

# INTRODUCTION

- Spirometry is a painless test to evaluate respiratory performance by measuring how much air can be inhaled and exhaled in one force.
- In spirometry measurements, the quantity of air inhaled and exhaled by the patients together with the speed of the exhalation are needed to describe the conditions of lung.
- The device used for spirometry testing is called a spirometer. In general, a spirometer has three basic parts: mouthpiece, airflow tube and electronic device.
- A designed spirometer must be able of conducting analysis and diagnosis of the human respiratory system.
- The common function of a basic digital spirometer is to plot the expiratory air flow against total expiratory volume graph, also known as the spirogram that is used by health professionals to describe lung functions.

# **ABSTRACT**

One of the effective ways to diagnose various respiratory diseases is using spirometry test. Good spirometer comes with excellent graphical user interface.

Spirometer is used to measure lung parameters such as Forced Expiratory Volume in the first second and the sixth seconds (FEV1 and FEV6).

This paper presents an algorithm with Graphical User Interface (GUI) for characterization of respiratory conditions using Arduino Software. The whole spirometry system consists of a breathing circuitry with pressure sensor and a data acquisition board

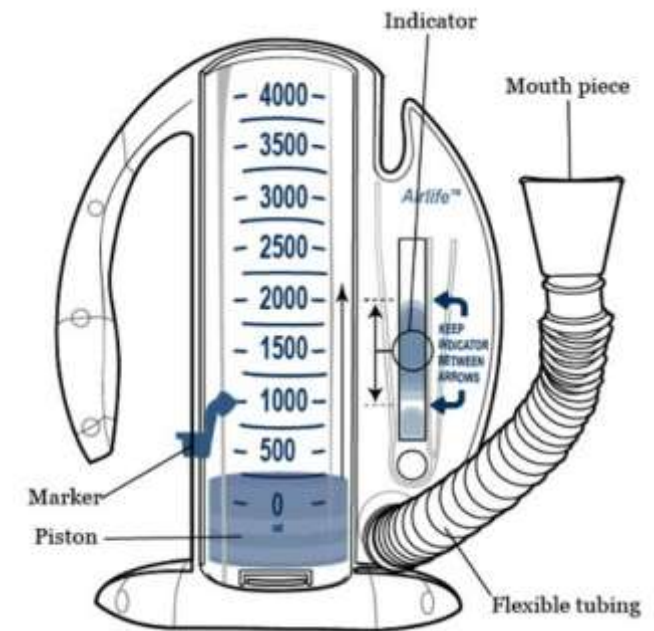
# Novelty of the Project

- The Digital Spirometer that is already available in the market that has been in usage is so high in cost that it is neither feasible nor affordable by the non-high class people.
- Our products' uniqueness is the usage of a good quality differential pressure sensor available in the market that is very affordable that makes our product a cheaper variant as whole.
- And we also have a Bluetooth based app tailor made for our product to track the performance and capacity of the patient's respiratory system. The data that is tracked from the device is cloud stored and can be accessed anywhere from the world using the login ID and password given to you personally.
- That data is so precise that it can be used to get opinions from the doctors and even can be submitted to the patients' hospital records.

# EXISTING METHOD

## TWO TYPES OF INCENTIVE SPIROMETERS

1.VOLUME TYPE - the tidal volume of the spirometer is set according to the manufacturer's instructions. the purpose of the device is to ensure that the volume of air inhaled is increased gradually as the patient takes deeper and deeper breaths.



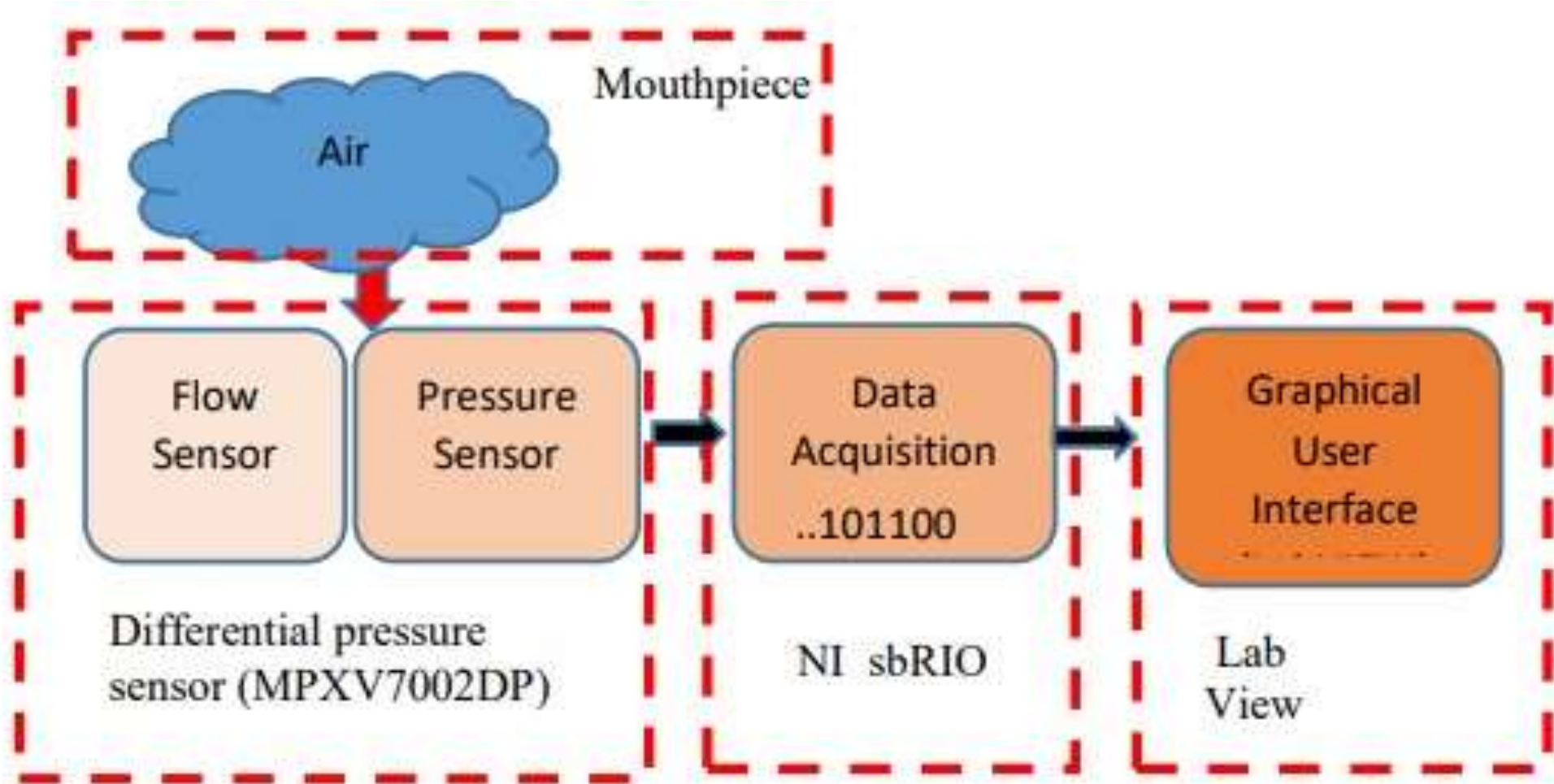
- 2. A FLOW SPIROMETER has the same purpose as a volume spirometer, but the volume is not preset. The spirometer contains a number of movable balls that are pushed up by the force of the breath and held suspended in the air while the patient inhales. the amount of air inhaled and the flow of the air are estimated by how long and how high the balls are suspended.

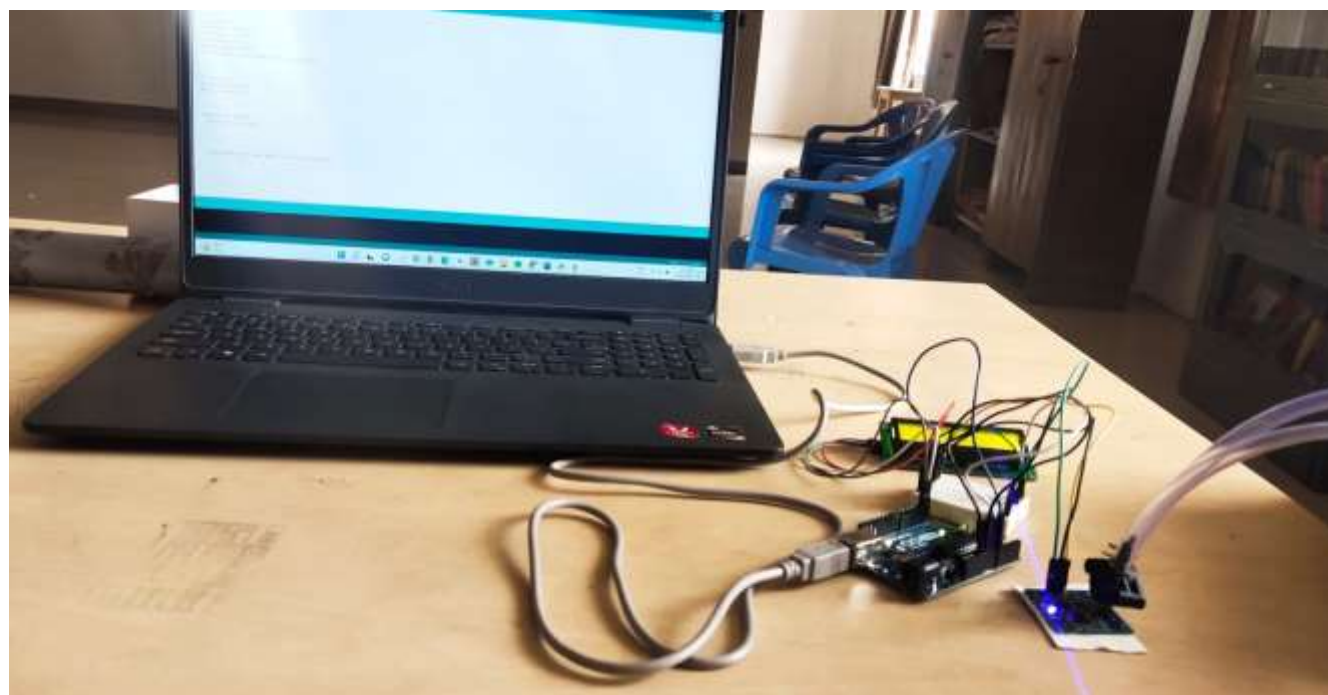
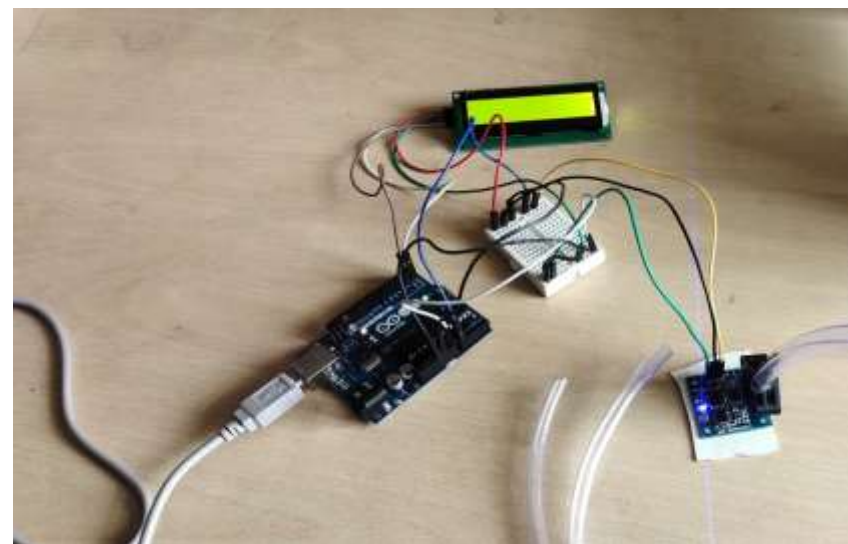
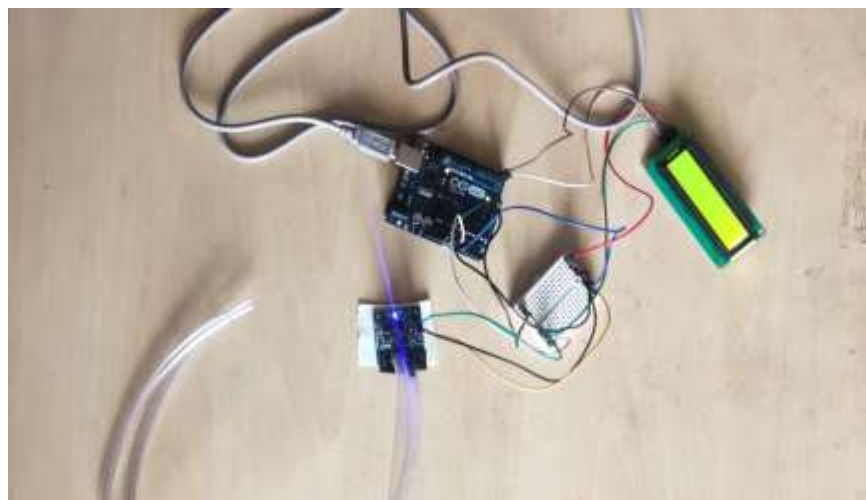


# OBJECTIVE

- An analog spirometer doesn't give us a precise and an exact value or reading of our lung capacity, because of which we are required to purchase the digital variant of the meter.
- A good quality digital spirometer which doesn't compromise the process of measuring and gives precise results cost around 20,000 INR which is not very affordable for the middle class and the lower class families and they ought to settle down compromising the results of the tests.
- And so the main objective of our idea is to reduce the cost or the amount spent on a spirometer in order to receive a precise reading of the lung capacity and to increase their lung capacity.

# BLOCK DIAGRAM







# DESCRIPTION – METHODOLOGY

- As we had seen in the block diagram from the previous slide a pipe acts as a mouth piece to our equipment. Through the pipe the need for the pressure input is satisfied. That is nothing but the mouth piece where the patient blows to check their lung capacity.
- This pipe input is connected to an elastic tube like structure whose other end is connected to a pressure sensor that measures the pressure that is blown by the patient and converts it into a reading of lung capacity
- This pressure sensor is connected to an Arduino board that is coded with the required command. The Arduino helps in receiving the readings from the pressure sensor.
- A display unit is connected to the Arduino to display the reading to the patient.
- The ultimate goal of a spirometer is to increase the lung capacity of the patient for which we've also coded the Arduino to display the target breaths that has to be blown in order to achieve the target lung capacity.

# ALGORITHM/ DESIGN EQUATIONS

Sex		Formula to Calculate FEV1 and FEV6/FVC
Men	FEV1	{liters} = $(4.30 \times \text{height}\{\text{meters}\}) - (0.029 \times \text{age}\{\text{years}\}) - 2.49$
	FEV6/FVC	{liters} = $(5.76 \times \text{height}\{\text{meters}\}) - (0.026 \times \text{age}\{\text{years}\}) - 4.34$
Women	FEV1	{liters} = $(3.95 \times \text{height}\{\text{meters}\}) - (0.025 \times \text{age}\{\text{years}\}) - 2.60$
	FEV6/FVC	{liters} = $(4.43 \times \text{height}\{\text{meters}\}) - (0.026 \times \text{age}\{\text{years}\}) - 2.89$

# PROJECT SIMULATION/HARDWARE TOOLS

## HARDWARE TOOLS:

- Arduino Uno
- Pressure sensor (MPX10DP)
- Display Unit
- Jumper Cables
- Bluetooth Module
- Nose Clip
- Bread Board

## SOFTWARE TOOLS:

- Arduino
- Android Studio

# Potential Areas of Application

- The proposed product will be the best for users with respiratory problems to measure their lung capacity in a precise manner and even use the data from the device to consult with the doctor. And the device will be so compact and portable that it will be light-weight to carry around.
- The proposed project can be made available at Govt. Hospitals, Private Hospitals, Medical Outlets, Medical Companies and in even e-commerce sites.

# Product Cost:

Product	Price
Digital Spirometer	Around Rs.25000
Proposed Spirometer	Around Rs.3000

# Market Potential

Name of the Product	Developer	Market Price
SP-10 Hand-held Digital Spirometer	Contec	INR 24,000
Helios 702 Spirometer	RMS	INR 81,000
Digital Spirometers	Romsons	INR 25,000
Spiromax - Portable Spirometer	Medicaid	INR 45,000

The above table is the examples few of the products available in the market. And as it is clearly depicts that the price of the presently available digital spirometers is not very comforting. The price of our product will definitely give an edge over the already existing ones in the market and will result in big margins of profit without a doubt.

# CONCLUSION

- Results from breathing experiments showed that the spirometer is capable of distinguishing between normal and abnormal respiratory conditions from the FEV1/FEV6 ratio and become the proof of principle for the development of a portable digital spirometer.

# REFERENCES

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