

ARM Based Payload Monitoring for Wheel Loader

G. DHIVYA, A. SENTHILKUMAR

Abstract— This project enable us to calculate the weight lifted by a bulldozer. A payload monitor measures and displays payload weight for a bulldozer vehicle by sensing the hydraulic pressure. ARM KL25Z is used to calculate the payload and Graphical LCD is used to display the calculated weight. The hydraulic pressure sensor is used to calculate the weight lifted by the bulldozer. It explores the payload calculation and the calculated value send to the PC or mobile [11] using GSM Module and stored using SD Card.

Keywords- Hydraulic Pressure Sensor, GLCD display, ARMKL25Z, GSM Module, and SD Card.

I. INTRODUCTION

In case of construction, mining, transportations and agricultural work the Earth movers like the Bulldozer, Excavators, Tractors, and Poclains and heavy trucks are playing very important roles. These Vehicles are used to push large quantities of soil, sand, rubble, or other such material during construction or conversion work and typically equipped at the rear with a claw-like device (known as a ripper) to loosen densely compacted materials. The owners of the Earth mover can't keep watch on their earth movers, when it works in remote places, so that malfunctioning with them may takes place. If these earth movers have the remote monitoring system which only under observation of owner so any time owner can catch the earthmover [2] movements, it will be monitoring and find positioning [3] and control [7] system as well. So that we have designed for bulldozer payload calculator.

II. EXISTING SYSTEM

A number of payload measuring devices have been developed. They measure the earth mover position, Fuel [1] working, halt and storing. ARM LPC2148 [4] microcontroller is used to monitor the earth mover position [8] and Fuel [1] working. In existing work the system consists of ARM, GSM module, GPS module LCD and the sensors. The sensor interfaces can be connected to the earth mover unites for the detection [9] of a variety of status data. The hardware structure of the system is dominated by ARM controller, GPS module, and GSM module, antenna, and other components.

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ARM controller as a central processing unit of the system, ARM embedded system has a critical influence on overall performance with real-time simulation and tracking. It has own of static RAM, embedded high speed Flash memory and A/D converter. It has Real-time clock and watchdog. The rich on-chip resources can meet the needs of general industrial control. It works stably and faster, is accessible to the plan. This design adapts the current leading GPS technology [6] and the integrated positioning. A GPS receiver module with high sensitivity, low power consumption, and 20 channels solutions to help Users gain and continuously track GPS signals at a very low signal intensity, which means can be used in the environment where it has never been thought to be accessible, such as Buildings in the city, dense forest and many indoor environment, with a positioning accuracy of less than 10 meters. GSM module is used for wireless communication. Having gained the domestic network card of Radio equipment, it operates in dual-band GSM900 and GSM1800, with power consumption of 2W and 1W respectively. Through this Interface, system can have real-time monitoring of Earth mover's Information, in order to make response timely. The GPS tracks latitude and longitude of the earth mover. With the help of multimedia cell phone or pc with internet, we can find exact location [5] of the earth mover equipped with this system. Nowadays a sensor is placed in truck. The bulldozer lift the weight and through it the truck. Then the truck is loaded the weighing scale measure the loaded truck and measure empty truck. Then we have to subtract the loaded weight and empty weight.

III. PROPOSED SYSTEM

In proposed work the system consists of ARM, Hydraulic Pressure Sensor, Limit Switch and LCD display. The sensor interfaces can be connected to the earth mover unites for the detection [9] of a variety of status data. The block diagram of the terminal board is shown in figure 1. ARM controller as a central processing unit of the system, ARM embedded system has a critical influence on overall performance with real-time simulation and tracking. It has own of static RAM, embedded high speed Flash memory and A/ D converter. It has Real-time clock and watchdog. The rich on-chip resources can meet the needs of general industrial control. The features of the ARMKL25Z is

- High performance ARM® Cortex™-M0+ Core
- 48MHz, 16KB RAM, 128KB FLASH
- 2xSPI, 2xI2C, 3xUART, 6xPWM, 6xADC, Touch Sensor, GPIO

- FRDM-KL25Z Onboard peripherals
 - MMA8451Q - 3-axis accelerometer
 - PWM Controlled RGB LED
 - Capacitive touch sensor
- Evaluation Form factor
 - 81mm x 53mm
 - 5V USB or 4.5-9V supply
 - Built-in USB drag 'n' drop FLASH programmer

IV. BLOCK DIAGRAM

The block diagram of the proposed method shown in the figure 1. The block consist of several units.

- Sensor unit
- Power Supply
- Limit Switch
- ARM Processor
- Display and Memory Unit

A. Sensor Units

A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical. Pressure sensors are used for control and monitoring in thousands of everyday applications.

Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. The hydraulic Pressure Sensor is used to measure the weight of the load bucket. The sensor is placed in the bucket. If the bucket is lifted in particular distance [15] from the ground level then only the sensor will measure the weight otherwise the buzzer will on. The sensor having 4-20mA current output. The Capacitive touch sensor is used for touch sensitive input.

B. Power Supply

A power supply is a device that supplies electrical energy to one or more electric loads. The term is most commonly applied to devices that convert one form of electrical energy to another, though it may also refer to devices that convert another form of energy (e.g., mechanical, chemical, solar) to electrical energy. The supply voltage is 12v. The sensor having 4-20mA output range. The microcontroller having 0-3.3v. So the current (4-20mA) will be converted into voltage (0-3.3v).

C. Limit Switch

Limit switch is a switch operated by the motion of a machine part or presence of an object. They are used for control of a machine, as safety interlocks, or to count objects passing a point. A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts.

When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection. There are two limit switches are used in these

method. The Switch1 is used for ON and OFF the controller. The Second Switch is used to measure the bucket lift distance [15]. If the bucket is lifted from the ground level and reach it in particular distance [15] then the switch will be pressed. Then the sensor will measure the weight and send to the controller. Otherwise sensor does not measure. The bucket is not lifted to particular distance immediately the buzzer will on.

D. Database

We have to create the database to store the calculated value. The back end database development was implemented using MS SQL 2000 [13] server. This software was chosen because;

- It has powerful data handling and processing capabilities making it an overall lead in developing an application that has high data requirements.
- It is easier and faster to build a database since it is readily structured.

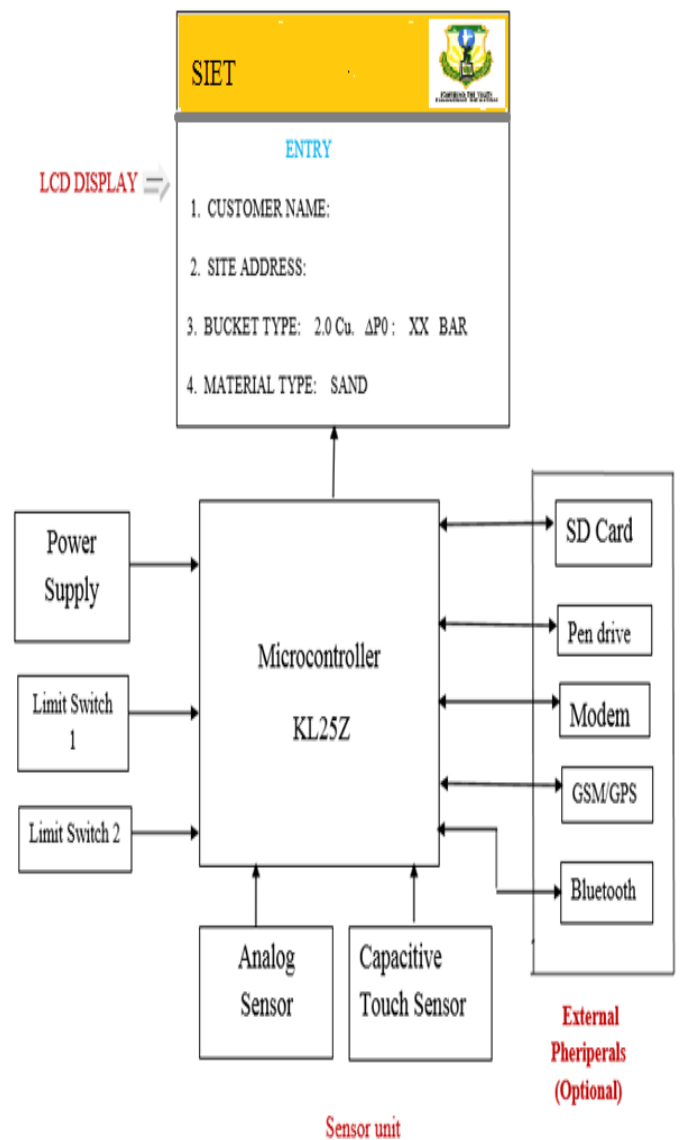


Fig 1: Block diagram for payload monitoring

E. ARM Processor

The ARM KL25Z processor is used for bulldozer payload calculator. These processor having high performance. In Comparison with AVR and PIC Microcontroller Arm is having several advantages. Here ARM Cortex KL25 is a 32 bit microcontroller. It having in built Accelerometer sensor, Capacitive touch Sensor. We can interface with SD card, Pen drive and Modem.

In AVR and PIC microcontroller we need to interface the accelerometer sensor separately. So the cost will increase if we choose these controller. Then the AVR and Pic microcontroller having limited number of external peripherals added. In ARM processor we can interface Bluetooth and GSM/GPS module. The ARM processor having high speed and low cost compare other microcontroller like PIC and AVR Microcontroller. Features of KL25Z:

- Easy access to MCU I/O
- Sophisticated Open SDA debug interface
- Mass storage device flash programming interface (default) – no tool installation required to evaluate demo apps
- P&E Multilink interface provides run-control debugging and compatibility with IDE tools
- Open-source data logging application provides an example for customer, partner and enthusiast development on the Open SDA circuit
- mbed enabled

F. Display and Memory Unit

For display we have to use Graphical LCD display. We are using 2.8 TFT capacitive LCD display. This GLCD can operate at 3.3v. The features of the Graphics display ILI9341 is:

- Display resolution: [240xRGB](H) x 320(V)
- a-TFT LCD driver with on-chip full display RAM: 172,800 bytes
- System Interface
- Low -power consumption architecture
- Operate temperature range: -40 °C to 85 °C
- a-Si TFT LCD storage capacitor : Cost on Common structure only

The Capacitive touch is used for the human interaction. We are used FT6206 Capacitive touch. The features of these touch is:

- Self-Capacitive Sensing Techniques support single point touch and differential sensing
- Absolute X and Y Coordinates or gesture
- Auto-calibration: Insensitive to Capacitance and Environmental Variations
- Built-in Enhanced MCU
- FT6206 supports up to 28 channels of sensors /drivers
- FT6306 supports up to 36 channels of sensors /drivers

Graphical LCD allows the user to draw lines, circles and boxes, set or reset individual pixels, erase specific blocks of the display, control the backlight and adjust the baud rate. The GLCD having capacitive touch Screen and having in built memory. We can store the data using these memory.

We just insert the memory and we can store the data. The capacitive touch sensor is used for user interface. We can enter the manual data through the touch panel.

V. PLMS ALGORITHM

The Preconditioned LMS algorithm which is optimized with respect to approximate a prior knowledge of the input autocorrelation signal. PLMS can result in significantly improved convergence speed with negligible complexity increase relative to the LMS algorithm [14].

It have been claimed to greatly increase the ANC or AVC system convergence rate by adding the inverse of the minimum phase version of the secondary path transfer function to decouple the secondary path effect. It increases the system convergence speed at the cost of increase computational complexity. It having accurate result and the convergence rate is sensitive.

A. Sensor Functionality



Fig 2: Flow chart for the sensor functionality.

B. Customer Information

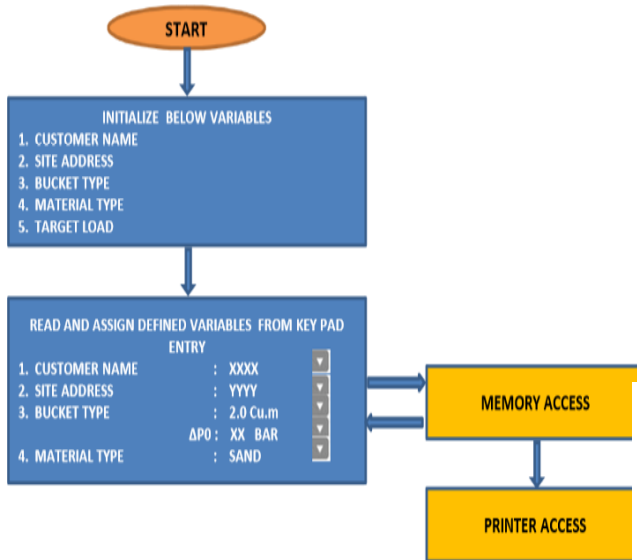


Fig 3: Diagram for the customer information.

VI. RESULT ANALYSIS

We have done this project in AVR microcontroller and got the output. Now we are implementing it in the ARM Processor.

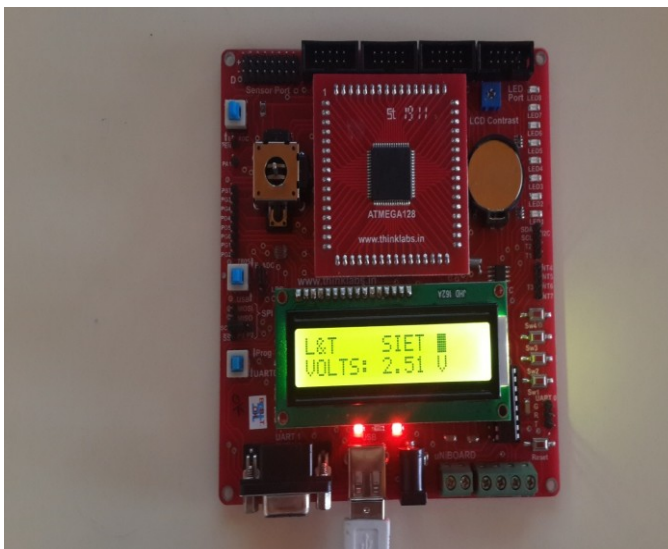


Fig 4: Payload Monitoring using AVR Microcontroller.

VII. CONCLUSION

The Earthmover monitoring system play the important role in remote monitoring and calculating the payload of Earthmover, and also gives the record details of work through storing every detail. In these we use the ARM KL25z processor to measure the work done of the bulldozer. The analog sensor is the hydraulic pressure sensor is used for measure the weight lifted by the bulldozer. The calculated payload will be displayed using Graphical LCD display and also calculated value stored in the memory. We can store the calculated value in database.

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