Thermal Energy Sensing Technique for Fire Detection and Warning System based on Image Processing

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Abstract* —*In recent times, rapid growth in technology leads to an overnight boost in electricity usage, thus increasing the probability of fire hazard or short circuit. To tackle such life threatening condition, there is an urgent need for system that is capable of resolving this kind of situation. In this regard we proposed a model based on image processing capable of detecting short circuits using image processing. Usage of an image processing in such application establishes a minimum human intervention and hence provides us a sensor less system. The accidental condition are detected using a color based fire detection algorithm performed using image processing. Our proposed work is adamant to provide an optimum solution for the life threatening condition which may cause huge loss of lives if not tackled properly. The proposed systemis cost effective and reliable for low income areas where the probability of accident caused by electricity ismore due to old and outdated wiring.

Keywords* — *Image Processing, Short Circuit and fire Analysis.

I. INTRODUCTION

Since the dawn of time, the sole purpose of mankind is to innovate technology to ease their everyday life and make them safer. Mankind had developed manual and computerized system for this purpose and still ambitious for more. Rapid growth of technology and infrastructure leads to the construction of huge skyscrapers in large numbers, so the probability of fire or short circuit also increase. Hence many unfortunate fire related incidents took place in the past causing high casualties. According to the World Health Organization (WHO) displayed in Fig-1, approximately 11.2% of the deaths occurs due to fire related incidents. The cause of these incidents are usually the lack of such system capable of alerting people on time about an impending danger. Video monitoring is widely used in almost all real-time application toprevent such incidents. Over the year many sensor based system are also developed for fire detection algorithms, however in most cases these devices would not work until the material comes in contact with the designated sensor and it might be possible that physical presence of an individual is required. The main advantage of choosing video surveillance over conventional sensor based system is its cost and ease of installation. It also eliminates the need of any physical presence of an individual to continuously monitor the conventional system

In recent times many algorithm for fire detection are utilized for security [1-3]. Many transport vehicles like trains are also installed with the systems capable of detecting fire [4]. Many forests are susceptible fire around the world, so to prevent forest fire researchers have provided with many solutions in this regard [5-10]. Liu, Zhenji, et al introduced a method of detecting fire based on ultraviolet light [11]. Heavy duty vehicles are also equipped with fire detection systems to prevent any incidents [12]. Fuzzy based algorithmare also used for detecting fire in real time [13-16]. AI application have also been utilized to train the modelin order to detect the smoke, fog and fire [17-20]. Internet of Things (IoT) application also utilized algorithm to detect fire and smoke from drone hovering above the burning building and provide best route for the firefighters to enter the building to save lives [21-24].

In our proposed model, a color based fire or short circuit detection algorithm is implemented in place of conventional method like sensors. Processing of an image is performed using MATLAB and if fire is detected an alert will be generated via SMS using GSM 900 module interfaced with the computer (PC).

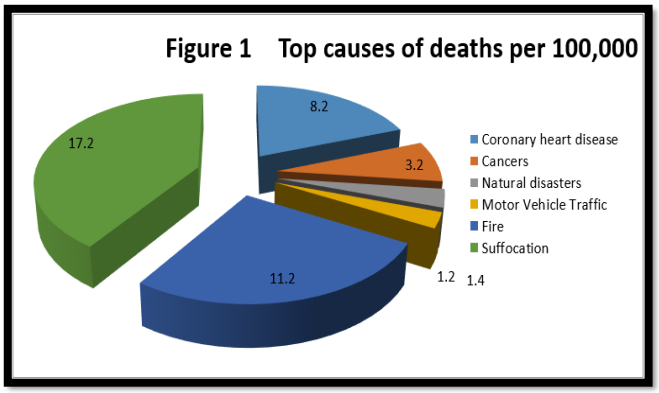

Figure-1: Causes of Deaths

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II. SYSTEM HARDWARE MODEL

Aim of this proposed work is to design and develop a system capable of detecting an occurrence of an accidental condition in a form of short circuit. A wireless camera implemented in the direction of the socketboard or circuit breaker which is used extensively or regularly. This camera acquires a frame from a live video stream and process it using MATLAB, where an algorithm is been developed using color based recognition. If the fire or short circuit is detected it will alert the building authority and raise an alarm for the people to evacuate the premises as soon as possible. A computer based system implemented is interfacedwith the GSM module to deliver the message to the authorities capable of tackling such situations, this message is delivered via SMS. An address of the accidents location is preprogrammed in the system as it is a stationary location. . Fig-2 is complete implementation of a hardware based model. In Fig-3, the interfacingof our GSM 900 Module with the PC on which the image is processed is displayed.

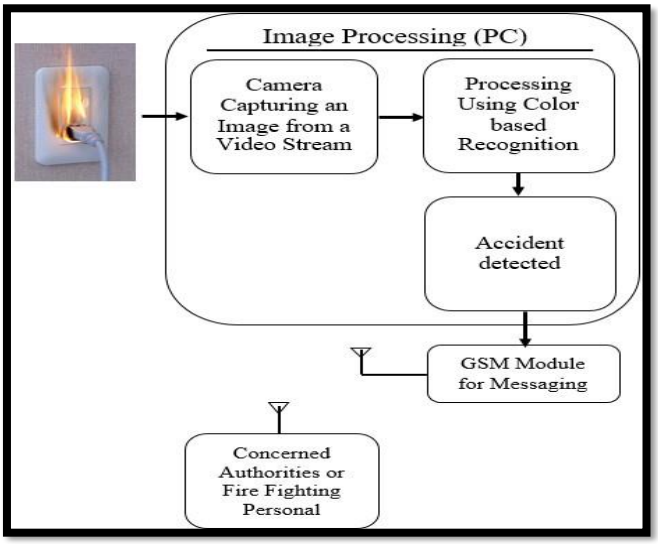

Figure. 2: Hardware System Model

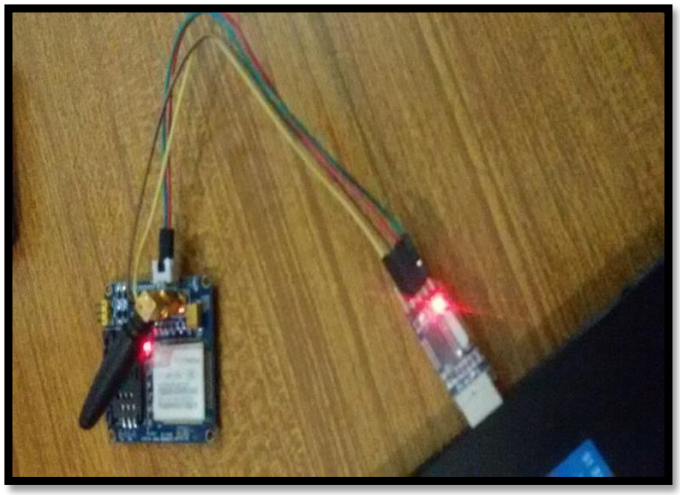

Figure. 3: GSM 900 Interfacing with PC

III. SYSTEM SOFTWARE MODEL

The main backbone of our proposed model is a processing the frame acquired from the live video stream represent in Fig-4. Due to the rapid development of infrastructure, short circuit or fire is now a major threatto human lives. This system is basically a sensor less model and depends on a camera for its input.

After the system initialization a frame is acquired from the live video stream and it will continuously monitor detection of the short circuit or fire. The acquired frame is converted in to their respective red andgreen format as the combination of these two colors make a yellow color that resembles fire, the key here is to not misunderstand any other color shade for fire. At this point a median filter is utilized to remove additional unwanted noises. The residual image gained from subtracting grayscale image obtained from anoriginal RGB image and RG (Red & green) images respectively. The shades obtained from the residual image containing pixels color resembling fire. Now to point out the fire containing region in an image, thisis done using regionprop instruction. If the fire or a short circuit is detected in an image, it will immediatelytransmit an SMS using GSM 900 module to the concerned authority and raise an alarm.

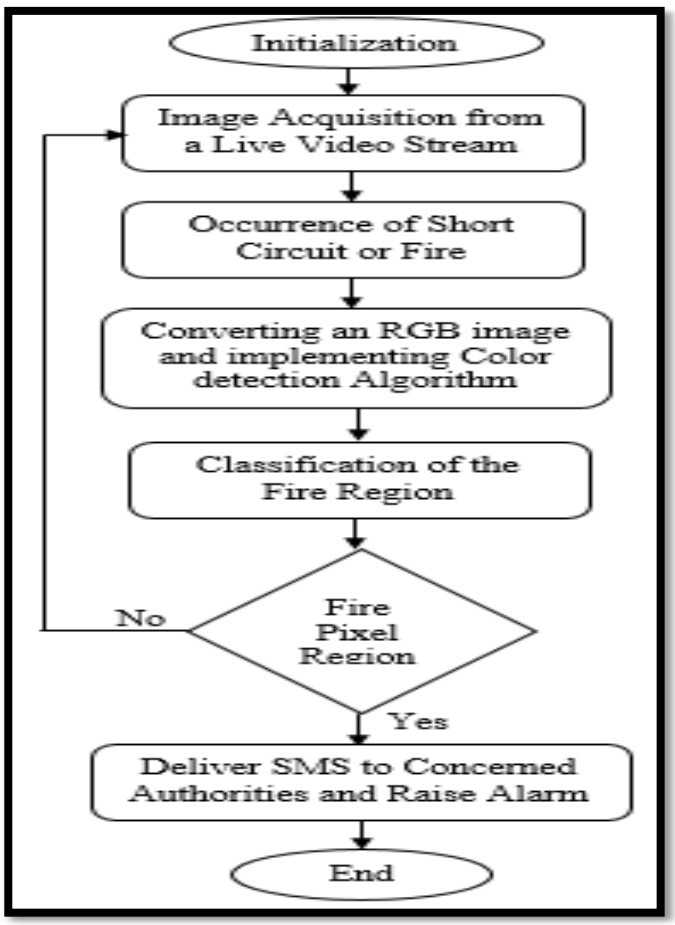

Figure. 4: Software Flow Model

IV. RESULTS

Fig-5 and 7 represents the original image captured from the live video steam (Top one) and the other imageis basically a residual image obtained by subtracting a grayscale image format of an original from the respective pure red and green color information which is obtained by extracting red and green color imagesindividually. After this process a median filter is introduced to further reduce any unwanted signal or noise.

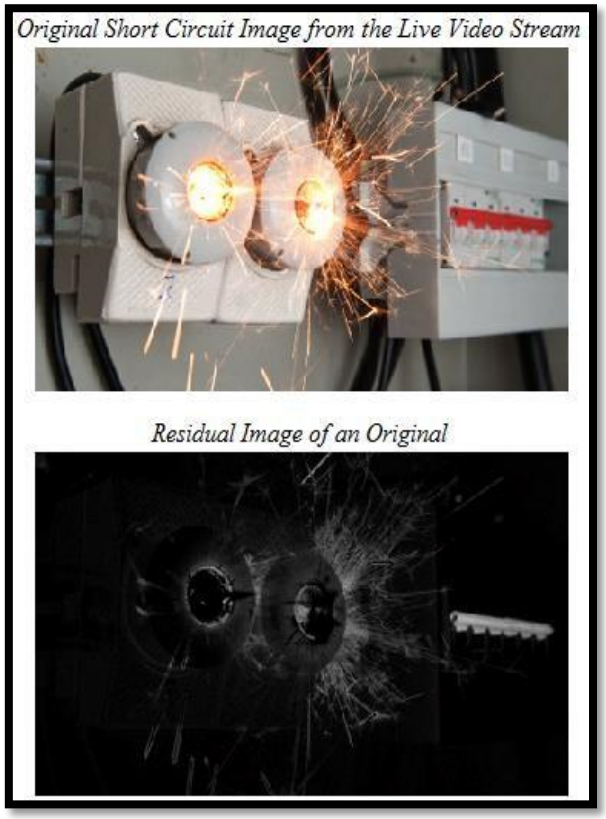

Figure. 5: Original & Residual Images First Image

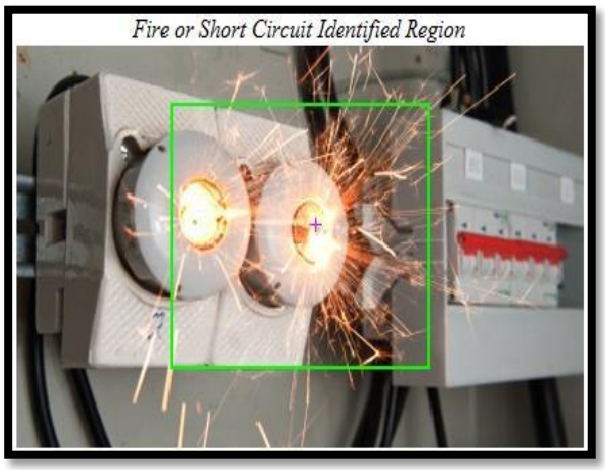

Figure. 6: Identified Region of Short Circuit in First Image

At this point, the slightly bright coloration in a residual image represents the color of an actual fire causeddue to a short circuit. In Fig-6, we can observe that there are switches present which are completely red butthey are not detected because of a very good reason that a yellow color is actually a combination of both red and green colors, hence the residual image in Fig-5 shows the brighter object is not identified but the one with slightly less brightness is identified.

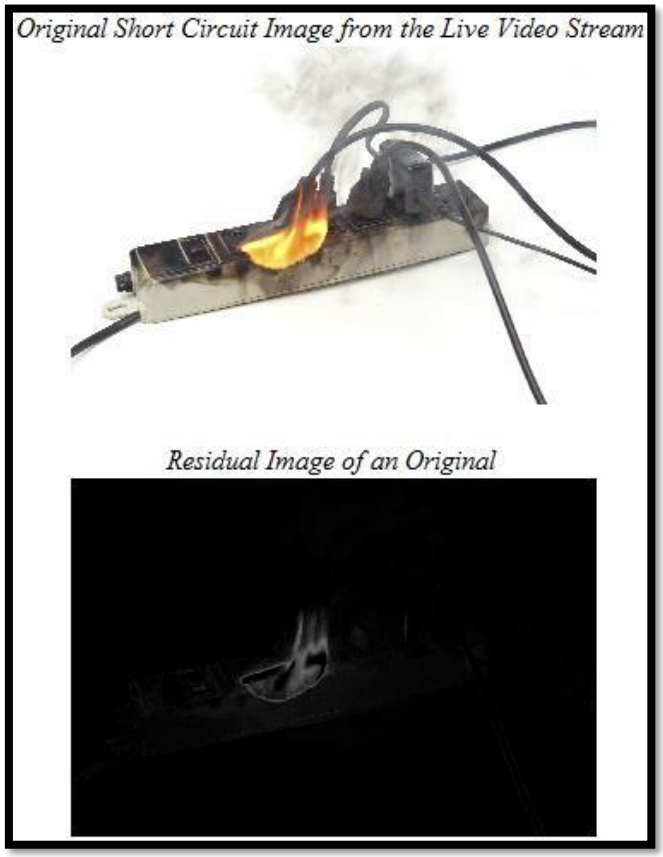

Figure. 7: Original & Residual Images Second Image

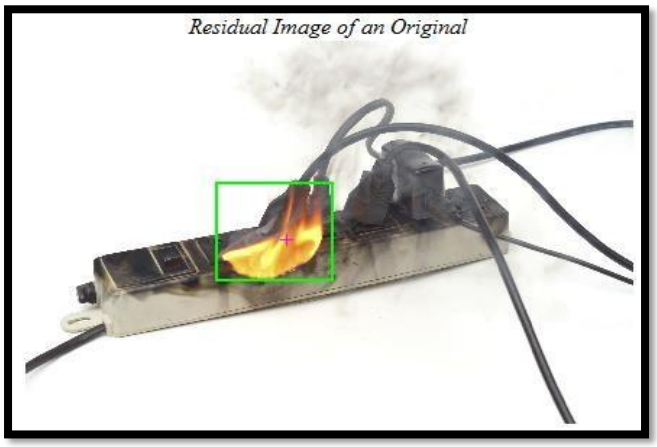

Figure. 8: Identified Region of Short Circuit in Second Image

V. CONCLUSION

Using a system based on image processing for such application can be really useful in all indoor environment. It can be really useful in industries that manufacture products that are highly susceptible to flame or may consume a huge amount of electricity which may cause short circuit. Our proposed model ischeap and can be implemented in any kind of an indoor environment. It is easy to install and all the equipment interfaced are easily available in the market. The system successfully detected a flame in a controlled environment and at the same time generated an alert and also send the SMS alert to the concernedauthorities.

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