MINISTRY OF EDUCATION, CULTURE AND SCIENCE

МОНГОЛ УЛСЫН ШИНЖЛЭХ УХААН ТЕХНОЛОГИЙН ИХ СУРГУУЛЬ
MONGOLIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

MONGOLIAN ACADEMY OF SCIENCES

MONGOLIAN YOUNG SCIENTIST ASSOCIATION

MONGOLIAN YOUNG RESEARCHER'S ASSOCIATION OF TECHNOLOGY AND INNOVATION

SCIENCE AND TECHNOLOGY FUND

CHAGDARJAV FUND

KHURELTOGOOT-2015

Technology and Innovation

Ulaanbaatar, Mongolia
2015

Controlling and measurement system for environment of heritage saving

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Abstract— **Aim of this study is two different sensor network applications that manage environments for heritage saving and describes how to collect and manage sensor data by the sensor grid architecture.**

Keywords*— *sensor, board, environmental condition, grid architecture

I. INTRODUCTION

The purpose of this paper is to establish the monitoring, measuring and control system for environmental conditions by using sensor grid architecture. We are studying to carry out the research focusing on grid computing of a versatile sensor device including an access point for wireless to heritage saving.

Mongolia has a lot of valuable heritages, but they could not be saved in a convenient environment. This research will intend to prepare the best environment to save heritages, implemented in Institute of Language and Literature. First, we have to research and determine the convenient environmental conditions. This research will be focused to design grid sensor architecture with sensor network that measures and control environmental conditions. First stage, we considered heritages of library or archival collection, such as book, paper, photographic material, magnetic tape.

Integrating a sensor network by grid architecture is possible to collect sensor data to web services for processing and managing environment. The sensor network of two environments can be processed in different tasks.

II. MATERIALS AND METHODS

A. A general method to produce control and measurement system

Following schematic shows the general method which produced this system.

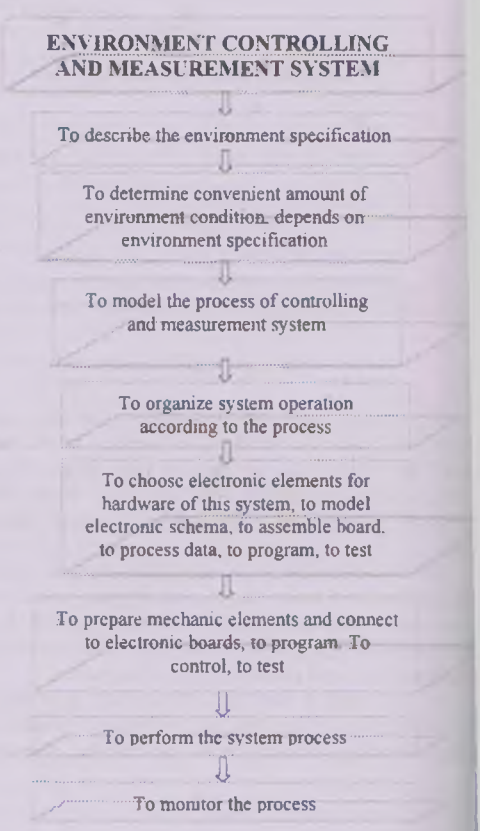

Fig. 1. General method schematic

B. Environment for Heritage saving

Knowing the environmental conditions for heritage saving is essential for planning the best strategy for the preservation of collections and targeting your resources effectively. [3]

Books, papers, and other heritage items in libraries and archival collections are made up of a variety of components. The useful life of these materials is determined by the inherent characteristics of these components and by the environment

which they are housed. Strict environmental controls are necessary to slow the rate of deterioration since the useful life of documentary materials is significantly affected by the levels of temperature, relative humidity, light, and air pollution in which they are stored. Minimizing fluctuations in temperature and relative humidity is an attainable goal, and it retards chemical deterioration. Environmental conditions for documentary materials stored separately from areas used by patrons can and should be maintained at more stringent levels than for materials stored in areas used by people. [1,2] If the environment will be managed by belongs environment conditions mode, the heritages can live a long time.

TABLE I. RECOMMENDATION OF TEMPERATURE

Materials	Temperature (C)	Allowable Range (+ or -)
Paper, & People	20°-22°	3°
& Paper Alone	16°	3°
graphic Materials	10°	3°
& Photographic Materials	16°	3°
ic Media	10°	1°

TABLE II. RECOMMENDATION OF RELATIVE HUMIDITY

Materials	Relative humidity (%)	Allowable Range (+ or -)
& Paper Alone	40-50%	5%
graphic Materials	35%	3%
& Photographic Materials	50%	3%
ic Media	30%	3%

TABLE III. RECOMMENDATION OF LIGHT

Type of Space	Light Level Range
	10-50 lux (1-5 fc)
	50-150 lux (5-15 fc)
work areas	300-600 lux (30-60)*

Our experimental object is Institute of Language and Literature in Mongolian Academy of Sciences. There are two repositories such as Linguistic depository and Tibetian codex depository, which is saved 10000 books included Tibetian, old Mongolian codex. The linguistic depository is saved 1066 magnetic tapes. Those graphics and tables are shown the environmental conditions of our research object that is measured in winter season.

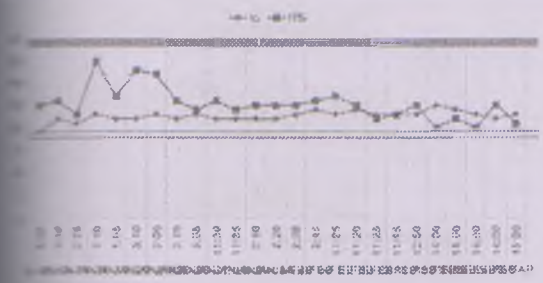

Fig. 2. Environment conditions of Linguistic depository

TABLE IV. ENVIRONMENT MEASUREMENT AMOUNT OF LINGUISTIC DEPOSITORY

	Temperature C	Humidity %
Max	25°	35
Min	19°	20
Median	22.6°	25.28

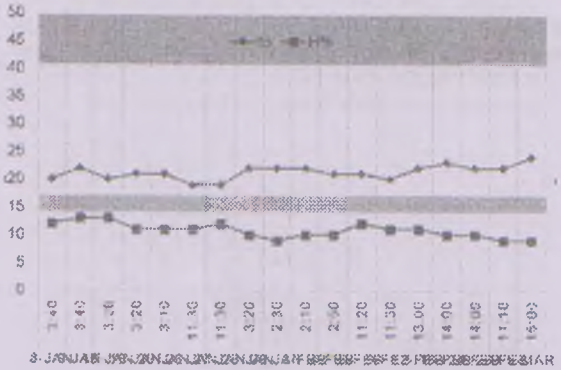

Fig. 3. Environment conditions of Tibetian codex depository

TABLE V. ENVIRONMENT MEASUREMENT AMOUNT OF TIBETIAN CODEX DEPOSITORY

	Temperature C	Humidity %
Max	24°	13
Min	19°	9
Median	21°	10.8

You can see from those measurement results, the environmental condition of our research object is not sufficient to the environment recommendation.

C. Principle of system operation

The controlling board of this system is used STM32F407, which receive and process the data of environmental condition from the sensor node. Depends on environment condition, we have chosen sensor nodes three different sensors such as temperature and humidity and light. After processing the sensor data, STM32F407 controls the actuator node according to the environment recommendation. And it should save all data of that process in data storage. It is necessary to decompose the environment changes. The next figure shows the general operation of measuring and controlling data. [5]

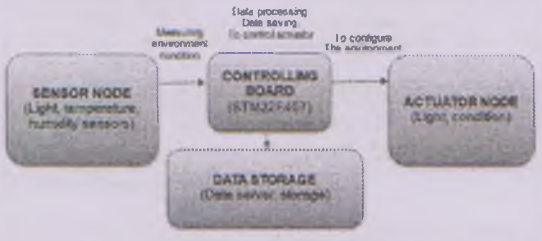

Fig. 4. The general process of measurement and controlling

III. RESULT AND DISCUSSION

A. Hardware processing

We have produced a layout schema of the sensor node, using EAGLE 6.4.0 Light CADSoft professional program.

In figure 5, we show you the layout schema and the PCB that we produced, using EAGLE 6.4.0 in Electrical measurement and measurement signal processing institute of Graz University in Austria. [4]

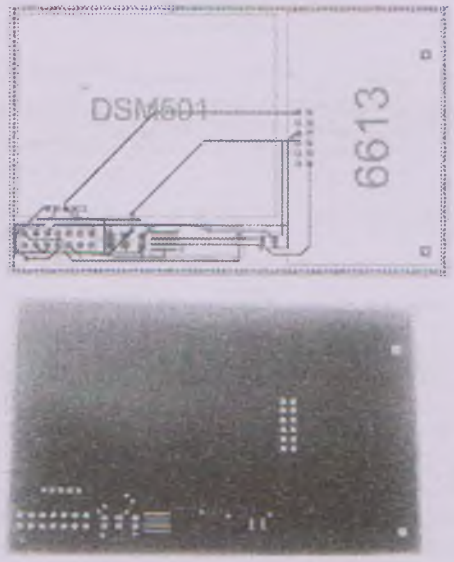

Fig. 5. PCB of sensor node

B. Software processing

The source program of STM32F407 is written in CoIDE software, based on C++ programing language.

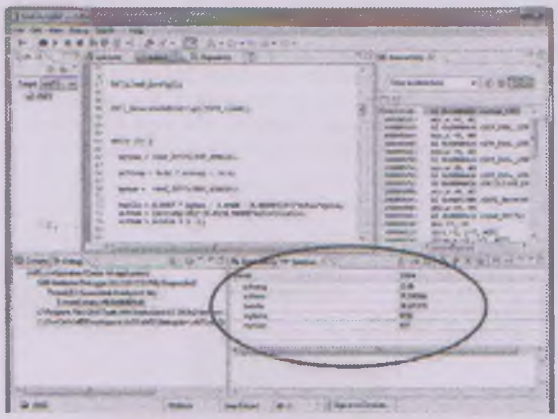

Fig. 6. Measuring sensor node data using CoIDE

We are showing you the main algorithm of sensor measurement. The data transmitting protocol are I2C.

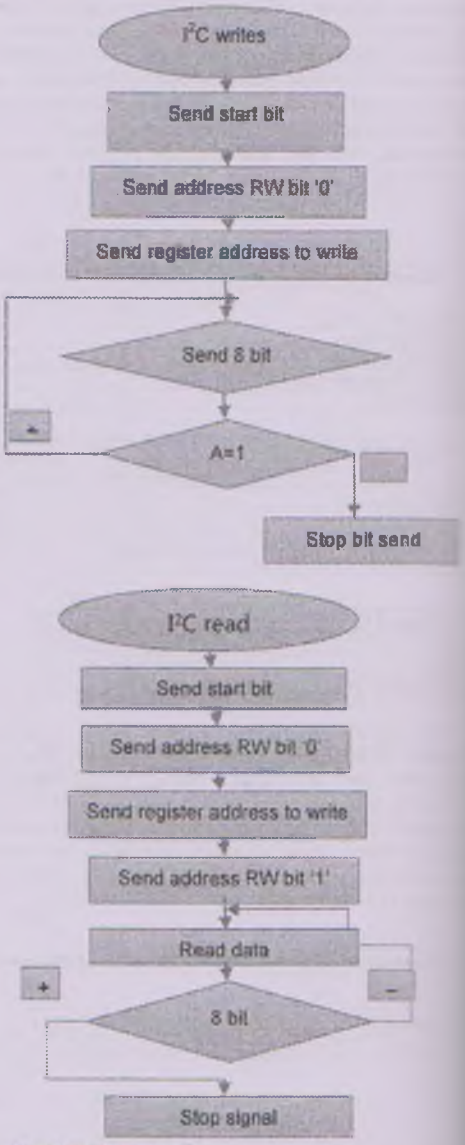

Fig. 7. Algorithms of sensor node

C. Control and measurement system based on Sensor Grid architecture, integrating Sensor network

The sensor grid system is integrated sensor network with grid computing. In this case, the system works that when a request comes in on the grid client node, it gets split into sensor tasks for different environments. Each sensor node measures the environment data by sub tasks and control sensor actuators.

determining environment condition mode. After processing the data they transmit each result. The main task of grid client node is integrating and returning the full results of all environments to web services. A database created in web server, operators can manage and monitor the environments.

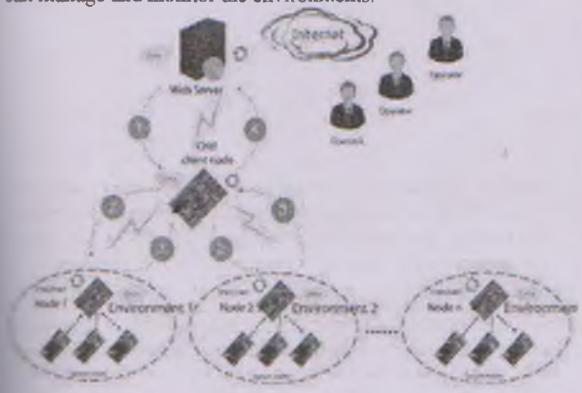

Fig. 8. Control and measurement system based on Sensor Grid architecture

1. Initial request
2. Splitting and processing with data
3. Returning measurement result
4. Integrating and returning full results

Sensor networks are processing data by distributed Grid computing specially MIMD design. Sensor nodes are a temperature sensor, humidity sensor and light sensor. They are using principal of multi instruction, multi data.

A collection of these sensor nodes forms a sensor network, which is easily deployable to provide a high degree of visibility into real-world physical processes as they happen, thus benefitting a variety of applications such as environmental monitoring, surveillance and target tracking. [2]

And the environment grid nodes collect sensor data and transmit it to the grid client node. And the sensor actuators are controlled by environment grid nodes. These combinations can be called sensor network. Integrating sensor network with the traditional grid architecture will allow data transmit to Web services.

The sensor grid network that we are installed, which shown in figure 4, is in Institute of Language and Literature. The environment modes of this two depositories are different because of heritage materials. Therefore the environment nodes implement multi different tasks and transmit multi different data to the grid client node.

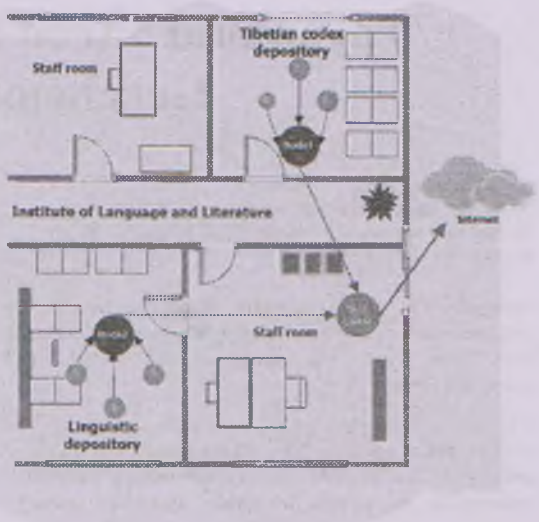

Fig. 9 Layout of control and measurement system in Institute of Language and Literature

IV. CONCLUSION

We tried to implement the primary experiment of the sensor grid network for the heritage saving environment. The main aim of this study is how to manage and monitor environmental condition, also how to combine and orderly process data using grid computing architecture. We had worked out that sensor grid architecture with sensor network will support heritage saving environment. The next time we have to study about wireless and GSM connection of the sensor grid network. This sensor grid system is planned to extend the various environments in Mongolia. Application in Mongolia we are focusing is for museum, monastery, national library and national archive.

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