Buddii

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Final Report

Buddii is an autonomous parental assistant and security device. Buddii will have the capability to provide live video and audio feed to a remote location. Buddii will have obstacle avoidance capabilities as well as the ability to stay in the vicinity of a child. It will be able to display the temperature, the lighting conditions in whichever room it is in and whether there is a fire or not. When Buddii is switched to security mode, it will have the ability to detect intrusion

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Complete Abstract

Buddii is an autonomous parental assistant and security device. Buddii will have the capability to provide live video and audio feed to a remote location. Buddii will have obstacle avoidance capabilities as well as the ability to stay in the vicinity of a child. It will be able to display the temperature, the lighting conditions in whichever room it is in and whether there is a fire or not. When Buddii is switched to security mode, it will have the ability to detect intrusion.

Buddii must react fast enough to avoid obstacles and follow a person while moving at moderate speeds. The sonar modules, PIR modules, and the CMU camera must all work together to acquire required data crucial to Buddii's operation. Buddii's transceiver is sending 1000kbits/sec @ 2.4Ghz. Two processors will be used to control Buddii; the first will control communications, the onboard LCD and some sensors while the second will be used for motor control (Sonar, PIR, CMU camera). The remote console will provide the user real-time wireless audio and video feed from Buddii. A 12-volt power supply will be used to power Buddii's motors while a 7.5-volt power supply will power Buddii's electronics.

Analysis of Competitive Products

Buddii will have a broad application domain. Buddii can be used as a babysitter, a general cross-room communication device and a security system. Currently, many robots exist that aid children. However, not many of them have the broad application domain as Buddii does. But the robots that have a more specified application domain provide features far more advanced that Buddii. For instance, Yujin Robotics Introduced iRobi, the Home Robot that has the capability of teaching kids English.

Project Features and Objectives

Buddii Version 2.0 Features

Temperature Sensor
Buddii will use his temperature sensor to monitor environment temperatures and send this data to his LCD as well as the remote console. If the temperature passes the threshold, Buddii will enter a fire-seeking mode where he will search the house for fire.

CDS Sensor
Buddii's CDS sensor can be used to sense lighting levels in the house and send this data to his onboard LCD as well as the remote console. If Buddii is in patrol mode and senses light when the sun is not out he will search for humans and sound an alarm.

PIR Array
The PIR array will be used to find and help track human targets.

SRF05 Sonar modules
The sonar modules will be used to detect and avoid obstacles. They will also assist in keeping Buddii from crashing into his target.

CMU Camera
The CMU camera will be used with the help of the PIR array to acquire and keep a target.

Flame Detector
Buddii will use his flame detector to search for fires when he is patrolling a house. If a flame is detected Buddii will sound an alarm and go crazy.

RF Transceivers
The RF transceivers will be used to wirelessly communicate between the remote console and Buddii. Sensor data such as lighting, temp, and flame will be sent using a RF transceiver.

Onboard 2x16 LCD
The onboard LCD will be used to display sensor data and to assist in debugging. This data will also be sent to the remote console.

Remote console
The remote console provides Buddii's user with the ability to wirelessly view his sensor data as well as live audio and video feed from Buddii. The console consists of the following:

A 5" LCD monitor where the live video feed will be displayed
A PSP screen equipped with a touch screen for selecting various data screens

In the future, the ability to wirelessly login to Buddii from anywhere in the world can be added. This would provide the user to see what's going on at home via Buddii's live camera / audio.

Concepts and Technology

Since Buddii (Version 2) is built on a pre-existing project, a portion of the pre-existing concepts and technologies will be imported and innovated. Of the pre-existing concepts and technologies being used are CPLDs, sonar sensors, PIR sensors and a CDS cell.

One of the primary additions to Buddii is the remote monitoring tool. This remote monitoring tool will be compromised of a two LCD screens, one strictly for video and audio and the other for sensor readouts, and a wireless transceiver. The LCD screen used for sensor readouts is a 24-bit color LCD screen and therefore requires advanced interfacing. A potential option is the use of a FPGA enabling components written in VHDL.

Renovations to the platform will also be done; a more sophisticated model is in the works. Technological renovations that consist of adding a CMU cam to help with the human following as well as fire detection sensors are also being added. Below is a more detailed technical overview of the existing and new concepts and technology.

Obstacle Avoidance

The previous obstacle avoidance hardware consisted of SRF05 Sonar Modules and Altera 7000 Series CPLDS. The sonar modules were interfaced with the CPLD that contained custom VHDL written components tailored to the SRF05. The CPLD also contained software that multiplexed each components output to the microprocessor. The new obstacle avoidance software will be written in C and implemented directly in the microprocessor. There will be no CPLD between the SRF05 and microprocessor. This requires that new existing VHDL components be re-written in C.

Human Following

The human following that previously existed was extremely unstable. Dependable operation depended on one maybe two people being around a robot. This however, is an unrealistic dependence. To remedy this, the PIR sensors previously being used will be using in conjunction with a CMU cam. The CMU cam functions by detecting certain colors. The PIR sensors will be interfaced with a CPLD that will multiplex the sensor’s outputs to a microprocessor.

Miscellaneous Sensors

In addition, Buddii will also have that capability to detect lighting conditions, temperature and the existence of a fire. The temperature sensing software will be

directly imported from the previous version. However, the temperature is in need of some vast improvements. The existence of fire will be detected with the use of a fire sensor that has not yet been chosen.

Wireless Communication

A concept completely new to the Buddii project is wireless communication. The use of wireless communication will be necessary for the new remote monitoring tool. The RF transceivers from Sparkfun are going to be used to transmit the sensor data from Buddii to the remote monitoring tool. A wireless video camera will also be implemented on Buddii's platform to send video and audio data to the monitoring tool. Below is a summary of the technology and concepts with the respective components and hardware.

Obstacle Avoidance

- SRF05 Sonar Sensors
- Interfaced directly to the microprocessor

Human Following

- PIR Sensors
- CMU Camera
- Altera 7000 series CPLD

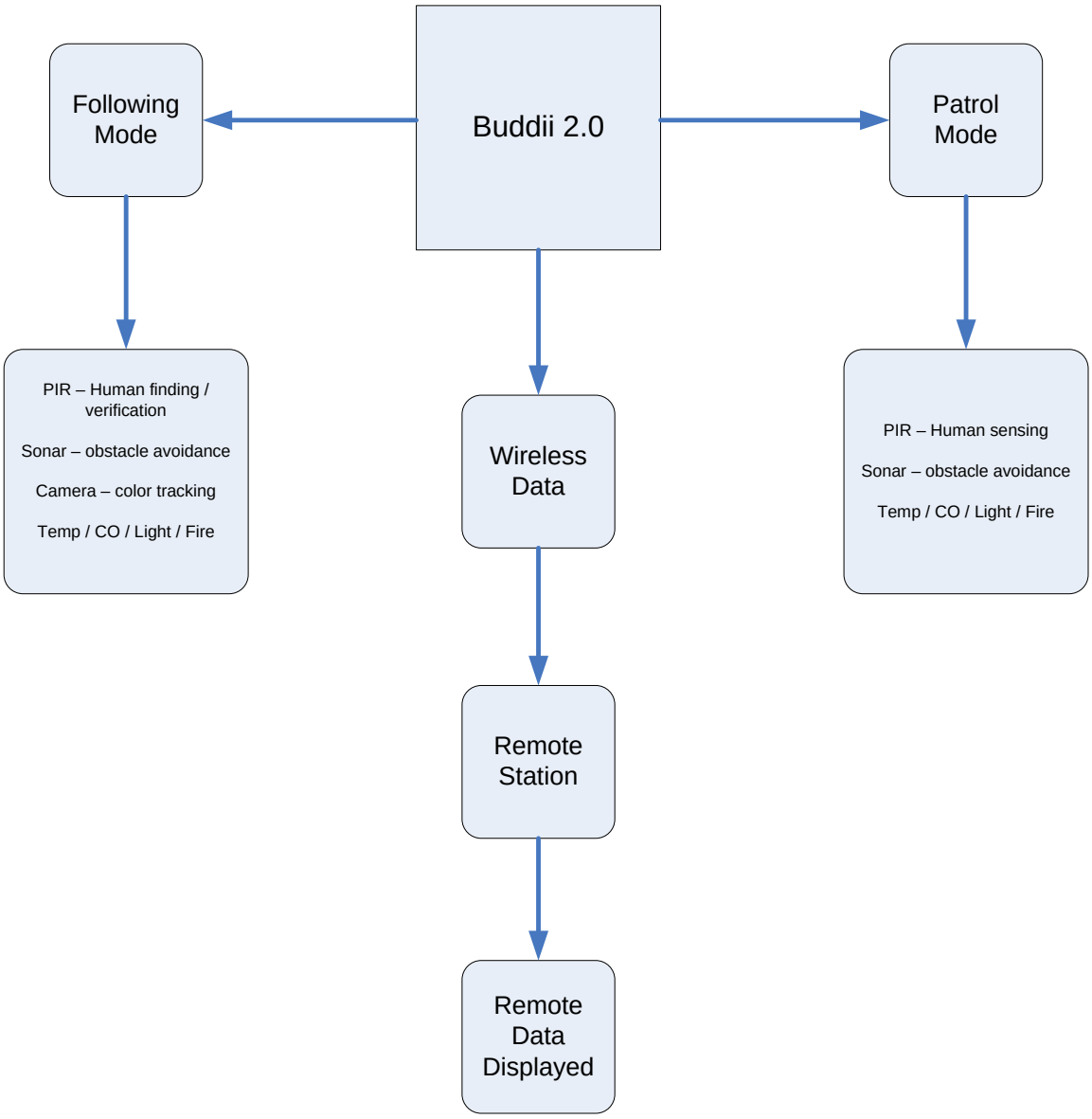
Miscellaneous Sensors

- CDS Resistor
- Thermocouple Resistor
- Fire Detection Component (Currently undecided)
- These components will most likely be interfaced directly with the microprocessor with corresponding C written software.

Wireless Communication

- RF transceivers
- Wireless video camera that transmits video and audio
- Two LCD screens
- Most likely a FPGA to handle the advanced interfacing of one of the LCDs.

Project Architecture



Flowchart and Diagrams

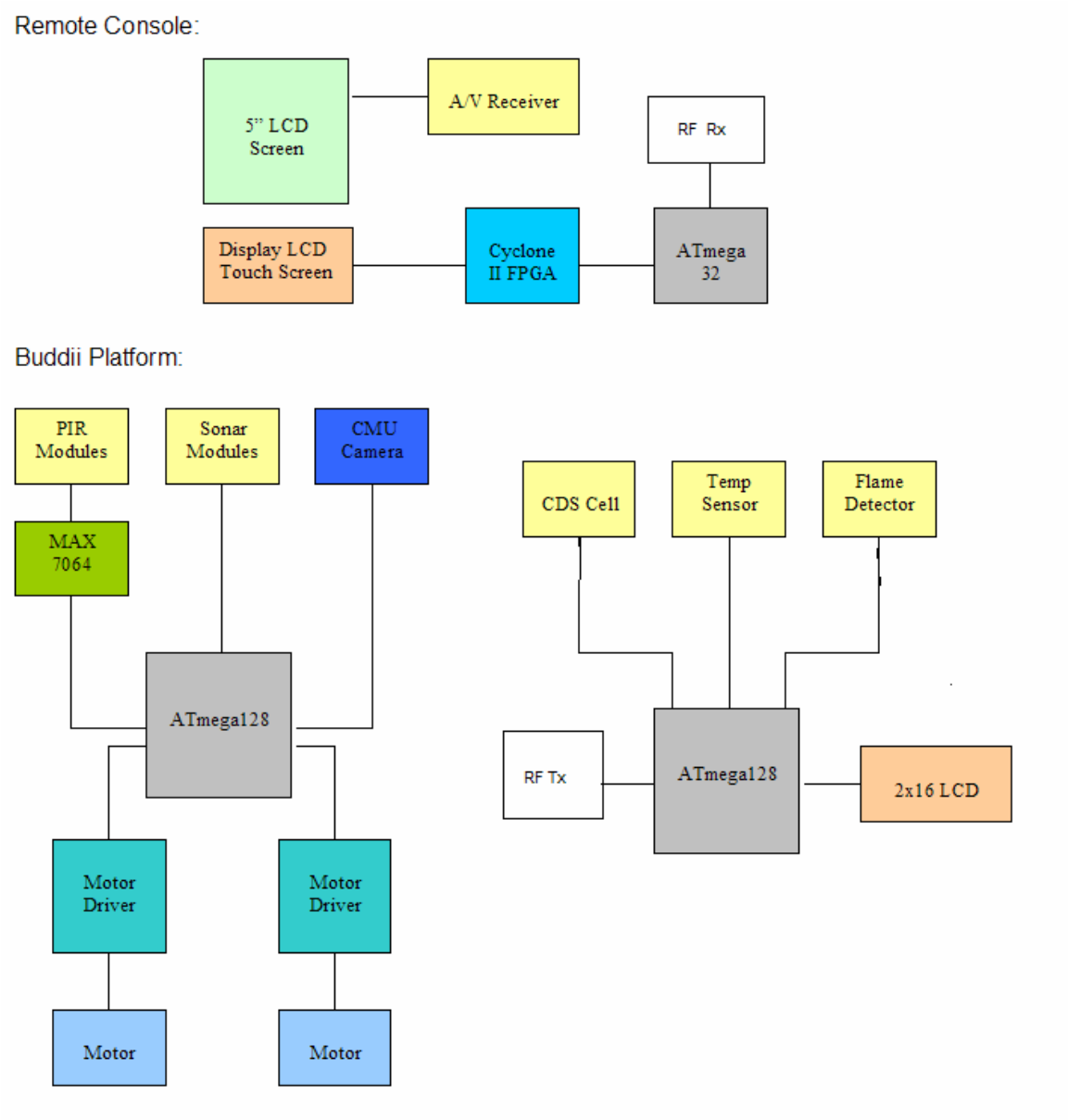


Figure 1: System Diagram.

Program Flowchart

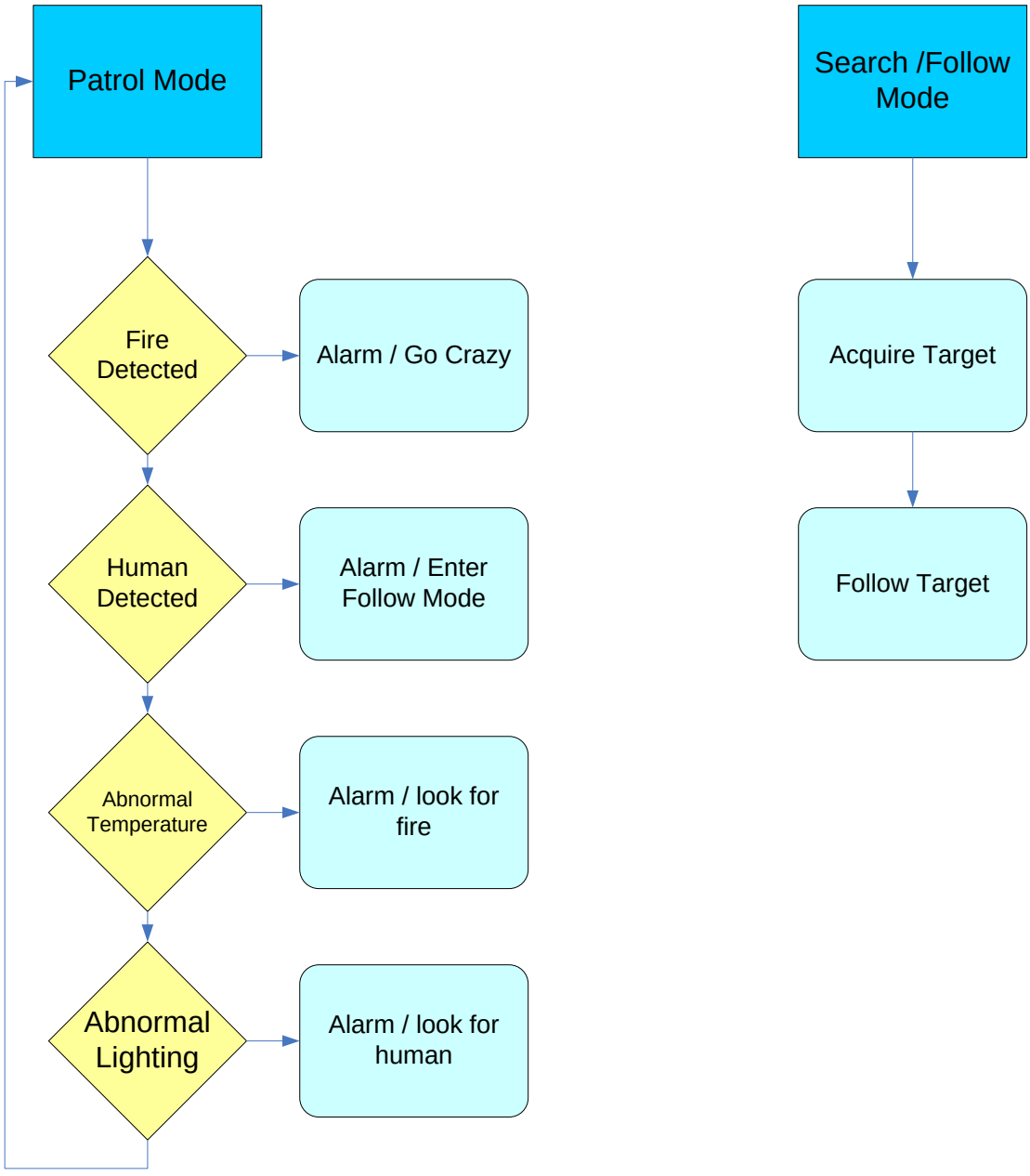


Figure 2: Program Flowchart

Motor Control CPU:

Security Mode:

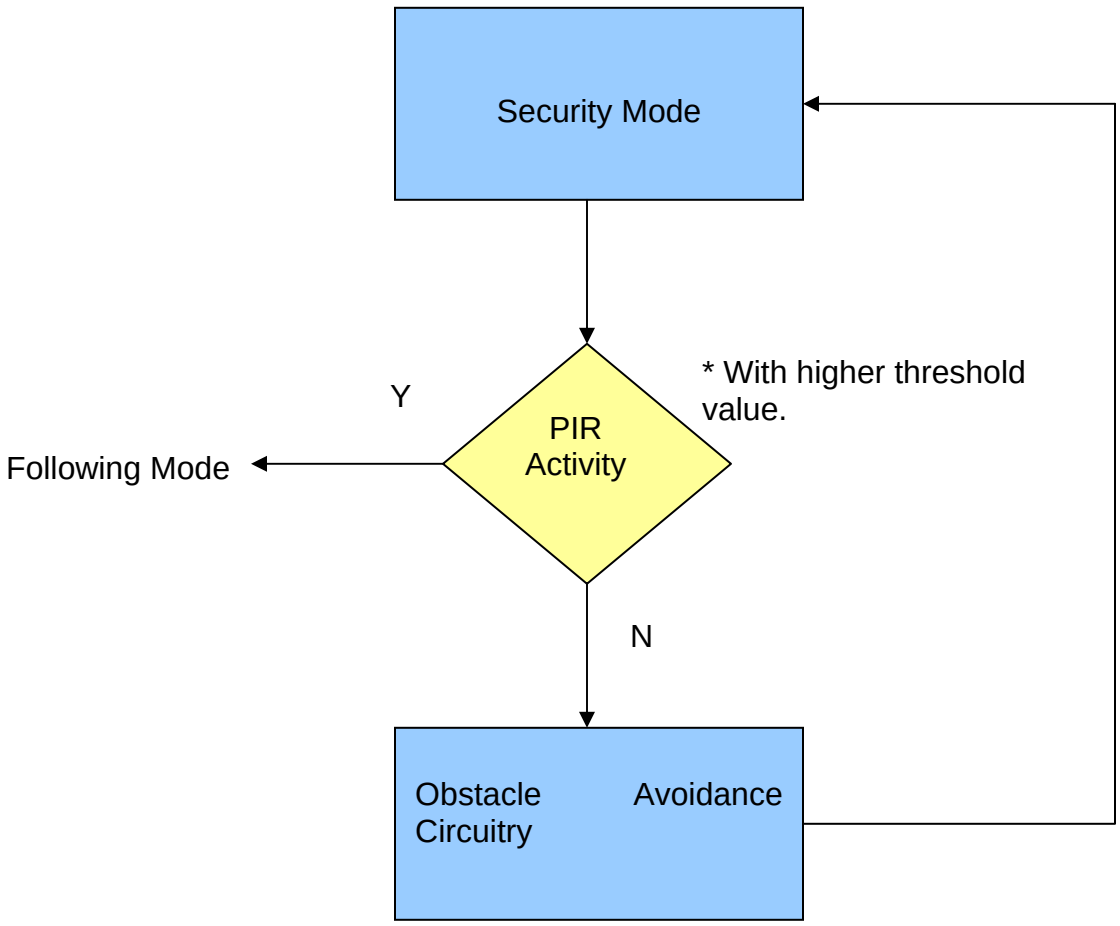
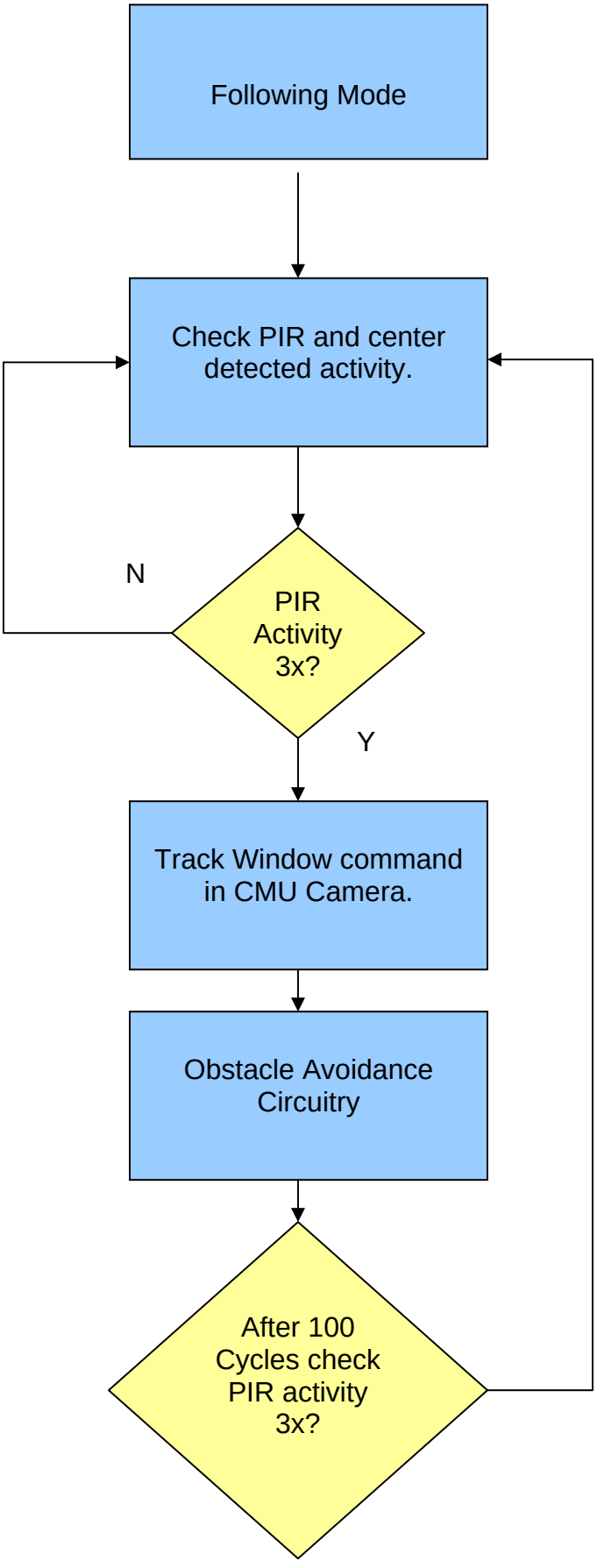


Figure 3: Motor Control CPU

Following Mode:



Communications CPU:

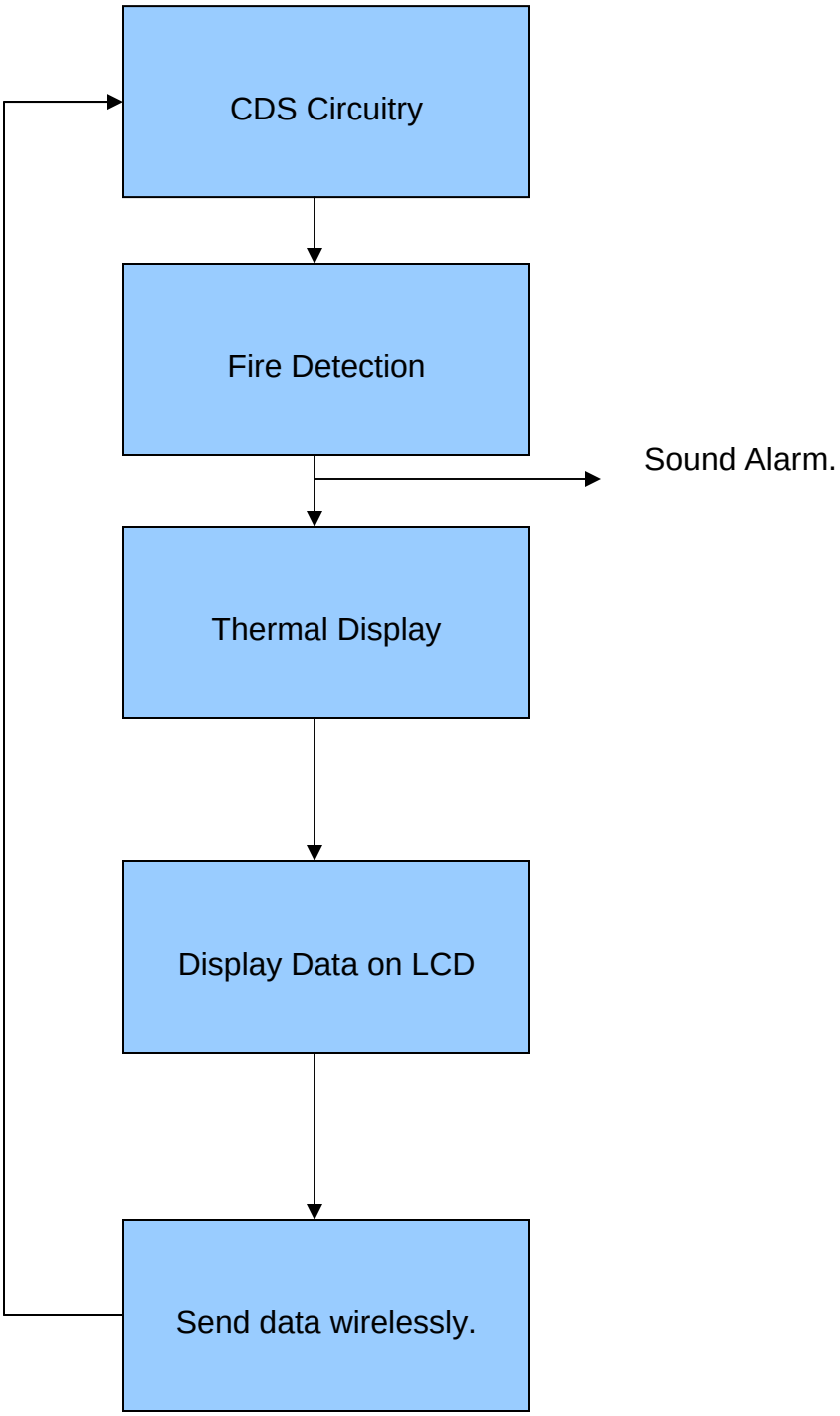


Figure 4: Communications CPU Software Flowchart

Handheld CPU:

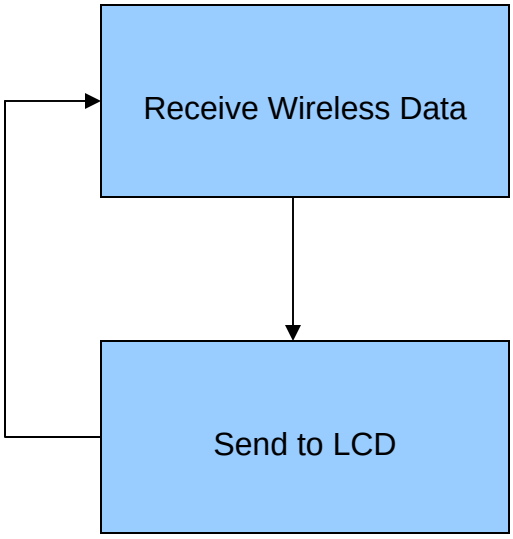


Figure 5: Handheld CPU Software Flowchart.

Separation of Workload

Task (Board Design)	Jason Taylor	Derek Otermat
Buddii Main Board Schematic	0%	100%
Buddii Main Board PCB	100%	0%
Buddii Wireless Board Schematic	0%	100%
Buddii Wireless Board PCB	100%	0%
Board Population	100%	0%
Testing / Debugging	50%	50%
Task (CAD)		
Platform Design	50%	50%
Sonar Bracket Design	50%	50%
PIR/CMU Bracket Design	50%	50%
Battery Mounts	50%	50%
Motor Mounts	100%	0%
LCD Bracket	50%	50%
Task (Design Fabrication)		
Platform Fabrication	100%	0%
Sonar Bracket Fabrication	50%	50%
PIR / CMU Bracket Fabrication	50%	50%
Batter Mount Fabrication	50%	50%
Motor Mount Fabrication	100%	0%
LCD Bracket Fabrication	50%	50%
Remote Enclosure	100%	0%
Task (Hardware Related)		
Sonar Testing / Debugging	50%	50%
PIR Testing / Debugging	50%	50%
CMU Testing / Fixing / Debugging	50%	50%
LCD Testing / Debugging	50%	50%
UVTron Testing / Debugging	50%	50%
Thermal Circuitry	50%	50%
CDS Circuitry	50%	50%
CO Sensor	100%	0%
Wireless Testing / Debugging	20%	80%
Cable Creation	50%	50%
Wireless Video / Audio Testing	50%	50%
Audio Circuit Testing / Debugging		
Task (Software Related)		
Motor Control Algorithms	50%	50%
Sonar Control Algorithms	50%	50%
PIR Circuitry (VHDL)	0%	100%

PIR Control Algorithms	50%	50%
CMU Algorithms	50%	50%
Thermo Algorithm	30%	70%
Fire Detection Algorithm	50%	50%
CDS Circuitry	50%	50%
Wireless Algorithms	50%	50%
Audio Circuit Algorithm	50%	50%

Bill of Materials

Parallax	PIR Sensors	5	$45.51
Sparkfun	PSP Screen / camera		$157.56
Sparkfun	LCD / transceivers		$113.20
Ebay	3.5" TFT monitor	1	$74.65
Seattle Robotics	CMU Camera	1	$118.95
LynxMotion	Wheels	4	$49.01
LynxMotion	Motors / hubs	4	$113.98
Digikey	All parts (minus my parts)		$200.00
Digikey	Regulators		$14.56
4PCB.com	Buddii 2.0 PCB	1	$64.09
4PCB.com	Remote PCB	1	$64.09
Sparkfun	Programmer / headers ($9)		$69.42
Acroname	UVTron	1	$76.95
Polycase	Enclosure	1	$16.56
Servocity	Female Header (3 pin) Packs	2	$23.85
Jameco	Female headers	10	$34.49
		Total	**$1,236.87**

Update Gantt Chart