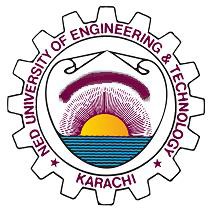
###### UNDERGRADUATE FINAL YEAR PROJECT REPORT

Department of Computer & Information System Engineering

NED University of Engineering and Technology



**Software-Defined Camera for Outdoor Surveillance Applications**

Group Number:

**Batch: 2018 – 2022**

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Ms Fakhra Aftab Lectureer

Project Advisor

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**Author’s Declaration**

We declare that we are the sole authors of this project. It is the actual copy of the project that was accepted by our advisor(s) including any necessary revisions. We also grant NED University of Engineering and Technology permission to reproduce and distribute electronic or paper copies of this project.

Signature and Date

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##### Statement of Contributions

[Mention here the contributions of each student in the project report work.]

##### Executive Summary

Write the summary of report here. Limit the summary to 350 words and use single- spacing between lines. It should include the following details:

* 1. Problem statement
  2. Background information
  3. Methodology used to solve the problem
  4. Major findings
  5. Conclusions

It should give a clear idea to the reader about what is included in the report without providing excessive details. Do not include citations, figures or cross references to tables and figures in the summary.

##### Acknowledgments

[Write the acknowledgments here. Use single-spacing between lines. You can acknowledge any faculty member, any national or international organization, or sponsor for helping you out in completion of this project. They may have provided you valuable resources in the form of data, personal experience, disciplinary expertise, instruments, or technical support. Ideally it should be one or two short paragraphs.]

##### Dedication [Optional]

[Write dedication here. You may want to dedicate this work to immediate family members or members of a board or society that works for your cause. Ideally, it should be only one or two lines in length. However, if you do not wish to include a dedication, delete this page. After deleting this page and updating the table of contents, this page will automatically disappear from the table of content. In case, you have decided to delete this page, the table of contents should begin from page v.]

##### Table of Contents

[Author’s Declaration ii](#_TOC_250033)

[Statement of Contributions iii](#_TOC_250032)

[Executive Summary iv](#_TOC_250031)

[Acknowledgments v](#_TOC_250030)

[Dedication [Optional] vi](#_TOC_250029)

[Table of Contents vii](#_TOC_250028)

[List of Figures viii](#_TOC_250027)

[List of Tables ix](#_TOC_250026)

[List of Abbreviations x](#_TOC_250025)

[List of Symbols xi](#_TOC_250024)

[United Nations Sustainable Development Goals xii](#_TOC_250023)

[Similarity Index Report xiii](#_TOC_250022)

[Chapter 1 Introduction 1](#_TOC_250021)

* 1. [Background Information 1](#_TOC_250020)
  2. [Significance and Motivation 1](#_TOC_250019)
  3. [Aims and Objectives 1](#_TOC_250018)
  4. [Methodology 1](#_TOC_250017)
  5. [Report Outline 2](#_TOC_250016)

[Chapter 2 Literature Review 3](#_TOC_250015)

* 1. [Introduction 3](#_TOC_250014)
  2. [[Title of the Section] 3](#_TOC_250013)
  3. [[Title of the Section] 4](#_TOC_250012)
  4. [More Sections 4](#_TOC_250011)
  5. [Summary 4](#_TOC_250010)

[Chapter 3 [Name of the Chapter] 5](#_TOC_250009)

[3.1 Introduction 5](#_TOC_250008)

[Chapter 4 [Name of the Chapter] 6](#_TOC_250007)

[4.1 Introduction 6](#_TOC_250006)

[Chapter 5 Conclusions 7](#_TOC_250005)

* 1. [Summary 7](#_TOC_250004)
  2. [Recommendations for Future Work 7](#_TOC_250003)

[Appendix A [Title of Appendix] 8](#_TOC_250002)

[References 9](#_TOC_250001)

[Glossary [Optional] 10](#_TOC_250000)

##### List of Figures

[Figure 1: Trend of Monthly Average High and Low Temperatures in Karachi (Shepherd,](#_bookmark0) [1956) 4](#_bookmark0)

##### List of Tables

[Table 1: Residual Stresses for a Plate 4](#_bookmark1)

##### List of Abbreviations

**FPC** Flat Plate Collector

**TSS** Tubular Solar Still

**EPBP** Economic Payback Period

##### List of Symbols

##### Text, letter Description automatically generated

##### United Nations Sustainable Development Goals

The Sustainable Development Goals (SDGs) are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice. There is a total of 17 SDGs as mentioned below. Check the appropriate SDGs related to the project.

* No Poverty
* Zero Hunger
* Good Health and Well being
* Quality Education
* Gender Equality
* Clean Water and Sanitation
* Affordable and Clean Energy
* Decent Work and Economic Growth
* Industry, Innovation and Infrastructure
* Reduced Inequalities
* Sustainable Cities and Communities
* Responsible Consumption and Production
* Climate Action
* Life Below Water
* Life on Land
* Peace and Justice and Strong Institutions
* Partnerships to Achieve the Goals

##### Similarity Index Report

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| **S. No. Student Name** | |  | **Seat Number** | **Signature** |
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xiii

[Attach here the first and last page of the plagiarism report generated by Turnitin.]

#### Chapter 1 Introduction

* 1. Background Information

A project report usually contains five or six chapters. Chapters should be divided into sections that should be numbered according to their chapter numbers. For instance, the numbering of sections of chapter one should be 1.1, 1.2, 1.3, etc.

The first chapter should be “Introduction” and it should provide the background information related to the project. The first section of the Introduction chapter should be titled “Background Information”. While the other sections should be “Significance and Motivation”, “Aims and Objectives”, “Methodology” and “Report Outline/Scope” of the Project. It should inform the readers what you did in the project, why you did it, and how you achieved it. This chapter provides a broad overview on what is discussed in the report.

* 1. Significance and Motivation

All the computer vision algorithms that perform image analysis and processing require high quality images. The conventional cameras available now a days have fixed internal architecture i.e.; they are not programmable; hence not aware of their environment and non-adaptive. These cameras can’t provide a constant and standard image quality in different scenarios.

All real time applications need to process data as fast as possible; the images need to be pre-processed as well before they can be used to generate useful results according to the requirements of an application. If the environment diverges from normal conditions or noise is generated, conventional cameras fail to maintain the standard image quality. As a result, more computationally intensive & time-consuming algorithms will be required to generate clean and clear images before using them in computer vision applications.

This leads to the need for a software-defined camera; where imaging sensor inside camera is adaptive to respond environment. Therefore, processing the images directly on the camera, taking advantage of the sensors to become environmentally conscious. Such a camera takes over the load of pre-processing images. The strategy is to make our camera smart enough so that it can sense its surroundings and noise, adjusts its internal hardware and select most suitable parameters for the situation even before the image is captured. In this way, the quality of image will be constant. However, in a practical scenario, some of the images might be affected but there would not be in depth data loss hence data recovery will be possible.

This project provide ease to customers of any environment varying image processing application [9] e.g.

* In surveillance systems, as it is used to recognize the suspected person or vehicle from a still image or video.
* In airports, automated systems could be used to check luggage.
* In biometric recognition, to identify an individual based on some biological feature such as eye, ear, fingerprint, etc.
  1. Aims and Objectives
* To study and determine exact parameters which can be manipulated to produce high quality images.
* To integrate different models of the environment for an efficient solution.
* To exploit the internal architecture of the image sensor.
* To develop image pre-processing IP cores and implement a solution that will integrate all the cores.
* To test the software-defined camera for outdoor surveillance applications under various environmental conditions.
  1. Methodology

Our project’s aim is to make camera smart enough, such that it produces high quality images in varying environment. The methodology we will use to achieve our target comprise of:

1. **Environmental Profiling:**

Conventional cameras will be used for capturing images in different environments at regular intervals. These images help in determining the most varying parameters.

1. **Image Sensor Integration:**

PCAM 5C module will be connected to the FPGA board and a set of open-source Vivado IP cores will be used for its configuration in software.

1. **Image Processing Cores using Vivado HLS:**

Vivado High Level Synthesis will be used for generation of different soft IP cores

* 1. Report Outline

The fifth section of the chapter one should be “Report Outline”. It should include the scope of the project and explain the general outline of the report by highlighting the content that is covered in different chapters and sections.

Kindly include more sections in the Introduction chapter if you prefer.

#### Chapter 2 Literature Review

* 1. Introduction

Traditional cameras are not flexible and also unaware of their environment. They cannot provide constant and standard image quality in every environment because of their fixed (non-programmable) internal architecture. Along with image quality, image pre-processing is also crucial. The images need to be pre-processed before they can be used to generate useful results. Therefore, ample amount of work done only to improve image quality and making pre-processing faster.

The authors of [1] use Field Programmable Gate Array (FPGA) architecture for making pre-processing faster. As the FPGA architecture has the ability to perform parallel processing, it will shorten the processing time and the efficiency will increase.

* 1. Edge Computing

The pre-processing generally occurs at server side. Server solution is simple and effective but it is costly and time consuming. Edge computing eliminates the need to send image data to server-side for processing. Provides a way to process the images directly on the camera by taking advantage of sensors and the use of end devices to take over the load of processing [3].

In [4] the detection and recognition tasks for surveillance are executed locally by edge devices. Only when devices are not able to execute the recognition task, a recognition request is sent to the server

* 1. High Level Synthesis

The properties of FPGA (Field Programmable Gate Array) make them a desired technology to implement digital image and video processing. HLS (High Level Synthesis) Vivado is one of the most used tools which can directly transform a C description to a hardware IP, described on Verilog or VHDL. FPGA reconfigurable circuit with its HLS software tools is become a very promising technology to be widely used in many applications encompassing all aspects and requirements of embedded system [5].

In [6] authors state that, escalating system-on-chip design complexity is pushing the design community to raise the level of abstraction beyond register transfer level. Despite the unsuccessful adoptions of early generations of commercial high-level synthesis (HLS) systems, we believe that the tipping point for transitioning to HLS methodology is happening now, especially for field-programmable gate array (FPGA) designs. The latest generation of HLS tools has made significant progress in providing wide language coverage and robust compilation technology, platform-based modeling, advancement in core HLS algorithms, and a domain-specific approach.

* 1. More Sections

Include sections as appropriate to your literature review.

* 1. Summary

Last section of each chapter should be Summary or Conclusion.

#### Chapter 3 [Name of the Chapter]

3.1 Introduction

Include more chapters as appropriate to your project. All chapters should start from a new page. The middle chapters should discuss your work on the project. Some famous headings for these chapters are Design and Calculations, Modeling and Simulations, Fabrication Work, Data Acquisition and Analysis, Comparison of Methods, Results, Discussion/Interpretation of Results, etc.

#### Chapter 4 [Name of the Chapter]

4.1 Introduction

More chapters.

#### Chapter 5 Conclusions

* 1. Summary

The last chapter should be “Conclusions”. It is ideally the fourth or fifth section of the report. This chapter should include the aims and objectives of the project. It should also summarize the important points in the previous chapters, and the findings and achievements of your project. If possible, write some recommended future work on the project based in your conclusions. Therefore, the last section of this chapter should ideally be “Recommendations”. For example, you may provide recommendations by discussing constraints of your project and ideas to eliminate them. You may also highlight other possible investigations to improve the efficiency of your project. Use present perfect tense to write the conclusions. The recommended two sections for the Conclusions chapter are “Summary” and “Recommendations for Future Work”.

Do not use cross referencing, external references, or footnotes in the Conclusions chapter. Make it a stand-alone chapter.

* 1. Recommendations for Future Work

Write details here.

##### Appendix A [Title of Appendix]

Include appendices, if applicable. Appendices should include the information that is not the primary part of the main body of the project report. This means that if this information is removed from the main body, it would not negatively affect the flow of ideas in the main body of the report. For example, it may include long computer programming codes while keeping a flow chart of the code in the main body of the report. It may also include lengthy numerical data while keeping their graphs in the main body of the report.

If the project report has only one appendix, then the label of this chapter should be “Appendix” (not “Appendix A”). To cite an appendix in the text, write full title of the appendix that is “Appendix A”, “Appendix B”, etc. Each appendix should start from a new page and should also include a short description of what is included in that appendix.

#### References

Shepherd, D. G. (1956). Performance of one-row tube coils with thin-plate fins, low velocity forced convection. *Heating, Piping Air Cond, 28*, 137-144.

##### Glossary [Optional]

|  |  |  |
| --- | --- | --- |
| **Term** | **Definition** | [Page at which it  first appeared] |
| **Azimuth** *angle between North, measured clockwise around the* Pg. 1 | | |

*observer's horizon and sun*

**Zenith** *an imaginary point directly above the observer/system, complement of altitude angle*

Pg