Brailliant Solutions

January 31, 2018

Andrew H. Rawicz
School of Engineering Science
Simon Fraser University
V5A 1S6

Re: Capstone Project Proposal for DynaBraille

Dear Dr. Rawicz:

Please find attached, Brailliant Solutions' proposal for DynaBraille, which will give a basic overview of our Capstone project. We hope to improve the lives of the visually impaired using DynaBraille which will convert multiple different forms of text into a convenient refreshing braille display.

The proposal consists of a project overview, basic product function explanations, deliverables, market analysis, team composition, project deadlines, and estimated project cost considerations.

At Brailliant Solutions we have a diverse and talented group of engineering students from Simon Fraser University in Biomedical Engineering, Computer Engineering, and Systems Engineering: Homan Lam, Kevin Cheng, Daniel Tan, and Jeffrey Wong. Not only are we all hard workers, but we are also extremely passionate about our work and our products.

Thank you for taking time out of your day to review Brailliant Solutions' proposal for DynaBraille. If you have any questions or concerns, feel free to contact our team lead, Homan Lam, via email at hla125@sfu.ca or via phone at (604) 600-3282.

Yours truly,

Homan Lam

Homan Lam
Team Lead
Brailliant Solutions

Brailliant Solutions

Project Proposal for: DynaBraille

Team #12:

Brailliant Solutions

Team Members:

Homan Lam
Jeffrey Wong
Kevin Cheng
Daniel Tan

Submitted to:

Dr. Andrew Rawicz – ENSC 440
Steve Whitmore – ENSC 405W
School of Engineering Science
Simon Fraser University

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Executive Summary

Imagine being visually impaired, going to a busy restaurant and after being seated you are given a menu and left alone to decide. Usually a waiter would assist in describing the dishes but since it's busy, no one is available to help. This is where we introduce DynaBraille, our solution to assisting the blind in reading plain text. With DynaBraille, scenarios like the one above will be no more as you will be able to scan plain text and have it converted into braille in real time so you can read it with ease and without the help of another person.

DynaBraille is targeted towards the visually impaired, and from our research there is currently no such product in the market that will provide the form and function that we do. Our proposed solution involves a camera to scan text, and with our dynamic braille pad convert the scanned text into braille letters and output it in real time.If time permits, we plan to implement other features such as voice output and braille conversion from files loaded in the product's memory.

At Brailliant Solutions, we are a team of engineers with a vision of providing the visually impaired with the best possible instant text to braille translation solution. Our team comprises of four fifth year engineering science students - two computer, one systems and one biomedical, each with diverse backgrounds and experiences. We are devoted to researching and developing the most optimal and low cost solution to provide the visually impaired all over the world with our state of the art assistive device.

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1. Introduction

Background: In today's day and age, being blind can be a big disadvantage and cause many difficulties in life. Based on the Global Data On Visual Impairments 2010, there are 285 million people visually impaired, 39 million being blind, and 246 million having low vision [1]. These numbers are only expected to grow with the aging population, as well as from the increased usage of electronic devices which cause increased eye strain. From this we can see that there is a relatively large market and desire for improving the quality of life for blind people. Although there are already many measures to help improve the ease of life for blind people, there are still many problems which remain to be explored and solved.

Proposal: One of many problems blind people encounter frequently is the inability to read plain text. This proposal addresses the feasibility of patenting and marketing a hand-held accessory device which allows blind people to read plain text in real time. This device scans plain text and physically outputs the same text in braille, one letter at a time, through the use of mechanical components. The device will have six actuators arranged in a cell (of 2 by 3) to emulate braille characters, with additional interfaces to control which letter to display. Moreover, the device will ideally be the size of a small phone or barcode scanner.

Figure 1: Concept picture of device shape

Technology & Design Process: The initial design concept consists of a camera capable of scanning pages of text (with audio cues to indicate whether text has been properly scanned), a microprocessor which can parse and store text from the image, and piezoelectric actuators to display braille letters. The braille would display one letter of the text at a time,and the device will have controls to quickly parse through the scanned text for a desired entry point. The design

process will involve researching for a camera capable of scanning an A4 letter with sufficient resolution, a processor capable of the required processing, a speaker, and mechanical components capable of emulating braille. From this data, multiple iterations of prototyping will be done, with each iteration improving upon the previous design.

User Experience & Quality Assurance: The final packaging for this product will contain a small braille and text manual for users. The quality standard of the initial design is that the device must have no more than a 1% failure rate before one year of use, and so a one year warranty will also be included with any retail sale of this product. To further ensure the product meets quality standards, there will be thorough component and system testing, and there will also be a website & support line for the product.

2. Project Overview

This section will outline the overall high level system design and overview of our product. We will also discuss the scope of the project and the requirements and deliverables that are to be produced. To finish off it will outline the risks that may be present as well as the benefits that the successful completion of this project will provide.

2.1 Scope

The purpose of DynaBraille is to provide an easy and convenient device to assist the visually impaired in reading text in their immediate surroundings. The goal of our project is to design and create a product that is both affordable as well as easy to use to help the visually impaired navigate the world more easily, especially when alone. To accomplish this, we establish the main requirements of our device, which include:

- Scan texts in a large variety of different font and sizes
- Scan text in ordinary lighting conditions
- Indicate to user that scanning was successful through audio cues
- Process text to braille reasonably quickly, mechanically output *legible* braille
- Allow users to conveniently parse through the text
- Process text from a stored pdf/ebook and converting that into braille
- Sized small enough such that it would be convenient to carry

The above outlines the main requirements of our device but if we have sufficient time, we plan to include other features like:

- Text to speech output
- Accompanying IOS/Android application

The device will also be supported with a company/product website and product support. In addition, the cost per device should be minimized, assuming large scale production is planned.

Since this project is spanned over 8 months, a deliverable of a proof of concept will be planned first due at the end of April which will be a working text to braille conversion of a single character. Our final product deliverable will be a fully working prototype that will be done by the beginning of August.

2.1.1 System Overview

To gain a better understanding of how our product will function, Figure 1 shows a high level system overview between the different modules and data flow in our system. DynaBraille is planned to support two different types of user input. The first is via the camera module, with which the user will take a picture of the desired text to be translated, and the second is through the internal storage where users can upload a text file or ebook that will be translated to braille.

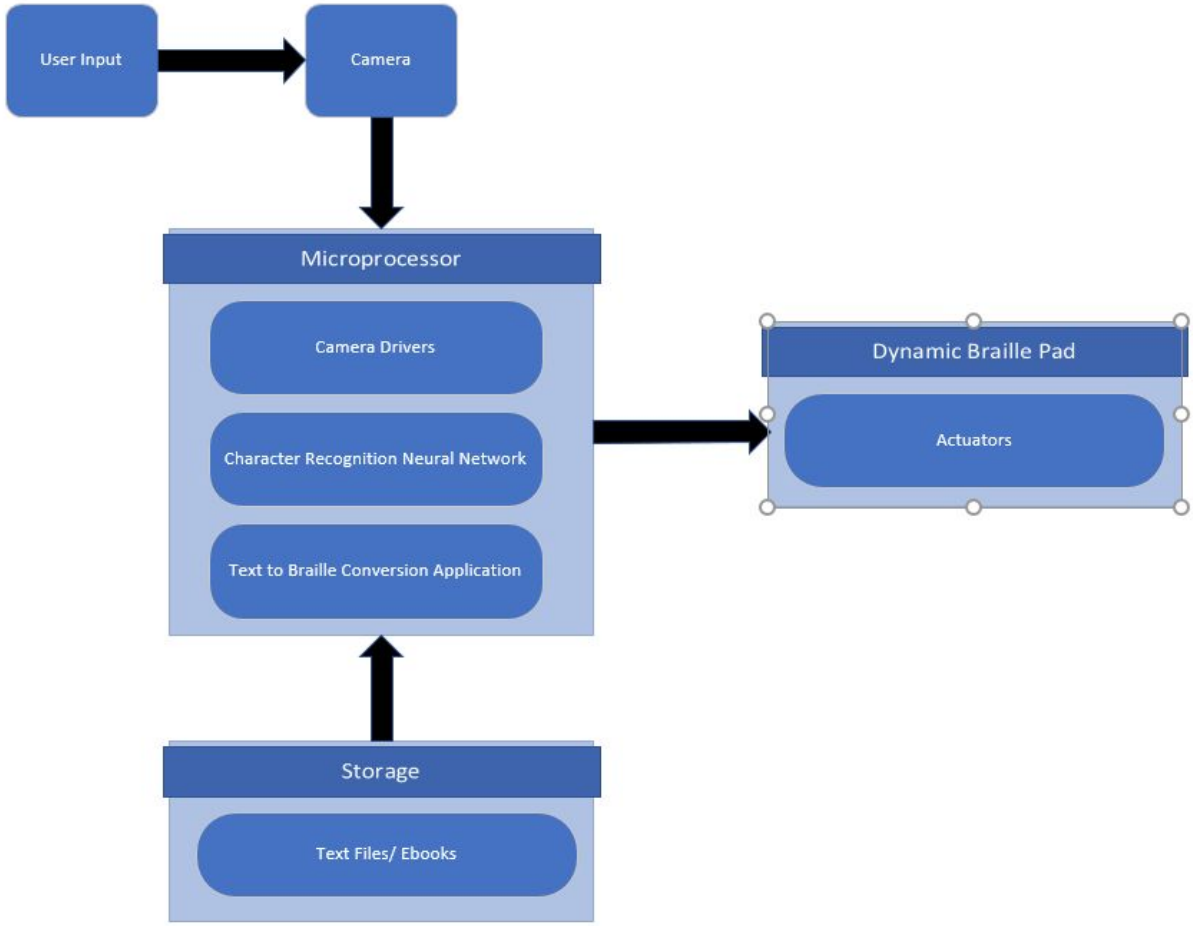

Figure 2 : System Overview of DynaBraille

Whichever way the data is provided, it will be passed to the microprocessor and converted into braille output for the user via a dynamic braille pad containing a 3x2 matrix of actuators. The modules in the microprocessor describe the software components where we will use a neural network to perform character recognition on the picture input. The text-to-braille module will then be responsible for taking the characters and converting them into braille format based on the 3x2 matrix. This data is then fed into the actuators to move the corresponding pins and produce the braille output.

2.2 Risks:

This section discusses the possible risks associated with investment in this product and the methods that we will use to mitigate the risks. The risks include: inability to design, prototyping, finalizing the project within the time window, inadequate appeal to consumer market, safety and reliability of our product.

To mitigate the possibility of failing to meet deadlines, the team members plan to produce a strict project timeline and ensure that it is met. The team will hold weekly meetings to check up on progress and redistribute the workload where necessary.

The time to market is relatively slack since there are no competitors and the population of blind people is not projected to decrease, and the needed funding for the prototype is not expected to be very large which is why it isn't considered as a major risk. Moreover, product awareness can be acquired by reaching out to blind communities.

To ensure reasonable safety standards, the device design will ensure harm from the device should be rare if not non-existent. Based on Health Canada's risk-based system, the device is an active and non-invasive device which falls under Class I [2]. This means the device is relatively low risk. In order to further protect the users and meet certain standards, the product will be designed with safety in mind. Since the device involves electrical power and moving mechanical parts, precautions will be taken to prevent the user from getting electrocuted, burned or pinched. In terms of reliability, the minimum target lifetime is one year, with the intent that only 1% of all fabrications will be defective before the one year period. There will be a designated quality assurance process for the software, hardware, and final product, to ensure the finalized device is up to standards.

2.3 Benefits:

Economical benefits: Successful marketing and sales of this product will mean a hefty profit for the stakeholders, as well as the build up brand/company reputation and more business opportunities.

Cultural benefits: With the successful completion of our product, DynaBraille will revolutionize the way visually impaired people are able to interact with the world. The need for people to

accompany them will decrease significantly and they will be able to become more self sufficient. The ability to read any text on the fly is something that will benefit the blind greatly and will improve their quality of life immensely.

3. Market/Competition/Research Rationale

3.1 Market:

In short, market analysis indicates that the vast majority of targeted consumer should be upper-middle and high class blind people in developed countries. Based on existing data in 2010 [1], there were 26 million people in the Americas and 28 million people in Europe who suffer from visual impairment. Other data from 2011 [3] suggest that over half the population in Europe and the Americas have upper-middle or high class income. A preliminary and simple extrapolation can be made, concluding that half of all blind people in these two regions can afford this product, and should be the target of this product.

3.2 Competition:

Although there exists articles referencing portable real-time text-to-braille devices, they exist either only as a design concept or as simple prototypes for projects, and there have been no exhibited attempts from any company or person to manufacture a similar device for retail purposes; ergo, there is currently no publically existing competition.

3.3 Research Rationale:

Although the are many blind people, the ratio of visually incapable to the visually capable is quite small, meaning that advertisement and product awareness will be a difficult and expensive venture, and sale potential will be much smaller compared to conventional products. To compensate, the device must be appropriately priced such that sufficient returns can be acquired from sales. Accompanied with the fact that there are presently no clear competitors, the final polished version of this product should be priced in around 200$ to 500$ (early estimate, prone to change).

4. Company Details

4.1 Company Name

The company has been decide to be Brailliant Solutions because it rolls of the tongue easily, and is descriptive enough such that people can deduce what the company is about; braille solutions for blind people.

4.2 Product Name

The product in question has been named DynaBraille because it also rolls off the tongue smoothly and is descriptive enough to allow people to deduce what the product is about.

4.3 Company Logo

Figure 3: Company Logo

4.4 Company background

The group members involved in this project are four hard working engineers who value old fashioned principles such as respecting everyone, seeing things through to the end, taking responsibility for our work, and bearing professional workplace conduct. The success of the project can be foreshadowed by the fact that every member contributes different approaches and ethical values when undertaking tasks, but possesses such strong interpersonal skills that any conflicts that arise are quick to be resolved.

4.4 Team Members

Homan Lam | hla125@sfu.ca | Team Lead

Homan is a 5th year Biomedical Engineering student at Simon Fraser University. From his co-op terms at Tantalus Systems Corp. and Aquatic Informatics, he has developed skills in software and hardware design, while also working in highly agile company environments. His expertise lies in product design with human factors, as well as project management.

Wong Yau Shing, Jeffrey| wongyauw@sfu.ca | System Engineer

Jeffrey is a 5th year System Engineering student in Simon Fraser University. He has 1 year working experience in Lyods Engineering Ltd. He has advanced skills at SolidWorks, programming, database, phone apps and electric circuit. He has comprehensive knowledge about hardware and software. He can work on all stages of a product, from research to development to design and from manufacture through to installation and final commissioning.

Kevin Cheng | kkc61@sfu.ca | Hardware Engineer

Kevin Cheng is a Computer Engineering with past internship experiences involving computer programming and electric circuitry. Programming-wise, has accrued aptitude in working with C and C++, and hardware-wise, he has acquired developed knowledge of professional practices when working with electric circuitry and soldering.

Daniel Tan | dzt@sfu.ca | Computer Engineer

Daniel is a 5th year Computer Engineering student at Simon Fraser University. His previous co-ops at Safe Software and LMI Technologies has granted him experiences and professional workplace skills in software development and debugging. His main expertise lies in C/C++ and object oriented programming.

5. Project Planning

As briefly discussed in the project scope, the development of DynaBraille will follow an 8 month development process that will result in a proof of concept prototype delivered by the beginning of April with a fully working prototype to be delivered by the beginning of August. Figure 2 shows an timeline depicting our major milestones for the first 4 month phase. Figure 3 is a detailed Gantt chart that depicts our long term plan for the 8 months including our goals and deadlines for software and hardware components which should be finished by June 15th. Testing and Integration will be the home stretch and is projected to be finished at the end of July.

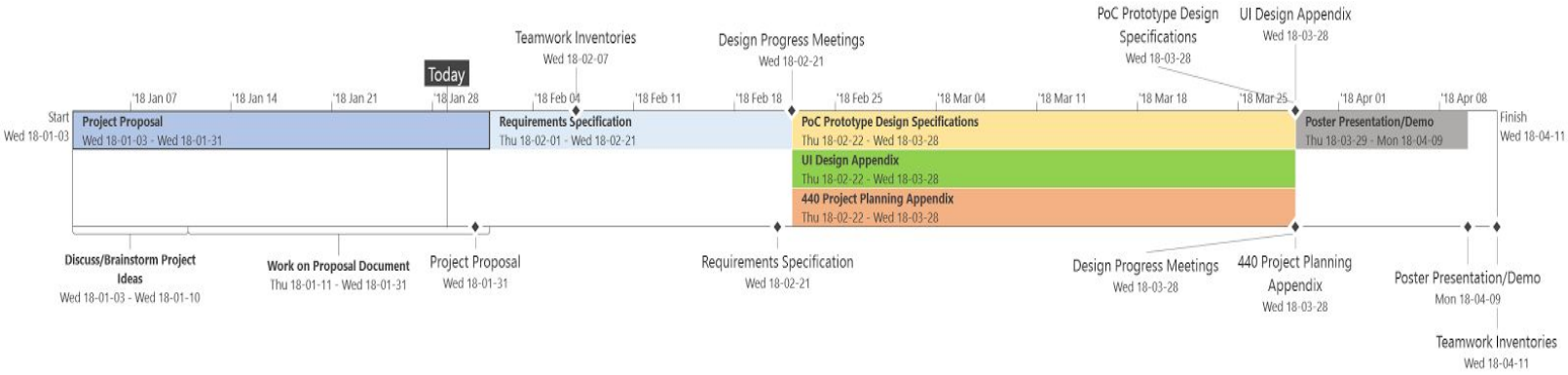

Figure 4 : Milestone Chart

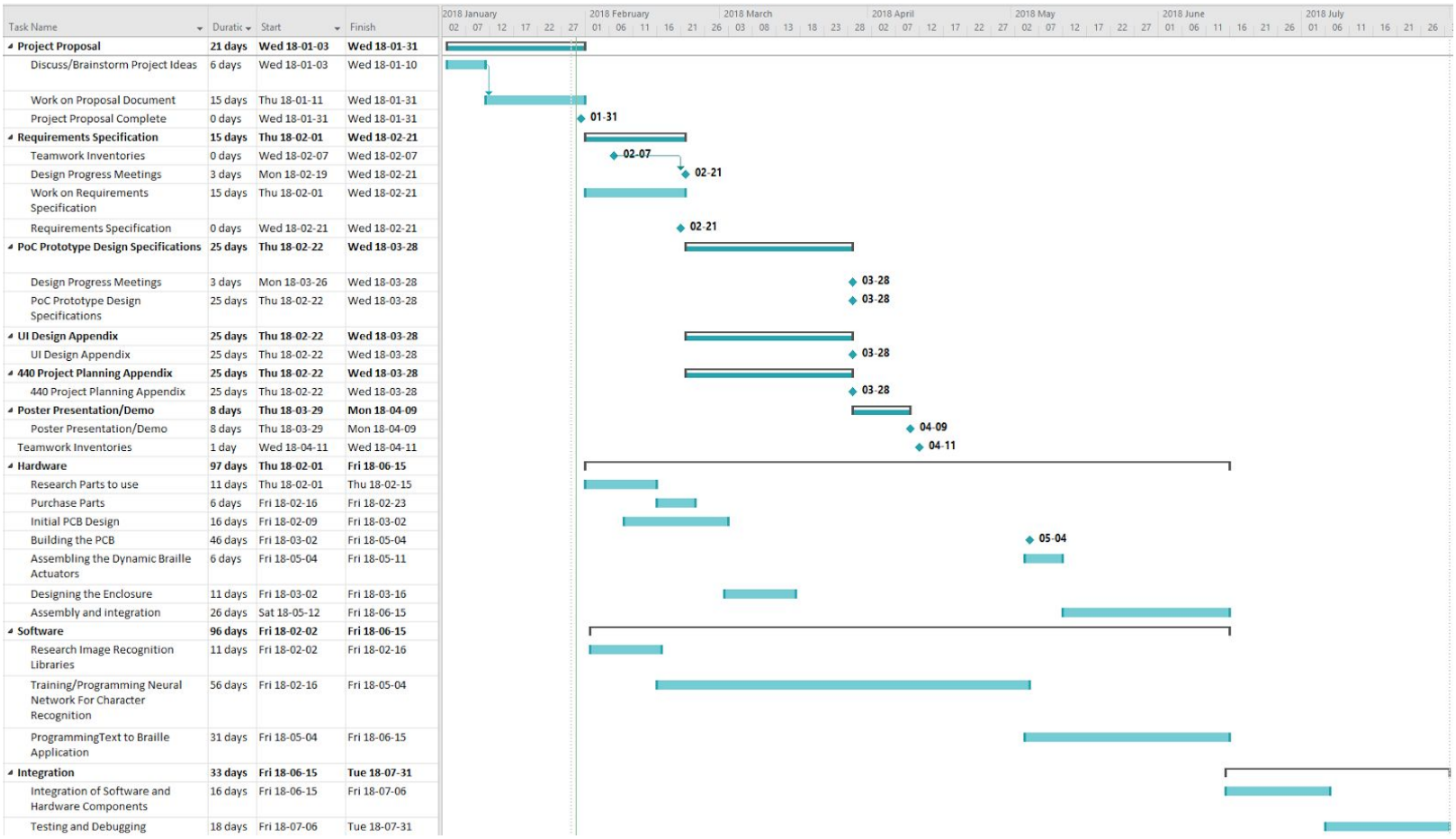

Figure 5 : Gantt Chart

6. Cost Considerations

During mass production, this price could drop to around $112 per device. As our device is a medical assistive device that meets different standards and regulations, we hope to be able to sell to the market at $299. This is a profit margin of around $187 per device not including labour and other fees. Funding will be received from the Wighton fund, with any extra finances required from our own company. In the future, we hope to attract many investors to expand our company.

Pricing estimates table is shown below.

Item	Price (approximate)	QTY	Subtotal
Main body case (3D printing)	$20	1	$20

Battery	$10	1	$10
Circuit board	$25	1	$25
Piezoelectric actuator	$7	6	$42
Camera	$100	1	$100
Processor	$25	1	$25
			Total: $222
Cost Contingency	25%		Final Total: $277.50

Table 1: Pricing estimates table.

7. Conclusion

DynaBraille could be an elegant solution to one of the biggest problems blind people face: not being able to read bodies of text. The device will allow users to read physical and electronic bodies of text and in real time, and removes the need of having to carry around their Braille counterparts. The device may also have others features like the ability to read users' texts wirelessly from devices such as phones and laptops. With regards to product development, the device will not only go through an extensive and iterative design process, but it will also be thoroughly verified and validated in order to create a highly reliable and low risk quality product. Tying everything together, the preliminary analysis indicates the presence of a large market for this device and relatively high profit margins. An investment in this product would bring a positive change to both the community and the pockets of its investors.

8. Glossary

Brailliant Solutions Company name
DynaBraille Product name
Piezoelectric Material which generates movement from electricity and vice versa
Actuator Device component used to generate movement

9. References

[1] "GLOBAL DATA ON VISUAL IMPAIRMENTS 2010", Who.int, 2012. [Online]. Available: http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf. [Accessed: 17- Jan- 2018].

[2] H. Canada, "Guidance Document - Guidance on the Risk-based Classification System for Non-In Vitro Diagnostic Devices (non-IVDDs) - Canada.ca", Canada.ca, 2015. [Online]. Available: https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/application-information/guidance-documents/guidance-document-guidance-risk-based-classification-system-non-vitro-diagnostic.html. [Accessed: 17- Jan- 2018].

[3] Pew Research Center analysis of data from the World Bank PovcalNet database, “World Population by Income”, Internet: “http://www.pewglobal.org/interactives/global-population-by-income/”, July 8, 2015 [January 1, 2018].