Raspberry Pi Based Sequential Switching

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***Abstract*— This thesis aims to present the system that to switch industrial loads using a user programmable logic control device for sequential operation.**

PLCs (Programmable logic controllers) used in industrial applications are very expensive for simple operations like sequential switching of loads. In this paper we demonstrate the working of this simple operation using a Raspberry Pi board which is a viable alternative for PLC. To develop this application requires programming through input key-buttons. In industries, there are many operations which requires some repetitive sequences in various orders and time intervals. For example, some loads need to be switched ON/OFF in specific time intervals. This method is proposed to switch the electrical loads sequentially by programmed instructions. Raspberry Pi module is programmed in such a way that the loads can be operated in three modes: Auto mode, Set mode and Manual mode. The status of loads by all modes are displayed on PC monitor or a TV.

***Index Terms*— Raspberry Pi, power efficient, vast programming language, cost effective, Standards based.**

I. INTRODUCTION

Industrial plants globally are gearing up to create competitive differentiation through innovative methods. Globalization, diversification, mergers and acquisitions are continually adding pressure on deliveries. They endeavor to succeed in the market place by containing costs, improving operating efficiencies, and decreasing time-to-market. The plant managers are aligning all strategies emphasizing on growth and productivity.

Akshay Gujarathi, Sohit Oza, Kaushik Dangodara under the guidance of Prof. Priya T. Hankare, Department of Electronics and Telecommunication K.J. Somaiya Institute of Engineering & Information Technology Mumbai 400022, India Recently an important amount of time and resources spent in the field of computing. A variety of switching devices are available today for use in control circuits, motor circuits, and as the main control panel disconnecting means. The possible applications for these switches overlap, product standards compliance, electrical installation codes / requirements and application parameters must be carefully considered when selecting a switching device.

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II. PRESENT SYSTEM

A PLC (Programmable Logic Controllers) is generally an industrial computer used to monitor inputs and based on its program or logic, to control (turn on/off) its outputs to automate a machine or a process. The point of supply for a PLC is generally single-phase and 120 or 240 VAC.

Courtesy of Siemens

Ladder logic work with graphic symbols similar to relay schematic circuit diagrams. In ladder diagram two vertical lines symbolize the power rails and circuits are connected as horizontal lines between these two verticals. Ladder logic is broadly used to program PLCs, where sequential control of a process or manufacturing operation is required. As shown, device require very large space. Programmable controllers can endure temperatures ranging from 0 to 60°C.

III. PROPOSED MODEL

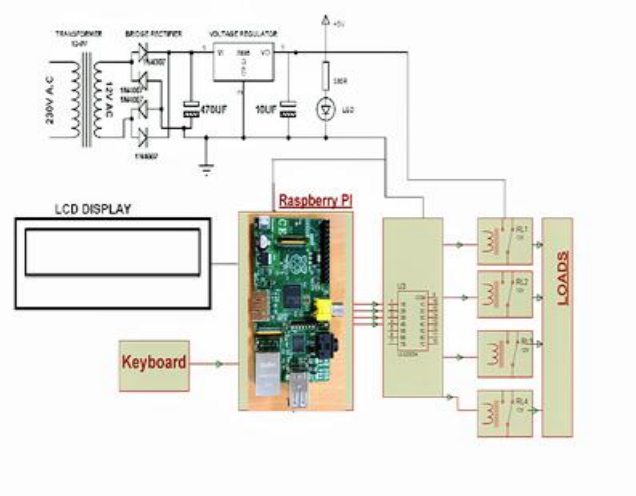


Figure: Block Diagram

A detailed block diagram of the system is shown in Fig.1

Raspberry Pi board can be operated in following 3 modes:-
In auto mode, the machinery works on default time settings where as in set mode, through timers, it works on input time set by the user and finally in the manual mode it functions while respective key-buttons are pressed depending on the user's need and flexibility.

IV. SYSTEM STRUCTURE

The system consists of Driving circuit which has step down transformer (230V AC-12V AC), Bridge rectifier which is used to convert AC into DC, Voltage regulator to enable voltage regulation and to give stable and ripple free output, Raspberry Pi board, Driving IC, followed by Relay's which are connected to industrial loads. We can connect LCD display as monitor and can also interface keyboard to Raspberry board.

V. SOFTWARE REQIREMENT

PHP GPIO program
The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as al BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C, Java, Perl and Ruby.

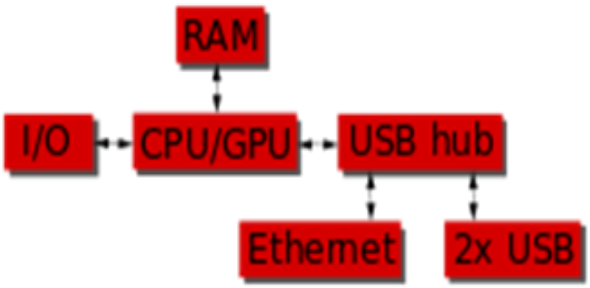
VI. DESCRIPTION OF BLOCKS

A. Raspberry Pi board

A Raspberry Pi board is an inexpensive, single-board computer, about the size of a credit card, that is capable of running Linux and other lightweight operating systems. Processor in module is quite similar to those found in smartphones. The Raspberry Pi board can be plugged into a monitor and keyboard and used to perform all of the popular functions of a regular desktop computer, like spreadsheets, word-processing and games. It also plays high-definition video. RPI Originally developed to make computing cheap and available to as many people as possible.

Dimensions

- Width 3.45 inches (87mm)
- Height 2.35 inches (60mm)
- Display view size 62mm x 26mm



The series helps to ensure that the system will operate with other Ethernet-enabled devices and IP applications. It also facilitates integration between business office applications and industrial equipment.
Power rating is from 300mA(1.5W) to 600mA(3W) & power required is 5 VDC. Weight is approximately 7g to 45g which is very convenient also it handles the temperature upto 0 to 80°C.

B. Liquid Crystal Display (LCD):

A liquid crystal display (LCD) is a thin, flat panel used for electronically displaying information such as text, images, and moving pictures. Liquid Crystal Displays are available to display arbitrary images (as in a general-purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.
Two major types of LCDs exist; the older passive matrix LCD and the newer, more commonly used active matrix LCD (AMLCD). The active matrix LCD employs several variations of liquid crystal technology and materials to allow LCDs to have a range of capabilities.

The basic structure and corresponding materials of an AMLCD are shown below

i. Polarizer (poly-vinyl chloride) 90o offset
ii. Top Glass Substrate (soda-lime or borosilicate glass)
iii. Color Filter
iv. Electrode (Indium Tin Oxide or ITO)
v. Alignment Layer (polyimide)
vi. Liquid Crystal Material
vii. Alignment Layer
viii. Thin Film Transistor (TFT) layer
ix. Bottom glass substrate
x. Polarizer (PVC)

Features

- Lightweight construction
- Portability
- Ability to be produced in much larger screen sizes than are practical for the construction of cathode ray tube (CRT) display technology.
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C. Relay Driver

ULN 2003

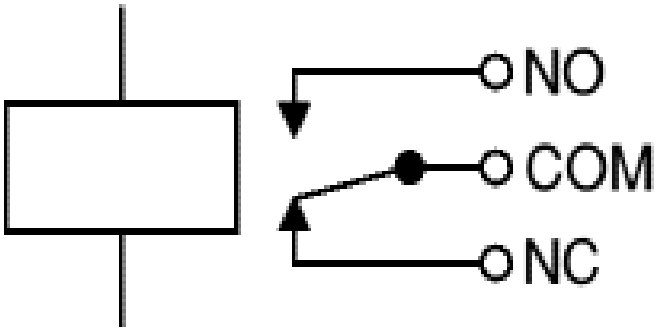
The ULN2003 Driver is a high voltage and high current Darlington transistor arrays. It delivers seven NPN Darlington pairs that feature high-voltage outputs with common-cathode Clamp diode for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA. Its Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers.
The ULN2003 has a 2.7kW series base resistor for each Darlington pair for operation directly with TTL or 5V CMOS devices.

Features

- 500 mA rated collector current (single output)
- 50 V output
- Includes output flyback diodes
- Inputs compatible with various types of logic

D. Relay

Relays are basically a simple switches which are operated both electrically and mechanically. Many relays use an electromagnet to perform a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is essential to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.
The relays are simple electromechanical switch. Current direct to coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The status of coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts as shown in the diagram.



VII. SOFTWARE

Operating Systems

The Raspberry Pi module primarily uses Linux kernel-based operating systems (it is not possible to run Windows on the Raspberry Pi). The ARM11 is based on version 6 of the ARM family on which several popular versions of Linux no longer run (in current releases), including Ubuntu. The install manager for Raspberry Pi is NOOBS. The OSs included with NOOBS are:
Arch Linux ARM
OpenELEC
Pidora (Fedora Remix)
Raspbmc and the XBMC universal source digital media center
RISC OS – The operating system of the first ARM-based computer.

VIII. CONCLUSION:

This study presents a simple and efficient switching system. Which provides automation in industry by operating industrial loads automatically with the help of the Raspberry Pi board. Thus, tasks performed by costly PLCs can now be achieved using a Raspberry Pi board making the device cost effective.

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