Smart Agriculture: Fruit Ripeness Monitoring and Determination using Electronic Nose

Background of the Study

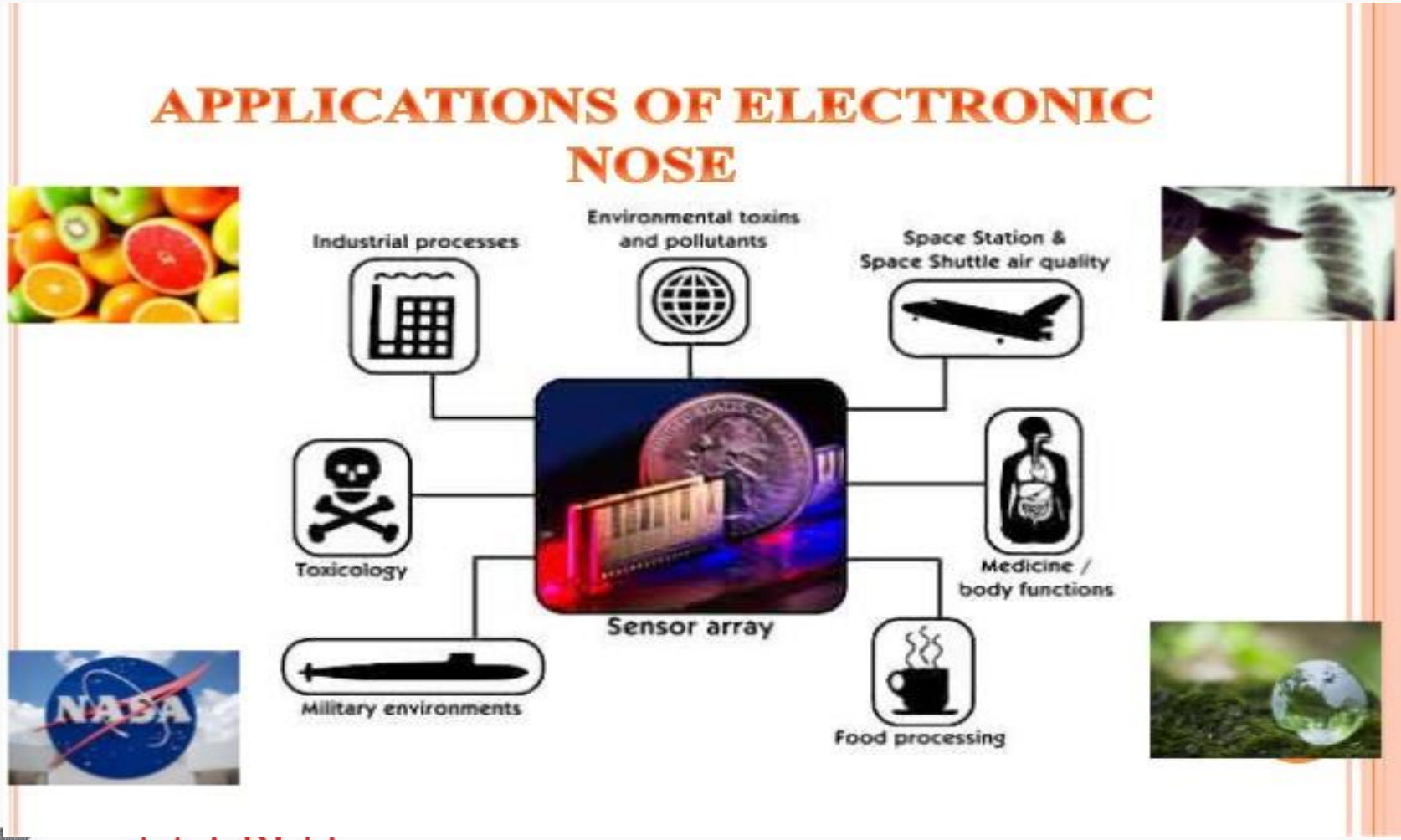
- There are natural factors that could be attributed to fruit ripening such as change in aroma, firmness, color, shape, composition, etc.[1]
- An electronic nose or e-nose makes use of one of those attributes. It resembles the human's sense of smell through an array of gas sensors that are mainly composed of electro-chemical metal oxide semiconductors (MOS), and is capable of analyzing the volatiles emitted by a ripening fruit.
- There have already been a number of studies that have proven the e nose to be a potential monitoring device in fruit ripeness for a variety of fruits: apple [2], banana[3], blueberry[4], grape[5], peach[6], tomato[7] and mandarin[8] but these were only limited to one fruit each as well as samplings taken.

Cont.

- As was stated before that an e-nose is mainly an array of electrochemical gas sensors, however the arrays stability deteriorates over time due to the effect of what is called a “sensor drift.” Drifts are gradual change in any quantitative characteristic that is supposed to remain constant.[9]
- Sensor drifts impair the reliability of gas sensing systems which in time causes the statistical models from sensor responses useless.[10]




Application of ENose

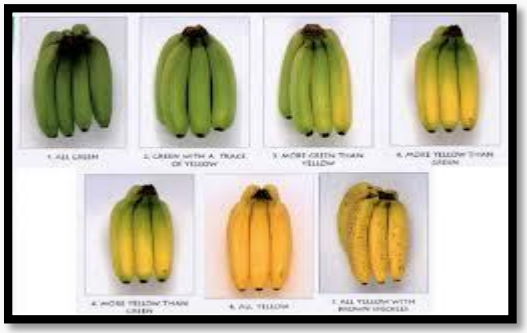


Objectives

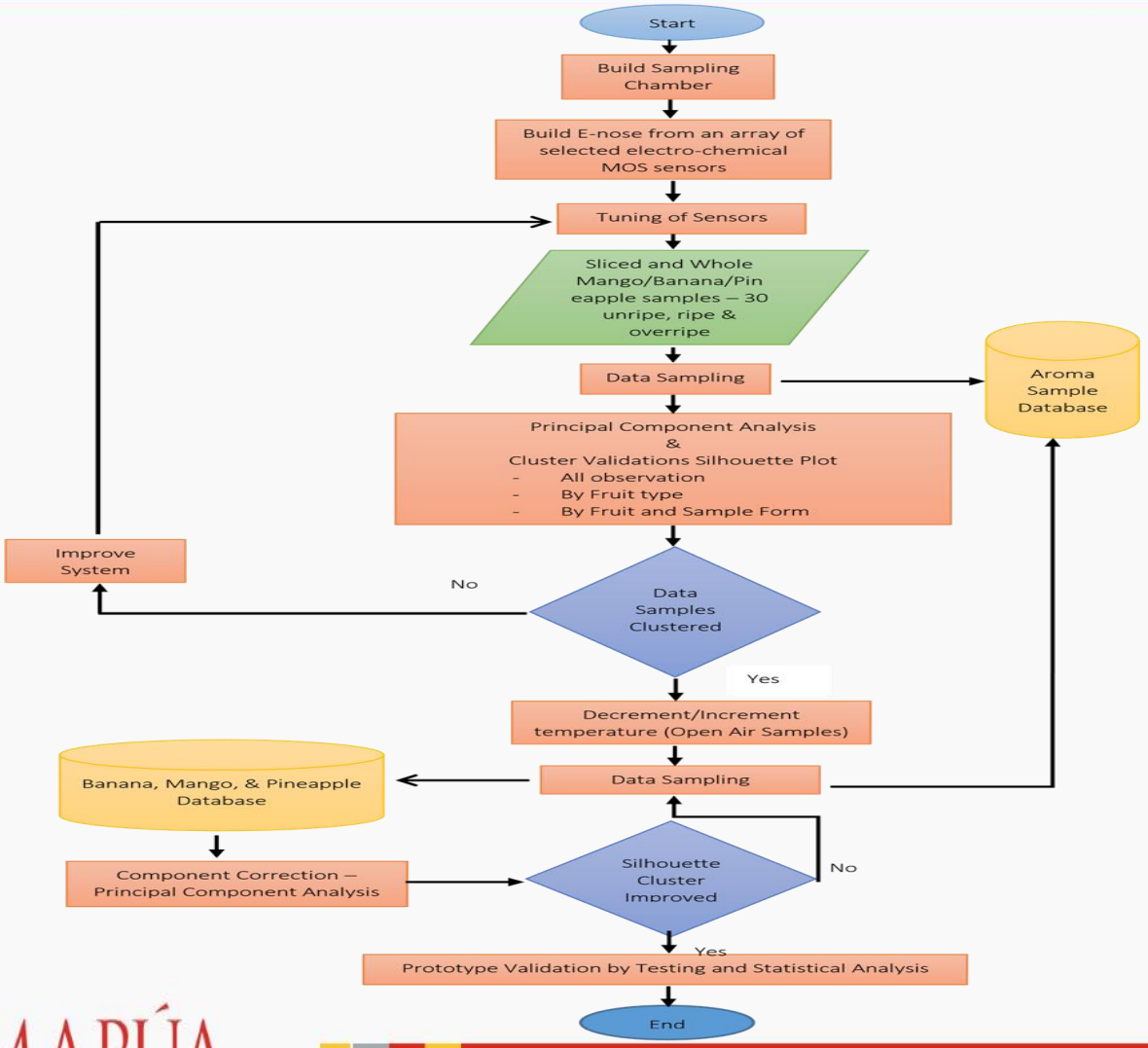
- General Objective
  - The aim of the study is to develop a portable e-nose system capable of determining the ripeness of the mentioned fruits and can counteract the drifting caused by temperature.

Cont.

- Specific Objectives
  - to develop an e-nose system from an array of electrochemical sensors that is sensitive to gases emitted by mangoes, bananas and pineapples upon maturation
  - to observe the correlations between the Statistical treatment scores of sliced and whole fruit samples
  - to record all sensors responses in a range of temperature and applying proper drift compensation.



Research Process Flow



Hardware Components

- The e-nose consisted of an array of 8 MQ and TGS chemo-sensors with various degree of sensitivity to various atmospheric gases; 8 electro-chemical sensors mounted on this e-nose are – MQ-2, MQ-3, MQ-4, MQ-5, MQ-7, MQ-9, MQ-135 and MQ-138.
- A DHT11 humidity and temperature sensor is to be installed within the containment to allow the user to have continuous monitoring of the internal temperature.
- Microcontroller/Microcomputer

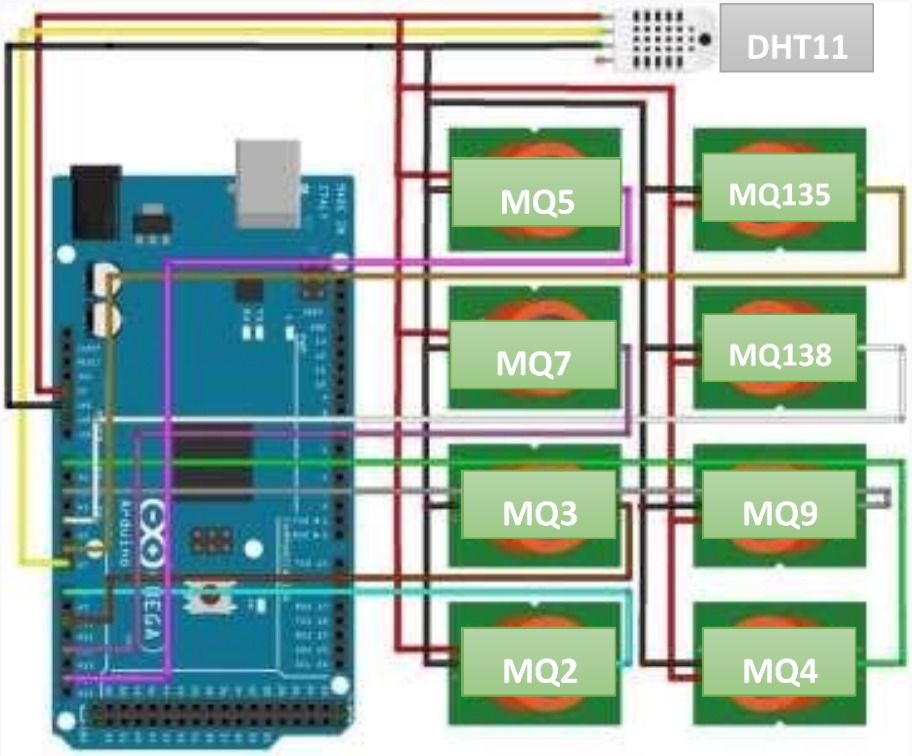
Cont.

- Chemo-sensors and their Target Gases

CHEMO-SENSORS	TARGET GAS/ES
MQ 2	• Methane • Butane • LPG • Smoke
MQ 3	• Alchohol • Ethanol
MQ 4	• Methane • CNG gas
MQ 5	• Natural Gas • LPG
MQ 7	Carbon Monoxide
MQ 9	Flammable Gases
MQ 135	• Benzene • Alchohol • Smoke
MQ 138	• Benzene • Toluene • Acetone • Propane • Formaldehyde Gas

Cont.

- Gas Sensor Wiring Setup



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- [10] Padilla, M., A. Perera, I. Montoliu, A. Chaudry, K. Persaud and S. Macro. Drift compensation of gas sensor array data by Orthogonal Signal Correction.

Images Resources

- http://forum.xcitefun.net/technology-news-electronic-nose-t45168.html
- https://finbarrbegley.wordpress.com/category/electronic-nose/
- http://pib.nic.in/newsite/PrintRelease.aspx?relid=123091
- http://prosur.es/en/2017/01/29/prosur-development-early-warning-tech-microbiological-alterations-based-electronic-nose/
- https://www.researchgate.net/figure/236484197_fig1_Fig-1-Color-chart-of-banana-fruits-in-various-stages
- http://indianexpress.com/article/lifestyle/life-style/heres-how-you-can-tell-the-ripeness-of-mangoes-without-having-to-taste-it-2796463/
- https://www.aliexpress.com/item/9-PCS-1-Lot-Gas-Detection-Sensor-Module-MQ-2-MQ-3-MQ-4-MQ-5/32436270993.html
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