UNIVERSITY OF MORATUWA, SRI LANKA
Faculty of Engineering
Department of Electronic and Telecommunication Engineering
Semester 4 (Intake 2020)

EN2160 - Electronic Design Realization

Preliminary Design Report

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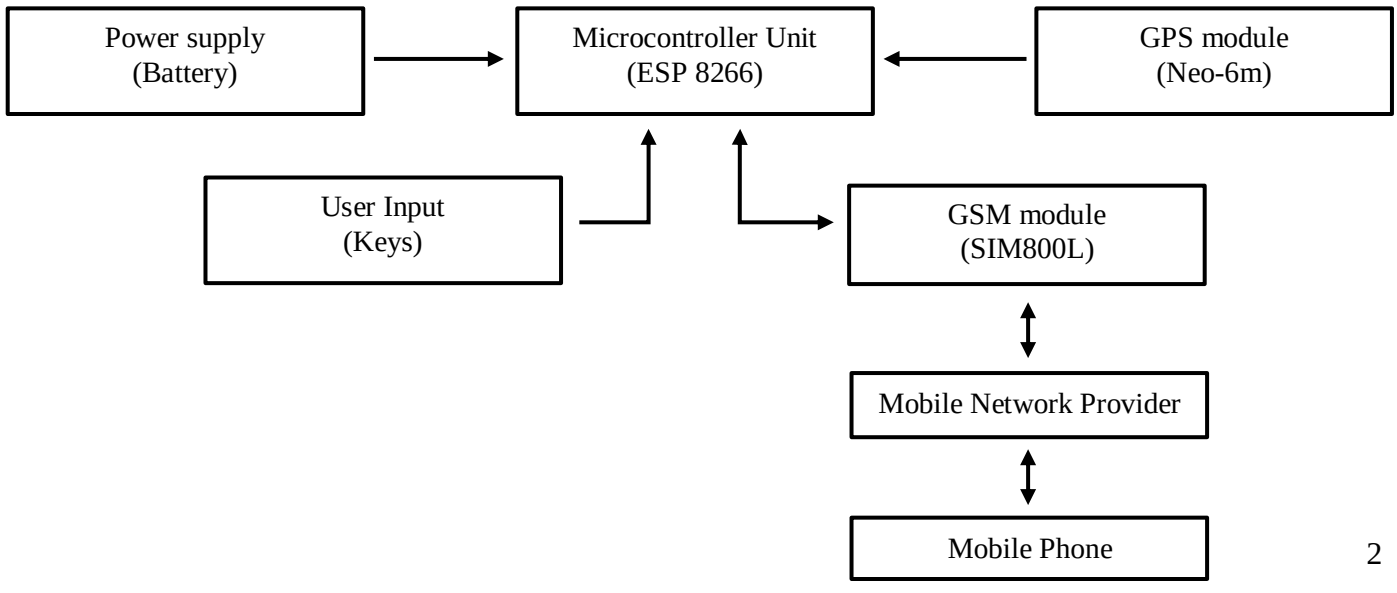
1. Introduction

This report documents the preliminary design process for a GPS tracker and compares the initial design with the design improvements made after gaining new knowledge from lectures. The report will cover the implemented (initial) preliminary design, identify problems considering the course content, and discuss the improvements proposed through brainstorming sessions and user surveys.

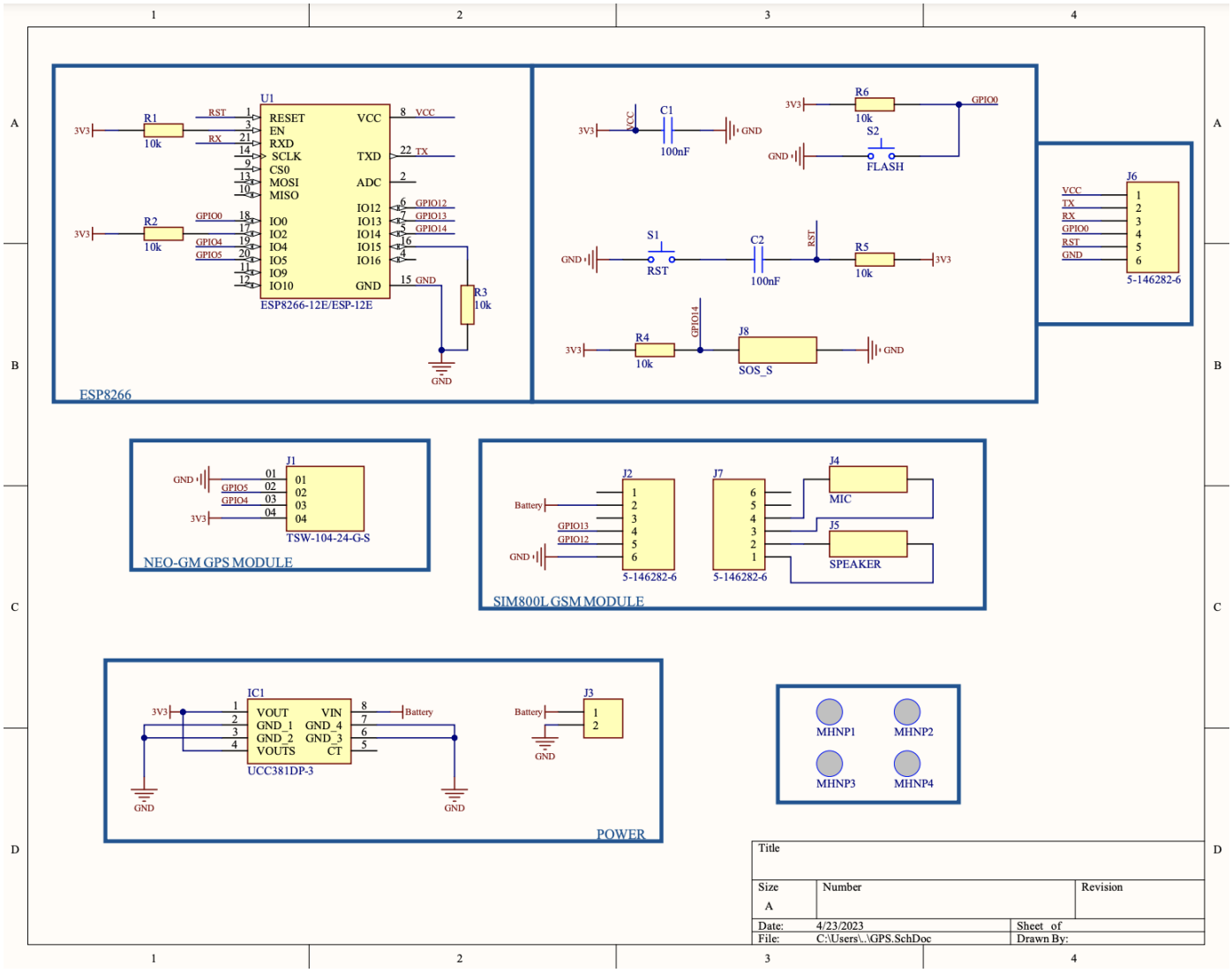
2. Implemented (Initial) Design

2.1 Functional block diagram of the Implemented Design

The initial design of the GPS tracker is very similar to existing products in the market. The additional feature of my design is the ability to alert a given phone number through a SMS message or a call in an emergency situation.
The initial design is powered by a Li-ion battery and the batteries were supposed to be charged by removing from the device and charging in a Li-ion battery charger.

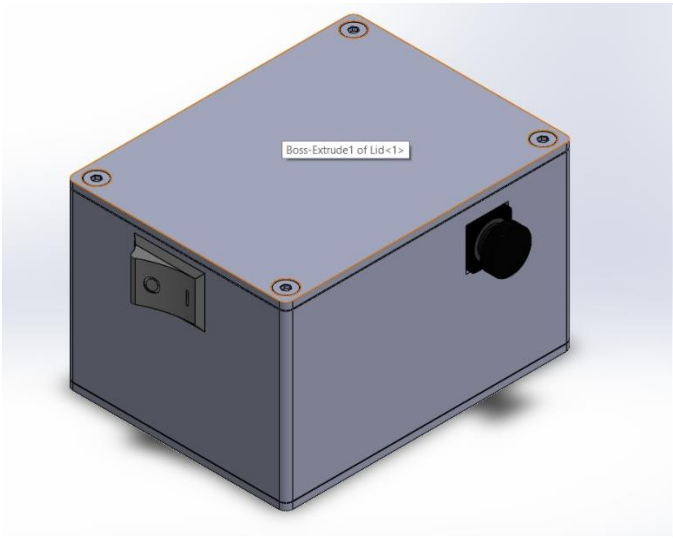


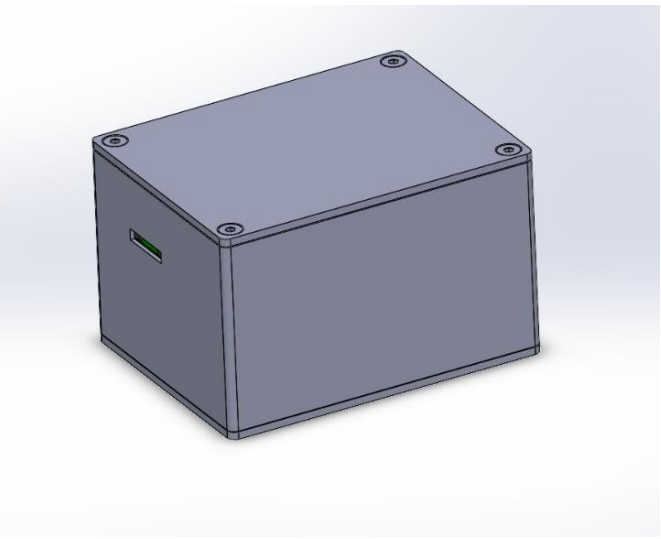
2.2 Schematic design of the Implemented Design



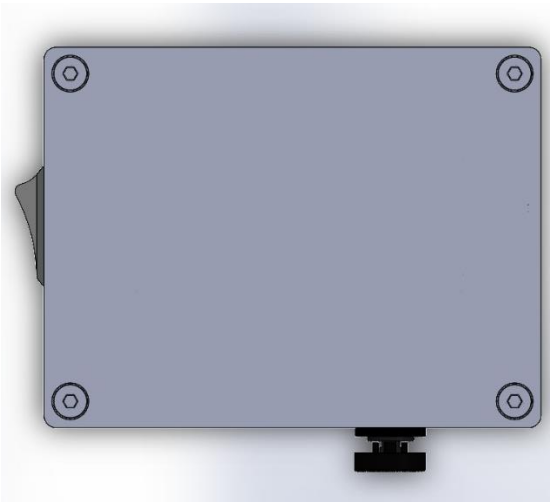
2.3 Solidworks design of the Implemented Design

Isometric View

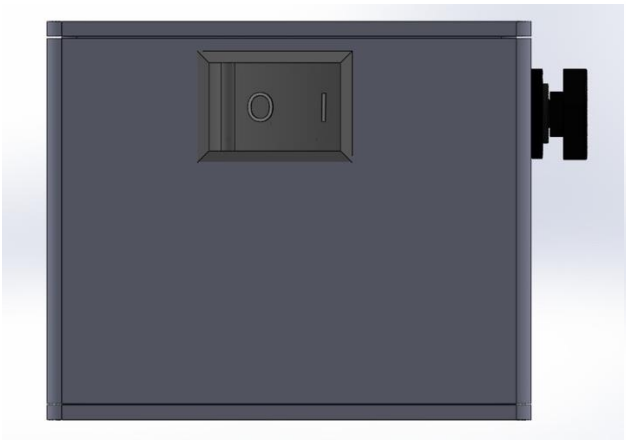




Top View



Side Views



3. Problems identified by considering the course content

The Schematic was not designed in a professional manner :

- Using net labels instead of wire connections to improve the neatness of the Schematic.
- Properly placing components such that inputs and outputs flow from left to right to improve readability.
- Naming components for easy identification from top to bottom and left to right.
- Placing high voltages at the top and low voltages at the bottom.
- Using different sheets for the design and naming them properly.

The Enclosure design :

- The design proposed initially was not visually appealing to the users with rigid structures (instead of aesthetic curvy design).
- The design was not hand-sketched prior to designing on Solidworks.
- Importing the hand sketches into Solidworks and incorporating them in designing the enclosure.

Encloser moldability :

- Draft analysis and the use of Draft tool to design a moldable enclosure.

User need analysis :

- Validating the problem and the solution and considering user inputs by conducting a survey to improve the product implementation.

Design cycle implementation :

- Going through an iterative process of getting input from users and brainstorming sessions, then hand sketching those enclosure designs.
- Rating the proposed designs based on the evaluation criteria and selecting the highest scored design and reiterating the design cycle to improve the quality of the end product.

Product documentation :

- Maintaining accurate and thorough records of the designing process.

4. Problems/Improvements identified/proposed by group members

Problems

- The product enclosure was not very attractive to them, mainly because of the size of the product and also the rigid shape.
- The product was heavy because of the Li-ion battery used.
- When designing the inside of the product, a proper wiring plan was not considered.
- Placement of the switches were inconvenient for the user.

Improvements

- Main improvement was to reduce the size of the product and also to incorporate aesthetic shapes into the design.
- Replacing the rechargeable batteries with a flat lipo battery to reduce the weight and also size.
- Try to integrate all the sensor modules of the product into the PCB to reduce wiring.
- Include proper place holders for antennas of GSM and GPS modules.

5. Problems/Improvements identified/proposed by users

A user survey including the following questions was conducted within the University premises to gather information for the implementation of the device.

Survey Questions:

1. How often do you find yourself in situations where you need to track your location or the location of your belongings?
2. What specific activities or scenarios would you typically use a GPS tracker for?
3. What are the most important features or functionalities you look for in a GPS tracker?
4. Do you prefer a standalone GPS tracker device or a mobile app-based solution?
5. How important is real-time tracking capability for you in a GPS tracker?
6. What is your preferred method of accessing GPS tracking data (e.g., smartphone, web portal, SMS alerts)?
7. Are there any specific environmental or terrain conditions that your GPS tracker needs to be able to handle effectively?
8. How long would you expect the battery of a GPS tracker to last on a single charge?
9. Are there any specific size or weight considerations for the GPS tracker that would be ideal for your needs?
10. What is the price range that is affordable to you for a GPS tracker that provides your specified needs?

The main problems with my initial design that was identified after conducting the User survey were,

- Size of the product
- Rechargeability of the batteries
- User Interface of the GPS tracker
- Accuracy of the GPS tracker

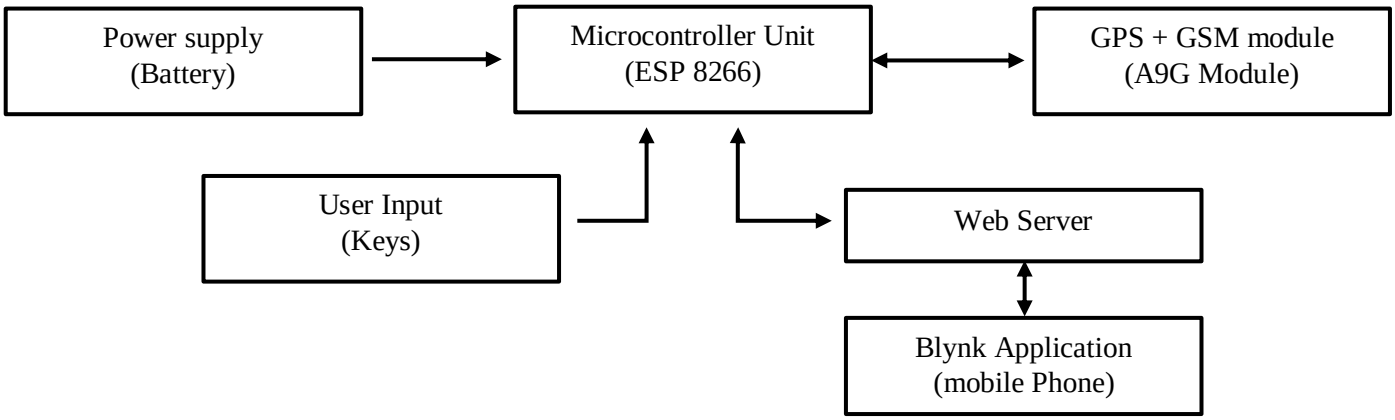
The following features were incorporated into the improved design after considering the User survey results.

- Incorporating curvy shapes into the design.
- Addition of battery charging unit for lipo battery with the Micro-USB port.
- Addition of Blynk app feature to view the GPS location.
- Using A9G board (GSM+GPS) to reduce the product size.

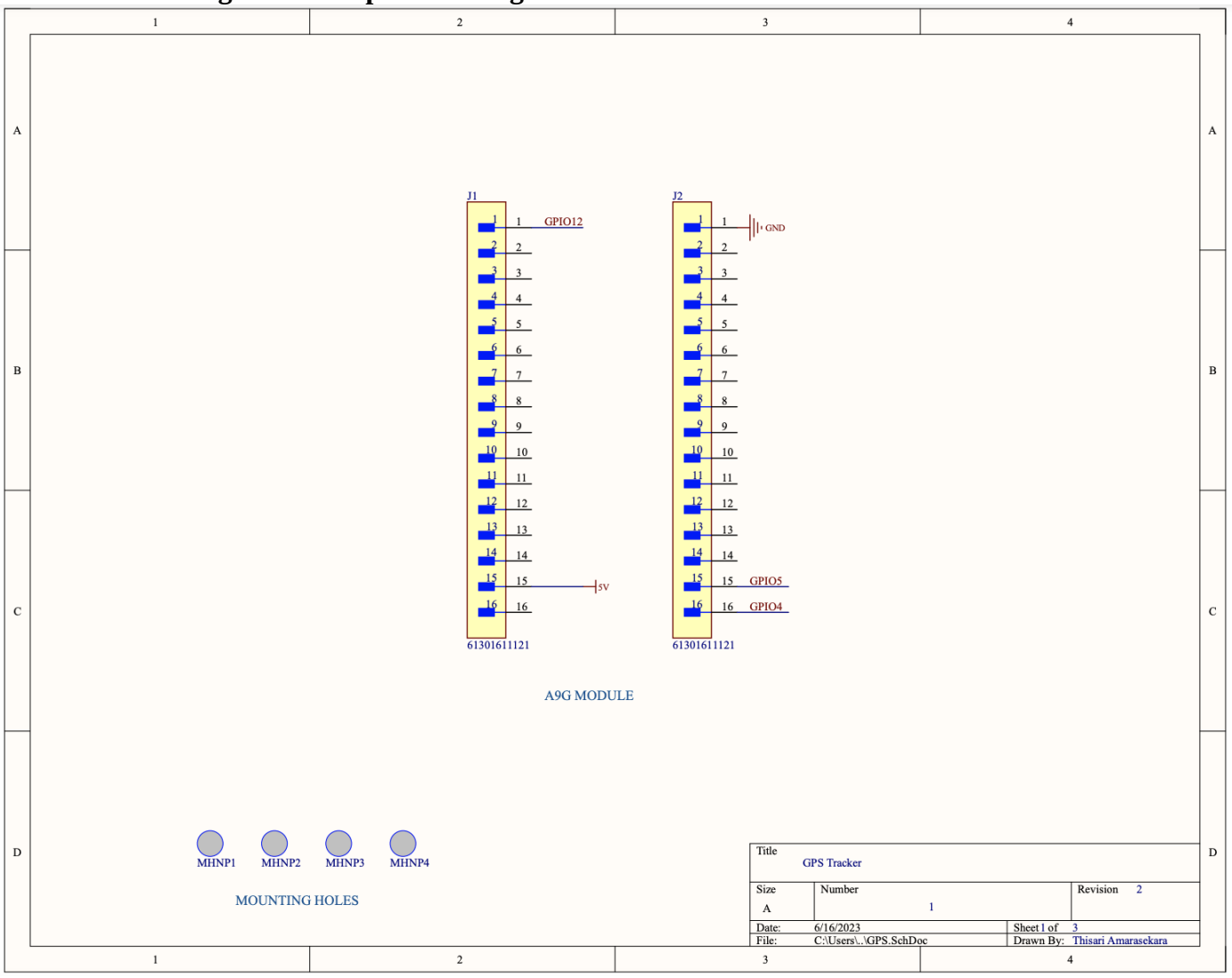
6. Improved Design

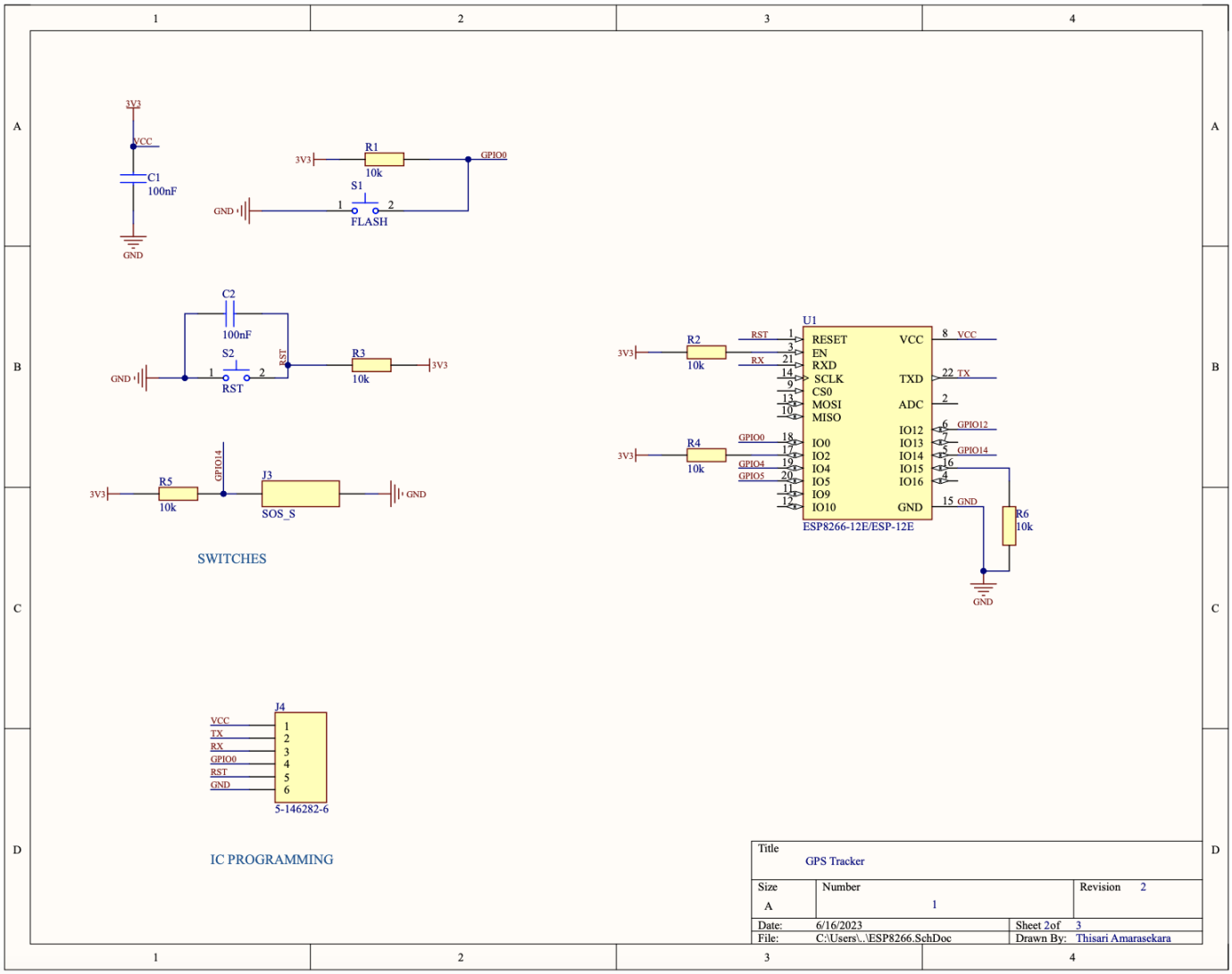
6.1 Functional block diagram of the Improved Design

The improved design of the GPS tracker is incorporated with the features of sending GPS location through SMS as well as through Blynk app. Also, the feature of SMS and Call alert is still incorporated into the design. The device is charged with a lipo battery and can be recharged using the Micro-USB charging.



6.2 Schematic design of the Improved Design

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100nF
GND
R1
10k
GPIO0
S1
FLASH
C2
100nF
S2
RST
R3
10k
R5
10k
GPIO14
J3
SOS_S
SWITCHES
U1
RESET
EN
RXD
SCLK
CS0
MOSI
MISO
IO0
IO2
IO4
IO5
IO9
IO10
VCC
TXD
ADC
IO12
IO13
IO14
IO15
IO16
GND
ESP8266-12E/ESP-12E
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R6
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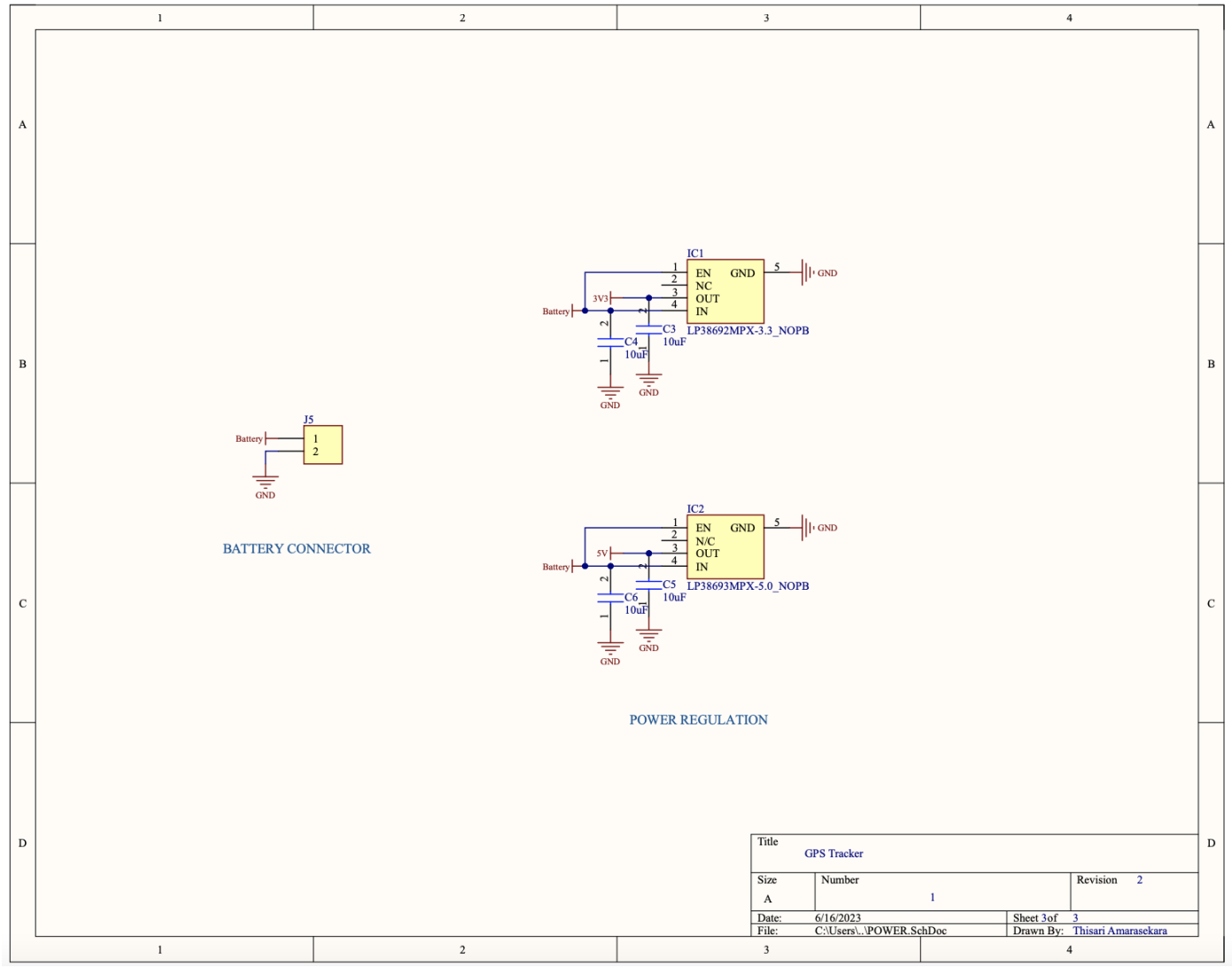
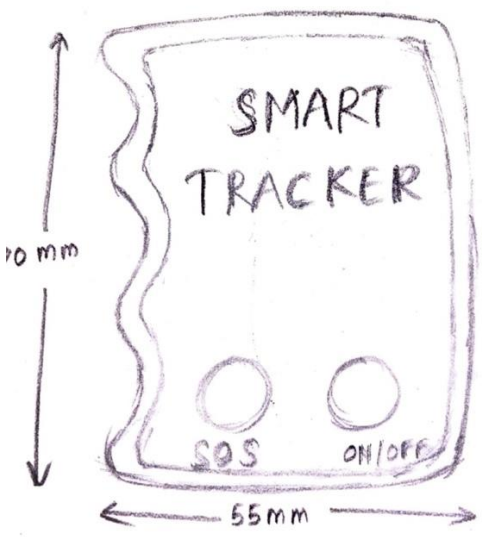
Drawn By:
Thisari Amarasekara



6.3 Solidworks design of the Improved Design

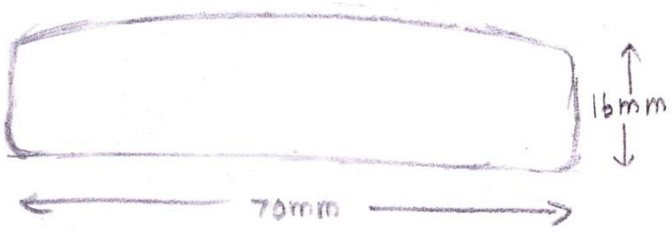
Hand Sketches

Front View:



Side View:

Bottom View:

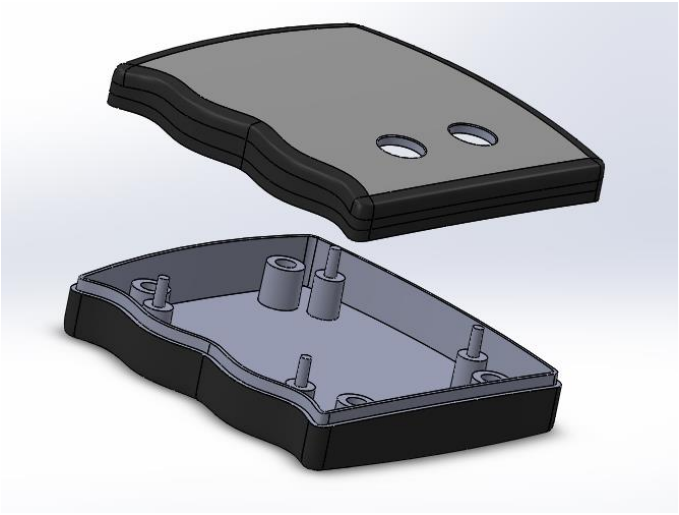


Solidworks Design

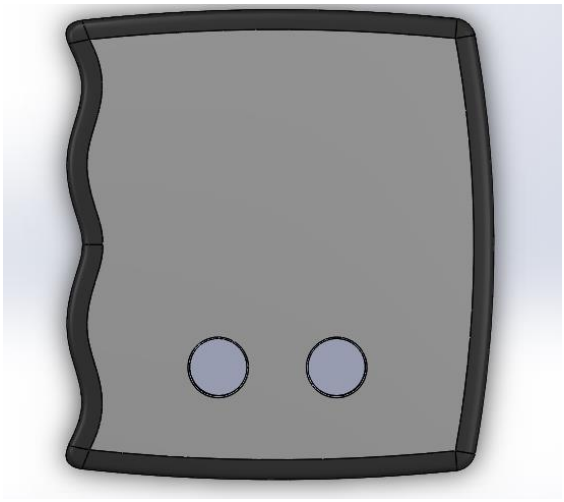
Hand Sketches incorporated in the Solidworks design:

Isometric View:

Two Parts:

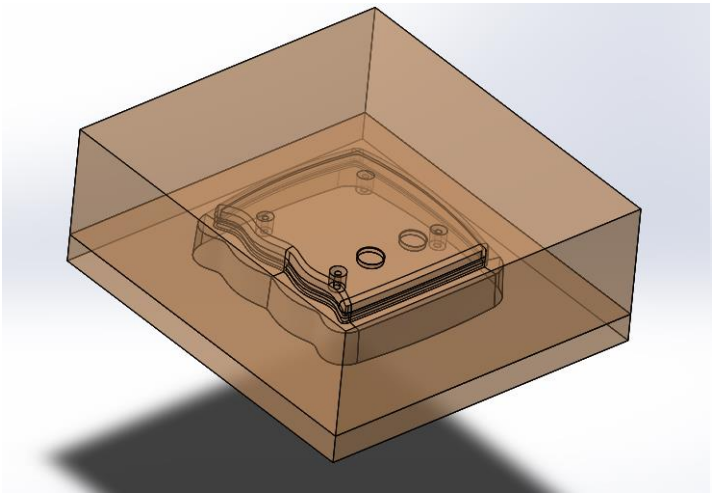


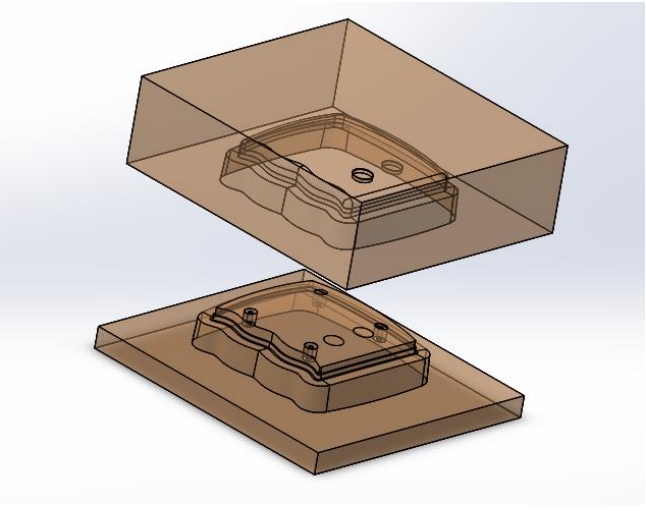
Front View:

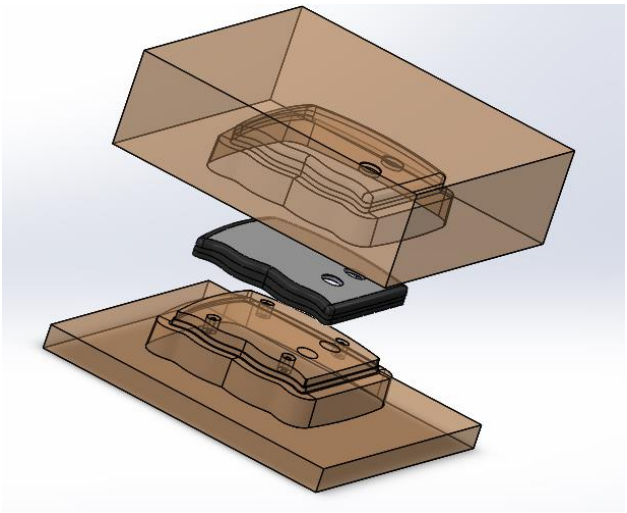


Side View:

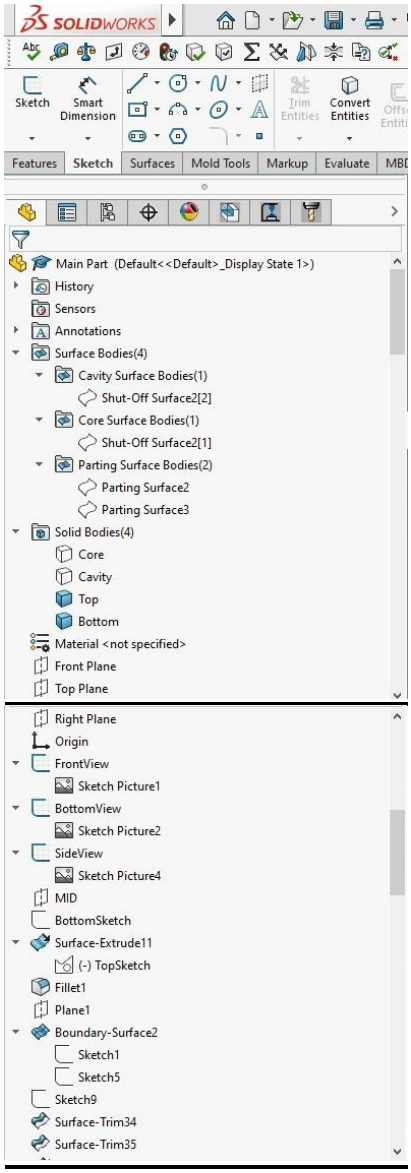
Mold Design

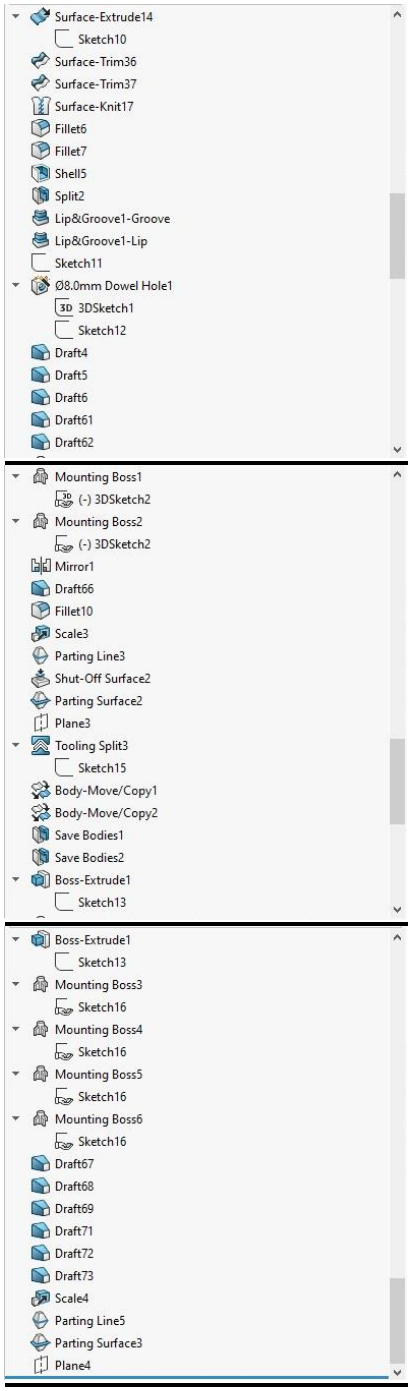






Model Tree


SOLIDWORKS
Sketch
Smart Dimension
Trim Entities
Convert Entities
Features
Sketch
Surfaces
Mold Tools
Markup
Evaluate
Main Part (Default<<Default>_Display State 1>)
History
Sensors
Annotations
Surface Bodies(4)
Cavity Surface Bodies(1)
Shut-Off Surface2[2]
Core Surface Bodies(1)
Shut-Off Surface2[1]
Parting Surface Bodies(2)
Parting Surface2
Parting Surface3
Solid Bodies(4)
Core
Cavity
Top
Bottom
Material <not specified>
Front Plane
Top Plane
Right Plane
Origin
FrontView
Sketch Picture1
BottomView
Sketch Picture2
SideView
Sketch Picture4
MID
BottomSketch
Surface-Extrude11
(-) TopSketch
Fillet1
Plane1
Boundary-Surface2
Sketch1
Sketch5
Sketch9
Surface-Trim34
Surface-Trim35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Sketch10
Surface-Trim36
Surface-Trim37
Surface-Knit17
Fillet6
Fillet7
Shell5
Split2
Lip&Groove1-Groove
Lip&Groove1-Lip
Sketch11
Ø8.0mm Dowel Hole1
3DSketch1
Sketch12
Draft4
Draft5
Draft6
Draft61
Draft62
Mounting Boss1
(-) 3DSketch2
Mounting Boss2
(-) 3DSketch2
Mirror1
Draft66
Fillet10
Scale3
Parting Line3
Shut-Off Surface2
Parting Surface2
Plane3
Tooling Split3
Sketch15
Body-Move/Copy1
Body-Move/Copy2
Save Bodies1
Save Bodies2
Boss-Extrude1
Sketch13
Boss-Extrude1
Sketch13
Mounting Boss3
Sketch16
Mounting Boss4
Sketch16
Mounting Boss5
Sketch16
Mounting Boss6
Sketch16
Draft67
Draft68
Draft69
Draft71
Draft72
Draft73
Scale4
Parting Line5
Parting Surface3
Plane4