ISSN 2395-1621

Flow Control Valve using GSM and Motor

[#1]Manojkumar A. Pole, [#2]Yogesh B. Rathod, [#3]Virendra R. Gholap,
[#4]Ashish S. Jadhav, [#5]Prof. J.S.Narkhede,

[1]manojkumarpole2@gmail.com

[#1234]Student, Department of Mechanical Engineering
[#5]Assistant Prof. Department of Mechanical Engineering
P.V.P.I.T, Pune.

ABSTRACT

Water flow control is one of the significant issues confronting real urban communities of the world and wastage during transmission has been distinguished as a major issue; this is one of the motivations for this research, to deploy computing techniques in creating a barrier to wastage in order to not only provide more financial gains and energy saving, but also help the environment and water cycle which in turn ensures that we save water for our future. We introduced our exploration in installing a control system into a programmed water pump controller through the use of different technologies in its design, development, and implementation. The system utilized microcontroller to automate the Flow valve of water and can distinguish the water in 4 different flow rates. Switch on/off the pump as needs be and start the motor of valve for controlling the water flow rate and show the status on a LCD screen. This research has successfully given a change on existing water level controllers by its utilization of calibrated circuit to demonstrate the water level.

Keywords: LCD , GSM , DC MOTOR .

ARTICLE INFO

Article History

Received: 27th May 2018

Received in revised form :

27th May 2018

Accepted: 30th May 2018

Published online :

30th May 2018

I. INTRODUCTION

Water flow control Sustainability of available water resource in many reason of the word is now a dominant issue. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Water is commonly used for agriculture, industry, and domestic consumption. Therefore, efficient use and water monitoring are potential constraint for home or office water management system.

Surface and Ground Water Resources Water in our planet is available in the atmosphere, the oceans, on land and within the soil and fractured rock of the earth's crust Water molecules from one location to another are driven by the solar energy. Moisture circulates from the earth into the atmosphere through evaporation and then back into the earth as precipitation. In going through this process, called the Hydrologic Cycle.

Priorities for water resources planning Water resource projects are constructed to develop or manage the available water resources for different purposes. The water allocation priorities for planning and operation of water resource systems should broadly be as follows:

1. Domestic consumption

This includes water requirements primarily for drinking, cooking, bathing, washing of clothes and utensils and flushing of toilets.

2. Irrigation

Water required for growing crops in a systematic and scientific manner in areas even with deficit rainfall

3. Hydropower

This is the generation of electricity by harnessing the power of flowing water.

II. OBJECTIVES

1. To reduce the human efforts.
2. To reduce the time wastage.
3. To reduce the water wastage.
4. Using GSM modem we can operate from anywhere via sending message to the controller.

III. CONSTRUCTION AND WORKING

It consist of following components,

1. Ball valve- A ball valve is a form of quarter-turn valve which uses a hollow, perforated and pivoting ball to control flow through it. It is open when the ball's hole is in line with the flow and closed when it is pivoted 90-degrees by the valve handle. The handle lies flat in alignment with the flow when open, and is perpendicular to it when closed, making for easy visual confirmation of the valve's status.

2. GSM Module- A GSM module is a distinguished type of module which accepts a SIM card and operates similar to a mobile phone. Whenever a GSM module is connected to a computer, it allows the computer to use the GSM module to communicate over the mobile network. GSM modules are most frequently used to provide the mobile internet connection; many of them are often used for sending and receiving SMS messages. There are several GSM modules that are available in the market out of which GSM SIM900 is the GSM module that has been used in this project.

3. Microcontroller- A microcontroller is a computer on chip that is, a single integrated circuit containing a core processor, memory unit, and programmable input/output ports. Microcontrollers are versatile and hence used in places where automatic control of products and devices, such as controlling of automobile engine systems, implantable medical devices, remote controls, toys and other embedded systems. The size and cost of employing a microcontroller is very less than that compared to a design that uses microprocessor whose units are separate such as memory, timer, counter and separate input/output devices, hence in order to achieve required performance at decent cost.

4. Arduino- Arduino is an open source electronics platform based on easy-to-use hardware and software. In this project we use Arduino-UNO board. The Arduino hardware platform already has the power and reset circuitry as well as circuitry to program and communicate with the microcontroller over USB. In addition, the I/O pins of the microcontroller are typically already fed out to sockets/headers for easy access. On the software side, Arduino provides a number of libraries to make programming the microcontroller easier.

5. Battery- The battery circuit is essential to operate the moisture sensor and to power the GSM Module, Microcontroller and Solenoid valves.12V, 2AhBatteries are used to provide supply to the above mentioned components in the circuit.

WORKING

Automatic scheduler for farmer with a GSM modem is able to control the switch during certain circumstance like late night or whenever the operator is away from the fields, etc. this can be done by the help of GSM modem. The operator can register his mobile number in the GSM modem by using the specified command.

We have four different modes to perform this operation.
Mode 1 with 25% -
If farmer want to switch ON the valve then the farmer will send the command i.e. @S1time#.thevalve will open with 25% at the mentioned time in the message.
Mode 2 with 50% -
If farmer want to switch ON the valve then the farmer will send the command i.e. @S2time#.the Valve will open with 25% at the mentioned time in the message.
Mode 3 with 75% -
If farmer want to switch ON the valve then the farmer will send the command i.e. @S3time#. The Valve will open with 25% at the mentioned time in the message.
Mode 4 with 100% -
If farmer want to switch ON the valve then the farmer will send the command i.e. @S4time#.the Valve will open with 25% at the mentioned time in the message.

Similarly, the valve can be schedule of off by sending the command to the controller i.e. @S0time#.The valve will get OFF. By using these commands we can control the flow and switch ON and OFF the valve and this is the motive of our project.

IV. SYSTEM DESIGN

1.Purchased Part –

a) GSM Module
b) Microcontroller
c) Arduino

Designed Part-

A) Shaft Design

For a main shaft which is a power generator, power is given as,
P=FxV----------(1)
Our whole assembly will have weight approximately equal to 60kilograms.Thus total force acting will be on 5 wheels. Out of those 4 wheels we have maximum load acting on rear wheels mounted on shaft. This shaft is subjected to approximately 50 kilograms of load. So force acting on shaft is given by,

F= mxg----------(2)

Putting m=50kg

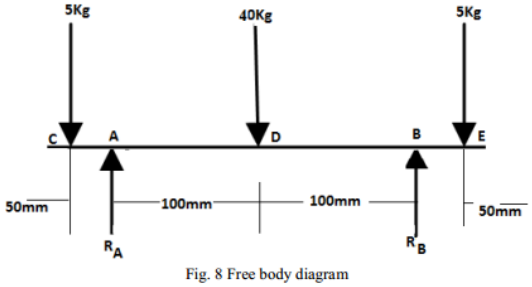

Fig. 8 Free body diagram

g = 9.81 m/s2
Thus
F = 50 × 9.81 = 490.5 N
Velocity is found out to be 10 cm/s i.e. V = 0.10 m/s

Thus
Power, P = 490.5x0.10 = 40.05 watts
We know that torque is given as, $T = Px60/(2\pi n)$
Assuming No. of Revolution, n=50rp
Thus, we have Torque, T =49.05x60/ (2πx25)
=9.36x103 N-mm

For a given shaft we have from diagram, Vertical reactions at wheels i.e. fixed supports,
RA = RB = (5+40+5) / 2= 25 kg
= 25x9.81

= 245.25 N

From bending moment diagram, maximum bending moment is found to be, M = 1750 Kg-mm
=17.167x103 N-mm
The resultant moment on a given shaft is given as
MR= (M + T)1/2
= ((17.167x103)2+ (9.36 x 103)2)½
= 19.552x103N-mm
Also we know that shaft diameter is given as,
d = [(MRx16)/ (πxτ)]1/3

SHEAR STRESS VALUES

Service Condition	τ_s (MPa)
Heavily loaded short shafts carrying no axial load	48-106
Multiple bearing long shafts carrying no axial load	13-22
Axially loaded shafts (bevel gear drive or helical gear drive)	8-10
Shafts working under heavy overloads (stone crushers, etc.)	4.5-5.3

Consider shear stress, τ = 50Mpa
d = [((19.552x103) x16)/ (πx50)]1/3
d = 12.581 mm
This is ideal diameter of shaft which is needed. Since a shaft may be subjected to extra load as it has to work in rough conditions and from availability point of view, we chose a safe diameter from DDHB (Table 3.5a) of standard shaft diameter of 15 mm.

Thus diameter of shaft, d = 15 mm

A) Motor Design-

P= 1/15 HP = 50 w
N1=6000 rpm
G= 5

P= (2*3.14N*T)/(60*1000)

T1=79.6178 N-M

T2/T1=G

T2/79.6178=5

T2=398.089
T design = T2 = 398.089 N-M

Design of I/P Shaft ,
Material selection:
Designation = 40 crl
Uts = 1100 MPa
Yt = 900Pa
As per ASME code ,

Fs= 0.18*UTs = 198 N/mm^2
Fs= 0.3* Yt = 270 N/mm^2
Considering the minimum of above two values;
Fs-max=198N/mm^2

Reducing 25%
Fs-max=148.5N/mm2

T=79.6178N-m
$T=79.6178*10^3$ N-mm

Assuming 25% over load
$Tdesign=1.25*T=99.5222*10^3$ N-mm

Check for torsional shear of shaft
Assuming d=16mm
$Fs_{act} = 16*Tdesign/(3.14*16^3)$
$Fs_{act} = 123.8884$ N/mm^2
Hence design is safe.

B) SPUR DESIGN

Design a pair of spur gear with 20^0 FD involute teeth having following specifications.
Power, P = 10KW
n_P = 1440 rpm
G = 4:1
FOS = 3
(6_{ut}) = 410 MPa
(6_{ut}) = 200 MPa
Solution:

Design for static beam strength

-Minimum number of on pinion to avoid interference,
Zp = 18 for $\phi = 20^0$
-Assume, module, m = 5 mm
6_p =410/3 = 136.67 N/mm^2
6_G = 200/3 = 66.67 N/mm^2
-number of teeth on gear,
Zg = G x Zp
Zg = 4 x 18
Zg = 72
-Pitch diameter of pinion & gear :
dp = m Zp
dp = 5 x 18
dp = 90 mm
dg = m Zg
dg = 5 x 72
dg = 360 mm
-Lewis form factor
Y = 0.154 – 0.912/Z , for 20^0 FD involute
Yp = 0.154 – 0.912/Zp

$Yp = 0.154 - 0.912/18$
$Yp = 0.1033$
$Y_G = 0.154 – 0.912/Zg$
$Y_G = 0.154 – 0.912/72$
$Y_G = 0.1431$
6b $Yp = 410 \times 0.1033 = 42.35$
$6_G\ Y_G = 200 \times 0.1431 = 28.26$
Hence the gear is weaker & shall be considered for design.
-Pitch line velocity ,
$V = \pi\ dp\ np/60 \times 10^3$
V=6.79 m/s
Tangential load,
$Ft=10^3*p/v$
$Ft=10^3*(10/6.79)$
Ft=1472.75 N
For given condition value of Cs=1.5 and Cm=1.3
Maximum load,
$Ft_{max} = Cs.Cm.Ft$
=1.5*1.3*1472.75
=2871.87 N
Velocity factor for (V < 8 m/s)
Cv =3.05/(3.05+V)
Cv=3.05/(3.05+6.79)
Cv=0.31
Effective load
Feff=Ftmax/Cv
=2871.87/0.31
Feff=9264 N
Lewis equation for beam strength for gear tooth
$Fb=\sigma*\gamma_g*b*\pi*m$
$=66.67*0.1413*\pi*b*5$
Fb=147.96 *b N
Now, Fb= Feff
147.96 b= 9264
b= 62.6 mm
The limits for face width are,
9.5 m= 9.5*5= 47.5 mm
And 12.5m= 12.5*5= 62.5 mm
Adopt,
b= 62 mm
m= 5 mm
1.Design for wear
Wear load,
Fw=dp*b*q*k
Here, dp=90 and b=62 mm
Q= 2*Zg/(Zg+Zp)
Q= 2*72/(72+18)
Q=1.6
For given condition, load stress factor $K= 0.2413*(BHN/100)^2$
Pinion material having BHN= 300
$K=0.2413*(300/100)^2$
K= 2.172
Fw = dp* b*q*k
Fw =90*62*1.6*2.172
Fw=19391.6 N
FOS= Fw /Fh= 19391.6/9264
FOS=2.09
As $FOS < FOS_{all}$
$FOS= 2 < FOS_{all}=3$
Hence the design is safe

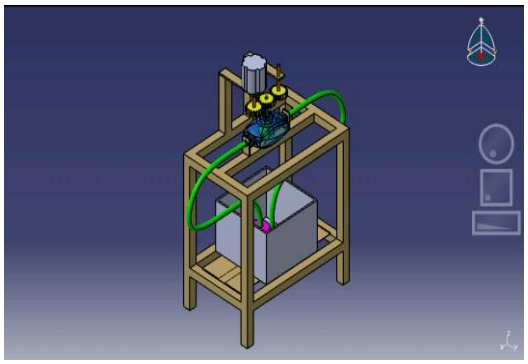

Fig. 1. Catia Design of model.

ADVANTAGES

- By using GSM modem we can operate from anywhere via sending message to the controller i.e. valve ON or valve OFF.
- Feedback message of every command is given by the controller via SMS to the operator.
- 1Low power required to operate
- It reduces the time required.
- Save the water at huge quantity.

APPLICATION

- Agricultural
- Industrial
- Corporation
- It can be used by the farmers as irrigation facilities in the farms for the cultivation purpose.
- It Can also be used in a factory for various purposes plant.

V. CONCLUSION

Thus the system so proposed is very helpful for the farmers in saving the water and reduce their time to reach the field to operate the valve. This system can also reduce the number of labours required to work in the field to change the water flow direction by the usage of solenoid valves. The farmer just has to message the commands from the remote area to control the water fed to the field. The system is more economical and less complex for the farmer to handle. This system can be found much simpler than previously proposed system.

REFERENCES

1. Thwe Mu Han,Ohn Mar Myaing, Design and construction of Microcontroller based water flow control system,International conference on circuits ,System and Simulation,IPCSIT ,IACSIT Press Singapore.

2. Bamigboye, O.O.; Ehiagwina,F.O.;Seluwa, E.O.Gba damosi, development of microcontroller based water pump controller, 8th International conference of the school of Engineering and Environmental , Federal Polytechnic, EDE 18-20 July , 2016

3. Olufemi O. Kehinde, Oladayo O. Baming boye and Fedrick O. Ehiagwina,Design and Implementaion of an AT89C52 Microcontroller Based Water Pump Controller , IJISET- International Journal of Innovative Science , Engineering and Technology, vol 3 Issue 7,July, 2016 ISSM(online) 2348 -7968 Impact Factor (2015)-4.332

4. Benjamin J.T.Binder,Alexey Pavlov,Dor A. Johnsen,Estimation of Flow Rate and Viscosity in A well with an electric submercible pump using moving Horizon estimation, 2nd IFAC Workshop on automatic control in offshore oil and gas production May 27-29,2015,Florianopolis,Brazil

5. NOR ARINA BT ADAM,Microcontroller (M68HC11) for fluid flow control, Kolej Universiti Kejuruteraan & Teknologi Malasia APRIL 2006

6. Prof S.V.Vanmore. Mr.Mahesh Khot.Mr.Lingaraj Shirasagi.Mr.Rohit Salavi.Microcontroller based Automatic Aquaponics System ,intrrnational reaserch journal of engineering and technology (IRJET) e-ISSN :2395-0056 Vol.:04 Issue :02 Feb-2017 www.irjet.net p-ISSN:2395-0072.

