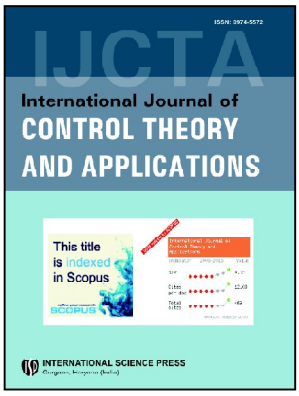

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Efficient Energy Consumption of Smart Camera Network in Vision Task

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Abstract: Multitasking in pedestrian tracking using Smart camera network can be done in static mode and dynamic mode for the reduction of energy consumption which might results in the missing of some of pedestrian tracking tasks. This paper mainly analysed the algorithms for a specific scenario of vision task with little amount of cameras by scheduling tasks of the pedestrian tracking with the objective of limited power consumption. Task switching and tracking of target during handoff takes place within the limited time. Correlation of different tracking areas results in the unwanted energy consumption since each task has a major role in the energy consumption, frequent access of cache and memory allocation. This paper represents the activation of memory running tasks and reduction of unwanted energy consumption activities by analysing on the real time vision task with some most complex scheduler approaches i.e., Distributed Market-Based Multitask Bidding approach, adaptive strategy selection algorithm which results in the increase in the lifetime and reduction in power consumption of the Smart camera network.

Keywords: multitasking, vision task, pedestrian tracking, task scheduling, energy consumption.

1. INTRODUCTION

Task allocation plays a prominent role in the effective use of different resources. Multitasking is the process of allocating multiple tasks at the same time. It allows multiple tasks to be executed simultaneously [12]. For target tracking simultaneously by assigning one static task and multiple dynamic tasks some of the targets are missing. It has a drawback of overuse of tasks and energy wastage [16]. To overcome this, one dynamic task is allocated and multiple static tasks are allocated to run at the same time. Task allocation and size will increase the performance, compatibility and reduces the complexity and completion time [1], [2].

Smart Camera Network is a real time visual analysis which can do multiple tasks with little or no human supervision. To complete the tasks in limited period of time computational capability should be large [13]. SCN should utilise all its nearby tasks with limited energy consumption. Bandwidth allocation might cause correlation, interference which results in loss of multiple tasks. Smart camera Networks should carry out multiple tasks by dynamically changing surrounding conditions. These are operated under periodic switching between different tasks with the consideration of energy, time minimisation [2].

2. BLOCK DIAGRAM

A task is assigned to each smart camera in a network**.** When a pedestrian comes to the tracking region, smart camera detects the target. Task scheduling determines which task to be done based on priority levels. Task priority can be assigned based on the different factors like ready state of the task, Task critical degree i.e. how far this can contribute to the limited task scheduling [3].

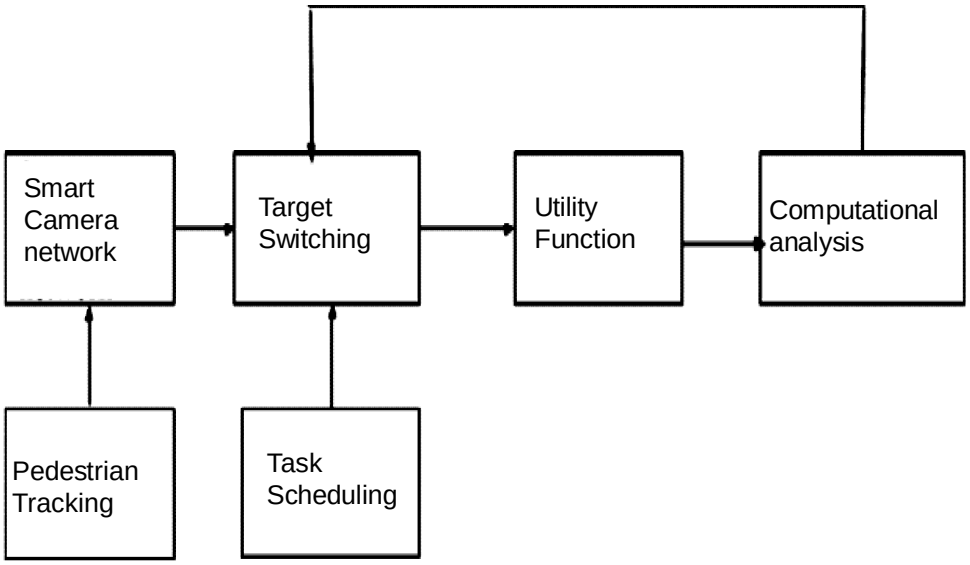

Figure 1: Block diagram of smart camera network in vision task

Task scheduling determines shift from one task to the other based on the time constraints. Task switching mainly switches from one task to the other based on the scheduling of the task, and bidding process. Utility function mainly determines the utility rate of each camera in the task related area and pass the utility rate of each camera to the entire camera. Bidding process will compare utility rate of all the cameras and hand over the task to the camera having highest utility rate. Thus target switching is done from one task to task, or interchange of tasks is done between different cameras [3].

(A) Smart Camera Network

Smart camera network pre-process themselves in picture or video data and without considering the remote server. Each camera can control on their own basis in the Field of View (FoV) [18].

This FoV is basically a circular segment but in visuals as a triangle. The smart camera network ideally will be grey colour, when a target enters into the field of view it turns active and the colour changes from grey to yellow [11].

Multitasking camera does not require state machine and central planning as in smart camera network. As the target enters into the camera region it is automatically tracked by the camera. Based on the movement of the target priority levels are changed [19]. As the target moves away of first camera and close to second camera, the priority level of first camera becomes less than the threshold value and the priority level of second camera comes into existence and the target tracking is handed over automatically to second camera. A distributed algorithm has been developed to select the particular camera for the particular task. Each camera can communicate with only small number of neighbouring cameras [2], [4].

Table I
Camera Differences

Normal Camera	*Smart Camera*
A normal Camera just takes photos and records videos based on the time basis.	Smart Camera has built in visual sensor for image processing and pattern recognition algorithm.
A normal is a remote sensing device which can capture the images, store it and move it to the nearby location.	A smart can detect the movement of the object and measure it, Recognize the behavior of human being and identification numbers at different surveillance areas without the remote sensor.
A normal Camera can be classified as Plate, Folding, Box, Rangefinder, Instant picture, single lens or two lens reflex camera based on the different sizes, lenses and applications.	Smart cameras are classified as PC based, Embedded based, Network based and hybrid based vision system applications.

(B) Pedestrian Tracking

Pedestrians are normally detected on the basis of different structures of human like arms, legs, and head. We combine all these bounding boxes and make them into a single box. The Resizing will increase the overall performance and reduces the overall detection time. This mainly operates on Non Max Suppression (NMS), Histogram of oriented gradients (HOG) for Human Descriptor, Support Vector machine (SVM) for pedestrian detector [17].

Pedestrian Tracking plays a prominent role in the present day society but a single directional tracking by multiple cameras is not adequate. So, Colour Histogram and Histogram of oriented gradients (HOG) were used in this pedestrian tracking for the detection of the humanoid.

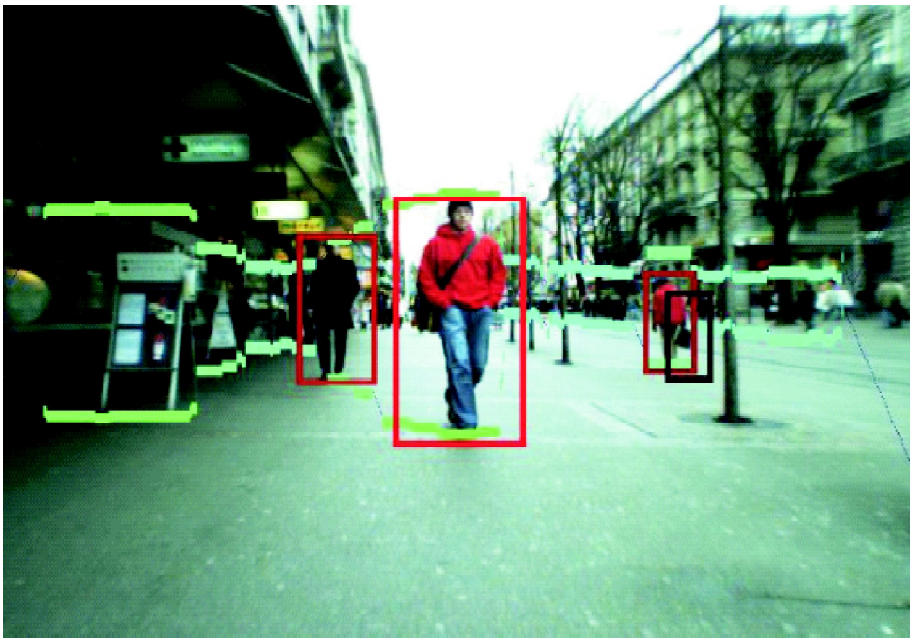

Figure 2: Illustrates the pedestrian detection

The above figure has bounding boxes overlapping with the original boxes. By applying Non-max suppression we suppress extra boxes and represent original detected box. By combining multiple boxing techniques of Face detection, Eyes detection, Motion Detection, Arm detection, Leg detection, Object detection etc.. Human is detected and considered. This will eliminate the objects carried by the man [10].

Figure 3: Illustrates the vision-task in real time

This Figure mainly represents the blurring image of a pedestrian. The HOG descriptor does not recognise the blurring image but it can represent the detected image. The Budding boxes are present for men and children. It uses HOG and SVM pedestrian detection. As multiple overlapping bounding boxes are present of larger size they are suppressed and represented by original image[5].

(C) Task managing

Task scheduling mainly assigns each task to the process on a timely basis. It mainly determines which task, where and when to be done with a time limit.

Task scheduling is mainly on the basis of

1) Which task should be assigned to which target
2) Adoptive utility path between different cameras to share information
3) Assignment of intelligent controller to each task and prevent the collision of task.

The greedy task scheduling is mainly used to decrease the number of resources and to be done within a time constraint. Task scheduling is mainly done on the basis of priority level and duplication. Task duplication is mainly done on the basis of analysing and assigning priority to each task. This will increase the utilisation rate and decrease the length of the processor and minimizes the time required by each task and movement from task to the switching point.

Task scheduling is mainly done on two factors [6].

- Scheduling-Assigning priorities to each task
- Routing-choosing the node and the camera for the task.

3. SCN-VISION TASK SCENARIOS

Vision tasks are allotted in such a way that it should satisfy the requirements of a camera with a limited power. Distributed market based bidding approach and adaptive strategy selection algorithm mainly determines which camera sets for the vision task. This strategy is varied in accordance with the task allocation in dynamic and static mode to increase the lifetime of a camera between 17%-65% [7].

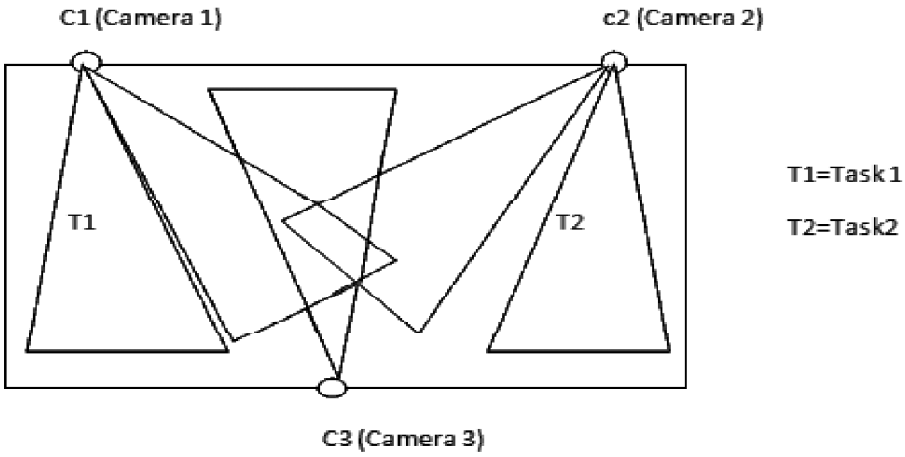

Figure 4: Illustrates the cameras and task setup

Visual task should be assigned to each camera. It eliminates the correlation of two tasks. When a target moves from one camera to another camera handoff is required. For this a third camera is required to trace the target during handoff [7].

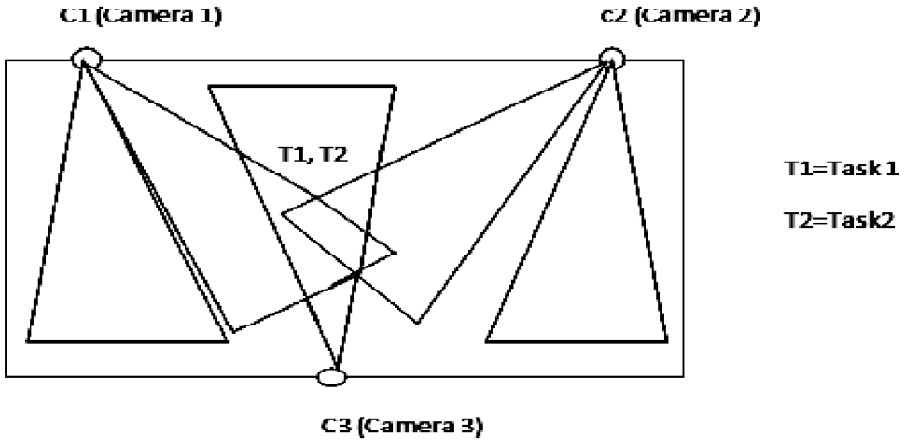

Figure 5: Illustrates the camera positions

4. TECHNICAL ANALYSIS

This section mainly represents the different algorithms in multitasking for pedestrian detection in smart camera network [16]. By the representation of necessary cameras in that region, assigning the task to be performed at particular time, where and when has to be performed. AS a particular pedestrian enters into the region of view is to be detected by smart camera network, it performs vision task in MATLAB for reduction of energy consumption and increase in the lifetime [14].

The allocation of the task, one in static and the rest changes dynamically with time which results in the change of energy level [13]. This will consider only the requirements and the energy usage of the resource but doesn't consider missing targeting tasks as they consider distributed embedded processing cameras of different features. Comparing to static task, dynamic tasks generate random values of resources and frame rate based on the Fov [8].

(A) Distributed Market Based Bidding Process Algorithm

Task is allocated to each node. When a target enters into the region of task, recognise the task, view and analyse the utility rate of each task. When it enters into the task related area or region, each camera receives the utility rate of nearby cameras. Compare the utility rate of neighbouring tasks and handover the task to the camera having highest bidding rate by prioritising it. Inform the utility rate, priority list and state of each task to all the cameras. The camera will be ideal state, if no target is in the task related area or not having enough resource or limited energy. Here the bidding process is done for only one task.

The present task assignment and scheduling is done by considering time duration and resource of present task but doesn't consider future use of energy resource and the life time. This results in the wastage of power if multiple tasks are in the same region. As different tasks are operated independently on the same target, energy wastage occurs and results in the correlation of the tasks [1].

(B) Adaptive Strategy Selection

To overcome correlation of different tasks and the wastage of energy, adaptive energy oriented multitasking is done for bidding process [14]. In this bidding of multiple tasks is done at the same time. As target enters into the task related area, tracking of the same task by multiple cameras will result in the wastage of power and decrease of lifetime. As the region of target is traced by multiple cameras, the target is to be handled only by the one camera at a time based on the priority levels of neighbouring cameras [19].

The adaptive utility function by the previous targets displacement estimates the needed speed for the present task. So it reduces the collision and missing of the present targets that are present on the different task of the system [20].

In this algorithm, we represent two threshold values to change the energy consumption rate by changing the weights assigned to it. If the energy is above first threshold, energy is utilised to give better performance without considering the lifetime of May ended based on decrease in the energy. If it drops below the first threshold value all resources is given equal importance, and weights are changed based on the equalisation of all the tasks. If it drops below second threshold value, weights are adjusted and decreased furthermore such that it might be used lower energy resource tasks and the prioritised immediate tasks. This adaptive utility function mainly allows different tasks to be allotted to different cameras based on the area of environment, time, work load and energy [1].

(C) Routing Algorithm

Starting from the first camera, we consider lowest energy consumption rate (E_i) with time out (T_i) of each camera until target is reached. The camera having the T_i value of required range is considered as the suitable task for the target and E_i is considered as the infinity value of that task. Based on the value of Ti the minimum E_i value is found for an each target and based on it the task is assigned. As the execution time is continuous and Ti is limited to a finite value, the time difference of interchange from one task to the other should be one clock cycle [2].

(D) Largest Task First Algorithm

Largest Task First arranges the tasks in a decreasing order by assigning priority to the tasks. Here the Load of the Task (T_i) is given by $\frac{ci}{pi}\cdot$ Largest Task First Strategy has been given as the 1:13 approximation algorithm for the frame based real time tasks with the same arrival and the deadline time. Largest task first algorithm is mainly used to enhance and reduce the leakage of the power consumption. By denoting I_m as the mth processor and T_m as the set of tasks assigned to mth processor. The task set T is denoted by the computational requirements C to

the period P of each task i.e $\frac{ci}{pi} \geq \frac{cj}{pj} if\ i < j.$ The load of a processor is mainly defined as the ratio of computational requirements to the period of all the tasks.

Largest Task First schedules the Tasks T into T_1: $T_2 ... T_m$. The task is assigned to the processor based on the smallest load of all the processors with the timeslot of each processor task. As the utility factor of all the tasks is 100%. The deadline for all the tasks can complete all the tasks in time [4].

(E) Simulated Annealing based Heuristic Algorithm

The Simulated annealing based heuristic algorithm is used for task scheduling to solve combination of optimisation problems. The simulated annealing mainly improves the solution by comparing with the neighbouring solutions and move to it if better else repeat the same. This is continued till the iterative solution reaches the threshold and certain amount of quality is maintained. If two neighbouring solutions are same, solution is generated by select a new task, reallocate it to the new core and reassign it to the new frequency.

The system will assign the schedulability based on the utility function. The new solution is compared with the present one and if it is greater than the threshold, it is accepted with probability of P which is the difference between the two values. This iteratively improves the solution. It is only given to one hyper period task which has only one solution and does not represent multiple hyper period tasks. This will terminate after the particular period called Exploration Time (ES).

This mainly operates on the periodic task but not on the scheduling algorithm. The heuristic algorithm considers both the periodic and the scheduling point. First it operates on the periodic basis by comparing the nearby solution. Based on the probability it is decided the task is accepted or not. Then it is scheduled. If it is not schedulable, till now used best solution is adopted for upcoming tasks. [9]

5. CONCLUSION

Energy consumption reduction and increase of lifetime is a challenging problem in a smart camera network and vision task. I this paper we represent different algorithms which have their own advantages and disadvantages based on the application.

Distributed market based bidding process algorithm can be used in the region of surveillance having limited pedestrian and high security. It can't recognise multiple targets at the same time. Adaptive strategy selection can be used to detect multiple pedestrians but results in use a energy for continued access of memory and missing of some tasks in ideal state. Routing algorithm is used for limited tasks with high energy resources, multiple tasks results in the reduction of energy.

Largest task first algorithm is mainly used for periodic task assignment based on the weight of the task; it doesn't recognise priority levels of each task. Simulated annealing based heuristic algorithm is mainly used for multitasking of periodic tasks and providing scheduling of tasks based on the priority level of the task.

REFERENCES

[1] Christos Kyrkou, Christos Laoudias, TheocharisTheocharides, Christos G. Panayiotou: "Adaptive Energy-Oriented Multitask Allocation in Smart Camera Networks,"IEEE Embedded system letters, Vol. 8, No. 2, (JUNE 2016).

[2] Kasim M. Al-Aubidy, Mohammed M. Ali, and Ahmad M. Derbas,: "Multi-Robot Task Scheduling and Routing Using Neuro-Fuzzy Control," International Multiconference on Systems, Signals & Devices, (2015).

[3] Xuanxia Yao, PengGeng, Xiaojiang Du, : "A Task Scheduling Algorithm for Multi-core Processors.International Conference on Parallel and Distributed Computing," Applications and Technologies (2013).

[4] Mehdi Jafarizadeh, Ali Zakerolhosseini, :"Performance analysis of processing load distribution in camera networks for multi target tracking," Iranian Conference on Machine Vision and Image Processing,(2015). Jsjncsj

[5] Hanene Ben Fradj, Cecile Belleud Michel Auguin,:"Main Memory Energy Optimization for Multi-Task Applications,"IFIP (2006).

[6] Samih M. Mostafa, Shigeru Kusakabe,: "Towards Reducing Energy Consumption using Inter-Process Scheduling in Preemptive Multitasking OS," IEEE , (2016).

[7] Eriksson, V. Pacifici and G. Dán,: "Efficient distribution of visual processing tasks in multi-camera visual sensor networks," IEEE International Conference on, Turin, pp.1-6, (2015).

[8] Juan C. SanMiguel and Andrea Cavallaro, "Energy Consumption Models for Smart Camera Network", IEEE 2016.

[9] Alma Oracevic, SuatOzdemir, "A Survey of Secure Target Tracking Algorithms for Wireless Sensor Networks", IEEE 2014.

[10] Phiros Mansur, SasikumaranSreedharan, " Survey of Prediction Algorithm for Object Tracking in Wireless Sensor Networks", IEEE 2014.

[11] Soomi Yang,: "Design and Implementation of Smart Camera Network for Efficient Wide Area Surveillance," International Journal of Energy, Information and Communications Vol. 5, (2014).

[12] Weixun Wang, Sanjay Ranka, Prabhat Mishra, "A General Algorithm for Energy-Aware Dynamic Reconfiguration in Multitasking Systems", Conference onVLSI Design, (2011).

[13] Mauricio and Casares, "Energy-Efficient lightweight algorithms for embedded smart cameras: Design, implementation and performance analysis", Syracuse University, May 2014.

[14] Ji Gu, Tohru Ishihara and Kyungsoo Lee, "Loop Instruction Caching for Energy-Efficient Embedded Multitasking Processors", IEEE 2012.

[15] Abhishek Gupta, Yew-Soon Ong, Liang Feng, and Kay Chen Tan, "Multiobjective Multifactorial Optimization in Evolutionary Multitasking", IEEE Transactions on cybernetics, 2016.

[16] Ning Jing, Liu Chengju, Wang Helin, Chen Qijun, "Self-balanced motion planning for humanoid robot based on dynamic multitasking mechanism", IEEE 13th International conference on networking, sensing, and control, 2016.

[17] Sayanan sivaraman, "Looking at vehicles on the road: A survey based vehicle detection, tracking and behaviour analysis", IEEE Transactions on international transaction systems, 2013.

[18] Markus Happe, YUjiao Huang, Ariane Keller, "Dynamic protocol stacks in smart camera networks", IEEE 2014.

[19] Shuixian Chen, XiNG Lu, Limin Sun,Shiming,"Target Domain Adaptation for face detection in a smart camera network", IEEE 2015.

[20] Fatemeh ReZaei, Babak H. Khalaj, "Distibuted Human Tracking in smart camera Networks by Adaptive Particle Filtering and Data Fusion", IEEE, 25 February 2013.