

AN INTELLIGENT INTRUSION DETECTION AND FOOD GRAIN PRESERVATION SYSTEM BASED ON ARM

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Abstract—Many parts of the world certain crops can be Produced throughout the year, the major food crops such as cereal grains and tubers, including potatoes, are normally seasonal crops. Therefore the principal aim of any storage system must be to maintain the crop in prime condition for as long as possible. Storage of food grains is a vital role in country. This paper proposed an intelligent system for monitoring and controlling the grain condition and also identifying the intrusion inside the storage place. This system is based on ARM9 core processor. The grain environment information such as temperature, humidity is collected and stored by Multi-sensor to provide a healthy environment. Thief identification is done using IR sensor which alert the securities through alarm. Cloud collects the grain environment information from GPRS module. Ultrasonic pest repellent circuit generates ultrasonic signals to repel pests such as little bugs, mosquitoes, rats, bats, cockroaches. The Experimental result has many good features such as good site stability, easy acquisition and real –time on-line detection. And the system has important significance for future grain situation monitoring.

Index terms—Grain condition monitoring and controlling, ARM9, Multi-sensor, Ultrasonic pest repellent circuit, GPRS module.

I. INTRODUCTION

Although in many parts of world certain crops can be produced throughout the year, the major food crops such as cereal grains and tubers, including potatoes, are normally seasonal crops. Consequently the food produced in one harvest period, which may last for only a few weeks, must be stored for gradual consumption until the next harvest, and seed must be held for the next season's crop.

In addition, in a market that is not controlled, the value of any surplus crop tends to rise during the off-season period, provided that it is in a marketable condition. Therefore the principal aim of any storage system must be to maintain the crop in prime condition for as long as possible. The storage and handling methods should minimize losses, but must also be appropriate in relation to other factors, such as economies of scale, labour cost and availability, building costs and machinery cost. Many observers view effective farm level grain storage as an opportunity to reduce food losses and increase farm family income and security at the same time.

Landless laborers may also benefit from good storage, as grain prices flatten out and in-kind wages can be protected from losses in their homes. Centralized government grain storage facilities frequently have proven to be a disappointment, suffering from poor quality control on incoming grain (with resulting high in-storage loss rates) that leads to low prices paid to the farmers. Even with smoothly functioning large-scale grain storage facilities substantial losses may have already taken place at the farm level before the grain ever reaches the centers.



Figure 1.1 preservation of food grains

Several studies of farm level grain storage losses in recent years have concluded that losses in the areas studied were much lower than previously supposed. Studies of this sort have some difficult methodological challenges to overcome, and the complete picture is not yet clear. Certainly there are farmers in some places with particular crops that are experiencing very low storage losses, while some farmers in other places are having high losses with other crops. People interested in this topic should carefully investigate the extent of local losses before launching programs.

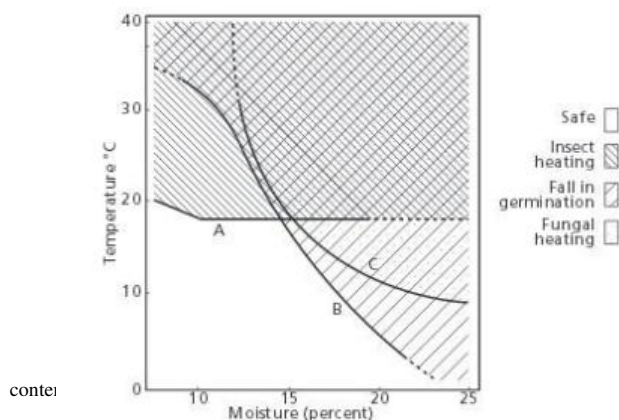
II. REQUIREMENTS OF GRAIN STORAGE

Cereal grains are edible seeds and, as such, would eventually be released from the plant when fully mature. Grains can be divided into three groups; cereals (maize, wheat, millet, rice, etc.), pulses (beans, peas, cowpeas, etc.), and oil seeds (soybeans, sunflower, linseed, etc.)

Crops left standing un-harvested start to show diminishing quantitative and qualitative returns through shatter losses and attacks by insects, mould, birds and rodents. It is therefore important to complete harvesting as soon as possible. In addition, it is necessary to remove dust and contaminants, which can include insects, and vegetable material, such as bits of straw and chaff and weed seeds. These will fill up pore spaces within the crop, inhibiting air movement and adding to any possible spoilage problems.

One of the most critical physiological factors in successful grain storage is the moisture content of the crop. High moisture content leads to storage problems because it encourages fungal and insect problems, respiration and germination. However, moisture content in the growing crop is naturally high and only starts to decrease as the crop reaches maturity and the grains are drying. In their natural state, the seeds would have a period of dormancy and then germinate either when re-wetted by rain or as a result of naturally adequate moisture content. Another major factor influencing spoilage is temperature. Christo Ananth et al. [3] proposed a system about Efficient Sensor Network for Vehicle Security. Today vehicle theft rate is very high, greater challenges are coming from thieves thus tracking/ alarming systems are being deployed with an increasingly popularity. As per as security is concerned today most of the vehicles are running on the LPG so it is necessary to monitor any leakage or level of LPG in order to provide safety to passenger. Also in this fast running world everybody is in hurry so it is required to provide fully automated maintenance system to make the journey of the passenger safe, comfortable and economical. To make the system more intelligent and advanced it is required to introduce some important developments that can help to promote not only the luxurious but also safety drive to the owner. The system "Efficient Sensor Network for Vehicle Security", introduces a new trend in automobile industry.

A damp or warm spot in grain will increase the rate of respiration. In addition to heat, another product of respiration is moisture. The heat and moisture from such a „hot spot“ can spread by convection, encouraging moulds and bacteria, which in turn respire and give off more heat and moisture. It therefore becomes a self-generating process. Insect activity also increases with a rise in temperature.



III.EXISTING FACILITIES

In existing system there were many methods used for preserving grains. Those methods reduced the human's life span. ZANDU PARAD tablets can use to fumigate the grains for better preservation. Condition: It is poisonous. It is used to prevent the grains/species from small insects such as debris, beetle, and mite. Fumigation: Ethylene dichloride and carbon tetrachloride mixture at rate of 1 litre for 20 quintals of grains or 35 litres per 100m³.four days is recommended. These tablets will have effect of causing loose motion. Zandu Parad tablet effects on human body such as dry skin, body odour, obesity Side effects of zandu parad tablets: Stress, anxiety, heart disease, weakened immune system.

Fumigation Grain purpose: Mix 1 kg of activate kaolin for every 100kg of grain and store Boric powder mixed with rice will also keep it fresh from insects and worms.

The above systems will leads to following issues such as wastage of manpower and resources, low system reliability, poor scalability peripheral device. Chemicals used for preserving food grains will affect humans and it decreases the life span of humans.

III. PROPOSED METHODOLOGY

An intelligent system for monitoring and controlling the grain condition is designed and also identifying the intrusion of unauthorized person inside the storage place during night. This system is based on ARM9 core processor. The storage place environment information such as temperature, humidity is collected by Multi-sensor arrangements to provide a healthy environment. Intrusion identification is done using IR sensor which alert the securities through alarm. All these information is uploaded to cloud using GPRS module. Ultrasonic pest repellent circuit generates ultrasonic signals to repel pests such as little bugs, mosquitoes, rats, bats, cockroaches etc. The Experimental results shows that grain condition intelligent monitoring system designed in this paper has many good features such as good site stability, easy acquisition and real – time on-line detection.

The temperature sensor senses the storage area temperature and humidity sensor measures the humidity of storage area. These values are inputs to ARM processor. The ARM processor is programmed with threshold of these two physical parameters. Whenever the result exceeds the threshold the processor activates the proper ventilation process through fan and bulb. The intrusion will be identified using IR sensor and to alert the securities through alarm. The information about storage place is updated in the cloud using GPRS module.

Ultrasonic pest repellent circuit is used to repel the pests instead using harmful chemicals. The Ultrasonic pest repellent circuit produces ultrasonic sound, the frequency above 20Khz. 20-30Khz suitable for repel the pests such as little bugs, mosquitoes.30-40Khz suitable for repel the pests such as rats ,rabbits.40-60Khz suitable for repel the pests such as bats, etc.

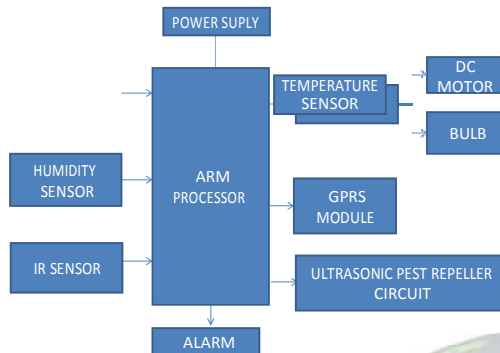


Figure 3.1 Block Diagram of proposed System

Temperature sensor is used for sensing the temperature of the storage place when the temperature crosses the threshold value of 40°C. To maintain the normal temperature here sensor is used to blow air through the valve in which it is opened by the motor. Humidity is the presence of water in air. The amount of water vapour in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapour also influences various physical, chemical, and biological processes. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence is very important, especially in the control systems for industrial processes and human comfort. Humidity sensor senses the humidity level of the storage place when the humidity level crosses the value of 200ppm, it opens the valve through motor and the heater starts providing needed temperature to maintain the normal humidity level inside the storage place. This is very helpful for preserving grains from small insects. These insects found in the place where humidity is much in condition.

GPRS module acts as the interface between ARM processor and Cloud. It collects the measured parameters of storage environment and transmits to the cloud. Cloud is data storage,

IV. HARDWARE DESCRIPTION

A) TEMPERATURE SENSOR:

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

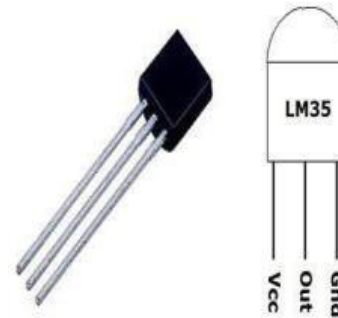


Figure 4.1 Basic Centigrade Temperature Sensor (+2°C to +150°C)

The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^\circ\text{C}$ at room temperature and $\pm 3/4^\circ\text{C}$ over a full -55 to $+150^\circ\text{C}$ temperature range. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to $+150^\circ\text{C}$ temperature range, while the LM35C is rated for a -40° to $+110^\circ\text{C}$ range (-10° with improved accuracy).

The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

B) HUMIDITY SENSOR

The HH10D relative humidity sensor module is comprised of a capacitive type humidity sensor, a CMOS capacitor to frequency converter and an EEPROM used to hold the calibration factors. Due to the characteristics of capacitor type humidity sensor, the system can respond to humidity change very quickly. Each sensor is calibrated twice at two different accurate humidity chambers and two unique sensor related coefficients are stored onto the EEPROM on the module.



Figure 4.2 Humidity sensor

C) IR SENSOR:

The infrared sensor can be used for obstacle sensing, line sensing, etc. and also as an encoder sensor. The sensor provides a digital output. The sensor outputs a logic one (+3.5V) at the digital output when an object is placed in front of the sensor and logic zero (0V), when there is no object in front of the sensor. An onboard LED is used to indicate the presence of an object. Operating Voltage: 5V Adjustable Range using preset (potentiometer on board) Since the sensor module works on INFRARED, for obstacles with reflective surfaces (white colored), the maximum range will be higher and for non-reflective surfaces (black colored), and the maximum range will be lower. This can in turn be used for detecting white/black lines (in line follower ROBOTS) or bright/dark objects (in object identification ROBOTS) Useful for various Robotic Applications, Room Visitor Counter Systems, etc.

1. Adjustable Range using preset (potentiometer on board)
2. Operating Voltage: 5V DC
3. Digital Output: logic one (+3.5V DC) logic zero (0V DC)
4. Mounting Hole of 2.5mm diameter for Easy Mounting.



Figure 4.3 IR Sensor

D) ARM PROCESSOR:

The ARM Cortex-M4 processor with FPU is the latest generation of ARM processor for embedded system. It was developed provide a low-power consumption, while delivery outstanding computational performance and an advanced response to interrupts. The ARM Cortex -M4 32-bit RISC Processor with FPU features exceptional code-efficiency, delivering the high performance expected from an ARM core in the memory size usually associated with 8-bit and 16-bit devices.

The processor supports a set of DSP instructions which allow efficient signal processing and complex algorithm execution. Its single precision FPU speeds up software development by using meta language development tools, while avoiding saturation.

Up to 15 communication interfaces.

1. Low-power operation– Sleep, Stop and Standby modes
2. A/D converters: up to 24 channels and 7.2 MSPS in triple interleaved mode.
3. 2x12-bit D/A converters.
4. Debug mode– Serial wire debug (SWD) & JTAG Interfaces



Figure 4.4 ARM Processor

E).GPRS MODULE:

General Packet Radio System is also known as a third-generation step toward internet access. GPRS is also known as GSM-IP that is a Global-System Mobile Communications Internet Protocol as it keeps the users of this system online, allows to make voice calls, and access internet on-the-go. Even Time-Division Multiple Access (TDMA) users benefit from this system as it provides packet radio access. GPRS also permits the network operators to execute Internet Protocol (IP) based core architecture for integrated voice and data applications that will continue to be used and expanded for 3G services.

Following three key features describe wireless packet data: The always online feature - Removes the dial-up process, making applications only one click away. An upgrade to existing systems - Operators do not have to replace their equipment; rather, GPRS is added on top of the existing infrastructure. An integral part of future 3G systems - GPRS is the packet data core network for 3G systems EDGE and WCDMA

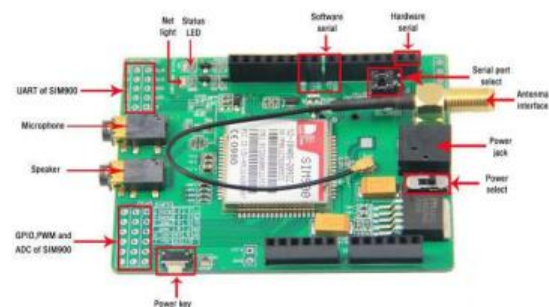


Figure 4.5 GPRS Module

F).ULTRASONIC PEST REPELLENT CIRCUIT:

The Electronic pest repellent generates powerful ultrasonic signals to repel pests. In addition to the Ultrasonic frequency oscillator built with the CD4047 IC, separate push-pull power amplifier and transformer are used to boost ultrasonic signals. The output of the power amplifier is coupled to a tweeter through output transformer X1, which is wound over ferrite core. Primary winding consists of 150 turns of 20 SWG while the secondary winding is 40 turns of 24

SWG wire. Adjusting potentiometer VR1 for maximum effectiveness. This is a powerful ultrasonic pest repellent circuit so use it only in outdoor places.

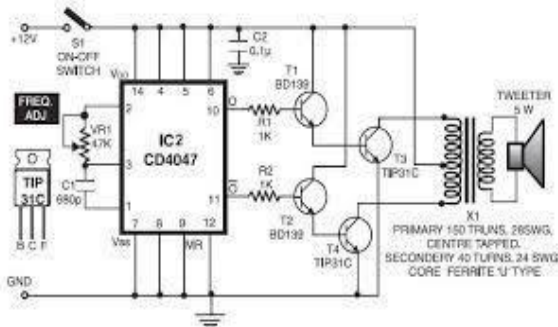


Figure 4.6 ultrasonic pest repellent circuit

V. SOFTWARE TOOLDESCRIPTION

A). KEIL μ Vision IDE:

The μ Vision IDE and Debugger is the central part of the Keil development tool chain and has numerous features that help the programmer to develop embedded applications quickly and successfully. The Keil tools are easy to use, and are guaranteed to help you achieve your design goals in a timely manner. μ Vision offers a Build Mode for creating applications and a Debug Mode for debugging applications. Applications can be debugged with the integrated μ Vision Simulator or directly on hardware, for example with adapters of the Keil ULINK USB-JTAG family. Developers can also use other AGDI adapters or external third-party tools for analyzing applications.

VI. CONCLUSION

The grain monitoring system based on ARM9 and WinCE is proposed in this paper. The hardware circuit design and the integration principles of multi-node information collection based on multi-gas channel are introduced. The intelligent system designed in this paper realizes the functions of the intrusion detection and control of temperature, humidity concentration. Compared with the traditional grain condition monitoring system, the system has high reliability, low cost, good anti-jamming capability, scalability, flexible maintenance and software upgrade. The intelligent monitoring system proposed in this paper provides a new approach for multi-functional grain condition monitoring technologies and systems. The research has significant practical value.

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