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Pibot:The Raspberry Pi Controlled Multi-Environment Robot For Surveillance & Live Streaming

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***Abstract*—In today's world, everyone is worried about their safety due to increase in crime rate. This has led to an increase in the importance of surveillance systems In this project raspberry pi is used to make a robot which in turn is used to make a real-time surveillance system possible within a local network. The live streaming is accomplished by using the mjpeg streamer and the server-client model is made using java.**

Keywords-surveillance,Pibot,raspberrypi,mjpeg streamer,server-client,local network.

I. INTRODUCTION

Today each and every one is concerned about their security since the growth rate of crime has increased. This caused people to have started to consider the significance of surveillance systems. Majority of the people are doing IP based installations rather than the analogue because of it being accessible from anywhere. In order to make the IP-based systems affordable for the people having low budget we need to develop a system which is cost effective and portable. This project uses raspberry pi model 'B' for making this real time surveillance possible. The Pi has the capability of installing and processing high resource software's which makes it possible to accomplish the objectives of live streaming & controlling the robot.

II. CURRENT SCENARIO OFSURVEILLANCE SYSTEMS

In today's world, everyone is worried about their safety due to increase in crime rate. This has led to an increase in the importance of surveillance systems. Two types of such systems are available that are Analog and IP- based video Surveillance systems. The analog systems are somewhat less expensive and easy to operate than the IP-based systems. But it has some limitations such as to cover a larger area we need to deploy more number of cameras and once the cameras are deployed at a particular place it is very cumbersome as well as complicated to shift them to a different location since the system is wired. According to the study of the Axis Communications, majority of the people are doing IP based installations rather than the analog [15]. This is because of the reason that IP-based video surveillance provides better picture quality and is also beneficial in terms of scalability and flexibility. But working with the IP-based systems requires some networking knowledge and people having low budget are unable to take advantage of the IP-based systems since these systems are way too expensive than the analog ones. So it clear that even if the presently available IP-based system overcomes some of the limitations of the analog systems but the camera requirement, complicated operation and cost is still a drawback of these systems.

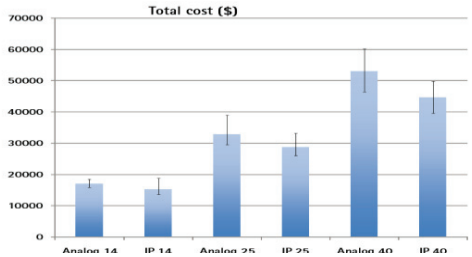

Fig.1 Total cost per camera layout alternative

III. WHY TO CHOOSE RASPBERRY PI

The Raspberry Pi is a mini-computer also known as SBC (Single Boarded Computer) [1] and the Arduino is a programmable microcontroller whose functionality depends on the way it is programmed. Comparing Arduino and raspberry pi will be like comparing a mere calculator to a full-fledged laptop [8]. The Arduino is a quite low power microcontroller which provides control over hardware [16] [17]. With the help of the Arduino Integrated Development Environment, programs (<32Kb) are interfaced with a hardware like switches, sensors, LCDs, the internet, other microcontrollers, etc. [8]. On the other hand Raspberry Pi is intended to function smoothly even while using high resource software. Ethernet, video and audio processing, large quantities of RAM and quite a large amount of storage space, makes it a mini-computer. It runs a complete operating system (OS) like Linux and various other flavors of Linux as well as Android. It can also develop programs within those operating systems that can control the systems functions and the IO that are made available [8].

Fig 2: Raspberry pi model B

Arduino and Raspberry PI might appear alike because they both are tiny little circuit boards with some electronic chips and pins on them to make it function but they are very different devices altogether [8]. In fact Arduino is a low power micro-controller; not a mini-computer like the raspberry pi [12]. A micro-controller is just a minor part of a computer, and only provides a part of the functionality of the Raspberry Pi [12].The Arduino is programmable with C language, but it cannot run a complete operating system (OS), whereas raspberry pi can run complete operating system like Linux and android [8]. The Raspberry Pi has Python as the main programming language, but can also run C, C++, Java, Ruby, Perl[6].The projects made in it are more of software based rather being hardware based [3]. It can yet do hardware control based project with the GPIO pins it has onboard. Arduino is an open-source hardware/development board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. It has included USB interface, 6 analog input pins, as well as 14 digital I/O pins [13]. Official Arduinos have used the megaAVR series of chips, specifically the ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560 [18]. The Arduino has an integrated development environment (IDE) which is a cross-platform application written in Java so that it can be used on any machine. Raspberry pi includes a complete operating system loaded on an SD card, audio out, HDMI and RCA video output and an Ethernet port [10][11]. An Arduino is picture-perfect for electronics projects. It contains various input and output that can be directly connected to components, sensors and is extremely easy to use [12].

Fig 3: Arduino board

Arduino runs the firmware which allows it to communicate with a computer via USB and gives access to work on it. [12]. Once a program has been dumped on it, it is good to go anywhere we plug it. We do not need to reboot, plug in a keyboard, or choose an application to run [4]. It does what it is been programmed to do directly. Beside the Raspberry Pi is an extremely powerful device which comes in a very small size which is perfectly suitable for embedded systems, or projects demanding more memory and processing power[13][2].

The Raspberry is considerably more complex for simple electronics projects like just flashing an LED [3]While on the other hand using the Arduino, it just comprises of connecting an LED and resistor to two pins and simply uploading about 8-10 lines of code [12]. Beside on Raspberry Pi if the operating system is already installed then there is only a need to install some libraries to control the GPIO pins. Raspberry pi can do everything an Arduino can, but in complex way. Nevertheless the Arduino is not as powerful as the Pi. The Arduino sends data to PC or Pi via serial.

IV. BLOCK DIAGRAM & WORKING

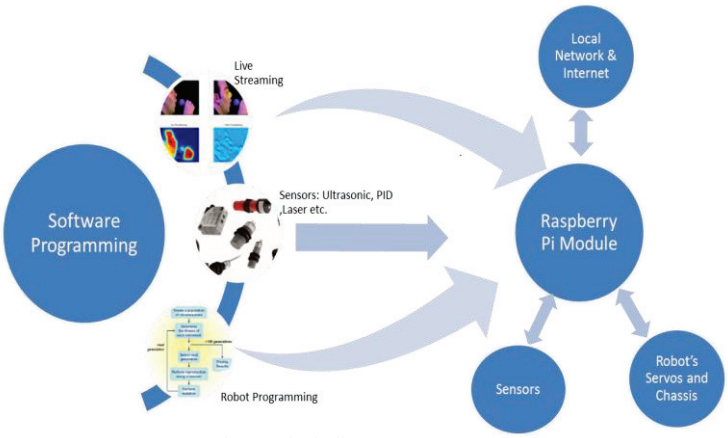

Fig.4: Block diagram

This is the proposed block diagram. This can tell in one glance about how the title can be proceeded. The raspberry pi being the centre and the core of this, for making the robot and is its control unit. The pi is placed on the robot chassis which is connected by servos. The servos are connected to the raspberry pi via a switching circuit. This is a normal switching circuit which is used to make a robot. This switching circuit consists of the relay which is activated via our Web GUI whenever the user directs the robot to move it forward, reverse or for that matter any direction which will trigger the relay and the servos will start and work accordingly. Valeriu, Florin and Adrian-Viorel [20] research paper entitled "Control System for Video Advertising Based on Raspberry Pi" describes the implementation of server client model for controlling the robot made in the java platform.

In this Pibot i.e. the raspberry pi controlled robot is having a server-client model. The server –client is made completely in java and will be able to run on any system be it windows, mac or Linux. This feature of being platform independent is the key reason to make this model in java. The Web GUI used to control the pi is also created using java and then linked to the server made. Widodo Budiharto[19] research paper entitled "Design of Tracked Robot with Remote Control" in 2014, he introduced a surveillance system which is remotely controlled with the help of controller by a means that does not restrict its motion and able to acquire the live feeds of surrounding environment , for example in rescuing disaster victims.

This complete model of Pibot will be connected to the local network and can be controlled via anyone, anytime, & anywhere. This Local network can be any place like home, office, prisons or for that matter anywhere which needs to have a temporary surveillance or a continuous one just plug it in the network and the robot is good to go. This connection will be done via wireless network made, created or available at that place and made available to pi via Nano Wi-Fi adapter. The live streaming is being done by the help of MJPEG Streamer. It will be installed in the pi and then initializing the camera module. This camera module is the one designed by the raspberry pi organization for raspberry pi specially. It's a 1080p 30fps 5megapixel camera. The MJPEG Steamer uses the concept of time lapse photography to stream the video. It takes photos at a periodic interval and them overwrites one over other to make it look like a continuous stream of video. Due to the computational power of pi we have to choose this method for streaming video.

To keep the robot safe it has been interfaced with an infrared sensor to it so that to avoid collision to any object if the person controlling it tends to or by mistake attempts to collide it somewhere. It has two servo motors of 30 rpm each. The servo motors are interfaced to the raspberry pi via a switching circuit .GPIO Pin 6,11,12 are used for interfacing the motors, where pin 6 is ground while pin 11,12 are general input/output pins. The switching circuit basically comprise of a microcontroller IC AT89c51 and three relay switch each for individual motor and third one for the infrared sensor to stop it if an obstacle comes in its way. It has three 9V batteries being used for the motors and the infrared sensor each. The raspberry pi is being Powered by a 10400mAh power bank having a constant output of 5V 1A. Brian et al., 2014 research paper entitled "Sudo Pi Cooler / Heater" describes a typical temperature sensing device in which temperature of an area is recorded and is adjusted based upon the preset values [21]. The temperature sensor using raspberry pi aims to provide an adaptable temperature sensing approach using a Raspberry Pi. So the user can interface various other sensors too to get more data of the environment in which it is used like the temperature sensor,CO2 sensor for mentoring the carbon di oxide content in that particular place.

V. PROS AND CONS

It is important for users that want to get the Pibot to consider whether it fits with their utilities and are willing to get this robot and tailoring the product to their own needs. Generally every project does have some advantages or disadvantages. Surely this project also has some pros and cons:

PROS:

- The biggest advantage of this robot is that it is fully dependant on the Raspberry Pi which is a micro-computer. This robot is useful for the organization where they can't afford the costly surveillance systems.
- This robot can occupy the whole auditorium or big hall for surveillance.
- If the user think that it is based on Raspberry Pi technology and user should have the extensive command on programming then NO. The robot comes with the all utilities and software's required for live streaming and surveillance so that the user can use it without any hesitation or fear that they might not be able to control it.

CONS:

- As raspberry Pi does not have an integrated Wi-Fi. User has to buy the Wi-Fi adapter or something like that to connect to the network wirelessly.
- This robot can occupy only one location for surveillance at a time.
- This should be the biggest disadvantage that this robot can do work in only local network, user cant connect robot via internet.
- For configuring the robot user has to go to system every time. This should be little hectic for user. Also considering that fact that this robot is not compatible with Windows operating system and cannot install it which most of the users are familiar to use.

VI. Conclusion & future scope

In this paper we have illustrated the capabilities of raspberry pi over arduino and advantages of the pibot over the conventional surveillance systems.

This project can be extended further by making the robot accessible via the internet. This can be implemented by making a android/iOS/windows phone app and then controlling it via the same. The robot can also made to implement the SLAM (simultaneous localization and mapping algos) to make it map the complete environment and then move autonomously after a certain periodic intervals to check everything. Also by giving it the ability to detect and recognize faces it can be made to alert us about any unknown person and take a snap of it and email us the same[2]. It can be made to follow a specific face continuously rather than manually operate it to follow someone like the small children in the age group of1-4 years so that kids are continuously in front of our eyes. Can also take help of sensors to maintain a safe distance from the kids for the safety of the robot.

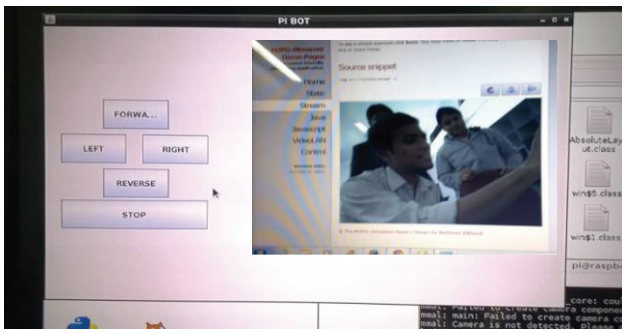

Fig 5: Live streaming & Web-GUI for controlling the robot

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