

**AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER**  
**DEPARTMENT OF INFORMATION TECHNOLOGY ENGINEERING**  
**LABORATORY MANUAL**

**314448: Laboratory Practice-I (Machine Learning)**  
**314448 (D): Laboratory Practice-I (Internet of Things)**

Sr. No.	Description
I.	<b>Institute and Department Vision, Mission, Quality Policy, Quality Objectives, PEOs, POs and PSOs</b>
II.	<b>List of Experiments</b>
1.	<b>Assignment on Data Preparation:</b> Download heart dataset and Perform following operation on given dataset – a) Find Shape of Data b) Find Missing Values c) Find data type of each column d) Finding out Zero's e) Find Mean age of patients.
2.	<b>Assignment on Regression technique:</b> Download temperature data and Apply Linear Regression using suitable library function and predict the Month-wise temperature. Assess the performance of regression models using MSE, MAE and R-Square metrics. Visualize simple regression model.
3.	<b>Assignment on Classification technique</b> Download GRE data and Apply Data pre-processing techniques if necessary. Perform data-preparation (Train-Test Split). Apply Machine Learning Algorithm. Evaluate Model.
4.	<b>Assignment on Clustering Techniques</b> Download customer dataset and Apply Data pre-processing techniques if necessary. Perform data-preparation (Train-Test Split). Apply Machine Learning Algorithm. Evaluate Model. Apply Cross-Validation and Evaluate Model
5.	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.
6.	Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.
7.	Design and implement real time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.
8.	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.

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## Vision and Mission of the Institute

### VISION:

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To create opportunities for rural students to become able engineers and technocrats through continual excellence in engineering education.

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### MISSION:

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Our mission is to create self-disciplined, physically fit, mentally robust and morally strong engineers and technocrats with high degree of integrity and sense of purpose, who are capable to meet challenges of ever advancing technology for the benefit of mankind and nature.

We, the management and the faculty, therefore, promise to strive hard and commit ourselves to achieve this objective through a continuous process of learning and appreciation of needs of time.

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## Vision and Mission of the Department

### **Vision:**

To transfer the rural learners into competent I.T. engineers and technocrats in emerging areas of I.T. Engineering education through continual excellence for the benefit of society.

### **Mission:**

- M-1:** To empower the youths in rural communities to be self-disciplined, physically fit, mentally robust and morally strong I.T. professionals.
- M-2:** To provides cutting-edge technical knowledge through continuous process in rapidly changing environment as per need of industry and surrounding world.
- M-3:** To provide opportunities for intellectual and personal growth of individuals in rural platform using high quality Information Technology education.

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

**To train the Information Technology students-**

1. To develop competent I.T. graduate with knowledge of fundamental concepts In mathematics, science, engineering and ability to provide solution to complex engineering problem by analyzing , designing and designing using modern I.T. software and tools.
2. To prepare I.T. graduate with professional skills of better communication, teamwork to manage projects in I.T. field at global level and ability to conduct investigations of complex problems using research based knowledge and research methods.
3. To develop I.T graduates with ethical practices, societal contributions through communities understanding impact of professional engineering solutions in societal and environmental context and ability of lifelong learning.

**PROGRAMME SPECIFIC OUTCOMES (PSOs)**

1. Apply principles of science, mathematics along with programming paradigms and problem solving skills using appropriate tools, techniques to expedite solution in I.T. domain.
2. Demonstrate core competencies related to I.T. in domain of Data structures & algorithms, Software Engineering & Modeling, Hardware, Distributed Computing, Networking & security, Databases, Discrete mathematics & algebra, Machine Learning, Operating System.
3. Demonstrate leadership qualities and professional skills in modern I.T. platform for creating innovative carrier paths in placements, entrepreneurship and higher studies

## PROGRAM OUTCOMES (POs)

### Engineering Graduates will be able to:

- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance:** Demonstrate knowledge and understanding of

## AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER

the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## QUALITY POLICY

THE AMRUTVAHINI COLLEGE OF ENGINEERING IS COMMITTED TO DEVELOP IN YOUNG MINDS THE STATE – OF – THE – ART TECHNOLOGY AND HIGH ACADEMIC AMBIENCE BY SYNERGISING SPIRITUAL VALUES AND TECHNOLOGICAL COMPETENCE CONTINUALLY IN A LEARNING ENVIRONMENT.

## QUALITY OBJECTIVES

- To strive hard for academic excellence and synergizing spiritual & moral values.
- To improve overall development of student.
- To enhance industry-institute interaction.
- To provide assistance for placement & entrepreneurship development.
- To promote and encourage R&D activities.

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Laboratory Practice-I			
Experiment No: 1	Data preparation in machine learning.	Page	1/3

**TITLE:** Download heart dataset and Perform following operation on given dataset –  
a) Find Shape of Data b) Find Missing Values c) Find data type of each column  
d) Finding out Zero's e) Find Mean age of patients.

**OBJECTIVE:** To learn fundamental concepts of data preparation and preprocessing in machine learning.

**THEORY:**

Data preprocessing is a process of preparing the raw data and making it suitable for a machine learning model. It is the first and crucial step while creating a machine learning model.

When creating a machine learning project, it is not always a case that we come across the clean and formatted data. And while doing any operation with data, it is mandatory to clean it and put in a formatted way. So for this, we use data preprocessing task.

**Why do we need Data Preprocessing?**

A real-world data generally contains noises, missing values, and maybe in an unusable format which cannot be directly used for machine learning models. Data preprocessing is required tasks for cleaning the data and making it suitable for a machine learning model which also increases the accuracy and efficiency of a machine learning model.

It involves below steps:

- Getting the dataset
- Importing libraries
- Importing datasets
- Finding Missing Data
- Encoding Categorical Data
- Splitting dataset into training and test set and Feature scaling

Laboratory Practice-I			
Experiment No: 1	Data preparation in machine learning.	Page	2/3

### 1) Get the Dataset

To create a machine learning model, the first thing we required is a dataset as a machine learning model completely works on data. The collected data for a particular problem in a proper format is known as the **dataset**.

### 2) Importing Libraries

In order to perform data preprocessing using Python, we need to import some predefined Python libraries. These libraries are used to perform some specific jobs. There are three specific libraries that we will use for data preprocessing.

### 3) Importing the Datasets

Now we need to import the datasets which we have collected for our machine learning project. But before importing a dataset, we need to set the current directory as a working directory.

### 4) Handling Missing data

The next step of data preprocessing is to handle missing data in the datasets. If our dataset contains some missing data, then it may create a huge problem for our machine learning model. Hence it is necessary to handle missing values present in the dataset.

### 5) Encoding Categorical data

Categorical data is data which has some categories such as, in our dataset; there are two categorical variable, Country, and Purchased.

Since machine learning model completely works on mathematics and numbers, but if our dataset would have a categorical variable, then it may create trouble while building the model. So it is necessary to encode these categorical variables into numbers.



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Experiment No: 1	Data preparation in machine learning.	Page	3/3

## 6) Splitting the Dataset into the Training set and Test set

In machine learning data preprocessing, we divide our dataset into a training set and test set. This is one of the crucial steps of data preprocessing as by doing this, we can enhance the performance of our machine learning model.

Suppose, if we have given training to our machine learning model by a dataset and we test it by a completely different dataset. Then, it will create difficulties for our model to understand the correlations between the models.

If we train our model very well and its training accuracy is also very high, but we provide a new dataset to it, then it will decrease the performance. So we always try to make a machine learning model which performs well with the training set and also with the test dataset. Here, we can define these datasets as:

**Training Set:** A subset of dataset to train the machine learning model, and we already know the output.

**Test set:** A subset of dataset to test the machine learning model, and by using the test set, model predicts the output.

For splitting the dataset, we will use the below lines of code:

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test= train_test_split(x, y, test_size= 0.2, random_state=0)
```

## 7) Feature Scaling

Feature scaling is the final step of data preprocessing in machine learning. It is a technique to standardize the independent variables of the dataset in a specific range. In feature scaling, we put our variables in the same range and in the same scale so that no any variable dominate the other variable.

**CONCLUSION:** - Hence, we have studied the importance of data preparation and preprocessing of data in machine learning.

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Experiment No: 2	Regression in machine learning.	Page	1/3

**TITLE:** Download temperature data from  
<https://www.kaggle.com/venky73/temperatures-of-india?select=temperatures.csv>.

This data consists of temperatures of INDIA averaging the temperatures of all places month wise. Temperatures values are recorded in CELSIUS.

1. Apply Linear Regression
2. Assess the performance of regression models using MSE, MAE and R-Square metrics.
3. Visualize simple regression model.

#### OBJECTIVES:

1. To learn and model regression technique in machine learning.
2. To evaluate the model.

#### THEORY:

Regression analysis is a fundamental concept in the field of machine learning. It falls under supervised learning wherein the algorithm is trained with both input features and output labels. It helps in establishing a relationship among the variables by estimating how one variable affects the other.

Imagine you're car shopping and have decided that gas mileage is a deciding factor in your decision to buy. If you wanted to predict the miles per gallon of some promising rides, how would you do it? Well, since you know the different features of the car (weight, horsepower, displacement, etc.) one possible method is regression. By plotting the average MPG of each car given its features you can then use regression techniques to find the relationship of the MPG and the input features. The regression function here could be represented as  $Y = f(X)$ , where Y would be the MPG and X would be the input features like the weight, displacement, horsepower, etc. The target function is  $f$  and this curve helps us predict whether it's beneficial to buy or not buy. This mechanism is called regression.

Regression in machine learning consists of mathematical methods that allow data scientists to predict a continuous outcome (y) based on the value of one or more

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Experiment No: 2	Regression in machine learning.	Page	2/3

predictor variables (x). Linear regression is probably the most popular form of regression analysis because of its ease-of-use in predicting and forecasting.

Briefly, the goal of regression model is to build a mathematical equation that defines y as a function of the x variables.

Next, this equation can be used to predict the outcome (y) on the basis of new values of the predictor variables (x).

Linear regression is the most simple and popular technique for predicting a continuous variable. It assumes a linear relationship between the outcome and the predictor variables.

The linear regression equation can be written as  $y = b_0 + b \cdot x + e$ , where:

- $b_0$  is the intercept,
- $b$  is the regression coefficient associated with the predictor variable x.
- $e$  is the residual error

Technically, the linear regression coefficients are determined so that the error in predicting the outcome value is minimized. This method of computing the beta coefficients is called the Ordinary Least Squares method.

The best model is defined as the model that has the lowest prediction error. The most popular metrics for comparing regression models, include:

- **Root Mean Squared Error**, which measures the model prediction error. It corresponds to the average difference between the observed known values of the outcome and the predicted value by the model. RMSE is computed as  $RMSE = \sqrt{\text{mean}((\text{observeds} - \text{predicted})^2)}$ . The lower the RMSE, the better the model.
- **Adjusted R-square**, representing the proportion of variation (i.e., information), in your data, explained by the model. This corresponds to the overall quality of the model. The higher the adjusted R<sup>2</sup>, the better the model

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Experiment No: 2	Regression in machine learning.	Page	3/3

Note that, the above mentioned metrics should be computed on a new test data that has not been used to train (i.e. build) the model. If you have a large data set, with many records, you can randomly split the data into training set (80% for building the

predictive model) and test set or validation set (20% for evaluating the model performance).

One of the most robust and popular approach for estimating a model performance is k-fold cross-validation. It can be applied even on a small data set. k-fold cross-validation works as follow:

1. Randomly split the data set into k-subsets (or k-fold) (for example 5 subsets)
2. Reserve one subset and train the model on all other subsets
3. Test the model on the reserved subset and record the prediction error
4. Repeat this process until each of the k subsets has served as the test set.
5. Compute the average of the k recorded errors. This is called the cross-validation error serving as the performance metric for the model.

Taken together, the best model is the model that has the lowest cross-validation error, RMSE.

**CONCLUSION:** - Hence, we have studied the regression model analysis and it's evaluation in machine learning.

<b>Laboratory Practice-I</b>			
<b>Experiment No: 3</b>	<b>Classification in machine learning.</b>	<b>Page</b>	<b>1/5</b>

**TITLE:** Every year many students give the GRE exam to get admission in foreign Universities. The data set contains GRE Scores (out of 340), TOEFL Scores (out of 120), University Rating (out of 5), Statement of Purpose strength (out of 5), Letter of Recommendation strength (out of 5), Undergraduate GPA (out of 10), Research Experience (0=no, 1=yes), Admitted (0=no, 1=yes). Admitted is the target variable.

Data Set Available on kaggle (The last column of the dataset needs to be changed to 0 or 1) Data-Set: <https://www.kaggle.com/mohansacharya/graduate-admissions>

The counselor of the firm is supposed check whether the student will get an admission or not based on his/her GRE score and Academic Score. So to help the counselor to take appropriate decisions build a machine learning model classifier using Decision tree to predict whether a student will get admission or not.

- A. Apply Data pre-processing (Label Encoding, Data Transformation....) techniques if necessary.
- B. Perform data-preparation (Train-Test Split)
- C. Apply Machine Learning Algorithm
- D. Evaluate Model.

### **OBJECTIVES:**

1. To learn and model Classification technique in machine learning.
2. To evaluate the model.

### **THEORY:**

The Classification algorithm is a Supervised Learning technique that is used to identify the category of new observations on the basis of training data. In Classification, a program learns from the given dataset or observations and then classifies new observation into a number of classes or groups. Such as, Yes or No, 0 or 1, Spam or Not Spam, cat or dog, etc. Classes can be called as targets/labels or categories.

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Unlike regression, the output variable of Classification is a category, not a value, such as "Green or Blue", "fruit or animal", etc. Since the Classification algorithm is a

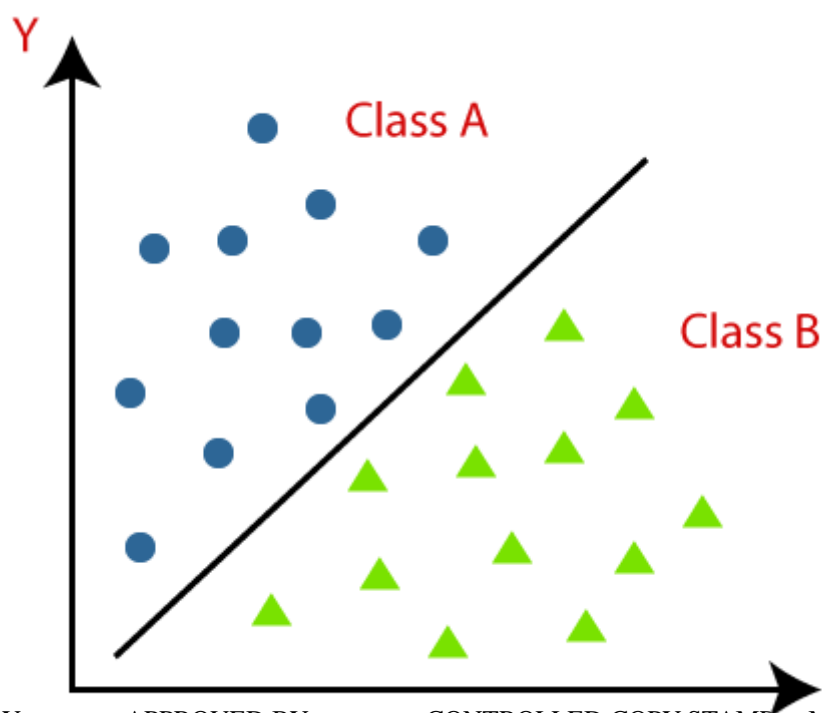
Supervised learning technique, hence it takes labeled input data, which means it contains input with the corresponding output.

In classification algorithm, a discrete output function( $y$ ) is mapped to input variable( $x$ ).

The best example of an ML classification algorithm is Email Spam Detector.

The main goal of the Classification algorithm is to identify the category of a given dataset, and these algorithms are mainly used to predict the output for the categorical data.

Classification algorithms can be better understood using the below diagram. In the below diagram, there are two classes, class A and Class B. These classes have features that are similar to each other and dissimilar to other classes.



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Experiment No: 3	Classification in machine learning.	Page	3/5

The algorithm which implements the classification on a dataset is known as a classifier. There are two types of Classifications:

- **Binary Classifier:** If the classification problem has only two possible outcomes, then it is called as Binary Classifier.  
Examples: YES or NO, MALE or FEMALE, SPAM or NOT SPAM, CAT or DOG, etc.
- **Multi-class Classifier:** If a classification problem has more than two outcomes, then it is called as Multi-class Classifier.  
Example: Classifications of types of crops, Classification of types of music.

Types of ML Classification Algorithms:

Classification Algorithms can be further divided into the mainly two category:

- **Linear Models**
  - Logistic Regression
  - Support Vector Machines
- **Non-linear Models**
  - K-Nearest Neighbours
  - Kernel SVM
  - Naïve Bayes
  - Decision Tree Classification
  - Random Forest Classification

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<b>Experiment No: 3</b>	<b>Classification in machine learning.</b>	<b>Page</b>	<b>4/5</b>
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### Evaluating a Classification model:

Once our model is completed, it is necessary to evaluate its performance; either it is a Classification or Regression model. So for evaluating a Classification model, we have the following ways:

#### 1. Log Loss or Cross-Entropy Loss:

1. It is used for evaluating the performance of a classifier, whose output is a probability value between the 0 and 1.
2. For a good binary Classification model, the value of log loss should be near to 0.
3. The value of log loss increases if the predicted value deviates from the actual value.
4. The lower log loss represents the higher accuracy of the model.

#### 2. Confusion Matrix:

The confusion matrix provides us a matrix/table as output and describes the performance of the model. It is also known as the error matrix. The matrix consists of predictions result in a summarized form, which has a total number of correct predictions and incorrect predictions. The matrix looks like as below table:

	<b>Actual Positive</b>	<b>Actual Negative</b>
<b>Predicted Positive</b>	True Positive	False Positive
<b>Predicted Negative</b>	False Negative	True Negative

#### 3. AUC-ROC curve:

- ROC curve stands for Receiver Operating Characteristics Curve and AUC stands for Area Under the Curve.
- It is a graph that shows the performance of the classification model at different thresholds.
- To visualize the performance of the multi-class classification model, we use the AUC-ROC Curve.



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Experiment No: 3	Classification in machine learning.	Page	5/5

- The ROC curve is plotted with TPR and FPR, where TPR (True Positive Rate) on Y-axis and FPR(False Positive Rate) on X-axis.

### Use cases of Classification Algorithms

Classification algorithms can be used in different places. Below are some popular use cases of Classification Algorithms:

- Email Spam Detection
- Speech Recognition
- Identifications of Cancer tumor cells.
- Drugs Classification
- Biometric Identification, etc.

**CONCLUSION:** - Hence, we have studied the classification model analysis and it's evaluation parameters in machine learning.

<b>Laboratory Practice-I</b>			
<b>Experiment No: 4</b>	<b>Clustering in machine learning.</b>	<b>Page</b>	<b>1/4</b>

**TITLE:** Download the following customer dataset from below link:

Data Set: <https://www.kaggle.com/shwetabh123/mall-customers>

This dataset gives the data of Income and money spent by the customers visiting a Shopping Mall. The data set contains Customer ID, Gender, Age, Annual Income, and Spending Score. Therefore, as a mall owner you need to find the group of people who are the profitable customers for the mall owner. Apply at least two clustering algorithms (based on Spending Score) to find the group of customers.

- a. Apply Data pre-processing techniques if necessary.
- b. Perform data-preparation(Train-Test Split)
- c. Apply Machine Learning Algorithm
- d. Evaluate Model.
- e. Apply Cross-Validation and Evaluate Model

**OBJECTIVES:**

1. To learn and model Clustering technique in machine learning.
2. To evaluate the model.

**THEORY:**

Clustering or cluster analysis is a machine learning technique, which groups the unlabelled dataset. It can be defined as *"A way of grouping the data points into different clusters, consisting of similar data points. The objects with the possible similarities remain in a group that has less or no similarities with another group."*

It does it by finding some similar patterns in the unlabelled dataset such as shape, size, color, behavior, etc., and divides them as per the presence and absence of those similar patterns.

It is an unsupervised learning method, hence no supervision is provided to the algorithm, and it deals with the unlabeled dataset.

After applying this clustering technique, each cluster or group is provided with a cluster-ID. ML system can use this id to simplify the processing of large and complex datasets.

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The clustering technique is commonly used for statistical data analysis.

Clustering is somewhere similar to the classification algorithm, but the difference is the type of dataset that we are using. In classification, we work with the labeled data set, whereas in clustering, we work with the unlabelled dataset.

The clustering technique can be widely used in various tasks. Some most common uses of this technique are:

- Market Segmentation
- Statistical data analysis
- Social network analysis
- Image segmentation
- Anomaly detection, etc.

### Types of Clustering Methods

The clustering methods are broadly divided into **Hard clustering** (datapoint belongs to only one group) and **Soft Clustering** (data points can belong to another group also). But there are also other various approaches of Clustering exist. Below are the main clustering methods used in Machine learning:

1. **Partitioning Clustering**
2. **Density-Based Clustering**
3. **Distribution Model-Based Clustering**
4. **Hierarchical Clustering**
5. **Fuzzy Clustering**

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Experiment No: 4	Clustering in machine learning.	Page	3/4

## Clustering Algorithms

1. **K-Means algorithm:** The k-means algorithm is one of the most popular clustering algorithms. It classifies the dataset by dividing the samples into different clusters of equal variances. The number of clusters must be specified in this algorithm. It is fast with fewer computations required, with the linear complexity of  $O(n)$ .
2. **Mean-shift algorithm:** Mean-shift algorithm tries to find the dense areas in the smooth density of data points. It is an example of a centroid-based model that works on updating the candidates for centroid to be the center of the points within a given region.
3. **DBSCAN Algorithm:** It stands for Density-Based Spatial Clustering of Applications with Noise. It is an example of a density-based model similar to the mean-shift, but with some remarkable advantages. In this algorithm, the areas of high density are separated by the areas of low density. Because of this, the clusters can be found in any arbitrary shape.
4. **Expectation-Maximization Clustering using GMM:** This algorithm can be used as an alternative for the k-means algorithm or for those cases where K-means can be failed. In GMM, it is assumed that the data points are Gaussian distributed.
5. **Agglomerative Hierarchical algorithm:** The Agglomerative hierarchical algorithm performs the bottom-up hierarchical clustering. In this, each data point is treated as a single cluster at the outset and then successively merged. The cluster hierarchy can be represented as a tree-structure.
6. **Affinity Propagation:** It is different from other clustering algorithms as it does not require to specify the number of clusters. In this, each data point sends a message between the pair of data points until convergence. It has  $O(N^2T)$  time complexity, which is the main drawback of this algorithm.

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Experiment No: 4	Clustering in machine learning.	Page	4/4

### Applications of Clustering

Below are some commonly known applications of clustering technique in Machine Learning:

- **In Identification of Cancer Cells:** The clustering algorithms are widely used for the identification of cancerous cells. It divides the cancerous and non-cancerous data sets into different groups.
- **In Search Engines:** Search engines also work on the clustering technique. The search result appears based on the closest object to the search query. It does it by grouping similar data objects in one group that is far from the other dissimilar objects. The accurate result of a query depends on the quality of the clustering algorithm used.
- **Customer Segmentation:** It is used in market research to segment the customers based on their choice and preferences.
- **In Biology:** It is used in the biology stream to classify different species of plants and animals using the image recognition technique.
- **In Land Use:** The clustering technique is used in identifying the area of similar lands use in the GIS database. This can be very useful to find that for what purpose the particular land should be used, that means for which purpose it is more suitable.

**CONCLUSION:** - Hence, we have studied the clustering model analysis and it's evaluation parameters in machine learning.

<b>Laboratory Practice-I</b>			
<b>Experiment No: 05</b>	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.	<b>Page</b>	<b>1/8</b>

**TITLE: -** To interface Sensors and actuators with Arduino

**OBJECTIVE: -** To Understand working of Arduino Uno

**THEORY: -**

**1.**

**AIM: To Interface sensors and actuators with Arduino UNO**

**OBJECTIVE:**

- To understand the working of Arduino UNO.
- To understand Arduino UNO programming.

**COMPONENTS REQUIRED:**

- Arduino UNO
- HC-SR04 ultrasonic ranging sensor
- Servo motors
- Breadboard
- Connecting Wires

## 2. Ultrasonic Sensor



- HC-SR04 ultrasonic sensor is used to measure distances.
- Provides 2cm to 400cm of non-contact measurement functionality.
- The sensor has only four pins:  
VCC (Power),  
Trig (Trigger),  
Echo (Receive), //Incase of PING Triger and Echo pins are same  
GND (Ground).

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SOFTWARE LABORATORY – II			
<b>Experiment No:05</b>	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.	<b>Page</b>	<b>2/8</b>

### 3. Ultrasonic's Sensor Parameter

#### **Ultrasonic sensor:**

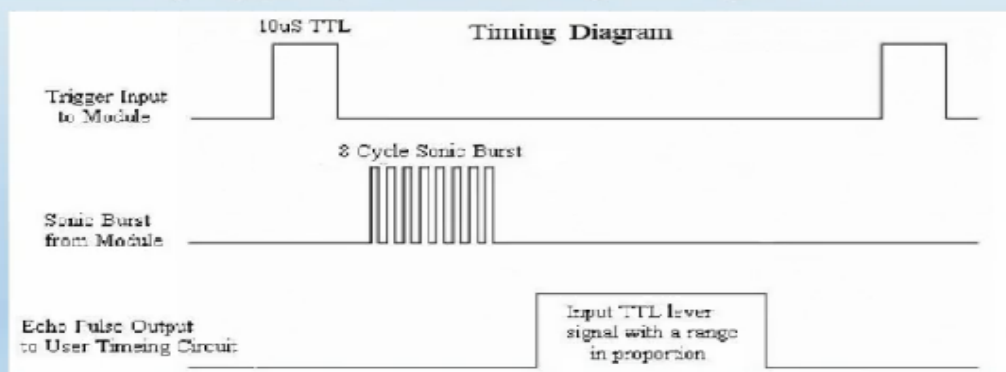
#### **Electric Parameter:**

- Working Voltage                      DC 5 V
- Working Current                      15mA
- Working Frequency                      40kHz
- Max Range                              4m
- Min Range                                2cm
- Measuring Angle                      15 degree
- Trigger Input Signal                      10uS TTL pulse
- Echo Output Signal                      Input TTL lever signal and the range in proportion
- Dimension                                45\*20\*15mm

### 4. Input

#### **Timing diagram:**

You need to send a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. You can calculate the range through the time interval between sending trigger signal and receiving echo signal.



**Formula: Range = high level time \* velocity (340 m/s) / 2;**



<b>Experiment No: 05</b>	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.	<b>Page</b>	<b>3/8</b>
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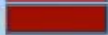
## 5. Servo Motor



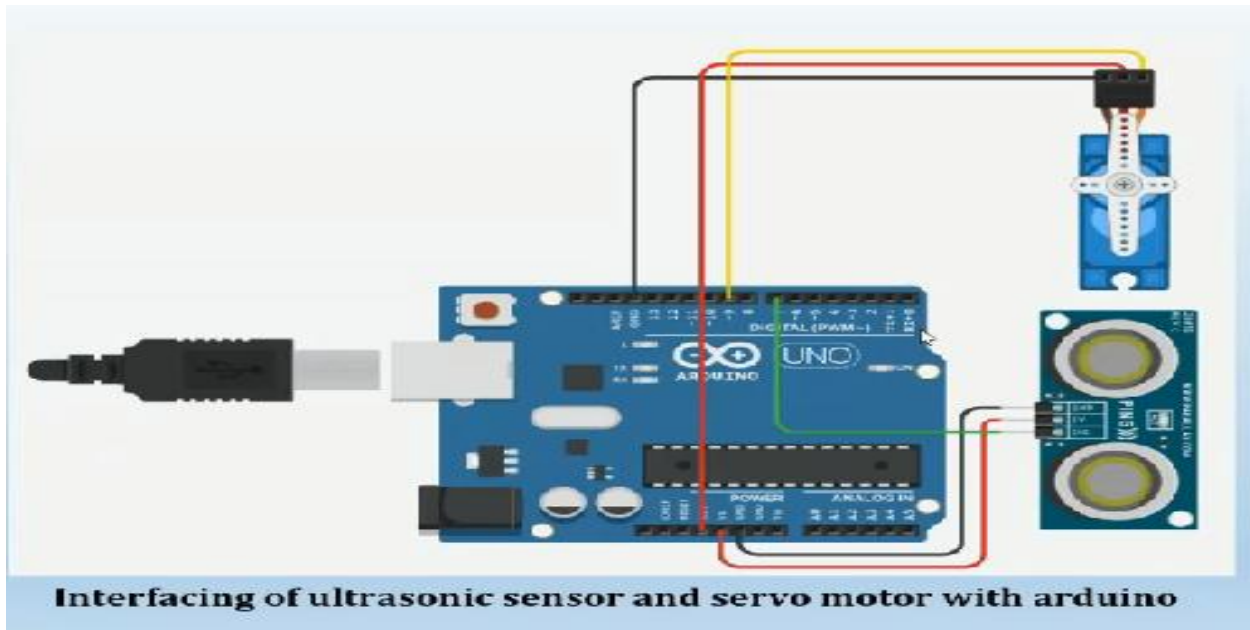
Servo motors have a servo arm that can turn 180 degrees.

### **Connection to Servo:**

If your servo has Orange - Red - Brown wires, connections are as follows:

-  Orange wire connects to Digital pin of Arduino.
-  Red wire connects to 5V pin
-  Brown wire connects to GND pin

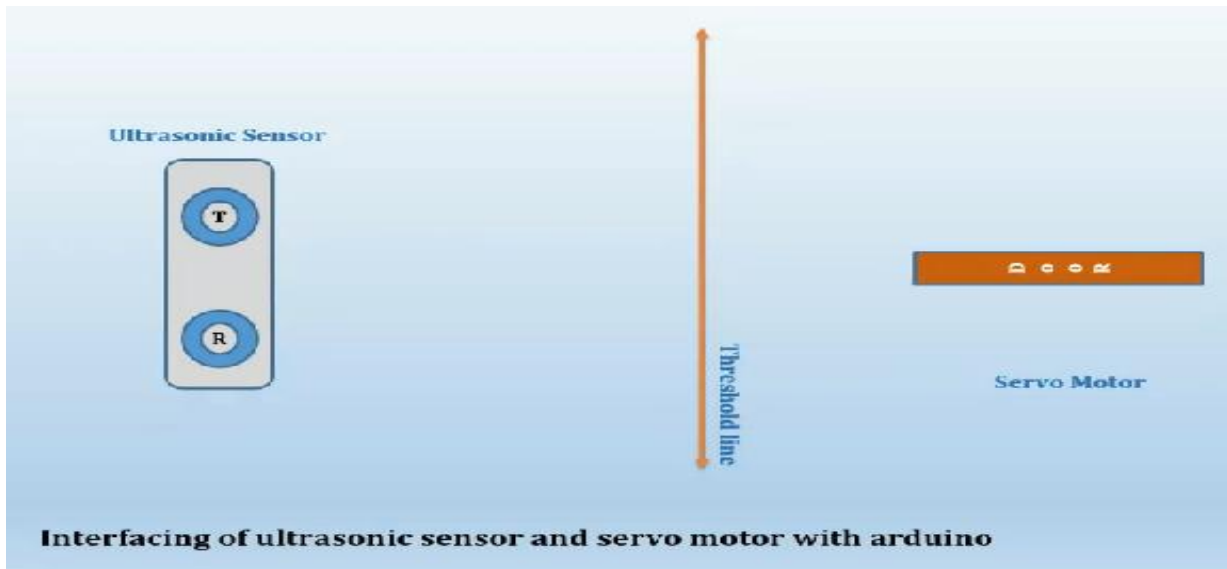
## 6. Interface of Servo motor with Arduino Uno Kit



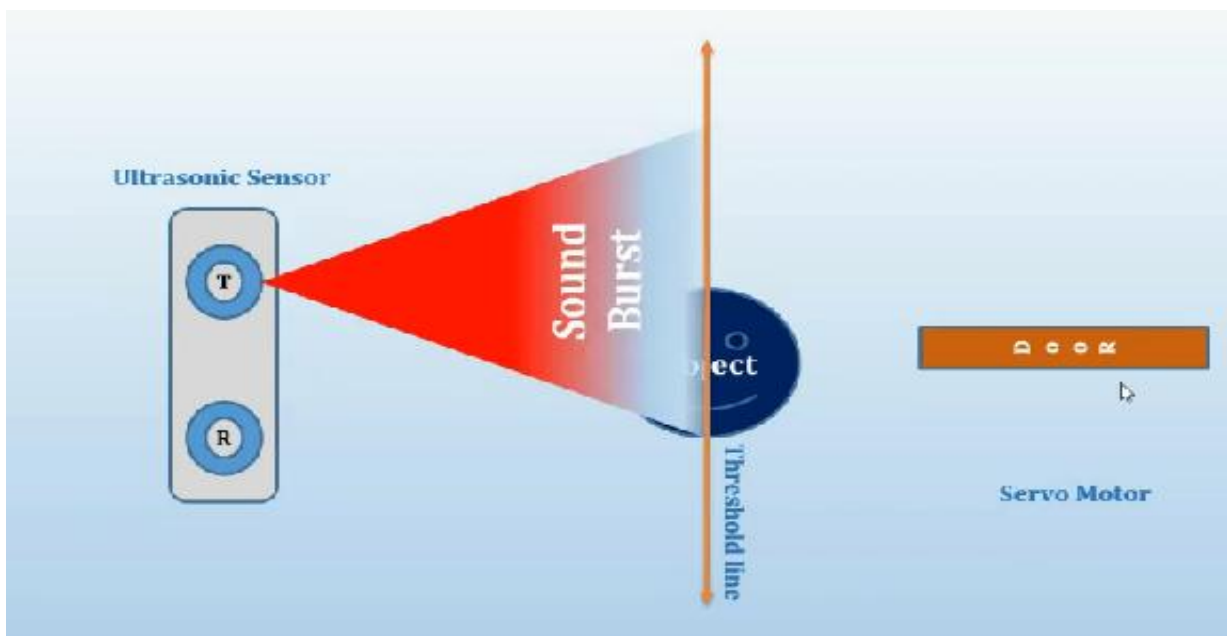


<b>SOFTWARE LABORATORY – II</b>			
<b>Experiment No: 05</b>	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.	<b>Page</b>	<b>4/8</b>

**7. Ultrasonic sensor set with some threshold value to identify object distance**



**8. Ultrasonic sensor T-Transmitter send burst sound and due to object create echo**



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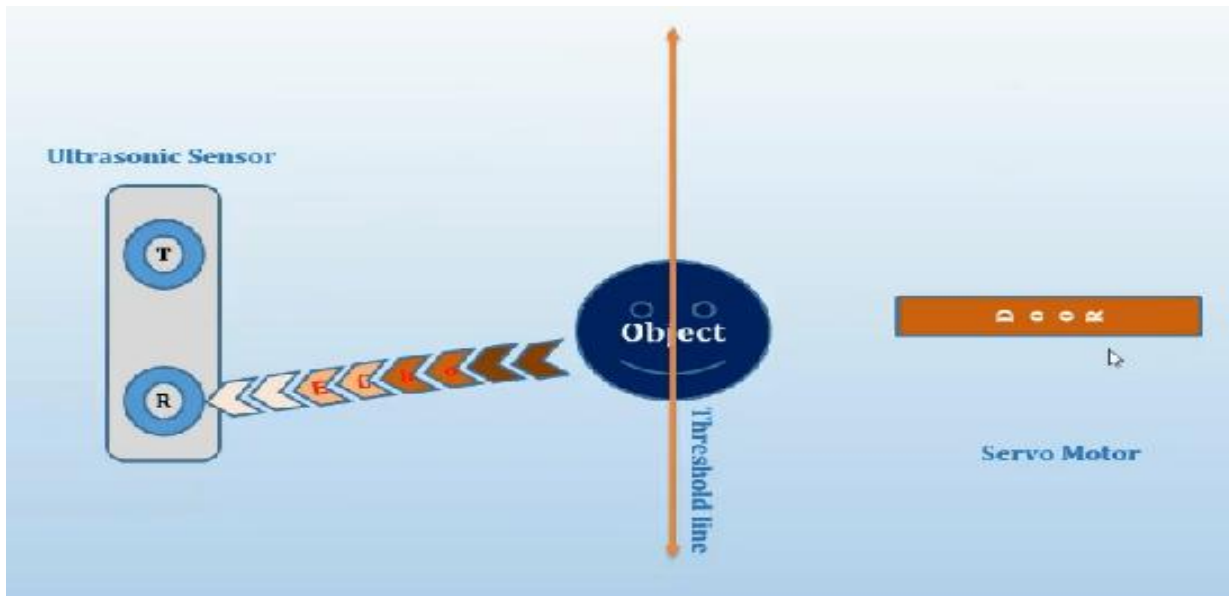
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<b>Experiment No: 05</b>	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.	<b>Page</b>	<b>5/8</b>
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**9. Echo reflect back and receive by R-Receiver and Circuit will get complete**

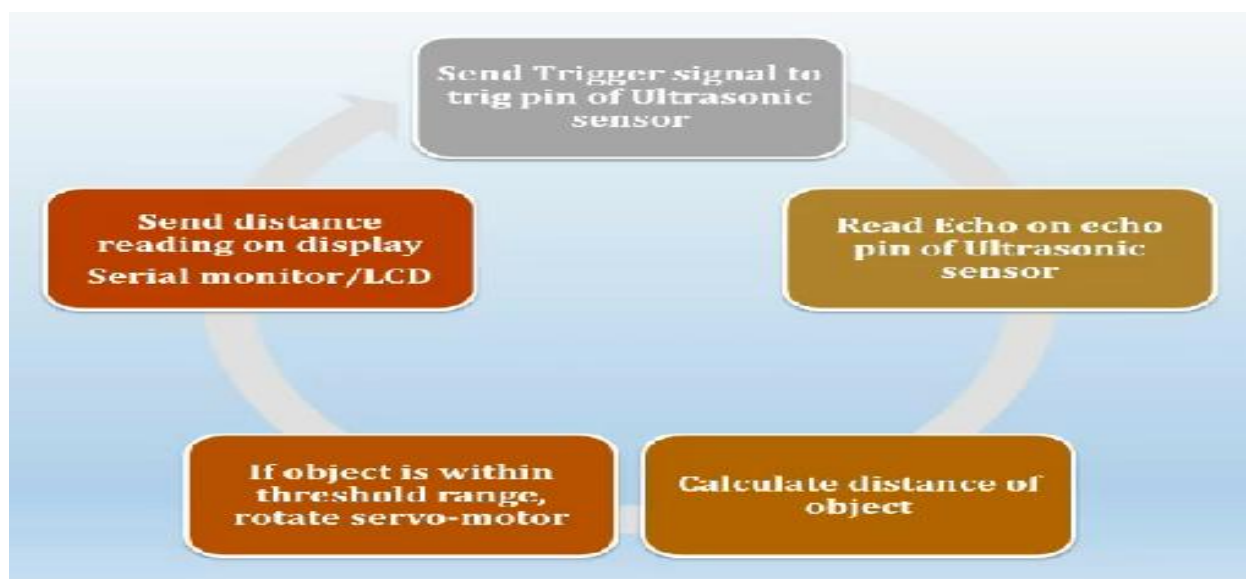


**10. On circuit complete door will open by 90 or 360 degree**



SOFTWARE LABORATORY – II			
<b>Experiment No:05</b>	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.	<b>Page</b>	<b>6/8</b>

**11. Process and working of system can see in clock wise direction from send trigger block.**



**12. Arduino Program written for trigger input for ultrasonic T sensor**

```

#include <Servo.h>
Servo myservo; // create servo object to control a servo
int inches = 0;
int cm = 0;

long readUltrasonicDistance(int triggerPin, int echoPin)
{
  pinMode(triggerPin, OUTPUT); // Clear the trigger
  digitalWrite(triggerPin, LOW);
  delayMicroseconds(2);
  // Sets the trigger pin to HIGH state for 10 microseconds
  digitalWrite(triggerPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(triggerPin, LOW);
  pinMode(echoPin, INPUT);
  // Reads the echo pin, and returns time
  return pulseIn(echoPin, HIGH);
}
  
```

<b>SOFTWARE LABORATORY – II</b>			
<b>Experiment No:05</b>	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.	<b>Page</b>	<b>7/8</b>

### **13. Set servo motor Position for rotation**

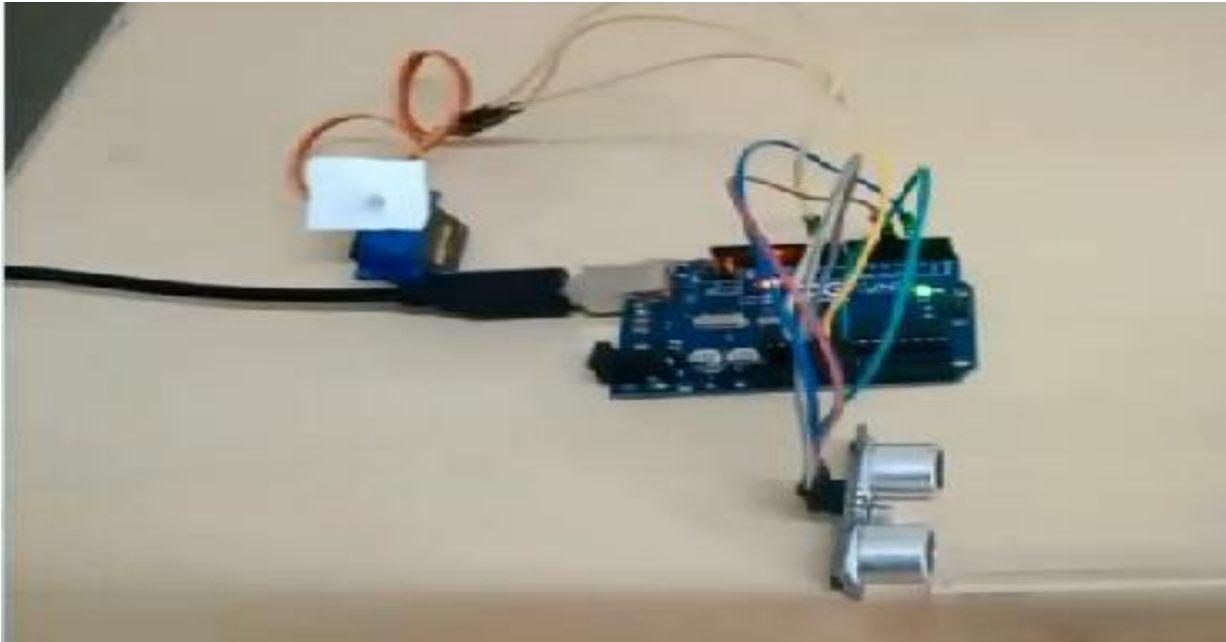
```
void setup()
{
  myservo.attach(9); // attaches the servo on pin 9 to the servo object
  Serial.begin(9600);
}
void loop()
{ cm = 0.01723 * readUltrasonicDistance (7, 7); // measure the ping time in cm
if ( cm < 100)
{ myservo.write(90); // sets the servo position according to the scaled value
delay(10);
}
else if ( cm > 100)
{ myservo.write(0); // sets the servo position according to the scaled value
delay(100);
}
else
{ myservo.write(0); // sets the servo position according to the scaled value
delay(100);
}
```

### **14. To send data on serial or O/P (This is not part of code)**

```
// convert to inches by dividing by 2.54
inches = (cm / 2.54);
Serial.print(inches);
Serial.print("in, ");
Serial.print(cm);
Serial.println("cm");
delay(100); // Wait for 100 millisecond(s)
}
```

<b>Experiment No: 05</b>	Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'.	<b>Page</b>	<b>8/8</b>
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**15.Actual Circuitry connection.**



**Conclusion:** Hence implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor'

.

Laboratory Practice-I			
Experiment No: 06	Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.	Page	1/10

**TITLE:** - To built a cloud ready Temperature sensor with the node MCU and any IoT platform

**OBJECTIVE:** -

- To Understand Interfacing of Temperature Sensor
- To log and Monitor temperature data over internet using Thing Speak IoT Server

**THEORY:** -

### 1. AIM and Required Components

**AIM:** To Build a cloud-ready temperature sensor with the NodeMCU and any IoT Platform

**OBJECTIVE:**

- To understand interfacing of temperature sensors.
- To log and monitor temperature data over internet using ThingSpeak IoT server

**COMPONENTS REQUIRED:**

- ESP8266 (NodeMCU)
- LM35/DHT11
- Breadboard
- Connecting Wires



**Laboratory Practice-I**

Experiment No:06	Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.	Page	2/10
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**2. Create account in Ubidots**

1. First of all, user needs to create an account on Ubidots STEM (for education), then Sign in and click on 'Get Started'.
2. Now go to the 'Channels' menu and click on the 'New Channel' option in the same page.
3. Now you will see a form for **creating the channel**, fill the Name and Description as per your choice. Then fill 'Temperature' in 'Field 1' field. Tick the check box 'Make Public' option below the form and finally Save the channel. Now your new channel is ready.
4. Now click on 'Token' tab and note the **Token**.
5. Now user need to upload the program to ESP8266 using Arduino IDE.
6. After uploading, open Device, add variable and then open Data - Dash Board icon in Ubidots STEM and observe the monitored temperature value on graph as shown below.

**3. Visit Ubidots Site for Creation of account**



**Fig : IoT Temperature Data Logger Using ESP8266 and DHT11 – Ubidots for education**

<b>Laboratory Practice-I</b>			
<b>Experiment No: 06</b>	<b>Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.</b>	<b>Page</b>	<b>3/10</b>

Ubidots is an IoT Platform empowering innovators and industries to prototype and scale IoT projects to production. Use the Ubidots platform to send data to the **cloud** from any Internet-enabled device.

#### **4. Sign In window for Ubidots**

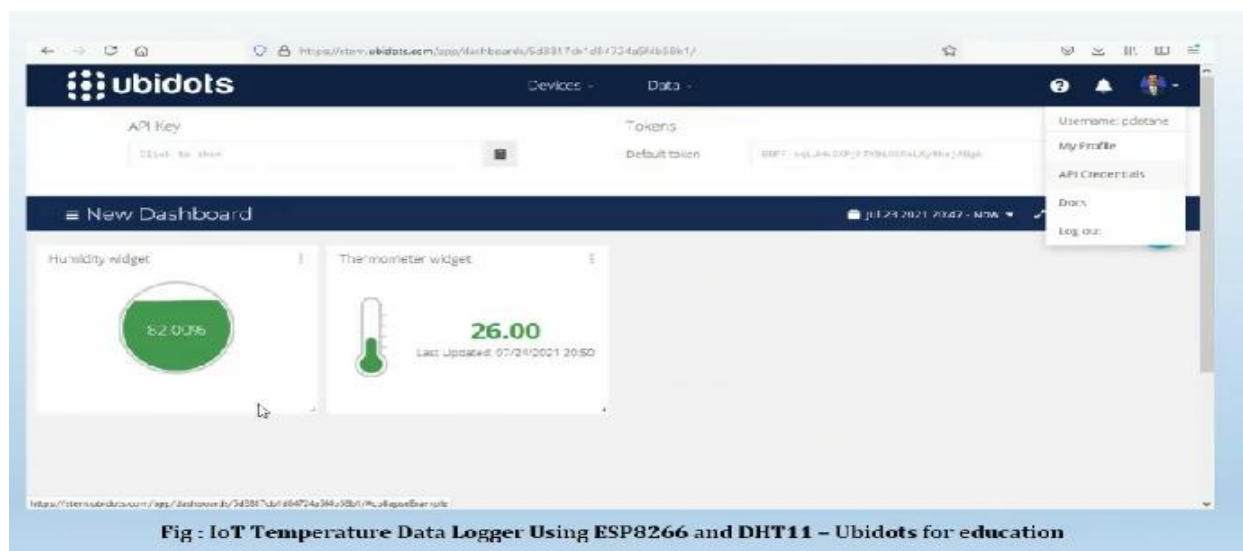


**Fig : IoT Temperature Data Logger Using ESP8266 and DHT11 – Ubidots for education**



<b>Laboratory Practice-I</b>			
<b>Experiment No: 06</b>	<b>Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.</b>	<b>Page</b>	<b>4/10</b>

5. After Sign in window will display as follow and Copy the unique token for Programming.



6. This is Dash board to check two parameter Humidity and Temperature (Shown in yellow Color) record from Location.



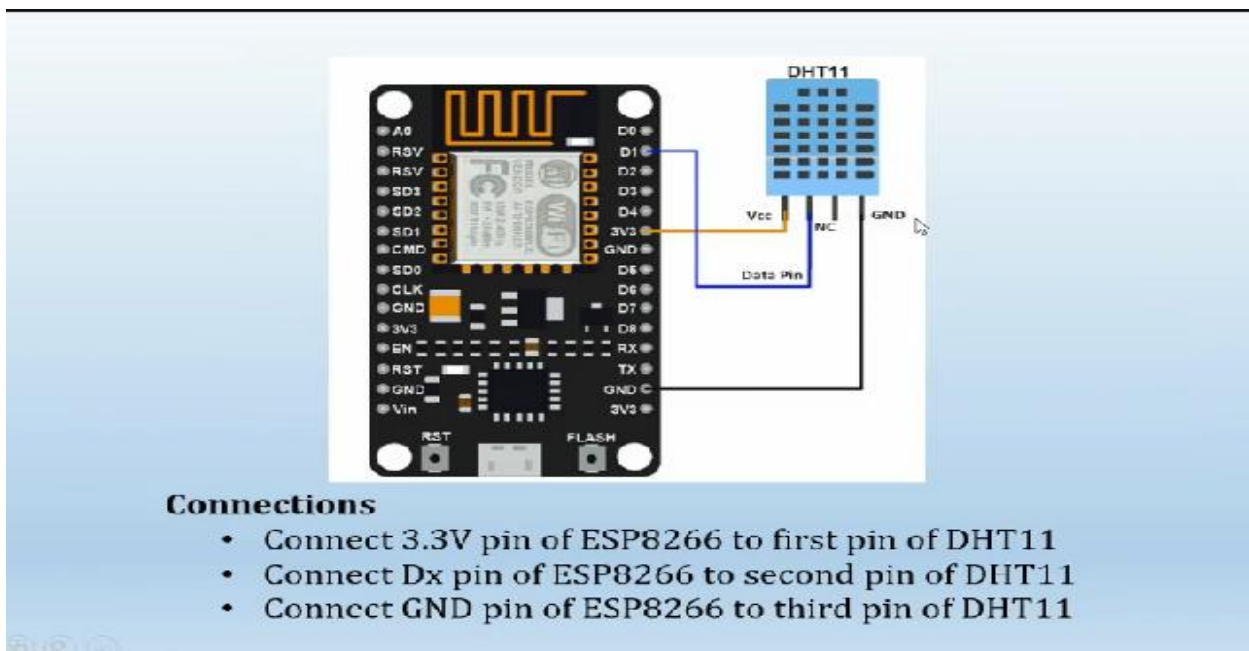
**Laboratory Practice-I**

Experiment No: 06	Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.	Page	5/10
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7. Graphical Representation is also possible to see in software



8. This is Arduino- Uno Board and its Connection



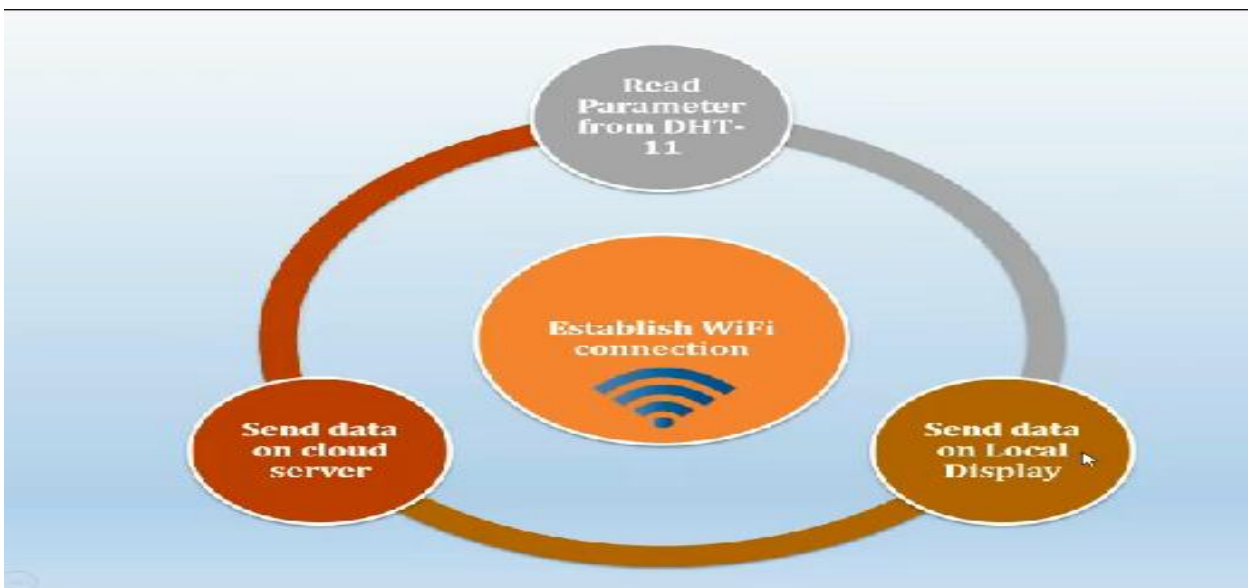
**Laboratory Practice-I**

Experiment No: 06	Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.	Page	6/10
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**9. Humidity and Temperature sensor will Monitor through Wi-Fi on Server**



**10. Process flow of Assignment.**



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<b>Laboratory Practice-I</b>			
Experiment No: 06	Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.	Page	7/10

**11.** Now in programming Use token copied from Ubidots and enter Id and Password of Your Wi-Fi in Coding as follow.

```
#include <ESP8266WiFi.h>
#include "dht.h"
#include "UbidotsMicroESP8266.h"
#define TOKEN "BBFF-
xqLjHkOXPjhTY0iUGRxLXyWhejABgk"
// Put here your Ubidots TOKEN
#define WIFISSID "OPPO A5 2020"
#define PASSWORD "pclatane123"
#define dht_apin D0
dht DHT;

Ubidots client(TOKEN);
```

**12.** Now in Wi-Fi function get connect using your Local address

```
void wifi()
{
  Serial.print("connecting");
  while (WiFi.status() != WL_CONNECTED)
  {
    Serial.print(".");
    delay(500);
    break;
  }
  Serial.println();
  Serial.print("connected: ");
  Serial.println(WiFi.localIP());
  client.wifiConnection(WIFISSID, PASSWORD);}
```

<b>Laboratory Practice-I</b>			
<b>Experiment No:06</b>	<b>Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.</b>	<b>Page</b>	<b>8/10</b>

- 13.** Now access Temperature and Humidity at local using Serial Port through Sensors. So use 2 Variable over here for Temperature and Humidity.

```
void setup(){
  Serial.begin(9600);
}
void loop(){
  int readdata = DHT.read11(dht_apin);
  float t = DHT.temperature;
  float h = DHT.humidity;
  delay(1000);
  Serial.print("Current humidity = ");
  Serial.print(h);
  delay(1000);
  Serial.print("%n ");
  Serial.print("temperature = ");
  Serial.print(t);
  Serial.println("C ");
}
```

- 14.** Now send Temperature and Humidity value on Cloud using Client.add function and repeat it for every 1000micro second.

```
client.add("humidity", h);
client.add("temperature", t);
delay(1000);
client.sendAll(true);
delay(1000);
}
```



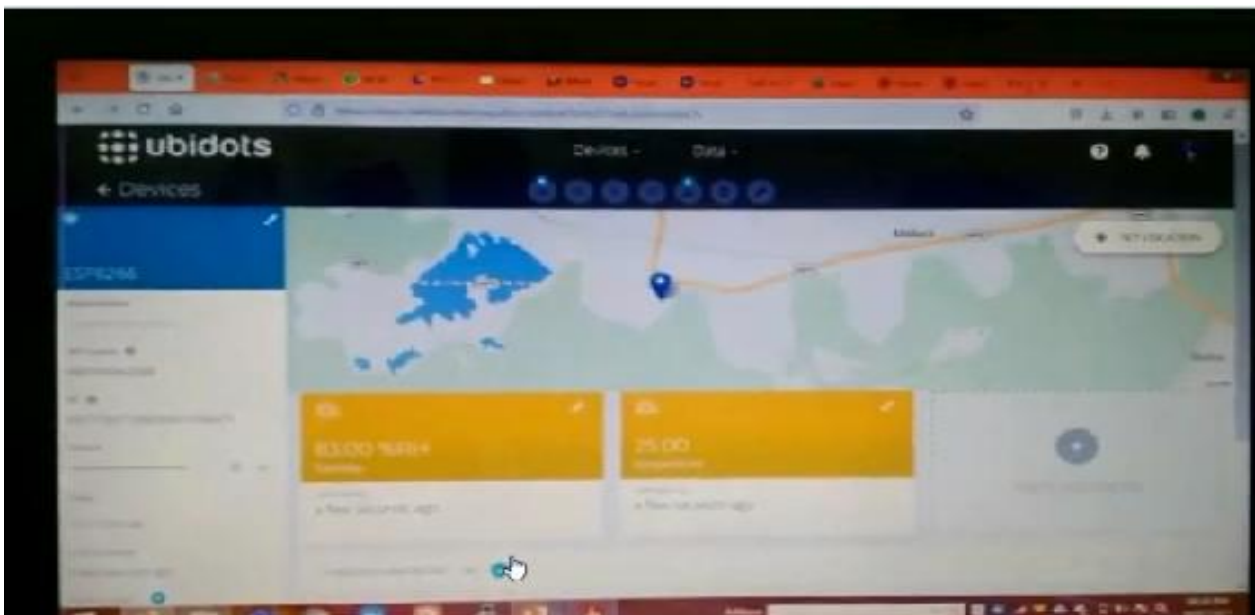
**Laboratory Practice-I**

Experiment No: 06	Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.	Page	9/10
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**15.** Now go for connection with DHT connection



**16.** Go to Ubidots Dash board to get reading of Humidity and Temperature sensor.



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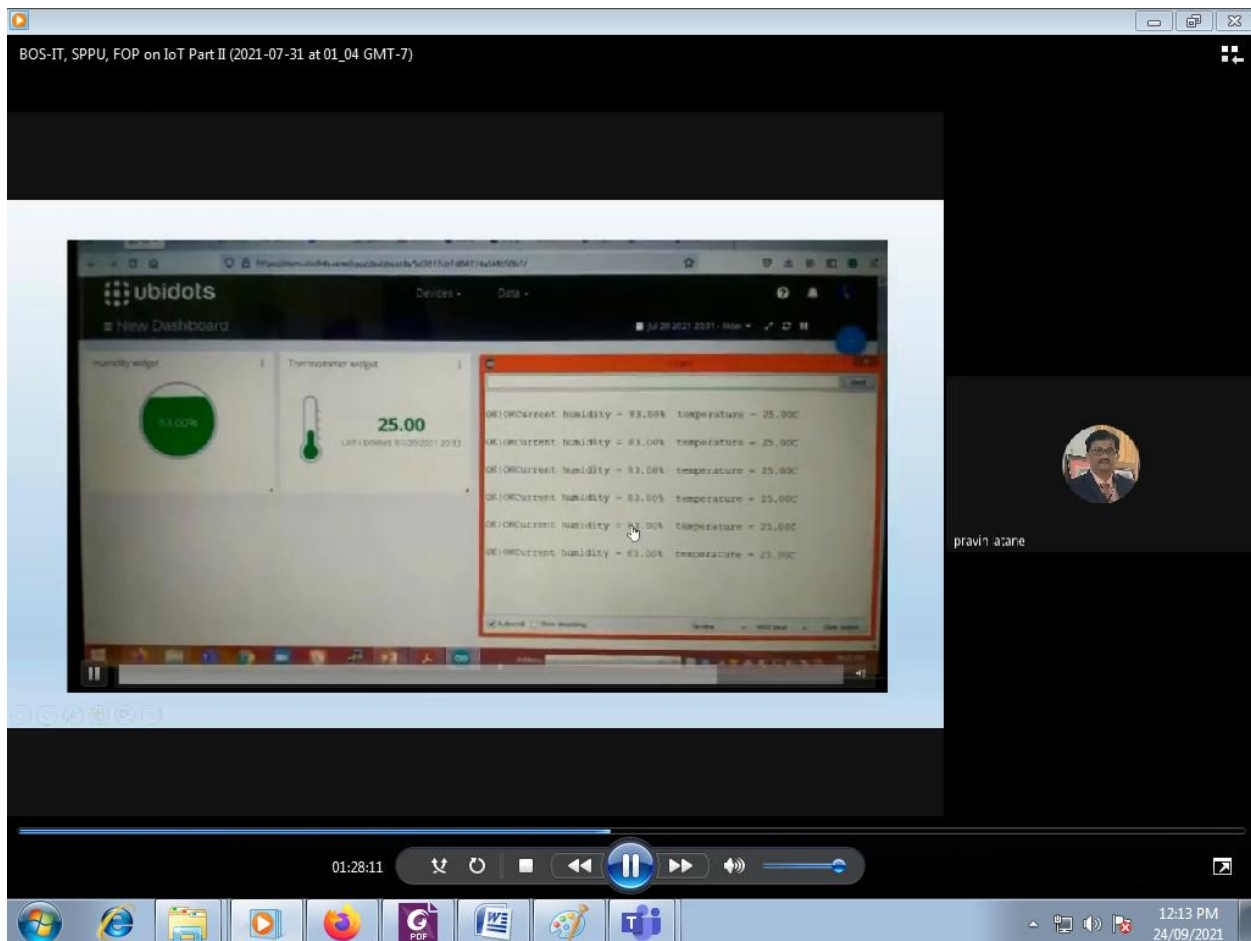
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<b>Laboratory Practice-I</b>			
<b>Experiment No: 06</b>	<b>Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.</b>	<b>Page</b>	<b>10/10</b>

### 17.Final Reading will get access through Ubidots



**Conclusion:** Hence implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'.

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## AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER

Experiment No: 07	Design and implement real time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.	Page	1/7
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**TITLE:** Real time Monitoring System using Android Phone by installing blink app.

**OBJECTIVES:**

1. To learn interface of sensors and actuators using Arduino Uno/ Raspberry pi.
2. To learn and understand android blink app as real time monitoring of soil

**THEORY:**

### 1. AIM and Required Components

## Assignment No. 3

- **Aim:** Design and implement a real-time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.
- **Objectives:**
  - To learn the interface of sensors and actuators using Arduino Uno/Raspberry Pi.
  - To learn and understand IoT platforms and their significance for real-time applications.

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Experiment No: 07	Design and implement real time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.	Page	2/7
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## 2. Required Components

### Assignment No. 3

#### • Components:

- **nodeMCU** / Arduino with WiFi / Raspberry Pi
- Soil Moisture Sensor ()
- Relay
- DC Mini Submersible Water Pump
- Breadboard
- Connecting Wires

#### • Software Applications:

- Blynk
- Arduino IDE

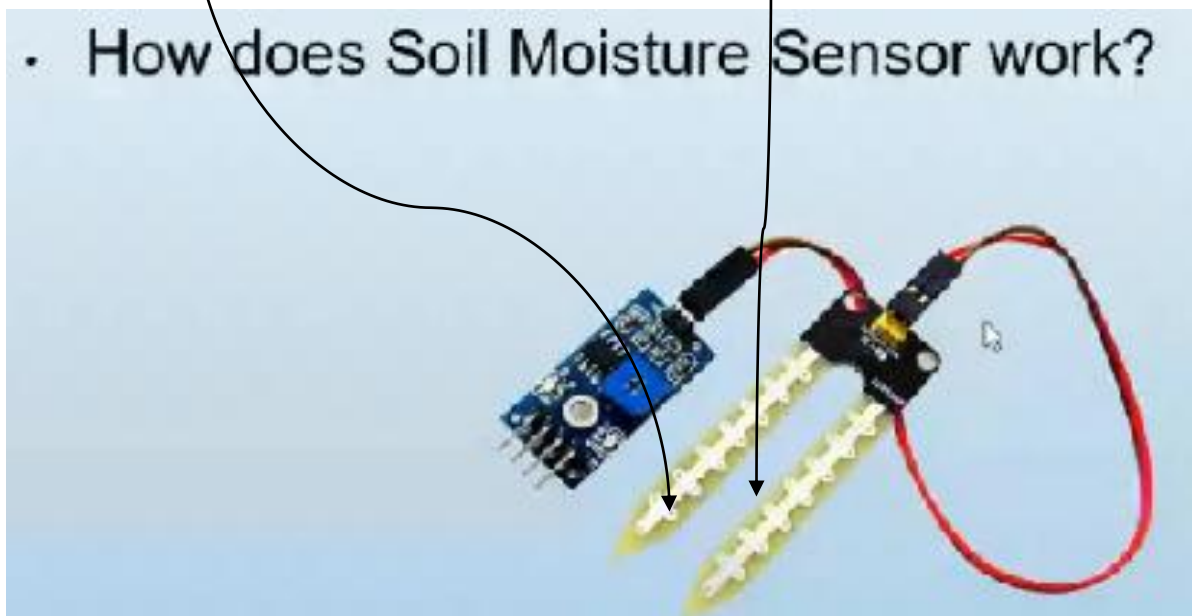
## 3. Applications of Soil Moisture Sensors

- Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation systems more efficiently.
- Soil moisture sensors measure the volumetric water content in the soil.

Experiment No: 07	Design and implement real time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.	Page	3/7
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**4. Soil Moisture Sensors Looks like as- having Two node**

- a. One is Probe
- b. Second creates analog as well analog signal



**5. Working of Soil Moisture Sensors**

**How does Soil Moisture Sensor work?**

- Sensor contains Probe and Module.
- The sensor contains a fork-shaped probe with two exposed conductors that goes into the soil or anywhere else where the water content is to be measured.
- Module pin:
  1. VCC
  2. GND
  3. DO (LM393 High Precision Comparator)
  4. AO

Experiment No: 07	Design and implement real time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.	Page	4/7
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6. Based on water Moisture in soil LED will Blink.

- Blynk
- Blynk is a Platform with iOS and Android apps to control Arduino, Raspberry Pi, and the likes over the Internet.
- Blynk works over the Internet. So the only requirement is that your hardware can talk to the Internet.
- You can download it on Google Play

7. For getting Information of Moisture on Mobile we need to install Blink App on Mobile and which is available in android site or Google play store for IoT. Then create your login to get token like in Ubidots to use in Project.

- Blynk (Steps)



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<b>Experiment No: 07</b>	<b>Design and implement real time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.</b>	<b>Page</b>	<b>5/7</b>
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8. Come on Widgets and Select Button you want to create in your Project.



9. On adding button looks like this use button for send information and switch purpose also can do parameter setting for LED, Soil etc.



<b>Experiment No: 07</b>	<b>Design and implement real time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.</b>	<b>Page</b>	<b>6/7</b>
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**10. Adding button process.**

- **Blynk (Steps): Ex. Adding Button**
  - Click on the Button.
  - Give a name to Button say led.
  - Under OUTPUT tab- Click the pin and select the pin to which led is connected to NodeMCU, here it is digital pin 5, hence select digital and underpin D5. And click continue.
  - Under MODE tab- Select whether you want this button as "push button" or "Switch".

**11. Demo by including Blink library files and etc.**

```

basicExtra - Arduino 1.8.15 (Windows Store 1.0.40.0)
File Edit Serial Tools Help

basicExtra
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

char auth[] = "pchtvj6z-m25Jli_IR9onOLWCBuu_Mg2b"; //code sent via email
/* RX pin on ESP8266 */
int digitalPin = 3;

void setup() {
  // put your setup code here, to run once:
  Serial.begin(115200);
  Blynk.begin(auth, "vivo 1917", "12345678"); //wifi name and password
  pinMode(digitalPin, INPUT);
}

int sensor=0;

..... [ 86% ]
..... [ 100% ]
  
```

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Experiment No: 07	Design and implement real time monitoring system using android phone (Blynk App.) such as 'soil parameter monitoring'.	Page	7/7
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12. Finally you will get output of Moisture in soil like below.

```

#include <BlynkSimpleEsp8266.h>
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

char auth[] = "pchvj6z...";
/* RX pin on ESP8266 */
int digitalPin = 3;

void setup() {
  // put your setup code here
  Serial.begin(115200);
  Blynk.begin(auth, "v...");
  pinMode(digitalPin, INPUT);
}

int sensor=0;

void loop() {
  // read the input pin
  int val = digitalRead(digitalPin);
  // print the value to the serial monitor
  Serial.println(val);
  // send the value to the Blynk app
  Blynk.write(digitalPin, val);
  // delay 1 second
  delay(1000);
}
  
```

Serial Monitor Output:

```

output : 45
Dry
output : 45
Dry
output : 45
Dry
output : 45
Dry
output : 45
Dry
output : 45
Dry
output : 45
Dry
output : 45
Dry
output : 45
Dry
  
```

**Conclusion:** - Hence we have implanted real time monitoring system using android phone (Blynk App.).

## AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER

<b>Experiment No: 08</b>	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.	<b>Page</b>	<b>1/8</b>
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**TITLE:** To design IoT based system for Health or Social Application.

**OBJECTIVES:**

1. To learn the interface of sensors and actuators for health application using Arduino or Raspberry pi to monitor patient.
2. To learn and Understand the application of IoT for patient and social application and its platform.

**THEORY:**

**1. Required Components**

**Software:** Arduino IDE as platform to put data on cloud can use ThingSpeak or Ubidots.

**Hardware:** Pulse Sensor, Pressure sensor, temperature sensor, ESP8266

### Components Required

1. Arduino Uno Board
2. WSP8266 WiFi Module
3. Pulse Sensor
4. 16\*2 LCD Display
5. Resistor : 2K & 1K
6. LED
7. Breadboard
8. Jumper Wires
9. LM35 Temperature Sensor

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<b>Experiment No: 08</b>	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.	<b>Page</b>	<b>2/8</b>
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## 2. Applications of Health care different sensors.

Wearable device contain IoT device which are use continuous monitoring of physiological parameter such as pulse rate and hart rate body teperature etc.



For purchase and knoe detail can go on [pulsesensor.com](http://pulsesensor.com) also. Front side and backside view of it Is shown as follow.



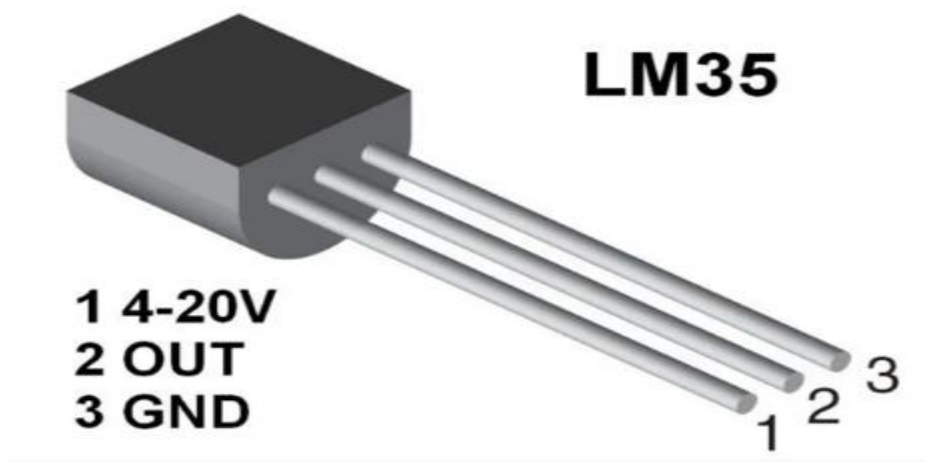


<b>Experiment No: 08</b>	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.	<b>Page</b>	<b>3/8</b>
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Pin configuration given as:

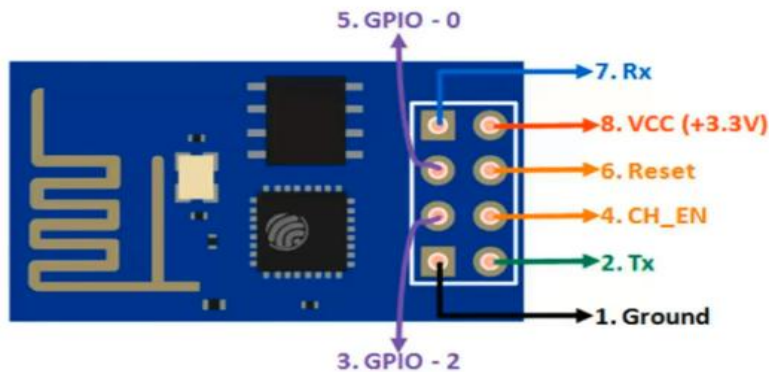


**3.** Temperature Sensor use in Health care system.



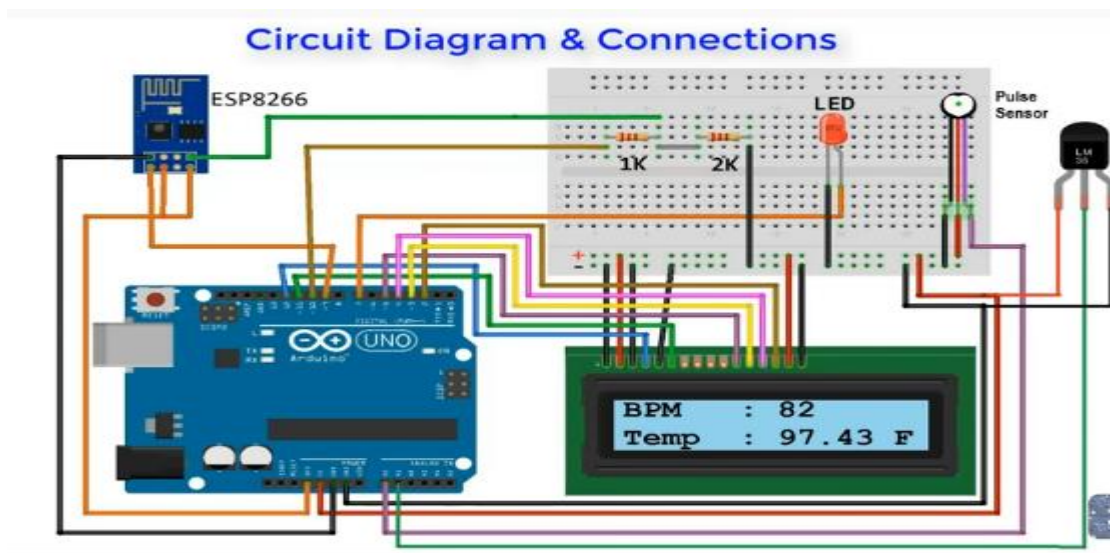
Experiment No: 08	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.	Page	4/8
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#### 4. ESP8266 For connection



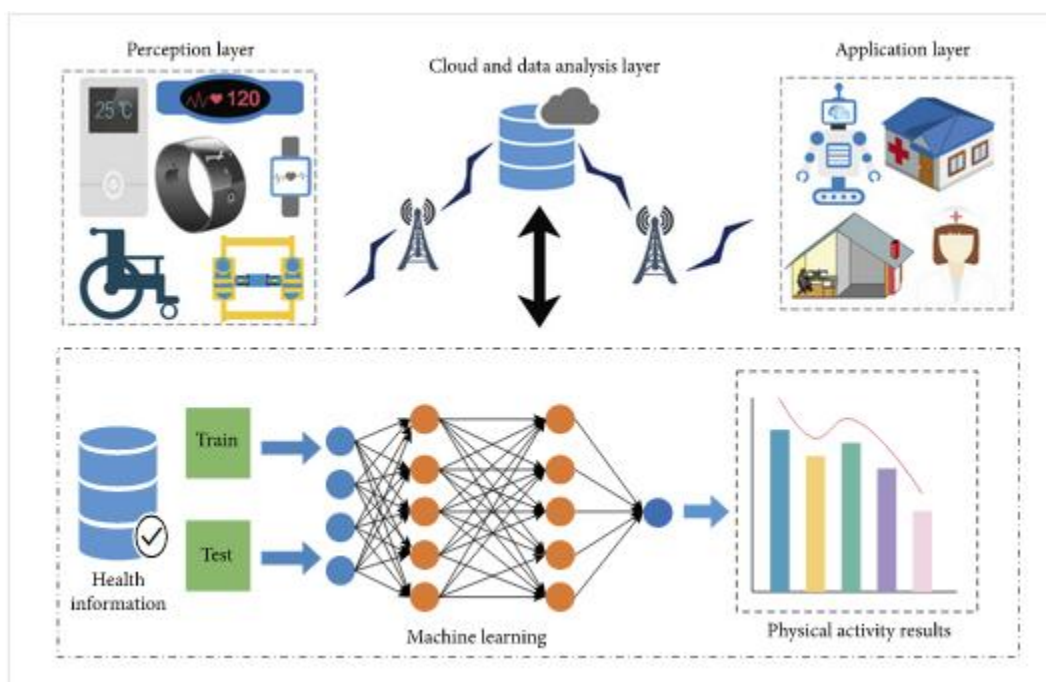
The **ESP8266** is a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability.

#### 5. Circuit diagram.



<b>Experiment No: 08</b>	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.	<b>Page</b>	<b>5/8</b>
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## 6. Working of Health care system on cloud and its analysis



**Fig.1.** A smart healthcare framework for AAL

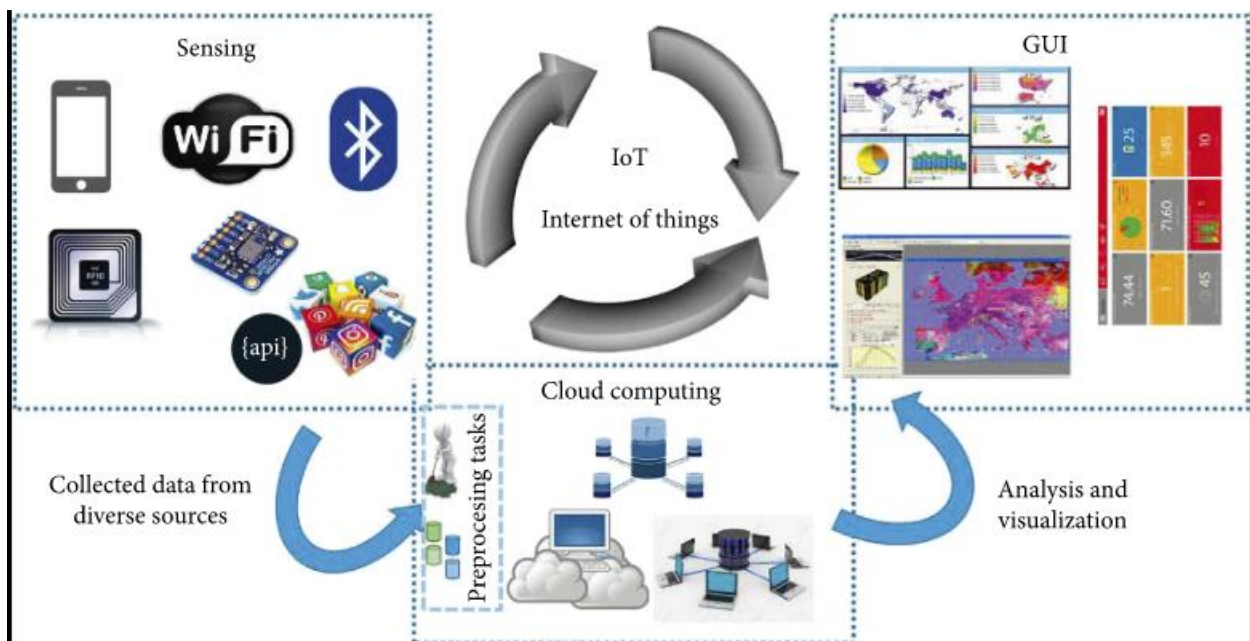
Ambient assisted living (AAL) is a specialized branch of artificial intelligence that integrates with IoT and is used for assisting aging people.

IoT-based healthcare systems are now able to track indoor air quality with help of assistive robots. These systems check the quality of air in the environment where the patient resides, and trigger alerts to the caregivers when there is a reduction in the air quality below a standard value. In cloud computing has been integrated with IoT to propose a secure, open, and flexible platform for AAL where an IoT-based gateway was employed. The gateway helped in addressing various issues that are associated with security, data storage, and interoperability in the IoT system.

<b>Experiment No: 08</b>	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.	<b>Page</b>	<b>6/8</b>
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## 7. Working of Mobile IoT Concept.

Mobile IoT or m-IoT depicts the association of mobile computing, sensors, communication technologies, and cloud computing to track patient's health information and other physiological conditions



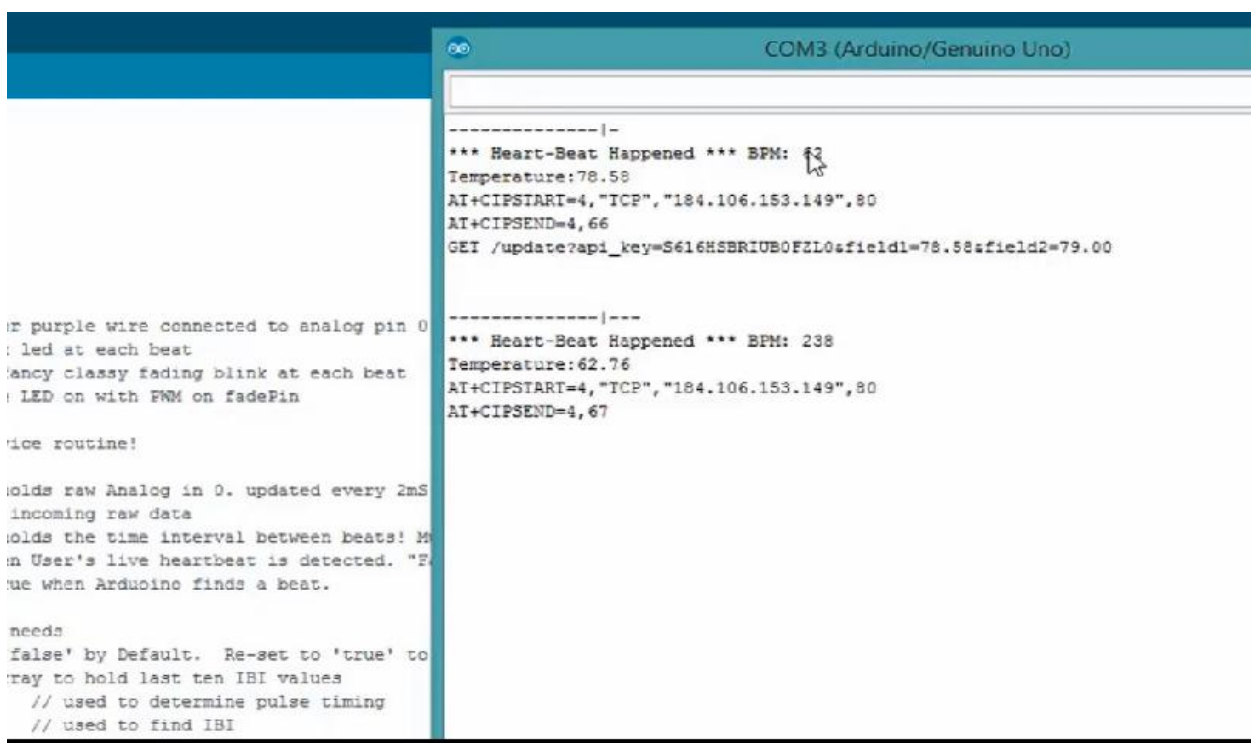
**Fig.2.** A generalized m-IoT environment

## AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER

<b>Experiment No: 08</b>	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.	<b>Page</b>	<b>7/8</b>
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8. For Cloud Base logon THINGSPEAK Platform.

9. Result will get at local screen like this.



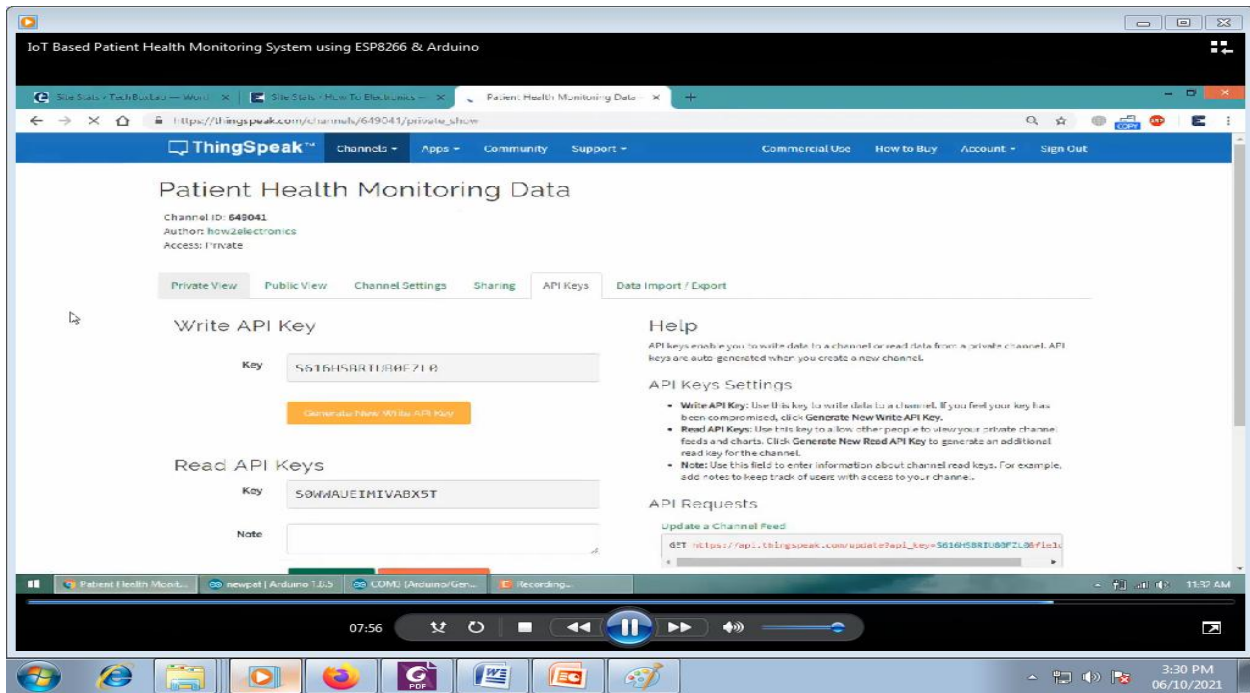
The screenshot displays the Arduino IDE interface. On the left, a portion of the C++ code is visible, showing comments and variable declarations related to an analog input, an LED, and a heartbeat detection routine. The serial monitor on the right, titled 'COM3 (Arduino/Genuino Uno)', shows the real-time output of the program. The output includes status messages like '\*\*\* Heart-Beat Happened \*\*\*', BPM readings (e.g., 132, 238), temperature data (e.g., 78.58, 62.76), and AT commands for TCP connection and data transmission to a Thingspeak server.

```
-----|-----  
*** Heart-Beat Happened *** BPM: 132  
Temperature:78.58  
AT+CIPSTART=4,"TCP","184.106.153.149",80  
AT+CIPSEND=4,66  
GET /update?api_key=S616HSBRIUB0FZL0&field1=78.58&field2=79.00  
  
-----|-----  
*** Heart-Beat Happened *** BPM: 238  
Temperature:62.76  
AT+CIPSTART=4,"TCP","184.106.153.149",80  
AT+CIPSEND=4,67  
  
-----|-----  
// purple wire connected to analog pin 0  
// led at each beat  
// fancy classy fading blink at each beat  
// LED on with PWM on fadePin  
  
// nice routine!  
  
// holds raw Analog in 0. updated every 2mS  
// incoming raw data  
// holds the time interval between beats! Must be nonzero  
// in User's live heartbeat is detected. "False" if no beat  
// true when Arduino finds a beat.  
  
// needs  
// false' by Default. Re-set to 'true' to  
// may to hold last ten IBI values  
// // used to determine pulse timing  
// // used to find IBI
```

## AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER

<b>Experiment No: 08</b>	Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.	<b>Page</b>	<b>8/8</b>
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**10.** Same output will be visible on cloud like Thingspeak



**Conclusion:** - Hence we have implanted design IoT based system for Health or Social Application.

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