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INSPECTING SOLAR PANELS THROUGH COMPUTER VISION AND DRONE TECHNOLOGY

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Abstract: *This research provides a unique method for tracking large-scale grid-connected photovoltaic modules in solar power plants using the superior YOLO v5 state-of-the-art tracking algorithm and classic artistic ideas. We talked about the need for a fully automatic drone that flies over the sun while gaming and taking video. Next, We YOLOv5 who learned to cross clean and dirty signs can be seen here. The features are described for the selected website and will be implemented using Raspberry Pi. This system takes snapshots using drones, creates documents and sends them daily to the relevant department via email in order to avoid timely actions and safety of solar panels. The undertaking is simple, but it is different due to the use of threshold reduction technologies for the analysis of large solar power plants. The examination time for the same period increases to approximately one hundred and twenty hours, reduced to five minutes of which 99. Ninety-three percent of the time is saved by the vision and the powerful automation process.*

Keywords—Solar panels, Yolo V5, Computer Vision, Internet of Things, Raspberry Pi, Inspection, Monitoring, contours.

I INTRODUCTION

Pakistan, with a latitude of 24 ° to 27 ° N and a longitude of 61 ° to seventy-six ° E, in the Sun Belt. This means that the United States has a long period of sunshine during the year. In other words, America has a great ability to use the energy of the sun for practical purposes. More precisely, the u. S. A crisis of energy. can be overcome with the help of free solar energy products, especially in rural villages [1]. A recent estimate shows that there are 40,000 villages in Pakistan that do not need electricity.

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According to the Alternative Energy Development Board (AEDB), ninety-five percent of the US population. S. the place receives the necessary sunlight. At sea level we have solar radiation of around 900 to 1000 w/m². Studies in collaboration with USAID related to solar panels prove that u. S.A. It has a capacity of two, nine million megawatts (MW) of electricity. More importantly, solar energy is widely recognized as a clean source of electricity generation worldwide.

Currently, Pakistan's electricity generation relies on a large number of power plants based on fossil fuels. These fossil fuel-based solutions are harmful to the environment and represent a huge burden on the US economy. Therefore, the trend of renewable energy is increasing in Pakistan. The fastest way to overcome the shortage of electricity protection is considered to be solar power generation [2]. In particular, solar energy is growing because it is easy,

more than sunlight and can be used from a distance. [2] Similarly, Pakistan has expanded the adoption of solar energy technology. From households to commercial establishments, people are installing photovoltaic (PV) panels on their roofs or vacant lots. Then, this reputation boosts the business of solar service providers and neighboring companies. This will benefit the United States and the people going there.

The first 178.08 kW on-grid solar project was commissioned by the Planning Commission and Engineering Council of Pakistan in 2010. A 2 MW machine was installed at the National Assembly of Pakistan Pakistan to generate electricity and add to the grid target [3] . The Pakistani parliament was the first forum in the industry to move to photovoltaic cells [4]. In 2015-16, a 1000 MW project came into operation, called Quad-e-Azam Solar Park in Bahawalpur [5]. Figure 1 below presents the concept of Quad-e-Azam solar park with a capacity of one thousand MW of energy. In order to promote the efficiency of solar technology, the government has issued a memorandum of understanding (LoS) and letter of intent (LoI) to several independent power producers (IPPs) and group [6].

Fig. 1. Quaid-e-Azam Solar Park at Bahawalpur 1000 MW capacity

The growing demand for photovoltaic power plants adds to the need for their protection and monitoring. Photovoltaic

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panels require good maintenance and cleaning to save your work worldwide. Dust damage affects panel performance [7]. Gaofa He, Chuande Zhou et al. [8] found that a dust layer of 4 g/square meter reduced efficiency by 40%. For small places it is easy to display and a simple situation is not easy, but it is far from the busy process for large areas. Although studies have been developed on waterless cleaning techniques [9], the main topic of this paper is the analysis of the photovoltaic panel site of the pharmaceutical industry in Karachi. This is done using aerial imagery from the drone era. The work is delivered in two contexts. In the first part of the work, clean panels are recognized and included using computer vision algorithms. The Raspberry Pi microcomputer is used

on site for emerging photographs taken from aerial images captured by drone. Second, the Internet of Things (IoT): the entire pipeline is created. It uses pandas and a simple mail transfer protocol that mechanically creates information from the output of our idea and prescient software and the email sent to the partner organization.

The format of this newsletter is as follows. In Part II, information related to methods used for solar module inspection is summarized. Section III shows the overall implementation of the mega solar device analysis method using YOLOv5 code. Section IV describes the simulation related to the proposed method. In the closing section, the conclusion of the product and future directions are drawn.

II Literature Review

In most cases, book review is enough to monitor small websites. However, large companies with mega-initiatives hire third party services to provide external services, including defect detection, maintenance, and inspection. Screening tests are necessary to ensure the full performance of renewable energy. Many researchers have suggested different methods for analyzing solar panels. In one paper, malfunctions in photovoltaic cells are detected by analyzing the energy production. Survey statistics are constantly reviewed to identify potential inefficiencies. The majority of outliers usually indicate defects and are attributed to a panel [9]. The method is increasingly used. However, at the same time, this is very difficult, weak and inconvenient for large websites. Some researchers also use string

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measuring gadgets to detect errors and lower performance [10]. This method is also related to the processing and analysis of data.

Hicham Tribak and Omar El Kadmiri et al. [12] propose a method that, first, a robot captures the image of the photovoltaic panel collected with a high definition (HD) camera. Then, they use the trellis method as constitutional coding, and the coding is accelerated with the spreading process. DCT discrete cosine reshaping is used for image watermarking. The pictures were made to look bright. All these steps are involved in photo stitching. The goal of the next level is to extract the points of interest from each captured image using the SURF algorithm. The final level is used to control the actual match points using RANSAC and homograph. Their systems also use Raspberry Pi microcomputers to implement devices.

Infrared tomography is an unnecessary time and space research activity [11][12]. Electric heating of various PV levels; then the thermal infrared camera can capture the following electromagnetic spectrum. Broken and damaged cells can be seen without problems using this method [13]. Different problems can be seen between thermal imaging and optical cameras. Since thermal weapons are transportable, third party service providers often perform this process manually with the help of their efforts. Workers go to each panel, in my opinion, with a hot gun in hand to monitor, and slowly cover the entire site. In the following stages, unmanned aerial vehicles (UAVs) are used with the same method as a thermal gun or an infrared thermal digital camera [14]. At the same time the work was included in the drone time so that all the heat measurements were released from the intervention guide. Now the error can be detected by the pressure and the temperature.

The technology of each photovoltaic cell can be analyzed to identify the problem. Due to the development of infrared thermal digital cameras and advances in drones, this method is attracting the attention of engineers and scientists. Drones provide a suitable solution for quickly inspecting photovoltaic products.

Álvaro Huerta Herraiz et.Al[17] used a deep learning technique based on R-CNN to determine the solar panel and the temperature location, using data that contains real-time images of solar power plant. If the R-CNN detects a hotspot area, then the data is connected using IR-UAV models that contain information such as height, direction, GPS 3 function, camera image angles and emotions and personality

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are mixed with visual objects to create the final result. . The results help to find the fault in the power station.

The concept of IoT for panel analysis is discussed by HSNalamwar et al. [15]. In the studies provided, the authors use data acquisition modules, sensors and block data to take into account the received electrical parameters. A custom Io T-integrated software platform is provided for energy efficiency monitoring. With the help of the reporting framework, the difference between the power generation and the signals. Likewise, some researchers work on small solar facilities available

III METHODOLOGY

The presented method of PV analysis was adopted and used by a large pharmaceutical organization in Karachi. After that, the designs solved the reduction of the solar power plant with minimum additives to guarantee a good price. The brand has the most important items. Observation of solar cells from a height (about 2 hundred
250 feet) after using conventional computer thinking and prescient algorithms for contour tracing and classification.

A. Object detection using YOLO v5 algorithm

YOLOv5 has tools for creating feature pyramids. Model widespread product scaling using activities. This allows the gadget to fall on balanced objects in images taken at a specific height. The information obtained from the flight of the drone when creating a business website. We manually categorized all batches of solar cells using the open source labeling platform Robo flow. The set of panels consists of a set of four to eight panels connected to each other on the roof. The use of YOLOv5 is intended for panel search.

The detected objects are then seeded for similar computer vision models.

The first part of our functional diagram shown in Figure 2 concerns the operation of the machine. The drone will fly from per-works to our entire project site. All drone routes are per-programmed to avoid any misdirection or external interference. The idea is to fly over the building and capture the image from above. If the body is successfully captured, it will be sent to Raspberry Pi microcomputers via IoT. The image processing algorithms and our Tkinter software running on the Pi will analyze the captured image and add it to the Excel file using the pandas library.

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Overall success is calculated with equal and dirty separation. After all the round, the daily data is sent to the participating organizations via the open Wi-Fi facility provided at the venue by the association. Likewise, it is not necessary to send Raspberry Pi microcomputers to drones. Raspberry Pi operates 24/7 on-site with Wi-Fi for data recognition, reflection, efficiency, and truth-telling.

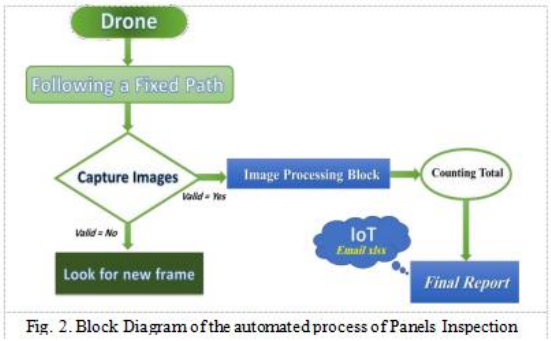

Fig. 2. Block Diagram of the automated process of Panels Inspection

Raspberry Pi microcomputer regularly works in headless mode for data processing. All the images captured by the drones are sent to the microcomputer immediately. It plays all the search rules and generates results. The data is transferred in automatic mode to the Raspberry Pi.

Now the point of interest is our image as a block in the image. The image processing block combines various photo processing techniques to calculate the numbers and check the smoothness of the panel.

The entire photography process is described in Figure 3. The step by step process by which we fulfill the requirement is explained.

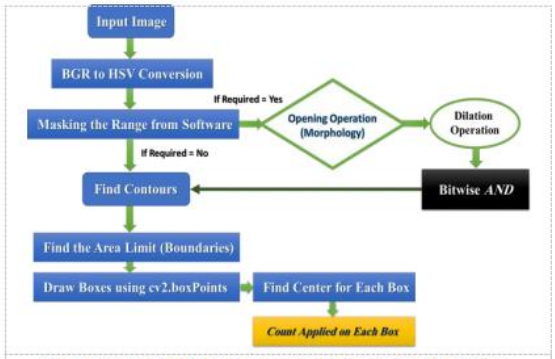

Fig. 3. Explanation of Image Processing Block of Panels Inspection

IV RESULTS AND DISCUSSIONS

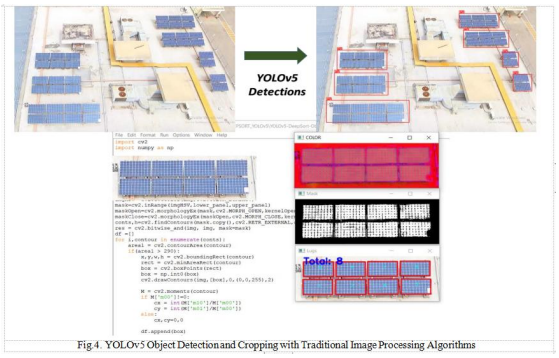

Fig.4. YOLOv5 Object Detection and Cropping with Traditional Image Processing Algorithms

vision algorithms defined in the methodology. The time can of processing and image capturing can be evaluated for mega project sites.

The complete process with complete calculation is shown in the image.

The block diagram specified in the procedure is applicable for real results using Python programming and Open CV library.

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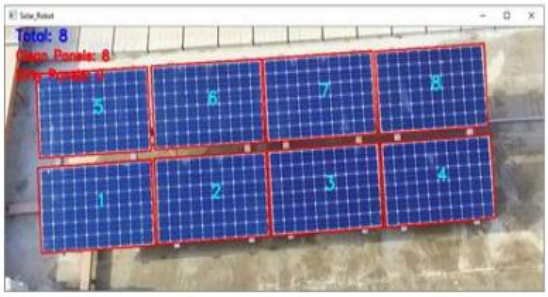

Fig. 5. Aerial Image one after Processing from Raspberry Pi

The second image is captured from a high altitude and is ideal for real-time applications.

Fig. 6. Aerial Image Two captured from the drone

The processed output is also shown in Fig. 7. All the contours are formed successfully with the count on each solar panel.

Fig. 7. Aerial Image two after processing from the Raspberry Pi

A. Quick measure for working on time

Through the advanced techniques set by the project manager, we can capture the image and see the number of seventy-four panels. Mathematically, this can be done as follows.

Total panels = 74 panels

Time required to fly, pull and make = 5 seconds A batch/frame of seventy-four panels = Total time is 5 seconds In 60 seconds = 12 batches can be included

All panels in 1 minute = 888 panels

B. Product search using YOLOv5 rules

We combine solar panel data from the net [19] and data collected from drones. We first organized the data and described it using the Rob flow device [20]. In the first step, we used 2.4k best images with clean and negative training for learning with 100 epochs. For per-testing and training, Google Col-lab is used to generate weighted data for the test. The results were tested in the video [21]. Some experimental results are shown in Figure 8.

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Fig. 8. Test result from trained YOLOv5 model

V CONCLUSION

The preparation process is very simple and robust to the test of time. This is a small part of our ongoing research. We also integrate a thermal infrared camera into the space, which works to find dirty things and find faults. Additionally, by using the calculation method, the use of GPS as in the old method can be eliminated.

The time count proves that our automated process will save sellers the prior effort of verification and monitoring. It's new, different and reliable for our application. This method can be further improved in the future by analyzing other aspects of the image, such as looking for illegal sunspots.

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