Project 3

Memento Mori :
VR Data Visualization of Un-natural Deaths in India

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Interaction Design
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Approval Sheet

The Interaction Design Project III titled
“Memento Mori : Data Visualization of Un-natural Deaths in VR”
by Akvil Sakhare (Roll Number 156330013), is approved,
in partial fullment of the ‘Master in Design’ Degree in
Interaction Design at the Industrial Design Centre,
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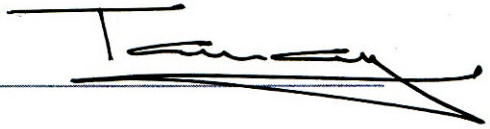
Guide 

Chairperson 

Internal Examiner 

External Examiner 

Date 23/05/17

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I declare that this written document represents my ideas in my own words and where others' ideas or words have been included, I have adequately referenced the original sources.

I also declare that I have adhered to all principles of academic honesty and integrity and have not falsifed any idea/data/ fact/source in my submission.

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Akvil Sakhare
April 2017

Abstract

In last few years Virtual Reality (VR) has experienced advancement after years of hibernation. As compared to traditional mediums of data visualization, VR as a medium is significantly different and the use of VR in data visualisation has not been explored much.

This report explores the process of visualising data in virtual reality by creating a data story by drawing upon various visualisation and design principles in two dimension (2D) and extend them in three dimensions (3D). By using the government data of unnatural death, the design process includes exploring the data, generating design ideas and iterating prototypes to come up with the final design.

The project, deployed as a VR application, is multiplatform and can run as a standalone application or in a web-browser. The evaluation takes into account observations, feedback and suggestions for improvement measuring the impact and fine-tuning the experience.

The project is an example of what is possible. It shows that VR data visualisations aren't inherently intuitive but can make a different sense if delivered by the means of storytelling.

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1. Introduction

1.1 Motivation

In last few years Virtual Reality (VR) has experienced advancement after years of hibernation. Most of these developments are centered around entertainment. VR has been used in media, architecture and even in therapy. But if a medium has to grow it has to be useful in a lot of situations[1]. As a new medium of HCI, use of VR in data visualisation has not been explored much. Being different from traditional and current 2D screen based ways of data visualization, VR seems to be good medium for multidimensional, volumetric, spatial data that can use the quality of immersion which comes with it. But it has issues in Interactions, Ease of navigation, Accessibility, Legibility, Perceptual Accuracy etc.[2] As the medium is new few attempts have been made in VR data visualisation creating a lot of scope for research in this field.

1.2 Objectives

With many constraints and added dimensions of time and space different approaches of data visualisations will have to be tried out before we come up with any specific techniques for the medium. For this reason this project proposes to study interactive data visualization in 3D in a VR tool (like oculus or google cardboard) and come up with some methods to show data best with the existing methods and come up with ideas to best show data in ways we haven't been till now. It also proposes to figure out the kind of data best suitable for the medium and attempt creating data driven stories.

1.3 Approach

Data visualisation is a field with good history and a lot of work has been done in the field. So it makes sense to start with secondary research and understand the essence of visualising data that has been developed over time and with different mediums. After the history and uses are understood, existing methods were reviewed and redesigned so that they become context specific and effective in terms of the kind of datasets and the medium. For this, a set of data that can be effectively represented is found. Then a series of visualisations are created and evaluated for their effectiveness. Once the visualisations are made, they are evaluated and iterated, to get feedback, develop insights and redesign implementing those insights that makes data visualisation more relevant in VR.

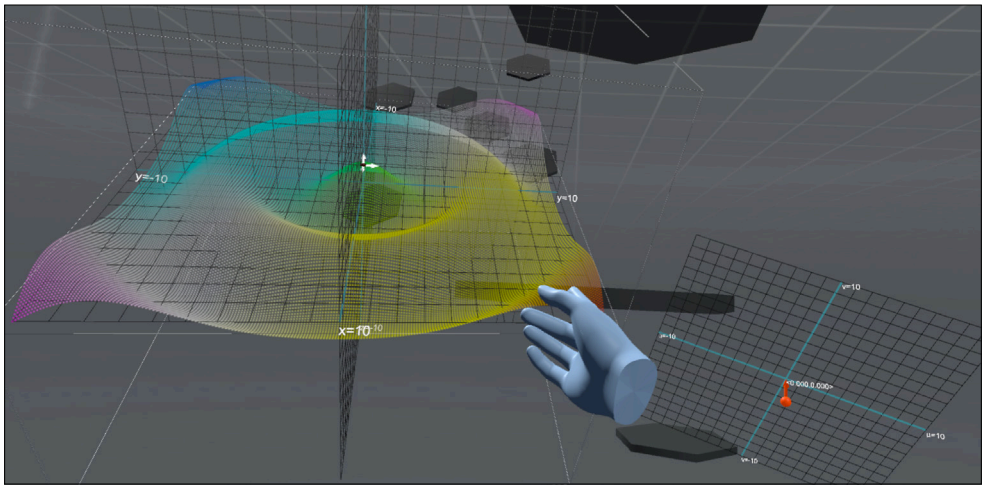
1.4 Outcomes

Following this approach resulted in research on existing methods and charts based on different uses. Documentation of this interactive technology and exploration of methods of dispersing information which is 3d data visualization. Starting with basic visualisation with simple data, the project produced a series of visualisations with increasing complexity and delivered the visualisations as a data story. Deployed as a VR application, the projrct, is multiplatform and can run as a standalone application or in a web-browser.

2. Secondary Research

2.1 Examples

Calcflow lets you,
• Manipulate vectors with your hands, explore vector addition and cross product.
• See and feel a double integral of a sinusoidal graph in 3D, a mobius strip and it's normal, and spherical coordinates.
• Create your own parametrized function and vector field.



Snapshot of Calcflow

DeathTolls
"DeathTolls Experience visualizes the data behind the dead through virtual reality. Every day, countless tragic deaths number reach us through the news. Iranian computer artist Ali Eslami puts the tragedy of the victims in another perspective through his virtual reality experience. He wants to make us aware of the reality that is sometimes overshadowed by big data."
- From the DeathTolls website

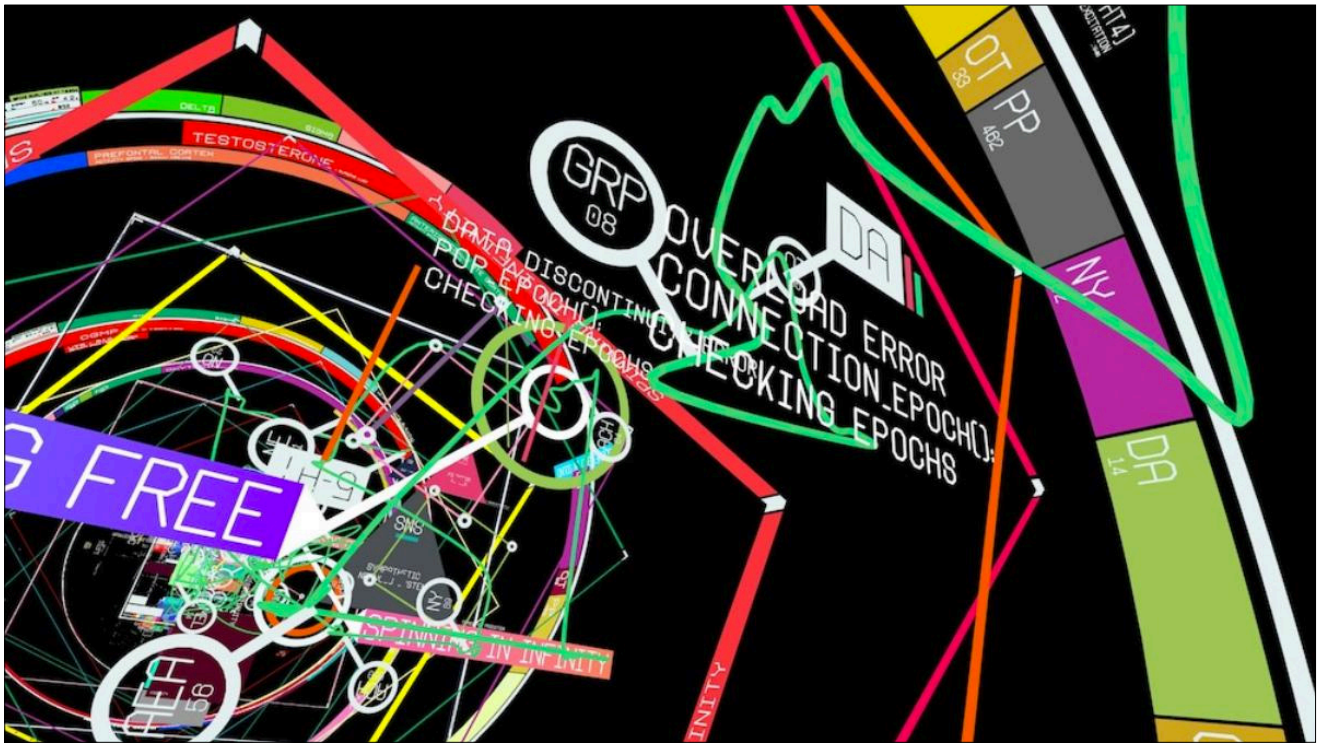
Data here is news headlines as quantities expressed qualitatively. I think, along with representation of data as quantities, VR can be used for immersion and subjectivity to make these quantities into qualities. The deathtroll is a good example because it picked up simple data, news headlines of mass killing, and represented it making use of immersion. It's simple and designed wisely, I like the smart move of using body bags, by skipping the modelling of human figures.

Snapshot of DeathTolls Experience

LoVR

"More than 100000 chemical reactions happen in your brain every second. So what about the moment you saw the girl of your dreams, and she saw you? If we could capture those few seconds what would the data look like? LoVR is a document of this moment."
- From the LoVR website

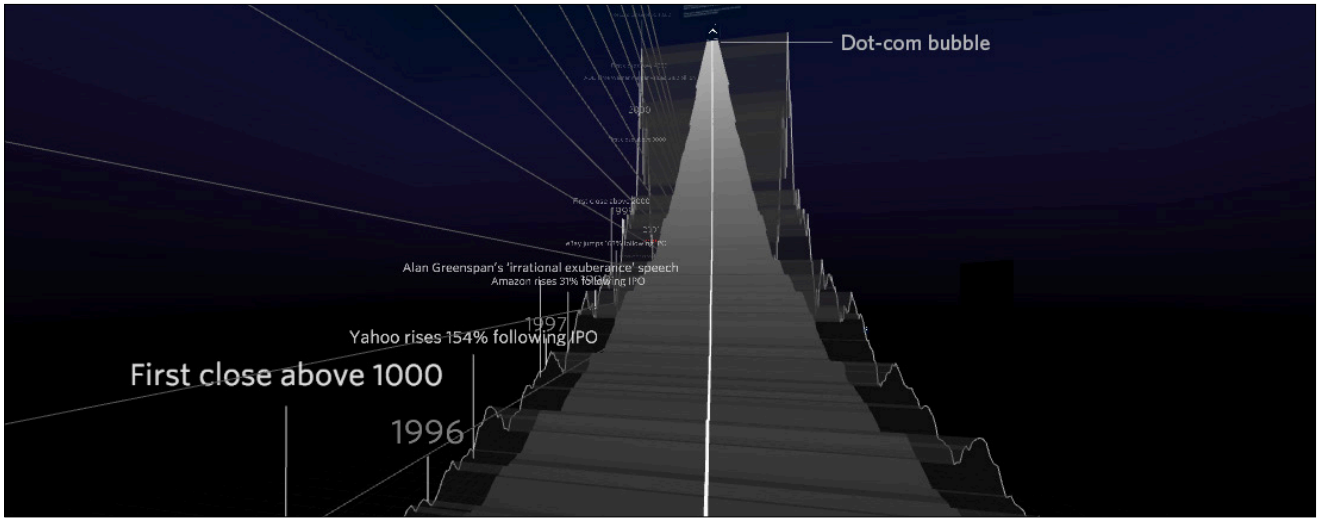
Though it is not interactive and the data is made up, still is a good example of data storytelling.



Snapshot of LoVR

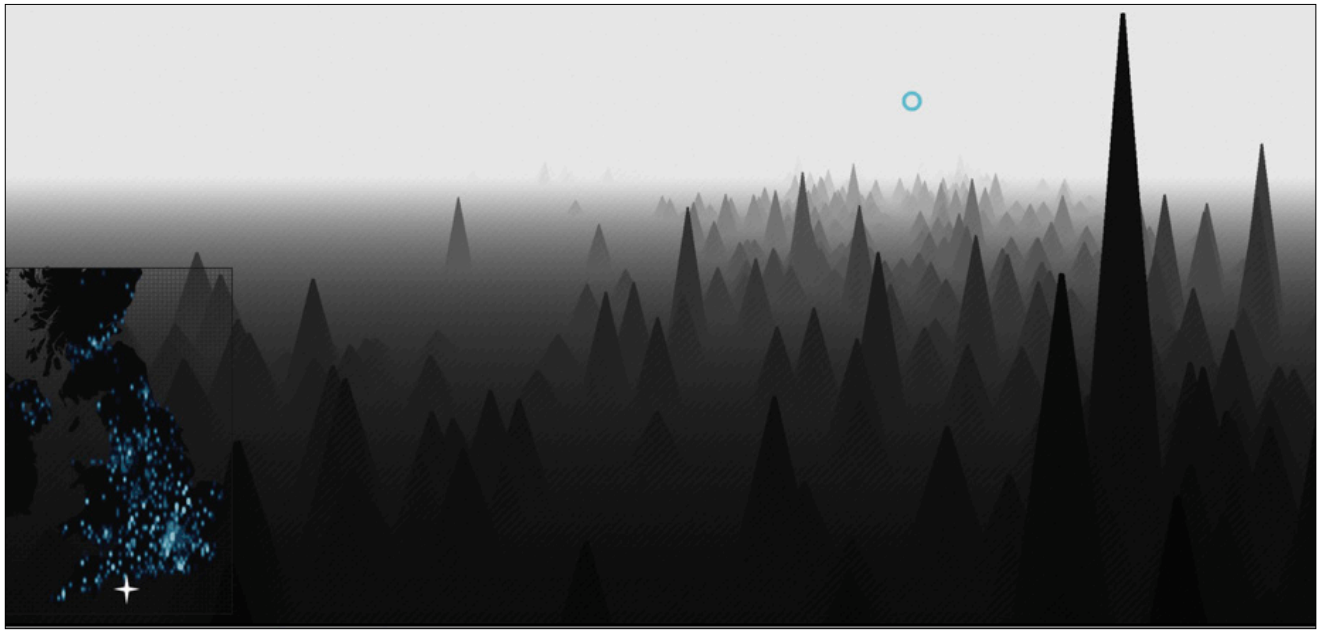
21 years of the Nasdaq as a rollercoaster

A good example of data storytelling using a line chart as the track of VR rollercoster ride.



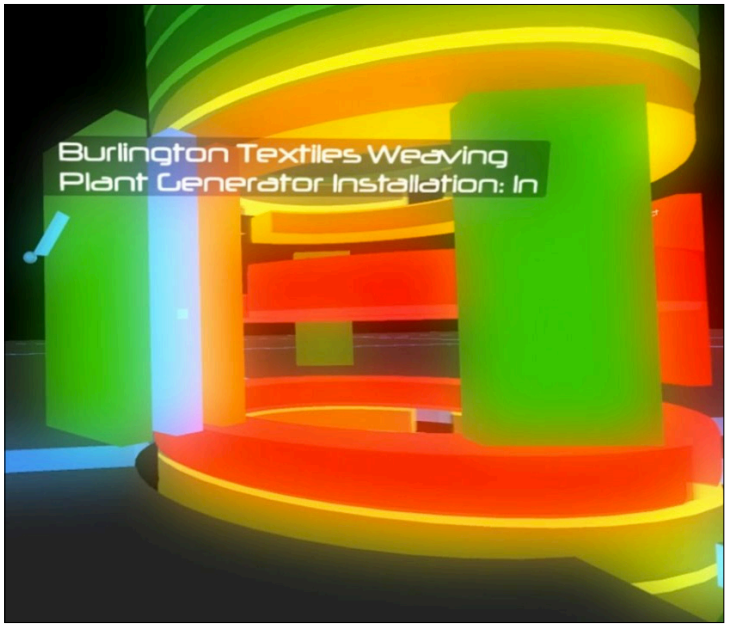
Snapshot of 21 years of the nasdaq as a rollercoaster

Where is Piers Morgan disliked the most?
This example shows data visualisation of map in VR with protruding cones to represent the number of people in different US states. It has two. walk and fly, over modes of navigation through the data.



Snapshot of Where is Piers Morgan disliked the most?

Virtual Reality to Visualise Data on Salesforce
In this visualisation the data is represented in a form of different layers one above the other forming a cylindrical surface. Details can be seen by clicking on specific layers.



Snapshot of VR Salesforce data visualisation

2.2 Data visualisation techniques

Data visualisation techniques intend to communicate data by encoding it in a visual form. The goal of these techniques is to clearly and efficiently communicate information to people.[5]

In her book Design for Information, Isabel Meirelles gives a brief introduction of different types of visualisation techniques with classical examples of data visualisation to explain each type.

“Graphic design in general, and information design in particular, depend upon cognitive processes and visual perception for both its creation (encoding) and its use (decoding). If the decoding process fails, the visualisation fails.”
- Isabel Meirelles, Design for Information

2D data representation techniques

Advantage of these techniques is that people know them so well that they won’t be confused when they look at them.

Bar Chart: Comparison of many items with one variable per item or one item with two variables. Used widely because it is very effective. Humans have a built in capacity to easily parse the differences between the rectangular shapes, we are wired to see this type of chart. Bar chart shows each value at a single point.

Line Chart: Comparison over time of many categories in few periods or Non-cyclic data over many periods If looking at data over time, line chart comes by default.

Column Chart: Comparison of single or few categories over time (Few periods)

Circular Area Chart: Comparison over time of cyclic data with many periods

Scatter Chart: Relationship or distribution between two variables

Bubble Chart: Relationship between 3 variables

3D area chart: Distribution of 3 variables

Column / Line Histogram: Distribution of single variable data points (few / many respectively)

Pie Chart: Static composition of simple share of total. Bad at showing slight variance in data points. Good to show variance in two values.

Timeline: There are two ways in which we conceive of time moving:[3] The subject is moving (ego-motion) and time is stationary. Time is moving and we are stationary

Maps: 5 standard ways to show data on the maps Markers, Layers, Choropleth, Heatmap, Flows

Tree maps: Used to represent Hierarchy

Stream graphs, Matrices, Box plots, Heat maps, Node-link diagram, Fish eye distortion, Adjacency matrix, Chord Diagram and Venn Diagram are some other techniques.

3. Technologies

3.1 Head Mounted Displays

There are two types of Head Mounted Displays (HMD), Mobile based and desktop based, each with its own qualities. Oculus rift, HTC vive, Playstation are desktop based, they are connected to a computer. Samsung Gear VR and Google VR (Cardboard and Daydream) are mobile based. Samsung Gear VR has its touchpad for input, while Google cardboard has a clicker.

In all platforms gaze based interaction is used. Desktop based HMDs are expensive and are not currently easily availabe in the Indian market. While a VR viewer like Google cardboard is cheap and easily available. Hence the project focuses on the use of Google cardboard to test its effectiveness.

3.2 WebVR

D3 is generally used for data visualisation purposes. Along with the new WebVR framework AFrame, it can be used to create VR data visualisation. As the technology is in nascent stage it was discarded after creating the first prototype due to its limitations and inflexibility for the purposes of the project.

3.3 Software

Two competing open source game engines that are extensively used to create VR applications are the unity game engine and the unreal game engine. While both have it's pros and cons, the project uses unity for the following reasons.

With version 5.1 Unity provided supported for some specific VR devices. This includes, Stereo 3de for OpenGL or Direct3dx, like what we see at 3D movie theater using polarized glasses, the image is blurry when the glass is not worn, with right hardware this can be used in VR applications.

Split screen stereo 3d, where there is a camera on the left and right, one camera for each eye. This is the favorable approach of all VR vendors. Unity also has specific support for Oculus family of devices. They use split screen stereo 3D but there are other oculus specific hardware support provided within the unity game engine. Similarly for playstations VR device, unity has specific support for sony technology. Unity has cross platform support. In VR space, different competing technologies emerge, unity is supporting the main players and provide capabilities to take their technology and make it cross platform. For example, samsung's gear VR works only on android, and something like google's cardboard which works on iOS, Android and Desktop systems, take some of it's technology and move it over to some other proprietary technologies. So you can go back and forth and easily deploy one source based on a variety of different VR platforms. It's important as the VR marketplace is shaking itself out.

3.4 Design Approach

Project focuses on the split screen and due to its position in the market oculus specific technology. With interaction in unity game engine on VR controller for a plugin based VR systems, specifically google cardboard and built in VR systems, specifically samsung's gear VR / Oculus. Building teleportation systems and cardboards gaze interface and see how it can be repurposed to work with built in systems. Finally deploy to cardboard and samsung's Gear VR on their respective supported platforms.

4. Search for Datasets

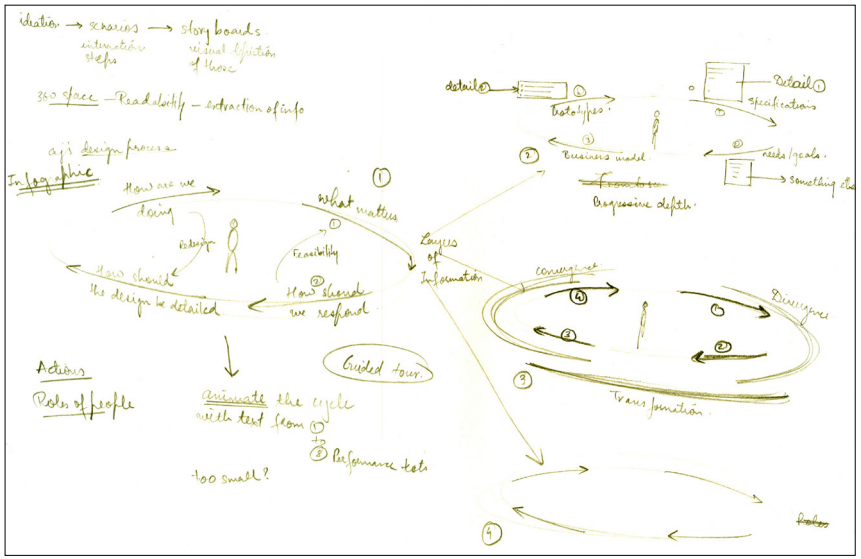
Following are some of the datasets that were looked at and considered for visualisation.

Medical data
Medical data is multidimnsional and is generally represented in 3D, so it would make sense to its create visualisations in VR. It was discarded as the data gathering requires expensive equipments and is user specific.

Ajanta
The idea was to create VR data visualisation of chronology created by Walter spinks. In volume 4, 5, 6 he has described evolution of features over time in various caves. Data is multidimensional; Time, caves and evolution of features.
It was discarded as the data needs to be extracted from the books which requires a lot of time which can be utilised in creating visualisations.

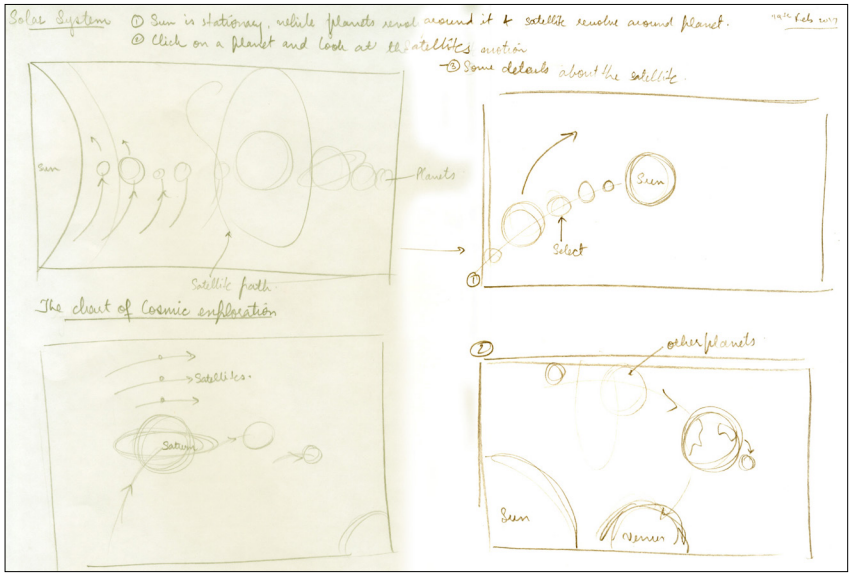
Napoleon march from moscow
Recreating the classic in VR by having a hyperlapse experience through the visualisation was an idea. You are flying over the road with annotations and the road is shrinking with actual people being eliminated.

Visualisation on India from government data
Picking up a dataset of indian government and create a VR visualisation around it. For example, number of things as per states. Like, life cycle in datasets of Birthrate, Education, Employment, Marriage and Death.

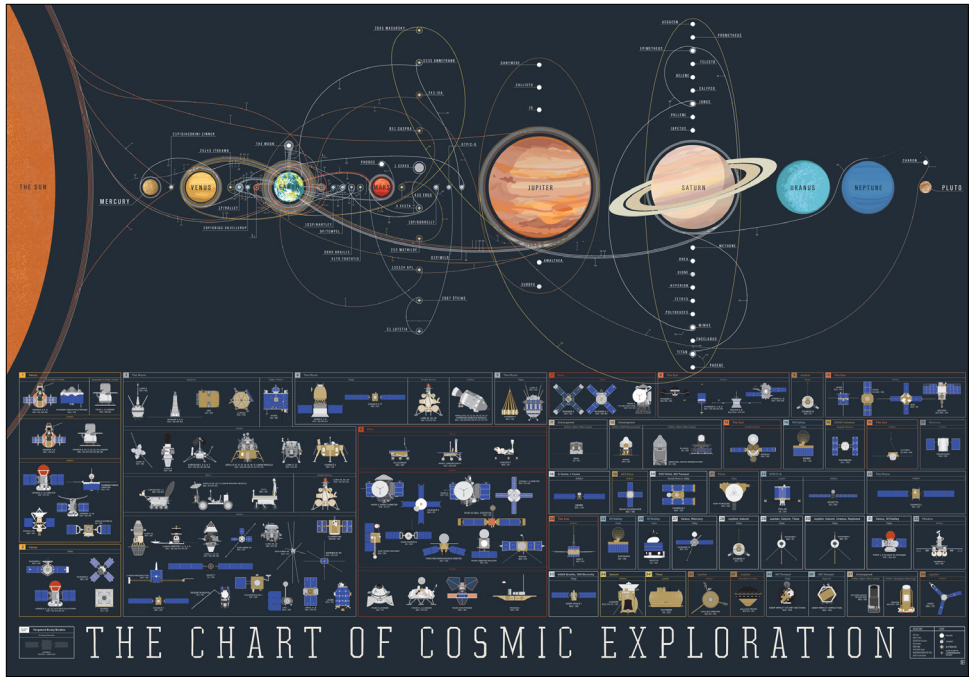


I looked at various existing infographics and visualizations to see how they can be translated into 3D VR data visualisations. Following are the sketchs of some of these explorations.

Interaction Design Process as circular layers of information around the user.

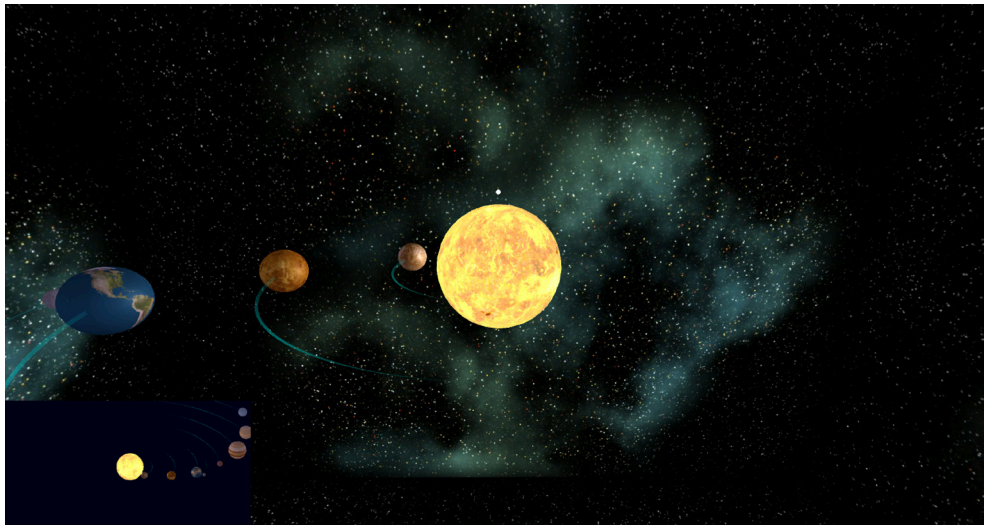


Concept for
The chart of Cosmic exploration

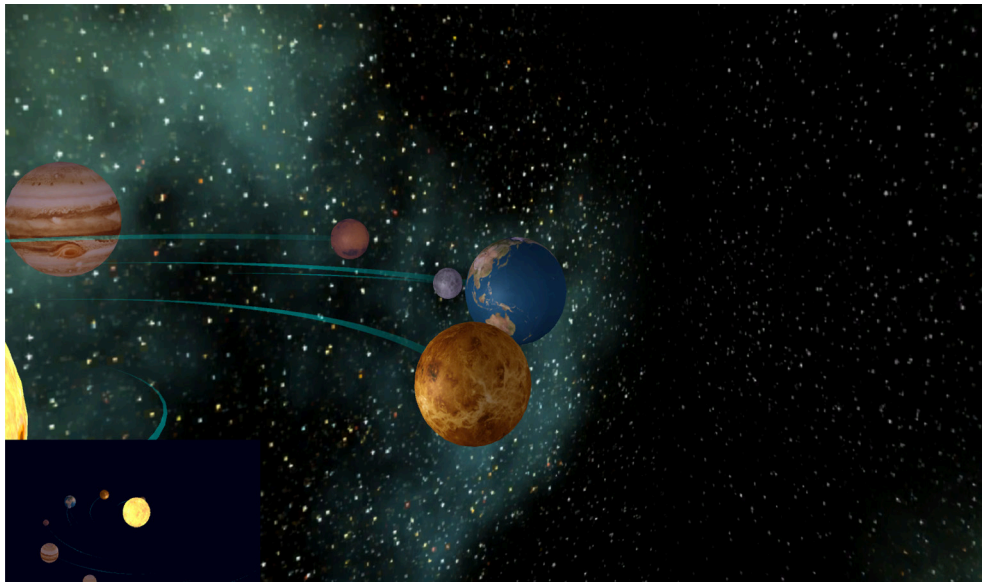


The chart of cosmic exploration howing all the satellites and their paths
Source: popchartlab.com/collections/best-sellers/products/the-chart-of-cosmic-exploration

"This color-coded chart traces the trajectories of every orbiter, lander, rover, flyby, and impactor to ever slip the surly bonds of Earth's orbit and successfully complete its mission."

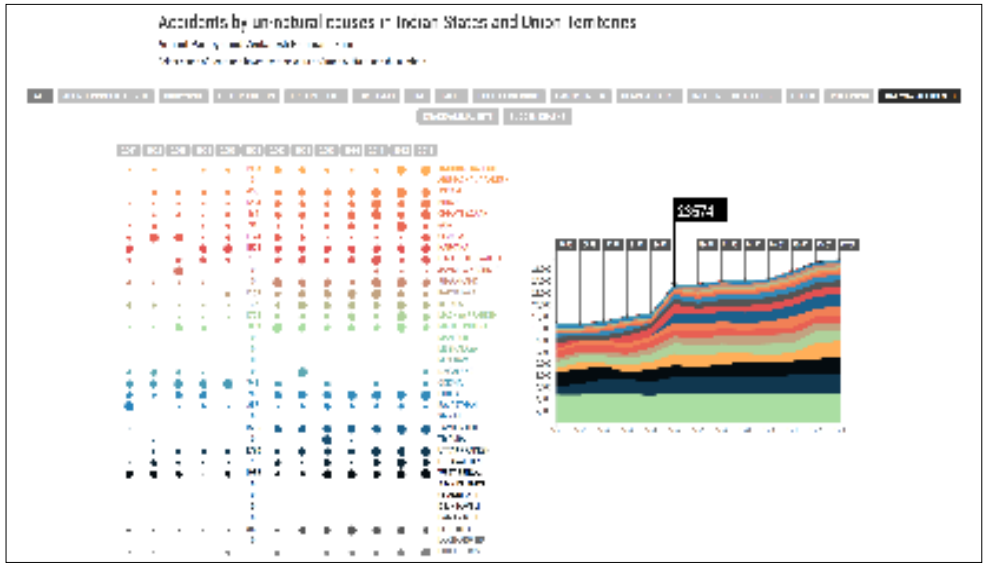


Prototype in Unity, Solar system with rotating planets revolving around the sun with trails to show their paths



A planet can be clicked and the whole scene can be viewed from its perspective

After these initial explorations, I got the data of unnatural deaths with following visualisations for my guide, Prof. Venkatesh Rajamanickam.



Bubble chart linked with area chart showing deaths over 13 years, causes can be selected from top

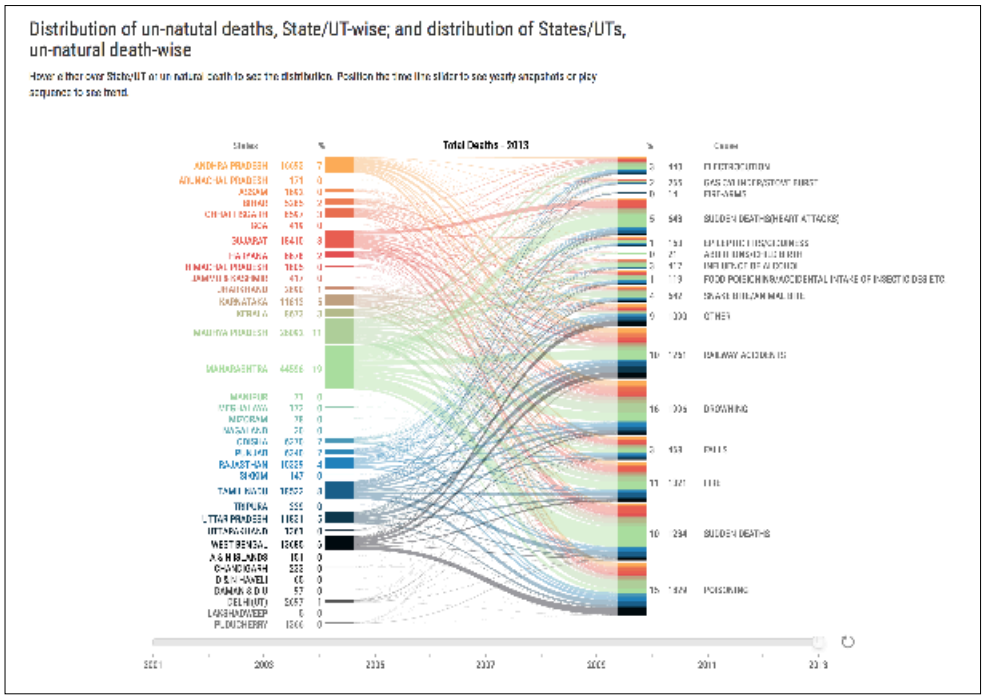
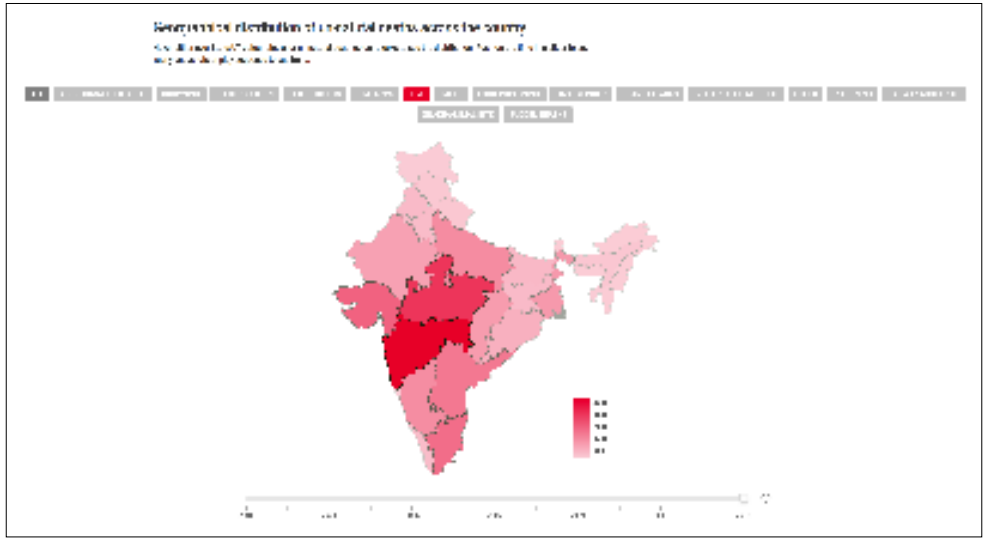


Chart listing states on left and causes on right with timeline



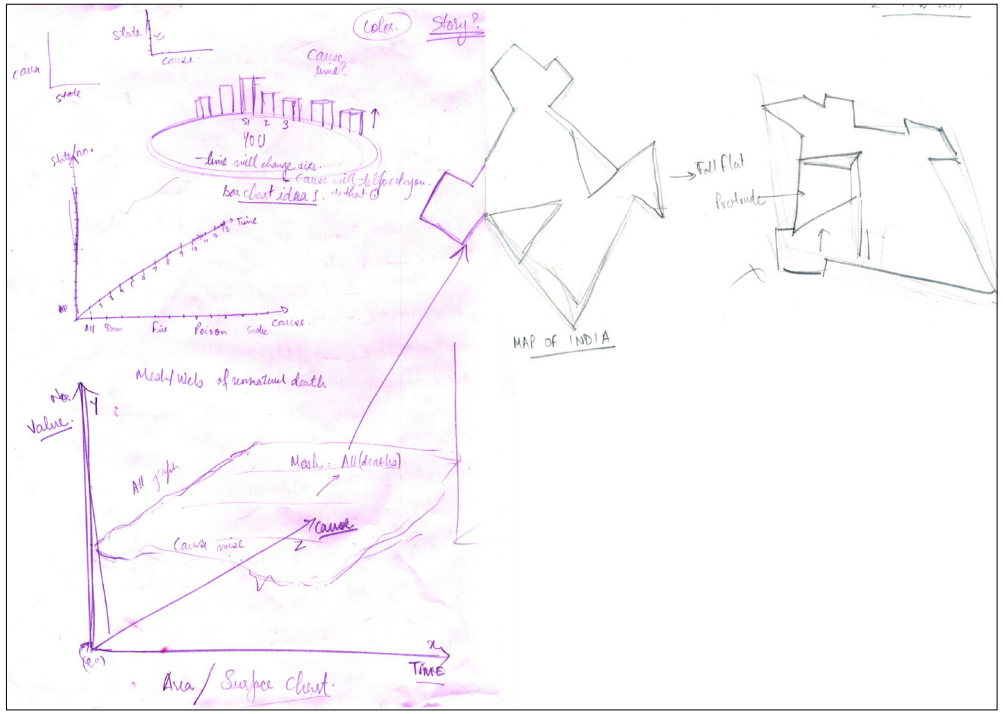
Map of India showing deaths in different states, causes can be selected at the top while the timeline at bottom shows number of deaths over 13 years

5. Ideation

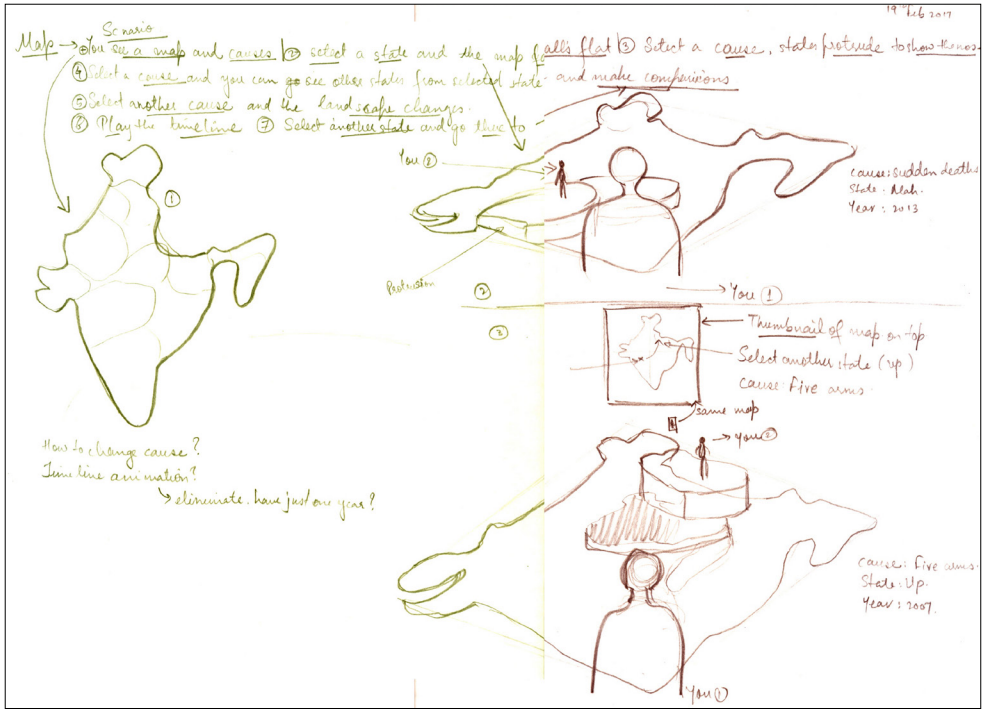
These are exploratory drawings to generate ideas for the visualisation.

5.1 Comparative Data Visualization

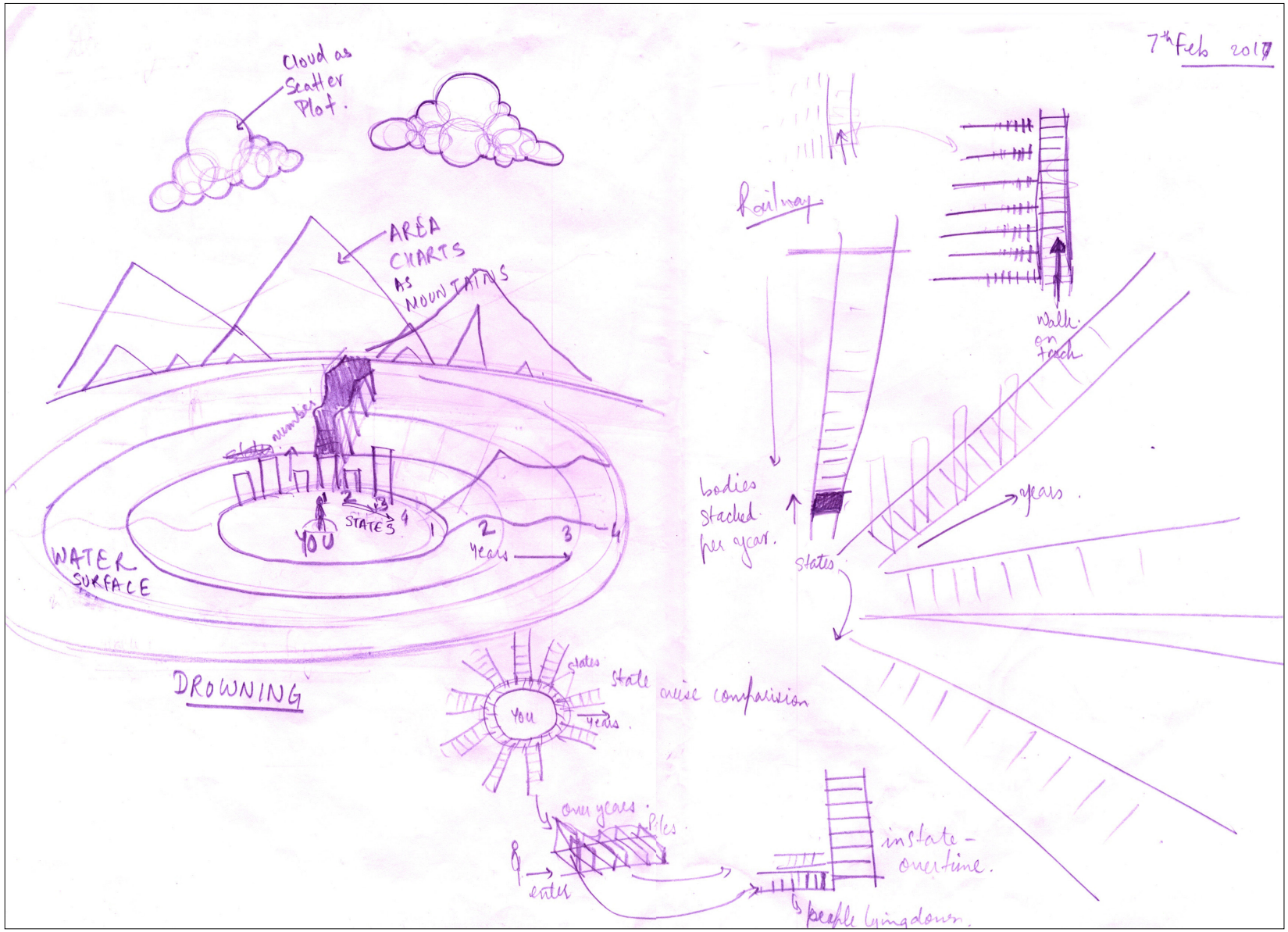
It is important to look at the data in relation to other data to draw conclusions. To compare cause with cause and state with state, the following ideas have values of states shown in a map and causes stacked together like bars.



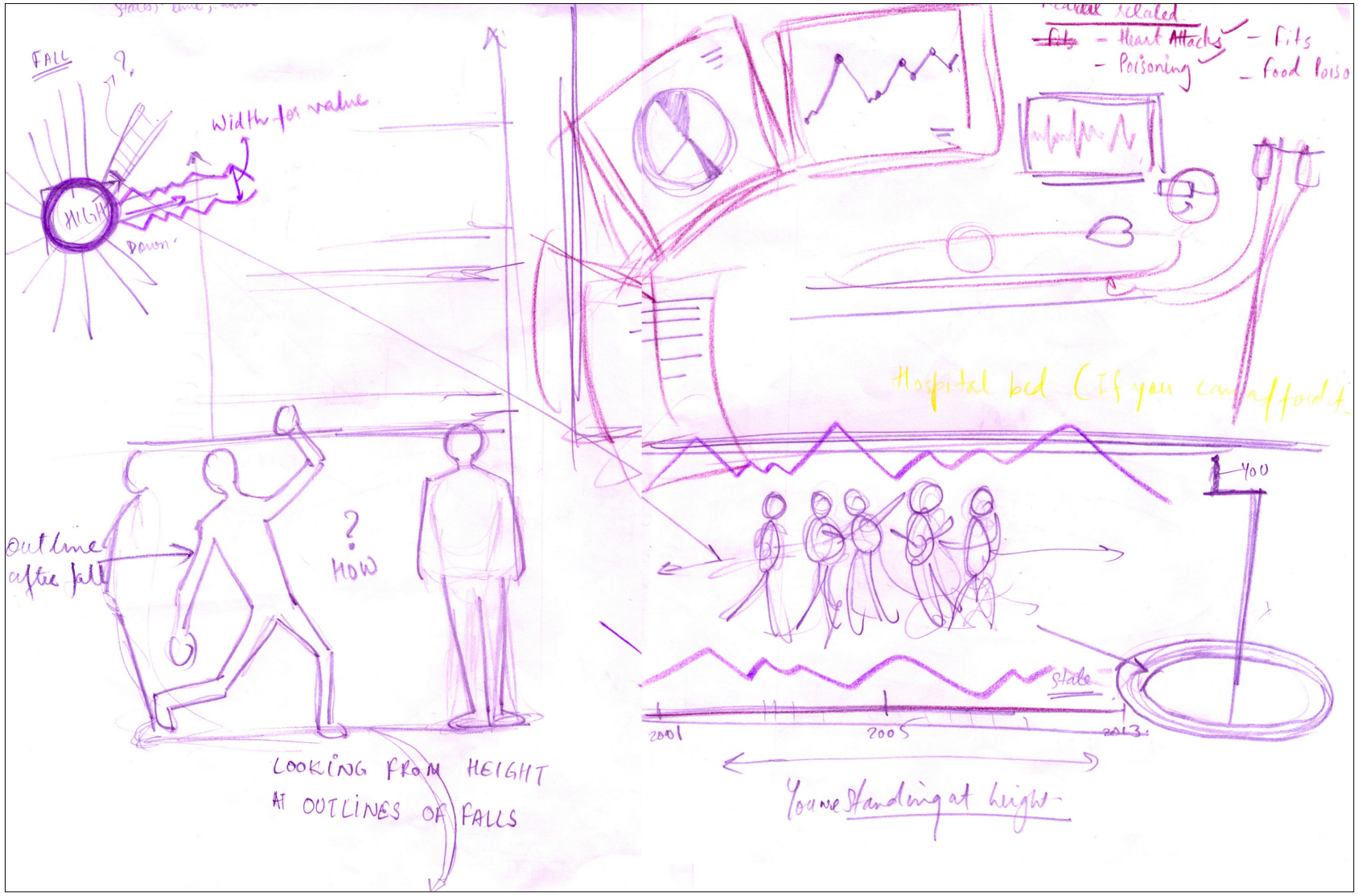
Initial drawing showing surface chart, circular bar chart and map



Detials drawing from the idea of map with user placement and scnario



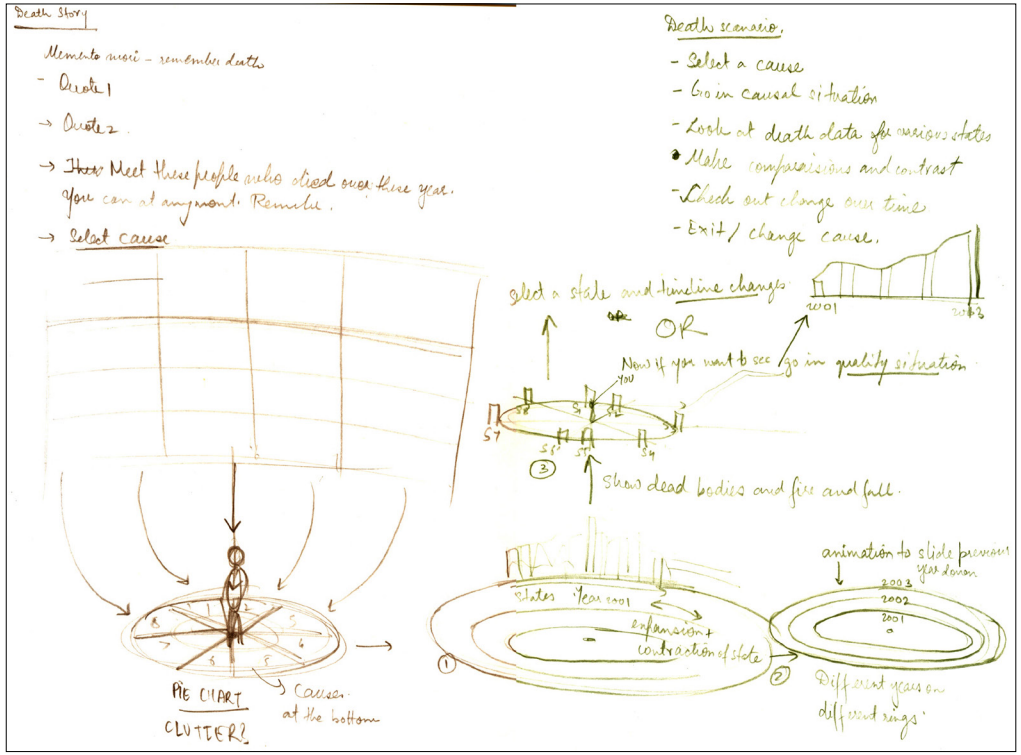
Exploratory drawings where data is represented in langscape with area chart as mountain ranges, bubble chart as clouds and the user standing in water looking at circular bar charts around him.
On right, the other idea is of representing data as bars in railway track.



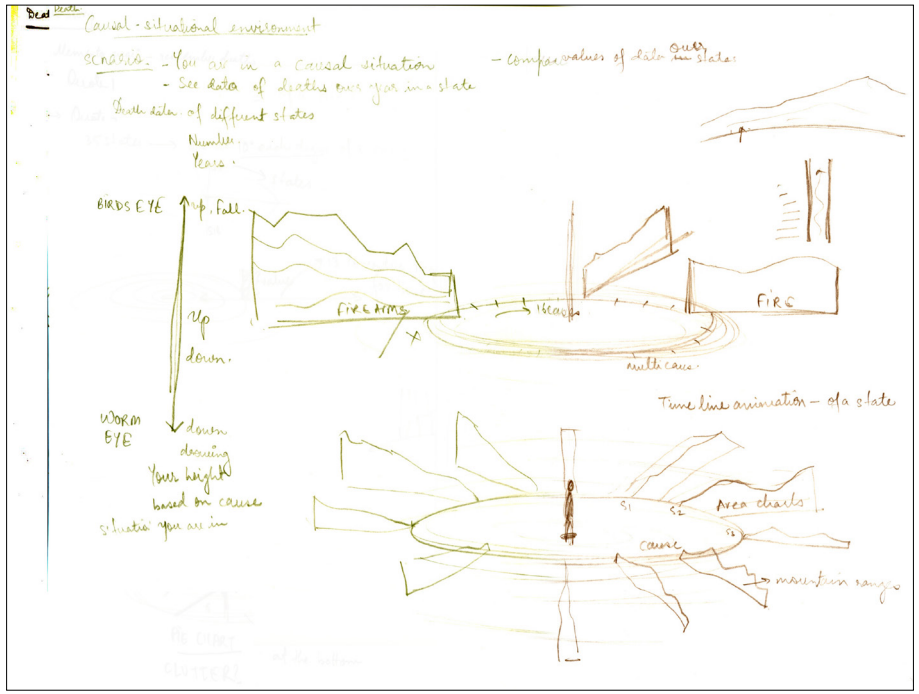
Exploratory drawings where data is represented as outlines of fallen dead bodies being looked from a heightfor the cause of deaths due to falls and hospital chamber where data is shown as various charts on different windows

5.2 Exploratory Data Visualization

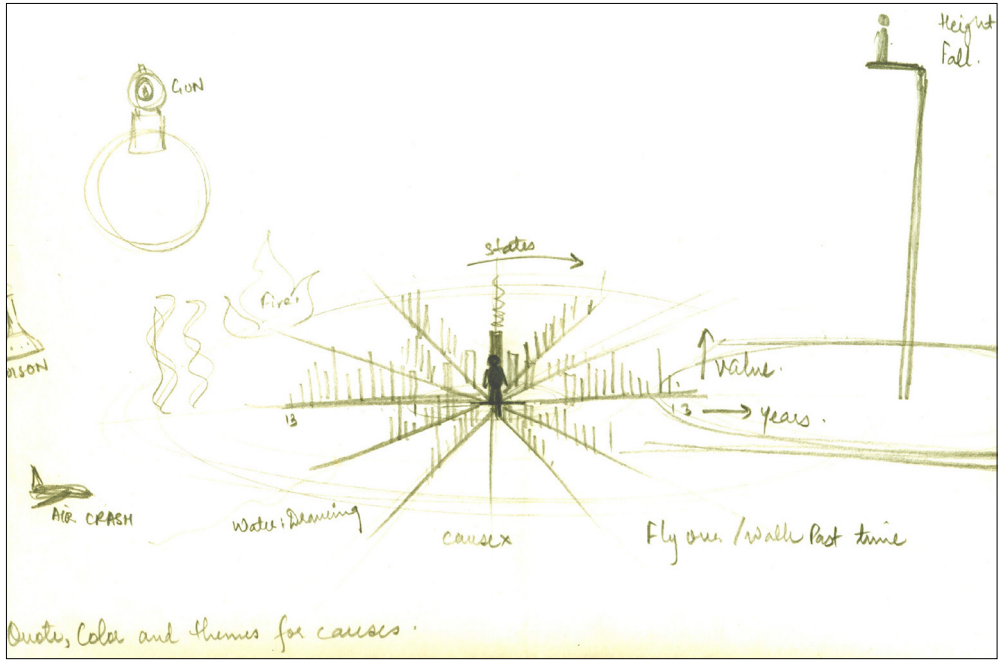
One of the key challenge in making such a visualisation will be the exploratory data visualisation where the user has to look at massive amount of data, mess around with it and draw conclusions from it. Specific navigation methods need to be considered to look at the data from different perspectives and carefully look at the patters that come out.



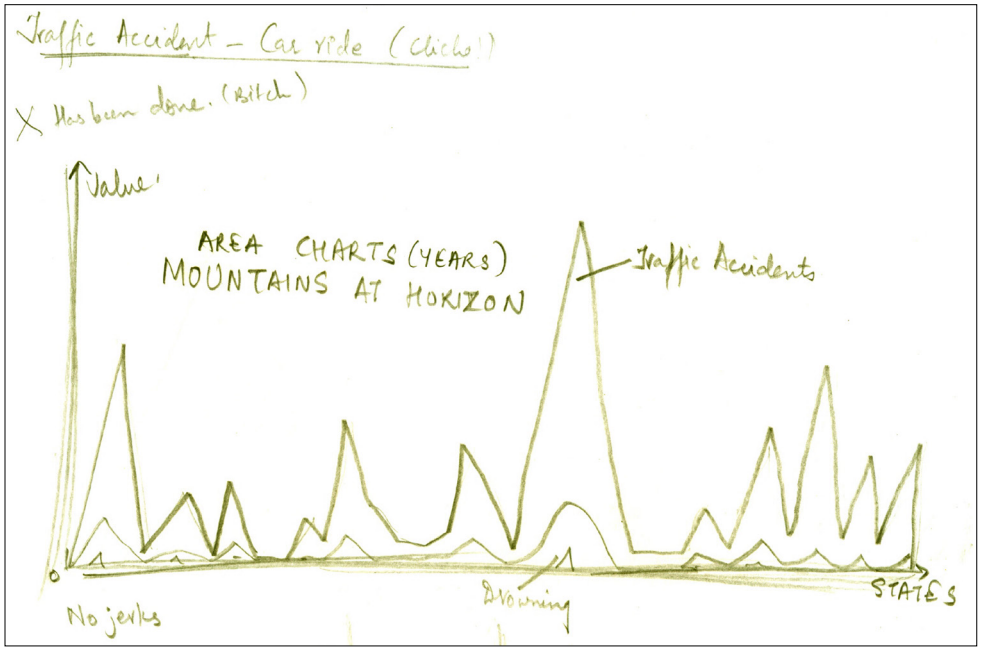
Data as pi chart at users feet and bar chart around the user with details of years as concentric rings and 35 states as each bar 10 degree apart.



Data as area chart around the user with different causes and states and the range of user location at the center



Data as bar chart around the user with different causes and states and different representaion of causes to view the data of specific cause

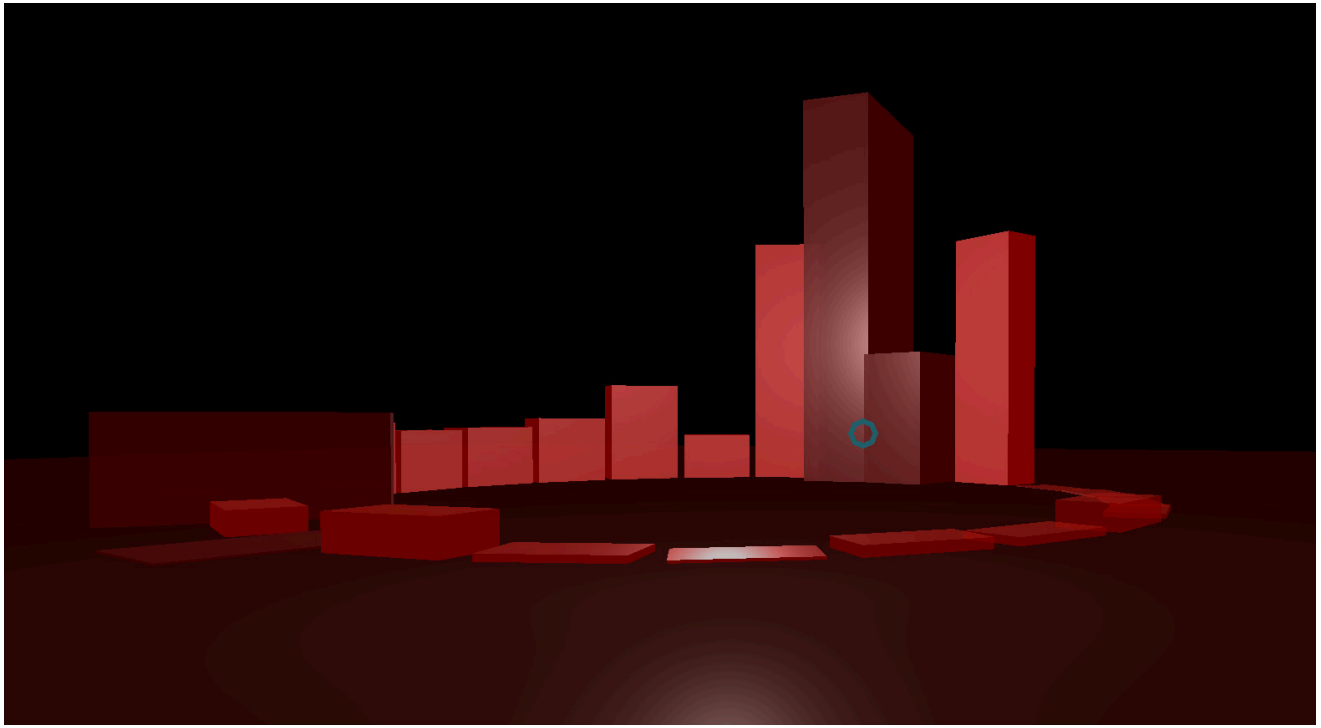


Data as area chart at the horizon as mountain ranges

5.3 Prototype 1

WebVR : using D3 and AFrame

Bar charts arranged in circular fashion showing total death data of Maharashtra. Bars grow when the pointer hovers over it and value is shown in console when clicked.
It's difficult to create advanced visualizations using these set technologies as its nascent and requires lot of redundant programming.



Prototype of circular bar charts arranged around the user made with D3 and AFrame

6. Data Exploration

6.1 Un-natural deaths from 2001 to 2013

Government Data is available as a .csv file with 21,000 rows, given are data of number of deaths from different states, with causes and year. Total number of deaths due to each cause is also given. Also, number of males and females injured and killed.

I started by making a pivot table with causes as rows with nested year as sub-rows and different states as columns. With values as the number of deaths / Total Killed, obviously.

Sparklines are inserted next to each cause to see the trend of deaths. Stacked bar charts of each causes for the same.

Two pivot tables to show trends of causes and states are made.
Table of causes, arranged in ascending order of total deaths, with respective charts show the trend of intensity each cause to number of deaths and the number of deaths with respect to the other in hierarchy. From the table of states a second table was made to see the ranks of different states due to different causes. It shows the trends of which state comes where in which causes.
Data spoke and insights showed up as a result of this process.

	A	B	C	D	E	F	G	H	I	J
1	STATE/UT	YEAR	CAUSE	CASES	MALE INJURED	FEMALE INJURED	TOTAL INJURED	MALE KILLED	FEMALE KILLED	TOTAL KILLED
2	ANDHRA PRADESH	2001	AIR-CRASH	0	0	0	0	0	0	0
3	ANDHRA PRADESH	2001	COLLAPSE OF STRUCTURE(HOUSE)	40	9	2	11	28	28	56
4	ANDHRA PRADESH	2001	COLLAPSE OF STRUCTURE(BUILDING)	18	1	2	3	29	7	36
5	ANDHRA PRADESH	2001	COLLAPSE OF STRUCTURE(DAM)	0	0	0	0	0	0	0
6	ANDHRA PRADESH	2001	COLLAPSE OF STRUCTURE(BRIDGE)	4	2	2	4	6	6	12
7	ANDHRA PRADESH	2001	COLLAPSE OF STRUCTURE(OTHERS)	84	17	8	25	80	33	113
8	ANDHRA PRADESH	2001	DROWNING (BOAT CAPSIZE)	33	6	0	6	34	7	41
9	ANDHRA PRADESH	2001	DROWNING(OTHER CASES)	1366	27	3	30	1044	362	1406
10	ANDHRA PRADESH	2001	ELECTROCUTION	611	8	10	18	573	92	665
11	ANDHRA PRADESH	2001	EXPLOSION (BOMB EXPLOSION)	8	16	4	20	13	16	29
12	ANDHRA PRADESH	2001	EXPLOSION(OTHER EXPLOSION LIKE BOILERS,	11	1	0	1	4	4	8
13	ANDHRA PRADESH	2001	FALLS (FALL FROM HEIGHT)	753	14	3	17	696	88	784
14	ANDHRA PRADESH	2001	FALL INTO PIT/MANHOLE	69	1	0	1	55	10	65
15	ANDHRA PRADESH	2001	FACTORY/MACHINE ACCIDENTS	48	9	0	9	40	17	57
16	ANDHRA PRADESH	2001	FIRE (FIREWORKS/CRACKERS)	28	16	3	19	31	8	39
17	ANDHRA PRADESH	2001	FIRE (SHORT-CIRCUIT)	292	8	2	10	264	43	307
18	ANDHRA PRADESH	2001	GAS CYLINDER/STOVE BURST	1003	21	52	73	204	732	936
19	ANDHRA PRADESH	2001	OTHER FIRE ACCIDENTS	582	6	13	19	169	390	559
20	ANDHRA PRADESH	2001	FIRE-ARMS	25	1	0	1	19	7	26
21	ANDHRA PRADESH	2001	SUDDEN DEATHS(HEART ATTACKS)	268	0	0	0	220	59	279
22	ANDHRA PRADESH	2001	EPILEPTIC FITS/GIDDINESS	50	1	0	1	34	15	49
23	ANDHRA PRADESH	2001	ABORTIONS/CHILD BIRTH	19	0	0	0	0	19	19
24	ANDHRA PRADESH	2001	INFLUENCE OF ALCOHOL	183	14	1	15	170	11	181
25	ANDHRA PRADESH	2001	KILLED BY ANIMALS	33	1	0	1	29	4	33
26	ANDHRA PRADESH	2001	MINES OR QUARY DISASTER	19	5	4	9	12	3	15
27	ANDHRA PRADESH	2001	FOOD POISIONING/ACCIDENTAL INTAKE OF INSECTICIDES ETC.	159	13	3	16	140	46	186
28	ANDHRA PRADESH	2001	SPURIOUS/POISIONOUS LIQUOR	23	4	1	5	20	3	23
29	ANDHRA PRADESH	2001	LEAKAGE OF POISINOUS GASES ETC.	4	0	0	0	4	0	4
30	ANDHRA PRADESH	2001	SNAKE BITE/ANIMAL BITE	643	7	5	12	508	125	633
31	ANDHRA PRADESH	2001	OTHER	556	10	9	19	398	181	579
32	ANDHRA PRADESH	2001	STAMPEDE	2	0	0	0	2	0	2
33	ANDHRA PRADESH	2001	SUFFOCATION	9	0	0	0	9	0	9
34	ANDHRA PRADESH	2001	TRAFFIC ACCIDENTS (ROAD ACCIDENTS)	27188	27725	6110	33835	6947	1427	8374
35	ANDHRA PRADESH	2001	TRAFFIC ACCIDENTS (RAIL-ROAD ACCIDENTS)	623	6	1	7	558	68	626
36	ANDHRA PRADESH	2001	OTHER RAILWAY ACCIDENTS	674	0	0	0	586	90	676
37	ANDHRA PRADESH	2001	OTHER CAUSES (PLEASE SPECIFY)	1096	530	191	721	880	361	1241
38	ANDHRA PRADESH	2001	CAUSES NOT KNOWN	486	113	72	185	509	179	688
39	ANDHRA PRADESH	2001	TOTAL	37010	28592	6501	35093	14315	4441	18756
40	ANDHRA PRADESH	2001	TOTAL COLLAPSE	146	29	14	43	143	74	217
41	ANDHRA PRADESH	2001	TOTAL DROWNING	1399	33	3	36	1078	369	1447
42	ANDHRA PRADESH	2001	TOTAL EXPLOSION	19	17	4	21	17	20	37
43	ANDHRA PRADESH	2001	TOTAL FALLS	822	15	3	18	751	98	849
44	ANDHRA PRADESH	2001	TOTAL FIRE	1905	51	70	121	668	1173	1841
45	ANDHRA PRADESH	2001	TOTAL SUDDEN DEATHS	520	15	1	16	424	104	528
46	ANDHRA PRADESH	2001	TOTAL POISONING	1385	34	18	52	1070	355	1425
47	ANDHRA PRADESH	2001	TOTAL TRAFFIC ACCIDENTS	28485	27731	6111	33842	8091	1585	9676

Snapshot of the State/UT-wise profile of accidents by un-natural causes during 2001-2013
Source: data.gov.in/catalog/stateut-wise-profile-accidents-un-natural-causes

6.2 Pivot Tables and Sparklines

Sum of TOTAL KILLED	Column Labels																				
Row Labels	A & N ISLANDS	ANDHRA PRADESH	ARUNACHAL PRADESH	ASSAM	BIHAR	CHANDIGARH	CHHATTISGARH	D & N HAVELI	DAMAN & DIU	DELHI(UT)	GOA	GUJARAT	HARYANA	HIMACHAL PRADESH	JAMMU & KASHMIR	JHARKHAND	KARNATAKA	KERALA	LAKSHADWEEP	MADHYA PRADESH	MAHARASHTRA
ABORTIONS/CHILD BIRTH	4	162	1	82	104	19	367	8	3	246	11	422	162	22	40	96	136	133	0	1911	4347
AIR-CRASH	0	28	13	0	0	0	9	0	0	0	30	21	12	6	14	4	7	1	1	7	38
CAUSES NOT KNOWN	171	10254	354	5806	1779	435	20192	122	23	9269	472	7211	2032	681	1088	1680	18999	3449	2	28546	12384
COLLAPSE OF STRUCTURE (BRIDGE)	0	7	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0
COLLAPSE OF STRUCTURE (BUILDING)	0	29	0	8	2	0	0	0	0	13	1	6	0	2	0	0	6	23	0	4	12
COLLAPSE OF STRUCTURE (DAM)	0	1	0	0	7	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	2
COLLAPSE OF STRUCTURE (HOUSE)	0	59	0	0	41	0	26	0	0	9	1	45	0	2	1	5	17	12	0	94	105
COLLAPSE OF STRUCTURE (OTHERS)	0	114	0	11	55	0	45	0	0	31	3	68	2	5	7	113	37	23	0	35	139
COLLAPSE OF STRUCTURE(BRIDGE)	1	53	20	75	79	0	18	3	1	9	0	45	9	39	1	22	4	12	0	59	28
COLLAPSE OF STRUCTURE(BUILDING)	4	499	6	56	93	3	40	6	0	224	2	196	75	30	9	89	157	212	0	86	566
COLLAPSE OF STRUCTURE(DAM)	0	23	0	5	35	0	133	0	0	1	0	44	0	0	20	43	6	5	0	25	4
COLLAPSE OF STRUCTURE(HOUSE)	0	712	8	24	555	11	363	2	0	205	30	1916	166	41	67	174	545	161	0	1334	1342
COLLAPSE OF STRUCTURE(OTHERS)	17	1579	58	146	609	8	376	2	3	348	81	1312	315	110	53	598	993	402	4	1302	1672
DROWNING (BOAT CAPSIZE)	16	477	3	461	1172	0	851	0	23	52	23	534	250	52	29	198	418	313	7	1614	298
DROWNING (OTHER CASES)	28	1395	20	214	216	5	1131	10	14	145	186	1112	50	79	25	0	1392	1196	2	3461	5040
DROWNING(OTHER CASES)	394	25937	256	3763	3604	62	16231	183	209	1739	2045	19745	5557	1522	586	2972	21598	18362	17	47489	59564
ELECTROCUTION	48	13750	42	738	1657	95	5354	80	50	2058	265	6594	3485	166	214	981	4499	2537	1	15828	14834
EPILEPTIC FITS/GIDDINESS	12	1906	5	8	317	21	1035	26	30	290	52	6331	686	99	47	213	1284	1197	1	2085	18045
EXPLOSION (BOMB EXPLOSION)	0	168	0	196	77	0	387	0	0	109	2	45	28	2	716	56	8	1	0	100	454
EXPLOSION(OTHER EXPLOSION LIKE BOIL	0	519	6	14	140	3	90	0	0	131	5	132	70	9	68	101	85	63	0	216	228
EXPLOSION(OTHER EXPLOSION LIKE BOILERS,	0	222	1	6	54	1	20	2	0	36	6	65	36	2	10	11	37	23	0	93	160
EXPLOSION(OTHER EXPLOSION LIKE BOILERS, GAS CYLINDER ETC.)	0	19	0	1	11	0	1	0	0	24	0	19	0	1	0	0	21	9	0	31	39
FACTORY/MACHINE ACCIDENTS	2	595	5	73	179	4	665	63	14	599	57	1531	497	107	69	248	338	198	0	1050	1227
FALL INTO PIT/MANHOLE	38	1697	9	42	201	20	813	12	7	351	236	3119	588	43	38	454	315	817	0	2109	5281
FALLS (FALL FROM HEIGHT)	118	13188	222	277	1006	245	4016	163	86	4244	1061	10886	2145	3205	633	988	5777	7148	1	8667	21204
FIRE (FIREWORKS/CRACKERS)	1	328	0	8	275	2	136	2	5	44	5	212	99	7	11	195	72	122	0	617	117
FIRE (SHORT-CIRCUIT)	7	3386	32	88	239	6	61	6	3	583	7	2824	302	159	112	304	869	186	0	486	1837
FIRE-ARMS	0	129	51	226	276	7	1050	0	0	440	2	52	212	18	1668	155	340	9	0	1508	300
FOOD POISIONING/ACCIDENTAL INTAKE OF INSECTICIDES ETC.	13	3122	17	318	3780	27	6702	3	4	957	31	5252	3659	1154	163	1788	1872	259	0	27123	17267
GAS CYLINDER/STOVE BURST	82	7951	7	160	1352	131	263	96	28	1409	138	8914	1617	125	110	566	3897	376	1	2415	4093
INFLUENCE OF ALCOHOL	37	3347	46	36	962	198	2887	58	30	1376	126	504	2539	767	112	768	3744	1133	0	4992	16097
KILLED BY ANIMALS	20	576	67	969	135	6	843	4	2	54	11	740	135	101	32	504	645	401	0	1113	1554
LEAKAGE OF POISINOUS GASES ETC.	0	130	0	30	143	1	42	0	1	19	0	423	59	13	29	39	207	10	0	323	94
MINES OR QUARY DISASTER	4	297	3	1	31	0	477	0	1	2	18	179	89	2	15	202	79	151	0	1667	297
OTHER	28	11917	217	2104	2439	124	3654	1	5	1741	70	4576	4194	1036	314	844	13691	1214	0	5519	2346
OTHER CAUSES (PLEASE SPECIFY)	2002	14743	137	1243	4089	821	23417	286	296	10798	1095	21087	9584	2089	1062	3577	13471	7194	3	46337	170274
OTHER FIRE ACCIDENTS	151	11389	78	1451	3934	140	8957	30	79	2986	434	19405	2456	505	167	2160	13891	2946	4	29727	61791
OTHER RAILWAY ACCIDENTS	0	20250	0	5156	14514	0	5959	0	0	11716	472	14665	13762	211	86	4207	14775	4536	0	19479	64403
SNAKE BITE/ANIMAL BITE	8	10191	4	78	611	5	10042	58	0	148	41	6372	656	174	38	369	7793	583	0	25114	14301
SORISSAOUS/POISIONOUS LIQUOR																					
SPURIOUS/POISIONOUS LIQUOR	0	1091	7	80	737	12	237	0	5	145	0	947	299	76	58	262	1469	15	0	404	391
STAMPEDE	0	355	0	1	22	0	151	0	0	11	1	66	126	110	0	13	118	106	0	203	351
SUDDEN DEATHS(HEART ATTACKS)	340	5463	128	574	1048	532	2842	170	95	2764	225	21396	5029	1725	775	733	6779	15352	9	9430	65805
SUFFOCATION	7	196	5	5	242	18	5316	2	1	118	13	796	277	127	30	348	125	178	0	4828	986
TOTAL	3850	335694	3438	46421	91930	4722	161097	2058	1305	81441	11138	250602	113029	26934	22034	46276	243623	118341	58	383712	727452
TOTAL COLLAPSE	22	3076	93	327	1479	22	1004	13	4	840	118	3632	567	229	158	1044	1765	850	4	2952	3870
TOTAL DROWNING	438	27809	279	4438	4992	67	18213	193	246	1936	2254	21391	5857	1653	640	3170	23408	19871	26	52564	64902
TOTAL EXPLOSION	0	928	7	217	282	4	498	2	0	300	13	261	134	14	794	168	151	96	0	440	881
TOTAL FALLS	156	14885	231	319	1207	265	4829	175	93	4595	1297	14005	2733	3248	671	1442	6092	7965	1	10776	26485
TOTAL FIRE	241	23054	117	1707	5800	279	9417	134	115	5022	584	31355	4474	796	400	3225	18729	3630	5	33245	67838
TOTAL POISONING	49	26451	245	2610	7710	169	20677	62	15	3010	142	17570	8867	2453	602	3302	25032	2081	0	58483	34399
TOTAL SUDDEN DEATHS	393	10878	180	700	2431	770	7131	262	158	4676	414	28653	8416	2613	974	1810	11943	17815	10	18418	104294
TOTAL TRAFFIC ACCIDENTS	297	187690	1609	27041	59619	1760	41854	660	287	37713	4352	95458	65532	12521	13603	24403	117882	51809	5	105747	222538
TRAFFIC ACCIDENTS (RAIL-ROAD ACCIDE	0	1386	0	347	598	0	977	0	0	16	7	505	93	0	220	437	88	454	0	793	225
TRAFFIC ACCIDENTS (RAIL-ROAD ACCIDENTS)	0	1052	0	96	932	0	251	0	0	25	39	182	53	0	0	60	91	163	0	374	299
TRAFFIC ACCIDENTS (ROAD ACCIDENTS)	297	165002	1609	21442	43575	1760	34667	660	287	25956	3834	80106	51624	12310	13297	19699	102928	46656	5	85101	157611
Grand Total	9296	966159	9637	1E+05	3E+05	12780	425817	5617	3528	220974	31450	713529	322638	77395	61910	131116	692248	340799	167	1050049	1980111

Pivot table with causes as rows with nested year as sub-rows and different states as columns

2	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
3																			
4	MAHARASHTRA	MANIPUR	MEGHALAYA	MIZORAM	NAGALAND	ODISHA	PUDUCHERRY	PUNJAB	RAJASTHAN	SIKKIM	TAMIL NADU	TRIPURA	UTTAR PRADESH	UTTARAKHAND	WEST BENGAL	TOTAL (STATES)	TOTAL (UTS)	TOTAL (ALL INDIA)	Grand Total	Sparklines
5	4347	11	11	2	0	94	8	158	291	0	220	16	733	67	286	9885	288	10173	30519	
6	38	0	10	0	3	0	0	10	16	0	14	0	20	25	2	290	1	291	873	
7	12384	512	466	189	28	19548	120	2218	18512	144	14030	738	15201	996	21468	208977	10142	219119	657357	
8	0	0	0	0	0	0	0	1	3	0	7	1	5	0	0	1167	14	1181	2404	
9	12	0	2	0	0	1	0	2	10	1	62	0	38	0	1	3615	250	3865	7953	
10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	438	1	439	892	
11	105	0	0	2	0	8	1	13	42	0	60	0	143	3	8	12717	256	12973	26643	
12	139	2	6	0	0	30	3	23	53	7	159	1	237	17	14	15771	428	16199	33638	
13	28	0	5	3	0	12	0	10	10	1	319	11	61	8	221				1139	
14	566	7	5	18	0	24	0	119	70	5	497	7	453	19	65				3642	
15	4	0	0	0	0	0	0	8	6	6	19	0	10	10	22				425	
16	1342	0	4	4	0	86	28	257	679	4	729	2	2623	83	121				12276	
17	1672	65	32	10	2	200	12	462	958	43	1357	18	1412	91	309				14959	
18	298	11	24	74	4	361	6	79	79	0	579	6	1647	41	271	9869	104	9973	29919	
19	5040	11	27	23	3	361	78	298	1141	13	721	37	390	55	424	313457	3943	317400	654103	
20	59564	130	363	187	63	6573	1057	5424	17965	235	16041	722	9334	1726	6442				298097	
21	14834	116	120	62	21	2183	330	3154	7301	59	5033	301	5931	467	1468	97160	2662	99822	299466	
22	18045	5	62	4	0	537	1930	980	1724	14	2937	62	873	92	238	40838	2310	43148	129444	
23	454	136	5	8	4	16	0	10	123	0	53	1	268	8	378	3250	109	3359	10077	
24	228	3	13	1	0	10	0	73	214	0	108	34	321	58	170				2885	
25	160	1	0	0	0	17	0	11	82	7	123	0	271	3	93				1393	
26	39	0	0	0	0	2	0	3	21	1	77	0	42	0	48	4451	197	4648	9666	
27	1227	5	14	5	0	273	28	565	947	1	618	3	846	98	192	10406	710	11116	33348	
28	5281	6	20	14	4	315	14	473	1566	2	785	37	1218	116	144	20462	442	20904	62712	
29	21204	63	171	165	31	4511	613	1660	6755	429	5683	109	2597	901	1917	105415	5470	110885	332655	
30	117	0	1	0	0	91	7	259	74	0	483	2	896	10	409	4429	61	4490	13470	
31	1837	3	12	2	5	871	6	454	357	2	855	76	644	73	451	14697	611	15308	45924	
32	300	42	43	22	57	58	0	521	77	6	224	18	16332	201	479	24076	447	24523	73569	
33	17267	9	4	7	1	3092	48	3296	11009	23	3841	132	7726	1584	2584	105815	1052	106867	320601	
34	4093	2	37	6	1	542	7	1920	1763	13	8408	13	1577	384	825	47475	1754	49229	147687	
35	16097	5	71	15	3	460	2552	2306	2676	78	2001	91	2146	309	739	48960	4251	53211	159633	
36	1554	1	52	4	3	1011	4	132	449	3	920	13	441	206	643	11704	90	11794	35382	
37	94	0	13	0	2	49	4	352	55	1	188	1	179	16	27	2425	25	2450	7350	
38	297	4	100	16	9	323	0	71	1108	0	124	0	320	60	60	5703	7	5710	17130	
39	2346	62	62	39	3	6218	44	3170	4067	90	18708	80	3272	445	15308	105659	1943	107602	322806	
40	170274	209	244	341	22	9591	848	6624	26262	92	24549	679	20427	1595	10937	420971	15054	436025	1308075	
41	61791	29	116	44	23	3626	471	1757	7993	65	16417	201	10509	717	6757	207545	3861	211406	634218	
42	64403	0	0	0	31	3421	54	9422	4086	0	14381	16	33789	546	29200	277367	11770	289137	867411	
43	14301	0	1	7	0	5883	184	568	3552	1	6478	8	1374	73	3691	98003	403	98406	295218	
44						14													14	
45	391	0	0	8	0	202	0	1713	87	1	1675	35	839	6	1093	11746	162	11908	35710	
46	351	0	0	0	0	19	0	31	216	4	231	0	87	9	12	2232	11	2243	6729	
47	65805	102	110	56	17	1513	833	5386	6278	41	11526	474	3513	1027	6941	174288	4743	179031	537093	
48	986	20	9	7	1	556	9	928	1757	6	253	6	2207	105	239	19566	155	19721	59163	
49	727452	3322	4269	2234	1110	114584	12090	88429	231056	2261	326699	6688	316945	23659	182505	3885482	105524	3991006	11973018	
50	3870	74	54	37	2	361	44	895	1831	67	3209	40	4982	231	761	33708	949	34657	103971	
51	64902	152	414	284	70	7295	1141	5801	19185	248	17341	765	11371	1822	7137	323326	4047	327373	982119	
52	881	140	18	9	4	45	0	97	440	8	361	35	902	69	689	7701	306	8007	24021	
53	26485	69	191	179	35	4826	627	2133	8321	431	6468	146	3815	1017	2061	125877	5912	131789	395367	
54	67838	34	166	52	29	5130	491	4390	10187	80	26163	292	13626	1184	8442	274146	6287	280433	841299	
55	34399	71	80	61	6	15458	280	9099	18770	116	30890	256	13390	2124	22703	323648	3585	327233	981699	
56	104294	123	254	77	20	2604	5323	8830	10969	133	16684	643	7265	1495	8204	273971	11592	285563	856689	
57	222538	1750	2034	889	800	45303	2845	42930	104708	863	179587	2753	199782	11955	97008	1722020	43567	1765587	5296761	
58	225	0	0	0	5	1988	0	203	164	0	149	6	5818	81	2739				17299	
59	299	0	0	0	0	20	0	91	62	0	660	0	1744	23	1817	25292	41	25333	58700	
60	157611	1750	2034	889	764	39874	2791	33214	100396	863	164397	2731	158431	11305	63252	1419361	31756	1451117	4353351	
61	1980111	9057	11749	6056	3186	310190	34931	251033	636523	6468	934101	18306	889023	67215	512015	10855361	287293	11142654	33427962	

Pivot table with causes as rows with nested year as sub-rows and different states as columns and Sparklines showing change data per row over coloumns

Sum of TOTAL KILLED	Column Labels																				
Row Labels	A & N ISLANDS	ANDHRA PRADESH	ARUNACHAL PRADESH	ASSAM	BIHAR	CHANDIGARH	CHHATTISGARH	D & N HAVELI	DAMAN & DIU	DELHI(UT)	GOA	GUJARAT	HARYANA	HIMACHAL PRADESH	JAMMU & KASHMIR	JHARKHAND	KARNATAKA	KERALA	LAKSHADWEEP	MADHYA PRADESH	MAHARASHTRA
AIR-CRASH	0	28	13	0	0	0	9	0	0	0	30	21	12	6	14	4	7	1	1	7	38
STAMPEDE	0	355	0	1	22	0	151	0	0	11	1	66	126	110	0	13	118	106	0	203	351
MINES OR QUARY DISASTER	4	297	3	1	31	0	477	0	1	2	18	179	89	2	15	202	79	151	0	1667	297
TOTAL EXPLOSION	0	928	7	217	282	4	498	2	0	300	13	261	134	14	794	168	151	96	0	440	881
ABORTIONS/CHILD BIRTH	4	162	1	82	104	19	367	8	3	246	11	422	162	22	40	96	136	133	0	1911	4347
FACTORY/MACHINE ACCIDENTS	2	595	5	73	179	4	665	63	14	599	57	1531	497	107	69	248	338	198	0	1050	1227
KILLED BY ANIMALS	20	576	67	969	135	6	843	4	2	54	11	740	135	101	32	504	645	401	0	1113	1554
SPURIOUS/POISIONOUS LIQUOR	0	1091	7	80	737	12	237	0	5	145	0	947	299	76	58	262	1469	15	0	404	391
SUFFOCATION	7	196	5	5	242	18	5316	2	1	118	13	796	277	127	30	348	125	178	0	4828	986
FALL INTO PIT/MANHOLE	38	1697	9	42	201	20	813	12	7	351	236	3119	588	43	38	454	315	817	0	2109	5281
FIRE-ARMS	0	129	51	226	276	7	1050	0	0	440	2	52	212	18	1668	155	340	9	0	1508	300
TOTAL COLLAPSE	22	3076	93	327	1479	22	1004	13	4	840	118	3632	567	229	158	1044	1765	850	4	2952	3870
EPILEPTIC FITS/GIDDINESS	12	1906	5	8	317	21	1035	26	30	290	52	6331	686	99	47	213	1284	1197	1	2085	18045
GAS CYLINDER/STOVE BURST	82	7951	7	160	1352	131	263	96	28	1409	138	8914	1617	125	110	566	3897	376	1	2415	4093
INFLUENCE OF ALCOHOL	37	3347	46	36	962	198	2887	58	30	1376	126	504	2539	767	112	768	3744	1133	0	4992	16097
SNAKE BITE/ANIMAL BITE	8	10191	4	78	611	5	10042	58	0	148	41	6372	656	174	38	369	7793	583	0	25114	14301
ELECTROCUTION	48	13750	42	738	1657	95	5354	80	50	2058	265	6594	3485	166	214	981	4499	2537	1	15828	14834
FOOD POISIONING/ACCIDENTAL INTAKE OF INSECTICIDES ETC	13	3122	17	318	3780	27	6702	3	4	957	31	5252	3659	1154	163	1788	1872	259	0	27123	17267
TOTAL FALLS	156	14885	231	319	1207	265	4829	175	93	4595	1297	14005	2733	3248	671	1442	6092	7965	1	10776	26485
CAUSES NOT KNOWN	171	10254	354	5806	1779	435	20192	122	23	9269	472	7211	2032	681	1088	1680	18999	3449	2	28546	12384
TOTAL FIRE	241	23054	117	1707	5800	279	9417	134	115	5022	584	31355	4474	796	400	3225	18729	3630	5	33245	67838
TOTAL SUDDEN DEATHS	393	10878	180	700	2431	770	7131	262	158	4676	414	28653	8416	2613	974	1810	11943	17815	10	18418	104294
TOTAL POISONING	49	26451	245	2610	7710	169	20677	62	15	3010	142	17570	8867	2453	602	3302	25032	2081	0	58483	34399
TOTAL DROWNING	438	27809	279	4438	4992	67	18213	193	246	1936	2254	21391	5857	1653	640	3170	23408	19871	26	52564	64902
TOTAL TRAFFIC ACCIDENTS	297	187690	1609	27041	59619	1760	41854	660	287	37713	4352	95458	65532	12521	13603	24403	117882	51809	5	105747	222538
TOTAL	3850	335694	3438	46421	91930	4722	161097	2058	1305	81441	11138	250602	113029	26934	22034	46276	243623	118341	58	383712	727452
Grand Total	5892	686112	6835	92403	2E+05	9056	321123	4091	2421	157006	21816	511978	226680	54239	43612	93491	494285	234001	115	787240	1364452

Table of causes in rows arranged in ascending order of total deaths

MAHARASHTRA	MANIPUR	MEGHALAYA	MIZORAM	NAGALAND	ODISHA	PUDUCHERRY	PUNJAB	RAJASTHAN	SIKKIM	TAMIL NADU	TRIPURA	UTTAR PRADESH	UTTARAKHAND	WEST BENGAL	TOTAL (STATES)	TOTAL (UTS)	TOTAL (ALL INDIA)	Grand Total	AO
38	0	10	0	3	0	0	10	16	0	14	0	20	25	2	290	1	291	873	
351	0	0	0	0	19	0	31	216	4	231	0	87	9	12	2232	11	2243	6729	
297	4	100	16	9	323	0	71	1108	0	124	0	320	60	60	5703	7	5710	17130	
881	140	18	9	4	45	0	97	440	8	361	35	902	69	689	7701	306	8007	24021	
4347	11	11	2	0	94	8	158	291	0	220	16	733	67	286	9885	288	10173	30519	
1227	5	14	5	0	273	28	565	947	1	618	3	846	98	192	10406	710	11116	33348	
1554	1	52	4	3	1011	4	132	449	3	920	13	441	206	643	11704	90	11794	35382	
391	0	0	8	0	202	0	1713	87	1	1675	35	839	6	1093	11746	162	11908	35710	
986	20	9	7	1	556	9	928	1757	6	253	6	2207	105	239	19566	155	19721	59163	
5281	6	20	14	4	315	14	473	1566	2	785	37	1218	116	144	20462	442	20904	62712	
300	42	43	22	57	58	0	521	77	6	224	18	16332	201	479	24076	447	24523	73569	
3870	74	54	37	2	361	44	895	1831	67	3209	40	4982	231	761	33708	949	34657	103971	
18045	5	62	4	0	537	1930	980	1724	14	2937	62	873	92	238	40838	2310	43148	129444	
4093	2	37	6	1	542	7	1920	1763	13	8408	13	1577	384	825	47475	1754	49229	147687	
16097	5	71	15	3	460	2552	2306	2676	78	2001	91	2146	309	739	48960	4251	53211	159633	
14301	0	1	7	0	5883	184	568	3552	1	6478	8	1374	73	3691	98003	403	98406	295218	
14834	116	120	62	21	2183	330	3154	7301	59	5033	301	5931	467	1468	97160	2662	99822	299466	
17267	9	4	7	1	3092	48	3296	11009	23	3841	132	7726	1584	2584	105815	1052	106867	320601	
26485	69	191	179	35	4826	627	2133	8321	431	6468	146	3815	1017	2061	125877	5912	131789	395367	
12384	512	466	189	28	19548	120	2218	18512	144	14030	738	15201	996	21468	208977	10142	219119	657357	

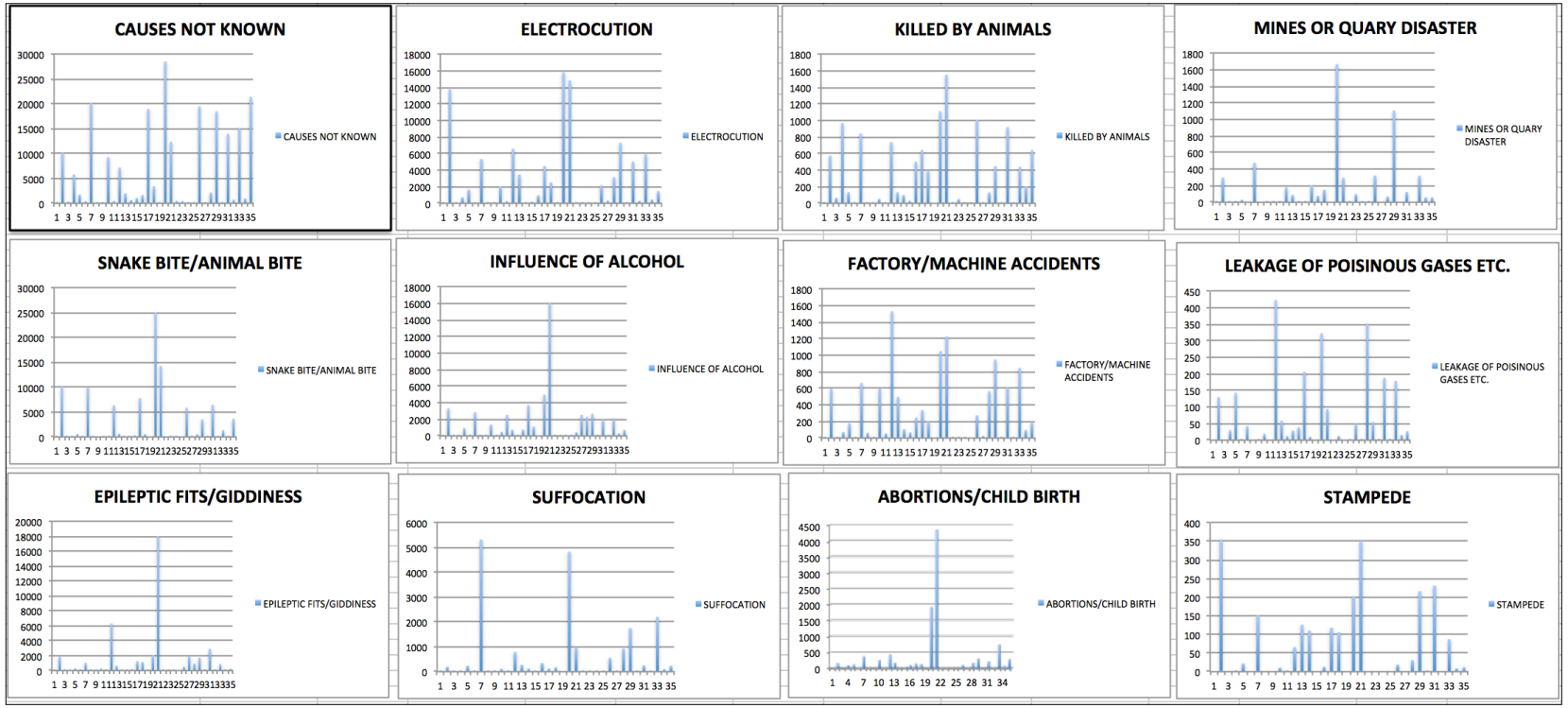
Table of causes in rows arranged in ascending order of total deaths with Sparklines showing deaths in different states due to each cause.

ABORTIONS/CHILD BIRTH	AIR-CRASH	CAUSES NOT KNOWN	ELECTROCUTION	EPILEPTIC FITS/GIDDINESS	FACTORY/MACHINE ACCIDENTS	FIRE-ARMS	FOOD POISIONING/ACCIDENTAL INTAKE OF INSECTICIDES ETC.	GAS CYLINDER/STOVE BURST	INFLUENCE OF ALCOHOL	KILLED BY ANIMALS	LEAKAGE OF POISINOUS GASES ETC.	MINES OR QUARY DISASTER	OTHER	SNAKE BITE/ANIMAL BITE
LAKSHADWEEP	SIKKIM	LAKSHADWEEP	LAKSHADWEEP	NAGALAND	NAGALAND	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADV	LAKSHADWEEP
NAGALAND	MIZORAM	DAMAN & DIU	NAGALAND	LAKSHADWEEP	LAKSHADWEEP	A & N ISLANDS	NAGALAND	NAGALAND	NAGALAND	MANIPUR	MANIPUR	D & N HAVELI	D & N HAV	NAGALAND
SIKKIM	DAMAN & DIU	NAGALAND	ARUNACHAL PRADES	MIZORAM	SIKKIM	DAMAN & DIU	D & N HAVELI	MANIPUR	MANIPUR	DAMAN & DIU	MIZORAM	SIKKIM	NAGALANI	DAMAN & DIU
ARUNACHAL PRADESH	A & N ISLANDS	PUDUCHERRY	A & N ISLANDS	ARUNACHAL PRADESH	A & N ISLANDS	PUDUCHERRY	DAMAN & DIU	MIZORAM	MIZORAM	NAGALAND	D & N HAVELI	CHANDIGARH	DAMAN &	MANIPUR
MIZORAM	D & N HAVELI	D & N HAVELI	DAMAN & DIU	MANIPUR	TRIPURA	D & N HAVELI	MEGHALAYA	ARUNACHAL PRADESH	DAMAN & DIU	SIKKIM	GOA	TRIPURA	A & N ISLA	MEGHALAYA
DAMAN & DIU	PUDUCHERRY	SIKKIM	SIKKIM	ASSAM	CHANDIGARH	GOA	MIZORAM	PUDUCHERRY	ASSAM	MIZORAM	A & N ISLANDS	PUDUCHERRY	MIZORAM	SIKKIM
A & N ISLANDS	MANIPUR	A & N ISLANDS	MIZORAM	A & N ISLANDS	MIZORAM	SIKKIM	MANIPUR	SIKKIM	A & N ISLANDS	D & N HAVELI	ARUNACHAL PRADESH	DAMAN & DIU	PUDUCHEI	ARUNACHAL PRADESH
D & N HAVELI	TRIPURA	MIZORAM	D & N HAVELI	SIKKIM	ARUNACHAL PRADESH	CHANDIGARH	A & N ISLANDS	TRIPURA	ARUNACHAL PRADESH	PUDUCHERRY	DAMAN & DIU	ASSAM	MANIPUR	CHANDIGARH
PUDUCHERRY	CHANDIGARH	ARUNACHAL PRADESH	CHANDIGARH	CHANDIGARH	MANIPUR	KERALA	ARUNACHAL PRADESH	DAMAN & DIU	D & N HAVELI	CHANDIGARH	SIKKIM	HIMACHAL PRADESH	MEGHALA	MIZORAM
MANIPUR	ASSAM	CHANDIGARH	MANIPUR	D & N HAVELI	DAMAN & DIU	TRIPURA	SIKKIM	MEGHALAYA	MEGHALAYA	GOA	CHANDIGARH	DELHI(UT)	GOA	A & N ISLANDS
MEGHALAYA	ODISHA	MEGHALAYA	MEGHALAYA	DAMAN & DIU	MEGHALAYA	HIMACHAL PRA	CHANDIGARH	A & N ISLANDS	SIKKIM	TRIPURA	TRIPURA	ARUNACHAL PRADESH	TRIPURA	TRIPURA
GOA	BIHAR	GOA	HIMACHAL PRADESH	JAMMU & KASHMIR	PUDUCHERRY	MIZORAM	GOA	D & N HAVELI	TRIPURA	A & N ISLANDS	NAGALAND	MANIPUR	SIKKIM	JAMMU & KASHMIR
TRIPURA	DELHI(UT)	MANIPUR	JAMMU & KASHMIR	GOA	GOA	MANIPUR	PUDUCHERRY	JAMMU & KASHMIR	JAMMU & KASHMIR	JAMMU & KASHMIR	PUDUCHERRY	A & N ISLANDS	CHANDIGA	GOA
CHANDIGARH	LAKSHADWEEP	HIMACHAL PRADESH	GOA	MEGHALAYA	D & N HAVELI	MEGHALAYA	TRIPURA	HIMACHAL PRADESH	GOA	MEGHALAYA	KERALA	TOTAL (UTS)	ARUNACH.	D & N HAVELI
HIMACHAL PRADESH	KERALA	TRIPURA	TRIPURA	TRIPURA	JAMMU & KASHMIR	ARUNACHAL PI	JAMMU & KASHMIR	CHANDIGARH	CHANDIGARH	DELHI(UT)	MEGHALAYA	NAGALAND	JAMMU &	UTTARAKHAND
JAMMU & KASHMIR	TOTAL (UTS)	UTTARAKHAND	PUDUCHERRY	UTTARAKHAND	ASSAM	GUJARAT	KERALA	GOA	UTTARAKHAND	ARUNACHAL PRADESH	HIMACHAL PRADESH	JAMMU & KASHMIR	UTTARAKH	ASSAM
UTTARAKHAND	WEST BENGAL	JAMMU & KASHMIR	UTTARAKHAND	HIMACHAL PRADESH	UTTARAKHAND	NAGALAND	ASSAM	ASSAM	ODISHA	TOTAL (UTS)	UTTARAKHAND	MIZORAM	JHARKHAN	DELHI(UT)
ASSAM	NAGALAND	JHARKHAND	ASSAM	JHARKHAND	HIMACHAL PRADESH	ODISHA	DELHI(UT)	CHHATTISGARH	GUJARAT	HIMACHAL PRADESH	DELHI(UT)	GOA	HIMACHAI	HIMACHAL PRADESH
ODISHA	JHARKHAND	BIHAR	JHARKHAND	WEST BENGAL	BIHAR	RAJASTHAN	TOTAL (UTS)	KERALA	WEST BENGAL	PUNJAB	TOTAL (UTS)	BIHAR	KERALA	PUDUCHERRY
JHARKHAND	HIMACHAL PRA	HARYANA	WEST BENGAL	DELHI(UT)	WEST BENGAL	ANDHRA PRAD	HIMACHAL PRADESH	UTTARAKHAND	HIMACHAL PRADESH	BIHAR	WEST BENGAL	UTTARAKHAND	DELHI(UT)	JHARKHAND
BIHAR	KARNATAKA	PUNJAB	BIHAR	BIHAR	KERALA	JHARKHAND	UTTARAKHAND	ODISHA	JHARKHAND	HARYANA	JAMMU & KASHMIR	WEST BENGAL	TOTAL (UT	TOTAL (UTS)
KERALA	MADHYA PRAI	KERALA	DELHI(UT)	ODISHA	JHARKHAND	UTTARAKHANI	JHARKHAND	JHARKHAND	BIHAR	UTTARAKHAND	ASSAM	PUNJAB	ASSAM	PUNJAB
KARNATAKA	CHHATTISGARI	ASSAM	ODISHA	HARYANA	ODISHA	HARYANA	KARNATAKA	WEST BENGAL	KERALA	KERALA	JHARKHAND	KARNATAKA	MAHARAS	KERALA
PUNJAB	MEGHALAYA	GUJARAT	KERALA	UTTAR PRADESH	KARNATAKA	TAMIL NADU	WEST BENGAL	BIHAR	DELHI(UT)	UTTAR PRADESH	CHHATTISGARH	HARYANA	BIHAR	BIHAR
HARYANA	PUNJAB	DELHI(UT)	TOTAL (UTS)	PUNJAB	HARYANA	ASSAM	ODISHA	DELHI(UT)	TAMIL NADU	RAJASTHAN	ODISHA	MEGHALAYA	PUNJAB	HARYANA
ANDHRA PRADESH	HARYANA	TOTAL (UTS)	PUNJAB	CHHATTISGARH	PUNJAB	BIHAR	ANDHRA PRADESH	UTTAR PRADESH	UTTAR PRADESH	JHARKHAND	RAJASTHAN	TAMIL NADU	UTTAR PRA	UTTAR PRADESH
TAMIL NADU	ARUNACHAL PI	ANDHRA PRADESH	HARYANA	KERALA	ANDHRA PRADESH	MAHARASHTR	PUNJAB	HARYANA	PUNJAB	ANDHRA PRADESH	HARYANA	KERALA	CHHATTIS	RAJASTHAN
DELHI(UT)	JAMMU & KAS	MAHARASHTRA	KARNATAKA	KARNATAKA	DELHI(UT)	KARNATAKA	HARYANA	TOTAL (UTS)	HARYANA	TOTAL (UTS)	HARYANA	WEST BENGAL	GUJARAT	RAJASTHA
WEST BENGAL	TAMIL NADU	TAMIL NADU	TAMIL NADU	RAJASTHAN	TAMIL NADU	DELHI(UT)	BIHAR	RAJASTHAN	PUDUCHERRY	KARNATAKA	ANDHRA PRADESH	JHARKHAND	HARYANA	WEST BEN
TOTAL (UTS)	RAJASTHAN	UTTAR PRADESH	CHHATTISGARH	ANDHRA PRADESH	CHHATTISGARH	TOTAL (UTS)	TAMIL NADU	PUNJAB	RAJASTHAN	GUJARAT	BIHAR	MAHARASHTRA	GUJARAT	ODISHA
RAJASTHAN	UTTAR PRADES	RAJASTHAN	UTTAR PRADESH	PUDUCHERRY	TOTAL (UTS)	WEST BENGAL	GUJARAT	MADHYA PRADESH	CHHATTISGARH	CHHATTISGARH	UTTAR PRADESH	ANDHRA PRADESH	MADHYA F	TAMIL NADU
CHHATTISGARH	GUJARAT	KARNATAKA	GUJARAT	MADHYA PRADESH	UTTAR PRADESH	PUNJAB	CHHATTISGARH	KARNATAKA	ANDHRA PRADESH	TAMIL NADU	TAMIL NADU	UTTAR PRADESH	ODISHA	KARNATAKA
GUJARAT	UTTARAKHANI	ODISHA	RAJASTHAN	TOTAL (UTS)	RAJASTHAN	CHHATTISGARI	UTTAR PRADESH	MAHARASHTRA	KARNATAKA	ASSAM	KARNATAKA	ODISHA	ANDHRA P	CHHATTISGARH
UTTAR PRADESH	ANDHRA PRAD	CHHATTISGARH	ANDHRA PRADESH	TAMIL NADU	MADHYA PRADESH	MADHYA PRAI	RAJASTHAN	ANDHRA PRADESH	TOTAL (UTS)	ODISHA	MADHYA PRADESH	CHHATTISGARH	KARNATAI	ANDHRA PRADESH
MADHYA PRADESH	GOA	WEST BENGAL	MAHARASHTRA	GUJARAT	MAHARASHTRA	JAMMU & KAS	MAHARASHTRA	TAMIL NADU	MADHYA PRADESH	MADHYA PRADESH	PUNJAB	RAJASTHAN	WEST BEN	MAHARASHTRA
MAHARASHTRA	MAHARASHTR	MADHYA PRADESH	MADHYA PRADESH	MAHARASHTRA	GUJARAT	UTTAR PRADES	MADHYA PRADESH	GUJARAT	MAHARASHTRA	MAHARASHTRA	GUJARAT	MADHYA PRADESH	TAMIL NA	MADHYA PRADESH

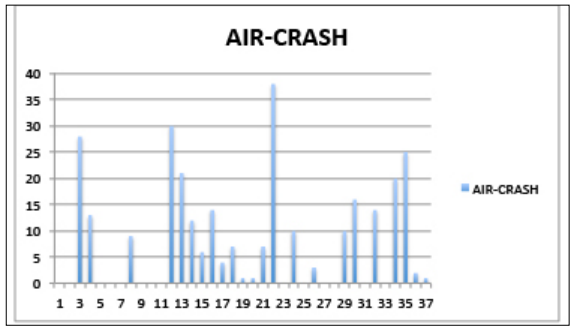
Different states arranged in ascending order of number of deaths due to different causes.

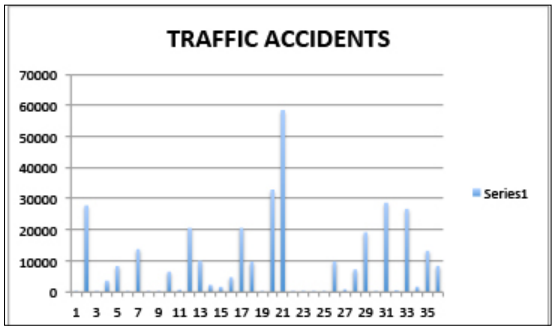
SNAKE BITE/ANIMAL BITE	STAMPEDE	SUFFOCATION	TOTAL	TOTAL COLLAPSE	TOTAL DROWNING	TOTAL EXPLOSION	TOTAL FALLS	TOTAL FIRE	TOTAL POISONING	TOTAL SUDDEN DEATHS	TOTAL TRAFFIC ACCIDENTS
LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWI	NAGALAND	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP	LAKSHADWEEP
NAGALAND	NAGALAND	NAGALAND	NAGALAND	LAKSHADWEEP	CHANDIGARH	DAMAN & DIU	NAGALAND	NAGALAND	NAGALAND	NAGALAND	DAMAN & DIU
DAMAN & DIU	DAMAN & DIU	DAMAN & DIU	DAMAN & D	DAMAN & DIU	NAGALAND	A & N ISLANDS	MANIPUR	MANIPUR	DAMAN & DIU	MIZORAM	A & N ISLANDS
MANIPUR	MANIPUR	D & N HAVELI	D & N HAVE	D & N HAVELI	MANIPUR	PUDUCHERRY	DAMAN & DIU	MIZORAM	A & N ISLANDS	MANIPUR	D & N HAVELI
MEGHALAYA	MEGHALAYA	ARUNACHAL PRAI	MIZORAM	A & N ISLANDS	D & N HAVELI	D & N HAVELI	TRIPURA	SIKKIM	MIZORAM	SIKKIM	NAGALAND
SIKKIM	ARUNACHAL PI	ASSAM	SIKKIM	CHANDIGARH	DAMAN & DIU	CHANDIGARH	A & N ISLANDS	DAMAN & DIU	D & N HAVELI	DAMAN & DIU	SIKKIM
ARUNACHAL PRADESH	CHANDIGARH	TRIPURA	MANIPUR	MIZORAM	SIKKIM	NAGALAND	D & N HAVELI	ARUNACHAL PI	MANIPUR	ARUNACHAL PRADESH	MIZORAM
CHANDIGARH	MIZORAM	SIKKIM	ARUNACHAI	TRIPURA	ARUNACHAL PRADESH	ARUNACHAL PRADESH	MIZORAM	D & N HAVELI	MEGHALAYA	MEGHALAYA	ARUNACHAL PRADESH
MIZORAM	A & N ISLANDS	MIZORAM	A & N ISLAN	PUDUCHERRY	MIZORAM	SIKKIM	MEGHALAYA	MEGHALAYA	SIKKIM	D & N HAVELI	MANIPUR
A & N ISLANDS	TRIPURA	A & N ISLANDS	MEGHALAYA	MEGHALAYA	MEGHALAYA	MIZORAM	ARUNACHAL PRA	A & N ISLANDS	GOA	A & N ISLANDS	CHANDIGARH
TRIPURA	JAMMU & KAS	MEGHALAYA	CHANDIGAR	SIKKIM	A & N ISLANDS	GOA	CHANDIGARH	CHANDIGARH	CHANDIGARH	GOA	MEGHALAYA
JAMMU & KASHMIR	D & N HAVELI	PUDUCHERRY	TRIPURA	MANIPUR	JAMMU & KASHMIR	HIMACHAL PRADESH	ASSAM	TRIPURA	ARUNACHAL PRADESH	TRIPURA	TRIPURA
GOA	PUDUCHERRY	GOA	GOA	ARUNACHAL PRADES	TRIPURA	MEGHALAYA	SIKKIM	JAMMU & KASI	TRIPURA	ASSAM	PUDUCHERRY
D & N HAVELI	GOA	CHANDIGARH	PUDUCHERI	GOA	PUDUCHERRY	TRIPURA	PUDUCHERRY	PUDUCHERRY	PUDUCHERRY	CHANDIGARH	GOA
UTTARAKHAND	ASSAM	MANIPUR	JAMMU & K	JAMMU & KASHMIR	HIMACHAL PRADESH	ODISHA	JAMMU & KASH	GOA	JAMMU & KASHMIR	JAMMU & KASHMIR	UTTARAKHAND
ASSAM	SIKKIM	JAMMU & KASHM	UTTARAKHA	HIMACHAL PRADESH	UTTARAKHAND	UTTARAKHAND	UTTARAKHAND	HIMACHAL PRA	KERALA	UTTARAKHAND	HIMACHAL PRADESH
DELHI(UT)	UTTARAKHANI	UTTARAKHAND	HIMACHAL I	UTTARAKHAND	DELHI(UT)	KERALA	BIHAR	UTTARAKHANI	UTTARAKHAND	JHARKHAND	JAMMU & KASHMIR
HIMACHAL PRADESH	DELHI(UT)	DELHI(UT)	JHARKHANI	ASSAM	GOA	PUNJAB	GOA	ASSAM	HIMACHAL PRADESH	BIHAR	JHARKHAND
PUDUCHERRY	TOTAL (UTS)	KARNATAKA	ASSAM	ODISHA	JHARKHAND	HARYANA	JHARKHAND	JHARKHAND	ASSAM	ODISHA	ASSAM
JHARKHAND	WEST BENGAL	HIMACHAL PRADE	DELHI(UT)	HARYANA	TOTAL (UTS)	MANIPUR	WEST BENGAL	KERALA	DELHI(UT)	HIMACHAL PRADESH	DELHI(UT)
TOTAL (UTS)	JHARKHAND	TOTAL (UTS)	PUNJAB	WEST BENGAL	ASSAM	KARNATAKA	PUNJAB	PUNJAB	JHARKHAND	DELHI(UT)	CHHATTISGARH
PUNJAB	ODISHA	KERALA	BIHAR	DELHI(UT)	BIHAR	JHARKHAND	HARYANA	HARYANA	TOTAL (UTS)	PUDUCHERRY	PUNJAB
KERALA	BIHAR	ANDHRA PRADESH	TOTAL (UTS	KERALA	PUNJAB	ASSAM	HIMACHAL PRAI	DELHI(UT)	BIHAR	CHHATTISGARH	TOTAL (UTS)
BIHAR	PUNJAB	WEST BENGAL	HARYANA	PUNJAB	HARYANA	GUJARAT	UTTAR PRADESH	ODISHA	HARYANA	UTTAR PRADESH	ODISHA
HARYANA	GUJARAT	BIHAR	ODISHA	TOTAL (UTS)	WEST BENGAL	BIHAR	DELHI(UT)	BIHAR	PUNJAB	WEST BENGAL	KERALA
UTTAR PRADESH	UTTAR PRADES	TAMIL NADU	KERALA	CHHATTISGARH	ODISHA	DELHI(UT)	ODISHA	TOTAL (UTS)	UTTAR PRADESH	HARYANA	BIHAR
RAJASTHAN	KERALA	HARYANA	CHHATTISGA	JHARKHAND	UTTAR PRADESH	TOTAL (UTS)	CHHATTISGARH	WEST BENGAL	ODISHA	PUNJAB	HARYANA
WEST BENGAL	HIMACHAL PRA	JHARKHAND	WEST BENG	BIHAR	TAMIL NADU	TAMIL NADU	TOTAL (UTS)	CHHATTISGARH	GUJARAT	ANDHRA PRADESH	GUJARAT
ODISHA	KARNATAKA	ODISHA	RAJASTHAN	KARNATAKA	CHHATTISGARH	RAJASTHAN	KARNATAKA	RAJASTHAN	RAJASTHAN	RAJASTHAN	WEST BENGAL
GUJARAT	HARYANA	GUJARAT	KARNATAKA	RAJASTHAN	RAJASTHAN	MADHYA PRADESH	TAMIL NADU	UTTAR PRADES	CHHATTISGARH	TOTAL (UTS)	RAJASTHAN
TAMIL NADU	CHHATTISGARI	PUNJAB	GUJARAT	MADHYA PRADESH	KERALA	CHHATTISGARH	KERALA	KARNATAKA	WEST BENGAL	KARNATAKA	MADHYA PRADESH
KARNATAKA	MADHYA PRAI	MAHARASHTRA	UTTAR PRAI	ANDHRA PRADESH	GUJARAT	WEST BENGAL	RAJASTHAN	ANDHRA PRAD	KARNATAKA	TAMIL NADU	KARNATAKA
CHHATTISGARH	RAJASTHAN	RAJASTHAN	TAMIL NADI	TAMIL NADU	KARNATAKA	JAMMU & KASHMIR	MADHYA PRADE	TAMIL NADU	ANDHRA PRADESH	KERALA	TAMIL NADU
ANDHRA PRADESH	TAMIL NADU	UTTAR PRADESH	ANDHRA PR	GUJARAT	ANDHRA PRADESH	MAHARASHTRA	GUJARAT	GUJARAT	TAMIL NADU	MADHYA PRADESH	ANDHRA PRADESH
MAHARASHTRA	MAHARASHTR	MADHYA PRADESI	MADHYA PR	MAHARASHTRA	MADHYA PRADESH	UTTAR PRADESH	ANDHRA PRADE	MADHYA PRAD	MAHARASHTRA	GUJARAT	UTTAR PRADESH
MADHYA PRADESH	ANDHRA PRAD	CHHATTISGARH	MAHARASH	UTTAR PRADESH	MAHARASHTRA	ANDHRA PRADESH	MAHARASHTRA	MAHARASHTRA	MADHYA PRADESH	MAHARASHTRA	MAHARASHTRA

6.3 Comparison and Contrast

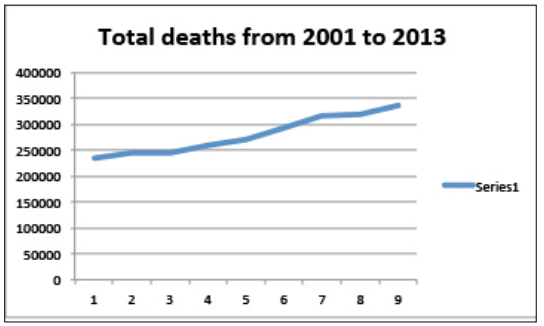


Initial Bar charts showing trends of deaths due to different causes.

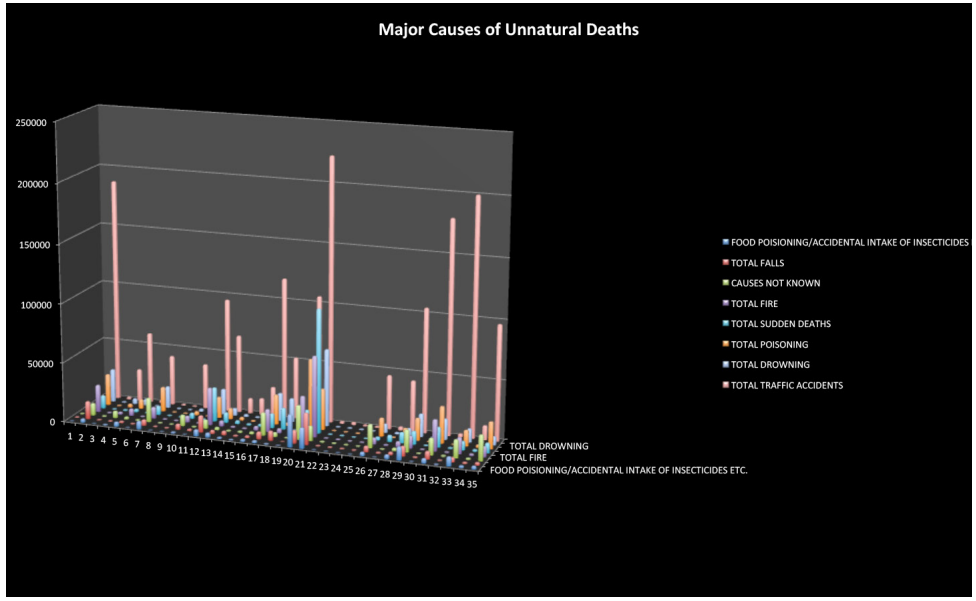




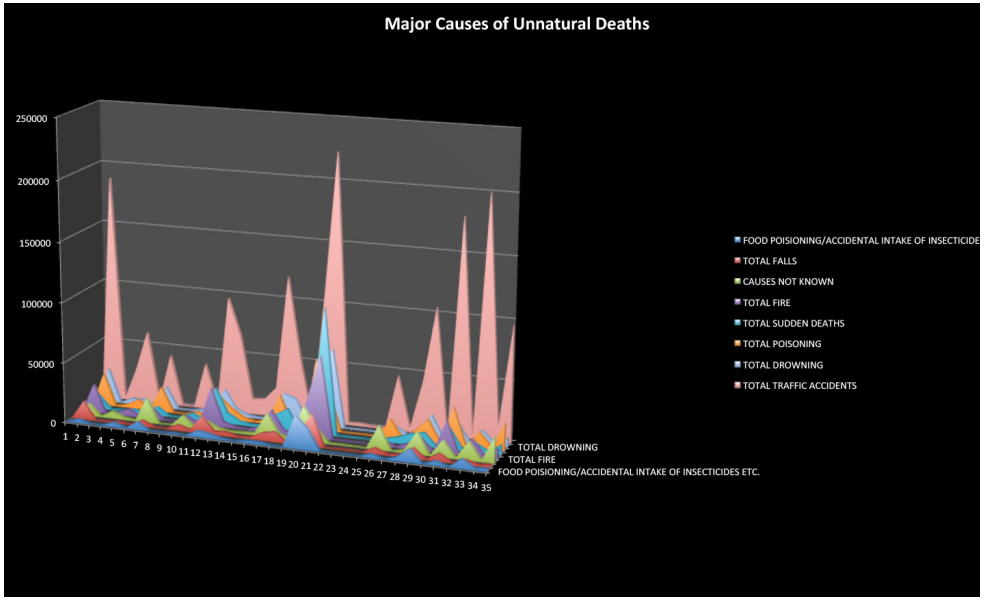
Bar charts showing trends of deaths due to air-crash and traffic accidents, The lowest and highest cause of unnatural deaths.



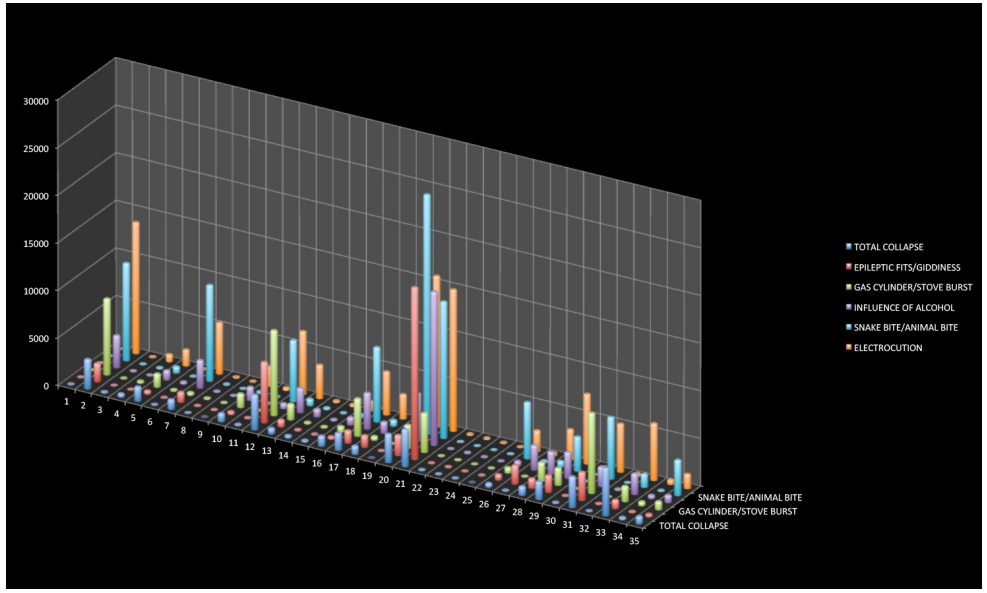
Bar charts showing total number of unnatural deaths from 2001 to 2013



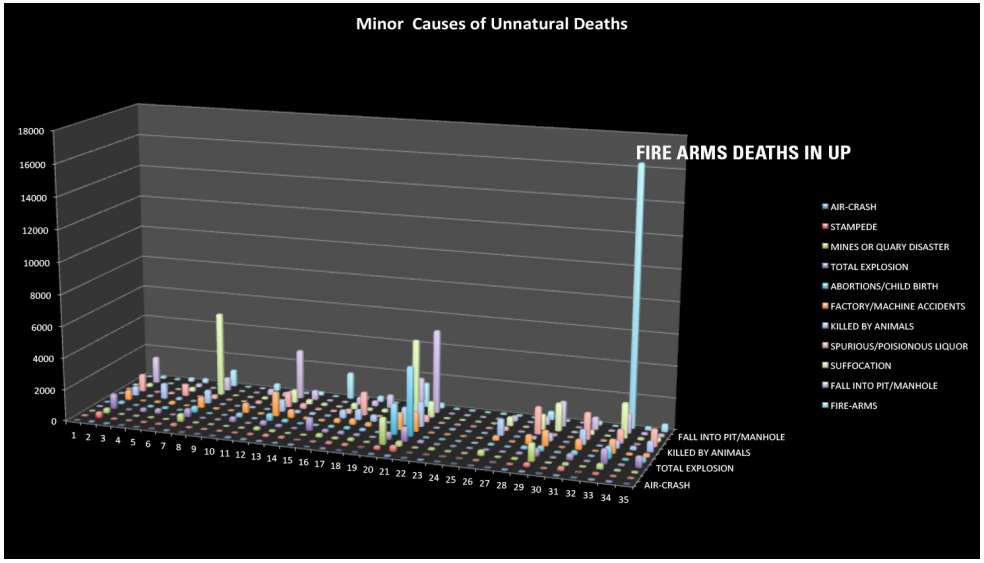
3D Bar charts showing causes that cause more than 1,00,000 deaths



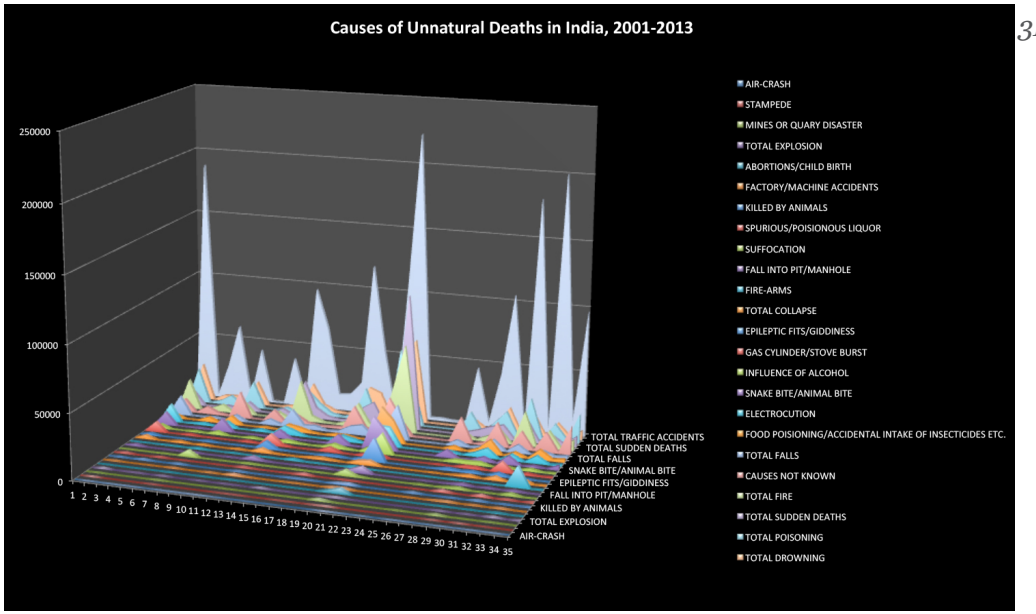
3D Area charts showing causes that cause more than 1,00,000 deaths



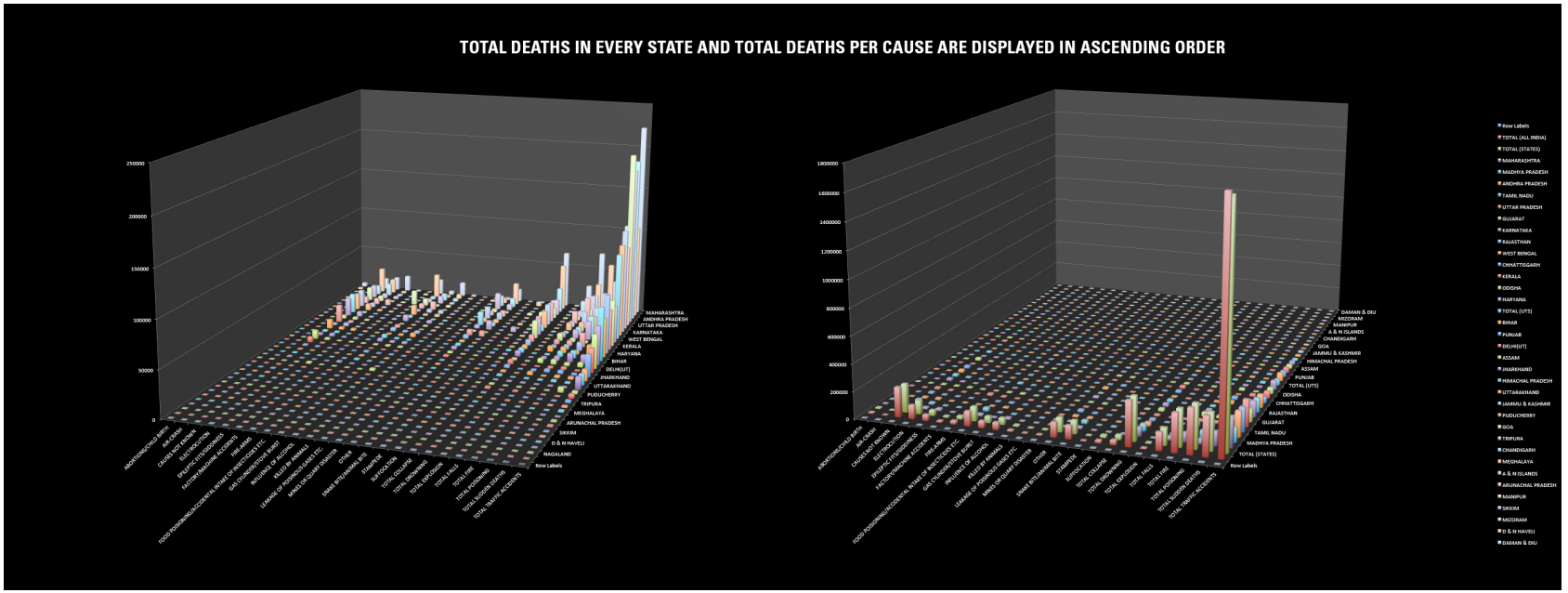
3D Bar charts showing causes that cause 1,00,000 to 30,000 deaths

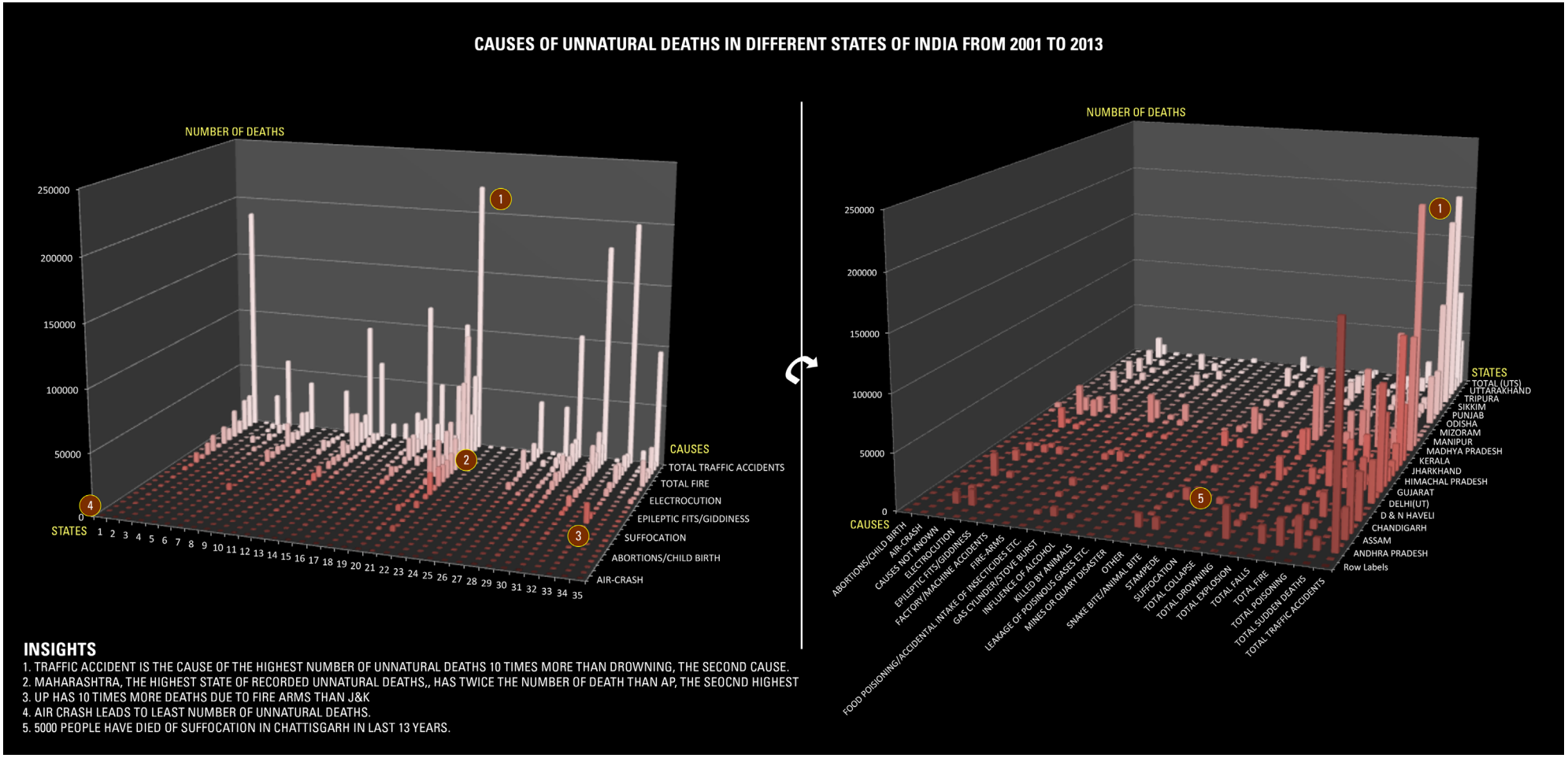


3D Bar charts showing causes that caused 30,000 to 0 deaths



3D Area chart of deaths due to unnatural causes in different states of India





3D Bar chart of deaths due to unnatural causes in different states of India from two angles, second rotated 90 degrees clockwise, with insights marked at the bottom

7. Insights

39,91,006 people have died in India due to unnatural deaths from 2001 to 2013.

Traffic accidents cause much more deaths than any other cause, killing 17,65,587 people.

3,27,373 died due to drowning which is the second leading cause of death, which shows that traffic accidents kill 5 times more people than drowning does.

Only 291 people have died due to air crash.

Highest deaths to be recorded are in Maharashtra - 7,27,452.
Second, Madhya pradesh - 3,83,71
Third, Andhra Pradesh - 3,35,694
Fourth, Tamil Nadu - 3,26,699

Deaths in Maharashtra seem to be almost twice as compared to other 3 states which have more or less similar count.

North Eastern states and Union territories have least amounts of deaths in almost all cases.

Zones of Causes

Causes can be divided in following zones according to the total number of deaths they have caused over the years (Top three states are given in brackets):

Major Cause of Deaths
Traffic accidents : 17,65,587 (Maharashtra, UP, AP)

4,00,000 to 1,00,000 Deaths
Drowning : 3,27,373 (Maharashtra, MP, AP)
Poisoning : 3,27,233 (MP, Maharashtra, TN)
Sudden deaths : 2,85,563 (Maharashtra, Gujarat, MP)
Fire : 2,80,433 (Maharashtra, MP, Gujarat)
Cause unknown : 2,19,119 (MP - 28,546, WB, Chhattisgarh)
Falls : 1,31,789 (Maharashtra, AP, Gujarat)
Food poisoning : 1,06,867 (MP, Maharashtra, Rajasthan)

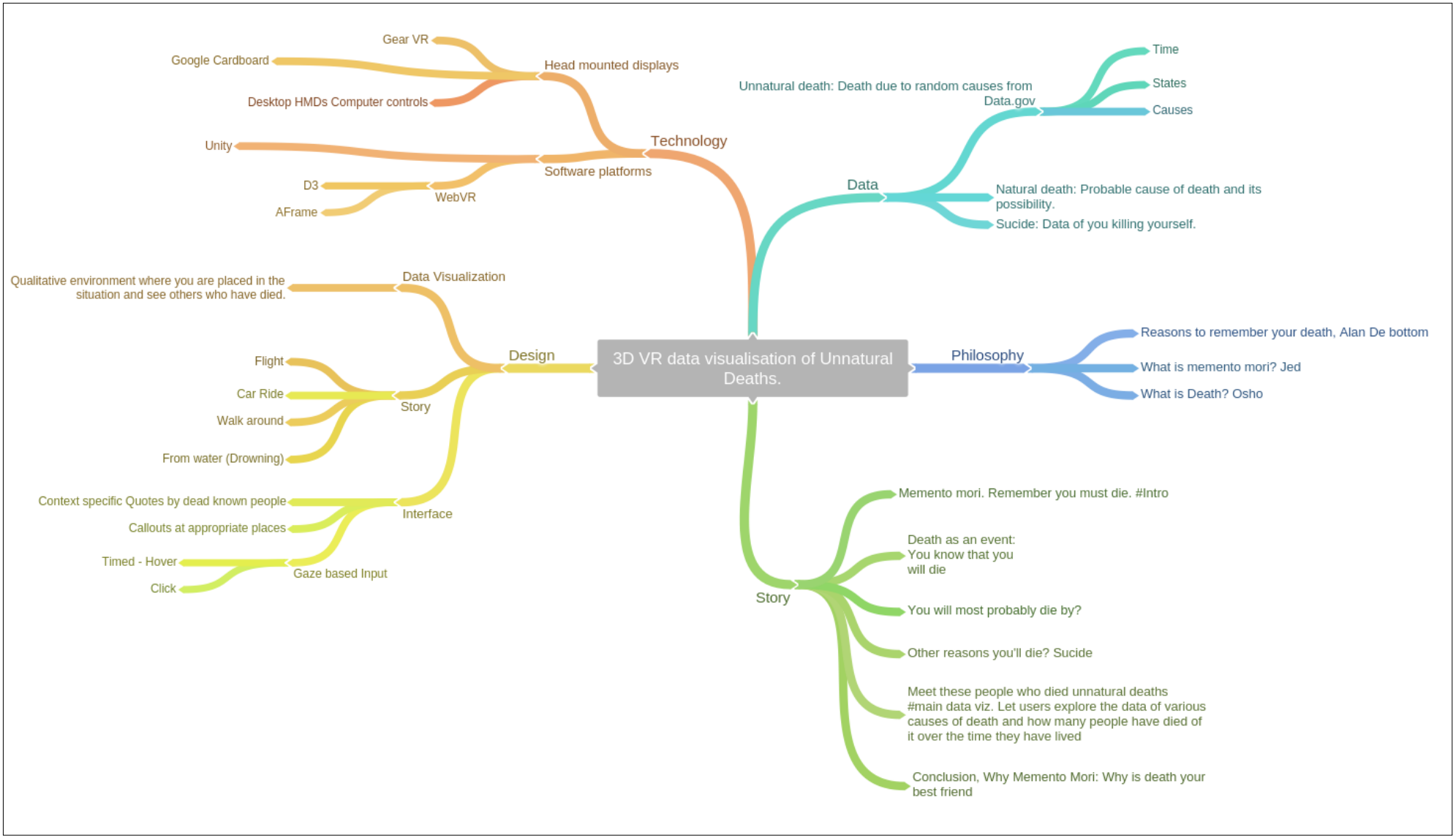
1,00,000 to 30,000 Deaths
Electrocution : 99,822 (MP, Maharashtra, AP)
Snake/Animal Bite : 98,406 (MP, Maharashtra, AP)
Gas cylinder burst : 49,229 (Gujarat, TN, AP)
Epileptic Fits/Giddiness : 43,148 (Maharashtra, Gujarat, TN)
Collapse : 34,657 (UP, Maharashtra, Gujarat)

30,000 to 0 Deaths
Fire-arms : 24,523 (UP - 16332, J&K - 1668, MP)
Suffocation : 19,721 (Chattisgarh - 5316, MP, UP)
Killed by Animals : 11,794 (Maharashtra, MP, Orissa)
Factory accidents : 11,116 (Gujarat, Maharashtra, MP)
Abortion : 10,173 (Maharashtra, MP, UP)
Explosion : 8,007 (AP, UP, Maharashtra)
Stampede : 2,243 (AP, Maharashtra, TN) and

Least amounts of deaths
Air crash : 291 (Maharashtra, Goa, AP)

Some facts from above,
UP has a epic proportion of deaths due to firearms, almost ten times more than J&K, the second state in the line.
Maharashtra comes in top three in almost all the cases.
More than 5,000 people have died due to suffocation in Chattisgarh.
The cause of 7% of sudden deaths in MP in unknown.

8. Mind Map



Mind Map of the general direction of the project

9. Design Idea

Qualities of Virtual Reality (VR) are immersion and subjectivity and a popular method of data storytelling is personalisation which can make good use of this quality of the medium. Personalisation is to try to create story consciously to connect directly to the audience and their need to understand certain things. To do this, often the best way is to allow them to make the story about themselves. [4] Power of medium like Virtual Reality to create immersion and subjectivity can be used to create this effect.
As far as abstract theme like death is concerned it is tainted by discomfort, fear, negativity and taboo. But according to many traditions and philosophies, reminder of death is a very positive thing for a mature human adult. The idea is to recall one's own death as against death as an event that takes place in everyone's lives. In art, 'Mementos Mori' are artistic or symbolic reminders of mortality. In practice people used to keep skull on dead men as a reminder of their own death.
I think, this data of unnatural deaths can be used in this context of 'Mementos Mori'. In the sense that looking at these people who have died of these unnatural causes might remind the viewer of his own mortality.

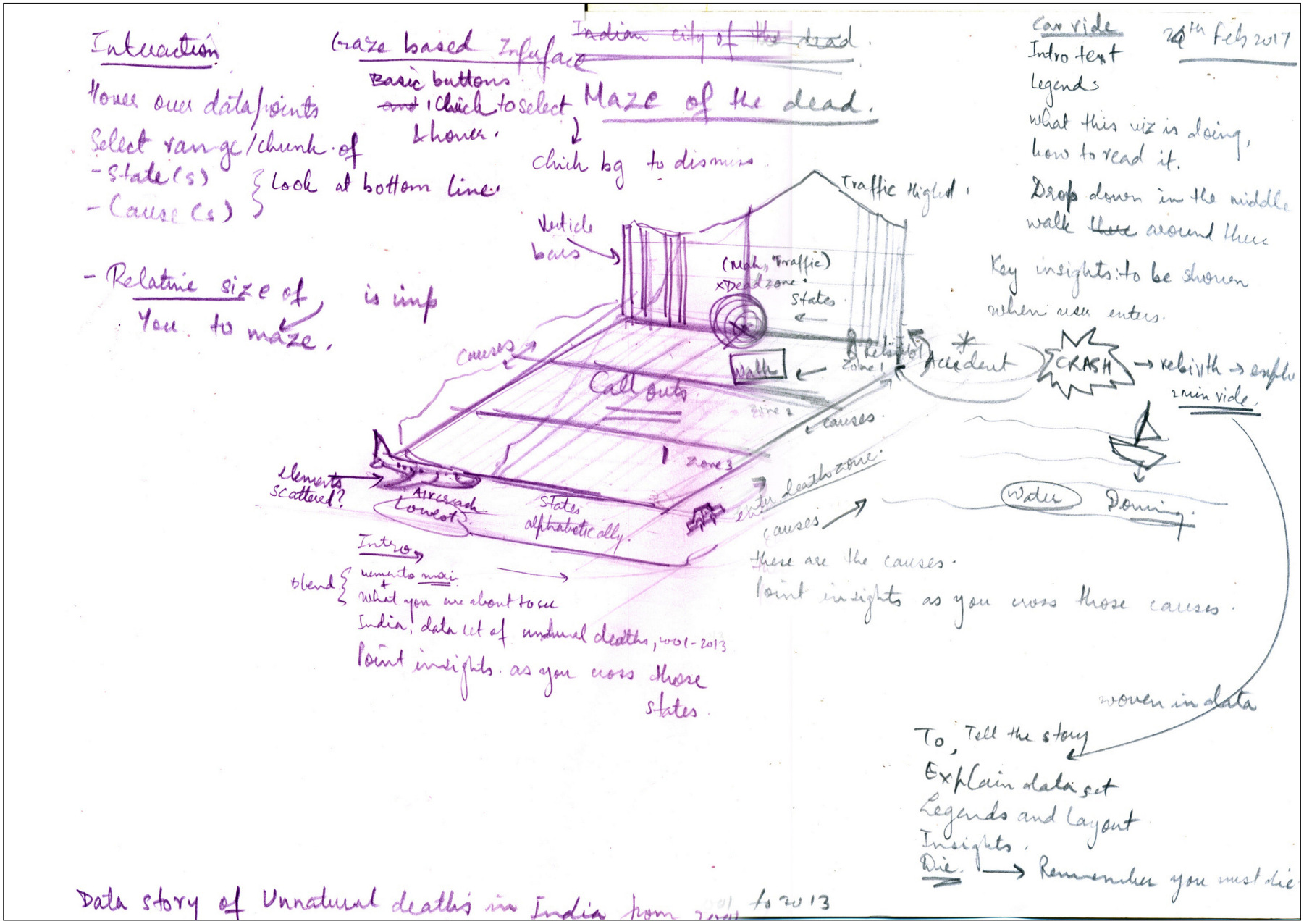
As stated by these syllogisms,

From
"Major premise: All mortals die.
Minor premise: All men are mortals.
Conclusion: All men die.
,
All men are mortals.
Socrates is a man.
Socrates is a mortal.

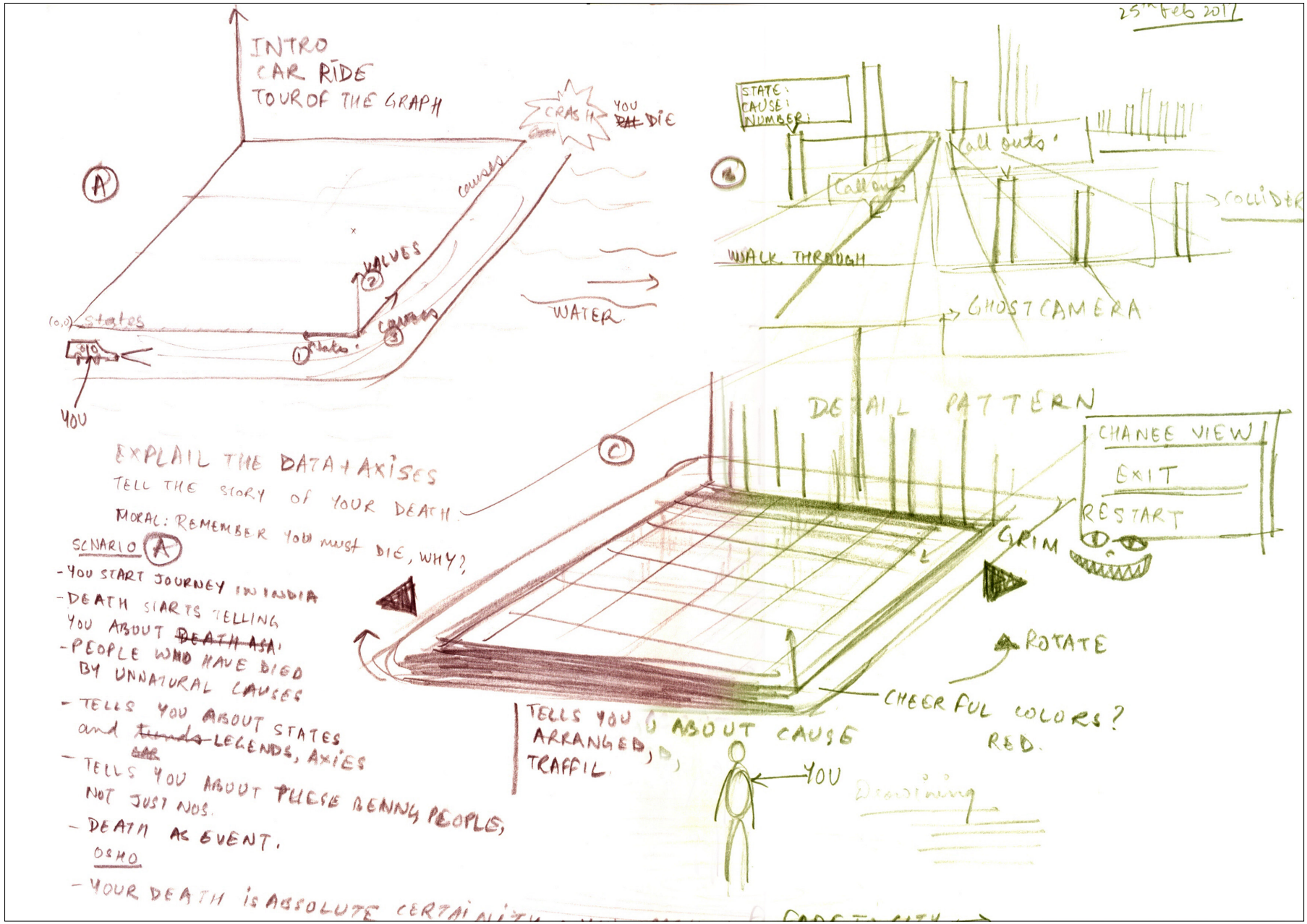
To
If All humans are mortals.
And You are a human.
Then You are a mortal.

Remember you must die.
Done."[10]

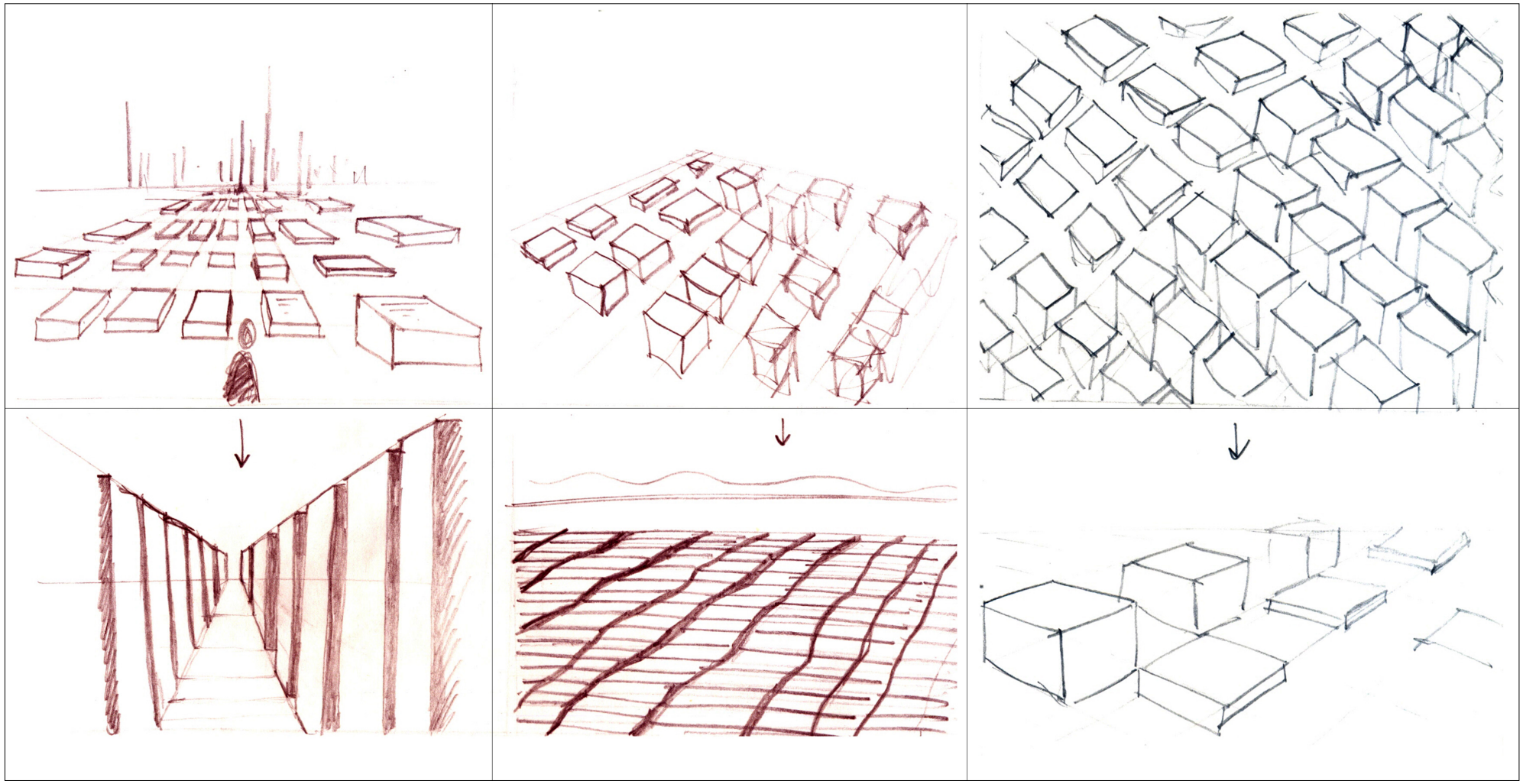
The visualisation spaces can be designed to keep the user in the situations in which these deaths have occurred and here he can do the data exploration of deaths of these people. So the idea is to keep the user in the situation / environment where he can find himself about to die and explore the data of people who have died of those causes and perhaps remind himself that death as his most certain subjective possibility.



First drawing of the city of the dead with all major points highlighted

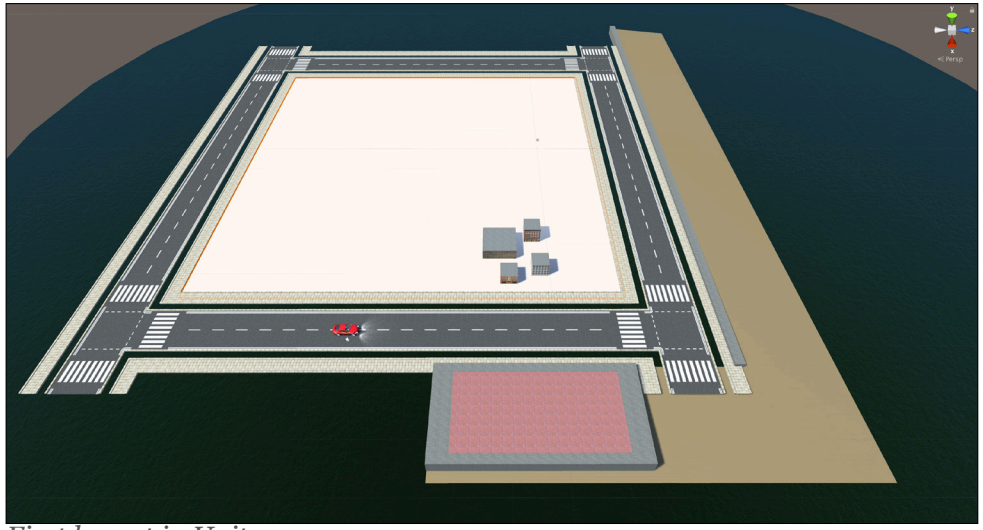


Different views of the city; car drive, walk and from water



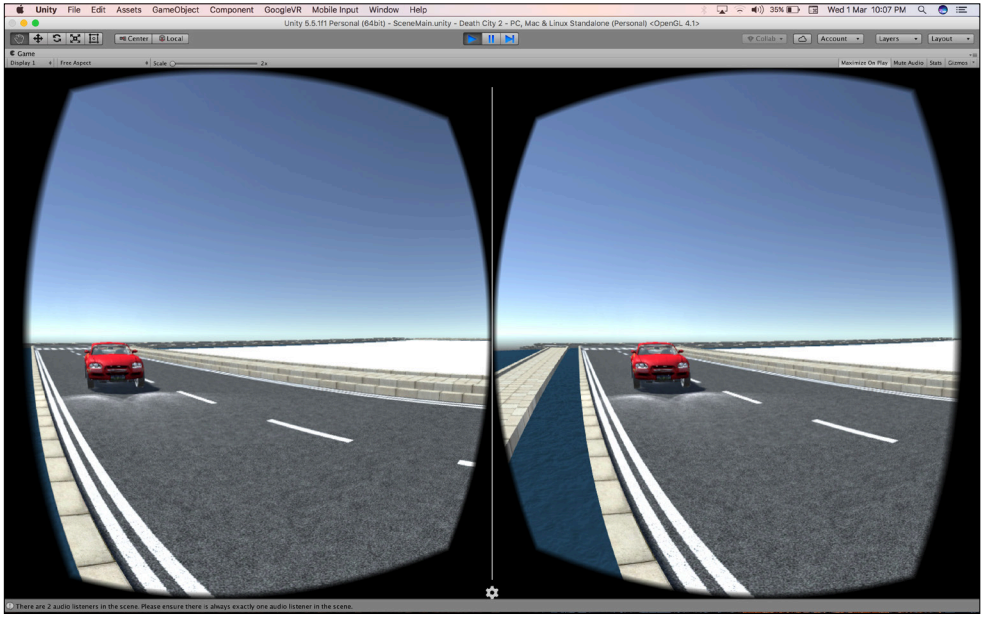
Drawings of diffrent views / perspectives from which the visualisation can be viewed

9.1 Prototype 2

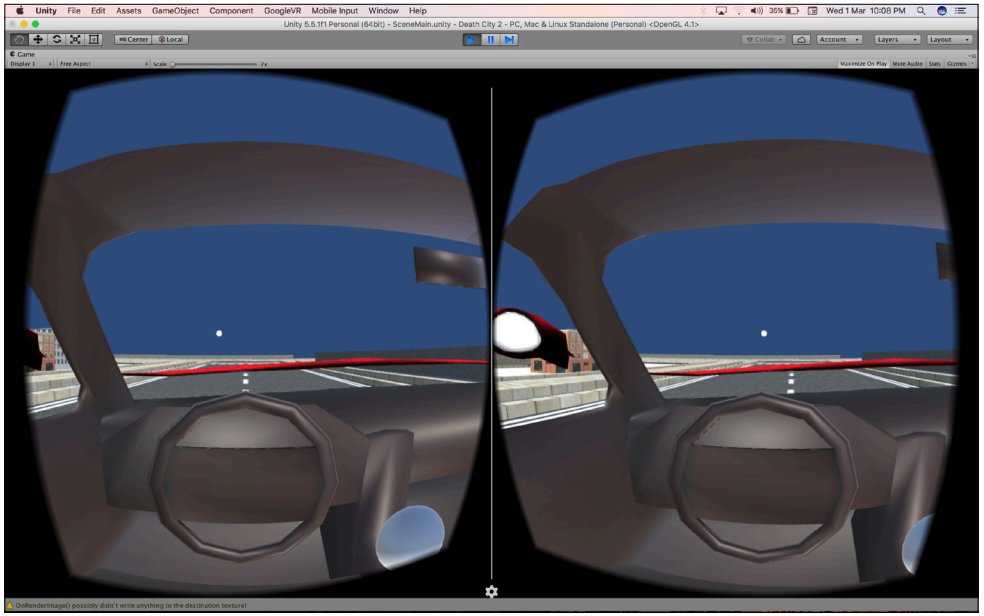


First layout in Unity

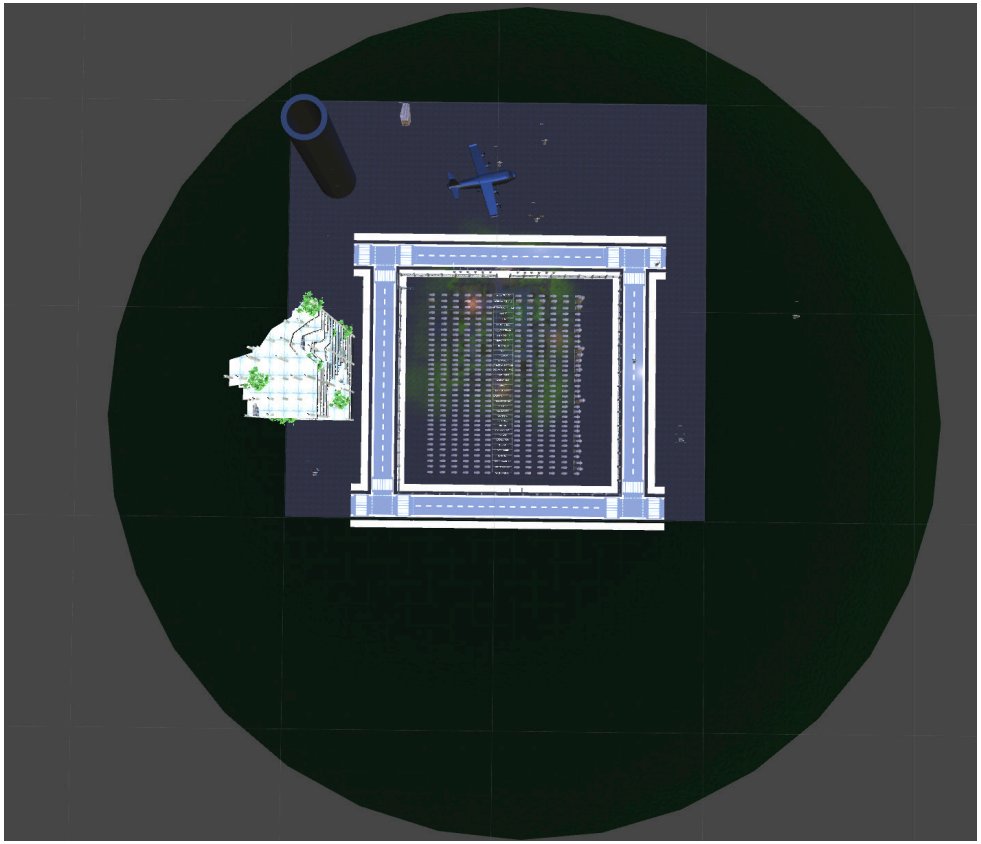
At this stage, the feedback from Prof. Girish Dalvi was to make the visualizations work in 3D space.
While Prof. Jayesh Pillai and Prof. Venkatesh Rajamanickam suggested me to work on the story to deliver the visualizations.
Resulting in the following iteration of the visualisation.



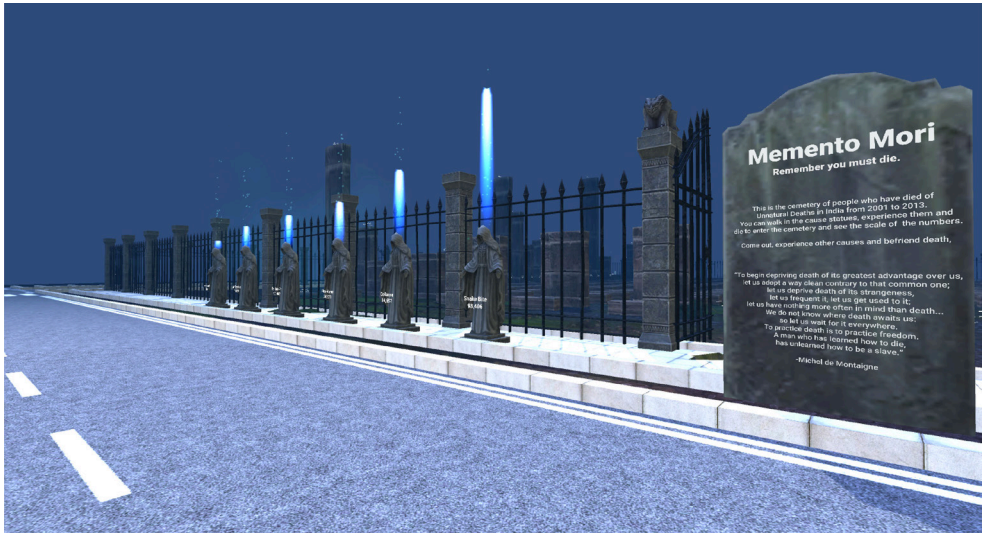
VR view, Walking through the scene



VR view, Driving the car



Layout of the first iteration



View of the first iteration

Visualisation in the first iteration

At this the feedback from Prof. Anirudha Joshi included the following points,

- How do I let people answer questions from the data? (Arrangement, Compare/Contrast, Sorting Mechanism, include other datasets)
- How is 3D helping over 2D? (Using depth and space)
- Aesthetics: Doesn't look Indian now, make it look Indian.
- What's your design contribution?

The final design tries to implement these suggestions.

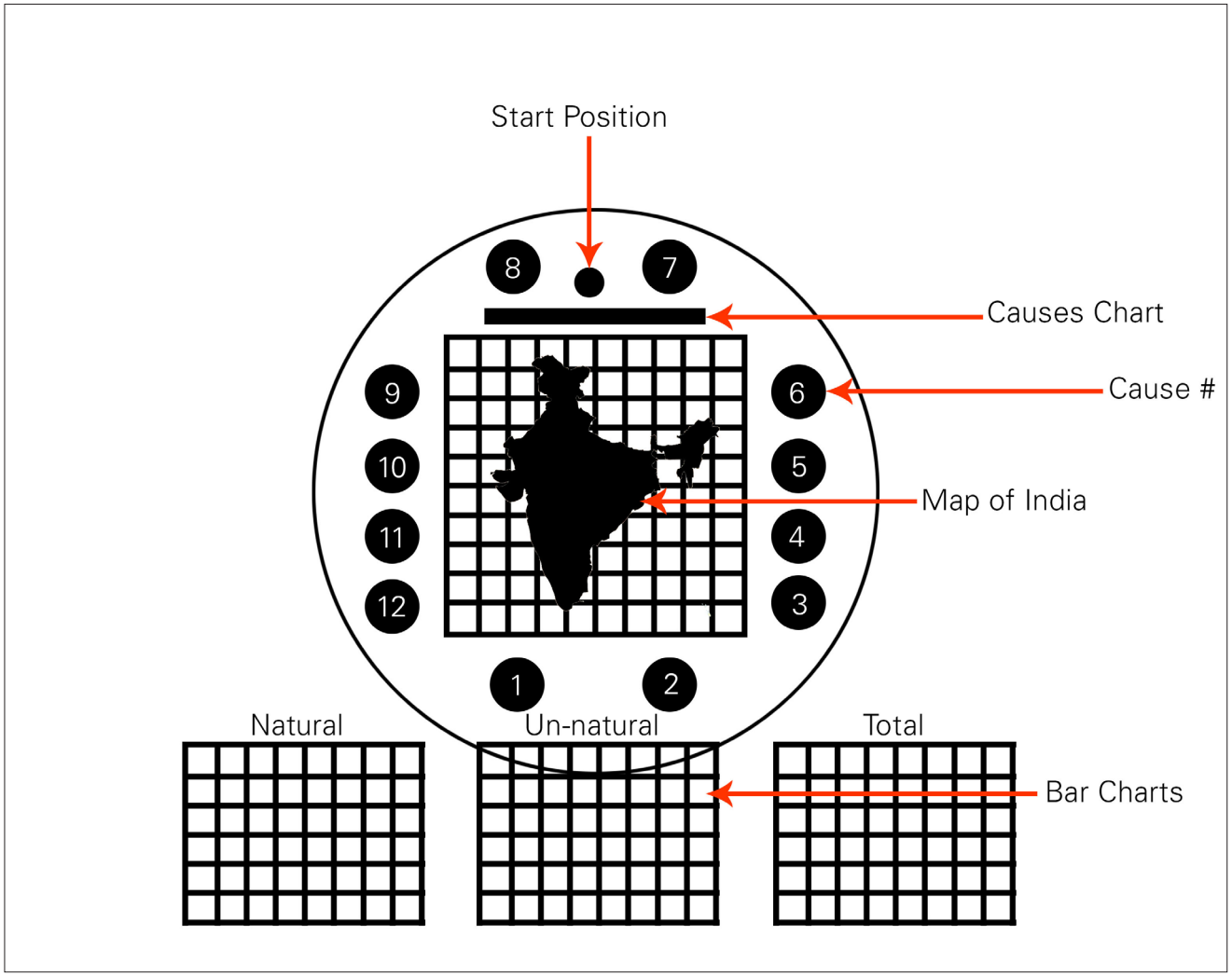
10. Final Design

10.1 Overview

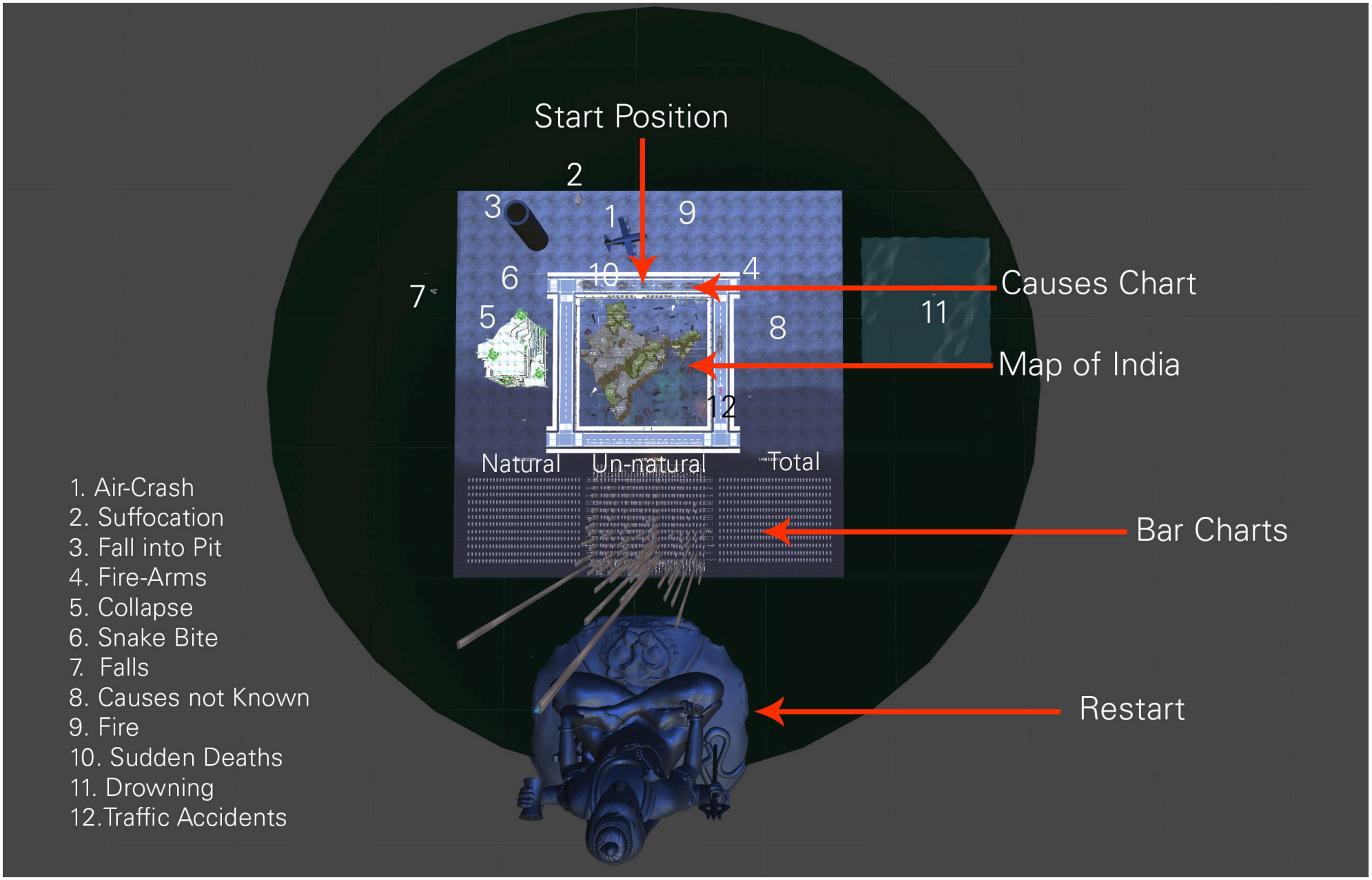
The final design is inspired from a talk by Osho on death where he suggests that the cemetery should be at the center of the city to remind people that, "*This is the final destination.*"[9]
So the land of dead is this final destination. Physically, its a place where the viewer is alone and is there to turn towards death, face it. Late night, just before dawn, it is dark and foggy with a dim light just enought to see what's ahead. The land of dead is a place with the record of all the people who live and dead people who once lived. It's Shiva place. There are two player states, alive and dead, both played by the viewer, alive as a human where he can walk around and dead as a ghost where he can fly. It's a perpetual loop in which the viewer enters the place, experiences the cause of death and dies till he realises the distinction of death as an event versus death as a absolute certainty as said in existentialism. According to Heidegger, this analysis enables us to have an understanding of our finitude, and this awareness makes authentic existence possible.[8]
Using the data in this way makes sense as it serves this purpose in addition to just making comparisions and looking for insights from the data, which is fine. But the nature of this perticular dataset in this medium allows for its use in a different context.

10.2 Layout

As traffic accidents and drowning are the causes of highest number of unnatural deaths, the city is made on water with roads and cemetary at the center and beyond.
To give the experience of death, the causes are given in front which takes the user to the actual situations spread around the city. You die in these death situations and enter the cemetary as a ghost, where you can navigate through the data.
Here the first visualisation of the map shows you values in different states. Then you turn towards death and see the cemetary has coffins arranged as bar charts scaled to the value of death caused by different causes in all the states along with natural deaths and total population.



Layout Design of the Final Concept

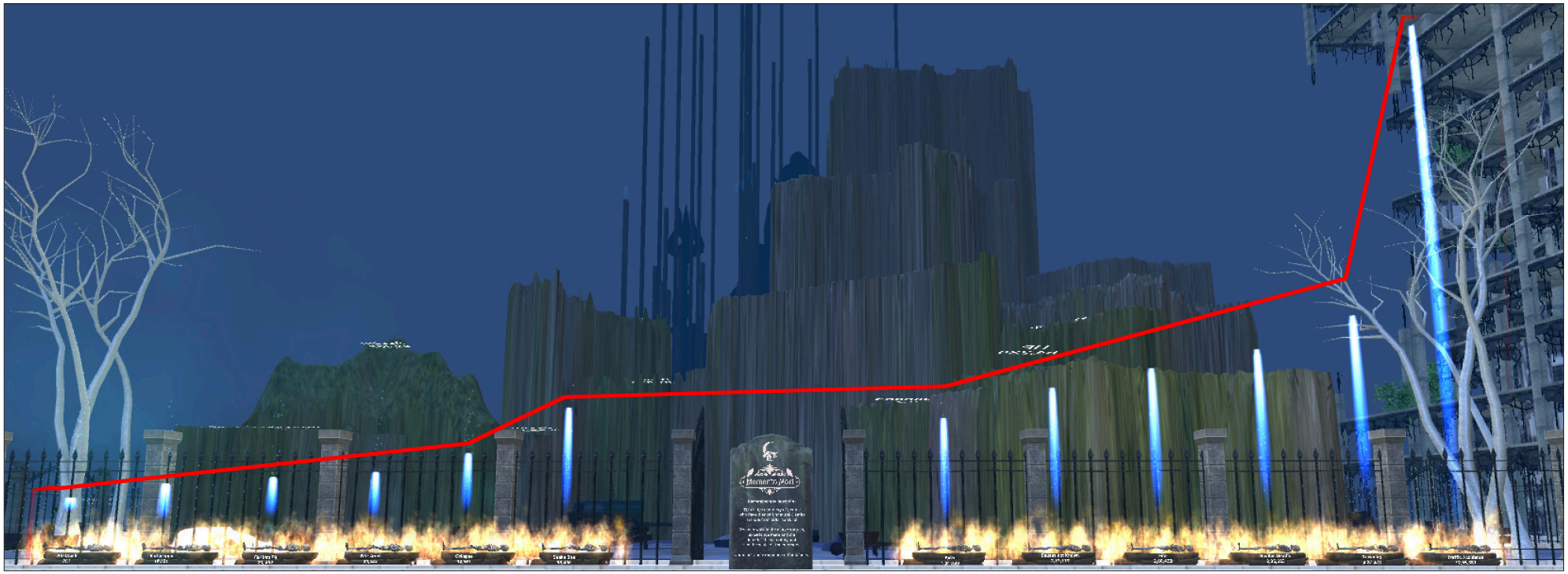


Layout of Final Design - Top View

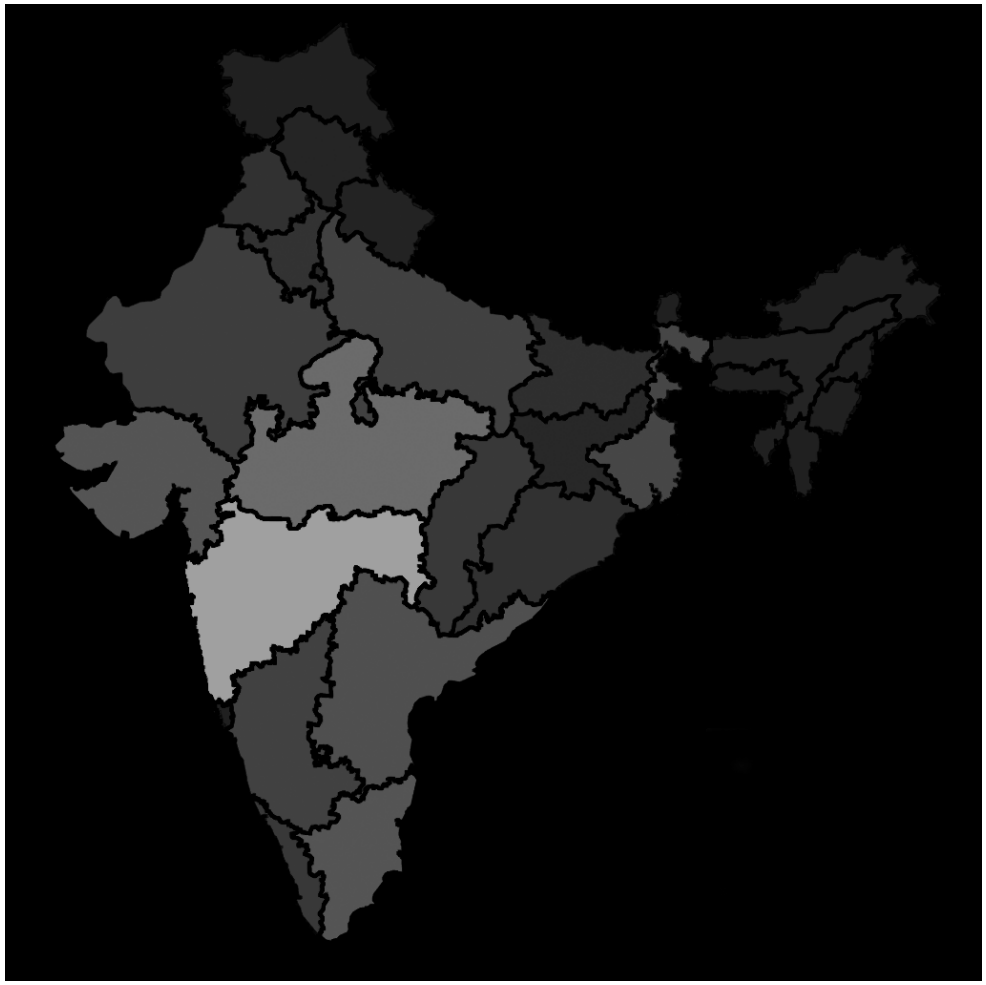
10.3 Visualisations

The approach of showing the visualisation with the story is used to reveal the information in layers. First the overview of data, then some deatils, then more deatils till the most detailed visuals in the end. The visualisations are shown in four levels. The first one is a basic bar chart that shows the comparisions of deaths due to different causes. The next is the information of three states with the expereince of the cause of death. Then comes the map where one can see the data in different states and the final bar chart has all the data of deaths in all the states and by all the causes. Thus increasing complexicity of the visualisation lets the viewer though different kinds of data visualisations.

1. Bar chart of death causes with light beams scaled to the values

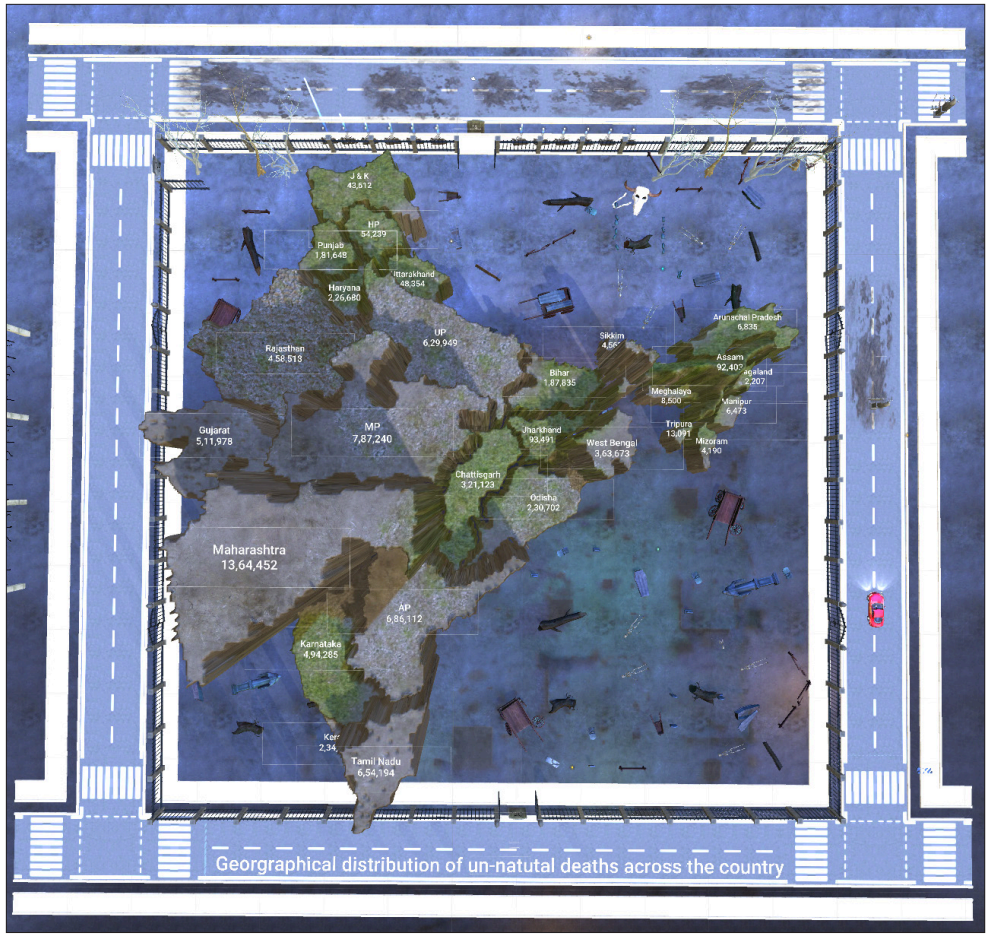


2. Bar charts of leading states in every cause situation

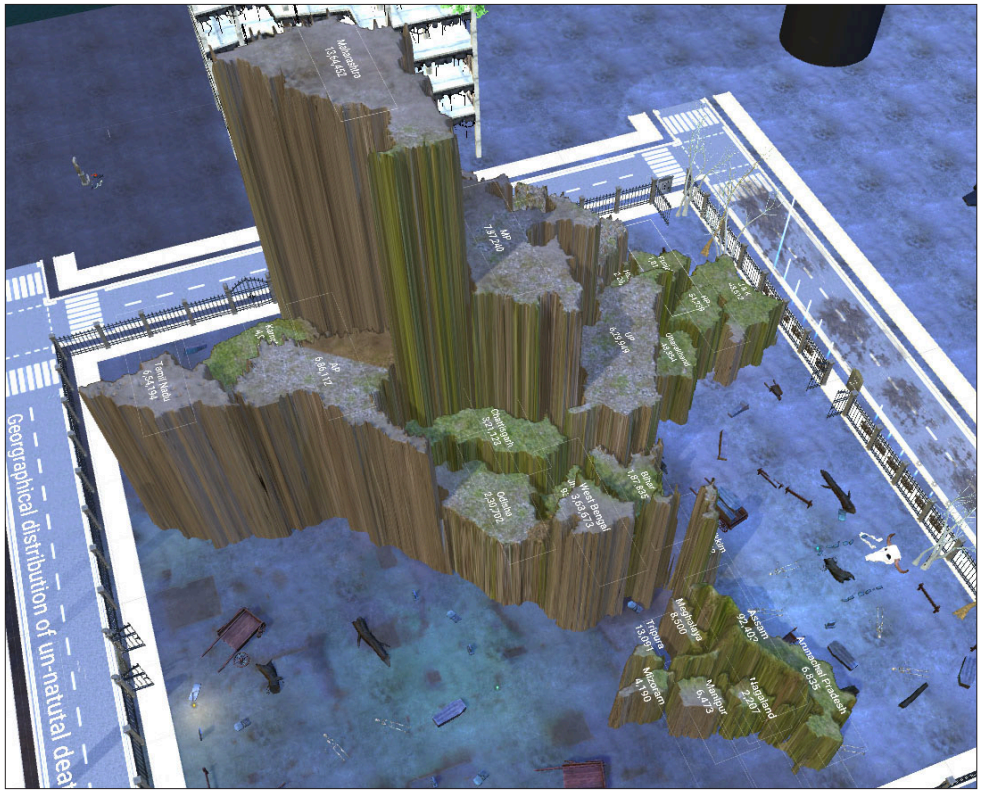


3. Height map generated by plotting the number of deaths in various states

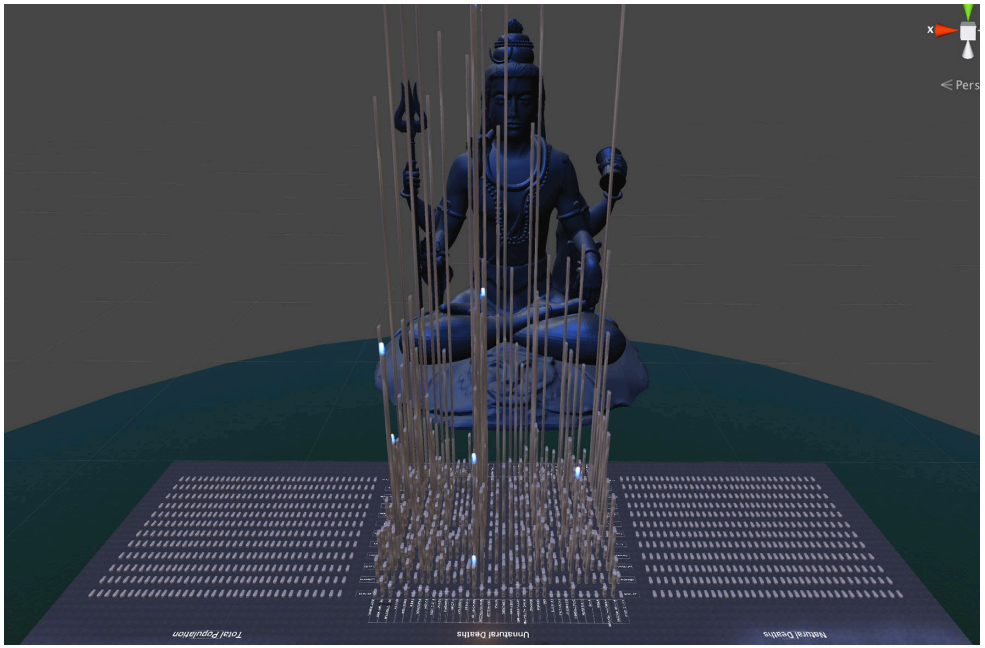
The above height map was generated by plotting the number of deaths in different states on the map surface. It was then used to generate the protruded map of India in unity. Lighter area corrosponds to higher value and is scaled appropriately using a script that converts height maps to terrains.
At present the map of total deaths is only there but it would make sense if the map changes according to the cause one enters from.



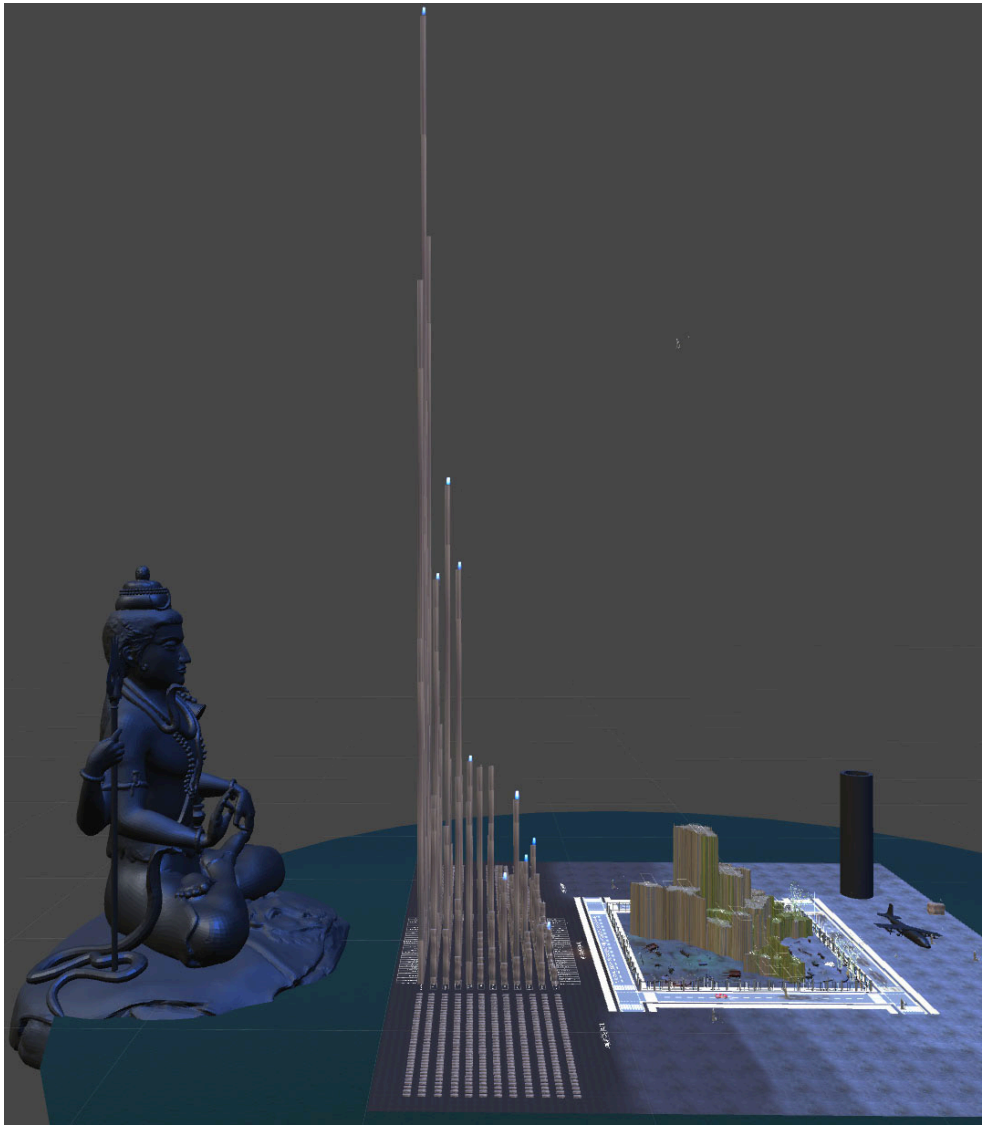
3. Map to show geographical distribution of totale number of unnatural deaths in the country



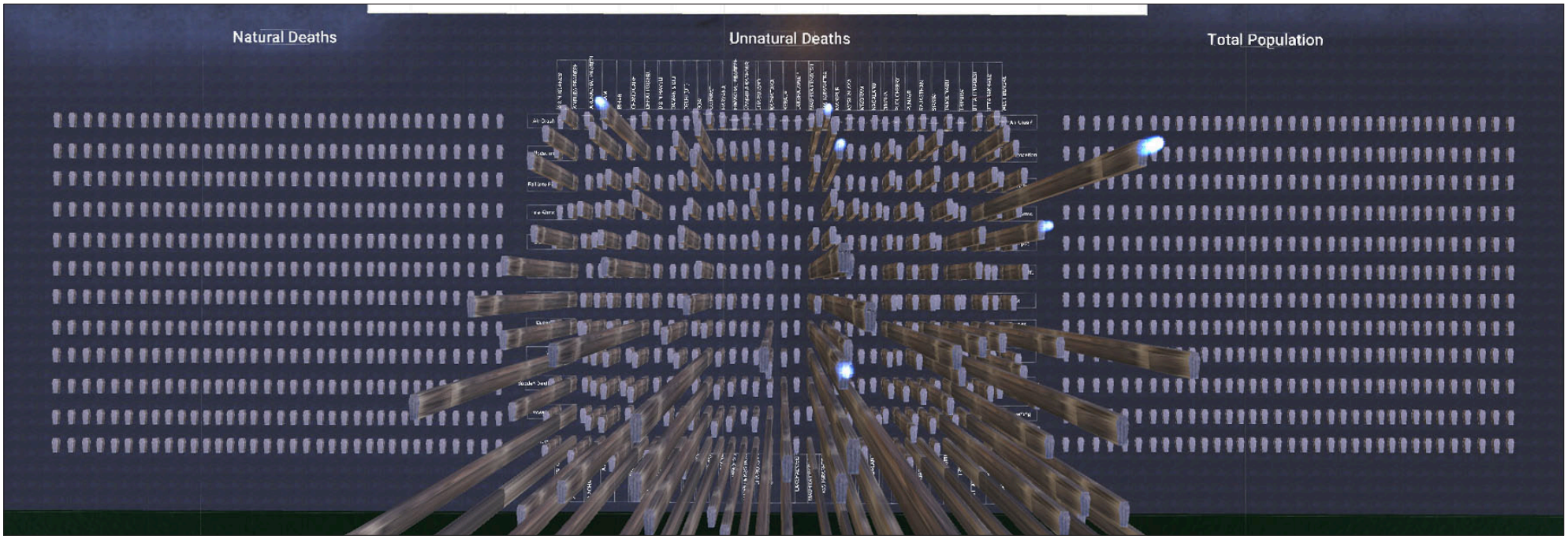
Map from side



4. 3D bar charts of Unnatural and Natural deaths and Total population

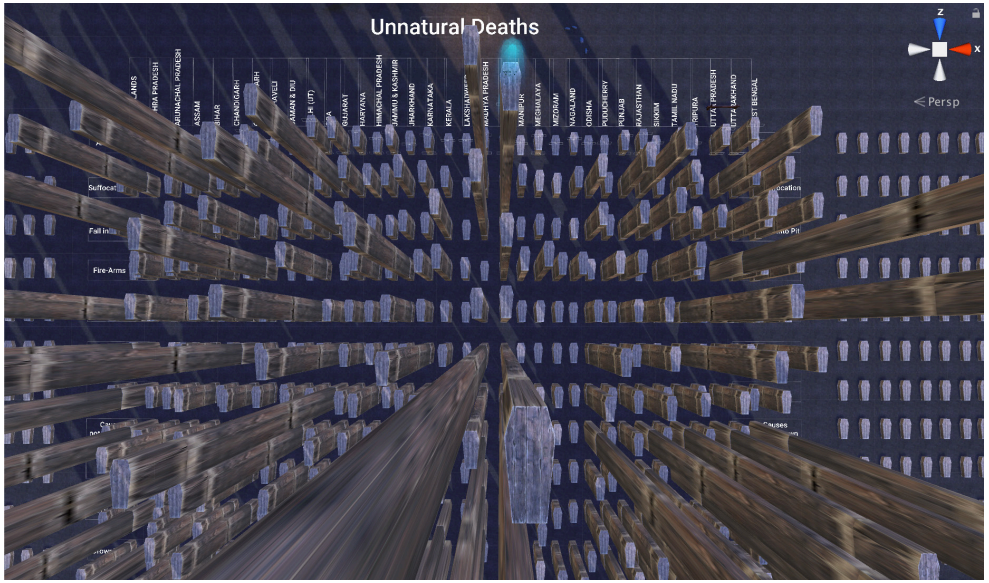


Bars are scaled to show the relative values of deaths by each cause in all the states and UTs



Three sets of data plots to explore the data, make coparisions amongst themselves and with each other

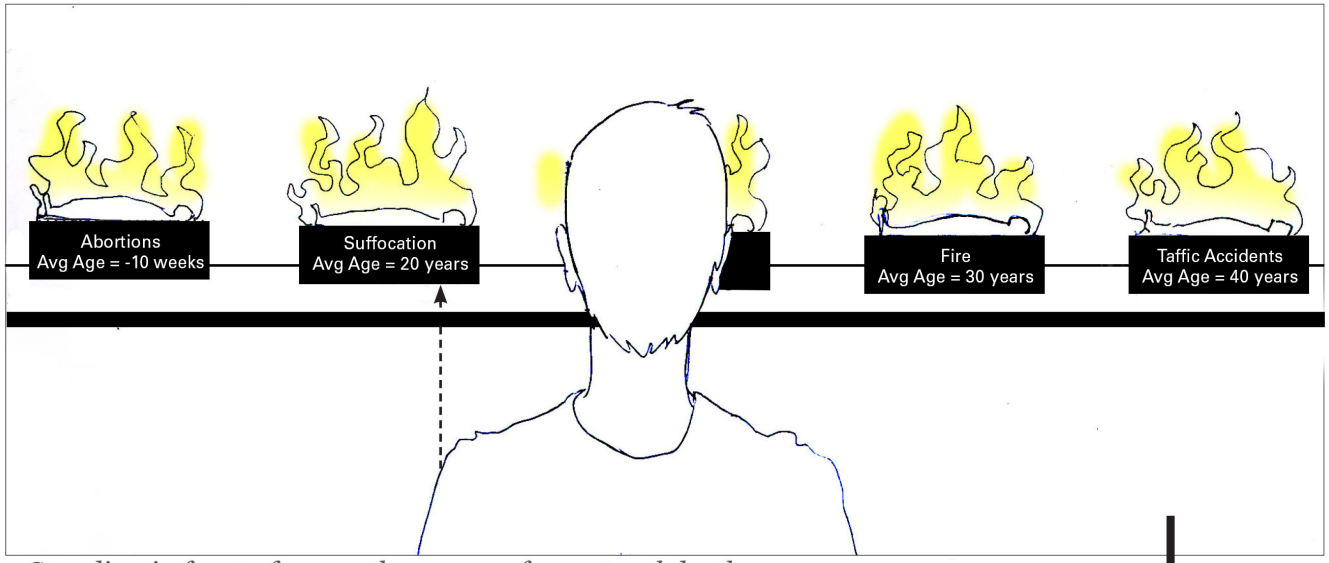
This is an attempt to create explolatory data visualisation where data is plotted and the user is free to look around, make comparisions, ask and answer questions and draw conclusions from the data on his own. The three data sets of totals population, deaths due to unnatural and natural causes should give a complete picture of the death scnario in the country.
A sorting mechanism would work well here, so that the viewer can pick and select which rows or/and coloumn he wants to look at.



Flying down the bar charts of coffins to feel the relative values with a dramatic effect

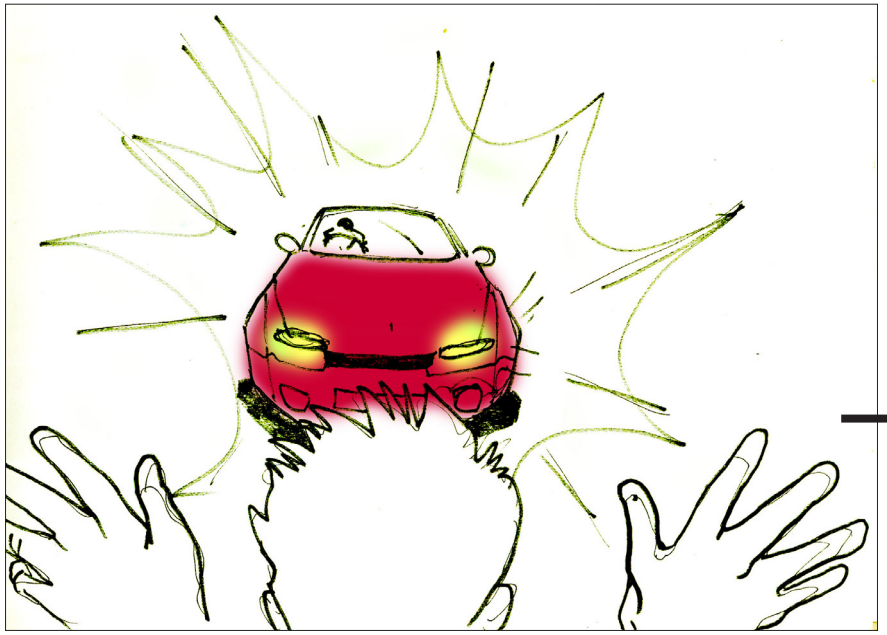
10.4 Story

I saw myself standing in front of a cemetary. There were a few burning pyres of dead bodies and each person had died of different unnatural causes.
I walked in a dead body and found myself in the situation in which that person had died. As I tried to move around, I died and found myself flying like a ghost above the country.
There I saw all kind of physical death there is, different plants, beasts and humans; different people in different states, all dead.
I turned around and there was a field where all the people who had died a unnatural death were burried. I saw them and thought that I know that everyone dies but what is more certain is my own death, this feeling that I can die at any moment.
Beyond I saw shiva, he was huge as I fly towards him I disappeared and was standing in front of the cemetary again, to die of a different cause.

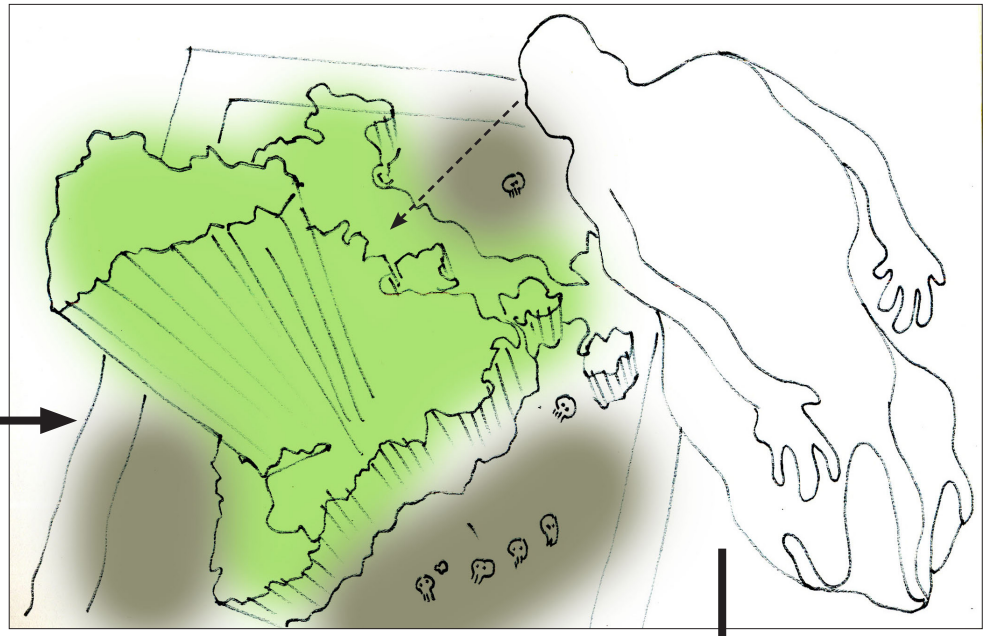


1.Standing in front of pyres, the causes of unnatural death

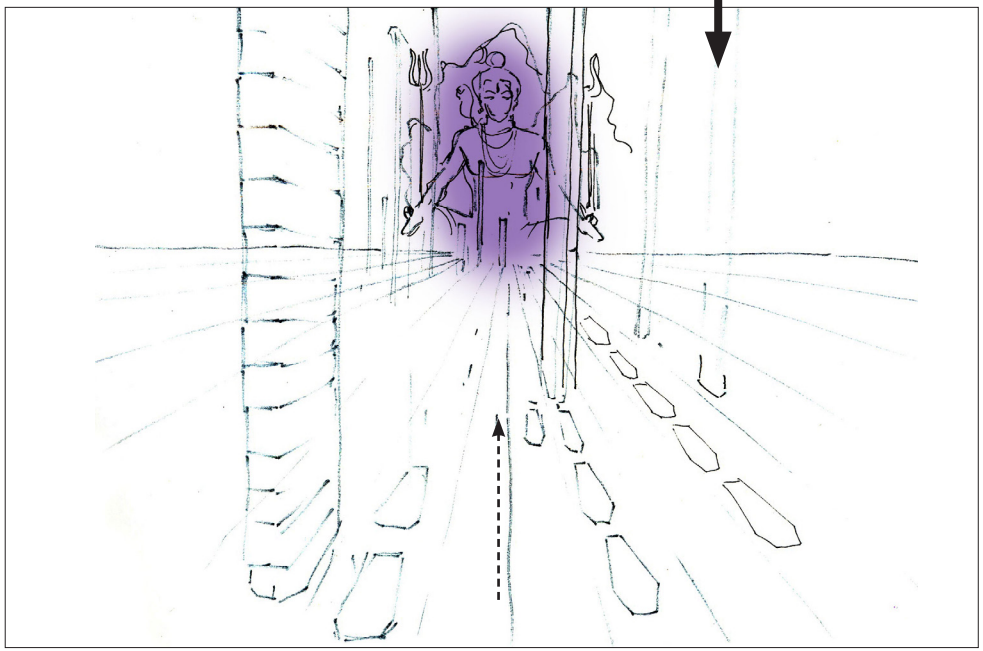
2. Selecting a cause by walking in a pyre



3. Being teleported to a death situation, traffic accidents, and dying by getting hit by a car



4. Flying as a ghost over the map



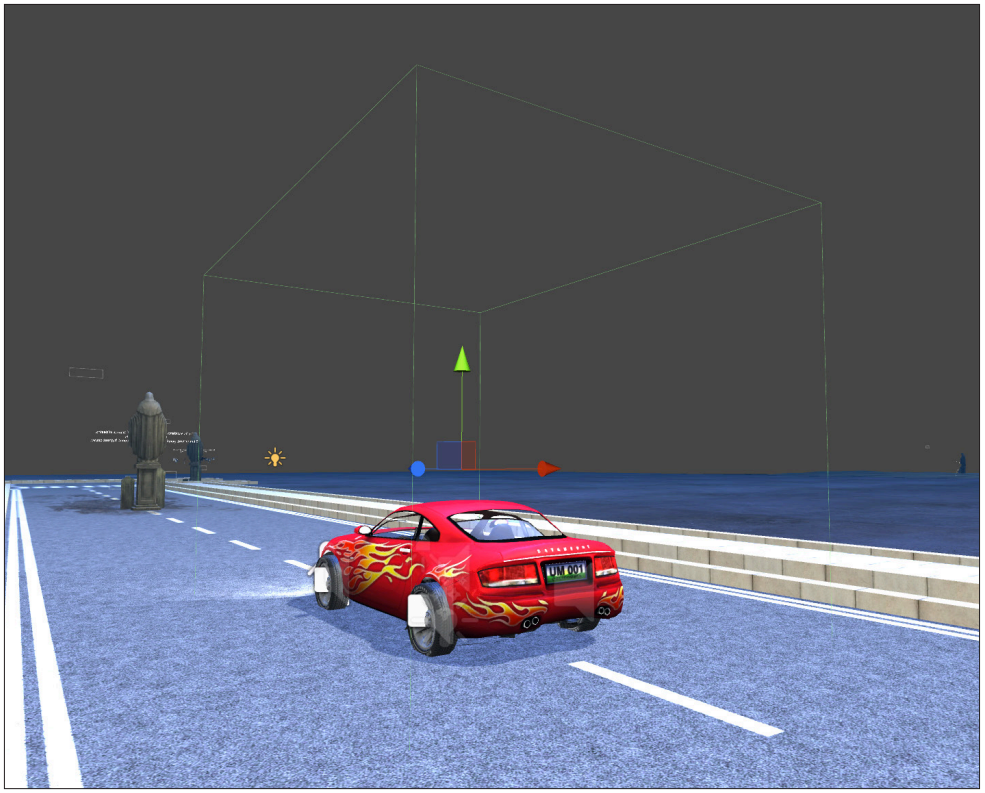
5. Viewer flying over the cemetary with coffins bar charts

10. 5 Mechanics

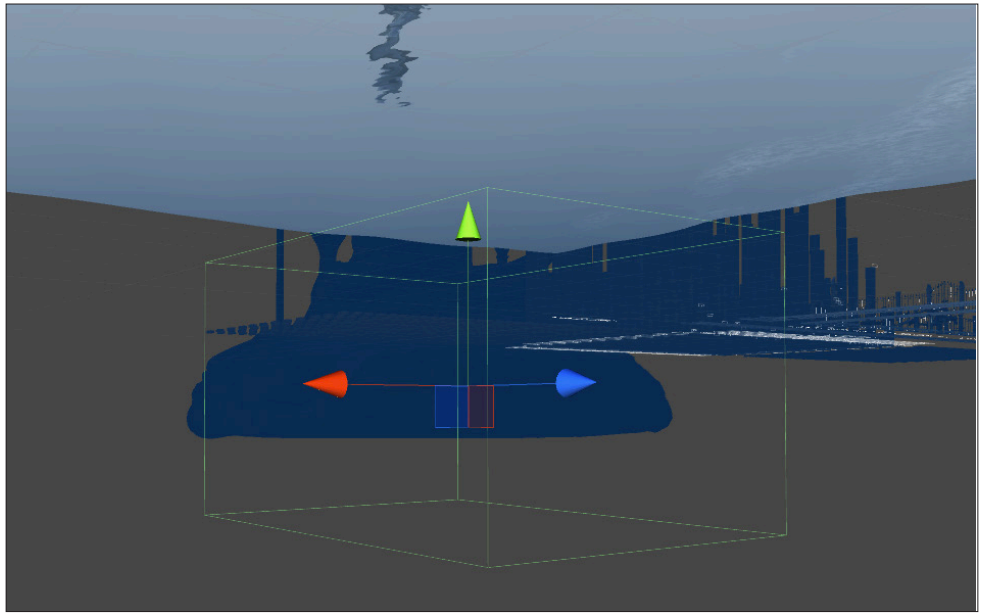
The viewer is in the scene, he walks around and enters the pyre which is a trigger that teleports the viewer to the situation of the cause of unnatural death. Triggers are zones which perform some action when the viewer enters that zone. All pyres and statues are triggers. The pyres teleport to the situations, while the longer statues teleport to the cemetary.
On entering the situation the viewer is a first person controller that can walk around and jump and after death the character controller is a flying camera which can make the viewer fly anywhere in the scene. There are other triggers in the scene, Shiva statue and big slate stones, that restart the visualisation from the beggining so that the viewer can experience other causes of unnatural deaths.

Trigger(yellow boundries) around the statue is the zone that teleports the viewer to the map as a ghost

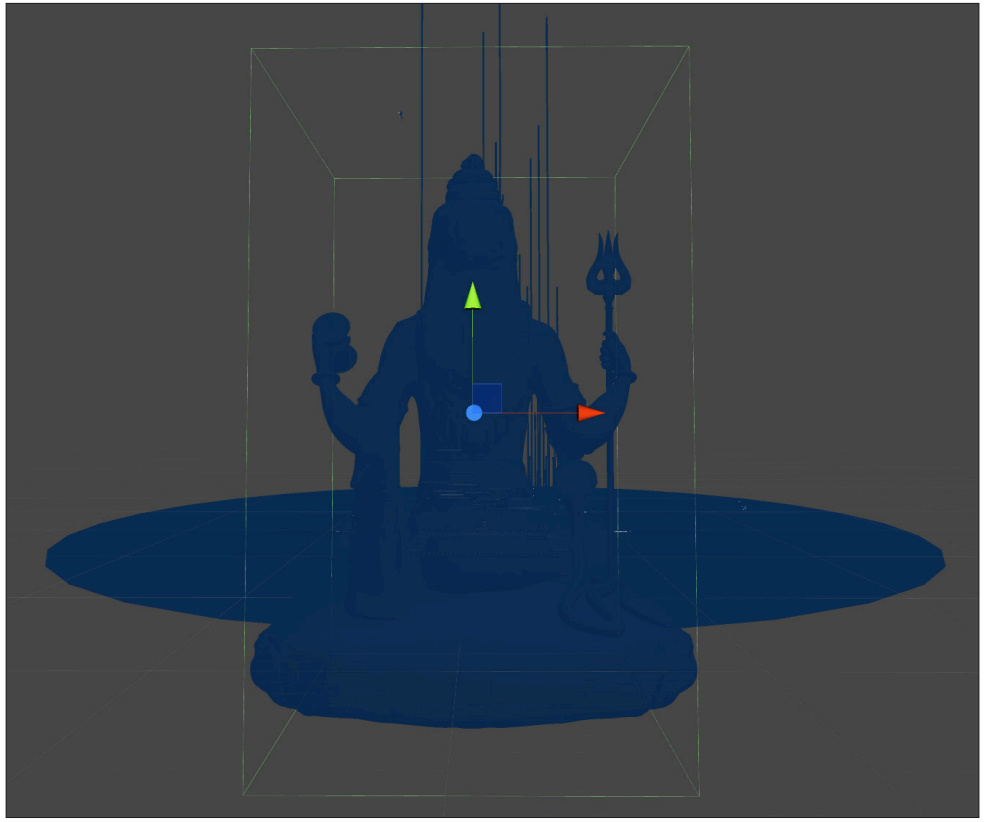
Triggers around the pyres teleport to the respective causes



Triggers of some causes like traffic accidents (image) are not around the statues but at the points were deaths makes sense, like falls has trigger after the fall



Triggers of drowning is under water to make the user experience the feeling of going down

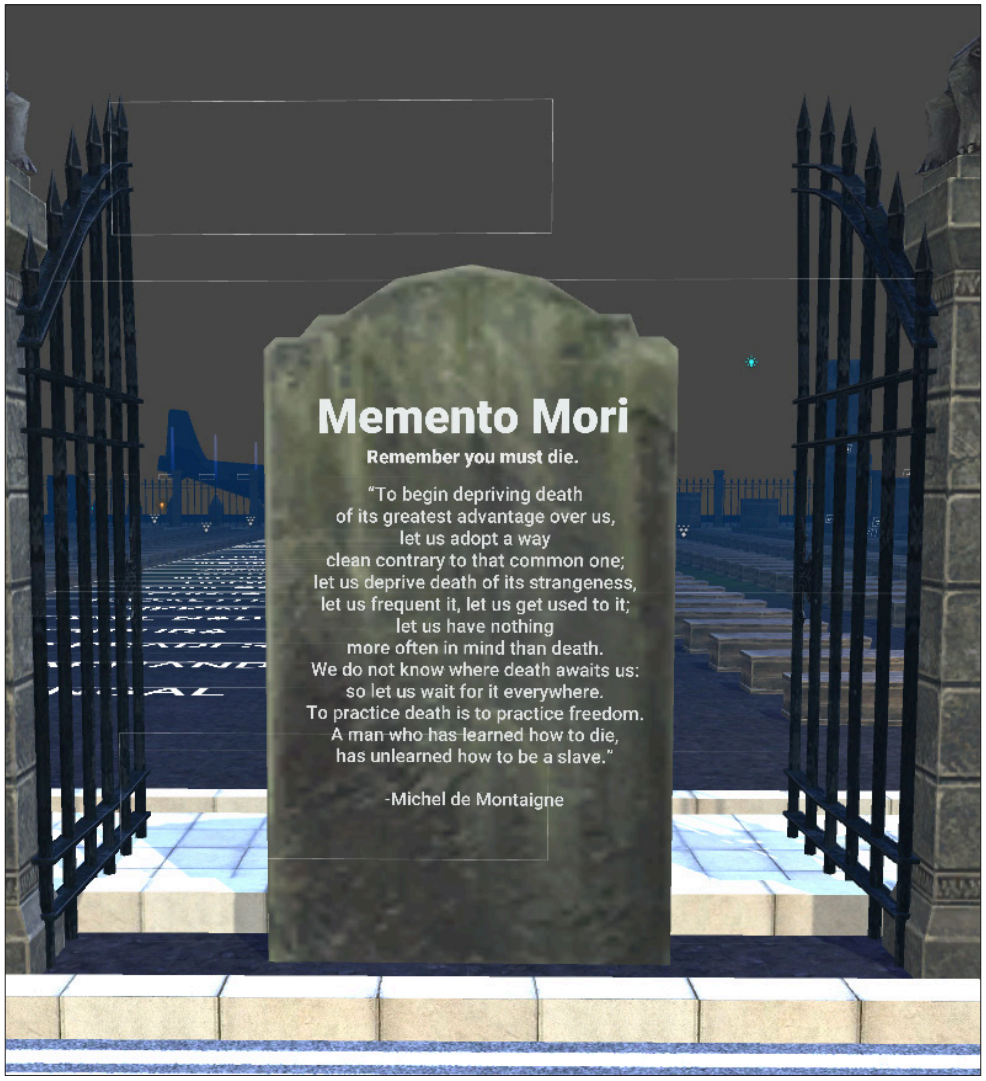


Shiva image as found on indian cemetaries is the restart trigger to continue the loop

The slate stones are restart triggers as well

10.6 Walk through

Front stone gives introduction to the data visualisation and also acts as a trigger to re-start the experience



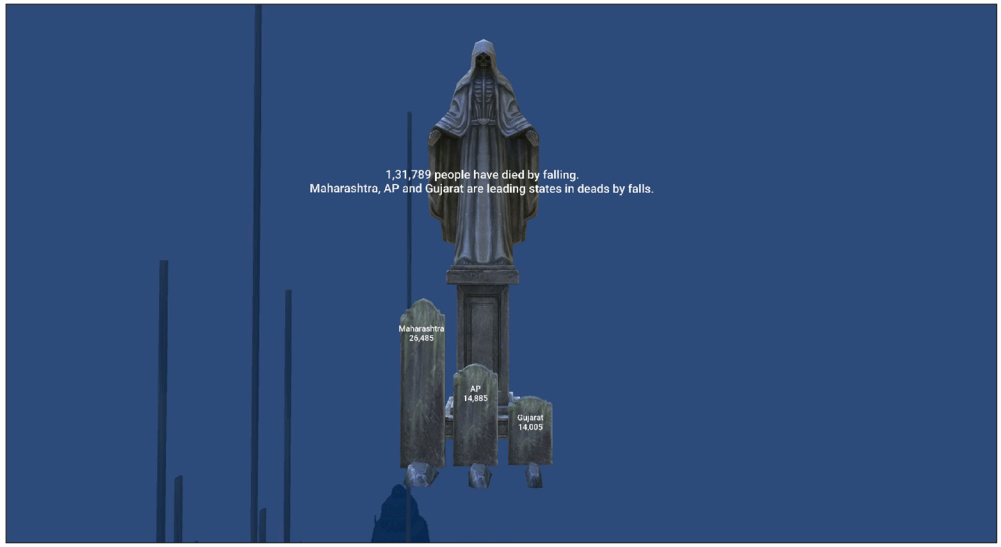
Back stone, also a trigger to re-start the visualisation has a quote on the nature of the experience of the visualisation

First view after the start of the experience with leaves falling from above

Left turn from start position shows minor causes of unnatural deaths shown by the light bars on top of the statues

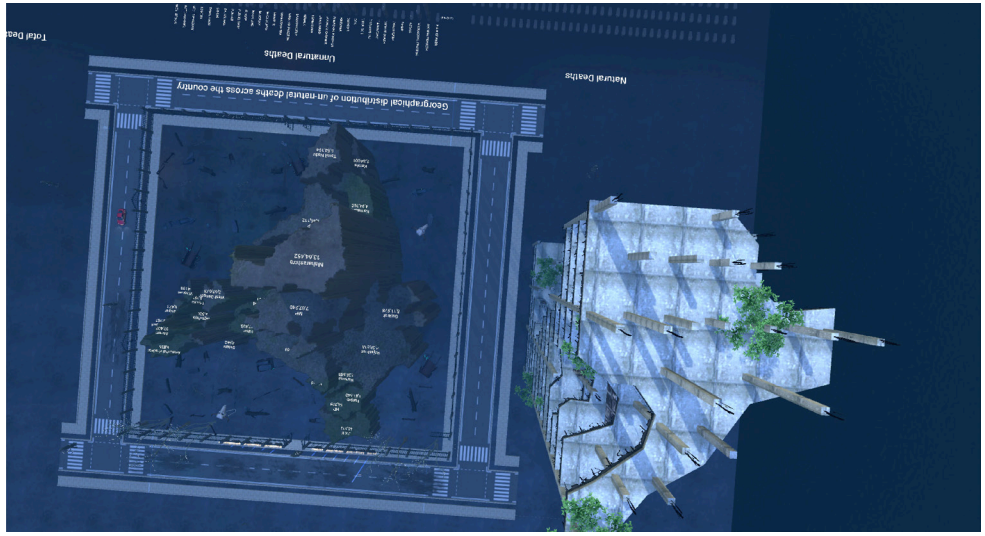
Right turn from start position shows major causes of unnatural deaths shown by the light bars on top of the statues

Viewer can walk around and enter any of the statues to go in the death situation written below the statue

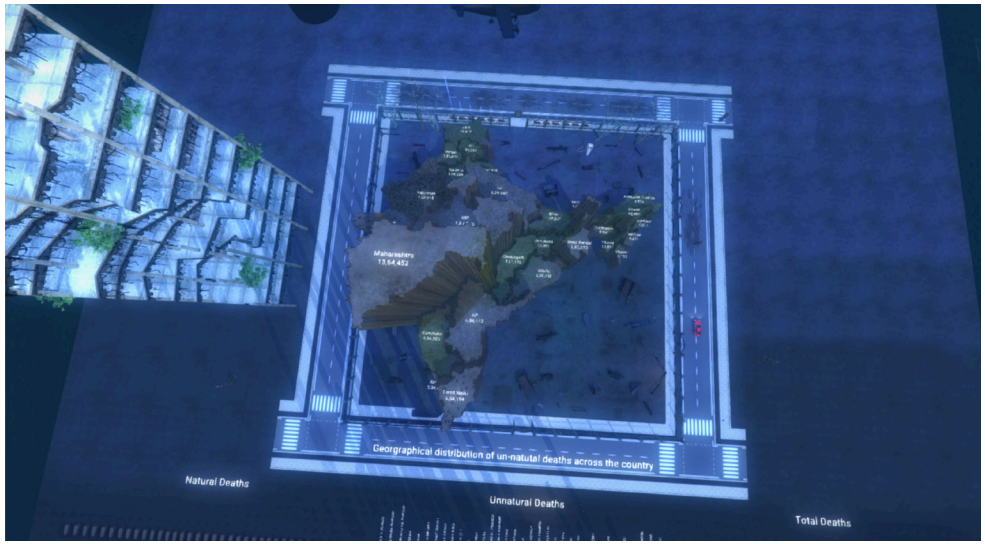


Cause: Falls; Viewer falls down from a platform and enters the cemetary

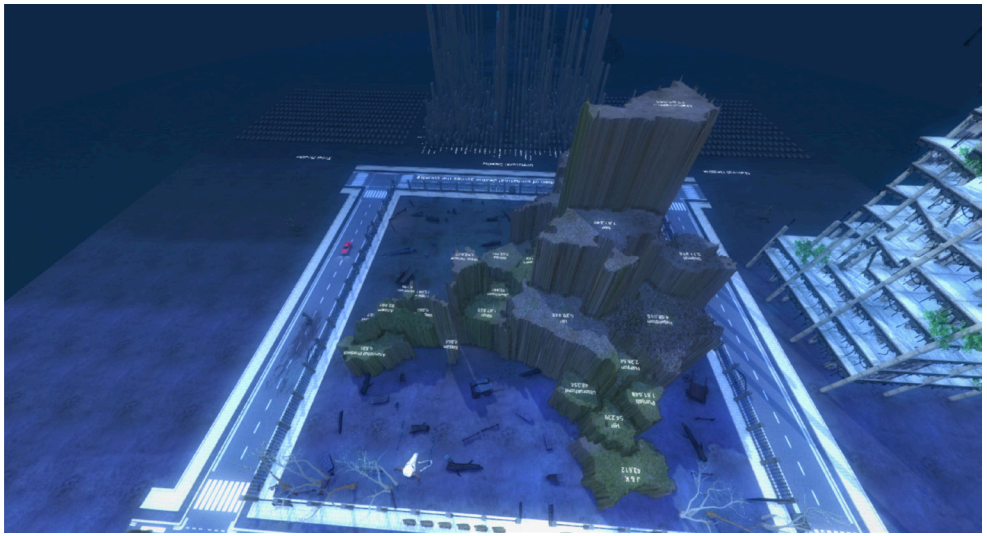
As an example, by selecting the cause Falls the viewer is teleported to the above space. Here he can see the scales of top three states and as he tries to walk towards the statue he falls down and the trigger at the bottom send him in the cemetary as a ghost. In other cases the statue itself is the trigger.



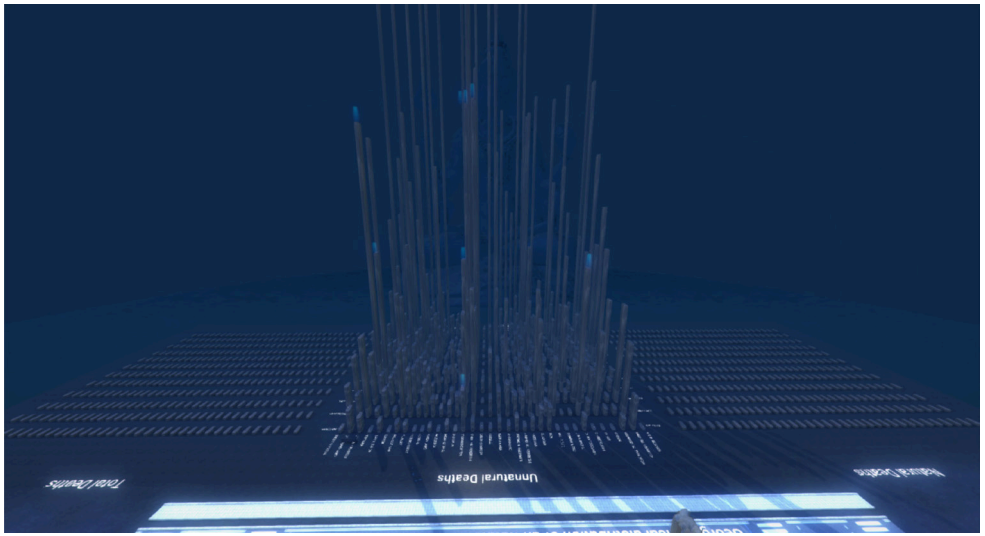
View while falling



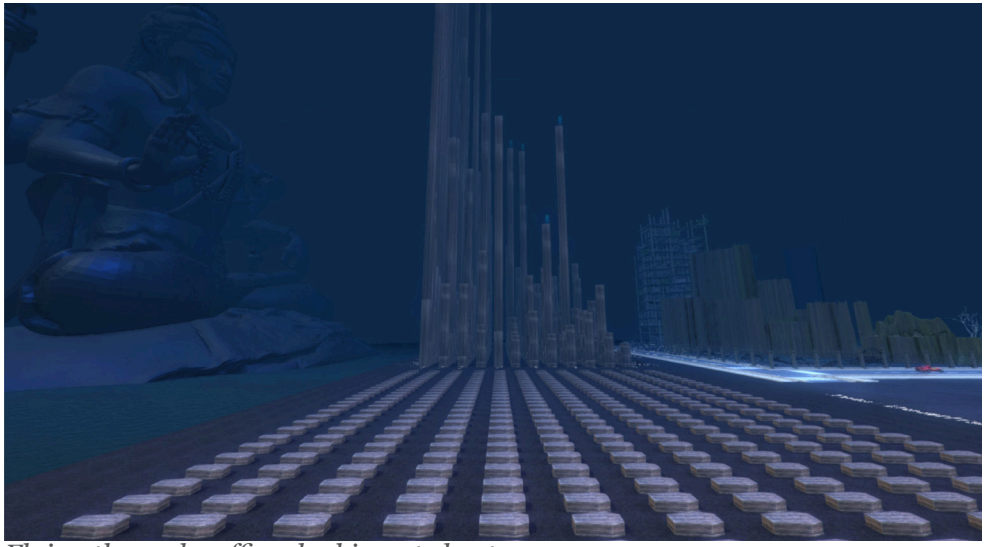
First view as the ghost after entering the cemetary



Flying around the map



Coffins as bar charts behind the map



Flying through coffins, looking at charts

Exit to restart the experience

10.7 Scenarios

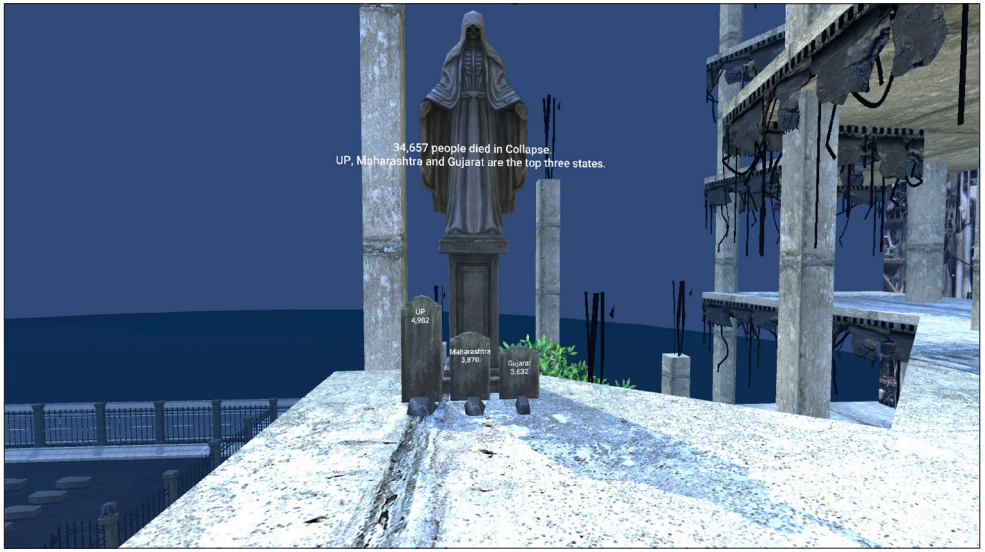
Following are the scnarios of unnatural deaths which the user can experienceand die in.

Cause: Air-Crash, takes you to a scene of a plane crash

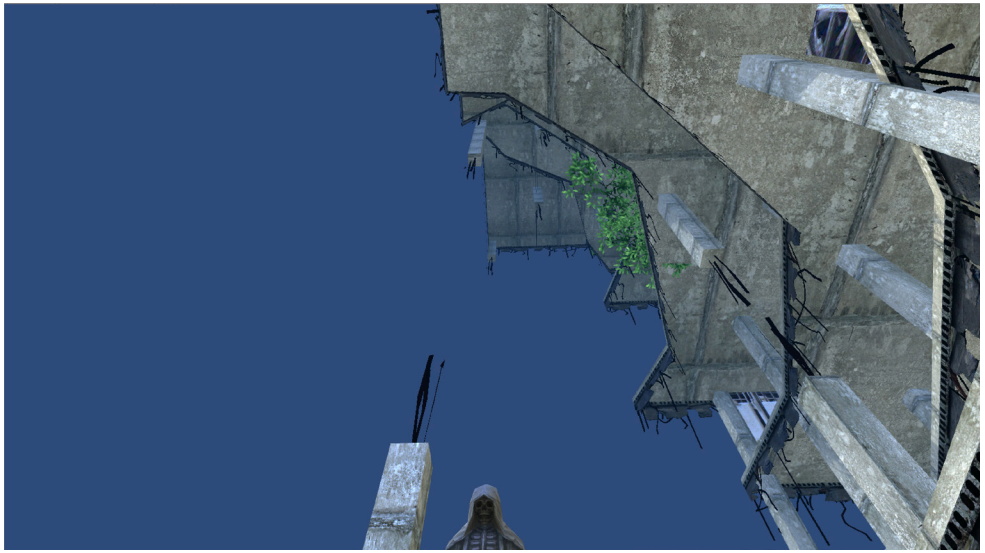
Cause: Suffocation, takes you inside a coffin

Cause: Fall in Pit, you fall in a pit and come here

Cause: Fire Arms, takes you to a scene where you get shot



Cause: Collapse, takes you in a old collapsable building



Cause: Collapse, looking up

Cause: Snake Bite, takes you to a place with snakes crowling around you

Cause: Cause not known

Cause: Fire, takes you inside a ring of fire

In the arrangement of pyres, Sudden Deaths comes after Fire but unlike other causes, sudden deaths gives direct entry in the cemetary.

Cause: Drowning, takes you to water where if you move you drown in water

Cause: Traffic Accidents

Crossing the statue triggers the animation of the car which comes and hits the viewer to take him further in the visualisation

11. Evaluation

The purpose of evaluation for the project is to understand the efficacy of VR as a data storytelling medium, issues that come up while exploring a data story and other issues while experiencing the data visualisation like usability, feasibility and conceptual issues. Evaluation was done using HTC vive.

11.1 Performance and Think Aloud

The usability test is conducted with multiple users. Each user is given a single type of form factor device to experience the visualisation. Participants were asked to think aloud or verbalise their thoughts while doing the task of completing one cycle of the visualisation and then were asked to go for other rounds with a different causes.

11.2 Engagement

Afterwards they were asked questions based on observations from the Think Aloud test.
For evaluating the effectiveness of the visualisations, story etc. with a Likert type scale and Qualitative Evaluation with unstructured questions.
(Which CAUSE caused the highest amount of Un-natural Death?
In the exploratory field of bar charts, did you find anything interesting?
Were you able to go through the visualisation?
Did you feel VR sickness?
Any comments on the experience?
What do you think would have been done differently?)

11.3 Results

Evaluation helped to find initial pain points in labelling, VR sickness and difficulty in navigation. It also led to the improvements in the next iteration which includes use of sound, navigation with controllers, using visual cues, redesign of the exploratory matrix, change of environment for every cause and so on.

Evaluation using HTC vive

12. Conclusion

Big data science is not about data, it is about discovering and understanding meaningful patterns hidden in the data. Virtual reality allows viewers to not just look at the data, but to experience and interact with it.
This report described the creation process of a VR data story. It shows the various stages of its creation and is an example of what is possible. It shows that VR data visualisations aren't inherently intuitive but can make a different sense if delivered by the means of storytelling.
VR technology shows promise for the future and is certainly worth pursuing additional research. Further research should be done to see if other approaches are more effective.

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Images

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