بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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MONA MAGHRABY

AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Electronics Engineering and Electrical Communications

Development of solar cell for large area motion detection

A Thesis submitted in partial fulfilment of the requirements of the degree of

Master of Science in Electrical Engineering

(Electronics Engineering and Electrical Communications)

by

Heba Abdelmoneim Atia

Bachelor of Science in Electrical Engineering

(Electronics Engineering and Electrical Communications)

Higher Institute of Engineering, EL Shourok Academy, 2014

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Date: 21 September 2021

Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Executive summary

Detecting the position and tracking the motion of a moving body is research topic that gained a significant interest from the researchers for a long time due to its very important role in many fields ranging from analyzing the human body movement for rehabilitation and sport performance, computer graphics, virtual surveillance to many other applications.

A lot of motion detection and tracking systems have been developed using different technologies such as systems that use inertial sensors and/or magnetic sensors, systems that is based on using markers fixed on the moving body and detecting them with cameras. Also, there are systems that depend on using video cameras and image processing techniques for motion detection which are considered the most used systems. Another new approach has been introduced in 2019 using a position sensitive detector (PSD) and optical components for motion detection.

The PSD is a sensor that can track a laser beam moving on its surface. It could detect the laser position in one or two dimensions where the output current indicates the incident light spot position. The PSDs are used in many applications such as non-contact distance measurement, vibration measurement, laser beam alignment, rotational speed measurement and many more applications.

In this thesis, we introduce a novel technique to detect and track the moving body motion by taking advantage of the common characteristics between the PSD and the solar cell to develop a solar cell that can function as a motion detector. First, a module of the modified solar cell was simulated by TCAD

simulation tools to calculate the detected photocurrent as a function of the position of an incident laser beam sourced by the moving object. Then, a practical module of the modified solar cell has been developed and used in a simple system for detecting the motion, where the output signal of this modified solar cell was processed using a microcontroller circuit. Next, the output is displayed using a PC application. It has been found that the measured system output matches the simulation results by measuring the same simulated output photocurrents. Finally, the position detection error was calculated to verify the proposed technique.

The combination of the useful features of both the solar cell and the PSD achieves some advantages. Regarding the solar cell, the benefits include its large active area compared to the PSD active area, low price and availability. While, for the PSD, the advantages include its high-speed response, excellent position resolution and wide-spread response range. The error assessment of the proposed system showed a low position detection error less than 10%.

Keywords:

Position Sensitive Detector, PSD, Solar Cell, Large Active Area, Motion Detector, Optical Motion Detection, Output Display, TCAD, Simulation, Position Detection Error

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