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► **To cite this version:**

Min Zhang, Yuhua Wu, Ting Yang, Shijun Li. Control System Design of Soy Sauce Koji-Making Based on ARM. 10th International Conference on Computer and Computing Technologies in Agriculture (CCTA), Oct 2016, Dongying, China. pp.197-203, 10.1007/978-3-030-06155-5\_19 . hal-02179999

**HAL Id: hal-02179999**

**<https://hal.inria.fr/hal-02179999>**

Submitted on 12 Jul 2019

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# Control System Design of Soy Sauce koji-making Based on ARM

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**Abstract.** Koji-making is an important part in the production of soy sauce. The traditional means of yeast pool ventilation starter depends on the experience of staff to control the environment of yeast antrum, which koji way automation level is not high, koji product stability is not guaranteed. This paper proposes a design method of soy sauce koji-making control system based on ARM processor S3C2440. It mainly consists of embedded microprocessor S3C2440, power conversion circuit, data storage circuit, display circuit, communication circuit composition. The Linux operating system is used to achieve the automatic control of the traditional process of making koji. The staff can judge the bending machine, fan working time directly through the soy sauce making koji control system, which improves the traditional production of soy sauce production level, and ensures the stability of the quality of the product.

**Keywords:** S3C2440, soy sauce, koji-making, control system

## 1 Introduction

With the technical progress of China's soy sauce brewing industry, koji equipment are constantly improved. In the 1960s, traditionally disk and plaque were used for koji-making. In the 1970s, plane ventilation system is adopted to make Koji, which made some progress than the traditional plate, plaque. In the 1980s, koji box appeared, such as the fixed koji box with a cover, tilting koji box with a cover and chained koji box. During the end of the 1980s and the beginning of the 1990s, there appeared the box-type cranes, disc-type machine-made koji and other forms [1].

Because of its high degree of mechanical automation, the mechanical processing of discs was supported by large enterprises. However, because of its high price, some small and medium enterprises still adopt the way of ventilation and koji [2,3]. Koji-making process for turning koji, ventilation time rely entirely on the experience of technical staff regulation, to regulate the temperature of yeast pool. While this conventional koji process of making products with good taste, unique flavor and other characteristics, but the quality is hard to achieve the best and output below the industry standard, the poor stability of the product.

Retain the traditional soy sauce manufacturing advantages and characteristics of process based, while improving the quality of the products, to maintain the stability of the product, combining advanced automation technology and communication technology, the soy sauce koji process of real-time monitoring, in order to achieve the optimization of management and reliable operation [4]. In this paper, the design of the control system of a soy sauce koji making workshops, the system based on S3C2440 processor as the core, based on embedded operating system Linux, combined with multithreading processing technology, to show the real-time workshop environment parameters, and then according to the experts to give the best of environment parameters, the working personnel can through the regulation of the system in a timely manner to control turn song and ventilation equipment of the time, to ensure the stability of yield and quality of soy sauce koji in the production process of koji making workshops.

## 2 Overall System Framework

The whole design scheme of the control system of soy sauce koji workshop is shown in Fig. 1. It is mainly composed of S3C2440 processor, voltage conversion circuit, data storage circuit, control interface circuit, communication interface circuit [5]. Core processor S3C2440 chip, which is mainly responsible for data processing. The voltage conversion circuit converts 5V voltage for the voltage of the system. Control interface circuit comprises LCD and touch screen, the LCD is used to display real-time data, and staff can find real-time environment parameters koji workshop by touching the screen.

Communication interface circuit comprises a serial port, USB interface, network interface, serial port for transplantation debugging information display system, USB interface with the network interface to download the bootloader, Linux kernel image at the same time and the koji making car for interactive data [6].

All the parts of the system using an independent modular design, any of debugging, maintenance, upgrading will not affect other modules work. Power module power is stable and reliable work of the whole system is stable and reliable. System power supply to 5V input, using different modules in the system power regulator chip level conversion, isolated between each module is effectively reduced harass [7].

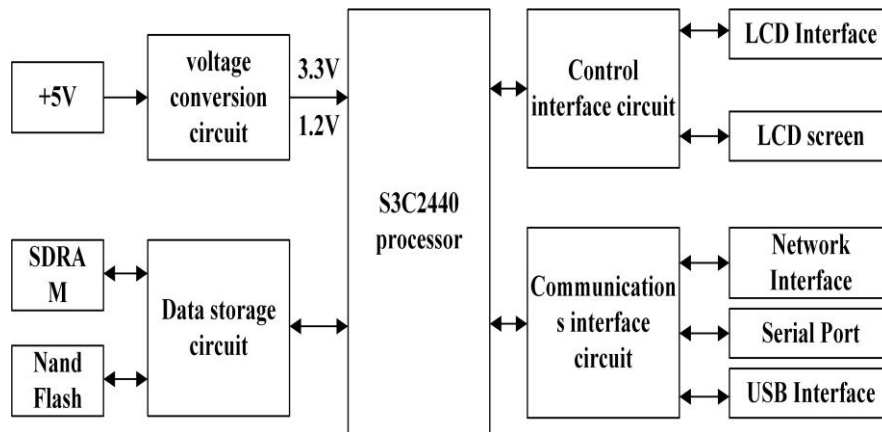


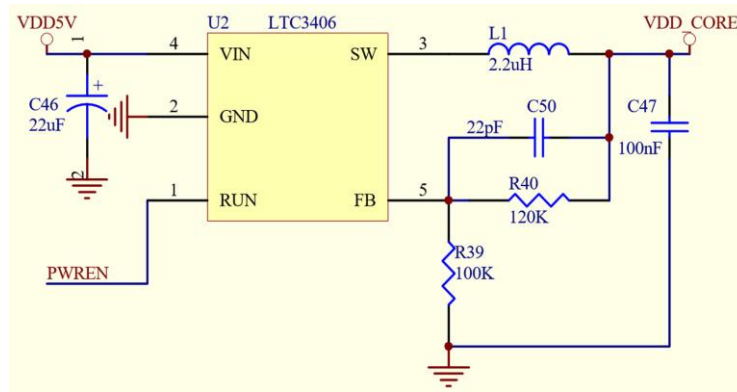
Fig. 1. The overall system framework

### 3 Hardware design

#### 3.1 Power Conversion Circuit

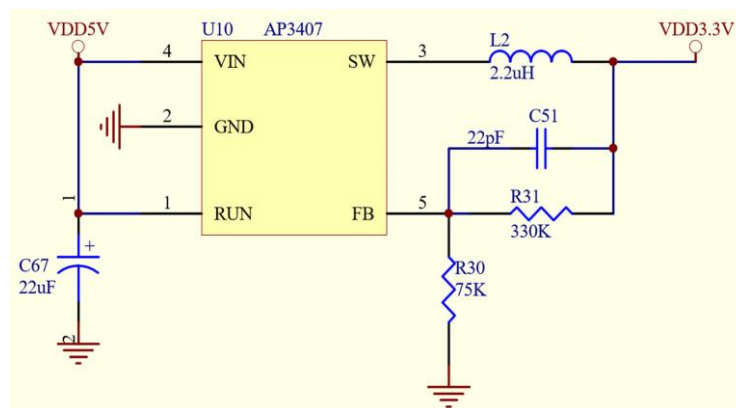
S3c2440 microprocessor including ARM core and the memory, the kernel needs a 1.2V power supply, memory is required to 3.3V power supply, external I/O need 3.3V power supply. In order to meet these needs, uses the voltage conversion circuit, the 5V voltage through a voltage conversion circuit is converted to 1.2V and 3.3V.

Power conversion circuit is mainly composed of ltc3406 chip, ltc3406 is a constant frequency current mode architecture, monolithic synchronous buck regulator using and operating input voltage for the 2.5V~5.5V, ltc3406 can be selected adjusting output or fixed 1.5V, 1.8V output. LTC3406 operation process of the power supply current is only 20uA, in shutdown state dropped to 1uA or lower. Due to these characteristics of ltc3406. Through ltc3406 to voltage conversion 1.2V to the kernel power supply, can maintain stable kernel operation. Core voltage conversion circuit as shown in Fig. 2.



**Fig. 2.** S3C2440 Core voltage conversion circuit

Ap3407 application is a kind of more extensive, inexpensive generic voltage converter, using this chip to the 5V voltage conversion to a 3.3V voltage, can save development costs, and to ensure the normal work of S3C2440 chip memory and external I/O. Such as shown in Fig. 3 is a 3.3V voltage conversion circuit.



**Fig. 3.** 3.3V Voltage conversion circuit

### 3.2 LCD Interface Circuit

LCD interface circuit includes LCD display interface and touch screen interface as shown in Fig. 4.

TFT-LCD with high resolution, rich color, fast response, contrast and brightness are higher, the screen can be a visual angle, easy to achieve a series of features such as large area [8]. The system in the AT043TN24 and resolution for 272 TFT LCD screen, interface circuit as shown in Figure 4, including Vsync is a touch screen vertical synchronous signal, Hsync for horizontal synchronous signal, VLCK for the clock signal, led and LED is 3.3V touch screen back photo voltage, R, G, B port transmission of data signals.

Has been in the real life in the extensive use of the touch screen, such as mobile phones, flat, ATM machines and other, with the push of a button compared to the more convenient and more comfortable to use the touch screen. At present on the market touch the type of screen there are many, such as ultrasonic touch screen, capacitive touch screen, resistive touch screens. The resistive touch screen due to the low cost and the electrical can direct access to the user's system and get a lot of use. But it essentially is a resistance divided voltage regulator, the rectangular area in touch the physical location of the point (x, y) conversion on behalf of the X and Y coordinates of the voltage [9]. As shown in Fig.4 directly through the TSYP, TSXP, TSYM, TSXM and touch screen YP, XP, YM, XM connections to achieve human-computer interaction.

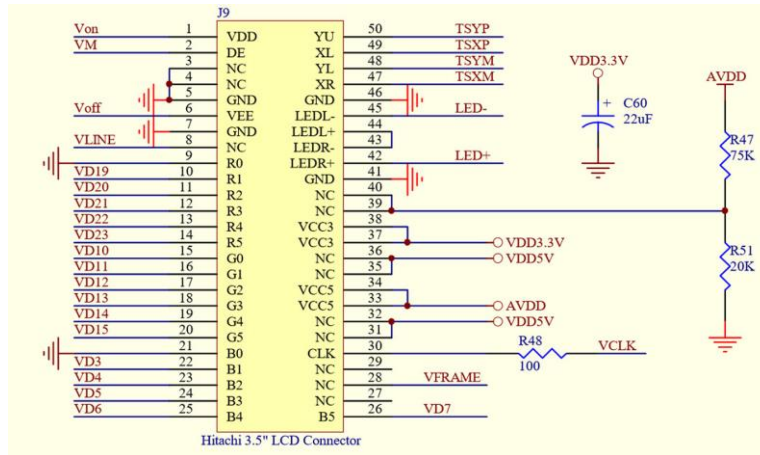


Fig. 4. LCD interface circuit

## 4 Software Design

### 4.1 Software design of control system

Software design is implemented in the operating system, the embedded operating system is the core of the whole system development. Because Linux is open source, a high degree of modularity, extensive hardware support, efficient, stable and easy to develop a graphical interface, support the advantages of network transmission and file system, so system software platform by multi task embedded Linux operating system to achieve. In data acquisition system, the Linux system can also handle multiple sensors are transmitted to the more complex control tasks, so as to improve the overall system response speed and parallel processing ability. Regulation system startup processes such as shown in Fig. 5.

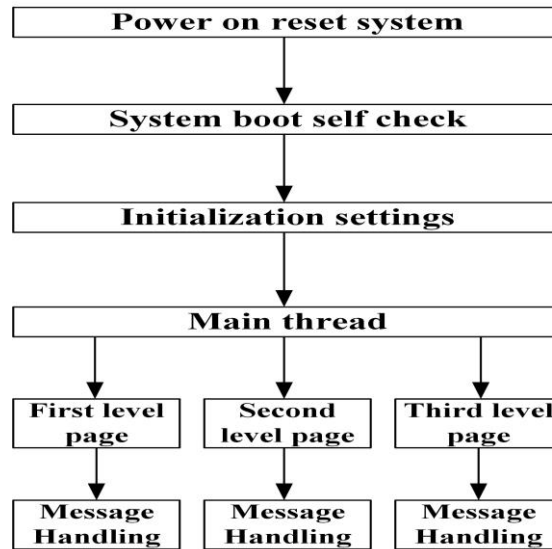


Fig. 5. Software design

### 4.2 Display Driver

Koji workshop control system is tailored to the Linux-2.6.22 kernel based on the display driver in the form of the module is loaded into the Linux kernel, the Linux operating system, device driver is in the form of documents, each device driver are stored in the dev directory, called the device file. The application can open and close read and write the driver files, to complete the operation of equipment operation, like ordinary data files. The user process of equipment file mode of operation is that some system calls. In order to system calls and device driver linked to Linux, all the equipment file provides a unified user interface, which is encapsulated in the operation file\_operations this structure inside the. Linux kernel through the file\_operations structure into the specific device file operation function, for example: when the upper application through the operating system Commission calls

open ( ) opens the device file is through the file operations data structure called open ( ) function. Display driver used main function interfaces as shown in Fig.6, mainly to complete set display palette, pixel display and other functions.

```
static struct fb_ops s3c_lcdfb_ops = {
    .owner      = THIS_MODULE,
    .fb_setcolreg = lcdfb_setcolreg,
    .fb_fillrect = cfb_fillrect,
    .fb_copyarea = cfb_copyarea,
    .fb_imageblit = cfb_imageblit,
};
```

Fig. 6. Display driver function

## 5 Conclusions

It mainly describes the soy sauce koji workshop control system hardware circuit design and software design and hardware circuit design are introduced in detail process of power conversion circuit, data storage circuit, control circuit, communication interface circuit of the chip selection and interface; software design specific start message processing system software were introduced in this paper, LCD display driver design. The hardware of the system adopts modular design, the software design using hierarchical structure, linux-2.6 embedded operating system as a platform, using multi thread processing control logic, construction of soy sauce koji making workshops regulation system, solves the traditional soy sauce koji making process rely on the experienced staff to control over bending machine, fan and other equipment to work time and improve the level of automation in the production of traditional soy sauce koji, improves the level of traditional soybean paste koji production, to ensure the stability of koji production and quality.

## Acknowledgments

The authors wish to express their gratitude to the projects: Control System Design of Soy Sauce koji-making Based on ARM from Education Department of Jilin Province, Jilin Province Economic Structural Adjustment Leading Fund Special Project (No. 2014Y108) and Changchun City Science and Technology Plan Project (No. 14nk029), Key Tackling Item of Jilin Province Science & Technology Department (No. 20140204045NY), for their generous support of this work. At the same time, the other authors also thank the corresponding author, Shijun LI, for his assistance in submitting this paper.

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