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Gilbert Gilibrays Ocen
Isabirye Moses Grace
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WATER BORNE DISEASES CONTROL IN LIVESTOCK THROUGH WATER TROUGHS MANAGEMENT SYSTEM

[1]Gilbert Gilibrays Ocen
Email: gilbertocen@gmail.com
[2]Isabirye Moses Grace
[3*]Mwase Ali
[3]Department of Accounting & Finance, Makerere University Business School
[*]Email: amwase@mubs.ac.ug
[4]Matovu Davis
Email: davismatovu@yahoo.com
[5]Bwire Flex
Email: bwifex@gmail.com
[1,2,4,5]Department of Computer Engineering, Busitema University, Busia, Uganda

Abstract

Purpose: This study aimed at designing a water trough management system that controls water borne diseases in livestock that come due to openness of the troughs. The commonly used methods for water supply to the cattle such as motion detections in a motion detector water pump system, animal nose operation in animal operated nose pump system and automatic water fountains are exposed to external factors like droppings of birds, dust carried by wind that contaminate the water and cause waterborne diseases hence infecting their cattle.

Methodology: A qualitative research method was employed by the study. Semi-structured in-depth interviews were conducted with farmers and experts in the field of cattle keeping.
Findings: Findings indicate that this system proved to be a viable proof of concept design that could aid in boosting good health in cattle herds. The designed system when employed on the farms enables cattle access only clean water since the trough is ever closed. It only opens when the cattle have come to take water and then water begins flowing from the tank to it. The external factors have no access to the inside of the trough. The water pumped to the trough is clean and safe to drink. The remaining water that the animals have drunk on is considered dirty and is pumped out.

Unique contribution to practice and policy: This paper suggests that a system based on this scheme could be utilized by both farmers and researchers to reduce the water borne diseases in cattle.

Key terms: *Water trough, Management system, Cattle, Water borne disease*

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I. INTRODUCTION

Water is an essential nutrient for cattle production, it accounts for 50-80% of cattle's live weight depending on age and degree of fat cover[1][2]. Water is a medium for transportation of nutrients, waste products, hormones and other chemical messengers. It aids in the movement of food through blood osmotic pressure and further is a major component of secretions such as saliva and milk[1]. Water is equally involved directly or indirectly in every physiological process occurring within the cattle[1].

The total body weight of dairy cattle is 56% to 81% water. Moreover, water is the main component of milk and waste products[1]. Therefore, dairy cattle have a substantial daily requirement for water, decreasing free water intake is undesirable as it will limit milk production and reduce health status resulting in decreased product profitability[2].

Providing high quality water to cattle will have benefits similar to the provision of quality forages[3]. Increased water consumption results in greater feed intake, improved health and increased weight gain[3]. The better the quality of the water, the more the cattle drink [4].

Water pumped to the water troughs is ever clean but due to their openness, the water later gets contaminated by the external factors[6]. These factors include droppings of birds, dust carried by wind, rain water. For cattle drinking from open troughs have a greater opportunity to get water borne diseases[7].

According to [2],water borne diseases are caused by the pathogens found in water contaminated with infected feces, urine, discharges and tissues due to water exposure to external factors. Water borne diseases include anthrax caused by *Bacillus anthracic*, paratuberculosis caused by *Mycobacterium tuberculosis*, rinderpest caused by *Paramyxovirus* and Actinomycosis caused by *Actinomycosis bovial* [2].

Existing systems are both automatically and manually operated and they use various technologies to provide safe water to cattle. These technologies include motion detections in a motion detector water pump system, animal nose operation in animal operated nose pump system and automatic water fountains. However, these methods are open to external factors such as droppings of birds, dust carried by wind that contaminate the water.

The contaminated water contains pathogens and viruses that cause waterborne diseases to cattle hence reducing their productivity to the economy [8]. Therefore, this paper provides a suitable design of the system that is ever closed and only opens when the cattle has come to take water and water also begins flowing into the trough. In this way, water borne diseases are reduced in cattle.

II. LITERATURE REVIEW

a) Motion Detector Water Pump System

The objective of this system is to stop water from being exposed to coldness and then preventing water from going back with hay hence solving water contamination. This system operates in a way that when any cattle walks up to the drinking bowl, an electronic motion detector turns on a pump that fills the drinking bowl with water, when the cattle leaves the detection area, the pump shuts

off and the water drains back down through the pump so the water is not exposed to external factors[20]. There is a filter that prevents hay and debris from going back down into the pump with the water. The pump is powered by a solar DC battery.

b) Animal operated nose pump system.

According to [18] this system aims at solving water contamination. The system works in a way that the cattle push a paddle out of the way to get the water in a sloped trough. After the cattle have drunk the water, the paddle returns and pumps about one unit volume of water into the trough for the cattle to drink again[18]. However,this system is confronted with the need train cattle on how to use the system and it takes long for them to get adopted to the system.

c) Automatic water fountain for supplying warm clean water to livestock.

It consists of an inner case, outer case, floating case installed inward of top portion of the water tank, a check valve installed to the bottom of the floating case, drain pipe, overflow pipe, heater, water level sensor and temperature sensor[21]. The check valve of the floating case is automatically operated to maintain the constant water level all the times and filter off the foreign objects into the water. The warm water may not be drunk easily by the cattle since it may exceed the temperatures that the cattle may want. The system was solves the problem of water contamination by providing warm water to cattle and also using the check valve to prevent feedstuff from going with water to the water tank after the cattle have finished drinking.

d) Livestock watering tank.

This system is composed of an insulated tank with a top, bottom and side walls. The top has an opening extending there through a buoyant spherical float which normally closes the opening and is roll able away from the opening along converging tracks in response to downward force applied by the head of a cattle seeking a drink of water[22]. When the cattle release the downward force, the float naturally rolls back along the tracks into sealing engagement with the opening. A water inlet system is provided so that when the water level in the tank drops to a predetermined level, additional water from a water source is provided to the tank. The tank also includes a drain and an overflow outlet. This system aims at solving the problem of water contamination where the system closes when the cattle are not drinking water.

III. METHODOLOGY

This study followed both a qualitative approach. The population of the study consisted of livestock farmers. The scope of the study was however limited to livestock farmers within Tororo district, Eastern Uganda. These farmers comprised of sixteen households from seven villages under Tororo district-Uganda having over twenty cows of different breed types.

The researchers made preliminary visits to locate the farms and brief the cattle farmers on research objectives and potential benefits of participating in this research. Farmers willing to participate were voluntarily selected. Farms visits were conducted to observe their management practices.

The sampling process consists of population definition, selecting a sample frame and sample methods determination, population and sample size determination [16]. There are various sampling techniques used in research and these include stratified sampling and purposive sampling [16].

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This study used purposive sampling to select the livestock farmers for the in-depth interviews. Semi-structured in-depth interviews were conducted with farmers and experts in the field of cattle keeping.

IV. SYSTEM ANALYSIS AND DESIGN

System Design

System design is the process of defining the architecture, components, modules, interfaces and data for a system to satisfy specified requirements. It can be seen as the application of systems theory to product development [17] [18].

From the interviews and literature reviews, and site observations water trough management system requirements were established. Program flow charts were used to map the logical design of the system. Arduino platform for coding hardware and Proteus for system design as well as simulating the various system components were the Integrated Development Environments (IDE) used to form part of the physical system design as presented in the next section a and b.

a) Logical design of the system.

The structure of the implemented water trough management system can be seen in figure 1 below. It shows the movement of signals and how data is transformed from inputs to produce outputs, how to make decisions depending on queries, the start and stop of the program.

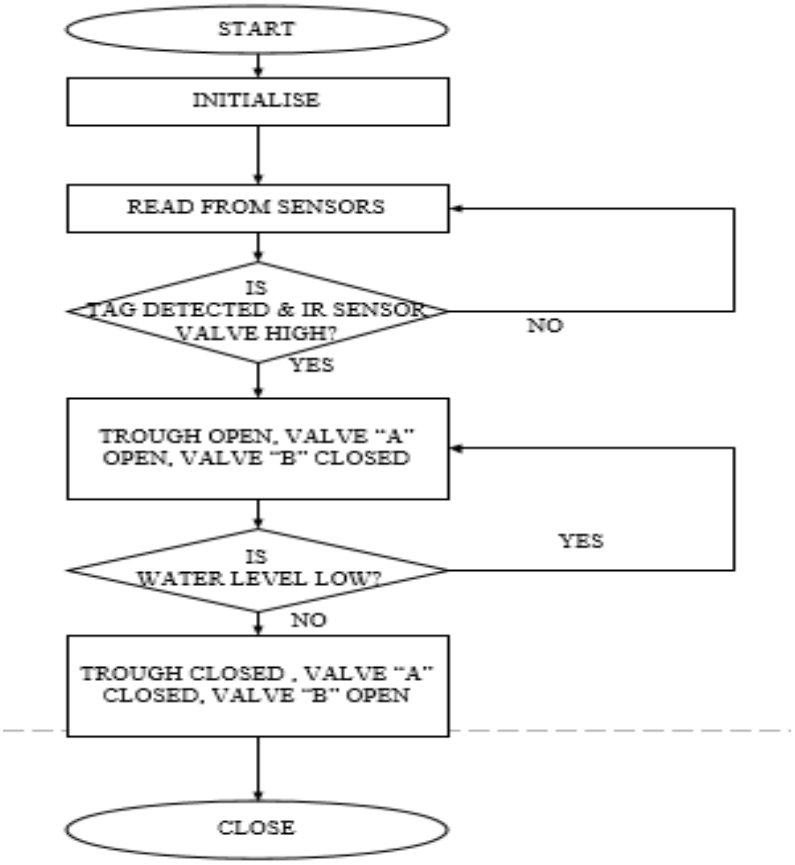

Figure 1**:** Logical design of the water trough management system.

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a) The Physical Design

As figure 2 below illustrates, when the cattle come, it comes with the NFC card on its ear which is read by the RFID reader on the system and the system opens. At the time of opening, the water also immediately begins flowing into the trough and then the water level sensor come in to control the water from over flowing. When the cattle have left, the system closes and the water stops flowing into the trough. The remaining water flows out of the trough into the reservoir since it is considered to be dirty. The system still goes back to its initial state of being empty. The water in the reservoir is then used for other purposes. The system does all those activities without the involvement of the farmer.

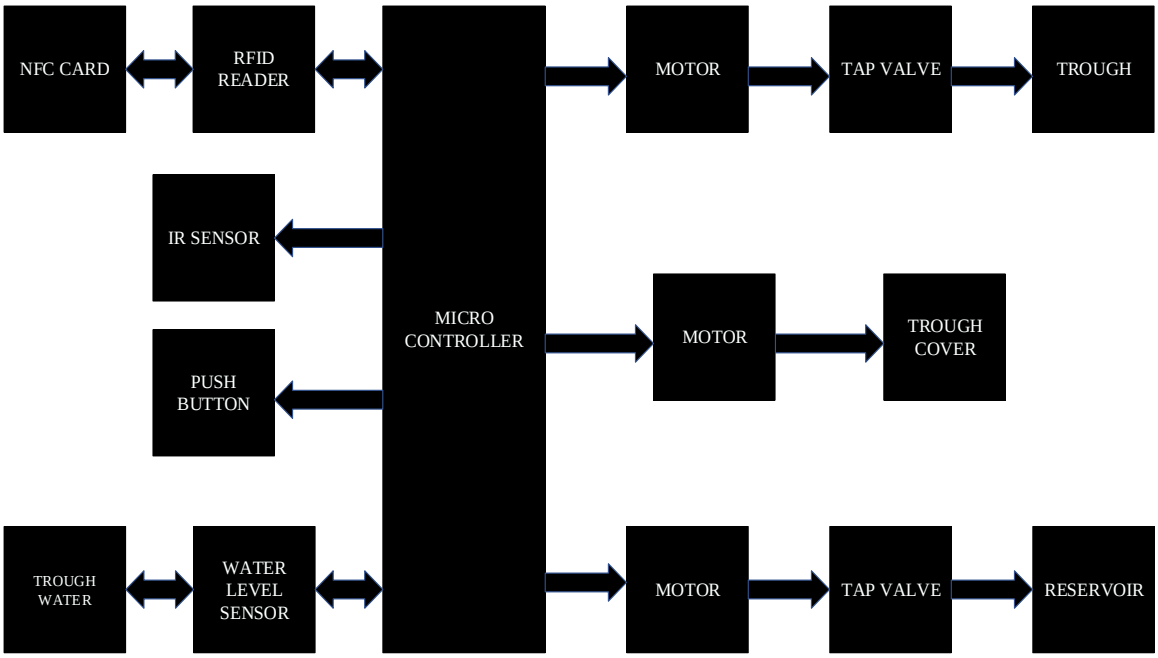

Figure 2: Physical design of the water trough management system.

V. DISCUSSION , RECOMMENDATIONS AND CONCLUSION

The study demonstrated that this system proved to be a viable proof of concept design that could aid in boosting good health in cattle herds. The findings revealed that although water pumped to the troughs is always clean, their openness exposes them to external factors which then favors the growth of bacteria that cause water borne diseases to cattle. The findings further suggest that other contaminates are from the cattle themselves. The study recommends that the designed system when employed on the farms enables cattle access only clean water since the trough is ever closed. It only opens when the cattle have come to take water and then water begins flowing from the tank to it. It is further recommended that a system based on this scheme could be utilized by both farmers and researchers to reduce the water borne diseases in cattle. In so doing, there will be improved livestock health and increased animal production. In conclusion, water borne diseases are a major cause of death rates in cattle therefore cattle farmers should use the developed water

trough management system to help in reduction of death rates in cattle that are due to water contamination. The system will also promote animal health and hence profit the farmers in the long run through increased animal production. Further studies may focus on extending a water purification section on the designed system as the system assumes that the water pumped into the trough is clean and safe for drinking by the cattle.

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