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GUI Based Industrial Automation using Python under Linux

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Abstract— **Industrial process control is now everywhere, Global industrial process monitoring and control environment. Since it is essential to make it operable by anyone, an efficient prototype is necessary with simple GUI, which is used to control and monitor the semi-automation process.**

I. INTRODUCTION

Automation or automatic control, is the use of various control systems for operate the equipment such as machinery, processes in factories, boilers and heat treating ovens, aircraft and other applications, steering and stabilization of ships, switching on telephone networks and vehicles with minimal or less human interference. Some processes have been completely automated.

The biggest benefit of automation is that it saves human error; however, it is also used to improve quality and save energy and materials and, accuracy and precision.

Automation has been achieved by various process industries like pneumatic, mechanical, hydraulic, electrical, electronic devices and computers, usually in combination. Complicated systems like modern factories, air-planes and ships typically use all these combined techniques.

Industry now a days are using more number of Automation and its varies between industry to industry, type of Industry, budget etc. Some of the Automation can be more complex and spent more money to operate.

Industrial Automation is essential now-a-days, So we are proposing a system that provides a sharp control and monitor of a machine automation partially in the way of the mechanisms: monitor and control.

It is important that, there should be a simple procedure involved in running the system instead of a complex type of technically operated procedure, thus we go for a GUI based User Control for the Automation where anyone can handle the system.

II. DESIGN APPROACH

Primary objective of this Industrial Automation is, it should be simplex, cost effective, consume low power and can control authorized person only.

RASPBERRY PI 2

The Raspberry Pi 2 uses a Broadcom BCM2836 SoC with 32-bit quad-core,900MHz ARM Cortex-A7 processor(as do many current smartphones), with 256 KB shared L2 cache[1]

GERT BOARD

The Gertboard is an input-output (I/O) extension board for the Raspberry Pi computer. It matches onto the GPIO (general purpose Input & Output) pins of

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the Raspberry Pi (the dual row of pins on the upper left corner) via a socket on the back of the Gerboard. A bit of care is required when putting the two devices together. It is easy to plug it just one row of pins into the socket, but all of the pins need to be connected. The GPIO pins given power to Gertboard , so you will need a power supply for the Raspberry Pi (RPi) that is capable of supplying a current of at least 1000mA.[4]

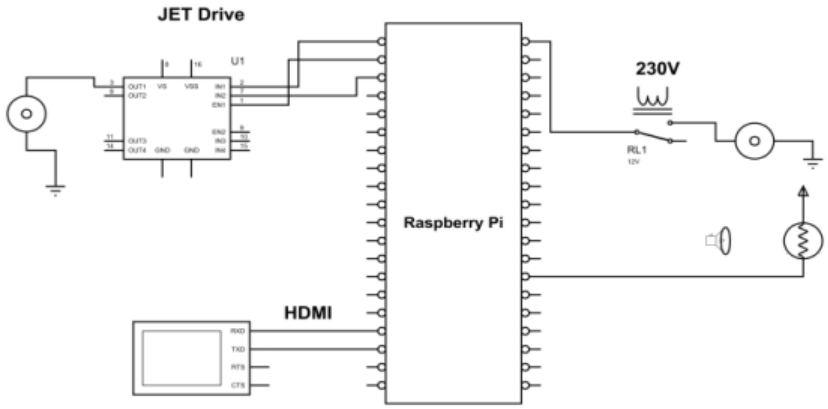

Figure 1: Proposed system working design

1. Linux Family

1.1 Cost – The Advantage of Linux is that we can install the software in free of cost. But Microsoft application cannot be get free of cost. Microsoft related application are available for bulky and sometimes Windows licenses normally are only allowed to be installed only one computer but a Linux operating system can be installed on any number of computers without paying single time The most obvious advantage of using Linux is the fact that it is free to obtain, while Microsoft products are available for a bulky and sometimes recurring fee.

1.2 Security – In line with the costs, the security aspect of Linux is much stronger than that of Windows. So No need of spending money for virus protection. The Linux operating system has been around since the early nineties and also managed to stay secure in the realm of spyware, widespread viruses and adware for all these years. The argument of the Linux desktop not being as widely used is a factor as to why there are no viruses. Linux OS is open source and if there were a widespread Linux virus released and there would be hundreds of patches released tomorrow, either the operating system use by ordinary people or by the distribution maintainers. We wouldn't need to wait for a patch from a single company like we do with Windows.

1.3 Choice (Freedom) – The power of choice is a great Linux advantage. With Linux, you have the power to control just about every aspect of the operating system. Two major features you have control of your desktops look and feel by way of the kernel and numerous Window Managers. In Windows, your either risking corruption or failure by installing a third-party shell or stuck using the boring default desktop theme.

1.4 LINUX OS STUDY

Core component of Linux system is

1. Bootloader

This is one part of the system that is executed first. When you have only one operating system installed, it simply loads the kernel. If you happen to have multiple versions of the Linux kernel installed or multiple operating system installed, it allows you to choose which one you want to start. The most popular bootloaders are Lilo (LInux LOader) and GRUB (GRand Unified Bootloader) and Most of users don't need to care about the boot loader, because it is installed and configured automatically. Actually, the boot Loader creates the boot sequence that the Linux Kernel requires.

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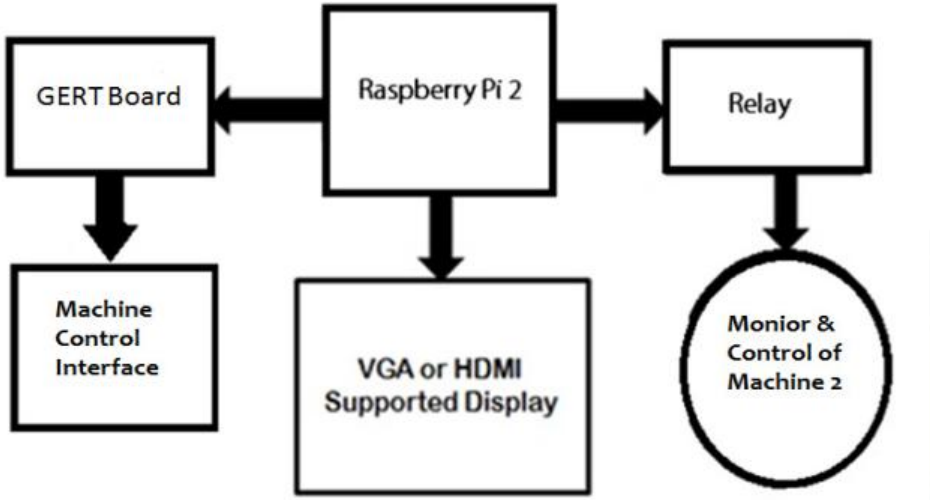

Figure2 : Basic architecture design

2. Kernel

The kernel is the middle component of the system that communicates directly with the hardware. In fact, the name "Linux" properly refers to a particular kind of this piece of software. It allows programs to overlook the differences between various computers. The kernel allocates system resources like processor time, memory, hard disk space and external devices to the programs running on the computer. It separates each and every program from the others, so that when one of them encounters an error, others are not affected. Most users don't need to worry about the kernel in day-to-day use, but certain hardware or software will require or perform better with certain kernel versions.

Figure 3 : RASPBERRY PI 2 and its features

2 PROPOSED WORKING

Hardware:

The system using below hardware

- Raspberry Pi
- 5V - DC – (700mA to 2A) microUSB Adapter
- HDMI to VGA Converter
- microSD card (4GB to 32GB)
- Sewing machine
- 2 Channel – 5VDc Relay module
- L293D – 2 Channel - Motor Driver
- Mechanical Prototype

The Gertboard has collection of functional blocks (the major capabilities of the board) which can be connected together in a many of ways using header pins. The functional blocks are:

- 12x buffered I/O
- 3x pushbuttons
- 18V, 2A motor controller
- 6x open collector drivers (50V, 0.5A)
- 28-pin and dual in line AT mega microcontroller
- 2-channel 8, 10, or 12 bit D to A converter
- 2-channel 10 bit Analogue to Digital converter

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5V DC - 2 CHANNEL - RELAY MODULE
Simple relay has a minimum of 5 pins:
Vcc, Gnd, Comm, NC & NO.
The output from Raspberry Pi GPIO is given to IN2 of the board which triggers the Relay-2.
So, the connected lines through NO & Comm will be connected electrically by the Magnetic control made inside the blue box via coil.
Its very safe to interface with such a Magnetic Coupling, where the input trigger gets via 5V and output NC, NO, Comm deals with a maximum of AC - 250 V / 10 A.
L293D – 2 CHANNEL MOTOR DRIVER
L293D is a Motor driver integrated circuit which is used to drive DC motors rotating in either direction.
It is a 16-pin IC and can control a set of two DC motors simultaneously.
The L293D uses 5V for its own power and external power source is needed to drive the motors, which can be up to 36V and draw up to 600mA.[3]
Software Used

- Operating System : Raspbian - jessie - 8.0
- Source Code : Python Language
- Environment : Python interpreter
- GUI Library : Tkinter pack
- GPIO Library : Rpi.GPIO pack

PYTHON GUI (TKINTER LIBRARY) – 2
Tkinter calls are translated into Tcl commands which are fed to this embedded interpreter, thus making it possible to mix Python and Tcl in a single application.
There are several popular GUI library alternatives available, such as wxPython, PyQt (PySide), Pygame, Pyglet, and PyGTK.
Tkinter is free software released under a Python license.
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3 IMPLEMENTATION

We decided to implement this concept using raspberry pi2 and python script.

Hardware design:
The development board contains raspberry pi2 which is brain of the system. It will receive the command from user and control the Motor. The GERT Board is a I/O extension board which will give the different DC output ranges from 5V to 50V. Using different voltage range we can drive the different voltage range of DC motors. In the other part relay is connected to the raspberry pi2 board which will drive the AC motor.
Software design:
The Front panel having the DC Voltage control and AC Voltage control. In the DC side control the 4 motor and AC side control one AC motor. Motor 1 user can switch ON the motor when click on the “ON” button and also user can OFF the motor 1 using “OFF” button. User can control the speed using CONTROL button. Same procedure can be followed for motor 2,motor 3 and motor 4. The AC side user can switch on the motor when click on the “ON” button and also user can OFF the motor 1 using “OFF” button. User can speed in “SPEED” section of the monitor

Figure 4 : Input/Output

4 DEMONSTRATION AND RESULTS

We were able to control the 12 motors which will operate the different voltage range using GERT board. The PWM will be generating based on the control button that will control the motor. So manager/chief engineer can operate/control the motor using mouse. Since this GUI is running in Linux environment cannot operate all team member. Authorized person can operate the motor and he/she can see the result (motor speed ,ON/OFF etc) in monitor itself.

5 CONCLUSION

In this paper, we proposed a design of GUI Based Industrial Automation that should control and monitor the any mechanical or electrical devices.
This GUI based system has given simple operate and high level of security.

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There is no possibility to corrupt the system as this is working in Linux environment

As for future enhancements, we will look for more efficient control the machinery using mobile.

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