List of Figures

1.1 Global tea production (Tea Board of India report 2015-2016) 5
1.2 Indian tea production (Tea Board of India report 2015-2016) 6
1.3 Domestic retention (Tea Board of India report 2015-2016) 7
1.4 Auction price (Tea Board of India report 2015-2016) 7
1.5 Block diagram of tea processing 11

3.1 Block diagram of DAQ 42
3.2 Block diagram of RS485 to RS232 converter 43
3.3 Circuit schematic of RS485 to RS232 converter 44
3.4 Block diagram of sensor node 45
3.5 Circuit schematic of sensor node 45
3.6 Block diagram of display node 46
3.7 Circuit schematic of display node 47
List of Figures

3.8 Temperature and RH sensor ............... 48
3.9 Signal conditioning circuit for temperature and RH sensor ............... 48
3.10 Flowchart of sensor node and display node ......................... 50
3.11 Flowchart of host .................................. 51

4.1 Schematic of the prototype ....................... 56
4.2 Photograph of the prototype ...................... 57
4.3 Block diagram of trough instrumentation ................. 58
4.4 Signal conditioning circuit for load cell ....................... 59
4.5 Calibration of weighing system ...................... 60
4.6 Residual versus independent plot for weighing system calibration .......... 61
4.7 ML, RH and temperature during withering in experiment 1 ............... 62
4.8 ML, RH and temperature during withering in experiment 2 ............... 63
4.9 ML, RH and temperature during withering in experiment 3 ............... 63
4.10 ML, RH and temperature during withering in experiment 4 ............. 64
4.11 ML, RH and temperature during withering in experiment 5 ............. 64
4.12 ML, RH and temperature during withering in experiment 6 ............. 65
4.13 ML, RH and temperature during withering in experiment 7 ............. 65
4.14 ML, RH and temperature during withering in experiment 8 ............. 66
4.15 ML, RH and temperature during withering in experiment 9 ............. 66
4.16 Feed forward network ................................ 69
4.17 Recurrent neural network ............................. 70
4.18 Series-parallel architecture ......................... 72
4.19 Parallel architecture ................................................................. 73
4.20 Actual and predicted MLs along with absolute errors in prediction (Dataset
1, experiment 9 and 1) ............................................................... 76
4.21 Actual and predicted ML along with absolute errors in prediction (Dataset 2,
experiment 1 and 2) ................................................................. 77
4.22 Actual and predicted ML along with absolute errors in prediction (Dataset 3,
experiment 2 and 3) ................................................................. 77
4.23 Actual and predicted ML along with absolute errors in prediction (Dataset 4,
experiment 3 and 4) ................................................................. 78
4.24 Actual and predicted ML along with absolute errors in prediction (Dataset 5,
experiment 4 and 5) ................................................................. 78
4.25 Actual and predicted ML along with absolute errors in prediction (Dataset 6,
experiment 5 and 6) ................................................................. 79
4.26 Actual and predicted ML along with absolute errors in prediction (Dataset 7,
experiment 6 and 7) ................................................................. 79
4.27 Actual and predicted ML along with absolute errors in prediction (Dataset 8,
experiment 7 and 8) ................................................................. 80
4.28 Actual and predicted ML along with absolute errors in prediction (Dataset 9,
experiment 8 and 9) ................................................................. 80
5.1 Positioning of sensor nodes in the trough ........................................ 85
5.2 Level of withering and third order polynomial curve in experiment 1 .... 87
5.3 Level of withering and third order polynomial curve in experiment 2 .... 88
5.4  Level of withering and third order polynomial curve in experiment 3 . . . . 88
5.5  Pattern of RH variations during withering process in the first pair of sensor
     nodes ................................................................. 91
5.6  Pattern of RH variations during withering process in the second pair of sensor
     nodes ................................................................. 91
5.7  Pattern of RH variations during withering process in the third pair of sensor
     nodes ................................................................. 92
5.8  Pattern of RH variations during withering process in the fourth pair of sensor
     nodes ................................................................. 92
5.9  Pattern of RH variations during withering process in the fifth pair of sensor
     nodes ................................................................. 93
5.10 Average temperature variations during withering process in the first pair of
     sensor nodes .......................................................... 93
5.11 Average temperature variations during withering process in the second pair
     of sensor nodes ....................................................... 94
5.12 Average temperature variations during withering process in the third pair of
     sensor nodes .......................................................... 94
5.13 Average temperature variations during withering process in the fourth pair of
     sensor nodes .......................................................... 95
5.14 Average temperature variations during withering process in the fifth pair of
     sensor nodes .......................................................... 95
5.15 Estimation of withering level (Exp 1) ........................................... 98