A Novell Setup of Electronic Techniques for Solving Asynchronous High Speed Illumination in High Speed Measuring

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Abstract. *With the demand in shorter process cycles in the production, the requirements for light pulses increase. This applies in particular to build stable and high intensity pulses with good reproducibility. With the help of the freezing the picture, the moving object can be almost independent of disturbances recorded. The aim of the project was a digitally controlled lighting control with regard to design specific criteria.*

On the market available flash and lighting controls were investigate the suitability of a particular application. Given the low fitness, theoretical and practical methods were used for providing a regulated current source. On this basis, a circuit design and board layout prepared. The prototype was made in preview to the use of programming. The programming took initialization routines between several microcontrollers and electronic components. After programming, practical tests were carried out and the desired properties investigated. The tests were positive and a manifold useful.

Keywords: Lighting Control, Flash Control, Strobe Controller

1. Introduction

Machine Vision is a wide area of parameters which can be affected. But also there are problem specifications, which are given and only can be optimized with other components. One parameter can be controlled is illumination.

Illumination is an inherent part in machine vision, because there is no image you can grab or analyze without it. Finding right adjustments of illumination for a device under test is not easy. Solving the measuring problem gets more difficult if the sample is in motion.

The resulting motion can be an effect from free fall, transportation mechanics (conveyer) or actuators, which generate vibrations to the system.

High precession measuring of geometrical variables is affect of these motions. To generate a snapshot, the camera-integration-time must be very low in dimensions of microseconds. The snapshot from a short moment is necessary, because the distance by time will be affect motion blur effects. A new addicting result problem of short integration-times is lower sensitivity of the camera-sensor. To get although object-information it is necessary that the light intensity must be high in a short time.

A sample of necessity is real time measurement in the production cycle of screws. The measurement at own is under high vibrations and parasitic vibrations. In the moment of measure the screw is on the fly. Summarized in this special measurement situation the camera is under vibration and the screw is in the air. Those are two parameters that provide a fail of a standard measurement.

2. Requirements at the device

The light will be generated by LED. There are two methods to control LED. One method is to control voltage and another is to control current. It came to the decision of current-control, because light intensity can be different at the same voltage and different temperatures.

After the background to generate an electronic system to control, adjust and regulate the illumination in machine vision. The Requirement specifications are the following. This section describes the format for paragraphs, figures, tables, equations and references.

Table 1: List of specifications

Parameter	Specification
Channels	2
Voltage IN & Out	24V
Current pulsed	Adjustable from 0 to 10 A
Current continuous	Adjustable from 0 to 2A
Step size	1mA
Timer	0 to 1s
Step size	1µs
Delay	<20µs
Parameter	Specification

To reach the specifications an elaborate electronic design must be created. The basic structure contains different integrated circuits – each for a separate job. For example there are microcontrollers, high current control circuits, USB-Controller, decoupled inputs, lots of filter circuits, but no current-measure-parts. To reach this short operation times a measuring system will be inert. There are different ways to measure the current with voltage above a shunt resistor or a contactless hall sensor. But this method is time inefficient. It would be an addition about test times of measuring voltage, converting into voltage, calculate new and settling the parameters of DAC.

3. Creating a structure of components

At the beginning there were ideas of a control-structure. The ideas have a range from one microcontroller for all to one for each channel or substitute microcontrollers for CPLD or FPGA. The founded concept is based on short reaction-times, after a trigger-signal. The concept is a combination of one master microcontroller and one microcontroller for each part. The matters for microcontrollers are low prices and a lot of functions. Fig.1 shows the simplified concept.

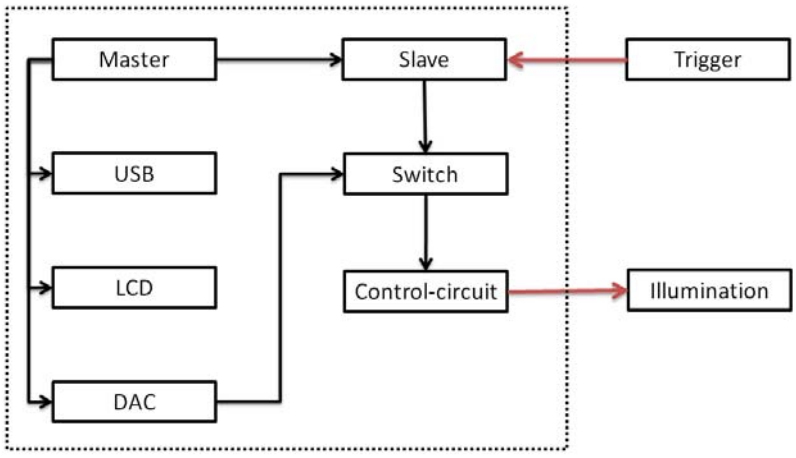

Figure 1: Simplified structure-design of global components [1]

Theoretical founded control circuit

The control circuit with his elements is special in its self. There are hands of methods to control and adjust a current. As example there are control circuits with fixed voltage regulator, transistor in a lot of combinations like current mirror, FET, OPA and combination of FET or transistor with an OPA.

After careful consideration of requirements and circuit possibilities, at the end the decision was falling at a combination of OPA with FET or transistor. The structure is visualized in Fig. 2.

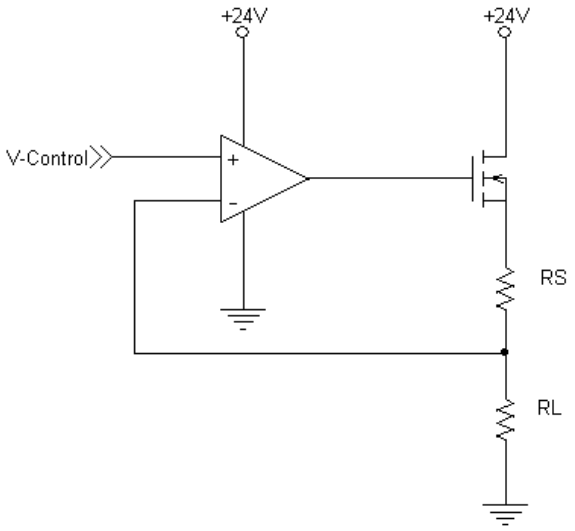

Figure 2. Simplified current-control-design of OPA and FET [2]

In Fig. 2 the resistor named RL is the light source and RS is a resistor for sense, also named shunt. Simplified the output can be described by developing formula (1) to (2) [3].

$$R = \frac{U}{I} \tag{1}$$

$$I = \frac{V_{Control}}{R_S} \tag{2}$$

where

R	resistance
U	voltage
I	current

Build-Up and practical tests

Building Up was made on a double-sided circuit board, illustrated in Fig. 3. Simple failures can be detected and solved. After placing and soldering there was the part of programming. Programming was made in a development environment in programming language C.

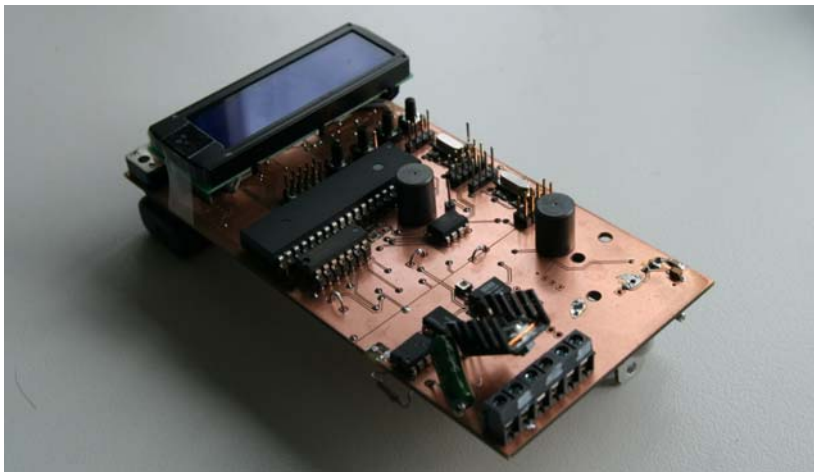

Figure. 3. Simplified structure-design of global components [4]

In aspect of practical tests there were tests about aspects like reaction time, time accuracy, time resolution, current accuracy, current resolution and specially slew rate.

4. Conclusions

Actually the prototype is well operating for high speed illumination. There are high precision adjustable timer and precision adjustable currents. All this parameters are tested at industrial test conditions.

High speed illumination can be used in machine vision systems. Because all parameters are adjustable, it can be adapted to every setup.

In the future are higher voltages or a higher number of channels able. The number of channels can be up to 255, because every channel is independent to the other.

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