International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-11, September 2019

Wireless Sensor Network and Industrial Internet of Things Based Industrial Machinery Control and Noise Detector

Rajesh Singh, Anita Gehlot, Himanshu Sharma

Abstract*: This paper describes a wireless sensor network and industrial internet of things based Industry machinery control and noise detector, where the using control platform is Arduino, While TCP and IOT is serving as a communication protocol. The function of Arduino is to understand data destination along with the functioning of data to that machine similarly sensors used to take information at their level and fed back for the proper functioning. This paper aims in designing a convenient wireless industry where cabling is not possible. It also has lower installation and maintenance charge for flexible Industry. This paper presents the measurement and reduction of noise from the machines for the betterment of workers.

Keywords: WSN, Internet of robotics things

I. INTRODUCTION

In every industry the cost of maintenance and production increases with the wired transmission too along with this many pumping machines lie outside the production plants, so in that harsh environment their cable can damage, so to get out from the cage of wired devices, why not industry be wireless, so with this paper we are proposing industry based on IOT and all the sensors are delivering there data wirelessly along with this we are providing detection and rectification of noise. Our aim is to design a wireless system for industries so, we can access remotely and can monitor its process using desktop as well as through smart phone in real time. Along with this even we are using wireless protocols to send command; security will be the strongest parameter of the sustainability of our system [1]. Here we are using an Internet of Things protocol we are serving as a mediator between sensors and data in cloud, but for this, we have to choose a MCU, which can perform required task with taking consideration of power management, response time and bandwidth, cost. So here we are focusing in the introduction of multi-MCU with FPGA bridge so, at edge level it can perform network management, embedded data collection and network communication. Now, with this it will reduce the power consumption in real time and improve its scalability than other. [2]. Along with this as safety is also a major concern in industry, so here we will design safety analysis for the machines as well as for a worker, here with help of a approach named accident reduction model which help us in determining the respective weights of human, machine security and work environmental safety for the decision making process in problem[3].But this safety concern is all about safety from the machines or of the machines, as the unwanted signals which we called noise can make machines unable to take decision so, we are detecting as well as rectifying noise, as when there is a difference between machine past and present it generate a noise and with help of algorithms we can rectify that noise, so whenever we get noise instead of only identify it will rectify too[4].For this rectification we have to check machine state regularly so, we are introducing a condition checking process in which we get to know about the machine state without intruding on its working, these checking processes is used to check vibrations, examine engine current mark etc. these we can use to check deformities[5]. So whenever we get noise we apply some algorithms to determine as well as reduce the noise, as noise reduction can serves better for the safety of workers so, our system should determine noise [6]. Again noise can also generate in rotating devices so with this we are developing algorithms, How to monitor the structural changes in rotating machines, as there structural changes can make them unfit for use as well as it will give poor result so, through graph model we represent statistical dynamics in machine monitoring[7].

Now, With this for fault diagnoses we have an Industrial Wireless Sensor Network (IWSN) and its use in fault diagnosis, like if sensor node will transmit diagnosis result once per hour then the node life time will reach to approx. 73 days [8].Here we implemented a single hop sensor for the ease of real time monitoring and data processing. We are using LabVIEW for the signal processing. [9].

II. HARDWARE DEVELOPMENT

This paper is building a wireless system The block diagram (Fig1) showing different departments of Industry distributed in a distribute networks. The main control unit will chooses the path or network (Internet Of Things) and sends the command to local control unit in industry which is pre-decided that the required command is for which distributed system. Every distributed system has its own WPAN for the data transmission at local level, and using that command it will then decide where to send command or for which machine the command is. At the machine level, sensor has to detect noise at every interval of time and it will reach the main control unit for the betterment of safety of machine as well as workers. fig2 is showing the machine sensor level of the industry, The generalize block diagram showing the data as well as power transmission from the transformer to the +5v DC.

Manuscript published on 30 September 2019.
*Correspondence Author(s)
Rajesh Singh*, SEEE, Lovely Professional University, Jalandhar, Punjab, India.
Anita Gehlot SEEE, Lovely Professional University, Jalandhar, Punjab, India.
Himanshu Sharma, ECE, UPES, Dehradun, Uttarakhand, India x

The converted +5v dc will supplied to Arduino platform for the decoding of code sent from main control unit, and to the display unit which will show that which relay is active at the current state. Once, the command make relay active, the respective machine will work and the noise detector circuits will detect noise. Local control unit is serving as a mediator between WPAN (XBEE here) and IOT (ESP8266). The AC power is converted into +5v dc for the Arduino platform and for the display unit (Fig3). When the data from machine sensor level or from main control unit will arrive, Arduino decides from where it is coming and to where it should send.

The main control unit (Fig4) will receive noise readings from the machines and according to it, it will detect which machine is working properly.

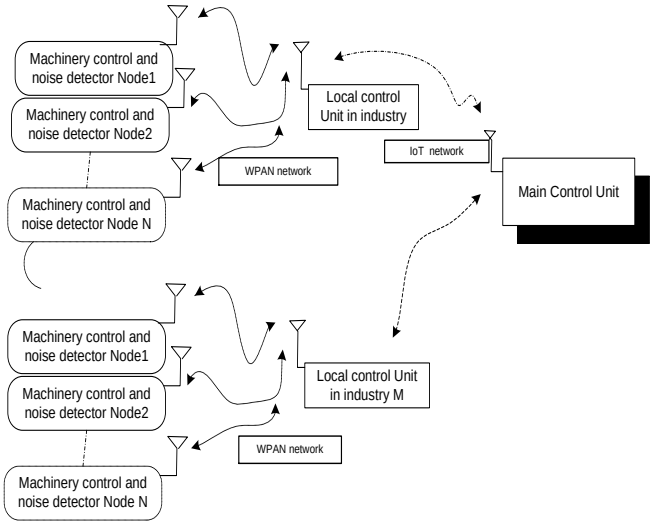


Fig1. Generalized Block diagram of Machinery control and noise detector

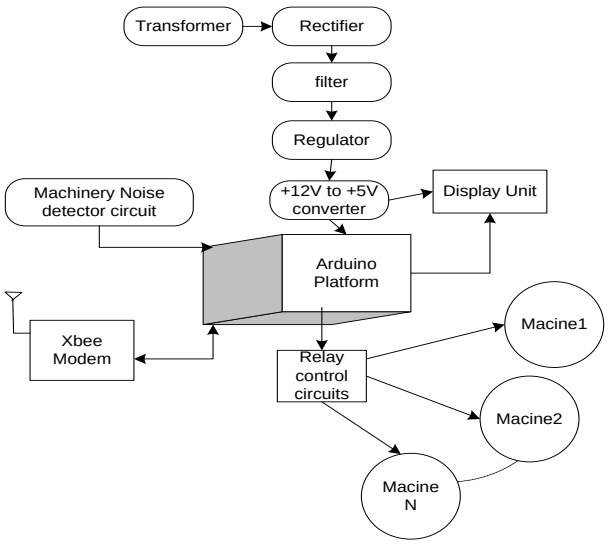


Fig2. Machinery control and Noise detector Node

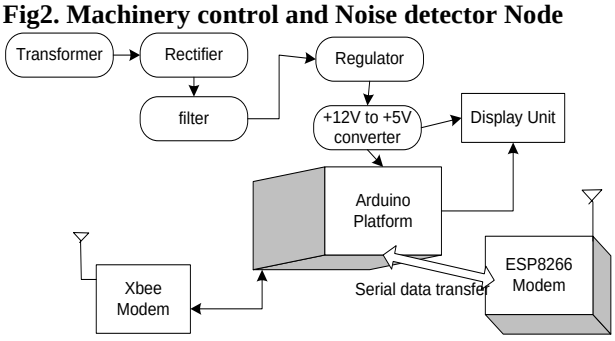


Fig3. Local control unit in Industry

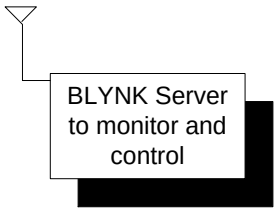


Fig4. Main control unit in Industry

TheFig5 shows, the model of machine sensor level of an industry, and showing a vibration sensor for rotating devices connected with an Arduino Uno, and a XBee module for the transmission of data along with the display unit shown below. Whenever Arduino gets data for the activation of relay 1, it will make the circuit complete and turn ON the machine 1(showing through the motor).Similarly, the respective vibrations value send from the machine sensor level to the distributed level through the XBee module and data from distributed level to this level will also follow the same path. Fig6 is showing local control unit, Comprises Arduino Uno, XBee and ESP8266 module and display unit.

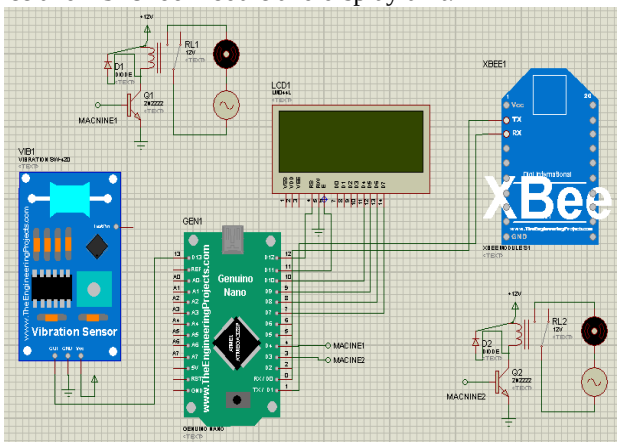


Fig5. Circuit of Machinery control and Noise detector Node

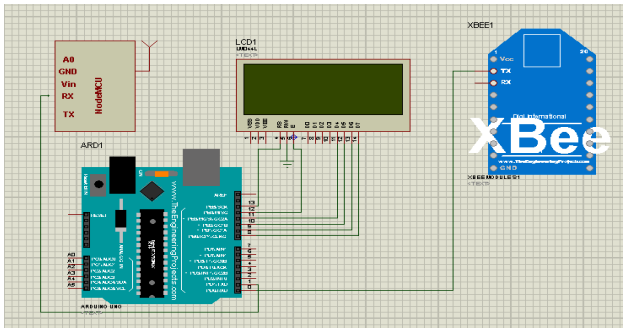


Fig6. Circuit of Local server for Machinery control

III. SOFTWARE DEVELOPMENT

If you This part of a paper is representing the software development of the process or flow chart of the process. The first step is to initialize all the inputs and outputs port, sensors and all the controlling devices. At the sensor level, If sensor is giving some output and the local server is giving some input to the machine then it will check for which machine is the output is?(fig7).

Retrieval Number: K13610981119/19©BEIESP
DOI: 10.35940/ijitee.K1361.0981119
Journal Website: www.ijitee.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

Similarly if it not getting any output from local server than it will re send into the loop for re checking the local server input. If we get to know that the local server data is for this machine A so, it will automatically make machine A ON or OFF according to the input command.

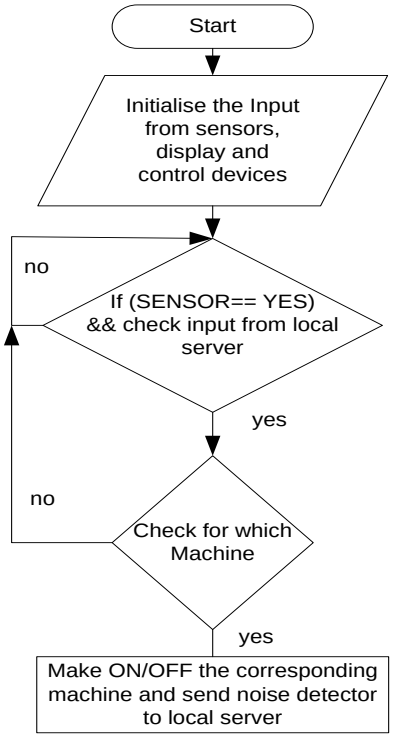


Fig7. Flow chart for Machine control and noise detector

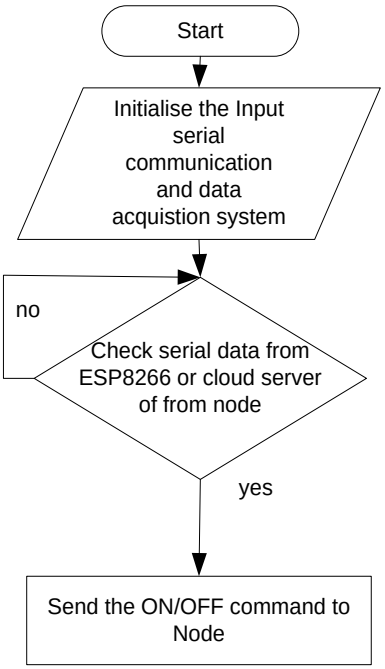


Fig8. Flow chart of local control

Now, for the local control, it will first initialize all the communication system;XBee, ESP8266.After this it will check for the data coming from main control through cloud server or from node, if it detect then it will decide for which distribution this data is?In addition, it will send ON/OFF command to that local control system (fig8). If it will not detect or get any data then it will again feed to loop for the further checking.

IV. IoT IMPLEMENTATION

Before A level2 IoT system has a single node/device that performs sensing and/or actuation and local analysis as shown in fig. The data is stored in cloud and application is cloud based. The system are suitable where the data involved is big. However, the primary analysis requirement is not computationally intensive and can be done locally itself. Example is smart machinery control system and noise detectors. In the system have single node measures vibration level and control the machinery like machine1, machine2… etc.

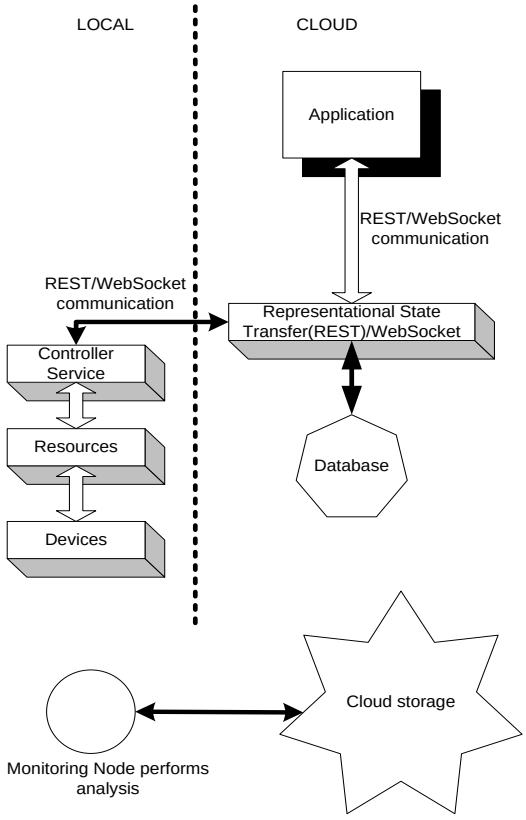


Fig 9 level 2 IoT implementation model

V. RESULT AND DISCUSSION

This paper is giving idea for how can an industry be automated wirelessly. Here is the only experimental setup, but through this idea, an industry can be well automated without any constraints. Through this paper, we analyzed that the growth of the noise is not only dependent on the no of running machines but also on the running of machines simultaneously, but through the setup, we are easily reducing the noise. Fig 10 shows the

Application development using Virtuino platform. The APP consist of ON/OFF control for two machines and data logger for vibration sensors and along with this we have 1 emergency stop button, Now if we make any machine turned ON it will make it on and through this app we can easily see, along with this noise meter is showing generation of noise.

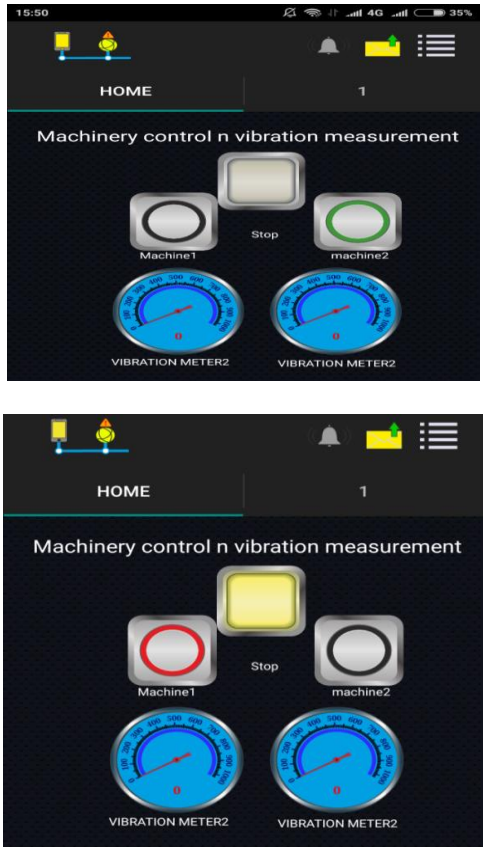


Fig10 Views of APP development in Virtuino platform

This paper proposed a generalized machine level(Fig11) device used for data transmission. side boxes representing relay boxes, screen will represent which machine is working and noise value generated by respective machine and the antennas for the wireless data transmission.

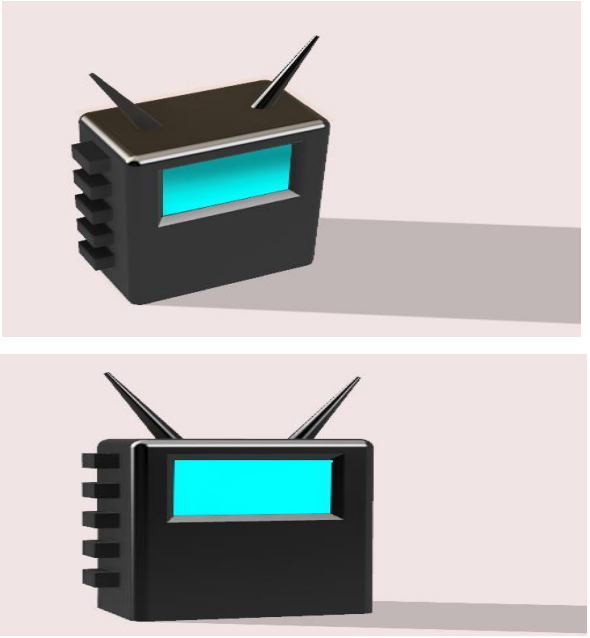


Fig11 (CAD model of a Proposed device)

VI. CONCLUSION AND FUTURE SCOPE

This paper is supporting wireless industrial automation using IOT. In now days, wireless technology for Industries providing better flexibility along with lesser price and through this controlling of plant is become convenient, This was the experimental setup and with the completion of this, the paper can justify the working of industry through the above mention procedure. Through this paper, we are designing a system based on IOT comprising two motors in place of machine for better visualization. In previous wired control, system usually required trenching and laying of costly copper wire while this problem were solved through the wireless industrial automation and gives us better result.

REFERENCES

1. Aponte-Luis, Juan, et al. "An Efficient Wireless Sensor Network for Industrial Monitoring and Control." Sensors 18.1 (2018): 182.
2. Chen, Ching-Han, Ming-Yi Lin, and Chung-Chi Liu. "Edge Computing Gateway of the Industrial Internet of Things Using Multiple Collaborative Microcontrollers." IEEE Network 32.1 (2018): 24-32.
3. Rajmohan, Palanivelu, and P. S. S. Srinivasan. "IoT based industrial safety measures monitoring and reporting system using accident reduction model (ARM) control algorithm." Cluster Computing (2018): 1-11.
4. Adeyeri, Michael Kanisuru. "Machine Signature Integrity and Data Trends Monitoring, a Diagnostic Approach to Fault Detection." Diagnostic Techniques in Industrial Engineering. Springer, Cham, 2018. 29-55.
5. Kurien, Caneon, and Ajay Kumar Srivastava. "Condition monitoring of systems in thermal power plant for vibration, motor signature, noise and wear debris analysis." World Scientific News 91 (2018): 31-43.
6. Józwik, Jerzy, et al. "Monitoring of the Noise Emitted by Machine Tools in Industrial Conditions." Journal of Ecological Engineering Vol 19 (2018): 1
7. Lu, Guoliang, Jie Liu, and Peng Yan. "Graph-based structural change detection for rotating machinery monitoring." Mechanical Systems and Signal Processing 99 (2018): 73-82.
8. Hou, Liqun, and Neil W. Bergmann. "Novel industrial wireless sensor networks for machine condition monitoring and fault diagnosis." IEEE Transactions on Instrumentation and Measurement 61.10 (2012): 2787-2798.
9. Tiwari, Ankit, Prasanna Ballal, and Frank L. Lewis. "Energy-efficient wireless sensor network design and implementation for condition-based maintenance." ACM Transactions on Sensor Networks (TOSN) 3.1 (2007): 1.

AUTHORS PROFILE

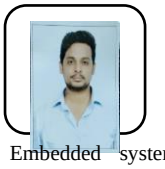
Dr. Rajesh Singh is currently associated with Lovely Professional University as Professor with more than fifteen years of experience in academics. He has been awarded as gold medalist in M.Tech and honors in his B.E. His area of expertise includes embedded systems, robotics, wireless sensor networks and Internet of Things. He has organized and conducted a number of workshops, summer internships and expert lectures for students as well as faculty. He has twenty three patents in his account. He has published around hundred research papers in referred journals/conferences.

Under his mentorship students have participated in national/international competitions including Texas competition in Delhi and Laureate award of excellence in robotics engineering in Spain. Twice in last four years he has been awarded with “certificate of appreciation” and “Best Researcher award-2017” from University of Petroleum and Energy Studies for exemplary work. He got “certificate of appreciation” for mentoring the projects submitted to Texas Instruments Innovation challenge India design contest, from Texas Instruments, in 2015.He has been honored with young investigator award at the International Conference on Science and Information in 2012. He has published ten books in the area of Embedded Systems and Internet of Things with reputed publishers like CRC/Taylor & Francis, Narosa, GBS, IRP, NIPA and RI publication. He is editor to a special issue published by AISC book series, Springer with title “Intelligent Communication, Control and Devices”-2017 & 2018.

Retrieval Number: K13610981119/19©BEIESP
DOI: 10.35940/ijitee.K1361.0981119
Journal Website: www.ijitee.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

Dr. Anita Gehlot is associated with Lovely Professional University as Associate Professor with more than ten years of experience in academics. She has twenty patents in her account. She has published more than fifty research papers in referred journals and conference. She has organized a number of workshops, summer internships and expert lectures for students. She has been awarded with "certificate of appreciation" from University of Petroleum and Energy Studies for exemplary work. She has published ten books in the area of Embedded Systems and Internet of Things with reputed publishers like CRC/Taylor & Francis, Narosa, GBS, IRP, NIPA and RI publication. She is editor to a special issue published by AISC book series, Springer with title "Intelligent Communication, Control and Devices-2018".



Himanshu Sharma is post graduate student of Automation and Robotics at The University of Petroleum and Energy Studies Dehradun. I completed my bachelors in Electronics and Instrumentation field from Institute of Technology and Management Gwalior. My primary area of interest is Automation, Wireless Communication, Embedded system design and Brain Computer Interface. I work monumentally with Brain Computer Interface and Industrial Automation.