Implementation of Micro-Controller Based Adaptive Motion Detection for Industrial Monitoring System

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Abstract
Industrial system has become concurrent research focus in most developed counties being an ultimate source of revenue benefited by citizens. This project emphasized on implementation of micro-controller based adaptive motion detection for industrial monitoring system as a factor that determines synergy and sustainability of industrial management. The camera will be interface with PC to detect the presence of object and report production activities through image capture and enable video stream for monitoring. The design is to create interface link between Microcontroller AVR PC, ATMEG16 and camera C3088. The PC will establish bi-directional communication with AVR while using I^2C communication protocol is used to interface camera and AVR. The industrial feedback process will be control with AVR based on adaptive motion detection from installed camera. The captured image obtain from the camera can be use for surveillance or can be process for image processing purpose in industries and organizations.
Keywords: Lighting, LED, economic usage, light energy, detection

Introduction

Video Camera is model used in transmitting signal to specific place, on a limited set of monitors. This is different from broadcast television since it signals is not transmitted openly though it may use point to point wireless connection mode. Cameras used for different application depend on design prototype. With respect to once often used for surveillance in areas that may need monitoring such as banks, casinos, airports, military installations, and convenience stores.

In recent time, an intelligent transportation system provides an attractive alternative to the traditional monitoring system, which depends almost on the facilities of the industrial management system for tracking or monitoring activities in a safety manner. A video camera, interface with computer vision techniques, makes up of a video-based intelligent transportation system using AVR ATMEGA16 controller device [2]. Detection of moving objects is the first relevant phase in this design. To meet the user and system requirements of efficiency and accuracy of a successful video-based system, moving objects detection algorithm should be characterized by some important features of the industrial segments, such as accuracy, real-timeless, etc. The accuracy of detection is a basic contemporary of requirement of the system. In general perspective, the accurate detection is time-consuming. Moreover, a real time system ensures that the detection information is provided in time, and the management commands from the microcontroller module are responded timely. In fact, a definite moving object detection method makes tracking or monitoring more reliable and faster, and supports correct classification, which is quite important for a system to be successful [3].

During the past decades, researchers in vision technique have already proposed various algorithms and techniques for detecting moving objects, such as, consecutive temporal difference (consecutive frames subtraction) [9,10,11,12], optical flow approach [1,4, 5,13,14], noise filtering and background subtraction [6, 7, 8,15,18,19], etc. Among these methods, background subtraction algorithms are most popular, because they are relatively simple in computing in a static scene. In a nutshell, the background is assumed to be static in this method. Thus, considering shaking cameras, waving trees, lighting changes are quite probable to cause serious problems to a background subtraction model [1]. In addition, in other to integrate scalability, a successful background subtraction method needs to model the background as accurate as possible, and to adapt quickly to the changes in the background. These whole requirements add extra complexity to the computation of the model and make a real-time detection difficult to achieve. Optical flow approach is quite excellent and experimental because it can detect the moving objects independently and it works very well in changing environments, even in the absence of any previous information of the background image. However, the computational cost of the approach is very expensive, which makes it very difficult to be applied in a real-time system design. And, this approach is quite vulnerable to disturbs, such as the headlights of the vehicles. Thus, it is not fit for the traffic control system but adoptive in industrial monitoring process.

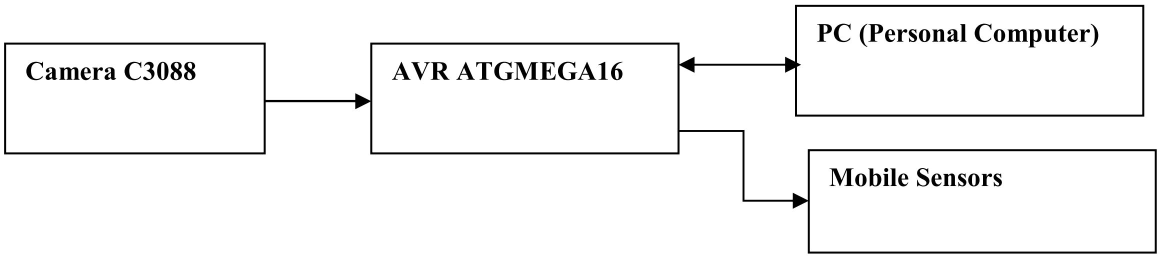

Figure 1: Showing interface links of the design system

II. THE FRAMEWORK OF THE PROPOSED METHOD

Figure 1 illustrates the block diagram of the design algorithm. The camera C3088 motion of the input frame is compensated and consecutive temporal difference is performed to extract moving areas from the captured image. The moving areas include the target areas (moving objects on target) and some uninteresting motion areas (the moving background). Post treatments are employed to optimize the detection by filling the small holes in the detected objects and removing uninteresting motions. Since casting shadows won't have large change between two consecutive frames and little change of shadows to be detected can be removed by the post treatments, casted shadows have little effect on the accuracy of detection. Thus, was handled in the design to improve the efficiency of this method. In other to perform this method in real-time and with high accuracy, there is needs to design every block carefully. Since the consecutive temporal difference approach requires no background model and little memory for computation, this model approach is quite efficient and accurate in that it has a low computational cost and it adapts quickly to the changes of the background.

First, the input frame is compensated by using a camera motion compensation algorithm, which takes some spots in the frame as basic pixels and estimates the motion of the camera with a square neighborhood matching method. The whole input frame is then adjusted to make up the motion of the camera. The square neighborhood matching method will be fully described in the following subsection. It shows how we record the deviation of the image.

Second, an improved consecutive temporal difference approach is used to quickly obtain moving areas of the input frame. This approach makes use of three consecutive frames. The three frames are divided into two groups. The first group includes the two previous frames (the two consecutive frames that go before the input frame), while the second group includes the input frame and the frame before it. By subtracting the two groups separately, we get two results of different areas from the two subtractions. Since the intersection of the two results is just the very part of the moving area in the frame previous to the input frame, we can obtain the moving areas by subtracting the second results by the intersection of the two difference frames.

Third, post treatments are used in this phase to fill the small holes in the detected objects and to remove uninteresting motions from the moving areas obtained in the second phase. Since shadows are not handled in this method, post treatments deal mostly with the two problems mentioned above. The math morphology techniques are used.

The moving areas are expanded and corroded first to fill the small holes and to get connecting fields, shaping entire objects. Then the area of the connecting fields are computed and segmented to decide whether the field belongs to the target image/objects or uninteresting motions. In this way, we shape the entire object by removing the small holes and eliminate uninteresting motions from the detection, leaving only the objects that interested in.

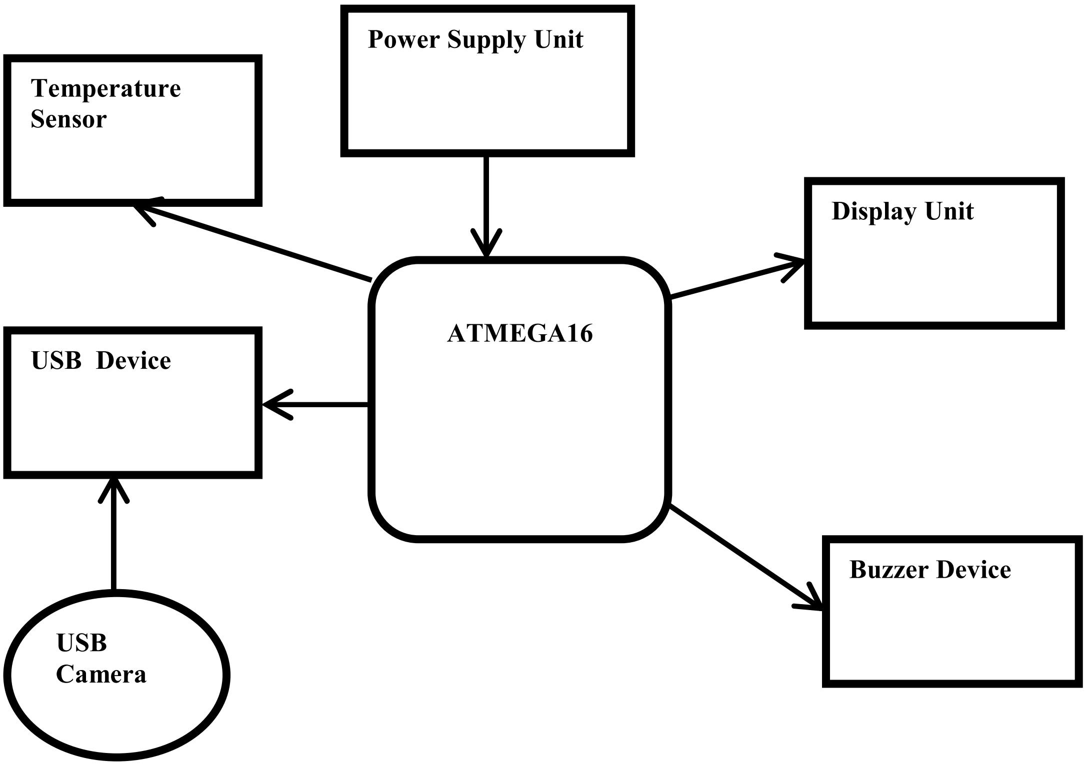

Figure 2: *Block Diagram of Location based Industrial monitoring system*

II. Proposed System Block:

This system takes capture image by means of camera connected to AVR ATMEG16 microcontroller through USB and the captured image is processed by using image processing technique. In this scenario image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; description of the output of image processing may be either an image or a set of characteristics or parameters related to the image. Camera view is used to detect object / human beings, ultrasonic sensor is used to objects, GPS is used to get location values while temperature sensor to determine atmospheric conditions. The use of Buzzer and DC motor is to alert the security at surrounding area where as to alert security at control room monitored conditions are viewed on corresponded camera. In this research work use ATMEG16 based microcontroller, which the current dominant microcontroller in mobile based products.

V. Hardware Interfaced To Proposed System

The essential programs code that are required in order to work with microcontroller was compiled using keil-mirco vision program which allow assembling language and c language respectively.

By using camera, every movement is monitored from any location through PC or laptop. If any motion is detected by camera, it can be either related to any person or related to any object at that moment. Therefore, it will capture that image and stores into the internal memory of the micro controller. The reduction of power consumption and easing of PC processing activities make better advantages over motion detecting systems. In this way there is possibility to design a lower power working motion detection system by using ATMEGA16 controller. The system uses USB camera which is connected to controller module through USB device. Camera receives image of a person and finds whether it is person or object location within industrial or organization segments. The camera captures the face of a person present in the region only in the form of frames by using Open CV library later it retrieves image pixel data and display [22].

Immediately it detects object and capture image then buzzer will turn on to alert monitoring team.

III. Experimental Results

As discussed earlier the experimental result in the form of image, location data i.e. Latitude and Longitude of desired location where the board is kept and Temperature of remote location. User can log on PC; the captured image can be access in the internal memory of AVR microcontroller. Corresponding temperature and position can view to identify person image on PC.

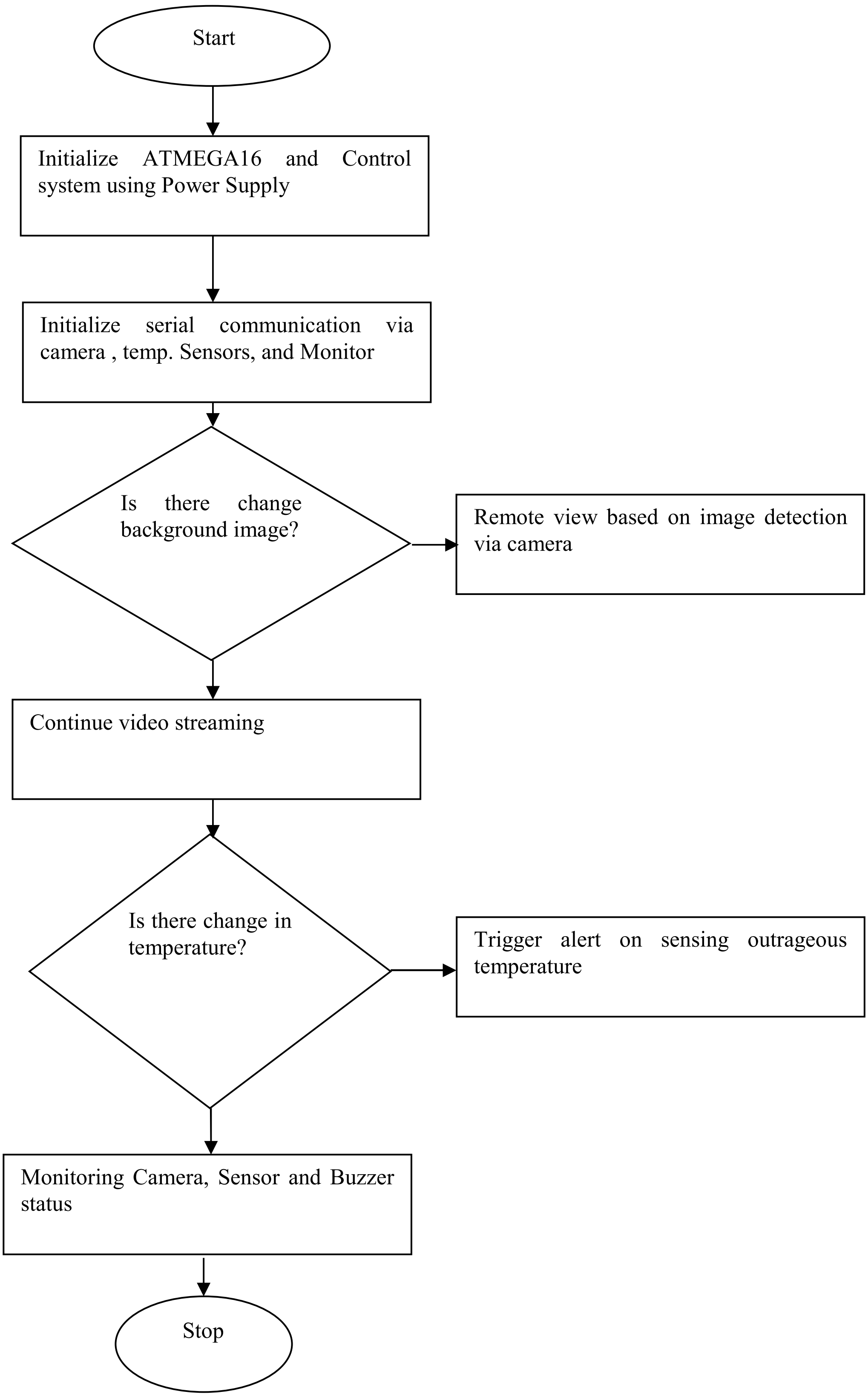

Fig 3: Result obtained on Desired serial cable

In this section, the effectiveness and accuracy of the proposed method is demonstrated with two cases in monitoring industrial activities with complex backgrounds where shaking cameras, changing elements are presented. The first video sequence used in this section is detecting motion based on motion detection. The average speed for stemming and capturing video sequences is about 100ns used on 1GB Pentium III machines.

Figure 3 demonstrates the ability of the proposed method to detect moving object in production segment. **Figure 3(a), 3(b) and 3(c)** are three consecutive frames in a video sequence in which human walking persons are presented. The frame 3(c) is taken as the input frame. Figure 3(d) is the difference frame of the original frames 3(a) and 3(b) obtained with temporal difference, and 3(e) is that of frames 3(b) and 3(c). The detected moving areas of the input frame, which is derived by subtracting 3(e) by the intersection of 3(d) and 3(e), is shown in Figure 3(f). From Figure 3(f), we can see that there are some small holes and uninteresting motions in the moving areas. Math morphology is applied to shape the entire objects and remove uninteresting motions, and the final detected region is shown in Figure 3(g). The average speed for this sequence runs 70 fps because the camera is relatively stable and the background is much more stationary in this sequence. (g) The final detected region Figure 3.

Experimental results of moving objects detection on a road

Figure 4 demonstrates the capability of our method to handle changing background. The three original images on top of the figure are taken from a video sequence got with a live video in a windy day. In the frames, the trees are shaking and some sundries are blown to fly over the floor.

The final result is shown in Figure 4(g). From the result, we can see that our algorithm works well in disturbing background. It removes the uninteresting motions from the detected region with satisfactory performance. The speed for this sequence runs about 54 fps.

IV. Conclusion and Recommendation

Based on consecutive difference and the square neighborhood matching algorithm in the system design. The design converse a method for motion detection in complication background in traffic monitoring stages, which is demonstrate to be effective, accurate and robust compared with other similar motion detection algorithms , the main betterment of the proposed method is that it requires only a little time and memory, thus agreeable for use in real-time applications. In adjunct, no prior knowledge of the background is needful for the implementation of this method, and it is quite robust to background changes, not accumulating previous mistakes. Tests on the standard data sets also show that it has an undercharged performance.

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