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Real Time Visual Servoing Using Raspberry Pi

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***Abstract*—Video processing is becoming widely used technique in robotics & automation systems to mimic human like sensing capabilities. Video processing of powerful platform has demonstrated widespread possibilities such as face detection around ball trajectory mapping games especially cricket robotics racer industrial vision-based inspection system. Video processing of powerful platform such as Intel & AMD processor has been widely researched & applied in main stream technique however there is very limited research on video processing on single board computers due to them constrains of processing power & memory. This work is aimed at development of a real time processing system based on raspberry pi single board computer which is a low-cost credit card size single board computer. The proposed work aims to demonstrated real time hardware control along with real time video processing to enfaces on the embedded nature of the single board computers & their application proximity to hardware control realm. Thus, a real time visual system is developed using raspberry pi SBC a web camera & opto isolated DC motor driver circuit. Vision processing is carried out by employing open CV (Image and Video Processing) in python.**

***Index Terms*—Raspberry Pi SBC, Opto-Isolated Dc Motor Driver, Real Time Video Processing, Embedded Video Processing, Open CV Python.**

I. INTRODUCTION

The paper deals with the design of an embedded surveillance system realized on a Raspberry Pi 3 B minicomputer. The work's main part focuses on the study of selected functions used by modern surveillance systems, like motion detection methods [1] and algorithms used for detecting human faces [2]. After selecting the proper methods, they are developed in the programming language C/C++ in way to exploit the computational power of the embedded minicomputer. An external web-camera captures static scenes which are used as input data for the image processing algorithms. These algorithms analyze the images in real time, yielding information about the moving objects and saving the video sequence if a motion has occurred. To automatize these tasks, basic Computer Vision approaches are modified and applied to the real-time camera feed [3]. The functions are provided by Open CV (Open Source Computer Vision), what is an open source library containing over 500 optimized algorithms for image and video analysis and manipulation. It has C++, C, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS [4]. The functions are Completely designed with the help of Open CV libraries and are optimized to operate effectively on the Raspberry Pi platform.

A. Video Processing

Video process may be a specific case of signal process, in particular image processing, which often employs video filters and where the input and output signals are video files or video streams. Video process techniques area unit utilized in TV sets, VCRs, DVDs, video codecs, video players, video scalers and other devices. For example—commonly solely style and video process are completely different in TV sets of various manufactures.

B. Open CV

Open CV (Open source computer vision) is a library of programming functions mainly intended at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then It seize (which was later acquired by Intel). This library is a cross-platform and free for use under the open-source BSD license. In other word Open CV (Open Source Computer Vision Library: http://opencv.org) is an open-source BSD-licensed library that includes several hundreds of computer vision algorithms. The document defines the so-called Open CV 2.x API, which is essentially a C++ API, as opposed to the C-based Open CV 1.x API (C API is deprecated and not tested with "C" compiler since Open CV 2.4 releases). Open CV encompasses a standard structure, which implies that the package includes many shared or static libraries.

II. LITERATURE SURVEY

In the paper, the basic issues and solutions of embedded video processing for computer vision were presented. The Raspberry Pi computer and several functions from the OpenCV project was used. The ROI (Region of interest) selecting and rectangle merge functions significantly increased the overall frame per second ratio of the system [5].

In this Paper Motion detecting methods provide information about actual events in the video sequence, but they return no information about the features of the moving object itself. The aim of the object detecting algorithm is to recognize the predetermined database of objects in the video sequences. In the case of a surveillance systems, these objects could be the faces of individuals appearing on the screen or license plates of the passing cars. In fact, the detected object can be almost anything and is only limited by the user's needs [6].

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In this paper, an embedded real-time video monitoring system is designed; the embedded web streaming server is based on the Linux Operating System. It succeeds in network video monitoring. The system has low-priced, good openness and portability and is easy to maintain and upgrade. Here the web browser is based on MJPG streamer for streaming captured video from camera placed in remote location [7].

The server periodically obtains videos from camera through the private network, such videos are transmitted from camera to the server. We conclude that real time video monitoring using arm we get better performance and we can transmit video using wire and also possible for wireless hence long-distance transmission is possible [8].

This project can easily be applied to places that need constant monitoring because Raspberry pi forms the basis of the project. Raspberry is cheap, offers a lot of technical possibilities and can be supplied from many locations. It works to simultaneously monitor the contents, temperature, and humidity of a room where it is installed. Many places, such as a cold food storage facilities, children's rooms, and summer homes can be monitored. No special program is required and the web browser on a mobile phone or computer is sufficient. A missing feature of the project is that it does not have a database [9].

This paper describes object tracking application and its implementation using different designs with rotating camera. This paper also proposes two different algorithms for rotation of the camera according to data given by the object detection algorithm. This paper also describes study and features of different object tracking algorithms in application. This implementation can be expanded for multiple object tracking as well. With static camera multiple objects can be detected and tracked as long as they are in the line of sight of the camera. Multiple cameras can be used to detect and track multiple objects [10].

III. MATHODOLOGY

In this block diagram we can see we use 5V, 2 Amp power supply for powering the raspberry pi and USB micro male to USB Type a OTG cable is used for connect web camera to raspberry pi and a GPIO(General Purpose Input Output) pin Goes to Opto Isolator and then it connect to Relay driver and then this signal goes to relay for set the direction of DC motor in order to clock wise and anti-clock wise for set the movement of camera.

Table 1: Working of Relay with DC Motor

RL1	RL2	DC MOTOR		
		A	B	GND
OFF	OFF	GND	GND	OFF
ON	OFF	+12V	GND	CLOCKWISE
OFF	ON	GND	+12V	ANTI-CLOCKWISE
ON	ON	+12V	+12V	OFF

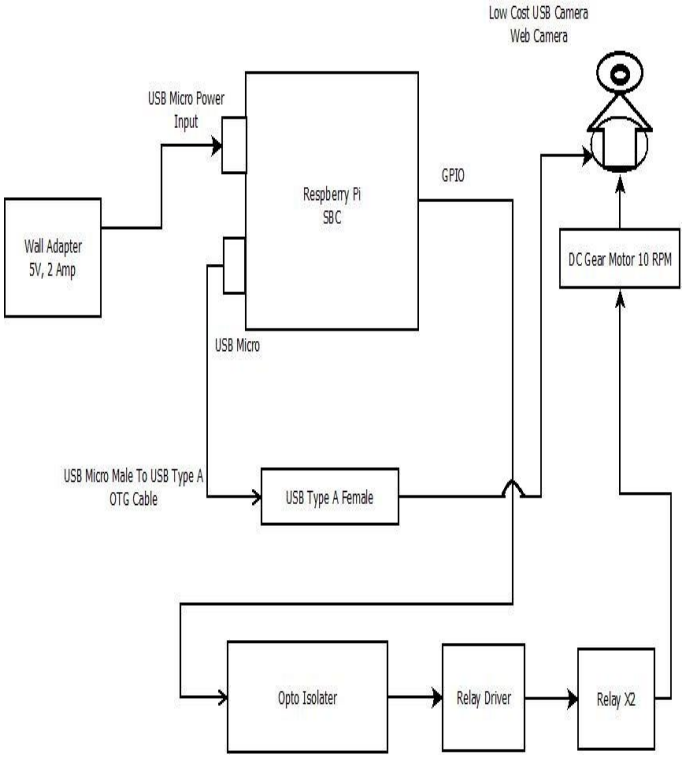

Fig1: System Block Diagram

DC Motor is a 10 rpm Gear motor. Gear box motor is used because it increases torque and reduces rpm.

Amid introductory setup Raspberry Pi was arranged as a smaller than expected desktop with USB designed camera module and an outside screen or versatile for seeing the caught video. Program is utilized for review of live video stream. The outer card is stacked with Raspbian OS. The Dynamic Host Convention is acquired for Raspberry Pi i.e. IP tended to is brought. After acquiring this the framework can be arranged and controlled remotely.

The live video can be seen by dialing in the IP address into a web program. Cost of the entire framework is $70. Cost of Raspberry Pi is less when contrasted with other options. We can ascertain the cost-per-super pixel and infer that picture determination on remote screen by raspberry pi is 60x720 (0.7 megapixels) and cost-per-megapixel picture is as roughly is $125.

IV. RESULTS

In this image we can see 1st we open the terminal then we issue a command that is Python VisualServo.py.

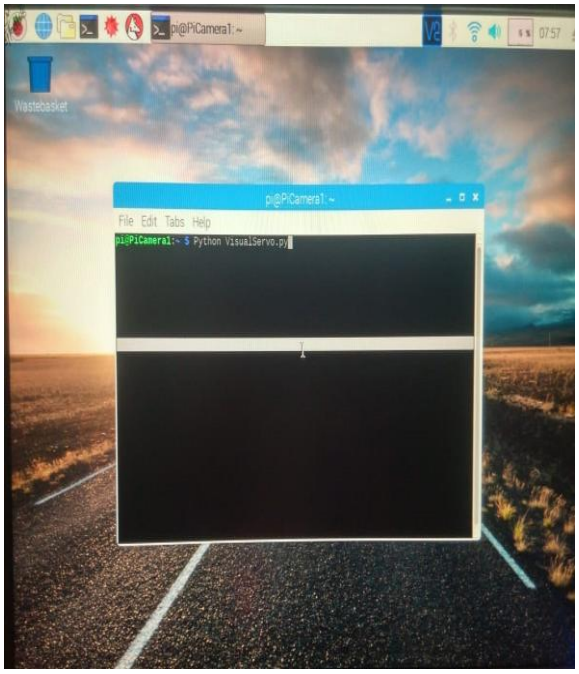

Fig 2: Terminal Window Image

In this Image we can see the ball is seen at center by camera so the motor doesn't rotate and camera is not moved. And we can also see the circumference with yellow boundary and we can see centroid of the ball with red dot.

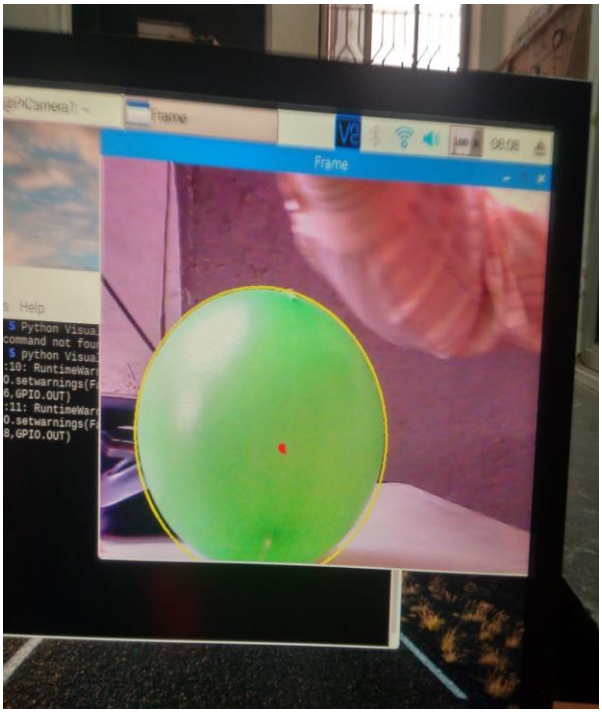

Fig 3: Ball at Center

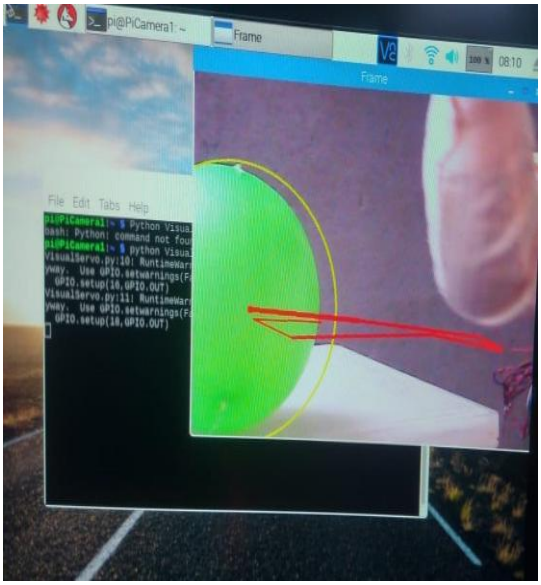

Fig 4: Ball at Left Side

In this window we can see ball is fall at left side due to this centroid of the ball according to system is change then motor rotate in anti-clock wise direction for set web camera at left side for matching the focal of ball.

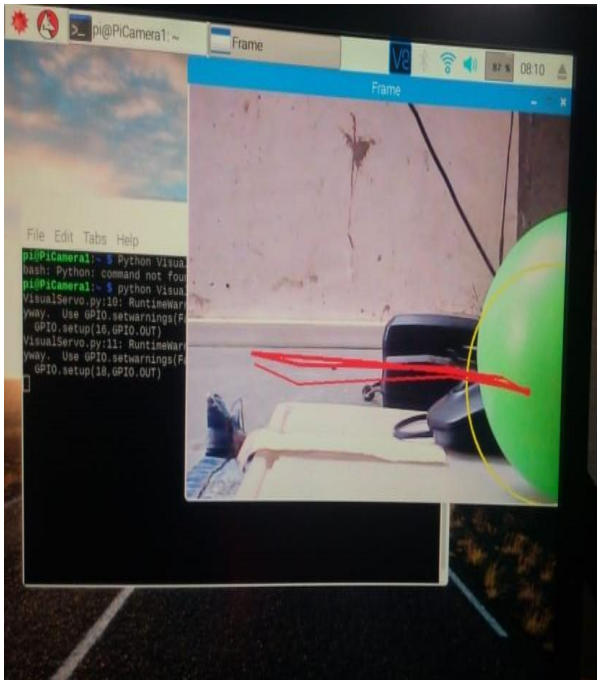

Fig 5: Ball at Right Side

In this image we can see ball is fall at the left side then motor rotate clock wise for set web camera to right side for adjust the focal of ball.

V. CONCLUSION

The proposed system targets to perform real time video processing on raspberry pi single board computer system. In visual servoing a video processing system tries to keep center of cameras field of view aligned to the center of the object of interest. This is achieved by mounting the camera on a motor & controlling the speed & direction of the motor according to the video processing results in real time to keep teaching a moving object. The object of interest chosen is a green color plastic ball & as demonstrated by the results above our proposed system perform exceptionally well to keep the ball in field of view.

VI. AUTHORS REVIEW

Authors are review many papers and they found design of an Embedded Video Processing system using Raspberry Pi Single Board Computer, Raspbian OS, Open CV & Raspberry Pi V2 Camera or External Webcam for Real Time Image & Video Processing. Design & development of Real Time Network Based Face Recognition & Access Control system with Local Video Processing & Central Server Authentication using Raspberry Pi Networking, & Access Control using Raspberry Pi GPIO's. Implementation of a Motion Detection system for Security & Surveillance function, to monitor specific areas 24X7, with storage of motion video, remote alarm trigger or local high Audibility Hooters or Locking Mechanisms. Integration of the above system with E-Mail client for remote notification of alarms & allowance of change of control parameters via E-mail. WhatsApp has become an indispensable communication tool, thus enabling integration of the proposed system with WhatsApp will allow easy & prompt monitoring of notifications & alarms & control activities. Implementation of PWM (Pulse Width Modification) based on Visual Servoing technique, to track objects of interest in Real Time, using servo motor controlled by RPi GPIO'S & PWM Pins with integrated control algorithm. Assimilation of other features such as automatic Networked Attendance, Visitor Logging, Energy Control & Saving etc. can be implemented.

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