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Software Based Land Vehicle Manufacturing and Investigation of Operability with Alternative Energy Sources

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ABSTRACT

Research in recent years has revealed that fossil fuels are running out and that energy production needs to be done in different ways. Solar energy is one of the sources used for this energy production. Solar energy has many application areas and has recently attracted attention as a clean energy source in the world. With the increasing interest in renewable and sustainable energy systems, solar-powered cars have also come to the fore. Prototypes of solar-powered cars/vehicles are being developed day by day. As solar-powered cars become common, not only will environmental pollution be reduced, but also noise pollution will be reduced. In line with all this information, this study it is aimed to design a prototype of solar cars, which will be the cars of the future. The make block program was used in the design of the prototype. Easy to install, this mBot is inspired by Scratch 2.0 and works with mBlock, allowing it to connect with computers or smart devices via Bluetooth or 2.4G (a different version) and this work, providing details about an experimental solar-powered land vehicle prototype. The electrical and mechanical features of the prototype are detailed. It is predicted that the product developed as a result of the study may be an exemplary prototype for future research.

Yazılım Tabanlı Arazi Araç İmalatı ve Alternatif Enerji Kaynaklarıyla Çalışabilirliğinin Araştırılması

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Mblock

ÖZ

Son yıllarda yapılan araştırmalar fosil yakıtların tükenmek üzere olduğunu ve enerji üretiminin farklı şekillerde yapılması gerektiğini ortaya koymuştur. Bu enerji üretiminde kullanılan kaynaklardan biri de güneş enerjisidir. Güneş enerjisinin birçok uygulama alanı vardır ve son yıllarda dünyada temiz bir enerji kaynağı olarak dikkatleri üzerine çekmiştir. Yenilenebilir ve sürdürülebilir enerji sistemlerine olan ilginin artmasıyla birlikte güneş enerjisiyle çalışan arabalar da ön plana çıkmaya başlamıştır. Güneş enerjisiyle çalışan arabaların/araçların prototipleri her geçen gün geliştirilmektedir. Güneş enerjisiyle çalışan arabalar yaygınlaştıkça sadece çevre kirliliği azalmakla kalmayacak, aynı zamanda gürültü kirliliği de azalacaktır. Tüm bu bilgiler doğrultusunda, bu çalışmada geleceğin arabaları olacak güneş panelli araçların yapımının bir prototip tasarlanması amaçlanmaktadır. Prototipin tasarımında make blok programı kullanılmıştır. Kurulumu kolay olan bu mBot, Scratch 2.0'dan ilham almıştır ve mBlock ile çalışarak Bluetooth veya 2.4G (farklı sürüm) aracılığıyla bilgisayarlara veya akıllı cihazlara bağlanmaya olanak tanımaktadır. Çalışmada prototipin elektriksel ve mekanik özellikleri detaylandırılmıştır. Çalışma sonucunda geliştirilen ürünün ileride yapılacak araştırmalar için örnek bir prototip olabileceği öngörülmektedir.

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Introduction

At the beginning of the new energy sources, which are called "alternative energy sources" in scientific terminology, the energy with unlimited resources comes from solar energy (Unalan, 2005). Vehicles are today's indispensable mechanical and electronic systems. When choosing a vehicle, the fastest and least costly methods are selected. However, energy is needed to operate vehicles. The rapid depletion of fossil fuels used to obtain energy and their expensiveness necessitated the search for new fuels in vehicles. In addition, the damage to the environment caused by the fossil fuels used has accelerated this search. An alternative energy source that has been used recently in studies conducted for this purpose is the sun. Due to the reasons mentioned, the idea of using an endless energy source such as solar energy as fuel in the car has emerged and tried (Tuncay and Ustun, 2004). Today, many solar-powered vehicles are produced. Solar energy has been the source of energy used instead of solid fuel in cars, golf carts, airplanes and marine vehicles (Whiteworth, 2011).

Although the general mechanical parts in solar powered cars are not different from known vehicles, they contain the general principles of an electric car in terms of electricity. Just like in an electric vehicle, in solar vehicles, the propulsion is provided by an electric motor and the energy is stored in batteries (Tuncay et al., 2006). In addition solar cells and related electronic circuits are available in solar powered cars. As a result, electric vehicles in today's market are more in demand than other vehicles. When the literature is examined, the development of electric cars has been a continuous and challenging process. Many studies have been carried out in the literature on the development of solar powered cars. Most of these studies are in the direction of increasing the efficiency of electric cars in a harsh environment.

In Turkey, solar energy is mostly used for the purpose of obtaining hot water in buildings. It is also used in street lighting and traffic warning systems. Although its use has become widespread in Turkey in recent years, there are also solar-powered vehicle applications. In photovoltaic applications, storage as well as generation of electrical energy affects the usability of solar energy in vehicles. For this reason, the use of solar energy in vehicles requires the evaluation of photovoltaic cells and battery groups together (Ozturk et al., 2012). The basis of all studies on the use of alternative energy in vehicles is the requirement not to reduce the vehicle's independent cruising distance below the usage

conditions. Due to the high energy density of their fuels, the ranges of gasoline and diesel engine vehicles are seen as difficult to reach (Cunanan et al., 2021).

When the researches and results on the subject in recent years are examined; Mahmoudi et al. (2017), they conducted a research titled: prototype design of a compact plug-in solar electric vehicle application for smart power management architecture. In this research, they were providing details about experimental Electric Vehicle prototype. The electrical and mechanical features of the prototype are detailed. As a result; first prototype, AC/DC converter would be external and would feed the Smart Charging System directly with 24VDC. At the end of the research, the chassis design was found to be successful; it was emphasized that some features needed to be improved, such as the roof surface being limited to 1.4m² and not being able to get two full-size semi-flexible panels.

Ustun et al., (2015), in their research, they studied the development of electrical design measurement, road performance simulation and energy management system of solar powered race vehicles. In this design, solar cells, electrical supply and battery circuits, direct drive brushless DC motor, motor driving and control circuits, data communication system, road driving scenarios and simulations and the energy management system that optimizes the racing performance of the vehicle are explained.

Kucuk (2019), investigated the design of a new projecting tool for solar systems in his study. In this study, material and cost analysis were made before the installation of solar energy systems. C interface program was used in the analysis study. In this interface, the necessary information is presented to the user during the installation of the solar energy system. Values that vary according to the system that the user will install are designed to be entered by the user. In addition to these options, insolation angle values were calculated according to the regions. Angle values are calculated according to the latitude of each province in Turkey and presented to the user in the interface.

Cobanoglu et al., (2021), they are studies within the scope of designing a solar powered charging station. In the study, cost analysis of different sized solar powered electric vehicle charging stations covering the next 25 years was made. In addition, its contribution to reducing the load on the network is also examined.

Purpose of the Research

In line with all this information, this study is aimed to design a prototype of solar cars, which will be the cars of the future. The make block program was used in the design of the prototype. Easy to install, this mBot is inspired by Scratch 2.0 and works with mBlock,

allowing it to connect with computers or smart devices via Bluetooth or 2.4G (different version). In this work, providing details about experimental solar powered land vehicle prototype. The electrical and mechanical features of the prototype are detailed.

Importance of the Research

In the design process, a prototype is a real product simulation that shows what the product will look like, what the product will do, and how the product will function before launching it. One of the important steps in a new product development process is prototyping. It is a work done to make it testable, interactive with the target audience of the product and to get the first comments about it by its future users. It is predicted that the product developed as a result of the study may be an exemplary prototype for future research.

Method

This research is an example of a prototype development model. Prototyping is an important activity in most new product development processes (Elverum et al., 2016). Prototyping model is a software development model in which a prototype is built, tested, and reworked until an acceptable prototype is achieved (Nacheva, 2017). The product prototype developed in the research has been validated for functionality. It is predicted that the product prototype developed in this research will form the basis for future models. In addition, this study is a software-based manufacturing construction study.

Product Design

Materials

- Solar panel
- Dc Motor
- Wheels
- Plastic Pulley
- Rubber Band
- Steel Wire
- Straw
- Cardboard

The above materials were used in the design of the product.

Features of Solar Panel Prototype

- Solar panels consist of photovoltaic semiconductor silicon cells that convert sunlight into electrical energy.
- The direct current generated by the sun rays falling on the solar cells located on the solar panels provides the generation of electrical energy.
- A silicon cell generates approximately 0.5 Volts.
- As a result of soldering the cells in series, the desired panel voltage and current value is reached.
- Solar panels, which meet the energy needs of homes and workplaces, are much more advantageous and less costly than artificial energy sources.

Working Principle

The solar panels on the solar car convert the solar energy into electrical energy. At the same time, there is a battery system on the car. The vehicle operates using the energy obtained from these panels and the energy of the battery.

The Mblock program was used for coding the product. MBlock is a block-based coding environment. The working logic is like Scratch. With the drag and drop method, it is possible to create large code blocks by placing the code blocks side by side, under each other and to move the character with these code blocks. MBlock sends blocks of code to robot kits to make the robot move in a tangible way.

MBlock is a software produced to code and run robots developed by Makeblock (Duran, 2022). But later it started to be used in arduino projects. With this program, programming started to be done easily with code blocks instead of complex arduino libraries. Code blocks are given below;

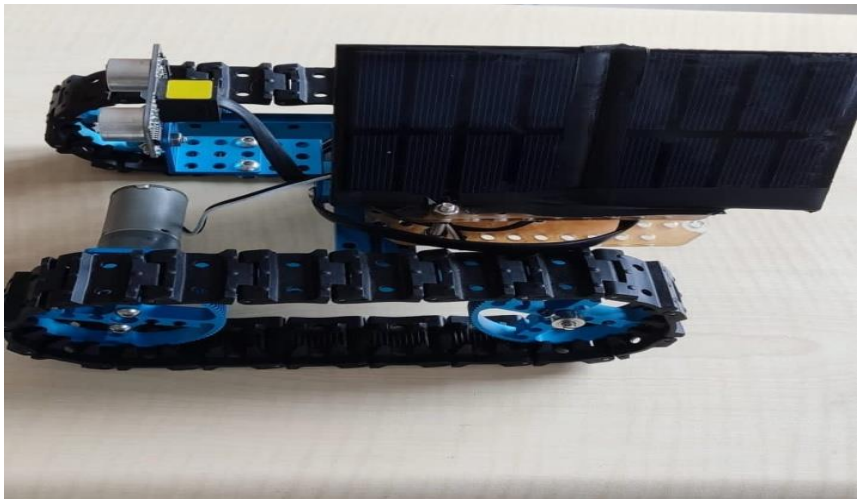
```
function sendPackage(argList, type){
var bytes = [0xff, 0x55, 0, 0, type];
for(var i=0;i<argList.length;++i){
var val = argList[i];
if(val.constructor == "[class Array]"){
bytes = bytes.concat(val);
```

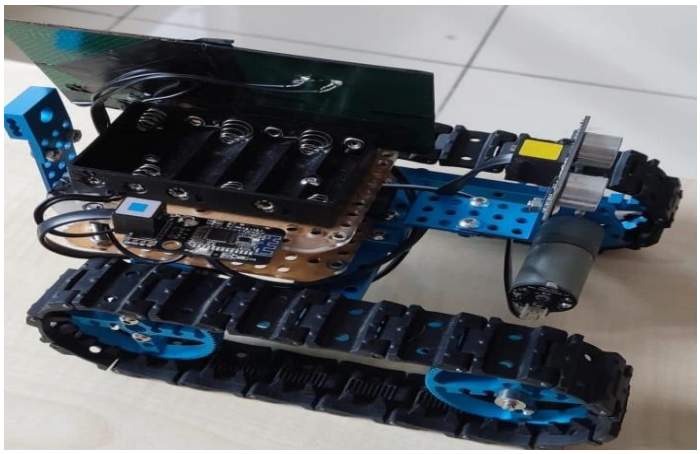
```
}else{
bytes.push(val);
}
}
bytes[2] = bytes.length - 3;
device.send(bytes);
}
function runPackage(){
sendPackage(arguments, 2);
}
function getPackage(){
var nextID = arguments[0];
Array.prototype.shift.call(arguments);
sendPackage(arguments, 1);
}
```

Figure 1. Mbl266ocj.js frame sending functions

Functions of Codes

Primarily light sensors are built into the LDR. Then resistors are placed on their analog pins and defined. Servo motors are placed on the input PINs, one lower and one upper. Finally, the solar panel plate is mounted on the main body. The legs of the LDRs are connected to the analog input pins a0, a1, a2, a3 with a female-male jumper cable. Servo motors are also connected to the 9th and 10th digital pins with a male to male jumper cable as in the circuit diagram. Lastly, coding was done. With these codes, the light level detected by the LDR is converted into a digital value using an analog input.





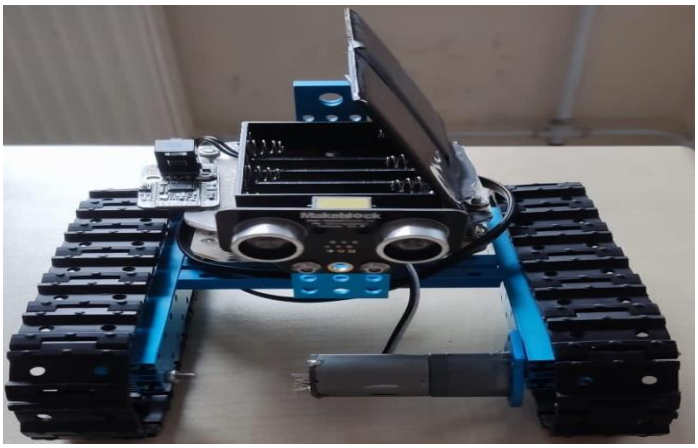


Figure 2. Solar powered land vehicle pictures

Results & Suggestions

The solar panel land vehicle developed in this study is a model robot similar to makeblock mBot designed for use in coding and robotics training. It was assembled using basic, general and affordable robotic materials. This study is aimed to design a prototype of a solar power vehicle, which will be the cars of the future. It is predicted that the product prototype developed in this research will form the basis for future models. In addition, this study is a software-based manufacturing construction study.

There are various shapes and types of vehicles available, as there is no standard design for solar powered vehicles in terms of construction. The key design criterion is to reduce weight and make the vehicle the safest possible while providing maximum sun exposure. The efficiency levels of photovoltaic cells and the energy capacities of the batteries affect the independent travel distance of the vehicles in the first degree. The improvement of these constraints will increase the use of solar energy in vehicles and the use of solar energy as a

secondary energy source in vehicles will be developed as an additional measure to increase the range in electric vehicles.

Prototype produced is open to development. The product can be controlled by tablet, smartphone or PC applications that can be developed according to the adapted protocol. It can also be integrated with different software that can do block-based programming with appropriate changes.

As a result, it was determined in the study that the produced prototype achieved the desired output power under normal conditions. The increase in charging stations and the shortening of the charging time will increase the interest in such vehicles. At the same time, the state's low taxation of solar cars or not is a situation that encourages their use and mass production.

Conflict of Interest Declaration

The authors of the article declare that there is no conflict of interest between them.

Contribution Rate of Researchers Declaration Abstract

The authors declare that they have contributed equally to the article.

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