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INITIAL PROJECT TOPIC: **Modular GSM GPS Tracker**_____

INITIAL EXPO CATEGORY: **ENE – Engineering: Electrical and Electronics**_____

Introduction / Problem:

I have identified a need in our country for a way to retrieve stolen goods especially vehicles like cars, motorcycles and bicycles as well as personal property.

This need is substantiated in my literature study. In a recent document published by the South African Police Service(SAPS) it is revealed there are 53 307 cases of car and motorcycle theft and 16 717 cases of car hijacking between April 2016 and March 2017 (South African Police Service, n.d.). It is also revealed in a statistical release done by Stats SA that there were 21 051 cases of bicycle theft, 284 252 cases of money/purse/wallet theft, and 18 119 cases of bag theft in this period. (Stats SA, 2017).

During my literature study I also found several pre-existing products that prevent some of these problems by using GPS Tracking or alarm systems. But most of these products are dedicated devices designed to only prevent the theft of one of the above listed items. Research done on these devices can be found in the journal of this project. My design will be different to these devices as it will be able to locate any stolen goods. The device will not be limited to finding only certain objects. There are well devices like TrackingTheWorld's 'Enduro' series trackers that are multipurpose (TrackTheWorld, n.d.). But this device doesn't offer any means to hide or attach the device, it is clunky and has a lot of unnecessary features. My device will be different as it will be customisable to suit the needs of the user. The main device will have no unnecessary features and will be very small and compact.

Engineering Goal:

The goal of this project is to ultimately design, test, produce and manufacture a modular electronic device that uses GPS to accurately track stolen objects from anywhere in the country. The reason for designing this device is to give users an easy way to retrieve lost or stolen goods by allowing the owner of the goods to view where their goods are located at all times. The device will be modular meaning that you can connect the core tracking module to different modules to add extra functionality and uses to the device to suit the user's needs. The device/circuity should be as small as possible – preferably smaller than a AA-battery in length – and must be mass producible. The circuit should draw a low current as to prolong the device's battery life. There should be no third-party involved in retrieving the co-ordinates thus the device should use common communication infrastructure like SMS to send the co-ordinates to the user.

In addition to designing, testing, producing and manufacturing a core device or module, a secondary module should also be designed, tested, produced and manufactured to demonstrate the modular nature of the device. In this case a data logging module will be created. This module should make

use of a SD card to log the device's location for later viewing. This log should be preferably be stored in a common file format. The device should not consume a lot more battery power and should not add much more weight to the device.

Design Requirements and Criteria:

*Requirements/Constraints for core module: **

1. The device should be easily manufacturable.
2. The device should not require a subscription to a third party.
3. The device should be modular, and features should easily be added.
4. The device needs to run from a battery.
5. The cost per device should not exceed R1000 (excluding shipping costs of imported components as shipping costs may vary).
6. The user needs to be able to communicate with the device to receive its co-ordinates using pre-existing communication infrastructure (like SMS).

*Requirements/Constraints for data logging module: **

1. The device should be easily manufacturable.
2. The device should log the location in a common file format.
3. The device should weigh as little as possible.
4. The device needs to run from the same power source as the core module
5. The cost per device should not exceed R250 (excluding shipping costs of imported components as shipping costs may vary).

Exceptions to the above listed requirements may only be made if the changes cause the device to be more effective and/or lowers the cost. Not more than two requirements should be omitted.

Criteria (Applicable to both modules):

1. The device's main circuitry should draw a low current as to prolong the device's battery life. (The lower the current draw is the better).
2. The device should have a small form factor (The smaller the device is the better).
3. The device should be user friendly.
4. The cost should be as low as possible (The lower the cost is the better).
5. The environmental impact should be considered whilst designing and testing the device.
6. The reparability and upgradability need to be considered.

Procedures:

1. *Conduct a literature study to find suitable components:*
   Study literature about pre-existing GPS Trackers to find out how they work. Identify what components(materials) will be required to make the GPS device. Find the best components to for fill the design requirements.
2. *Design the first prototype of the core module:*
   The goal of the first prototype will be to test the concept. The components will be tested to determine whether they meet the design requirements. The first revision of the software will also be created in this step.
3. *Analyse and discuss the results of the first prototype of the core module:*
   In this step the results of the first prototype will be analysed to see whether it meets the design requirements and criteria.

4. *Design the second prototype of the core module of the core module:*
   Using the results of the first prototype see where improvements can be made in the design to make it more compact and better meet the design criteria. Try using less components and test other components to see whether they will work better.
5. *Analyse and discuss the results of the second prototype of the core module:*
   In this step the results of the second prototype will be analysed to see whether it meets the design requirements and criteria. Pay attention that there are no unnecessary features and components.
6. *Design the final prototype of the core module:*
   Using all the results of the previous projects design the final prototype.
   The goal of this prototype is to finalise the hardware, get rid of bugs in the software, make a model that is easily manufacturable.
7. *Analyse and discuss the results of the final prototype of the core module:*
   In this step the results of the final prototype will be analysed to see whether it meets the design requirements and criteria. Think about what the shortcomings of the device is. Think of ways the design can be improved in the future to eliminate or minimalize the shortcomings.
8. *Design the first prototype of the datalogging module:*
   The goal of the first prototype will be to test the concept and chosen components and to write a modified revision of the software that allows the core module to interact with the datalogging module.
9. *Analyse and discuss the results of the first prototype of the datalogging module:*
   In this step the results of the first prototype will be analysed to see whether it meets the design requirements and criteria.
10. *Design the final prototype of the datalogging module:*
    In this step a final design for the datalogging module will be made using the results from the first prototype.
    The goal of this prototype is to finalise the hardware, make the software works with the new hardware and to make a model that is easily manufacturable and that works well with the core module.
11. *Analyse and discuss the results of the final prototype of the datalogging module:*
    In this step the results of the final prototype will be analysed to see whether it meets the design requirements and criteria. Think about what the shortcomings of the device is. Think of ways the design can be improved in the future to eliminate or minimalize the shortcomings. Also pay attention on how well the datalogging module works in conjunction with the core module.
12. *Final Report:*
    Document the entire project including the literature study. Include all work done, document how all the procedures were followed. Conclude the project.

Data Analysis:

The data gathered in this project will be analysed using the following procedures:

1. How many of the design requirements does the prototype for fill. If the prototype doesn't for fill one of the requirements include the reason for this shortcoming. Provide ways that the device can be altered to get rid of in these shortcomings in the requirements.
2. Compile a table like *Table 1* to analyse how well the design for fills in the design criteria. List ways how the device can better fit in the criteria.

3. Decide whether the device successfully met the requirements based on the analysed data. If it does not yet successfully meet the requirements use the analysed data to improve upon the design and create a new design and prototype.

Table 1: Analysis of prototype to design criteria.

Criterion	How well does the device meet the criterion?	What can be done to make the device better meet the design criteria?
Example: The device's main circuitry should draw a low current as to prolong the device's battery life. (The lower the current draw is the better).	The device has a size of 15 cm * 16 cm * 20 cm. It meets the criterion quite well.	A different sim card slot like the ~~example~~ reader can decrease the size to 15 cm*16cm*15cm

Bibliography

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