MEMS Club Report for the month of October

List of Activities in MEMS Lab in the month of October

SL No	Activity	Date of Event
1	MEMS Internship on Micro sensor designing tools	Oct 12,2022 to oct 22, 2022
2	Training to vidyagiri high school students on basics of micro sensors application on botanical applications	Oct 22, 2022 to oct 30, 2022

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Designs conducted in the internship

1. Simulation of Branch Line Coupler using MEMS
2. Simulation of Coaxial Cable for different impedance using MEMS Comsol Multiphysics
3. Simulation of Micro gripper using MEMS Comsol
4. Design and Simulation of MEMS Capacitive Pressure Sensor for High Sensitivity Applications
5. Design and Simulation of MEMS Surface Acoustic Wave Sensor
6. Design of cantilever sensor in COMSOL
7. Design of plus structure beam using COMSOL
8. Design of MEMS based pressure sensor using COMSOL.
9. Pressure analysis on cantilever structure using COMSOL.
10. Heat analysis of micro heater using COMSOL.
11. Analysis of fluid samples movement in microstructure using COMSOL
12. Bending analysis of thin film with polysilicon material
13. Design of MEMS accelerometer using COMSOL

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Objectives of the Internship

- To give the complete basic knowledge about Finet element analysis tools to students.
- To undersgtand the importance of micro structure design industry tools.
- To get the basic knowledge about tools usage.
- To understand the real time analysis of basic gemoetrical structure.

Day 1

Prof Guruprasad has started the session with the orientational speech about the objectives of the internship and contents of internship. Then he has started the first session " imporantance of microstructure designing tools in the MEMS industry" in the session he has covered the concepts of sensors, working of sensors, challenges in scalig the dimensions of the sensors. Challenges in fabrication of small dimensions. Imporantace of specific tools . he has mentioned 7 different finet element analysis tools dedicated for MEMS structure design. Finaly explained the possible design understandings of the COMSOL Multiphysics. Finally he has given the list of possible experimentation that can be designed and simulated in the COMSOL Multiphysics.

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The second session is conriued by Dr. Sathish. He has explained the wokring priciple of branch line coupler. Applications of branch line coupler. The designing methodology of branch line coupler. He has focussed on the mathematical modeling of branch line coupler which are needed for the design in the COMSOL.

Glimses of hands on session

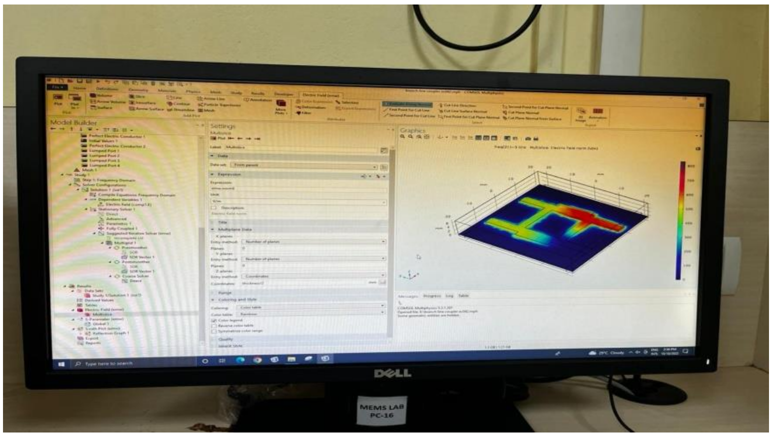

Figure 1: Design and simulation of customised branch line coupler

Day 2

Dr. Sathish has started the explaination of MEMS accelerometer, he has explianed the wokring principles, design constraints anf applications. He has explained the complete sci paper and methodology to do the fabrication of accelerometer.

Guruprasad has explained the basic gemoertrical needs and mathematical models needed to execute the accelerometer in the COMSOL software. Then he has focused on the types of fabrication. He started to explain the complete steps inivolved in the surface micro machining process for MEMS accelerometer.

Glimses of Accelerometer simulation results

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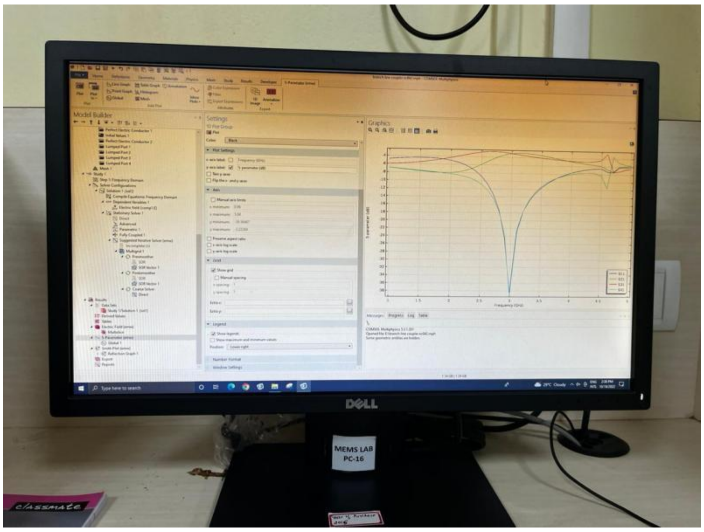

Figure 2 : The displacement curve in desined MEMS accelrometer in COMSOL.

Day 3

Dr. Sathish has started the session with the explaination of genomterical prereqisites for the design procedure in COMSOL. He has taken the example of capacitive pressure sensor. He has explained the working concept, applications, desing methods and types of designs for capacitive pressure sensors. He explained one innvative paper on the capacitive pressure sensor and intracted the students about the geomtical parameters needed for the capacitive pressure sensor.

Guruprasad has started the practical geometrical calculations for the students. He has selected the thin film structure to explain the mathematical model concepts before starting the design in comsol. He started the practical demostration of thin film structure bending analysis with statin less steel material. all the students were made the batch and each batch is taught with the design steps in detail with an example of thin film.

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Glimses of practical design of thin film:

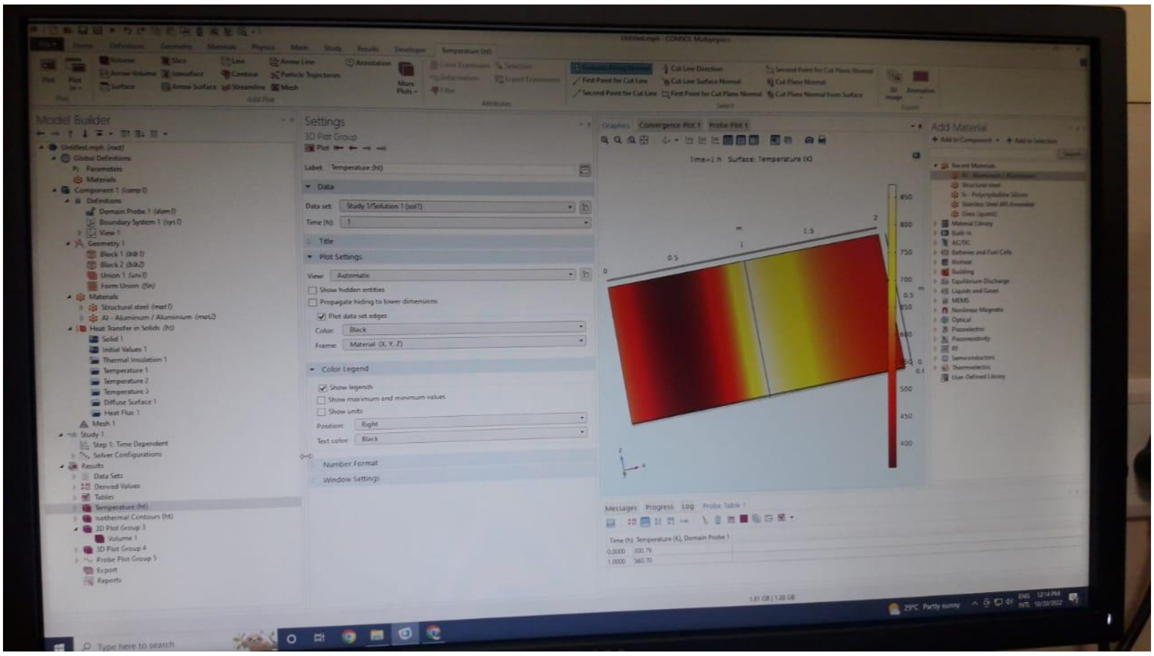

Figure 3 : Thin film design and simulation steps explanation

Day 4

Dr Sathis has started the session with the explanination of bulk micromachining fabrication process. he has expplaned the fabrication of cantilver structue using bulk micro machining.

Guruprasad has ecplained the LIGA process of MEMS sensor fabrication, he has explained the difference between bulk and surface micromaching process. he has showed the realtime prodcut whixh is developed by surface micromaching.

Day 5

Dr. Sathish has started the session with the explaination of genomterical prereqisites for the design procedure in COMSOL. He has taken the example of capacitive pressure sensor. He has explained the working concept, applications, desing methods and types of designs for capacitive pressure sensors. He explained one innvative paper on the capacitive pressure sensor and intracted the students about the geomtical parameters needed for the capacitive pressure sensor.

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Day 6

All the students were devided into the batch of two students and each batch is assingned with perticular design assigment and the students were allowed to excute their own designs in the COMSOL.

Glimses of designes by students:

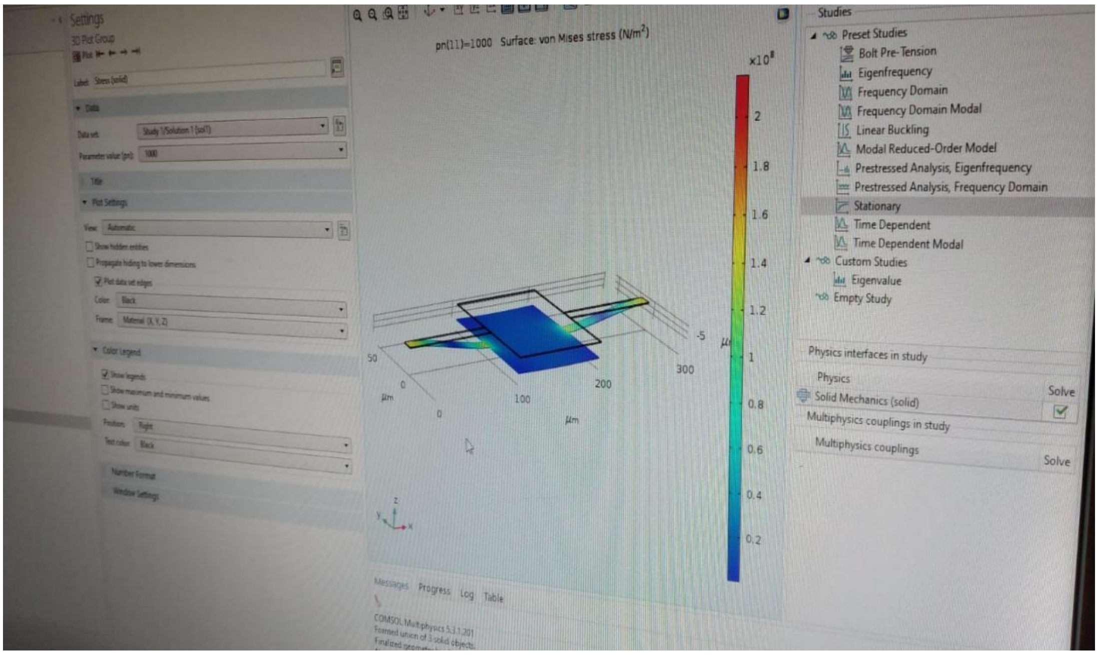

Figure 4 : MEMS based pressure sensor design

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Day 7

Guruprasad B has started the hands on explanation complete steps to design the electrostatic switch to develop the electric sensor with cantilever comb structure. Snipet of the electrostatic switch as electric sensor is design in comsol is shown below.

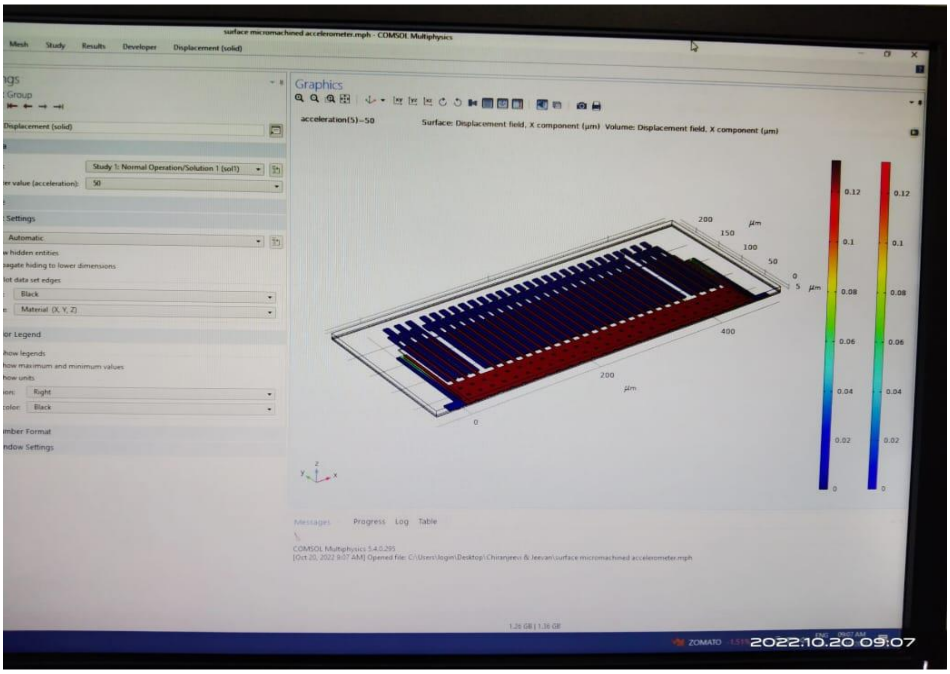

Figure 5 : Electrostatic switch design with comb structre for MEMS electric sensor

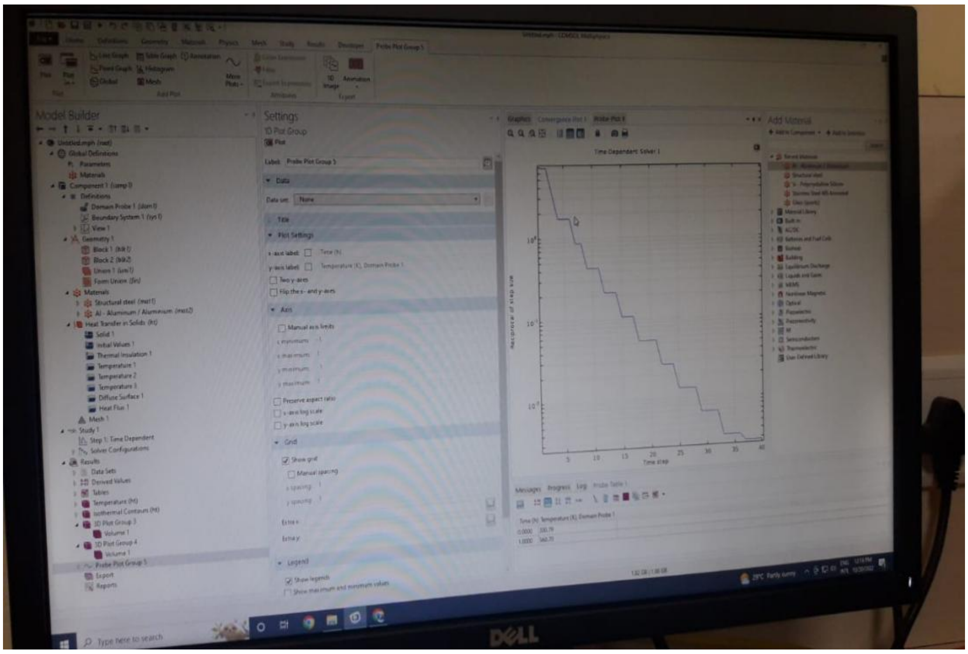

Figure 6 : Frequency response of liquid flow in micro tube

Day 8

Guruprasad has focused on the explanation of steps to design the micro fludic analysis in micro tubes. He has explaned the different methods of taking wizard models, solid mechanics selections needed for fluid mechanics design in the comsol tool. He has completely ecplained one model and assigned the students to design with different fluid selection. The snipet of the micro fluidic tube design is shown below.

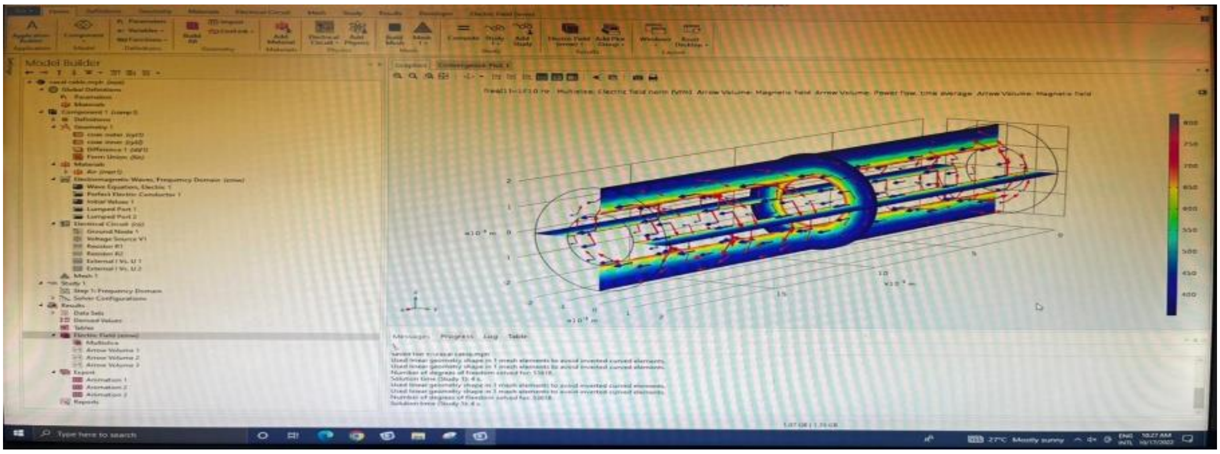

Figure 7 : Design of micro tube for drug delevery applications

Day 9

The students are provided with digital microscope for the practcal view of fabricated cantilever with polysilicon material and polymer coating. The snipet of microscopic practical images is shown in below.

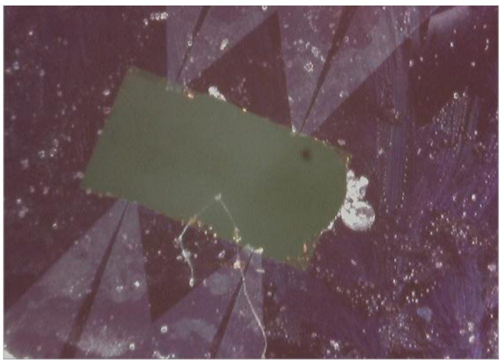

Figure 7: The Microscopic view of fabricated cntiliver

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Day 10

The practical demostration of device session has continued and in this session Guruprasad has higlitgted the importance of wire booning techniques and showed the practical wire bondong gold doped silver drops in the fabricated cantilever. The snipet is shown below.

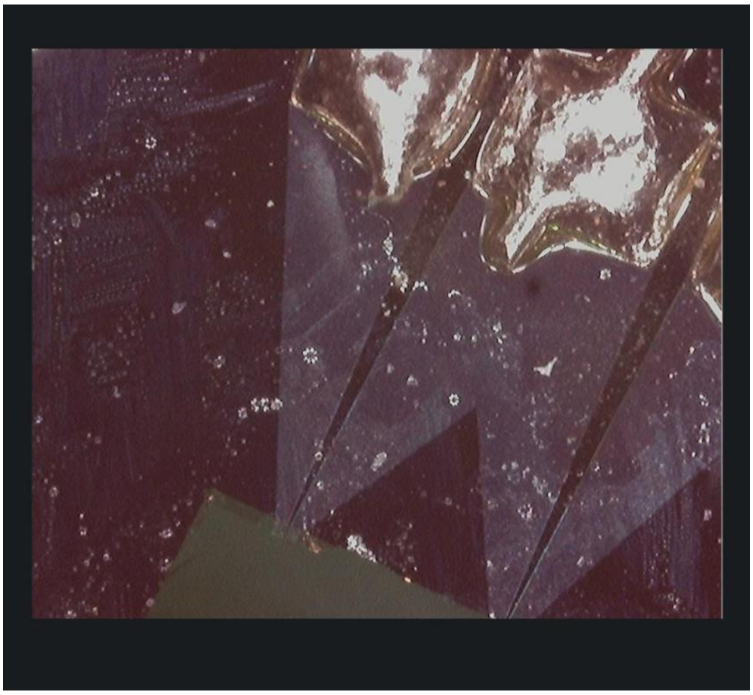

Figure 8 : Microscopic view of wire bonding dropets

Validectory:

Dr. Sathish has addressed the students and asked the opinion about the internship sessions. Dr. D V MAnjunatha has visited the internship and addressed the students and spoke about the importance of the MEMS designing tools. He has asked the students to write the feed back about the whole internship experience. All the students were given with feed back forms and the validectory completed with thanking all the supporters.

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Activity 2 (From Oct 22 to Oct 30)

The 4 students from vidyagiri alvas high school were given training about the basics of research parameters in micro sensors for botonical applications. They have slected the project on DEMONSTRABLE DEVICE TO PROVE PLANTS HAS HUMAN EMOTIONS. They we trained with practical experimentation of micro sensors in shobavana of AIET campus. The details of the whole experimentation conducted in the student activity is explained the following sections.

Recently in this new era humans are involved in deforestation. People are cutting the plants and killing the greenery environment mercilessly. Not only this, demolishing of plants and forest for human greediness is very cruel nature of human life. So our purpose of this experimentation is to prove experimentally that plant also has emotion fear, happiness like every human being have. Plants can interact to each other, they react external stimuli. This concept of scientific form of detectable change in plants due to external stimuli is first coined by the great Indian scientist J.C Bose but there is no demonstrable electronic device to support his theory. Now we are trying to develop a demonstrable electronic device to prove that pants reaction to the external stimuli in terms of detectable voltage. Our objective is to explain to the world about the wonders of nature and to feel and get closer to the nature. By this experiment, we are trying to bring a message to our society to treat the Plants as our friends and we should not misuse it for mans greediness.

Save earth and save nature is voice of whole earth now. The WMO report on global climate in 2015-2019 release by united national security, general says that global average temperature has increased 1.1C compared to 2011 to 2015. This continuous increasing in global temperature every year definitely vanish the whole human life. One fine day earth may not become the favourable planet for human to live. The reason for this type of continues increases in global warming are extreme industrialization, deforestation and more of heat trapping gasses from human industry activity. Due to extreme deforestation we don’t have executive plants to absorb global heat. Even though, the country is advertising about it in many ways about the importance of forest to the society. But the society is ignoring the future threat from the thin executive information. This experimentation is an endeavour proves and demonstrative through electric device about the plants emotion like fear, happiness and reaction to external stimuli. We want to alert to the society about the importance of plant by proving experimentally that plants in nature love us. We must love nature. We should not misuse the nature.

1. Procedures used in the experiment

- The Tulsi (Ocimum Tenuiflorum) and Alovera (Aloe barbadensis miller) plant are considered for experimentation.
- The alovera plant (Aloe barbadensis miller) and tulsi (Ocimum Tenuiflorum) are taken for consideration.
- A voltage sensor is pierced into the stem of the plants.
- The voltage sensor is connected into audiono Uno board.
- The output of audino board is displayed as sinusoidal signal output in computer GUI (Graphical User Interface).
- **The alovera (Aloe barbadensis miller) is squeezed continuously. The sudden change in the output voltage is observed for every squeeze and normal constant potential difference of 21-22 mv is maintained without external squeeze and irritation.**
- **For tulsi (Ocimum Tenuiflorum) constant output voltage from stem is mentioned around 100-110mv. But sudden changes observed when the leaves are exposed to fire.**

2 A summary of the key points and an overview of how the investigation was conducted

- The two plants alovera (Aloe barbadensis miller) and tulsi (Ocimum Tenuiflorum) are selected to conduct the experimentation of testing the detectable change in voltage due to external stimuli; like squeezing and fire.
- The plants are connected with sensitive voltage sensor also with audino board to detect the change in voltage due to external stimulus. The voltage change is recorded in GUI of computer using audino Uno.
- The sudden fluctuation in output sine wave due to external squeeze force is observed in sinusoidal output graph.

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3. Experimental Data

DAYS	Plant Name	Normal condition (Without stimulus)	Saturated voltage at normal condition	When exposed fire
Day 1	Tulsi	110mv to120mv (This voltage is slowly decreasing and saturated to 65mv to 70mv)	65mv to 70mv	85mv to 90mv
Day 2	Tulsi	115mv to125mv (This voltage is slowly decreasing and saturated to 55mv to 60mv)	55mv to 60mv	86mv to 92mv
Day 3	Tulsi	120mv to135mv (This voltage is slowly decreasing and saturated to 64mv to 68mv)	64mv to 68mv	90mv to 98mv
Day 4	Tulsi	109mv to111mv (This voltage is slowly decreasing and saturated to 30mv to 42mv)	30mv to 42mv	55mv to 68mv
Day 5	Tulsi	119mv to129mv (This voltage is slowly decreasing and saturated to 48mv to 55mv)	48mv to 55mv	75mv to 87mv
Day 6	Tulsi	133mv to138mv (This voltage is slowly decreasing and saturated to 58mv to 78mv)	58mv to 78mv	69mv to 80mv
Day 7	Tulsi	135mv to140mv (This voltage is slowly decreased and saturated to 80mv to 90mv	80mv to 90mv	98mv to 116mv

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Days	Plant name	Normal condition (without stimulus)	Saturated voltage at normal condition	Mechanical Squeezing
Day 1	Alovera	25mv to 30mv (This voltage is slowly decreasing and saturated to 15mv to 20mv)	15mv to 20mv	40mv to 55mv
Day 2	Alovera	15mv to 25mv (This voltage is slowly decreasing and saturated to 20mv to 22mv)	20mv to 25mv	35mv to 38mv
Day 3	Alovera	22mv to 29mv (This voltage is slowly decreased and saturated to 34mv to 28mv)	23mv o 27mv	40mv to 48mv
Day 4	Alovera	30mv to 36mv (This voltage is slowly decreased and saturated to 21mv to 24mv)	17mv to 21mv	32mv to 41mv
Day 5	Alovera	17mv to 24mv (This voltage is slowly decreased and saturated to 25mv to 30mv)	25mv to 27mv	37mv to 47mv
Day 6	Alovera	22mv to 39mv (This voltage is slowly decreasing and saturated to 18mv to 23mv)	18mv to 25mv	38mv to 43mv
Day 7	Alovera	14mv to 16mv (This voltage is slowly decreasing and saturated to 19mv to 22mv)	14mv to 16mv	20mv to 27mv

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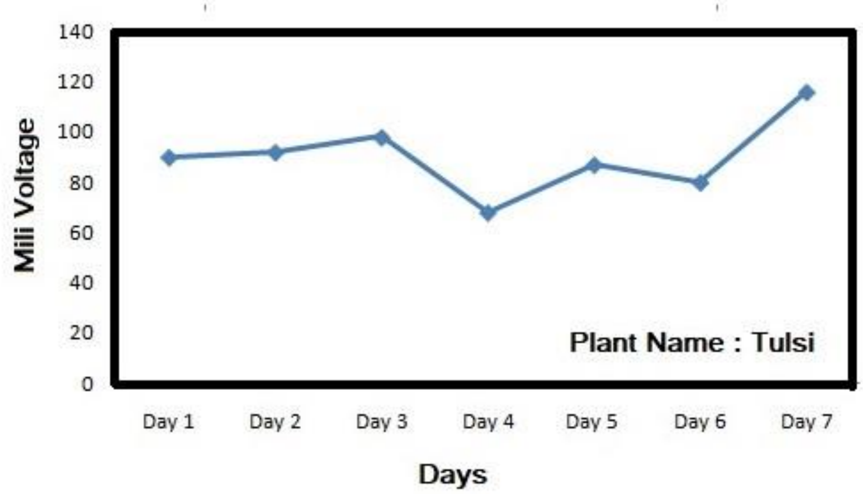
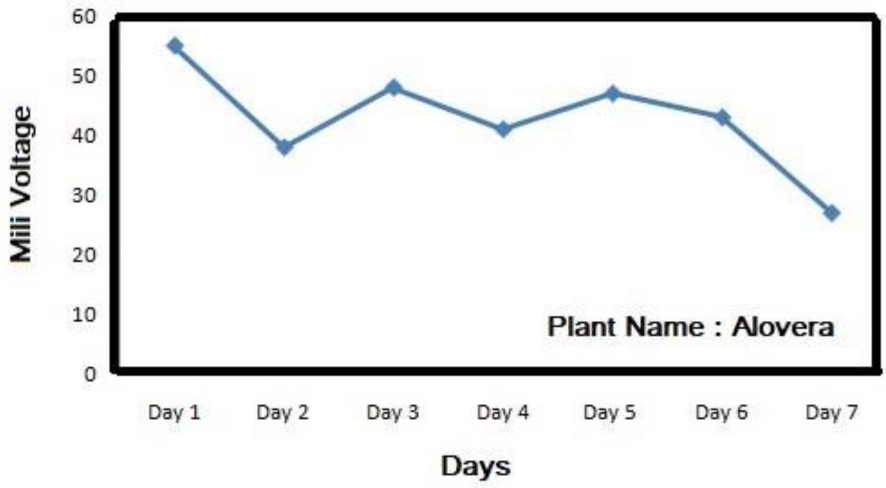
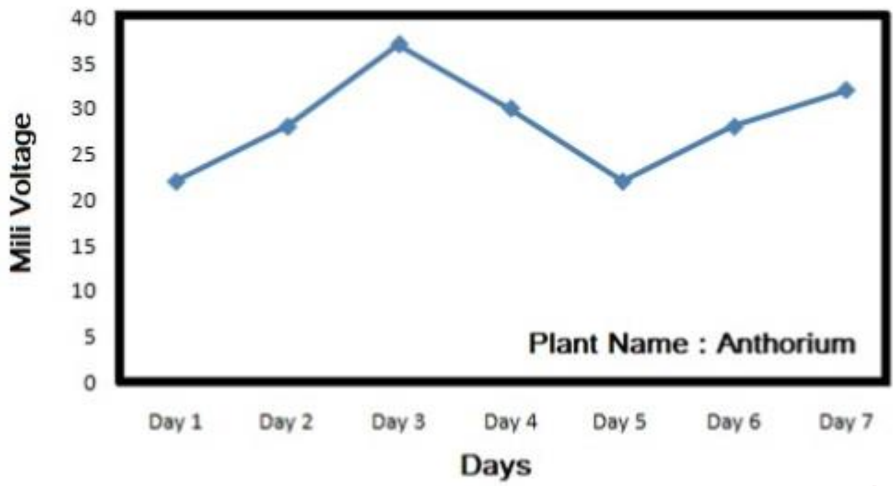
Days	Plant name	Normal condition (without stimulus)	Saturated voltage at normal condition	Plant Exposed to cold water
Day 1	Anthorium	15mv to 25mv (This voltage is slowly decreasing and saturated to 11mv to 20mv)	11mv to 20mv	13mv to 22mv
Day 2	Anthorium	17mv to 22mv (This voltage is slowly decreasing and saturated to 10mv to 26mv)	10mv to 26mv	18mv to 28mv
Day 3	Anthorium	24mv to 32mv (This voltage is slowly decreasing and saturated to 20mv to 30mv)	20mv to 30mv	28mv to 37mv
Day 4	Anthorium	28mv to 35mv (This voltage is slowly decreasing and saturated to 14mv to 28mv)	14mv to 28mv	24mv to 30mv
Day 5	Anthorium	10mv to 15mv (This voltage is slowly decreasing and saturated to 12mv to 17mv)	12mv to 17mv	15mv to 22mv
Day 6	Anthorium	12mv to 18mv (This voltage is slowly decreasing and saturated to 10mv to 15mv)	10mv to 15mv	17mv to 28mv
Day 7	Anthorium	20mv to 30mv (This voltage is slowly decreasing and saturated to 18mv to 29mv)	18mv to 29mv	22mv to 32mv







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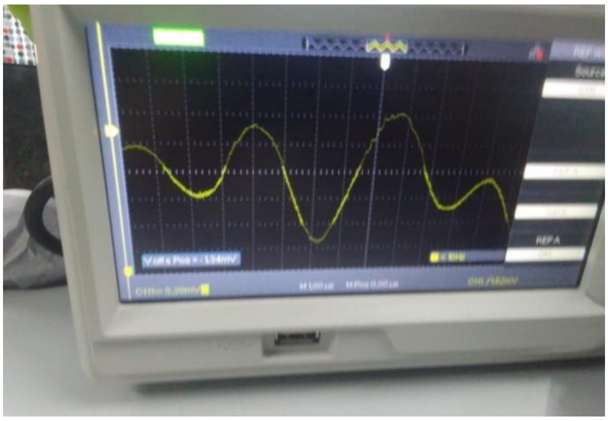
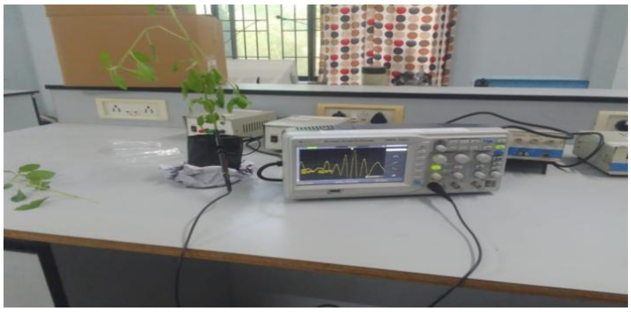
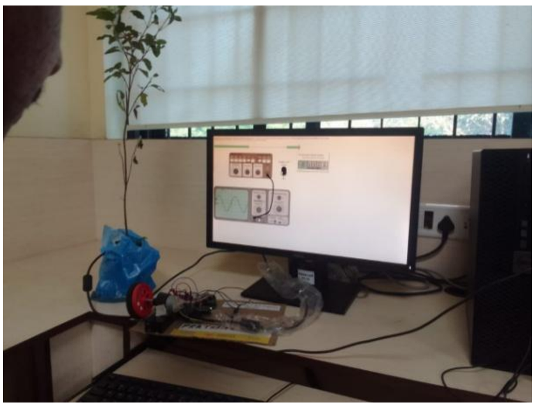
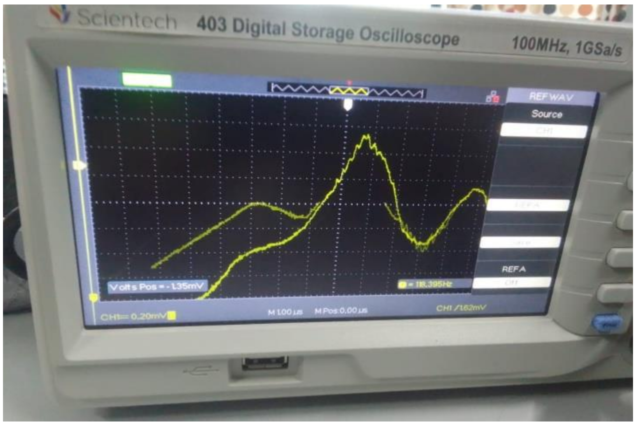
3.1 Glimpses of Experimentation









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