Proc. Annual Symposium on Research & Industrial Training, 03(2016) 291-295
Department of Electronics – Wayamba University of Sri Lanka

ARDUINO BASED WIRELESS PRODUCTION MONITORING SYSTEM

S.V.P.T. Sandamali*, J.M.J.W. Jayasinghe

Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka
*tharangikasandamali@gmail.com**

ABSTRACT

When considering the quality engineering process of the CCS Lanka (Pvt) Ltd, it is important to know the efficiency of the past hour and the current states of the production line. This project aims to provide a clear picture of the assembling line. It helps to identify the current state and to design a future state for the series of events. A system has been designed to count the number of PCBs which pass through the assembling line. The system was comprised of an Arduino board with base station computer (server) and another Arduino board (node) which communicates with each other through NRF24L01+2.4GHz wireless transceiver module. Server is designed to get updates from node and to display current state of the line.

Keywords: Production monitoring, Counting production, Efficiency

1. INTRODUCTION

Productivity is the main important measurement in any production line or a manufacturing company. Productivity measures the relationship between inputs into the production process and the resultant outputs. Productivity can be measured in several ways. Some of those are output per worker or hour of labor, output per hour / day / week, output per machine, unit costs (total costs divided by total output)[1]. The proposed system was designed to find current state of the production line. This is the easiest way to find the productivity based on output per hour /day /week. This system also helps to find the efficiency of the production line during the past hour. This project included the wireless production monitoring system for collect the data from machines in a production assembling line. This data is directly used for analyze in graphical user interface such as LabVIEW. Data acquisitions for such systems are conventionally done

using wired sensors connected to a central controller. A less expensive and more advanced solution for this data acquisition is by using a distributed Arduino based microcontroller network connected wirelessly using Industrial, Scientific and Medical (ISM) bandwidth. This network uses a specially developed customizable counting algorithm to count PCBs simultaneously and reliable communication between nodes is ensured by using a unique Round Robin Algorithm (RRA). The system was comprised of the main Arduino board with the base station computer(server) and data acquisition Arduino board(node) which communicate with each other through NRF24L01+ 2.4GHz wireless transceiver module. The software portion of the project resided on the Arduino board and on the base station computer. Every node is capable of counting up to eight sensor inputs in parallel and the data is stored in the node's non-volatile memory[5]. The acquired data is then transmitted to the base station upon request. The design is open up to use 10 number of nodes.

2. EXPERIMENTAL

The data acquisition system mainly contains two parts which are the data acquisition board and the main server. It is necessary to use a separate data collector at each point that needs its status. As the data collector an Arduino board with NRF24L01+ 2.4GHz wireless transceiver module has been used. It has the capability to collect the data and communication wirelessly with main server and Arduino mega board is used as main server[2].

2.1 Data Acquisition Board

The data collector consists of three parts: sensor capture, the Micro Controlling Unit (MCU), and the wireless transceiver module. The sensor capture hardware consists of the relays that change the 24V sensor logic level into 5V logic level. The circuit works with 5-24V power supply and it contain 5V regulator for MCU and 3.3V regulator for wireless transceiver module. A detailed schematic of the board can be found in the appendix. The count goes up as the logic level change as LOW HIGH LOW.

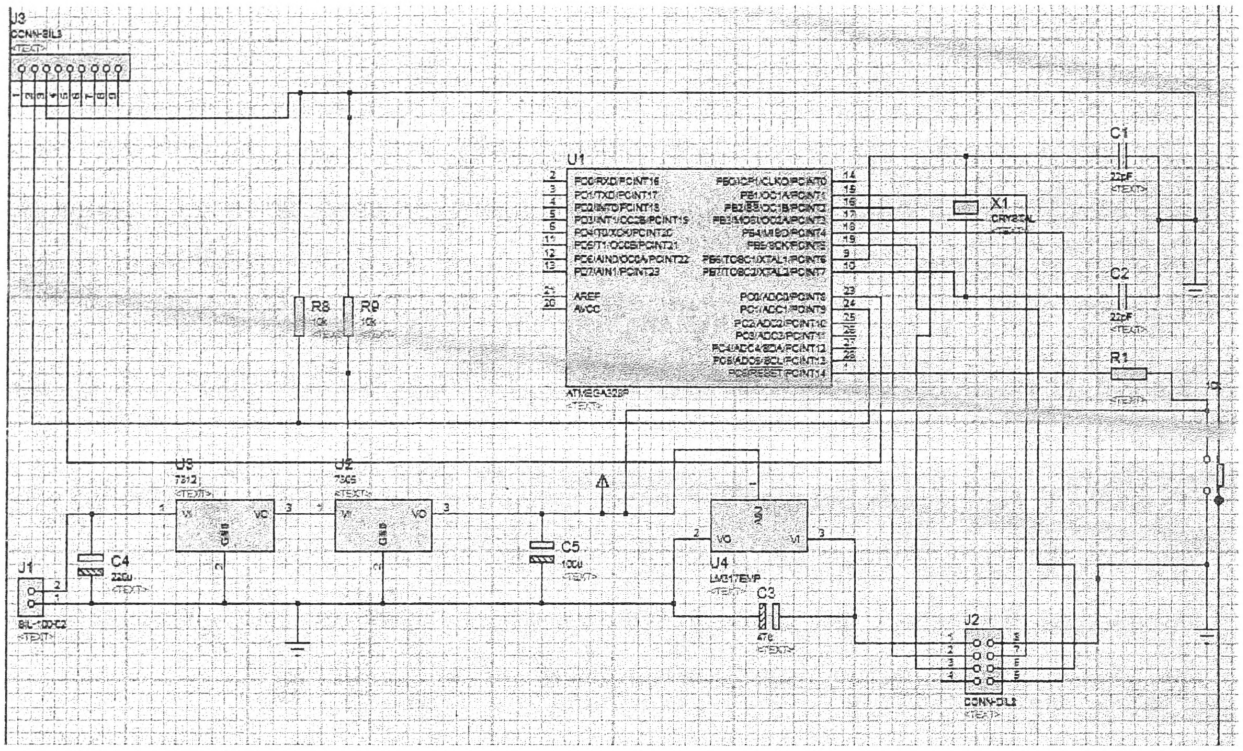

Figure 1: Data Acquisition Schematic

2.1.1 Server software

The server is programmed to work with the base station computer. The server module is connected to the base computer via USB as a virtual COM port. All communication between server and base computer is done through COM port. Server is programmed to wait for instructions from base computer. Once an instruction is received a request is sent to the corresponding node and returns the status of the operation to the COM port as a boolean value. If the operation was successful the return value is 1 and 0 otherwise. If the node is not available or no reply was received a string message is returned before the boolean value. Request to get count of a node return counts of input pins separately. The request messages are integer numbers and the replies for the count values are long numbers where the message is coded within the digits of the numbers.

To read the count of any node request for count must be sent to the server. Once the request is received the server communicates with the node and collects the counting data. If the communication was successful the reply is sent to the COM port by the server. The reply is in the form of line separated long values. Number of lines depends on the number of enabled pins. Every line contains a code which indicated the reply type, node number, pin number and count.

2.2 Node software

The node is programmed to work independently and is able to communicate with the server via nRF24L01 radio module. Parallel input monitoring program is used to count PCBs. The program checks the input pins and if the pin changes from low to high the time is recorded. Once the input changes back to low the time input was kept high is calculated and checked against the PCB check time. If the time is higher than the check time the count is increased and saved on the EEPROM. A 5ms de-bouncing time is introduced to avoid noise interference. Every node has its own frequency channel for communication. Once the node number is set in the code the channel is set automatically. The channels are selected such that the interference in selected channels is, minimum in the area where the system is implemented. The node is programmed to accept requests from the server and act accordingly[5].

3. RESULTS AND DISCUSSION

Arduino based wireless production monitoring system mainly designed to work as a counter. So the number of PCBs which passes through the conveyer belt has been counted. LabVIEW interface has been used to control and analyze the collected data by two nodes. The system contained the feature of target number of PCB within given time period. After completing that time period, the system generates a signal to perform the efficiency of the production line.

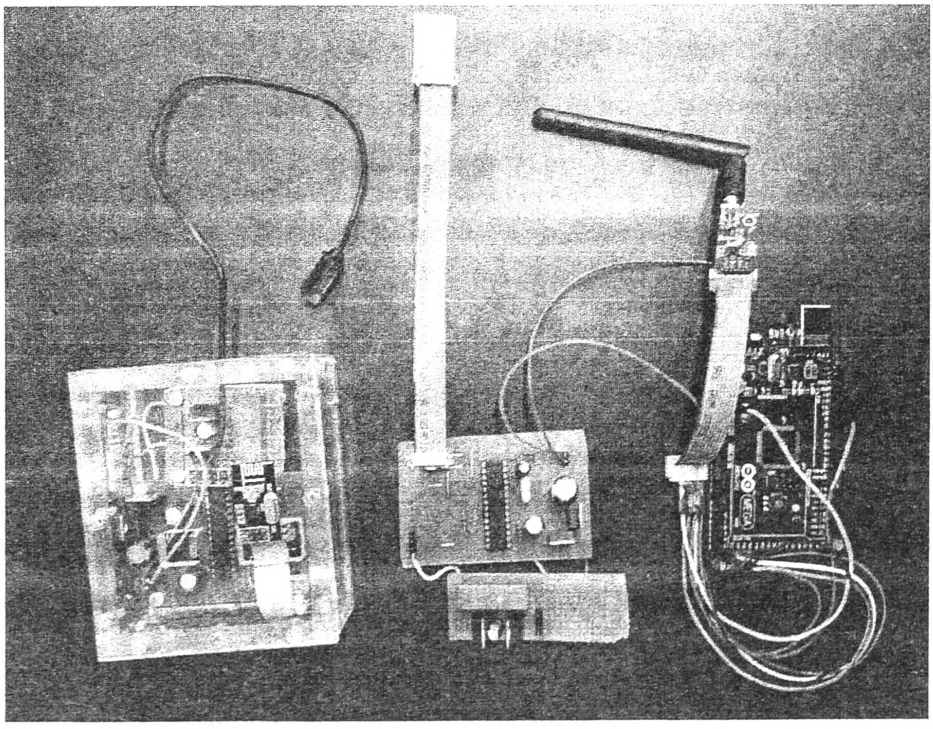

Figure 2: server and node circuits

4. CONCLUSION

The production line at CCS Lanka (pvt) Ltd maintained the manual PCB counting systems to count the number of PCBs which passes through the conveyer belt. But it is hard to implement and maintain because one employee should be allocated for the counting process always. An Arduino based production monitoring system was designed to fulfill the above requirements. The system is a data acquisition system that mainly focused to be used for value stream mapping with a LabVIEW interface for a production assembling line. The data is mainly sensor outputs. The project aims to provide a clear picture of the assembling line which helps to identify the current situation and designing a future state for the series of events.

ACKNOWLEDGEMENTS

The first author would like to acknowledge and express her gratitude to the Training Manager at CCS Lanka (Pvt) Ltd and also extend her sincere thanks to the staff of Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya.

REFERENCES

[1]. http://www.tutor2u.net/business/reference/production-efficiency

[2]. https://arduino-info.wikispaces.com/Nrf24L01-2.4GHz-HowTo

[3]. http://www.mouser.com/applications/rf-wireless-technology/

[4]. http://cerasis.com/2013/10/07/lean-environment/

[5]. http://www.qualitygurus.com/courses/mod/forum/discuss.php?d=

[6].http://www.instructables.com/id/Burning-the-Bootloader-on-ATMega328-using-Arduino-/