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FACULTY OF ENGINEERING.

**DESIGN OF A TOILET SEAT CLEANING MECHANISM TO
PREVENT THE SPREAD OF UTIs IN PUBLIC TOILETS.**

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BU/UP/2016/542.

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*A final year project report submitted to the Faculty of Engineering in partial
fulfillment of the requirements for the award of a Bachelor of Science in Water
Resources Engineering.*

22 Feb, 2022.

DECLARATION

I, the undersigned, declare that this design project is my original work, except where due acknowledgement has been made. I declare that this work has never been submitted to this University or any other institution for funding/ for partial fulfillment of any award.

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SUPERVISORS' APPROVAL.

This design proposal is submitted as a partial fulfillment for the award of Bachelor of Science in Water Resources Engineering in Busitema University, with our approval as academic supervisors.

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DEDICATION.

To my lecturers, and my best friend Noah.

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ABSTRACT

A urinary tract infection (UTI) is an ailment that affects any part of the renal (genitourinary) system due to abnormal bacterial growth within the system (I. Odongo et al., 2020, Odoki et al., 2019) mainly caused by *Escherichia coli*, a bacterium common in the gastrointestinal (GI) tract. UTIs are one of the leading causes of morbidity in medical practice, and they are among the most common

bacterial infections with increasing antimicrobial resistance (I. Odongo et al., 2020, Sekikubo et al., 2017, C. O. Odongo et al., 2013), which makes them a first class societal potential hazard as they risk becoming incurable due to their high mutation rates.

Other pathogens such as *Enterococcus* sp., *Staphylococcus saprophyticus* (honeymoon cystitis), *Klebsiella* sp., *Enterobacter* sp., *Citrobacter* sp., *Proteus-Morganella-Providencia* sp., norovirus, and *S. aureus*, also contribute to UTIs to a smaller extent. UTIs may present any combination or all of the following symptoms; dysuria, lower abdominal pain (LAP), pyuria, fever, itching, genital & suprapubic pain, blisters & ulceration of the genitalia, and vomiting in children under 5 years (Odoki et al., 2019). The annual contraction rate is estimated at 150 million people, amounting to an average direct healthcare bill of USD 6 billion globally. There was a recorded lifetime incidence of 40-50% of adult women in USA in 2014 and 10% of post-menopausal women admitted to

having a UTI the previous year. In Senegal, the prevalence was reported at 0.7% for those admitted to Dakar Senegal, the university hospital. The prevalence for Algeria the prevalence was 4.5% for those in acute care for over 2 days. In Uganda, the overall national

prevalence was documented as 38.8% and 22.3% in Bushenyi district (Odoki et al., 2019), 35% in Mbarara (Johnson et al., 2021).

In a study to establish the relationship between washrooms and drug-resistant bacteria (Suen et al., 2019), it was found that the humid and warm environment of the washrooms favors the growth and multiplication of microorganisms. The seat cleaning mechanisms will solve the irregular seat cleaning schedules, make the toilets more visually appealing and instill a mental satisfaction of safety (no expectation of disease) in the users, enhance the attainment of SDGs 3 & 6, objective 4 of the NDPIII which anticipates a WASH coverage (improved toilets in particular) of 80% from the current 19% (Authority, 2020). The system was tested for tensile limits using the FEA in SolidWorks, and the resulting stability results were found satisfactory. The NPV of the project was calculated at UGX86, 797,549.7625 using a risk factor of 10%, and the profitability index was established as UGX104.

Key words; UTI, prevalence, diagnostic, sensors, linkages, resistance, *E. coli*.

Table of Contents

CHAPTER ONE (INTRODUCTION)	11
1.1 BACKGROUND.	11
1.2 PROBLEM STATEMENT.	15
<i>1.2.1 PROBLEM ANALYSIS.</i>	<i>15</i>
1.3 RATIONALE	16
1.4 PROJECT OBJECTIVES	16
<i>1.4.1 Main objective.</i>	<i>16</i>
<i>1.4.2 Specific objectives.</i>	<i>16</i>
1.5 SCOPE OF THE STUDY	17
1.6 CONCEPT DIAGRAM.	18
CHAPTER 2: LITERATURE REVIEW.	19
2.1 UTIs; a panorama.	19
2.2 UTI prevalence perspectives.	19
2.3 UTI treatments.	19
2.4 UTI prevention techniques.	20
2.5 Sensing technologies.	20
<i>2.5.1 Motion and proximity sensors.</i>	<i>20</i>
<i>2.5.2 Water level sensors.</i>	<i>20</i>
<i>2.5.3. Contact or touch sensors.</i>	<i>21</i>
<i>2.5.4 Olfactory sensors.</i>	<i>21</i>
<u>2.5.4.1 UTI diagnostics.</u>	<u>21</u>
2.6 Linkage systems	25
<i>2.6.1 Kinematic pairs</i>	<i>26</i>
<i>2.6.2 Kinematic chains</i>	<i>27</i>
<i>2.6.3 Four bar linkages/chains.</i>	<i>28</i>
<i>2.6.4 Mechanism inversion</i>	<i>29</i>
<u>2.6.4.1 Grashof inversions.</u>	<u>30</u>
<u>2.6.4.2 Non-Grashof mechanisms and inversions.</u>	<u>30</u>
2.7 Conclusion	37

CHAPTER 3: METHODOLOGY.	38
3.1 Specific objective 1: To design the different components.	38
<i>3.1.1 Design considerations.</i>	<i>38</i>
<i>3.1.2 Machine description.</i>	<i>38</i>
<u>3.1.2.1 Conceptual diagram.</u>	<u>38</u>
<u>3.1.2.2 Components description.</u>	<u>39</u>
<i>3.1.3 Working principle.</i>	<i>41</i>
<i>3.1.4 Material selection.</i>	<i>41</i>
<i>3.1.5 Design analysis.</i>	<i>41</i>
<u>3.1.5.1 Component sizing.</u>	<u>41</u>
<u>3.1.5.2 Operation mechanics.</u>	<u>43</u>
3.2 Specific objective 2: To fabricate and assemble the components	43
<i>3.2.1 Fabrication of the various components.</i>	<i>43</i>
<i>3.2.2 System assembly.</i>	<i>43</i>
3.3 Specific objective 3: To test the performance of the system.	44
3.4 Specific objective 4: Economic analysis.	Error! Bookmark not defined.
<u>Reasons for conducting an NPV assessment of the</u> <u>project.</u>	<u>44</u>
CHAPTER 4: RESULTS AND DISCUSSION.	45
4.1 Designing the various system components.	45
<i>1. The fixed link.</i>	<i>45</i>
<i>2. The coupler.</i>	<i>45</i>
<i>3. The effector.</i>	<i>46</i>
<i>4. The trammel constituents.</i>	<i>46</i>
4.2 Fabrication and assembly of the system components	47
<i>4.2.1 Fabrication of the components.</i>	<i>47</i>
<u>Production procedure.</u>	<u>47</u>
<i>4.2.2 Assembly of the components.</i>	<i>47</i>
4.3 Testing the performance of the system.	49

4.3.1 Fixed link mechanics.....	49
4.3.2 Coupler rotations.	49
4.3.3 Effector translations.	49
4.3.4 Trammel accuracy.	49
4.4 Economic analysis of the prototype.....	50
<u>Analysis assumptions:.....</u>	<u>50</u>
4.4.1 Capital cost of the project.....	50
4.4.2 Cost-benefit analysis of the project.....	50
<u>1. Noncommercial scenario.....</u>	<u>50</u>
<u>2. Commercial scenario.</u>	<u>51</u>
4.4.3 NPV assessment.....	52
CHAPTER 5: CONCLUSIONS, CHALLENGES AND	
RECOMMENDATIONS.....	54
5.1 Conclusions:.....	54
5.2 Challenges.	54
5.2.1 Reasons for the challenges.	54
5.3 Recommendations.	55
APPENDICES.	56
REFERENCES.....	59

Table of figures.

Figure 1; The UTI problem analysis.....	16
Figure 2: A 3D impression of the system	18
Figure 3; Analytical prowess of the Outsense.	22
Figure 4; The Outsense sensor.....	22
Figure 5; The Monit sensor.?	23
Figure 6; Conditions for operation of the Walabot toilet tracker.....	24
Figure 7; The Smardii user interface.	25
Figure 8; The Smardii sensor.....	25
Figure 9: Demonstration of the difference between mechanisms and structures.	28
Figure 10: Single slider crank mechanism.....	31
Figure 11: The pendulum pump.....	Error! Bookmark not defined.
Figure 12 : The oscillating cylinder engine.	32
Figure 13: Rotary internal combustion engine.....	32
Figure 14: The slotting tool.....	33
Figure 15: The Oldham's coupling inversion.....	34
Figure 16: THE SCOTCH yoke mechanism	35
Figure 17: The elliptical trammel	35
Figure 18: The axes of the elliptical trammel	36
Figure 19: The system conceptual diagram	38
Figure 20: The fixed link	39
Figure 21: The coupler link.....	39
Figure 22: The effector	40
Figure 23: The brush.....	40

List of tables.

Table 1: UTI prevalence as recorded in the Busitema university main campus clinic.....	13
Table 2: Force table of each of the links.....	43
Table 3: Fixed link specifications.....	45
Table 4: Coupler specifications.....	46
Table 5: Effector specifications.....	46
Table 6: Trammel specifications.....	47
Table 7: The capital cost calculation.....	50
Table 8: Table of the discount rate for the two years.....	52
Table 9: NPV calculation table.....	53

CHAPTER ONE (INTRODUCTION).

1.1 BACKGROUND.

A urinary tract infection (UTI) is an ailment that affects any part of the renal (genitourinary) system due to abnormal bacterial growth within the system (I. Odongo et al., 2020) (Odoki et al., 2019) which consists of kidneys, ureters, bladder, and the urethra. The bladder infection, also known as cystitis, is mainly caused by *Escherichia coli*, a bacterium common in the gastrointestinal (GI) tract; sexual activity, however, could also contribute to this type of condition. The urethral condition occurs when the bacteria travel to the urethraⁱⁱ from the rectum orifice. Cystitis and urethritis are termed lower UTIs, which when left untreated progress to the kidneys to cause pyelonephritis (upper UTIs), resulting in permanent kidney damage (Johnson et al., 2021).

UTIs can be community-acquired or nosocomialⁱⁱⁱ. Community-acquired UTIs (CA-UTIs) occur in one's life in their respective community setting and/or within 48 h of hospitalization. Nosocomial UTIs (N-UTIs) happen after 3 days of hospital discharge or after two days of admission when the patient was not infected at the time of admission. UTIs may be symptomatic or asymptomatic, complicated or uncomplicated, chronic, and recurrent. The noticeability of the symptoms is dependent on the organ of the renal system affected, the etiologic^{iv} organisms involved, and the strength of the patient's immune system (Odoki et al., 2019). UTIs are one of the leading causes of morbidity in medical practice, and they are among the most common bacterial infections with increasing antimicrobial resistance (I. Odongo et al., 2020, Sekikubo et al., 2017, C. O. Odongo et al., 2013), which makes them a first class societal potential hazard as they risk becoming incurable due to their high mutation rates.

UTIs are caused by bacteria, and the Enterobacterales order is by far the most common documented pathogenic cause of the infections. This is mainly due to their possession of uroepithelium attachment devices, and their ability to produce the enzyme beta-lactamase, which can destroy some antimicrobial drugs like methicillin. *Escherichia coli* (*E.coli*) is the most documented pathogen in world healthcare practice, including Uganda, (Odoki et al., 2019, C. O. Odongo et al., 2013) causing both CA-UTIs and N-UTIs. Other pathogens such as *Enterococcus* sp., *Staphylococcus saprophyticus* (honeymoon cystitis), *Klebsiella* sp.,

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