ECE 350 Final Project Proposal

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1 Our Group

Our group consists of

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2 Project Overview

We are trying to create a game involving two remote-controlled physical robots and multiple checkpoints spread across a playing surface. When the robots run into a checkpoint, they will either receive a power-up or a point. The status of the game and scoreboard will be displayed on a VGA. We will use wireless communication to communicate between the FPGAs, the checkpoints, the robots, and the controllers. Some checkpoints will represent power-ups while other checkpoints represent point values. Power-ups include features such as faster motor speed or inverting the other player's controls. Overall, the processor will significantly contribute to many of our operations, including communication, score calculation, checkpoint sensing, controllers, and power-ups.

3 Inputs and Outputs

Because we intend to use remote control robots, natural inputs and outputs include game controller buttons and motor drives. Additional inputs exist for the controllers to sense steering wheel direction and gas pedal depression. With wireless controllers, radio modules also serve as additional inputs/outputs for all wireless interfacing subsystems.

The display of the current game score will also be output on a VGA display. The SD card reading and audio output also serve as an additional input and output.

4 Tasks

Task 1 SD card - 30 points

We propose this task to be worth 30 points for its novelty, having never been done before.

The SD card is proposed to be used for playing music on the VGA scoreboard. The input is the addresses of the data to be fetched and the output is the data fetched.

The SD card will require the use of the processor to initiate and decide what sound files to play depending on the game state and user input.

Task 2 Controllers - 10 points

We propose this to be worth 10 points for its relationship to the rest of the system.

The difficulty will be non-trivial because it requires the accurate wiring of the controllers to the FPGA board and the proper reading/interpreting of the inputted signals in real time. Lag is very bad, so we must do our best to make everything as fast as possible.

Inputs include the controller buttons and outputs include the robot commands.

The processor is necessary to interpret signals such as play/pause and

Task 3 Controller enhancements - 20 points

We propose this task to be worth 20 points for its coolness factor and fun factor.

The controller will be actually be a driving-simulator style steering wheel and gas pedal. This would make the game super fun to play and also feel legit.

We believe the task to be of moderate difficulty due to the significant mechanical considerations that have to be made in designing the parts.

The inputs would be the buttons and angle sensors for the steering wheels and gas pedals. The outputs would be control signals to the robots. Another output would be the rumble of the controllers.

The processor would be required to interpret the steering wheel and pedal inputs and translate them into robot commands.

Task 4 Wireless controllers - 20 points

We would like to request 20 points for this task.

The wireless controller will require the use of radio modules to send robot commands from the controller FPGAs to the robots. Given the complexity of the wireless protocol, this task is expected to be extremely difficult.

The FPGA controller would have to output to the radio module. The robot would have to input from the radio module.

The processor would be needed to package the robot commands into wireless data to be sent to the robot.

Task 5 Building of the Robot - 30 points

We propose the building of the robot to be worth 30 points for the time required to assemble the numerous components.

The robots will not directly use the FPGAs, but they will still interface (I/O) with the FPGAs by taking the controller inputs and sending out when the robots hit buttons.

The processor is not expected to be used for this task.

Task 6 VGA scoreboard - 10 points

We propose that this task is worth 10 points. This task will involve displaying currently obtained power ups and the current scores of both players. This is a nontrivial task because it requires us to keep track of the state of the game. The input is the current state, the output is the VGA, and no significant processor use is needed.

Task 7 Score calculation - 10 points

We propose that this task is worth 10 points. We use the processor to add points based off a set of rules for each player. This task is non trivial because it requires us to create a set of rules to determine when a player should receive points based off the source of their previous points. The input is button communication, the output is the VGA board, and there is significant processor use.

Task 8 Multi-board FPGA - 20 points

We request this task to be worth 20 points. This lets you connect multiple FPGAs together to play multi-player over the wire. The input and output are both heavily needed for radio communication and this task involves significant processor use.

Task 9 Multi-player - 20 points

We request this to be worth 20 points due to the fact that requiring multi-player operation influences so many areas of the project. Therefore, the difficulty is expected to be great due to the subsystem inter-dependencies and considerable difficulty expected in debugging.

The multi-player functionality does not directly use inputs or outputs, but obviously has deep connections to the inputs and outputs of other subsystems.

The multi-player functionality is expected to have significant processor use to process all the logic involved in game state, robot capabilities/states, controller coordination, and score distribution.

Task 10 Wireless communication - 30 points

We request this task to be worth 30 points for requiring the reliable intercommunication between several components including robots, checkpoint flags, and the scorekeeper.

Inputs include touch detection by robots and checkpoints as well as controller buttons such as play/pause. Outputs include robot capabilities (i.e. power-ups).

The processor would be needed to interpret wireless data from the buffer and save it into appropriate memory locations.

Task 11 Checkpoint sensing - 10 points

We request that this task be worth 10 points for the difficulty of having sensor pairs reliably coordinate their inputs to be registered at the same time, every time. We do use the processor here for verifying matching between robots and checkpoints. Inputs would be the timing values at which checkpoints and robots "detected" each other, and the output points are displayed on the VGA.

Task 12 Mechanically Correlated Power-ups - 20 points

We request this to be worth 20 points for the scope of the power-ups. The processor is intensively used for this task, since we want to keep track of actions such as measuring the duration of power-ups and changing the speed of the robots. The input is a checkpoint and robot message and the output is a change in throttle or steering to a robot.

Task 13 VGA Visual Component - 10 points

We believe displaying interesting aesthetics on the VGA would be 10 points. The processor is not really used here, and this task is not very difficult. We still plan to display the score, power-ups earned by each player/robot, and some extra features for displaying player-earned points. There are no specific inputs, but the output is VGA for displaying the visuals.

Task 14 OLED checkpoint displays - 10 points

We request 10 points for using an OLED display on the checkpoints that display what that type of checkpoint is. For example, if that checkpoint represents a speed powerup, the OLED will display a rabbit.

This task requires outputting to the OLED display and does not require inputs since the checkpoint's function is determined by the game logic.

This task is not expected to require significant use of the processor, though it may if the function of the checkpoints dynamically changes.

5 Rough Timeline

We hope to have a form of wireless communication working and the VGA scoreboard coded by the first project checkpoint. By the second checkpoint we hope to have the robot and controllers built and programmed in addition to completing score calculation and creating a multi-board FPGA. By the third checkpoint, we hope to have finished up checkpoint sensing, worked with the SD card, finished the power-ups, and added controller enhancements. In the time between the third checkpoint and the demo, we hope to be working only on visual enhancements and debugging.