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SIT123: Data Capture Technologies

Lab Report 1: Arduino Blink (30 marks)

Welcome to Arduino!

Arduino is an electronic prototyping platform. Different types of sensors & actuators can be attached to Arduino boards to create our own sensing-thinking-acting systems.

Throughout this unit, we will use Arduino to create different sensing devices, and to retrieve the collected sensor data.

In this task, we will try out an introductory exercise, to learn the basic concepts of Arduino.

Due Date Friday 8:00pm, Week 3 – 30th July 2021

Hardware Required

Arduino Board with in-built LED

USB cable

Software Required

Arduino programming environment

Pre-requisites: You must do the following before this task

Class (Lecture)
The labs are built on concepts we discuss in class (lecture). To be able to carry out the lab tasks, you need to know the ideas introduced in the lecture. In addition, the lab tasks are also explained in the lecture. If you come to the lab without attending/watching that week's lecture,

you will be in a difficult situation. You must attend/watch that week's lecture before coming to the studio.

Reading/Videos
Some labs will have required reading material and/or videos, which you must read/view **BEFORE** you start the lab. If you are on-campus, this means that we expect you to have gone through these materials, when you arrive at the robotics studio.

Why should you read/watch pre-lab materials?

These materials will help you understand the background which the lab tasks require. Students come to university from diverse backgrounds. Some of you may be familiar with the background information, some of you may not. When you come to the lab prepared, you're already equipped with confidence and will be able to participate in activities better. Ultimately, class time will be much more productive, dynamic, and fun for everyone.

Here are the pre-lab materials for our first task:

1. Watch TED Talk: https://www.ted.com/talks/massimo_banzi_how_arduino_is_open_sourcing_imagination#t-1114 (~15 minutes)
2. Watch https://www.lynda.com/Arduino-tutorials/Creating-your-first-sketch/783858/5015739-4.html (~3 minutes)
3. Read this task sheet from beginning to end.

Task Objective

- "We have an Arduino board with an in-built LED light. We need the LED light to be turned on and off continuously, every one second."

Task Submission Details

There are six questions in this task. Answer all of them in this word document itself and submit to unit site.

Q1: The TED talk given under the Pre-Lab materials, shows how Arduino is being used for interesting projects to capture data from the environment, process it, and use it carry out useful actions.

Fill the given table below to answer the following:

What are three projects that use captured data as given in the TED talk? What data do they capture? What sensors do you think they could use to capture this data?

Project name	Data captured	Sensors to capture the data
Automatic cat feeding	The built-in chip of the collar on the cat	CD player. Some cardboard, couple pf sensors, a few blinking LEDs
Enough Already	Processing infrared signals from the TV	UNO R3
Botanicalls	Measure the amount of moisture present	Wi-Fi Module , sensor probes,

(6 marks)

Q2: Consider the given Task Objective. Think about how this simple system can be decomposed to 'Sense-Think-Act' as discussed in class (lecture).

a) What is the 'sensing' requirement in this system, if any?

Use sensors to record data from the environment

b) What is the 'thinking' requirement in this system, if any?

Analyse the collected data

c) What is the 'acting' requirement in this system, if any?

Draw conclusions from the data (and) perform actions, such as automating functions, visualizing and taking informed decisions.

(3 marks)

Q3: Please refer to the provided 'Arduino Blink Activity Sheet' and follow the steps.

a) In Arduino-speak, what is a "sketch"?

"Sketch" means that the program written with Arduino software is called a sketch. When these sketches are written in the editor, and "ino" is saved. The editor features are copy and paste search and replace text. The information area provides feedback when saving and exporting and also shows errors.

b) setup() and loop() are key Arduino constructs. These are required in every Arduino sketch.

i) Which of the above two, runs once at the very beginning of your program and never again (unless you reset or upload new code)?

Setup()c programs are run once at the beginning and never run again (unless reset or new code is uploaded)

ii) Which of the above two, is used to continuously run code over and over again?

Loop() is used to keep running the code over and over again to achieve the function. the function does precisely what its name suggests, and loops consecutively

iii) What does **pinMode()** do?

The pinMode () function is used to configure a particular pin to act as an input or output. The internal pull-up resistor can be activated in INPUT_PULLUP mode.

Hint: http://arduino.cc/en/Reference/HomePage

c) What is a comment?

Comments are lines of code used to inform yourself or others of how your program works.

d) What does the following line of code do:

```
delay(x);
```

The delay () function to pause the execution of your Arduino program for a specified period of time.

Hint: http://arduino.cc/en/Reference/HomePage

e) There is something you need to check before uploading your sketch. What is this?

The verify tool simply examines the sketch, checks for errors, and compiles.

(7 marks)

Q4: How can you test the Blink program to make sure it is working as given in the Task Objective?

In Arduino, select File->Examples->Basic->Blink. use the validation tool and compile the code, press the check mark button in the upper left window. The Confirm button will compile the Arduino code. If the compile phase is successful, see the message in the output window at the bottom of the IDE and the LEDs change. . And observe whether the light meets the signal of sos Moss code

(1 marks)

Q5: Now that you have built and tested your Blink program, it is time to deliver it (hand it over). Take a five second video of your Arduino board with the LED blinking (use your phone to record) and upload it to youtube. Include the link here. Alternatively, if you are on campus, show your working project to your tutor in the lab and get it marked.

Already demonstrated to the instructor in the classroom

(3 marks)

Q6: The Morse code is a method of transmitting text information as a series of on-off lights, or clicks.

a) Create a new Arduino project named 'BlinkSOS'. Copy and paste your code from the Blink example to the newly created project. Modify the code in the new project, to send an SOS signal in Morse Code via turning the LED on and off.
Upload the 'BlinkSOS.ino' file with this document to cloud Deakin.

(5 marks)

[Some helpful hints have been provided for you at the end of this document]

b) How did you test your code to make sure it is working correctly?
Using the verify tool and compile the code, press the checkmark button in the upper left window. The Confirm button compiles the Arduino code. If the compilation phase is successful, you will see the following message in the output window at the bottom of the IDE.

(2 marks)

c) Take a video of your Arduino board running 'BlinkSOS' program and upload it to youtube. Include the link here. Alternatively, if you are on campus, show your working project to your lecturer/tutor in the lab and get it marked.

(3 marks)

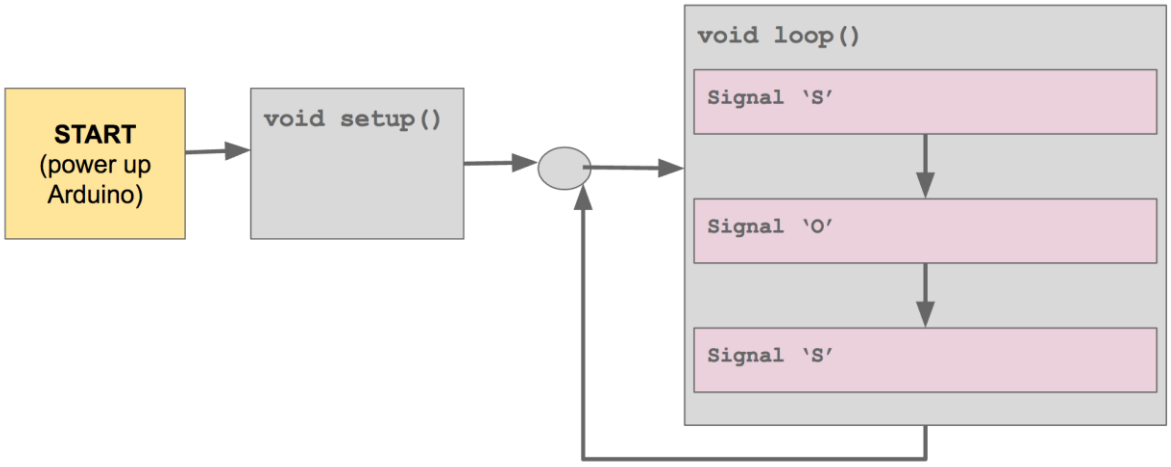
Remember to submit this to cloud Deakin under the correct Assignment folder.

Hints for Q6:
SOS signal in Morse Code: https://www.youtube.com/watch?v=GnHv7h_5P9M
Use the International Morse code given here:
https://en.wikipedia.org/wiki/Morse_code#/media/File:International_Morse_Code.svg
More information about Morse Code: https://en.wikipedia.org/wiki/Morse_code
Here is a sample code snippet signalling the letter 'S' below:

```
/**
   * First signal 'S'
   * Morse code for S is - - -
   * that is, three short blinks.
   */
  digitalWrite(LED_BUILTIN, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(500);                       // wait for half a second
  digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);                     // wait for a second
  digitalWrite(LED_BUILTIN, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(500);                       // wait for half a second
  digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);                      // wait for a second
  digitalWrite(LED_BUILTIN, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(500);                       // wait for half a second
```

```
digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
delay(1000);                       // wait for a second
```

Use your knowledge from the first task, and lecture to decide where the above should go in your code. You now have ‘S’. Next you must write for letters ‘O’ and again ‘S’.



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SIT123: Data Capture Technologies

Lab Work Week 2.1:

Getting started with Sensors (30 marks)

In this task, we will attach sensors to the Arduino board, and collect sensor data. Similar to last week, we will use software engineering methods to plan and organize our exercise.

Due Date Friday 8:00pm, Week 3 – 29th July 2022

Hardware Required

Arduino Board
USB cable
HCSR505 PIR (Passive Infra Red) Motion Detector
DHT22 Temperature and Humidity Sensor
DFrobot Soil Moisture Sensor
Male to Female Dupont Jumper Wires
Male to Male Dupont Jumper Wires

Software Required

Arduino programming environment

Pre-requisites: You must do the following before this task

1. **Attend Class (Lecture)**
2. **Read this sheet from top to bottom**

Task Objective

For this task, your tutor/lecturer will be your client. Here are your client's requirements:

- **"We have an Arduino board and some sensors. We need to be able to measure air temperature, humidity, motion, and soil moisture, and see the collected data in real-time on the computer screen."**

Task Submission Details

There are 4 questions in this task. Answer all of them in this word document itself and submit to unit site.

Q1: Consider the given Task Objective. Think about how this simple system can be decomposed to 'Sense-Think-Act' as discussed in class (lecture).

a) What is the 'sensing' requirement in this system, if any?
Motion Dectector: whether the object is moving.
Temperature and Humidity: Detects the temperature of the surrounding area or object
Soil Moisture: Detection of humidity
b) What is the 'thinking' requirement in this system, if any?
Motion detector. When motion is detected, the data is recorded and the LED lights up and then turns off. If no motion is detected, data is recorded and the LED does not glow.
Temperature: touch or get close to surrounding objects to record
Soil moisture: Check soil moisture, here use wet wipes instead, record soil.
c) What is the 'acting' requirement in this system, if any?
(3 marks)
measure motion: When movement is detected, the LED lights light up, recording the data

temperature: When the ambient temperature is detected, the data is recorded.

Soil moisture: Check soil moisture, here use wet wipes instead, record soil.

Q2: PIR Motion Detector

Please refer to the provided '**Sensing Motion Activity Sheet**' and follow the steps.

a) Refer to the given code in HCSR505motion.ino. What does the following line mean?

```
Serial.begin(9600);
```

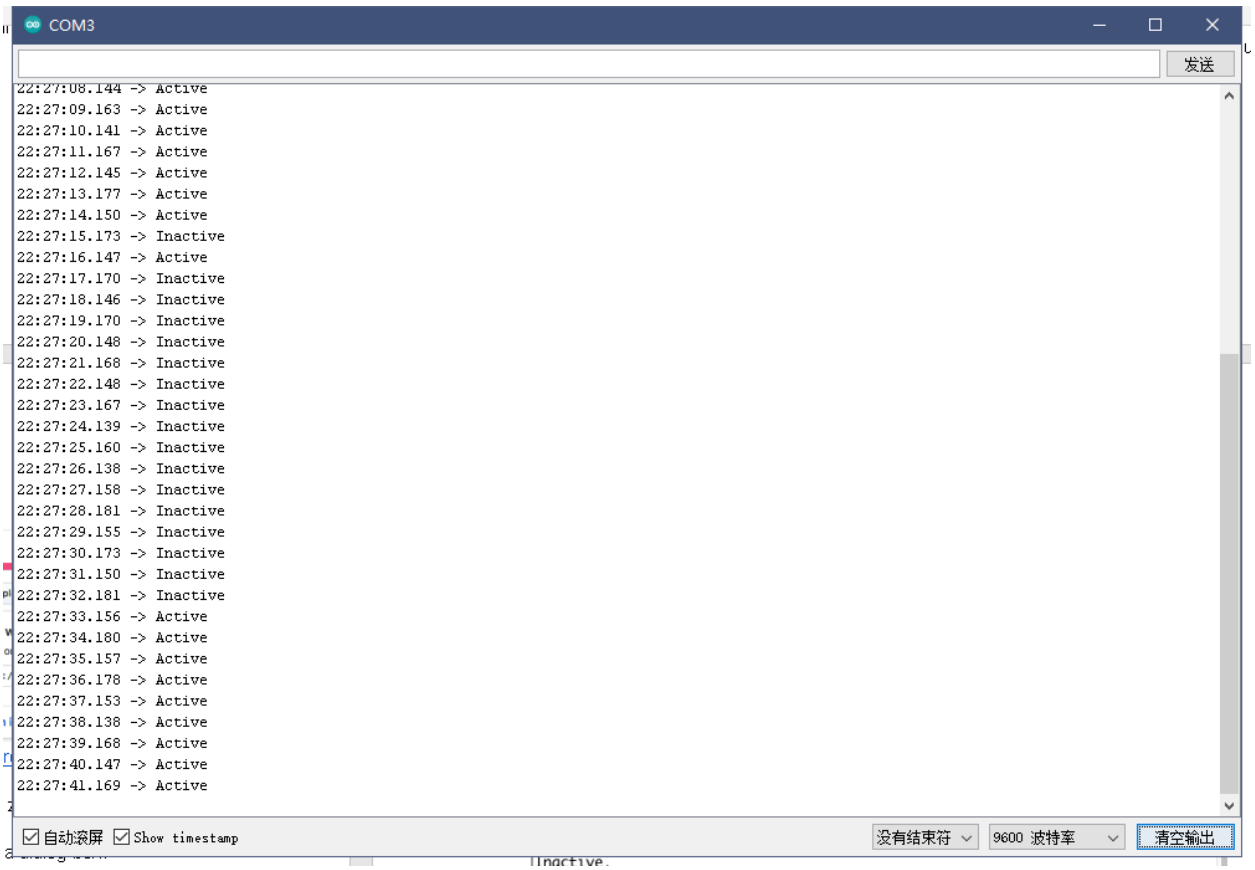
Enables the Arduino to exchange information with the serial monitor at a data rate of 9600 bits per second.
(1 mark)

b) If the Arduino transfers data at 4800 bits per second and you're sending 12 bytes of data, how long does it take to send over this information?

(2 marks)
12 *8 =96, 96/4800 = 0.02second

c) What is a simple strategy to test this program to make sure it is working as given in the requirements?
(1 mark)
Observe whether the serial port monitor shows active or inactive

c) Take a screenshot of your Serial Monitor displaying motion data logs. Add the image here.



(2 marks)

e) Run your program for three minutes. In that time, make sure the sensor can detect 'Active' as well as 'Inactive' data by creating some movement for it to detect. Retrieve the collected data as text file and save it your computer's hard drive, naming it 'lab2_motionData.txt'. Upload 'lab2_motionData.txt' with this lab report.
(3 marks)

Q3: Temperature and Humidity Sensor

a) Please refer to the provided '**Sensing Temperature and Humidity Activity Sheet**' and follow the steps. Consider the given code in the activity sheet and fill the table below. The first row is completed for you.

term	explanation	example usage from code
variable	A variable is a place to store a piece of data. It has a name, a value, and a type.	float temp;
library	Arduino supports extensions using libraries, which provide additional functionality for use in sketches, from Sketches > Include Libraries > Add.zip Library.	#include <DHT.h> #include <DHT_U.h>
comment	Use the // symbol followed by the code you want to comment on, and enter the comment after it. The statement after // is not compiled by the compiler	// put your setup code here, to run once:

(2 marks)

b) A spec of the DHT22 sensor is given in the link below. It mentions that the sampling rate is 0.5 Hz.
https://lastminuteengineers.com/dht11-dht22-arduino-tutorial/

i) What does the sampling rate mean?

It is defined as the sample data per second when the digital signal is collected from the analog audio signal.

ii) Where is this used in the Arduino code?

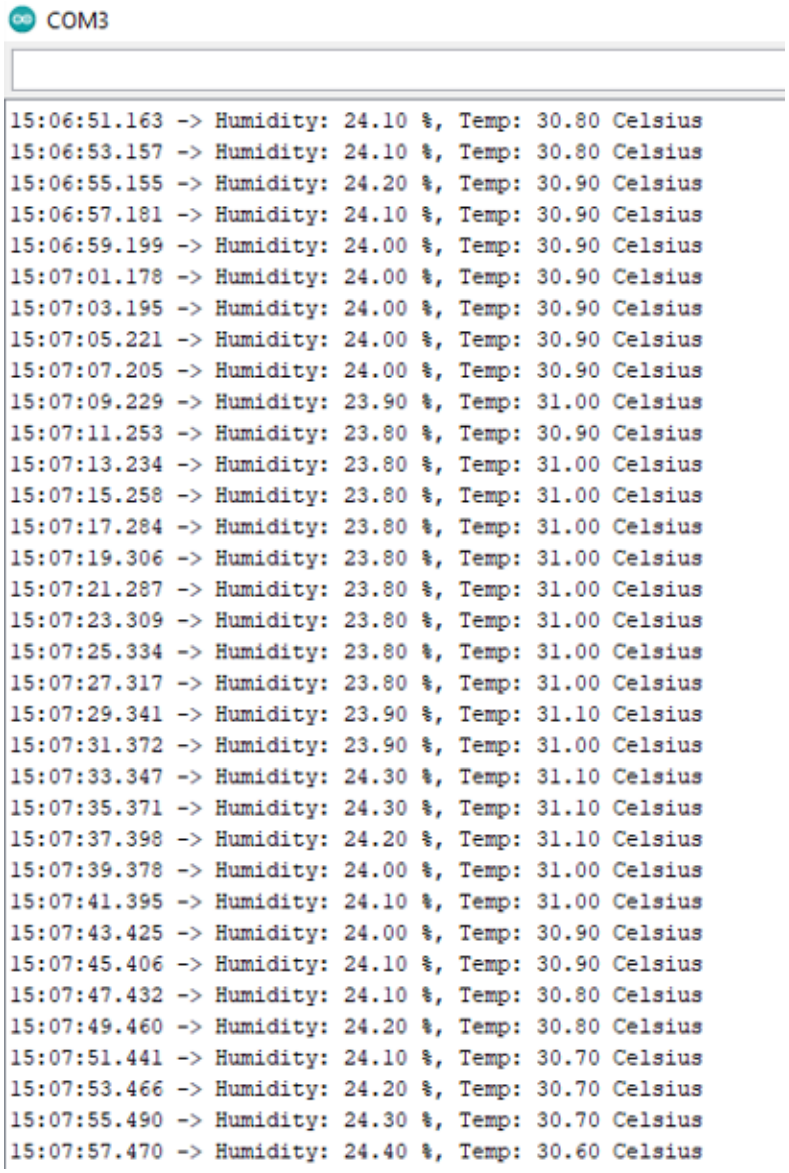
delay(2000);

(2 marks)

b) What is a simple strategy to test this program to make sure it is working as given in the requirements?

Observe whether the temperature and humidity are displayed in the serial monitor. (1 mark)

c) Take a screenshot of your Serial Monitor displaying temperature & humidity sensor data logs. Add the image here.



(2 marks)

e) Run your program for five minutes. Retrieve the collected data as text file and save it your computer's hard drive, naming it 'lab2_temperatureData.txt'. Upload 'lab2_temperatureData.txt' with this lab report.

(4 marks)

Q4: Soil Moisture Sensor

Please refer to the provided '**Sensing Soil Moisture Activity Sheet**' and follow the steps.

a) Refer to the given code in DFRobotSoilMoisture.ino. What does the following line do?

```
val = analogRead(0);
```

connect sensor to Analog 0

(1 mark)

b) How is `analogRead` different than `digitalRead`?

digitalRead() is generally used to switch either high or low (1 or 0, on or off). analogRead(). - Reads an analog pin and returns an integer between 0 and 1023 or tells us the brightness or speed.

[Hint: we used `digitalRead` in the code for HCSR505 PIR Motion detector]

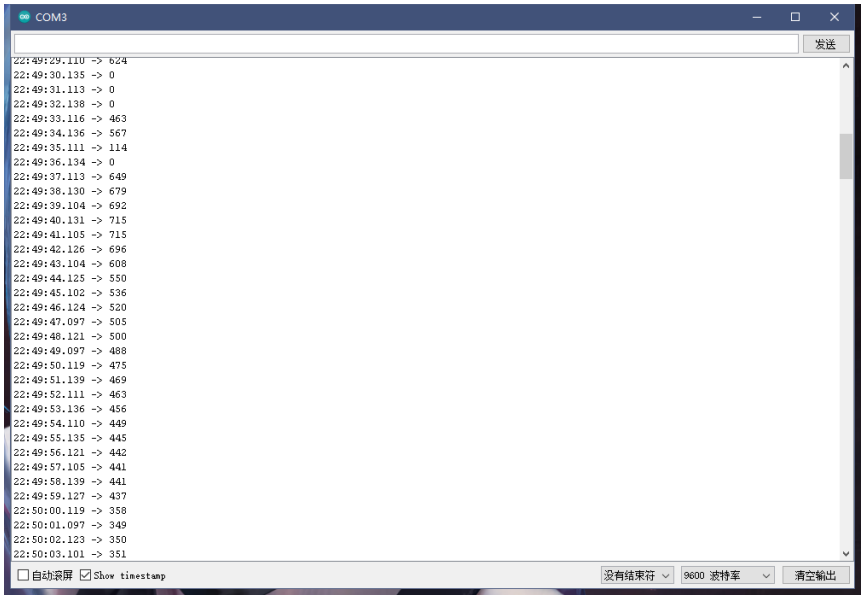
(1 mark)

c) What is a simple strategy to test this program to make sure it is working as given in the requirements?

Observe whether the humidity is displayed in the serial monitor

(1 mark)

d) Take a screenshot of your Serial Monitor displaying soil moisture sensor data logs. Add the image here.



(2 marks)

e) Run your program for three minutes. Experiment testing the sensor in the air, in water & wet tissue. Retrieve the collected data as text file and save it your computer's hard drive, naming it '**lab2_soilMoistureData.txt**'. Upload '**lab2_soilMoistureData.txt**' with this lab report.
(2 marks)

Important: When you are finished, gently unplug the jumper cables from the Arduino pins and the sensor pins.

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SIT123: Data Capture Technologies

Lab Report 2.2:

Preparing data (30 marks)

In this task, you will investigate a given data set, look for inconsistencies in the data and propose methods to fix them.

Due Date Friday 8:00pm, Week 3 – 29th July 2022

Pre-requisites: You must do the following before this task

1. **Attend Class (Lecture)**
2. **Read this sheet from top to bottom**

Task Objective

1. Use the provided dataset HumidityDataset.CSV on collection of Humidity values for location X. The file is available here: https://d2l.deakin.edu.au/d2l/le/content/1190434/viewContent/6267134/View
2. Investigate the data for inconsistencies. These inconsistencies could include:
   a. Missing data, rows and column values
   b. Mismatched data fields
   c. Mismatched date formats
3. Propose ways to fix consistencies, these fixes could include:
   a. Propose and use default values
   b. Remove missing rows
   c. Fix data format mismatches

4. Fix the data

Task Submission Details

There are 2 questions in this task. Answer all of them in this document itself and submit to unit site.

Q1: Once you have cleaned your data, submit the cleaned data file to unit site with this document.

(15 marks)

Q2: Submit brief details on which inconsistencies you have found, what was your approach for fixing them and discuss the Pros. and Cons of your approach, using the given table below:

Inconsistencies found	Approach for fixing	Pros. and Cons of your approach
Missing rows ID	Rewrites the missing data from the data before and after the missing line.	This is easier to do than deleting a whole row
Missing Stamp	Rewrites the missing data from the data before and after the missing line.	This is easier to do than deleting a whole row
Wrong dateline	Correct the wrong date below according to the date above	This is easier to do than deleting a whole row

(You may add more rows to the table as required)
(15 marks)

Hum Null , “64.70”

Inconsistencies found	Approach for fixing	Pros. and Cons of your approach

Issue of Humidity	Change the incorrect temperature or null to the correct temperature or write null as 0	This has the advantage of avoiding unnecessary deletions
Stamp duplication	Calculate the median data from the above and the following data	This has the advantage of avoiding unnecessary deletions