5 Pen PC : Battle between functionality and portability

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Abstract: 5 pen PC technology is a new emerging technology that is under developing stage by NEC corporation. It is a pen style personal networking gadget package (PISM) that has 5 pens, each pen having different function. All these pens are connected with each other through short range wireless technology and the whole set is connected to internet through cellular phone function. These small loosely bounded pens are connected to each other through Bluetooth technology and to communicate with the outside world they are connected to Wifi. The main purpose behind developing PISM is to develop a gadget that is as small as mobiles and as effective as desktops i.e to develop a gadget that people can carry with them anywhere and also getting all the features of desktops and laptops with the same ease. In this paper firstly we will review the PISM technology and then we will compare PISM with desktops, laptops, tablets and smart phones. We will discuss how PISM is better than other technologies. Also we will discuss various problems, issues with PISM and will identify unanswered questions and issues related to this technology. Finally we will discuss the future scope of 5 Pen PC. Then we will conclude that whether PISM is really a replacement to all these gadgets or is just another addition to world of gadgets and also that whether its advantages outweigh its disadvantages or not? We will discuss that do this technology actually solves the purpose behind its development. We will discuss whether it will resolve the battle between functionality and portability.

Keywords: Virtual, Mobile Computing, Portability, Effectiveness, Bluetooth, Wifi, Cellular Phone Technology

I. INTRODUCTION

5 pen PC Technology is a new emerging technology that is under developing stage by NEC corporation. It is a personal networking gadget package that has 5 pens, each pen having different function. These 5 pens rest in docking stand and has lithium ion battery for charging.

Basically this technology has 5 loosely bound pens which are very small in size, easy to carry and at the same time giving same or more effectiveness in performing the tasks that we can perform through desktops, laptops, tablets, etc. This technology is seen as replacement of desktops, laptops, tablets, etc. As pens are very handy, it's very easy to carry them. [1]

All these pens are connected with each other through short range wireless technology and the whole set is connected to internet through cellular phone function. These small loosely bounded pens are connected to each other through Bluetooth technology and to communicate with the outside world they are connected to Wifi. This technology is seen as replacement of desktops, laptops, tablets, etc.

The main purpose behind developing 5 Pen PC is to develop a gadget that is as small as mobiles and as effective as desktops i.e to develop a gadget that people can carry with them anywhere and also getting all the features of desktops and laptops.

The designer of this pen is Toru Ichihash and is under developing stage by NEC Corporation. [2, 3] The prototype for 5 pen PC was built in year 2003 by Japanese company NEC Corporation which was presented in ITU telecom world summit in Geneva, Switzerland. [4] This summit was held in December in which more than 11,000 people from 175 different countries participated. [5] The ITU Telecom exhibition is held every four years. The theme behind the exhibition for year 2003 was to showcase the dynamic collaboration – making your business grow. The convergence of different fields like computing and networking technologies, etc. was showcased to display advancements in these fields. [6]

Figure 1. 5 Pen PC prototype model displayed in ITU Telecom exhibition 2003

The 5 pen pc technology is based on the idea that "What is the future of IT in small". Everything in PISM is based on the concept that replaces bulky gadgets with the small, compact pens. This technology removes the need of physical keyboards, monitors. The main purpose is miniaturization of the bulky components. [7]

This technology replaces the bulky computer system with very small, compact, easy to carry pens. This will provide lot of advantages as it allows us to have ubiquitous computing.

Inspite of lot of advantages there is very big Question mark on this technology? There are various problems identified in this technology. Also there are various unanswered issues related to 5 Pen Pc. The problem identified from which 5 pen pc suffers makes the development of this technology in dilemma. It raises the

question whether it's worth developing this technology. Will it be able to serve its purpose? There is a battle between functionality and portability.

In all the previous papers related to PISM technology only discussion about components of Pens was done. Also in some papers only components were elaborated with little bit of its advantages and disadvantages. In our paper we will discuss these components, its advantages and disadvantages along with its comparison to the already existing technologies. We will try to find out how PISM is better than other technologies. Also we will identify unanswered questions related to this technology. Finally we will discuss the future scope of 5 Pen PC. Then we will try to explore whether its advantages outweigh its disadvantages or not? We will discuss that do this technology actually solves the purpose behind its development.

II. DESCRIPTION ABOUT PENS

The PISM has 5 pens that have different functionalities to work like a complete computer system. Out of these 5 Pens: One pen work as processor, other as keyboard, another as monitor, other one as camera and last one as communicator. All the 5 pens rest in holding block or docking stand where it recharges its batteries. [1, 8, 9]
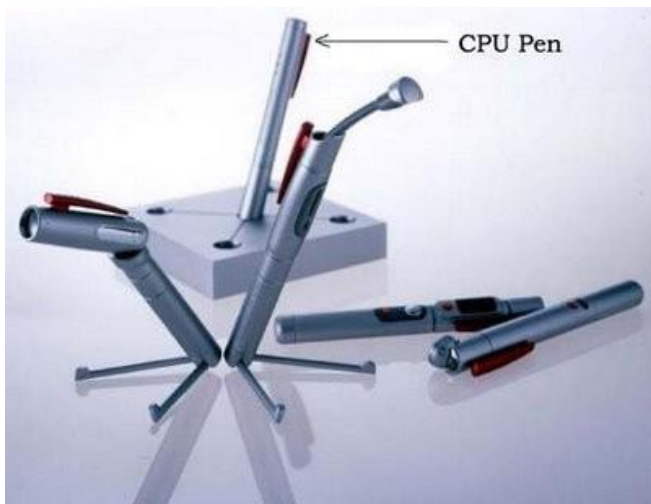

Figure 2.   5 Pens resting in a dock

A.   CPU Pen:

The functionality of processor is performed by this pen. It act as computing engine and carries out the instructions to perform arithmetic, logical and I/O operations. It fetches the instructions, decode it, execute it and write back the results. It has dual core processor embedded in it which works on windows Operating system.

B.   Keyboard pen:

The PISM technology uses the concept of virtual keyboard. Pen emits the laser light on to the flat surface to form the keyboard. The QWERTY arrangement of keys gets displayed on to the surface and what we are typing or doing is identified according to the coordinates of location [8]. It uses the camera to track the finger movements [9]. As the keyboard is displayed virtually it replaces the need of physical keyboard. [10] This feature makes the 5 pen pc compact, portable and easy to carry. Also as it do not require

physical keyboard it gives one more advantage that it reduces the risk of key stroke logging.
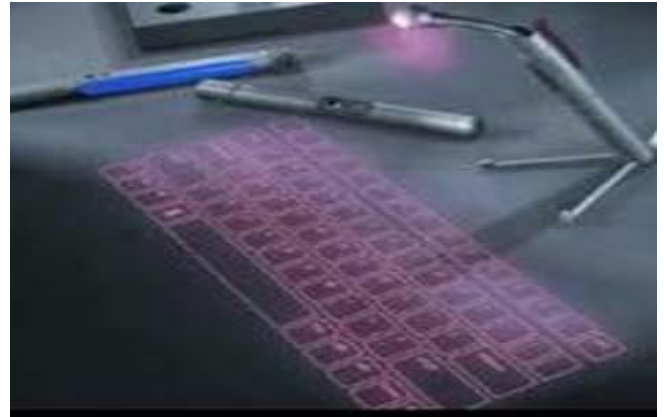

Figure 3.   Keyboard Pen Displaying Virtual Keyboard

C.   Camera pen:

This pen has digital camera in it. It is basically required for applications like video conferencing, video capturing, image capturing, etc. It actually works like a webcam which has 360 degrees visual communication, that is, it allows us to have round display. It displays the images captured immediately and provides the features to delete, crop, edit the image, etc.

D.   Display pen:

In PISM technology, display pen replaces the need of physical monitor. Like in case of keyboard PISM uses virtual keyboard, similarly it uses the concept of virtual monitor. It uses the LED projection for display. Pen provides the projection of A4 size and having resolution 1024 * 768.   It displays the pictures with clarity and good clarity. There are various projection technologies like CRT projector that uses cathode ray tubes, LCD projector that uses light gates, LCOS projector that uses liquid crystal silicon, etc. As the screen is displayed virtually it replaces the need of physical monitor. This feature makes the 5 pen pc compact, portable and easy to carry.
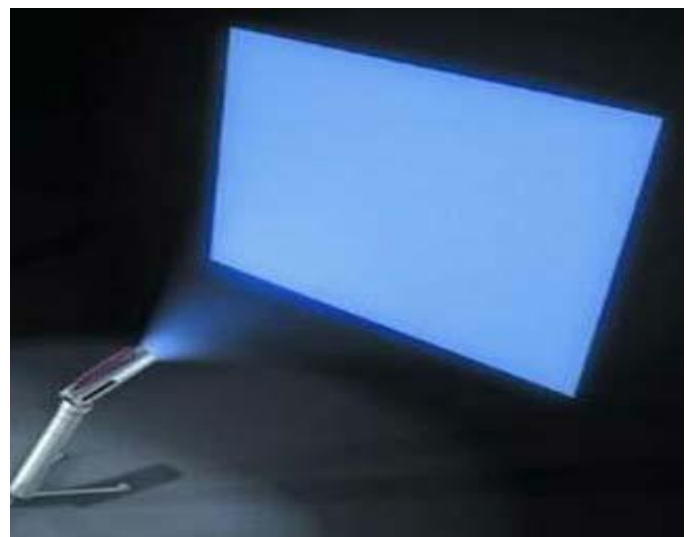

Figure 4.   Display Pen projecting A4 Size Screen

E.   Communication pen:

Communication pen connects all the pens with other. Through this the pens can communicate with each other. For

example, the image captured by Camera pen can be displayed through display pen. All these pens are connected with each other through short range wireless technology and the whole set is connected to internet through cellular phone function. Bluetooth is used as short range wireless technology that uses radio technology called frequency hopping spread spectrum. Cellular phone function is used for communication with outside world. A cellular network is distributed in form of cells which are in the shape of hexagon and each cell has fixed transceiver known as cell site.

F. Battery:

PISM has lithium ion battery. All pens rest in docking stand which recharges the batteries. The batteries are designed in such a way that they are small in size but works for longer duration.

Table I.   Different Pens

Sr. No.	Pen	Features	Remarks
1	CPU Pen	• Computing Engine • Perform Arithmetic, Logical operations • Executes the instructions	• Performance depend on clock rate and IPC
2	Camera Pen	• Provides digital camera • Required for videoconferencing, video recording, image capturing	• Provides 360 degrees visual display
3	Keyboard pen	• Virtual keyboard to give Input	• Emits laser light • Forms the virtual keyboard
4	Display Pen	• Work as Output screen	• Uses LED projection • A4 Size display • 1024 * 768 Resolution
5	Communication Pen	• Allows all the pens to communicate with each other and to the outer world	• Uses Bluetooth, 802.11 B/G and cellular phone technology
6	Battery	• Charging the pen	• Lithium ion battery • Small in size

III. COMPARISON OF 5 PEN PC TECHNOLOGY WITH EXISTING TECHNOLOGIES

With so many gadget choices in the market these days, it can be very difficult for customers to decide where to spend the money. Different technologies are famous with different population categories. Desktops, Laptops, tablets, smart phones, etc are wildly popular within different groups and demographics, mostly because they deliver specialized experiences to their users. There is a battle between functionality and portability. When trying to decide between technologies, it's generally not a particular technology a "winner," but only a more preferable choice for your specific requirements.

So here we will compare technologies with each other and will try to find out how PISM technology is better than other existing technologies. We will compare on the basis of mobility and effectiveness in performing tasks. We will discuss whether miniaturization of all the components is as effective as bulky fully fledged components or not?

A. Comparison of 5 Pen PC with desktop computers:

a) Advantages of 5 pen pc over desktop systems:

Desktop systems are very bulky and we can't carry them with us. Also it uses wires to connect all the components that make it large and heavy and therefore difficult to carry or use. On the other side if we see 5 pen pc it is very light and easy. As 5 pen pc removes the need of wires, physical keyboard and physical monitor, it makes 5 pen pc very easy to carry with us. Also digital camera pen provides round display i.e. provides 360 degree visual display which is not possible in desktop systems. Also as it do not have physical keyboard it reduces the risk of key stroking. PISM technology implements e-fingerprinting, it makes the gadget more secure.

B. Comparison of 5 Pen PC with laptops:

a) Advantage of laptop over desktop:

If we compare desktops with laptops we will find out that laptops are as efficient as desktops. All tasks that we can perform with desktops are possible through laptops. But at the same time laptops have much more portability; we can carry it with us. It requires less space. A laptop is generally characterized as a mobile personal computer -- a device on which you can perform all the tasks available on a desktop but in a mobile, light, compact fashion. Laptops are highly portable and allow you to use your computer almost anywhere. Laptop computers have a single cord to contend with, rather than the multiple cords associated with desktop computer use. Some of the problems that desktop systems have are solved by laptops. This arise the question if laptops have solved the problems so how 5 pen pc is better than laptops? Why we need pens? [11, 12]

b) Advantage of 5 pen pc over laptop:

Although Laptops systems have reduced the space issue, wires issue but it still has few problems. In the case of a Laptop the keyboard is integrated as part of the main body means still laptops have physical keyboard and physical screen. This need is not the case in 5 pen pc. PISM has virtual keyboard and virtual screen or in other words we can say it has keyboard and screen of size of pen only. This makes it very compact and handy. It's very easy to carry with us. Another thing that laptops webcam do not provide 360 degree round display which is possible through camera pen. [11, 12]

C. Comparison of 5 Pen PC with tablets:

a) Advantage of tablet over laptop:

Tablets are compact, very lightweight and extremely easy to carry than laptops. Most tablets have 7-inch to a 10-inch display screen. Tablets have weight less than 1 pound whereas laptops computers weigh anywhere from 3 to 9 pounds. Not only can this heavy weight be an annoyance to carry in a backpack or briefcase, it can cause back pain if they are carried for extended periods of time. So tablets are much easier to carry. But it does not possess the processing power equal to laptop. Its functionality as a computing

device is very limited, although it's very comfortable and useful for people who browse the Web casually, such as read the news or popular websites, and those who play "lightweight" games, or want to watch TV or films while traveling. So it's completely depend on the usage and application that is to be used, that whether to go for laptop or tablet. In case of tablet it is more portable than laptop but has less functionality in comparison to laptop. Now the need arises to compare the 5 pen pc with tablets because the space constraint problem of laptop is further reduced by tablets. [13, 14]

b)   *Advantage of 5 pen pc over tablet:*

5 pen pc as compared to tablet is more compact and much more easy to use. As Pen pc has all of its components in the shape of pen, it is much easier to handle. Also we are used to handle pens in our daily routine. This is the advantage in terms of portability. There are also various others advantages. 5 pen pc is as efficient in functionalities as laptops. It provides much bigger display screen. It has display of A4 size. It's much bigger as compared to tablets. Also it has full fledged virtual keyboard so it's much comfortable to work on it. . If we compare on the productivity front, typing over the touch keypad is difficult, especially while typing long documents and emails. An alternative can be attaching a Bluetooth keyboard to the tablet that will destroy the concept of high portability, which is its main advantage. Again the feature 360 degree round display is provided by pen pc and not by laptop. 5 pen pc is better than tablets in terms that it is handier, more compact still having bigger display, better keyboard and better display coverage. [13, 14]

D. Comparison of 5 Pen PC with Smart Phones:

a)   *Advantage of smart phone over tablet:*

Tablets are already smaller in size as compared to laptops but still are bigger than smart phones. You can't carry a tablet in your jeans pocket, but rather have to have a purse all the time. Not everyone, including a growing number of women, carries a purse or bag everywhere they go. For daily usage smart phones are preferred over tablets. Smart phones can do all those tasks that tablets can do. Also smart phones have better cameras at the same cost. Again the same question arise that when smart phones are better than tablets then 5 pen pc is required? [15, 16]

b)   *Advantage of 5 pen pc over smart phone:*

The pen technology has gadget in the form of form which makes it easier to carry. Also it provides round display which is not possible in smart phones. If we compare on the productivity front, typing over the touch keypad is difficult, especially while typing long documents and emails. On the other hand 5 pen pc provides complete keyboard functionality without harming the portability concept. It's easier to work on and easy to carry. 5 pen pc offers the better multi tasking with better portability. [15, 16]

IV. ADVANTAGES OF 5 PEN PC OVER TECHNOLOGIES

The main advantage of 5 pen pc is its miniaturization i.e. whole bulky computer system is converted into small

handy pens. This is done by replacing physical monitor and keyboard by virtual screen and virtual keyboard. The purpose behind this compaction is to make it portable and handy so that we can use it while on move.

    a.   5 pen pc is compact
    b.   Miniaturization of the bulky components.
    c.   Higher mobility
    d.   It's very easy to carry
    e.   No wires required to connect the components
    f.   Uses Bluetooth, 802.11 B/G and cellular phone technology already existing technologies to communicate with each other and to the outer world
    g.   Replaces the physical keyboard with virtual keyboard
    h.   The A4 size screen is converged into single pen
    i.   Replaces the physical screen with virtual screen
    j.   A full fledged keyboard is converged into single pen
    k.   Camera pen provides 360 degree visual display
    l.   Reduces the risk of key stroking
    m.   It implements e-fingerprinting which makes it more secure
    n.   5 pen pc provides complete keyboard functionality without destroying the portability concept.

As the main purpose behind the development of 5 pen PC is to develop a gadget that is as small as mobiles and as effective as desktops i.e. to develop a gadget that people can carry with them anywhere and also getting all the features of desktops and laptops.

This can have various applications like one of them is in education. Faculties can use these pens to deliver the lecture. Pens are very to carry and teacher can carry these pens with them and will not occupy space. It will be very easy to write anything using virtual keyboard and display diagrams, presentations through the virtual screen which will make classes more interesting. [17, 18]

Inspite of lot of advantages there is very big Question mark on this technology? There are various problems identified in this technology. Also there are various unanswered issues related to 5 Pen Pc. Problems identified from which 5 pen pc suffers makes the development of this technology in dilemma. It raises the question whether it's worth developing this technology. Will it be able to serve its purpose? There is a battle between functionality and portability.

V. LIMITATIONS OF 5 PEN PC OVER TECHNOLOGIES

The main advantage of 5 pen pc is its miniaturization i.e. whole bulky computer system is converted into small handy pens. Through the use of virtual keyboard and virtual display the need of actual physical keyboard and monitor is removed. Also the display pen provides 360 degrees visual display which is not possible in any other technology till date. It implements e-fingerprinting which makes it more secure. Also as it implements the concept of virtual keyboard it reduces the risk of key stroking. In the previous section we have seen lot of advantages of 5 pen pc over already existing technologies like desktop, laptops, tablets, and smartphones. But problem identified raises the question that whether 5 pen pc actually solves this purpose? Whether its advantages outweigh its limitations or not?

The problem is keyboard pen and display pen uses the concept of projection to create keyboard and monitor. But the question is whether it is possible to get proper projection

will on move. Because it requires flat surface to display screen and keyboard which is not possible while travelling. So it will be not to get proper display of screen and keyboard while travelling which was the main reason behind it development.

Also another problem is pens are needed to be placed in proper positions on docking stand to work. As pens are very light in weight there will be chance of falling down on done jerk or while taking steep turns. Also while travelling the virtual screen and keyboard will keep on moving according to road conditions which will make it harder to use.

Especially if we are in car or bus we will not be able to get the proper projection surfaces. Also it is difficult to place the docking stand and set pens in comfortable positions.

Projection may cause difficulty in driving.

Also if we are travelling through public transport like train, aero plane, metro, bus, etc it will create another problem of privacy. If we want to use the pen, screen and keyboard will be projected on surfaces. Screen is of A4 size which will hinder the privacy. A4 size is pretty much big size that people sitting behind you or with you will be able to see whatever you are doing. Also keyboard is pretty much big that people can see you typing. So it will make difficult work confidentially.

Also there are chances of pen falling down as they are very light in weight or slipping while travelling. This may damage the pen as pens are very delicate. Each pen is very costly and also damaging of single pen will affect the whole system.

Also as pens use wifi to communicate with the outer world there will be difficulty in getting wifi signals everywhere, though out journey or at every place.

Also if you are going in public places like malls, movie halls, parks, etc there will be problems in using the pen because of all these reasons. You will not be able get flat surface to set up the docking stand and position the pens, Privacy will be hindered, wifi may not be available.

Also playing games will be difficult while travelling because screen and keyboard will keep on shaking.

Everything in PISM is dependent on wifi, if wifi is not available or signal strength is weak then system will be almost waste.

Table II.   Comparison between advantages and disadvantages of 5 Pen PC

Sr. No.	Advantages	Disadvantages
1	o. 5 pen pc is compact p. Higher mobility q. It's very easy to carry r. No wires required to connect the components s. Uses Bluetooth, 802.11 B/G and cellular phone technology already existing technologies to communicate with each other and to the outer world t. Replaces the physical keyboard with virtual keyboard u. The A4 size screen is converged into	• Pens are very costly • Pens are very delicate • Damage of single pen will affect the whole system. • Projection need flat surface • Not possible to get proper display of screen and keyboard while travelling • Pens are needed to be placed in proper positions on docking stand to work. • Pens are very light in weight there are chances of falling down of pen on jerk or while taking steep turns. • Especially if we are in car or bus we will not be able to get the proper projection surfaces.
	single pen v. Replaces the physical screen with virtual screen w. A full fledged keyboard is converged into single pen x. Camera pen provides 360 degree visual display y. Reduces the risk of key stroking z. It implements e-fingerprinting which makes it more secure	• If we are travelling through public transport like train, aero plane, metro, bus, etc it will create another problem of privacy. • In public places like malls, movie halls, parks, etc there will be problems in using the pen. Not be able get flat surface to set up the docking stand and position the pens, Privacy will be hindered, wifi may not be available. • Playing games will be difficult while travelling because screen and keyboard will keep on shaking. • Everything in PISM is dependent on wifi, if wifi is not available or signal strength is weak then system will be almost waste.

A.   Various unanswered Issues:

There are various issues that are not discussed in any previous papers like

Whether it will be able to connect to hard disks, pen drives, etc or not?

How storage is managed?

Memory is extensible or not?

Whether it will be able to handle multicore processors or not?

Will it able to handle any other operating system?

Which projection technology is used for display?

How much heat is dissipated while working?

What cooling procedure is opted?

Whether it will be able to work while charging the battery?

Can it connect to laptops or smart phones with Bluetooth?

VI. CONCLUSION

The 5 pen pc technology is based on the idea that "What is the future of IT in small". Everything in PISM is based on the concept that replaces bulky gadgets with the small, compact pens. This technology removes the need of physical keyboards, monitors. The main purpose is miniaturization of the bulky components. This technology replaces the bulky computer system with very small, compact, easy to carry pens. This will provide lot of advantages as it allows us to have ubiquitous computing. The main advantage of 5 pen pc is its miniaturization i.e. whole bulky computer system is converted into small handy pens. This is done by replacing physical monitor and keyboard by virtual screen and virtual keyboard. The purpose behind this compaction is to make it portable and handy so that we can use it while on move.

Inspite of lot of advantages there is very big Question mark on this technology? There are various problems identified in this technology. Also there are various unanswered issues related to 5 Pen Pc. The problem identified from which 5 pen pc suffers makes the development of this technology in dilemma. It raises the question whether it's worth developing this technology. Will it be able to serve its purpose? There is a battle between functionality and portability.

But problem identified raises the question that whether 5 pen pc actually solves this purpose.

The problem is keyboard pen and display pen uses the concept of projection to create keyboard and monitor. But the question is whether it is possible to get proper projection will on move. Because it requires flat surface to display screen and keyboard which is not possible while travelling. So it will be not to get proper display of screen and keyboard while travelling which was the main reason behind it development.

Also another problem is pens are needed to be placed in proper positions on docking stand to work. As pens are very light in weight there will be chance of falling down on done jerk or while taking steep turns. Also while travelling the virtual screen and keyboard will keep on moving according to road conditions which will make it harder to use.

Especially if we are in car or bus we will not be able to get the proper projection surfaces. Also it is difficult to place the docking stand and set pens in comfortable positions.

Projection may cause difficulty in driving.

Also if we are travelling through public transport like train, aero plane, metro, bus, etc it will create another problem of privacy. If we want to use the pen, screen and keyboard will be projected on surfaces. Screen is of A4 size which will hinder the privacy. A4 size is pretty much big size that people sitting behind you or with you will be able to see whatever you are doing. Also keyboard is pretty much big that people can see you typing. So it will make difficult work confidentially.

Also there are chances of pen falling down as they are very light in weight or slipping while travelling. This may damage the pen as pens are very delicate. Each pen is very costly and also damaging of single pen will affect the whole system.

Also as pens use wifi to communicate with the outer world there will be difficulty in getting wifi signals everywhere, though out journey or at every place.

Also if you are going in public places like malls, movie halls, parks, etc there will be problems in using the pen because of all these reasons. You will not be able get flat surface to set up the docking stand and position the pens, Privacy will be hindered, wifi may not be available.

Also playing games will be difficult while travelling because screen and keyboard will keep on shaking.

Everything in PISM is dependent on wifi, if wifi is not available or signal strength is weak then system will be almost waste.

The problem identified from which 5 pen pc suffers makes the development of this technology in dilemma. It raises the question whether it's worth developing this technology. Will it be able to serve its purpose? There is a battle between functionality and portability. But problem identified raises the question that whether 5 pen pc actually solves this purpose.

By comparing advantages and limitations of 5 pen pc with other technologies shows that at some point it is advantageous and at some point not. So it looks like it is just another addition to world of gadgets. It cannot completely replace other gadget. Its future scope is limited to the applications for which it will be used as it has limitations in functionality and portability. It looks like as if it PISM is limited to function it can perform due to concept portability that is added to it. It is only beneficial for official purpose only where it is used as projectors. The case in which it is used as projector for displaying will be effective but not while travelling or public places.

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