Chapter Pre: Table Of Content.
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Chapter Pre: Table Of Contents.
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4.1.1.2.1 Pros.

4.1.1.2.2 Cons.

4.1.1.3 Raspberry PI.

4.1.1.3.1 Pros.

4.1.1.3.2 Cons.

4.1.2 Programming Language and Its Frameworks.

4.1.2.1 Requirements.

4.1.2.2 Arduino C.

4.1.2.2.1 Specifications and Popularity.

4.1.2.3 JavaScript.

4.1.2.3.1 Specifications and Popularity.

4.1.2.4 Python.

4.1.2.4.1 Specifications and Popularity.

4.1.2.5 Shell.

4.1.3 Database.

4.1.3.1 Requirements.

4.1.3.2 SQL and Its Variants.

4.1.3.3 MongoDB.

4.1.3.4 Real Time Database.

4.1.3.4.1 RethinkDB.

5 Project Requirements.

5.1 Physical Computing.

5.1.1 Sensors.

5.1.1.1 Minimal Implementation.

5.1.1.2 Realistic Implementation.

5.1.1.3 Ideal Implementation.

5.1.2 Outputs.

5.1.2.1 Minimal Implementation.

Chapter 1: Introduction.
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Quantitative social data is hard to get because the lack of social sensor. More over, the values are extremely varied under slight differences in circumstances. Currently, there are three common ways to get those quantitative data, which are polls, questionnaires, and interviews.

As far as the time goes, the term "social" can go beyond real life interaction. The term "social" has no necessity to interact with someone else in person anymore. Contrary to the amount of tools those are available to use to get social data from Internet activities (e.g. Facebook's like button, Reddit's down vote and up vote buttons, ...), there are only few technologies that could be use to facilitate real-life social data mining. Sociometric Badge in the other hand, is a tool that was made specifically to measure and take quantitative data from real-life social activities. Sociometric Badge, offers a platform to track social activities within a pre-determined space (e.g. conference, office building, ...). At its basic, Sociometric Badge takes the energy and pitch of its wearer's voice when social interaction happens and together infrared face-to-face detection it can determine whether a proper social interaction happen. All in all, Sociometric Badge is just like a Fitbit but for social achievement.

The first iteration of Sociometric Badge has abilities to measuring simple body gesture, extracting speech features (energy and pitch), radio transceiver to send and receive data over other Sociometric Badges, local positioning system from a relative base station, it knows when face-to-face interaction is happening, and Bluetooth for proximity and connection to mobile phone application. Although the Sociometric Badge can work with just face-to-face detection and speech features extraction, the focus of real-life social interaction as it is in social networking cannot be achieved without an ability to interact to other Sociometric Badge. Hence, it has build-in Bluetooth to display data to a mobile phone application and to upload data manually to a server. The current Sociometric Badge is now handled by a company named Humanyze which is from the same people who brought this badge in the first place. Compared to the first iteration, the recent Sociometric Badge has a dedicated server application and the badge is now able to stream data in real-time to the server. On that account, its wearer can receive feedback immediately. In essence, every new iterations of Sociometric Badge would emphasize on processing and taking data in real time.

The main problem of real-life social sensor is that there is no alternative thing to buy aside from the Sociometric Badge. Since Sociometric Badge went inside a commercial company there is little to no update on what are the current state of the arts. Furthermore, it is not as commercially available to buy, seeing there is no obvious way to buy Sociometric Badge aside from sending an email to the company. In the need of an alternative, there is recently a similar project from the same group that made Sociometric Badge. It is open source and it is called "Rhythm Open Badge". The project of Rhythm Open Badge let people to create their own sociometric badge using their instructions. However, this raised another concern that the people that needs to get quantitative measurement

usually are not adept in electronics nor programming. That, and with the fact that Rhythm Open Badge is made with tools those are not well known and the lack of documentations, are what motivate this project to create an alternative of Sociometric Badge for people who has no background in electronics and programming.

This project will focus on the project's progress and what went wrong and its solutions. Next chapter will discuss on things those motivate this project. Then moves into hardware and software development, testing, problems and solutions, and finally the conclusion of this project and recommendations.

Chapter 1: Introduction.
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Ideally, doing an observation for social experiment should not require the experimenter to set up an artificial environment, unless it is meant to. The problem with traditional method of social data gathering is that the technologies used to leverage the process make the observation less natural. Moreover, the process is not scalable for multiple instances of data gathering. Specifically for naturalistic kind of observation, the most ideal practice is to keep the environment as it is as well as having an ubiquitous data gathering tools. However, this situation is contrary to the distance between the observation object and experimenter and the data gathering tools. There are two sensible solutions for this problem, the first one is for both or either the experimenter and the tools to be blended into the environment naturally. Or, to have both or either them to be outside of the observation environment.

With, nowadays, everything can be connected to the Internet, it is simple to build tools to observe social interaction from any part on the world. Now the problem lies on how to make the tools fused together into the environment. For making such a ubiquitous technology, I set my spotlight on developing a wearable social sensor, of which the main goal of this project.

There are two main inspirations for this project. The first one is Sociometric Badge and the other one is Rhythm Badge. Historically, Sociometric Badge is the latest attempt to create an augmented name tag that is used in busy teamwork oriented place like in an office space. The Sociometric Badge looks back into 1992's Active Badge from Olivetti Research as its inspiration. After through DIY - approach iterations, the Sociometric Badge now is trying to set off as the first commercialized wearable device to enhance how people interact to each other.

Since the original Sociometric Badge went commercial, there are little to no documentation available for the Sociometric Badge. This suggests the main motivation for Rhythm Badge. Rhythm Badge is an open solution to Sociometric Badge. There are codes, schematics, and documentation available. However, looking at Rhythm Badge project repository the methods and tools used to produce a Rhythm Badge are not common. Rhythm Badge uses .... And based on Google Trends

these tools that Rhythm Badge uses sits in ... search queries. I initially feel that I am the only one that do not know anything about the tools mentioned. But with low search queries from Google Trends, the components and the tools those are used to make Rhythm Badge are indeed unpopular choices.

Then, problem is according to ... people that usually wants to do social observation is not fond of electronics and programming. Hence, in case they want to leverage their social observation with such tool like Rhythm Badge, they need to find another person that has experiences with the components and the tools those are used to make Rhythm Badge. Considering the low search queries from Google Trends, finding such person would be an uneasy task.

This project is set to please both makers and those who wants to do social observation in closed group. The scenario is that for both makers and the social observant to work together to make a tool similar to Sociometric Badge. With regard to the Rhythm Badge, the components and tools chosen for this project need to be as accessible as possible to the makers in term of how easy they are to find and to be studied. This project aims to kick start the development by setting an example of an alternative Sociometric Badge for both makers and social observant that can easily be tweaked based on their needs.

Structures….

Chapter 1: Introduction.
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Ideally, doing an observation for social experiment should not require the social scientist to set up an artificial environment, unless it is meant to. The problem with traditional method of social data gathering is that the technologies, used to leverage the process, make the observation less natural. Moreover, the process is not scalable for multiple instances of data gathering. Specifically for naturalistic kind of observation, the most ideal practice is to keep the environment as it is as well as having an ubiquitous data gathering tools. However, this situation is contrary to the distance between the observation object and the social scientist and the data gathering tools. There are two sensible solutions for this problem, the first one is for both or either the social scientist and the tools to be blended into the environment naturally. Or, to have both or either them to be outside of the observation environment. With, nowadays, everything can be connected to the Internet, it is simple to build tools to observe social interaction from any part on the world. Now the problem lies on how to make the tools fused together into the environment. For making such a ubiquitous technology, I set my spotlight on developing a wearable social sensor, of which the main goal of this project.

There are two main inspirations for this project. The first one is Sociometric Badge and the other one is Rhythm Badge. Historically, Sociometric Badge is the latest attempt to create an augmented name tag that is used in busy teamwork oriented place like in an office space. The Sociometric

Badge looks back into 1992's Active Badge from Olivetti Research as its inspiration. After through DIY - approach iterations, the Sociometric Badge now is trying to set off as the first commercialized wearable device to enhance how people interact to each other.

Since the original Sociometric Badge went commercial, there are little to no documentation available for the Sociometric Badge. This suggests the main motivation for Rhythm Open Badge. Rhythm Open Badge is an open solution to Sociometric Badge. There are codes, schematics, and documentation available. However, looking at Rhythm Open Badge project repository the methods and tools used to produce a Rhythm Open Badge are not common. Rhythm Badge uses NRF51-DK development kit. And based on Google Trends this development kit sits in 0 : ~65 interest over time per day since 2014 . This development kit interest point is compared to more well – used development kit, Arduino. I initially feel that I am the only one that do not know anything about the development kit mentioned. But with low interest point from Google Trends, the components and the tools those are used to make Rhythm Badge are indeed unpopular choices.

The study of social sciences live in different spectrum to knowledges necessary to make Rhythm Open Badge. Hence, in case social scientists want to leverage their social observation with such tool like Rhythm Open Badge, they need to find another person that has experiences with the components and the tools those are used to make Rhythm Badge. Considering the low search queries on tools those are used to create Rhythm Open Badge from Google Trends, finding such person would be an uneasy task.

This project is set to please both makers and those who wants to do social observation in closed group. The scenario is that for both makers and the social scientist to work together to make a tool similar to Sociometric Badge. With regard to the Rhythm Open Badge, the components and tools chosen for this project need to be as accessible as possible to the makers in term of how easy they are to find and to be studied. This project aims to kick start the development by setting an example of an alternative Sociometric Badge for both makers and social scientist that can easily be tweaked based on their needs.

Chapter 1: Introduction.
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Ideally, doing an observation for social experiment should not require the social scientist to set up an artificial environment, unless it is meant to. The problem with traditional method of data gathering is that the technologies, those are used to leverage the process, make the observation less natural. Moreover, the process is not scalable for multiple instances of data gathering. Specifically for naturalistic kind of social observation, the most ideal practice is to keep the environment untouched as well as having ubiquitous method for data gathering. However, the latter part is, traditionally, contrary to the distance within the observation object and the social scientists. There are two sensible solutions for this problem. The first solution is to have both social scientists and

their data gathering tools to be outside of the observation environment, let say this is similar as a park ranger using binoculars to observe wildlife from watch tower. Whereas, the second solution is to have both social scientists and their data gathering tools blended into the observation environment. With, nowadays, everything can be connected into the Internet, observation can be done in any part of the world. Now the problem, then, how to make the social sensor that blends into the observational environment. Specifically, for established and closed area like conference or office environment, I set my spotlight on developing a wearable social sensor as an ubiquitous data gathering tools.

There are two main inspirations for this project: Sociometric Badge and Rhythm Open Badge. Historically, Sociometric Badge is the latest attempt to create augmented name tag that is used in busy teamwork oriented place like in general office space or meeting room. The development of this badge looks back into 1992's Active Badge from Olivetti Research as its root inspiration. After through DIY - approach iterations, Sociometric Badge is now trying to set off as the first commercialized wearable device to enhance how people interact to each other.

Since Sociometric Badge went commercial, there are little to no documentations available on its recent development. This suggests the main motivation for Rhythm Open Badge. I think, as far as similarities on features, Rhythm Open Badge is an open solution for Sociometric Badge. There are codes, schematics, and documentation available. However, looking at Rhythm Open Badge project repository the tools used to make one are not common. The first version of Rhythm Open Badge uses RFDuino and programmed with Arduino C as its development suite. Whereas the its latest version uses nRF51 and coded in C. After comparing each keywords in Google Trends, currently, between nRF51 and RFDuino has 26:10 interest over time, which means that nRF51 is more popular thing to search. Now comparing nRF51 to recent popular development boards between Arduino Uno, Raspberry PI 3, Raspberry PI Zero, and nRF51 results in 16:42:25:0. Although RFDuino is a modified Arduino with focus on radio communication, I never heard nRF51 before. However, the result from Google Trends suggests that nRF51 is indeed unpopular choice compared to other popular development boards.

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of an alternative Sociometric Badge for both makers and social scientist that can easily be tweaked based on their needs.

This paper start with the State of the Art of previous to recent implementations. Then, this paper defines who are the user group and the goal for each user groups. Ideally this project would like to satisfy all possible user groups. However, since I am also inside a user group, there will be bias, although I will try to keep as neutral as possible. After the design goals are determined, then the next thing to formulate is the Project Requirements. Here, I will define limitations, aspects those are not being part of this project and the reasons. Furthermore in Project Requirements, I will discuss my tools of choice and why it is better than the other options. The next chapter will discuss about project implementations. These implementations will be based on the complexity of the result. There are minimal implementation for testing, realistic implementation, and ideal implementation. The last lengthy chapter will be about testings and its results. Before concluded in final Advice for Future Works.

Chapter 1: Introduction.
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Ideally, doing an observation for social experiment should not require the social scientist to set up an artificial environment, unless it is meant to. The problem with traditional method of data gathering is that the technologies, those are used to leverage the process, make the observation less natural. Moreover, the process is not scalable for multiple instances of data gathering. Specifically for naturalistic kind of social observation, the most ideal practice is to keep the environment untouched as well as having ubiquitous method for data gathering. However, the latter part is, traditionally, contrary to the distance within the observation object and the social scientists. There are two sensible solutions for this problem. The first solution is to have both social scientists and their data gathering tools to be outside of the observation environment, let say this is similar as a park ranger using binoculars to observe wildlife from watch tower. Whereas, the second solution is to have both social scientists and their data gathering tools blended into the observation environment. With, nowadays, everything can be connected into the Internet, observation can be done in any part of the world. Now the problem, then, how to make the social sensor that blends into the observational environment. Specifically, for established and closed area like conference or office environment, I set my spotlight on developing a wearable social sensor as an ubiquitous data gathering tools.

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- State of the art introduction.
    - What is state of the art?
    - Why it is necessary?
    - How to make state of the art.
    - What is the implementations for this project?
    - Any good categories?
    - What things to analyze?
    - What to look when looking into implementations?
- State of the art introduction paragraph.
    - In this chapter, previous to recent technologies those are similar to Sociometric Badge will be discussed.
    - This is a state of the art. Usually state of the art is about showing similar researches those had been done.
    - The state of the art in this paper is for discussion which devices share similarities to the Sociometric Badge.
    - These devices will be then shown its features.
    - These features across different implementation will be combined.

In order for one to cook the best cuisine, they need to know what is the best ingredients as well as the best techniques. In this chapter I will delve into some relevant implementations similar to what this project is trying to make.

From my perspective, there are four aspects to look and to learn from these previous to recent implementation of Sociometric Badge. These aspects are hardware, software, storage, and all the logics to glue all of them together. However, this chapter will look specifically into the hardware aspect, since it is the only aspect that can be known for sure.

This project aims to create a social data gathering tools similar to Sociometric Badge. Both Sociometric Badge and Rhythm Open Badge comes with their own limitations. For example with Sociometric Badge, its user cannot see on what is happening behind the badge itself, like what kind of process it runs and inability to adjust based on specific needs, unless, perhaps, the user contacts the company behind sociometric badge. Rhythm Open Badge is currently still in development. There are minimal documentations as well as broken links in their website. Nevertheless, personally, I consider Rhythm Open Badge seems like solid solution, with it uses low powered

controller that can be turned on with only a coin battery. This project would like to make an alternative with providing minimal.…

For an individual to cook good foods, they needs to use the best ingredients as well as to know how to cook properly. In this chapter, I would like to delve through previous to recent implementations of devices those are similar to Sociometric Badge to determine what are the suitable ingredients to create an alternative version to the Sociometric Badge.

I think there are four classifications to look into, when determining what are the components and the tools to make implementations listed in this chapter.

From my perspective, there are four categories to fill when determining components and tools used to make each of the implementations. The first one is hardware, then software, storage, and finally all logics that glue these all together. For these implementations, the hardware would be likely the sensors and the main processing unit for each of the implementations. The software will be any binaries that is used to support each of the implementations, for example infrared input output manager and web administration panel. The storage is about on how each of these implementations store its data. And finally there will be the main interface for client and server that wired all of these components together.

However, the only thing that can be looked into without being specified otherwise is the hardware. Hence, that is why this chapter will look closely on what kind of hardware used to help and to make each of the implementations.

This chapter will discuss on what are the previous to recent implementations of the Sociometric Badge. This chapter will look into aspects those help to make the badge as well as aspects.…

This project aims to make an alternative social data gathering tools similar to Sociometric Badge. There are some similar implementations those can be looked to determine what are the features.

This chapter will discuss about any other similar devices to the Sociometric Badge. The devices I put here has at least one function that the Sociometric Badge might benefit from. There four aspects that can be looked from these devices: hardware, software, storage, and logics that glue these together.

The hardwares are mainly the main processing unit of the device as well as the input and output. For the processing unit, this paper only looks whether it is low powered or not and which programming language used to program the board. Since this project deals with ubiquitous technology, the hardwares those will be looked into are mainly the input units. These input units are mostly sensors that capable to take one or two features from analog data it receives. For example microphone will be able to get pitch and volume features for every sound it receives.

This chapter is about other devices that shares similarities to the Sociometric Badge. In order to satisfy this project goal to make an alternative version of the Sociometric Badge that can be easily fit into the user's needs, this project needs to look on what is already there to be studied. The

Sociometric Badge itself takes inspiration from its previous iterations and from these iterations there are some features those are added and also removed. This chapter will look into these features and then determine what is this project's requirement for the alternative Sociometric Badge.

From my perspective there are five categories to look into form these implementations. They are the hardware, the software, what storage each devices uses to store its data, what kind of connectivity it has, and how it was programmed.

Since this project is dealing on ubiquitous technology the output should be physically minimal to none. Then, the main point on hardwares are the main processing unit and the sensors used to take analog data. There are three qualities that this project is looking on processing unit: whether or not it is a low power processing unit, how popular the development board is, and finally which programming language used to program the development board. For sensors this project looks into how many features each sensors can take from one stream of analog data. For example a microphone can take pitch and volume of sound it received.

The softwares are more like into what kind of application need to be used to develop the device as well to complement the device during run - time. There are two qualities to look into, which are, whether the software is open source and what are the requirements to install and run the software. For example if there are administration interface to manage client as well as web server.

Considering the nature of social data gathering tools, the only output necessary is where the received data is stored. There are no specification aside from how the data can be looked.

The last qualities to look is the connectivity. Sociometric Badge generally inform each others by delivering ID through infrared transceiver. Then, the data moved manually into the main computer. There are other possibilities as well, like peer to peer connection between badge and bi - directional connection to the main server where the badge can then store its data.

Chapter 2: State Of The Art: Introduction.
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By looking into previous and recent implementations of devices those are similar to Sociometric Badge. I hope that I can determine what are the possible implementations. These implementations will look into three categories: minimal implementation, realistic implementation, and ideal implementation.

This project started by defining what is the ideal Sociometric Badge. These ideal Sociometric Badge can be realized in case knowledge, money, and time do not matter. The idea of defining the ideal Sociometric Badge is to set a grand example that can be further dumbed down according to the project and limitation. The realistic implementation is what people can expect for the result

comes from this project. Whereas the minimal implementation is the bare minimal functional social sensor that can be tested. At the point this project's progress achieved minimal implementation test can be conducted.

The qualities that this project looking from previous and recent implementation are: how open the knowledges are (codes, schematics drawing, part list, …), the popularity of the components and tools chosen to make the said implementation, and, from what the social experimenter needs, how many inputs and outputs are there.

And then, in the Project Requirements, by combining all the possibilities listed in this state of the art the ideal Sociometric Badge can be adhered. Realistic implementation then comes after user requirements, design goals, and limitations combined with ideal implementation.

Chapter 2: State Of The Art: Contents.
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Meme Tag.

Meme Tag is dated as early on 1997, when the term meme still meant culture's DNA. The Meme Tag was used in a conference. Its user starts by visiting a booth and set what is their idea in a short sentence. When the wearers of Meme Tag meet to each others, they can tap it to exchange the meme that previously set. This tag was used primarily to see on how people connects to each others.

Hardware wise it has a 16 x 2 LCD panel to show the meme. It connects to each other through infrared and presumably also connect to the computer in the booth by the same methods. And it used mc68hc11fncfn3 chip from Motorola as its main processing unit.

UbER Badge.

UbER Badge takes inspiration from Meme Tag then Thinking Tag. The badge functions nearly the same with Meme Tag aside from UbER Badge has both RF and infrared connection. It has peer to peer connection as well to hop its messages around the other badge, hence its users are not neccesarily to tap their badge close. The infrared connection is used to detect line of sight communication. For inputs, this badge has a simple two pinned electret microphone to capture the features of any sound received by the microphone. And instead of using LED display UbER Badge uses LED Matrix to display data in form of graph or simple alpha numerics.

Sociometer.

There was a wearable device named Sociometer that is the only devices listed in this chapter that is not in form of a badge but shoulder pad. This Sociometer was designed with ergonomics in mind and intended to be specifically made for social data gathering tools. There are less informations on

its specifications. However, it is shown to have at least microphone, low powered IR transceiver to detect only nearby face to face conversation, and accelerometer to detect body language. It is also known to be modular, as it can be attached with other sensors like gyroscope.

nTag.

nTag is a commercial badge made to manage a lot of people in a conference. Its features are, for example, to conduct real - time voting for any participants within the conference, logistics, as well as information sharing between the event organizer and its wearer. It has a local positioning system with RFID and has a display to fit small sentence. Since, it is mainly to be used in a conference, I assume, there is an administrator control panel somewhere to dispatch the questionnaire or survey.

Sociometric Badge.

Sociometric Badge is the main inspiration of this project. Its first iteration came in 2007 with features like microphone, IR transceiver, Bluetooth for data gathering, RF transceiver for local positioning system, as well as accelerometer. Software wise, it has a real - time phone application, and a server to store data. However, what kind of functionalities the server provides is not known.

The current iteration of Sociometric Badge comes from the company, Humanyze. It has better form factor as well as, it is shown in their website, client and administrator control panel. However, the connection between each badge and where data can be stored still need to be done manually.

Rhythm Open Badge.

Rhythm Open Badge is the current open solution to the Sociometric Badge. It has two iterations, the first one is using RFDuino where as the latest one is using nRF51 development kit. The latest version is using low powered Bluetooth and there are no documentations on other features aside it has microphone, a server made using Python, and Android application for proof of concept.

Chapter 2: State Of The Art.
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In this chapter I will go look though all possible implementations of Sociometric Badge. Before building the realistic solution for this project I need to chop through the Sociometric Badge into several basic principles that will be benefit the target group. Each of these principles will related to whom are this project are meant to. The main target of this project is to create a basic tool that help social scientists to leverage their social experiment, similar to the Sociometric Badge. The hypothetical basic tool mentioned is supposed to carry out only the fundamental functionalities of the Sociometric Badge. From this most basic implementation, the users can then can apply their own requirements to create their own ideal tool that suit their own needs. Specifically for this

project, the users will be the social scientists who will be greatly helped to have such a tool like Sociometric Badge and the makers who will help social scientist to build and tweak the tool.

The main principle for state of the art implementation as from the social scientists perspective is the usability. The main concern for social scientists to have Sociometric Badge, is that they cannot find the perfect fit out of the Sociometric Badge. In ideal scenario, let say, when everyone has the same capability to create one, there would be tools similar to Sociometric Badge fitted with with their own requirements for any possible needs. This project sets to create an alternative version to Sociometric Badge that shares the basic usabilities for any given cases so far.

In order to know what kind of propositions are necessary to satisfy most of social scientists, the qualities that this project search for state of the art are the inputs, of the implementations discussed here, the popularity of the technology used to make ones, media of communication, how the data stored, as well as the form itself.

The input that dealt in this chapter are more into which kind of data those are relevant to social experiment. Any input that comes naturally from human will be considered but a basic user experience input like a physical button will not be considered as a details that would affect social experiment, hence such details will not be included. What I meant by "naturally comes from human" is that the input will not be listed in this chapter because the human intentionally make the interaction. If human aware of their action, this should not be considered as an input, since the one of the design goal for this project is to create an ubiquitous wearable social sensor.

The popularity of the technology used and the implementation will determine the impact of each implementations to the world. The more popular the implementation is, the easier it is to get informations. The goal of this project is to create an alternative to the Sociometric Badge. However, the main user group, which is the social scientists, usually will not the one who create the badge, instead it will be someone else with basic expertise of electronics and programming. Hence, the more popular the implementation and the toll used to create it the better it would be for the social scientists to find this someone who will build the badge. This also meant for the social scientists to make better communication to the makers, as these social scientists are the one who understand the requirements. For this purpose, I will look the popularity based on Google Trends as well as the number of results produced from specific queries related to the components/methods/tools Google search engine. Hence, for this aspect of state of the art, I need to determine what kind of components, methods, and tools are important to create the implementation. And then, I would try identify relevant search keywords to be used within Google Trends and Google search engine to determine the popularity of components, methods, and tools those are used to make the implementation.

Media of communication is how the implementation communicate, to whom it connects into, whether it is one - way or two - way communications, and whether this happens automatically or manually. Analysis on this matter will help to determine to where data is passed into as well as to determine simple communication diagram.

The last part is how the data is stored and how can it be retrieved by the social scientists or general user. In general this parameter will be about the output of each implementations. Anything that shows information in the physical world, for example like web user interface, LEDs blinking, that is related to the input received from the implementation will be considered. This part will also look into how the data is stored, which database is used, or whether or not the implementation used one in the first place.

From the makers perspective, this paper will look into how easy it is to make the implementation if only documentations are available for free. The documentations that this paper are looking for are the part lists, the schematics, the source codes. And for the development in this chapter the main building blocks will be defined. These building blocks are, in bigger picture, the main controller and the programming language used to program the controller.

By the end of this chapter, there will be implementations those are not directly related to Sociometric Badge, but it has features those are nice to have in the Sociometric Badge. These specific state of the arts will have their own specifications but the date of which each implementations known to public will be noted. This will be achieved by searching the earliest possible article within the Internet.

The two main users of this project are the social scientists and the makers. The main end user will be the social scientists those conduct social observation. However, since this paper is intended to be a starting point to create an alternative version of Sociometric Badge as well as due to my own personal experience as a maker, this project will have tendency to look state of the art implementation from technical point of view. And as a whole, these state of the art implementations will look into their simplicity and usability.

Table

Meme Tag

Meme Tag was first publicly known in 1997. It was made as a wearable device that helps people co - operate with each others. Meme Tag usually used in conference where the homogeneity among its participant is high. Then, Meme Tag tries to group people even further by another topics that independent to the conference topic. Thus, make people with same interest other than what it is in conference meet each others. The usage of Meme Tag is similar to nowadays Twitter, but instead of use tweet online, the wearer of Meme Tag need to meet other people in person to share their message.

At the point when Meme Tag was used, the process to set one is straight forward. After user register at the conference in - site, they will be guided into a computer booth where they can set their first meme (message). Then, they can share their meme by touching other Meme Tag face to face. The connection between Meme Tag to the computer booth is unknown but the peer - to - peer communication between Meme Tag to share meme is done using infrared. I would suggest that the

connection between Meme Tag to the booth computer is done using infrared communication as well, since at that point USB is not yet popular and there is no cable socket found in Meme Tag part list. Moreover, there was a web server as well to hold the captured memes.

Meme Tag formed as bare as it was. There was no case used to cover, wearer could see the LCD display directly, as well as other electronics components behind it.

What this project can learn from Meme Tag is its easiness to be setup during conference where there are a lot of people in queue to get their Meme Tag setup.

Meme Tag has a decent documentations. These are including the main documentation page itself, tutorial, part list, PCB design, but there are no source codes.

The Sociometer

The Sociometer described as a wearable sensor packages. It was made in 2002 for helping researcher measuring interaction between people. The development of The Sociometer not only focused on its hardware but it also took ergonomics design as its main concern. The result is a shoulder pad packed with a lot of sensors for social data gathering, that, although it is not as ubiquitous as the previous implementations, it is easy and can be comfortably worn through day. The result was that users are very happy to use it, thus its presence was neglected by the users.

It was equipped by microphone, accelerometer, and infrared. There are other sensor as well that can be easily attached, like for example gyroscope. The microphone was used to capture incoming sound and then has its features extracted (pitch and volume). The Sociometer used low - powered infrared to detect if face - to - face communication between its wearer happened. The accelerometer was used to know if the body language between participant in a conversation synced or nearly the same.

As for this project, the usage of low - powered infrared could help to determine whether face - to - face communication is currently happened. Normal infrared would detect any incoming signal as far as 5 meters. But, the low - powered one will only be detected in 1 meter range. This would ensure that only valid face - to - face communication happens. The study of form factor is a good example on how to setup less - presented wearable device. Although the size is big for a wearable electronics device, due to its ergonomics and form - factor the user will not be worn out after long time use. This technique presents another dimension of ubiquitousness, of which, device not only blend to the environment but also to its user.

There are no documentations available to make Sociometer aside from the initial research paper and other related research paper.

UbER Badge

UbER Badge is the best implementation for this project. As it is in its description, it was intended to be a development platform that can be extended to satisfy any possible cases. At its most basic

setup, when it was introduced in 2003, it has microphone and infrared transceiver for social data gathering as well as local positioning system using RFID. It communicate to each other with hopping transmission between other UbER Badge.

Form wise UbER Badge has noticeable LED matrices as a display instead of LCD screen that Meme Tag uses. The basic design offers a simple casing to cover its innards.

This project could learn from how UbER Badge make everything to be easily extensible. The use of modular circuitry enabled other people to adjust UbER Badge to meet personal needs.

Due to the nature of open source development platform the UbER Badge has the most documentations from any other implementations listed in here.

nTag

nTag was first known in 2003 and it went commercial until ~2008. This wearable device was used to manage a lot of people within the same place. Although there is not specific input for social data gathering, it packed with applications to regulate people. It is mainly used in conference,

nTag was first known in 2003 and it went commercial until ~2008. This wearable device was used to manage a lot of people within the same place, especially conference. In my opinion nTag was the Meme Tag that went commercial. It has the same sociometric principle that was also in Meme Tag, which is to exchange message within participants as well as stimulating conversation for like - minded people. On top of that nTag was packed with a applications to help conference organizers to manage a lot of people. For example is has a functionality for the organizer to throw a questionnaire that the nTag wearer can just answer right away within the badge and then display the results in real time as the wearer finished answering the questionnaire. All in all, nTag offered control for the conference organizer and networking for its wearer.

Form wise, nTag build like a regular badge. The distinction is that it has an LCD display that can handle at least a small (~7 words) sentence. There are input buttons that I suggest these were meant as answer buttons in case of questionnaire and polling from the conference organizer. Also, there is a connection from the badge to database. The database is used to store values from questionnaires as well as other important information like the whoever had meet the wearer during the conference along with information on which room the wearer currently in. It is equipped with infrared transceiver to exchange message and RFID for local positioning system.

nTag offers flexibility that none other implementations in this state of the art has. This is due to it has the most basic input and output, the LCD and push buttons. With these basic components the amount of things it can do is so many.

Because nTag is a commercial product there are no documentations on how to make one.

Sociometric Badge

Sociometric Badge is what the Sociometer has become. It is a wearable electronics device to do sociometric data gathering. It packed with a inputs such as, microphone, Bluetooth, accelerometer, and RFID. The first iteration of the Sociometric Badge came in 2007, up until the latest version which came in as an IP to a company named Humanyze. Unfortunately, since this went commercial, there are little to no information on the current development of the Sociometric Badge.

Sociometric Badge packed with a lot of sensors, there are voice input from microphone, presence detection using infrared, Bluetooth to determine the proximity of the badge with other similar badge, RFID for local positioning, and accelerometer to determine body language. These all then packed into nice looking form factor that looks no different than other office badge. There are administration control panel as well control panel for regular wearer as well. The first iteration of the Sociometric Badge in 2008 has a Java based cell phone application that used to display real - time data visualization directly from the badge. However, the recent Sociometric Badge, that I have looked, needs to have its data manually moved from the badge into the main computer using Bluetooth.

Sociometric Badge is the main inspiration for this project. The goal of this project is to create the flexible development platform that was once UbER Badge with recent technologies to make an alternative to Sociometric Badge.

Although the first initial version of the Sociometric Badge has research papers but since it went into a commercial company there are no research papers that directly about the Sociometric Badge. And it has no documentation aside from these research papers.

Rhythm Open Badge

Rhythm Open Badge is the newest approach to the Sociometric Badge since it went commercial. The project's first commit into its GitHub repository was on 21st January 2016. The project is still going up until this moment and it has two stable version to be used. At first, before the shutdown, Rhythm Open Badge has a Google Hangout plug - in to simulate the similar functionality of the Sociometric Badge but with online interaction in mind. Additionally, it also has an Android application to make an Android phone to be the Rhythm Open Badge itself despite some limitations.

Although the project is open source, currently, it has little documentations. There are source codes available, there are Eagle CAD PCB file as well as very simple part list. But there is no way for a commoners to know how to build one by looking at the documentation that it currently has. It uses nRF51-DK a low powered Bluetooth development kit to make the device, but it does not mention to which functionalities the Bluetooth serves.

The form factor is very small and what could inspire related project is the usage of low powered Bluetooth micro controller that can be powered with only a coin battery.

Unrelated Implementations

- **Hackaday Super Con Badge** is an electronics badge for Hackaday annual conference. Hackaday itself is a tech heavy conference filled with like – minded people who are interested in hacking. This badge is simple, it has 2 AA batteries as its main power source, a set of directional button (up, down, right, and left) and as a display it has LED matrices. The main purpose is to let its wearer hack the badge from the firmware into its kernel and it has a pre – installed Tetris video game. The concept that can be learned is how the badge can be set within the badge itself. The user can, obviously, use computer to hack the device and re – compile back codes into the device. But, with the directional buttons and LED matrices, it is enough to explore, navigate, and set some basic settings within the device.
- **AND!XOR DEFCON Badge** is a badge from DEFCON conference. Similar to Hackaday annual conference, DEFCON also has an annual conference for people who are interested in cyber security. AND!XOR badge is similar to Hackaday Super Con Badge, it has a screen and buttons. What makes it different is that the ability to set the whole program using Serial communication. Serial communication is what is used to put codes into Arduino board. So, instead of compiling the whole codes to change parameters, this AND!XOR Badge can be set just using Serial communication via USB connector in the bottom of this badge. This will make sure that the end user will not change anything important from what is already compiled in the device.

With regard of social scientists as the main end user for this project. Having an ability to set parameters from the device itself, like it is in Hackaday Super Con Badge, is great. Social scientists will set the parameter before hand. Then the respondents will wear the badge like it is not a data gathering tools. Since the alternative Sociometric Badge this project is trying to make will be wore by the respondents and not for the social scientist itself, having an on – board setting is not necessary. Perhaps a simple indicator like LCD display or LEDs to display informations would be the solution for this project.

From the social scientists itself, it would be the best solution if there is a method to set the alternative Sociometric Badge without having to compile back the codes into the device. AND! XOR Badge provides its user by simple command line interface to set some parameters by connecting it into any computer with its provided USB connector.

Conclusion

There are two main principles when I was looking for possible state of the art implementation: usability and simplicity. Both can stand on its own, but it can also be combined. The usability is the what each of the implementation has to offers to social scientists. Whether it is relevant for social data gathering or not as well as any other features around the implementation that supports social data gathering. The simplicity is the main quality for the makers. The simplicity comes as how simple it is for makers to build and tweak the implementations. This quality comes as whether there

is a documentation, schematics or PCB design, part list, as well as the source codes. The more of these elements are available the simpler it is to make and to tweak.

As from defining on what is the most hypothetical basic Sociometric Badge, based on the table, it is known that these implementations has at least three inputs each. The common inputs are, audio, local positioning system, as well as face to face detection for any other wearer nearby. Since, local positioning system need to be tested in more established environment and I do not have access to one, I concluded that the most basic inputs for device similar to the Sociometric Badge are audio input and face – to – face detection between peers.

Chapter 3: User Groups And Design Goals: Without Design Goals.
Mikael Pratama Kristyawicaksono (S1241079). 20170314-1004-GMT+2.

- User and goals.
- In this chapter I will talk about each users and each of its goals.
- There are two main users in this paper, the social scientists and the other user group is the maker.
- Social scientists defined as a user group that will use the solution determined from this project.
- Makers defined as a user group that will make the solution determined from this project.
- Actually, both user group are not necessarily to use or make the solution determined from this project.
- Instead they need to know that this solution exists.
- So, instead this paper insisted to use the what this project is making, it shows to the audiences that the solution is exists and this paper will show you how the idea is realized.
- The main idea of this project is to show that simple tools like Sociometric Badge is there.
- And this project wants to tell the available tools and ingredients, so that the social scientists can connects the idea to the makers according to any specific needs that social scientists want.
- So what to tell in this chapter?
    - Who is the user?
        - Explanations for each users.

        - What are the fail - able conditions of each user group?
        - What are the goals of each users?
        - What can be communicated between these users?
        - What is the expected knowledge?
        - What is the limitation of the user?
        - What is the user do?
        - What should be communicated between these users?
    - I need to determine what is the qualitative and quantitative aspect of the proposed solution.
    - Perhaps, I need to make an example.
- The user groups….
- Check what is the idea behind UbER Badge.
- UbER Badge was the only badge that has the same goal with this project.

Introduction

There are two user groups for this project: social scientists and makers. The social scientists is defined by people who like to conduct social experiment, whereas maker is defined as someone who make technology representing DIY sub – culture. For this project the social scientists will be the end user of the alternative of Sociometric Badge this project trying to make. Additionally, the makers will be the developer of such badge.

In order to make the befitting badge, both user groups need to communicate on the requirements and the limitations. Social scientists need to determine what are their requirements and the makers then define what is their limitations as well as the current technical limitations.

This chapter will discuss on what role each user groups serve, what is the ideal communication, and example of communication between social scientists and makers as this project went.

Social Scientist

Social scientist is person who conduct and study social science. As from Merriam Webster dictionary, social science is a branch of science that deals with the institutions and functioning of human society and with the interpersonal relationships of individuals as members of society. This project deal with technology that could leverage the work of social scientists. As social science lives in different spectrum from common technological background, experiment on the use of

technologies seems not quite nourished compared into other studies like design or business. In result there are spaces that more specific technology could fill in.

In term of data gathering in physical world, many social scientists still using traditional methods like interview, observation, questionnaire, and survey. There are improvement on any of those methods but observation. As it was mentioned in the Introduction, observation still stuck with manual observation, with the observer and the object present nearby to each others.

The term of computer exists in anything (ubiquitous technology) and the Internet exists in anything (Internet of Thing, *IoT*) can be used to leverage social observation. There are good ingredients those can be taken from those implementations found in State of the Art to make more advance but *home – brewed* tool to help to make a tool for social observation. However, since the nature of the social science itself, social scientists need to work together with people, those, at least know how to make things (electronics and programming).

Maker

As it is defined in The New York Times, maker is a technology based sub – culture based on DIY culture. The sense of Do – It – Yourself is that for one to be able to make something without professional experience as as professional tools. For this project, looking for specific people that exactly has the knowledge of embedded device and also programming is not easy. However, there are a lot of hobbyists that could achieve to make the same thing for low entry technical project like this project.

The problem for makers is the same from what it is in social scientists side. In most cases, makers do not understand what are the social requirements expected for device this paper trying to make. Thus, at basic, both user groups are expected to have discussion a lot. The discussion should be prioritized on the requirements and the limitations of the project. Requirements need to come from the end user group which is the social scientists and makers define both technical limitations and their own limitation.

Conclusion

As it is for this project, the requirements will be defined from the previous implementations in State of the Art, whereas the technical limitations and technology of choice will be determined in the next chapter, Technology Implementations.

The requirements start with defining the most advance version of the alternative Sociometric Badge that could be exists with unlimited resource (time, money, skills). This will be then determined as the ideal implementation. After this, makers will present with the limitations and appoint which technologies might fit for which purposes. The social scientists and the makers need to communicate this way again to dumbed down the ideal implementation into more realistic implementation. During the project makers then keep giving back minimal implementation for the social scientists to do testing.