

THE SUBLINE

By

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The Subline

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*"Life is a journey, not a destination."*

-Ralph Waldo Emerson



Fig. 1 - Image designed by me - Milton Glaser I Love NYC Logo

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**Abstract**

1899 whereby designers created a bike, fixed to a single rail track while a third wheel was attached to the second railing. However, this design appears not to be user friendly therefore this research will highlight the modernized improvements to suit the current environment.

In outlining the main design proposal, secondary solutions will be explored to address identified challenges such as air and noise pollution, rats infestation and the prevalence of crime. These challenges have been negatively impacting the environment around the subway stations as well as the user experience. The secondary proposals consist of the use of piezoelectric materials, security cameras and an eco-friendly air filtering system (Algae Bioreactors) which will be explained further in this paper.

Both the main design and secondary proposals will demonstrate the practicality and viability of revamping the abandoned tunnels which will bring about an interactive solution for city dwellers.

On average an individual spends more than an hour every day in the subway as it is considered a common mode of transportation in New York city. As part of the daily experience, metallic noises, dark lights, dirty walls, and phone screens are heard or seen underground. However, over the years, the rails, tracks, platforms and stations of the New York subway system has become degraded, unused, and abandoned areas for various reasons as they have become abandoned by the Transit Authority.

The purpose of this research is to consider new transportation routes and modes for cyclists and pedestrians in New York City, as an approach that both enhances mobility and expands the existent city map through its study and use of abandoned subterranean spaces as a design possibility. The main design proposal seeks to create a space and system for city dwellers which can be considered as an adaptive environment for abandoned underground spaces.

The research will explore the possibility of turning abandoned rail tracks into retrofittable space for human transit by developing a more humanized, individualistic, and alternative ways to commute. The main design proposal relates to the modernization of a concept from



Fig. 2 Crowded Underground, NYC - AP- Pietro Quintino Sella



Fig. 3 - (This image gives me a sense of hope and hopelessness, Light End of the tunnel) - Photograph from IM Free Website

## ***Introduction***

bicycle lanes and pedestrian walkways. This potential viable solution could benefit city dwellers from a health perspective, among other benefits, as well as provide additional transportation space for the already crowded city. The overall benefits and challenges will be examined throughout this paper.

New York city is generally known as the one of the biggest cities in the world as it is home to millions and attracts a multitude of people with different cultural backgrounds. Therefore, the city caters for a variety of modes of transportation such as taxi's, buses, rail, ferry, and the subway. It also provides for bicycle and walking lanes throughout the city.

The focus of this research will be solely on the subway transportation system which is one of the world's oldest public transit system. Due to the high volumes of city dwellers, it is the most used mode of transportation as it covers the whole city. Due to the fact that it is one of the oldest systems in the world, this has resulted in a number of abandoned rail tracks as the subway system has undergone changes over the years.

Taking into the account the various reasons for the use of abandoned rail tracks, this research will examine the solution of turning the rail tracks and tunnels into

## ***Chapter 1***

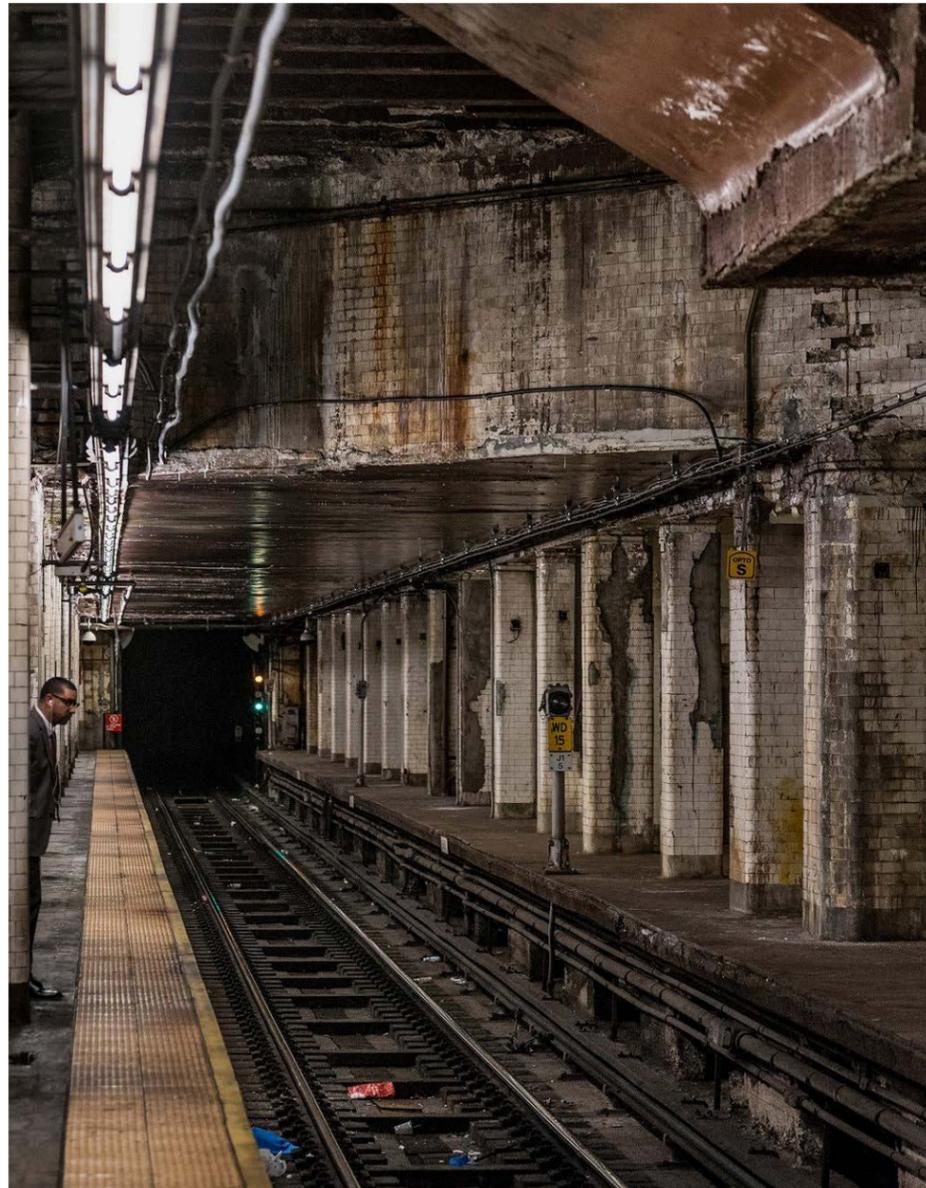


Fig. 4 - Chambers Street Station, NYC subway

### *Introduction to the New York Subway*

It is difficult to attest to the intrinsic value of a mass rapid transit system in the functioning of a modern metropolis. As cities expand economically and in population size, the physical berth of the cities limits inevitably do so too. New York city is no exception to the fast-growing pace of a modern city especially considering how the city attracts millions of new city dwellers and immigrants from around the world.

An efficient rapid transit system is not only a logical solution to the problem of dense mega populations thriving but imperative in preserving the sanitary integrity of the populace of a city. To avoid a population which is sandwiched on top of each other and is a recipe for immense misery and frustration, the city requires constant growth and development in terms of public facilities such as the transportation system.

The obvious lateral solution to this problem is literally lateral expansion of the city living spaces. However, as cities outer limits expand, citizens, must not find themselves marooned at the edges of these metropolises, they must have a way of traveling, or commuting from their affordable homes on the outskirts of the cities, to

their 9-5 jobs in the bustling centers of these metropolises, or whichever far-flung neighborhood they happen to find employment in.

In an 1891 article on the technicalities and logistics of the prospective growth of New York City, Lewis Haupt, a civil engineer specializing in waterways outlined the mathematical necessity to build neighborhoods out of the arable farmlands of Brooklyn, Queens, and the Bronx, in order to alleviate the population density of Manhattan.<sup>1</sup> He argued that in order for the high volume of immigrants entering New York to be sent to the outskirts of the city would require transportation from these living areas right to the metropolitan center.<sup>2</sup>

The concentration of population in cities, as revealed by the present census, serves to impress more forcibly than ever the importance of solving for the rapid transit problem. Unless provision is made for cheap, safe, speedy, and comfortable transportation, it is evident that the moral and physical conditions required for the normal growth of large communities will soon become vitiated and stagnated or the decay of the transit system will ensue.

New York Times staff writer, Jonathan Mahler describes the prospective failure to innovate the NYC subway system as a “gross act of self-destruction” on the part of New York, and indeed the USA as a whole.<sup>3</sup> From Paris to London, to Beijing and Seoul; it has been noted that none of these of the cities would find themselves as the

<sup>1</sup> Haupt, Lewis, Rapid Transit in Great Cities (1891) Accessed 12 June 2021 [https://www.nycsubway.org/wiki/Rapid\\_Transit\\_in\\_Great\\_Cities\\_\(1891\)](https://www.nycsubway.org/wiki/Rapid_Transit_in_Great_Cities_(1891))

<sup>2</sup> Ibid

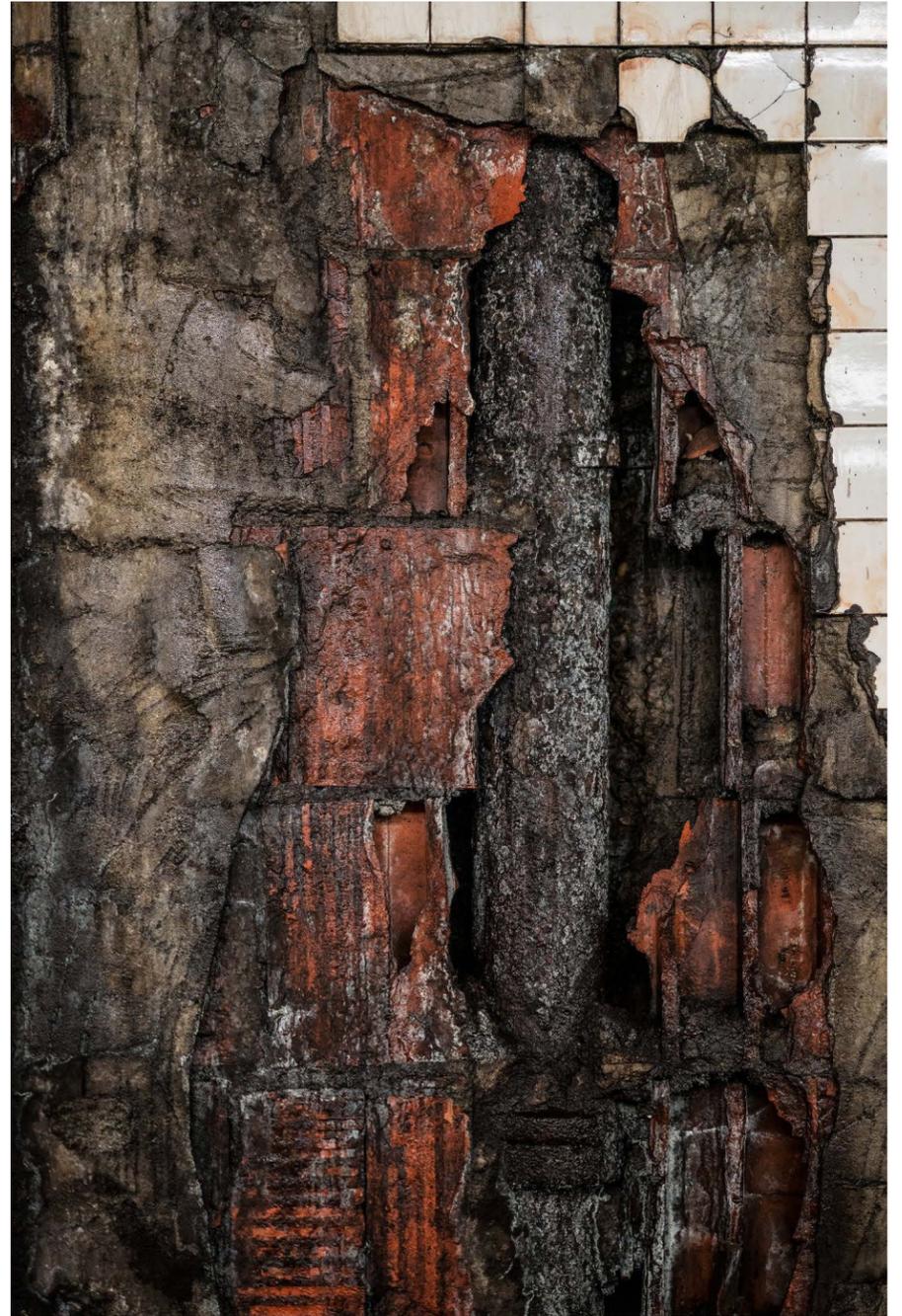
<sup>3</sup> Mahler, Jonathan, The Case of the Subway, New York Times, (January 3 2018) Accessed 12 June 2021 <https://www.nytimes.com/2018/01/03/magazine/subway-new-york-city-public-transportation-wealth-inequality.html>

Fig. 4.1 - People like Sardines, NYC Underground, 2019, AP- Pietro Quintino Sella



Fig. 5 - Man Tired AP - Pietro Quintino Sella

Fig. 6- section of wall underground NYC, 2018, AP- Pietro Quintino Sella



economic and cultural powerhouse they are now without their populations not having grown equivocally with the undeniably industrial age invention of the mass rapid transport system growing skeletally beneath their streets.<sup>4</sup> New York and even the USA as a whole would not be the powerhouses they are now, had it not been for the creation of the subway system.

### *Introducing the forgotten space*

However, as the years go by, and urban areas pop up at alarmingly rapid rates, New York's transportation system lags behind its Far-Eastern counterparts with systems half the size of Beijing and Seoul. Whilst the skyward-looking spirit of New York tends to be one of its most memorable contributions to the world and perhaps one of its most identifying characteristics; its underground transportation answer to this has undoubtedly paved the way for New York to be the city it is today.

Furthermore, if New York city wants to keep looking skyward and become more progressive, it is observed that it is beneath the ground that New York city authorities must look to, in order to distinguish themselves as the greatest city in the world from a transportation system perspective. The world has seen New York city achieve grand designs time and time again over the last few centuries, and the subway system is an example of this, having been built over a hundred years ago which at that time was considered a trailblazer. However, in order to maintain this status, the city needs to ensure that it upgrades as fast as the city is growing and guarantee a living urban environment.

As mentioned earlier, the New York Subway system carries a number of degraded, unused and abandoned rails, track, platforms and stations. These rail lines and stations were previously owned by private companies therefore competed against each other on the market. However, the city of New York took them and over and they eventually started to close. For some of these tracks, they were demolished and others were just left abandoned or used as storage facilities. Currently, there are more than 61 disused stations in New York City which ranges from, permanently closed but existing, opened but with closed platforms or entrances, unfinished, temporarily closed, and finally some are being reconstructed.

For the purposes of this paper, only three examples of closed stations will be discussed due to the high number of unused stations and rails.

One of the well-known abandoned stations at City Hall is located along 6 line which became redundant during the construction of the N/R/Q tunnel.<sup>5</sup> It is now being used

<sup>5</sup> New York City Subway, Abandoned and Disused Stations, accessed 11 June 2021, [https://www.nycsubway.org/wiki/Abandoned\\_](https://www.nycsubway.org/wiki/Abandoned_)



Fig. 7 - Section of abandoned tunnel AP: photography dark-cyanide

as a space to park trains overnight.<sup>6</sup>

Secondly, the closed Bergen Street station is located in Brooklyn and has become a favorite exploration experience for urban explorers.<sup>7</sup> This station has been in existence since 1933.<sup>8</sup>

Lastly, a part of the Nevins Street station was closed off with a remaining section still active to the public.<sup>9</sup> In 2016, the closed section of the station was used to host a guerrilla exhibition to highlight the mass shootings in America. This is an example of the use of abandoned stations for events.<sup>10</sup>

Even though only three closed stations were highlighted, the purpose was to provide a brief overview of the types of closed substations which many have been forgotten. For some, they are remembered through their use by the art community and curious explorers.

and_Disused_Stations	
6	Ibid
7	Ibid
8	Ibid
9	Ibid
10	Ibid



Fig. 8 - The opening of the first subway in New York, City Hall Station, Oct. 27, 1904



Fig. 9 - City Hall today

<sup>4</sup> Ibid

Chapter 2

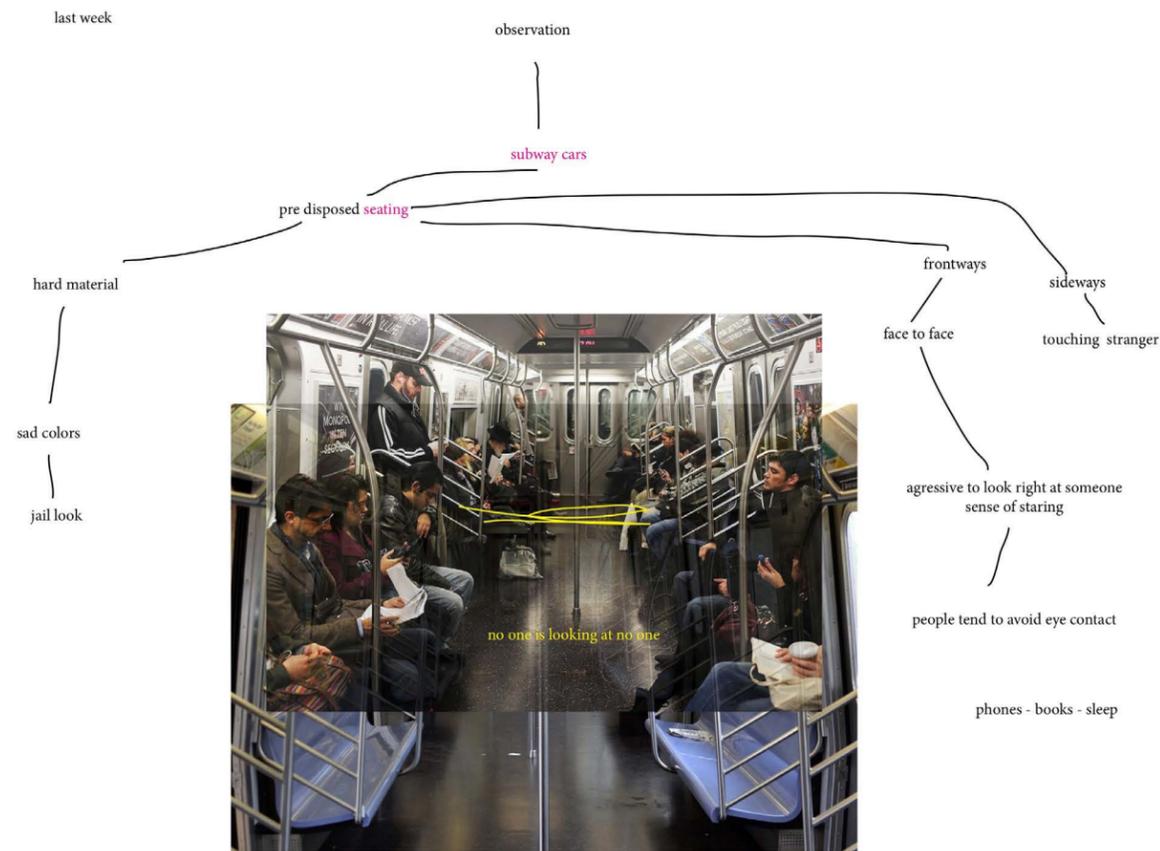


Fig. 10- Screenshot from my observations in the subway, analyzing people and behavior, 2019

Research Methodology

T

The research methodology of this paper consists of a mixture of desktop research such as academic research, news and articles and interviews as well as personal observations made during the use of the New York city subway transportation system.

The reason for the mixture of research methodologies is to ensure an all-round research approach to the problem statement considering that it entails not only literature review but also a personal experience of the problem statement. The literature review was conducted on a diverse type of written material accessed through reputable websites and is the primary source of this research. The secondary source of the interviews conducted with Moses Gates and Zachary Joslow and personal observations

recorded through years of use of the subway system.

Lastly, the research methodology also consists of the use of a principle known as disruptive thinking which will be used to propose solutions to the research question. The principle of Disruptive Thinking relates to the challenging of the status quo whereby traditional thinking towards transportation must be relooked in order to bring about a completely different approach. It brings about innovation and a multifaceted solution. The aim is to propose solutions which incorporates a progressive and future looking approach.

Personal Observations

When conducting research and to ensure effective understanding of the problem statement, personal experiences of the New York subway transportation system has been included in this research paper which will be supported by desktop research. The observations from these personal experiences are outlined as follows.

Personal interaction with the New York city began in 2017 and upfront, it was immediately observed that the city was filled with a multitude of cultures, culinary experiences and languages representing the world. The city was filled with a thriving micro economy which consisted of small food businesses. Furthermore, the arts were well represented with a number of arts facilities such as Metropolitan Museum of Arts and inked skateboarders casually shared conversations about the game last night with equally interesting statuesque high fashion models. Structurally, the city is made up of gigantic skyscrapers which it is well known for and quite overwhelming when walking through the city streets.

In regards to the subway transportation system, upon personal interaction with the system, the first observation made was that it lacked clean air and the lighting system had quite an impact on one's eyes. From a mental point of view, navigating your way through the underground system appears to be overpowering as the system is overcrowded thus an immense amount of pushing and shuffling occurs. However, despite the high volumes of individuals using the system, there is a sense of loneliness which while using the subway. This particular observation is key as it speaks to the mental state of a user of the subway system.

Therefore, the above-mentioned research methodology seeks to explore alternatives on how to utilize the abandoned rails effectively so as to ensure city dwellers can use the rails to ride bicycles while avoiding identified challenges. The challenges will be discussed in the following chapter.



Fig.12 - T SAKHI Architects' interactive wall for Lebanese Pavilion, addressing Lebanon's social barriers

Fig. 11 - Using disruptive methodology technique to my subway problem- examples, 2019

WHAT PEOPLE DO :

PROCESS :

A person develops an emotional relationship with another other person through various situations and aspects ( physical-unphysical )

DETAIL

No Barriers - acceptance - Peace - Love - collaboration - donation - kindness - sharing pain and pleasure - difficult experiences - solving problems - commonalities - attraction- physical contact - intimacy - private - games - time - ideologies - religions - identifications - equality - personal - good weather - music - food - smiling- acts of love - odours smell perfume - shutting doors

INVERT BIG CLICHES

invert

barriers walls distance unconfined space - war fight conflict kill - hate - uncollaborate - steel robe - unkindness mean egoistic - easy experiences - destroying solutions unsolving solutions - uncommonalities what makes us different - unattraction ugliness - unphysical contact distance - public open visible - real no games real consequences - no opinions - ateo - no identification - race - no personal no judgmente - wierd weather - unmusical -

SCALE

whats abundant that could be scarcer  
what is scarcer that could be abundant  
what is expensive that could be free

what if there was a wall that could bring people together

what if a tiny space where people were mashed up could bring them together

look for an opposit action:

TRAINS

what if trains didnt take you from point a to b  
what if trains didnt take you through the city  
what if trains moved vertically  
what if trains didnt take you anywhere  
what if trains where simply not moving  
what if there where no trains  
what if trains had no doors  
what if trains had closing doors  
what if trains had no walls  
what if trains where rounded  
what if trains were a secondary funtion to the subway  
what if you could get off the train anywhere  
what if the train didnt have to stop to get people in  
what if the train was long infinite- like a circle - always moving  
what if delays were not a thing  
what if trains looked orgnaic and natural

PEOPLE IN SUBWAY

what if people didnt have to stand or sit  
what if people didnt have to walk downwards or upwards  
what if people didnt have to touch anything to stay in balance  
what if it what people were prohibited to look at cellphones  
what if people were forced to stare at eachother  
what if people were forced to touch eathother  
what if people could sleep in the subway cars and platforms  
what if people were allowed to walk on the rails  
what if people were allowed to walk in the tunnels  
what if people cleaned the subway  
what if people had to pay my minute  
what if people had to put coins or card swipe to make the car moving  
what if people had to at least put one garbage in the trash  
what if people had to birng plants instead of tickets  
what if people went to the subway but not for trains  
what if people didnt have to wait  
what if people lived in the subway  
what if we were forced to pay a mininum to performers  
what if subway performers were rich  
what if homeless were very clean  
forced to talk  
forced to make at least one aquatene  
what if people were fined if they were to much on their phone  
what if chairs or walls could talk  
what if floor was big screen for everyone  
with floors where touch screens with feet  
what if homless would be the ones donating  
what if homless had to contribute for the cleanliness of the subway  
what if people used their phones for control the subway cart  
what if trains could be design by people

SUBWAY

what if subway was free or very expensive  
what is there were no windows at all  
what if there were no chairs or poles  
what if seats where very comfortable  
what if rhe subway was privatized  
what if the subway was natural  
what if the tunnell were green  
what if the subway was a really nice place to hangout  
what if the suways had restaurants or tables to eat  
what if the subway was a place for intensive city agriculture  
what if the subway could be also a place of leisure  
what fi the subway could have different utilitarian uses  
what if moving trains was used for other things  
what if S.cars werent the only moving thing or systemem  
what if surfaces could be autocleaned  
what if people had o clean one section to get out of the ug  
what if garbage could move by itself  
what if plastic could kill it self  
what if rats were clean  
what if rats could help clean or carry things  
what if rats were encourage to multiply

a tube facing one and another no where to look but eachother , holes creeks and openings stimulate interaction between people

a design furniture to make people touch eachother, maybe sit in wierd was that would stimulate laghter

because it was not dangerous anymore, rails areas would not be used anymore by trains but by people. people would use it to move around the city through rai bicycle s

what  
what if people  
what if people d  
what if it what  
what if p  
what if j  
what if people  
what if p  
what if pe  
wl  
wh:  
what if people had t  
what if people  
what if pe  
what if pec  
w  
wl  
wh:  
w  
forc  
what if people v  
w  
what  
with l  
what if  
what if homless hi  
what if people i

Fig. 13 - Using disruptive methodology technique to my subway problem- examples, 2019

Chapter 3

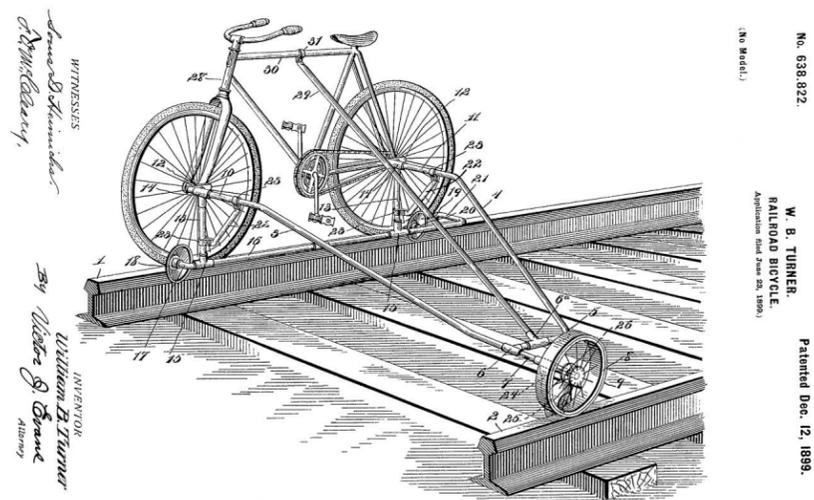


Fig. 14 - William B. Turner, Patented Rail Bicycle Paper, 1899

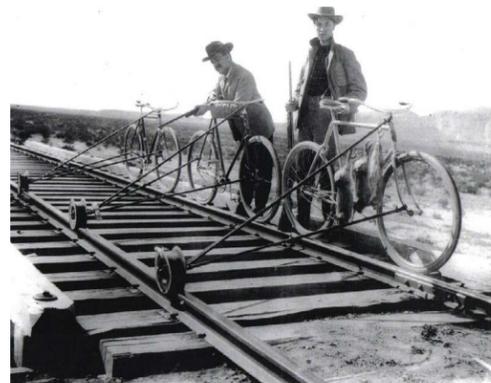


Fig. 15 - People Using William Turner's Rail Cycling device- IM Free Website

Analysis of the Problem Statement

the patent did not become popular as the design did not pick up with cyclists.<sup>12</sup> This may have been because the bike itself with the third wheel was not user friendly and may have contained heavy metal which cluttered the user experience. Furthermore, the third wheel protruding from the bike could possibly have made riding it difficult. Lastly, the build of such an invention would have been time consuming. Therefore, such a design would have to be modernized to meet the needs of cyclists such as ease of use, lightweight so as to ensure a pleasant riding experience and quick to store.

Currently, there are a number of abandoned underground tunnels which have been decommissioned over the years. Over the last few years, some of these tunnels have been used for art events, among others. However, with the expanding city and increased transportation needs, the transportation system may begin to experience gridlock therefore alternative modes should be introduced which are complimentary to the existing transportation system in New York city. Therefore, upon analysis of the research problem, the aim is to analyze challenges faced by both cyclists and pedestrians.

In 1899, a rail bike was designed and patented by William Turner which involved created a custom-made bike with a third wheel for use on rail tracks.<sup>11</sup> The bike with a third protruding wheel from the side was aimed at providing an alternative mode of transportation however

<sup>11</sup> University of North Texas. (n.d.). Portal To Texas History. Retrieved June 13, 2021, from Railroad Bicycle: <https://texashistory.unt.edu/ark:/67531/metaph508126/?q=railroad>



Fig. 16 - Different examples of current rail bicycles, Google Images

A modern design of a rail bike would also need to compliment the city's current transportation system as opposed to competing with other modes. With the fast pace of modern society, the new rail bike would need to be convenient and not waste too much time of the cyclist taking into considering the hustle and bustle of New York city.

Based on the research conducted, there are a number of secondary identified challenges which are associated with the main research problem which need to be acknowledged. These challenges relate to environmental conditions surrounding the abandoned rail tracks such as air and noise pollution, crime rate and a rat infestation. In order to propose solutions on how to turn the abandoned rail tracks into usable bicycle lanes, the challenges will first be explored.

Firstly, in regards to air pollution, it has been observed that the air quality within the subway system is particularly low and nauseating as stated by <sup>13</sup>. According research conducted by Bell, two of the subway stations which were tested "exhibited unhealthy levels of air pollution at levels three times the average concentration measured in Beijing". There were the Central and Boro Hall stations.<sup>14</sup> The stated levels are alarming especially considering that they exceed that of Beijing which is notoriously known for its how air pollution.<sup>15</sup>

13 Bell, Stephen. "Air Quality in the NYC Subway: Worse than You Might Think." Medium, January 24, 2020. <https://medium.com/age-of-awareness/air-quality-in-the-nyc-subway-worse-than-you-might-think-285452679646>

14 Ibid

15 Ibid

Secondly, the noise pollution has become increasingly noticeable in subway which has the potential to affect one's hearing. The Hearing Health Foundation <sup>16</sup> conducted a study to evaluate the noise levels withing the subway system.

Thirdly, the current crime rate is of concern to the users of the subway system. Abandoned subway tracks and stations are often associated with the proliferations of criminal acts however according to the national crime rate, New York city is considered one of the safer larger cities in the USA.

#### *Chapter 4*

16 Hearing Health Foundation. "Subway Noise Can Harm Your Hearing." Accessed November 11, 2020. <https://hearinghealthfoundation.org/subway>.

## Proposed Solutions

The purpose of this section is to outline the main design and secondary proposals which aim to address the identified challenges in the previous chapters. The solutions aim to revamp the abandoned subway stations so as to provide a more friendly user experience of the subway while catering to the different transportation needs of city dwellers.

### Main Solution: Design Proposal

In New York city, the biking community is fairly large with about 10 million rides per year in 2019<sup>17</sup>. The city implemented a bike-share system called Citi Bike and is the largest of its kind in the U.S<sup>18</sup>. This system provides additional transit options for NYC residents and has the potential to improve urban transport systems.

Before discussing the main design proposal, it is prudent to first outline the basis on which the main design proposal was strategized. The High and Low Line systems were reviewed to determine suitability which is discussed as below.

### The Story of the Highline

17 Walker, Alissa. "How Bike Share Became the Decade's Biggest Transit Success Story." *Curbed*, December 16, 2019. <https://archive.curbed.com/2019/12/16/20864145/bike-share-citi-bike-jump-uber>.

18 Ibid

In simple terms, the Highline refers to abandoned rail tracks and stations which are aboveground. As these rail tracks follow through and around the city, they have the potential to be refurbished into bike lines and walk pathways.

Historically, the High Line was built in 1934 and carried freight trains which consisted of food and merchandise and were ran into the city on an elevated track so as to avoid dangerous street crossings<sup>19</sup>. However, over time, these rail tracks were decommissioned with the last one shut down in 1980.

In a study conducted, called "Reclaiming the High Line"<sup>20</sup>, it was determined that revamping the High Line far outweighed than demolishing it. The construction of the High Line took place in three sections between the years of 2006 and 2014.<sup>21</sup> It began with remediation work in terms of removing existing materials above the concrete deck then moved onto upgrading the "railings, the installation of the concrete pavers, integration of lift and stair cores, and, finally, the placing plants"

Therefore, the results of the study concluded that design should be focused on refurbishing the rail track as well as the surrounding to areas to provide walkways.

The recommendations of the study were as follows<sup>22</sup>:

Pedestrian use is the best reuse for the High Line

19 Design Trust for Public Space. "Reclaiming the High Line." Accessed November 14, 2020. <http://designtrust.org/projects/reclaiming-high-line/>.

20 Ibid

21 Keskeys, Paul, *An Urban Masterstroke: The Complete History of the High Line*, accessed 10 June 2021, <https://architizer.com/blog/inspiration/stories/the-complete-history-of-the-high-line/>

22 Ibid



Fig 17 - Abandoned section, The Highline. Article from Susanna Harries- <https://gardentrant.com/>

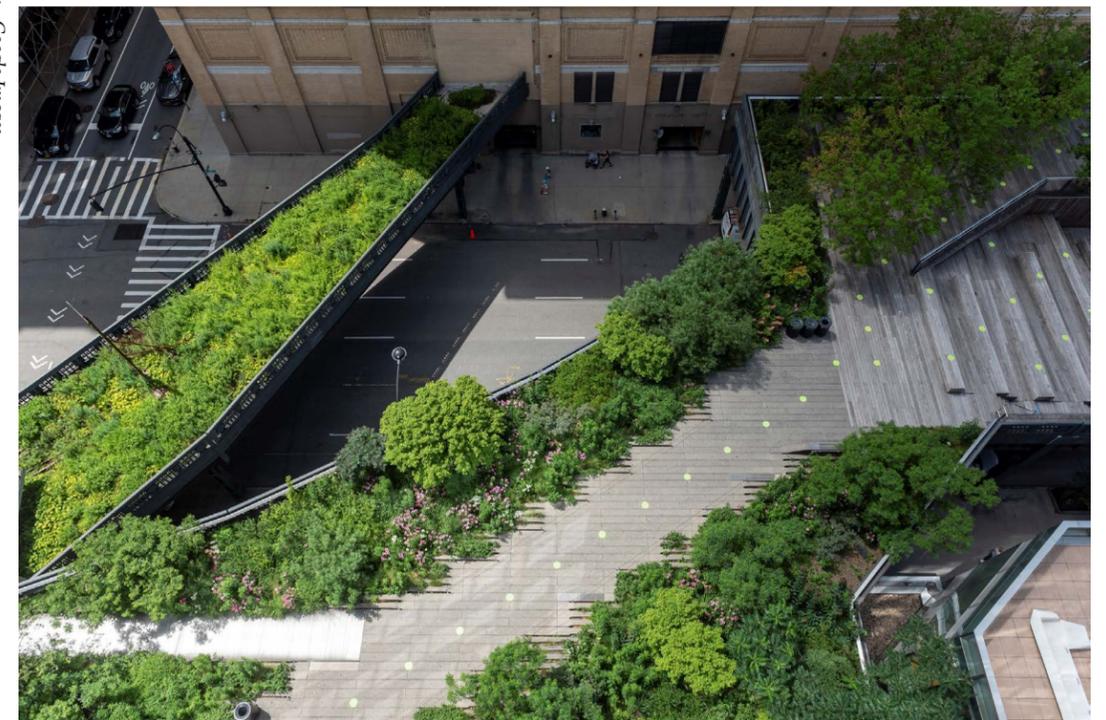


Fig 18 - The Highline today - Google Images

Visitors should enjoy a variety of environments  
 Plantings should recreate original meadows  
 Art should be part of the design and programming  
 The space should be recreational and contemplative  
 The space should include some commercial uses  
 The space should not become a mall  
 Zoning incentives should be used to attract private financing for this public amenity

The main design proposal will refer to some of the above listed recommendations from the study in order to provide a well-rounded solution for cyclists and pedestrians. Visitors of the revamped tunnel should enjoy a variety of different. Over and above the experiences for visitors, the space itself needs to be contemplative which will be discussed further below.

The Story of Lowline

In terms of the Lowline, it refers to a project to illuminate and revamp an historic trolley terminal on the Lower East Side of New York City which was abandoned. It was refurbished by creating an underground park by the use of solar technology. The aim was to create a public space which is community orientated and cultural in nature will become both a local resource and an attraction for worldwide visitors.



Fig. 19 - The Lowline Forrest \_ The Lowline.org

Overview of the Main Design Proposal

The main design proposal consists of an adaptive system to be used by people in the abandoned underground tunnels and stations of New York city. Having bike paths underground right next to other functional subways platforms would be a quick and accessible option. The proposed solution would provide cyclists and pedestrians with the ability to travel the underground safely and in an environment which is stimulating to their mental and psychological senses.

During the research phase, Moses Gates, a Regional Plan associate in NYC, former professor at Pratt, author of Hidden Cities, and a leading authority in the field of abandoned and unexplored urban areas, was interviewed in regards to the main design proposal<sup>23</sup>. Mr. Gates provided his professional opinion and assisted to identify a particular section of an abandoned tunnel which is located right in the Manhattan city center, within the canal street area to be exact.<sup>24</sup> Based on his expert advice, this main design proposal relates to the abandoned lines which run from Chambers Street, passing through the Canal St areas, down towards the Manhattan bridge.<sup>25</sup> This tunnel was decommissioned in the 1960s and it is considered suitable to implement an adaptable system which will re-use all rails, including the third rail.<sup>26</sup>

23 RPA. "Moses Gates." Accessed April 14, 2021. <https://rpa.org/about/staff/moses-gates>  
 24 Ibid  
 25 Ibid  
 26 Ibid

Furthermore, this section of tunnel is considered a great proof of concept as a first stage and is referred to as "The Subline". City dwellers can access this section of the tunnel from the street level tunnel on Canal Street and will end at Chamber Street. This proposed tunnel is accessible on both sides.

Fig. 20 - Above: the abandoned tunnel area indicated by Moses Gates. On the bottom: The subline system: In pink, are the Platforms. On top; the bicycle docs, and in white, the modular pavement following the rails.

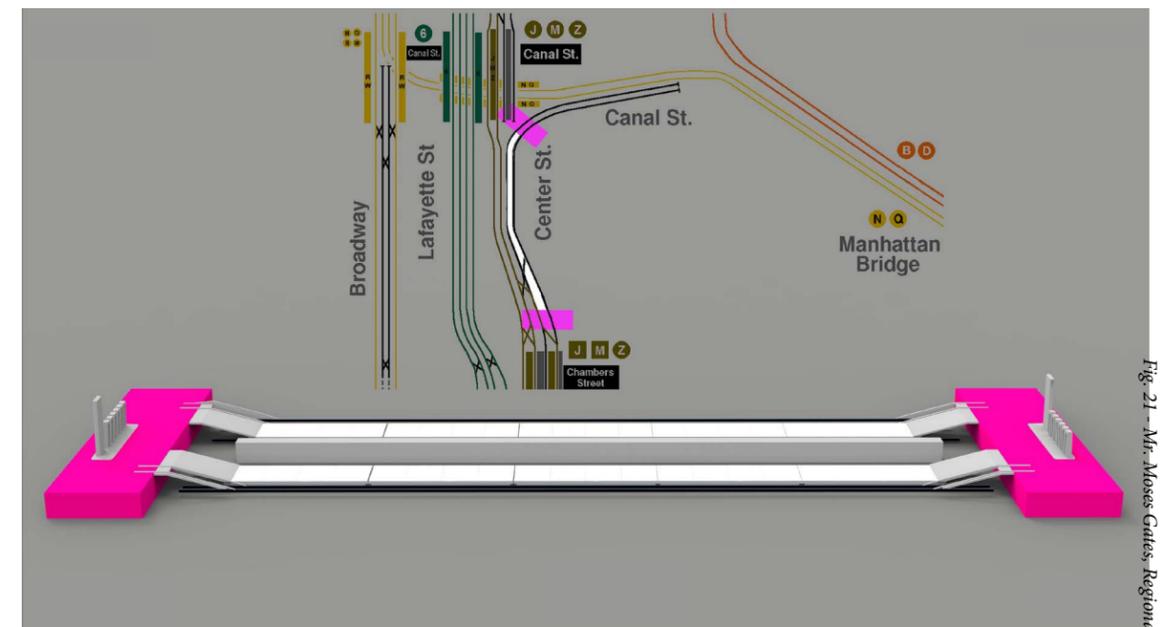


Fig. 21 - Mr. Moses Gates, Regional Plan associate in NYC, Google Images



**The Subline** is divided into two sections for cyclists and pedestrians. Firstly, the underground rail track will be transformed to create a modern bike line which will exclusively run underground through the abovementioned tunnel. Secondly, parallel to the bike line will be a modular rail platform to be used by pedestrians.

#### Bike Line for Cyclists

In regards to the bike line, a docking station on both ends of the bike line will be created where the bikes will be located. The aim is for a cyclist to retrieve the bike from the docking station and place it on the bike line for use. These types of bikes will be designed for balance, stability and compatibility in order to fit on the narrow-elevated line to avoid de-railing. The proposed design was inspired by first patented rail bike by William Turner in 1899, as highlighted in Chapter 3.<sup>27</sup>

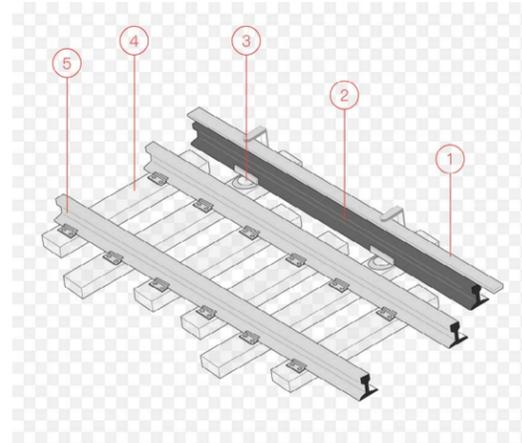


Fig. 22- Diagram of the NYC underground rail

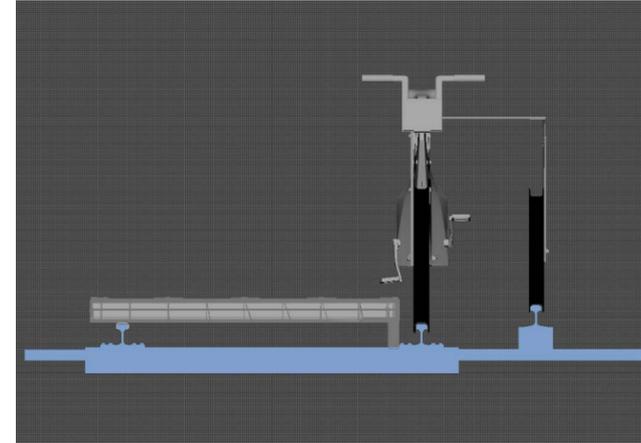


Fig. 24 - Technical drawing of the platform and the rail bicycle- front view

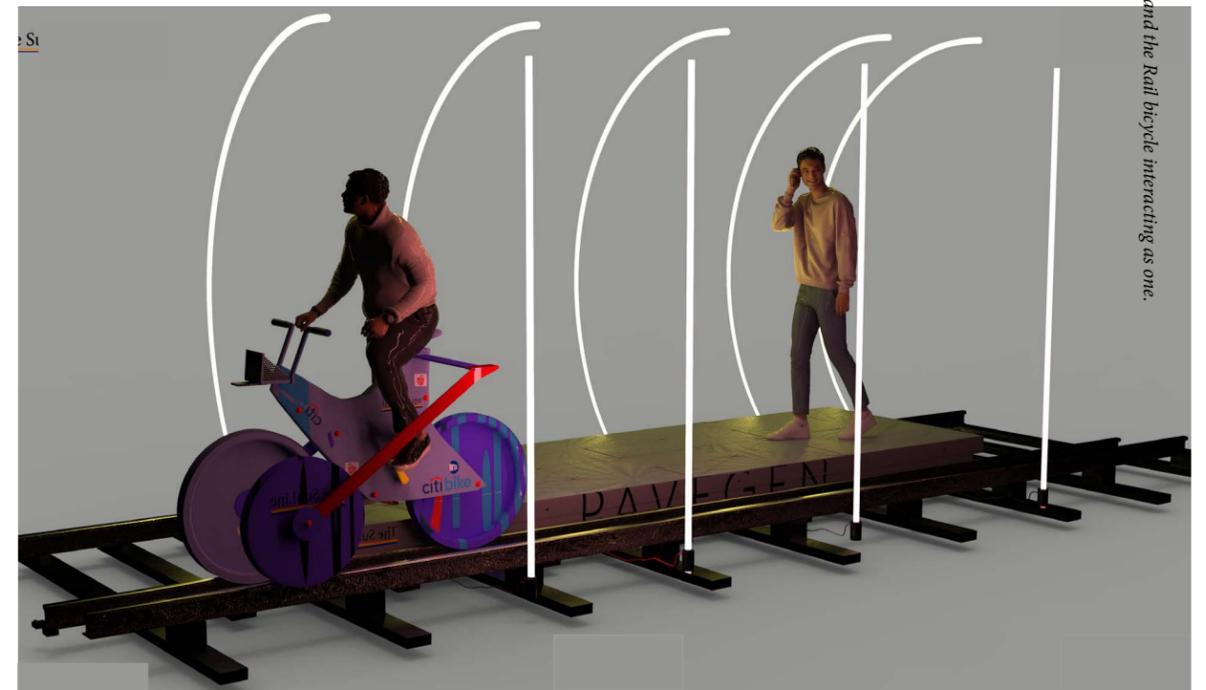
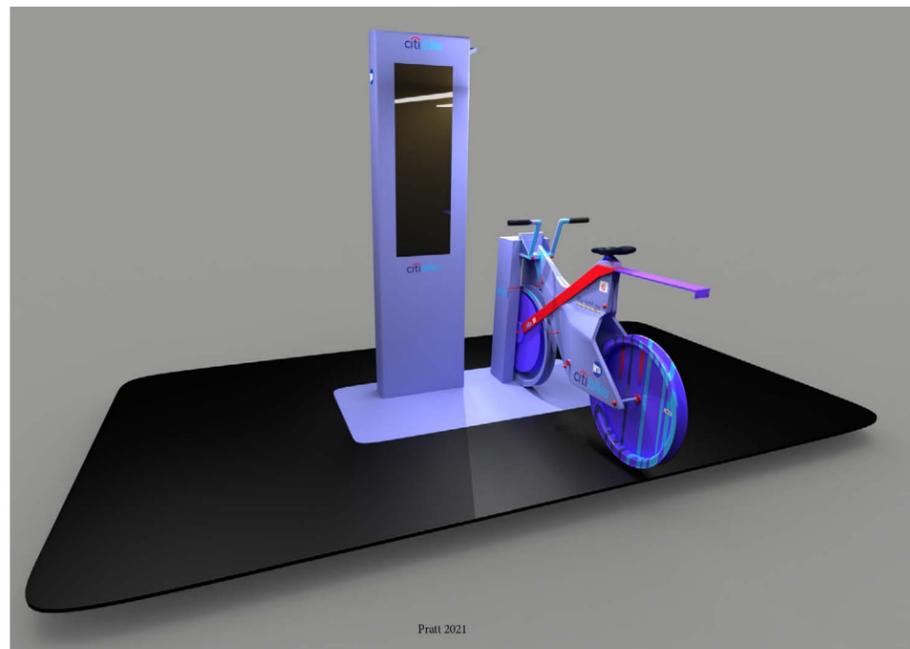


Fig. 25 - Rendering of The Subline - The platform and the rail bicycle interacting as one.

Fig. 23 - Rendering of The Subline rail bicycle- Bike Sharing Dock



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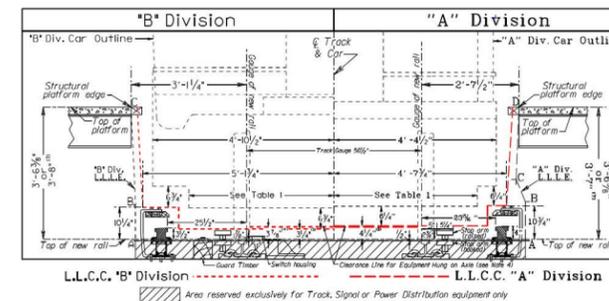


Fig. 26 - Image received from Zack Joslow- MTA Architect Assistant- drawing that is meant for determining the clearances for subway cars, 2021

27 See note 11

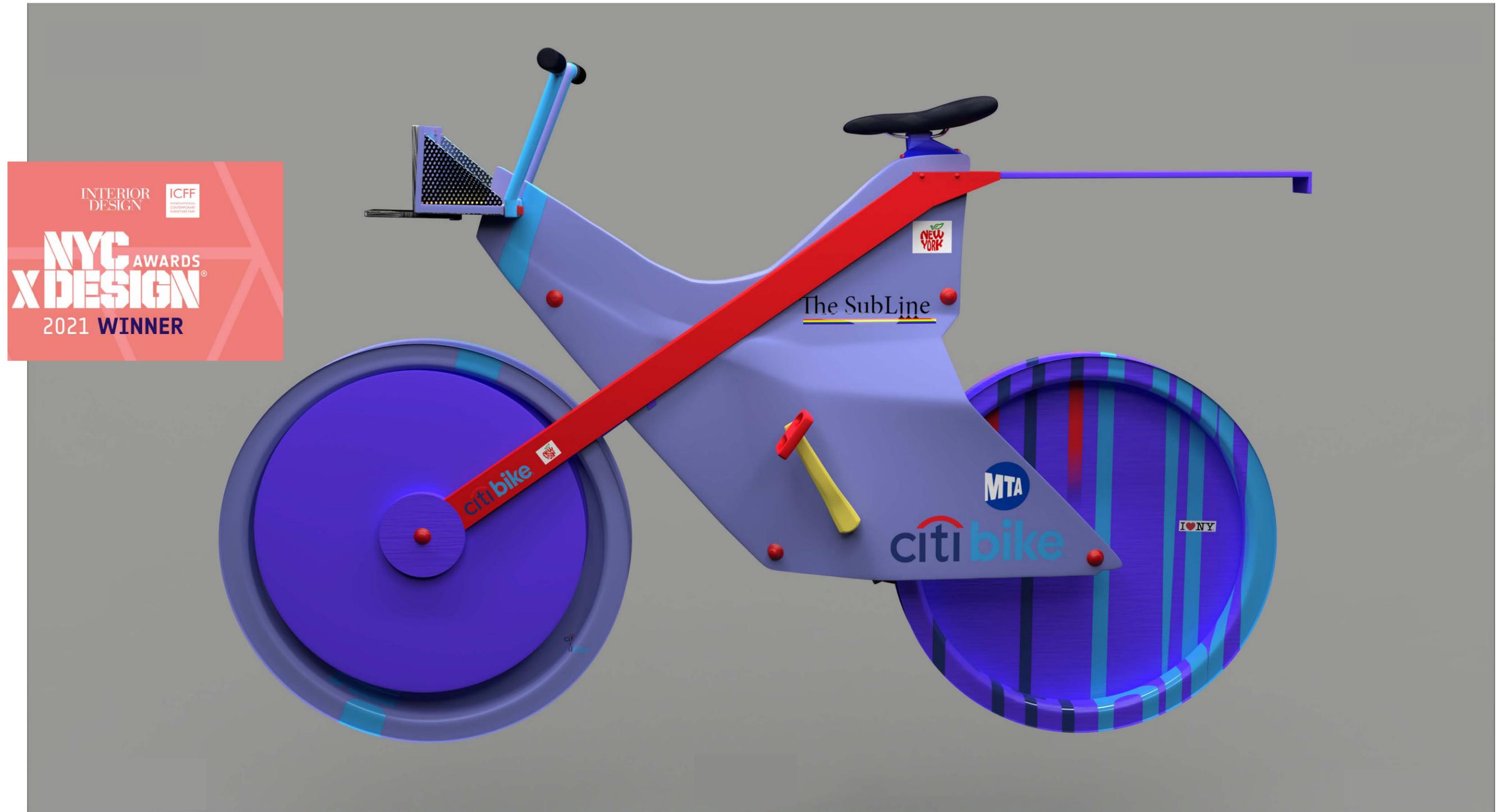
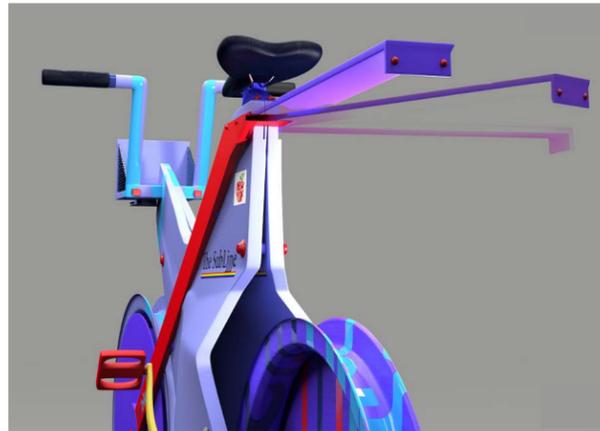


Fig. 27 - Rendering of the Subline Rail Bicycle - The Subline won The NYC-X Design Awards in the student category in May 2021

To modernize the 1899 rail bike patent, the first area of concern was the protruding arm which was clustering and quite unaesthetic. The protruding arm which extended from the bike onto the second rail track was bulky and not user friendly. Therefore, the proposal is to re-design the protruding arm into a transformable device which is easy to use. It is proposed that the protruding arm becomes a foldable mechanism which is housed right under the bike's seat and only taken out when the bike is to be used. This will result in less space being used and will make for a much easier transition from the docking station onto the rail track. Upon the bike being pulled out of the docking station, the cyclist will navigate the bike onto the first rail track, pull out the foldable third wheel and place it onto the second rail track for use.



#### Rail Pavement Platform for Pedestrians

In terms of the rail pavement platform to be designed for pedestrians, it is proposed that a pavement is created parallel to the bike line whereby pedestrians will walk freely alongside the cyclists. The pavement will be built on top of the abandoned rails. This pavement is a modular system hooked to rails and is a system where on the bottom has a rail profile dent which snaps to rail locking the pavement. Furthermore, the use of piezoelectric materials on the rail pavement platform will address any challenges associated with this proposal, which is explained further below.

#### Secondary Proposals to address challenges identified

During the development of the main design proposal, secondary proposals were explored to address challenges associated with the bike line and rail pavement platform. These proposals are considered complimentary to the main design proposal so to as demonstrate a holistic understanding of the research problem. They are aimed at addressing the challenges of air and noise pollution as well as the crime situation within the abandoned subways which impact both the cyclists and pedestrians.

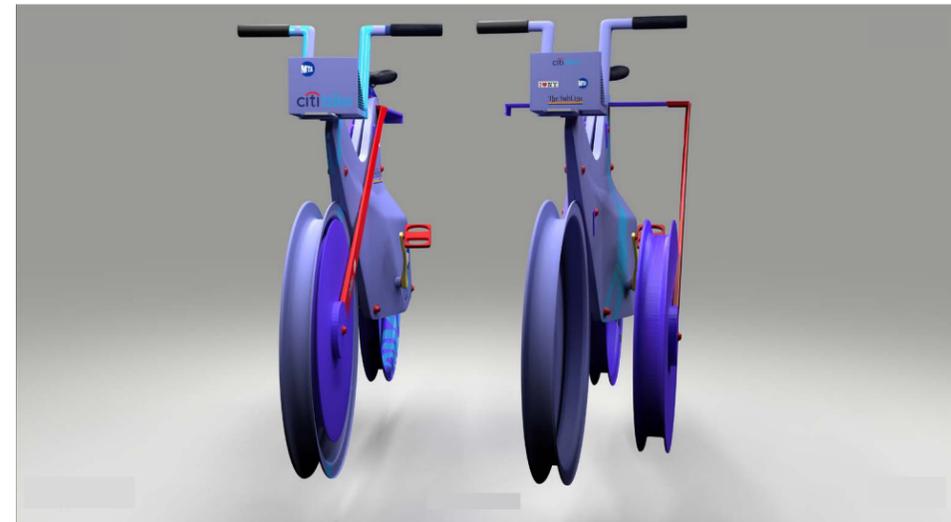
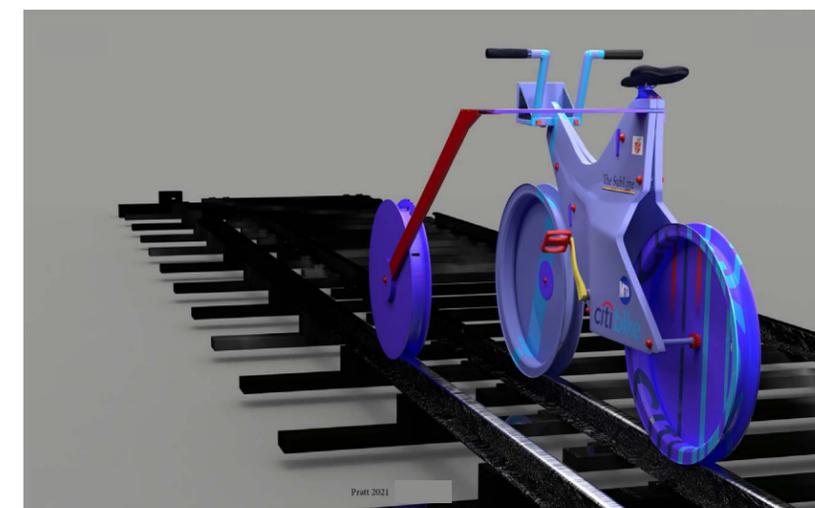


Fig. 28, 29, 30, 31 - Rendering highlighting the movement of the protruding arm



## Use of Piezoelectric Materials

In regards to the rail pavement platform for pedestrians, a key factor is that the area is well lit because natural light is absent in the underground tunnels. Good lighting is a fundamental aspect not only to deter crime but also psychologically as dark areas negatively impact one's mind<sup>28</sup>. The proposal is that the rail pavement platform contains the ability to generate energy with the footsteps of the pedestrians therefore piezoelectricity is created<sup>29</sup>. With the kinetic energy (motion) of pedestrians, it gathers and transform this energy into a lighting source around the rail pavement and bike line<sup>30</sup>. The end result is that a self-sustained lighting is continuously produced by the pedestrians. Moreover, lights could become works of art to create an exciting space. The light source could potentially emanate colored neon lights and geometrical shapes which will stimulate senses. This would have a retro-futuristic feel and experience which would turn the underground tunnel into an exciting and iconic space in New York city.

Fig. 32 - The Rail Platform, Piezoelectricity creating lights underground



## Use of Security Systems

Secondly, to address the identified challenge of crime, it is proposed that a well distributed security camera system is installed within the tunnel for monitoring purposes as well as to provide a sense of safety for the pedestrians and cyclists. The inspiration for this proposed solution is from San Sebastian's tunnel in Spain which is considered the world's longest bicycle commuter tunnel. It is 850 meters long and a part of a 2-kilometer section of former railway that connects two neighborhoods. The tunnel features 29,360 sensor security cameras, a public address system and closed-circuit camera link for a Municipal Guard. It closes at night between 23:00 and 07:00. This type of technology is fundamental in making the tunnels safe as confirmed by Lisa A Brown, National Senior Director of Johnson Controls.<sup>31</sup> She stated that

<sup>28</sup> Burnett, John, and Alex Yik-him Pang. "Design and Performance of Pedestrian Subway Lighting Systems." *Tunnelling and Underground Space Technology* 19, no. 6 (November 1, 2004): 619–28. <https://doi.org/10.1016/j.tust.2004.03.001>

<sup>29</sup> Maghsoudi Nia, Elham, Noor Amila Wan Abdullah Zawawi, and B.S. Singh. "Design of a Pavement Using Piezoelectric Materials." *Materialwissenschaft Und Werkstofftechnik* 50 (March 1, 2019): 320–28

<sup>30</sup> Ibid

<sup>31</sup> Source Security, Lisa Brown, accessed 10 June 2021, <https://>

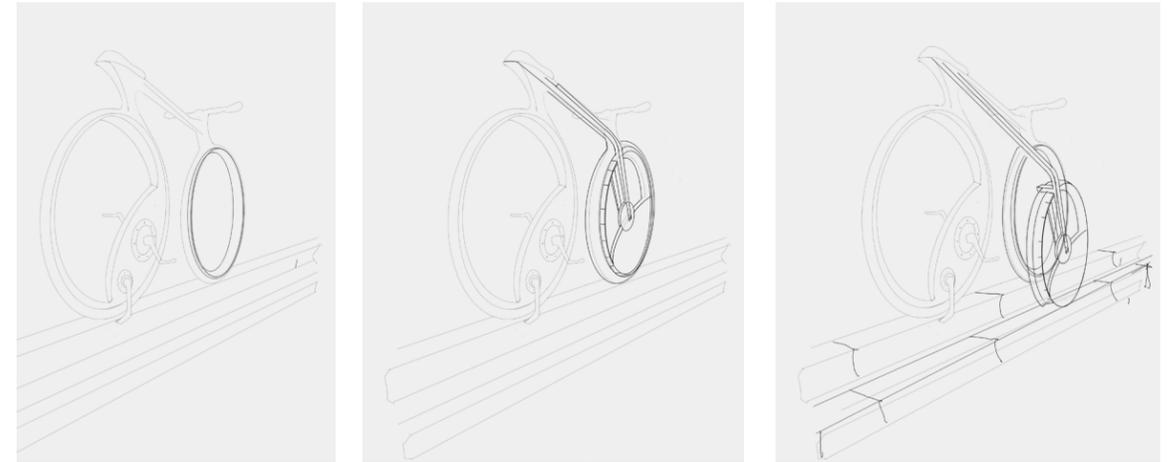


Fig. 33 - Design Process - Sketching the third wheel system and the protruding arm Idea. First Concept

Fig. 34 - The Rail Platform rendering, Piezoelectricity creating lights underground

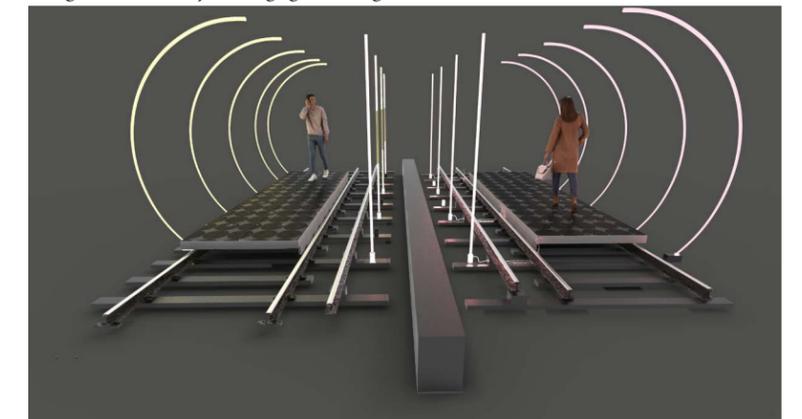
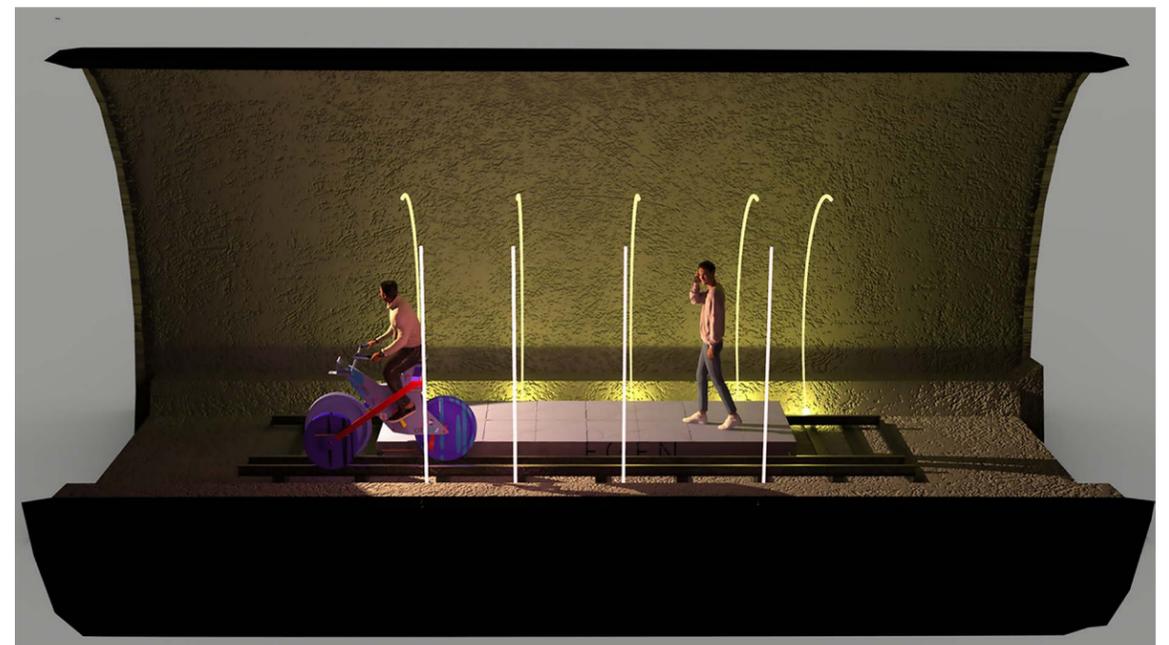


Fig. 35 - The Subline - Image from thesis presentation



“Smart technology integrations can really transform how communities make their residents and visitors feel safer and more comfortable so they can be at ease. Take a community park, for instance; with the right technology implementations, residents walking through late at night don’t need to look over their shoulder with every step. Lighting and video surveillance systems can be integrated with motion sensors to automatically activate when movement in the area is detected.”<sup>32</sup>

Eco Friendly Air Filtering System (Algae Bioreactors)  
To address the issue of air pollution, algae bioreactors could be used for air cleansing<sup>33</sup>. Research has shown that mechanical wear of the brake-wheel and wheel-rail interfaces are the primary source of air pollution and that ventilation mode and airflow rate also play an important role. It can be concluded that the main issue here are these small toxic particles (PM) created by the rubbing of wheels on rails, together with poor ventilation within the tunnels. Therefore, the use of algae bioreactors as a filtering air system would be effective in addressing the highlighted issue<sup>34</sup>. Algae, when used in conjunction with AI-powered bioreactors, is up to 400 times more efficient than a tree at removing CO2 from the atmosphere.<sup>35</sup> In a scientific study it is stated that phycoremediation, which is the utilization of macroalgae

and microalgae to remove to remove pollutants (CO2, nutrients, metals, xenobiotics) and it gained popularity due to inexpensive growth requirements (light, CO2, and even salt water).<sup>36</sup> The envisioned look of the tunnels is that with bikes being ridden through the tunnels, self-generating neon lights and green liquid bioreactor tubes would form part of the underground ambiance.



Fig. 36 - New 3D-printed algae could revolutionize the way we make things- Image from Inhabitat.com



Fig. 37- Urban Algae Canopy, featured Algaetecture: a project in which micro-algae photosynthesis is used to produce the same amount of oxygen as four hectares of woodland. 2014, Mialn Design Week

36      ibid

## Conclusion

Subline will revolutionize the world of the underground tunnel and cyclists and pedestrians will gain a better walking and cycling experience psychologically and physically.

With all the aforementioned proposals, cyclists and pedestrians will be encouraged to keep using the space and hopefully convince city dwellers who use other mode transportations to also integrate this mode of transportation into their normal daily commute throughout the city.

New York City has an incredible real-estate infrastructure completely left to degradation with great potentialities. Investors, engineers, and designers are already exploiting these spaces and similar ones with beautiful creations, some of these have the potential to change the future of metropolis forever. This is because New York City is one of the world’s capitals of ideas, creativity and forward-thinking.

The main design and secondary proposals have been identified as viable and practical solutions to re-vamping the underground tunnel into a space which cyclists and pedestrians can use. Furthermore, an adaptable bike pavement or an underground bike that would slide through the rails of Manhattan could indeed become a reality in today’s New York city. The transformation of the rail tracks will result in the integration of a Citi bike with a modernized version of the 1899 patent whereby Citi bikes are adapted with a third wheel located under the bike seat. The use of docking stations on other side of the platform will preserve the public bike sharing system which New York city has become well known for. The

The subway is a great utility used by New Yorkers to get from point A to B however the traveling experience underground becomes gloomy as commuters keep glued to their mobiles and the world silent with earphones on. This research project began with observations of people using the subway in this manner and how they interacted with the subway as a whole. It became apparent that a different environment was needed which would enhance they traveling experience for them and give them an experience which would speak to the psychological senses.

www.sourcesecurity.com/people/lisa-a-brown.html

32      Ibid

33      Lamm, Ben. “Algae Might Be a Secret Weapon to Combatting Climate Change.” Quartz. Accessed November 18, 2020. <https://qz.com/1718988/algae-might-be-a-secret-weapon-to-combatting-climate-change/>.

34      Ibid

35      Ibid

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