Insectarium – Insecto

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Abstract— It is estimated that by the year 2050 the Earth population will increase to 9.6 billion thus the world hunger is expected to grow even further.
Global hunger issue is a grave problem and will grow even further within the next years. Recurrent and easily manageable sources of food are a necessity
This paper deals with one of the possible solutions to eradicate hunger in the world, through engaging people in a more sustainable feeding process.
The project approaches this with an automatic system to breed aspects of the Insectarium. The quality material is used such as PMMA (Polymethyl Methacrylate) which provides the enclosure with superb insulation. The system also uses low powered devices such as Arduino which controls the Insectarium and reduces maintenance and costs.
This product was conceived as an innovative and sustainable idea using reusable and quality materials. The design and the components give people a chance to win a war with hunger in the present and the future, what makes our product desirable and forward-looking.

Keywords—insectarium, global hunger, mealworms.

I. INTRODUCTION

One of the major worldwide issues for people is the lack of good quality sources of food. It can affect anybody regardless of age, race, religion or cultural background.
In the past, growing and eating insects was more popular in the Asian and African regions, as population there is higher on a limited land area than in the rest of the world. Therefore, hunger is a real problem felt to a much larger extent. So far in most of the world, the main use of insects has been as animal feed. However, using insects as a source of food for people is being integrated into Europe step by step on a smaller scale as it is not a socially acceptable trend. As land devastating food production which has worked over the course of time is no longer sustainable for the human population, people are forced to re-think their eating habits. Research regarding this problem has been done over the course of years since people have acknowledged it as a problem. Researchers are leaning towards certain type of bug larvae to be an answer to the hunger issue, as they contain higher source of nutrition [2].
This paper aims to give an insight into one of the options to answer this global issue. The insectarium in development is designed by taking into account the living habits of a specific

bug – the mealworm. This bug was chosen considering researches made forehand and the products currently on the market [3], [4]. Product is designed to be cost-effective, functional and environmentally friendly at the same time, while still having a functional and elegant look.

II. State of the Art

Currently the Insectarium market has a lot of different types of enclosures, however most of them are bug-specific. An enclosure which could be applied to different insects with a vast range of needs is currently non-existent for household users.

However the product was designed by taking into account the living specifics of a certain type of bug – darkling beetle and its larva. Research on the internet indicated that the mealworms have a preferable humidity and temperature need to achieve a slightly faster development of the bugs.[1] Sponsor had set some requirements for the enclosure- product had to have a heating/cooling system, humidity sensor, software and hardware to control the system and also the enclosure itself had to look presentable.

A. Materials

1. Arduino Uno - is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started [2].

2. Microcontroller- is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications [4].

3. Humidity sensor- A sensor which detects and measures atmospheric humidity. In it, an electrical quantity such as resistance or capacitance varies along with the surrounding humidity, and an output voltage or current corresponding to these fluctuations is produced.

Figure 1: Humidity Sensor

4. Power supply- is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. very power supply must obtain the energy it supplies to its load, as well as any energy it consumes while performing that task, from an energy source. Depending on its design, a power supply may obtain energy from various types of energy sources, including electrical energy transmission systems, energy storage devices such as a batteries and fuel cells, electromechanical systems such as generators and alternators, solar power converters, or another power supply.

   All power supplies have a power input, which receives energy from the energy source, and a power output that delivers energy to the load. In most power supplies the power input and output consist of electrical connectors or hardwired circuit connections, though some power supplies employ wireless energy transfer in lieu of galvanic connections for the power input or output. Some power supplies have other types of inputs and outputs as well, for functions such as external monitoring and control [4].

5. Temperature control system - Temperature control is a process in which change of temperature of a space (and objects collectively there within) is measured or otherwise detected, and the passage of heat energy into or out of the space is adjusted to achieve a desired average temperature [5].

B. *Conclusions*

Insectos aim was to create a product which is nearly self-sustainable, economical and practical.

To achieve that Arduino Uno was implemented to control the heating/cooling fan and humidity sensor, which monitor the temperature and humidity of the enclosure.

As the product should be easily manageable the enclosure has an LCD controller to change the necessary settings required for the customer.

Another issue which ocurred was the separation of different stages of the bug development. The problem was tackled by giving the insectarium several sections, giving the breeder the ability to separate the eggs from the rest of the bug population.

C. *Related products*

On the market the main competitors are DIY(do it yourself) farms and a product that is focused on breeding black soldier flies- Farm 432. The main difference between the product that we are developing and the products currently on the market is the work load put into breeding the bugs. With our insectariums automatic systems you could breed different species of bugs knowing the living preferences of the insects and inserting the data into the system. With other products that is not the case, to breed certain types of insects in the perfect conditions a lot of work is required to create and maintain the desireable environment. Another upside for Insectos product is the quantity of bugs you could breed while having the better conditions, as bugs development speeds up when the inter-climate conditions are correct. The enclosures design is elegant and it would be a fine multi-purpose accessory for any potential user on the market.

III. Methods and Materials

A. *Electronic devices*

The electronic devices we are using are sensors, heaters, cooling fans and Arduino as our programme. The electronic devices change temperature, lighting, aeration and are easy to use and consume a small amount of energy. Therefore these are sustainable options.

Figure 2: Cooling Fan

Programme

Arduino is used as our programme since it is easy to use and is able to meet the Insectarium demands in our project. This programmable device allows to control temperature automatically by connecting several devices such as heaters and cooling fans to the programme.

Sensors

The sensor chosen is a DHT11 sensor which is a versatile choice since it can measure temperature.

Heater and Humidity Element

The humidity and the heating element are from a toaster. They are also low powered and easy to install with Arduino which makes it a good choice. Heat calculations are used to find out the correct power needed to heat the insectarium such as ohm's law. This also helped to decide the correct heater to use in the project.

Display

The insectarium has a LCD display with keyboard to allow the user to select the correct temperature and humidity he/she wants for the specific insects she is wanting to grow and maintain in the enclosure to allow user friendly options and ease of use.

B. *Architecture*

PVC / PMMA

After checking every alternative the choice went to the PVC and PMMA because of its good properties. The decision is to use PVC in those parts of the Insectarium where there is no need of a transparent piece, due to its good resistance. Furthermore it is easy to work with.

The use of PMMA allows the client to see the insects and the inside of the Insectarium, without opening the top of it.

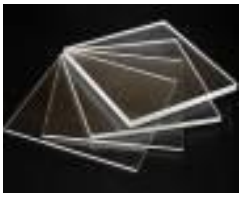

Figure 3: PMMA

NET

The use of a net in the middle of the Insectarium allows to separate the bugs from the eggs by shaking the whole device. The holes have especially that size that there is no chance for other stages to come through. The advantage is to control the insects and to avoid the eating of itself.

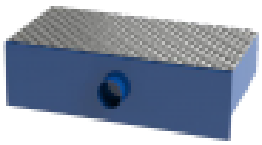

Figure 4: Net in the drawer

DRAWER WITH HANDLE

When the client pull on the handle the drawer comes out, including all separating lavas. Thus, there are two positions. First one is closed when the client wants to separate and let the eggs fall through the net. The second position is opened if the client wants to remove the falling out products. The construction is seen in Figure 1.

WHEELS

For transporting the Insectarium and to make it as easy as possible there are four wheels installed. That makes it simple to move the Insectarium wherever you want or just changing the place while cleaning the flat.

UHU PLASTIC UNIVERSAL GLUE

The use of UHU Glue is for assemble all walls together. The quality is good enough that it is sure, with a sensible handling there is a long lasting lifecycle of the Insectarium.

Figure 5: Insectarium with glued walls

IV. CONCLUSION

An Insectarium was designed based on the requests and requirements of our client. The enclosure was designed to be sustainable, eco-friendly, low-cost and have an effective, dynamic and functional use. On the way to accomplish those demands we have had obstacles on the way- disputes on the design, monetary issues and difficulties choosing and aquiring the materials necessary to build our Insectarium. As the product had a strict budget which we couldn't fit in with our primary material considerations, we had to tweak the used materials and devices used for the Insectarium. Instead of creating the enclosure completely out of PMMA we found a more economical option of using a different type of plastic- PVC. Also for fitting the budget, changes had been made to the electronic components used in the Insectarium, an alternative for the heating element was found in an old hairdryers component. The product has several components to make it more user-friendly such as the LCD screen and the keyboard to allow the users to adjust the Insectarium as pleased. Design plays a big part of the products desirability on the market, so we have tried to find the balance between the design and the functionality while keeping the costs as low as possible.

The project has been a challenge to every person in the team, everybody had to put an effort into the part their responsible of, through doing research each and every person has developed or improved their knowledge of teamwork, research, marketing, time-management, sustainability and many other fields required to finish the project.

By the end we managed to come out with an Insectarium which matches all of the requirements set for us.

V. FUTURE DEVELOPMENT

The recommendation for the products future and the distribution for the customers are three important points: We want to offer our product as simple as possible for the customers. We decide to make more or less of the design changeable, that the customers can adjust it to the flat for instance. Design such as the background, the living room the colors of the plastics. Another feature we think about is to make the Insectarium mobile as possible. For instance by attaching wheel and handles to carry it and give the possibility to attach it on the wall, so the customers can place their Insectarium where they want to. The last improvements are small extras which are orderable individually such as fixed tweezers, water/ food dispenser or special sensors.

Which is most important when electrical devices are installed is the alarm buzzer or better the emergency stop. We plan the install it for the first production because of the safety.

All special thoughts we have should be realized in the future. Not like a standard but as features these are orderable individually to make the product more innovative and special for each and every customer.

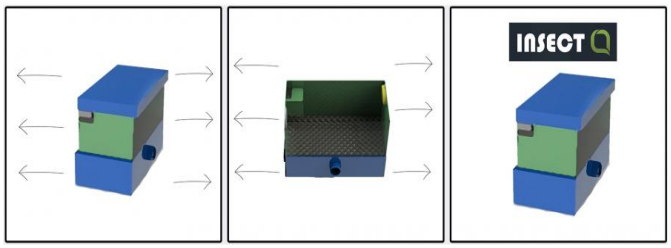

Figure 6: The whole, finished Insectarium

Apart from the features the objectives refer to the years. We do not want to progress in that much of years, but come forward with an aim:

Table 1: Strategic Objectives

Time	Description
2015	get ready the production of the whole Insectarium including all possible devices
2016	sell at least 5 insectariums inside Europe with no special distribution
to 2018	get a publicity of about 15-20% of the humans
to 2020	increase the amount of green farmers and the resulting nourishment of about 10%
2020	more than 25 customers of all sorts for the Insectarium

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Thanks that we could absolve the semester here in Porto with the support of ISEP University. The support to pervade the own project from the beginning till the end.
With every step, planning on its own, including the building of the product.

Our informative poster and leaflet will help you by deciding for doing an important step in a better, more sustainable future for the world. Contact us by E-Mail.

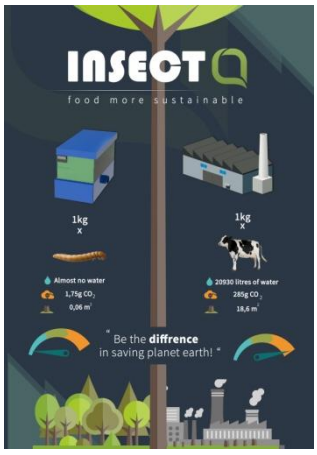

Figure 7: Poster

Figure 8: Leaflet

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