

GLOBAL MIGRATION DYNAMICS: VISUALIZING PATTERNS AND CONTEXTS

mercury.swin.edu.au/cos30045/s104221423/WorldMigrationProject/

Team member: Hoang Minh Khue, Le Tran Bao Kien

Tutor Date: Monday morning, 9 AM – 12 PM

Spring 2024

Word Count:

Hoang Minh Khue – Le Tran Bao Kien

S104221423 – s104223584

Table of Contents

1. Introduction.....	2
1.1. Background and Motivation.....	2
1.2. Visualization Purpose	2
1.3. Project Schedule	3
2. Data	4
2.1. Data Source	4
2.2. Data Processing	6
Hand Processing:.....	6
World Bank(www.worldbank.org):	6
United Nations (www.un.org):	10
Code Processing:.....	13
Additional files:.....	15
3. Requirements	15
3.1. Must-have Features:	15
3.2. Optional Features:.....	15
4. Visualization Design:.....	16
4.1. Conceptualize (Design Iteration) stage:	17
4.2. Visualize Stage:	18
4.3. Materialize Stage:	20
4.4. Implementation Stage:	21
5. Final Design.....	24
6. Conclusion.....	25
References	26

1. Introduction

1.1. Background and Motivation

One of the key characteristics of human history has been migration, which has shaped civilizations, economies, and cultures on many continents and during many eras. People have moved about throughout history as a necessary component of human existence, from the ancient nomadic tribes to the contemporary diasporas fueled by globalization. The topic of global migration has become increasingly important and well-known in the modern era due to a variety of causes, including political unrest, economic inequality, environmental damage, and climate change.

In a time of growing globalization and interconnection, the dynamics of human mobility are more intricate and nuanced than in the past. There are many different reasons why people move, such as to pursue better job prospects, further their education, be with family, or seek safety from persecution or violence. Furthermore, population movements are driven by environmental causes including natural catastrophes, environmental degradation, and climate change, which exacerbate already-existing vulnerabilities and inequities.

It is impossible to exaggerate the importance of the global migration issue in the modern world. As the number of individuals living in forced displacement reaches previously unheard-of heights, migration has become a significant humanitarian, social, political, and economic concern. It has significant ramifications for host communities, transit nations, and international geopolitics and has a significant impact on the rights and well-being of migrants. Furthermore, a wide range of other urgent challenges, including urbanization, sustainable development, labor markets, social cohesion, and human rights, are intertwined with migration.

1.2. Visualization Purpose

It is becoming more and more necessary to visualize migration patterns and contexts due to the complexity and difficulties involved in global migration. A potent tool for deciphering the complex dynamics of migratory flows, exposing temporal and spatial trends, finding patterns and correlations, and locating underlying causes and effects is data visualization. Visualization helps stakeholders, policymakers, scholars, and the public better understand the scope and complexity of migration phenomena by converting complex statistics into understandable and visually appealing representations.

Furthermore, migration data visualization acts as a catalyst for comprehending and resolving the underlying reasons and effects of migration. It offers insightful information about the geographic distribution of migrants, their travel routes and corridors, the demographics of migrant communities, and the social, economic, and environmental settings in which migration takes place. Equipped with such discernments, policymakers can devise empirically grounded tactics

and measures to tackle the obstacles presented by migration, alleviate its adverse effects, and capitalize on its prospective advantages for both migrant populations and receiving communities.

To summarize, the visualization of migration patterns and contexts serves two purposes: first, it improves comprehension of the intricate dynamics of global migration; second, it provides guidance and information for policy and decision-making processes that aim to address the obstacles and maximize the benefits associated with human mobility. Through the effective use of visualization, we can shed light on the paths and histories of migration, give voice to the opinions and experiences of migrants, and help create more just inclusive, and sustainable societies in a global community that is becoming more interconnected by the day.

1.3. Project Schedule

Week 2-4: Project Kickoff and Data Collection

- Define project objectives and scope.
- Assign roles and responsibilities within the team.
- Identify and gather relevant data sources on global migration.
- Begin initial exploration and assessment of the collected data.

Week 5-6: Data Cleaning and Processing

- Conduct thorough data cleaning to address missing values, inconsistencies, and outliers.
- Standardize data formats and ensure data compatibility.
- Perform any necessary data transformations or aggregations to prepare the data for visualization.

Week 7-8: Design and Prototyping

- Brainstorm visualization ideas and design concepts.
- Develop initial prototypes of visualization layouts and elements.
- Gather feedback from team members and stakeholders to refine the design.

Week 9-10: Implementation

- Translate finalized design concepts into code using chosen visualization tools or libraries.
- Integrate cleaned and processed data into the visualization.
- Conduct iterative testing and debugging to ensure functionality and usability.

Week 11: Refinement and Evaluation

- Fine-tune visual elements, layouts, and interactions based on user feedback.

- Conduct thorough testing of the completed visualization across different devices and browsers.
- Evaluate the effectiveness and usability of visualization in conveying migration patterns and contexts.

Week 11-12: Documentation and Presentation

- Compile comprehensive documentation of the project process, including data sources, cleaning and processing methods, design decisions, and implementation details.
- Prepare a final presentation summarizing key findings, insights, and implications of the visualization.
- Submit the completed project process book and present the visualization to the instructor and class.

2. Data

2.1. Data Source

The primary sources for raw data in this project are the World Bank (worldbank.org) and the United Nations (un.org). These reputable organizations provide comprehensive datasets related to global migration, offering insights into migration trends, demographic characteristics, and socio-economic contexts across countries and regions worldwide.

- **The World Bank** (www.worldbank.org):
 - The World Bank offers a wealth of demographic and socio-economic data, including information on international migration patterns, immigrant populations, and migration-related variables such as country of birth, citizenship status, and migration flows. Data from the World Bank's Migration and Remittances dataset and other sources provide valuable insights into migration trends within countries and globally.
 - **Data Set 1:** Life Expectancy data from the World Bank's World Development Indicators dataset.

1. **Data Type:** The data set includes the following variables:

- i. Country Name (Categorical)
 - ii. Life Expectancy (Quantitative)
- **Data Set 2:** GDP per Capita data from the World Bank's World Development Indicators dataset.

1. **Data Type:** The data set includes the following variables:

- i. Country Name (Categorical)
- ii. GDP per Capita (Quantitative)

- **Data Set 3:** Population data from the World Bank's World Development Indicators dataset.

1. **Data Type:** The data set includes the following variables:

- i. Country Name (Categorical)
- ii. Population (Quantitative)

- **File Type:** Raw data obtained in .csv format.

- **United Nations (www.un.org):**

- The United Nations is a leading source of data and research on global migration, providing comprehensive statistics and analyses on international migration trends, refugee movements, asylum seekers, internally displaced persons (IDPs), and other migration-related topics. Datasets from UN agencies such as the International Organization for Migration (IOM), the United Nations High Commissioner for Refugees (UNHCR), and the United Nations Department of Economic and Social Affairs (UN DESA) offer valuable insights into the scale, dynamics, and impacts of migration worldwide.

- **Data Set:** Global Migration Statistics from the United Nations

- **Data Type:** The data set includes the following variables:

- 1. Country Name (Categorical)
- 2. Number of Immigration People (Quantitative)

- **File Type:** Raw data obtained in .xlsx format, converted to .csv format using www.cloudconvert.com/xlsx-to-csv website.

These two main data sources serve as foundational pillars for this project, providing reliable and authoritative data that underpins the visualization of global migration patterns and contexts. Additional supplementary data sources may be explored to enrich the analysis and address specific research questions or objectives identified during the project's development.

2.2. Data Processing

Hand Processing:

Although the datasets obtained from the organizations guarantee high integrity and timeliness, data cleaning and reorganization are essential to achieve the desired level of "conformity" necessary for visualization in D3.js. The data processing procedure involves distinct steps for each of the retrieved datasets, as each one necessitates pruning, pivoting, and aggregating to a certain degree. Once the design selection is finalized, the dataset will be further filtered to align with the specifications of the data visualization design, marking the milestone of "conformity" and indicating that the data is prepared for visualization.

World Bank(www.worldbank.org):

The original data is structured as a CSV (Comma-Separated Values) file, with the first dataset for **Life Expectancy** containing rows representing different countries or regions and columns representing attributes such as the name of the country, country code, indicator (in this case, life expectancy at birth), and numerical values indicating life expectancy for each year. The second dataset was for **GDP per capita (Current US\$)**, in which each row represents a country, and the columns include the country name, country code, indicator name (GDP per capita), indicator code, and GDP per capita values for different years. The years range from at least 1960 to 2022, with missing data represented by empty fields. The final dataset from the World Bank is for the **Total Population** data. Each row represents a country or region, with columns indicating the name of the country or region, the country code, the type of data (in this case, total population), and population values for different years. The years from 1960 to a more recent year, likely reflect the most up-to-date available data. The population values are in numeric format. Additionally, there are rows representing aggregates such as "World" and "Upper middle income.". The following three figures depict the three original datasets downloaded from the World Bank.

Screenshot of Microsoft Excel showing the 'Data Source' sheet for 'World Development Indicators'. The table contains data from 1960 to 1984 for various countries, including life expectancy at birth. The table has 21 columns labeled A through AC. The first few rows show data for countries like Aruba, Afghanistan, and Angola. The last few rows show data for countries like Antigua and Barbuda, Australia, Austria, Azerbaijan, Belarus, Belgium, Benin, Burkina Faso, Bangladesh, Bulgaria, Bahrain, Bahamas, Bosnia, Belarus, Belize, Bermuda, Bolivia, Brazil, Barbados, Brunei, Bhutan, and so on. The table is sorted by country and indicator.

FIGURE 1: LIFE EXPECTANCY AT BIRTH FROM WORLD BANK.ORG

Screenshot of Microsoft Excel showing the 'Data Source' sheet for 'World Development Indicators'. The table contains data from 1960 to 1984 for various countries, including GDP per capita. The table has 21 columns labeled A through AC. The first few rows show data for countries like Aruba, Afghanistan, and Angola. The last few rows show data for countries like Antigua and Barbuda, Australia, Austria, Azerbaijan, Belarus, Belgium, Benin, Burkina Faso, Bangladesh, Bulgaria, Bahrain, Bahamas, Bosnia, Belarus, Belize, Bermuda, Bolivia, Brazil, Barbados, Brunei, Bhutan, and so on. The table is sorted by country and indicator.

FIGURE 2: GDP PER CAPITA (CURRENT US\$) FROM WORLD BANK.ORG

FIGURE 3: POPULATION, TOTAL FROM WBWORLD BANK.ORG

The first step of cleaning is to remove unnecessary rows and columns that do not contain important information needed for the visualization. This process was done by hand since all three files only contain a single table, and by cleaning and renaming the file to *WB_LifeExpect.csv*, *GDP.csv*, and *Population.csv* respectively, we can better handle the file here on out. Figures 3, 4, and 5 depict the aforementioned.

File		Home		Insert		Page Layout		Formulas		Data		Review		View		Automate		Help		Acrobat		Terabox																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Paste		Clipboard		Font		Merge & Center		Number		Format		Conditional Formatting		Format as Table		Cell Styles		Insert		Delete		Format		AutoSum																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
A1	Country	Country	Country	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator	Indicator																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
1	Country	Country	Country	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
2	Aruba	ABW	Life expect.	SP.DYN.LEV.LEV1	65.59837	65.59837	66.35654	66.35654	67.11938	67.04429	67.36976	67.699	68.03648	68.37745	68.72841	69.09615	69.4461	69.79915	70.13966	70.46529	70.7778	71.08903	71.37771	71.66978	71.95285	72.22013	72.49242	72.76987	73.04223	73.31961	73.59897	73.87767																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
3	Afghanistan	AFG	Life expect.	SP.DYN.LEV.LEV1	32.33756	32.76698	33.22993	33.66693	34.35349	34.99663	35.39953	35.82341	36.26939	36.71283	37.16261	37.62017	38.0731	38.50944	39.05593	39.58593	40.11985	40.68763	41.25824	41.82361	42.35361	42.89361	43.42931	43.95949	44.47622	44.97262	45.47262	45.97262	46.47262	46.97262	47.47262	47.97262																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
4	Angola	AGO	Life expect.	SP.DYN.LEV.LEV1	33.22650	33.54776	33.888	34.44743	34.17146	35.00222	35.39561	35.79785	36.20227	36.60727	37.01422	37.42576	37.84332	38.26185	38.67532	39.0712	39.4412	39.77246	40.10549	40.50778	40.89549	41.27053	41.65378	42.03778	42.41378	42.79378	43.17378	43.55378	43.93378	44.31378	44.69378	45.07378	45.45378	45.83378																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
5	Albania	ALB	Life expect.	SP.DYN.LEV.LEV1	62.25457	63.27346	64.16825	64.88711	65.4382	65.82739	66.0982	66.68272	67.44745	68.66181	69.47595	70.95795	71.58995	72.3988	72.58995	72.79895	73.00964	73.48453	74.74122	76.11551	76.49567	76.75242	77.00964	77.25356	77.48456	77.73256	77.98456	78.23456	78.48456	78.73456	79.03456	79.28456	79.53456	79.78456																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
6	Andorra	AND	Life expect.	SP.DYN.LEV.LEV1	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000	80.00000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
7	Arab World	ARB	Life expect.	SP.DYN.LEV.LEV1	46.81505	47.39723	47.97777	48.56087	49.14739	49.73266	50.30678	50.864	51.40392	51.93273	52.46109	53.0043	53.57235	54.16648	54.78034	55.40528	56.03012	56.64595	57.2518	57.85579	58.46915	59.10246	59.75808	60.40314	61.04304	61.68304	62.32304	62.96304	63.60304	64.24304	64.88304	65.52304	66.16304	66.80304	67.44304	68.08304	68.72304	69.36304	69.99304	69.63304	69.27304	68.91304	68.55304	68.19304	67.83304	67.47304	67.11304	66.75304	66.39304	65.93304	65.57304	65.21304	64.85304	64.49304	64.13304	63.77304	63.41304	62.95304	62.59304	62.23304	61.87304	61.51304	61.15304	60.79304	60.43304	59.97304	59.61304	59.25304	58.89304	58.53304	58.17304	57.81304	57.45304	57.09304	56.73304	56.37304	55.91304	55.55304	55.19304	54.83304	54.47304	54.11304	53.75304	53.39304	52.93304	52.57304	52.21304	51.85304	51.49304	51.13304	50.77304	50.41304	49.95304	49.59304	49.23304	48.87304	48.51304	48.15304	47.79304	47.43304	47.07304	46.71304	46.35304	45.99304	45.63304	45.27304	44.91304	44.55304	44.19304	43.83304	43.47304	43.11304	42.75304	42.39304	41.93304	41.57304	41.21304	40.85304	40.49304	40.13304	39.77304	39.41304	38.95304	38.59304	38.23304	37.87304	37.51304	37.15304	36.79304	36.43304	36.07304	35.71304	35.35304	34.99304	34.63304	34.27304	33.91304	33.55304	33.19304	32.83304	32.47304	32.11304	31.75304	31.39304	30.93304	30.57304	30.21304	29.85304	29.49304	29.13304	28.77304	28.41304	28.05304	27.69304	27.33304	26.97304	26.61304	26.25304	25.89304	25.53304	25.17304	24.81304	24.45304	24.09304	23.73304	23.37304	22.91304	22.55304	22.19304	21.83304	21.47304	21.11304	20.75304	20.39304	20.03304	19.67304	19.31304	18.95304	18.59304	18.23304	17.87304	17.51304	17.15304	16.79304	16.43304	16.07304	15.71304	15.35304	14.99304	14.63304	14.27304	13.91304	13.55304	13.19304	12.83304	12.47304	12.11304	11.75304	11.39304	11.03304	10.67304	10.31304	9.95304	9.59304	9.23304	8.87304	8.51304	8.15304	7.79304	7.43304	7.07304	6.71304	6.35304	5.99304	5.63304	5.27304	4.91304	4.55304	4.19304	3.83304	3.47304	3.11304	2.75304	2.39304	2.03304	1.67304	1.31304	0.95304	0.59304	0.23304	-0.10304	-0.56304	-0.90304	-1.24304	-1.58304	-1.92304	-2.26304	-2.60304	-2.94304	-3.28304	-3.62304	-3.96304	-4.30304	-4.64304	-4.98304	-5.32304	-5.66304	-6.00304	-6.34304	-6.68304	-7.02304	-7.36304	-7.70304	-8.04304	-8.38304	-8.72304	-9.06304	-9.40304	-9.74304	-10.08304	-10.42304	-10.76304	-11.10304	-11.44304	-11.78304	-12.12304	-12.46304	-12.80304	-13.14304	-13.48304	-13.82304	-14.16304	-14.50304	-14.84304	-15.18304	-15.52304	-15.86304	-16.20304	-16.54304	-16.88304	-17.22304	-17.56304	-17.90304	-18.24304	-18.58304	-18.92304	-19.26304	-19.60304	-19.94304	-20.28304	-20.62304	-20.96304	-21.30304	-21.64304	-21.98304	-22.32304	-22.66304	-23.00304	-23.34304	-23.68304	-24.02304	-24.36304	-24.70304	-25.04304	-25.38304	-25.72304	-26.06304	-26.40304	-26.74304	-27.08304	-27.42304	-27.76304	-28.10304	-28.44304	-28.78304	-29.12304	-29.46304	-29.80304	-30.14304	-30.48304	-30.82304	-31.16304	-31.50304	-31.84304	-32.18304	-32.52304	-32.86304	-33.20304	-33.54304	-33.88304	-34.22304	-34.56304	-34.90304	-35.24304	-35.58304	-35.92304	-36.26304	-36.60304	-36.94304	-37.28304	-37.62304	-37.96304	-38.30304	-38.64304	-38.98304	-39.32304	-39.66304	-40.00304	-40.34304	-40.68304	-41.02304	-41.36304	-41.70304	-42.04304	-42.38304	-42.72304	-43.06304	-43.40304	-43.74304	-44.08304	-44.42304	-44.76304	-45.10304	-45.44304	-45.78304	-46.12304	-46.46304	-46.80304	-47.14304	-47.48304	-47.82304	-48.16304	-48.50304	-48.84304	-49.18304	-49.52304	-49.86304	-50.20304	-50.54304	-50.88304	-51.22304	-51.56304	-51.90304	-52.24304	-52.58304	-52.92304	-53.26304	-53.60304	-53.94304	-54.28304	-54.62304	-54.96304	-55.30304	-55.64304	-55.98304	-56.32304	-56.66304	-57.00304	-57.34304	-57.68304	-58.02304	-58.36304	-58.70304	-59.04304	-59.38304	-59.72304	-60.06304	-60.40304	-60.74304	-61.08304	-61.42304	-61.76304	-62.10304	-62.44304	-62.78304	-63.12304	-63.46304	-63.80304	-64.14304	-64.48304	-64.82304	-65.16304	-65.50304	-65.84304	-66.18304	-66.52304	-66.86304	-67.20304	-67.54304	-67.88304	-68.22304	-68.56304	-68.90304	-69.24304	-69.58304	-69.92304	-70.26304	-70.60304	-70.94304	-71.28304	-71.62304	-71.96304	-72.30304	-72.64304	-72.98304	-73.32304	-73.66304	-74.00304	-74.34304	-74.68304	-75.02304	-75.36304	-75.70304	-76.04304	-76.38304	-76.72304	-77.06304	-77.40304	-77.74304	-78.08304	-78.42304	-78.76304	-79.10304	-79.44304	-79.78304	-80.12304	-80.46304	-80.80304	-81.14304	-81.48304	-81.82304	-82.16304	-82.50304	-82.84304	-83.18304	-83.52304	-83.86304	-84.20304	-84.54304	-84.88304	-85.22304	-85.56304	-85.90304	-86.24304	-86.58304	-86.92304	-87.26304	-87.60304	-87.94304	-88.28304	-88.62304	-88.96304	-89.30304	-89.64304	-89.98304	-90.32304	-90.66304	-91.00304	-91.34304	-91.68304	-92.02304	-92.36304	-92.70304	-93.04304	-93.38304	-93.72304	-94.06304	-94.40304	-94.74304	-95.08304	-95.42304	-95.76304	-96.10304	-96.44304	-96.78304	-97.12304	-97.46304	-97.80304	-98.14304	-98.48304	-98.82304	-99.16304	-99.50304	-99.84304	-100.18304	-100.52304	-100.86304	-101.20304	-101.54304	-101.88304	-102.22304	-102.56304	-102.90304	-103.24304	-103.58304	-103.92304	-104.26304	-104.60304	-104.94304	-105.28304	-105.62304	-105.96304	-106.30304	-106.64304	-106.98304	-107.32304	-107.66304	-108.00304	-108.34304	-108.68304	-109.02304	-109.36304	-109.70304	-110.04304	-110.38304	-110.72304	-111.06304	-111.40304	-111.74304	-112.08304	-112.42304	-112.76304	-113.10304	-113.44304	-113.78304	-114.12304	-114.46304	-114.80304	-115.14304	-115.48304	-115.82304	-116.16304	-116.50304	-116.84304	-117.18304	-117.52304	-117.86304	-118.20304	-118.54304	-118.88304	-119.22304	-119.56304	-119.90304	-120.24304	-120.58304	-120.92304	-121.26304	-121.60304	-121.94304	-122.28304	-122.62304	-122.96304	-123.30304	-123.64304	-123.98304

FIGURE 4: LIFE EXPECTANCY DATA AFTER CLEANING BY HAND

Global Data Summary - Q3 2024																												
Category	Region	Country	Demographic		Economy		Environment		Healthcare		Technology		Agriculture		Manufacturing		Transportation		Energy		Finance		Telecommunications		Retail		Aerospace	
			Population	Age Group	GDP	Unemployment	CO2 Emissions	Renewable %	Healthcare Expenditure	Healthcare Progress	Technology Investment	AI Adoption	Agriculture Output	Manufacturing Output	Transportation Index	Energy Consumption	Finance Sector	Telecommunications	Retail Sales	Transportation Growth	Energy Policy	Finance Growth	Telecommunications Growth	Retail Growth	Aerospace Growth			
1. Country A	North America	USA	328,000,000	18-64: 65%, 65+: 35%	\$22.5 Trn	4.2%	550 Mt	15%	\$1.2 Trn	90%	\$1.5 Trn	95%	100 Mt	120 Mt	85	1000 TWh	15%	1.2 Trn	10%	1000 TWh	15%	1.2 Trn	10%	1000 TWh	15%			
2. Aruba	ABW	GDP	(cun.NY.GDP.MKTP.CD)																									
3. Afghanistan	AFG	GDP	(cun.NY.GDP.MKTP.CD)																									
4. Argentina	AGO	GDP	(cun.NY.GDP.MKTP.CD)																									
5. Albania	ALB	GDP	(cun.NY.GDP.MKTP.CD)																									
6. Andorra	AND	GDP	(cun.NY.GDP.MKTP.CD)																									
7. Arab World	ARE	GDP	(cun.NY.GDP.MKTP.CD)																									
8. Argentina	ARG	GDP	(cun.NY.GDP.MKTP.CD)																									
9. Armenia	ARM	GDP	(cun.NY.GDP.MKTP.CD)																									
10. American	ASM	GDP	(cun.NY.GDP.MKTP.CD)																									
11. Antigua and	ATG	GDP	(cun.NY.GDP.MKTP.CD)																									
12. Australia	AUS	GDP	(cun.NY.GDP.MKTP.CD)																									
13. Austria	AUT	GDP	(cun.NY.GDP.MKTP.CD)																									
14. Azerbaijan	AZE	GDP	(cun.NY.GDP.MKTP.CD)																									
15. Belarus	BLR	GDP	(cun.NY.GDP.MKTP.CD)																									
16. Belgium	BEL	GDP	(cun.NY.GDP.MKTP.CD)																									
17. Benin	BEN	GDP	(cun.NY.GDP.MKTP.CD)																									
18. Bolivia	BOL	GDP	(cun.NY.GDP.MKTP.CD)																									
19. Bulgaria	BGR	GDP	(cun.NY.GDP.MKTP.CD)																									
20. Bahrain	BHR	GDP	(cun.NY.GDP.MKTP.CD)																									
21. Bahamas	BHS	GDP	(cun.NY.GDP.MKTP.CD)																									
22. Bosnia and	BH	GDP	(cun.NY.GDP.MKTP.CD)																									
23. Belarus	BLR	GDP	(cun.NY.GDP.MKTP.CD)																									
24. Belize	BZ	GDP	(cun.NY.GDP.MKTP.CD)																									
25. Bermuda	BMU	GDP	(cun.NY.GDP.MKTP.CD)																									
26. Bolivia	BOL	GDP	(cun.NY.GDP.MKTP.CD)																									
27. Brazil	BRA	GDP	(cun.NY.GDP.MKTP.CD)																									
28. Barbados	BRB	GDP	(cun.NY.GDP.MKTP.CD)																									
29. Brunei	BRN	GDP	(cun.NY.GDP.MKTP.CD)																									
30. Bulgaria	BGR	GDP	(cun.NY.GDP.MKTP.CD)																									
31. Botswana	BWA	GDP	(cun.NY.GDP.MKTP.CD)																									
32. Cambodia	CAM	GDP	(cun.NY.GDP.MKTP.CD)																									
33. Central African	CAF	GDP	(cun.NY.GDP.MKTP.CD)																									
34. Canada	CAN	GDP	(cun.NY.GDP.MKTP.CD)																									
35. Central Europe	CES	GDP	(cun.NY.GDP.MKTP.CD)																									
36. Switzerland	CHE	GDP	(cun.NY.GDP.MKTP.CD)																									
37. Channel Islands	CHN	GDP	(cun.NY.GDP.MKTP.CD)																									
38. Chile	CHL	GDP	(cun.NY.GDP.MKTP.CD)																									
39. China	CHN	GDP	(cun.NY.GDP.MKTP.CD)																									
40. Colombia	COL	GDP	(cun.NY.GDP.MKTP.CD)																									
41. Costa Rica	CRI	GDP	(cun.NY.GDP.MKTP.CD)																									
42. Côte d'Ivoire	CIV	GDP	(cun.NY.GDP.MKTP.CD)																									
43. Cyprus	CYP	GDP	(cun.NY.GDP.MKTP.CD)																									
44. Czech Republic	CZE	GDP	(cun.NY.GDP.MKTP.CD)																									
45. Denmark	DNK	GDP	(cun.NY.GDP.MKTP.CD)																									
46. Ecuador	ECU	GDP	(cun.NY.GDP.MKTP.CD)																									
47. El Salvador	SLV	GDP	(cun.NY.GDP.MKTP.CD)																									
48. Egypt	EGY	GDP	(cun.NY.GDP.MKTP.CD)																									
49. El Salvador	SLV	GDP	(cun.NY.GDP.MKTP.CD)																									
50. Ethiopia	ETH	GDP	(cun.NY.GDP.MKTP.CD)																									
51. Finland	FIN	GDP	(cun.NY.GDP.MKTP.CD)																									
52. France	FRA	GDP	(cun.NY.GDP.MKTP.CD)																									
53. Germany	DEU	GDP	(cun.NY.GDP.MKTP.CD)																									
54. Greece	GRC	GDP	(cun.NY.GDP.MKTP.CD)																									
55. Guatemala	GTM	GDP	(cun.NY.GDP.MKTP.CD)																									
56. Honduras	HND	GDP	(cun.NY.GDP.MKTP.CD)																									
57. Hungary	HUN	GDP	(cun.NY.GDP.MKTP.CD)																									
58. Iceland	ICL	GDP	(cun.NY.GDP.MKTP.CD)																									
59. India	IND	GDP	(cun.NY.GDP.MKTP.CD)																									
60. Indonesia	IDN	GDP	(cun.NY.GDP.MKTP.CD)																									
61. Iran	IRN	GDP	(cun.NY.GDP.MKTP.CD)																									
62. Iraq	IRQ	GDP	(cun.NY.GDP.MKTP.CD)																									
63. Israel	ISR	GDP	(cun.NY.GDP.MKTP.CD)																									
64. Italy	ITA	GDP	(cun.NY.GDP.MKTP.CD)																									
65. Japan	JPN	GDP	(cun.NY.GDP.MKTP.CD)																									
66. Jordan	JOR	GDP	(cun.NY.GDP.MKTP.CD)																									
67. Kazakhstan	KAZ	GDP	(cun.NY.GDP.MKTP.CD)																									
68. Kenya	KEN	GDP	(cun.NY.GDP.MKTP.CD)																									
69. Kyrgyzstan	KYR	GDP	(cun.NY.GDP.MKTP.CD)																									
70. Laos	LVA	GDP	(cun.NY.GDP.MKTP.CD)																									
71. Latvia	LVA	GDP	(cun.NY.GDP.MKTP.CD)																									
72. Lithuania	LIT	GDP	(cun.NY.GDP.MKTP.CD)																									
73. Luxembourg	LUX	GDP	(cun.NY.GDP.MKTP.CD)																									
74. Malta	MAL	GDP	(cun.NY.GDP.MKTP.CD)																									
75. Montenegro	MNE	GDP	(cun.NY.GDP.MKTP.CD)																									
76. Morocco	MOR	GDP	(cun.NY.GDP.MKTP.CD)																									
77. Moldova	MDA	GDP	(cun.NY.GDP.MKTP.CD)																									
78. Mongolia	MNG	GDP	(cun.NY.GDP.MKTP.CD)																									
79. Morocco	MOR	GDP	(cun.NY.GDP.MKTP.CD)																									
80. Namibia	NAM	GDP	(cun.NY.GDP.MKTP.CD)																									
81. Nepal	NPL	GDP	(cun.NY.GDP.MKTP.CD)																									
82. Niger	NER	GDP	(cun.NY.GDP.MKTP.CD)																									

FIGURE 5: GDP PER CAPITA DATA AFTER CLEANING BY HAND

FIGURE 6: TOTAL POPULATION DATA AFTER CLEANING BY HAND

United Nations (www.un.org):

Different from the dataset gathered from the World Bank, the original data from the United Nations is structured as an XLSX (Microsoft Excel Open XML Format Spreadsheet) file, with multiple tables each representing a different dataset. The following figure depicts the original data downloaded from the United Nations.

FIGURE 7: RAW DATA FILE DOWNLOADED FROM UN

With the first step of making the dataset usable for our project, the file needs to be converted to a CSV format. By using a web-based application called “cloudconvert” (www.cloudconvert.com/csv-to-xlsx), we were able to obtain the required file. Based on the above figure, the file contains multiple tables, each representing an aspect of immigrant and emigrant when being considered for comparison between countries. This was an obstacle for us when trying to process the data. Instead of processing the whole file, we decided to pick out the tables that held information that was crucial to the aim of the visualization. The table we have chosen is Table 1 (International migrant stock at mid-year by sex and by major area, region, country, or area, 1990 – 2017). With the process of handling the dataset by hand, we have split the said table into different files, with each name containing the format “*Migrate_XXXX.xlsx*” where “XXXX” corresponds to each respective year. The original Table 1 is as follows:

FIGURE 8: THE ORIGINAL TABLE 1 FROM THE UN DATASET

After the process of hand-cleaning data for table 1, we have the following files:

File	Actions	Last Updated
GDP.csv	update	2 days ago
ISO_codes.csv	update	6 minutes ago
LatLong.csv	update	2 days ago
Migrate_1995.xlsx	update	2 days ago
Migrate_2000.xlsx	update	2 days ago
Migrate_2005.xlsx	update	2 days ago
Migrate_2010.xlsx	update	2 days ago
Migrate_2015.xlsx	update	2 days ago
Population.csv	update	2 days ago
WB_LifeExpect.csv	update	2 days ago

FIGURE 9: SPLIT THE TABLE MENTIONED ABOVE INTO DIFFERENT FILES

Each of these files has the same format, with the only difference between each one being the year they represent. For example, the following figure is a representation of the format, more specifically the file “*Migrate_2000.csv*”.

FIGURE 10: MIGRATE_2000.CSV EXAMPLE

All the “*Migrate_XXXX.xlsx*” was formatted the same for ease of use and cleaner data representation.

Code Processing:

With each of the previously hand-processed data files, we put them into the same directory called “*raw_data*” for ease of navigation and differentiation. All the previous files were not suitable for generating a visualization, so we had to come up with a Python-based program to help us process the data better and faster. The code can be explained as the following:

1. **Data Processing:** The program reads and processes various demographic and economic data from different sources, including data related to countries, population, life expectancy, GDP, and migration.
2. **Statistical Calculations:** The program calculates various statistics related to migration, such as positive and negative stock, net migration, and immigration fraction.
3. **Data Output:** After processing and analyzing the data, the program outputs the results into structured formats, including JSON and CSV files, which can be used for further analysis, visualization, or integration with other systems.

```

1 # Define constants
2 labels = ['Country Name', 'Country Code']
3 years = [1980, 1985, 1990, 1995, 2000, 2005, 2010, '2015']
4 used = labels + years
5 not_used = ['destination', 'Numeric', 'Data Type', 'Total', 'Other North', 'Other South']
6
7 # Read the manually prepared data
8 countries = pd.read_csv('./raw_data/CountriesList.txt', delimiter=' ', index_col='Country Code', engine='python')
9 latlong = pd.read_csv('./raw_data/latlong.csv', index_col='Alpha 3', engine='python', usecols=['Alpha 3', 'lat', 'long'])
10 iso_codes = pd.read_csv('./raw_data/ISO_codes.csv', index_col='Country code')
11 pop = pd.read_csv('./raw_data/population.csv', index_col='Country code', usecols=used)
12 life_exp = pd.read_csv('./raw_data/life_expectancy.csv', index_col='Country code', usecols=used)
13 gdp = pd.read_csv('./raw_data/gdp.csv', index_col='Country code', usecols=used)
14 migrate_data = pd.read_excel('./raw_data/migrate_1990.xlsx', header=0)
15
16 # Initialize variables to store read data and results
17 countries_dict = countries.to_dict()
18 countries_list = countries.index.tolist()
19 latlong_list = latlong.index.tolist()
20
21 shared_index = countries_list[1:][set(countries_list[1:]) & set(latlong_list)]].index
22 shared_index = pop.index.intersection(shared_index)
23
24 pop = pop.reindex(shared_index)
25
26 immigrants = {}
27 emigrants = {}
28 maxs = {}
29
30 in_lines = {}
31 em_lines = {}
32
33 positive_stock = pd.DataFrame(0.0, index=pop.index, columns=years)
34 negative_stock = pd.DataFrame(0.0, index=pop.index, columns=years)
35 net_stock = pd.DataFrame(0.0, index=pop.index, columns=years)
36 total_stock = pd.DataFrame(0.0, index=pop.index, columns=years)
37 in_frac = pd.DataFrame(0.0, index=pop.index, columns=years)
38
39 # Reusable functions
40
41 # Scale values for easier reading
42 def scale(value, max_val):
43     return ((value * (0.2)) / max_val) + 0.2
44
45 # Calculate migration data for each defined year
46 def calc_migration(year):
47     migration = pd.read_excel('./raw_data/Migrate_{}_year.xlsx', header=0)
48
49     migration = migration.query('Numeric < 000 and Numeric > 999')
50     migration['Country Code'] = iso_codes.loc[migration['Numeric'], 'alpha-3'].values
51     migration.set_index('Country Code', inplace=True)
52     migration_shard_index = migration.index.intersection(shared_index)
53     migration = migration.reindex(migration_shard_index)
54     pop[year] = pop[year].reindex(migration_shard_index)
55
56     good_countries = set(migration['Destination'])
57
58     for code in migration.columns[G]:
59         if code not in good_countries:
60             migration.drop(code, axis=1, inplace=True)
61         else:
62             migration.rename(columns={code: migration.index[migration['Destination'] == code][0]}, inplace=True)
63
64     new_not_used = []
65     for not_used_col in not_used:
66         if not_used_col in migration:
67             new_not_used.append(not_used_col)
68
69     return migration.drop(new_not_used, axis=1)
70
71 # Calculate the origin and end of a migration
72 def mig_line(origin, destination, status, value, scaled_value):
73     d = dict()
74     d['origin'] = ('latitude': latlong.loc[origin]['lat'],
75                    'longitude': latlong.loc[origin]['long'])
76     d['destination'] = ('latitude': latlong.loc[destination]['lat'],
77                         'longitude': latlong.loc[destination]['long'])
78     d['value'] = value
79     d['scaled_value'] = scaled_value
80     if status == 'in':
81         d['id'] = origin
82         d['name'] = countries_dict['Country Name'][origin]
83         d['label'] = origin
84         d['id'] = destination
85         d['name'] = countries_dict['Country Name'][destination]
86         return d
87
88 # Process each row in the migration data file
89 def mig_row(row_name, row, status, max_val):
90     if status == 'in':
91         target = destination + migration
92         target += target[origin + migration
93         l = mig_line(origin, row_name, status, value, scale(value, max_val)) for origin, value in row.items()]
94     elif status == 'em':
95         target = origin + migration
96         l = [mig_line(row_name, destination, status, value, scale(value, max_val)) for destination, value in row.items()]
97     return l
98
99 # Filter out the insignificant data
100 def mig_lines(migration, status, threshold, maximum):
101     assert status in ['in', 'em']
102     if status == 'in':
103         for code, row in migration.iterrows():
104             for code, row in migration.iterrows():
105                 if code == row['origin']:
106                     if row['value'] > threshold:
107                         if row['value'] > maximum:
108                             migration.drop(code, row['row'] > threshold), 'in', maximum)
109
110     return d
111
112 # Process data for each defined year
113 for year in years:
114     immigrants[year] = calc_migration(year)
115     emigrants[year] = immigrants[year].transpose()
116     emigrants[year] = emigrants[year].transpose()
117     in_lines[year] = mig_lines(imigrants[year], 'in', 1000, maxs[year])
118     em_lines[year] = mig_lines(emigrants[year], 'em', 1000, maxs[year])
119
120     positive_stock[year] = immigrants[year].fillna(0.0).sum(axis=0)
121     negative_stock[year] = emigrants[year].fillna(0.0).sum(axis=0)
122
123     total_stock[year] = positive_stock[year] + negative_stock[year]
124     net_stock[year] = positive_stock[year] - negative_stock[year]
125
126     in_frac[year] = net_stock[year] / total_stock[year]
127
128     life_exp = life_exp.reindex(life_exp.index.intersection(shared_index))
129     life_exp.drop('SNP', inplace=True)
130
131     pop = pop.reindex(pop.index.intersection(countries.index))
132     gdp = gdp.reindex(gdp.index.intersection(pop.index))
133
134     gdp_per_cap = gdp.copy()
135     for year in years:
136         gdp_per_cap['gdp_per_cap'][year] = gdp[year] / pop[year]
137
138     gdp_per_cap.rename(columns={'Country Name': 'name'}, inplace=True)
139
140     # Write to processed files to use in inverse-join
141     with open('./processed_data/immigrant.json', 'w') as out: json.dump(in_lines, out, indent=2)
142     with open('./processed_data/emigrant.json', 'w') as out: json.dump(em_lines, out, indent=2)
143     with open('./processed_data/countries.json', 'w') as out: json.dump(countries_dict['Country Name'], out, indent=2)
144     gdp_per_cap.to_csv('./processed_data/gdp_per_cap.csv', index_label='id')
145     life_exp.to_csv('./processed_data/lifeTotalMigrants.csv', index_label='id')
146     total_stock.to_csv('./processed_data/NetTotalMigrants.csv', index_label='id')
147     in_frac.to_csv('./processed_data/NetTotalRatio.csv', index_label='id')

```

FIGURE 11: PYTHON-BASED PROGRAM FOR DATA CLEANING

Additional files:

Apart from all the above dataset files, two more were considered to be crucial during the process of creating the visualizations: *ISO_codes.csv* and *LatLong.csv*.

3. Requirements

3.1. Must-have Features:

Interactive Visualization:

a. Hover Effect:

- Implemented the world map to display detailed data and explanations when hovering over specific countries or regions.
- Added to the map to highlight migration pathways and showcase detailed data.

b. Drill-Down:

- Different description box tabs are shown when clicking on specific countries, providing a How-to-read section and a summary/background section. Additionally, a detailed data table is displayed.

c. Selectors:

- Implemented the world map, allowing users to select a country and view migration patterns to and from that country.

Additional Information:

- Providing ample context is crucial for visualization understanding, so we provide additional labeling.

Clear Data Labeling:

- Ensures users grasp the represented data.

Color Contrast:

- Different colors represent distinct migration flows, aiding readers' visual clarity.

3.2. Optional Features:

Tooltip Integration:

Tooltips offer instant context, eliminating the need to memorize information. While this functionality couldn't be implemented, an alternative has been provided to serve a similar purpose.

4. Visualization Design:

We structure our visualization design process into four stages, each applicable to both initial development and refinement. These stages are as follows:

1. Conceptualize:

- Brainstorming & Sketching: Generate rough ideas based on project goals and data. This includes sketching layouts, exploring visual elements (maps, charts, graphs), and storytelling approaches.
- Research & Inspiration: Analyze existing migration visualizations to learn from best practices.
- Target Audience: Consider user needs (policymakers, researchers, public) for effective communication.
- Technical Feasibility: Evaluate visualization techniques considering data complexity, performance, and resources.

2. Visualize:

- Refine Sketches: Polish initial sketches based on feedback, using design software or prototyping tools.
- Prototype Layouts: Develop layouts balancing visual appeal and functionality. Experiment with data element arrangement, scales, and annotations.
- Color Palette & Style: Explore color schemes, typography, and graphic styles for a cohesive and engaging presentation. Apply color theory for readability and meaning.

3. Materialize:

- Finalize Design: Make final decisions on styling, colors, and additional visual elements. Create a style guide for consistency.
- Iterate on Feedback: Refine based on usability testing and user research, ensuring accessibility for diverse users.
- Interactive Elements: Consider tooltips, filters, and animations to enhance engagement and exploration. Design intuitive navigation to guide users.

4. Implementation:

- Coding the Design: Translate final design concepts into code using appropriate libraries (d3.js).
- Data Integration: Integrate cleaned and processed data, ensuring accuracy and relevance. Use data-driven visual encoding techniques (size, color, position).
- Testing & Debugging: Conduct thorough testing to identify and resolve technical issues or compatibility concerns. Test across devices, screen sizes, and browsers.
- Iterative Changes: Propose changes based on usability testing to optimize engagement and comprehension. Document the implementation process for future updates and maintenance.

4.1. Conceptualize (Design Iteration) stage:

We want to offer a straightforward, interactive layout in the first early stages of the visualization design process that will work for the public, who is our target audience. We adopt distinct approaches to various visualizations while working with classified sorted data, all the while maintaining consistency to guarantee a user-friendly experience.

Without thoroughly reviewing the data we have discovered, we created a rough sketch for the first visualization, Migration Pattern, to convey our ideas to the reader. We concentrated on "World Map" style visualizations and carefully considered our options because our goal is to visualize the flow of immigrants and emigrants from different countries to one another.

The figure below is our attempt to implement a "World Map" visualization, which in our opinion, was the go-to way to help users grasp the concept of Immigrant and Emigrant flows relative to countries all over the world.



FIGURE 12: AN ATTEMPT AT THE WORLD MAP SKETCH

Throughout our research, we have found other visualization alternatives but mostly aren't suitable for the scope our project is going for. A bar chart is a great implementation of a visualization to describe the flow of immigrations and emigrations over time. Still, sadly that's only applicable for a single country for each country, since implementing for all countries over the world can make a bar chart seem inadequate when the user wants to compare between countries. Instead, we have chosen the Bar Chart as a supporting visualization for the main one, i.e. the World Map above. Another type of supporting visualization we decided to implement was a Pie Chart, for which the goal was to visualize the men and women percentage in immigrating or emigrating between countries.

4.2. Visualize Stage:

We now produce a set of higher fidelity designs after looking into our design decisions, which aids in contextualizing the idea behind these visualizations. We would like to see a justified, centered look at the Migration Pattern visualization, with different sections representing different rates of immigration and emigration.

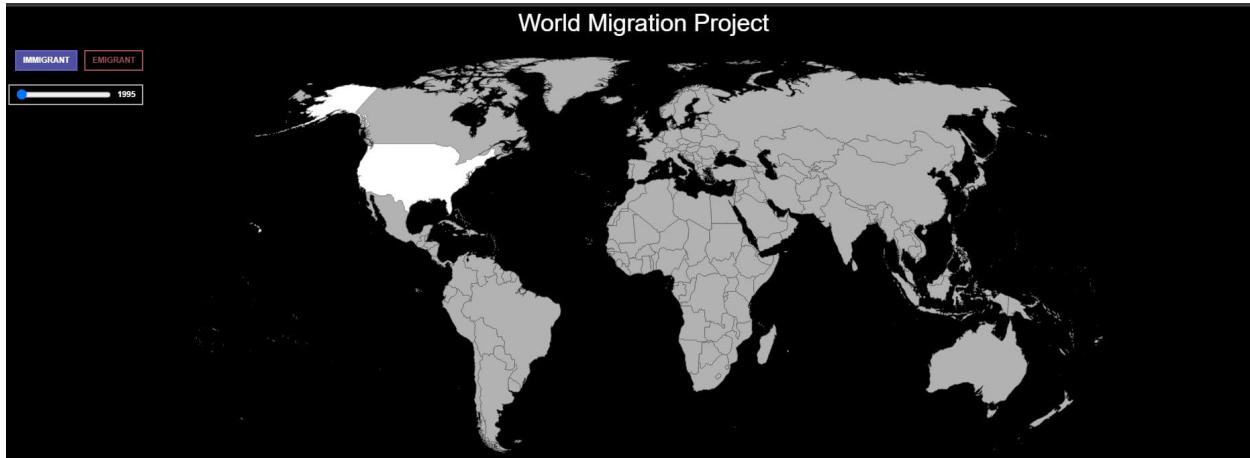


FIGURE 13: FIRST ITERATION OF THE WORLD MAP

The figure depicts our first iteration of a World Map. The key feature is the clear delineation of countries by black borders. There's no indication of country labels or other details on this specific screenshot, and the scale isn't evident, making it difficult to gauge the relative size of different regions. However, this map serves as a simple yet informative way to visualize the Earth's landmasses divided into individual nations. There is no additional information about the World Migration Project on the screenshot. It is unclear what the purpose of the website is, or what kind of information it provides about migration.

With these ideas in mind, a mockup for the website was made by me in an Excel sheet to gather feedback from the lecturer, Dr Hoang Xuan Tung. We made suggestions on how to implement the GDP per Capita data into the visualization to help users better understand the correlation between the immigration/emigration rate and how the GDP of a country can affect those numbers. We have chosen a side-to-side Pie Chart depicted in the figure below, to help users compare developing and developed countries. It would contain the percentage of men and women when immigrating or emigrating, and the user can specify which country to visualize.

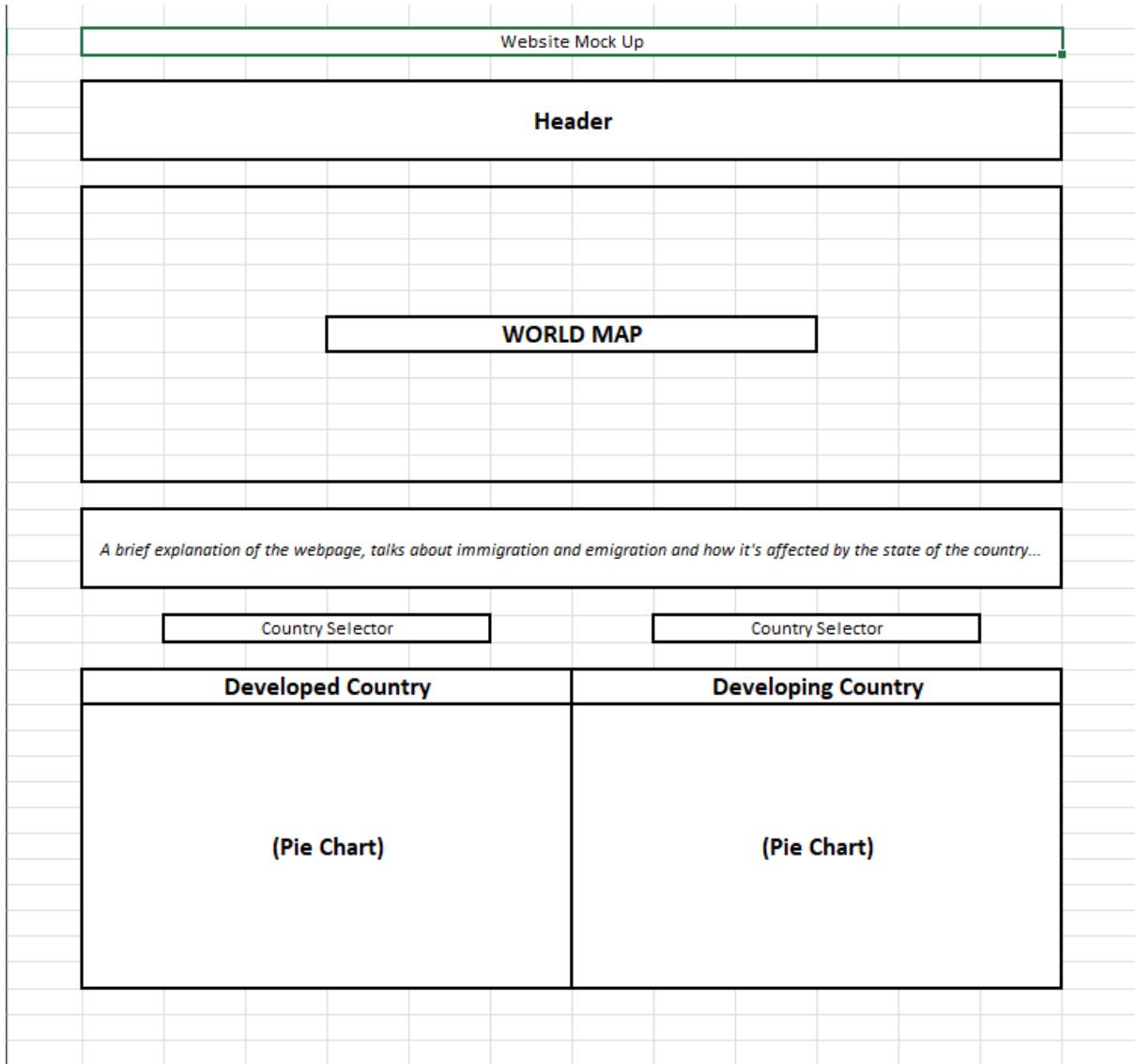


FIGURE 14: MOCKUP DESIGN OF THE WEBSITE

After receiving feedback from Dr. Hoang Xuan Tung, we have decided to implement a color system within the World Map to display the GDP per capita, making the two Pie charts below the main visualization redundant. This will be further elaborated in the next section of this report.

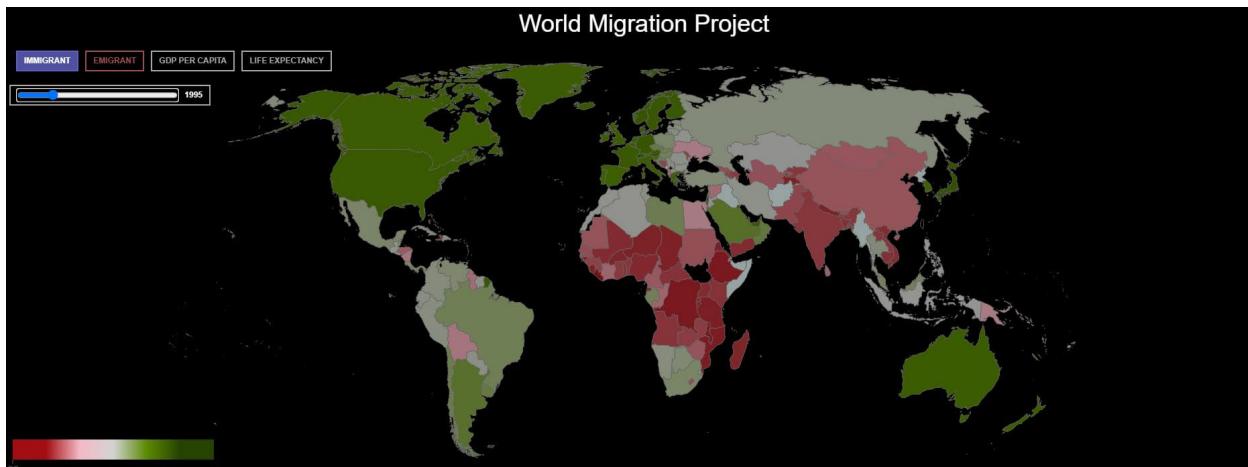


FIGURE 14: SECOND ITERATION OF THE WORLD MAP

With suggestions from Dr. Hoang Xuan Tung, the idea was to use a single World Map to display the flow of immigration and emigration using colored lines, flowing in or out of a selected country. Options are displayed at the top-left of the World Map to prompt the users between viewing the immigrant flow, which would be represented by a curved line flowing in from other countries, with the emigrant being represented in the same way. At this stage, we were still working on a simple way of showing the difference between the in-flow of immigrants and the out-flow of immigrants. A simple color scale between red and green was used to represent the differences in **GDP per capita**, and **Life expectancy**. However, there was a problem as our team felt the lack of supporting charts, as the website lacked basic information about the said World Map, so we were prompted to raise concerns during the next Stand-Up meeting.

4.3. Materialize Stage:

Between the two Stand-Up meetings 2 and 3, our team was able to add additional user controls to help navigate the world map, while changing the color scale to better represent the changes in the data (i.e. GDP per capita and Life expectancy). The result was the following figure.

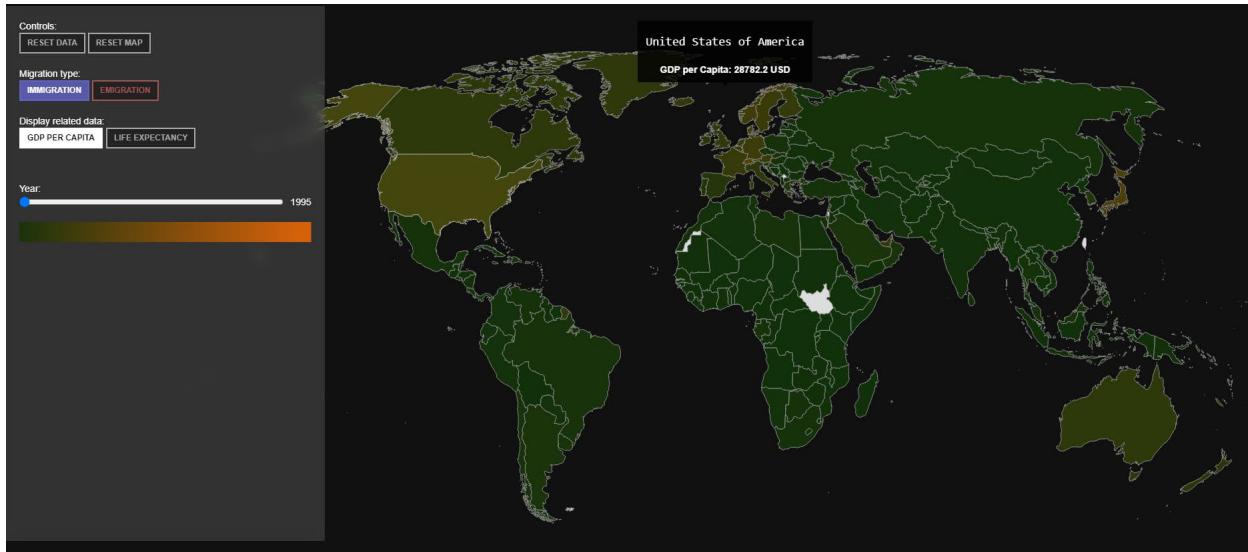


FIGURE 15: THIRD ITERATION OF THE WORLD MAP

With Stand-Up Meeting 3 coming to an end, we decided to add another supporting visualization, a simple line graph that shows the net immigrant/emigrant rate of a country. With the idea of helping the users grasp the concept of immigrant and emigrant better, we feel that the said supporting visualization would provide ample support, displaying numbers that help users to conceive the flow of immigrants and emigrants better from the World Map alone.

4.4. Implementation Stage:



FIGURE 16: FOURTH ITERATION OF THE WORLD MAP

The final design for our Stand-Up Meeting 4 is displayed above, with almost every feature we aim to create, the map contains everything needed for a user to navigate and use the World Map effectively. The newly implemented user interface showcases a Migration Data showcase of selected countries, which would display every country immigrating or emigrating relative to the selected country.

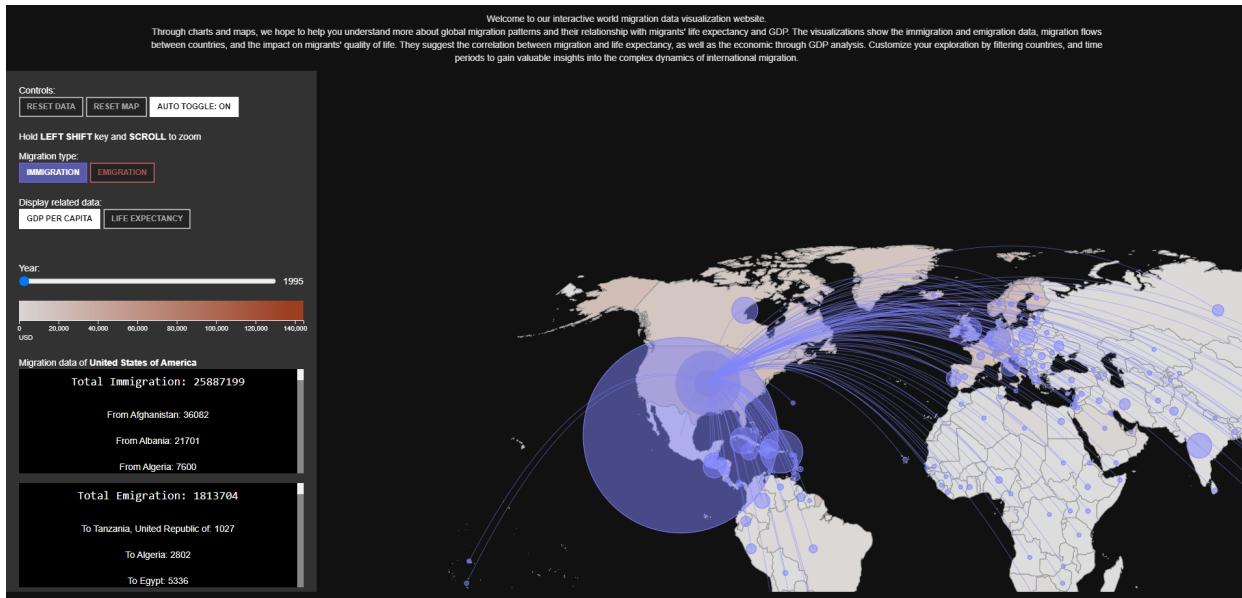


FIGURE 17: EXAMPLE OF THE NEW USER INTERFACE (U.S.A. IN 1995)

With the previously mentioned supporting visualization, we have found a way to implement it. By selecting a country on the World Map, a second visualization will appear beneath the World Map. This visualization aims to help users understand more about the numbers of immigrants compared to emigrants of a country.

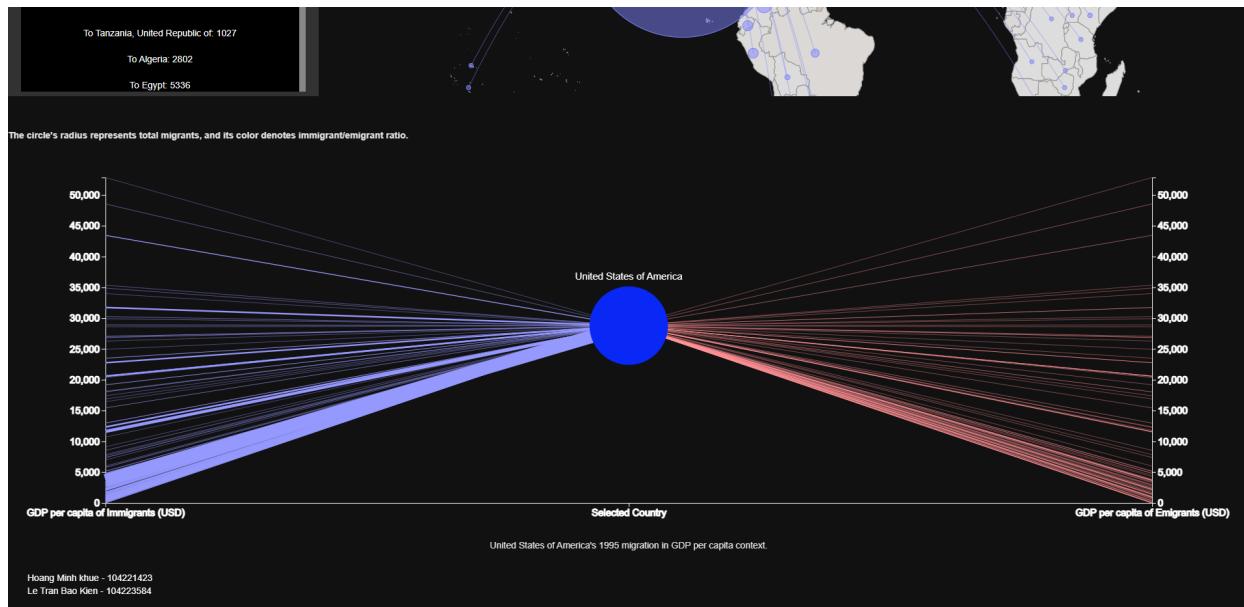


FIGURE 18: EXAMPLE OF THE SUPPORTING VISUALIZATION (U.S.A. IN 1995)

With the final product completed, we felt the need to help users find countries easier, since for some, locating countries through geographical is not an easy task, so we opted to implement a search bar function, to help users find specific countries.



FIGURE 19: IMPLEMENTATION OF THE SEARCH FUNCTION, FINAL ITERATION OF THE WORLD MAP

5. Final Design

The final version of our data visualization set is shown below; you can also view it by clicking the provided Mercury link (mercury.swin.edu.au/cos30045/s104221423/WorldMigrationProject/).

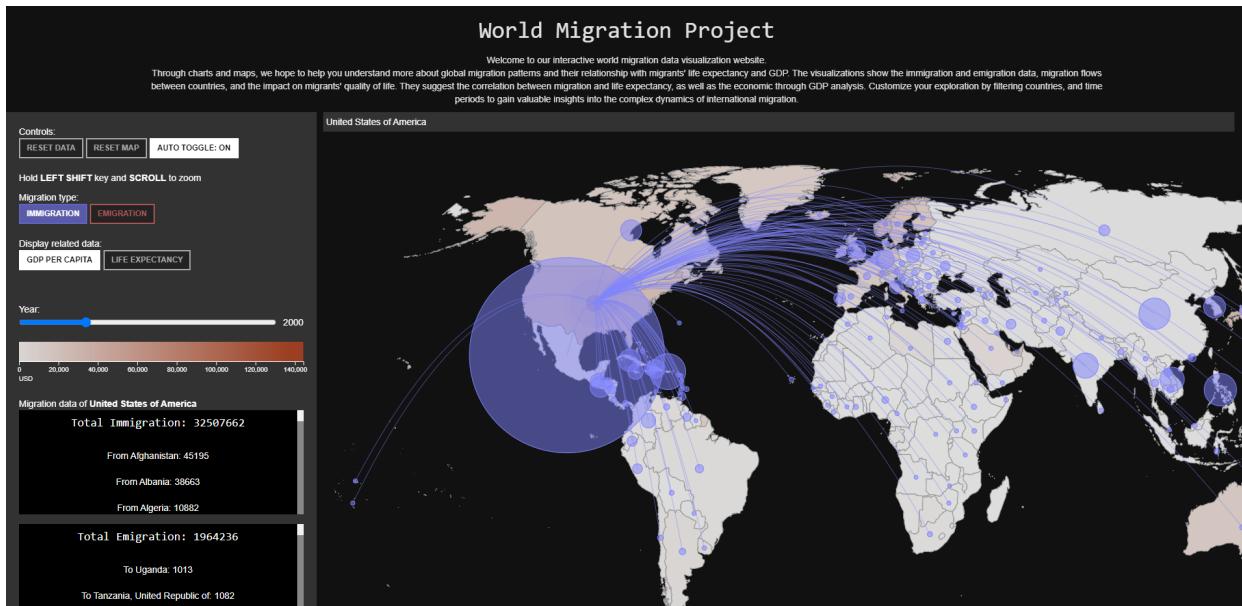


FIGURE 20: FINAL DESIGN OF THE WEBSITE 1

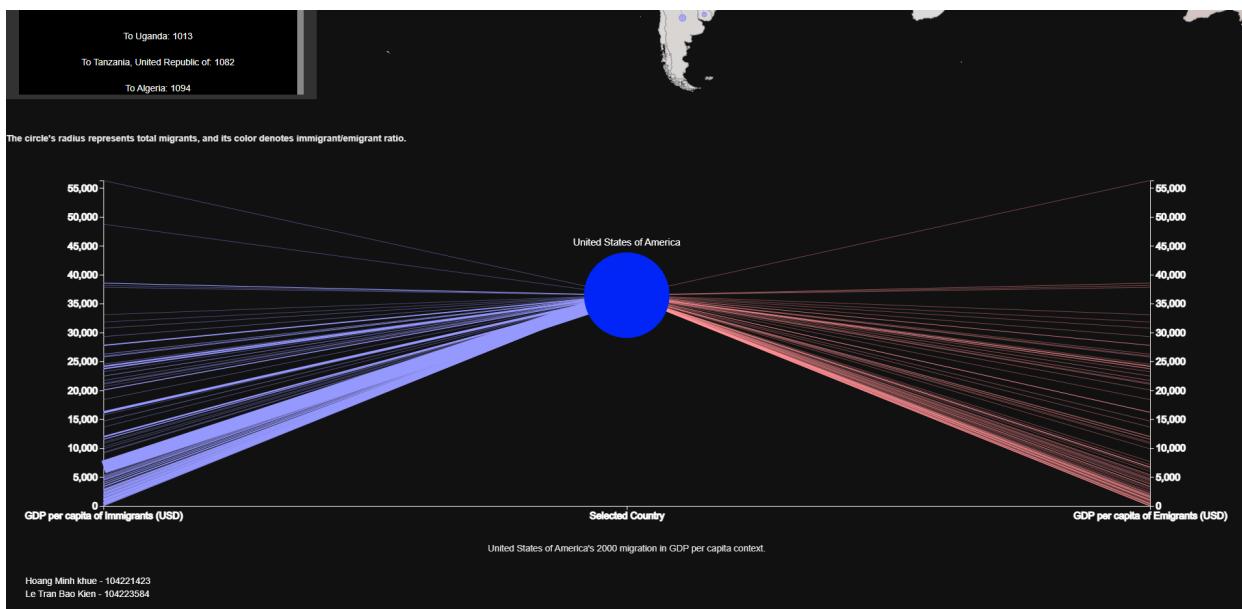


FIGURE 21: FINAL DESIGN OF THE WEBSITE 2

6. Conclusion

In today's globalized world, migration—especially cross-country migration—has become extremely common. There are pull and push factors at play in this trend. We extracted, processed, analyzed, and visualized the global migration to highlight the aforementioned phenomena. We selected two distinct kinds of diagrams. A world map is utilized to illustrate and contrast the migration flow, GDP per capita, and life expectancy; a line chart is employed to illustrate the variations in the migration numbers. The JavaScript D3.js library was used to plot the data. The essential features for both visualizations are interactive visualization, extra background information, a distinct data label, and contrasting colors for the various data points. Lastly, usability testing was done to make sure the visualization is easy to use, effectively conveys information, and meets the needs of the intended audience.

References