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# Image Processing and IOT Based Applications

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**Abstract: In this paper various IOT (Internet of Things) based applications have been reviewed. The roles of image processing in IOT Based systems has been explored. There are number of image processing based technologies which are being integrated into IOT based applications. The paper gives an overview of role of image processing in IOT based smart systems in different application areas. The work could be useful for developing and exploring the new applications of image processing in IOT based systems.**

***Keywords****: IOT (Internet of Things), Image processing, Sensors.*

## I. INTRODUCTION

In today time the role technology in the life of human being is increasing day by day. IOT (internet of things) which is becoming a new buzzword among the technologists, involves the internetworking of things i.e. different devices communicate to each other in order to perform various functions. IOT architecture is based on layers like sensor layer, data center layer and service oriented layer etc. Each layer is having its own technologies and protocols. In the sensor layer and service layer, image processing based technologies are involved [1-4]. Image processing offers various type of camera based sensors and processing of their generated data could lead to multiple types of IOT ready applications. In the paper various IOT application areas have been explored to give a brief review of role of image processing in IOT. In the paper, sections 2 is providing the information about role of image processing in medical solutions, section 3 is dealing with image processing in agriculture, sections 4,5,6,7 are presenting the image processing role in smart cities, smart surveillance, smart traffic management based applications and in other applications respectively. In the end, section 8 is providing the conclusion.

## II. IMAGE PROCESSING IN IOT BASED MEDICAL SOLUTIONS

In the medical based applications, image processing is playing a very important role. There are a number of medical technologies where the role medical image processing is very crucial. Medical IOT based applications mainly includes the Remote Patient Monitoring and Clinical Monitoring [7]. In addition to that preventive measures based applications are also part of smart health care. All these applications require the Image processing based technology which could be integrated into medical health care systems. Various type of inputs to be taken from cameras and processing of CT, MRI images could be integrated into IOT based medical applications.

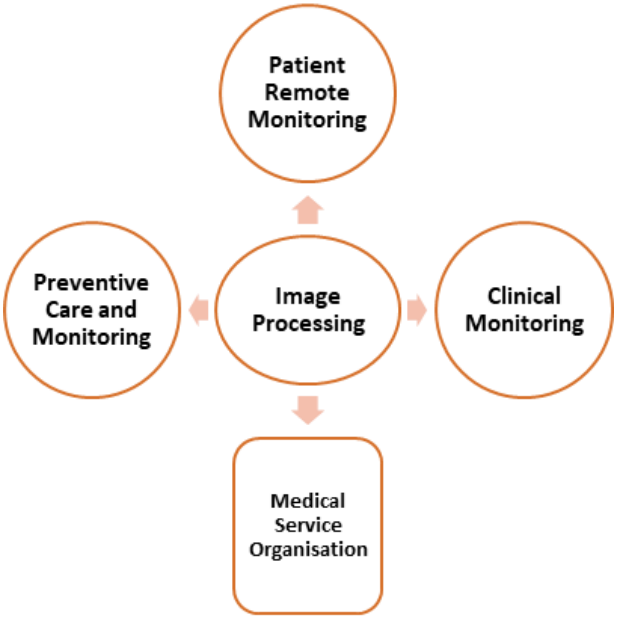


Figure 1. Image Processing in Medical applications

## III. IMAGE PROCESSING IN IOT BASED AGRICULTURAL SOLUTIONS

In the developing and populated countries, need of food is a big challenge. IOT based applications provides the good solutions for agriculture productivity. IOT based applications are mainly implemented in three categories like large scale farming, medium scale farming, small scale farming or green house farming [6]. In these entire applications image processing provides recording and processing of date to improve the farming. Moreover, in the other applications like smart animal monitoring image processing is again having its applications. Image processing based systems may provide the solutions to check the quality of crop, may also indicate the stage of crop and requirement of preventive measures etc.

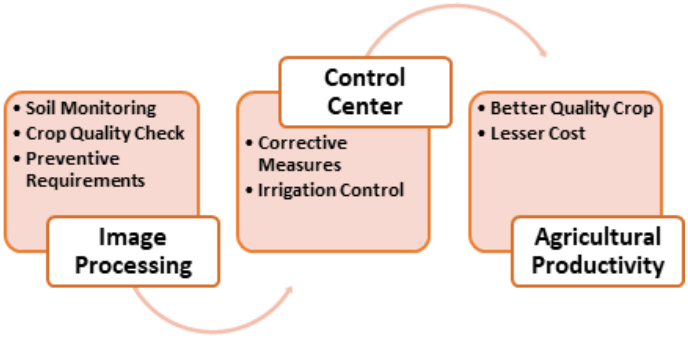


Figure 2. Image Processing in IOT based Smart Agriculture.

## IV. SMART CITY AND IMAGE PROCESSING

Smart City is very advanced vision where IOT has explored a number of applications, most of the applications again relies on Image Processing. In the smart city controlling of lighting of buildings and controlling of street lighting, Power management etc. and various other applications are considered [5]. Smart management also relies on image processing based systems. In smart city camera based sensors and image based processing at control centers leads usage of digital image processing in multiple parts of smart city as shown in figure 3.

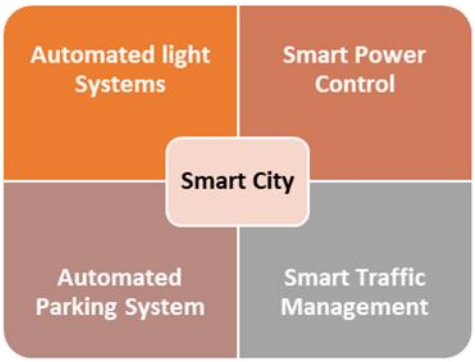


Figure 3. Smart City Systems

## V. SMART SURVEILLANCE AND SECURITY

In the security based applications image processing can also play good role. There are number areas which are sensitive and may require 24 X 7 surveillance. Implementation of full time surveillance may include advanced applications of image processing. IOT based smart security includes the surveillance of roads, sensitive areas, surveillance of buildings and also accidental alarming systems. All these examples require camera based sensors and image based processing in control centers. With the help of various image processing applications all these systems can be made practical.


Figure 4. Smart surveillance System

## VI. SMART TRAFFIC MANAGEMENT

In big and crowded cities, traffic management is a big challenge; a number of roads may require good controlling of traffic to avoid accidents and traffic jams. IOT is having a vision of providing an automated solution to vehicles traffic management. Smart traffic control may include the automated traffic light control system which would be based on real time status of traffic. It could include the camera based inputs that can be controlled through image processing based algorithms. Emergency situation based alarming system could also be developed along with IOT applications.


Figure 5. Smart Traffic Control

## VII. OTHER APPLICATIONS

The image processing can provide different form of primary data for various IOT applications. In many applications of Modern IOT there is essential need of image processing. In applications like biometric identifications, home automations, industrial manufacturing, quality check of products, in shopping centers image processing is having a vital role [8].

## VIII. CONCLUSION

With reference to the applications it can be concluded that image processing is having a huge scope in upcoming

IOT based solutions. In order to fulfill the requirements of future needs, good development of image processing is also essential. In many scenarios IOT is a vision in present time and it is expected that in order to make IOT more practical image processing is going to play a good role.

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