SMART MASK FABRICATION: A CONDUCTING CLOTH BASED BREATH HUMIDITY SENSOR

IITM Technology Available for Licensing

Problem Statement

- **Humidity monitoring** is essential in many fields beyond personal usage, including food processing and medicine.
- Millions of people in the world suffer from a variety of common respiratory problems like asthma, **chronic obstructive pulmonary disorder** and cystic fibrosis.
- These problems can be regulated by monitoring the components such as carbon dioxide (CO2), water vapour, and other volatile organic compounds (VOCs) contained in the individual's exhaled breath.
- Examining breath samples for disease prognosis is a promising **non-invasive option**. However, the widespread deployment of traditionally used methods like Mass spectrometry and Raman spectroscopy has been hampered by a number of factors, such **as high cost, need for trained staff, and inflexibility.**
- Thus, the conducting cloth based breath humidity sensors in the form of **wearable face mask** have proven to be a useful solution to a few of the problems.

Technology Category/ Market

Chemicals - Polymers, Sensors
Computer Sciences & IT – Deep Learning
Applications - Smart Textile, Consumer electronics and Healthcare.
Market: The global humidity sensor market size is projected to grow $11.85 billion by 2027, growing at a **CAGR of 14.2%** from 2020 to 2027.

Technology

The System comprises of 3 parts:

1. Fabricating the conducting cloth based breath humidity sensor:

- The non-woven **polypropylene** (PP) cloth is soaked in water for 12h, after which the cloth is immersed in aniline solution for 2 min and later soaked in clean water. Thereafter, the cloth is soaked in ammonium persulfate and after which again immersed in clean water (**SILAR method).**
- This cycle is repeated for 17 times for growth of **Polyaniline** (PANI) on the cloth, which turns the colour from blue to green. (Fig. 1)
- The next step is Interdigitated silver electrodes were screen-printed on the conducting cloth and was stitched on a mask and transforming it into a **smart mask**. The sensor was then connected to the measurement circuit via conducting thread using silver paste.

2. Microcontroller

Microcontroller measures the **voltage drop** across the sensor.

3. Android application

- An application is developed to collect and **visualize the data** from the microcontroller. (Fig. 2)
- Using deep learning, the data collected is analyzed to classify and detect the **patterns in breathing**.

1. **Fabricating the conducting cloth based on breath humidity sensor**
2. **Interdigitated electrodes screen printed on the sensor with Ag paste**
3. **Cloth sensor stitched onto a face mask; across sensor the voltage drop is measured by microcontroller**
4. **An Android-based mobile application was designed to collect the sensor data via the Bluetooth and data analysis was performed live using time series classification algorithm**

Fig. Graphical representation of the system

Intellectual Property

- IN 202241008331
- IITM IDF Ref. **2293**

Key Features / Value Proposition

- This humidity sensor using conducting polymers is capable of **differentiating slow, normal and fast breathing** patterns from nose as well as the mouth.
- **Quick response time** - The sensors have very quick response time of about **one second** and can detect a range of relative humidity from **0 - 95%.**
- Textile such as PP, cotton, silk, nylon, polyester were used as substrate and poly aniline was in-situ polymerized on the substrate using SILAR.
- **Portable sensor** – Uses Arduino prototyping platform coupled with Bluetooth module for collecting data wirelessly.

TRL (Technology Readiness Level)

TRL - 3 , Proof of concept stage.

Research Lab

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Fig. 1

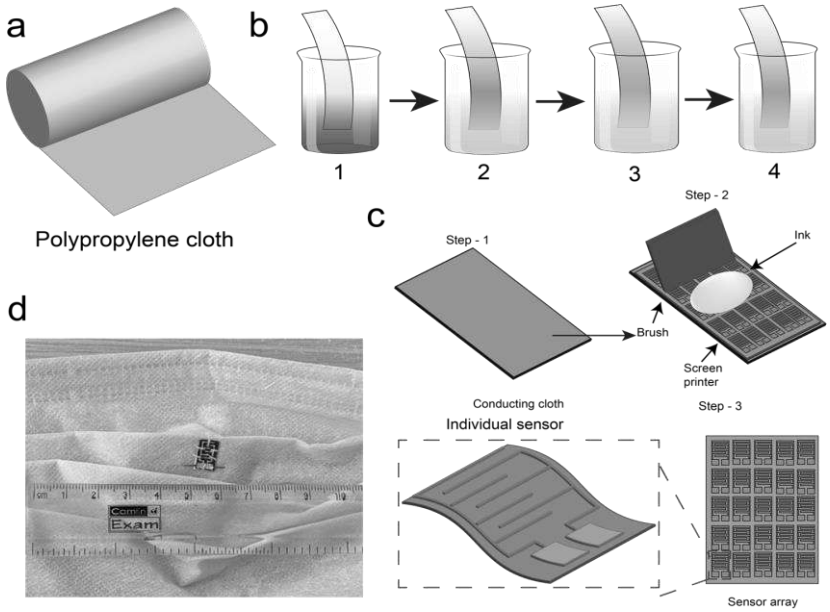

Fig. 2

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