WWW.IJRPR.COM

**International Journal of Research Publication and Reviews**

Journal homepage: www.ijrpr.com ISSN 2582-7421

# Harvesting Energy from Sound

***Sarika Patil[1], Neha Navarkar[2], Ankita Shelke[3], Kunal Kumar[4]***

Associate Professor[1], Department of Electronics and Telecommunication Engineering
[2,3,4]BE Students, Department of Electronics and Telecommunication Engineering
D Y Patil College of Engineering, Akurdi Pune, India
sapatil@dypcoeakurdi.ac.in [1], neha.snavarkar@gmail.com [2], ankitashelkeb@gmail.com [3], kunalkr210@gmail.com [4]

**ABSTRACT—**

Sound energy related to material vibration is the main source of noise pollution and the least pollution among the types of pollution that most people ignore to recycle and convert it into energy. The purpose of this project is to develop a device capable of producing useful energy from sound and waste heat known as noise pollution and power banks based on waste heat with appropriate architectural design, component design, code generation, and integrated systems. Design and develop. Researchers choose design science research methods and V-model methods to investigate device performance. Power banks based on sound pollution and heat dissipation were tested in different noisy areas. The device was tested in different locations to prove its ability to work in different noise environments. The efficiency of device is effective in using noise to charge the power bank, especially in noisy places where the power bank continuously charges the battery. Compared with commercial power banks, power banks based on noise pollution and heat dissipation obtained similar results. Charging is also done in various gadgets that most likely use power banks that are effective and efficient. Future improvements in noise pollution and waste heat-based power banks will make this device a secondary source of noise pollution recycling, and waste heat can be the basis for large-scale power generation.

**Keywords—Diaphragm, Piezoelectric material, sound energy, Electricity, noise, sound vibration**

## I. INTRODUCTION

One of the main problems for this generation is pollution and as we know that recycling is the only solution we can do to reduce it, which is noise pollution and heat waste or noise pollution, so pollution is ignored. There is no possible way to clean our surroundings from sound, but on the other hand, there is a way to recycle the electrical energy produced by sound vibrations, which causes pressure waves, which transform them into different sound levels. Mechanical and electrical energy.

There are many ways to generate alternative energy from sound energy, which is the main source of noise pollution and electrical energy waste. Mechanical filters are used and pressure and sound are transformed in the same way because the sound is in the form of vibrations that will be collected in electro electric and thermoelectric materials. Piezoelectric and thermoelectric materials [1][17] increase the desire to think about the use of noise pollution and waste heat [2], which is a threat to the environment and requires the processing of this type of waste to become a useful material. Available in most developing countries [3]. This noise comes from various places such as public places, factories and points close to industry. The idea of using a power bank as a main tool because mobile phone accessories is one of the needs of the modern generation [4][18], [5][19] as the mobile phone has become one of the needs of the modern generation and how short it is. Battery life affects the use of this gadget for communication and entertainment. , including the use of a power bank as a device that can give our phones a longer life, explains the use of a power bank. To phone accessories that give extra life to the device. Today's phones have bigger screens, faster processors, and more audio capabilities, and require more power when in use.

The possibility of renewable energy as a source of energy banks in addition to electricity from a point of convenience [5][15][13]. Many previous projects have used solar energy to develop a phone charger that uses pressure as an energy source with the help of piezo materials to generate electricity [6]. Sound can also be a source of energy. This is made possible by using certain components and equipment that can change sound or acoustic to mechanical (pressure) and ultimately produce electrical energy. Piezoelectric and thermoelectric material processes and how they can produce energy from one form to another. Piezoelectric and thermoelectric as conductors [8][10], in this study, the collected sound will be converted into electrical conversion with applied voltage [9][11][12]. The vibration will come from the vibrations carried by the sound waves near the conductor.

## II. LITERATURE SURVEY

Because of the available technology, the researchers chose to conduct a study that could help with recycling and produce a device that could help people in their daily lives as far as sound or sound energy. Briefly, the proponent decided to develop a power bank based on noise pollution and waste heat. A noise pollution and waste heat base power bank will convert noise pollution and waste heat into electricity and store what it has converted for the moment of need.

This research has been done to harness noise pollution and waste heat for better purpose and improve the use of smartphones and mobile gadgets which are now becoming essential devices for everyone. [10]; [11]; [12] with noise pollution and waste heat based power banks, pollution can be recycled for many useful purposes. Using piezoelectric and thermoelectric materials, convert sound energy from mechanical energy to electrical energy. [13]. A

research paradigm, Figure 1 below, is a visualization of the researcher's concept.

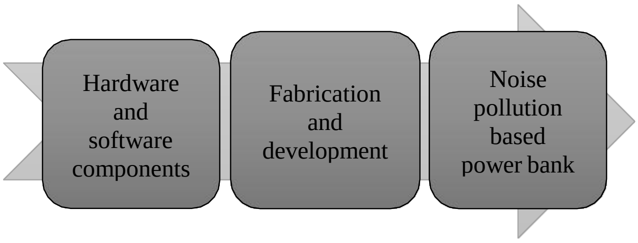


**Figure 1: Research Paradigm.**

The research paradigm shows the development process of a power bank based on noise pollution and waste heat. It includes input, process and output. The input includes the hardware and software components required to complete the expected device, then the process includes the construction and development of a noise pollution and waste heat based power bank and the output is the finished product produced by the researcher. Input and processing. The output is noise pollution and waste heat based power bank. The research paradigm was reinforced by a conceptual paradigm as shown below.

A conceptual model of research. It introduced noise pollution and waste heat base power bank process. The diagram also includes the input, process and output of the device. The noise, which is under the input, will be harvested over the area that will be used for testing. This is the model that will go through the noise pollution and waste heat based power bank and piezoelectric and thermoelectric materials courses to come up with the output. During the process, using a power bank based on noise pollution and waste heat, the cut sound will pass through the microphone and come out as electricity.

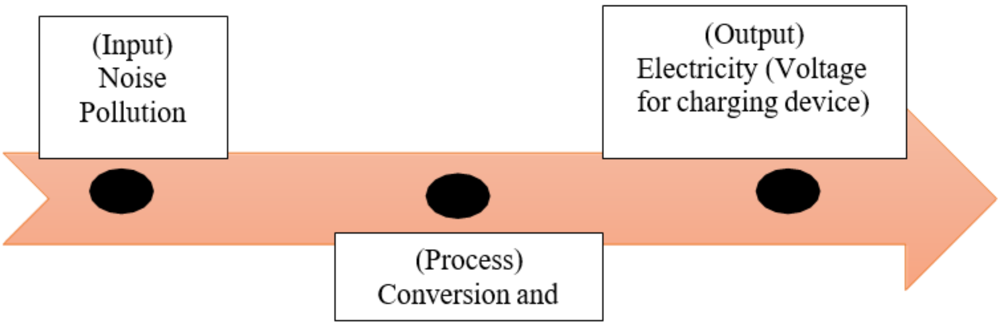


**Figure 2: Conceptual Paradigm.**

The objective of this research is to develop a power bank based on noise pollution and waste heat. This will be more important for researchers who need to investigate the conversion methods of energy form to other that is sound energy from electrical energy to become a new source of useful energy [14]; [15].

## III. METHOD

This study used an experimental method to elucidate the mechanisms by which these factors contribute to the design and development of a power bank based on noise pollution and waste heat, and also utilized Design Science research methods that involve the creation of new knowledge through the design of new or innovative artefacts such as .algorithms, human/computer interfaces and system design methodologies or language [16].

The solver chooses the V Model procedure to ensure the effectiveness of the project. The appropriate model for this project is the V model. Figure 3 illustrates the process.

The proponent listed the materials to be used in the development of the project, then the first thing the proponent did was to study and collect data related to the project. In addition, the collected data and information from various sources and the designer assembles the above components to start the production and finally the software design, which includes the details of the software side of the project, such as a data flow diagram (DFD), illustrates how the data is processed by the system from in terms of inputs and outputs.

The diagram reveals external entities to the system and shows how data moved from one process to another. Subsequently [17] it includes structure such as vibration source, batteries and users. Furthermore, the relationship between the power bank and the entities. The sound or noise creates pressure on the power bank based on noise pollution where the conversion takes place [18]. Thus, after the conversion, the electrical energy is transferred to the battery for the user's consumption.

### *A. Block Diagram*

The system is designed to produce dc output to store in a battery or to use in real applications. The block diagram depicted above is the functional working of the system proposed. Input in the case of a system will be noise or any kind of sound to convert it into energy. The sound transducer is used to complete the expected process of energy conversion. The output of this transducer is then amplified and rectified for further applications. The above diagram depicts the process by which the system achieves its goal. If this technique is followed repeatedly, the device will generate electricity from sound or noise.

There are two known methods for converting sound into energy, using the diaphragm or using piezoelectric material. However, the combined use of both methods can give the maximum expected output.

A bridge wave rectifier is used to effectively convert AC to DC with minimum ripple.

The output of the rectifier circuit is then fed to the rechargeable battery for further use or directed to the application circuit.

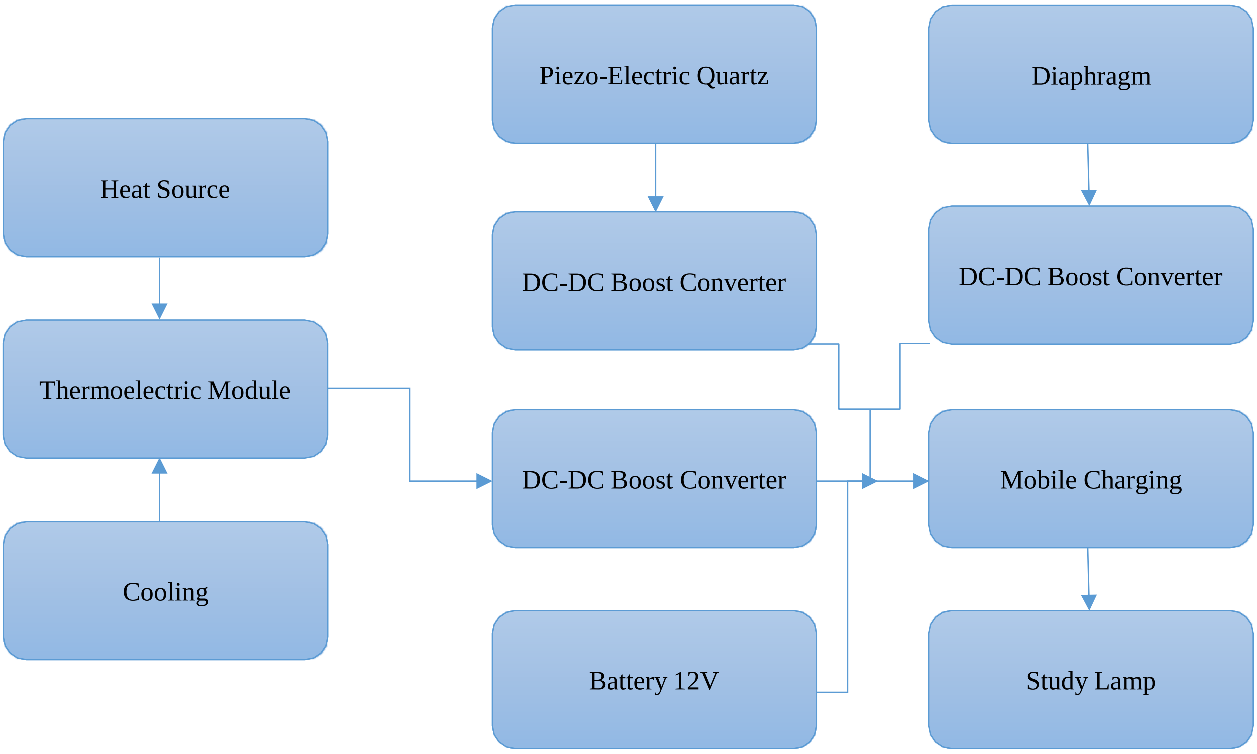


**Figure 3: Block Diagram**

### *B. Circuit Design*

The transducer helps to take a sound wave as an input and convert it into electrical energy, which is then passed through a step- up transformer to achieve maximum voltage. A diode is connected to a transformer to convert AC voltage to DC voltage which will be stored in the battery. Diodes form the bridge rectifier structure which will give us maximum output rectified with less ripple. The capacitor is used to filter out the ripple present in the output of the rectifier.

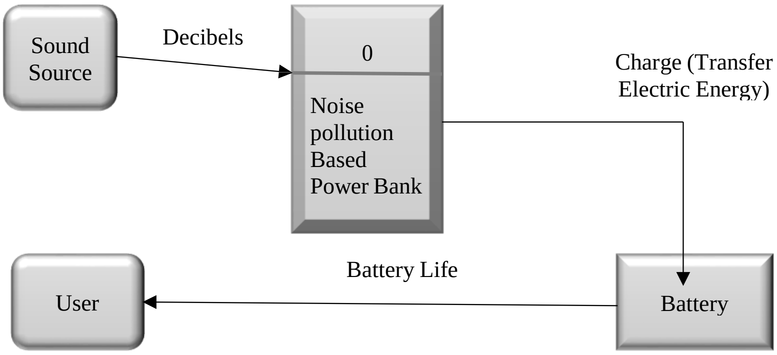


**Figure 4: Entity Relationship Diagram**

The electrical energy which is produced by a sound transducer is too small to use. For this reason, a step-up transformer is connected to a transducer to get maximum voltage use. The alternating low voltage is converted to alternating high voltage via a step-up transformer and the winding on the secondary side exceeds the winding on the primary side. The working principle of the step-up transformer is shown in the next chapter which is used for this proposed design

An entity relationship diagram (ERD) shows the different types of environments that produce high levels of noise that can be provided for a power bank. The output of the power bank will charge the battery used by a single user.

A use case diagram illustrates the use of a noise pollution and waste heat based power bank in which, the user needs to use the power bank with the phone in which the decibels and battery percentage were displayed.

The main flow of the device's system workflow. It starts with the initialization process where the device acquires sound for storage. When the devices are turned on, the system will be initialized then the system will monitor the captured sound and print the measured decibels, then the device will charge the external device connected to it.

A power bank model was tested for noise pollution and waste heat in various noisy areas around Puerto Princesa City, including canteens, public markets, power industry, KTV bars, disco bars, public transport, malls, movie houses and other noisy places. Tools used for fabrication included a drill bit for making holes on the device enclosure, pliers and cutters for connecting wires, and soldering iron and soldering lead for soldering.

To determine voltage, current, and resistance, the proponent used Ohm's Law, where: V = voltage, I = current, and R = resistance.

To determine the sound level or decibel, the following formula:

20log10 ( $ut$ ) (1) Where:

V$out$ = Voltage going into the device V$in$ = Voltage coming out of the device

The result of this formula is expressed in the unit of decibels (dB). Using the voltage gain decibels is determined by the equation:

$V2 = V110^{20}$ (dB) (2)

The current consumption of an electret microphone is a maximum of 0.5mA, but it does not affect the voltage stress on the capacitor. Instead, the current between the microphone and the capacitor is calculated using the equation:

$I = Vb\ e{-}t/RC$ (3)

Where:

V$b$ = source voltage R = resistance t = time

RC = Time Constant (Resistance x Capacitance)

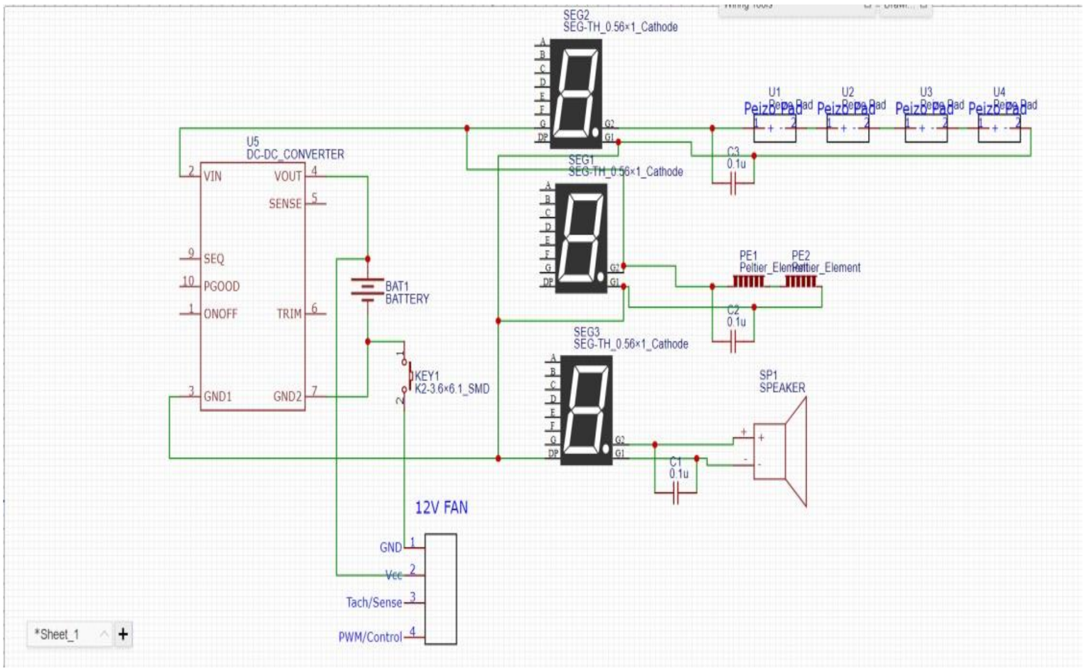


**Figure 5: Circuit Design**

*C. Result*

**Table 1: Voltage gain Converted from Measured Decibels.**

| Noisy Places | Decibels( dB) | Voltage Gain(m V) |
|---|---|---|
| Normal (Sunny) | 44 – 49 | 282mV |
| Rainy | 44 – 55 | 562mV |
| Canteen | 44 - 54 | 501mV |
| Class Room | 44 - 74 | 501mV |
| Hall Ways | 44 - 66 | 1995mV |
| Mall 1 | 44 - 58 | 794mV |
| Mall 2 | 44 - 75 | 5623mV |
| Mall 3 | 44 - 70 | 3162mV |
| Public Market | 44 - 74 | 5011mV |
| National Road | 44 - 75 | 5623mV |
| Road Intersection 1 | 44 - 75 | 5623mV |
| Road Intersection 2 | 44 - 72 | 3981mV |
| Disco Bars | 44 - 77 | 7079mV |
| Comedy Bars | 44 - 82 | 12589m V |
| Closed | 44 - 82 | 12589m V |
| Open | 44 - 75 | 5623mV |
| Movie houses | 44 – 73 | 4466mV |
| Public Transport | 44 - 79 | 8192mV |
| Restaurant 1 | 44 - 76 | 6309mV |
| Fast food Chain | 44 - 75dB | 158mV - 5623mV |

In this experiment, a Sound meter android app was used to measure the sound, while the digital millimetre was used to measure the corresponding voltages. The piezoelectric sensor captured the input sound and converted it into electrical energy, which was then measured. The results showed that the output voltage was directly proportional to the intensity or pressure of the sound. The voltage was further enhanced by rectification using a filter, which resulted in a higher voltage output than without the filter. The necessary components were interconnected to create a system that generated power from sound input, where the sensor captured the sound and produced the corresponding output voltage.

*D. Applications*

The system will help us in many ways. It will increase local employment. Where street light does not reach the road, accidents caused by darkness will be removed. This method is so simple that it can be set anywhere.

It can be implemented in electric vehicles to use the sound of a car horn and use the stored energy to turn on the headlights or for minor applications

The system can also be used on roadside pathways to collect the energy from passing vehicles and then use it to charge the street lights.

Festivals like Ganapati Miravnuk can be a good source to get sound energy, another environment to get more decibels of sound energy is from DJ nights or Clubs with high-volume speakers.

Train horns can produce the maximum decibels that we can use to convert into electrical energy and can be used to light up the whole railway station.

It can also be implemented in movie theaters and stored energy can be used anywhere necessary.

## IV. CONCLUSION

There are several sources of sound that go unnoticed, one of which is noise generated by industry. Using transducers to convert sound waves (noise pollution) into energy shows that noise can act as an alternative source of energy. It should be noted that the values from the motorcycle can be further improved, since they were obtained after the damping effect of the exhaust pipe. This method further gives way here to a largely unexplored source of clean energy. The results show that as the noise level increased, so did the corresponding voltage that was measured on the multimeter. The results further show that there is a non- linear relationship between the acoustic energy and the developed voltage. This relationship can be deepened by using better equipment. This shows that over a sustainable period of time, the adopted methods can be used to generate enough electrical energy to be successfully stored in a DC battery.

## V. FUTURE SCOPE

Sound energy is perpetual. That makes it an undying resource for energy. Whether from an inanimate object or a sentient being, sounds come from everywhere. And hence it makes sound a never-ending source of energy as long as the atmosphere without a vacuum exists!! Even when it is seemingly quiet, there is always sound.

As we know, sounds constantly fill our acoustic environment. Like all energy, sound energy has the potential to generate electricity. Just like the sun provides unlimited solar energy and the breeze provides wind energy, sound energy is renewable because sentient beings and insentient objects alike constantly produce sound.

While sound waves and energy production principles have long been understood, the technology to convert sound energy to electricity is in its infancy.

However, as scientists and technicians investigate and improve the technologies involved in sound-generated electricity, sound energy may produce mass electricity one day.

If that sounds like a pipe dream, remember solar and wind power were once beyond our grasp too. Hence even if this technology is in its inception stage it has a long way to go in the future that lies ahead

### V. REFERENCES

[1] "Types of Renewable Energy", http://www.renewableenergyworld.com/index/ tech.html

[2] Gomez, Cynthia M., Air Quality, Noise Management and Energy Saving Practices, City Ordinance no. 1720-2011, City of Santa Rosa Environment Code pp. 20-23

[3] Hon. Marcelino R. Teodoro. Republic of the Philippines House of Representatives, Quezon City, Metro Manila, Philippines. http://www.congress.gov.ph/download/ basic_15/HB01839.pdf. Date retrieved: November 23, 2015.

[4] Kirby Cabrillos, John Vingem Geaga, Reg Vincent Natividad, Ryan Ceazar Santua http://www.slideshare.net/zeroyan/final-research-to-print Accessed: November

[5] Angelo Casemiro. "Gererating electricity by Walking" http://www.iflscience.com/technology/teenager-invents-

energy-generating-shoe-insoles Retrieved: November 26, 2015

[6] Alankrit Gupta, Vivek Goel, Vivek Yadav. Conversion of Sound to Electric Energy. International Journal of Science & Engineering Research, Volume 5, Issue 1, January- 2014, ISSN 2229-5518

[7] Shalabh Rakesh Bhatnagar. Converting Sound Energy to Electrical Energy Interna- tional Journal of Emerging Technology and Advances Engineering ISSN 2250-2459, Volume 2, Issue 10, October 2012 Retrieved: July 5, 2015

[8] Karki, James, Signal Conditioning Piezoelectric and Thermoelectric Sensors, Texas Instruments Mixed Signal Products Application Report SLOA033a – September 2000

[9] Konka, Hari Prasad, Characterization of Composite Peizoelectric Materials for Smart Joint Applications, B. Tech, Jawaharlal Nehru Technological University, 2007

[10] Tim Stilson "Piezoelectric and Thermoelectric Sensor" Source: http://soundlab.cs.princeton.edu/learning/ tutorials/sensors/ node7.html Accessed: October 31, 2015

[11] Tannith Cattermole "Mobile phones charged by the power of speech" http://www. gizmag.com/mobiles-powered- by-conversation/16417/ Accessed: November 23, 2015

[12] Shiela Marie Graza. "TIP QC Students Develop a Device Noise into Electrical Energy" http://kawingkawing.ph/tip-qc-students-developed-a-device-that-converts-sound-to-electricity/ Retrieved: November 23, 2015

[13] Rumsey, Francis; McCormick, Tim, Chapter 3 Microphones, Sound and Recording an Introduction (5th Edition), Focal Press Publishing.

[14] Sound lab "Piezoelectric and Thermoelectric Sensor" Source: http://soundlab.cs.princeton.edu/ learning/tutorials/sensors/node7.html Accessed: October 31, 2016.

[15] Doctrine in EST. Policy. Noise Standards in the Philippines. http://d0ctrine.com/ 2012/04/03/noise-standards-in-the- philippines/ Retrived: November 23, 2016

[16] Hon. Marcelino "Marcy" R. Teodoro. Republic of the Philippines House of Repre- sentatives, Quezon City, Metro Manila, Philippines. http://www.congress.gov.ph/ download/basic_15/HB01839.pdf. Date retrieved: November 23, 2016.

[17] Vijay Vaishnavi and Bill Kuechler. Design Science Research in Information System. Downloaded from: http://desrist.org/desrist/content/ design-science-research-in-information-systems.pdf. Date retrieved January 16, 2016.

[18] The Object Primer 3rd Edition: Agile Model Driven Development with UML http:// www.agilemodeling.com/artifacts/dataflowDiagram.htm date Retrieved: October 12, 2017.

[19] PacestarSoftware.http://www.pacestar.com/edge/index.html: Date accessed: June 22, 2017