Introduction to IoT and Its Industrial Applications (CS698T)
Indian Institute of Technology Kanpur
Assignment 2

QUESTION 1

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1. **Building Irrigation System:**
   The irrigation system was build on Wokwi simulator. The system works in three stages: input stage, processing stage and output stage.

   (a) **INPUT:**
   We needed four input units to take the surrounding temperature and humidity values for 4 different zones in the field. For that we used 4 DHT22 sensor. Each sensor detects both temperature and humidity values. We also needed one sensor to detect the luminosity value for whole field. For that we used Photoresistor(LDR) sensor.

   (b) **PROCESSING:**
   For processing unit we used Arduino Mega. It first uses the reading from LDR and convert it to lux value to decide if its day or night. If lux value is < 50, it is nighttime and then percentage of water to be supplied to the zones is set to 0. In daytime it uses the input values(temperature and humidity) for each zone and our ML model to predict the required water flow percentage in each zone. This percentage is first converted to degree notation(0-180) and then given to output units in each zone. The percentage amount is also provided to a display unit.

   (c) **OUTPUT:**
   Four output units were used in those 4 zones to regulate the amount of water supply in that particular zone. Servo motors were used for this task. One output unit displays all the zone wise percentages of water supply. We used LCD 20x4(I2C) for this task.

2. **Sensors and Actuators Used**

   (a) **Photoresistor(LDR): [x1]**
   This sensor detects luminosity level of surrrounding. It has 4 pins VCC, GND, AO(Analog o/p) and DO(Digital o/p). We connected the VCC to 5V power supply and GND to Ground pin on our board respectively. The AO pin was used to take input to our Arduino board.

   (b) **DHT22: [x4]**
   This sensor was used to detect values of temperature and humidity for each zone. It has 4 pins VCC, SDA(Digital data pin), NC(Not connected)and GND. The VCC and GND pins were connected to 5V power supply and Ground pins on board respectively. SDA pins were connected to the Digital i/o pins of our board.

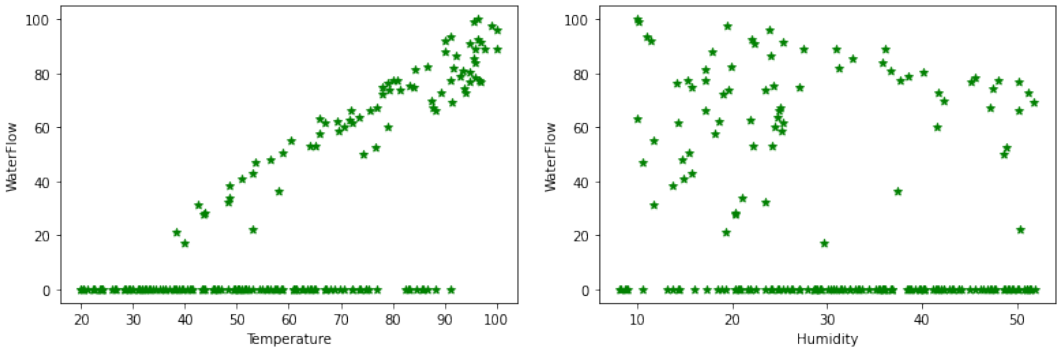
   (c) **Servo Motor: [x4]**
   These were used to regulate the water flow in each zone. They take an integer value between 0-180 as input and rotates according to allow the water to pass. 0 value implies no water supply and 180 implies full water supply. Each motor has 3 pins PWM(pulse width modulation), V+(Power) and GND. The PWM pin is connected to PWM pins on board. The V+ to 5V supply and GND to ground.

   (d) **LCD 20x4(I2C): [x1]**
   This is used to display the percentage of water flow in different zones. It has 4 pins VCC, GND, SDA and SCL. The VCC and GND pins were connected to 5V power supply and Ground pins on board respectively. The SDA and SCL were connected to SDA and SCL ports of the board respectively.

3. **Machine Learning Model**

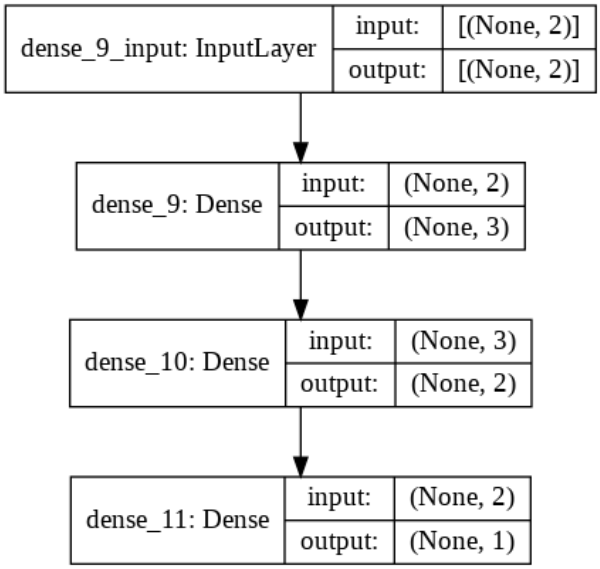
(a) Data

To train the model data with 200 data points. This dataset has features Humidity and Waterflow. And its corresponding water flow percentage. This data shows a linear relationship between temperature and water flow.

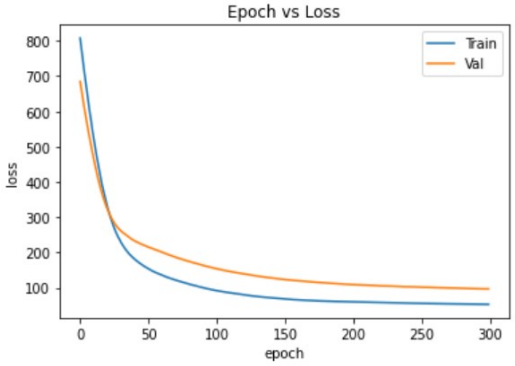


(b) Model Architecture

We have used the Keras library to implement a two-layer perception model. The model has two dense hidden layers with Rectified Linear Unit (ReLU) as an activation function. The first hidden layer has three nodes, and every node takes two input Humidity and Temperature values. The second hidden layer has two nodes; every node takes three outputs from the first layer. The next layer is the output layer; this layer has a single node without any activation function. This layer inputs from the previous layer predict the water flow percentage for our humidity and temperature values.



(c) Model Training
The model uses the Mean squared error loss function and Adam optimizer. Adam is an adaptive learning rate optimization algorithm that is designed specifically for training deep neural networks. Eighty percent of data was used to train the model, 10 for testing and 10 for validation. We have trained the model with 300 epochs and in a batch of 32.



(d) Prediction
To make predictions following are the weights and biases of the model are used. In the simulator, we have used these weights to predict water flow percentage. Weights and biases are multiplied with their respective input layer by layer to predict water flow percentage.

		Node 1	Node 2	Node 3
Hidden Layer 1	weights humidity	-0.491866	-1.0614316	-0.4307963
	weights temperature	-0.01059842	0.07211161	1.3132615
	biases	0	0	0.08891865
Hidden Layer 2	weights i/p 1	-0.87787795	0.5774244	
	weights i/p 2	1.0744598	0.7851182	
	weights i/p 3	-0.44219005	0.95790935	
	biases	0	0.11467338	
Output Layer	weights i/p 1	-0.6685886		
	weights i/p 2	0.7450541		
	biases	0.13448663		

Table 1: Weights of model

4. **Link to project:** https://wokwi.com/arduino/projects/313941559971152450