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Research paper

Designing a Portable Camera Image Acquisition System Operating Within an Indoor Wi-Fi Network and Optimized for A Robotic Vehicle

Anu Priya George[1*], X. Felix Joseph[2]

[1]*Research Scholar, NICHE, India.*
[2]*Associate Professor, Dept. of ECE, Bule Hora University, Ethiopia. E-mail:felixjoseph75@gmail.com*
**Corresponding author E-mail:anuabrain@gmail.com*

Abstract

Nowadays people working in industrial sectors face lot of problem like placing a valuable objects or things in some place unknowingly and searching it. To overcome this problem we are moving into the field of Object searching and identify which assist industrial sectors and research labs. Object searching mechanism is a challenging task. Real time object search poses many difficulties in recognizing objects. We are tending to do real time image capturing as well as recognizing techniques and it will forward data through Wi-Fi used in embedded device. The proposed system makes use of computer vision techniques based on real time image processing and recognizing the object and send via internet to PC.

Index Terms: *Cortex-m4, camera, Wi-Fi, PC, IOT.*

1. Introduction

The Internet of Things (IoT) is the wireless communication happening between every system in different areas such as automobile, industry, home appliances and so on where the data are gathered by sensor simultaneously it can exchange the data to other end through programming the system. The IoT make powerful expose to be well known or wirelessly control from corner to corner over the traditional system, it has the capability to connect the physical world into a PC without reducing the proficiency and also provides the way for everyone to make connectivity at any time. When IoT is integrated with sensors and actuators, it turns interested in circumstance of wide application of digital physical application which includes innovations as intelligent haulage, smart urban areas and power plants.

Machine-to-Machine (M2M) communication is taken place by IoT, initially it started in device level to exchange the data, then it moves to system and finally it carried over to organization for different applications. The integration of IoT in embedded devices is essential to establish robotization in every zone of different application, similarly it authorizing to develop applications like radiant network and increasing towards the scope, for example, strong urban communities.

"Things", in the IoT sense, can put forward a wide collection of devices, for instance, heart checking embeds, biochip transponders on develop animals, electric molluscs in waterfront waters, autos with worked in sensors, DNA examination strategy for biological/support/pathogen watching, or field movement devices that assistance fire-contenders in interest and shield responsibilities. Honest to goodness scientists prescribe with respect to "Things" as an "indistinguishable mix of hardware, programming, data and organization".

These device accumulate important data with the help of various existing developments and after that self-rulingly stream the data between various devices. Current market cases integrate home robotization, for instance, the control and computerization of lighting, warming (like sharp indoor controller), ventilation, circulating air through and cooling (HVAC) systems, and machines, for instance, washer/dryers, mechanical vacuums, air purifiers, stoves, or ice chests/coolers that use Wi-Fi for remote watching.

Internet connected application is extended for large number of new application field in order to collect information fastly. In addition to that the required data need to store, and it will be taken as reference document for future process. Applications like smart city and smart energy monitoring system which incorporates IoT technology which is a part of the whole product.

The paper [1] depicts the state identification of traffic light and its limitation for autonomous vehicles. It portrays the traffic light monitoring for red light runners [2] using image processing technique. Some other techniques were used for traffic light recognition system such as Markov Random Field, fuzzy method and morphological methods [3]. Real time image processing based smart vehicle was described [4]. Beacon system based vehicle location identification using the digital image processing is illustrated in [5]. The requirement of identifying the vehicle discussed in [6] using camera by fixing it in the nearby place of traffic light. Vision based traffic control system is monitored at the meeting point, which is not relevant for some vehicle and its robustness is discussed in [7-8]. Some of the research work has come across the distance calculation between the vehicle and traffic light which is established by image processing techniques. In addition to that location data is identified by using the GPS module at the same time traffic light allocation is observed in environment by means of the digital maps [9-10].

2. System Architecture

Figure 1 shows our proposed system. We implement image detection and recognition using a real time embedded platform. The image captured by the camera module is read by the controller through DCMI port. Image will be taken through serial communication ports and send as JPEG image format.

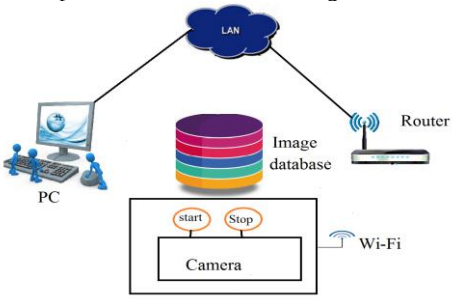

Fig. 1: system architecture of proposed system

After that, the stored image transported to UART pins. Through that UART pins, the data sent to our Wi-Fi device (CC3200) UART pins from that are taken, and data transmitted as packets through it. Then the data's will be received by the PC through UDP protocol (which will be the LAN connection) VIA router.

Hardware Description

In the proposed we require a microcontroller with large amount of RAM memory. Along these lines STM32F429 from STMicroelectronics is preferred as the fundamental MCU, which is one of the effective microcontrollers at present available in the market.
It is an ARM Cortex-M4 based microcontroller which can operate upto 180 MHz. It has 2MB of Flash memory and 256 KB RAM memory. All the more critically it has a DCMI (Digital Camera Interface) port to interface camera sensors. Furthermore, we utilize Wi-Fi enabled CC3200 microcontroller from Texas Instruments for transmitting the image data to the PC through the wireless communication network.

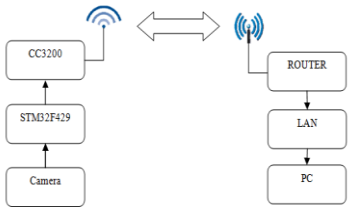

Fig. 2: Block diagram of camera unit

Figure 2 demonstrates the block diagram of proposed method for camera unit. The module of the system incorporates ARM Cortex-M4 processor unit to operate at 80 MHz and a Wi-Fi subsystem to produce high performance as output. The system is connected to internet securely via Wi-Fi module which is consists of an ARM MCU, radio frequency, baseband and Media Access Control. CC3200 chip supported Smart config, AP mode and WPS to maintain security in a wireless network. It includes embedded TCP/IP stack and multiple Internet protocols for easy web access. It can sustain for more than a year as of single coin-cell battery and also consumes low power. The device uses wireless communication protocol to connect to the internet. Normally we need a wireless router to act as the wireless access point. Wi-Fi is a local area wireless computer technology that allows devices to connect to the network using 2.4 GHz radio band.

Camera Image Acquisition

The efficient functionality of single-chip UXGA camera and image processor in a miniature footprint package is provided by low voltage CMOS image sensor which is known as OV2640 CAMERACHIPTM. The OV2640 presents full-outline, sub-sampled, scaled or windowed 8-bit/10-bit images in an extensive variety of configurations, controlled through the Serial Camera Control Bus (SCCB) interface.
This camera module has a potential to take 15 frames per second with absolute client control to adjust the image quality and data exchanging in UXGA resolution. The SCCB interface is used for training all required image processing functions which include noise cancelling, exposure control, colour saturation. Additionally OV2640 incorporates compression mechanism for maximum processing power.

Fig. 3: Camera module

However, Omni Vision CAMERACHIPS utilize to enhance image quality by reducing or removing common illumination sources of image contamination, For example, fixed pattern noise, smearing and so on, to generate a clean fully stable color image. The above shown figure 3 shows the camera module that we use in proposed system so our images will be transferred serially through I2C.

DCMI

We transfer the data's directly from camera to hardware through DCMI port. The hardware unit of DCMI contained, except the register of the data, ten registers of the control/status. It: the register of control, the register of a state , the register of a state of interruptions, the register of resolution of interruptions, the register of an interrupt mask, the register of reset of flags of interruptions the register of the codes of internal synchronization, the register of reset of a mask of the codes of internal synchronization, the register of start values at capture of a part of a frame and the register of value of a fragment of a frame in a mode of Crop Window And, by itself, the register of the data.

Wi-Fi Interface Description

In the proposed system WI-FI module we have chosen the CC3200 microcontroller as we said in architecture. CC3200 has its in built WI-FI module. So hereby we can activate the WI-FI module easily by utilising it.

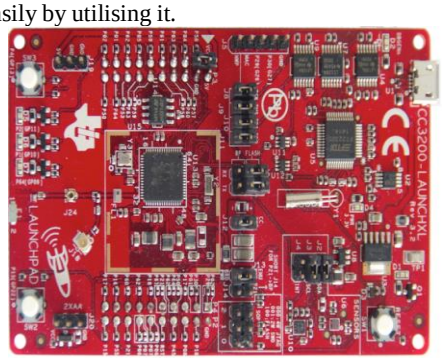

Fig. 4: CC3200 launch pad

Figure 4 show that the Wi-Fi based Microcontroller with which we transferring the image through the Wi-Fi to our system.

Image Transfer Mechanism

Fig. 5: Image transfer mechanism

Figure 5 shows that the image transfer mechanism is done with the help of Wi-Fi protocol. Then the taken image will be processed using the Processing tool and we will read and view the image in real time in our PC.

3. Software Description

Udp Protocol Overview

UDP is lightweight protocol no connection establishment and no connection state Small packet header overhead. In the beginning it is originally proposed to exchange information for simple application. Standard application UDP include in Domain name server (DNS) simple network management protocol (SNMP) and Light weight directory protocol (LWDP). Figure 6 shows that the UDP structure. UDP is a protocol for IP datagrams which serves as a multiplexer/demultiplexer to transmit datagram from one application layer to other layer present in the OSI model.

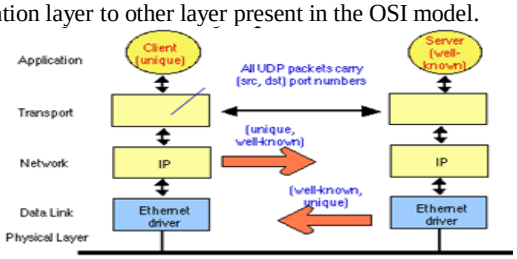

Fig. 6: Structure of UDP

Data transfer between network layers is present by UDP in easy way of approach. Transmission of data packets is occur by UDP from one network layer to other network layer in a best-effort approach, which means there is no built-in system used for acknowledgement by the packet receiver. Moreover, sending a UDP packet does not need any link to be well-known in progress. Along these lines, sending a UDP packet is extremely proficient, however sometimes it inclined to mistake or misfortune.

As UDP is a simpler and light weight protocol it's very easy to transfer the Image into several packets without loss of its resolution the UDP will transfer the data's. So we go with UDP to make the transmission highly reliable. Then this protocol is used to video and audio transmission. Since it is unreliable and not ordered the message if the message sends has some loss in its transfer. In UDP video transmission is possible without any data loss.[11]

4. Results and Discussions

The Figure 7 shows the transfer of image from STM32F429 through DCMI port and I2C serial communication to CC3200 via UART communication. The resolution of the image from the camera will be 340*260 pixels. That image will be divided into several packets of data and divided images will be sending to CC3200 and that will transferred through pc by packet format in UDP Protocol. The IP will be created and through that transmission will happen. The following steps given below is used to process at that instant the command window will be displayed.

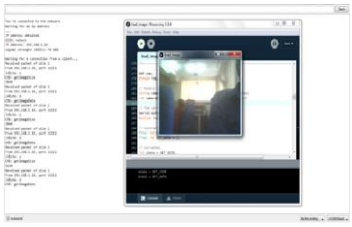

Fig. 7: Final output displayed in PC

1. The PC software now requests the camera unit to send the image size value in number of bytes and the camera unit immediately responds to this request with the image size data.
2. In the next step, the PC software requests the camera unit to send the image. The camera unit will now send the entire image data in JPEG format, within multiple UDP packets.

By this way the image data gets received in the PC and saved in memory.

5. Conclusion

In this paper explained about both image acquisition and image transfer to PC through a Processing tool. The system consumes low power although it comprises the live image steaming and object identification through serial processors and IoT technology. The successful implementation of DCMI camera application required for high rate sensing application can be efficiently implemented on hardware. We have demonstrated this by designing a simple image acquisition and transferring it through Wi-Fi controller and receiving the data's from UDP protocol that's through LAN communication. In Future the image received Via Wi-Fi and UDP protocol will be processed using MATLAB Image Processing toolbox to identify the objects.

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