B. Eng. Tech. Projects (FYP @FKTEN)

General Requirements

Note: *These are MY requirements - to those who are interested doing their projects under MY supervision.*

Recommended development platform for all projects is Linux. I personally use and recommend Slackware. Devuan is also a good option. Projects that involve source codes (e.g. HDL, C, C++) are **required** to use source code management (SCM) software (git).

General Comments

Update20171217 Beginning 2018, I will set milestones (i.e. mini-objectives) for each project title. I figure this would be a better way for students to actually see what I expect them to achieve while working on the project. My previous way of using scopes does not seem to work - although I thought that would make it more flexible on the outcome of the project.

Note*: The following explains my previous method of describing projects. I'm keeping this around for now, but only for personal record. Students no longer need these.*

For each project title, I've included some keywords, objective(s) and scope. The keywords are there for you to do some background research before you jump into this - I don't want you to give-up on me (it's a waste of everybody's time) towards the end of the project. I put in objectives and scope to let you know what is expected out of this project. So, your results will be based on these expectations.

I define an objective as the targeted final result. I usually set only ONE primary objective and optionally a secondary objective that will/should not affect your final results (though it usually gives you extra marks if completed) - too many objectives usually leads to unsatisfactory results. Meanwhile, scope visualizes how much work is expected - for example, one can say that the primary objective is to design an 8-bit microprocessor. So, the scope should mention maybe something like you're expected to produce schematics with instruction set that covers data transfer/processing and program control, complete with logic simulation results.

Project Titles 2025

SYSTEM DEVELOPMENT

1.
Development of a Vision-based Vehicle Registration Identification System
- Description: This project is mainly software development, with real hardware implementation (Raspberry Pi platform). The main target is to implement vision-based vehicle registration identification system on real hardware. Implementation MUST BE written based on my1imgpro library (i.e. libraries like OpenCV cannot be used). ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): vision system, image processing
- Pre-requisite: Computer Programming, Image Processing
- Objective: To develop a Vehicle Registration Identification System
  - Milestone 1: Implemented algorithm for vehicle registration plate detection
  - Milestone 2: Implemented algorithm for character recognition (identification)
  - Milestone 3: Implemented system on real hardware (Raspberry Pi platform)

2.
Development of an Automated Storage and Retrieval System
- Description: This project is a combination of hardware/software development. It requires the student to develop a small-scale storage/retrieval system (refer to this). Of course, a management software for the system is also expected. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontrollers, warehouse management, automated storage retrieval system, asrs
- Pre-requisite(s): Microcontrollers/Embedded System, Programming
- Objective: To develop an automated storage/retrieval system and its management system
  - Milestone 1: Produced a model for storage/retrieval system (at least 32 - 4×4 on both sides)
  - Milestone 2: Developed software for basic storage/retrieval
  - Milestone 3: Developed a simple warehouse management software

DIGITAL SYSTEM DESIGN

SYSTEM DEVELOPMENT

1.
Implementation of RISC-V Core on FPGA
- Description: This is a design project to implement a working microprocessor based on the RISC-V ISA. It involves writing HDL (Hardware Description Language) codes and simulating it on a simulation software. The final implementation needs to be fully tested and subsequently be improvised (if possible). ***Warning:*** *An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.*
- Keyword(s): RISC-V, FPGA, reconfigurable computing, microprocessor softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement custom RISC-V core on FPGA
- Scope:
  - Milestone 1: Completed basic core @RV32I instruction decoding (at least data movement and ALU)
  - Milestone 2: Completed State Machine for instruction fetch/execute cycle.
  - Milestone 3: Completed Testbench for all implemented modules (and verified)

2.
Implementation of 8051-Binary-Compatible Core
- Description: This is a design project to implement a working 8051-binary-compatible core. A similar implementation for 8085 microprocessor is available here. It involves writing HDL (Hardware Description Language) codes and simulating it on a simulation software like ModelSim. The final implementation needs to be fully tested and subsequently be improvised (if possible). ***NOTE:*** *An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.*
- Keyword(s): 8051, FPGA, reconfigurable computing, microcontroller softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement 8-bit microcontroller core (8051 clone) on FPGA
  - Milestone 1: Completed Instruction Decoding for ALL 8051 instructions
  - Milestone 2: Completed State Machine for 8051 Instruction Fetch and Execution
  - Milestone 3: Completed Testbench for 8051-Binary-Compatible Core

Project Titles 2024

SYSTEM DEVELOPMENT

1.
Development of an Autonomous Mobile Robot Platform

- Description: This project is mainly hardware development - with some software development (microcontroller) work. It involves producing a working mobile robot platform (maybe something like this? or this?). Any open designs available online can be used (usually done using free cad tools like FreeCAD or OpenSCAD), but the platform needs to have basic navigation interface (motor, servo, sensor, etc.). This project also need a basic autonomous navigation software to be developed. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontrollers, mobile robots, autonomous navigation
- Pre-requisite(s): Digital Electronics, Microprocessor System, Microcontrollers/Embedded System
- Objective: To develop a mobile robot platform with basic navigation features
  - Milestone 1: Assembled an easily-reproducible mobile robot platform (chassis+motor+servo+controller)
  - Milestone 2: Developed software for basic autonomous driving (e.g. drive straight, turn)
  - Milestone 3: Completed autonomous mobile robot platform with basic navigation (e.g. obstacle avoidance)

2.
Smart Farm Irrigation System Monitoring and Control

- Description: This is a hands-on project that may be used at UniMAP's Institute of Sustainable Agro-Technology (INSAT). Initial work involves developing a system that needs to control irrigation of a small plot, and monitor temperature and possibly water usage. All data will be sent to a centralized data center for the whole farm. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontroller, embedded system, data server
- Pre-requisite(s): Microcontrollers/Embedded System Development
- Objective: To develop an irrigation system monitoring and control platform
  - Milestone 1: Develop valve control system (timer & manual override)
  - Milestone 2: Develop monitoring & control application (can be web-based OR desktop)
  - Milestone 3: Produce a simple profiling system (e.g. water usage, temperature/humidity)

3.
Development of a Vision-based Vehicle Registration Identification System

- Description: This project is mainly software development, with real hardware implementation (Raspberry Pi platform). The main target is to implement vision-based vehicle registration identification system on real hardware. Implementation MUST BE written based on my1imgpro library (i.e. libraries like OpenCV cannot be used). ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): vision system, image processing
- Pre-requisite: Computer Programming, Image Processing
- Objective: To develop a Vehicle Registration Identification System
  - Milestone 1: Implemented algorithm for vehicle registration plate detection
  - Milestone 2: Implemented algorithm for character recognition (identification)
  - Milestone 3: Implemented system on real hardware (Raspberry Pi platform)

SYSTEM DEVELOPMENT
DIGITAL SYSTEM DESIGN
1. **Implementation of 8051-Binary-Compatible Core** ◦ Description: This is a design project to implement a working 8051-binary-compatible core. A similar implementation for 8085 microprocessor is available here. It involves writing HDL (Hardware Description Language) codes and simulating it on a simulation software like ModelSim. The final implementation needs to be fully tested and subsequently be improvised (if possible). ***NOTE:*** *An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.* ◦ Keyword(s): 8051, FPGA, reconfigurable computing, microcontroller softcore ◦ Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture ◦ Objective: To implement 8-bit microcontroller core (8051 clone) on FPGA ▪ Milestone 1: Completed Instruction Decoding for ALL 8051 instructions ▪ Milestone 2: Completed State Machine for 8051 Instruction Fetch and Execution ▪ Milestone 3: Completed Testbench for 8051-Binary-Compatible Core

Project Titles 2023

SYSTEM DEVELOPMENT

1.
Development of a Vision-based Vehicle Registration Identification System
- Description: This project is mainly software development, with real hardware implementation (Raspberry Pi platform). The main target is to implement vision-based vehicle registration identification system on real hardware. Implementation MUST BE written based on my1imgpro library (i.e. libraries like OpenCV cannot be used). ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): vision system, image processing
- Pre-requisite: Computer Programming, Image Processing
- Objective: To develop a Vehicle Registration Identification System
  - Milestone 1: Implemented algorithm for vehicle registration plate detection
  - Milestone 2: Implemented algorithm for character recognition (identification)
  - Milestone 3: Implemented system on real hardware (Raspberry Pi platform)

2.
Development of an Autonomous Mobile Robot Platform
- Description: This project is mainly hardware development - with some software development (microcontroller) work. It involves producing a working mobile robot platform (maybe something like this? or this?). Any open designs available online can be used (usually done using free cad tools like FreeCAD or OpenSCAD), but the platform needs to have basic navigation interface (motor, servo, sensor, etc.). This project also need a basic autonomous navigation software to be developed. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontrollers, mobile robots, autonomous navigation
- Pre-requisite(s): Digital Electronics, Microprocessor System, Microcontrollers/Embedded System
- Objective: To develop a mobile robot platform with basic navigation features
  - Milestone 1: Assembled an easily-reproducible mobile robot platform (chassis+motor+servo+controller)
  - Milestone 2: Developed software for basic autonomous driving (e.g. drive straight, turn)
  - Milestone 3: Completed autonomous mobile robot platform with basic navigation (e.g. obstacle avoidance)

DIGITAL SYSTEM DESIGN

SYSTEM DEVELOPMENT

1.
Implementation of RISC-V Core on FPGA
- Description: This is a design project to implement a working microprocessor based on the RISC-V ISA. It involves writing HDL (Hardware Description Language) codes and simulating it on a simulation software. The final implementation needs to be fully tested and subsequently be improvised (if possible). ***Warning:*** *An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.*
- Keyword(s): RISC-V, FPGA, reconfigurable computing, microprocessor softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement custom RISC-V core on FPGA
- Scope:
  - Milestone 1: Completed basic core @RV32I (at least data movement and ALU)
  - Milestone 2: Verified core functionality using simulation
  - Milestone 3: Performed testing on FPGA hardware

2.
Implementation of 8051-Binary-Compatible Core
- Description: This is a design project to implement a working 8051-binary-compatible core. A similar implementation for 8085 microprocessor is available here. It involves writing HDL (Hardware Description Language) codes and simulating it on a simulation software like ModelSim. The final implementation needs to be fully tested and subsequently be improvised (if possible). ***NOTE:*** *An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.*
- Keyword(s): 8051, FPGA, reconfigurable computing, microcontroller softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement 8-bit microcontroller core (8051 clone) on FPGA
  - Milestone 1: Completed Instruction Decoding for ALL 8051 instructions
  - Milestone 2: Completed State Machine for 8051 Instruction Fetch and Execution
  - Milestone 3: Completed Testbench for 8051-Binary-Compatible Core

Project Titles 2022

SYSTEM DEVELOPMENT

1.

Development of an Automated Storage and Retrieval System

- Description: This project is a combination of hardware/software development. It requires the student to develop a small-scale storage/retrieval system (refer to this). Of course, a management software for the system is also expected. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontrollers, warehouse management, automated storage retrieval system, asrs
- Pre-requisite(s): Microcontrollers/Embedded System, Programming
- Objective: To develop an automated storage/retrieval system and its management system
  - Milestone 1: Produced a model for storage/retrieval system (at least 32 - 4×4 on both sides)
  - Milestone 2: Developed software for basic storage/retrieval
  - Milestone 3: Developed a simple warehouse management software

2.

Development of a Battery-powered Tracking Module with Monitoring System

- Description: This project is a combination of hardware/software development. It requires the student to produce a low-power tracking module using microcontroller (both hardware and software development involved). The Monitoring System software can be modified from an existing system provided. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontrollers, gsm module, api server, web development
- Pre-requisite(s): Microcontrollers/Embedded System, Programming, Web Development
- Objective: To develop a battery-powered tracking module and its monitoring system
  - Milestone 1: Designed a low-power tracking module containing 8051 and GSM module (battery-powered)
  - Milestone 2: Developed software for the tracking module
  - Milestone 3: Developed monitoring software for the tracking system

DIGITAL SYSTEM DESIGN

SYSTEM DEVELOPMENT
1. **Implementation of 8051-Binary-Compatible Core** ∘ Description: This is a design project to implement a working 8051-binary-compatible core. A similar implementation for 8085 microprocessor is available here. It involves writing HDL (Hardware Description Language) codes and simulating it on a simulation software like ModelSim. The final implementation needs to be fully tested and subsequently be improvised (if possible). ***NOTE:*** *An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.* ∘ Keyword(s): 8051, FPGA, reconfigurable computing, microcontroller softcore ∘ Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture ∘ Objective: To implement 8-bit microcontroller core (8051 clone) on FPGA ▪ Milestone 1: Completed Instruction Decoding for ALL 8051 instructions ▪ Milestone 2: Completed State Machine for 8051 Instruction Fetch and Execution ▪ Milestone 3: Completed Testbench for 8051-Binary-Compatible Core

Project Titles 2021

SYSTEM DEVELOPMENT

1.
Development of a Vision-based Vehicle Registration Identification System
- Description: This project is mainly software development, with real hardware implementation (Raspberry Pi platform). The main target is to implement vision-based vehicle registration identification system on real hardware. Implementation MUST BE written based on my1imgpro library (i.e. libraries like OpenCV cannot be used). ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): vision system, image processing
- Pre-requisite: Computer Programming, Image Processing
- Objective: To develop a Vehicle Registration Identification System
  - Milestone 1: Implemented algorithm for vehicle registration plate detection
  - Milestone 2: Implemented algorithm for character recognition (identification)
  - Milestone 3: Implemented system on real hardware (Raspberry Pi platform)

2.
Development of an Autonomous Mobile Robot Platform
- Description: This project is mainly hardware development - with some software development (microcontroller) work. It involves producing a working mobile robot platform (maybe something like this? or this?). Any open designs available online can be used (usually done using free cad tools like FreeCAD or OpenSCAD), but the platform needs to have basic navigation interface (motor, servo, sensor, etc.). This project also need a basic autonomous navigation software to be developed. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontrollers, mobile robots, autonomous navigation
- Pre-requisite(s): Digital Electronics, Microprocessor System, Microcontrollers/Embedded System
- Objective: To develop a mobile robot platform with basic navigation features
  - Milestone 1: Assembled an easily-reproducible mobile robot platform (chassis+motor+servo+controller)
  - Milestone 2: Developed software for basic autonomous driving (e.g. drive straight, turn)
  - Milestone 3: Completed autonomous mobile robot platform with basic navigation (e.g. obstacle avoidance)

SOFTWARE DEVELOPMENT

SYSTEM DEVELOPMENT
1. **Development of an ARM Emulator (Simple Raspberry Pi Simulator)** ◦ Description: This project is purely software development. The main target is to develop a simple Raspberry Pi Simulator with basic GPIO control functionalities. This, however, requires an ARM emulator that can at least execute basic instructions like data transfer (register/memory), arithmetic and branching. ◦ Keyword(s): arm emulator, raspberry pi simulator ◦ Pre-requisite: Computer Programming, Computer Architecture ◦ Objective: To develop an ARM emulator that can be used to simulate Raspberry Pi SBC ▪ Milestone 1: Completed ARM Instruction Decoder (preferably with working assembler/compiler) ▪ Milestone 2: Completed ARM System with Memory ▪ Milestone 3: Developed a simple Raspberry Pi Simulator

Project Titles 2020

SYSTEM DEVELOPMENT

1.
Smart Farm Irrigation System Monitoring and Control
- Description: This is a hands-on project that will actually be used at UniMAP's Institute of Sustainable Agro-Technology (INSAT). Initial work involves developing a system that needs to control irrigation of a small plot, and monitor temperature and possibly water usage. All data will be sent to a centralized data center for the whole farm. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontroller, embedded system, data server
- Pre-requisite(s): Microcontrollers/Embedded System Development
- Objective: To develop an irrigation system monitoring and control platform
  - Milestone 1: Simple valve control system (timer & manual override) with power consumption analysis
  - Milestone 2: *to be decided...*
  - Milestone 3: *to be decided...*

2.
Development of a Quadcopter Drone with Autonomous Flying Capability
- Description: This project is revolves around the idea of replicating an open source quadcopter/drone design (here & here), while introducing autonomous flying mechanism(s). ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): drone, quadcopters, uav
- Pre-requisite(s): Microcontrollers/Embedded System Development
- Objective: To develop a working quadcopter that is capable of autonomous flying
  - Milestone 1: Assembled a quadcopter platform
  - Milestone 2: Developed/Modified software for autonomous flying
  - Milestone 3: Tested autonomous flying feature

DIGITAL SYSTEM DESIGN

SYSTEM DEVELOPMENT
1. **Implementation of 8051-Binary-Compatible Core** ∘ Description: This is a design project to implement a working 8051-binary-compatible core. It involves writing HDL (Hardware Description Language) codes and simulating it on a simulation software like ModelSim. The final implementation needs to be fully tested and subsequently be improvised (if possible). ***Warning:*** *An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.* ∘ Keyword(s): 8051, FPGA, reconfigurable computing, microcontroller softcore ∘ Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture ∘ Objective: To implement 8-bit microcontroller core (8051 clone) on FPGA ▪ Milestone 1: Completed Instruction Decoding for ALL 8051 instructions ▪ Milestone 2: Completed State Machine for 8051 Instruction Fetch and Execution ▪ Milestone 3: Completed Testbench for 8051-Binary-Compatible Core
SOFTWARE DEVELOPMENT

SYSTEM DEVELOPMENT

1.
Mapping and Localization for Mobile Robot Platform Using Robot Simulator
- Description: This project is purely software development but with embedded systems application. A robot simulation software like Player/Stage is needed. The development revolves around creating an algorithm for a mobile robot platform so that it can reliably map its surrounding and at the same time localize itself within that environment (something like this).
- Keyword(s): mapping, localization, simultaneous-LAM (SLAM), mobile robot, robot simulation software
- Pre-requisite: Computer Programming, Maths
- Objective: To develop a practical mapping and localization algorithm/application
  - Milestone 1: Developed Usable Mobile Robot Platform Model on an Existing Simulator
  - Milestone 1: Integrated Basic Mapping Algorithm
  - Milestone 2: Integrated Localization Algorithm

2.
CAD Tool Development: Logic Simulator
- Description: This project is purely software development but with applications in digital electronics. It involves creating a simple netlist format for digital circuits and developing a parser for the format. The software need to be able to create internal data structure for the logic circuit and execute logic/timing simulation. A simple waveform viewer is also needed, but any available open-source tool can be used for this.
- Keyword(s): CAD, circuit simulator, logic simulator
- Pre-requisite: Computer Programming, Maths, Digital Logic
- Objective: To develop a circuit (@logic) simulator
  - Milestone 1: Developed a parser for custom netlist and a data structure for logic circuit
  - Milestone 2: Developed timing/logic simulation tool
  - Milestone 3: Completed verification of timing/logic simulation tool

Project Titles 2019

SYSTEM DEVELOPMENT

1.
Development of an Autonomous Mobile Robot Platform
- Description: This project is mainly hardware development - with some software development (microcontroller) work. It involves producing a working mobile robot platform (maybe something like this? or this?). Any open designs available online can be used (usually done using free cad tools like FreeCAD or OpenSCAD), but the platform needs to have basic navigation interface (motor, servo, sensor, etc.). This project also need a basic autonomous navigation software to be developed. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontrollers, mobile robots, autonomous navigation
- Pre-requisite(s): Digital Electronics, Microprocessor System, Microcontrollers/Embedded System
- Objective: To develop a mobile robot platform with basic navigation features
  - Milestone 1: Assembled an easily-reproducible mobile robot platform (chassis+motor+servo+controller)
  - Milestone 2: Developed software for basic autonomous driving (e.g. drive straight, turn)
  - Milestone 3: Completed autonomous mobile robot platform with basic navigation (e.g. obstacle avoidance)

2.
Development of a Battery-powered Tracking Module with Monitoring System
- Description: This project is a combination of hardware/software development. It requires the student to produce a low-power tracking module using microcontroller (both hardware and software development involved). The Monitoring System software can be modified from an existing system provided. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
- Keyword(s): microcontrollers, gsm module, api server, web development
- Pre-requisite(s): Microcontrollers/Embedded System, Software Engineering, Web Development
- Objective: To develop a battery-powered tracking module and its monitoring system
  - Milestone 1: Designed a low-power tracking module containing 8051 and GSM module (battery-powered)
  - Milestone 2: Developed software for the tracking module
  - Milestone 3: Developed monitoring software for the tracking system

Project Titles 2018

SYSTEM DEVELOPMENT

1.
Development of an Autonomous Mobile Robot Platform
    - Description: This project is mainly hardware development - with some software development (microcontroller) work. It involves producing a working mobile robot platform (maybe something like this? or this?). Any open designs available online can be used (usually done using free cad tools like FreeCAD or OpenSCAD), but the platform needs to have basic navigation interface (motor, servo, sensor, etc.). This project also need a basic autonomous navigation software to be developed. ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
    - Keyword(s): microcontrollers, mobile robots, autonomous navigation
    - Pre-requisite(s): Digital Electronics, Microprocessor System, Microcontrollers/Embedded System
    - Objective: To develop a mobile robot platform with basic navigation features
        - Milestone 1: Assembled a mobile robot platform (chassis+motor+servo+controller)
        - Milestone 2: Developed software for basic autonomous driving (e.g. drive straight, turn)
        - Milestone 3: Completed autonomous mobile robot platform with basic navigation (e.g. obstacle avoidance)

2.
Development of a Raspberry-Pi-based Phone
    - Description: This project is a combination of hardware/software development. It requires the student to produce a working phone based on Raspberry Pi, along with a GSM module and a touch-screen LCD. Software development involves developing bare-metal codes (no Linux or any existing OS can be used). ***Warning:*** *This project requires purchases of components/modules that may not be reimbursed by the department.*
    - Keyword(s): raspberry pi, bare-metal, smartphone, touch screen lcd
    - Pre-requisite(s): Microcontrollers/Embedded System, Software Engineering
    - Objective: To develop basic touch screen phone based on Raspberry Pi
        - Milestone 1: Completed Interfacing GSM Modem to Raspberry Pi (i.e. make calls, etc.)
        - Milestone 2: Completed Interfacing Touch Screen LCD to Raspberry Pi (i.e. input, display)
        - Milestone 3: Completed A Working Phone (including basic OS) based on Raspberry Pi

DIGITAL SYSTEM DESIGN

SYSTEM DEVELOPMENT
1. **Implementation of 8051-Binary-Compatible Core** ∘ Description: This is a design project to implement a working 8051-binary-compatible core. It involves writing HDL (Hardware Description Language) codes and simulating it on a simulation software like ModelSim. The final implementation needs to be fully tested and subsequently be improvised (if possible). ***Warning:*** *An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.* ∘ Keyword(s): 8051, FPGA, reconfigurable computing, microcontroller softcore ∘ Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture ∘ Objective: To implement 8-bit microcontroller core (8051 clone) on FPGA ▪ Milestone 1: Completed Instruction Decoding for ALL 8051 instructions ▪ Milestone 2: Completed State Machine for 8051 Instruction Fetch and Execution ▪ Milestone 3: Completed Testbench for 8051-Binary-Compatible Core
SOFTWARE DEVELOPMENT

SYSTEM DEVELOPMENT

1.
Mapping and Localization for Mobile Robot Platform Using Player/Stage
- Description: This project is purely software development but with embedded systems application. A robot simulation software like Player/Stage is needed and will be used. The development revolves around creating an algorithm for a mobile robot platform so that it can reliably map its surrounding and at the same time localize itself within that environment (something like this).
- Keyword(s): mapping, localization, simultaneous-LAM (SLAM), mobile robot, player/stage software
- Pre-requisite: Computer Programming, Maths
- Objective: To develop a practical mapping and localization algorithm/application
  - Milestone 1: Developed Usable Mobile Robot Platform Model on Stage
  - Milestone 1: Integrated Basic Mapping Algorithm
  - Milestone 2: Integrated Localization Algorithm

2.
CAD Tool Development: Logic Simulator
- Description: This project is purely software development but with applications in digital electronics. It involves creating a simple netlist format for digital circuits and developing a parser for the format. The software need to be able to create internal data structure for the logic circuit and execute logic/timing simulation. A simple waveform viewer is also needed, but any available open-source tool can be used for this.
- Keyword(s): CAD, circuit simulator, logic simulator
- Pre-requisite: Computer Programming, Maths, Digital Logic
- Objective: To develop a circuit (@logic) simulator
  - Milestone 1: Developed a parser for custom netlist and a data structure for logic circuit
  - Milestone 2: Developed timing/logic simulation tool
  - Milestone 3: Completed verification of timing/logic simulation tool

Project Titles 2017

SYSTEM DEVELOPMENT
1. **Development of a Mobile Robot Platform** ◦ Description: This project is mainly hardware development - with some coding on 8051 controller. ◦ Keyword(s): microcontrollers, mobile robots, 8051 core ◦ Pre-requisite(s): Digital Electronics, Microprocessor System, Microcontrollers/Embedded System ◦ Objective: To develop a mobile robot platform with basic navigation features ◦ Scope: ▪ produce a working mobile robot platform (maybe something like this? or this...) • may use open designs available online • use free cad tools like FreeCAD or OpenSCAD ▪ include/enable basic navigation interface (motor, servo, sensor, etc.)
HARDWARE/BOARD DEVELOPMENT
1. **Extendable FPGA Development Board for Reconfigurable Computing Research Platform** ◦ Description: This project is purely hardware development. ◦ Keyword(s): FPGA, reconfigurable computing, development board ◦ Pre-requisite: Digital Electronics, Microprocessor System ◦ Objective: To develop an extendable FPGA development board to be used as platform for reconfigurable computing research/applications ◦ Scope: ▪ produce a working prototype for FPGA development board ▪ design a working interface for future extensions ▪ include/enable reconfigurable computing features in the design?
DIGITAL SYSTEM DESIGN

SYSTEM DEVELOPMENT

1.
Implementation of OpenRisc Core on FPGA
- Description: This is a design project using VHDL
- Keyword(s): OpenRISC, FPGA, reconfigurable computing, microprocessor softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement custom OpenRISC core on FPGA
- Scope:
  - implement a working core
  - testing and improvise (if possible)

2.
~~Implementation of 8051-Binary-Compatible Core on FPGA~~ TAKEN
- Description: This is a design project using VHDL
- Keyword(s): 8051, FPGA, reconfigurable computing, microcontroller softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement 8-bit microcontroller core (8051 clone) on FPGA
- Scope:
  - implement a working core
  - testing and improvise (if possible)
  - **WARNING** An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.

3.
Application of Random Number Generator (RNG) on FPGA (Simple Game Implementation?)
- Description: This is a design/analytical project based on the RNG proposed on this page.
- Keyword(s): RNG, random number generator, FPGA, reconfigurable computing
- Pre-requisite: Digital Electronics, Computer Architecture
- Objective: To study the effectiveness of hardware RNG on FPGA
  - Secondary Objective: To implement an application that utilize hardware RNG
- Scope:
  - implementation, testing, and improvise (if possible) the proposed hardware RNG
  - testing is essential - maybe design an alternative test-suite to the one used

4.
Implementation of 16-bit Floating Point Arithmetic Unit on FPGA
- Description: This is a design project using VHDL
- Keyword(s): floating-point arithmetic unit, FPGA, reconfigurable computing
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement a custom 16-bit floating-point arithmetic unit on FPGA
- Scope:
  - implement a working floating-point unit
  - testing and improvise (if possible)

SOFTWARE DEVELOPMENT

SYSTEM DEVELOPMENT

1.
Mapping and Localization for Mobile Robot Platform Using Player/Stage
- Description: This project is purely software development but with embedded systems application.
- Keyword(s): mapping, localization, simultaneous-LAM (SLAM), mobile robot, player/stage software
- Pre-requisite: Computer Programming, Maths
- Objective: To develop a practical mapping and localization algorithm/application for mobile robot platform
- Scope:
  - using this
  - something like this
  - test on simulator platform only...

2.
~~Implementation of Behavior-based Mobile Robot Platform~~ TAKEN
- Description: This project is purely software development.
- Keyword(s): behavior-based robot, evolutionary robotics
- Pre-requisite: Computer Programming, Artificial Intelligence
- Objective: To implement a behavior-based mobile robot system
- Scope:
  - implement/analyze an evolutionary algorithm (like this)
  - implement/modify a mobile robot platform (maybe based on this)
  - explore/use Stage mobile robot simulator
  - simulate the system to train/evolve into a reliable system for a chosen application
- Note:
  - sample implementation using EyeSim mobile robot simulator will be provided

3.
Development of Road Map Database for Web Applications
- Description: This project is purely software development.
- Keyword(s): mapping, road maps
- Pre-requisite: Computer Programming, Database/Web Programming
- Objective: To develop a Road Map Database for Web application
- Scope:
  - must build a proper database systems capable of storing road map data
  - data may be obtained from OSM?
  - must be able to serve road map data upon request
  - must implement a client-side sample application

4.
Development of Data Processing Software for Vehicle Monitoring System
- Description: This project is purely software development.
- Keyword(s): data mining, data analysis
- Pre-requisite: Computer Programming, Database/Web Programming
- Objective: To develop a data processing software for Vehicle Monitoring System
- Scope:
  - based on available data gathered by CEASTech's Vehicle Monitoring System
  - need to analyze useful information that can be generated
  - need to implement algorithm(s) to produce that information
  - must implement a client-side sample application

5.
Development of University Course/Student Data Management System
- Description: This project is purely software development.
- Keyword(s): university course/student data management, data analysis
- Pre-requisite: Computer Programming, Database/Web Programming
- Objective: To develop a web-based software for University Course/Student Data Management
- Scope:
  - basically continuing (finishing up) this project
  - need to enable multiple admin, multiple lecturer per course
  - need to enable student to view current coursework marks

Project Titles 2016

SYSTEM DEVELOPMENT

1.
Development of a Mobile Robot Platform
- Description: This project is mainly hardware development - with some coding on 8051 controller.
- Keyword(s): microcontrollers, mobile robots, 8051 core
- Pre-requisite(s): Digital Electronics, Microprocessor System, Microcontrollers/Embedded System
- Objective: To develop a mobile robot platform with basic navigation features
- Scope:
  - produce a working mobile robot platform (may use open designs available online)
  - include/enable basic navigation interface (motor, servo, sensor, etc.)

2.
~~Development of a Protoype Mobile Phone~~ TAKEN
- Description: This project is an all around systems development (i.e. hardware interfacing, programming).
- Keyword(s): Raspberry Pi, GSM, mobile phone
- Pre-requisite(s): Digital Electronics, Microprocessor System, Microcontrollers/Embedded System
- Objective: To develop a simple mobile phone with touch screen interface
- Scope:
  - revolves around Raspberry Pi, a GSM module and an LCD with touch screen
  - working phone is the main priority
  - may include work on build custom android for benchmarking

HARDWARE/BOARD DEVELOPMENT

1.
Extendable FPGA Development Board for Reconfigurable Computing Research Platform
- Description: This project is purely hardware development.
- Keyword(s): FPGA, reconfigurable computing, development board
- Pre-requisite: Digital Electronics, Microprocessor System
- Objective: To develop an extendable FPGA development board to be used as platform for reconfigurable computing research/applications
- Scope:
  - produce a working prototype for FPGA development board
  - design a working interface for future extensions
  - include/enable reconfigurable computing features in the design?

DIGITAL SYSTEM DESIGN

SYSTEM DEVELOPMENT

1.
Implementation of OpenRisc Core on FPGA
- Description: This is a design project using VHDL
- Keyword(s): OpenRISC, FPGA, reconfigurable computing, microprocessor softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement custom OpenRISC core on FPGA
- Scope:
  - implement a working core
  - testing and improvise (if possible)

2.
~~Implementation of 8085-Binary-Compatible Core on FPGA~~ TAKEN
- Description: This is a design project using VHDL
- Keyword(s): 8085, FPGA, reconfigurable computing, microprocessor softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement 8-bit microprocessor core (8085 clone) on FPGA
- Scope:
  - implement a working core
  - testing and improvise (if possible)

3.
Implementation of 8051-Binary-Compatible Core on FPGA
- Description: This is a design project using VHDL
- Keyword(s): 8051, FPGA, reconfigurable computing, microcontroller softcore
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement 8-bit microcontroller core (8051 clone) on FPGA
- Scope:
  - implement a working core
  - testing and improvise (if possible)
  - **WARNING** An existing implementation is already available on the internet. Evaluation for this project will be based on progress - you need to show that you implement this on your own.

4.
Application of Random Number Generator (RNG) on FPGA (Simple Game Implementation?)
- Description: This is a design/analytical project based on the RNG proposed on this page.
- Keyword(s): RNG, random number generator, FPGA, reconfigurable computing
- Pre-requisite: Digital Electronics, Computer Architecture
- Objective: To study the effectiveness of hardware RNG on FPGA
  - Secondary Objective: To implement an application that utilize hardware RNG
- Scope:
  - implementation, testing, and improvise (if possible) the proposed hardware RNG
  - testing is essential - maybe design an alternative test-suite to the one used

5.
Implementation of 16-bit Floating Point Arithmetic Unit Core on FPGA
- Description: This is a design project using VHDL
- Keyword(s): floating-point arithmetic unit, FPGA, reconfigurable computing
- Pre-requisite: Digital Electronics, Microprocessor System, Computer Architecture
- Objective: To implement a custom 16-bit floating-point arithmetic unit on FPGA
- Scope:
  - implement a working floating-point unit
  - testing and improvise (if possible)

SYSTEM DEVELOPMENT

SOFTWARE DEVELOPMENT

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- Pre-requisite: Computer Programming, Maths
- Objective: To develop a practical mapping and localization algorithm/application for mobile robot platform
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  - something like this
  - test on simulator platform only…

2.
~~CAD Tool Development: Circuit Simulator~~ TAKEN
- Description: This project is purely software development but with applications in microelectronics.
- Keyword(s): CAD, circuit simulator, logic simulator
- Pre-requisite: Computer Programming, Maths, Semiconductor Devices, Digital Logic
- Objective: To develop a circuit (@logic) simulator
  - Secondary Objective: develop a waveform viewer as well
- Scope:
  - use open source parser or write own (can be a project on its own?)
  - must be capable of timing simulation (timing model)
  - alternatively: write a VHDL version of the Icarus Verilog?
  - another branch: start from spice3f5 - get it to compile on linux & improvise

3.
CAD Tool Development: Automatic Place & Route
- Description: This project is purely software development but with applications in microelectronics.
- Keyword(s): CAD, automatic place and route, APR
- Pre-requisite: Computer Programming, Maths, Semiconductor/PCB Layout
- Objective: To develop an automatic place and route (APR) tool
- Scope:
  - use open source parser or write own (can be a project on its own?)
  - can be board-level or ic-level (select input netlist type and output format)

MICROELECTRONICS

1.
Development of Memristor Device Model for Spice Simulation
- Description: This project is purely software development but requires good background in low-level electronics (semiconductor physics).
- Keyword(s): memristor, device model, spice
- Pre-requisite: Computer Programming, Device Physics
- Objective: To develop a spice simulation model for a memristor device
- Scope:
  - obtain open-source spice simulator code
  - learn how a model is created in spice
  - learn characteristics of a memristor
  - write a device model for memristor
  - find a way to validate proposed memristor model
  - (if possible) fabricate a memristor, build a simple test circuit and verify simulation results?