Monitoring the Level in a Large Structure Localization Method

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Abstract: In many manufacturing processes and robotic applications, localizing geometric structure is very important and useful. Localizing a large structure on the sea is a challenging process as sensory information. The purpose of this paper is to create a new localization method for large structures by using laser beam. In this paper, we propose a new method of large structure localization. This method is mainly based on using inexpensive PC included a LD, a PD, and a real time data transmission (RTDT) system to acquire precise measurements.

Keywords: Localization, localizing geometric structure, laser beam sensor, real time data transmission, RTDT

I. INTRODUCTION

In many manufacturing processes and robotic applications, localizing geometric structure is very important and useful. Localization of a general structure has been studied in many papers [1-4]. In the construction industry, large objects are normally measured directly using tapes and plummets. However, LD and PD with wireless communication capacity eliminate the burden of direct contact to the object. This eliminates the risk to operators who previously had to move around a large dangerous structure. This approach also gives more precise data to the level measurement, and is more productive. In addition, it creates a retrievable digital record on to the PC database (Microsoft Excel).

In order for this method to be accepted generally it must be inexpensive and accessible to people with no knowledge of laser measurements. This method is mainly based on using inexpensive PC included a LD, a PD, and a real time data transmission (RTDT) system to verify the precise level measurement. We have applied this method to monitor the correct level of a large structure on the near sea. As the result, it is possible to detect the height of a large structure with only minor errors.

II. EXPERIMENTS

1. Description of the laser measurement system

Fig. 1(a) shows the schematic diagram of our monitoring system for measuring the correct height of a large
structure. The rotating laser system on the floor emits the red beam at 635*mm* in wavelength and 2mm in diameter. The receiver catches the laser beam, and the real time data is transferred to monitoring room by the RS-422 communication or Bluetooth, then it is displayed on the LCD. The specifications of laser transmitter are as follows. Automatic control range of angle: ±5°, rotating speed : 50~ 300*rpm*, accuracy : ±20″

The diameter of beam from laser sensor is about 2*mm*. In 5*mm* interval, two sensors are located, and then it becomes possible to detect the size of laser beam in the near region. The size of laser point gets larger as it goes further. Therefore many receiving sensors installed on PCB could detect the laser beam. At that moment, the output signal from the laser beam is transmitted to the input of microprocessor. Fig. 1(b) shows the enlarged beam spot in the far away region. In this case, the microprocessor read the signal from center of the enlarged laser beam. Therefore, it could be possible to detect the correct level even though the larger beam size in a long distance.

Fig. 2(a) shows the driving circuits of receiving sensor. The photo sensor perceives the signal from the rotating laser beam, at that moment, the obtained TTL

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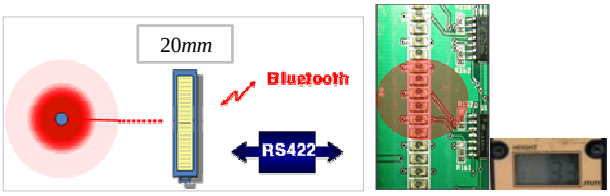

signal is transmitted to the microprocessor. Only constant frequency is transmitted by using band-pass filter circuit, while the scattering light is cut off. Up and down frequency near the constant frequency is ignored by the programming techniques. Therefore, it is designed to perceive signal of rotating laser beam. Fig. 2(b) shows Fig.1. The schematic diagram of monitoring system, and the enlarged beam spot in the far away region

the waveforms which come out from the receiving sensor. The upper yellow waveform is obtained from the amplifier, and the lower blue waveform is obtained from the ending part of Fig. 2(a). This is also the input signal for microprocessor. Fig. 3 shows the transmitting circuit of RS-422 and Bluetooth which sends the retrievable perceiving signal to PC through the communication systems. It is possible to send signal selectively with wireless or not.

Fig. 4 shows real time data transmission (RTDT) module. It consists of three parts which are the laser beam sensors, RTDT board, and the PC monitoring system. The RTDT module has 10 channels which deal with accumulated data in real time communications with RS-232. At this moment, each sensor has its own numbering and the height is displayed on the PC monitor with numbering. In case of wireless, each signal is transmitted by the Bluetooth module.

Each signal from laser beam sensors is read on the PC monitor in a real time. And the change of accumulated data is displayed with graphs on the PC monitor. The difference between previous and current data is also displayed. All the data is stored in Excel file according to the elapsed time. Fig. 5 shows the example of experimental arrangement. The location of installed sensors is shown in this figure. There are more than 3 laser sensor poles in P-line and S-line. These sensors perceive the beam spot from the rotating laser on ground, the perceived data is transmitted to the PC monitor in real time. Up-down balance is sustained by comparing with the reference level. The location of NEAR and FAR sensors perceive the barge level which is right or left.

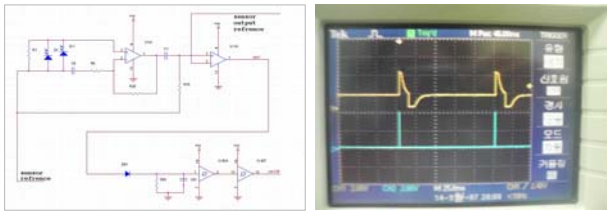

Fig.2. The driving circuits of receiving sensor, and the waveforms which come out from the receiving sensor

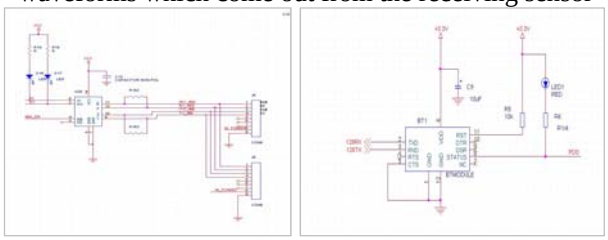

Fig.3. The transmitting circuit of RS-422

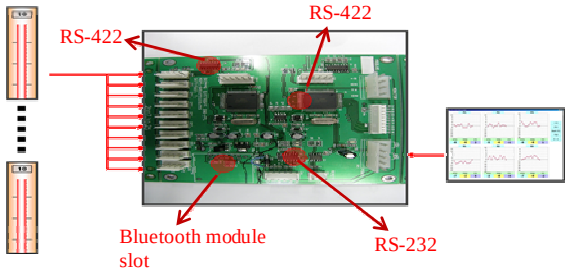

Fig.4. The real time data transmission (RTDT) module

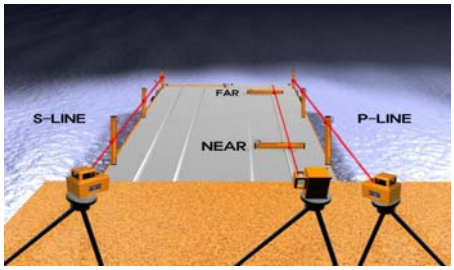

Fig.5. The example of experimental arrangement

III. CONCLUSIONS

In this work, we try to attempt the real time localization by using inexpensive PC included a LD, a PD, and a real time data transmission (RTDT) system to verify the precise level measurement. We attempt this method to monitor the correct level of a large structure on the sea. As the result, it is possible to detect the height of a large structure with a small error.

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