STANDALONE SYSTEM FOR REAL TIME RGB TO GRAY SCALE CONVERSION USING RASPBERRY PI

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Abstract:-

Image Processing is a field that demands heavy computations along with high processing speeds. Hence practical implementation of such sophisticated algorithms requires thorough knowledge of high end hardware as well as software. Therefore building such systems for standalone applications is a challenging problem. This paper implements a simple colored RGB video stream conversion to gray scale, in real time, which forms the basis for many preprocessing algorithms, on a ARM7 processor. The code constitutes of a Simulink model running on a raspbian wheezy operating system. It uses the hardware support package for raspberry pi provided by MATLAB. The system performs in real time and has been tested for standalone application as well.

Keywords: Image processing, Raspberry Pi, Simulink.

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I. Introduction: A lot of work has been carried out in image processing and applications in the last few decades. Practical implementation of these algorithms for development of standalone applications is one of the thrust research areas today. Such real time standalone systems can have a variety of applications ranging from surveillance to biometrics, from automation to robotics. We, in this paper describe the development of a real time and standalone system for a basic image color space conversion operation. This operation forms the preprocessing part of nearly all the higher end algorithms in image processing The proposed system uses Raspberry Pi board with System On Chip (SOC) ARM7, 900 MHz, 1GB RAM quad core processor along with Ethernet port, HDMI, USB and SD card interfaces. It also has 40 pins including 8 General purpose Input/output (GPIO), one SPI bus, one I2C bus, one UART bus and 3.3V, GND and 5V.The Raspberry Pi needs an external Secure Digital(SD) card to store its operating system and also all the user data. Raspbian wheezy, a optimized linux kernel along with simulink coder from MATLAB hardware support packages has been used.

The paper is organized as follows. Section 2 consists of the literature referred. In section 3 the system block diagram is presented. Section 3 also talks about the hardware and software implementation. Section 4 includes the experimental setup for the system. Section 5 deals with algorithm used and finally we conclude the paper with observations in the results and conclusion section i.e. section 6.

II. Literature Survey:

Work has been done on image processing application using raspberry Pi along with open CV[1] also Monkallas praveena et el. [2] describes a Open CV based face recognition system based on Principal Components analysis using RPi. An automated toll system using raspberry Pi and Open CV is reported [3]. Whereas we have used a code free approach of simulink model based programming in the proposed system.

III. Block Diagram

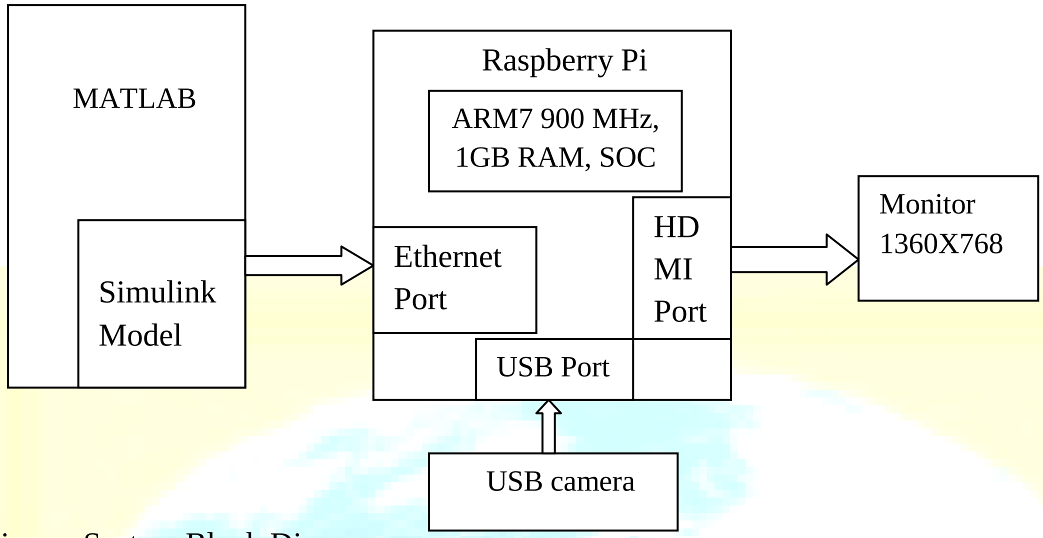


Figure: System Block Diagram

IV. Experimental Setup:

Software requirement: Operating system for the board is Linux based Raspbian Wheezy along with the hardware support package from MATLAB, which contains a simulink coder, useful for deploying the simulink model on the hardware, is downloaded from MATLAB Hardware Support Packages [4]. The OS is installed in 8 GB micro SD card. The card is inserted into the SD card slot of the laptop, or may be connected to a PC via a card reader and formatted using format loader. Then the operating system image, generated by the downloaded MATLAB support package for Raspberry pi, is then loaded in the card. Settings for Ethernet IP address, Subnet Mask and Gateway were configured during the process of OS installation. The card is then carefully inserted in Raspberry Pi and the system boots and initializes the I/O peripherals. The programming is done using Simulink model and is described in the next section.

Hardware requirements: USB keyboard, USB mouse, USB camera and a HDMI monitor have been used. We have used a HD 8MP webcam for capturing images.

V. Algorithm:

Following steps are performed for building and deploying the model:

1. Pick the required blocks from simulink library and build the model as shown in fig

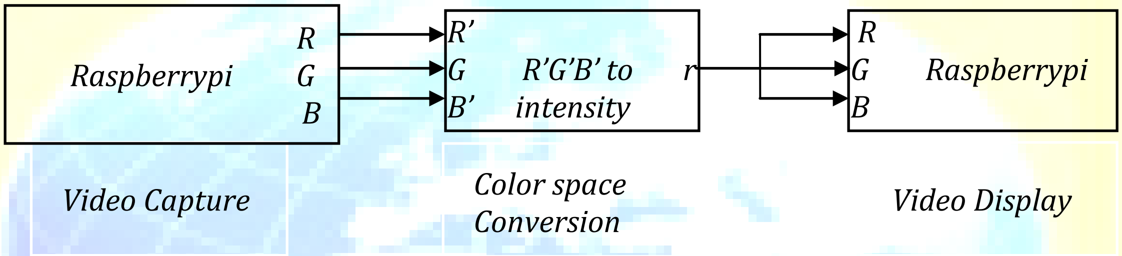
2. Compile the model to perform error check.

3. After successful compilation, the builded model is deployed to the hardware via the Ethernet port, using the “Deploy to hardware command” in MATLAB.

4. Once the model is deployed, it can be run as a standalone system by executing the *ModelName* file in the MW directory, created on RPi after deploying the model.

Simulink Model:

The simulink model consist of a raspberry pi image acquisition block, a adder block, a user defined matlab function and a SDL display for displaying the results



The model consist of a V4L2 (video 4 linux Ver.2) block to capture live video, a Color Space conversion block to perform RGB to intensity transformation and a SDL (simple Direct media Layer) video display. The first block, provided with the Raspberry Pi support package, takes input from a HD webcam of 720 pixel resolution, with 8 MP photo qualities. Next is a color space conversion block, from the regular computer vision toolbox, which takes separate color signals as input and produces a one dimensional intensity signal as output. This output is then provided to the SDL display block, which comes with the Raspberry Pi support package.

Next, we compile the model and perform error check. Once the model is found to be error free, it becomes ready to be deployed on the hardware. The configuration parameters for the raspberry pi hardware like Host name, user name, password etc are set. Finally with the help of deploy to hardware command, the model is deployed to the hardware and the output is observed on the monitor/HDMI device connected to raspberry pi.

VI.Conclusions: A simple colored RGB video stream conversion to gray scale, in real time, which forms the basis for many preprocessing algorithms, on a ARM7 processor is developed. The code constitutes of a Simulink model running on a raspbian wheezy operating system. It uses the hardware support package for raspberry pi provided by MATLAB. The system performs in real time and has been tested for standalone application as well. The developed system can be further expanded to various real time parameters.

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