



PLANTACO

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وَارَثَ التَّيْسَ التَّحْلِيمَ

Abstract

Air pollution have been threatening our life in various ways, it affects our health and our future as it leads to climate changes and global warming which causes decreasing in the Nile river water levels due to water evaporation and a formation of a black cloud filled with pollutants. The leading factor in this is the significant increase in greenhouse gases in the air, mainly carbon dioxide, according to WHO – world health organization- Cairo's air is 11.7 times more polluted than levels recommend. Governments and individuals have tried many solutions in order to raise the awareness about the problem and increase the planted sector around the country. These solutions weren't long lasting which made them ineffective. An effective, ecofriendly, applicable and low costed solution was demanded so we decided to develop a home planting application using kotlin programming language, based on NASA's 1989 Study about Interior Landscape Plants for Indoor Air Pollution Abatement which stated that indoor plants can scrub the air of cancer-causing volatile organic compounds like formaldehyde and benzene and decreases the amounts of carbon dioxide gas in the air as they use it during photosynthesis process. It also stated that the amount of leaf surface area influences the rate of air purification, our application suggests various home-plants to each individual according to the conditions of the area they are staying in, in addition to that it's connected was an open-care system which waters the plant itself using only a pump, a water container and a moisture sensor. The results were meeting the design requirements according to the testing survey, the open-care system saved water, the planted sector was increasing and there was a long lasting contribution. We found out that people were more likely to contribute in such a solution as it requires less physical work, filters the air in the houses and serves as a nice decoration.

Introduction

Egypt suffers from many grand challenges that can be categorized into two groups: environmental and economic problems. Environmental problems include energy, global health, water, pollution, and climate changes. Economic problems include: transportation and urban congestion. In previous capstone project we have been working on energy class to find renewable sources for it or decrease the consumption. In this year we are working to develop a mobile application to help in solving air pollution and climate changes problems. Air pollution is resulted from the increasing in some factors which were identified according to World Health Organization to: particulate matter lead (Pb), ground level ozone (O₃), carbon monoxide (CO), nitrogen dioxide (NO₂), and Sulphur dioxide (SO₂), the Central Agency for Public Mobilization and Statistics (CAPMAS) has reported a rise in Egypt's carbon dioxide emissions resulting from petroleum products and natural gas consumption, emissions for 2016/2017 were 210 million tons compared with 206.2 million tons in 2015/2016, making an increase of 1.8 percent. In addition to that the capital of Egypt's air is 11.7 times more polluted than the levels recommend according to World Health Organization. It seems to be just a small problem, but it affects us in many ways for example, Climate change: increase the temperature which will increase the global warming and Public health: dust, fumes, smokes, mists, gaseous pollutants, hydrocarbons, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and halogen derivatives in the air which at the high concentrations can cause vulnerability to many diseases including different types of cancers. A lot of solutions were suggested for solving it, some solutions were governments' actions, others were individuals' actions Governorate's action like: Laws, Regulations, Campaigns and Advocacy, which strengths are limits the factories, grand institutions emissions and rising awareness in large percentages between people. weaknesses are the laws don't have a grand impact upon individuals' behavior and people doesn't take long-term actions as they only start changing attitudes for a couple of days. Individuals' actions like: Conserve energy and Recycle, which strengths are reducing the usage with high levels and the number of undecomposed wastes. weaknesses are requiring a lot of manual work which is most of the times neglected requires high energy most of the times. After searching about prior solutions and collected ideas, we decided to develop a mobile application about planting, which will decrease the percentages of emission gases that play an important role in pollution and climate changes. In order to get good results, we chose design requirements that can be easily tested and achieved through working like applicability, effectiveness, cost-efficient and eco-friendly Which can be achieved by making the mobile application accessible on all devices by providing a full experience to the user on their iOS or Android smartphones, IOT system uses small space with simple equipment, using materials with low price that achieve the same results or better than high materials price, Making the application free to download from app store or play store, and Application's output, which mean Increase the awareness than previous solution, must be bigger than input compared to the latest solution already tried.

Materials & Methods

Developing the application: -

1. We used android studio as a platform.
2. We developed the application using kotlin coding language and xml.
3. We included:
 - A feature that aloud the user to find plants according to the temperature and humidity which he inserted as shown in **figure (1)**.
 - Various plants with different humidity and temperature.
 - Information related to each plant, As shown in **figure (2)**.
 - User interface.
4. We connected the application with open care system.

Developing the open care system:

1. We used C++ language to write the cod of the care system and used Arduino as IDE.
2. We connected the moisture sensor and the pump with the Arduino and coded them. As shown in **figure 3**
3. We connected the Arduino with the application through an IoT system (the pump waters the plant after the moisture sensor reads a specific range of values)

Testing methods:

- Testing the care system:

We watched the plants growth for several weak and calculated the amount of water used then compared it with the traditional irrigation ways amounts.

- Testing the other design requirements:

1. We made a survey to determine what needs improvements from the perspectives of users.
2. We modified the flaws in the application.
3. We launched it again.

Material	Price	Picture	Material	Price	Picture	Material	Price	Picture
Pot	10 L.E		Jumper wires	Personal tool		dt-06 Wi-Fi module	175 L.E	
Arduino board	Personal tool		Moisture sensor	Personal tool				
Breadboard	Personal tool		Water pump	Personal tool				

Table (1)

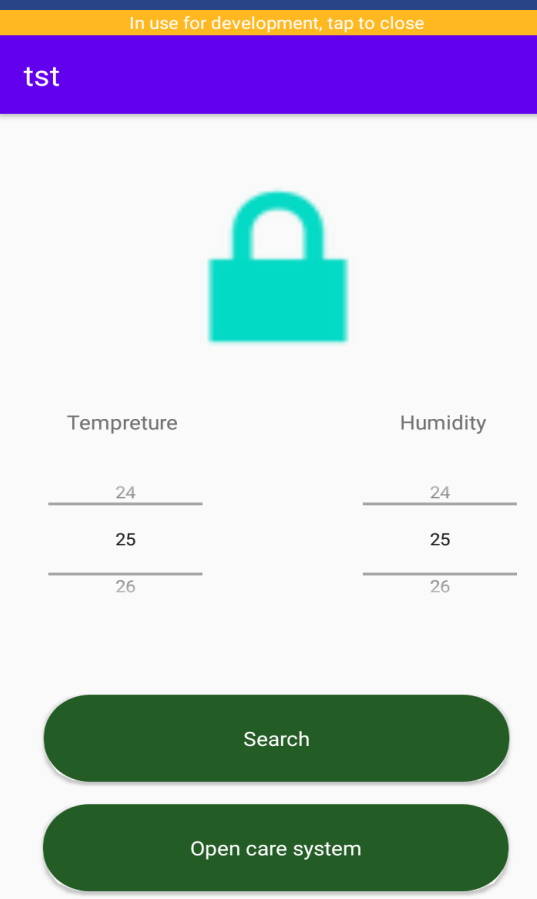


Fig (1)



Fig (2)



Fig (3)

Results

Testing is one of the most important steps in any project as it demonstrates what needs modification and what doesn't. In our project we tested the effectiveness of the application by focusing on users' opinions -using a survey-, water saving, IoT system and achieving other design requirements.

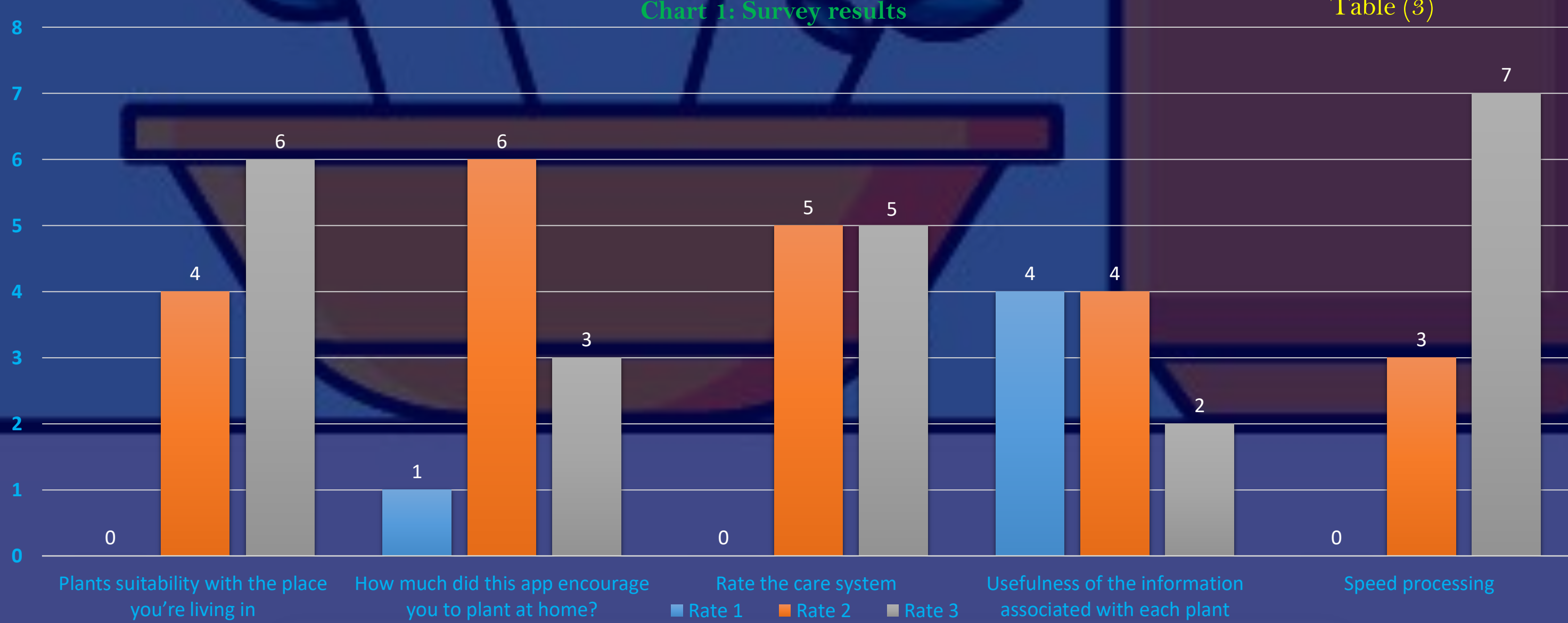
1. The **bar chart** illustrates the answers of 10 of our application users on a survey composed of 5 features that the user can rate on the scale from 1 to 3 in addition to a comment section. After that we updated the information and asked again to make sure the users are satisfied, then we calculated the effectiveness to be 90%.
2. Water saving: It was estimated that people consume 210 milliliters to water each plant daily so we focused on saving it by using a moisture sensor and a pump illustrated in **table 2**. There was a problem with the code as the pump pumped water even if the moisture sensor outcome was less than that demanded, an updates in the code were made.
3. Design requirements testing is shown in **table 3**.
4. IoT testing is shown in **table 4**. We had problems with the pump at the beginning so

Moisture sensor output	Pump output	Trial	Amount of water used daily
Less than or = 320	No	1	250 milliliters
More than 320	Yes	2	180 milliliters
		3	140 milliliters

Table (4)

Table (2)

Chart (1) Survey results



Analysis

According to IPCC's Fifth Assessment Report on Climate Change, we need to decrease the amounts of greenhouse gases emissions by 40% to 70% in order to limit the global mean temperature increase attendant on climate change to two degrees Celsius, which is considered a safe limit. This global temperature increase lead to a significant decline in the levels of water in the Nile river which is the main source of water and demanded for almost all the agricultural and industrial activities in Egypt. Co₂ amounts increased highly in the recent years as shown in **chart (1)**, which accounts for approximately 80% of the greenhouse effect, can be reduced by increasing the planted sector in each country. Home-planting was proven to be a significant method when it comes to increasing the planted sector and consequently to

reduce the amounts of dangerous gases and purify the air by a NASA's research summarized in **Table (1)**.

Plants mainly uses carbon dioxide in order to make their own energy through photosynthesis process, they end up releasing oxygen instead of the used gas. Our application briefly functions to choose a plant suitable for the surrounding conditions of the user (temperature and humidity) and to take care of the plant through an IoT system that waters the plant and notifies the user when the water in the container is fully consumed.

Developing an effective application required a lot of testing to achieve various design requirements.

- Testing the water care system demanded various connection codes, the moisture sensor with Arduino, the Arduino with the Wi-Fi module and finally the server with the module. That granted a properly working system.
- The application was developed using kotlin language, it has a lot of pros such as it is processed fast on iOS and Android devices, fills a little storage which is less than 10 mb and doesn't consume much energy, through this applicability was achieved.
- The application is free to download on play store and app store and the associated kit costs only about 200 LE in addition to that it doesn't consume any fossil fuels which assigns it as an eco-friendly app that raises the awareness about a global problem.

There was a sub-problem associated with home-planting as the planters consume more water than needed for each plant, therefor Plantaco application open-care system focuses on reducing water waste, by using a moisture sensor and a pump, when the sensor reads a certain value it supports the plant with an appropriate amount of water, we faced some problems because the pump was pumping

water even if the moisture sensor reads a value less than the certain value so we checked the code again and made modifications then it worked properly.

Finally, we surveyed 10 users about the opinions and whether it worked properly or not, the questions were testing various features in application to determine what is convenient for the user and modify the debugs. According to the results most users features they have tested. There was an additional comment section in the survey, 4 of surveyed users thought the application information wasn't enough so we made an update with more information and asked them again and they were finally satisfied.

STEM subjects has always represented a huge part of our daily lives, everything we learn is somehow connected with what we do and how we create things and solve problems. In developing this application, we mainly focused of what we learned in

- 1- Biology: we learned about photosynthesis (fig.), cellular respiration and the organelles of the plant, it was very useful as we understood the mechanism of every process in the plants that we support growing.
- 2- Physics: we learned about communication and networks which was very useful in the IoT system which is mainly about connecting two systems through Wi-Fi, it widened our horizon and allowed us to understand how Wi-Fi modulation work.
- 3- Chemistry: we learned about gases concentration and their increase risks, especially fossil fuels.

Conclusion

We concluded that:

1. According to the survey, people were more involved, in solving the problem after the application offered suggestions and care, than ever
2. The care system save much more water than the traditional irrigation ways.
3. Using kotlin language is better than using java and easier
4. Android studio is an extremely useful platform as it provides an xml sheet that is self-coded
5. Native applications, which takes less space, process faster on all mobile phones

Literature cited

Foderaro, L. W. (2019, May 1). Climate change has contributed to droughts since 1900- and may get worse. Retrieved from <https://www.nationalgeographic.com/environment/2019/05/climate-change-linked-drought-past-century-via-tree-rings/>.

Gerber, A. (2015, May 11). Learn Android Studio: Build Android Apps Quickly and Effectively. Chicago: Adam Gerber.

Lippman, A. (2000). Media, networks, and content. IBM Systems Journal, https://www.ibm.com/support/knowledgecenter/S8695A_7.0.0.com.ibm.com.cpython.doc/ibm.doc/api.BusinessAnalytics.A_BAPI_BA_Social_Networks/connected-sensors.html

Support, E. W. (2019, July 15). Environmental Factors Affecting Plant Growth. Retrieved from <https://extension.oregonstate.edu/horticulture/indoorplants/indoor-plant-factors-affecting-plant-growth>

Wolverton. (1989, July 1). A Study of Interior Landscape Plants for Indoor Air Pollution Abatement. Retrieved from <https://ntrs.nasa.gov/search?q=1989071989>.

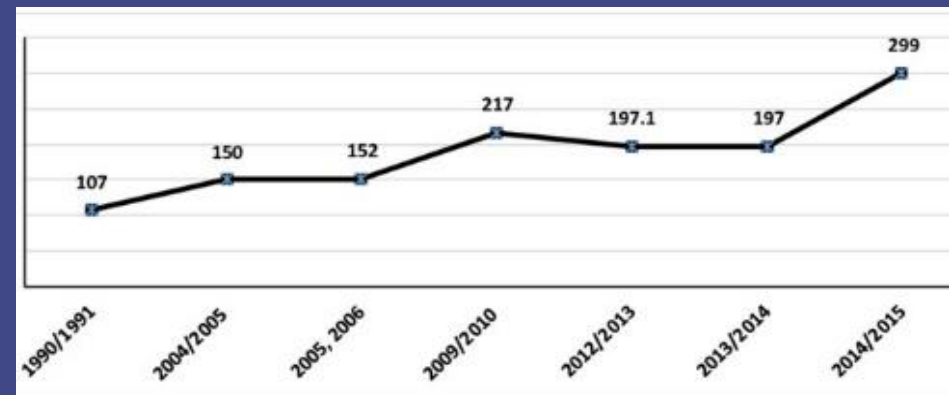


Chart (1) The amount of carbon dioxide in parts per billion (ppb) from 1958 to 2019

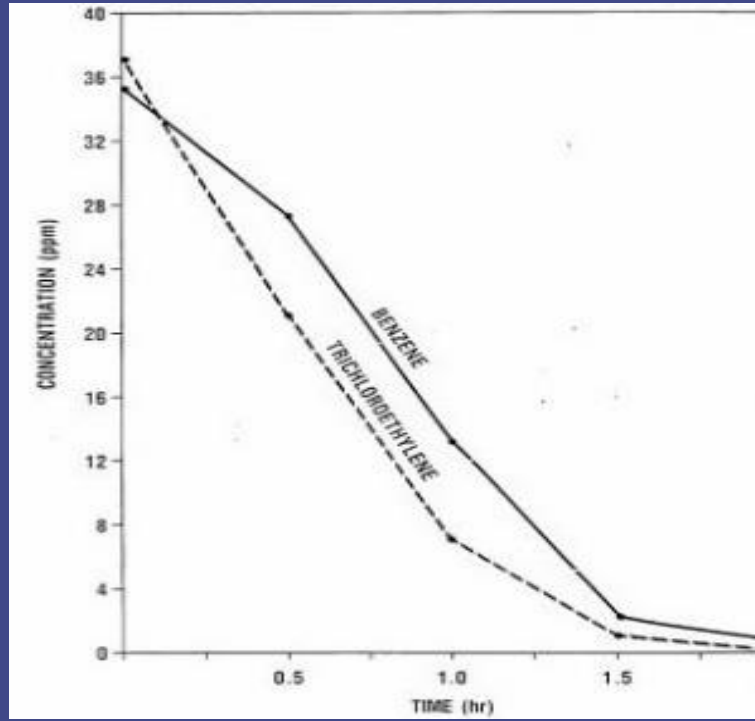


Chart (2) The decrease in biomass and the increase in carbon dioxide in a sealed plant chamber

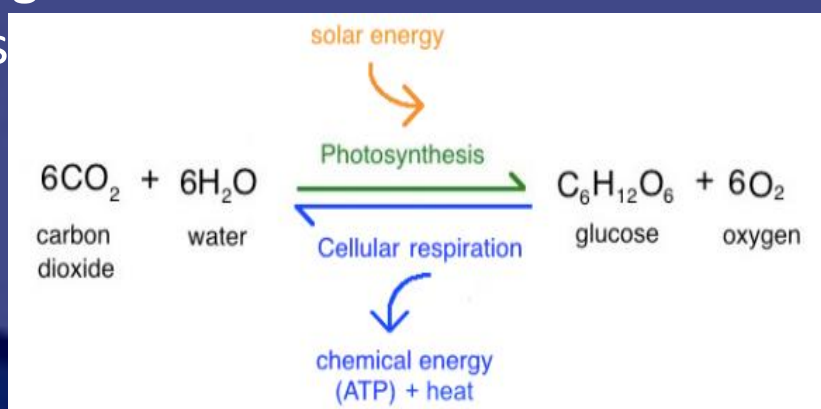


Fig (4) Photosynthesis summary

Recommendat ions

The world evolves so rapidly by science because knowledge never stops at a certain point; we should benefit from the experiences of others in the development of these experiments to discover what is new. We used some means that helped us to develop the project and we recommend with:

1. Linking the application with an indoor plants store.

2. Making researches about each country and recommend the available plants in this area.

3. Adding more plants to increase the range of the users around the world.

4. Making the robot detect whether there is any insect destroy the plant and kill it

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For further information

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