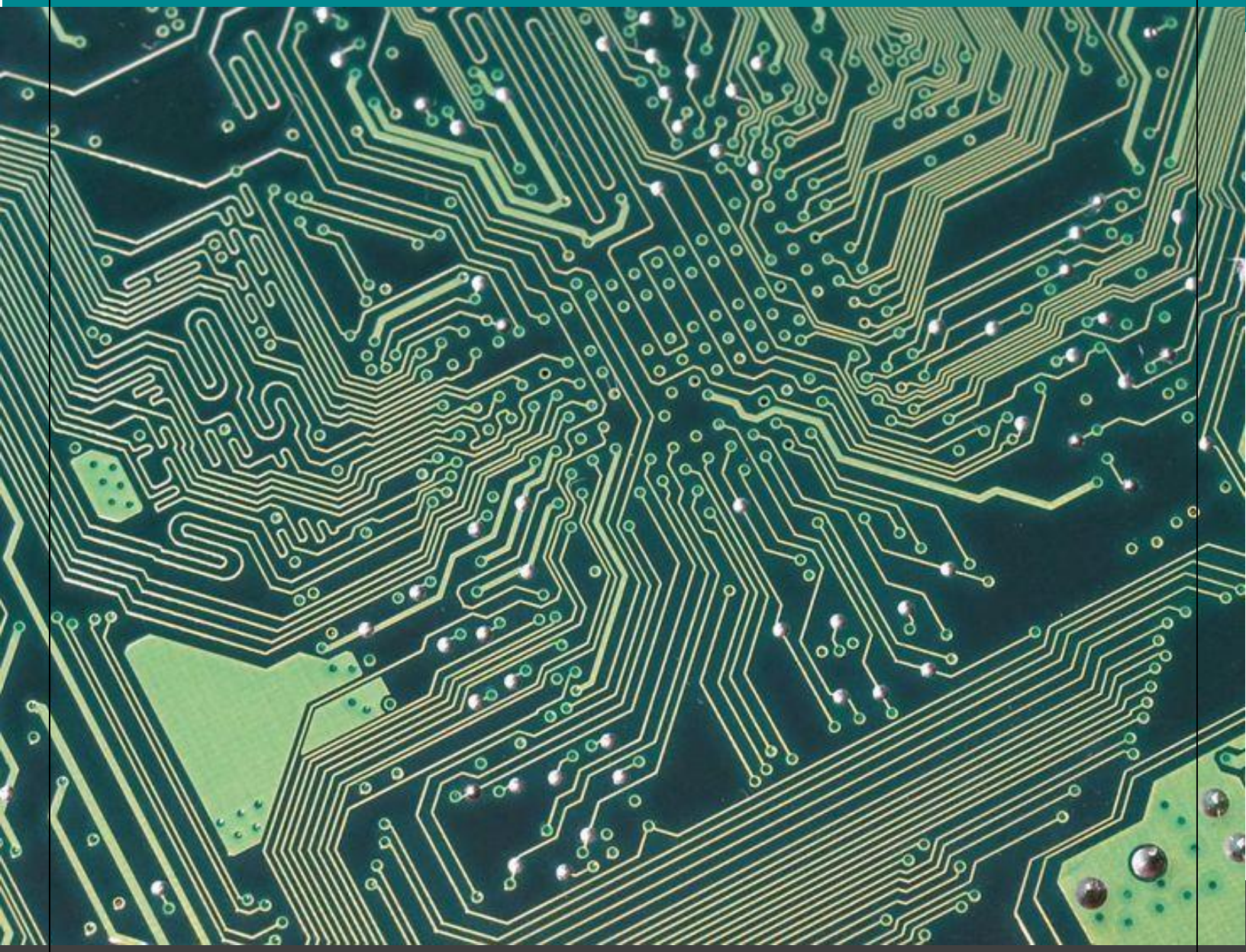
EN 1190 Engineering Design Project



Project Report – Mobile Phone Detector

Team - EN - 25

WIJESIRI H.D.K.G. (wijesirihdkg.20@uom.lk, 200728R)
WIJETHUNGA C.K. (wijethungack.20@uom.lk, 200732A)
WIJETUNGA W.L.N.K. (wijetungawlnk.20@uom.lk, 200733D)

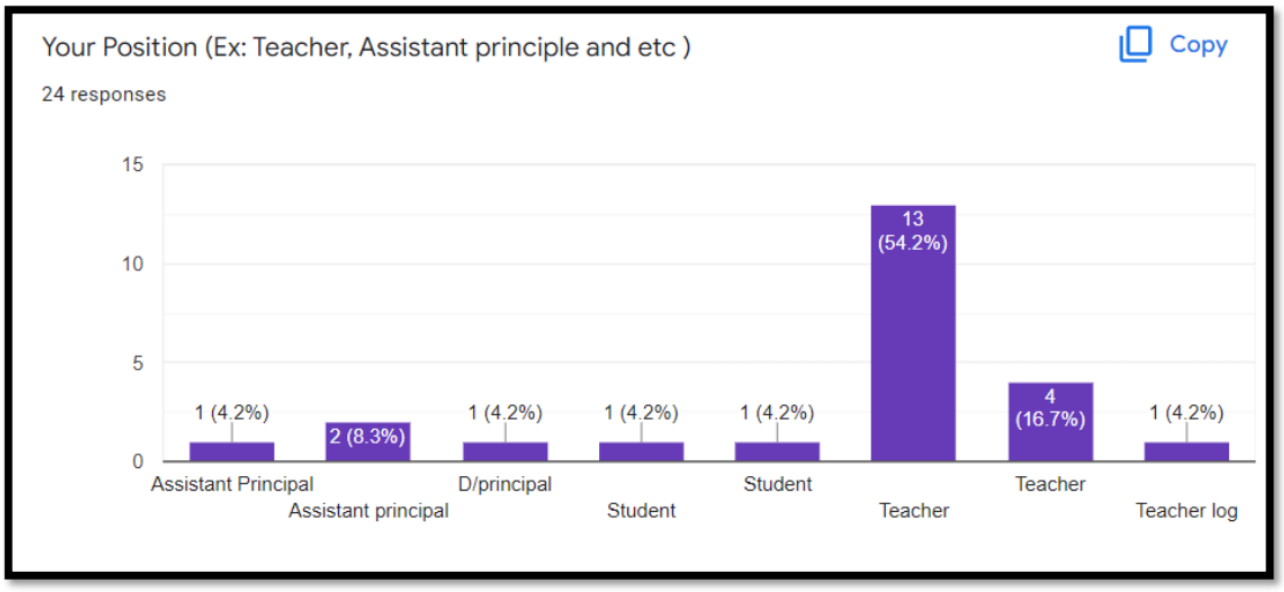
A. Problem Description, Motivation and Justification for Selection

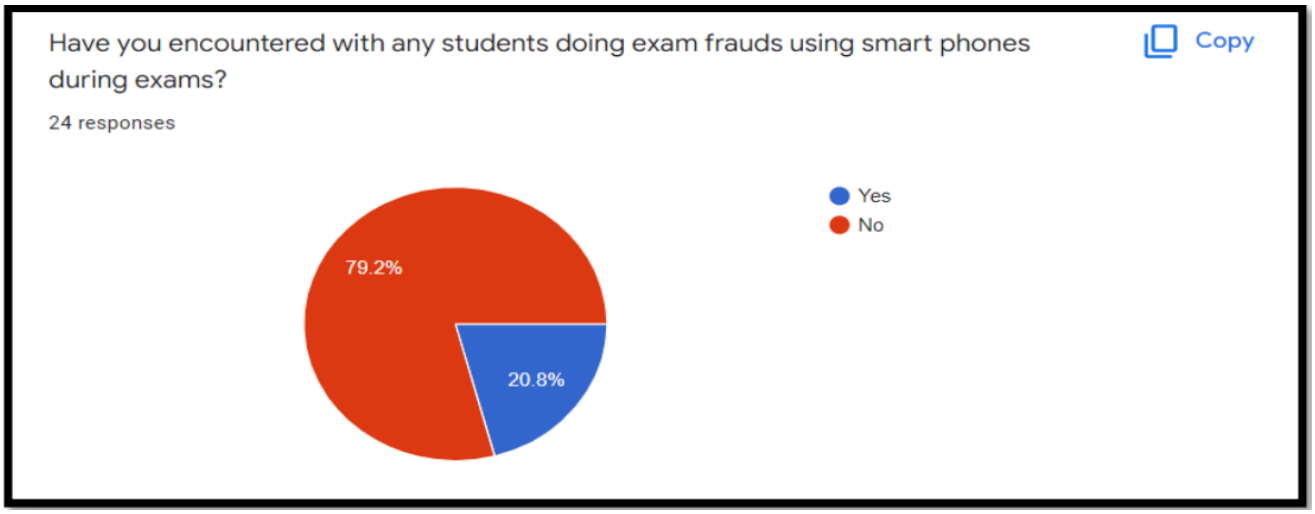
i. Cheating in examinations with mobile phones and its consequences

One of the major reasons that make students cheat in exams is the overemphasis that has been placed on passing exams. More effort has been directed towards passing exams than learning due to the high competition in the job market in Sri Lanka. With the competitive examinations happening in Sri Lanka, students tend to cheat during examinations irrespective of their age using traditional cheating methods including hiding notes in a pencil case, behind ruler, or clothes, writing on arms/hands, leaving the room, etc.

With the improvement in technology and with the COVID – 19 pandemic situation, students tend to use electronic devices such as smartphones, laptops and personal computers more often to access study materials and to attend classes through the internet. The advancement and wide usage of mobile phones have promoted them to become the learning media. Their interaction with smartphones increased rapidly and with that, students got to know more tips and tricks about smartphones. It led to another type of examination fraud, “Making examination frauds using smartphones”. This trend is still in the early stages of the examinations held at school.

The following survey which was done in a school community proves the above fact.





According to this survey, still, the number of exam frauds done using smartphones is quite less because examinations held at school are not cared for by most of the students.

But when it comes to examinations like GCE Ordinary Level examination and Advanced Level examination, major exam frauds which include using electronic devices (especially smartphones) during the examination was recorded in the recent examinations.

• A/L exam cheating via WhatsApp: Student detained Investigations have been launched into the actions of a teacher who had assisted a student in Mannar to answer a GCE Advanced Level Examination paper. The teacher is reported to have used WhatsApp to send answers to the student from the Madhu area in Mannar to answer the question paper.

Source - https://www.newswire.lk/2022/02/17/a-l-exam-cheating-via-whatsapp-student-detained/

• Exam fraud: Lifetime ban imposed on A/L student. A lifetime ban has been imposed on the student who was found guilty of leaking the GCE A/L Chemistry paper, from sitting any examinations held by the Examination Department, the department said.

Source - https://www.dailymirror.lk/breaking_news/Exam-fraud-Lifetime-ban-imposed-on-A-L- student/108-135870

From a general point of view, cheating creates unfair competition amongst students in a class (Tee and MacKown, 2014). The implications of examination-malpractice among students are frightening and devastating. Examination –malpractice

destroys the foundation and fabric of any educational system. It makes formal assessments unreliable, educational-objectives unattainable and portends a bleak-future for any society. The emergence of e=cheating has added to the challenges of conducting credible and reliable examinations (Alonge, 2003). Our education system is globally recognized. Therefore, exam cheating may cause to decrease in that level. So, we must think about it deeply and at least try to reduce them from our examination system. If not, clearly the victims will be the students of our country.

It is clear that some students have a clear motive to do exam fraud during the examinations and the tendency of bringing mobile phones to the examination halls will increase.

In (Martin et al., 2020), it has been shown that online learning publications are continuously being increased from 2009 to 2018, and one of the leading research themes is course assessment. Course assessment is very challenging in online learning due to the lack of direct control over students and educators.

Although a considerable number of literature reviews exist about online learning, there is no such review study to provide comprehensive insight into cheating motivations, cheating types, cheating detection, and cheating prevention in the online setting.

According to a research analysis on cheating of cellphone-based cheating on entrance exams by Hiroko Kanoh (Yamagata University, Japan),

- Finding out one's answers by searching via the internet using a cellphone has an average of 9.45 out of 10.
- Send spoofing e-mails has an average of 8.27 out of 10.

Technological advances and online learning have enhanced education; however, they also have facilitated cheating in courses (Turner & Uludag, 2013). For instance, an examinee could use a mobile phone to text someone to get the answer. Although this would be difficult in the exam hall, some examinees could text without looking at their mobile phones. Applying scientific calculators, Mp3 players calculator, and wireless equipment such as an earphone and a microphone are other tools that facilitate cheating in offline exams (Curran et al., 2011).

ii. Problem Statement

Previously, there was no technology to detect the cell phones in the examination hall and in cell phone restricted areas. There is manual checking and there is still a chance of having the cell phone with the person if he is not checked properly. Most of the examinations held by the Department of Examinations in Sri Lanka are held in classrooms at government schools which do not have detectors to detect any switched-on mobile phones. Schools cannot afford to buy such detectors with the current monetary crisis in the country and with the high price of mobile phone detectors in the markets. And, if they want to buy them, they need a higher number of units to be installed in every classroom.

iii. Motivation

The purpose is to design, fabricate and validate the detection-system. Although this design is particularly focused on preventing cheating in examinations, this work is also potentially useful not only for mobile-phone detection during examinations, but also for other unauthorized-usage of mobile-phones in restricted/sensitive areas with limited prohibited mobile-phone-assess.

B. Technical Feasibility

Circuit components

- Voltage source = 9V Dry cell
- An inductor of 10uH
- Resistors of following values
  - 10 Ohm - 1
  - 100 Ohm - 2
  - 200 Ohm - 1
  - 3 kilo Ohm - 1
  - 100 kilo Ohm - 1
- A capacitor of 100nF
- A npn transistor
- An IC
- A red LED
- A buzzer

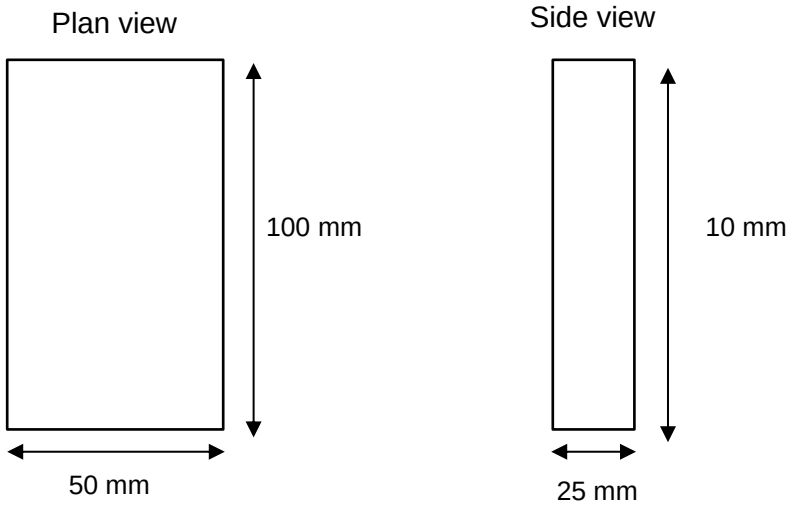
Here we are going to use the concept of when a mobile phone is active, it radiates RF signal that passes through nearby space. The signal contains electromagnetic RF radiation from the phone.

It can be made within three days if relevant components are available.

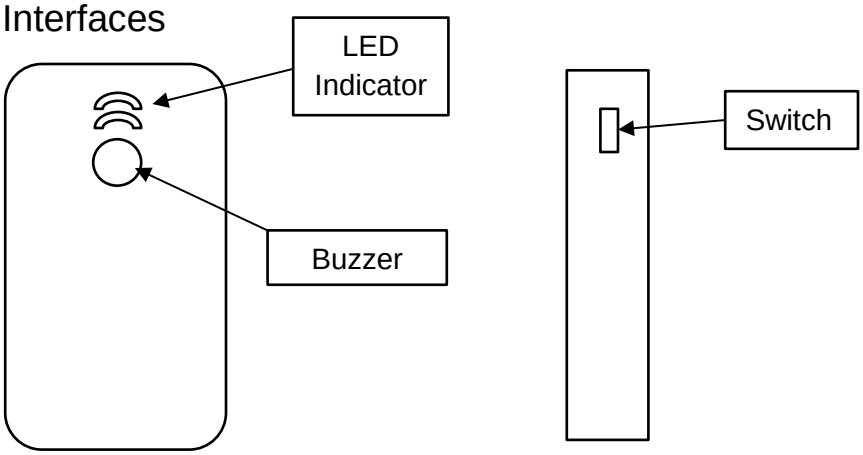
C. Technical Specifications

Key features of the mobile phone detector which is proposed will be as follows.

- Physical dimensions



- Interfaces



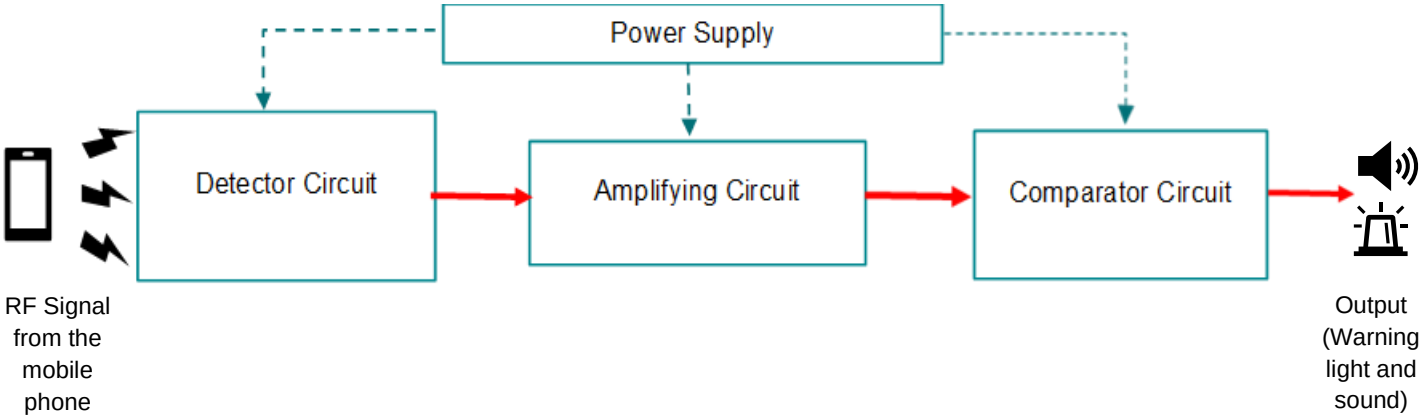
- Weight - 250 g
- Power consumption - 0.01 W

D. Product Architecture

In the mobile phone detector that is proposed in the proposal, there will be 3 main circuits to perform the task.

- A detector circuit
- An amplifying circuit
- A comparator circuit

Therefore, the block diagram of the circuit will be as follows.



I. Detector Circuit

The detector circuit will be used to detect RF signals from the activated mobile phone. The following components will be there in the detector circuit.

- An inductor
- A Schottky diode
- A ceramic capacitor
- A resistor

When the mobile phone is receiving or sending a text, call or streaming using cellular data, the RF signal will induce a voltage (An AC signal) in the inductor via mutual induction. The Schottky diode will rectify that low frequency AC signal. And finally, the filter capacitor will rectify the AC ripples which will be there in the signal and the resulting signal will be the input for the amplifying circuit.

II. Amplifying Circuit

The amplifying circuit will amplify the output signal of the detector circuit so the signal can be compared with the reference voltage which is applied to the inverting terminal of the comparator.

Here a simple bipolar junction transistor BC 547 in the common emitter configuration will be used to amplify the rectified RF signal. The circuit is biased using a voltage divider which consists of 2 resistors. The operating point collector emitter voltage is maintained at 5V, and collector current will be 2 mA. So, the collector resistor will be around 3K Ohms. The input resistor which will be used to bias the transistor will be a 100K Ohms resistor.

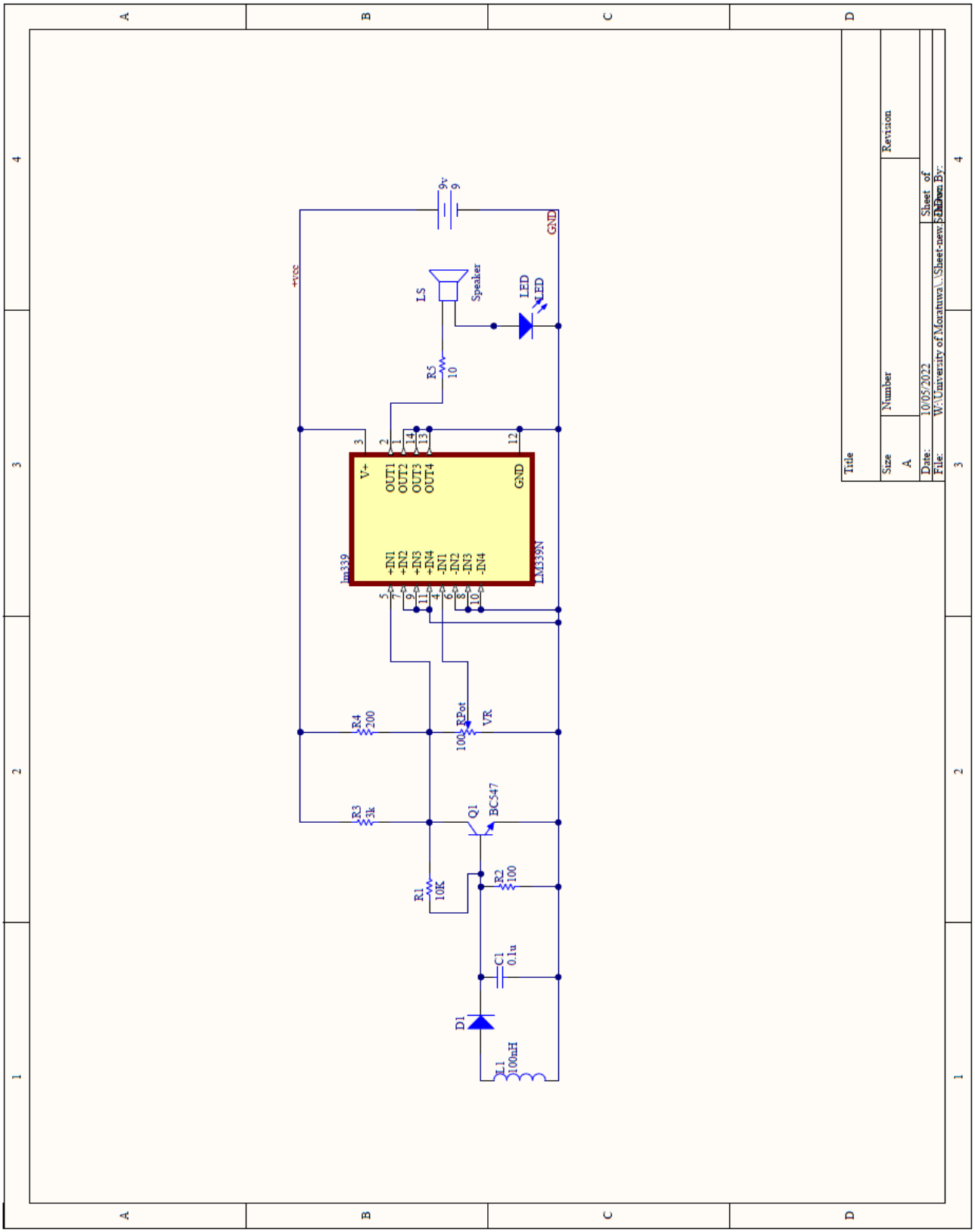
III. Comparator Circuit

As the comparator, an operational amplifier will be used. It will be in the open loop configuration. The output signal of the amplifying circuit will be given as input to the non – inverting terminal of the operational amplifier.

When a RF signal is detected, the voltage at the non – inverting input will rise, and it will be higher than the reference voltage in the inverting input. So, the output of the operational amplifier will be LOGIC high which will switch on the buzzer. When the signal is not present, the reference voltage will be higher than the input voltage, so the output of the operational amplifier will be a low voltage which will stop the buzzer from working.

The reference voltage (Voltage at the inverting terminal) is set low of the order of 4V because the output of the amplifying circuit will be a low value

As the operational amplifier, LM 339 IC will be used. Normally it has 4 comparators but here only one comparator will be enough.


9v
9
GND
+vcc
LS
Speaker
LED
LED
R5
10
V+
OUT1
OUT2
OUT3
OUT4
GND
lm339
+IN1
+IN2
+IN3
+IN4
-IN1
-IN2
-IN3
-IN4
LM339N
R4
200
RPot
100
VR
R3
3k
Q1
BC547
R1
10K
R2
100
C1
0.1u
D1
L1
100mH
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Size
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Number
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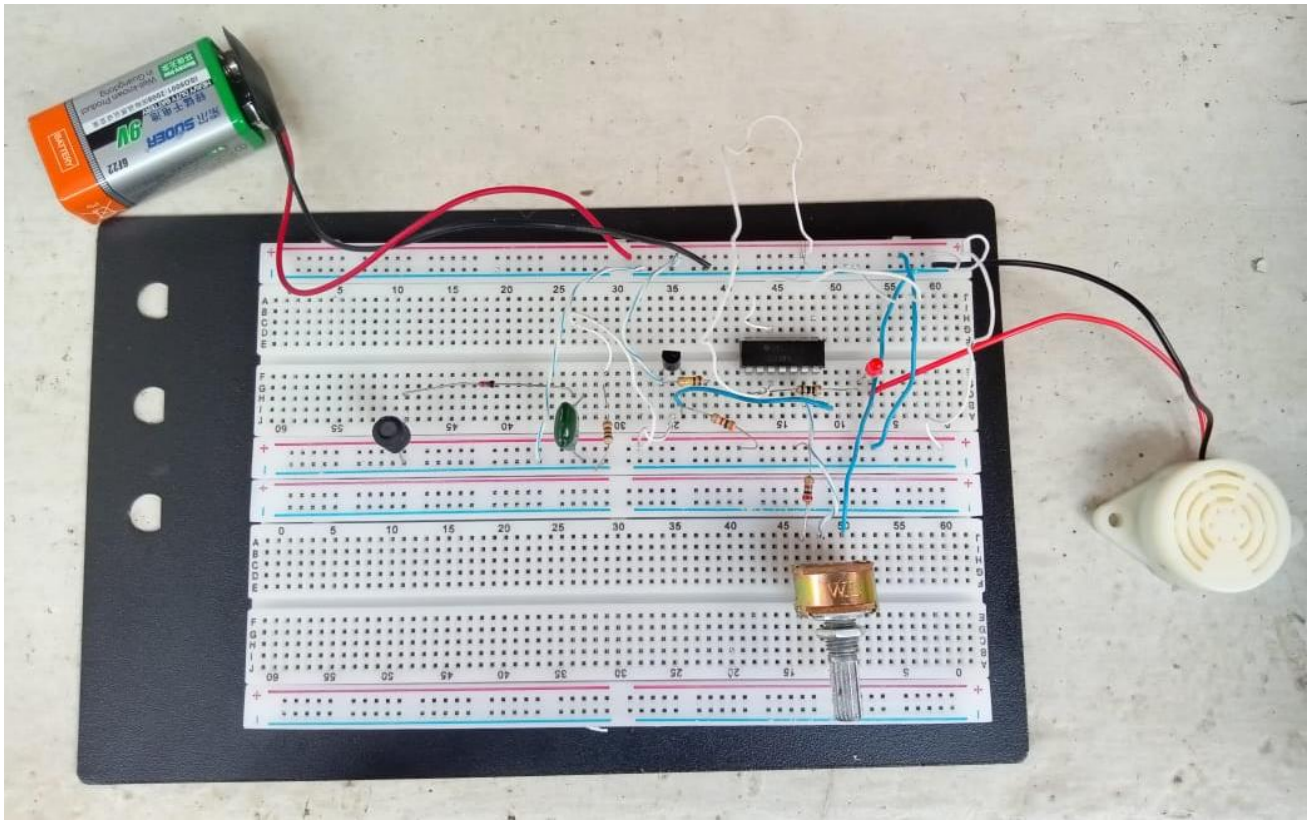
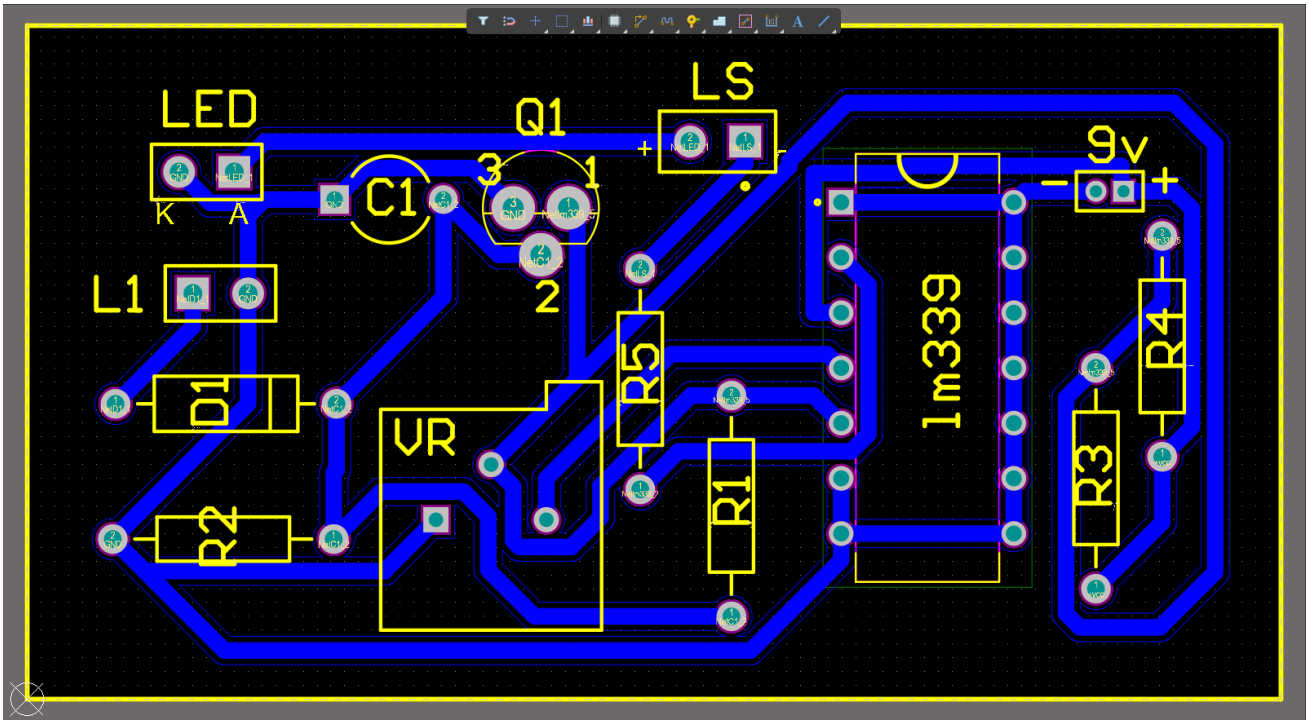
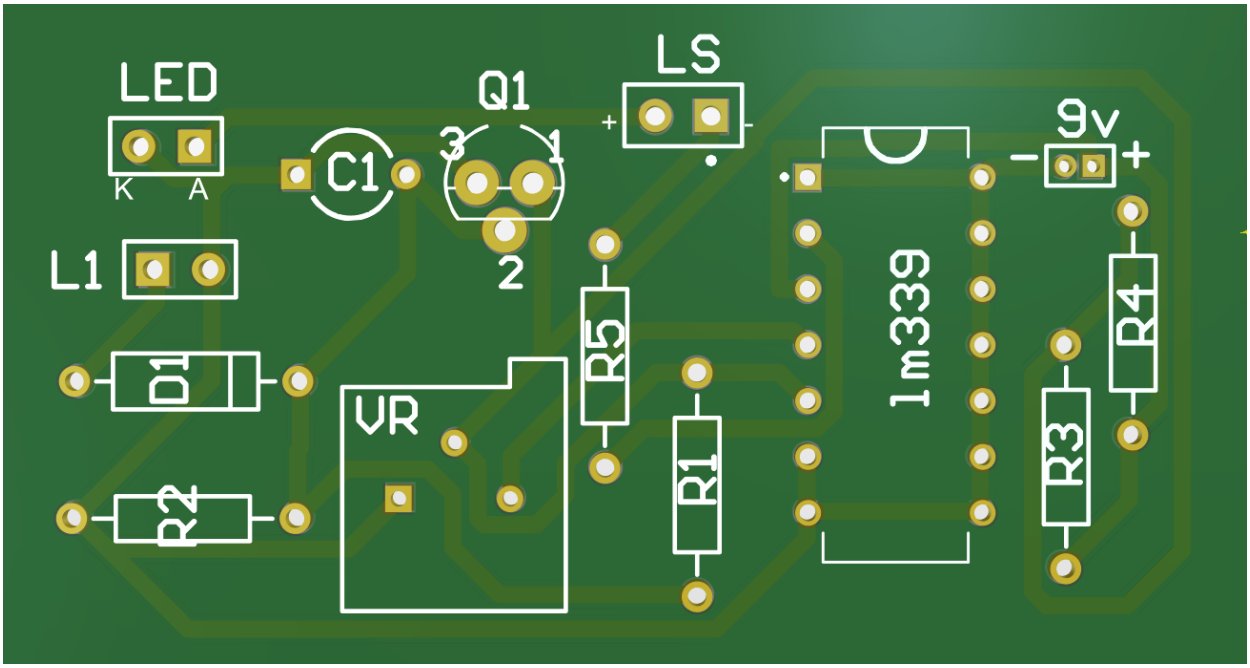
Schematic



Initial circuit design



PCB Design



3D View

Reference

https://www.snapeda.com/search/?q=potentiometer&search-type=parts

https://www.snapeda.com/parts/BC547/ON%20Semiconductor/view-part/?ref=search&t=BC547

https://www.snapeda.com/parts/BAT54/ON%20Semiconductor/view-part/?ref=search&t=BAT54#

https://www.snapeda.com/parts/250-102/WAGO%20Innovative%20Connections/view-part/?ref=search&t=2%20pin%20connecter

https://www.snapeda.com/search/?q=inductor+100nH+with+two+terminals&search-type=parts

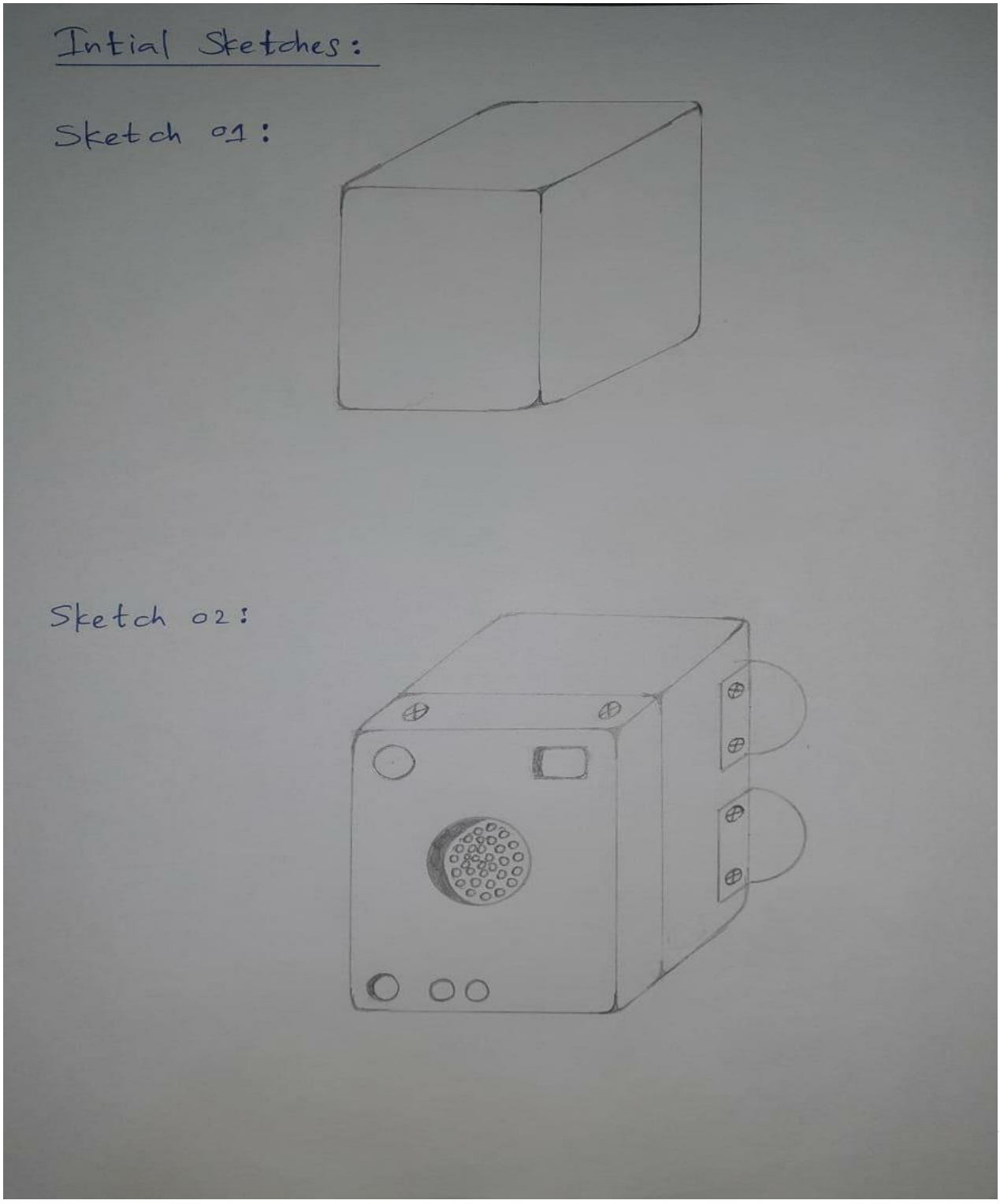
https://www.snapeda.com/search/?q=LED&search-type=parts

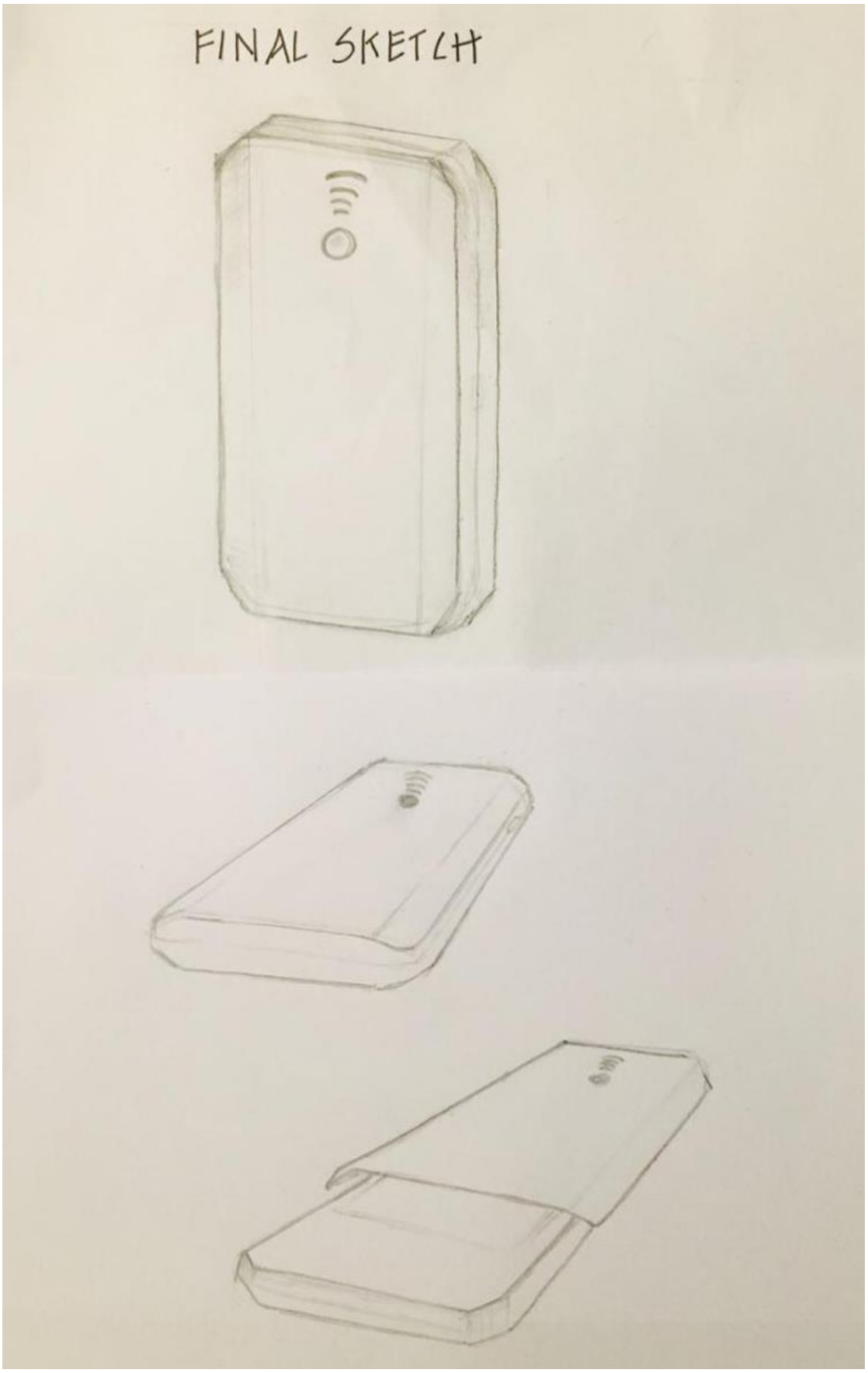
https://www.alldatasheet.com/datasheet-pdf/pdf/3071/MOTOROLA/LM339N.html

https://www.snapeda.com/search/?q=LM339&search-type=parts

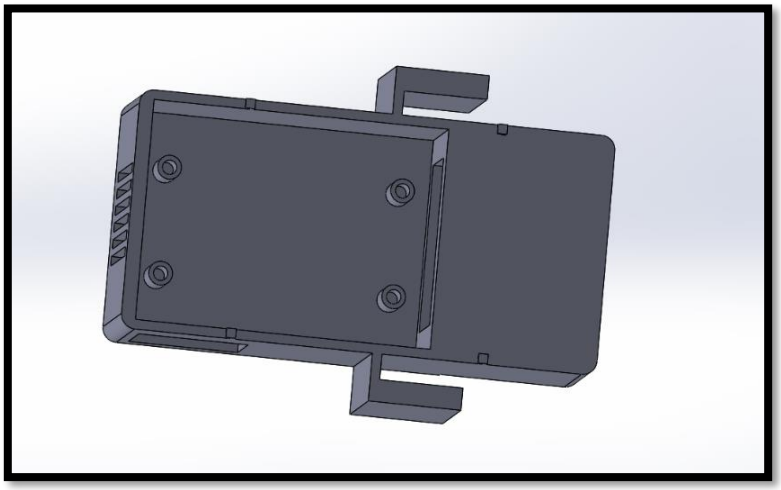
https://www.snapeda.com/search/?q=loudspeaker&search-type=parts

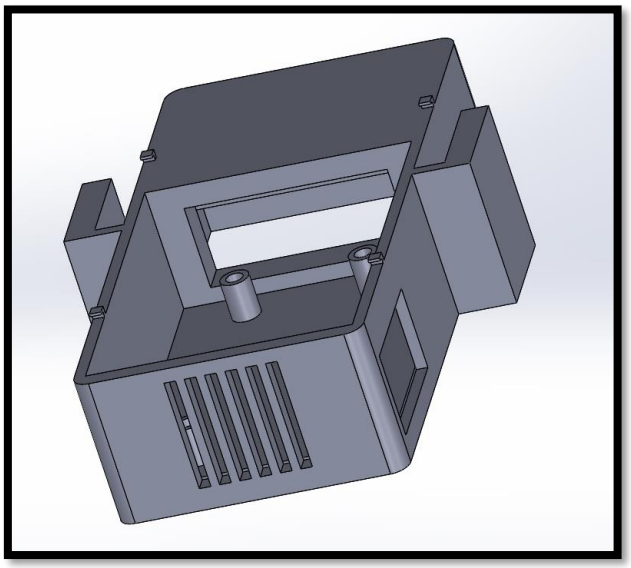
E. Sketches of the Product Enclosure

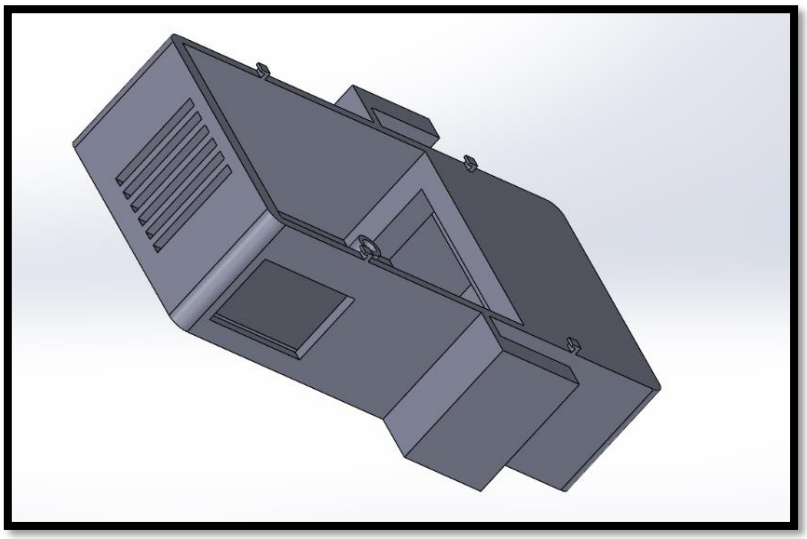


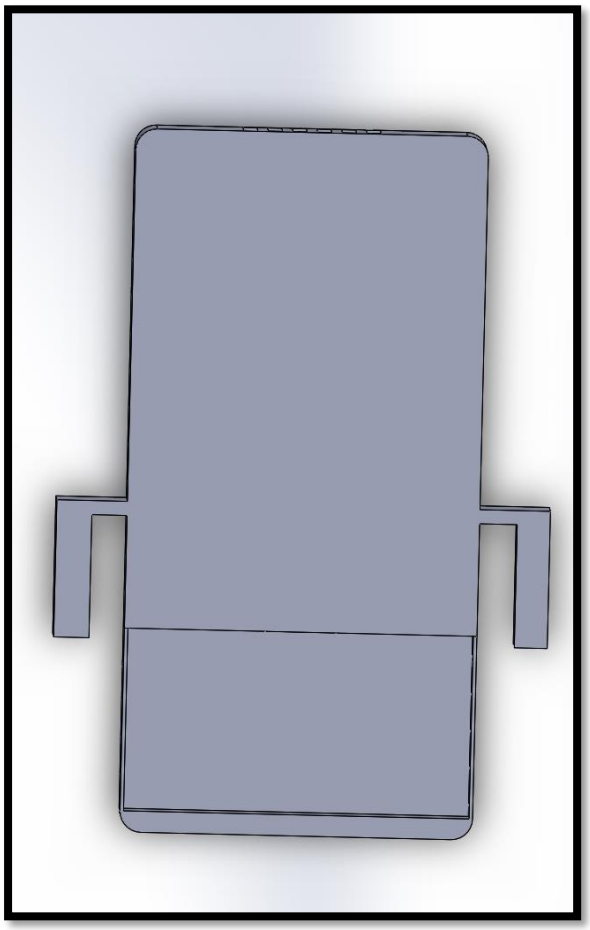

FINAL SKETCH

F. Product Enclosure Design

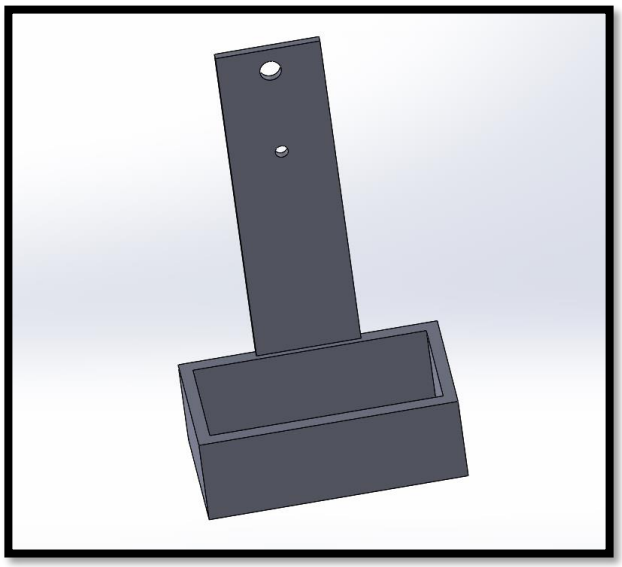


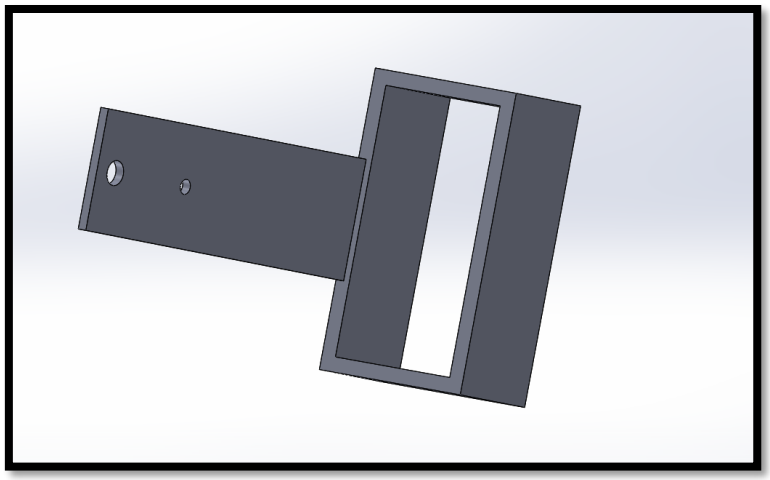




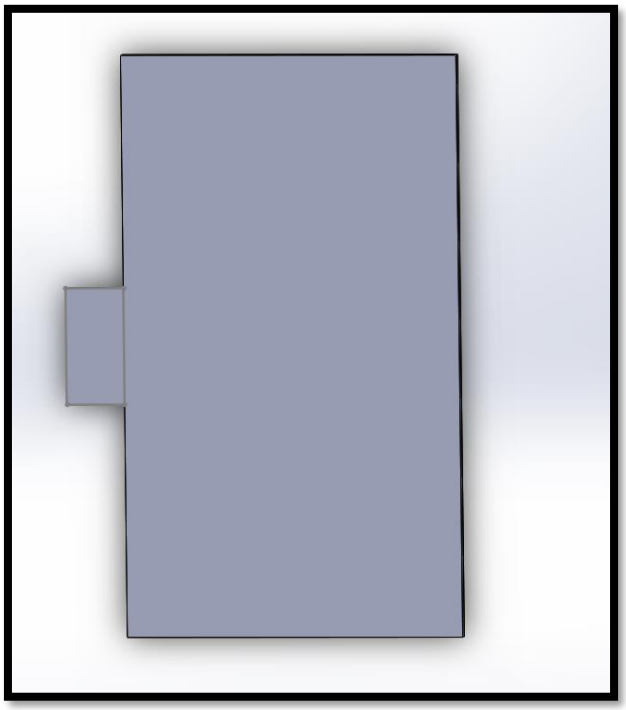


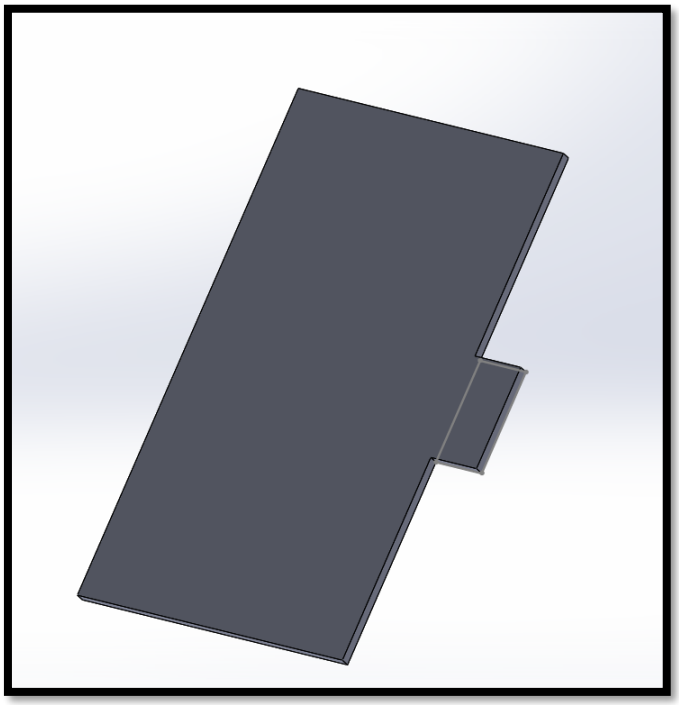
Main box where the PCB and the dry cell are inside.



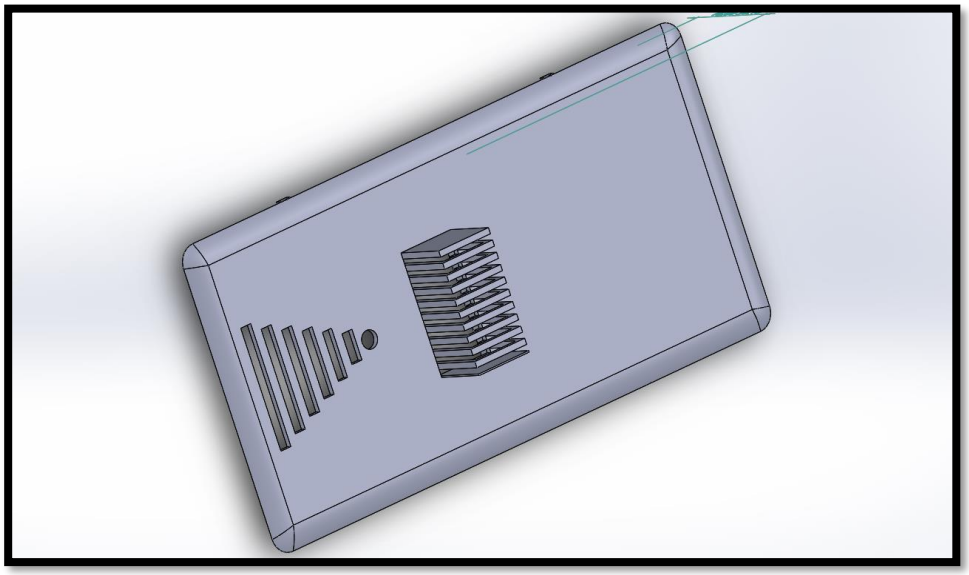


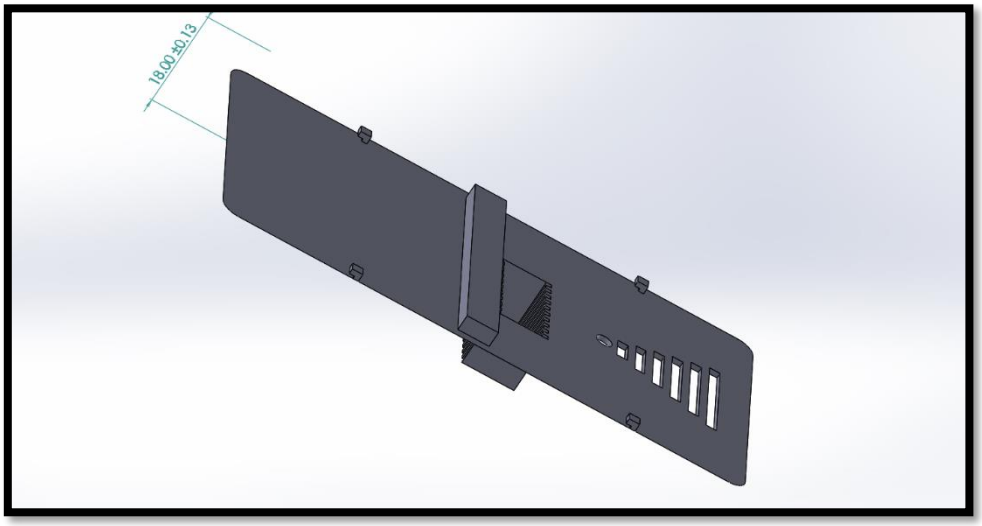
Wall mount design



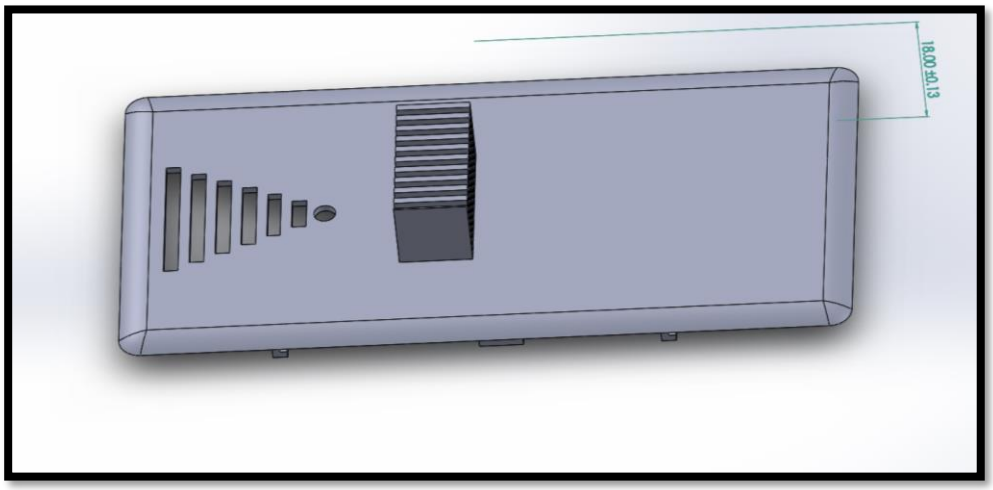


Cover design for the 9V dry cell





Cover design for the main box



G. UI Design

As per the user interface design, controls that are visible for the user will be the switch, the indicator LED, and the buzzer.

The on / off switch is visible because it is only necessary to switch on the device when an examination is taking place in the classroom. Otherwise, unnecessary power dissipation will occur in the circuit draining the dry cell and it is a risk for the circuit components as well.

The indicator LED is made visible because it is the main indicator which shows that a switched-on mobile phone is detected. So, the output of the LED should be clearly visible.

The inductor is also place a bit outside the PCB so the detection can be done without being interfered by the walls of the box.

Other components such as 9V dry cell, the PCB are placed inside the enclosure.

F. Observations and Constraints of the Device

Based on the preliminary observations, it was found out that this device can detect a mobile phone within a radius of 200 millimeters. Since the cost for the components is cheap, it is recommended that at least 5 of these devices should be mounted inside a classroom where an examination is taking place.

The 9V dry cell drains out in a rapid manner when the device is under usage. Further, only one comparator is used in the IC for the operation of

the device. If all the other ICs can also be used, the detection radius can be increased further.

G. Marketing, Sales and Beyond

New device is the cheaters' worst nightmare.

This is small and compact in size, Portable and lightweight, Easy to handle and operate, Simple and easy to construct, Cost-effective, with Less power consumption.

Since the mobile phone detectors in the market are expensive, our product is the best solution.

This can be used to prevent use of mobile-phones in examination halls, and for detecting the use of mobile-phones for spying and unauthorized video-transmission; it is also useful where the use of mobile-phone is prohibited or restricted; in particular, it can be used for military and civil defense purposes to detect mobile phones (subject to increasing its radius of operation- range), and it can be used in hospitals and airplanes where, mobile signals interfere with the electronic-equipment, which may have fatal-consequences.

We can introduce our product to the examination department and use and test the product in selected schools as a marketing plan.

Then we can sell our product to the government. Selling our product in the market with the recommendation from the government is our marketing plan.

We can sell our product to institutions that conduct private tuition classes.

We can place advertisements on social media.

We have a plan to sell our product on local shops and on online selling platforms like eBay.

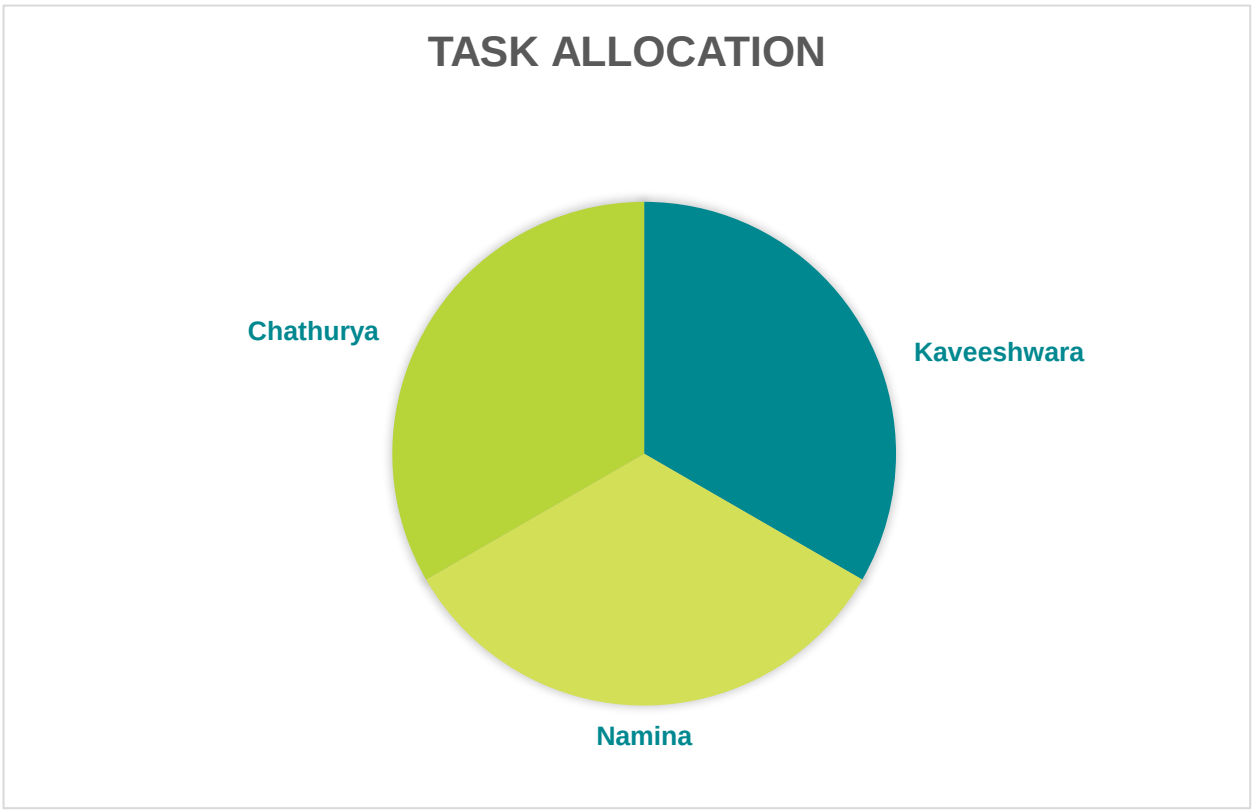
H. Budget with Bill of Quantities

Component	Number of components	Unit price (Rs)	Total price (Rs)
9V Dry cell	1	250	250
10uH inductor	1	8	8
100 Ohm resistor	1	1	1
100K Ohm resistor	1	1	1
3K Ohm resistor	1	1	1
200 Ohm resistor	1	1	1
100 Ohm resistor	1	1	1
10 Ohm resistor	1	1	1
100nF capacitor	1	10	10
BC547 transistor	1	10	10
LM339 IC	1	50	50
RED LED	1	10	10
Buzzer	1	80	80
Switch	1	10	10
Plastic casing	1	1500	1500
Nails	4	5	20
Stickable clips	2	50	100
Total			2054

I. Task Allocation

Group Members- Namina, Chathurya, Kaveeshwara

Task	Start date	End date	Owner/Owners	Duration
Find a problem	14/5/2022	21/5/2022	Three members	7
Analyze problem and choose a solution	21/5/2022	24/6/2022	Three members	3
Design a circuit	24/6/2022	27/6/2022	Namina	3
Analyze the circuit	27/6/2022	30/6/2022	Chathurya	3
Development of the circuit	30/6/2022	3/6/2022	Kaveeshwara	4
Type of the enclosure	3/6/2022	6/6/2022	Namina / Chathurya	3
Marketing side	6/6/2022	13/6/2022	Chathurya / Kaveeshwara	7
First product overview	13/6/2022	20/6/2022	Three members	7
Analyze again	20/6/2022	30/7/2022	Kaveeshwara Namina	10
Final proposal submission	30/7/2022	24/7/2022	Three members	24


TASK ALLOCATION
Chathurya
Kaveeshwara
Namina