RMIT University
EEET2259 – Engineering Design 3B

Final Report

School of Engineering
RMIT University

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EXECUTIVE SUMMARY:

The checking of a rainwater tank's capacity is a cumbersome task, often done manually by the owner. Manual methods regularly used by owners are at best unreliable and inaccurate, while also being dangerous and not providing any indication of if a tap has been left on and the tank is drop quickly in supply. With rainwater tanks supplying 63% of the water to households and small businesses outside urban areas [1], The Rainwater Tank Monitoring and Feedback System (RTMFS) will allow rainwater tank owners to monitor their tanks water level with efficiently and accurately. The system will locate the water level of the tank and store the data on a web server database via Wi-Fi. Users will be able to view their tanks capacity through an Internet web page that can be accessed remotely.

The system will measure the water level with an electronic device controlling a distance sensor reading the water level. The water level data will be sent over Wi-Fi to a website for the user to access with a computer. The electronic device will be powered by a battery which will be charged by a solar panel.

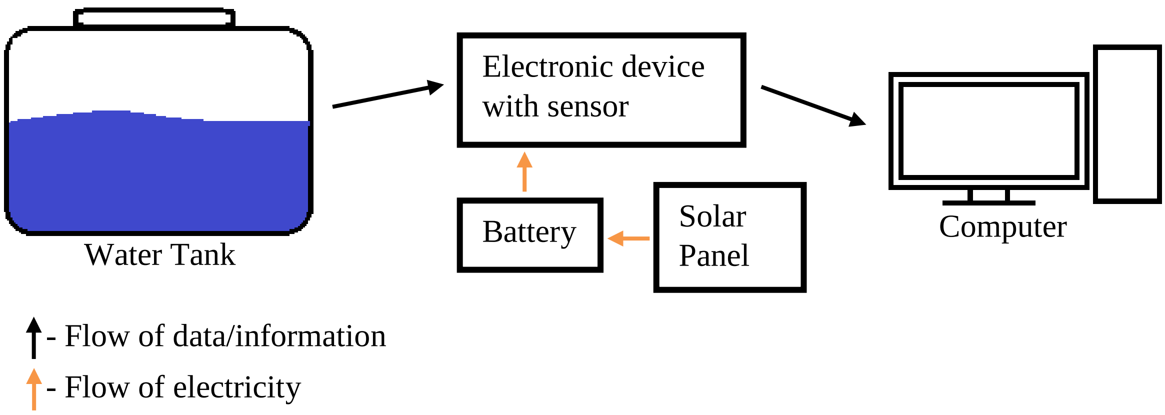


Figure 1: Block Diagram of RTMFS

A successful prototype has been developed that reads the water level twice every hour and displays the water level successfully to a user friendly webpage. The system includes an alarm feature where the user will be notified by email if the water level drops too rapidly between readings. The prototype has been calculated to operate twice every hour and last up to 20 days without charge. The system is environmentally sustainable as it operates exclusively on solar power. The RTMFS will cost $70.

INTRODUCTION:

Throughout Australia's country towns and remote locations thousands of home owners and hundreds of business rely directly upon water tanks as their primary or only source of water [1]. However, as a result of Australia's harsh and hostile conditions and extensive periods of drought these home and business owners face the issue of losing their only water supply with little to no warning. The rain water level monitoring system is designed to eliminate this issue by providing home and business owners with real time measurements of their vital water supply all from the comfort of their office and/or lounge room. As well as this, the RTMFS will alert customers if the tank is rapidly decreasing in volume for instance if a tap if left on. The RTMFS incorporates an ultrasonic distance sensor which is used to measure the depth of water, an ESP8266 Wi-Fi unit used to communicate with a data base setup on a local area network and finally the results are then outputted on a user friendly graphical interface.

COMPETING TECHNOLOGIES:

Most rural residents and business owners still rely upon measuring the level of their water tank with a measuring stick or flotation device. This is due to competing technologies being expensive and complicated to set up. The current leading companies producing water tank measuring equipment are Senix and Gallagher. Senix system provides accurate measurements however, the depth of the tank is only outputted as a numerical value and there is no system in place to monitor the fluctuation of the water level over a period of time. The Senix system also requires the software package senixVIEW to be purchase separately. Like Sinex Gallagher also requires components to be brought individually and due to the none optional touchscreen display the system is deemed as unaffordable.

STATEMENT OF FINAL DELIVERABLES OF THE PRODUCT:

The water level monitoring system is available in a range of options depending upon user's requirements and price range. All models are easy to use and navigate and require the user to input very easy to obtain and minimal specifications. Unlike most major manufactures the basic model is designed to be affordable and user friendly. The basic system takes 2 readings per hour and displays the recordings on a user-friendly graphical user interface. The basic model database stores readings as a daily average and displays them over a weekly period before resetting. Due to the likeliness of taps being left on and tanks being susceptible to damage all systems incorporate an alarm feature which prompts operators when there is an excessive drop in water level. More expanded models of the system include additional features such as: monitoring multiple water tanks, adaptive alert monitoring and for the readings to be taken at the users discretion as well as storing data for monthly and yearly periods enabling users to use information for long term planning. System parameters which alter between users such as; water tank depth and location are altered for all model ranges with low additional cost.

PERFORMANCE CRITERIA:

Criteria	Exceed Expectations	Achieved	Satisfactory	Unsatisfactory
Solar Panel + Battery	Battery lasts 20+ days with charge	Battery lasts 19 days with charge	Battery lasts 15 days with charg	Battery lasts under 15 days with charge
Ultrasonic sensor	N/A	Can take accurate measurements between 0.25m-4.5m	Can take accurate measurements between 0.3m-4.5m	Measurements cannot be taken lower than 0.65m or greater than 3.9m
ESP8266	Can send and receive data from +30feet	Can transmit and receive information for 30feet and accurately display information on a line plot	Can transmit and receive information for 25feet and accurately display information on a line plot	No graphical user interface and information can only be transmitted at a maximum of 20feet

Figure 2: Displays the performance criteria for the system

At minimum the final product had to meet the satisfactory level of the performance criteria in figure 2, whilst also being cost effective and reliable. It was decided that the ultrasonic sensor needed to be able to read distances between at least 0.9m-4.5m as many of the major suppliers for rain water tanks have tanks that range in height between 0.8m – 4m [2] [3]. The battery was chosen to last for a minimum of 19 days to ensure that the battery never fully depletes as in Victoria there is an average of 8 hours of sunlight [4]. The ESP8266 criteria was chosen as most tanks are within roughly 25ft of a router.

STAKEHOLDER ANALYSIS:

Stakeholders	Current orientation	Impact rating	Expected influence on project	Issues/Concerns	Support
Project Manager	Supportive	High/ High	Responsible for monitoring the project and ensuring all mile stones are achieved. Providing support for Team members	Fail to meet set milestones. Project requirements may change	Constant decentralised communication with other stake holders
Team members	Supportive	High/ Medium	Responsible for the design, manufacturing and testing of the prototype product.	Parts may not be delivered in time and budget maybe exceeded. design may not be functional with other sections of project	Effective communication pathes with project manager and mentor and ability to alter design aspects
Mentor	Supportive	medium/ Medium	Work with project manager and team members to assist in meeting milestones	Project may be too ambitious or exceed capabilities. Team members may not meet expectations	Updated and inform of progression, concerns and potential restraining forces. Provide regular reports detailing progression
RMIT (sponsor)	Supportive	Medium /Low	Financial support for the construction of the project	Project maybe to dangerous, funding may be wasted or abused	OH & S guidelines followed, constant update of progression reflecting current market relevance
Customer	Neutral	High/ High	Current needs and requirement	Project may not meet needs or expectation. May be too expensive	Regular feedback provided. Following and altering project requirements as desires and conditions change

Figure 3: Stakeholder Analysis

PRODUCT DESIGN:

PRODUCT SPECIFICATIONS:

Life span	25-30+ years (Solar Panels need to be serviced)
Height of water tank:	Water tank can be between 1m – 4m in depth
Distance of readings:	Water tank can be 30ft away from user
Readings of water level:	Readings are reported back to the customer twice every hour
Graphical User Interface (GUI)	Readings are displayed on a line graph in order for user to evaluate water level of a period of time
Alarm system:	If water level drops at a fast rate an alarm is triggered to warn user

Figure 4: General final product specifications

DESIGN METHODOLOGY:

The design approach used to ensure that our project has been successful from conception to finalization was the prototyping approach. The prototyping design approach is used when the final deliverables of a project are not clear. The stages of design are constantly prototyped and tested to converge towards what is deemed acceptable for the final product. Due to the lack of experience in this team, this approach was best suited as it allowed for flexibility in the design. Initially the project started using a novel approach of thermistors to measure water level, but as the design continued to be prototyped it was decided that using an ultrasonic sensor was more applicable as this gave better resolution to the user something which became apparent was more important as the project progressed. As a result, using the prototyping approach was a better alternative than the waterfall management approach as aspects of the design and final deliverables changed with the evolution of the product.

Throughout the prototyping stages, initial research was conducted to compile information concerning existing solutions and relevant technologies. This research also afforded valuable insight into the weaknesses and limitations of existing products. A notable gap in currently available products was inability of monitoring systems to display tank capacity for users to access remotely or to alert users if the tank supply was decreasing very rapidly, for example the simple mistake of leaving a tap on after being distracted occurred. Throughout the research conducted it was found that Jaycar currently offers a generic “Ultrasonic Water Tank Level Meter”, which is also available on eBay [5]. Another common alternative is the “Rain Harvesting Water Tank Level Gauge” offered by Bunning’s Warehouse [6]. Neither option allows the user to monitor the capacity of their rainwater tank remotely or to be alerted of potential water outages due to simple mistakes. After completing this preliminary research, it enabled this project in the end to be better suited to the actual needs of the consumer.

PRODUCT SUB-COMPONENTS AND INTER-CONNECTIONS:

- Portable solar panel power bank
- Esp8266
- NodeMCU micro controller
- Ultrasonic sensor
- Waterproof adaptable box
- Magnetic adjustable phone mount

A more detailed block diagram visualizing the interconnections of the system can be observed below:

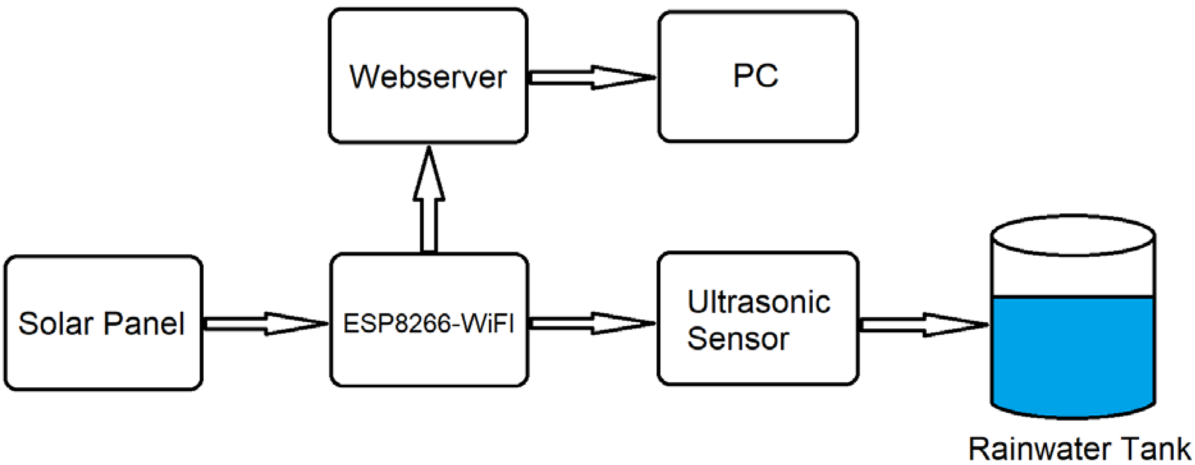


Figure 5: Detailed block diagram

The Rainwater Tank Monitoring and System is comprised of a NodeMCU microcontroller, ultrasonic sensor, and a 30,000mAhrs solar panel and power bank. The PCB will be housed within a waterproof IP66 adaptable case. An adjustable swivel mount will be fitted to the exterior of the box to hold the solar panel and power bank. The ultrasonic sensor will be installed inside the rainwater tank accordingly. Waterproof connections will then run from the interior of the case to both the power bank and ultrasonic sensor.

PROJECT MANAGEMENT APPROACH:

To sufficiently monitor the progress of the project, the action point system was employed as well as the use of a master timeline. At weekly meetings the team leader as well as group members would set goals that needed to be completed by the next week to ensure that the course requirements were met and that the project continued to be developed. At every meeting the action points previously set were addressed and progress was dealt with according to the timeline that was also used to set milestones and goals. In Appendix 1 the timeline and action points can be seen. A decentralized management approach was taken, and the work load was evenly distributed amongst team members. Team members were able to carry out the work delegated to them in their own manner. This allowed for a high level of creativity and moral as each team member was able to think of their own ideas and solutions to the problems being encountered. The weekly team meetings were also a chance for team members to present their findings and collaborate on new ideas, giving us all an opportunity to reflect on overall and individual progress.

SIMULATION & CALCULATION RESULTS:

Calculation of inductor for buck converter:

Below are equations used as provided by the TPS560200DBVR Dc-Dc buck converter chip to choose a sufficiently sized inductor for the output filtering of the converter[X]. As well as this an inductor of 10uH was selected as per the recommended component values as seen in appendix XX (component table selection). Below are the calculations completed:

$\mathbf{I_{LPP}}$:

$$I_{LPP} = \frac{Vout}{V_{in(\max)}} * \frac{\left(V_{in(\max)} - V_{out}\right)}{(Lout)} = \frac{3.3}{5} * \frac{(5-3.3)}{10 * 10^{-6}} = 0.94A$$

$\mathbf{I_{peak}}$:

$$I_{lpeak} = I_{out} + \frac{I_{LPP}}{2} = 0.5 + \frac{0.944}{2} = 0.97A$$

$\mathbf{I_{LOUT}}$:

$$I_{LOUT} = \sqrt{I_{OUT}^2 + \frac{1}{12} * I_{LPP}^2} = \sqrt{(0.5)^2 + \frac{1}{12} * (0.94)^2} = 0.569$$

After completing these design calculations, the inductor chosen was 10uH 2A inductor.

ESP8266 Simulation Results:

The NodeMCU was programmed with the Arduino IDE to connect to local Wi-Fi and get assigned a IP address and UDP port number. It will then wait for a UDP packet to be sent to it then read the analogue pin and send a reply UDP packet with the value of the analogue pin. An app called Packet Sender was used to send a packet from the computer to the NodeMCU and as shown below we were successful.

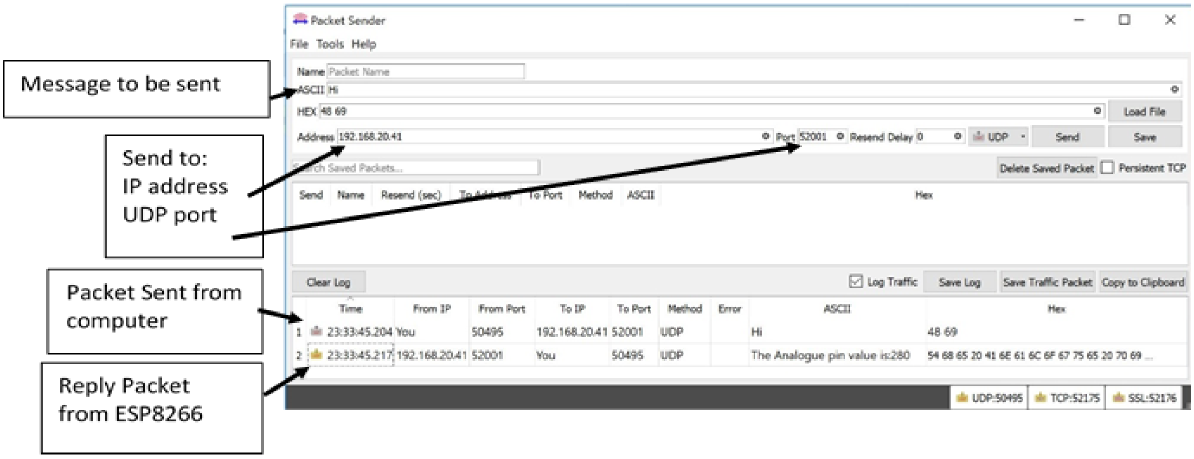
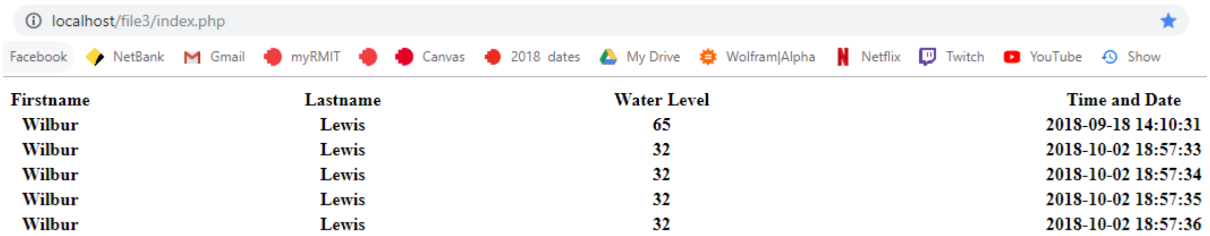


Figure 6: Packet sending between computer and ESP8266

<u>Connection to database to send and receive data</u>:

For this we used the XAMPP package which allows you to run an Apache HTTP Server and MySQL database on a personal computer (PC). The NodeMCU was connected to Wi-Fi and using HTTP GET requests we were able to add data to the database. as shown below is our database and an arbitrary water level reading of 32 is sent from the NodeMCU to the database each second.



Firstname	Lastname	Water Level	Time and Date
Wilbur	Lewis	65	2018-09-18 14:10:31
Wilbur	Lewis	32	2018-10-02 18:57:33
Wilbur	Lewis	32	2018-10-02 18:57:34
Wilbur	Lewis	32	2018-10-02 18:57:35
Wilbur	Lewis	32	2018-10-02 18:57:36

Figure 6.1: Testing of webpage displaying trial data

<u>COMPONENTS:</u>

The components used are as follows:

Component	**Description**
USB-A Connector	USB-A input for solar output
10uF, 0.1uF Capacitor	Used for input & output of buck converter
Resistors – Varying Ohmic Values	For voltage dividers for Vsense buck converter pin and level shifting from 5v to 3.3v and 3.3v to 5v
2N3904 BJT	Level shifting between 3.3v to 5v
TPS560200DBVR	Buck Converter IC
SN74AHC1G14DCKR	5v logic inverter IC for level shifting 3.3v to 5v
JSN-SR04T-2.0	Ultrasonic Range Sensor
NodeMCU-lol1n	Development board with ESP8266 integration
Solar Panel + Battery Pack	Battery for system.
10uH 4A dc Inductor	Output filtering of buck converter

Figure 7: Table of components

Components were selected in accordance to specific design specifications, for example recommendations by the buck converter datasheet or the level shifting of signals from 3.3v to 5v. The ultrasonic sensor that was chosen was the best sensor available within the bounds of the strict budget given by RMIT as industrial waterproof ultrasonic sensors are too expensive for a small budget. The sensor chosen is quoted as being waterproof [XXX] but does not come with any IP rating. If this project were to become a commercial product, a more precise and IP rated industrial sensor would be sourced.

DETAILED SPECIFICATIONS FOR PROTOTYPE MODEL:

The detailed specifications can be seen in Appendix 4.

EXPERIMENTAL RESULTS:

Fabrication process began by designing the PCB board for the electronics as well as finding a suitable IP rated housing for the electronics. The schematic developed can be seen below for the PCB:

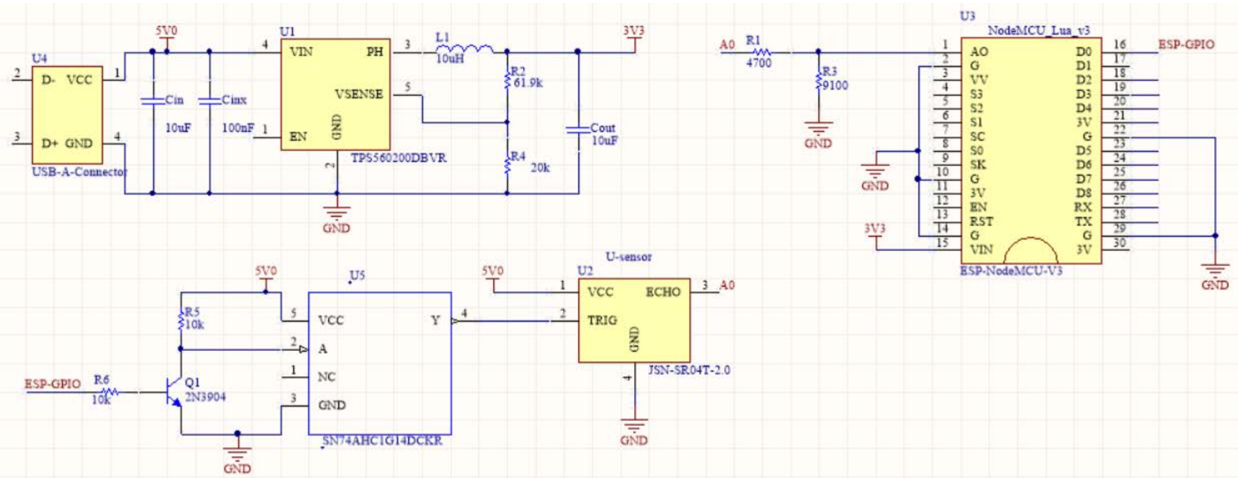


Figure 9: Schematic for PCB

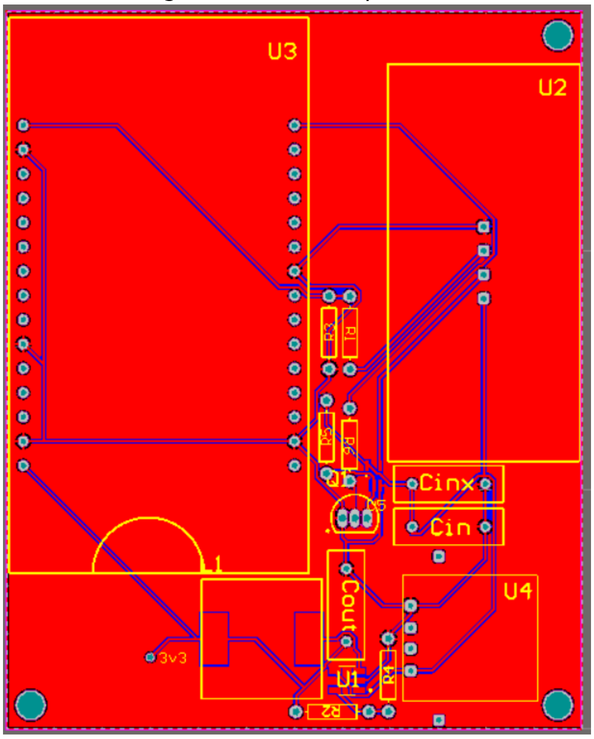


Figure 9.1: Schematic for PCB

Initial testing was carried out testing the PCB board to ensure that all of the electronics were operating as planned, then the ESP communications necessary were tested and the GUI. The full test plan as stated in the Completion and Test can be seen in the table below completed after testing:

<u>Test plan:</u>

Description	**Result**	**Pass/Fail**
Output of buck converter is 3.3v.	Buck converter was measured and correctly stepped the voltage down from 5v to 3.3v.	Pass
3.3v to 5v logic shifter correctly shifts signals.	Input to logic shifter was pulsed with 3.3v signal. On the output of the level shifter a 5v signal was measured.	Pass
5v to 3.3v logic shifter correctly steps down voltage.	The step-down logic converter was measured to correctly step down 5v from sensor to 3.3v	Pass
ESP8266 successfully connects to local network	ESP8266 connection was tested by sending a trial packet to the computer	Pass
ESP8266 successfully wakes up from deep sleep	ESP8266 was tested to going into deep sleep and then waking up to connect to network	Pass
ESP8266 correctly reads pulse width of echo signal from ultrasonic sensor	ESP8266 was test reading different pulse width lengths from the sensor	Pass
ESP8266 pins correctly trigger the ultrasonic sensor	ESP8266 was tested pulsing the sensor and the response pulse width was read for determine distance	Pass
Webserver stores values and outputs them to website	Webserver was created and test data was entered into the database and was correctly shown	Pass
Solar panel battery system output is 5v	Solar panel battery system output is measured as 5v	Pass
Ultrasonic sensor correctly reads distance from the quoted specification	Sensor will read between 0.2-4.5m	Pass
GUI Correctly shows values on line graph	The GUI shows values over the graph in a user friendly manner	Pass

Figure 10: Test plan used to test the system

Initially the system was designed to use thermistors in order to read the water level the calculations can be seen in appendix 2. The testing for these can be seen below:

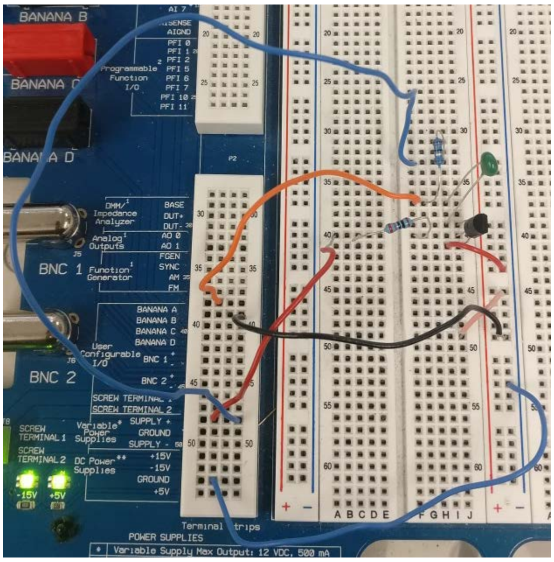


Figure 11: Circuit configuration

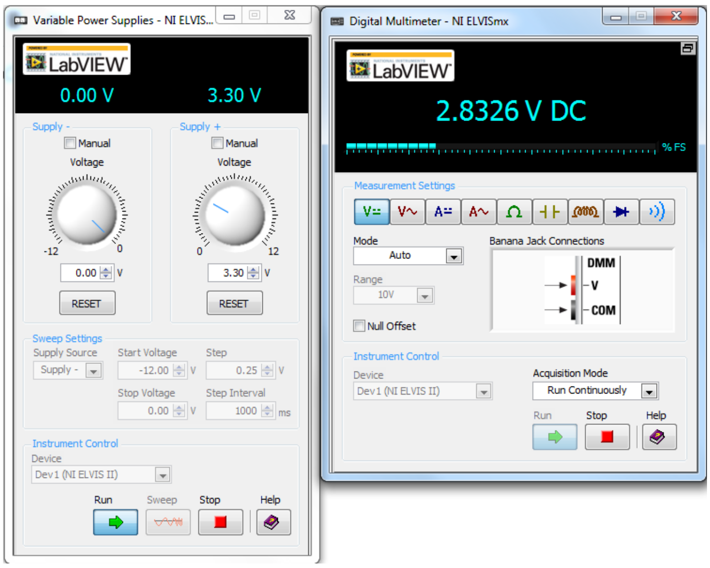


Figure 11.1: Thermistor exposed to air

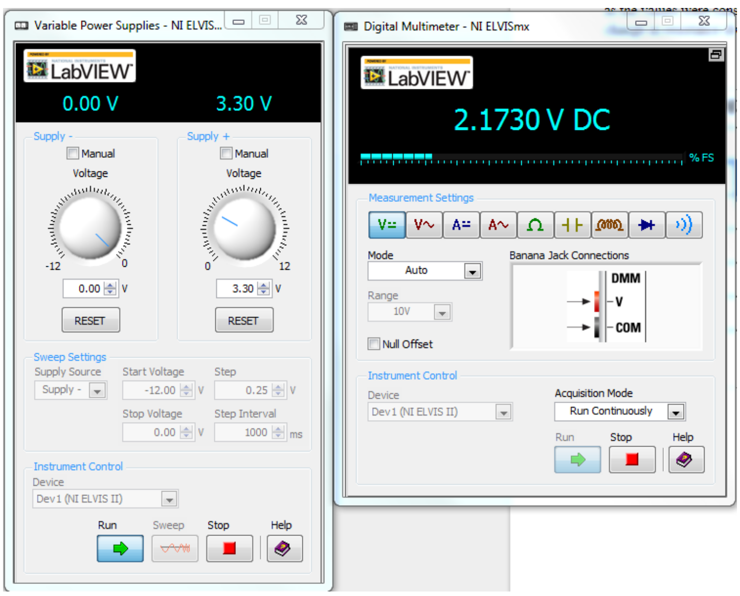


Figure 11.2: Thermistor exposed to water

Based on these test conditions it was came to the conclusion that the thermistor method would work. This was eventually overhauled by the ultrasonic sensor as it was decided based on feedback from academics that the user would need more precise water level readings.

Below are the results obtained that display the system working as a whole with the water levels being displayed onto a webpage with the line graph as well as the login page that the user needs to use:

Figure 12: Login page

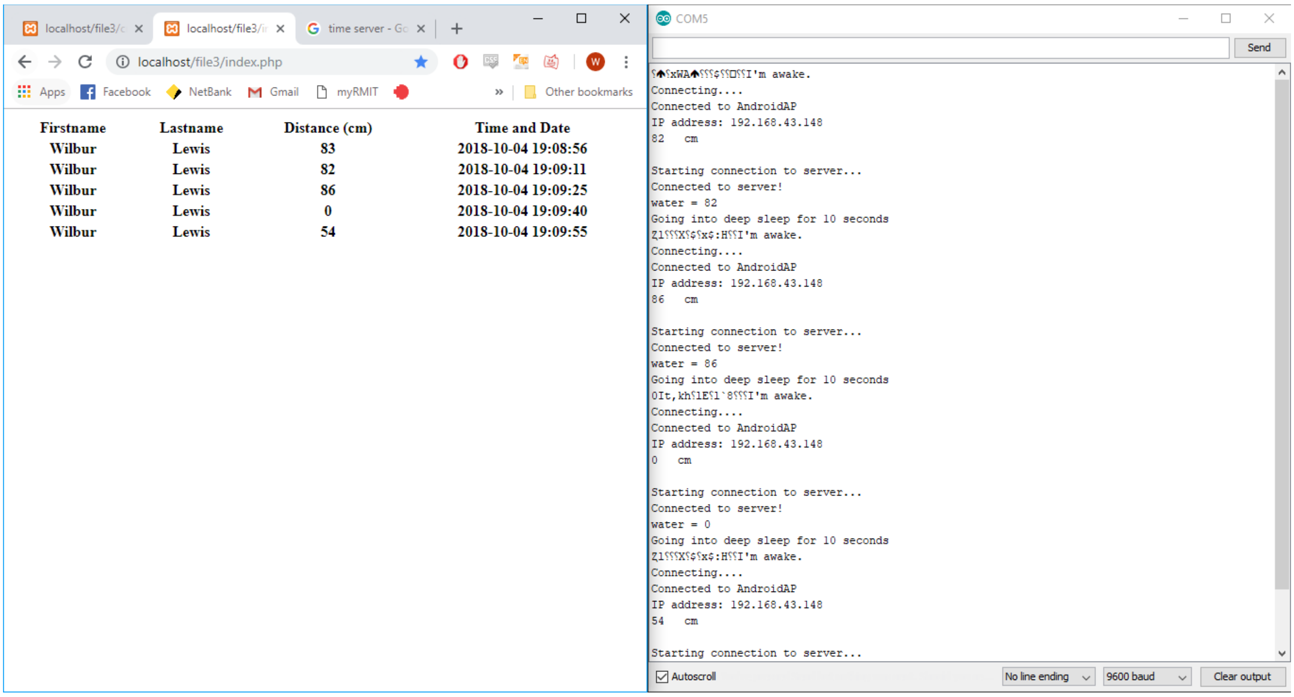


Figure 12.1: ESP readings every 10 seconds

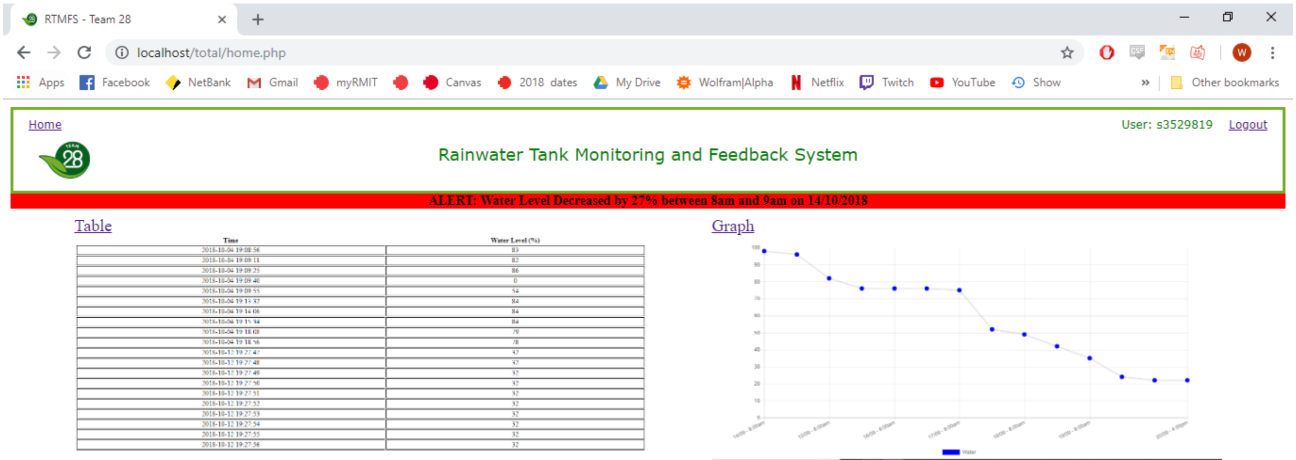


Figure12.2: Webpage displaying data from sensor to the user

The web server was created to have a login system, alarm system and displays the data to the user in the form of a table and graph. As you can see in figure XX there is an alert on the home page saying how much the water has decreased by and in what time period if the alarm is triggered. There is also a graph and a table of the water level readings. Clicking on the table or graph will go to another web page of the full graph/table. On the top right is also a user identification and a logout button.

In figure XX the ESP is reading the distance with the ultrasonic sensor every 10 seconds. The ESP is put in deep sleep for 10 seconds and then wakes up and takes a distance reading. This reading is then sent to the web server where it is stored. In the figure the readings in the database match the readings by the ESP. The code for the ESP communications can be seen in appendix 3.

FINAL PROTOTYPE:

Figure 12: Final Prototype

The figure above is demonstrating the final prototype that was developed. As shown the PCB sits inside the IP66 housing and the waterproof solar panel is situated outside to charge / power the PCB The prototype is intended to be installed onto the roof of the water tank as shown below:

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Figure 12.1: Final Prototype installed onto tank

FUTURE DEVELOPMENTS:

To make this project more commercially viable there are several developments which could be improved on from the proof of concept that has been achieved in this project. One of the developments could be to implement an adaptive alarm system. This would mean that once the initial alarm is triggered an alert is sent to the user. When this happens, the system will enter a different sleep cycle allowing it to take readings every minute to determine how severe the next warning should be for the user. Based on the rate at which the tank is emptying the system will alert the user via SMS or Email with an appropriate message ranked from critical to catastrophic water loss. As well as measuring the rate at which the water is decreasing this will also be scaled against the tank volume to give a more accurate indication of actual threat to the supply. Amongst this the user interface could also be enhanced to incorporate multiple displays from various tanks as well as improving on the ultrasonic measurement system to utilize a more precise sensor to alleviate the slight measurement area that could be associated with the current models. On top of this if the market indicated a move towards non WiFi based solutions the system could be adapted as such to increase the marketability.

CONCLUSION:

This project has been able to solve an issue that is present in many rural areas throughout Australia. By working coherently and effectively as a team and achieving the results as outlined in this report the product that has been created can have the potential to become an even more attractive solution for the marketplace by making some extra developments which will further steer this product away from its competitors.

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APPENDIX:

1. Action Points & Timeline

- Semester 1:

Action Points	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Electronics	Plan Ideas	Plan Ideas	Monitoring System	Assignment 1	Thermistor Research	Thermistor Research	-Test thermistors in water / air -Observe current needed	-Size thermistor current - Create schematic	-Decide on current amplification method	Allocation of Final Report Roles	-Finish circuit design -Finalize Schematic	Final Report
ESP-WiFi	Plan Ideas	Plan Ideas	ESP WiFi	Assignment 1	ESP Research	ESP Research	-Consolidate i/o of ESP, research UDP - Start PJ notes research UDP	-Does ESP have ADC? -ESP processing options	-Java - Pj's Notes	Allocation of Final Report Roles	-Send UDP packet to ESP/ from ESP to computer -Read ADC inputs	Final Report
Power Supply	Plan Ideas	Plan Ideas	Marketing / Power supply	Assignment 1	Power Supply Research	Power Supply Research	-Battery / Solar calculations - Begin work on buck converter	-Size solar panel - Finalize buck converter	-Choose solar panel - Choose buck converter	Allocation of Final Report Roles	Complete Risk assessment	Final Report

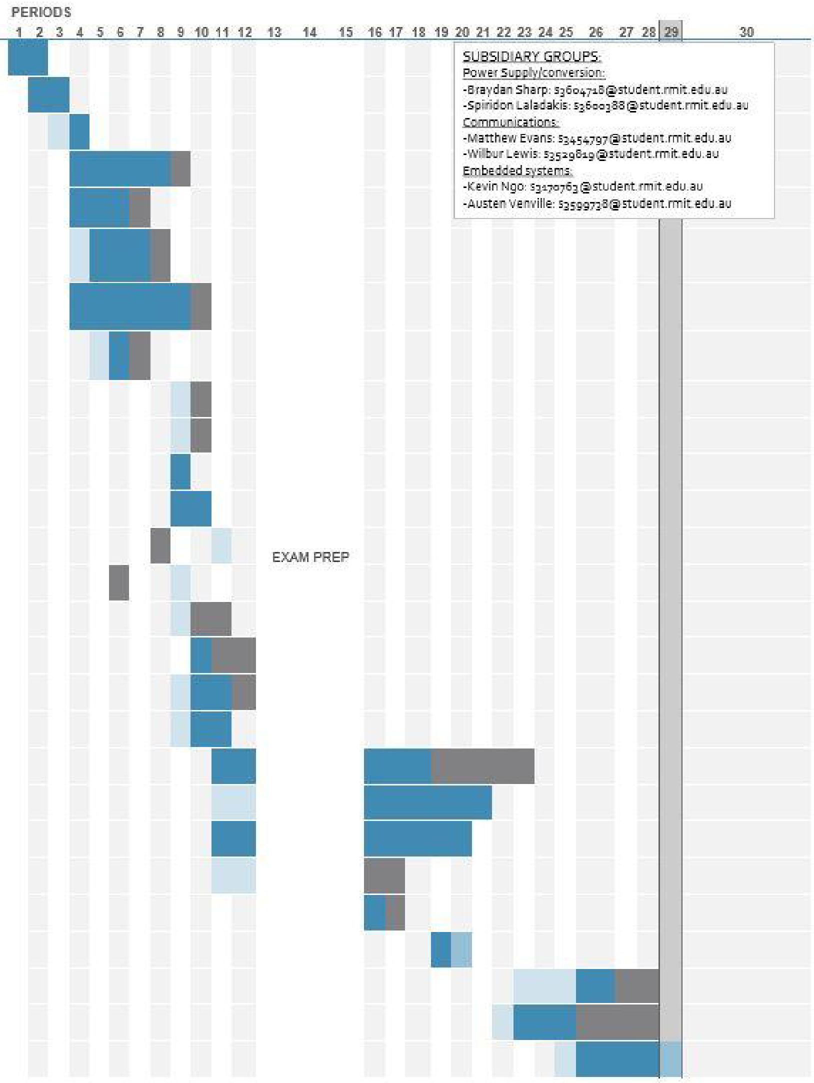
- semester 2:

Action Points	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Electronics	PCB Design	PCB Design	PCB Design	Test & Completion Plan	Test & Completion Plan	PCB Finalization and component selection	PCB Finalization and component selection	Testing of electronics	PCB testing & final report	PCB testing & Final Report	Final Report	Presentation
ESP-WiFi	Database and web user interface development	Database and web user interface development	Database and web user interface development	Test & Completion Plan	Test & Completion Plan	ESP connection to database ESP reading water level with ultrasonic sensor	ESP connection to database ESP reading water level with ultrasonic sensor	Finalise database and web user interface	Finalise database and web user interface	Finalise database and web user interface	Final Report	Presentation
Power Supply	Power supply finalised	Power Supply ordered	Power supply housing design	Test & Completion Plan	Test & Completion Plan	Power supply housing design/Component received	Power housing design finalised and purchased	Power supply testing	Power supply testing	Power supply housing fitting	Final Report	Presentation

EEET2258: Water Level Monitoring System Project Timeline

Period Highlight # | Plan Duration | Actual start | % Complete | Actual duration | % Complete (beyond plan)

Task	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Brain storm ideas	1	2	1	2	100%
Select project	2	2	2	2	100%
Project definition/character	3	2	4	1	100%
Embedded system research	4	5	4	6	100%
Power conversion research	4	3	4	4	100%
Power supply research	4	4	5	4	100%
Communications Research	4	6	4	7	100%
Requirements Analysis	5	2	6	2	100%
Embedded system schematics	9	1	10	1	100%
Power conversion schematic	9	1	10	1	100%
Power supply diagrams	9	1	9	1	100%
Communications block diagram	9	2	9	2	100%
Embedded systems component orders	11	1	8	1	100%
Communications compnent order	9	1	6	1	100%
Power conversion component order	9	1	10	2	100%
Power supply component order	10	1	10	3	100%
End of semester report	9	3	10	3	100%
Presentation preperation	9	3	10	2	100%
Embedded system intial fabrication/testing	11	8	11	13	100%
Creation of web server	11	11	16	6	100%
creation of data base	11	10	11	10	100%
Power conversion intial fabrication/testing	11	4	14	4	100%
Power supply intial fabrication/testing	13	4	16	2	100%
Completion and Test plan	19	2	19	2	90%
Final Report	23	4	26	3	100%
construction of complete system	22	4	23	6	100%
Final presentation preperation	25	5	26	4	80%



2. Thermistor Calculations

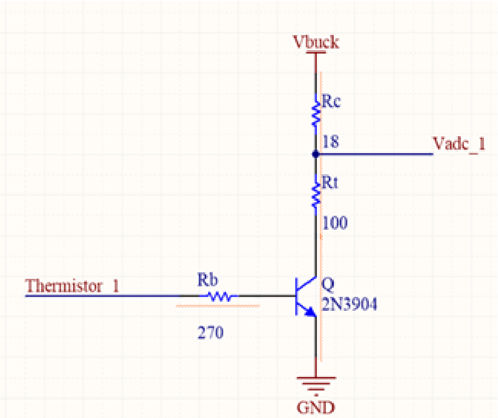


Figure: Thermistor Configuration

Every thermistor will have the circuit configuration as seen in figure to the left. For example, we will look at thermistor 1 sitting at the top most position of the tank. Thermistor_1 is the signal coming from the output of the demultiplexer. Vbuck is the output from the buck converter (3.3v, 0.5A). We will use an NPN BJT transistor 2N3904. Rb will regulate the current entering the base of the BJT, Rc will limit the max current in Ic and ensure that even if Rt is very low, the transistor Ic_max will not be exceeded.

Below are the calculations chosen to achieve the current required through Rt.

Calculation of Rc; $Rc = \frac{Vbuck - Vce}{Ic} = \frac{3.3 - 0.2}{180 * 10^{-3}} = 17.2\Omega \approx 18\Omega$

Minimum Ib; $Ib = \frac{Ic}{\beta} = \frac{180 * 10^{-3}}{30} = 6mA = 10mA$

Value of 10mA is chosen to ensure that the transistor is turned on.

Calculation of Rb; $Rb = \frac{Vesp - 0.7}{Ib} = \frac{3.3 - 0.7}{10 * 10^{-3}} = 260\Omega \approx 270\Omega$

When the current is applied at Ib, the transistor will turn on and generate a current of 180mA. 180mA will be more than enough current to make the thermistor heat up enough so that when it is in water the heat will dissipate differently to when it is in air (as water will keep the thermistor cooler). The voltage being measured, Vadc, will be sent to a multiplexer, and then to the ADC pin (TOUT) for comparison later.

3. ESP Code

```
#include <ESP8266WiFi.h>
#include <WiFiClient.h>

const int d_0 = D2; //   make d_0 assigned to pin D2 - TRIG
const int d_1 = D1;
int sensor_val = 0;  // variable to store the value coming from the sensor\

const char* ssid = "AndroidAP";
const char* password = "poppy123";


//ESP8266WebServer server(80);
WiFiClient client;

void setup() {
  // Start Comm
  Serial.begin(9600);
  Serial.setTimeout(2000);

  delay(1000);
  // Wait for serial to initialize.
```

```
  //while(!Serial) { }
  delay(1000);
  Serial.println("I'm awake.");
  delay(1000);
  WiFi.begin(ssid, password);
  Serial.print("Connecting...");

  // Wait for connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }

  Serial.print("\nConnected to ");
  Serial.println(ssid);
  Serial.print("IP address: ");
  Serial.println(WiFi.localIP());
  delay(1000);

  pinMode(d_0, OUTPUT);
  pinMode(d_1, INPUT);

  digitalWrite(d_0, LOW);

}

void loop() {
  // Initiate Pulsing of Sensor
  digitalWrite(d_0, LOW); // Set Low 2us
  delay(2);
  digitalWrite(d_0, HIGH); // Set High 10us
  delay(10);
  digitalWrite(d_0, LOW); // Make low again
  int distance = pulseIn(d_1, HIGH, 26000); // Read pulse time from D1
  distance = distance/58; // Convert to distance
  Serial.print(distance); // Display
  Serial.println("   cm");
  //int d_read = digitalRead(d_1);
  //Serial.print(d_read);
  //Serial.println("   logic");

    Serial.println("\nStarting connection to server...");

if (client.connect("192.168.43.198", 80)) {
    Serial.println("Connected to server!");

    client.print("GET /file3/receive1.php?"); // This
    client.print("water="); // This
```

```
   client.print(distance); // And this is what we did in the testing section above. We are making a GET request just like we would from our browser but now with live data from the sensor
   client.println(" HTTP/1.1"); // Part of the GET request
   client.println("Host: 192.168.20.5"); // IMPORTANT: If you are using XAMPP you will have to find out the IP address of your computer and put it here
   client.println("Connection: close"); // Part of the GET request telling the server that we are over transmitting the message
   client.println(); // Empty line
   client.println(); // Empty line
   client.stop();    // Closing connection to server
   Serial.print("water = ");
   Serial.println(distance);
   }
   else {
   // if the esp doesnt connect to the web server
   Serial.println("--> connection failed\n");
  }
  delay(50);


  delay(50);
  Serial.println("Going into deep sleep for 10 seconds");
  ESP.deepSleep(10e6); // 20e6 is 20 microseconds
}
```

4. Detailed Specifications

Ultrasonic sensor specifications:

Operating voltage	5V DC
Operating Current	30mA
Operating Range	0.25m- 4.5m
Resolution	5mm
Operating Temperature	-10 °C- 70°C
Cable Length	2.5m
Dimensions	41mm × 28.5mm / 1.61 ×1.12 inches
Weight	54g

Specifications of Ultrasonic Sensor

Solar Panel Unit:

Battery type	Li-polymer battery
Capacity	30,000mAh
Solar Panel	5V/200mA/1W
Battery life	+3years
Size	144mm x 76mm x 22mm
Weight	244g

Specifications of 30,000mAh Portable Solar Panel

NodeMCU ESP8266 specifications:

Hardware parameters	
Peripheral Bus	GPIO
Operating voltage	3.0 ~ 3.6V
Operating current	Average 80mA
Operating temperature range	-40º ~ 125ºC
WiFi Protocols	802.11 b/g/n
Frequency range	2.4G~2.5G
Power consumption	
Modern sleep	15 mA
Light sleep	0.9 mA
Deep sleep	10 µA
Power off	0.5 µA
Security	
WiFi Mode	Station/softAP/SpftAP+station
Security	WPA/WPA2
Encrytion	WEP/TKIP/AES
Network protocol	1Pv4, TCP/UDP/HTTP/FTP

Specifications NodeMCU ESP8266