CENG 491- Project Proposal

Venture Co.

Perimeter Search and Patrolling Using Limited Capacity Unmanned Air Vehicles

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1.)Group Name:
Venture Co.

2.)Project Name:
Perimeter Search and Patrolling Using Limited Capacity Unmanned Air Vehicles

3-)Project Developers (Group Members):

Name:	**Id:**	**E-mail:**	**GSM :**
Efe Suat ERDUR	*1560143*	*e1560143@ceng.metu.edu.tr*	*05059389557*
Fırat AKYILDIZ	*1559871*	*e1559871@ceng.metu.edu.tr*	*05065542443*
Yunus Emre AKBABA	*1574425*	*e1574425@ceng.metu.edu.tr*	*05077395155*
Basrican ŞEN	*1560812*	*e1560812@ceng.metu.edu.tr*	*05069167537*

4.)Sponsor:
Anel ARGE

5.)Clear description of which problem you intend to solve:

Perimeter Surveillance Systems is a class of radar sensors that monitor activity surrounding or on critical infrastructure areas such as airports, seaports, military installations, national borders, refineries and other critical industry and the like. They mostly use static cameras and sensors. These systems are known as Perimeter Surveillance Radar (PSR). Such radars are characterized by their ability to detect movement at ground level of targets such as an individual walking or crawling towards a facility. Such radars typically have ranges of several hundred meters to over 10 kilometers. These radar systems are quite efficient if the guarded area is well known and it is eligible to construct such platforms, which are exampled above. On the other hand, if the guarded area is unknown and can be changeable, constructing static sensor solutions are useless. Low cost unmanned air vehicles have increasing popularity day by day and can also be used to provide situation awareness in such environments.

6.)Clear definition of what kind of system you will develop to solve this problem:

In this project, it is expected to implement a distributed multi agent based simulation system. A computer simulation is the mathematical modeling of real world phenomena. Computer simulations have become a useful part of mathematical modeling of many natural systems in physics (computational physics), astrophysics, chemistry and biology, human systems in economics, psychology, social science, and engineering. Simulations can be used to explore and gain new insights into new technology, and to estimate the performance of systems too complex for analytical solutions.

The simulation system that we are expected to implement is not only supposed to solve our problem about exploring unknown areas in the virtual environment , but also supposed to be easily integrated into real life. More detailedly, the communication and transmitting the video images in a P2P environment should be implemented realistically that can be ported on real systems with no or a little modifications.

7.)A market research on already available solutions. How does your system differ from?

7.1)Products

7.1.1)Bosch Perimeter Surveillance Solution:

Bosch Security Systems, Inc. introduces the Dinion Infrared Imager, a rugged camera designed for perimeter surveillance and other outdoor applications. With 2X-Dynamic Technology and Variable Field Illumination, the Dinion Infrared Imager consistently delivers high-quality video even in harshly lit or completely dark environments.

Available in analogue and IP models, Dinion Infrared Imagers deliver up to 525 feet of detection level performance in low or no light. Designed to improve perimeter protection at critical sites - such as energy, transportation and defence applications - the imagers also achieve classification level surveillance up to 390 feet away at night, making them ideal for installation along a fence line.

For more information, please check reference[2].

7.2.2) FLIR - Multilayered Surveillance

A multilayered surveillance approach is critical to protecting high value assets and infrastructure. This approach includes a combination of sensors such as imaging cameras, thermal imagers and radars. These sensors can be networked through a common command and control software backbone, providing situational awareness and implementing video analytics to improve efficiency. A standard scenario might include medium to long range radars, which provide a command view of a large facility and/or perimeter, such as an airport. These can be augmented with shorter range radars, as needed, to eliminate blind spots. These radars would be interoperable with selected cameras equipped with "slew-to-cue" functionality. With this functionality, the radar can detect an intruder, track movement and pinpoint geo positioning, while the cameras provide visual identification and information concerning the impending threat to assist in measuring the response.

For more information, please check reference[3].

7.3.3) FLIR- High Resolution Wide Area Surveillance

The Ranger® R-1400 is a high resolution radar that accurately detects personnel and vehicles up to 1400 meters range. And, it operates in virtually any climate, weather or lighting condition to provide 24/7 security, scanning 360° every second.

The Ranger R-1400 scans a full 360 degrees covering over 6 square km (2.3 square miles). Additional units can be networked in an overlapping array to protect larger areas, like borders. As part of the FLIR Wide Area Surveillance radar system range, the Ranger R-1400 may be networked with Ranger R-350 and Ranger R-12000 radars to conform to terrain profiles and form an impassable radar area outside and inside your perimeter.

7.2)Open Source Frameworks

7.2.1) MASON:

Mason is a fast discrete-event multi-agent simulation library core in Java, designed to be the foundation for large custom-purpose Java simulations, and also to provide more than enough functionality for many lightweight simulation needs. MASON contains both a model library and an optional suite of visualization tools in 2D and 3D.

7.2.2)OpenEaagles Simulation Framework:

OpenEaagles is a multi-platform simulation framework targeted to help simulation engineers and software developers rapidly prototype and build robust, scalable, virtual, constructive, stand-alone, and distributed simulation applications. It has been used extensively to build applications that demand deterministic real-time performance or simply executed as fast as possible. This includes applications to conduct human factor studies, operator training, and the development of complete distributed virtual simulation systems. OpenEaagles has also been used to build stand-alone and distributed constructive applications oriented at system analysis.

7.2.3) AnyLogic:

Anylogic is a Simulation software for building web based business games, business simulations, and strategy simulations using agent based models, system dynamics models, and discrete event models. You can build highly sophisticated models containing all three modeling paradigms. AnyLogic is based on UML-RT and uses "Hybrid State charts" to achieve this unique capability. The software has been applied to many different domains to build business models, strategy models, business games, economic models, social system models, war gaming models, biological systems models, physics models, and software performance models.

7.3)How does our system differ from the existing products?

As the result of our researches, we see that the existing projects are tried to solve our problem by using static sensors and cameras. As we indicated in the 'problem you wanted to solve' part, it is quite fair to solve the problem if the area is well known and it is eligible to construct such platforms. But considering exploring a unknown and changeable area, these solutions become deficient and our researches about the solutions of this conditions came to naught. We believe that our 'Perimeter Search and Patrolling Using Limited Capacity Unmanned Air Vehicles' system will be able to solve this problem after it is ported into the real life and get a considerable success on military purposes.

8.)Detailed characteristics of your project (What will be the coverage?

-What will be the coverage?
The project will consist of building a control and distributed task execution framework to be used with unmanned air vehicles.

-What will be the limitations?

It is not expected to implement the system in real life with real situations and real unmanned vehicles. It is expected to create a distributed agent based simulation system.

-What will your system do and what won't do? Specify as detailed as possible.

The user should describe the perimeter to search and a common task order (such as sequential or parallel search of the area, etc.). The framework should distribute the task among selected unmanned air vehicles and coordinate them accordingly to accomplish the task. The task order should be distributed and coordinated among the vehicles by considering the limitations of the vehicles, such as ad-hoc wireless communication range (ex: smaller than 100 m), battery power (ex:smaller than 20 min), limited video buffer (ex: smaller than 5 min), speed of the vehicles, etc. The main purpose is collecting the whole video images of the area and transmitting them to the main station in a timely manner. To transmit the video images, peer to peer communication should also be implemented.

In this project, it is not expected to implement the system to be used in real situations with real unmanned air vehicles. The system should be implemented using a distributed agent based simulation systems. However the modelling should be only limited with UAV navigation and manoeuvring operations. The communication and transmitting the video images in a P2P environment should be implemented realistically that can be ported on real systems with no or a little modifications.

Who will be using your product?

After our simulation system is successfully tested, the company is going to integrate our multi agent system into real life with real situations and real unmanned vehicles. After this integration finishes, the final project as a whole would be able to be used by military services to explorer a unknown area, be informed about the conditions and supply necessary military support to a specific area.

What will be the end product?

A distributed agent based simulation system.

9.) Workplan of the whole project (as a Gantt Chart) :

10.)References (those references you in fact used in the preparation of the proposal):

[1] http://en.wikipedia.org/wiki/Perimeter_Surveillance_Radar
[2] http://www.sourcesecurity.com/news/articles/co-289-ga.6694.html
[3] http://gs.flir.com/technology/infrared-and-radar/airport-perimeter-surveillance/
[4] http://gs.flir.com/products/icx-surveillance/radar/sts-1400/
[5] http://cs.gmu.edu/~eclab/projects/mason/
[6] http://en.wikipedia.org/wiki/OpenEaagles
[7] http://www.coensys.com/anylogic.htm