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Research Article

Unique Sky Cultivation Using Solar Energy

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ABSTRACT

The idea behind this project is to grow more food with less land and less water. Landless farmers can adopt this system to create more land to produce more food than is available. This is a sky box garden that can be maintained with sunlight and water and fertilizer. The giant compact unit with rotary framework is built to grow plants with 8 chambers, the rationale behind selecting such a mechanism is to cultivate a greater number of plants within a limited soil/region. Connected to the primary framework of the wheel mechanism, this multi-purpose rotary business container can hold vegetables, grains, etc. It works with a Basic wheel mechanism capable of decreasing the area or volume needed to grow food such as a high torque DC motor in the middle of the wheel mechanism now controlled by a remote controller developed by an RF module and a small installed system. The control circuit consists of chips and relays 89C2051 designed to turn the wheel clockwise or counterclockwise. Therefore, the tanks connected to this system can be positioned on the ground for purposes of irrigation and other maintenance activities. Acrylic sheets are used to create suspended planters filled with soil. This stands as a prototype module, the fundamental notion involves 8 compact earth boxes mounted on the drive wheel is used for demonstration purposes. However, in real-time scenarios, it's feasible to construct large wheels at a reduced expense. The design of the mechanism occupies minimal space, so it can also be used in open fields for farming. Solar energy is used to drive the bike, a 10W panel is used for this purpose and the power is used to charge the battery, the mechanism can work even without the Sun. One of the main advantages of implementing this type of sky farming is that it is not accessible to animals.

Keywords: *Sky Cultivation, Solar-Powered Farming System, Vertical Farming Mechanism, Ferris Wheel Agriculture Model, Sustainable Smart Agriculture*

1. Introduction

Given the estimated global population of 9.2 billion by 2050, ensuring their sustenance will present a significant challenge. As a result of industrial progress and urban expansion, our fertile land is diminishing with each passing day. In 2015, researchers revealed that the Earth had experienced a 33% reduction in its cultivable land within the preceding four decades. The extent of future losses within the next 40 years remains uncertain to us. Increasing need for sustenance owing to population growth and dwindling arable land is among the most formidable hurdles confronting us. Numerous individuals hold the view that vertical farming offers a resolution to this obstacle. Does vertical farming truly represent the forthcoming direction of agriculture? If so, what form or blueprint holds the most promising answers? Many proponents argue that crops can be cultivated atop building rooftops. The practice gained immense popularity as numerous individuals embraced this method. Nonetheless, a primary limitation of this system rests in its intricate upkeep, compounded by the fact that, it cannot add excessive weight to the roof so that more soil cannot be poured over the roof. Therefore,

we would like to introduce a unique concept that introduces the technology of an automatic rotating Ferris wheel structure that facilitates maintenance and creates space in the air.

Increasing arable land is a logical response to increasing food production. Currently, there are about 1.5 billion hectares of arable land in the world. Over the past 40 years, about a third of arable land has been threatened by erosion, seawater and pollutants affecting soil health and bio productivity. Since most of the fertile land is already used for cultivation, the expansion of cultivated land will be limited to a few areas.

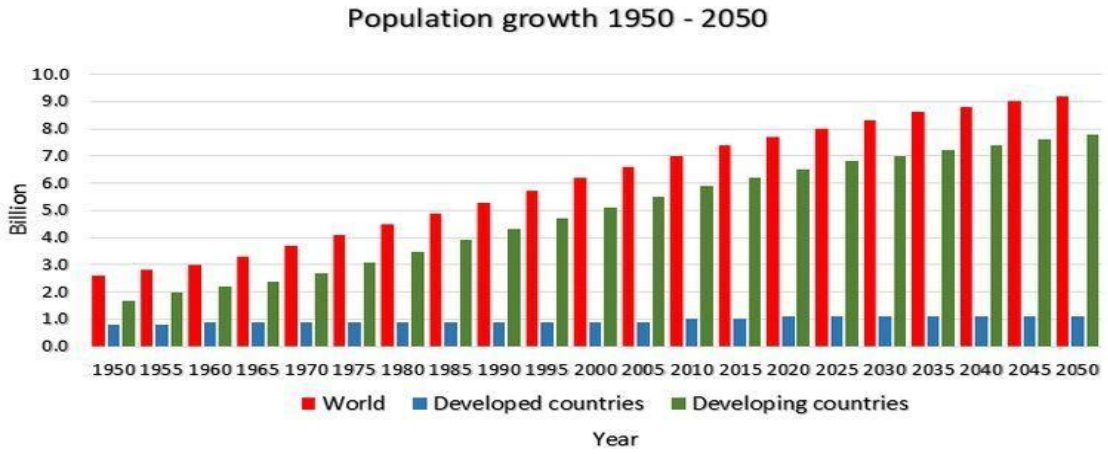

Fig. 1. Estimated population growth 1950 – 2050

The working model built here, known as the Ferris Wheel Farm, solves the food crisis caused by the population crisis and lack of farmland.

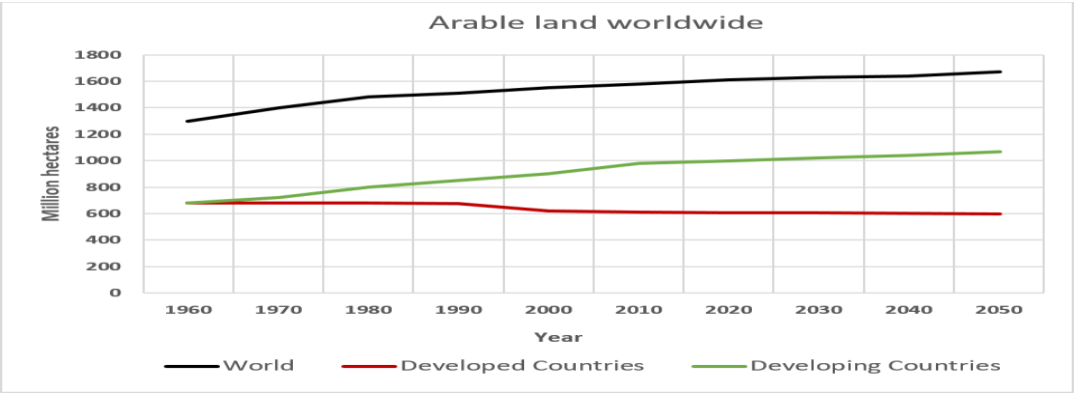

Fig. 2. Estimated availability of arable land

Ferris wheel farming is characterized by the fact that it represents a form of greenhouse farming in which the ground container is shielded by a transparent chamber. The lower tank is installed on the edge of the Ferris wheel and performs a circular movement up and down. Also called sail transfer device, circulation device, also known as movable betting frame. Here it needs two wheels, which must be attached to a solid and sturdy metal stand with the help of an axle mechanism. As the availability of fossil fuels diminishes, We must explore various energy sources to discover alternative means of generating energy, Solar energy is plentiful, and renewable energy stands as the fundamental origin of all recognized energy types. It will be a very viable alternative in the future as it is transparent, safe, free and non-polluting. Generating electricity directly from sunlight through photovoltaic conversion is among the methods of utilizing solar energy, and these photovoltaic modules are currently accessible

across the nation. For a considerable time, solar energy has been seen as the optimal energy reservoir yet understanding its harnessing and advantageous application was limited. Human-driven progress in science and technology has paved the way for the creation of solar cells and accompanying innovations. A solar module consists of several of these PV cells". The performance the output of the solar panel varies in accordance with the intensity of the incoming sunlight. With almost unlimited potential and free availability, solar energy is an environmentally friendly, infinite or inexhaustible source of energy that can be used on a large scale to meet humanity's energy needs. High costs, rapidly depleting fossil fuels and public interest in green energy production are fuelling interest in the use of solar energy. This comprises information regarding solar strength, spectrum, angle of arrival, and cloud coverage over a time-dependent span. Since the initial cost is high, a long lifetime is expected to return the cost of the system both economically and in terms of energy consumption. Currently, panel manufacturers state that the lifespan of the panels is 15 years. Few companies claim that their panels can last up to 20 years. Therefore, it is important to validate panels by comparing different technologies. For this reason, panels should be thoroughly tested before installation. The main reason is to measure work performance under different conditions. Solar modules should be tested in close operating conditions. Measuring systems Can be structured to ascertain the electrical characteristics of solar cells. The primary purpose of solar panels is to capture solar energy, generating electricity directly from sunlight via the process of photoelectric conversion. Solar-electric modules are now widely available in the country, so they can be used in a variety of applications and can partially load the grid. This is the main advantage of this type of sky. Plants are grown in soil containers of limited size and the depth of the containers is also limited, so less water is used compared to conventional tillage. The ability to minimize water wastage is also an important advantage. Crops are grown on vacant lots, so the crops grown are kept away from animals, rats, bandicoots, etc. So, this is another benefit that increases productivity. Sealing the container in a glass chamber protects the plants from sudden climate changes such as extreme cold, heavy rain and strong wind. This allows you to grow all kinds of crops, fruits, vegetables, flowers throughout the year, regardless of the season.

2. Literature Survey

A research framework that allows farmers to obtain detailed information about soil, crop cultivation, crop yield and productivity [1]. These technology-driven agriculture solutions help farmers make smarter agricultural decisions through resource optimization and intelligent planning. The development of IOT-based smart agriculture and smart devices is changing agricultural production because it not only improves quality and yield but also increases the cost of agriculture. The goal of this smart farming is to monitor the environment by receiving live data such as temperature, soil moisture and humidity. All this is achieved by using temperature and humidity. The system proposed in this paper is based on a microcontroller and several sensors. This system can monitor different soil condition parameters. Problems faced by farmers in agriculture include fodder crops, groundwater absorption, and environmental temperature [2]. Problems arising from physical and chemical causes can be improved by farming using modern technology. That's why we use automation technology and IOT. This research includes intellectual ideas and methods developed from it. One uses a Node MCU sensor to receive messages about temperature, humidity, humidity, animal movement, and cattle movement in the field that can destroy crops, and we receive notifications of each event on our mobile devices. Control smart farming events with the easy-to-use Blink app to reduce costs. C. The most important parameter affecting the Indian economy is agriculture [3]. Irrigation is also the most important factor in agriculture. timely irrigation is necessary to produce a good crop. It is very difficult for farmers with large fields. To solve this problem, we rely on smart agriculture based on IOT. Use IoT-based smart agriculture to monitor and irrigate fields anytime, anywhere. Projects include soil moisture sensors, temperature sensors, humidity sensors, etc. It includes various features to facilitate proper watering such as various

sensor points that are deployed at different points of the farm to automate irrigation anytime, anywhere [3]. This project will contribute to the welfare of farmers through a smart farming system using IOT technology. This new system will increase the quantity and quality of products. The IOT device provides information about the status of farmland and based on the income of farmers [4]. This paper presents an advanced IOT based solution to monitor soil and climate conditions for efficient plant growth. Advanced systems can monitor temperature, humidity and soil moisture using an MCU node and multiple sensors connected to it. It also sends notifications about the environmental conditions in the field via SMS to the farmer's phone via Wi-Fi. The prospective applications of IOT and wireless sensors in agriculture, as well as the anticipated difficulties in integrating these technologies with traditional farming methods. a thorough examination of Internet of Things devices and communication technologies pertaining to wireless sensors utilized in OOT devices [5]. What sensors are available for uses in agriculture? B. Plant conditions, irrigation, pest management, and soil preparation. Discover how innovative technology supports farmers during the whole harvest process—from planting to harvesting, packing, and shipping. This study also looks at the practical uses of unmanned aerial vehicles, like crop yield optimization and crop monitoring. Where appropriate, the most recent IOT-based systems and architectures for agricultural applications are also included. Lastly, it highlights research opportunities and existing and future trends in IOT in agriculture based on this thorough assessment.

IOT application in the field of agriculture. Better yield management, resource management, efficient farming, quality improvement, crop monitoring, and field monitoring are all made possible by IOT. Temperature, soil pH, soil moisture, humidity, and water volume sensors are among the IOT sensors incorporated in the suggested approach. In this study, we look at modern farmers' utilization of ancient farming practices and the difficulties they encounter. The suggested model is a straightforward IOT sensor architecture that gathers data and transmits it over a Wi-Fi network to a server. Based on the data, the server can then act.

To propose a tracking system that intelligently aggregates and presents monitoring information gathered from the agricultural site. The researchers introduced the IOT, which uses multiple sensors to collect environmental data in smart farms [7]. All results are calculated and displayed through the tracking system. Customers can be assisted with detailed information, especially the quality of the planting process, through the scanner [8].

An intelligent farming system with sensors. Smart farming system in limited closed areas. Various sensors are strategically placed to measure parameters such as soil moisture content, temperature, pressure, light intensity and pH. It is designed so that anyone can set it up at minimal cost. This creates the favorable environmental conditions that plants need and increases productivity [9].

Opportunities, challenges and technical enablers. 21st century agriculture is powered by connected vehicles. The integration of various technologies creates great potential for automated work with minimal supervision.

3. Existing Model

Crops are grown vertically in layers, a practice known as vertical farming. This frequently includes soilless growing methods including hydroponics, aquaponics, and aeroponics that are intended to enhance plant development, as well as controlled area agriculture. Buildings are typical vertical farming system constructions. In 1999, Dixon Despommier, a Columbia University professor of public health and the environment, introduced the idea of vertical farming as it exists now. A 50,000-person capacity greenhouse garden was created by Despommier and his pupils. The concept of vertical farming was successfully popularized despite this design's lack of implementation.

Fig. 3. Vertical farming

3.1. Agricultural Efficiency

Conventional agriculture requires a large amount of arable land that is finite and cannot be sustained for future generations. The area under agricultural land per capita is predicted to drop by almost 66% between 1970 and 2050 as the population grows. In certain instances, vertical farming can generate ten times more per hectare than traditional farming. Indoor agriculture enables year-round crop growth, in contrast to traditional agriculture in non-tropical regions. Depending on the crop, year-round cultivation can boost arable land's output by 4-6 times, or up to 30 times for crops like strawberries. Because vertical farming uses discrete crop sectors, it can generate high-yielding crops.

3.2. Air Capability

Conventional outdoor crops are susceptible to weather events such as rain, monsoon, storms, tornadoes, floods, fires, and droughts and are dependent on favorable weather patterns. By the end of the century, India's agricultural output could decline by 30% due to changes in temperature and rainfall patterns. In arctic and subarctic regions like Alaska and northern Canada, where farming is nearly impossible, the problem of harsh weather is more acute.

3.3. Environmental Protection

Productivity increase can return to the natural state for each agricultural unit standing on open agricultural land. Vertical farming reduces the amount of arable land and conserves many natural resources. Deforestation and desertification can be prevented by agricultural interventions in natural biomes. Indoor food production reduces or eliminates traditional arable land, mechanized farming and harvesting, conserving soil and reducing emissions.

3.4. Purchase Price

Selecting the greatest yielding plants and appropriate equipment are only two of the many expensive steps in the vertical farming process. Because land in metropolitan regions is typically more expensive, land prices alone account for a large portion of the initial investment expenditures. However, by utilizing pre-existing structures like shipping containers, abandoned factories, and office buildings, many vertical farms can lower equipment costs. As an alternative, vertical farming can be set up in places unsuitable for traditional farming. Costly equipment including air conditioners, racks, LED lights, water pipes, and computers is needed for most vertical farms.

3.5. High operating costs

The planting technique chosen, each with its unique set of needs, has a significant impact on the running costs of most vertical farms. Currently used vertical farming techniques that are most common include hydroponics, aeroponics, and geoponics. For instance, hydroponics and aeroponics require highly specialized labor to function properly, whereas geoponics systems have cheap maintenance, labor, and engineering requirements. The ultimate cost of ownership is further increased by the expenses of seeds, nutrients, and media for these systems. For small hydroponic operations, seeds, growing media, and nutrients account for an average of 6% of overall operating costs; for large hydroponic operations, this average is 13%, according to Pure Greens Arizona LLC.

Artificial illumination using LED (light emitting diode) systems replaces natural light in vertical farming. There can be 12–16 hours of light per day, and occasionally up to 20 hours, depending on the requirements of the plant type. The most crucial and energy-intensive component of a vertical garden is the lighting. According to a German researcher who examined the economics of growing crops in vertical farms, a 37-story vertical farm's yearly energy consumption is predicted to be 3.5 gigawatt-hours. This significant energy use raises the cost of production as well as emissions and the carbon impact. One flower discriminates against another, making it more difficult to pollen, which leads to fertilization and the development of seeds and fruits. Bees, birds, wind, and other natural pollinators fertilize outdoor plants. If these pollinators are absent, the result is vertical farming, which can result in large financial losses if left unchecked. Small, malformed fruits and poor fruit sets are frequently the results of insufficient pollination. For small farms, hand pollinating plants is an efficient solution, but for vertical farms spanning millions of square feet, the issue can escalate rapidly.

4. Proposed Model

The design of the Mini Ferris Wheel Structure Module includes eight compartments dedicated to cultivating crops. The rationale for opting for this mechanism is to maximize crop yield within a confined space. The spinning multi-soil hopper connected to the mainframe of the wheel apparatus can minimize the floor space and volume required for growing vegetables and grains with a simple wheel mechanism. The wheel mechanism is fixed on the shaft. This motor is controlled by a remote controller consisting of an RF module and a mini built-in system. The regulating circuit with the Microcontroller chip 89C2051 and relay is configured to set the wheel in motion clockwise or counterclockwise, which allows the suspended receptacles connected for elevating this mechanism from the ground for irrigation and other maintenance operations can be placed in an accessible place. The hanging container filled with soil is made of acrylic plate. Since this is a preliminary module, the fundamental idea behind eight suspended small dirt containers mounted on movable wheels is used for demonstration purposes. However, in real-time scenarios, the Ferris wheel is capable of built with a reduced effort. The configuration of the apparatus takes up almost no space on the floor, so the empty space can also be employed for farming. The motion of the wheels is powered by solar energy. To achieve this goal, it utilizes a 10W solar panel, the power of which is used to charge the battery so that the mechanism can work even in the absence of the sun. The main advantage of this type of open cultivation is the inaccessibility of animals. The working model built here, referred to as The Ferris Wheel Farm tackles the food scarcity resulting from the challenges of population growth and lack of agricultural land. Ferris wheel farming is characterized by the fact that it represents a form of greenhouse farming in which the ground container is shielded by a transparent chamber. The lower tank is installed at the end of the Ferris wheel and performs a circular movement up and down. It is also called tarpaulin transfer device, circulation device, and called movable planting frame. If the boards are covered with glass, then we can talk about a microclimate for planting. This method does not require the use of pesticides and produces organic food. As the population grows and consumption increases, humanity's demand for the earth's

resources increases, the arable land per person shrinks, and the world's food problem is extremely serious. Food shortages, high food prices and hunger could deepen the dilemma within the upcoming. The fundamental truth in countries like China and India is the presence of a substantial population within a limited geographical space. To address the population crisis outlined above, along with issues like unused land in arid and desert regions, food scarcity, agricultural pollution, and challenges posed by climate change, the present innovation introduces a concept referred to as a Ferris wheel or Ferris wheel farm. The technical plan of the invention implemented within this system consists of attaching the soil container to the wheel rim. Here it needs two wheels, which must be attached to a solid and sturdy metal stand with the help of an axle mechanism. As the availability of fossil fuels diminishes, we must look for alternative sources of energy. Of the many sources of energy, solar energy is abundant and sustainable energy represents the foundational origin of all recognized energy varieties. That will be a very viable alternative in the future as it is transparent, safe, free and non-polluting. In recent years, solar energy has been increasingly used for various purposes. In this context, this project work focused on the development of a low-cost photovoltaic hacksaw system for machine shops is being considered. Since the work in this project is primarily about solar energy, it is important to learn about solar radiation and photovoltaic (PV) systems. With almost unlimited potential and free availability, solar energy is an environmentally friendly, infinite or inexhaustible source of energy that can be used on a large scale to meet humanity's energy needs. High costs, rapidly depleting fossil fuels and public interest in green energy production are fuelling interest in the use of solar energy. Detailed information about its availability is necessary to assess the energy potential of a specific location. This entails information about solar strength, spectral range, incident angles, and cloud coverage as time progresses. Schematic representation of the envisioned system's structure in Fig. 4.

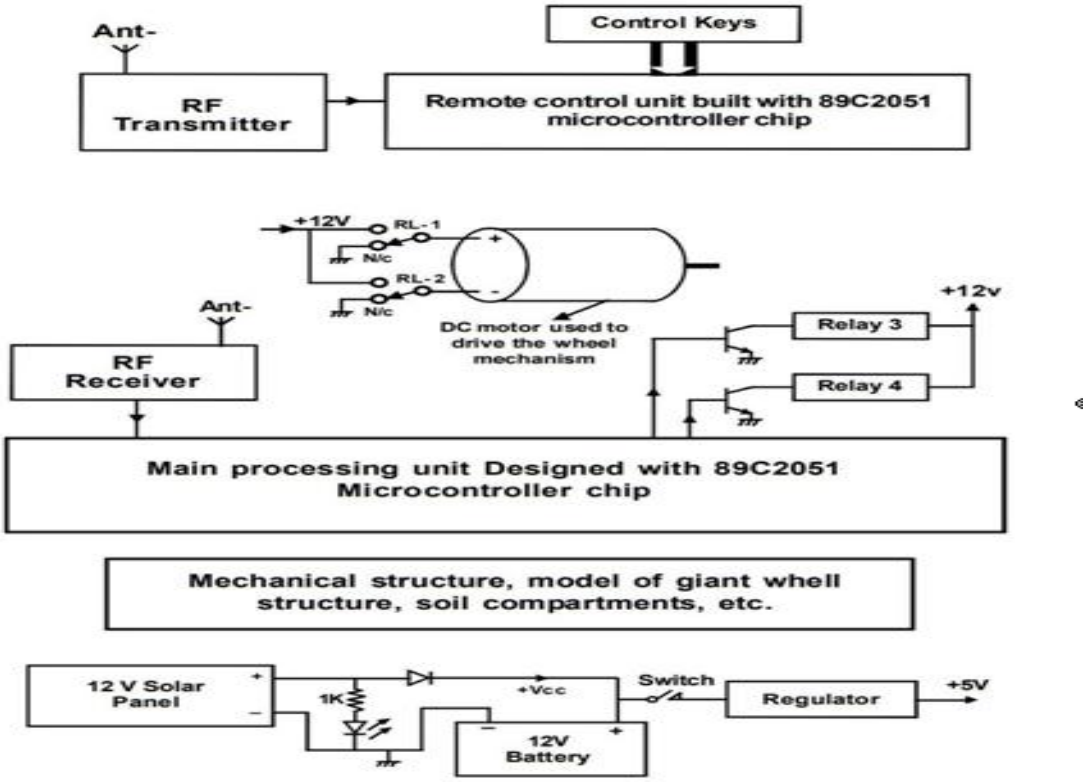

Fig. 4. Schematic of Unique Sky Cultivation with Solar Source

As a control circuit, the control mechanism is controlled by a small remote controller equipped with an RF module. Both the remote-control unit and the wheel control unit consist of an 89C2051 microcontroller chip. Radio communication allows information to be sent from one place and received from another place without cables called wireless communication system. Broadcasting is the most significant type of radio communication. Abrupt variations in the current flowing through a conductor produce radio waves. These radio waves traverse space in a manner like the waves that arise on a pond's surface when a stone is dropped into the water. A modest current like the initial current that generated the radio waves is created in the second conductor of the conductor these fast-moving radio waves strike as they cross paths. This establishes a channel of communication between two distant locations. Radio waves belong to a specific class of waves called electromagnetic waves, which is a type of energy produced by a combination of the electrical and magnetic effects of rapidly changing currents. Although radio waves are invisible to the naked eye, they travel at the speed of light waves, or 1.86 miles per second. Both light waves and radio waves are electromagnetic waves. Sound also travels in the form of waves, but sound waves are not electromagnetic waves. Compared to electromagnetic waves, sound waves travel at a much slower speed of 110 feet per second. For this reason, you will first see a flash, and after a short delay, you will hear thunder. Microcontrollers used in project work also play an important role. Control systems are being implemented with microcontrollers more. As a result, it's critical to comprehend microcontroller-controlled systems thoroughly. These days, microcontrollers are a crucial component of all control systems. Improved performance-based specifications, operation, and functionality are guaranteed by dedicated microcontroller drivers. Because of the computing and communication power of microcontroller devices, the architecture of instrumentation and control systems has changed. Microcontrollers ought to be viewed as instruments for communication and computation. Common, affordable, compact, and surprisingly powerful for their size are DC motors. They are the most manageable. For a DC motor to run, just two signals are required. A DC motor rotates an object by taking a DC voltage as input. Typically consisting of two wires, a DC motor can be directly supplied by either a DC source or a battery. A control circuit that modifies the motor's direction and speed can also be used to power a DC motor. Because DC motors are cheap, have variable speeds, need a larger starting torque than operating torque, require numerous start/stop cycles, and require closed-loop positioning, they are commonly utilised in robotics applications. DC motors commonly used in mechatronics have a voltage of 12V. Figure 5 depicts the imagined system's entire configuration.

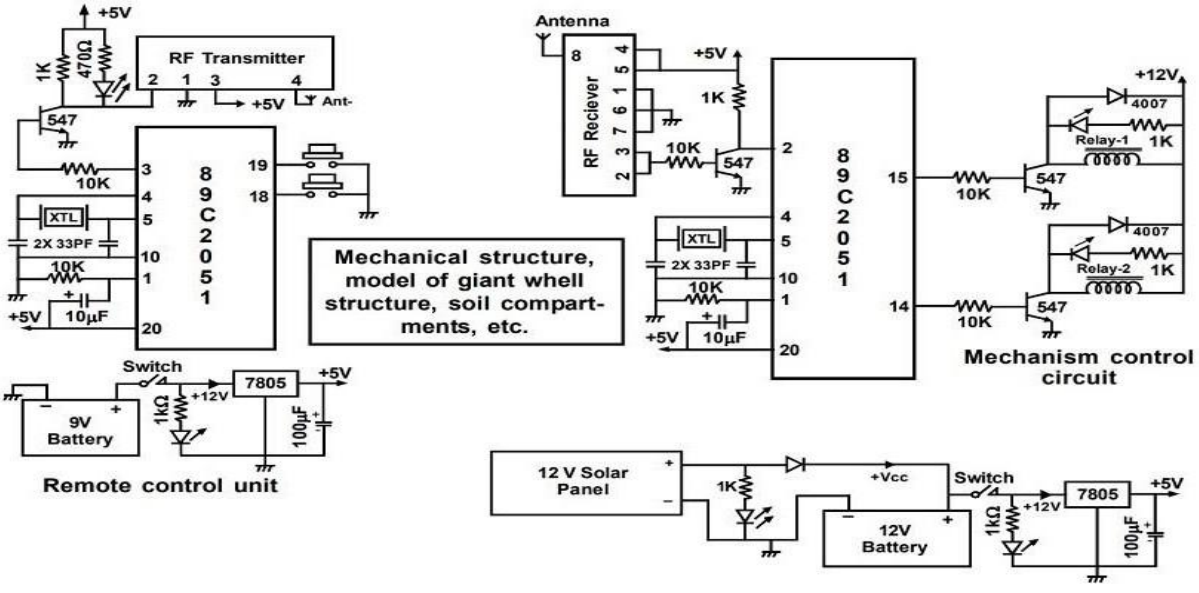

Fig. 5. Schematic Illustration of Unique Sky Cultivation with Solar Source

As explained in the introduction, the world's population is increasing day by day and people need more land for housing and other activities such as industry and work. In this regard, the cultivated area is gradually decreasing, which is a rather dangerous symbol. To overcome this problem, the technique presented here is the best solution, allowing more space for cultivation. This is the main advantage of this type of sky farming. Plants are grown in soil containers of limited size, and the depth of the containers is also restricted, so less water is used compared to normal soil cultivation. The ability to minimize water waste is also an important advantage. Crops are grown in empty plots, so that animals, rats, bandicoots, etc., cannot approach the cultivated crops. So, this is another benefit that increases productivity. Sealing the container with a glass chamber can protect the plants from sudden climate changes such as extreme cold, heavy rain, and strong winds, and can protect all kinds of plants such as fruits, vegetables, and flowers. It can be cultivated all year round regardless of the season. Finally, the biggest benefit is the ability to put different crops in different containers to increase productivity while taking up less space.

5. Results And Analysis

Our project uses Ferris wheel to cultivate the crops in multi layers, the working model of our project is operated through remote control. Power is supplied through the solar panel and Ferris wheel runs through DC motor.

Fig 6. Circuit of RF transmitter Configuration

Fig 7. Solar panel and its configuration

Fig 8. Ferris Wheel

6. Conclusion

The aim of this article is to construct a foundational model of a Ferris wheel structure. The design of the wheel that spins in a vertical orientation is a striking example of modern engineering with many uses. The objective is to reach all above-ground tanks to perform maintenance tasks such as watering, spraying pesticides and removing weeds to rotate them to the desired level. To test this concept in action, a small prototype giant wheel structure was designed for live demonstration and driven by a powerful DC motor with a spur gear mechanism. The wheels are controlled by a remote control and the results are satisfying. As a result of the ongoing industrial progress and urban growth are leading to a daily decline in cultivable land. In 2015, researchers documented that the Earth had witnessed the depletion of one-third of its cultivable land within the preceding four decades. The extent of future losses over the next four decades remains uncertain. The growing need for food because of population growth and dwindling arable land is one of the biggest challenges we face. This model solves the problems caused by the population crisis. The model presented here is a kind of Ferris wheel.

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None.

Conflict of Interest

The authors declare no potential conflict of interest in this publication.

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