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Advanced Automated Visual Inspection System of Colored Wires in Electric Cables

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ABSTRACT

In this paper, an automatic visual inspection system for checking the colored wires in electric cable is presented. The system is able to insert the cables wires through motors and rooting wires in correct block with the help of cable separator. This variability is managed in an automatic way by means of a learning subsystem which require to give manual input from the operator. once the model of a correct wire is rooted with sensor, it can automatically inspected to particular block.The main contributions of this paper are: color wire recognition is done with the help of color sensor. This work is motivated by the need of performing an accurate quality control an automated inspection method is necessary for effectively assuring a quality check on 80%. software system is composed by two main modules: the first one localizes the wires from where to source the wire, while the second performs color detection where to root the wire. This paper explains how it is possible to recognize the wires in many different ways; moreover, a reliable method for identifying colors.

Key words: Cable Feeder, Cable Separator, Arduino, Color Sensor, Interfacing ICs, Buzzer, Embedded C.

I. INTRODUCTION

E Embedded can be defined as the processing or altering an existing in a desired manner. Which performs automatic processing, manipulation and interpretation of visual information, and it plays an increasingly important role in our daily life. Also it is applied in a variety of disciplines and fields in science and technology. Some of the applications are television, photography, robotics, remote sensing, medical diagnosis and industrial inspection. Probably the most powerful processing system is the human brain together with the eye. The system receives, enhances and stores color at enormous rates of speed. Color information obtained from cable feeder can be used in the following domains such as road sign detection, face detection, skin color detection, object detection, iris identification and object tracking etc.

The present work is motivated by the need to perform an accurate quality control check on the production of cable wires. The automatic optical inspection method of capturing the images of colored wires implementation with quality check on 80% of the produced parts. Quality check systems based on visual inspection can be very convenient and capable with an interfacing IC and embedded C.

II. EXISTING SYSTEM

Visual inspection for industrial production is a very active field, that spans across several sectors, ranging from food production, and medical production, to fabric production, exploiting also quite complex computer vision techniques derived from other fields, as it is the case of quality check systems based on visual inspection can be very sophisticated, and capable of interfacing with CAD models. The exploitation of computer vision techniques in the industrial environment can lead to very successful results, but requires special care in the selection of the hardware components and setup. Another strong constraint that visual inspection systems must meet is represented by the capability of being real time, i.e., they should be able to check the production without affecting the production process speed. From this point-of-view, visual inspection systems are similar to robotic vision systems, that must be able to extract data from the environment in real time so that the robot can take proper actions in time. Several works in the literature have focused on metal parts and electric connections: in, a system for inspecting metal connectors is presented, particularly focused on checking dimensional constraints; a similar type of inspection is also described. Analysis of color information is a widely explored field in computer vision for any kind of applications, including visual inspection. Color indexing is often tackled by means of histograms, that area convenient way for managing color information and creating clusters of similar colors. More sophisticated techniques for handling color information also exist in the literature in moments of color distributions are considered, while color signature based on bag of colors are presented in color itself can be described in a number of different color spaces, that can ease the task of discriminating one from another.

The techniques mentioned above were mainly developed to work on real-world scenes, as it often happens in robotics and computer vision applications like video surveillance or object recognition. They can deal with objects that have non-uniform color, and with scenes that undergo illumination changes, but do not aim at an accurate color measurement. On the contrary, such effects do not existing an industrial context, because it is often possible to control illumination and the imaging process; however, in industrial visual inspection a much higher accuracy in color measurement is needed. This is the case of the work presented here: illumination is obtained by means of a LED illuminator, and external light is shielded. This makes our case rather different, since we have a strong knowledge of the phenomenon that is observed, e.g., the cylindrical shape of the wire that causes a gradient that is repeated on all wires. The histogram-based approach is not suitable in our case, because it loses the spatial information: all colors are organized based on their values, while we need to discriminate between them based on geometrical considerations, e.g., the peculiar shape of the wires. Our choice was to exploit the knowledge about the imaging process to eliminate noise exploiting geometrical information rather than working on histograms. Illumination is another critical issue when dealing with color, as different illuminations can sensibly affect histograms or any other indicator based on colors.

Color analysis is seen from a different perspective in this work: instead of exploiting techniques that are very robust to, e.g., illumination changes, the focus here is to obtain a very accurate measure in a controlled environment. Differently from mobile robotics applications, the color measurement in a visual inspection system needs to be much more accurate, as wires of very similar colors should be distinguished, and the material of the insulation should be also detected distinguishing between effective and matte materials, that show a rather different color signature on the wire. The system deals with some noise factors that are accurately modeled, as they are part of a well-known manufacturing process.

Overall, it can be said that the color analysis algorithm presented here needs to provide very accurate results, based on images taken in a controlled environment. The industrial context also affects the relationship between segmentation and color measurement: for example, in segmentation is driven by color analysis, while in this work the opposite path is exploited: segmentation is achieved by means of background subtraction, and its result drives the analysis of wire color.

This approach provides better results, as segmentation is easy to perform and provides accurate results thanks to the a priori knowledge of the scene being observed. Color analysis is made completes dependency on a number of factors sensibly higher than shape analysis, namely, surface roughness, material, and insulation.

This work builds on the preliminary system presented in, which has been expanded and thoroughly tested, and is described in detail in this paper. Even though the system presented here relies on some state-of-the-art computer vision techniques, it faces a number of issues that are peculiar to cable crimping visual inspection, like an accurate color measurement in presence of strong noise factors, and the capability of dealing with bent and overlapped wires. To the best of our knowledge, this is the first time a system addressing this task is presented.

III. PROPOSED SYSTEM

In visual system can done when the electric cables are rooted through the cable feeder. The cable feeder, which contains the motors and wires as part in feeder. The cable wires are in our project given manually and then motors are helpful to drive the wires and to separate wires. When the electric wires are rooted through the motors and the colors which are sensed by the color sensor which is used to identify the color of the wire and separate the wires and displays on LCD. If the cable wire is given wrong at the motor, the sensor is not able to transfer through it because the identification of wire is wrong then it that makes sound. When it placed at wrong place and that displayed on the LCD the connection of cable is given wrong and indicate correct cable wire to root the cable to particular block.

Visual inspection for industrial production is a very active field, it is the case of Quality check systems based on visual inspection can be very advanced, industrial environment can lead to very successful results, but requires special care in the selection of the hardware components and setup. The techniques mentioned were mainly developed to work on embedded. They cannot deal with color that have non-uniform color, but do not aim at an accurate color measurement. However, in industrial visual inspection a much higher accuracy in color measurement is needed, the color measurement in a visual inspection system needs to be much more accurate; as wires of very similar colors should be distinguished, its result drives the analysis of wire color

IV. BLOCK DIAGRAM

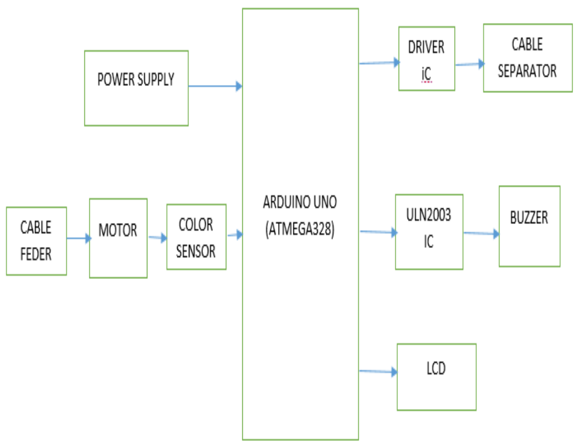


Figure 1. Block Diagram

Description:

The cable inspection system described to recognize the colors of wires. It's work with the help of

Microcontroller, Driver IC, and Motor etc. So it can be applied to any situation in which the colored wires has to be checked. One of the project requirements are interfaced with an IC it should not be modified; therefore, the visual inspection system had to be installed in the empty space inside the cable feeder itself. While designing the visual inspection system, a set of constraints were imposed in order to integrate the inspection system into the cable separator, which caused severe limitations on the system geometry.

Visual inspection needs to be performed just after cable feeder, while they are being guided out of the IC by means of recognizing the electric cables with the color sensor. However, the quality inspection needs to be observed by the sensor, with relying on the identification of the connectors where cable separators are used.

4. Hardware Components:

1. Arduino UNO
2. Color sensor
3. Power Supply
4. LCD

1 Arduino UNO (ATMEGA 328):

Figure 2. Arduino Board

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode (), digital Write(), and digital Read() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40mA and has an internal pull-up resistor (disconnected by default) of 20-50kOhms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write () function.

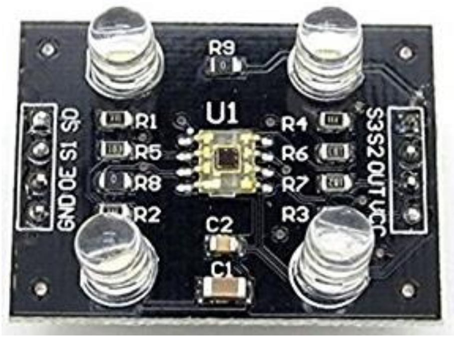
SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

LED: 13 There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

2 Color Sensor:

The TCS230 programmable color light-to-frequency converter combines configurable silicon photodiodes and a current-to-frequency converter on single monolithic CMOS integrated circuit. The output is a square wave (50% duty cycle) with frequency directly proportional to light intensity (irradiance). The full-scale output frequency can be scaled by one of three preset values via two control input pins. Digital inputs and digital output allow direct interface to a microcontroller or other logic circuitry. Output enable (OE) places the output in the high-impedance state for multiple-unit sharing of a microcontroller input line.

The light-to-frequency converter reads an 8 x 8 array of photodiodes. Sixteen photodiodes have blue filters, 16 photodiodes have green filters, 16 photodiodes have red filters, and 16 photodiodes are clear with no filters. The four types (colors) of photodiodes are inter digitated to minimize the effect of non-uniformity of incident irradiance. All 16 photodiodes of the same color are connected in parallel and which type of photodiode the device uses during operation is pin-selectable. Photodiodes are120 µm x 120 µm in size and are on 144-µm centers.



Figuer 3. Color Sensor

3 Power Supply:

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.

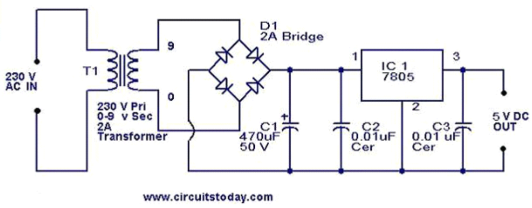


Figure 4. Power supply diagram

The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full- wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

4 LCD (Liquid Crystal Display):

The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. In this tutorial, we will discuss about character based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff and tricks you can do with these simple looking LCDs which can give a new look to your application.

The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers. Most LCDs with 1 controller has 14.

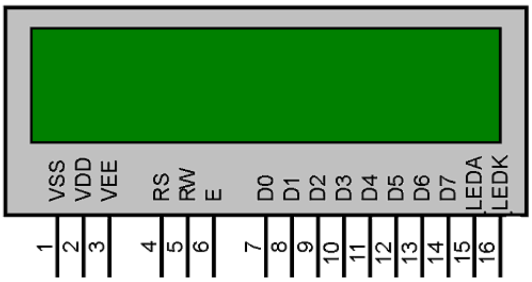


Figure 5. Liquid Crystal Display

Pin description of LCD:

Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections).

VSS, VDD and VEE

Pin 1 (VSS) is a ground pin and it is certainly needed that this pin should be grounded for LCD to work properly. VEE and VDD are given +5vlots normally. However VEE may have a potentiometer voltage divider network to get the contrast adjusted. But VDD is always at +5V.

RS, R/W and E

These three pins are numbered 4, 5 and 6 as shown above. RS is used to make the selection between data and command register. For RS=0, command register is selected and for RS=1 data register is selected.

R/W gives you the choice between writing and reading. If set (R/W=1) reading is enabled. R/W=0 when writing.

Enable pins is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high to low pulse must be applied to this pin in-order for the LCD to latch in the data present at the data pins. It may be noted here that the pulse must be of minimum 450ns wide.

D0-D7:

The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contents of LCD's internal register.

V. FLOW CHART

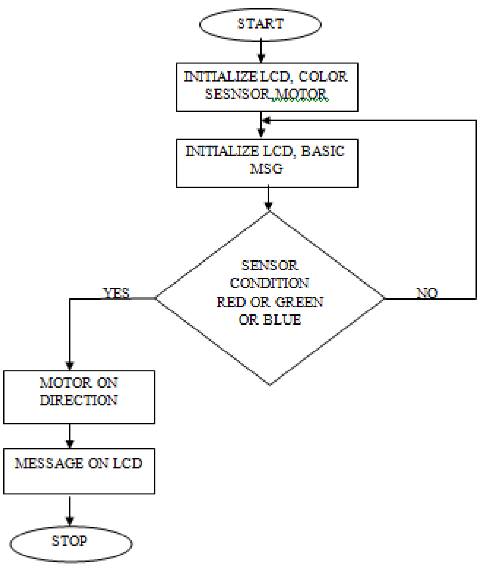


Figure 6. Flow chart

VI. SOFTWARE USED

Arduino IDE:

An integrated development environment (IDE) is a software application that provides comprehensive facilities to computer programmers for software development. Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects. The Arduino Integrated Development Environment or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them.

Language used:

EMBEDDED C:

Embedded C is a set of language extension for the C programming language by the C standards committee to address commonality issues that exist between C extensions for different embedded system. Embedded C uses most of the syntax and semantics of standard C, e.g.: main () function, variable definition, data type declaration, conditional statements, loops, arrays and strings etc.

Advantages:

1. Cost is low.
2. Easy to manufacture.
3. System is secured.

Applications:

1. In industrial applications, colors are an essential part of branding, store layout, web design and product classification.

VII. CONCLUSION

The wires are sorted out with respect to color such as red, green, blue in respective box. Also buzzer makes sounds the color hat detected by color sensor. Also LCD give display of color name. system for automatic visual inspection for production of cables with wires has been presented. The system learning module that enables it to inspect any kind of cable, with color detection to correctly assembled cable feeder and that can be observed after color recognition is done. The system can deal with difficult situations to recognizes the wires and to separate the wire with the help of motors.

VIII. FUTURE SCOPE

1. We can sense multiple color by color sensor and sorted more wires using extra hardware assembly.
2. We can use a Robotic arm to pick and place the wire.
3. By using counter we can count the number of wires

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