= Galaxy Game =

Galaxy Game is a space combat arcade game developed in 1971 as one of the last games created in the early history of video games . Created by Bill Pitts and Hugh Tuck , it was one of the first coin @-@ operated video games ; its initial prototype display in September 1971 at the Tresidder student union building at Stanford University was only a month after a similar display of a prototype of Computer Space , making it the second known video game to charge money to play . Galaxy Game is an expanded version of the 1962 Spacewar ! , potentially the first video game to spread to multiple computer installations . It features two spaceships , " the needle " and " the wedge " , engaged in a dogfight while maneuvering in the gravity well of a star . Both ships are controlled by human players .

The initial prototype , which cost Pitts and Tuck US $ 20 @,@ 000 to build , was composed of a Digital Equipment Corporation PDP @-@ 11 minicomputer attached by a cable to a wooden console with a monitor , controls , and seats . It charged players 10 cents per game or 25 cents for three , and drew crowds " ten @-@ deep " . The pair built a second prototype , replacing the first in the student union building in June 1972 . It featured the capability to play multiple games simultaneously on four monitors , though due to space restrictions only two consoles with monitors were actually installed . These consoles had a blue fiberglass casing , and the PDP @-@ 11 was housed inside one of the consoles . By the time of its installation , the pair had spent US $ 65 @,@ 000 on the project , but were unable to make the game commercially viable . The second prototype remained in the student union building until 1979 , when the display processor became faulty . It was restored and placed in the Stanford computer science department in 1997 , then moved to the Computer History Museum in 2000 , where it remains .

= = Background = =

At the beginning of the 1970s , video games existed almost entirely as novelties passed around by programmers and technicians with access to computers , primarily at research institutions and large companies . One of these games was Spacewar ! , created in 1962 for the Digital Equipment Corporation (DEC) PDP @-@ 1 minicomputer by Steve Russell and others in the programming community at the Massachusetts Institute of Technology . The two @-@ player game has the players engage in a dogfight between two spaceships , set against the backdrop of a starfield , with a central star exerting gravitational force upon the ships . The game was copied to several of the early minicomputer installations in American academic institutions after its initial release , making it potentially the first video game to be available outside a single research institute . Spacewar was extremely popular in the small programming community in the 1960s and was widely recreated on other minicomputer and mainframe computers of the time , later migrating to early microcomputer systems . Early computer scientist Alan Kay noted in 1972 that " the game of Spacewar blossoms spontaneously wherever there is a graphics display connected to a computer , " and contributor Martin Graetz recalled in 1981 that as the game initially spread it could be found on " just about any research computer that had a programmable CRT " . Although the game was widespread for the era , it was still very limited in its direct reach : the PDP @-@ 1 was priced at US $ 120 @,@ 000 and only 55 were ever sold , most without a monitor , which prohibited the original Spacewar or any game of the time from reaching beyond a narrow , academic audience . The original developers of Spacewar considered ways to monetize the game , but saw no options given the high price of the computer it ran on .

In 1966 , Stanford University student Bill Pitts , who had a hobby of exploring the steam tunnels and buildings of the campus , broke into a building he found out to be the location of the Stanford Artificial Intelligence Project , which held a DEC PDP @-@ 6 time @-@ sharing computer system with 20 Teletype consoles connected to it . Fascinated by the computer and having taken several introductory computer classes , Pitts convinced the head of the project , Lester Earnest , to let him use the computer after hours . Soon , Pitts had ceased going to classes , instead spending his nights in the computer lab interacting with the graduate and postgraduate students and playing

Spacewar on the PDP @-@ 6 . Pitts often played against Hugh Tuck , a student at California Polytechnic State University who was a friend from high school . During one Spacewar session that took place , depending on the source , between 1966 and 1969 , Tuck remarked that a coin @-@ operated version of the game would be very successful . Such a device was still unfeasible due to the cost of computers , and the pair did not pursue the project . In 1971 , however , Pitts , who by then had graduated and was working at Lockheed as a PDP @-@ 10 programmer , learned of the 1970 DEC PDP @-@ 11 , which was sold for around US $ 14 @,@ 000 . While this was still too high for a commercially viable product , as most electronic games in arcades cost around US $ 1 @,@ 000 at the time , Tuck and Pitts felt it was low enough to build a prototype to determine interest and optimal per @-@ game pricing .

= = Gameplay = =

The gameplay of Galaxy Game , like Spacewar , involves two monochrome spaceships called " the needle " and " the wedge " , each controlled by a player , attempting to shoot one another while maneuvering on a two @-@ dimensional plane in the gravity well of a star , set against the backdrop of a starfield . The ships fire torpedoes , which are not affected by the gravitational pull of the star . The ships have a limited number of torpedoes and a limited supply of fuel , which is used when the player fires his thrusters . Torpedoes are fired one at a time , and there is a cooldown period between launches . The ships follow Newtonian physics , remaining in motion even when the player is not accelerating , though the ships can rotate at a constant rate without inertia .

Each player controls one of the ships and must attempt to shoot down the other ship while avoiding a collision with the star . Flying near the star can provide a gravity assist to the player at the risk of misjudging the trajectory and falling into the star . If a ship moves past one edge of the screen , it reappears on the other side in a wraparound effect . A hyperspace feature , or " panic button " , can be used as a last @-@ ditch means to evade enemy torpedoes by moving the player 's ship to another location on the screen after disappearing for a few seconds , but the reentry from hyperspace occurs at a random location , and there is an increasing probability of the ship exploding with each use . Player controls include clockwise and counterclockwise rotation , forward thrust , firing torpedoes , and hyperspace . Galaxy Game features , as improvements over the original , optional modifications to the game to have faster ships , faster torpedoes , to remove the star and its gravitational field or reverse the gravity to push away from the star , and to remove the wraparound effect . The movement of the ships was controlled with a joystick , while the torpedoes , hyperspace , and game options are controlled via a panel of buttons .

= = Development = =

After deciding to begin work on a coin @-@ operated version of Spacewar , the pair , with assistance from Tuck 's family , bought a PDP @-@ 11 and started working on a prototype . They spent a total of US $ 20 @,@ 000 to build a single arcade machine for two players , like the original Spacewar , deciding to price the game at ten cents per play or 25 cents for three games , with the winner of a match given a free game . They used a PDP @-@ 11 / 20 version of the PDP @-@ 11 (US $ 14 @,@ 000) , a Hewlett @-@ Packard 1300A Electrostatic Display (US $ 3 @,@ 000) , and spent the remainder on the coin acceptors , joysticks , wiring , and casing . Pitts build the computer hardware and handled the programming , while Tuck , a mechanical engineer , designed the enclosing cabinet . The display adapter for the monitor was built by Ted Panofski , the coin acceptors were sourced from jukebox manufacturer Rowe International , and the joysticks found at a military surplus store as remainders from B @-@ 52 bomber controls . The code for the game was based on a version of Spacewar running on a PDP @-@ 10 in the Stanford artificial intelligence lab , but modified with additional features .

Pitts and Tuck renamed their product from Spacewar to Galaxy Game due to anti @-@ war sentiment and founded a company called Computer Recreations in June 1971 to operate the game as it neared completion . The development of the prototype machine took around three and a half

months . By August , they were finishing the final touches and had gotten permission to place the machine at the Tresidder student union building at Stanford as a test site . It was then that they received a call from Nolan Bushnell , who had heard of their project and wanted to show them his similar project he was working on .

Bushnell had also played Spacewar during the 1960s and wanted to make an arcade game version of it , but had gone in a different technological direction . He and Ted Dabney had initially started with a US $ 4 @,@ 000 Data General Nova computer which they thought would be powerful enough to run multiple simultaneous games of Spacewar ; when it turned out to not be , they had started investigating replacing the computer hardware with custom @-@ built parts . They had soon discovered that while a general @-@ purpose computer cheap enough for an arcade game would not be powerful enough to run enough games of Spacewar to be profitable , a computer purpose @-@ built for solely running one game could be made for as low as US $ 100 . By August 1971 when Bushnell called Tuck and Pitts , he and Dabney had already displayed a prototype of their Computer Space game in a bar near Stanford and had found a commercial manufacturer for the game in Nutting Associates . They were curious about what Tuck and Pitts had done to make a commercially competitive version of the game , but were relieved , though also somewhat disappointed , to find that they had not solved that problem yet .

Tuck and Pitts , on the other hand , while impressed with Bushnell 's hardware were not impressed with the game itself . They felt that Computer Space , a single @-@ player game without the central gravity well of the original game , was a pale imitation of Spacewar , while their own Galaxy Game was a superior adaptation of the game . A few weeks later , in September 1971 , the Galaxy Game prototype debuted . The veneered walnut console , complete with seats for players , was located on the second floor of the building and connected to the PDP @-@ 11 in the attic by a 100 @-@ foot cable . It was very successful ; Pitts later said that the machine attracted crowds of people " ten @-@ deep " watching the players . They briefly attached a second monitor hanging above the console so that the watchers could more easily see the game . The low prices meant that they did not come close to making back the price of the PDP @-@ 11 , but they were excited by the game 's reception and had not intended the prototype to be profitable . As the initial Galaxy Game prototype was displayed to the public one month after the first Computer Space prototype , it is believed to be the second video game to charge money to play .

As a result of the reception to Galaxy Game , Pitts and Tuck started work on an expanded prototype . For the second machine , they built a full blue fiberglass casing for the consoles , improved the quality of the joysticks with the help of an machine shop , and modified the computer with a newer display processor to support up to four games at once on different monitors ? either multiple simultaneous separate games or up to four players playing the same game on two screens . They also placed the PDP @-@ 11 inside one of the consoles rather than in a separate location . While the original plan had been to work on driving down the development costs after the initial prototype , the popularity of the game convinced the pair to instead focus on making a better machine that could run multiple games to recoup the upfront investment . The new version was installed in a cafe in the student union building in June 1972 , though with only two monitors due to space restrictions . The original Galaxy Game prototype was displayed at several locations around the area , but was not as successful as it had been at the student union building . By the time the second prototype was completed the pair had spent US $ 65 @,@ 000 on the project and had no feasible way of making up the cost with the machine or commercial prospects for a wider release . Pitts later explained that he and Tuck had been focused on the engineering and technical challenges of producing a faithful coin @-@ operated Spacewar game and paid little attention to the business side of the project ; he felt that Computer Space had been more commercially successful because Bushnell had focused more on the business side of his idea than the technical .

= = Legacy = =

The second Galaxy Game prototype remained on display in the Tresidder building until May 1979 , when it was removed due to the display processor becoming unreliable . Throughout its time on

display , it remained popular , with " ten to twenty people gathered around the machines most Friday and Saturday nights when school was in session . " Pitts later claimed that by the time the machine was removed , it had managed to make back the original investment . After its removal , the machine was dismantled , with the computer parts stored in an office and the casing outdoors . The unit was restored in 1997 with a recreated display processor and put on display for several years in the computer science department at Stanford with two consoles attached for free use by students . Due to issues with space and maintenance , in 2000 it was moved into the Computer History Museum in Mountain View , California , in the displayed storage section . In August 2010 , the museum loaned the console to Google to be placed at their headquarters campus at the request of Pitts ? who wanted the game to be played as well as displayed ? due to a discussion with senior vice president Jonathan Rosenberg , who had been hired as a 13 year old by Tuck and Pitts in the mid @-@ 1970s to keep the machine cleaned . It has since returned to the museum as a playable exhibit .