FACE MASK

Preliminary Report

Team: New York Face mask Team

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DISCLAIMER

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1 BACKGROUND

1.1 Introduction

It has been seen during the pandemic of the coronavirus, use of face mask has become a necessity, important, and must to wear so that it can save the person from getting indulge with the virus. The virus itself has a structure that inserts through the mouth and infects the lungs, and this virus can cause death as well. The best way to become safe from the virus is by using the mask because it covers the mouth and does not let the virus enters the mouth. But there are some difficulties in using the mask-like breathing problem, inhaling and exhaling of oxygen into the lungs and even a person wearing a mask is difficult to recognize.

Another problem using the face mask is that it is useful for a short duration but for a long time it is not suitable as the virus molecules can sustain over the mask, so the risk of attacking the virus increase with the mask even. Another problem with wearing a mask is that non-verbal communication is difficult to understand because lips are cover, even more than half of the face is cover by the mask so expressions cannot see and non-verbal communication becomes difficult. Furthermore, a person wearing a mask needs to speak loudly so that the listener can understand.

With all these difficulties in wearing the regular masks that include cloth masks, KN95 masks, and other masks, there is a need for such a mask that will overcome all these difficulties and will not cover the face as well so that the person can recognize easily. This project is about designing such a mask that will not cover the face, and it will easy to wear for a long time. The mask will help in breathing as well by using electronic sensors.

This project is of interest to the sponsors because of its need in the current pandemic and the idea is quite attractive that will not only help to fight this pandemic but it will be useful in the future as well. Another reason for the sponsor's interest is that this mask will provide relief and because of its useful features it causes the sponsors to take interest in it. The project will cause benefits to the stakeholders in all the ways as the mask is beneficial to use for a long time and easy to wear.

This project is important because it covers all the contemporary issues faces by wearing masks and wearing masks for a long time is really important. Hence these face masks will make the life of stakeholders easy and will let them safe from the pandemic coronavirus, hence this shows how important this project is.

1.2 Project Description

The project requires designing a face mask that will help the users to keep it waring for a long time. It contains the following features:

A differential manometer will monitor the pressure inside the mask and infer the phase of respiration. The monitor detects pressure below the atmosphere (vacuum), a small fan puffs in filtered air to aid inhalation.

As pressure exceeds the atmosphere (exhalation), a pilot-assisted check valve opens outlet ports that direct the flow down and desecrates it.

There should be a microphone in the mask that senses the wearer's speech and plays it through speakers on the outside of the mask.

This should be powered with a rechargeable battery worn somewhere on the body that will provide hours of use between charges/battery swaps.

1.3 Original System

This is an original system and it has not developed before at the time of starting the project. The project has started from the scratch and no such mask has developed yet.

2 REQUIREMENTS

In this project it needs to design a face mask that will use the technology in such a way that it will help the user in breathing, communicating, and saving from the attack of the coronavirus. This section will present the customer requirements that have been provided by the client and convert them into the engineering requirements. These requirements will use in the next sections as well to select the final design and identify if the objectives have been met by the design or not.

2.1 Customer Requirements (CRs)

Customer requirements are the objectives and project descriptions provided by the client. The client provides the description in the form of paragraphs, while it will convert them into the table. The table contains the important points from the project description and this table has given the name customer requirements. The design has to fulfill the customer requirements in order to become successful design. The requirements table has given below:

Table 1: Customer Requirements

Customer Requirements
Allow unrestricted exhalation and inhalation
Allow unrestricted speech and non-verbal communication
Allow easy eating and drinking while wearing mask
Allow uninterrupted operability in an 8-hour working day
Speaker present to make the voice loud
Easy to wear
Not act as a carrier of virus
Reliable
Durable

These requirements have generated from the project description provided by the client.

2.2 Engineering Requirements

These are basically the technical requirements, and it contains numbers as well. In simple words engineering requirements are quantitative values while CR's are qualitative values. Engineering requirements contains the numerical values set as a target and these numerical values use in the future to test the design whether the design is meeting the requirements or not. These requirements must present in the design and each requirement can easily measure in the design to confirm to which extent the project design is fulfilling the need of client. These requirements have generated from the customer requirements and have shown below in the table.

Table 2: Engineering Requirements

Engineering Requirements	Operational Values
Length	< 8 inches
Battery Time	> 8 hours
Expiration Rate	6 liter/min
Tidal Volume	0.5 liter
Transparent Material	< 2
Weight	< 50 g
Battery Capacity	2500 mAh
Filter Size	< 300 m x 300 m

These requirements will use for designing the project and these will use to test the design as well in order to see which engineering requirements have met by design.

The length of the mask is important feature because it describes how much area it will cover on the face, therefore the size of 8 inch maximum will be enough to cover the face properly.

The battery time is the ON time of battery and it will provide the supply to the mask, so longer the duration is better and hence 8 hours at least should be the battery time of product.

Expiration rate is the rate at which the oxygen is entering into the mask, and in other words it is also known as flow rate of oxygen and it should be 6 liter/min maximum.

Tidal volume is the volume of air that can cross the mask and it should be around 0.5 liters.

The transparency of material describe through the index level and air index is 1, while glass index is 1.5, so the index of the material should be less than 2 so that face can clearly visualize.

The mask should be light in weight and hence the maximum weight it can gain is 50 grams.

Battery capacity is the capacity of energy it can store and hence it can store maximum of 2500 mAh.

Size of filter is from where the oxygen will enter and leave from the mask and the maximum size of that filter should be 300 m x 300 m.

2.3 House of Quality (QFD)

This is a chart to uses to make the relation between customer requirements and engineering requirements, and from the relation a priority order of engineering requirements can generate. The priority order will tell which engineering is most important and which engineering requirement is least important. For each customer requirement, it analyze against each engineering requirement and assign a number that describe how strong these two relates to each other. The chart has given below

Table 3: House of Quality

Customer Requirement	**Weight**	**Engineering Requirement**	Length	Battery Time	Expiration Rate	Tidal Volume	Transparent Material	Weight	Battery Capacity	Filter Size
Unrestricted exhalation and inhalation	9		3		9	3				3
Unrestricted non-verbal communication	9		1		1	3	3			1
Easy eating and drinking	9		1		1		1	1		
Work for long time	3			9				1	9	
Speaker present to make the voice loud	3			1				3	3	
Easy to wear	3		3		1	1	1	3		
Not act as a carrier of virus	3									
Reliable	1						1	1	1	
Durable	1						1	1	1	
Absolute Technical Importance (ATI)			54	30	102	57	41	32	38	36
Relative Technical Importance (RTI)			14%	8%	26%	15%	11%	8%	10%	9%
Target ER values			8 in	8 hours	6 l/m	0.5 l	2	50 g	2500 m	300x300m
Tolerances of Ers			2 in	1 hour	2 l/m	0.1 l	1	10 g	200 ma	5x5 m^2
Testing Procedure (TP#)			1	2	3	4	5	6	7	8

It is clear from the house of quality that the most important engineering requirement is expiration rate, and the least important requirement is weight.

2.4 Functional Decomposition

Functional decomposition is basically describing the functioning of the project, what is coming as input into the system, while what is getting from the system as output. While the functioning inside the system also describes in functional decomposition. There are two function models, black box model and functional model uses to describe the complete functionality of a function.

2.4.1 Black Box Model

The black box model shows the inputs and outputs of a system without defining what is happening inside the system. It only shows the number of inputs, types of inputs and number of outputs and what are the outputs. Here is the black box model for the system

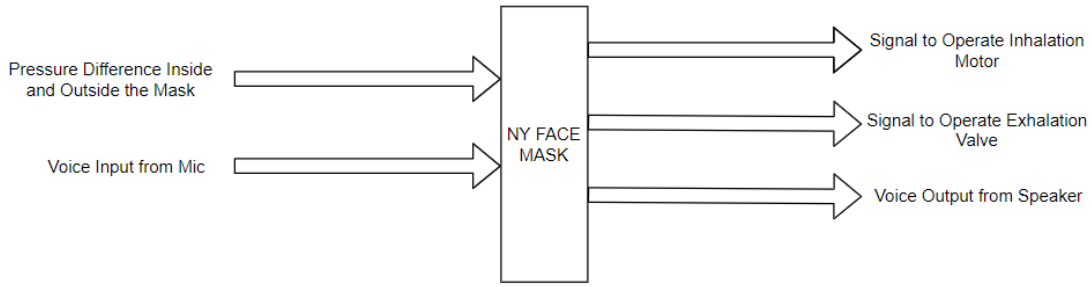

Figure 1: Black Box Model

In the above model there are two inputs, one is taking the pressure difference from the inside and outside of the mask, and second input is voice input from the microphone. And there are three outputs inhalation system, exhalation system and voice coming from the speaker.

2.4.1 Functional Model

The functional model describes the functionality of a device from the internal point of view, as it shows how the signals at the inputs converts to the output and through which path it generates the output. All the functioning inside the system describe in the functional model. Here is the functional model

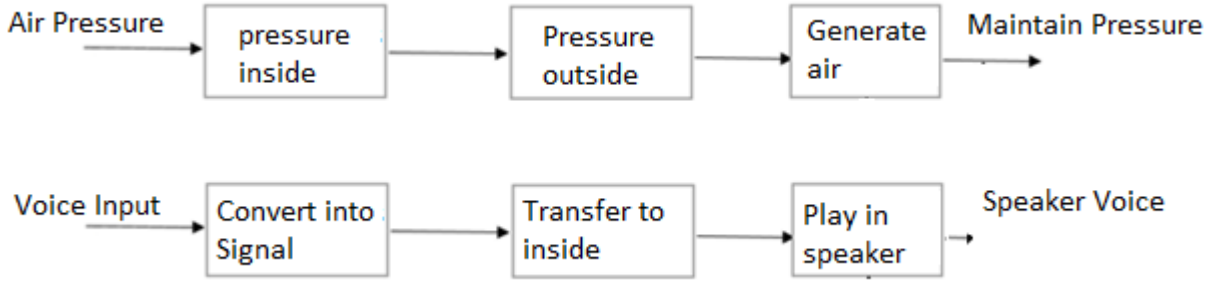

Figure 2: Functional Model

The functional model describes the internal function of the project.

3 DESIGN SPACE RESEARCH

In chapter 3, it talks about the research which is important for any design project. The design project needs a creative design which can be done by doing a good research because it helps in finding the old works done on the same concepts and from the existing work new ideas can generate and also get the help of how to implement any design. The understanding of main functions, and sub-functions can also be done through the research therefore it is important to perform a proper research about the design project to expand the thinking about the project.

3.1 Literature Review

The literature review done by each person on different concept of design and it given below:

3.1.1 Abdullah Alshammari

Solid-State Digital Pressure Transducer

The strong state computerized transducer speaks to another norm in exactness pressure transduction for the up and coming age of airborne sensors. The pressure transducer produces beat train yields as a proportion of pressure by creating strains in a silicon stomach which fuses piezoresistive detecting components [3]. These components are dispersed opposition capacitance (RC) networks which are diffused into a stomach surface as the control components of stage move oscillators. By this methodology, an advanced (recurrence) signal produced at the source can be communicated without commotion and separation impediments and the requirement for accuracy simple to computerized change is killed. The gadget displays points of interest in the territories of unwavering quality, precision, size and cost over present-day simple gadgets. The strong state advanced pressure transducer is being created to meet the necessities of supersonic and subsonic air information applications when combined with an elite air information PC. This application requires low hysteresis with repeatability and soundness which are the fundamental highlights of the strong state pressure transducer. Other potential applications are FM information obtaining frameworks and modern robots.

3.1.2 Abdallah Alotaibi

The performance of an integrated air purifier for control of aerosol, microbial, and odor

Another kind of an air purifier has been created for a synchronous control of airborne, microbial, and scent in living conditions utilizing ozone, crown precharger, an electric minipleats channel, and an ozone-decaying catalyzer just as a semiconductor ozone sensor for wellbeing control. Ozone is created in the crown precharger by improving negative crown with the utilization of a higher-than-conventional voltage [4]. This gadget, which is named AIP, shows 85% one-through number assortment effectiveness for airborne particles in the size scope of 0.1-1.0 mm. AIP shows an extremely good freshening up execution for man-began and living climate started smells, for example, alkali, hydrogen sulfide,methylmercaptane, and so on The AIP likewise successfully slaughters, through long presentation to low-focus ozone, most microorganisms, organisms, infections, and different microbials and little creepy crawlies gathered in its channel.

3.1.3 Jehad Alqubaisi

Arduino-Nano Based Low Cost Power Converter Learning Kit

This paper presents the ease power converter learning unit for power gadgets lab in the undergrad electrical designing course. This paper likewise inspects the learning result of an Arduino Nano and MOSFET based converter learning pack. With assistance of this converter pack, the understudy can become familiar with the working and control of a wide range of fundamental force converter circuits which is available in their electrical designing undergrad educational program. This is an attachment and play sort of learning pack with least association changes needed to change over from one kind of intensity converter to different sorts of intensity converter circuit. This learning pack encourages to learn and control all sort of essential force converter circuits like the chopper, inverter, AC voltage regulator, and rectifier. It underpins the single stage just as the three-stage power transformation and control. The absolute expense of the fundamental converter unit is under Rs.1400 i.e., which is under $20 [5]. The successful helpfulness and simplicity being used of the pack are assessed by the criticism from the third-year understudies of electrical designing course. The aggregate criticism result shows the ease converter pack is a lot of supportive to comprehend the fundamental ideas of the force converter circuit.

3.1.4 Adi Alqurashi

A Pressure sensor study and research

The correlative presentation and investigation of a sort of modern field pressure estimation sensor are completed in this paper by us. The rule of work and force flexibly circuit of the pressure sensor is concentrated in detail [6]. The steady current source power flexibly mode is received in this paper, which is awesome for the sureness of estimation. So as to go a further advance to investigate affectability circumstance affectability execution, limited component examination research strategy is taken for the pressure sensor chip for a few times. By methods for limited component investigation, we realize that the pressure sensor has great affectability and level of linearity. This paper gives a few significant logical references to exploring and planning the pressure sensor.

3.1.5 Sultan Alzahrani

A Study of High Sensitive Diaphragm for Silicon Microphone Applications

This paper presents the plan and examination of a high touchy stomach for electret receiver applications. All in all, the affectability of the electret receiver relies upon the electrical affectability and the mechanical affectability of the stomach. The high mechanical affectability can be controlled by the mechanical properties of the stomach. So as to get high touchy receivers, the properties of low tractable pressure and bigger territory of the stomachs were manufactured. In this examination, the spacer and the thickness of the backplate of the electret mouthpiece are 16 mum and 120 mums, individually [7]. The stomach made of polyimide and Si 3 N 4 materials with different thicknesses and regions were assessed. It was discovered that the stomach made of polyimide gives the better affectability as thought about that made of Si 3 N 4

materials. Then again, the bigger territory of the stomach brings about the higher affectability of the receiver. The comparing affectability is 9 mV/Pa in the recurrence scope of 50 Hz to 12 kHz under the electret material with - 120 V.

3.2 Benchmarking

Some of the existing designs will discuss in this section that has been found after the research. These existing designs consist of the main function and also existing designs consist of sub-functions as well.

3.2.1 System Level Benchmarking

The system level existing designs are presenting in this section.

3.2.1.1 Existing Design # 1: 1982 Mask

This mask is unique mask in the shape, while it contains a filter but the clothing in the mask is irresistible and it will be difficult to wear this mask for a long time. Here is the existing design showing below

Figure 3: 1982 Mask [4]

3.2.1.2 Existing Design # 2: Rsenr Mask

This is another type of mask already existed, and in this mask there are dust mask respiratory filters which can replace as well and it covers the face properly and tightly held with the nose so that no dust can cross the mask, but the problem is still the same, respiratory system does not work good with this mask when wearing for long time and it has shown below [5].

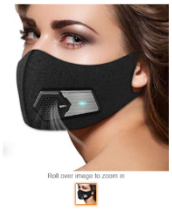

Figure 4: Rsenr Mask [5]

3.2.3 Existing Design # 3: DM Zing Mask

In this existing design, the mask covers the face almost more than 50%, and from the mask respiratory system works well for short period of time, while for long period of time it takes difficult to breath well and it covers the nose tightly so it causes trouble to the nose as well. The design has shown below [6].

Figure 5: DM Zing Mask [6]

3.2.4 Existing Design # 4: Broad Mask

This is a type of mask which covers the face broadly and provide a gap between mask and lips, while it is useful for longer period as well but the respiratory system does not work good in this mask even for short period of time because of its dust filter and it has shown below [7].

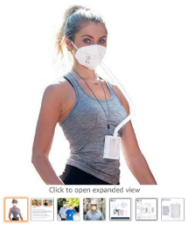

Figure 6: Broad Mask [7]

3.2.2 Subsystem Level Benchmarking

The subsystem level of the project contains different components like pressure transducer, speaker and microphone, air discharge valve, air filter, battery etc. From these subsystems a pressure transducer is describing in this section.

3.2.2.1 Subsystem #1: Pressure Transducer

It is a device that uses to determine the pressure at one point and it can use to determine the difference in the pressure from one point to another point like it can use to find the pressure difference inside the mask and outside the mask.

3.2.2.1.1 Existing Design # 1: BPE282

This is a pressure transducer that has accuracy like 80%, while the cost of the transducer is high and it consume lot of power and produce noise as well. And it has shown below

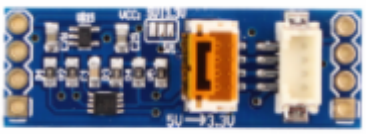

Figure 7: BPE282 [8]

3.2.2.1.2 Existing Design # 2: MPXV7002DP

This is another existing design in which the transducer can give high accuracy, and it cost les as well. While the power consumption is low as well in this transducer. And it has shown below.

Figure 8: MPXV7002DP

3.2.2.1.3. Existing Design # 3: ESP8266

Another existing design for the pressure transducer is presenting here, in which the cost is not effective but the accuracy is the main issue which is quite low.

Figure 9: ESP8266

3.2.2.2 Subsystem # 2: Controller

Controller is using to control all the components in the device, each instruction transfers from the controller to each component, and there are different types of controllers available stating in the following section.

3.2.2.2.1 Existing Design # 1: Arduino Nano

The Arduino nano gives all the features in the single chip and it provides an easy way to code the controller. Arduino provides an easy access to do the communication as well. The cost of Arduino is low [11].

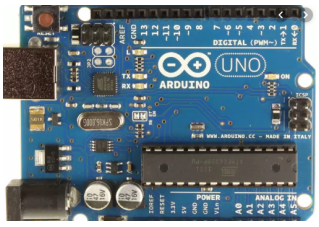

Figure 10: Arduino Controller

3.2.2.2.2 Existing Design # 2: Raspberry Pi Controller

Raspberry Pi controller is another controller uses to communicate with the components. It also provides the LAN access as well but the cost of raspberry is high.

Figure 11: Raspberry Pi

3.2.2.2.3 Existing Design # 3: BeagleBone Controller

This is a high-speed controller with the ARM processor and it contains high memory as well but the cost of the product is high.

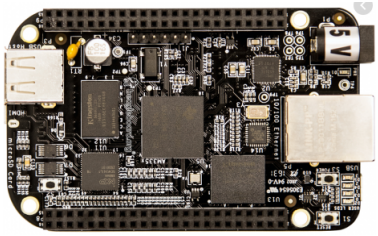

Figure 12: Beaglebone

3.2.2.3 Subsystem # 3: Microphone

This is another subsystem uses to communicate with others. The microphone will help in amplifying the voice of the user and it can make easy to understand by the others.

3.2.2.3.1 Existing Design # 1: SparkFun Electric Microphone

This is a microphone that uses to transfer the voice clearly from one end to another end. The cost of this product is low as compare to the other microphones available in the market.

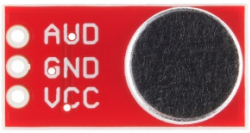

Figure 12: SparkFun Electric Microphone

3.2.2.3.2 Existing Design # 2: Adafruit Electret Microphone

This is an existing design and the microphone contains the adjustable gain with the amplifier settings while the cost of this product is higher than the SparkFun microphone.

Figure 13: Adafruit Microphone

3.2.2.3.3 Existing Design # 3: Comidox

This is a high sensitivity microphone while noise ratio is high in this module and it has shown below in the following figure.

Figure 12: Comidox

4 CONCEPT GENERATION

The concept generation is the most important part in any design project. In this section all the different ideas have generated and then compared with each other to select the final design.

4.1 Full System Concepts

4.1.1 Full System Design # 1: Cloth Mask

This is a design in which the cloth is using as a material to make the mask, while it contains the filter as well for the respiratory system. This cloth mask will cover tightly with face and keep the dust particles away. The mask can use to protect any sort of Corona effect as well.

Advantages:

1. Comfortable
2. Low Cost

Disadvantages:

- Integration of components is difficult

Figure 13: Cloth Mask

4.1.2 Full System Design # 2: Plastic Mask

This design of mask consists of plastic, while it contains the polynomial surface as well to provide an easy to use mask. The mask will cover the whole face while it will provide the filter for the inhale and exhale system.

Advantages:

- Low Price
- Systems can integrate easily
- Easy to use
- Comfortable
- Easy to Manufacture

Disadvantages:

- Can break easily if pressed harsh.

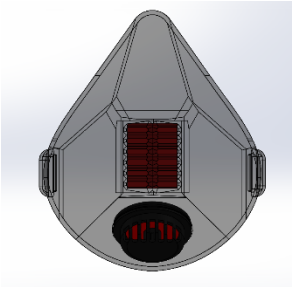

Figure 14: Plastic Mask

4.1.3 Full System Design # 3: Curved Plastic Mask

Another design has created in which the mask has developed in the curved form and with the material.

Advantages:

1. Comfortable

Disadvantages

1. High cost
2. Difficult to manufacture
3. Difficult to integrate the components

Figure 15: Curved Plastic mask

4.2 Subsystem Concepts

Different sub-systems design has generated in this section.

4.2.1 Subsystem # 1: Pressure Transducer

4.2.1.1 Design # 1: BPE282

This is a pressure transducer that has accuracy like 80%, while the cost of the transducer is high and it consume lot of power and produce noise as well. And it has shown below

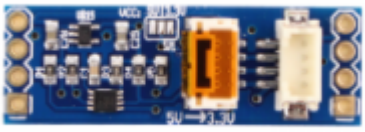

Figure 16: BPE282

Advantages:

- Low Cost
- Integrate with Arduino easily

Disadvantages:

- Low Accuracy

4.2.1.2 Design # 2: MPXV7002DP

This is another existing design in which the transducer can give high accuracy, and it cost les as well. While the power consumption is low as well in this transducer. And it has shown below.

Figure 17: MPXV7002DP

Advantages:

- Integrate with Arduino easily
- High Accuracy
- Low power consumption

Disadvantages:

- Little high price

4.2.1.3. Design # 3: ESP8266

Another existing design for the pressure transducer is presenting here, in which the cost is not effective but the accuracy is the main issue which is quite low.

Figure 18: ESP8266

Advantages:

- Integrate with Arduino easily

Disadvantages:

- Low Accuracy
- High Cost
- High power consumption

4.2.2 Subsystem # 2: Controller

4.2.2.1 Design # 1: Arduino Nano

The Arduino nano gives all the features in the single chip and it provides an easy way to code the controller. Arduino provides an easy access to do the communication as well. The cost of Arduino is low.

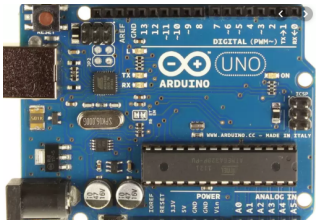

Figure 19: Arduino Controller

Advantages:

- All things are accessible in single unit

Disadvantages:

- Low strength Wi-Fi

4.2.2.1 Existing Design # 2: Raspberry Pi Controller

Raspberry Pi controller is another controller uses to communicate with the components. It also provides the LAN access as well but the cost of raspberry is high.

Figure 20: Raspberry Pi

Advantages:

- Controller is faster in speed

Disadvantages:

- Less memory available on the controller

4.2.2.3 Existing Design # 3: BeagleBone Controller

This is a high-speed controller with the ARM processor and it contains high memory as well but the cost of the product is high [13].

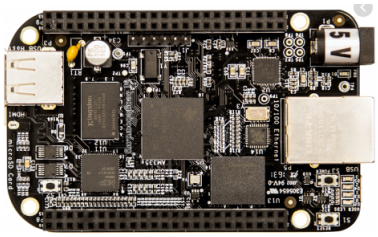

Figure 21: Beaglebone

Advantages:

- High speed

Disadvantages:

- Costly
- Low memory
- Less efficient

4.2.3 Subsystem # 3: Microphone

4.2.3.1 Design # 1: SparkFun Electric Microphone

This is a microphone that uses to transfer the voice clearly from one end to another end. The cost of this product is low as compare to the other microphones available in the market.

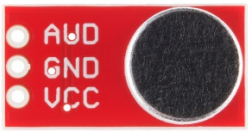

Figure 22: SparkFun Electric Microphone

Advantages:

- Fast
- Efficient
- Highly sensitive

Disadvantages

- Costly

4.2.3.2 Design # 2: Adafruit Electret Microphone

This is an existing design and the microphone contains the adjustable gain with the amplifier settings while the cost of this product is higher than the SparkFun microphone.

Figure 23: Adafruit Microphone

Advantages:

- Highly sensitive

Disadvantages

- Costly
- High noise

4.2.3.3 Design # 3: Comidox

This is a high sensitivity microphone while noise ratio is high in this module and it has shown below in the following figure.

Figure 24: Comidox

Advantages:

- Sensitive

Disadvantages

- Costly
- High noise

5 DESIGN SELECTED

For the chapter 5, it talks about generation of concept which are important to do for any designing project. And for the selection of final design there are different methods that need to use, which includes Decision matrix, Pugh chart, Pairwise comparison chart etc. These of the methods can help in selecting the final design on the criteria of engineering and customer requirements.

5.1 Technical Selection Criteria

For selecting the final design, the criterion is simple, that evaluate each design according to the engineering requirements and select the final design that fulfills the requirement maximum. It takes the grade to each design against each requirement and then sum all the values, higher the value will be the final design. This has done in both full systems, and also in subsystems.

5.2 Rational for Design Selection

The final design has selected through the following table

Table 4: Evaluation Chart

Criterion	**Possible Selection**	**Cloth Mask**	**Plastic Mask**	**Curved Plastic Mask**
Comfort		10	8	8
Aesthetics				
Manufacturability		7	10	5
Cost		9	10	6
Component Integration		4	10	6
Total		**36**	**47**	**35**

Hence the best design is Plastic Mask because it has the highest numbers and looking at the advantages, it is the one which contains the maximum advantages, and fulfilling the requirements of the project properly. While the other two designs have rejected and will not use. Here are the salient features of this design.

- HEPA Air filter at Both Inhalation and Exhalation Ports
- The outer frame of the mask will be 3D printed – Plastic Sheets will be pasted on polynomial shaped edges
- Suction Fan and Ventilation System will be fitted on the front Rectangular Inhalation Port
- Air discharge valve will be fitted onto Discharge Port
- Electronics are supposed to be fitted on the mask – The final design iteration is under progress which will provide provisions to fit electronics and battery

With all these features, the design is best to use among the other two designs. Also it is fulfilling the customer requirements as well:

- ✓ Allow unrestricted exhalation and inhalation
- ✓ Allow unrestricted **speech** and **non-verbal communication**
- ✓ Allow **easy eating and drinking** while wearing mask: We are working on design iterations to make it possible
- ✓ Allow **uninterrupted operability** in a **8 hour** working day
- ✓ "Surviving Facemask Experience with a Laugh" – Incorporate fun features like voice altering: This feature will be incorporated once the functional design is created

And this design is fulfilling the engineering requirements as well:

- ✓ Ventilation System - Tidal Volume of 0.5 L with Expiration Rate of 6 L/min
- ✓ Transparent Plastic material for manufacturing with wearable rubber at corner
- ✓ Arduino Nano based System electronic system
- ✓ Light-weight linkage mechanism: This mechanism is being designed for the facemask to provide provision for eating and drinking
- ✓ 2500 mAh battery supply

With all these requirements fulfilled by this design it has selected as a final design. Now coming to the sub-system selections. The table has shown below

Table 5: Pressure Transducer Selection

Criterion	**Possible Selection**	**BPE 282**	**MPXV7002DP**	**ESP8266**
Accuracy		8	10	5
Cost		10	9	7
Integrability with Nano		10	10	10
Power Usage		8	10	8
Signal Noise		8	10	6
Total		**44**	**49**	**36**

Hence the best transducer to use is the MPX transducer, while the BPE282 transducer can set up as a backup plan in case the MPX transducer does not work properly.

For the selection of controller following table has been used.

Table 6: Controller Selection

Criterion	**Possible Selection**	**Arduino Nano**	**Raspberry Pi**	**BeagleBone**
Accuracy		10	10	5
Cost		10	9	7

Integrability		10	8	10
Power Usage		10	8	8
Signal Noise		10	10	6
Total		**50**	**45**	**36**

Hence the best solution here is Arduino Nano to use in the device and the other two controllers are not setting up for any backup plan because of the reason that Arduino has the capability to easily handle this system. And looking at the advantages of Arduino, it is more than other two controllers, that's why it has selected.

For the selection of microphone following table has used:

Table 7: Microphone Selection

Criterion	**Possible Selection**	**SparkFun**	**Adafruit**	**Comdix**
Accuracy		10	7	5
Cost		8	7	7
Integrability		10	8	5
Power Usage		10	8	8
Signal Noise		10	8	6
Total		**48**	**38**	**31**

Hence the selected design is the SparkFun microphone because of its higher advantages stated earlier. While the other two designs are rejected. Some other parts have been selected using the following criteria.

HEPA Air Filter

Here are some details about HEPA air filter

- Cannon HEPA Air Filter
- Product Cost: $12.6
- Filter Size: 296 by 296 mm
- The filter will be cut into small pieces for inhalation and exhalation ports of the mask
- Particulate Size: PM 2.5 hence suitable for COVID-19 Airborne Particle

5.2.1 Final Design

The final design CAD model has created and it has shown below

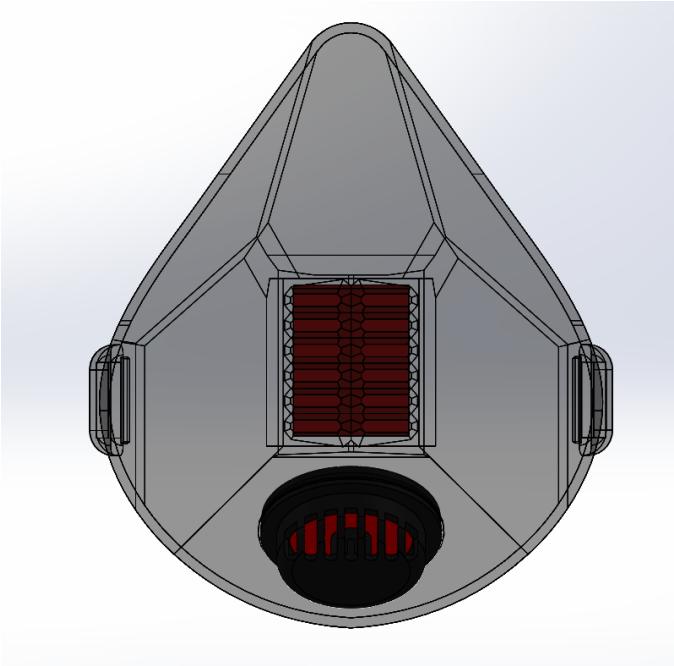

Figure 25: Final CAD Model

Another view of CAD model has shown below

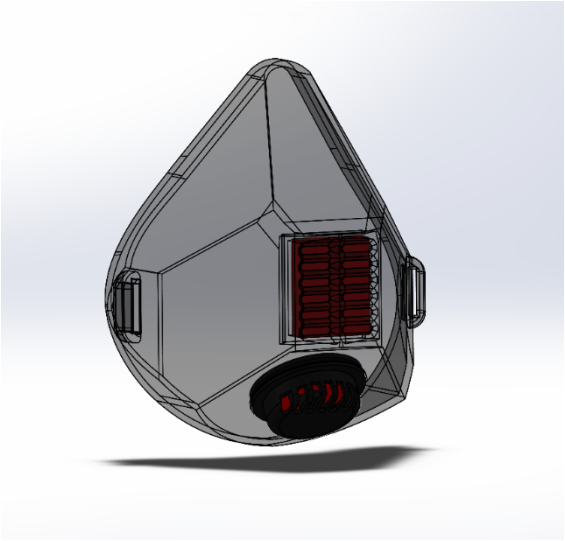

Figure 26: Final CAD Model side view

The breakdown cost has calculated and shown below in the table.

Table 8: Breakdown Cost

S.No.	Details	Cost (USD)
1	MPXV7002DP Pressure Transducer	48.99
2	Arduino Nano	20.70
3	DC Motor for Ventilation System *	15.00
4	H- Bridge and Electronics for Motor *	10.00
5	3D Printed Ventilation System and Components +	50.00
6	LiPo Battery for the Mask	30.00
7	HEPA Filter	12.60
8	Microphone, Speaker and Related Electronics	20.00
9	Additional Cost for the Project including Buffer Amount	30.00
	Total	**237.29**

6 REFERENCES

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APPENDICIES

APPENDIX A – Bill of Materials

Table 9: Bill of Materials

Table 8: BOM

S.No	Items	Quantity
1	MPXV7002DP Pressure Transducer	1
2	Arduino Nano	1
3	DV Motor for Ventilation System	1
4	H - Bridge	1
5	LiPo Batery	1
6	Electronic Microphone and Speaker	1
7	HEPA Filter (Large Piece Cut to make Inhalation and Exhalation Piece)	1
8	Plastic Sheet for Mask Fabrication (Super B Size)	1
9	Elastic Straps for the Mask	2
	OTHER COMPONENTS	
	3D Printed Components	
	Auxilary Electronic Componnets	