Design of Smart Furniture for a Smart City

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Bachelor of Technology

In

Industrial Design

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Declaration

We Hereby Declare That This Thesis Is Our Own Work And Effort. Throughout This Documentation Wherever Contributions Of Others Are Involved, Every Endeavour Was Made To Acknowledge This Clearly With Due Reference To Literature. This Work Is Being Submitted For Meeting The Partial Fulfilment For The Degree Of Bachelor Of Technology In Industrial Design At National Institute Of Technology, Rourkela For The Academic Session 2011 – 2015.

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Certificate of Approval

This is to certify that the thesis entitled "**DESIGN OF SMART FURNITURE FOR A SMART CITY**" submitted to the National Institute of Technology, Rourkela by **SWAROOP PANDA**, **Roll Number 111ID0422** and **KUSHAL GOEL**, **Roll Number 111ID0514** for the award of the Degree of Bachelor of Technology in Industrial Design Engineering is a record of bona fide research work carried out by then under my supervision and guidance. The results presented in this thesis has not been, to the best of my knowledge, submitted to any other University or Institute for the award of any degree or diploma. The thesis, in my opinion, has reached the standards fulfilling the requirement for the award of the degree of Bachelor of technology in accordance with regulations of the Institute.

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Abstract

The government of India has decided to set up smart cities across the country. The intent is to improve the lifestyles of the people. For this purpose, it has defined certain parameters of the Smart cities. These parameters, such as smart environment, smart energy, smart transportation, smart governance, have been provided with characteristics and features upon which they are to be modelled. However there has been no mention about smart furniture. Furniture forms an integral part of houses and offices. The use of smart furniture is expected in smart cities. This project consists of developing concepts and ideas on smart furniture. The ideas that have been defined by the Government have been embedded in the design philosophies. A survey is also conducted to obtain data regarding user preferences. The data obtained is analysed to draw inferences. Then from these inferences the design principles are worked out. The concepts of the different products of Smart Furniture are developed using these design principles. The conceptual models of a chair, a bed and a table are designed.

Contents

List of Figures

1 Introduction

The Government of India has recently announced the setting up of Smart Cities in India. A smart city can be defined as a developed urban area that creates sustainable economic development and high quality of life by excelling in multiple key areas; economy, mobility, environment, people, living, and government. Excelling in these key areas can be done so through strong human capital, social capital, and/or ICT (Information Communication Technologies) infrastructure. Certain characteristics of the Smart City such as communication technology, smart buildings, smart governance, smart energy, smart environment, and smart transportation have been well defined. For instance smart energy is defined as energy which can be transmitted with minimal losses and can be produced without polluting the atmosphere. Similarly, smart governance is defined as public friendly governance. This means a rigid and an improved feedback system and an effective public Redressal system. However there is no rigid definition for smart furniture to be used in these Smart Cities. Furniture is an important part of lifestyle. Furniture is a necessity in houses and offices. Chairs, tables, sofa sets are almost found everywhere and are integral part of the aesthetic and utility value of any building. They are the building blocks of identities of any building or house. The primary intent of building up a smart city is to improve the quality of lives of the people. As a result it is very important that each of the parameters of the Smart City is well defined. Furniture happens to be a critical factor in determining the lifestyles of the people. Hence, it is important to define the characteristics and features of the smart furniture.

1.1 Problem Statement

The project aims to design Smart Furniture for a Smart City. This is done by analyzing the features of the Smart Cities and preferences of the people living in them.

1.2 Objective of the work

The objective of this project is to develop concepts for the smart furniture to be used in smart cities. The course of the work begins by studying and analyzing the defined characteristics and features of the Smart cities, such as smart energy, smart governance and smart transportation, and drawing out inferences from these characteristics in order to build up design principles. This is done by picking up the common features of each of the defined parameters. After this analysis, a survey is conducted on a culturally diverse population. The data obtained is then analyzed. Patterns are looked out for and inferences are drawn out for analysis. Similarly, from these drawn out inferences design principles are built. Finally, concepts are developed for smart furniture using the above inferred design principles.

1.3 Review of Literature

The term Smart City is a kind of a cloudy concept with different meanings and interpretations. Many institutions and individuals have provided various accounts of the concept. Giffinger (et al 2007) defines a Smart City as "Regional competitiveness, transport and Information and Communication Technologies economics, natural resources, human and social capital, quality of life, and participation of citizens in the governance of cities." The Smart Cities Council says that "A smart city is one that has digital technology embedded across all city functions." Caragliu and Nijkamp in a 2009 paper suggest that "A city can be defined as ‘smart’ when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement." Frost & Sullivanin 2014 stated that "We identified eight key aspects that define a Smart City: smart governance, smart energy, smart building, smart mobility, smart infrastructure, smart technology, smart healthcare and smart citizen." The Institute of Electrical and Electronics Engineers Smart Cities says "A smart city brings together technology, government and society to enable the following characteristics: smart cities, a smart economy, smart mobility, a smart environment, smart people, smart living, smart governance." The Business Dictionary defines a Smart City as "A developed urban area that creates sustainable economic development and high quality of life by excelling in multiple key areas; economy, mobility, environment, people, living, and government. Excelling in these key areas can be done so through strong human capital, social capital, and/or ICT infrastructure." The Department for Business, Innovation and Skills, UK 2013 stated that "The concept is not static, there is no absolute definition of a smart city, no end point, but rather a process, or series of steps, by which cities become more 'livable' and resilient and, hence, able to respond quicker to new challenges." The Government of India in 2014 termed that a "Smart City offers sustainability in terms of economic activities and employment opportunities to a wide section of its residents, regardless of their level of education, skills or income levels.”

Taking all of the above definitions and interpretations into account it is also suggested that a smart city should use information technology to make more productive use of physical infrastructure such as roads, buildings and other assets and to support a robust economic, social and cultural development, to engage efficiently with local people in matters relating to governance by means of unobstructed innovation processes and e-participation with ample stress on citizen participation, to learn, adapt and respond more effectively and quickly to altering circumstances. They should advance towards a strong synthesis of all dimensions of human intelligence (artificial intelligence could also be of great help) within the city. The brainpower of cities should reflect in the increasingly efficient combination of digital telecommunication networks, embedded intelligence, sensors and tags and software.

Research labs of reputed universities across the World have developed prototypes and have provided solutions for Smart Cities. The Smart Cities Lab at MIT focuses upon intelligent and sustainable buildings, mobility systems (GreenWheel Electric Bicycle, Mobility-on-Demand, Citycar, and Wheel Robots). The IntelCities research association has developed solutions for e-government, planning systems and citizen involvement. The URENIO(Urban and Regional Innovation Research), in the School of Engineering at the Aristotle University of Thessaloniki has developed a series of Smart city platforms for the innovation economy

focusing on strategic intelligence, technology transfer, collaborative innovation, and incubation.

On the other hand, Large Information Technology and telecommunication corporations such as CISCO, IBM and Microsoft have provided new solutions and have developed initiatives for Smart cities. CISCO launched the Global Intelligent Urbanization initiative to help cities around the world to use the network for integrated city management, better quality of life for its citizens, and economic development. IBM declared its Smarter Cities Programme to stimulate economic growth and the quality of life in Smart cities with new approaches of thinking in the urban ecosystem.

Embarking upon the above ideas the government of India formulated its own policy of the Smart cities. These policies also covered the various characteristics that the model Smart City should consist of. All of these characteristics were used with the adjective 'Smart' so as to add the semantic effect into each of the ideas. For instance, the buildings constructed in these Smart Cities would be called as Smart Buildings, the administration process would be known as Smart Governance, the energy would be called as Smart Energy, the transportation in these cities would be known as Smart Transportation and so on. The Government of India has provided details regarding each of the above characteristics. These details were presented at the Smart City Conference and exhibition in 2015.

The Government of India provided demographical data regarding the estimated population of the Smart Cities and the money that is required to be spent in building these smart cities. India is estimated to have a population of 1.25 billion (World Bank Data) and is growing every day. The major concern is the accommodation of the ever increasing urban migrated population. For this purpose the Government of India has reportedly decided to allocate 60000 million for the smart cities project. It has also decided to build smart infrastructure in another 500 cities for the growing urban population and to foster development. However, the Smart cities may require additional funding at various stages of its constructions. The Government of India has decided to allow Private sector corporations and companies to make investments in these Smart Cities. This would take off burden from the Government and would increase the private sector participation in the development process. The Smart City project is thus talked to be a public private partnership venture.

As the Smart City idea is an ambiguous and cloudy venture, a Smart City Conference was organized in 2015. This is a platform where multifaceted ideas regarding smart cities will be put on the table for discussions and debates. This platform will attract various government officials, investors, managing directors, chief executive officers, members of the board of directors, other industry leaders, researchers, eminent professors, members of institutions conducting research on Smart Cities, and other stakeholders who are developing solutions for the Smart Cities. This platform intents to connect the chief executive officers, other industry leaders, chief managing directors, various government officials, eminent professors of reputed universities across the globe, investors and other stakeholders in the Smart City venture. In this platform the Government of India laid down its policies on various characteristics of the Smart City venture in consultation of the above mentioned stakeholders of the private sector [4]. These characteristics include Smart Buildings, Smart Transportation, Smart Energy, Smart Environment, Smart Governance, Smart Information Technology and Communications, Smart Education and Smart Health.

1. Introduction

Smart Buildings: The Government of India would build 110 million houses to accomplish the objective of houses for all by 2022. This objective can be fostered by encouraging private sector investments in this venture. The recent annual investments in the housing sector are US$ 120 billion, and are expected to be around US$ 2 trillion by 2022, turning to about US$ 250 billion annually. More than 2,771 green buildings projects are registered with the Indian Green Building Council (as of August 2014) with a footprint of over 2.23 billion square feet .The buildings in India consume around 40 percent of total energy generated, and 20 percent of water (CSE).The Buildings in India generate 40 percent of the carbon emissions, 30 per cent of solid waste, and 20 per cent of water effluents (CSE). It is estimated that India can save around US$ 42 billion every year with effective management of lighting, heating, air-conditioning et cetera (McKinsey & Company).

Smart Governance: Smart cities will be those cities where the quality of governance is increased with the synthesis of applications and data centers through the use of Information Technology and communication. Smart governance is a process of reform in the way government works, and is transparent in its functioning. Hence it is easily accessible by the public who can get their desired information and services in the requisite time. This brings public institutions closer to the public by using information technology services such as e-services, social media platforms, applications and other platforms. The governance is improved and the delivery of public services is transformed. Government departments will perform rigorous examination on the smart services, and will find ways to make the services more effective. Redressal systems should be meticulously designed and properly monitored. It should act timely and behave in a professional manner. The collection of feedback is the key to develop and improve smart services to the public as it creates an efficient communication channel between the public and the administration. The city mayors, municipal commissioners and city development authorities will have to play a vital role in the implementation of the reforms in the Smart Cities.

Smart Energy: India functions as the third largest transmission and distribution electricity network in the world and yet faces quite a few challenges including, lack of sufficient access to electricity, supply shortfalls, massive losses and reliability. The changing trend towards smart grid will address these issues and transform the existing network into a more effective, safe and reliable one that has the potential to provide electricity access to all its citizens. Implementing smart meters will allow utility companies to collect data from every meter. This will make sure that bills are made correctly and there is no inconsistency. The data can be analyzed to obtain patterns of electricity consumption and to provide a much more efficient solution to this issue. It is estimated that India will install 130 million smart meters by 2021.The the Central and state governments can implement new energy laws and can offer new incentives for efficiency projects.

Smart Environment: India's installed electricity generation capacity at 250 GW. This is the world's fifth-largest electricity generation capacity. This power is generated from various sources such as natural gas, oil, coal, hydro, solar, nuclear, biogas, wind etcetera. However, India is mainly dependent on coal to produce electricity. But coal happens to be the main source of greenhouse gases which are the main causative agents of global warming. Thus, the

need of the hour is to focus on more effective and productive use of coal or alternative fuels and renewable sources of energy such as solar power, wind energy et cetera. The potential generation capacity for renewable energy in India is estimated at 249.18 Giga Watts (Novonous Research), and the installed capacity is about 31.69 Giga Watts. (Central Electricity Authority).The Ministry of New and Renewable Energy (MNRE), a ministry under the Government of India has a potential target to achieve an installed capacity of 41.40 GW by 2017, which is a US$10.51 billion opportunity. On the other hand, the demand for clean and distilled water continues to rise for domestic and industrial purposes. The health burden of pathetic water quality is very high to be taken care of taking into consideration the surmountable number of diseases that are caused and spread by water pollution. It is estimated that around 38 million Indians are affected by waterborne diseases per year. Sanitation issues in the urban areas are much severe and require immediate attention. The sewerage systems suffer from poor maintenance and negligent attitudes thus leading to overflows which have severe environmental and health concerns. To get around water supply, waste water and sanitation issues cities should seek to incorporate the latest technologies, products, solutions, systems so as to collect data to diagnose problems and to prioritize and manage maintenance concerns. Government authorities in cooperation with the interested private investments should build community toilets, and should work to incentivize other sanitation incentives. Various programmes aiming to promote health awareness should also be organized. Another crucial issue to be addressed is the Solid waste management system. Around 60 million tonnes of Municipal Solid Waste (MSW) is generated in India per annum. With rapid urbanization and changing lifestyle and food habits, the amounts of municipal solid waste will continue to rise. The dump sites in almost all cities are handling more waste than they normally hold, and the task of finding new landfills near these cities is not practically feasible. Many of the dump sites lack systems for leachate collection, landfill gas collection or monitoring. These results in ground and surface water pollution from runoff, air pollution is caused by fires, toxic gases, and odour. This further creates public health problems due to mosquitoes. There needs to be a focus on solutions to reduce waste and environmental pollution and to vacate land that would otherwise be used for landfill.

Smart Transportation: Transportation is an important characteristic for the smart cities. Thus there is a requirement to review city transportation systems in India and to provide new and improved solutions for transportation systems. EVs / HEVs (Electric Vehicle/Heavy Electric Vehicle) with systems for recharging them, and battery storage facility is expected to play an important role in improving the lifestyles of people in Smart cities. Monetary incentives can foster development in cities. To encourage the use of EV's, the government has launched a National Mission on Electric Mobility, with a target of 6 million electric vehicles by 2020. Electric vehicle charging stations in urban areas and along state and national highways are to be introduced by 2027.Also, the use of bio-fuels is being encouraged with an ethanol-blending program (ethanol with petrol) to lower India's oil imports. Moreover, high speed railway facilities are to be introduced on important routes across the country including these Smart cities.

1. Introduction

Smart IT and Communication: India holds the one hundred and twenty second rank in the world for fixed broadband penetration, with only 1.1 per 100 users having access to fixed broadband (The Broadband Commission).India ranks 10 and also holds the one hundred and the sixth rank in the world for mobile broadband penetration, with only 4.9 per 100 users having access to mobile broadband (The Broadband Commission). India has about 243 million internet users, with 70 percent accessing the Internet through mobile phones and tablets, and the rest through desktops and laptop computers. On the other hand it has around 933 telecom subscribers which include 59 percent urban users and 41 rural users (Telecom Regulatory Authority of India).In spite being Facebook's second largest market worldwide, the social media penetration in India remains at just 8 per cent of the total population. India's average Internet speed is 1.5 Mbps, the lowest among Asia Pacific region. Only 4.9 per cent of Indian internet users have access to speed higher than 4 Mbps (Akamai Technologies). IT and communications technology will be a vital component of the investments allocated by the Governments to build smart cities. The government has realized the importance of technology in building such intelligent platforms in the Smart Cities. Issues such as public safety, security, prevention of terrorist activities, and prevention of accidents can be dealt with advanced application of technological platforms. Technology can also be used to provide swift responses to monitor and manage and detect critical situations. In order to implement Smart IT and communications the Government should develop a strongly wired and wireless broadband network, and ensure its availability throughout the city to all its residents. Smart cities can use smart IT and communication technologies to improve the lifestyles of its citizens by the provision of important services over communication networks.

Smart Health: The healthcare sector in India is expected to grow at a rate of 15 per cent, to reach USD 90 billion in 2017 from USD 58.2 billion in 2014.The per capita healthcare expenditure is expected to increase from USD 57.9 in 2011 to USD 88.7 by 2015. Survey reports suggest that there is an availability of only 0.9 hospital beds for every 1,000 patients in India and only 0.7 physicians per 1,000 people in India [5]. India's health budget was enhanced by 27 percent in FY 2014-15 to USD 5.86 billion, with a special focus on improving affordable healthcare for all. The government of India has also proposed to set-up four new AIIMS in the country. India's primary advantage over other countries is the availability of its large pool of well-trained medical professionals and cost effective delivery of healthcare services. The Smart cities are expected to take a lesson from these shortcomings through the use of efficient technologies.

Smart Education: India is houses around 600 million people under the age of 25 years. India has around 1.4 million schools and more than 35,000 higher education institutes, including both government institutes and private institutes. By the year 2020 it is estimated that India will have the world's largest tertiary-age population and second largest graduate pool. Rise in the income levels, rapid urbanization, increasing awareness about the importance and the use of quality education has resulted in growth of the education sector. The Government of India has taken several initiatives to boost the growth of this sector, including setting up of several schools and universities and making significant deals with foreign countries to establish institutions in mutual agreements. The education market in India is presently worth around

USD 92.98 billion. India's online education market is expected to be USD 40 billion by 2017. Smart education will change the working of the education sector. Students and teachers will shift to e-learning delivered through computers, tablets and mobile devices from textbooks and reference books. Schools must adopt new technologies and technologically upgrade the infrastructure to allow students and schools to stay connected. Moreover, the adventures of massive online open courses are flourishing. Ventures such a coursera, edx, khan academy are in very high demand amongst the students. Although it is a visible fact that classroom teaching nad education is no match to an online and open course, an online course can act as a bridge between distances over a thousand miles. For instance a student accessing the internet in a rural part of India can now learn from a video that is developed by of a professor of a prestigious American university.

Furniture is the mass for the movable objects which are intended to support several human activities such as seating (e.g., stool, chair and sofas) and sleeping (e.g., beds). It is also used to carry objects at a convenient height so that work can be done easily or to store things. It can be a product of design and can used for a decorative art. It serves as symbolic and religious purposes. The furniture can be made up of many materials incorporate with metal, plastic or wood etc. It can be used for variety of wood working joints which ultimately depicts the local culture in the society. There are several types of furniture available in the market such as sofas, chairs, beds, table, desk, dressers, cupboards etc. Usually, the objects kept in a home or other buildings to make it suitable for our living and comfortable for us or working in.

A chair is kind of a piece of furniture having a raised surface which is used to sit on, commonly for use for one person and sometimes used by several people. It is mostly supported by four legs and has a back. Meanwhile, a chair can have three or more legs according to specific needs for the user and can be made up of different shapes and sizes. A chair without having a back or arm rest is called a stool. Or it can be converted into a raised tool which is called a bar tool. A chair having arms is called an armchair and with a folding action and reclining footrest which is called a recliner. A permanent chair which is used in theatre or trains called a seat or in an airplane called a airline seat and when riding, it is called a saddle and bicycle saddle and for automobile called a car seat or infant car seat. When chair is having a wheel then it is called as a wheelchair and when hung it is called a swing. A chair which is used for more than one person is known as a couch, sofa, settee or loveseat or a bench. A separate footrest for a chair is called as an ottoman, hassock.

There are two crucial and historical studies of ergonomics which is concerned with building a chair, which provide scientific arguments for ergonomics design and have led the way to this development; A kerblom's (1948) EMG studies of muscles tensions in erector spineus and the measurements of spinal intra-disc pressure by Nachemson and his collaborators (Andersson et al. 1979). These studies demonstrate convincingly that as a chair user sits down, disc pressure increases by about 40 – 50% as compared to standing. However, since there is no nerve endings in the discs, most chair users are unaware of any increase in pressure[1].

1. Introduction

In order to investigate the ergonomics features of chairs an experimental approach has often been taken, where users try out different chairs and rate their relative discomfort. A classic study by Shackel et al. (1969) validated the General Comfort Scale for measurement of chair comfort. The evaluation was performed on 10 chairs. There were only a few significant differences in comfort/discomfort, and it was not possible to establish a rank order between the chairs. Bendix et al. (1985) compared comfort/ discomfort of three office chairs with inclined seats that could be tilted using twelve subjects. No significant difference was found. Daley et al. (1985) compared three seemingly very different chairs using Shackel's General Comfort Scale, Chair Feature Checklist, Body Area Discomfort and chair rank order preference. Here as well, there were no significant differences. Hoskewitz and Rholes (1986) compared three seemingly very different chairs but obtained no significant differences. Lee et al. (1993) measured general and local discomfort in 16 car seats. There were no significant differences in seat pressure and local comfort/discomfort. Wilder et al. (1994) compared two truck seats with steel springs and gas springs using six test subjects. There were no significant differences in comfort between the seats [2].

A rocking chair which is also known as a rocker is a type of chair having two curved bands which is attached to the bottom of the legs, communicating the legs on each side to each other. The rocking chair contact with the floor at only two points which gives the occupants the ability to rock back and forth by shifting the weight of the person or by pushing lightly with his/her feet. It is commonly made up of wood and some of rocking chair can be fold also to some extent. The purpose of using rocking chair is associated with the maturity and social class. Nowadays, many adults are occupying these chairs and its gentle motion soothes them and fetches attraction one's brain which may be associated with the rocking motion with that of the safety and comfort. Rocking chair is widely used for its comfort level because whenever a user sits in one without rocking , the chair automatically rocks backward until the user's center of gravity is met, which imparts a good ergonomic benefit with the user kept at an un-stressed angle and position.

A Windsor chair is a kind of chair having a solid wooden seat into which the chair-back and in which legs are round-tenoned in shape, pushed into drilled holes which contrasted to standard chair, and where the legs are uprights of the back are continuous. Usually, the design of seats of Windsor chair is carved into a shallow dish or saddle in shape for better comfort. The legs and uprights are usually turned on a pole lathe traditionally. There are nearly seven different forms of Windsor chair incorporated by Sack back Windsor Armchair , Hoop-back Windsor chair , Comb- back Windsor chair , Continuous arm, Low back, Rod back, Ricker Fanback Windsor arm chair, Lyman mower Windsor side chair

A wingback chair is an easy chair or can be called as club chair having "wings" which is mounted at the back of the chair and which is stretching down to meet the arm rest. The purpose of using these "wings" was to surround the head or torso parts of the body in order to provide comfortable from drafts and to enjoy the heat from a fireplace in the areas where the user would be sitting. While this is created as an aesthetic that apparently enjoyed by many modern furniture lovers, it is initially a functional element that is meant to protect the person.

2 Methodology

2.1 Analysis of the collected data

In order to design a chair for a Smart City, the implementation of a user centered approach is very crucial. This is because with massive scale urbanization individualistic ideas and mindsets have had leverage over collective ideas and mindsets. As a result the designs need to be done keeping the individuals tastes and preferences in mind. Each individual has a unique history and a unique set of experiences that needs to be captured. This can only be done through a direct one on one interaction with a user. However, it is not possible to collect data by interaction of so many users. This process would be tedious and will take a lot of time. The collection and the analysis of data would be highly cumbersome and tedious. But this process can be ingenuously performed by selecting a group which is culturally diverse. Culturally diverse means that people in that particular group belong to different regions of the country. This implies that these individuals have had unique histories and unique sets of experiences and therefore will have unique tastes and preferences. Although the individual tastes and preferences within the group would be difficult to differentiate, this method is effective in determining the aggregate interests of people of varied cultural backgrounds.

After selecting the group of people, which is culturally diverse, it is now important to decide the mode of interaction with these people. Collecting data through verbal interaction is not possible. Cultural diversity may bring differences in languages, which makes the interaction prone to misinterpretation. The data collected would lack consistency and authenticity. On another note, collecting verbal data is cumbersome and is prone to errors. Verbal interaction has the advantage of providing facility for a subjective treatment of the cultural elements. However, in this study, the room for subjective elements is quite small. This is because the study concentrates on cultural data. This data is then to be analyzed and then certain conclusions can be drawn from this data. This method is more suitable and appropriate than collecting subjective data as subjective data are inherently subjective and hence it is not possible to find common grounds for analysis of this data. It is then decided that the best possible method to collect data to is get a written feedback in the form of a survey form.

The survey from would demand answers from the user in an objective format. In certain cases the user needs to note down a value while in others a user needs to choose one option from a set of multiple options provided in the survey form. The survey form also asks for the gender and the age group of the user. This tool is helpful for characterizing the data set. The questions are limited to fifteen in number so as to not make the user frustrated or overloaded for the want of more time to fill the survey form. The questions are worded with simple words that are used in everyday parlance so as to make no space for misinterpretation of the queries.

2. Methodology

QUESTIONNAIRE FOR FINAL YEAR MAJOR PROJECT

This survey is conducted for the collection of cultural data of the different geographical regions of India which would be used to study the designs of the houses and cities of these areas.

1. The language that you are most comfortable with is
   A) Your regional language B) English C) Hindi

2. Which weather in Rourkela makes you feel comfortable?
   A) Rainy and Humid (August –September) B) Cold (October November)
   C) Very Cold (January February) D) Hot and Dry (March April)
3. Which weather in Rourkela makes you feel very uncomfortable?
   A) Rainy and Humid (August -September) B) Cold (October November)
   C) Very Cold (January February) D) Hot and Dry (March April)

4. How strongly do you believe in the following issues? Rate in a scale of 1-5.
   i. Nationalism
   ii. Feminism
5. What kind of clothes do you prefer to wear?
   A) Western B) Traditional

6. On any given day, which meal would you normally prefer?
   A) Vegetarian B) Non- Vegetarian
7. What is the preferable quantity of spices your meal should have?
   A) High B) Medium C) Low

8. What genre of movies/books do you watch/read?
   A) Fantasy B) Historical Non Fiction C) Others
9. What kind of music do you love to listen?
   A) Film Music B) Folk C) Bands D) Classical

10. How often do you attend social functions?
    A) Very Often B) Often C) Rarely D) Very rarely
11. Have you ever taken part in a plantation programme?
    A) Yes B) No

12. How educated is your family?
    A) Some Post- Graduates B) All graduates C) Some Graduates
13. What is your basic parental occupation?
    A) Business B) Government Employee C) Corporate Employee
14. Where does your family belong to in the economic strata of India?
    A) Rich Class B) Upper Middle Class C) Lower Middle Class
15. Do you have pets at home?
    A) Yes B) No

Tick your age group (in years): < 20 20-30 30-50 >50

Gender: Male/Female Mention your native state:

2. Methodology

In the survey form the queries put forward are containers of cultural information. The language of a particular community suggests its lifestyle. This is because language is a form of communication. For instance, a community which majorly speaks in its native language cannot be thought of as a westernized cluster because people can only interact within themselves using the native language. To interact with people of different communities one needs to speak in other languages or in a universal language such as English. By that same logic, communities speaking in English can be thought of as a westernized and a posh cluster as they interact and deal with people from other distant and different communities.

Climatic conditions are also responsible for determining the lifestyles of the people in that particular region. For instance, people residing in the lands with extreme climates, that is, very high temperatures in summer and very low temperatures in winters, have different ways of living than people living in moderate climatic conditions or people living in the coastal regions. People get conditioned according to the climatic conditions of their geographical area. In Areas with extreme climates people wear different kinds of clothes, eat different kinds of food, and do different kinds of work than people who live in coastal regions or regions with moderate climatic conditions. Climatic conditions are also responsible for the crops that grow in a particular geographical region. Hence, the economy of a particular region is heavily dependent upon its climatic conditions.

The idea of Nationalism is a feeling of patriotism. It is a feeling of superiority, in the context of a country, over other countries. This is a defining feature of a cultural background of a particular community. A Nationalistic group is often resistant towards western ideas. It is more dependent on traditional and indigenous ideas. It firmly believes in domestic products and concepts and thinks that this is the best way of life. Such cultures have a natural resistance towards change and are conservative in its attitudes.

The philosophy of Feminism is the advocacy of female rights on the grounds of equality. This is also crucial to the cultural study of a particular group. From ages, different communities around the worlds have had different and numerous attitudes towards women. From highly liberal to highly conservative, a wide spectrum of views was present. However, in the era of postmodernism, and in the aftermath of the French Revolution where the concept of equality flourished, women's rights gained ground. This led to women uprisings and the aggressive campaigning for the equal status to man and the woman. Also from decades feminism has been connected to beauty. As a result it has close ties with culture of a particular community. The way a society views its women, treats its women describes the attitudes of the people of that society. These attitudes then form the building blocks of the culture of that particular society. A society that asks its women to put on a veil has a different mindset, and hence a different culture, than a society that allows its women to wear western clothes. These attitudes are mostly generic and have been inherited from the past traditions and customs. However in certain cultures, westernization has penetrated and conservative attitudes are giving way to liberal ones.

The kind of food one prefers to eat is also a deciding factor of the mindsets of people of a particular region. Different kinds of foods consist of different kinds of materials which again require different levels of metabolism. For instance, a non vegetarian food consists of a larger quantity of fat and hence requires more metabolism than a vegetarian food which consists of less fat. Similarly the quantity of spices in the meal determines the rate of metabolism. Food having higher quantities of spices requires a higher degree of metabolism than food having lower quantities of spices. Metabolism is a biological activity. This process releases or takes in energy in the form of heat. Hence this process is responsible for changing the temperatures of the human body. Now, mental activity is dependent upon the physical characteristics of the body. For instance, a sultry weather is not as comfortable as a cool and a pleasant weather. As a result, when the temperatures of the body change, the mental processes change. As the processes change, mental attitudes are changed. These mental attitudes build up the cultural sphere of the society. So the kind of food one prefers is definitely a factor that determines his or her cultural attitudes.

The kinds of books and music people read and listen to are crucial factors in the cultural sphere. Books and music are doors to move outside the realm of reality. They provide a path to a new world. Stories help people to get out of their lives and fill in the shoes of the protagonist. Similarly music with its melody and harmony provides a visceral experience to people to spend time outside their real lives. The kind of books that a particular person reads shows the world that he wants to be in. It depicts the utopian planet that the person wants to be in, the kind of relationships he wants to have, the kind of work he wants to do and so on. Hence this provides a door to the fantasized mental states of the person. It shows the states that the person wants to be in. A person reading and relishing a romantic story has different mental attitudes than a person reading and enjoying a biopic. The cultural differences are naturally evident from these observations. Music has a visceral effect on human beings. There are different kinds of musical instruments with different sounds. Each of them has a particular taste to cater to. Then there are different genres of music. A western classical melody is quite different from a Gregorian chant or even oriental music. Moreover, in the advent of postmodernism, rock and pop music have become highly popular and classical and oriental musical forms have become antiquated. The rock and the pop music incorporate ideas of popular culture in their music and their lyrics. There is heavy usage of postmodern elements in those kinds of songs. The tastes and the preferences for music determine the cultural attitudes of the people in the region. A person listening and enjoying a western classical piece has quite different cultural attitudes that a person who enjoys pop or rock music. This is in fact evident in the lifestyles of the rock and pop musicians who lead an extravagant and a flamboyant lifestyle. In contrary, musicians of the western classical genre or the oriental genre have somber lifestyles. Moreover the ambience and the settings of the performances of these shows depict remarkable contrast. In a western classical symphony the audience sits quietly with applause at the beginning and at the end, while at a rock concert, the audience are up on their feet and are dancing to the tunes of the musicians. Thus, musical preferences help to collect cultural data.

2. Methodology

The social orientations and the degree of social engagements are important factors to adjudicate the cultural practices and preferences of a group. The social orientation of a person suggests his attitudes towards the society or other people in general. This tends to the question that whether this person is concerned about his social status or not. For intake an extroverted person, who most of his times spends his good times with friends or even strangers, demands a greater social status and outlook than an introverted person who mostly keeps into himself. This factor is important because it suggests how a particular person carries himself in a social sphere. If he demands supreme respect and status he would require showy attitudes. The person wants attention and wants to be noticed by the public. Similarly a person who does not seek public attention too much is nether concerned with showy behavior or status.

In this twenty first century, climate change has become a very crucial issue in the World. Many people have taken personal and first hand responsibility to do something about it. It is due to this phenomenon that the so called ‘green’ products have come to existence. These products claim that they do not cause pollution and can be recycled back into the environment. There are many awareness programs that run by the governments and by the nongovernmental organizations in order to initiate the save the environment process. There are a lot of people who have taken to plantation programs which neutralize the adverse effects of the air pollutants. Now these initiatives change the mindsets and attitudes of the people. People are now more inclined to use green products than to use products which cannot be efficiently recycled. These small changes in their preferences bring about massive changes in their cultural preferences. For instance, people might chose to eat vegetarian food, which consumes less oil to be cooked, over a non-vegetarian dish which requires more oil to be cooked. Similarly, people may not prefer to buy leather and other products that are made from animal skins.

Education and occupation are the building blocks of the cultural background of any society. Education develops the basic and rudimentary knowledge in a child. After this development a child takes cues from his environment to understand the world around him. On top of that he gets in contact with the electronic and the print media which further shapes his perceptions. The forms of entertainment also mould his understanding of the world. This is how a person gets his own cultural skeleton of the world. The kind of occupation determines the lifestyle of people. Working in the construction sector in the direct sun is completely different from working in the IT sector inside an air conditioned room. Both of the above settings have different kinds of engagements and hence different mindsets, attitudes and a different way of looking at life. Occupation also determines the income of the people. The people working in the construction sector have lower levels of income than people working in the IT sector. The amount of money that one has determines the amount of money that he can afford to spend. Spending determines what kinds of products and services a particular group can buy or access. These material services now determine their lifestyles. This in turn determines their way of looking at life and hence their cultural attitudes and preferences.

2. Methodology

Apart from the data collected from the survey questionnaire, inferences in determining the design principles of the chair can also be obtained from the parameters provided by the Government of India for designing a Smart City. For instance, the government wants to develop Smart transportation. In this concept of Smart transportation it has planned to run modes of transport that are economical as well as green. The term economical is in the sense that the customers are required to pay less for travelling a particular distance. The term 'Green' means that the modes of transport do not emit harmful pollutants which are dangerous to the atmosphere. For instance buses or cars that run on liquid petroleum gas do not emit as harmful gases as do vehicles which run on petrol or diesel. A much more effective way of developing smart transportation systems would be to work on metro. Now, these metros run on electricity and hardly emit any harmful pollutants into the atmosphere. Buses and other vehicles that use fuels for combustion can be got rid of easily if the metro system is activated in a particular city. Now, taking an inference from smart transportation, one of the design principles could be to find replacement of a potentially dangerous resource. This is very useful in the case of the material used for building up the chair. Nowadays chairs are built from a variety of material that is many times harmful for the environment. Deforestation is one of the effects of manufacture of wooden chairs in a large scale. Hence the chair has to be such that the material is recyclable and does not cause too much damage to the surrounding ecosystem. Secondly, there is the issue of a price. In the competitive global market there is a fierce competition regarding price. There are companies which offer same or better quality at lower prices. They achieve this feat by optimizing their manufacturing processes. Hence the chair that needs to be designed should be economical in all fronts.

The government also talks of developing smart healthcare. This policy would include sharp and active mechanism to deal with emergency situations. It also deals with lucrative heath insurance policies giving an assurance to the citizens regarding their healthcare. Here the preference is on feedback mechanisms. From this policy we can infer that there should be good feedback mechanisms for the chair. A product should be built keeping in mind that any error made by the user, is an error of the product. So it is necessary for every good and elegant product to keep in consideration the errors that can be committed by the user. This is a pre-emptive measure that has to be taken into account while designing any product. Hence in the chair we need to look at the errors that the user may commit. For instance, the user may slip forward or backward due to the lazy or unconscious movement of the legs. Hence the legs of the chair should be oriented in such a manner that they should not slip owing to force applied unconsciously by the user's leg.

Moreover the user has this tendency to move forward or backward the chair to get in contact with a table of any object. Hence t is important that movement of the chair should be permissible in certain directions so as to provide comfortable usage of the chair. The plots of the data obtained from the survey questionnaire and the analysis that covers the inferences. The plots have multiple and different variable on either axis which is mentioned clearly below the respective plots.

2. Methodology

The survey was conducted on a group of people of cultural and geographical diversity. The group also belonged to different age groups. The questionnaire was handed over to them and they were requested to fill the questionnaire in their convenient time. It was also taken into consideration that some questions might intrude into their personal spaces or private lives. Hence, they were instructed not to attempt such questions and report these questions to the survey conductors. However during the course of the survey no such report was made and people were comfortable to answer all the questions.

After the survey results were obtained the data was input in the excel sheets and was analyzed. The different parameters mentioned in the questionnaire were looked upon carefully. The parameters that were relevant to the study were considered for drawing out plots. These plots would help us to understand the relationships between the different parameters of the study. From these relationships inferences can be drawn out which would later then help to deduce the design principles that are to be used while designing the chair. To decide which parameters are relevant, firstly, graphs are drawn at random. These random graphs are then looked into to see whether there are any patterns or not. If any pattern is present then the relationship is studied closely and inferences are drawn out accordingly.

Moreover, the characteristics of the Smart city that were defined by the Government of India are also looked upon carefully. It is upon these principles that the characteristic of Smart Furniture needs to be developed. For instance, the government plans to develop Smart energy that is green and clean. Now the term green means that it does not cause harmful effects on the forests or on the ecosystem. The energy that will be produced will take into consideration the environmental impact of the energy generation process. Similarly, the term clean means that there would be negligible and minimal pollutants that will be emanating from the energy generation process. Energy generation, from coal, produces pollutants of different kinds. These pollutants have harmful effects on human beings and on the surrounding environment. The aim of Smart Energy is to develop energy generation methods so that these pollutants can be minimized. The government also plans to develop smart governance where the interaction between the government officials and the public is very transparent and the government is conveniently accessible. This means that the government should be more public-friendly and the relationship of the government and the public should be brought closer and closer. Moreover, the activities of the government should be transparent. This means that all the activities that the government does and performs should be visible to the public so that the public could take note of it and report inconsistencies or irregularities if it notices any. The above observations help to infer certain characteristics that the Smart Furniture should have. It should be green, that is it should not preferably use wood, clean, the material used should not be a causant agent for pollutants in the atmosphere and be user friendly that is it should maximize the comfort level of the users.

2. Methodology

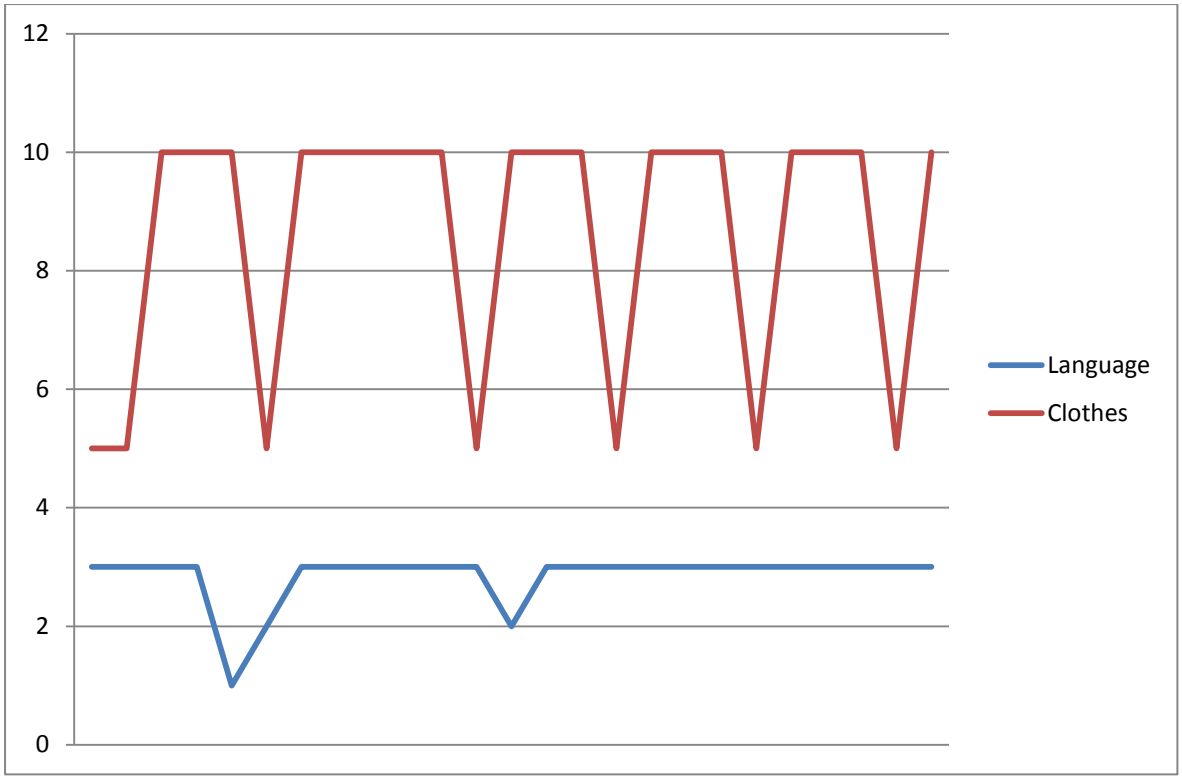

Figure 1: Language and Clothing Preferences

The x axis in the above plot is the sample space consisting of people as sample points. The y axis represents numbers that have been allocated to the variants of the parameters, language and clothes. 1 on the y axis represents the language 'English', 2 represents the language 'Hindi' while 3 represents other languages. Similarly, 5 represents western clothing preference and 10 represents traditional clothing preference.

The plot seems to quite variable in nature with the lines having sharp variations. Although traditional clothes occupy most of the space, they are not consistent in their graph and the graph keeps on coming down to the western axis. In the language line we observe that the line is fairly straight for a lot of time and then it digresses down a bit. The graph seems consistent with few indentations pointing downwards.

The above observations have given us certain inferences. Firstly, in the southern region western attitudes and preferences have had little influence. This is owing to the fact that people majorly prefer traditional clothing over western clothing and people tend to use their native language instead of English. Moreover, there is a scarcity of Hindi speakers in the southern region of the country. This tends to the fact that strong nationalistic feelings should not be that dominant in this region. The language seems to be highly consistent and the states in these regions can be said to have been formed on linguistic basis and hence can be thought of has having strong regional feelings. This could be a reason why the western attitudes and mindsets have not had much influence in this region.

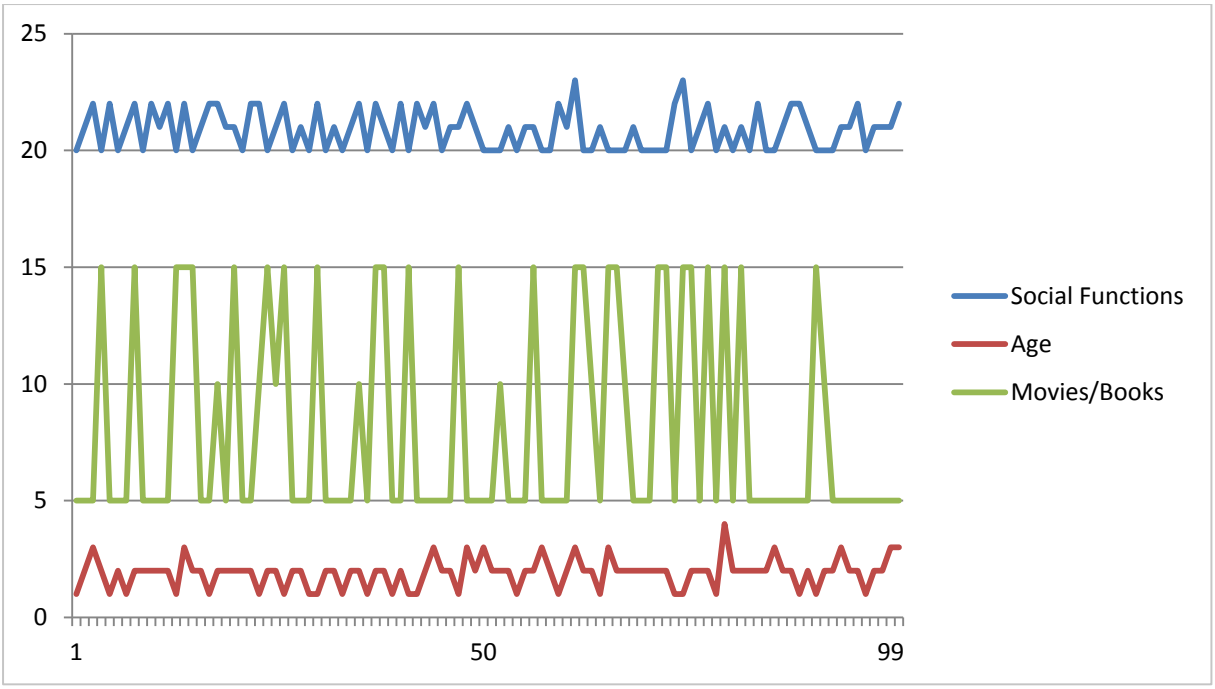

Figure 2: Age Group, Social Activities and Reading Preferences

The x axis in the above graph represents a sample space consisting of sample points as individual people. The numbers in the y axis represent the variants of the parameters that have been mentioned. 1 represents the age group '<20', 2 represents the age group '20-30', 3 represents the age group '30-50' and 4 represents the age group '>50'. Similarly, 5 represents fantasy, 10 represents historical nonfiction while 15 represents other genres of books. 20 represents the idea of attending social functions often, 21 represents the idea of attending social functions very often, 22 represents the idea of attending social functions rarely and 23 represents the idea of attending the social functions very rarely.

All of the three line graphs are very randomly distributed. There is lack of uniformity in the graph as the lines are having variable and sharp indentations. The lowest line graph that denotes the age group suggests that there is an element of heterogeneity in the sample space as the line has many indentations and curves. The second curve gravitates always at 5. It is inconsistent as it has many uprisings at regular intervals. The third curve is the most random and sporadic as it varies continuously across the axis.

The above observations lead us to certain crucial inferences. It is seen that people, irrespective of the age group are gravitated towards fantasy books and movies. This is a daily observation as fiction is always on a high demand. However, we cannot conclude conveniently because there are people who are read and peruse books of other genres including history and nonfiction. On the side of the social interaction it can be safely concluded that the degree of social engagements do not depend upon the age groups above twenty, and varies quite randomly across the sample space of individuals. This also states the independence of the degree of social engagements upon other factors.

2. Methodology

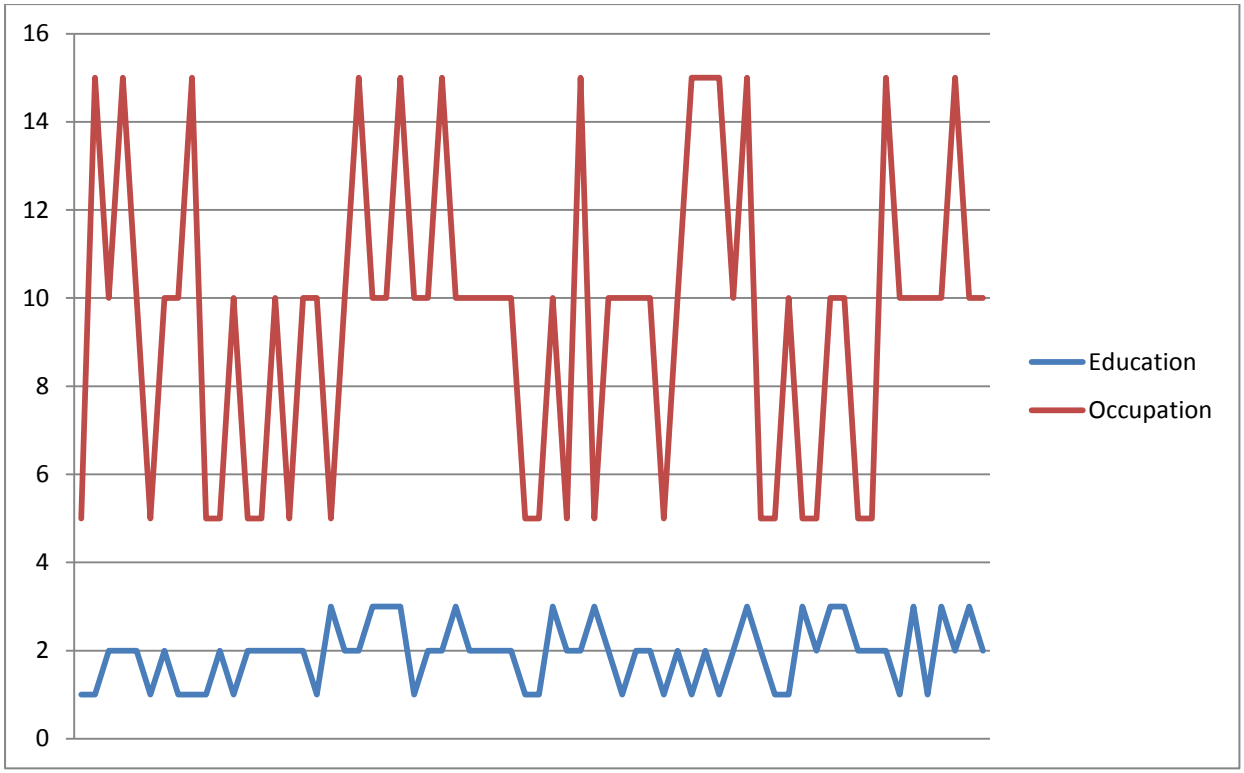

Figure 3: Education and Occupation of Male Population

The x axis in the above graph represents a sample space consisting of sample points as individual males. The numbers in the y axis represent the variants of the parameters that have been mentioned. 1 represents the educational group post graduates, 2 represents the educational group some graduates, 3 represents the educational group all graduates. Similarly, 5 represents a corporate job, 10 represents a government job while 15 represents a business.

The two line graphs are very randomly distributed. There is lack of uniformity in the graph as the lines are having variable and sharp indentations. The lowest line graph that denotes the educational group suggests that there are people in the sample with substantial educational prowess. The first curve gravitates on the educational group of 'some graduates'. The second curve gravitates always at 10. It is inconsistent as it has many uprisings and also lowly regions at regular intervals.

The above observations lead us to certain crucial inferences. It is seen that males are educated at least at the graduate level. This observation corresponds to the fact that nowadays the educational standards in the country have risen and males are motivated to study further. The occupation is not correctly in sync with the educational backgrounds. There are post graduates who are into business and there are postgraduates who are into the corporate sector. There are similar randomized relationships between other educational groups and occupations. We can here conclude that education is not the prime decider of the occupation.

2. Methodology

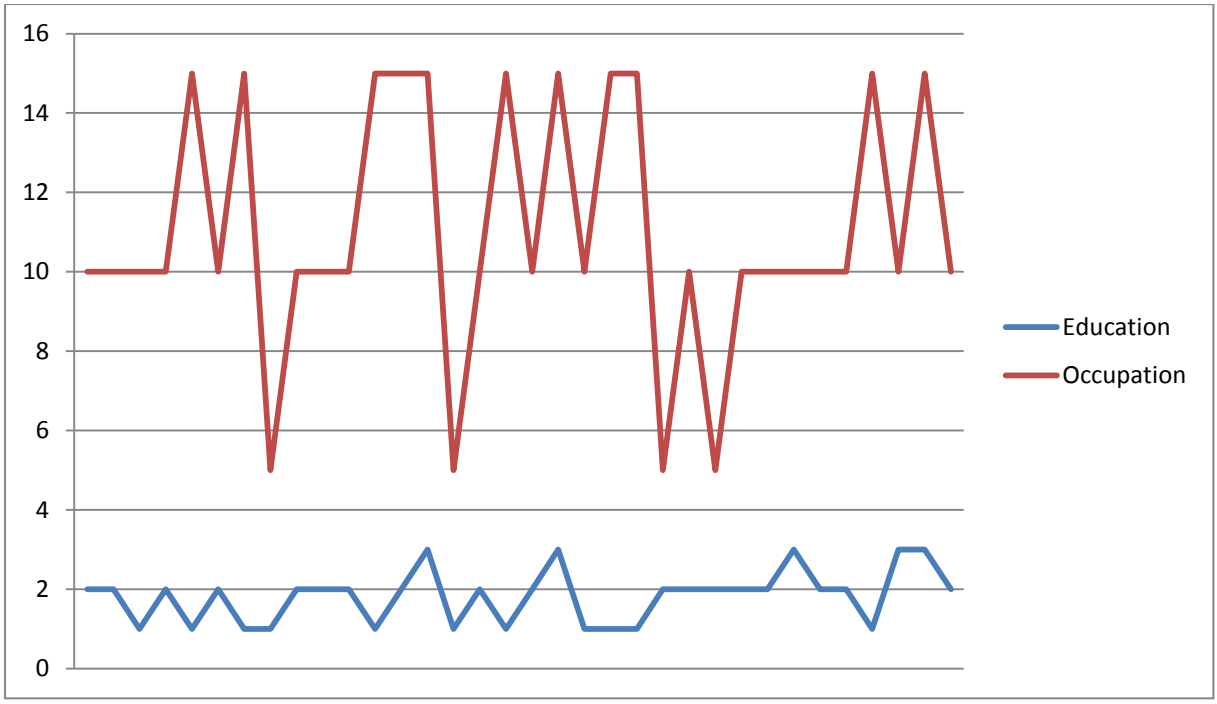

Figure 4: Education and Occupation of Female Population

The x axis in the above graph represents a sample space consisting of sample points as individual females. The numbers in the y axis represent the variants of the parameters that have been mentioned. 1 represents the educational group post graduates, 2 represents the educational group some graduates, 3 represents the educational group all graduates. Similarly, 5 represents a corporate job, 10 represents a government job while 15 represents a business.

The two line graphs are very randomly distributed. There is lack of uniformity in the graph as the lines are having variable and sharp indentations. The lowest line graph that denotes the educational group suggests that there are people in the sample with substantial educational prowess. The first curve gravitates on the educational group of 'some graduates'. The second curve gravitates sometimes around 10. It is inconsistent as it has many uprisings and also lowly regions at regular intervals.

The above observations lead us to certain inferences. It is seen that many females are educated at least at the graduate level. However, this is not directly corresponding to the recent studies that suggest lower literacy rates amongst women. The occupation is not correctly in sync with the educational backgrounds. There are post graduates who are into business and there are postgraduates who are into the corporate sector. There are similar randomized relationships between other educational groups and occupations. However, we do see a slight inclination of women towards government jobs as this provides the much needed job security for women. This is in correspondence of the fact that certain state governments have provided reservations for women in their jobs so as to provide households with a job security. Hence we can conclude that the feminist ideology is gaining ground in parts of the country.

2. Methodology

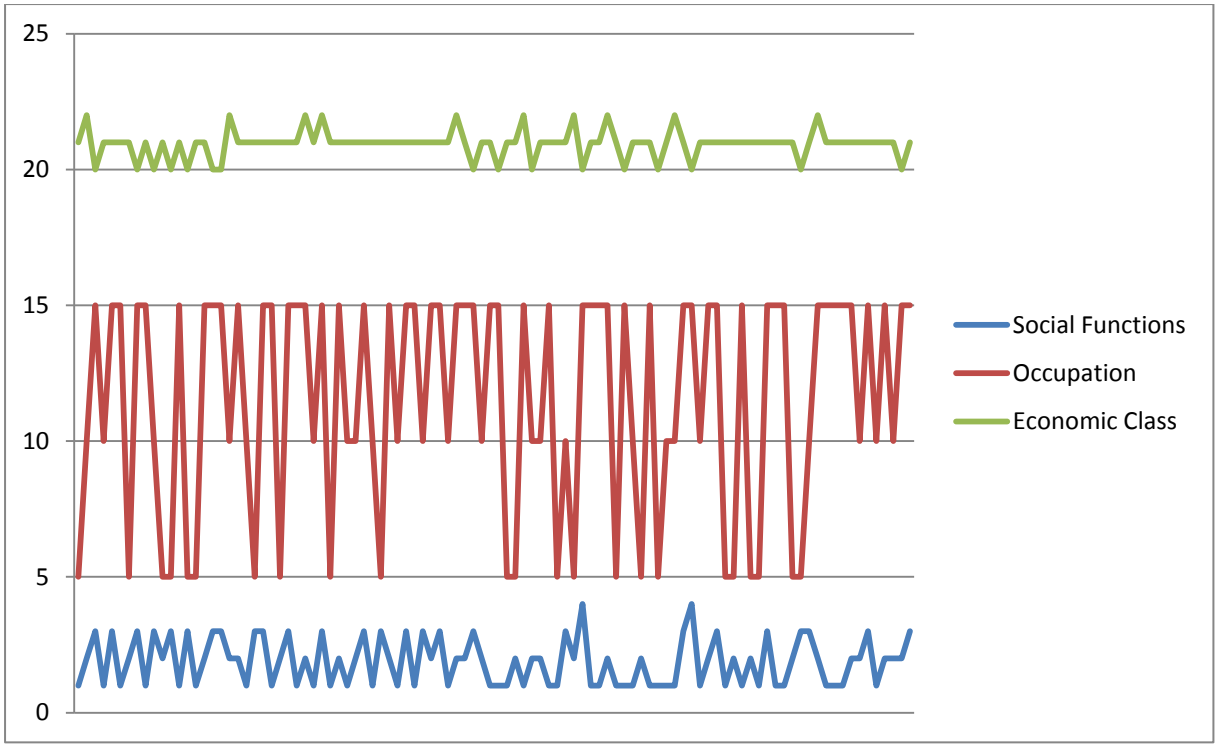

Figure 5: Occupation, Economic Class and Social Activity

The x axis in the above graph represents a sample space consisting of sample points as individual people. The numbers in the y axis represent the variants of the parameters that have been mentioned. 1 represents the group that represents attends social functions often, 2 represents the group that attends social functions very often, 3 represents the group that attends social functions rarely and 4 represents the group that attends the social functions very rarely. Similarly, 5 represents a corporate job, 10 represents business while 15 represents a business. 20 represents the section of lower middle class, 21 represents the section of upper middle class, and 22 represents the rich class.

All of the three line graphs are very randomly distributed. There is lack of uniformity in the graph as the lines are having variable and sharp indentations. The lowest line graph that denotes social engagements of the people shows randomness in its highest degree. The second curve is also dynamic and it keeps on moving around the three magnitudes or the variants of that particular parameter. The third curve is also random but least of the above two. The third curve moves around 21.

This plot draws out certain inferences. The social engagements of the people are neither dependent upon the income of the people nor their profession as such. The argument that a social engagement of people is an independent variable gets strengthened in this context. Moreover, a particular profession does not guarantee a singular and a common level of income as seen in the graph. This is in correspondence to daily observations that people belonging to the same profession belong to different stages of the economic ladder of the society.

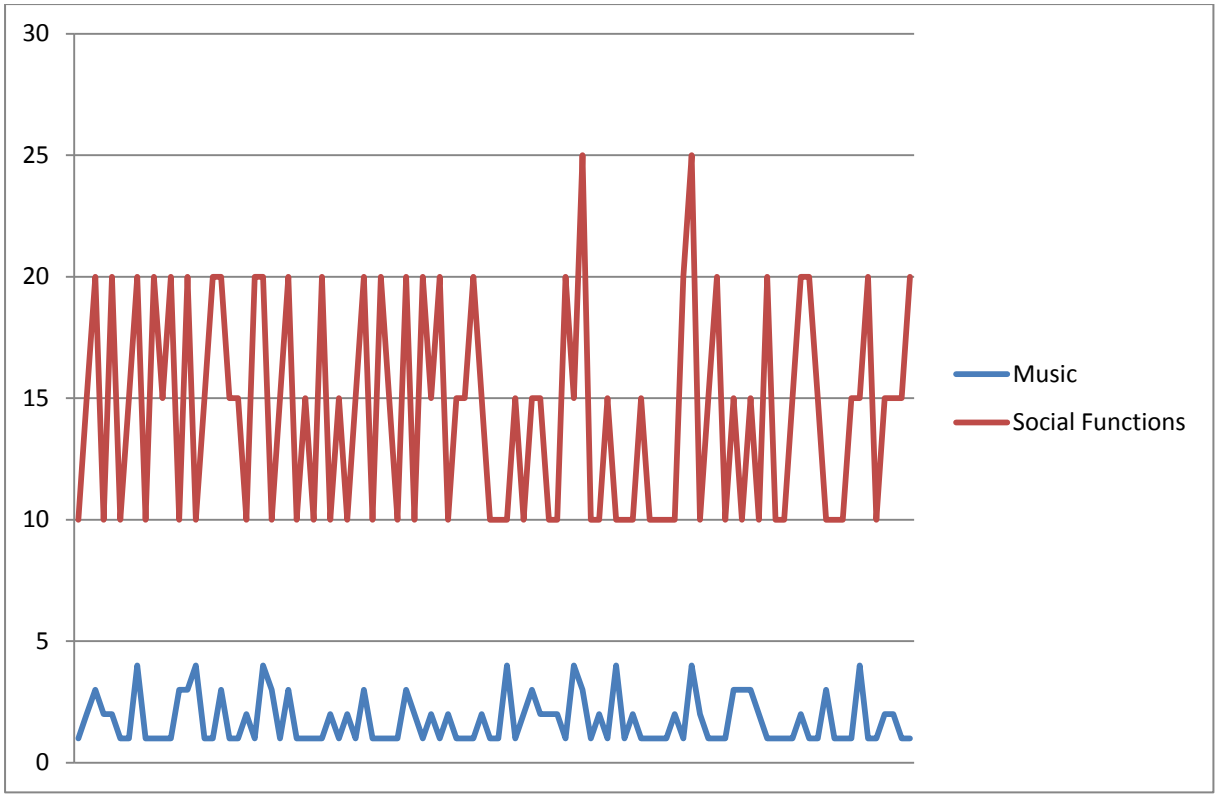

Figure 6: Music Preferences and Social Activity

The x axis in the above plot is the sample space consisting of people as sample points. The y axis represents numbers that have been allocated to the variants of the parameters, social engagements and musical preference. 1 on the y axis represents film music, 2 represents the language classical music, 3 represents folk music while 4 represents music of other genres. Similarly, 10 represents the group of people who attend social gatherings often, 15 the group which attends social gatherings very often, 20 the group which attends social gatherings rarely while 25 the group which very rarely attends social gatherings.

The two line graphs are very randomly distributed. There is lack of uniformity in the graph as the lines are having variable and sharp indentations. The lowest line graph that denotes musical preferences of the people shows randomness in its highest degree. The second curve is also dynamic and it keeps on moving around the three magnitudes or the variants of that particular parameter.

This plot draws out certain inferences. The social engagements of the people are neither dependent upon the income of the people nor their profession as such. The argument that a social engagement of people is an independent variable gets more strengthened in this context. Moreover, the music preferences vary across the x axis. As a result it can be concluded that it would be very difficult to characterize any specific genre of music for any particular group of people. People from different age groups prefer the same genre of music while people from the same age group prefer the same genre of music. Hence it is very difficult to characterize.

2. Methodology

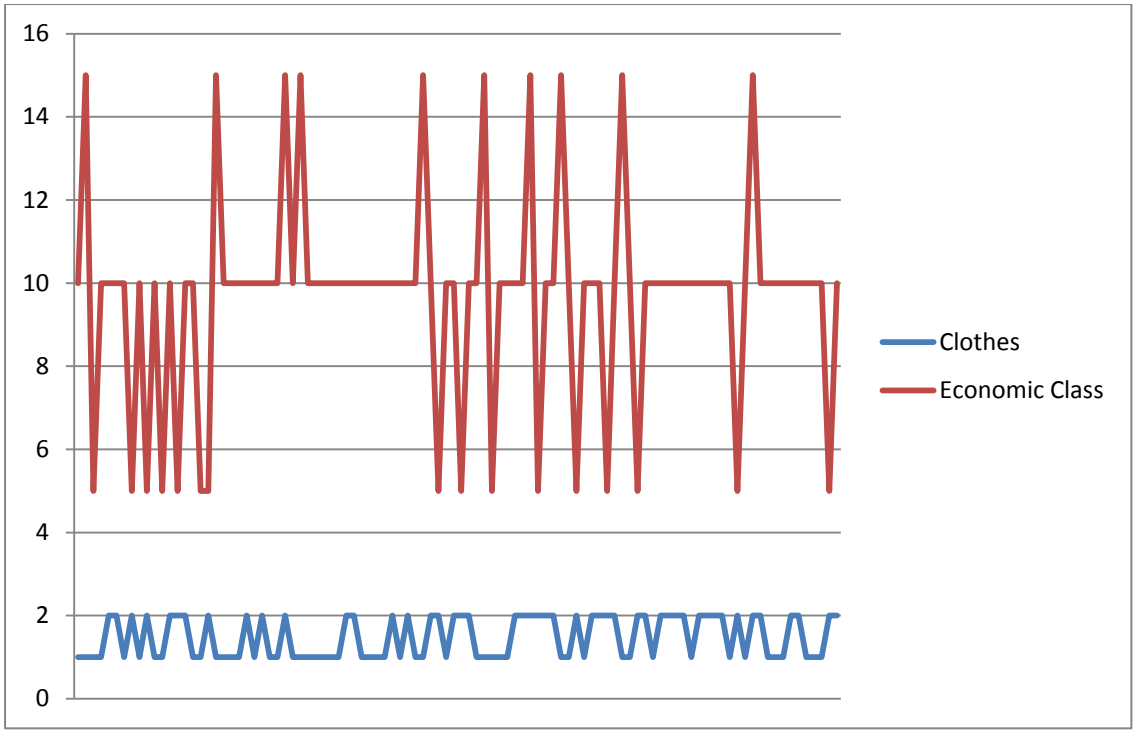

Figure 7: Economic Class and Clothing Preferences

The x axis in the above plot is the sample space consisting of people as sample points. The y axis represents numbers that have been allocated to the variants of the parameters, the clothing preferences and the economic class. 1 on the y axis represents the group which as western clothing preferences while 2 on the y axis represents traditional clothing preferences. Similarly, 5 represents that group that belongs to the lower middle class of the society, 10 represents the group that belongs to the upper middle class of the society and 15 represent the group that belongs to the rich class of the society.

The two line graphs are very randomly distributed. There is lack of uniformity in the graph as the lines are having variable and sharp indentations. The lowest line graph that denotes clothing preferences of the people shows randomness in its highest degree. The second curve is also dynamic but is stable at certain regions in and around the value 10.

This plot draws out certain inferences. There is no strict one to one relationship between the economic class of people and their clothing preferences. It is seen that people irrespective of their positions in the economic ladder randomly choose between traditional and western clothes. Moreover, the economic class of the sample space also varies across the axes. However, the graph stabilizes around the group of upper middle class people. As a result we can conclude that there is lack of any kind of concrete evidence of any kind of correlation between the economic ladder people belong to and the clothing preferences that they have. The same was also ascertained in some of the inferences form the above graphs.

2.2 Inferences from the collected data

From the analysis provided above we can obtain several inferences. Firstly, irrespective of region, gender or age group people are inclined towards using western clothes over traditional clothes. Although this is not directly reflected upon the data that is collected, but it is clearly noticeable in the preferences of books and movies. This suggests that in spite of strong traditional and conservative roots western cultures, attitudes and preferences have proliferated into the Indian society which is clearly reflected in the data. This is also reflected in the kind of music people enjoying listening to. The dominant element remains the Indian film music which is again infiltrated by the western cultures. Hence from the above findings we can conclude the presence of strong western feelings and attitudes in the groups belonging to the Indian society.

People, irrespective of their economic class or their occupation tend to engage in social interactions often. This was the observation in the data that people are more inclined to attend social gatherings often. It can be deduced from here that people are much more concerned about their social status nowadays. One of the reasons why people so often attend the social functions is to solidify their image in the social sphere. People irrespective of region or any other factor like to show off their possessions in order to gain the desired respect and the admiration form the society. On top of that the educational backgrounds of people are getting richer day by day. This factor has brought significant changes in the pattern of thinking that people have regarding pricing their possessions. People are much more concerned about the brand and the utility value of the gadgets that they buy and have because they think of it as a part of their identity.

Finally the products need to be smart. This idea is in direct correspondence with the idea that it is being built for a smart city. The government has defined several parameters for smart city, such as smart energy, smart transportation, smart communication, smart governance et cetera. Each of the above parameters was described using unique characteristics for each of them. The idea of a smart product can be inferred from the above characteristics. For instance, the government wants to develop very strong feedback mechanisms for many of the parameters. This means that products and services need to be extremely user friendly and redressal systems should be efficiently designed to solve issues of products at the user level. The user must not find it inconvenient to handle the product or any kind of difficulty in solving an issue with the product.

The smart cities are also concerned with optimization. This relates to the fact that the requirement is maximum utility from minimal number of resources. In each of the mentioned parameters it is mentioned that there should be high efficiency in the working capacity. The product should be concerned with its utility and its aesthetic value, as both are requisites for optimal performance. Optimizing of a product involves increasing the utility value of a cost while keeping the price level and the aesthetic value, or the appearance of the product, at a constant value.

2.3 Design Principles from inferences

The analysis of the data collected through the survey questionnaire and the analysis of the characteristic features of the Smart Cities as defined by the government has given us certain inferences. Now, these inferences should be used to develop the design philosophy of the smart furniture. This is to be done by understanding the inference and abstracting these inferences into design so that the product reflects each of the inferences. The design principles should have correspondence with each of the inferences.

Firstly the product needs to be smart. The word smart can have numerous and multifaceted interpretations. However, going as per the analysis performed, smart can refer to improved utility and enhanced aesthetic value. Although this definition constricts the meaning of the term smart, this definition is adequate and sufficient to work upon the design principles. Improved utility means improved performance. The design should not overlook or neglect the functioning of the product which should be its primary and objective goal. The term improved refers to the increase in the efficiency of the product. Moreover, the aesthetic value of the product should increase. This means that it should look attractive. The design should be in such a way that it should stand out from rest of the products in the vicinity. This can be achieved by application of novel ideas in the design. The idea should necessarily break the conventional rules of thumb of working and aesthetic setups. The product, in order to achieve this feat should be an ‘out of the world’ product. The design should not conform to orthodox principles of design using lines, forms, shapes which have been used over and over in all kinds of products.

Secondly, the design should be westernised. This means that it should involve tastes of the west. The colours, lines and textures should have a universal language to which it can communicate. This is to satisfy the inference that western cultures have proliferated into all parts of the country irrespective of cultural and other factors. As a result traditional designs are gradually losing value and are now evolving into different forms that incorporate western design ideas and philosophies into them. This has motivated designs to concentrate on the western way of doing things. The shape and the structure should necessarily be given a western look and appearance.

Thirdly, the design should be elegant. Elegance comes from simplicity in its use. In the world of all kinds of complicated things, simplicity has its value. People are much inclined to stay away from complicated things and mechanisms. Recent studies have shown that making choices out of many options requires quite significant cognitive effort and people tend to stay ways from them. Technologically heavy products come with sophistication and require considerable mental load to be operated. The smart furniture should be designed in such a manner that the least amount of mental and physical workload should be required to operate or use the product. The mechanisms used should be simple and easy to comprehend while the products should not be intimidating in its outlook.

2.4 Concept Development

2.4.1 Smart Furniture: Chair

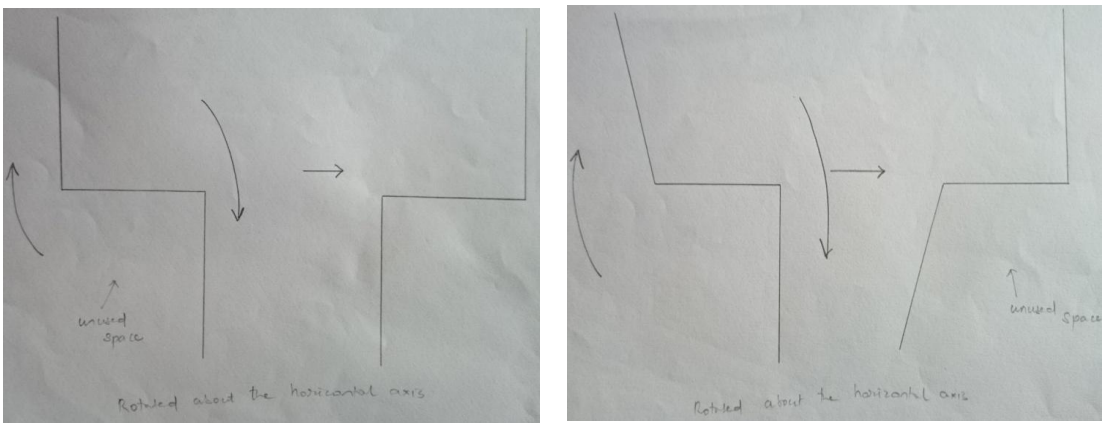

Figure 8: Space Constraints in a Chair

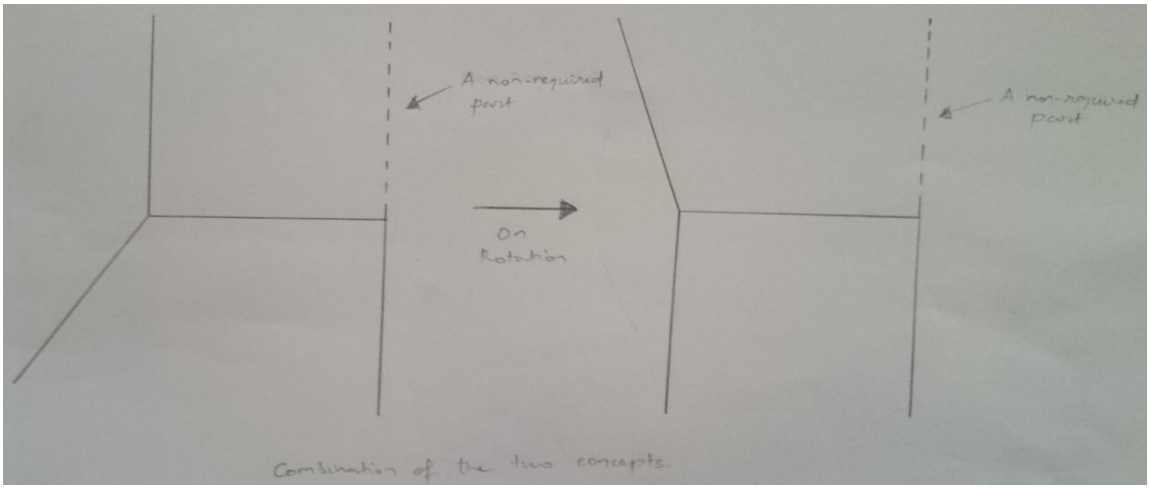

Figure 9: Effect of Rotation

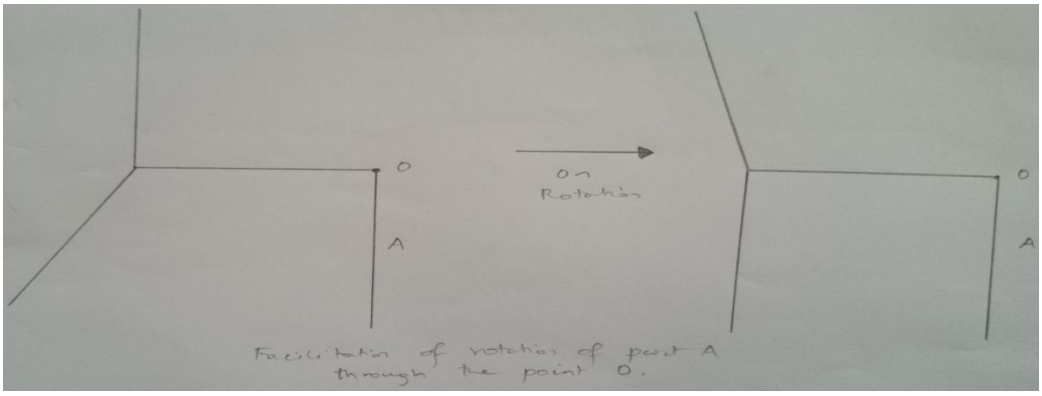

Figure 10: Removal of additional Part

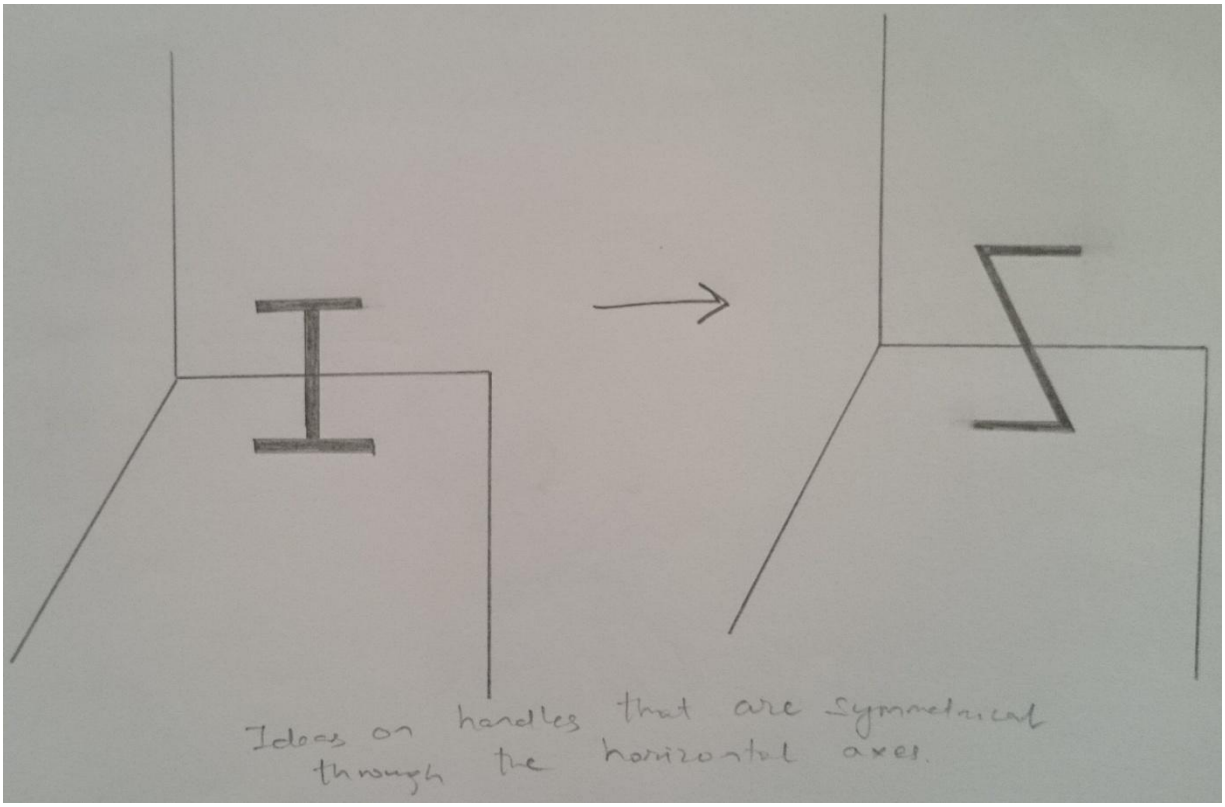

Figure 11: Handles

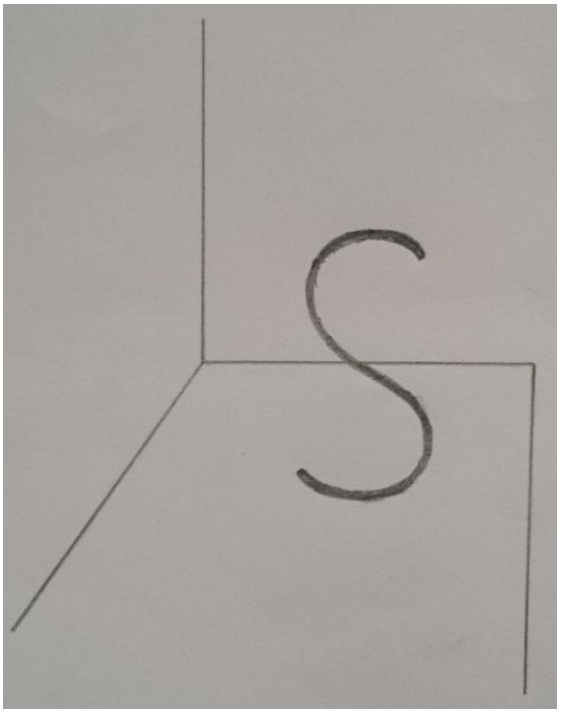

Figure 12: Side View of the Chair

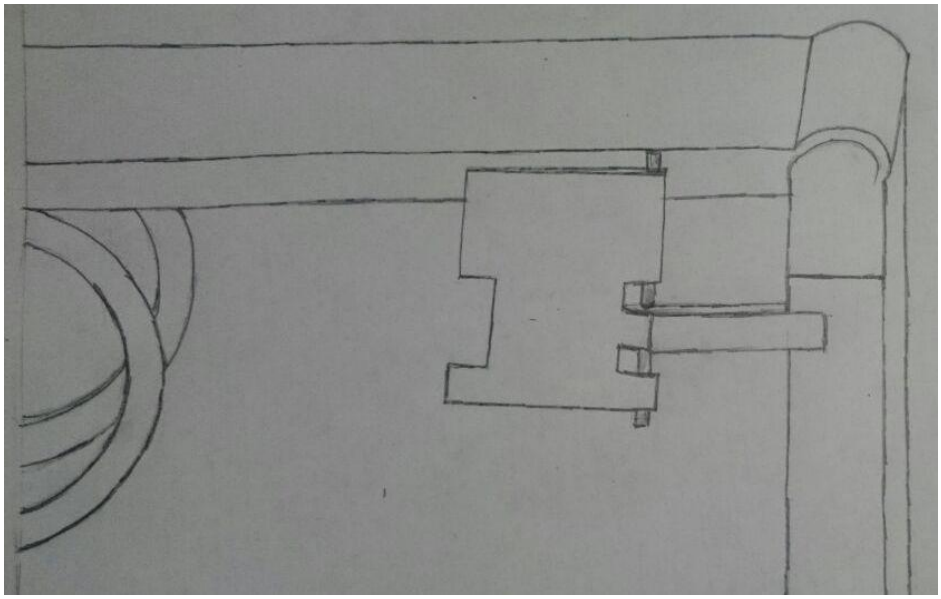

Figure 13: View of the Fixing Mechanism

The above are the concept sketches for the design of a chair. Figure 8 shows the idea of rotation. This idea comes into the place owing to the fact that in a conventional chair there are unused spaces. These spaces form a hollow cavity which is of no good. This undesirable feature is present in almost every chair. If two chair, having backrests at different angles are combined then there always is present a part which is undesirable and obstructs the act of sitting on the chair. Fortunately, this problem can be resolved by allowing movement of one of the supports of the chair. The support that is way from the backrest can be allowed to move around its joint. If this movement is allowed, then this support can also be used if the chair is reversed, that is, there is no need of an additional support which had initially caused an obstruction for sitting. Now, using this principle both the backrests can be used. If the backrests are of different kinds then we can obtain a multipurpose chair from a single chair.

However, this allowance for movement of one of the supports can cause for some issues. As the support is not rigid, it is free to move in any direction that is forward or backward. Both of these movements need to be stopped. The backward movement can be stopped by using rubber stoppers or using stoppers of any kinds. The forward movement needs to be stopped using a single mechanism. This mechanism involves using a pin to lock the support firmly on its joint. This is a rigid mechanism and would not allow the movement of the support in any direction whatsoever. For comfort purposes, the backrests on both the sides of the seat have elastic sheets that can take any shape as per the requirement of the user. Given below are the diagrams of the chair in the two orientations.

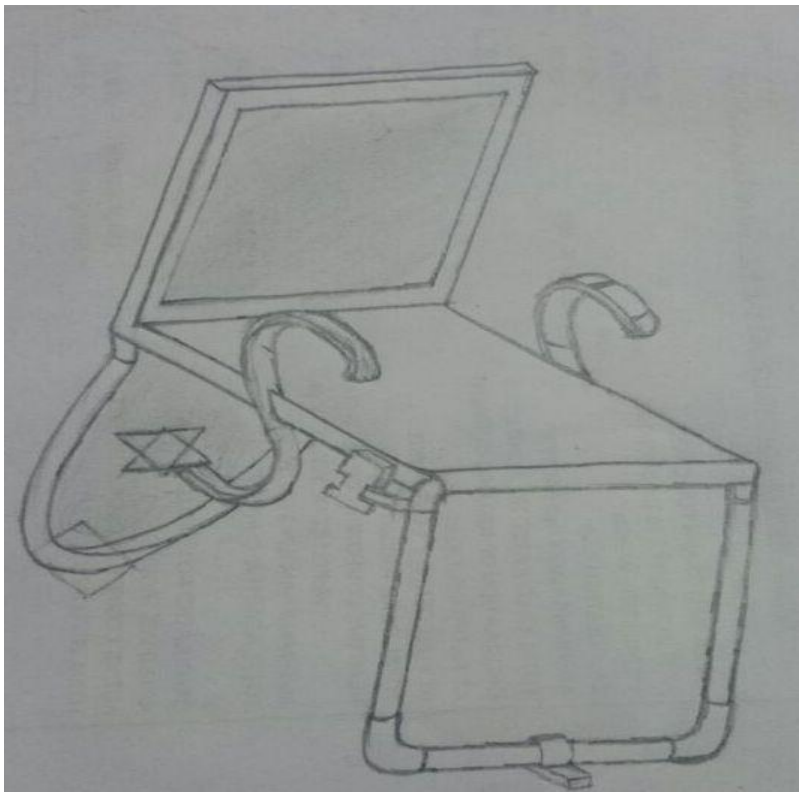

Figure 14: Side View of the Chair

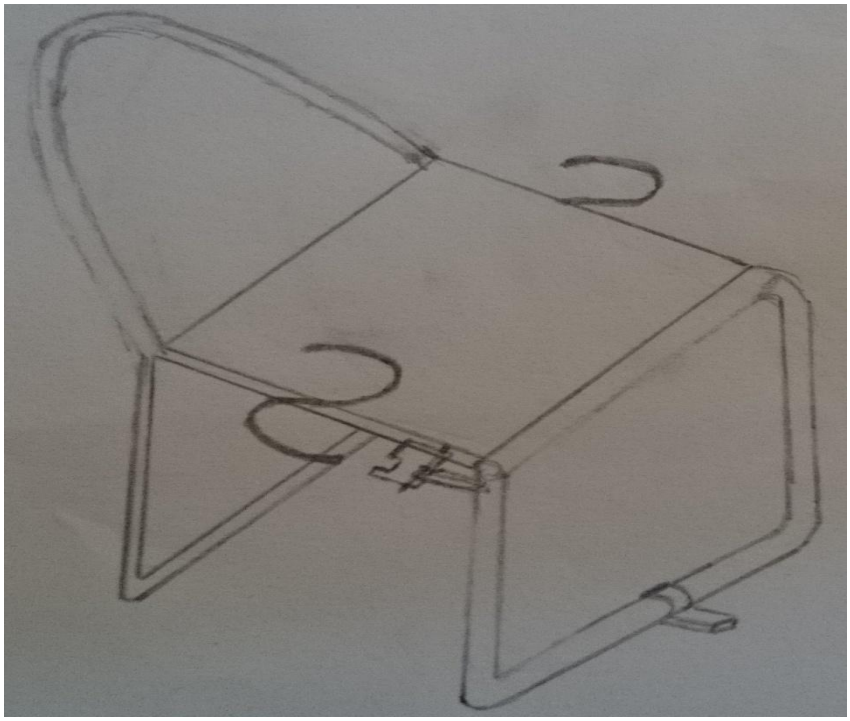

Figure 15: Chair in the Opposite Orientation

2.4.2 Smart Furniture: Bed

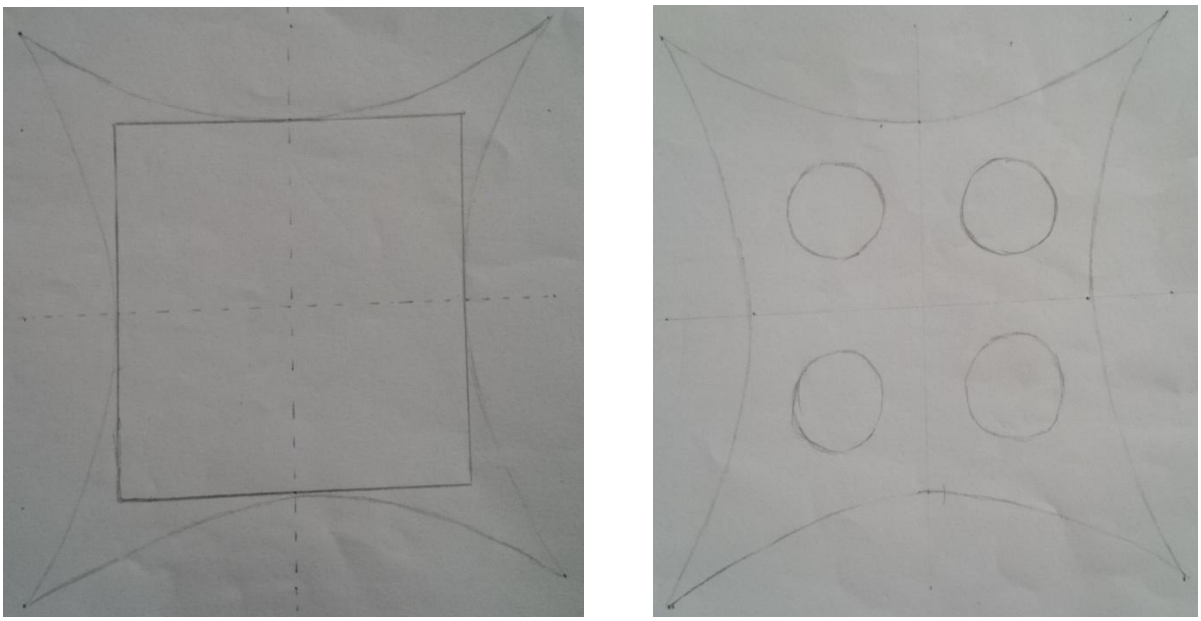

Figure 16: Top and Bottom view of the bed

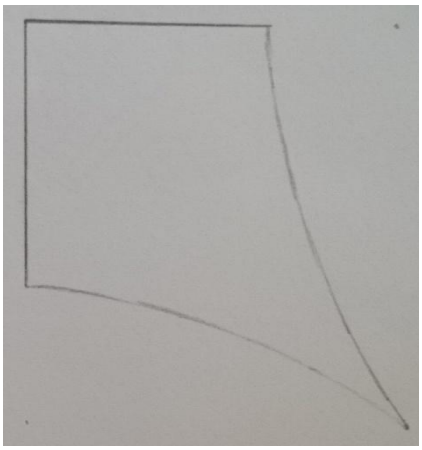

Figure 17: The Single Part of the Bed

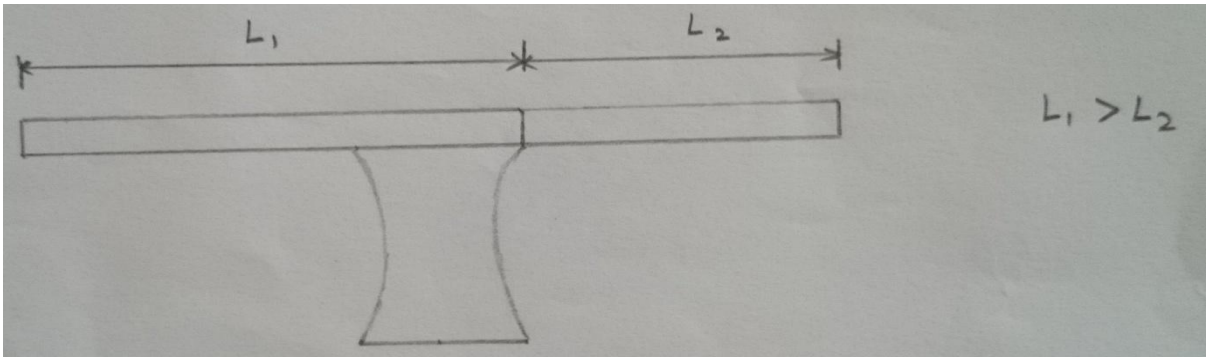

Figure 18: Side View of the Single Part

2. Methodology

Beds form an important part of furniture. It is always in demand in the market in which it is available in numerous different forms, shapes and sizes. However, with the idea of smart furniture certain problems and issues with the existing designs of the bed can be solved. The space complexity, present with the chairs is also present here. There is space which acts as hollow dimension and does not allow for any productive usage. Another complexity that we have is that of displacement. When people move from one place to another they need to get their things displaced. Beds many times are a cause of trouble because during displacement they have to be dislodged and then carried and again set to form. This is a tedious process and is prone to errors.

The smart bed, a part of smart furniture is elegant in its look while having four petals protruding out thus providing a very good top view. This is away from the conventional settings of having beds that are square or round in shape. Moreover, this has got a utility value. The parts that are protruded are to be used for keeping accessories. Normally beds have this facility right near one's head that is difficult to access as the required body movements are very constraining. In order to get around this problem, the portions of the bed that facilitate the keeping of the needed accessories are designed to be placed somewhere beside the sleeping area so as to facilitate the easy accessibility of the needed materials.

The smart bed also has one more interesting and attractive feature. The bed can be divided into four parts along the line of symmetries right across the beds. This provides a convenient way of dislodging and recombining the parts of the bed. These are much easier to transport and displace as the parts are small and can be even carried single. Moreover, the bed can be used for other purposes. For instance the four parts that can be dislodged and then connected back again can be used as sofas. Hence, with the use of an appropriate mattress the bed can e used as a conventional bed for sleeping as well as the bed can be used for making four sofas. This is convenient and not tedious as the four parts can be dislodged easily and can be displaced to another room with no difficulty.

This design is necessarily western. The colours, lines and textures have a universal language to which it can communicate. This is to satisfy the inference that western cultures have proliferated into all parts of the country irrespective of cultural and other factors. As a result traditional designs are gradually losing value and are now evolving into different forms that incorporate western design ideas and philosophies into them. This has motivated designs to concentrate on the western way of doing things. Moreover, people are much inclined to stay away from complicated things and mechanisms. Recent studies have shown that making choices out of many options requires quite significant cognitive effort and people tend to stay ways from them. The smart furniture should be designed in such a manner that the least amount of mental and physical workload should be required to operate or use the product. This design of the bed is simple and elegant and does not require sophistication in any form to be understood or to be worked upon.

2.4.3 Smart Furniture: Table

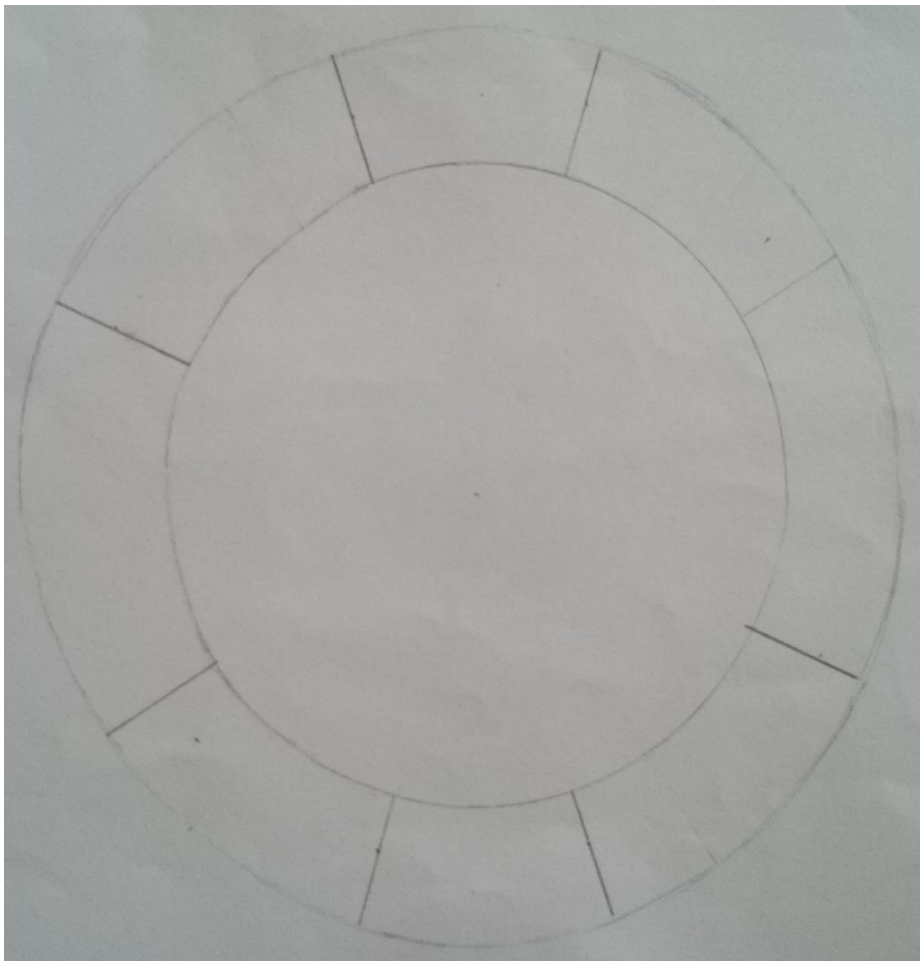

Figure 19: Top View of the Table

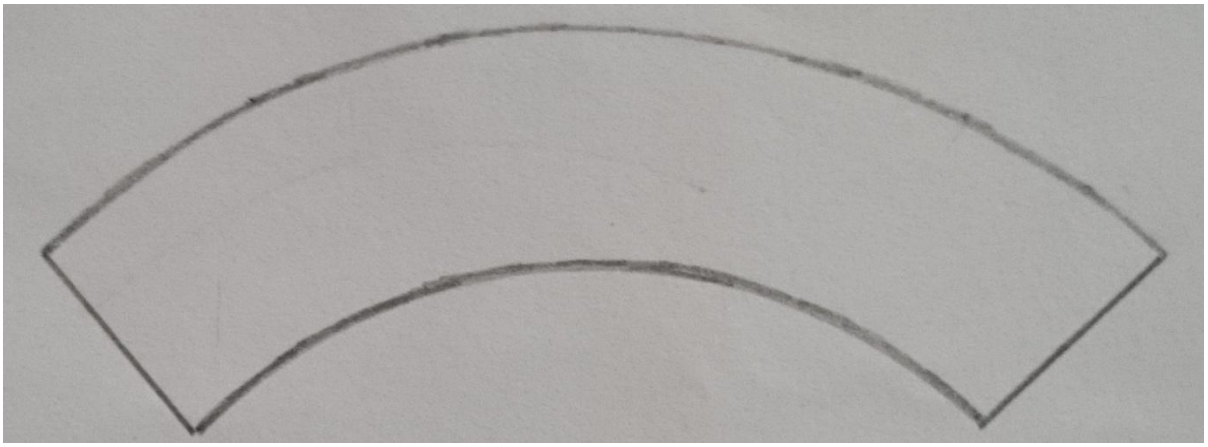

Figure 20: A Single Part of the Table

Tables are also an important part of the furniture. Tables are used in multiple settings such as a study table, for eating, and for work. As table is widely used and is vital part of the lifestyle it is important for us to define smart tables for smart cities accordingly. As by the logic of chairs and beds, tables too are a part of the identity of any house, office or any building. They are important in shaping and building up the idea of smart furniture.

In this case, we have taken the instance of a study table. There have been certain minute changes in a conventional study table that has brought about new insights and changes into the holistic structure of the study table. In this case, the study table is designed as an arc which is a part of a bigger circle. Hence this table would not be generally available in a single piece but rather in a bulk. This bulk would consist of several portions, each of them forming a piece if the circle. So, if we use each of the pieces of circle as an individual circle we can have the general classroom arrangement with all the pupils seated in a row facing the blackboard towards the teacher. But if it is decided that the pieces will be joined together to form the circle then the students can sit around the table facing each other and not the teacher. This is an essential part of the chair because this feature is not present in the conventional chairs as the squares cannot be arranged into a circular structure where pupils are sitting across each other.

This design is very simple as we see that a little manipulation in the shape has brought about a good structural change in a holistic way. This is an important feature as this massively improves classroom interaction. In a conventional setting of a classroom pupils sit in rows facing the teacher and the blackboard. It is difficult to look backwards and interact with people who are sitting behind a particular student. This hinders the all important student interaction in a class. Even if a particular teacher wants to have a student – student interaction, he asks them to sit in awkward manners which are not ideal for discussions. This can be prevented by a circular table in which people sit facing each other and need to move to look at other pupils face.

This design is elegant. Elegance comes from simplicity in its use. In the world where there are a lot of complicated things, simplicity has a very high value. People are much inclined to avoid complicated things and mechanisms and are attracted to simple things. Recent studies have shown that making choices out of many options requires quite significant cognitive effort and people tend to stay ways from them. These chairs are just altered in shapes. The alteration is not massive and is just a slight change in the dimension and its shape. However, when a set of chairs is assembled they form an elegant shape which can be used for multiple purposes such as in board room meetings. They can also be used in interviews as they can form a closed structure which is not completely a circle but an arc which is more than a hundred and eighty degrees. It is not mandatory to join all the arcs to form the circle. Any number of arcs can be used to form circular shapes. Moreover, the design can be used in different cases having different number of divisions of the circle. The circle can be divided into any number of parts. Thus, this design concept is simple and elegant for a smart furniture.

3 Results and Discussion

The concepts for smart furniture was developed using inferences from survey data and from the defined parameters. The concepts were sketched out to show the steps and the methods that were used in developing the conceptual models. These concepts included the concept of elegance, western thoughts and showiness. Three products were chosen to develop ideas for these prototypes. There are numerous and various different kinds of furniture that is available today. The other types of furniture that can be built can be made using these same concepts. By using the concept of reducing and reusing space as in the case of a smart chair any other furniture can be built. Similarly, using the idea of dislodging and setting it back, like in the case of bed, varieties of furniture can be developed and worked upon. The ideas should not necessarily be the same. These ideas are the basic and rudimentary ones that need to be developed and worked upon. Some ideas can be discarded off in the face of new and elegant ideas while some other ideas can take the place of other novel ideas. Figures 21, Figure 22, Figure 23 are the three products that are developed using the developed concepts and ideas. They do not represent dimensional accuracy but are conceptual models built out of drawn out inferences. The concepts have been camouflaged in the products. Each product has a set of embedded ideas drawn out from the studies. Each of the products can be termed as smart.

However, these products, or preferably termed as conceptual models, are just designs and not prototypes for manufacturing. These are just design ideas. The conceptual model of the chair shows the shape, size, structure and the mechanism of its parts. It does not show any manufacturing details such as the correct angles, the lengths, and the diameters. The model does not mention the way of joining the parts or its exact function ability. The model also does not mention the materials that are to be used for building the product. The material selection for the particular product needs to be accompanied by other manufacturing specifications and hence it is inappropriate that an incomplete investigation is performed on the material selection. The figures presented below just show the concepts that are developed in building them.

There is scope for further work on this topic. As mentioned earlier, many varieties of furniture are available in the market. Other furniture products can be designed using these concepts. The concepts can be used as they are or can be manipulated and used in combination with other novel ideas. All of them would be the pathway to develop smart furniture. Ideas are infinite. More concepts can also be generated. A more detailed study of the existing smart cities in various different countries can be studied and new concepts can be generated. Similarly, for making concepts more users oriented, surveys can be done extensively at regular intervals to get continuous feedback on the changing trends of the markets. New insights can be developed and new inferences can be drawn. More advanced methods of looking at data can also be developed by using advanced software techniques.

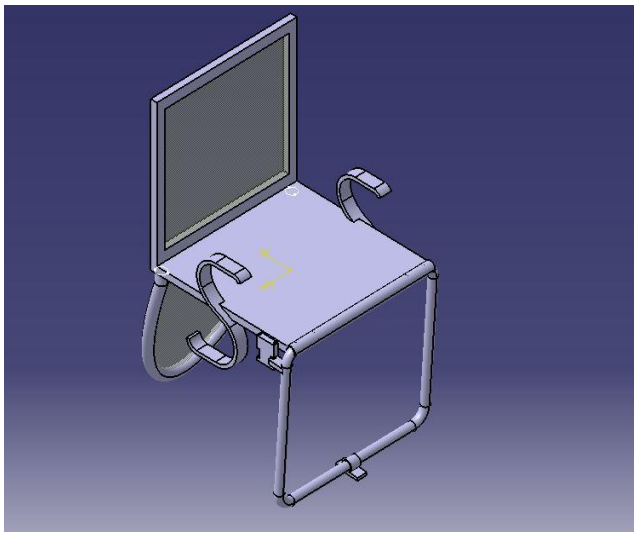

Figure 21: CAD Model of the Chair

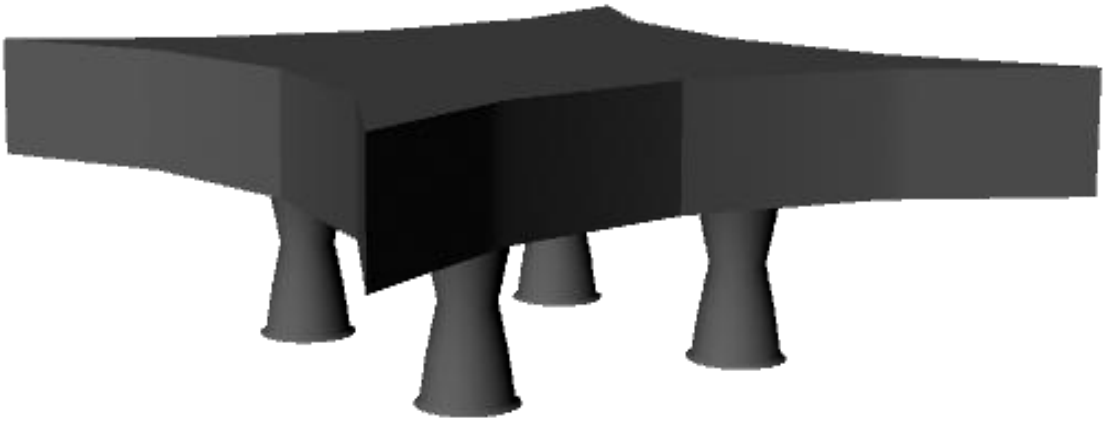

Figure 22: CAD Model of the Bed

Figure 23: CAD Model of the Table

4 Conclusion

This project is about developing conceptual models and ideas on smart furniture. These are developed using the characteristics and parameters that are defined by the Government of India in the context of a Smart city such as smart transportation, smart energy, smart healthcare, smart governance and smart communications. These ideas are closely studied and are analysed. From this analysis crucial inferences are drawn out. In order to make any product more user centric, a survey is also conducted to obtain data regarding user preferences. The data that is obtained is also analysed to draw inferences. By using these inferences as guidelines design principles are formed. These design principles are then used to develop ideas and conceptual models. The conceptual models that are built are that of a chair, a bed and a table. Each of them incorporated the idea of a Smart Furniture. The concept of the Smart furniture on the other hand was developed by the design principles and the analysis that was performed on the existing data and the data obtained from the results obtained from the survey.

5 Scope of Future Work

The design principles that have been deduced and the analysis that had been performed can be used to build and design more products. Furniture is not only limited to a chair, a bed or a table. There are various kinds and types of furniture which can be designed on these guiding principles. For instance, a sofa can be designed keeping in mind the guiding design principles. These design principles are also not limited to furniture alone. The other aspects of the city life can also be designed. For instance, the idea of smart houses or smart construction can also be developed. Moreover, the data can be used to find out new insights. This can be done by re-analysis of the collected data. From this, new perspectives and ideas will emerge. These can then be used to formulate new design principles which can then be used again to develop new concepts and products. A complete new set of design principles can be deduced from the data that has been collected in this study. These design principles will lead to new concepts.

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