# GRID EYE SENSOR SYSTEM FOR MULTI-TARGET TRACKING AND DETECTION

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NORTHROP GRUMMAN

intel Atom inside

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# Background

- Who:

  The requirements for this project have been principally set by Northrop Grumman NGC.

- What:

  Design of the Grid-Eye Sensor System will detect both the position and the intensity of the heat radiated by the surface of either a single or multiple targets.

- Why:

  Northrop Grumman will thus have the choice to utilize the finished product for commercial and military purposes as they see fit in satisfying their needs.

# Problem Formulation

In the last decade, the world has been exposed to terrorist acts. Government and private enterprises have taken a number of measures in order to secure and protect infrastructure as-well-as individuals from terrorist attacks.

Examples that aid in added security: are

- increased camera surveillance
- additional security personnel in and around buildings.

# Current Status of Art

- Passive Infrared Sensor
  - An electronic sensor that measures infrared light radiating from objects in its field of view
  - Disadvantages
    - No sense of motionless objects
    - No accurate detection in direction of movement.
    - No creation of thermal images.
  - Advantages
    - Low gain with wide temperature range
    - Digital output via an external interface
    - Selectable frame rate and operating modes
    - Detection of moving objects and people

# Current Status of Art

- **Thermopile** (Single Element)
  - Electronic device that converts thermal energy into electrical energy
  - Used to provide an output in response to temperature as part of a temperature measuring device (infrared thermometers)
  - Built in lens which offers 60 degree viewing
  - High Gain model with high temperature accuracy

# Current Status of Art

- Advantages
  - Detect changes in temperature
  - Sufficiently small to conceal for surveillance purposes
- Disadvantages
  - Sensitive to physical and electrical shock
  - Sensitive to humidity
  - Very fragile for packaging and in transporting

# Current Status of Art

## Alternative Technologies

- Vibration motion Sensors
  - A motion detector that detects simple vibration
- Wave Radar Motion Sensors
  - Use microwave signals to emit frequencies to bounce off of the surrounding area
- Ultrasonic sensors
  - Detects targets by interpreting the echoes from radio or sound waves

# Solution Approach

Functional blocks will constitute the major layout of the whole system:

- Pan/Tilt Servo
  - The Servo will be mounted upon the base of a tripod or a table and will be set to tilt manually when desired while also perform a 180°rotation.
- Grid-Eye sensor
  - Sensor will be mounted upon the servo in order to rotate along with the rotating part of it. It will detect and track people and/or objects with the highest temperature among others when set to HTM.

# Solution Approach

- Intel Board (Notebook Computer)
  - A Microprocessor which will interface with both the servo and the sensor in order to establish control both upon the speed and the direction of motion of the servo when the sensor is set to track the hottest target among others.

# Solution Approach

- Arduino (Uno or Mega)
  - A microcontroller that will serve to take direct temperature values and thermal image data from the sensor via an external interface in a form suitable for storage and usage to provide application concept for the system.
  - The Arduino Board will also interface with the Intel Board in order to allow the end user on the Intel Board to use a convenient computer program to show a graphical representation of thermal image of the object.

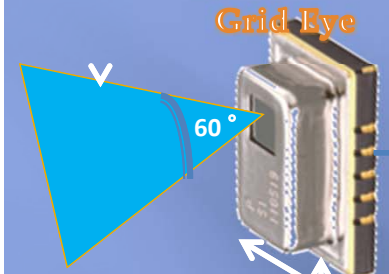
# Systematic Approach

Software for Processing that will be used:

- Matlab
- Arduino Compiler
- Processing Compiler
- C++
- OpenCv

# Systematic Approach

$60^0$ field of view

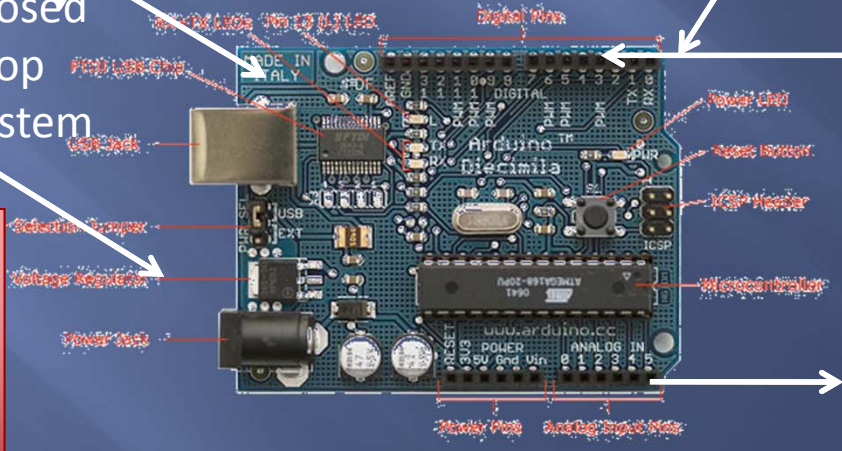



Detect and tracks people and/or objects with the highest temp. When set to HTM

Microprocessor which interfaces with both the servo and the sensor.

1500 feet direct line of site


Closed loop system


Mounted on the base of a tripod or table and will be set to tilt manually when desired while performing a 180° rotation.

Takes direct temperature values and thermal image data from the sensor via an external interface in a form suitable for storage.

# Task and Project Management

We expect to have a working prototype of the device by the date of EECE day April 2013. The device is expected to detect an object, produce a thermal image and display that image on a computer monitor. When more than one objects with different temperature are present, the sensor will track the object with the highest temperature once set on the HTM by the end user on the base computer.

# Task and Project Management

- Study and learn the properties and the functions of each major component of our system
- Divide system into functional blocks
- Develop block diagrams to represent the layout of communication between each part
- Testing and modification if necessary

# Tasks and Project Management

| Objective | Timeline |
|---|---|
| Initial Proposal | September 2012 |
| Wirtten Proposal 1 | October 2012 |
| Written Proposal 2 | October 2012 |
| Pre Presentation | November 2012 |
| Final Written Proposal | November 2012 |
| Presentation 2 | November 2012 |
| Design Finalizations | December 2012 |
| Ordering Of Parts | December 2012 |
| Testing of project | January 2012 |
| Testing of project | January- February 2012 |
| Documentation of project | March 2012 |
| Final Presentation | March 2012 |
| EECE Day | April 2013 |

**Note every week there are weekly progress meeting with the customer***

# Task and Project Management

Each group member will be required to comprehend every aspect of the project utilizing multi-discipline engineering fundamentals.  All three-member team will be assigned a specific task to accomplish within a determined period of time and it will be distributed as follows

# Task and Project Management

| Group Member | Task |
| --- | --- |
| Pierre Charles | Detection and tracking of objects by the sensor and the subsequent transmission of temperature data from the sensor to the Arduino Board |
| Daley Gunter | Develop a wireless communication protocol that allows an end user utilizing the Intel Board microprocessor to send command to the sensor to switch to the desired mode whenever necessary. |
| Shaddy Abdelaal | Control implementation within the system and software development. |
| All | Testing, Thermal Imaging, Building of the complete base. |

# Costs and Resources

| Unit | Cost |
|---|---|
| Screws | $25.00 |
| Grid Eye Sensor | Unit Price= $35.00(Qty=$140.00 |
| Intel Atom Board | $0 Provided |
| Mounting Fixture | $500 |
| Servos | $200 |
| Arduino Board | $65.00 |
| Wireless Modem | $100.00 |

# Conclusion

This proposed design has been realized in accordance with standardized communication protocols and with consideration for efficient power usage, minimal cost and product size. This document has presented the proposed design of a Grid-Eye sensor that has the ability to detect multiple thermal targets where the sensor assembly will have the ability to use a HTM to track the target with the higher temperature. The Grid-Eye Sensor Assembly shall be integrated with an Arduino UNO open source as recommended by our client. An Intel Processor will be required for interfacing with both the Grid-Eye Sensor and the Servo and the allowed interface between the computer and the Sensor Assembly shall be a USB cable.

# Questions