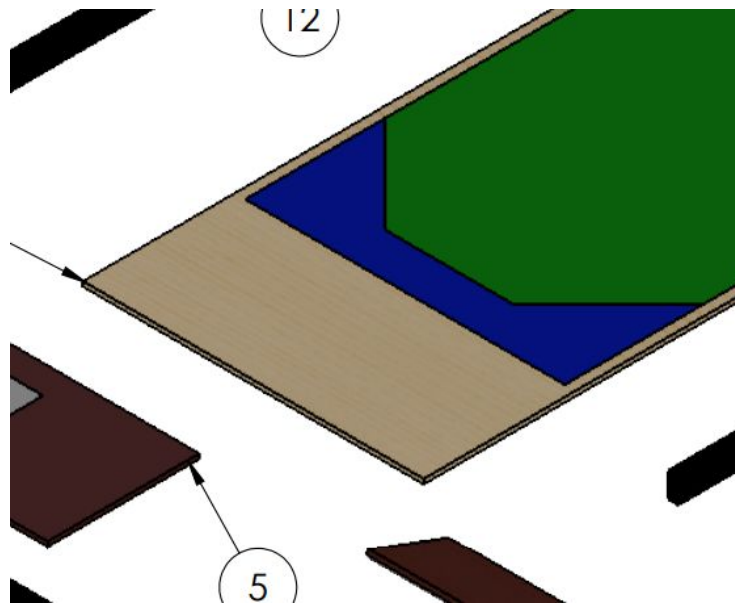


Figure 6: Playing Field "Water area" (Gangplank not shown)

Table 5: The Water Materials	
Part Description	Part Number/Details
Light Detection Signal Switch	Wangdd22 - LYSB01E6W0HPU-ELECTRNCS https://www.amazon.com/gp/product/B01E6W0HPU/ref=oh_aui_detailpage_o01_s00?ie=UTF8&pvc=1
Mini Lasers	Ketofa WYHP https://www.amazon.com/gp/product/B00R73MC1S/ref=oh_aui_detailpage_o01_s00?ie=UTF8&pvc=1

Destination B

Destination B is a 6" x 2.25" rectangle made from $\frac{3}{4}$ " plywood that rests on top of a limit switch. The hinge is centered on the 6" x 2.25" plywood piece on the long side as shown in Figure 7. The $\frac{3}{4}$ " plywood+hinge assembly is centered 42" from the East outermost part of the field. From the inside edge of the 2x4, the plywood portion of the assembly is 4" away, and the hinge portion of the assembly is 3" away (see Figure 7).

The limit switch is mounted on the 2" side of a 2" x 1.625" piece of $\frac{3}{4}$ " plywood; this piece is centered at 42" from the East outermost part of the field flush against the 2x4 so that the hinged $\frac{3}{4}$ " plywood rests on the switch. The switch will activate when approximately 0.5 lb of weight is applied to the top edge of the 6" x 2.25" plywood piece. The attached screws shown in Figure 7 are used to protect the switch from any sudden forces applied to it. The screws are mounted 0.5" from the corners of the plywood and raised approximately 0.3" from each surface. It is recommended that the screws be raised to just barely allow the button to be fully activated but not fully compressed.

Table 6: Destination B Parts

Part Description	Part Number/Details
Everbilt 2-1/2 in. Zinc Plated Narrow Utility Hinges	Model#: 15399 http://www.homedepot.com/p/Everbilt-2-1-2-in-Zinc-Plated-Narrow-Utility-Hinges-2-Pack-15399/202033983
Limit Switch (2 needed)	Model #: E13-00E https://www.digikey.com/product-detail/en/zf-electronics/E13-00E/CH102-ND/90930?WT.src_h=1&gclid=CjwKCAjwyIHPBRAIEiwAHPS-GA8MNF6NQMDsHg1W77MDAmaogIG_03ZF8yIkL-y_mPWNUewmYf04BoCm5YQAvD_BwE

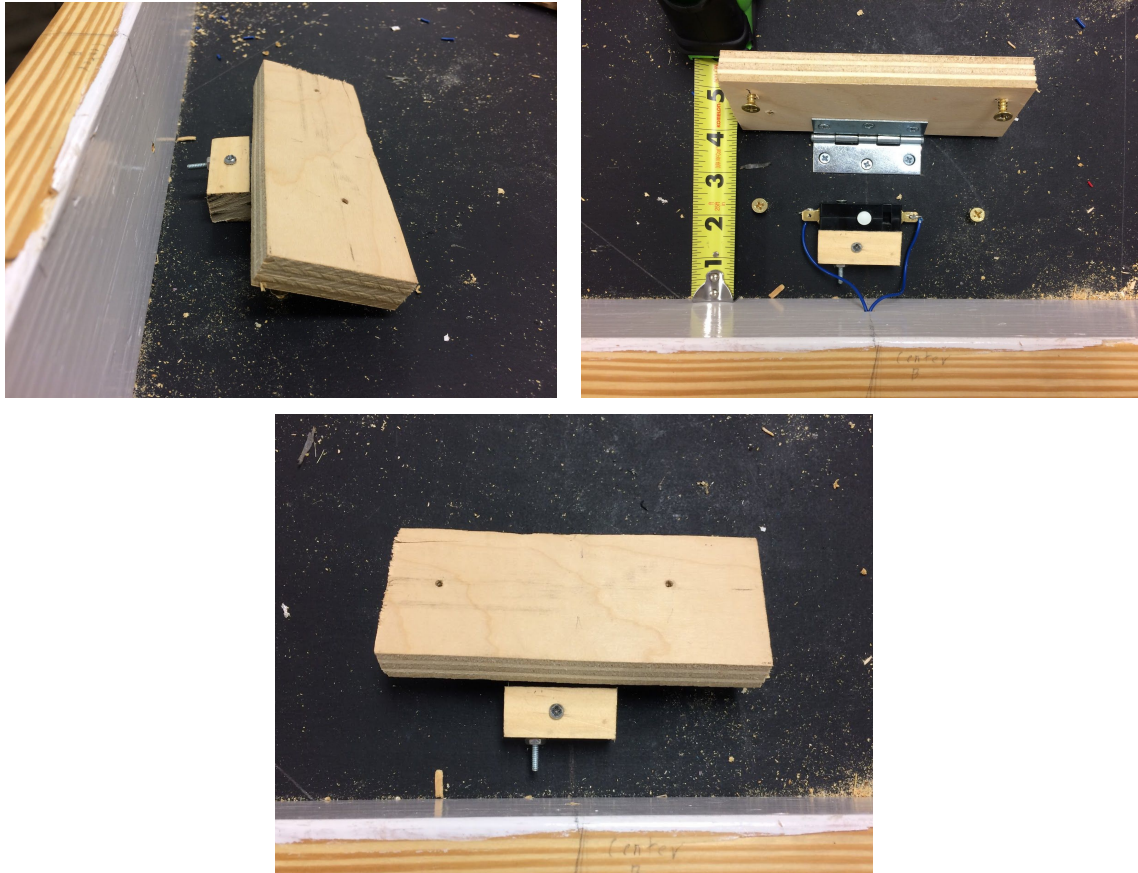


Figure 7: Destination B

Note: Images above (Fig. 7: Dest. B) are for demonstration purposes and will change once correct parts have been delivered

Green Indicator LED

A green-colored LED will be located above each objective of Destination A, B, and C. The LED will light up only if the correct objective is pressed based on the initial signal received at the start of the round. If the wrong objective is activated, the LED will not illuminate, signifying that the wrong objective was pressed.

Table 7: Indicator LED Parts	
Part Description	Part Number/Details
Indicator LED	Model #: C503B-GCN-CY0C0791 https://www.digikey.com/products/en?keywords=C503B-GCN-CY0C0791
5mm LED Diffuser	Model #: CLB_300_CTP https://www.digikey.com/products/en?keywords=CLB_300_CTP

Pirate Flag Destination

The pirate flag will be raised via a 3D printed pirate ship wheel attached to a rotary encoder. The 3D printed wheel will slip over the clear knob supplied with the rotary encoder; the light from the LED will remain visible through the clear knob. The encoder will be located on a 10" x 15" piece of $\frac{3}{4}$ " plywood. The rotary encoder is located 10.25" from the plywood surface when mounted on the edge of the field. This piece is centered 24" from the Northern edge of the field, mounted on the outside of the 2x4 with 10.875" of the board above the Eastern 2x4. The rotary encoder is centered 7" from the top of the 2x4 and on the centerline of the short side of the 10" x 15" plywood piece.

Table 8: Pirate Flag Destination Parts	
Part Description	Part Number/Details
Rotary Encoder - Illuminated (RGB)	Model #: COM-10982 ROHS https://www.sparkfun.com/products/10982


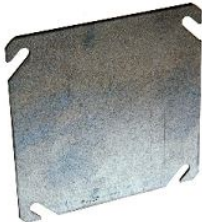

Treasure Chest

The treasure chest is a 4" x 4" x 1 $\frac{7}{8}$ " electrical conduit box filled with eight, 4 ounce pyramid fishing sinkers. These weights will be loose inside the box. The chest will be sealed with a 4" square blank cover. For each round the chest will be located 18" from the center of the chest to the inside of the eastern wall, centered on the North-South axis.



Figure 8: Treasure Chest

Table 9: The Treasure Chest Materials	
Part Description	Part Number/Details
4 in. 30.3 cu. in. Steel Square Electrical Box	Model#: 521711-25R http://www.gordonelectricsupply.com/index~text~5999644~path~product~part~5999644~ds~dept~process~search?gclid=CjwKCAjwyIH PBRAIEiwAHPS-GMFsh-uDUNxt3RlvMUrYkbi1qOmVKBM3uRzLgSZ6E7sAI9_yp1vnpRoC-YMQAvD_BwE
4 in. Square Blank Cover, Flat	Model#: 8752 http://www.homedepot.com/p/4-in-Square-Blank-Cover-Flat-8752/100542712
8x 4oz. Pyramid sinker weights	Model#: PYR-4 https://www.amazon.com/South-Bend-PYR-4-Pyramid-Sinker/dp/B003OAOIKI/ref=sr_1_1?ie=UTF8&qid=1507318744&sr=8-1&keywords=4+ounce+pyramid+sinker

Table 10: Treasure building material		
Steel Square Electrical Box	Square Blank Cover	4 - ounce pyramid sinker weight (4 shown, 8 needed in total)
		

Scoring

Teams will earn doubloons based on completing tasks and actions as specified in the Playing rules and Table 8.

Two Qualifying Rounds: Round 1, and Round 2

1. All qualifying rounds will be scored by the same criteria.
2. There shall be multiple identical playing fields. Teams will compete at the same time on separate fields.
3. Rounds will be 4 minutes each max. Rounds start once the first IR signal is sent and end when Destination C is pressed, or when a team member contacts the robot.
4. Each team will have a randomly generated set of coordinates sent to their robots via the IR LED each round.

Elimination round: Round 3

1. The top 4 teams with the highest **combined** score from the qualifying rounds will proceed to the final round.
2. The top 4 teams will start at a base score of zero entering the final round. No points earned from the qualifying rounds will be counted in the final round. For the teams who do not qualify, their final standings will only be the combined scores from the qualifying rounds. Final round scores are more significant, so the top scoring team in the qualifying rounds may not be the top scoring team in the final round.
3. The final standings for the top 4 teams will show their score from the final round in parentheses, followed by the combined score from the qualifying round. Example final scores (final round score if applicable, combined qualifying score):
 - 1) (1200) 1400
 - 2) (1100) 1400
 - 3) (900) 1400
 - 4) (500) 1500
 - 5) 1300
 - 6) 1200
 - 7) 1200
4. The team with the highest score from the final round only wins the competition.
5. Finals will occur during the banquet on Saturday.

Table 11: Scoring (per round)		
Action	Doubloons	Notes
Time remaining.	240 to 0	<p>Doubloons will be issued based on the number of seconds the team has remaining after completing the round.</p> <p>Formula: Doubloons earned = 240 - Completion time (seconds).</p>
Display Correct Code	200	<p>Correct decimal code displayed on LCD or 7-segment display. A period must be displayed after the number. Teams are displaying the route number (see Table 1), not the binary number.</p> <p><u>Examples:</u> Received Binary: 000 Displayed Decimal: 1.</p> <p>Received Binary: 011 Displayed Decimal: 4.</p>
Activate the Correct Destination A	50	Press the correct button on Destination A
Cross gangplank from ship	100	Crossing the gangplank and the indicator LED from Destination A is green (the correct button was pressed)
Cross gangplank from ship without active Destination A	50	Crossing the gangplank while the indicator LED is not on.
Activate Destination B	200	Maneuver robot onto the correct lever.
Move Treasure Chest	100	<p>Move the treasure chest out of its designated area, indicated by an orange outline that it the exact dimensions of the chest itself.</p> <p>If chest is picked up after moving out of bounds, 200 points will be awarded and the robot will not qualify for an extra 100 points in this category (see next row)</p>

Pick up and store Treasure Chest in/on robot, with Key (Destination B)	200	<p>Successfully picking up and storing the treasure chest in or on the robot. Destination B must be completed first to earn 200 points. If an attempt to pick up is made and the chest is dropped, the 200 points is still honored. If the chest is moved, but still making contact with the playing field, 100 points will be awarded (see above row).</p> <p>Earning 200pts (both methods qualify if attempt is obvious):</p> <p>Picked up box or attempted: the chest is lifted off the field within the 20"x20"x20" area requirement</p> <p>Storing box or attempted: chest is lifted on top, inside, or on side of the robot or within the 20"x20"x20" area requirement while the chest is not in contact with the field</p>
Finish on ship with treasure chest	300	Finish on the ship with the treasure chest and robot completely within the confines of the ship.
Fully Raised Flag Position	200	<p>Raise the flag to the top of the flagpole by turning the captain's wheel clockwise. Teams may turn the wheel as many times as they like. The final flag position and lit LED color as the robot releases contact will be awarded the corresponding points.</p> <p>4.75 to 5.25 turns: 220 points 5.25 and above turns: 0 points</p>
Partially Raised Flag Position	100	<p>Raise the flag to halfway up flagpole by turning the captain's wheel clockwise. Teams may turn the wheel as many times as they like. The final flag position and the lit LED color as the robot releases contact will be awarded the corresponding points.</p> <p>2.75 to 4.75 turns: 110 points 0 to 2.75 turns: 0 points</p>
Activate the Correct Destination C	100	Finish in the correct location by pressing the correct button.

Team Shirts	50	Hardware Team handlers must wear Team Shirts throughout hardware competition. 75 doubloons will be issued for every round.
Team Flag	50	Team must provide a Team Flag with their team logo. Total of 3 team flags will be required, one for each round, assuming team qualifies for elimination round.
Team Logo	50	Must match Team Flag and be visibly identifiable on the robot. 75 doubloons will be issued for each round played.