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# Wasted materials by E-waste

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# Abstract

Nowadays, the importance of recycling electronics is increasing. Because we are using valuable materials in it, such as copper, aluminum and gold. According to the researches, the request of copper will double in the following years. Request for other materials which are used in the technological field, is increasing. Besides throwing away old electronic stuff, it's better to use them again.

To encourage society to recycle more, we will use an image recognition algorithm implemented mindlogger application. Our aim with this project is only to create awareness in society towards e-waste.

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# 1 Introduction

Electrical and Electronic Equipment (EEE) is increasingly in demand in today's society, driven by higher levels of disposable income, increasing urbanization and industrialization, and population growth.

A large proportion of EEE has a short life span, and is often perceived as being difficult or expensive to repair. Brands spend billions creating consumer demand for the latest models, leaving older technology obsolete and unwanted even when it remains serviceable. After its use, EEE is disposed of and becomes Electronic Waste, often shortened to e-waste.

E-Waste contains a mixture of valuable materials that can be recycled (but which usually aren't), and toxic materials such as lead, mercury and cadmium which can be hazardous to our health and to the environment.

Moreover, 57.4 Mt (Million Metric Tonnes) of e-waste was generated in 2021. The total is growing by an average of 2 Mt a year which represented 49.8 billion dollars in 2020. Global electronic waste volume is projected to grow to 74.7 Mt by 2030 – meaning it will have almost doubled in only 16 years.

E-waste does not biodegrade, and therefore will accumulate wherever it is dumped, in much the same way that plastic waste does. Over time, any greenhouse gases contained within the e-waste will slowly be released into the atmosphere.

Electronic waste is an under-reported yet still very significant global issue. It wastes precious resources, contributes to climate change, is hazardous to the environment and to human health. Worst of all, it's completely unnecessary. This is one issue that each of us can help to tackle at an individual level. If we make a conscious decision to live a more eco-friendly lifestyle, our choices can make a big difference.

We will show you through our project an answer to the problem of e-waste management. We will show you how, thanks to crowdsourcing, we can make people aware of the need to recycle their electronic devices. Then, we will show how we have integrated the recognition of the type of electronic devices with artificial intelligence.

*An illustration of the benefits of recycling.*

# 2 State of the Art

Needless to say, this is not the first study to draw attention to the issue of e-waste. There have been impressive examinations showing the combined amount and cost of waste before. These studies, from worldwide quantities to national and even regional scales, remain the focus of attention of many researchers like us.

In the picture below, we can understand that there is a huge amount of e-waste in this year and it's increasing swiftly. Who is the responsible for this? The ordinary people, us.


*The amount of the global e-waste. It's increasing every single second.*

The wide counters are effective in showing how frighteningly we are yielding our raw materials, but our interlocutor here attend the public. If we don't engage the public, as a stakeholder in our academic works, all the effort devoted in the labs will be wasted.

In our project, we adopted the induction method rather than the deductive method. In this way, we believe that we will raise the awareness that the owners of thousands of tons of waste are not the world, countries or governments, but individuals in the societies.

In a simple sense, the process starts with users uploading photos of their e-waste to the system. The deep learning algorithm we set up after the upload tells the user what type of product the uploaded photo is and how much and what raw material it contains. After initially showing how much raw material individuals save, we plan to show how much is saved locally. In this way, we plan to increase the recycling process of e-waste by raising collective awareness. By increasing the accuracy score of our algorithm with the data we receive from users, we will include other missing categories among the algorithm's predictions.

*The way we use as a method is one to many*

# 3 Methodology

As the availability and use of electronics increases across the globe, e-waste has become the fastest-growing waste stream in the world. E-waste refers to any electronic devices that have reached the end of life. The e-waste recycling process in four steps :

**Collection**: The first step of this process is the collection of electronic products through recycling bins, collection locations, take-back programs, or on-demand collection services.

**Storage**: While safe storage may not appear critical, it can prove very important.

**Manual Sorting, Dismantling, Shredding**: E-waste then goes through the initial stage of manual sorting, where various items (such as batteries and bulbs) are removed for their own processing.

**Mechanical Separation**: The two key steps are magnetic separation and water separation.

The materials, now separated, are prepared for sale and reuse. For some materials, such as plastic or steel, this means joining another recycling stream. Every step of the process is important. Our project builds on these recycling methods and will interact with the process in different ways. We will see how through this process we can use crowdsourcing and AI.


*An e-waste bin which can be found in supermarkets.*

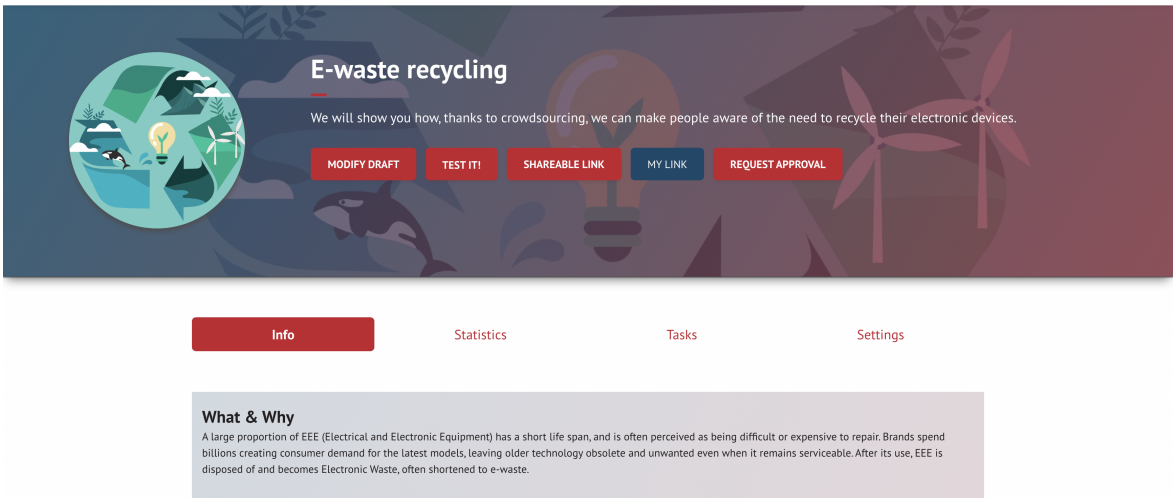
## 3.1 The choice of Mindlogger for crowdsourcing

Then we decided to try crowdsourcing. Crowdsourcing is the practice of obtaining ideas, services, or content by soliciting contributions from a large group of people, or more specifically, an

online community rather than from traditional employees or service providers.

From the collection of electronic devices done by the different similar projects, we have deduced that there is a need to raise awareness about the possibility of recycling electronic devices. We offer the possibility through our Mindlogger-based solution that it is possible to identify the type of electronic device and its sensitivity to recycling.

We have created a project on Mindlogger that we have made public. The purpose of this project is to, thanks to crowdsourcing, make people aware of the need to recycle their electronic devices. As a first step, we want the participants of this crowdsourcing project to become aware of the importance of e-waste recycling. There is a description page that explains what the project is about and how, who the creators of the project are and who the contributors are.

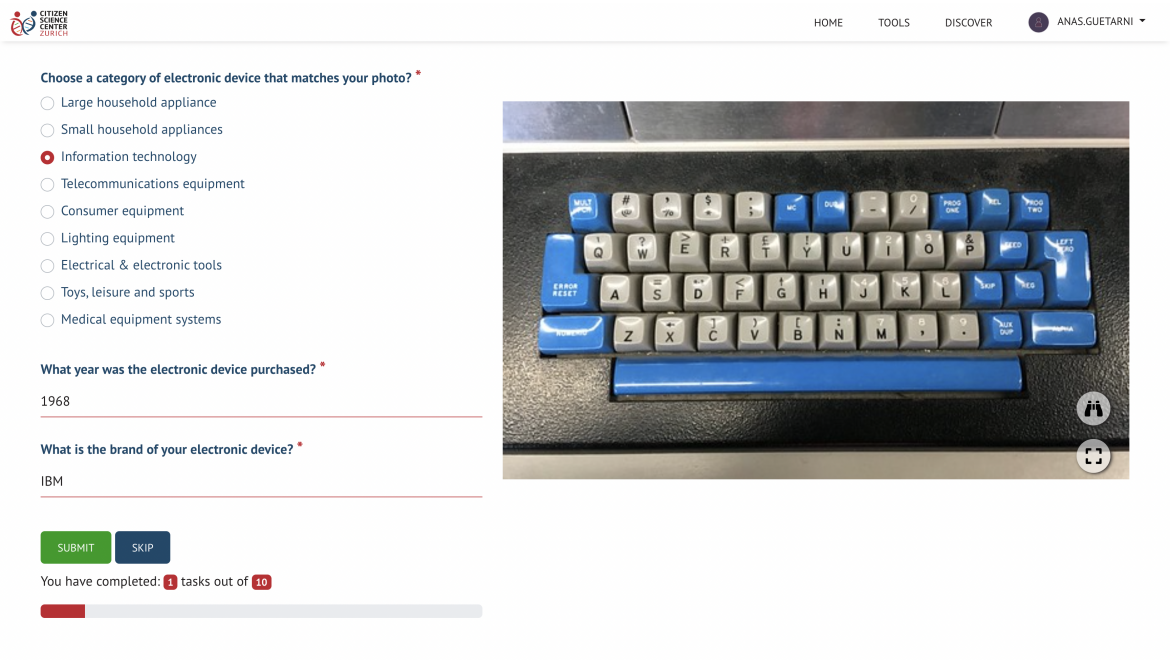



*Mindlogger dashboard.*

Mindlogger allows us to interact with participants of our crowdsourcing service. We have set up a questionnaire on the platform to enrich the dataset that we want to implement for the artificial intelligence part. The questionnaire will consist of a functionality allowing to take a picture of the electronic device wishing to be recycled, then the participant will have to fill in a list of fields in a form below :

1) Choose a category of electronic device that matches your photo?
2) What year was the electronic device purchased?
3) What is the brand of your electronic device?

And in a second time, we can see an image of the questionnaire that we have set up. It allows us to enrich our dataset according to an image and the three questions mentioned below. For the moment we have only set up three questions and a sample of 10 images. In the future, we would like to enlarge our sample and ask other relevant questions. The goal is to have the users confirm the electronic device displayed. Once we have a large number of answers, we could enrich the dataset we have for our artificial intelligence and thus allow us to have a very high result on electronic device recognition.




*An exemple of the Mindlogger form.*

In this way, we've submitted our Mindlogger project which is now approved by the administrators of the platform. We could have through this prototype implementation that it is possible to realize a crowdsourcing project on the subject of electronic waste recycling. We can through this project make people aware to throw away their electronic devices to offer them a new life. This gesture, which must become part of the mentalities of the future generations, must start now. This implementation could thus allow beyond sensitizing people, to inform them about the places of collection of electronic devices.

## 3.2 The choice of AI in our project

In the AI part of our project, we used the Convolutional Neural Network. We reached a data set related to e-waste via Kaggle. But the data set was not suitable for us. There was no sign that we could distinguish products from different categories. We ranked them within their own genus. After this separation, a data set with 6 categories was formed. These categories are: keyboard, laptop, mobile, monitor, mouse, mix. After that, we divided them into two as train and test data.

Next, we brought the dimensions of the photos down to model-appropriate standards, known as preprocessing. In the modeling part, we used an algorithm structure suitable for the acceptance of those who did research before. Since our data set comprises images, it took about an hour and a half to learn our model. While testing the model with different variables, we had to wait for a long time.

As a result, the model was trained and we made three different predictions. We can say that our model, which predicts 2 of them correctly, makes good predictions despite its low accuracy score. The model is available on Github.

# 4 Performances

## 4.1 The scaling in Mindlogger

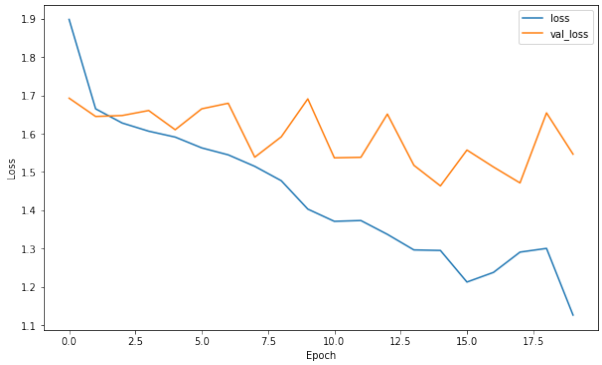
Mindlogger is a very powerful tool in the crowdsourcing world that allows you to conduct a case survey in record time. This project is currently under development, which means that in the future, given the current advances, this tool will have additional features that will improve the user experience. Mindlogger has a significant scaling in the coming years given the evolution of crowdsourcing in recent years by Google, Amazon and many other large companies.

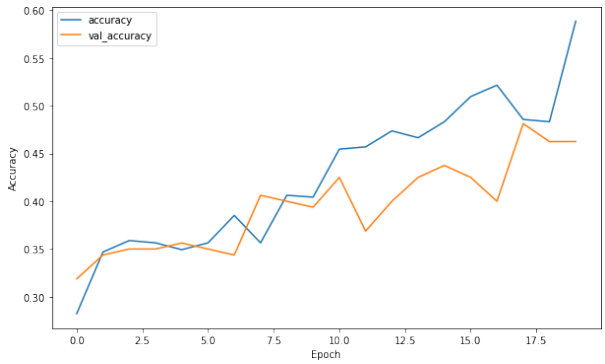
If we manage to get a large number of participants, we have seen that scaling is possible by discussing with the platform administrators. The implementation of a personalized space can be set up in order to make the user experience more fluid.

## 4.2 The results of our AI

In deep learning algorithms, it is usually accuracy and loss values that measure performance. For this reason, we evaluated the performance of the model based on these two values and the accuracy of its predictions.

Due to the very low initial values, we slightly increased the amount of our data using the Image Data Generator. After that, our loss and accuracy values improved visibly. As can be seen below, our two values are relatively more stable.




Data Augmentation can be used as a temporary solution to improve the results. But for a well-structured solution, of course, increasing the data will be the most accurate and impressive method.

# 5 Conclusion

For the realization of this project, we divided the tasks from a technical point of view. Yavuzhan, with his enriched skills on the subject, focused on the realization of the artificial intelligence part. Many problems were encountered on the arrangement of the dataset but finally resulted in the creation of this prediction algorithm. Anas realized the crowdsourcing part which consisted essentially in setting up the project on Mindlogger. We then documented our research and results together to form this report.

Through this project, we were able to discover that a new way of carrying out a project was possible. Crowdsourcing makes it possible to grow projects that can attract the attention of a number of participants. We proposed a new solution to raise awareness and inform people about the impacts of electronic waste. The implementation we proposed allows a system to recognize the type of electronic device presented from an image. This artificial intelligence can then be implemented in an application for example that will allow people to direct them to the nearest recycling point. This solution will open the door to other similar projects thanks to the code of the artificial intelligence which is completely accessible as well as its dataset enriched by the various participants.

We would like to see in a few years the innovations and evolutions regarding the recycling techniques of electronic devices. In view of the current situation presented by the United Nations, we could quickly run out of these materials that are currently present in all our devices.

*Save God nature.*

# 6 References


1) Current status and Future Perspective of recycling
2) Copper and important materials
3) E-waste Statistics
4) Supply Chain Explanation
5) Electronic waste reclycing act
6) What can we do about the growing E-waste problem?
7) Why should E-waste be recycled?
8) Real time E-waste counter
9) Mint innovation fold electronic waste
10) Mindlogger e-waste project
11) The Govlab Academy Canvas
12) Image classification with CNN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