



Co-funded by the  
Erasmus+ Programme  
of the European Union



# PROJECT RESULT 1

Internet of things prototype aimed at  
students with a risk of social exclusion

## Environmental Considerations

Abstract

This document describes the reasoning and an ecological and environmental insight, trying to mimic existing passive houses and existing energy-saving systems, but with a low-cost solution for educational purposes.

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## Eco Friendly Houses

### Why there is a need for environmentally friendly homes

In the past decade, "going green" and "sustainability" have become new buzzwords in the majority of houses. As the worldwide epidemic enforced lockdowns, the demand for eco-friendliness became even more pressing. Air and noise pollution subsequently dissipated, revealing a cleaner atmosphere. It also prompted the worldwide building industry to reconsider the usage of eco-friendly materials in an effort to decrease the negative effects of our buildings on the planet.

"Green buildings" (constructed from eco-friendly materials) have existed for some time, but only recently have they received widespread notice. Green buildings are recognized for maximizing resource conservation and minimizing environmental impact. In addition, these materials do not compromise safety, quality, or other fundamental characteristics of sturdy structures.

The world around is becoming environmentally friendly. People may initially be confused by the word and wonder how the homes they already live in might be environmentally hazardous. One word provides the answer: energy. Everything you utilize and see is a sort of energy. The primary goal of an eco-friendly home is to minimize expenditures and energy consumption, as well as recycle as much as feasible. The building of an eco-friendly home employs raw materials that are not only safe for the environment, but also ecologically responsible for as long as the home is in use.

In terms of cost and energy efficiency, eco-friendly homes and green buildings have a substantial advantage over non-green structures. These are some of the advantages of an eco-friendly home that win people over every day, and why we should not hesitate to invest in something that promises a brighter future for future generations.

## Eco-friendly construction materials

An eco-friendly construction material is one that does not affect the environment during manufacturing, use, or disposal and is easily recyclable.

In recent years, the demand for eco-friendly construction materials has increased gradually. In addition to their eco-friendliness, these materials provide a number of other benefits although still their acceptance rate remains low. There is an immediate need to raise knowledge about these materials and the benefits they provide, since doing so would inspire the building sector to implement sustainable materials on a wide scale. Using eco-friendly products has enormous long-term benefits. Constructing a green home greatly minimizes carbon emissions and conserves energy, resulting in lower energy costs. Environmentally friendly construction materials are those that make the most efficient use of resources, generate the least amount of waste, and are safe for the environment and humans.

### Suggested Eco-Friendly Construction Materials:

**Cob** - Cob is essentially a mixture of subsoil, water, fibrous organic material (usually longer straw), and in some circumstances lime. The oldest known cob construction is more than 10,000 years old. In light of the housing crisis and climate change, we were compelled to consider alternatives. Cob is one of the materials that are gradually making a comeback. In addition to being eco-friendly, cob is a natural material that is really simple to work with, and its roughness allows you to make any design you can imagine. It acts as a natural insulator and is extremely energy efficient. Hence, cob homes require minimal to no heating.

**Recycled Steel** - Recycled steel is a material that retains its qualities after being recycled. Steel is the most recyclable material in the world. Each year, more steel is recycled than plastic, paper, aluminum, and glass combined. The benefits are when you use recycled steel in the construction process, you know it will be robust and lasting. It is also a significant energy cost reduction.

**Wool from sheep** - Sheep's wool is a fully natural, eco-friendly, and rapidly renewable material. Wool is most commonly used to create warm blankets and sweaters. It is also an excellent house insulator, since its fibers create millions of tiny air pockets that retain air. Wool is typically used as a component of ceilings, walls, and attics. The benefits are that wool is readily accessible, energy-efficient material.

**Wood that is Reclaimed, Recycled, or Sustainable** - Old wood is among the most common building materials, and for a good reason. It is visually appealing, user-friendly, and reminiscent of nature inside. Reclaimed or recycled wood has a far smaller environmental effect than new timber. Yet, when acquiring new wood, it is crucial to acquire it from a forest that is maintained responsibly. In addition to its use in home construction, it is a fantastic material for natural-looking flooring and exposed beams. It has become one of the most utilized materials in eco-friendly buildings. Being surrounded by natural materials, such as wood, considerably improves overall health.

**Cork** - Cork is derived from cork oak trees, which are among the most renewable and environmentally beneficial resources. Cork ceiling panels, acoustic walls, and flooring are constructed with a magnificent green buoyant material with a unique function. Cork is a robust substance that is resistant to liquids and dampness (hence the wine). Because of its composition, it may absorb vibration. The collection of cork can contribute to the battle against global warming.

**Bricks of Clay** - Clay brick is a natural substance composed of water and earthen clay. It is completely recyclable, completely Earth-friendly, and does not emit any dangerous compounds when discarded. Clay brick is an energy-efficient building material. In the summer, it keeps a home cooler, while in the winter, it retains heat for a longer amount of time.

**Wheatboard** - Wheatboard is a material composed of wheat straw and resin. It is a good building material since it is fireproof, mold-resistant, and does not emit harmful gases. Wheatboard may be used as flooring in addition to being utilized as insulation in walls and ceilings. Wheatboard is also quite simple to work with and can be cut using common equipment. It can be nailed or fastened into position without the use of special tools or adhesives.

**Straw bales** - Straw bales offer excellent insulating qualities, are resistant to fire, and are recyclable. Straw bales are frequently used as a filler for timber structures, as well as a load-bearing base to support the roof. They offer great advantages, such as the thermal insulation qualities of straw bales, and the fact that they are approximately three times those of conventional materials. They are extremely thick, which might be advantageous, and take minimal energy to create. They may last up to a century and burn far more slowly than wood.

## Eco-Friendly Smart Houses

There should be no doubt in today's society that we as a society need to be more ecologically conscious. Being green and utilizing sustainable products is beneficial to the ecosystem and may contribute to the longevity of the planet. Most individuals care about the environment and wish to contribute to its improvement.

Surprisingly, smart houses are the newest frontier for eco-friendly living. In recent years, some individuals have associated smart houses with technical sophistication and comfort. Unfortunately, few individuals viewed them as a means of encouraging environmentalism. This is fast changing as publications such as Elle Décor emphasize methods to make your smart home more environmentally friendly.

One of the best ways to accomplish this is by evaluating the various smart home solutions that are already in existence. They can make a significant contribution to environmental friendliness. Below are a few ways in which an intelligent house might be environmentally beneficial.

## Why should we build Smart Green Homes

Many people and builders are searching for eco-friendly solutions as a result of climate change and growing sustainability awareness. Many people are still unaware of the reasonably familiar concept of a smart green home. Eco-friendly homes using the newest technologies are referred to as smart green homes. These houses provide for the needs of the residents while being environmentally friendly. Green homes and smart homes are frequently used synonymously. There is, however, a slight distinction between the two. Smart green homes place equal emphasis on sustainability and environmental friendliness as green homes do. A feasible strategy that greatly contributes to energy savings is a smart green home. Green builds or green buildings are other names for eco-smart homes, eco-green homes, eco-living homes, and eco-friendly living homes. Although being a word that is used frequently, few people are familiar with smart green homes.

### Suggestions for an Eco Friendly Smart House

**Less Energy Used on Heating and Cooling** - Heating and cooling have a significant impact on the environment. This is especially true for heating and cooling systems with inadequate regulations. The heating and cooling of their homes throughout the year is a common area where individuals squander a large amount of energy. They maintain excessively high temperatures during cold weather and excessively low temperatures during warm weather, even when they are not in the home. When you have smart home appliances, it will be much easier to handle the heating and cooling in your house. You may configure the system to actively pump heat or cool air only when someone is present in the home. It is far more effective than simply having a programmable thermostat since you have control from anywhere. For instance, if you left for work and later discovered you left the heat on, you can simply use the app for your smart home gadgets to turn it off. This conserves resources and money.

**Better Use of Equipment and Lights** - Electricity produces a substantial carbon impact. Several studies have demonstrated that illumination accounts for fifty percent of our carbon footprint. Up to 17% of the total is caused by illumination alone. Thankfully, there are several strategies to benefit the environment by decreasing power use. Smart gadgets manage appliances and lighting to reduce their energy use. Unnecessary lighting and appliance use wastes energy, similar to indoor heating and cooling systems. After returning from work or a vacation, you may discover that you left household appliances or lights on. Because you can operate anything from your smartphone, you no longer have to worry about these issues. One of the greatest advantages of this sort of technology is that it allows you to save money and worry less about forgetfulness.

**Save Water in Garden** - There is always the possibility that you are watering the garden excessively in order to keep it looking wonderful. Alternatively, you may set up a watering plan that is linked to genuine local weather forecasts, to ensure that you water no more than the ideal quantity. This will allow you to avoid wasting water, which will, in turn, reduce expenses.

### The Ecological Advantages of a Smart House

With their broad automation, sensor, and remote control capabilities, smart home systems provide several environmental benefits. However uncertain as to why this is significant, consider that making a house more energy efficient will save people money and reduce overall carbon impact. There are several methods to reduce the overall carbon footprint, and installing smart technology in a house is a fantastic starting point. Below are a few strategies to preserve energy and natural resources using smart home gadgets.

**Temperature regulation** - In addition to being programmable, the most powerful smart thermostats are also capable of sensing the environment and changing user preferences. Simple programmable thermostats will help you conserve energy by activating the heat or air conditioning only when necessary and changing the temperature when no one is home. They feature more extensive programming than earlier generations of programmable thermostats, allowing you to set them for both workday and weekend routines, as well as operate them from your phone if your plans change. Some smart thermostats can detect when a door is left open and shut down the system accordingly, or they may even learn your heating/cooling preferences. Others can be linked to sensors in your house to initiate or deactivate the heating, ventilation and air conditioning (HVAC) system.

**Home sensors** - Regarding sensors, smart home sensors are available for nearly anything conceivable, including light and temperature sensors that automatically switch off lights and thermostats if you forget. Leak sensors may be installed in inconspicuous areas to detect leaks before they become visible, saving you money on repairs and minimizing water wastage. The SmartThings motion sensor, for example, may be programmed to switch on lights, activate security alerts, regulate portable heating or air conditioning, and do other things based on your movements. These devices make forgetting to turn down the heat, turn off the lights, or set the alarm a thing of the past. Contact sensors may be put on contact surfaces of things that open and shut, to inform you if a window or refrigerator door is left open by accident.

**Irrigation** - According to studies, intelligent irrigation systems may preserve 30% to 50% of the water utilized for this reason. They do this by, among other things, customizing watering schedules to the demands of the landscape and recognizing environmental changes (such as an unexpected rainstorm) that alter a garden's watering requirements. There are two types of intelligent irrigation systems: weather-based systems and soil moisture sensor systems. Connecting weather-based controllers to a network enables them to monitor local weather conditions. As its name suggests, soil moisture sensors monitor soil moisture content and transfer this data to a controller that controls when and for how long to irrigate.

**Lighting systems** - Smart lighting consists of two components: the bulbs themselves and networked technologies that allow for automatic or remote on/off management. Start smart lighting by replacing standard light bulbs with Philips Hue bulbs. They are LED, which is significantly more energy-efficient, and remote-controlled. Several of them also provide temperature variations, allowing you to modify the lighting atmosphere as your daily demands vary. Moreover, LED bulbs are mercury-free, considering that even energy-efficient CFLs contain this harmful element. With a smart lighting system, you can remotely turn off the light in your kid's room if they fall asleep without doing so, schedule lights to turn on/off at specific times when

you're on vacation to give the appearance of being home without running them 24/7, and otherwise customize your lighting environment to provide only the light you need at the time you need it.

**Window coverings** - People often overlook the significant impact that passive cooling and heating through windows may have on indoor temperature. Connecting smart window coverings to systems such as Alexa and Google Home enables them to automatically adapt based on the time of day and your requirements. These devices can contribute to energy saving by offloading a portion of the heating, ventilation, and air conditioning (HVAC) system and assisting in other ways. For example, if you have problems getting out of bed in the morning, smart blinds may be programmed to open when your alarm sounds, allowing the early sun to assist you to awaken. Blinds automatically adjust to block out sunlight in the summer and admit it in the winter. You may purchase bespoke sets or kits to enhance your existing window coverings.

### Summary

These are just a few examples of how smart home devices may be utilized to boost energy efficiency and convenience. The impact on the environment of these gadgets is not insignificant, nor are the economic savings: An EPA research indicated that utilizing a smart thermostat alone might result in 10 to 30 percent lower energy expenses. When adopted on a wide scale, residential electricity and water conservation have the potential to greatly impact the rate of climate change. Start with a few smart light bulbs, or jump in with a central control hub such as Alexa, and equip your house with the variety of available smart gadgets.

## Why should we be using Eco-Friendly 3D filaments for prototyping?

What is a 3D filament that is good for the environment?

New to the market are eco-friendly 3D filaments, which can be used instead of traditional plastic filaments. 3D printing uses a lot of energy and often uses materials that don't break down. For example, ABS is made from petroleum. It is one of the most common filament extrusion materials for 3D printing. New technologies make it possible to 3D print in a way that is good for the environment and costs less. As an environmentally friendly alternative to plastic filaments, many biodegradable filaments made from recycled materials have been made.

By adding a biodegradable plastic base (in the form of fibers or powders), it is possible to make filaments with a high percentage of organic material.

3D printing using used plastics



### How to turn old plastic into materials for 3D printing

With Tyler McNaney's Filabot or MIT's Recyclebot, you can turn old plastic waste into eco-friendly filament at home. These machines turn trash into 3D filament, which can be used in a 3D printer.

With the Filabot, a regular milk bottle can be turned into 2.5 metres of 3D filament. First, the machine crushes bottles, boxes, and other recyclable plastic waste to turn it into plastic pellets (or granules). The machine then heats these pellets and pushes them out in the shape of filament. The filament is then wound around a spool so that a 3D printer can use it again.

### Use 3D-printed objects and waste plastic from plastic printing

To set up a 3D printer correctly and make good 3D models, you have to be patient and try a lot of different things. Many of these tests lead to failed prints, extra material, supports (?), or just old pieces that are no longer useful. Extruders for plastic waste like the Filabot or ProtoCycler can use this plastic waste to make new things. In addition to being good for the environment, this new idea saves users a lot of money because they can spend less on the 3D filament.

### Buy 3D filament made of recycled materials

The Dutch company Refil sells 3D filament made from ABS and PET, which are both recycled plastics. Most of these two types of plastic come from bottles and car dashboards. Refilament is the name of this award-winning idea. Casper van der Meer, one of the people who started Refil, says that the recycled filament, which doesn't have any toxic additives, has the same qualities as regular filament and costs between \$30 and \$40 per spool.

### 3D printing with 3D filament that breaks down naturally

#### PLA is a 3D printing material made of cornflour.

When it comes to filament deposition, PLA is the most common 3D printing material after ABS. Cornstarch is used to make PLA. It works with most 3D printers that use extrusion technology. PLA is a material that breaks down in nature, unlike ABS. PLA can also be used to print things that will come in contact with food because it is not toxic. PLA's biggest flaw is that it is very sensitive to moisture and tends to break instead of bend. This makes it harder to control than ABS.

#### Paper is a sustainable alternative to plastic for 3D printing.

Mcor Technologies, which is now called CleanGreen 3D, is a company that makes 3D printers. They have made 3D printing material from paper. Their Laminar 3D printing technology cuts and glues together sheets of paper one by one to make an object. Paper is not as good for the environment as PLA, but it is a good alternative to materials that are more harmful.

### Materials for 3D printing made from plants

Many plant-based filaments, like FilaSoy, which is made from soy, and SeaWeed, which is made from seaweed, have been made. The 3DFuel Algix is also available, and it is made from algae which is a nuisance.

Wood is another natural material that can be used to make 3D filaments. For example, 40% of Laywood is wood, which gives it a feel and look similar to wood. ColorFabb has even made two 100% organic filaments: WoodFill, which is made of 70% PLA and 30% wood fibre, and BambooFill, which is made of 50% bamboo and 50% PLA.