A Digital Configurable On-Delay & Off-Delay Timer

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ABSTRACT

The research work carried out here has been extensively surveyed by going through the literature and properly investigated by adopting the reverse engineering approach with few of the similar type of timers available in the market. So, the scope of this research work is high as the timer is a very critical component in most of the cyclic and sequential industrial processes. There is a quest to design more rugged, configurable and multi-functional timer units so as to replace the existing analog as well as static digital timers. The objective is to design and develop a microcontroller based integrated on-off delay timer relay. The timer must be designed in such a way that it could be configured easily by the user at any instant of time with the help of some push buttons.

Keywords: IoT, Web server, NodeMCU, Home Automation

INTRODUCTION

The timers have always proven to be the most critical component of an automation system specifically in those systems where the process handling by machines is purely dependent upon time. The timers can be used as a multi-functional device which can provide real-time alerts, generation of duty-cycle for the application of pulse width modulation, on-time control, off-time control. As every process these days are basically time bound processes and such time bound process if properly monitored and controlled initially can provide promising results while increasing the overall production in industries. So, timers are basically referred to a device that keeps an account of time in seconds, minutes or hours. There are multiple timers deployed around we come across in our day-to-day life. It is such an essential component today that we as humans cannot think beyond living without timers. Timers can be found in Lighting, Appliances, Washing Machines, Microwave Ovens, Traffic Lights, Sprinkler Systems, Induction heaters, Geysers, Stop watch, etc. Timers can be further classified as mechanical timers and electronic timers.

Timers are required in industries to perform some sequential operations. There are multiple types of timers used in industry but two types of timers are most commonly used. These two timers are known as On-Delay Timers and Off-Delay Timers. On-Delay Timers are used to introduce delay in the On-Operation of an equipment or machine. For example, in Star-Delta Starter. Normally three contactors are used in the Star-Delta Contactor. These are Star Contactor, Main Contactor and Delta Contactor. When the motor starts then during the start condition first Star and Main contactors will pick-up and delta contactor will pick up after some delay. So, to hold this triggering of Delta contactor with a specific delay is performed by the on-delay timer. Similarly, off-delay timers are used to provide delay to the off-operation of a system. For example, in overload relays we need to provide delay for tripping. Let us suppose there is a motor with full-load current specifications as 20Amperes but it draws 22Amperes current then this condition is the overload condition for the motor. Ideally the

motor must be turned off immediately but practically we do not turn off the motor immediately rather we wait for some time so that if the motor comes back to its normal current then there is no need to stop it otherwise it should be stopped by energizing the relay to trip the circuit breaker. For this purpose, the off-delay timer can be used.

OBJECTIVE OF RESEARCH

The objective is to design and develop a microcontroller based integrated on-off delay timer relay. The timer must be designed in such a way that it could be configured easily by the user at any instant of time with the help of some push buttons.

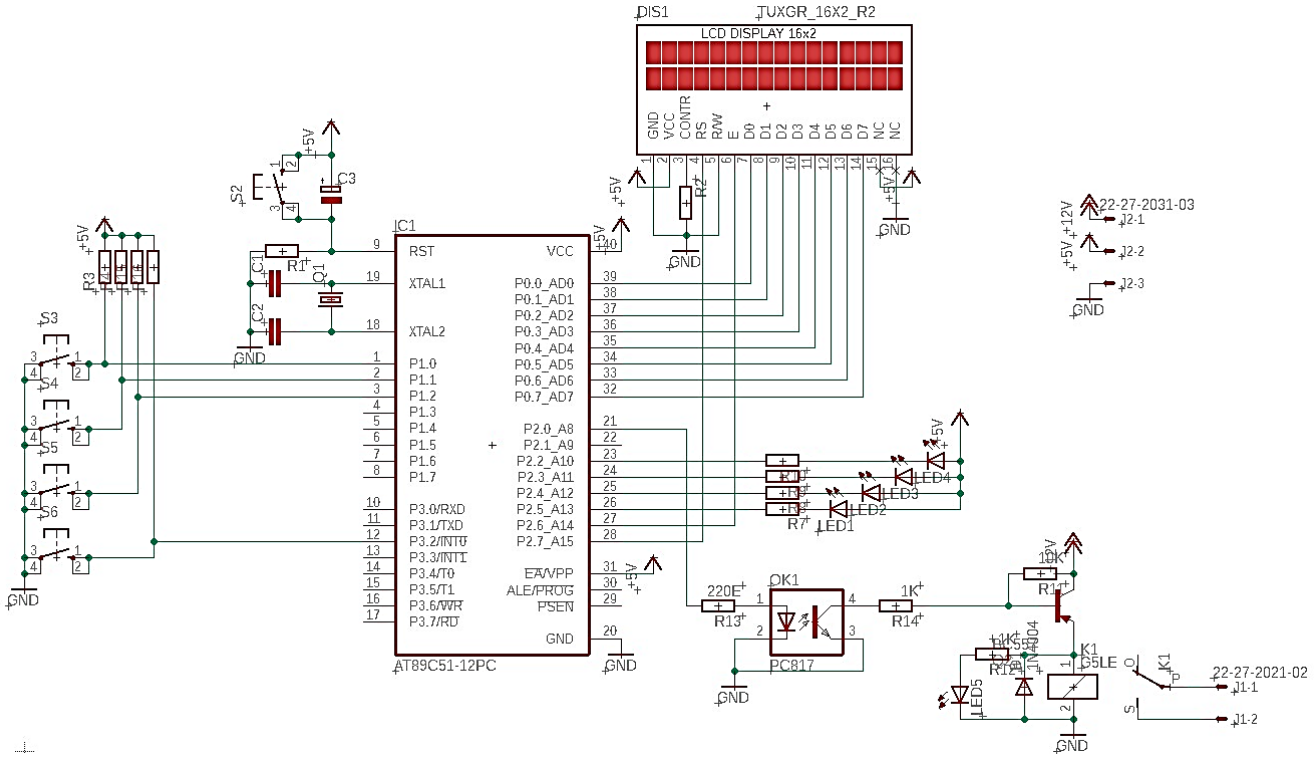

Figure 1 Snapshot of HTML based Web Dashboard

PROBLEM STATEMENT

Considering the inferences drawn from the literature survey it has been found that there is a research gap. For certain applications there is an active requirement of a programmable timer with on-delay and off-delay configurability using buttons. The problem has been formulated keeping in view of the requirement made here. The problem is to design and develop a working prototype of a configurable timer using microcontroller to control the switching of an electrical equipment via a relay. Another problem identified is to display the current status of the relay to the user along with the time of on-delay cycle and off-delay cycle in seconds using an LCD and LED indicators. Also, to configure the timer there is a need of interfacing the tact switches to the microcontroller so as to increment the time of on-delay cycle and off-delay cycle in seconds. The firmware needs to be written as per the hardware connections along with multiple debugging and compiling cycles carried out till, we get the desired results. A mechanical design is required for the front panel to deploy this complete circuit. Real-time testing must be carried out to identify the flaws and to find if there is any further scope of improvement possible.

PROPOSED SOLUTION

The aim is to design and develop a digital real-time cyclic timer for hydroponic applications. The proposed system will be developed around an eight-bit microcontroller platform as shown in figure-1 and will be dynamic in nature due to its configurable feature. The following points demonstrate the key features of the system proposed here. The digital cyclic

timer offers an uninterrupted operation cycle for both on-time and off-time to be configured separately by the user. On-board tact-switches for hassle-free configuration of on-time and off-time. Deployment of LED indicators to indicate the current status of system operation. The system can handle maximum output load upto 10Amperes at 230VAC.

SCOPE OF RESEARCH

The research work carried out here has been extensively surveyed by going through the literature and properly investigated by adopting the reverse engineering approach with few of the similar type of timers available in the market. So, the scope of this research work is high as the timer is a very critical component in most of the cyclic and sequential industrial processes. There is a quest to design more rugged, configurable and multi-functional timer units so as to replace the existing analog as well as static digital timers.

IMPLEMENTATION

Here in this work a microcontroller based low-cost digital cyclic timer has been proposed. The proposed electronic industrial timer must possess programmable capability for easy configurations in both on-time and off-time. The timer is basically used to control the cyclic on-off operation of a relay which can further be used to switch some other single-phase AC load connected via 3-pin socket. The generated pulse width modulated wave can be used in controlling operations for multiple applications including hydroponics, foggers, air-conditioning systems, etc. LCD is provided to display the current time. LED indicators are used to display ON and OFF switching status.

(a) (b) (c)

Figure 2 LED Indicators (a) System OFF State (b) System ON State (c) System in Configurable Mode

EXPERIMENTAL RESULT

As it is a programmable device so there is a requirement for hardware components and tools to prepare the physical prototype and to make it work software tools are also required for editing, compiling, debugging, testing, of source code and burning that code into the microcontroller. As an online rapid prototyping platform TinkerCad is preferred. To obtain the desired results and design schematic Proteus is used.

CONCLUSION

Through this proposed work we came to know about the utility of configurable on-delay and off-delay timer to control the switching of a relay intended to control a sequential process. The system has been tested for different on-delay and off-delay timer values and calibrated through modifications in hardware as well as software. Relay has been the key element to turn ON and OFF according to these time limits set by the user. This system can be integrated as a part of a more sophisticated systems where to maintain a controlled time environment is critical.

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