Modern C++ and SDL2 Project

Make a remake of the game 'Tempest' from Atari (1981) that will be as faithful as possible to the original version. The programming will be done **in modern C++** (11/14/17/20) and the display with the **SDL2 library.**

The game and the rules : https://strategywiki.org/wiki/Tempest

Gameplay Video : https://www.youtube.com/watch?v=AMto2HJJSSA

Enemies details : https://strategywiki.org/wiki/Tempest/Gameplay#Characters

Starting code : https://git.unistra.fr/maliki/sdl2_base_vectors

Specification :

- Use **modern C++** (11/14/17/20)

- **Documentation** of the code and functions

- Write **classes for your objects** and **SDL2 encapsulation**

- Use of **inheritance** and **polymorphism**

- Use of **const** and **references** whenever possible

- No static or dynamic table, use the **STL containers**

- Use of **STL algorithm**

- No pointers use unique, **shared** and **weak_ptr**

- For random numbers no rand()/srand() use **std::uniform_real_distribution** and **std::uniform_int_distribution**

- The texts (menus, score, etc.) will be drawn with the **Hershey fonts :** http://paulbourke.net/dataformats/hershey/

Blaster [edit]

You energize this player though the electrical field. The trick is to keep moving. Your fire power is unlimited, but comes in a volley of shots that must hit something before you can fire again. On the entry-level screens (1, 3, 5, 7, or 9), it's best to fire constantly, in order to keep the enemy under control. You'll have to plan your fire more strategically on later screens. Your path is limited to the perimeter of the different playing fields.

Flippers [edit]

These hourglass-shaped enemies are very quick and very dangerous. They can flip from lane to lane rapidly. Spawned by Tankers, Flippers progress quickly towards the ends of the lanes. Try to kill them while they're in this process. When they've reached the top of the lanes, they chase you with lightning speed in a bid to flip on top of you and capture you. You can still kill them then, but it's tough—you have to time your shot for that brief moment between when they flip into your line of fire and the moment they capture you. It's always preferable to kill them when they're still in the lanes. Flippers first appear in first level (the blue circle), but don't start flipping from lane to lane until the second level (the blue square).

Tanker [edit]

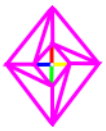
In and of themselves, Tankers present minimal danger. They become dangerous either 1) after you jolt them or 2) when they reach the top of the lane. In either situation, they split into two Flippers. And Flippers are dangerous. Kill the Tankers as close to the bottom of the well as you can. Don't let them get too high. If you kill them near the top of the well, the Flippers will be on top of you. Tankers move slowly, in one lane only. Tankers begin to appear on the third level of play (the blue plus).

Spikers [edit]

Spikers first appear in level 4 (the blue bowtie). They are slow-moving, predictable enemies that never cross lanes. They never reach the top. Spikers have but one purpose: to create Spikes—as long as possible. Spikes cannot be killed; they are simply whittled down bit by bit by your shots. Enemies can use Spikes for protection since your shots can't go any lower than the tip of a Spike. Spikes also cause problems at the end of an electrical pattern—after all the animated enemies have been dealt with. In order to reach a new electrical pattern, you must travel down through a lane. If there's a Spike in the lane, you'll be impaled. The game gives you a lead time to deal with remaining spikes: starting off by visually warning you, "AVOID SPIKES". This lead time, however, shortens as the game progresses. If you fry the Spikers fast enough, the Spikes they leave will be short, and you can quickly chip away at them. Destroy Spikers as quickly as you can or you'll have to contend with longer Spikes. Watch out for the bullets that Spikers shoot at you as well.

Fuseballs [edit]

Fuseballs first appear during level 11 (the blue flat). They're very elusive as they normally move along the edges of the lanes to dodge your shots. They're aggressive, but they aren't fast, especially during those times when they drift across a lane, which is also the only time they're vulnerable to your shots. They're very clever. Destroy them at the first opportunity. If ignored, they will eventually get out of hand as they'll reach the top of the well where they're continuously pursue you. At this point, only the Zapper can destroy them. The Fuseball Tankers won't appear until level 33 (the yellow circle). Like regular tankers, these break apart into two enemies (Fuseballs), when shot or when they reach the edge of the well. If you shoot a Fuseball Tanker, move immediately out of the way or the Fuseballs that appear will charge your Blaster and destroy it.



Pulsars [edit]

First appearing during level 17 (the red circle), these enemies attempt to short-circuit lanes within the electrical field (thus the lanes they're on don't show ends). When they stop moving, expand and turn white, they're about to pulse. It is impossible to cross lanes that Pulsars have effectively short-circuited. You must get into their lanes and quickly attack them before they pulse. If you're caught in a lane when a Pulsar short-circuits it, you're dead. Pulsar Tankers are the very last enemy to arrive in the game, appearing at level 41 (the yellow steps). They split up into two Pulsars when shot, or when they escape the well. Unlike when fighting Fuseball Tankers, it's important to remain perfectly still when you destroy a Pulsar Tanker. The Pulsars they emit will appear on either side of the lane that the Tanker was in, and may immediately short-circuit either lane.

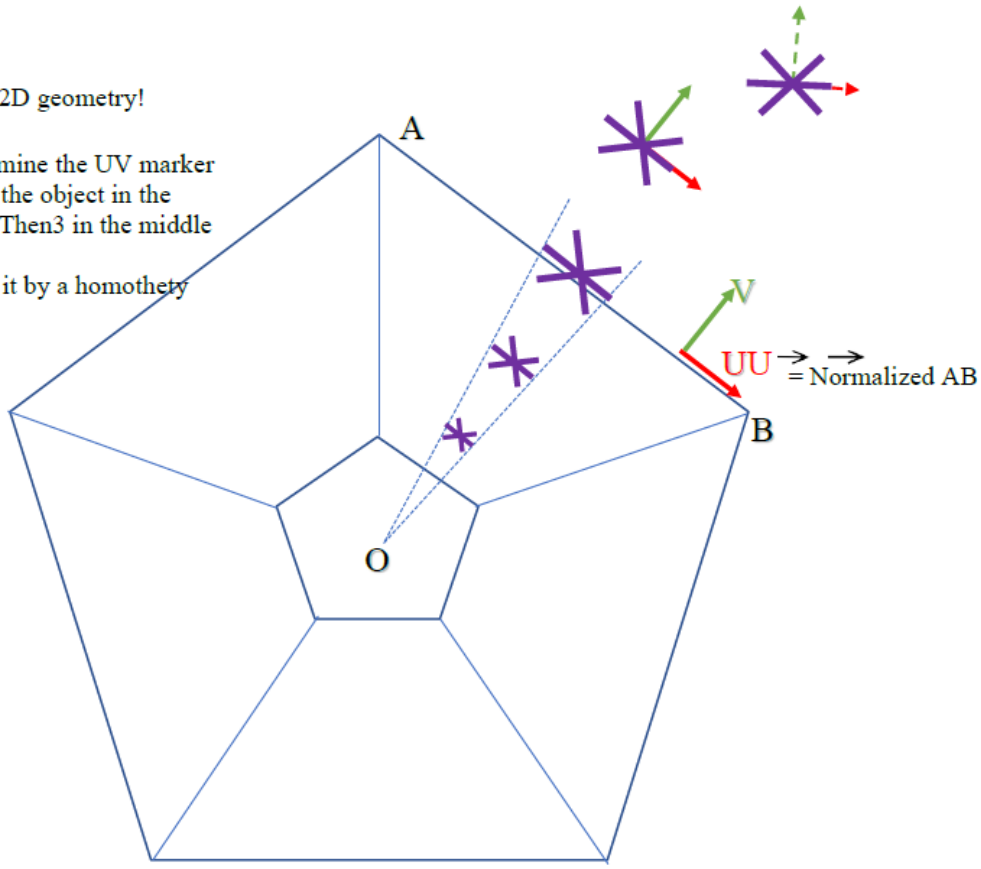
Scoring [edit]

- **Flipper**: 150
- **Tanker**: 100
- **Spikers**: 50
- **Pulsar**: 200
- **Fuseball**: 250, 500, or 750

Details about the vector part :

A little 2D geometry!

1 Determine the UV marker
2 Place the object in the marker Then3 in the middle of AB
4 move it by a homothety



Matrix M of frame (U,V)

Ux		VxUx-
Uy		
Uy		VyUyUx

Put a point in the frame P' = M*P : Px

	Py	
Ux		-UyUxPx- UyPy=
P'x Uy		UxUyPx+ UxPy =
P'y		

It is then enough to add the position of the polygon (in the middle of the segment AB)
A homothety (simple multiplication by a real h) allows then to move each point P on its band towards the bottom.

To be precise it will be necessary to adapt the homothety (2D speed), slower at the center than at the periphery due to the perspective. The homothety factor will thus have to evolve according to z^2, with z=0 ->h=1 (at the periphery) and z=d ->h=h0 (at the center) h0 being the homothety of the central shape / external shape
The value of d being the depth of the tunnel. h0 and d define the perspective ratio (focal length). $h = 1 - a \cdot z^2$ with $a = (1-h0)/d^2$. If we arbitrarily fix d=1 we have :

$h = -1\ (1-h0) \cdot z^2$ with z in [0,1] for the tube from (edge to bottom).