School of Computer Science and Informatics

Coursework Submission Cover Sheet

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Special Provision	

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Student number of submitting group member	

By submitting this cover sheet you are confirming that the submission has been checked, and that the submitted files are final and complete.

Declaration

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I hereby declare that the attached submission (or my contribution to it in the case of group submissions) is all my own work, that it has not previously been submitted for assessment and that I have not knowingly allowed it to be copied by another student. I understand that deceiving or attempting to deceive examiners by passing off the work of another writer, as one's own is plagiarism. I also understand that plagiarising another's work or knowingly allowing another student to plagiarise from my work is against the University regulations and that doing so will result in loss of marks and possible disciplinary proceedings.

INITIAL PLAN - REMOTE TRAP ACTIVATION DETECTION USING IOT

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Project Description

Currently the Danau Girang Field Centre (DGFC) has multiple traps in the jungle to help with their research of wildlife in Malaysia. They have no way of monitoring whether the traps have been activated and require to go out multiple times on a daily basis to manually check whether there are any animals that have been captured. This is not ideal as it takes a lot of resources and time, whilst also affecting the wellbeing of the animal if not released for a prolonged amount of time.

This project is based on providing a solution for this problem and developing an IoT solution to help monitor and alert researches when a trap has been activated. I will be looking at developing a sensor module that monitors different variables and based on the activity send an SMS text message to the researches if there is a possibility that the trap has been activated.

Initially I will be trying to develop a device that can accurately monitor variables such as sound, vibration, movement, temperature and humidity. Using these variables I will try and analyse the results through tests and create rules on when an SMS text message should be sent. The temperature and humidity results are more for the environments condition to understand whether the animal is at risk to dehydration if not released in time.

Project Aims and Objectives

The main aim of this project is to develop an IoT module which can accurately detect a trap activation through sensors and send an SMS text message to alert users. To achieve this aim the objectives will be as follow:

- Architect Arduino design for sensors and traps
    - Look at similar projects and confer the best design drawing mockups.
- Develop Arduino with sensors attached
    - Learn about Arduinos and different sensors.
    - Understand and attach sensors to Arduinos appropriately.
    - Program sensors to function with Arduino outputting results.
- Test Arduino and sensors to create results
    - Do real world testing using mockup traps to understand the results created from sensors.
- Create rules in which SMS text message is sent with high probability of trap activation
- Implement real world scenario in DGFC

If the project is completed within the time frame other aims that are not necessary for the completion of the project include:

- Camera module to record movement on an SD card for researches to collect footage.
- Bespoke 3D printed case for IoT Device.

Work Plan

After speaking to my supervisor there were two possible designs to be able to detect trap activation using Arduinos.

The first design was to have multiple Arduinos with a singular sensor attached to monitor a cage. The benefits to this design are:

- Each Arduinos battery would last longer as it would only consume the use of one sensor.
- Each Arduino would be smaller in size and easier to create a case for.
- Multiple sensors could be used to ensure that an animal has been captured by comparing results of the same sensor.

The disbenefits to this design are:

- More costly as more Arduinos are used and more SIMS will need to be used.
- Each sensor on a standalone device is not as accurate as multiple sensors working together.

The second design was to have two Arduino sensors one at the entrance of the trap and one pointing towards the entrance placed inside the trap, or if there are multiple entrances one at each entrance. The benefits to this design are:

- More accurate data from sensors being placed in specific positions where any input means high probability of animal being captured.
- More cost efficient as using less Arduinos and multiple sensors per Arduino, also less SIM cards being used.
- Can look for correlations in data between multiple sensors to detect trap activation. Again this means it is more likely a trap has been activated.

The disbenefits are:

- Battery life is not as long, as multiple sensors are in use.
- Can be more difficult to create a case as more sensors are being used, more components need to be protected.

After considering both designs I have opted to choose the second design and use a couple of Arduinos with multiple sensors. The reason behind this choice is because you can make the IoT devices more smart by using multiple sensors on a single device to make a more intuitive alert as to whether a trap has been activated or not. For example, with a single sound sensor if a trigger was activated it may assume the trap has been activated although the sound was in the distance. Using the sound sensor with a motion sensor and vibration sensor, if sound had been detected, motion had been detected and the cage was vibrating in small time frame it is more likely something has been trapped in the cage. I have created exhibit A to show where Arduinos may be placed, also to support my judgement I have included exhibit B and C to show what real world traps look like.

Exhibit A:

Exhibit B:

Exhibit C:

Time Plan

Week Commencing	*Milestones*
Week 1 (27th Jan)	Complete Initial Plan: - Research about Danau Girang Field Centre and the animals they research and traps they use. - Look at similar projects relating to IoT in the jungle and understand challenges and scope of project. - Research Arduino sensors and order sensors that will be used. - Create initial designs and confer with supervisor.
Week 2 (3rd Feb)	Understand Arduino Grove implementation: - Look at online resources such as guides and documentation on Arduino Grove sensors. - Practice uploading test code to Arduino. - Research and download any IDEs or libraries that will assist me in implementing sensors. - Record all resources used to be referenced.
Week 3 (10th Feb)	Implement sound sensor for Arduino: - Look for online resources and program Arduino to acknowledge and receive input from sound sensor (reference any resources used). Test sound sensor for Arduino: - Perform different environmental tests to understand sensitivity of sound sensor.
Week 4 (17th Feb)	Start implementing vibration sensor: - Look for online resources and program Arduino to receive input from vibration sensor (reference any resources used). Test vibration sensor for Arduino: - Perform different environmental tests to understand sensitivity of vibration sensor. - Understand if vibration input correlates with sound sensor (if so, create graph/visual diagrams for evidence).
Week 5 (24th Feb)	Start implementing motion sensor: - Look for online resources and program Arduino to receive input from motion sensor (reference any resources used). Test motion sensor for Arduino:

	- Perform different environmental tests to understand what motion will be picked up from motion sensor e.g. fast objects, slow objects, amount of motion, distance. - Record any results to include in report.
Week 6 (2nd March)	Start implementing temp/humidity sensor: - Look for online resources and program Arduino to receive input from temp/humidity sensor (reference any resources used). Test temp/humidity sensor: - Look for different environments to test humidity and temperature. - Use other devices to measure accuracy of temperature and humidity.
Week 7 (9th March)	Test all sensors: - Look for correlation between sensors to measure a more accurate probability of a trap being activated. - Test sensors in different environments and see if results are affected e.g. rain, wind, temperature. - Create any material that will help analyse and show results. Have first review meeting: - Ensure project is going as planned. - Talk about any issues regarding sensors. - Ensure direction of project is still relevant. - Show current development. Start writing final report.
Week 8 (16th March)	Implement and test SMS function: - Add SMS grove component to Arduino. - Configure a SIM card to be used with the Arduino. - Use online resources to help program a function to send a text message. - Activate function manually to ensure text message is being sent.
Week 9 (23rd March)	Create test rules to trigger SMS function: - Individually create rules for each sensor such as “if sound above 70 decibels sent text message”. - Test these rules to ensure messages are being sent. - Create a more complex rule using data from multiple sensors to trigger an SMS text message being sent. - Test rules and triggers thoroughly.

Week 10 (30th March)	Create test environment and demos for Arduino: - Try and mimic real trap activation using some sort of demo unit. - Setup Arduino and perform various actions to trigger all sensors to acquire data. - Continue testing rules and triggers. - Record any results that are relevant. Have second review meeting: - Review current status ensuring both core requirements are met and are working (SMS function, Sensors functioning). - Receive any feedback and apply to results/programs.
Week 11 (6th April)	Analyse results: - Analyse results from test environments to improve past triggers to be more accurate with real world scenario. - Create graphs and any diagrams that can help display results for future comparison. Ensure final report is kept up to date.
Week 12 (13th April)	Improve programs: - Implement new complex triggers based off of test results. - Re-test all triggers to ensure Arduino is fully functioning.
Week 13 (20th April)	Test and analyse results: - After new programs have been implemented analyse results thoroughly again to ensure they create a more accurate representation of trap activation. - Create graphs and any diagrams to help compare results from past results.
Week 14 (27th April)	Finalise IoT Device: - Ensure all sensors are fully functioning. - Ensure text messages are still sending. - Time to solve any issues that may have arisen. - Finalise final report.
Week 15 (4th May)	Deadline: - Submit all work.

Although I have worked with IoT before, working with Arduinos and microsensors is a technology I have not touched. I have allowed enough time to research, implement and test each sensor to ensure it is fully working. My review meetings are placed after two core parts of the projects which are implementing the sensors and creating a function to send an SMS message. This should ensure if the core requirements are not meant I am able to get help soon after from my supervisor.

Risk Assessment

Risk Description	Likelihood	Impact	Risk Mitigation
Sensor breaking	Low	Medium	Be careful when handling the device. Have spare sensors available on hand.
Arduino Breaking	Low	Medium	Be careful when handling Arduino. Have a backup Arduino just in case of any issues.
Not finishing implementation on time.	Medium	Medium	Ensure that time is managed well and keep to the time plan. Try to get core components created by deadline, as after project deadline there is still time until deployment in Malaysia and smaller fixes can be done later.
Code not functioning correctly	Medium	High	Create tests and test code in multiple ways.
Losing code.	Medium	High	Backup code every hour using online cloud platforms such as Github and Google drive.
Creating a program/device which is inaccurate. Could lead to falsely detecting trap activation regularly.	High	High	When creating tests, test multiple times and use mean values to create triggers. Look carefully at data and choose appropriate triggers whilst checking with supervisor to ensure nothing is overlooked.

Conclusion

To conclude I will be developing an IoT device consisting of an Arduino with multiple sensors to detect a trap being activated. I will be configuring and developing sound, vibration, temperature/humidity and motion sensors testing and creating triggers that will send an SMS text message if a trap has thought to have been activated. I will be looking for any correlation between multiple sensors to notify researches if there is a high probability a trap has been activated to ensure that resources and time are not wasted.

At the end of the project I will produce a final report consisting of the development stages of the project, results and an evaluation from any new knowledge gained that may benefit researches at the Danau Girang Field Centre.

Lastly to measure progress I will be meeting my supervisor on a weekly basis and attend two review meetings which will be held in Weeks 7 and 10.