6.111 Project Proposal
    This is for the displaying the data gathered by the human tracking system. If it turns out that the human tracking system is too complicated, the user inputs for the game will come from NES controllers.
VGA Display: Pac Man

Reset, up, down, left, right (testing)
Reset, speed, direction (tracking)

XVGA

PAC Man game
Uses instances of the sprite generator
Reads from map

Sprite generator

ROM
Contains map

Ghost
Pathfinder:
Input:
enable, xy
of pac man,
state of pac
man, ghost
speed
Output:
xy of ghosts

Counter
Input:
enable
Output:
expired

used to keep
track of how
long pac
man has had
the power
pill

Ghost
Generator:
Input:
enable
Output:
Ghost_dead,
Xy of ghost

Ghost
pathfinder
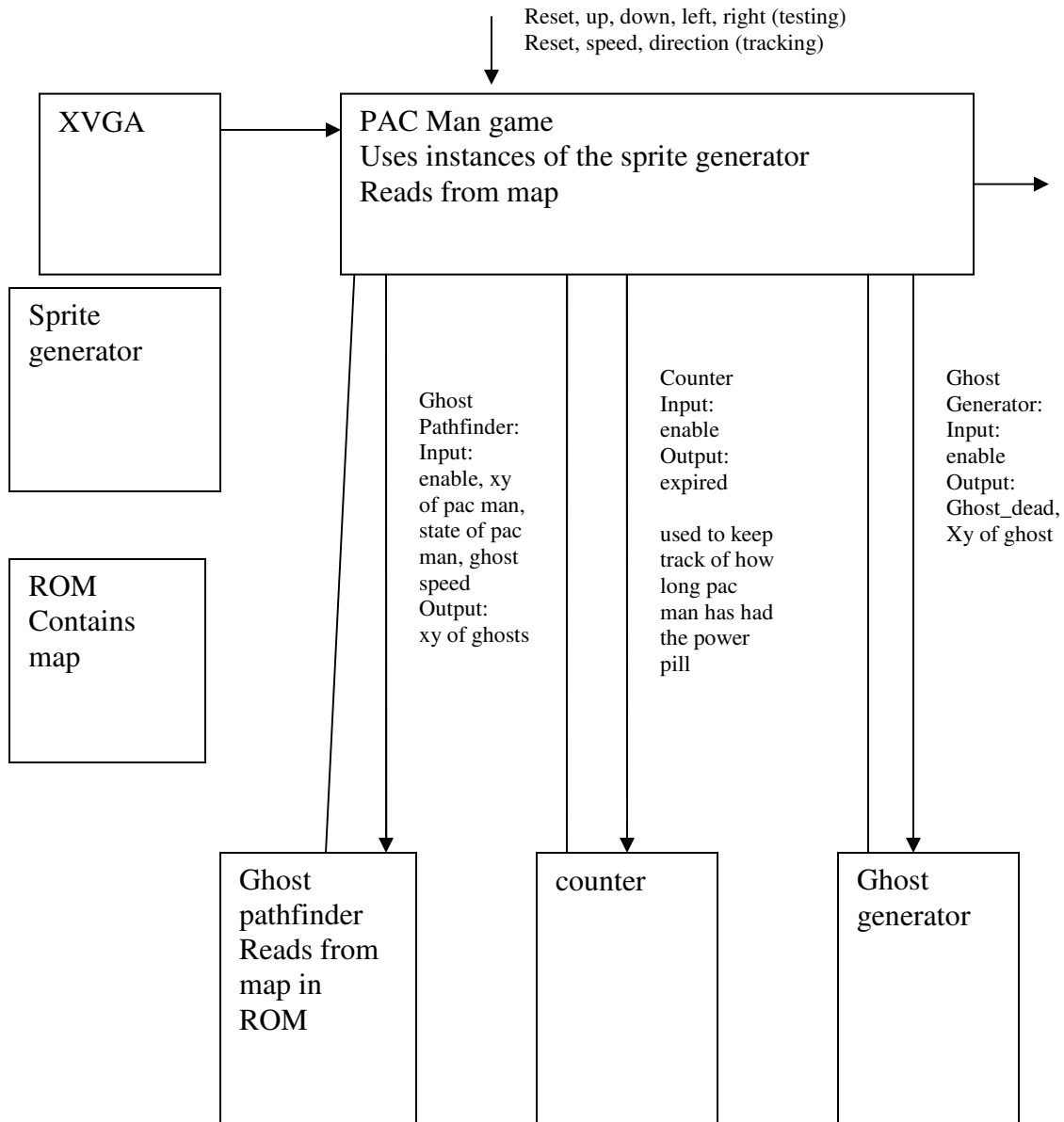Reads from
map in
ROM

counter

Ghost
generator

Figure 1:
Block diagram of the Pac Man display.   The game module draws the screen and keeps track of internal variables. The ghost pathfinder will allow ghosts to take the shortest path to pac man. The counter keeps track of how long pac man has the effects of the power pill. The ghost generator creates a new ghost after a time delay when pac man eats a ghost.

The Pac Man game will consists of 4 modules. The main module is the game controller, which will keep track of the internal variables such as the score and displays the current game screen. The secondary modules are the ghost pathfinder module, the counter module, and the ghost generator module. The game controller will be using instances of a sprite generator module to create the Pac man, ghost, and various other sprites. A map will be present in memory, and will be read by all the game controller and ghost pathfinder modules.

GAME SPECIFICATIONS
This game will attempt to resemble the original Pac Man game as closely as possible. The game will be over either when Pac Man eats all the dots or gets eaten by a ghost. If Pac Man eats a power pill, then he will be able to eat the ghosts. An eaten ghost gets respawned after a length of time. Power pill effects only last a short time. After the effects wear off, the ghosts can eat Pac Man again.

GAME MAP
The game map will be a grid of 32x32 pixel squares. The location of the sprites will be determined by their grid coordinates and not their specific pixel coordinates. The maximum size of a sprite will be 30x30 pixels. The remaining pixels in the grid square will form the walls of the maze.

GAME CONTROLLER
This module will start displaying the screen every time the vsync input from the XVGA goes low, and will enable the ghost pathfinder to start calculating the next set of moves for the ghosts when vsync goes high. The game controller receives user input from the labkit up, down, left, right and reset buttons. It receives the pixel counts from the XVGA module. It will also receive location data for each of the ghosts. At game start, the game controller will read the map from memory and populate the map with dots, power pills, ghosts, and Pac Man using instances of sprite generator modules. There will likely be separate sprite generators for each type of sprite. When a sprite is eaten (ghost, dot, pill), a flag will be set for that sprite. Sprites whose dead flag is true will not be displayed.
The ghosts will start in a center enclosure and will return there if they get eaten. Each cycle, Pac Man will move to eat dot, and the ghosts will take the shortest path possible to eat Pac Man. The game controller will receive the new coordinates for each of the ghosts from the ghost pathfinder module. If the coordinates of a ghost overlaps with Pac Man's coordinates, and Pac Man does not have the effects of the power pill, then Pac Man is eaten. When Pac Man eats the power pill, the game controller sets the pill_eaten flag to true, and sends an enable to the counter. When the game controller receives an expired signal from the counter, the pill_eaten flag is set to false, and Pac Man will no longer be able to eat ghosts. If Pac Man overlaps with a ghost and the pill_eaten flag is true, then Pac Man will eat the ghost. The game controller will then send an enable and the number of the ghost Pac Man ate to the ghost generator, which keeps track of how long it will be before each eaten ghost will respawn. When Pac Man eats a dot or a power pill, they disappear from the screen, and Pac Man's score will increment by 1 for each dot he eats. When the score equals the number of dots eaten, the game will be over.

The testing version of Pac Man will receive user input from the labkit buttons. The final version of Pac Man will receive the speed and direction of the user from the ultrasound sensors.

GHOST PATHFINDER
The ghost pathfinder will take the last known location of Pac Man, the current locations of the ghosts, and the state of Pac Man to calculate the next moves for the ghosts. Each square immediately next to Pac Man is labeled 1. All squares next to squares labeled 1 are labeled 2 and so on until the entire board is labeled. Ghosts will move to the lowest number square that is not blocked by a wall. If a ghost is surrounded with squares of the same number it will pick randomly which direction it will go. The module will output the next xy coordinates for each ghost to the game controller. This module will be active computing the next screen when the game controller is drawing the current screen.

GHOST GENERATOR
The ghost generator will receive an enable and the number of the ghost that was eaten from the game controller. A counter specific to that ghost will start counting. The ghost generator should be able to handle up to four dead ghosts at any given time. Once the counters reaches a certain number (specific number yet to be determined), the sprite_is_dead flag for that sprite will be set to false, and the coordinates for the sprite will be set back to its starting position

COUNTER
This simple module will count up to a certain number if enabled by the game controller and will send an expired signal back to the controller when the number is reached.