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Development of Spinning Monitor to Facilitate the Sider in Textile Mills

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Abstract: ***In India, textile mills occupy a vital role in exporting the quality materials and offering above 35 million people employment opportunities. In India Textile mills run over 24x7, siders working inside covering area of 500 meters working in the spinning process runs continuously to monitor and set right the yarn breakage instantly to minimize the production loss. During the spinning process, siders need to monitor around more than 2000 spindles at every instant of time, makes them restless and leads to the unproductive work due to continuous walk to cover the entire spindle area even though the yarns in many of the spindles is unbroken. Due to this, the efficiency of the sider, as well as production and its quality, is affected. To avoid this, prototype model developed with IR sensors arrangement in each spindle to monitor the broken yarn and shares the broken yarn spindle information to the respective sider through the android device and take the sider to the particular spindle location to set right the yarn through line follower robot. The output of the sensor continuously support to monitor the status of yarn as soon as it is noticed,Through android devices linked via cloud computing make the sider to have productive work in set right the yarn with very less effort. In this paper, the efficiency of the spinning mills is improved and eradicates continuous manual monitoring of yarn breakages by siders, reduces their time and walking distance per shift through integrating of simple IR sensors through cloud computing.***

Keywords: ***Raspberry Pi, Cloud Storage, Yarn breakage Monitor, Spinning.***

I. INTRODUCTION

The spinning segment plays a very vital role in the textile industry to manufacture yarn with assured quality workers manually monitor the spinning yarns continuously and join the broken yarn.

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The spinning process runs continuously with a sider (manual supervision) to monitor and rectify the yarn breakage immediately as soon as it is noticed in order to minimize production loss.

The main concerns among spinning mill ring frame siders, (Two sides per operator called sider) today sider walks approximately 15 km per shift, feel high fatigue, repetitive work, higher attrition rate leads to a shortage for siders. During the spinning process, siders need to monitor the spindles at every instant of time makes them restless and leads to unproductive work due to continuous monitoring make the demand for the workers. Babel, et.al (2014) discuss the various stages through which fibers pass to convert them into yarn. Every department has a different number of workers to carry or supervise the work with fiber dust and its quantum varies from section to section.

The opening section has more fiber dust and it is minimum in the spinning section. The workers engaged in spinning mills encounter different occupational health problems. Thirty respondents were interviewed and observation of work environment was made. The results revealed that spinning mill workers were facing the health problems related to coughing and sneezing, Sweating, eye irritation, breathlessness due to the presence of dust in the working environment. The workers in textile mills also suffocate from respiratory health problems lead to high demand for workers in the spinning section. So, a technology to auto monitor the yarn breakage in spindle, share information and take the sider to exact location is inevitable for modernization of textile mills through the Internet of things.

II. METHODOLOGY

Workers continuously monitor the spindles in simplex section and also in various other sections to monitor the discontinuous yarn and walking up to 15 km per shift to rectify the yarn breakages. The difficulty of the existing method is workers walk in the simplex section with more distance continuously with unproductive work and more time consumption to join the yarn.

Poorna D. B and Ananda Raj P (2013) proposes that in spinning mills, most of the workers are women employees. The work environment of the mills causes a lot of stress to the women because of continuous long working hours, ill-health, physical and mental sickness, which leads to fatigue, stress, auditory damage, breathing problems, and so on. Hence, the present study aimed to understand the factors that caused stress to the mill workers and also provides some suggestions which can be used by the mill workers to overcome stress.

Babel (2014) reported that maximum numbers of the respondents (60%) were in the age group of 41 to 50 years and metric pass (40%) and belonged to nuclear families (80%). The problems encountered due to spinning were: headache (95%), Fatigue (93.3%), Coughing and sneezing (48.82%) itching/irritation in eyes (43.3%) and skin allergies. The problem of hearing loss due to noise pollution was reported by 21.7 per cent of respondents. From this, the workers become victims of serious health issues, mainly women workers who are mostly working as sider in spinning mills are affected by restless working, respiratory diseases, Fatigue. Apart from workers health issues, the production is heavily affected due to the demand for workers.

III. PROPOSED METHOD

The proposed system consists of Infrared sensors placed in every spindle interfaced with the raspberry pi processor which sends the broken yarn information to the Android device through cloud computing as shown in the block diagram of Figure 1. Yarn breakage in each spindle is continuously monitored by individual Infrared sensors. Python code is loaded into the raspberry pi which retrieves data from the sensors and based on this data flow shown in figure 3, the shortest path the sider has to move is informed to them through an android device. To eliminate the sider walking, a line follower is designed which helps them to move to the broken yarn location easily. Line Follower Robot block diagram shown in figure 2 is capable of following a line, by using a pair of IR sensor and DC motor.

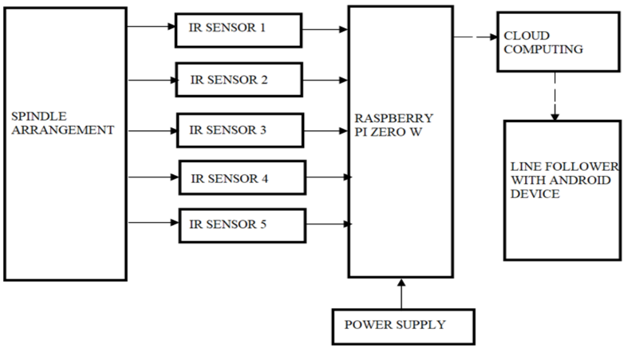

Fig. 1. IOT based Smart Spinning Monitor

Line follower used as an autonomous path tracker for the siders by utilizing either a black line in white or vice versa. This line follower detects a particular line and keeps following it. The details like the spindle's number whose yarn is broken and also the shortest route for the next broken yarn along with direction is displayed in the android device. Based on the inputs received, raspberry pi decides the necessary change to be made in steps as per the flow chart available in Figure3. This helps to completely reduce the walking of the sider in the ring frame section. Android device is placed in the line follower on which the sider moves to the broken yarn location. Outputs are stored in cloud computing and visible on the android device for preventive maintenance work and record the work of workers.

Internet of Things (IoT) or the connectedness between devices, systems and processes hold great potential for the spinning mill. IoT in spinning manufacturing holds the promise of potential positive impact with automated processes, higher output, predictability in production and maintenance.

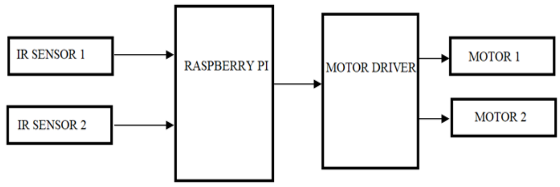

Fig. 2. Block Diagram of the Line Follower

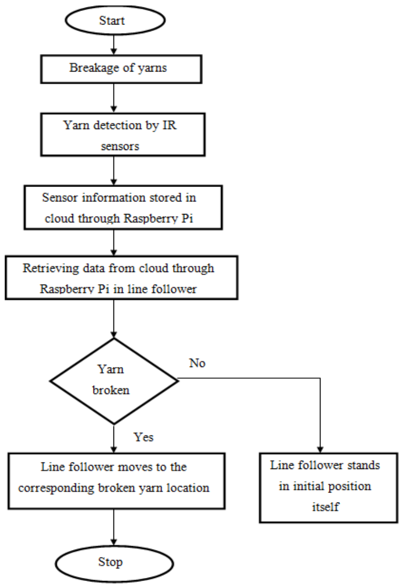

Fig 3. Flow chart of IoT Based Smart Spinning Monitor

IV. HARDWARE SETUP

A. Raspberry Pi Connections

The pin configuration of raspberry pi with IR sensor connected is shown in Figure 4. The pin 8 is connected to the first InfraRed Sensor(IR-1). The pins 10,12,16,18 of the raspberry pi are respectively connected to the IR-2, IR-3, IR-4, IR-5. The pin 14 and pin 2 of the raspberry pi is grounded and power supply.

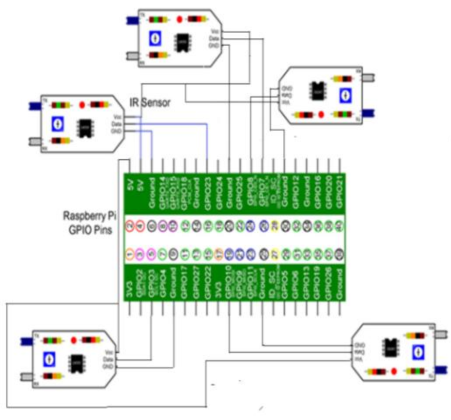

Fig. 4. circuit diagram for IoT based smart spinning monitor

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B. Raspberry Pi Activation

The device is connected to the raspberry pi by following the above steps. Once the device is connected to the raspberry pi, an IP address is generated to the device which has to enter in the VNC Viewer. Similarly, one or more devices can be connected to the raspberry pi and each raspberry pi gets activated.

Virtual network computing (VNC) viewer installed on the local computer and connects to the server and controls another computer over a network connection. The server transmits a duplicate of the remote computer's display screen to the viewer and interprets commands coming from the viewer and carries them out on the remote computer. After the OS installation, in the raspberry pi configuration, the VNC viewer should be enabled. Similarly, the device to which the raspberry pi has to be connected should also have VNC viewer.

C. Interfacing Raspberry Pi to Other Device

After installing the OS in raspberry pi, using HDMI pin the raspberry pi is connected to monitor. Raspberry pi needs 5V power supply can be given using USB cable through the laptop or using a mobile charger. After giving the power supply, the OS starts to boot. The raspberry is password protected and any device which wants to get connected with it must know the raspberry pi's password. Raspberry has WIFI settings and here the WIFI name and password is set.

D Cloud Storage

To connect to the cloud, a cloud provider is needed. In this project, Think Speak website is used. In this, a user is registered with email id. For each sensor, a channel has to be created in it. Since five sensors are used in this project, five channels are created. The new channel can be named uniquely for identification as shown in figure 5. In this project, field 1, field 2, field 3, field 4 and field 5 is named as field label 1, field label 2, field label 3, field label 4 and field label 5 respectively. When a channel is created, a channel ID and a key are generated in Think speak as shown. To store our data into the cloud a separate coding is required. In this coding, the channel ID and key have to include. When the coding to find the broken yawn and ThinkSpeak are merged, the data gets stored in the cloud, which can be retrieved in an excel sheet. This data will be displayed in the android device held by the sider to check if all yawns are proper and not broken which makes their work simple.

V.RESULT

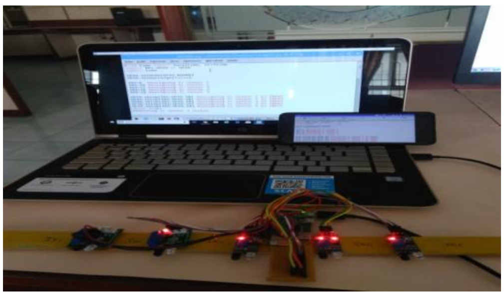

Fig. 5

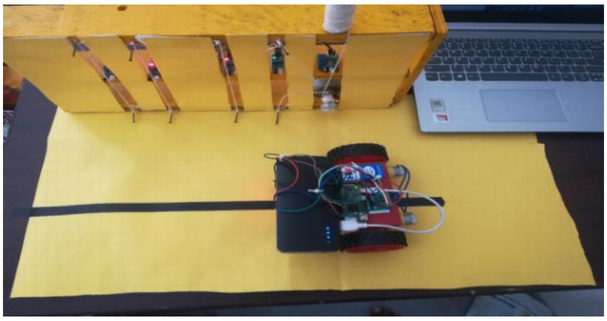

Fig. 6. Prototype Model Developed

The prototype model developed with five IR sensor arrangements in each spindle is shown in figure 5 and figure 6. In spinning mills, the number of spindles available is more than 2000 per sides. In this paper, 5 spindles are arranged with IR sensors and DC motor for sensing and driving the yarn to design the prototype model. The sensor provides a digital output of logic 1 (5 volts) when the yarn has no breakage and logic 0 (0 volts) during breakage to the raspberry pi.

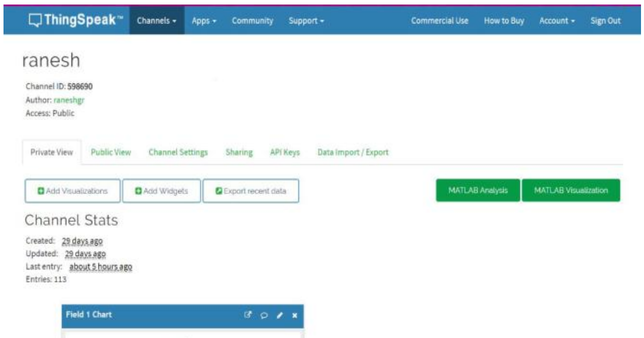

Fig. 7. Channel ID created in

The output data continuously collected from the sensors connected to cloud storage through channel formation in a cloud of ThingSpeak cloud provider as shown in figure 7. Each sensor is created as field and its output is exhibited in the form of a chart with date and time of detection of the sensor as shown in figure 8. For each sensor, a chart will be exhibited in the channel with X-axis represents the date and Y-axis represents the field label.

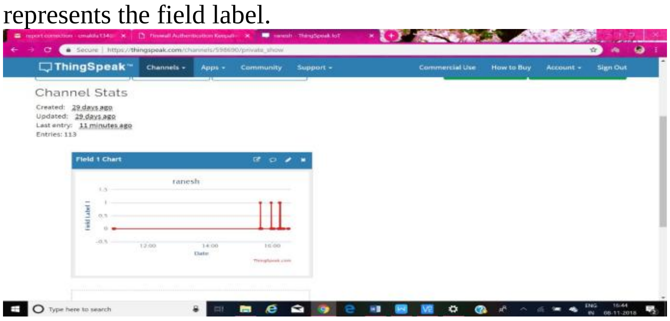

Fig. 8. Data Storage

Figure 9 shows all the yarns are monitored through IR sensor for any breakage, output display appears as 0 indicates Yarn 1, 2, 3, 4 are in the right manner and the yarn number 5 had broken are detected through raspberry pi and have continuous online monitoring. The python code gets executed by acquiring the data from the sensor and produces output as 1 and yarn 5 is broken and the other sensors detect the yarn which gives the output as 0. The code is programmed to sleep for about 2 seconds when the yarn is not detected.

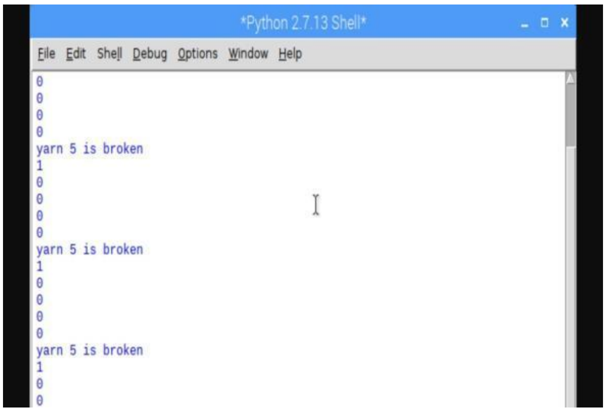

Fig. 9. Output of Yarn Detection

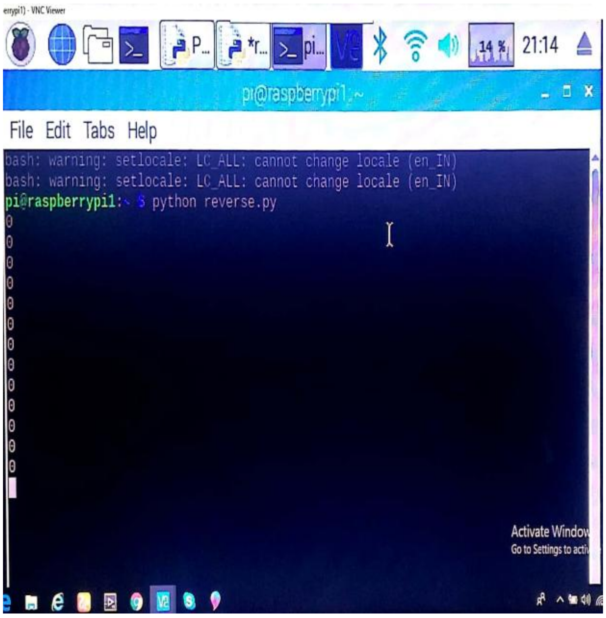

Fig. 10. Data Retrieved from Cloud

Data from the cloud is retrieved as shown in figure 10 through Raspberry Pi in the line follower. The output is displayed as zero as all the IR sensors detect the yarns and hence the line follower will be in its starting position. When one yarn is broken, line follower moves to the particular broken yarn location. Data retrieved from the cloud activated the line follower to move to the broken yarn location with the help of raspberry pi 2. For each spindle, 0.2 seconds delay is provided for moving the line follower to spindle location.

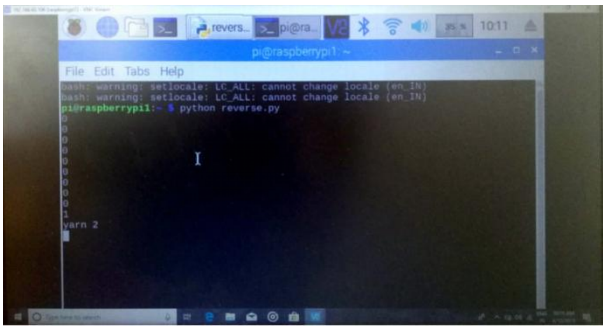

Fig. 11. Output of Line Follower in Raspberry Pi 2

The data of broken yarn is retrieved from the cloud as shown in figure 11 and the line follower will be directed the siders mobile to reach towards the respective broken yarn location. The output displays after 42 seconds when the yarn is broken.

V. CONCLUSION

In this paper, the efficiency of the spinning mills improved through sider assistant eradicates the manual monitoring of yarn breakages and engaging in productive work by integrating sensors for yarn breakage detections through cloud computing reduces the time and walking distance of the sider. The walking distance of the sider is reduced per shift as they can see the output from the cloud and move to the place where the broken yarn is present which reduces manual monitoring. The output from cloud used for the analysis of maintenance work and repeatability of yarn breakage spindles to be taken care and provide the detail of sider work per shift. This sider successfully implements in spinning mills to have an assistant for the sider to minimize their workload especially beneficial for a lot of women workers employing in Spinning sections of Textile mills. An electric vehicle is needed for the movement of sider in industries while in this project, a line follower is designed instead of the electric vehicle.

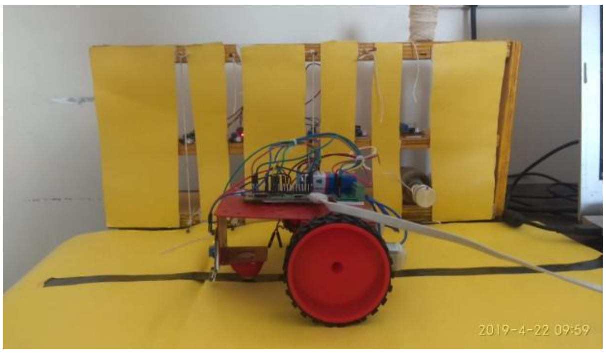

Fig. 12. Line Follower's Position when Yarns are Broken

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