Digital Logic 2024

Abstract

This document contains the requirements and guidelines for the "Digital Logic" pilot exam bonus project.

I. LIST OF PROJECT TOPICS

A. *Project Idea 1: Fake news generation*

We have one intruder in the *Happy Elementary school* that is disrupting the happy atmosphere by tampering the pupils messages sent on the local school chat. Given the data over a network from "Local School" is organized in packages of 6 sizes having the following format: preamble(7 bytes) destination (6 bytes), source (6 bytes), packet type (1 byte). The intruder has somehow intercepted the data traffic, and is changing the content of the messages, if positive such that they become slightly or fully negative.

For the preamble we have - 7 identical bytes - uncoded on-the-wire bit pattern transmitted from left to right: 10101010, decimal in Ethernet LSb-first 55, hexadecimal LSb-first bytes for 8-bit wide buses 0x55.

The first bits of the packet type encode the 6 supported payload sizes: 42, 48, 46, 52, 64, 80, 128.

As, the minimum payload is 42 bytes when the actual payload is less than the minimum, padding octets are added accordingly. Payload contains text (ASCII) and emoticons (codes).

This perpetrator is a mean one! He/She analyzes text and whenever it encounters nice words and expressions of up to two words such as: good job!, well done!, goody!, how nice!, frumos, like it!, imi place!, woow!, super! are replaced by nu prea frumos, asa si asa, nu imi place sau nu prea imi place, nu vreau, e urat, etc..
He **eats up** all the nive emoticons and instead puts not so nice appraisals.

Students sometimes miss-spell or purposely spell wrongly some words. E.g. LoV for Love, etc. make sure you handle such cases.

this solution should have at least 4 words/expressions and 4 emoticons in its database.
Design the perpetrators system such that its is able to reach a throughput of 1Gbps.

B. *Project Idea 2: Stop aggression!!*

Aggression is the most significant psychopathological risk factor. It is a multifaceted construct and can affect students' social, mental and physical health. A study conducted on 900 students, including 445 girls and 455 boys, 563 parents and 104 elementary school teachers in the fourth, fifth and sixth educational grades in Kermanshah city in 2018 has shown that 29% and 10% of the students had moderate and high levels of aggression, respectively. Also, 30.6% of them were moderate victims and 45.6% were intense victims. Verbal aggression among children and adolescents is getting alarmingly prevalent. For this reason, *Happy Elementary and Middle school* has implemented a system that monitors the levels of verbal (textual) aggression on the school forum in a bit to better understand and try and fight this disturbing trend.

The system sniffs the data of the Ethernet packages (please refer to 802.3 standard for the Ethernet packet and frame structure) in a bid to discover the most aggressive classes and the time windows when these manifest (IP based - each Access Point has its own IPs allocated). After a period of time (programmable), all data is reset, and a record of the top 3 offenders is kept. The list of offenders is analyzed at the end of each week.

The payload data from the Ethernet packet analyzed should take note of the following:

- **Students sometimes miss-spell or purposely spell wrongly some words. E.g. LoV for Love, etc. make sure you handle such cases.**
- **this solution should have at least 4 words, and 4 regexp defined and 4 emoticons in its database.**

We encourage you to select them based on some studies for the younger generation.

Design the aggression monitoring system such that its is able to reach a throughput of 1Gbps.

C. *Project Idea 3: Catch the busybody!*

Design a system that is able to detect and counter a Denial of Service attack for a server. Refer to meaningful literature solutions such as: link.

Although, we don't expect a bullet proof solution, this assignment requires a sound, practical, supported by some mathematical background (a small algorithmic part) solution to be presented!

We don't expect the system design, although it would be nice to have a full demonstrator!

D. *Project Idea 4: Faking exit polls surveys!*

A very important event has been scheduled with around 10000+. **p** survey companies sent each **k** employs to collect data from the p access hallways of the event building. Given the large number of people their impressions expressed as verbally are encoded as: -3, -2, -1, 0, 1, 2, 3. This part is done by the survey company employees. Each person exiting the venue is asked appreciatively the same thing (different wording, same meaning) p times. Each access hallway has m_1 up to m_2 gates. In order to make sure there is no mishap an extra safety margin is made. During each period of time (each moment a group of people exit the gates, one person exiting from each gate), the employs from the same company aggregate the following info: sum of all the encoded impressions of the interviewed people. The m_1 up to m_2 employees from a company sometimes switch gates. Each of the aggregated answers is saved in memory.

Due to unforeseen events, or laziness, some of the answers each company are lost. The employees responsible for collecting them use they personal relations to collect them from people from other survey companies. They put all their data together. But, what do you know! Not all companies are the information is truthful, and they discover that their recorded data appears to have errors!! Some answers appears to be recorded incorrectly, ar some aggregation is redundant information does not appear quite alright.

They dig dipper! Their revenue is at stake! Data must be recovered at all cost.
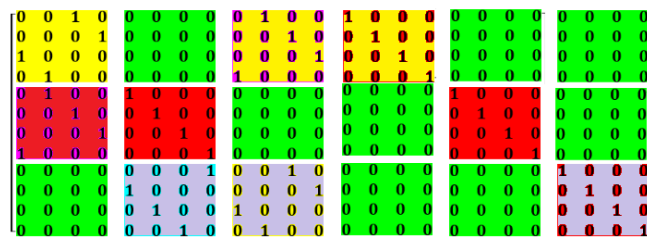

Fig. 1. Exit pattern for 24 people, 3 hallways having 2 gates each. Line 0 shows person 0 and person 9 exiting at the same time hallways 1. Column 12 is the aggregated info for the two person. The yellow lines correspond to company A, the red to B, and purple to C

Design a system that recovers the data and "scrubs" errors.

E. *Project Idea 5: Communication system: encoder, noise, and decoder*

The error correction code is given by the TA. also, instructions on how the encoding and the decoding are executed.

If the decoding algorithm (C model) is given by the TA - a 5G code will be used, otherwise a smaller code will be employed.

Requirement: Design a simple the system for a given error correction code. - link

TABLE I
TIMELINE, MILESTONES AND DELIVERABLE

Due	Milestone	Deliverable
week 8	M_0	teem set, idea selected, abstract, execution plan and responsible, spec for system and subcomponents
week 11	M_1	detailed plan and start of implementation
week 14		First version of system
First exam week	M_3	Final report and demonstrator

II. M_0 MILESTONE 0

Team members, team, contact person, and PROPOSAL ABSTRACT (one for each group) and tentative system block diagram, with subsystem specifications, and work breakdown for all team members. This item and the PROPOSAL which follows are to be prepared jointly with your partner.

III. M_1 MILESTONE 1

Write the PROPOSAL.
It is comprised of:

- A description of the project in words, stating what your system is going to do and how you plan to implement it.
- A block diagram.
- A set of specifications that define in detail what your system is (in input, output terms) and what tests will be used to prove that it functions properly.
- A statement of how the project work is to be divided among the partners. The block diagram should be referenced.

The project should be partitioned into separately testable subsystems. Each subsystem is to be the responsibility of a single partner. The proposal should be typewritten. Typically, it should be three to five pages in length, single-spaced, plus the block diagram and any figures you may need.

In order to proceed to the next step, you need approval from the TA. Thus, you are required to email the PDFs to the TA by 11AM on the day before the discussion with the TA. Your approved PDF document version will be posted on the virtual campus.

IV. M_2 MILESTONE 2

Project CONSTRUCTION: build, debug and test your subsystem. Preliminary delivery.

V. M_3 MILESTONE 3

Complete the project and submit the PROJECT REPORT. Material from the proposal can be used. The report should be prepared jointly:
The Introduction and Summary sections can be joint efforts of the project team, but it must contain separate sections, individually written, describing subsystems for which each partner is responsible. Each section of the report should indicate the responsible author.

VI. CALENDAR

VII. BOARDS AND RESOURCES

Available Xilinx Boards:

- ZEDBoard
- Zynq 7020

PMOD extenssion boards for Xilinx Digilent Bords:

- camera
- Joystick
- TFTLCD

Available Altera Boards:

- DE10Lite
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VIII. IDEAS AND REFERENCES OF STUDENT PROJECTS

- MIT Introductory Digital Systems Laboratory - browse through the projects presented: link
- Image processing, VGA, MIPS, Microcontroler: link.
- Image processing Xilinx link.
- Neural NeT - Digit detection: link
- Neural NeT - Decoding (open-HW): link
- FPGA game projects (e.g. FPGA Defender) link
- OpenHW contest and project repos - browse through the results: link