[Project] Frugal but Efficient Spear Trap Battery Design (WIP)

Discussion in '[T-MEC] Terraria Mechanical Engineering Corps' started by ZeroGravitas, Nov 16, 2014.

Thread Status: Not open for further replies.

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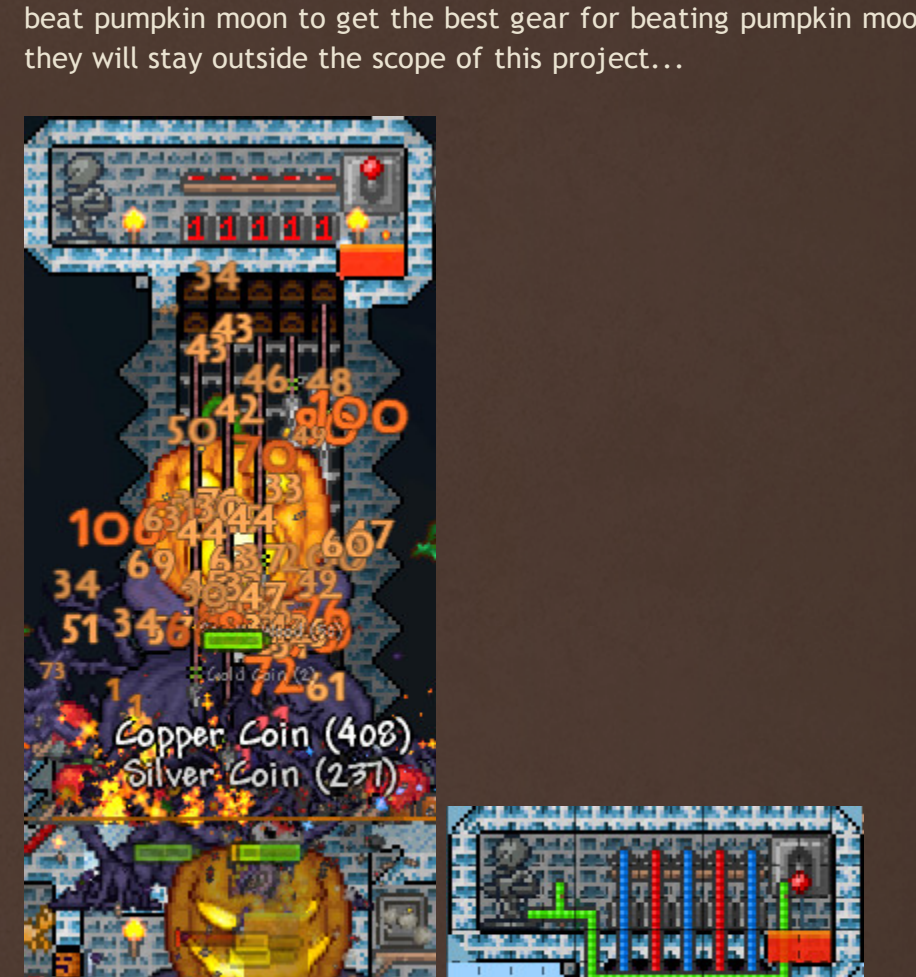
Aim - To come up with a (or even *the*) best design for an arrangement of spear traps. Relatively resource light, so it might be built with the resources found in only 1 (large) world. Simple to wire and preferably as compact as possible, so it looks neat and might be built by any budding player. So a compromise between optimisation and simplification.

Use - My prototype design has mostly been used in my pumpkin & frost moon autofarm (with slime based damage blocking), but it can definitely be used for Golem farming too. Any other suggestions? I imagine it being used by (new) players as a key component of bootstrapping up the equipment tree: you need to beat pumpkin moon to get the best gear for beating pumpkin moon, etc. It's not good against more mobile bosses (like ice queens), unfortunately, so I guess they will stay outside the scope of this project...



Function - the engine obviously runs a lot like my optimal dart traps, see it in action briefly in the item hoik video. I used 1s timers here, as not many are needed and I couldn't have a continuous flow of skeletons while sitting right in the middle of the run (underneath). Skeletons walk at ~5.5 tiles/s, so can activate 5 spear traps per second. With a 2s cooldown on the trap, that allows for a 10 trap activation loop. The clever part of the above design (over DicemanX's bird engine powered stacks, for example) is doubling up the traps into two layers, with the second row activated by the same signals, but only working on alternate seconds. This is achieved by having one row in cool-down when the first sequence of activation pulses comes, hence establishing a continuously staggered pattern. The green wire activates the delayed row of traps when the skeleton is spawned.

In making the design compact (and pretty), I put platforms inside the run (initially for the timers), unfortunately this makes the skeletons jump, so the pressure plates then can't be on the ground any more. The statue had to be moved 2 tiles further away too, for a full firing sequence on the delayed row. There's a slight difference in the skeleton AI between day and night that messes this up. The player must stand at the switch end of the device to start it, and then to stop it with a second skeleton. The timers can be reached for manual deactivation if anything goes wrong.

Spreading out the firing sequence horizontally has little effective difference from a vertical stack when it comes to large mobs (as shown above), as all spears still hit. It also gives wider ground coverage for far fewer traps. Obviously a small mob on the ground underneath will only get hit once per second, so it's far from optimal for grinding them alone, but as they generally have a lot less health (and there's often lava too) it doesn't have a huge detrimental effect on kill rate. Spawn rate is still a limiting factor to an extent.

Alternatives - I've briefly tried a crab engine, but it's a little slow perhaps, only powering a 4 trap sequence. Rabbits/fish might be tried instead, for a 'stingy' approach. Nekojita Chem had a completely different approach with his engine (shown in his "Speed of Minecart" Video), using minecart track plates after a single booster track segment for a reliable sequence speed.

What I'm Asking the Group For - All thoughts, comments, refinements, alternative designs welcome. I'm saying this can be a 'group project'. If this makes it to a guide video I would obviously credit any collaborators fully, but one of you may well get there first (you should have ample chance, heh), which is fine with me, provided proper acknowledgements. I'm mostly trying to get half-completed ideas out there...

Tutorial Threads and Info

Night likes this.

ZeroGravitas, Nov 16, 2014 Report #1 Like

Vendidurt · Eye of Cthulhu · Start a Conversation

I like to activate continuous traps with a single bird along a row of pressure plates to activate them, get to the end, and activate a dart trap to quickly ~~and painlessly~~ remove them from the machine. As opposed to with skeletons, where you have to be on a specific side. It isnt as compact, however. In my testing, birds go about 40 blocks in 3 seconds so it is pretty easy to stagger the timings.

> Shrooms said: ↑
> *Mushroom Army. Fear us.*

Fully AFK console Worm Food farm

Vendidurt, Nov 16, 2014 Report #2 Like

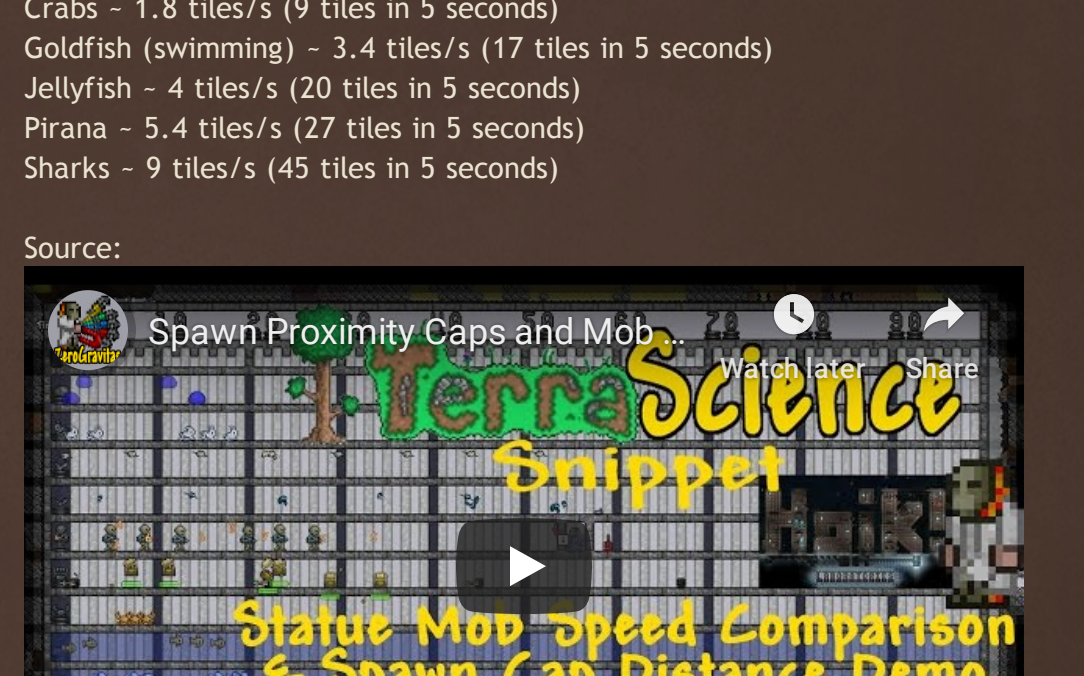
DicemanX · Brain of Cthulhu · Start a Conversation

I look forward to working on this, and I'm glad that you got the ball rolling ZeroGravitas! I ultimately want to be able to construct a spear trap battery that can deliver the maximum 6 hits per second to all mobs with the fewest resources possible. I think one thing that could help is creating a quick summary of travel speeds of both mobs and the spear trap spears, along with spawn caps/limits in case it'll be necessary to spawn multiple mobs. I will copy over my summary from your spawn proximity cap video guide if you don't mind, and if you'd like you can shift it to your initial post:

Statue Spawn Caps/Limits:
Rule 1 - 0.5s cool-down on each of statue's 6 input tiles. (Note: Cool-down is also triggered by unsuccessful activations(!), when spawn is blocked by any rule 2 to 4.)
Rule 2 - No spawn if 3 or more mobs within ~13 tiles of statue footprint.
Rule 3 - No spawn if 6 or more mobs within ~39 tiles of statue.
Rule 4 - No Spawn if 10 of statue's mob type in world.

Mob Speeds (over first 5 seconds of travel):
Blue Slimes (dry) - 3 tiles/s (15 tiles in 5 seconds)
Rabbits - 3.8 tiles/s (18.5 tiles in 5 seconds)
Birds - 10.6 tiles/s (52 + 1 tiles in 5 seconds)
Bats - 13.5 tiles/s (40.5 tiles in 3 seconds)
Skeletons - 5.5 tiles/s (27.5 tiles in 5 seconds)
Mimics - 7 tiles/s (35 tiles in 5 seconds)
Crabs - 1.8 tiles/s (9 tiles in 5 seconds)
Goldfish (swimming) - 3.4 tiles/s (17 tiles in 5 seconds)
Jellyfish - 4 tiles/s (20 tiles in 5 seconds)
Pirana - 5.4 tiles/s (27 tiles in 5 seconds)
Sharks - 9 tiles/s (45 tiles in 5 seconds)

Source:



I also know that you mentioned the movement speed on the spears from spear traps, but I cannot find where you mentioned it - could you refresh my memory?

Lastly: any recommendations on how to most effectively measure the number of hits in one second? Is there a way to show milliseconds using WMP or VLC?

In Windows Media Classic there is a frame step button that advances the frame by 1 in the interface, and CTRL-G while paused brings up the time in milliseconds. I could not find any options to bring up milliseconds in VLC.

Last edited: Nov 17, 2014

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DicemanX, Nov 16, 2014 Report #3 Like

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but dont mobs have a vulnerability period after taking a hit?

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stupidjesse, Nov 17, 2014 Report #4 Like

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> stupidjesse said: ↑
> *but dont mobs have a vulnerability period after taking a hit?*

I assume you mean invulnerability period? For piercing damage sources there is a cap of 6 hits per second, but for non-piercing damage sources I'm not sure what cap, if any, exists. Through empirical testing I've observed that combining damage from traps, minions, and lava progressively increases dps, so it doesn't seem that the damage types interfere with one another. However, it would be great to get confirmation by looking at the code to see if there are any invulnerability frames after a hit from a non-piercing source.

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DicemanX, Nov 17, 2014 Report #5 Like

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OK did a little testing using Windows Media Classic.

I recorded a 2 second clip of a spear trap activation, and used WMC's feature of advancing the frame one at a time. Each time I advanced the frame, the spear tip traveled through exactly a distance of 0.5 blocks. When the spear tip touched the ground, it would move up by 0.5 blocks in the next frame.

One thing that puzzled me though - WMC has a CTRL-G function that brings up the precise time in milliseconds and the frame number (FPS is reported at 60). This means that each frame should advance the time by very close to 0.017ms. However, when I checked the times while advancing the frames one by one, that pattern was not followed. Instead, I got this sequence of times per frame starting at the 79th frame in the video (times are in seconds and milliseconds):

1.334
1.344
1.355
1.370
1.383
1.422
1.445
1.459
1.473

Any idea why the jumps in time for each jump in frame are so erratic? In any event, it looks as if the speed of the spear is exactly 0.5 blocks per frame, or 30 blocks per second.

However, the rate is not the same when the spear first emerges. Jumping one frame from the spear tip not present to the spear tip appearing, a distance of 1 full block is covered (the full spear tip graphic doesn't appear yet). In the next frame, another full block is covered (the full spear tip graphic now appears). In the frame after that, the spear moves a distance of 0.5 blocks and maintains that 0.5 blocks per frame rate.

So for the two blocks immediately below the spear trap, the rate of movement is 1 block/frame or 60 blocks/sec, and for the rest of the distance the rate is 0.5 blocks/frame or 30 blocks/sec.

EDIT: the 1 block/frame rate is only when the spear tip is emerging from the trap for the first two blocks. When the spear is withdrawing back into the trap, it maintains a constant 0.5 blocks/frame rate even for the two blocks below the trap.

EDIT#2: One more thing that is highly relevant - spear tips travel a maximum distance of 19.5 blocks from the trap. The optimization (trying to reach 6 hits/sec) will likely include having spear trap batteries adjacent to one another, but having alternating pits so that spear tips travel a greater distance in alternating columns.

Assuming most mobs are 3 blocks high, that means an individual spear will spend 12 frames within the body of that mob. If you have a pit of 2 blocks, then the spear will initially spend 6 frames within the body of the mob for the first 3 blocks going down, then 8 frames within the 2 block pit going down then up, then again 6 frames within the body of the mob. To make sure that another spear tip enters the body of the mob 4 frames later (to make sure that another hit will take place in 10 frames) a 1 block higher spear trap will have to be activated 22 frames later. The next trap 1 block higher will have to be activated 20 frames after that etc.

This would require a lot of traps in a column. However, if the horizontally adjacent spear trap battery had a deeper pit than 2 blocks, the spear tips could be staggered in such a way as to increase the number of times between spear trap activations, reducing the number of spear traps needed in a column. In fact having a pit of 4 blocks would mean that the adjacent spear tip that travels into the pit would enter the mob body 10 frames after the spear tip in the adjacent column with no pit leaves the mob body.

Just thinking out loud.

Major conclusion#1 = create holes every other column in a region below the spear trap batteries to get closer to reaching the 6 hits/sec cap.

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DicemanX, Nov 17, 2014 Report #6 Like

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how about something like this? i was going to make it longer but wanted to make it short so you can get the point of it. so instead of just 2 short rows, pictured is staggered rows with a cascading effect going right to left. i dont know why I did it that way when left to right would have been easier, but it works the same.

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i'm kidding...

stupidjesse, Nov 17, 2014 Report #7 Like

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critcodedtuna · Terrarian · Start a Conversation

> DicemanX said: ↑
> *Lastly: any recommendations on how to most effectively measure the number of hits in one second? Is there a way to show milliseconds using WMP or VLC?*

You could also try VirtualDub, which has a frame step with a millisecond time counter. I did some quick math on those time sequences, and I think it's just funny math on WMC's part. The shortest difference was 0.010s, and the longest was 0.039s. But the average difference across the whole range of times came out to the expected 0.017s for 60FPS.

Precise slow motion capture involves capturing an scene at an incredibly high frame rate, hundreds or thousands of frames per second. Of course, with Terraria I'm not sure how practical (or even possible) that would be. I'm not sure what you're using to capture, but perhaps you could turn frame skip off and capture at 120FPS?

Minor editorializing: Computer timing (read: PC clock timing) is funny. Computers are great at doing things quickly (looking at everything Terraria tries to do every 0.017s game tick, it's almost a wonder it runs as fluidly as it does). The problem is that they kind of suck at doing things precisely. I find the game has about 30-40 threads running at any given time, and they're all getting where they need to be at different times. Performance is highly variable. With frame skip off and a bunch of traps running, I get 180-200FPS, but it's very erratic. I wouldn't be surprised if it were possible to capture the game output at 300FPS, the spear tip would probably jump around erratically played back at 60FPS due to difference between event processing and draw intervals. I'm not really sure if locking the game rate to 60FPS would even it out or make it more skewed. I think what I'm getting at is that while millisecond timing is interesting, it might not be that useful for determining damage output accurately. Figuring out total sustained damage over longer period of time is probably more accurate, if that makes any sense. Then again, I think I've been trying to go over this in my head long enough now that I might be succeeding in confusing myself.

Sharp-dressed bunnies inspired by /u/Uhmbreeon

critcodedtuna, Nov 17, 2014 Report #8 Like

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Vertical wiring is certainly an interesting idea worth exploring!

One thing you might consider creating is a standard set-up against which you can test all your experimental set-ups. Here's an example:

[IMG]

The set-up on the left guarantees 6 hits/second, while the set-up on the right is the experimental set-up. I turn on all the traps with one switch, then with the other switch I keep summoning mimics and watching which dies faster over many trials. I do this with 0% crit chance and with 100% crit chance gear. Testing only at 0% crit chance should be fine though.

The standard grinder uses 12 rows of spear traps. I have 4 columns but 1 should be enough for testing with mimics so long as you trap the mimics inside a 2 block-wide space.

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DicemanX, Nov 17, 2014 Report #9 Like

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> critcodedtuna said: ↑
> *You could also try VirtualDub, which has a frame step with a millisecond time counter. I did some quick math on those time sequences, and I think it's just funny math on WMC's part. The shortest difference was 0.010s, and the longest was 0.039s. But the average difference across the whole range of times came out to the expected 0.017s for 60FPS.*

Yeah it works out nicely at least, although given the consistency of the spear tip jumping precisely 0.5 blocks with every frame - would it be good enough to ignore the times altogether and just base it on frames? I'll have to give VirtualDub a try as well - thanks for the link!

By the way I'm using FRAPS and Handbrake, although I'm still relatively new to video capturing.

> *Minor editorializing: Computer timing (read: PC clock timing) is funny. Computers are great at doing things quickly (looking at everything Terraria tries to do every 0.017s game tick, it's almost a wonder it runs as fluidly as it does). The problem is that they kind of suck at doing things precisely. I find the game has about 30-40 threads running at any given time, and they're all getting where they need to be at different times. Performance is highly variable. With frame skip off and a bunch of traps running, I get 180-200FPS, but it's very erratic. I wouldn't be surprised if it were possible to capture the game output at 300FPS, the spear tip would probably jump around erratically played back at 60FPS due to difference between event processing and draw intervals. I'm not really sure if locking the game rate to 60FPS would even it out or make it more skewed. I think what I'm getting at is that while millisecond timing is interesting, it might not be that useful for determining damage output accurately. Figuring out total sustained damage over longer period of time is probably more accurate, if that makes any sense. Then again, I think I've been trying to go over this in my head long enough now that I might be succeeding in confusing myself.*

Thanks for the info - I never really realized things are that much more complicated. I thus ultimately plan to test the performance of every design in-game based on repeated trials involving the simultaneous pitting of an experimental spear trap engine versus a standard that uses an overabundance of traps to guarantee the cap of 6 hits per second. I use mimic statues and spawn mimics in the two engines simultaneously at either 0% crit or 100% crit.

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DicemanX, Nov 17, 2014 Report #10 Like

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Not managed to read all of everyone's comments there (wow, so much replies!) but I'd been measuring time by recording short clips in fraps at 60fps and then just leafing through in VLC. The key though was to include a skeleton hoik (rail gun) as an absolute timing index point of reference, since there can be skipped frames or general ambiguity.

Also, I've just created a new thread to start in making our engineering cheat sheet, so that might suite having discussions about trap speed measurements, etc. Keep up the good work!

Last edited: Nov 17, 2014

Tutorial Threads and Info

ZeroGravitas, Nov 17, 2014 Report #11 Like

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> DicemanX said: ↑
> *Major conclusion#1 = create holes every other column in a region below the spear trap batteries to get closer to reaching the 6 hits/sec cap*

Yup, or equally, for 6 hits/sec you only need to fire 3 traps per second, if the pit underneath is spaced just right that each spear returns at just the right time to double up the number, as you say. Or course, this needn't be the same spear tip taking consecutive hits, each time, you could interleave them, by having a far deeper pit (but I'm not sure there's any advantage to that).

This type of optimisation context (for small, stationary targets) seems most relevant for grinding statue mimics and sharks (i.e. your ectoplasm farm). Think it will generalise to naturally spawned mobs too - would we have to confine them into a very small space?

> critcodedtuna said: ↑
> *With frame skip off and a bunch of traps running, I get 180-200FPS*

WHAA?! Terraria will go over 60fps?!! I guess I won't know as my main monitor only runs at that speed.... But does the increased frame rate mean anything? It's not just duplicating frames?... Do hoiks go faster? (or is collision detection capped at 60 times/s?) Do other behaviours change? Do sprites in movement take extra, interpolated steps in between what I would see?!...

> DicemanX said: ↑
> *would it be good enough to ignore the times altogether and just base it on frames*

Unless Crit is going to blow my mind, answering the above, then I'd say go by frames. Perhaps think about movement speeds in terms of pixels/s too (as well as tile/s), as it's not necessarily exact divisions of tiles. But if collisions and hits are only ever calculated each tick, then any rendering in between is purely decorative (i.e. irrelevant).

Tutorial Threads and Info

ZeroGravitas, Nov 17, 2014 Report #12 Like

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critcodedtuna · Terrarian · Start a Conversation

> ZeroGravitas said: ↑
> *WHAA?! Terraria will go over 60fps?!! I guess I won't know as my main monitor only runs at that speed.... But does the increased frame rate mean anything? It's not just duplicating frames?... Do hoiks go faster? (or is collision detection capped at 60 times/s?) Do other behaviours change? Do sprites in movement take extra, interpolated steps in between what I would see?!...*

Apparently it can, but I think I glitched it. I was fiddling with the frame skip option, tabbed out to look at something else, tabbed back to the game, and next thing I know my frame rate was uncapped. I quit out of the game for a while, started it back up to check something else out, and couldn't reproduce it -- stuck at 60FPS again. The rendering while glitched was *much* smoother and enemies moved a bit quicker. I didn't think to check hoiks or other speed-dependent stuff. The best part of it was quitting out to the title screen and seeing the parallax scroll going at 700FPS.

I'd love to be able to figure out what I did, because it was kind of awesome.

Sharp-dressed bunnies inspired by /u/Uhmbreeon

ZeroGravitas likes this.

critcodedtuna, Nov 17, 2014 Report #13 Like

DicemanX · Brain of Cthulhu · Start a Conversation

> ZeroGravitas said: ↑
> *This type of optimisation context (for small, stationary targets) seems most relevant for grinding statue mimics and sharks (i.e. your ectoplasm farm). Think it will generalise to naturally spawned mobs too - would we have to confine them into a very small space?*

It can be for longer stretches too since you can have as many adjacent batteries as you'd want, but the system of alternating holes would require that the dart trap batteries be right next to each other instead of spacing them 1 block apart. Of course for frugal batteries the spacing could be greater if the trash mobs are of lesser interest than the event bosses, but I figured it's best to first achieve the hit cap with the least number of spear traps for all mobs (which would be good for speed runs), and then work on making more frugal versions.

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stupidjesse likes this.

DicemanX, Nov 17, 2014 Report #14 Like

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OK, so I stumbled onto another design with the class of vertical engines I've dubbed "rainsticks". I've described them in some detail at the bottom of my fastest engines guide. Their plate layout works well for player or bat powered timer activation @ 6 per second (on consecutive platforms, 3 per second with a alternate plates). And the orientation means there's no need to go around a corner with the wiring loom:

What do people think?

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ZeroGravitas, Dec 8, 2014 Report #15 Like

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http://steamcommunity.com/sharedfiles/filedetails/?id=354103617
i combined the stingy spear trap battery with dicemanx's logic gate. all the bits and pieces are there but the execution could have been done better, but its my fault because i rushed to do it instead of taking my time and thinking everything threw. now that i think about it i should have moved the trap batter up some, then connected the top output as the input for the bat statue and use the bottom output as the input for the mimic statue.

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i'm kidding...

stupidjesse, Dec 10, 2014 Report #16 Like

ZeroGravitas · The Destroyer · Start a Conversation

> stupidjesse said: ↑
> *i combined the stingy spear trap battery with dicemanx's logic gate.*

Lol. So you can select fireworks A, mimic mincer on/off, fireworks c. It's a kind of multiplexer.

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ZeroGravitas, Dec 10, 2014 Report #17 Like

(You have insufficient privileges to reply here.)

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