SMART MASK

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Keywords:

Smart Mask, Medical Mask, COVID 19, Filters, IOT, Sensors, Voice Amplification, Bluetooth.

Introduction:

The idea of covering one's mouth and nose during surgeries was first proposed in the turn of the 20th century (made with gauze or bandages). It was based on the findings of Carl Friedrich Flugge that was published in 1897 on development of droplet infections associated with Tuberculosis. Face masks were used regularly by doctors, people handling hazardous chemicals, waste handlers, traffic policemen, but due to the covid-19 pandemic face masks have become a common sight today used by most of the general population. There are many types of face masks available in the market today and they are single use and disposable masks, reusable masks, n95 masks, HEPA masks and so on. There is also observed a recent trend of smart masks in the market with advancement in IOT and Embedded technology that offers features such as health monitoring, air quality monitoring, connectivity with other devices etc. We present a smart mask that can amplify the user's speech and generate a clear and loud output through the speakers integrated into the mask. This mask is helpful to people in carrying out everyday conversations and communicate clearly and effectively without the mask muffling the user's speech while also being protected from airborne infections, allergens, deadly viruses like Corona virus. It also incorporates a Bluetooth module to collect the voice input of the user in its analog form and transform it into digital form so that it can be wirelessly transmitted over short distances. The Bluetooth connectivity that the mask provides can be utilized to connect with other devices such as laptops, Smartphones, Tablets that can convert speech into text using our web-based application. The mask can also be connected to external speakers to address large audience. The main aim of the mask is to deal with one of the few problems faced while wearing it, which we have all experienced ourselves is that it comes in the way of communication.

Objectives:

The objective of the project is to design and create a mask that can amplify or strengthen the user's voice and use the speakers within it to propagate the amplified voice

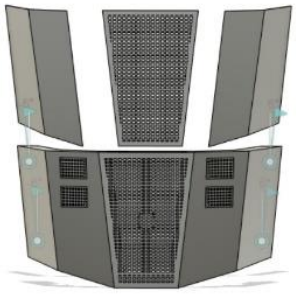
to its immediate surroundings, this will be helpful in day-to-day conversations while also practicing social distancing. Integration of a Bluetooth module to wirelessly transmit voice data over short distances. Development of a java script and HTML based speech to text web application to convert speech input received via Bluetooth to text output that can be displayed or saved, this feature is useful for teachers to translate their speech into text or anyone wishing to save notes or to document anything important. The Bluetooth connectivity that the mask offers will be helpful for event hosts and representators to address large gatherings of people at events, Conference etc. The mask also has provisions to replace its filters to increase its effectiveness and also to extend its use.

Methodology:

The mask's shell is designed using Autodesk Fusion 360 software and is 3D printed using SLA and TPU. SLA is hard and provides strength and rigidity to the mask, TPU is flexible and soft and is utilized where the mask comes in contact with the user's skin to ensure comfort. It has provisions to replace HEPA filters which are highly effective against pollution and airborne pathogens and viruses. The internal hardware consists of 1. PAM8403 class D amplifier 2.TG113 Bluetooth module 3.Li-ion rechargeable battery 4. Speakers 5. Electret Microphone 6. Connecting wires and a Switch. The basic feature of this smart mask is that of air filtering through replaceable HEPA filters. HEPA is an acronym for High Efficiency Particulate Air. It can theoretically remove up to 99.97% of dust, pollen, mold, bacteria, and airborne particles. It blocks particles that are larger than its pore size of 0.3 microns and lets air to pass through without any difficulty. The mask also has 3 modes of operations, based on the user's need and they are defined as follows.

Mode 1: Mode 1 is useful for addressing at most 40 participants or audience. In mode 1, the voice captured by the microphone is amplified and fed into the speakers within the mask to amplified voice signals to the immediate surroundings which is useful to conduct every day conversations clearly without removing the mask and maintaining social distance.

Mode 2: Mode 2 is useful for addressing large number of participants or audience in seminar halls and conferences. In mode 2, the voice captured by the microphone is amplified and amplified voice signal is sampled to convert from its analog state to digital state and is then wirelessly transmitted to a Bluetooth receiver using I2S protocol which is useful to address large crowds and gatherings through which sharing of common mic is avoided.



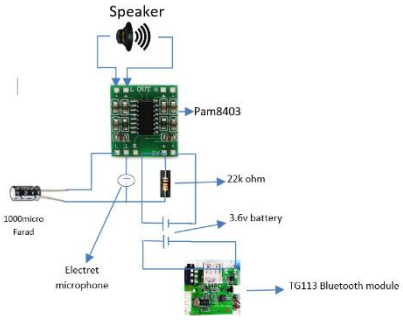
front view of the mask designed using fusion 360

side view of the mask designed

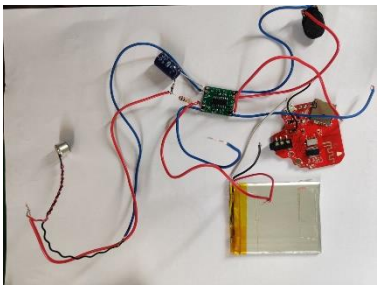
Mode 3: Mode 3 is for Speech to Text conversion. In mode 3, the voice captured by the microphone is amplified and amplified voice signal is sampled to convert from its analog state to digital state and is then wirelessly transmitted from the Bluetooth transmitter in the mask to a Bluetooth receiver in the device that is connected to the internet that runs the web application. The digital voice received is then converted to text in the web-based application. This mode is helpful for teachers to recite notes while it is simultaneously converted to text and displayed for the students to note down.

front view of the 3D printed

rear view of the 3d printed



Circuit diagram



circuit implementation

Results and conclusion:

The proposed smart mask is designed and 3D printed successfully, the mask is sturdy, durable, protects the user from infections and diseases by filtering the inhaled air and trapping the dust and virus particles using the HEPA filters. It is also comfortable to wear for long durations due to the flexibility and softness offered by the TPU used. The amplifier and the speakers strengthen the voice captured by the microphone and is clearly audible up to a distance of 10 - 15 meters. The battery capacity of 2000mah is capable of powering the circuit for 6-8 hours based on the usage of the different modes available. The speech to text web application developed using JavaScript is accurate and listens continuously to the voice inputs transmitted wirelessly from using the Bluetooth module. The Bluetooth module also helps in connecting the mask with other external speakers and can also handle Hands free calling.

The proposed objectives of the project have been successfully implemented using IoT, Embedded technology, and wireless connectivity enabling the people to communicate effectively while wearing a mask to protect them from infectious diseases, pollution etc. It is also helpful for teachers to dictate notes using the mask so that it will automatically be transcribed into text format, it is also helpful in taking notes, memos, or to document any information. It can be used to address large gatherings, crowds without concerns of using a microphone shared by other speakers.

Scope for future work:

In order to accommodate various face sizes and shapes we recommend using 3D scanning to get a rough estimate for the mask design for a tight fit and better protection. Developing and training a custom Speech recognition model for even higher accuracies in case of continuous voice recognition and transcribing as well as support for various other languages. Usage of Flexible plastics or silicon for the mask body and an integrated circuit with amplification and Bluetooth transceiver in a single chip or body. There is some lag observed in the audio transmission due to the A2DP profile used and hence usage of wifi or zigbee technology for faster transmission.