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STUDYING THE EFFECTS OF CELLPHONE RADIATION USING IOT AND MACHINE LEARNING TECHNIQUES

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Abstract: Phones have become an integral part of our day-to-day life. There is no day for us where we can go through without phones. Approximately 7.26 billion people own phones, that is, around 91% of the population own mobile phones. India is the second largest country to own phone. India is also the 7th largest country by area covered in the world, which is approximately 32 lakh sq. km. Imagine the count of 7.26 billion phone's radiation on 32 lakh sq. km. area and how much it affects us. There are many among us who use mobile phones as alarm and keep it near our head. And there are people who keep their phones close to their head and speak with others for longer duration of time. At all these instances we can say that phones are kept much closer to our head. This paper aims to take a small step towards illustrating how much radiation does our phones emit in accordance with the area factor. As prevention is better than cure, we can try to eliminate the indirect risk factors that may affect our health. We get to know about the harmful effects of radiation on us and can try to be more aware of cellular radiation. This paper is a study on low-cost piezoelectric buzzer-based radiation detector circuit setup made with the help of Arduino ATmega328 and an ultrasonic distance sensor
Keywords: Arduino, ATmega328P, ultrasonic distance sensor, cellular radiation, piezoelectric buzzer

1. INTRODUCTION

As of 2022, there will be 6.648 billion smartphone users worldwide, which means that 83.32% of the world's population owns a smartphone. A total of 7.26 billion people own smartphones and feature phones, representing 91.00% of the global population[1]. His 2021 mobile subscriber count in India is his 1.2 billion, of which about 750 million are smartphone users. It plans to become the second largest smartphone maker in the next five years. According to Deloitte's 2022 Global TMT (Technology, Media and Entertainment, Telecom) forecast, "The smartphone market is expected to reach 1 billion smartphone users by 2026. Demand for smartphones is expected to increase as the Internet spreads. This increase in demand is driven by the need to adopt fintech, e- health and e-learning. A similar trend is expected in rural areas where the life expectancy of a phone is his four years. By 2026, about 80% is expected to be replaced by new equipment and 20% is expected to be used equipment. 5G could become the most rapidly adopted mobile technology due to its diverse applications such as high-speed gaming and remote healthcare. From 2022 onwards, 5G adoption will increase year-on-year,

leading to increased sales of 5G smartphones in India. These trends have forced many streaming companies to revise their initial strategies. Pricing for streaming services will remain competitive as service providers look to stabilize and consolidate their customer bases [2].
India stands at the 7th place with 3,287,263 sq. km. area in occupied by the country. With the second largest population in the world and the 2nd largest phone user in the world, imagine the radiation density per sq. km. in our country. With the growing trend of internet and mobile users as well as the emergence of 5G the mobile phone sales in on demand. Henceforth within a few years almost everyone of us will have a mobile phone. Given that so many people use mobile phones, even a modest increase in adverse health effects could have significant public health implications. Exposure to radio frequency (RF) fields emitted by mobile phones is typically more than 1000 times greater than that emitted by base stations, and mobile phones are likely to cause significant adverse effects. Little research has been done on the effects. Exposure done exclusively.
Based on various human epidemiological evidence linking exposure to RF radiation from mobile phones to cancers of the head (glioma and acoustic neuroma), RF fields have been identified by the International Agency for Research on Cancer as a human classified as possibly carcinogenic to No studies to date have shown exposure to RF fields in the environment. B. Base stations increase the risk of cancer and other diseases. Scientists have reported other health effects of cell phone use, including changes in brain activity, reaction times, and sleep patterns. These effects are minor and of no apparent health significance. Further studies are underway to confirm these results. Using your mobile phone near some medical devices (such as cardiac pacemakers, implantable cardioverter-defibrillators, and certain hearing aids) can interfere with their operation. 3G mobile phones and newer devices greatly reduce the risk. There is also the possibility of interference between mobile phone signals and aircraft electronics. Some countries use systems to control the output power of mobile phones to authorize the use of mobile phones onboard in-flight aircraft. Studies show that using a mobile phone (handheld or hands-free) while driving for distraction increases the risk of traffic accidents, resulting in about three to four times more accidents [3].Thus, it is the right time for us to understand the correct balance between mobile phones. This paper helps us to give an insight on how mobile phones emit radiation and how India is becoming radiation dense.

2. LITERATURE REVIEW

A paper on effects of cell phone radiation

Cell phone radiation occupies the range of 800 MHz to 2000 MHz emits radio frequency (RF). We are surrounded with abundant electromagnetic energy.Human exposure to radiation from mobile devices is commonly measured by the Specific Absorption Rate (SAR). It is a measure of the rate at which energy is absorbed by the human body when exposed to radio frequencies. A research student and technician at a microwave laboratory in India, where he worked eight hours a day, experienced headaches, confusion, depression, sweating, mood swings, irritability, poor concentration, dizziness, fatigue, weakness, insomnia, and more. I found various problems in Acoustic neuromas are benign growths of tissue that form in the auditory nerve that leads from the inner ear to the brain. They are slow-growing benign tumors of the auditory nervous system. If left unchecked, further tumor growth can be life-threatening. Radiation has the ability to alter DNA molecules because the frequency of the electromagnetic fields emitted by

mobile phones is so high that charges shuttle on the DNA double helix. The interaction between microwaves and electrical charges disrupts genetic material, or genes [4].

RF Intensity Indicator

Radiofrequency radiation can result in health impacts, often called the 'thermal effect', which causes heating energy. In addition, RF radiation will affect children and they may have the risk of developing brain tumors. This paper aims at building a portable device that is easy to use and can be used by anyone to detect the strength of RF. An RF detection circuit using breadboard was made and then the connection was given to Arduino. This helps in measuring the signal is high or not [5]. This project thus indicates the RF signal but does not calculate it.

Choosing the Right Classification algorithm

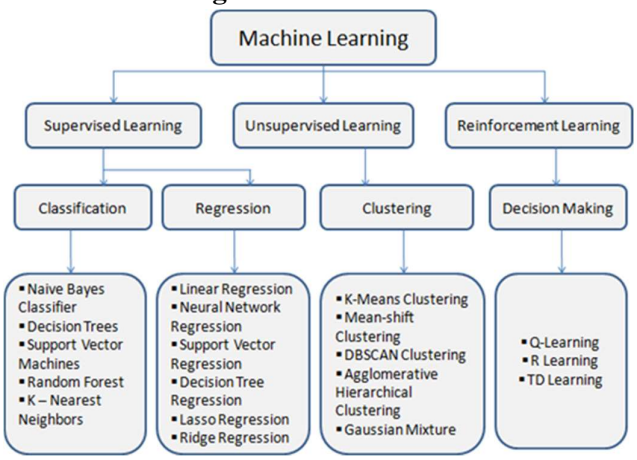


Fig1: Machine learning Techniques types

Machine Learning is the ability of the machine to learn from experience E for a task T and apply the experience E to do the task T with a performance P such that P improves significantly. There are three types of machine learning: supervised learning, unsupervised learning, and reinforcement learning. Supervised means you are

learning. That means providing algorithmic information to aid learning. The results you provide to the machine

are the labeled data, and the rest of the information you provide is used as input characteristics. Supervised learning requires the user to assist machine learning, while unsupervised learning does not use the same labeled training set and data. Instead, the engine looks for less obvious patterns in the data. This type of machine learning is very useful when you need to identify patterns and use data to make decisions. In reinforcement learning, the algorithm or agent used learns by interacting with its environment and receiving positive or negative rewards. The data that we will be providing in this paper has all it's label. Henceforth we will be proceeding with supervised algorithm that is much suitable and takes lesser time to learn the features. After reading through [6] [7], I have decided to go with K-nearest neighbors that is easy to plot different classes in a plane.

Distance Sensing

Bats are wonderful creatures. They cannot see, but their eyesight is sharper than that of humans. Ultrasonic ranging is a technique used by bats. Ultrasonic sensors provide an easy way to measure distance. Ultrasonic sensors use non-contact technology to measure the distance between objects in the air. They measure distance without damage, are easy to use and reliable. The echo time behavior of ultrasonic sensor detectors is based on the transit time from the trigger pulse to the surrounding object, is not linear, and depends on the reflective properties of the object surface. This application is based on the reflection of sound waves. In order for this device to calculate distance, the target to be measured must always be perpendicular to the plane of propagation of the ultrasonic waves. Target orientation is therefore a limitation of this system. The ultrasonic detection range also depends on the size and position of the target. The larger the target, the stronger the reflected signal and the more accurate the distance calculation [8].

3. PROPOSED DESIGN

Arduino Uno

Arduino Uno is an open source microcontroller board based on ATmega328. There are 14 digital input/output pins and 6 analog inputs. It includes everything you need to support your microcontroller, just connect it to your computer with a USB (Universal Serial Bus) cable and you're good to go. The Arduino Uno can be programmed using the Arduino Integrated Development Environment (IDE). A simple C-based program code for Arduino is called a sketch. Arduino can program up to 32K of memory. The Arduino can function autonomously without being connected to a computer, or it can be programmed to primarily respond to commands sent by the computer.

HC-SR04 Ultrasonic distance sensor

This cost-effective sensor offers contactless measurement capability from 2 cm to 400 cm with a distance accuracy of up to 3 mm. Each HC-SR04 module contains an ultrasonic transmitter, receiver and control circuitry. The HC-SR04 only has 4 pins: VCC (power), Trig (trigger), Echo (receive) and GND (ground).

Radiation Sensor board

It contains amplifier CA3130EZ and timer NE555P with capacitor clubbed to it. This is useful for measuring the Rf Signals which it absorbs at a measure of 1 meter. It also contains a piezoelectric buzzer that gets triggered when signal is sensed. [9] [10]

Electret microphone

An electret microphone or electret condenser microphone (ECM) is an electrostatically working capacitor-based microphone. This works on low power well. Here in this project no amplifier is used as we just need to detect the sound rather than getting it clearly. This does not need any voice like quality analog sensing.

System Architecture

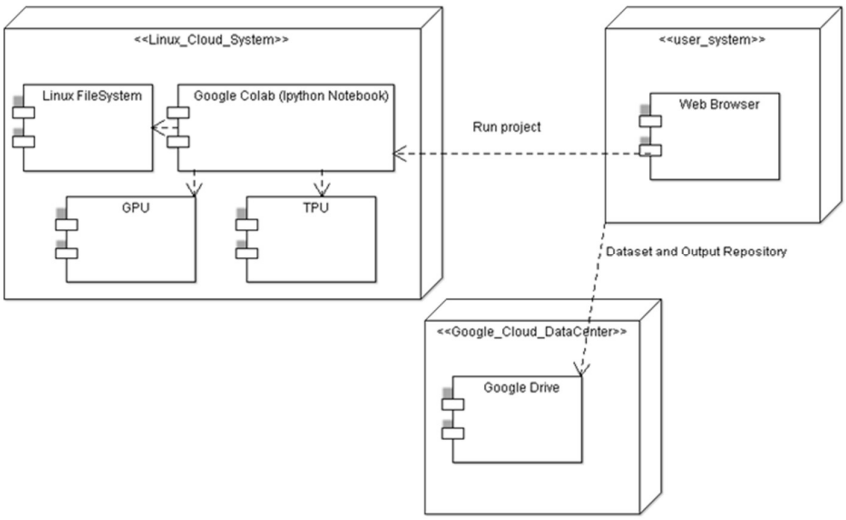


Fig2: Google Colab interaction Architecture

This is the system architecture for how we enable the capabilities of machine learning using google colab. The backend contains linux system on cloud with resources provisioned to each collab user. The configurations of colab are as follows: Cloud Storage – Google drive (15 Gb storage), Colab Hard disk Space - 68.40 GB, Type of Services - Software as a Service (SaaS), Colab GPU - 12GB NVIDIA Tesla K80 GPU, RAM – 12 GB, Colab CPU - vCPU(1 core, 2 threads) Intel Xeon CPU @ 2.20GHz, Colab Runtime – 12 hrs

Methodology

Microphone reading measures beep intensity average i.e, the beep intensity peak is calculated and it's average is taken. Where time is a small constant number that is above the clock frequency and not in milli seconds. Assuming that an average human might be in-front of the circuit for 3 seconds. The offset is set as three.

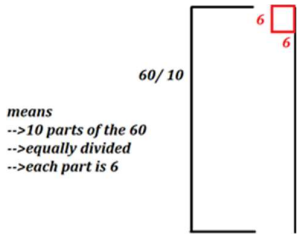
Radiation as area factor = (Average of Beep intensity)/DistanceScaling Factor is kept as 10

here

$$Rc = \frac{(\text{Average of Beep intensity})/\text{Distance}}{100} \times 10$$

$$Rca = \frac{(\text{Average of Beep intensity})/(\text{Distance} \times \text{Distance})}{100} \times 10$$

Where Rc is the Radiation calculated in terms of Distance And Rca is the Radiation calculated in terms of Area



This gives us Decibels per cm unit. This can further be calculated as Decibels per cm2. This circuit thus gives us the average radiation comparison between different models as a factor of area. The higher the value the higher is the radiation.

Circuit and Working

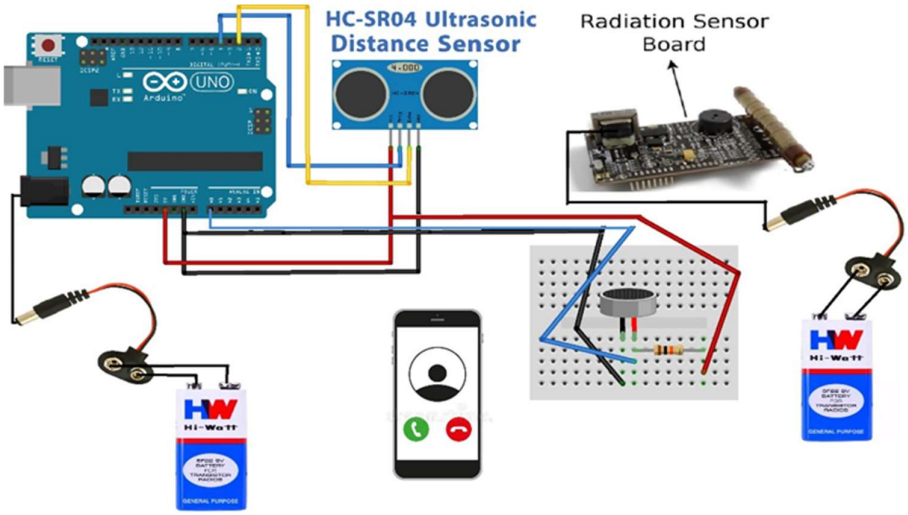


Fig2: Proposed design

The Arduino board is connected with Ultrasonic sensor. It is given power supply through battery. In a breadboard an electret microphone is connected and the connection is given to Arduino analog input pins. The radiation detector board is given power supply with battery. When is cellphone is brought near the detector circuit it beeps. The microphone senses the beeps and sends the signals to Arduino board. Once the signal is detected, the ultrasonic sensor measures the distance and the microphone measures the beep intensity. The louder the beep, the louder will be the signal strength and the louder will be the radiation. A phone which is bought near will have louder beeps, but that doesn't mean high radiation. Henceforth, the distance is also taken into account. By this, squaring the distance will help as get a factor of area. The data then collected is stored and stent to Jupyter notebook. And with the help of K nearest neighbors we can predict the brand of the phone with the given radiation, which helps us to get to know which phones to prefer.

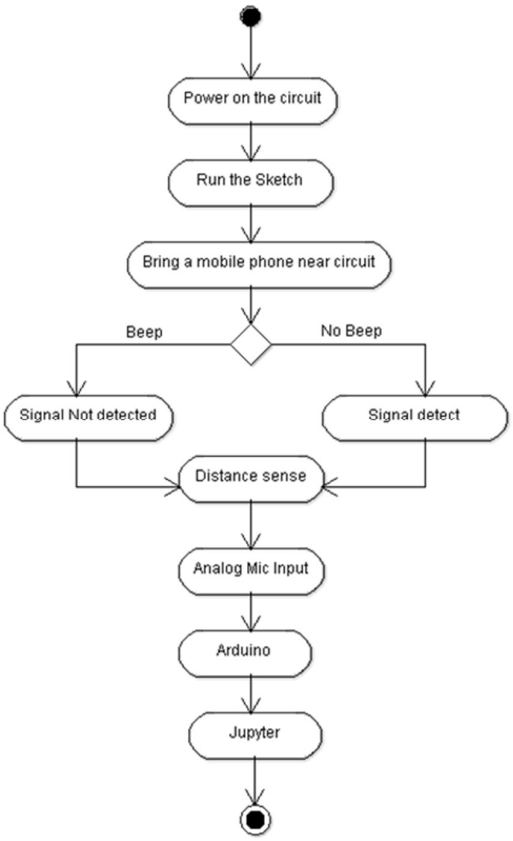


Fig4: Flowchart of radiation detection process

3. RESULTS AND DISCUSSION

When the frequency of beeps sensed through the microphone is converted into a scale of 10. And an average of 10 seconds can be taken to perform each experiment instance then we get the value in decibel per cm unit. Different brands of phone were used which people surrounding me had. And the sample result can be visualized as here.

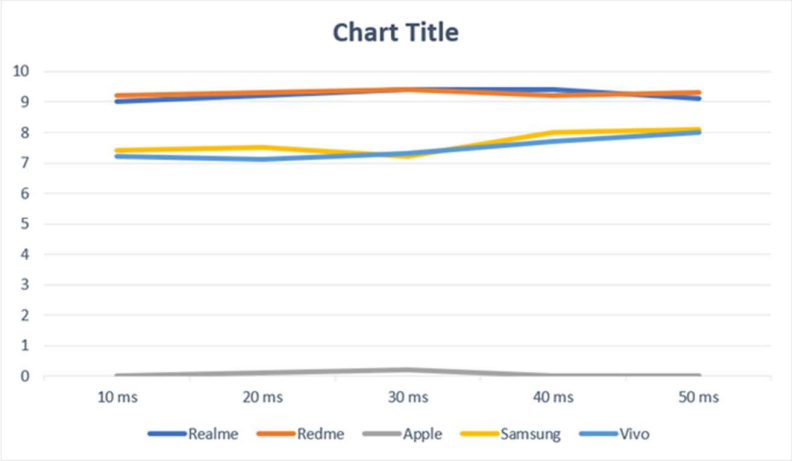


Fig5: Visualization of Data for different brands

It can be noted further that Redmi and Realme devices had the highest amount of radiation emitted. Both of them had generated equal values and the highest among its competitors. Vivo

and Samsung had equal amount of radiation emitted taking the next place. Apple had the least amount of radiation emitted. The circuit was unable to detect the radiation as if it was negligible. This data is then fed into an unsupervised machine learning model given the radiation data and to predict the brand of the phone. The K-nearest neighbor algorithm is preferred to do this task as we can segregate different classes on a plane.

It is thus recommended that we try to avoid keeping phone near our head while sleep. And also try to use headphones if you are talking for longer hours. Try to prefer alarm clocks instead of phones.

4. CONCLUSION AND RECOMMENDATION FOR FUTURE WORK

The radiation of different brands of phones were compared in this paper. To improve the work, we can try to improve the range of the circuit for both the radiation detector as well as the as the ultrasonic distance sensor. This will improve the efficiency of the circuit and can be implemented in more practical situations. The data further gathered can be used to create a machine learning model and train it further more with this immense data. This improved model can be used to detect other wireless devices presence for security application.

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